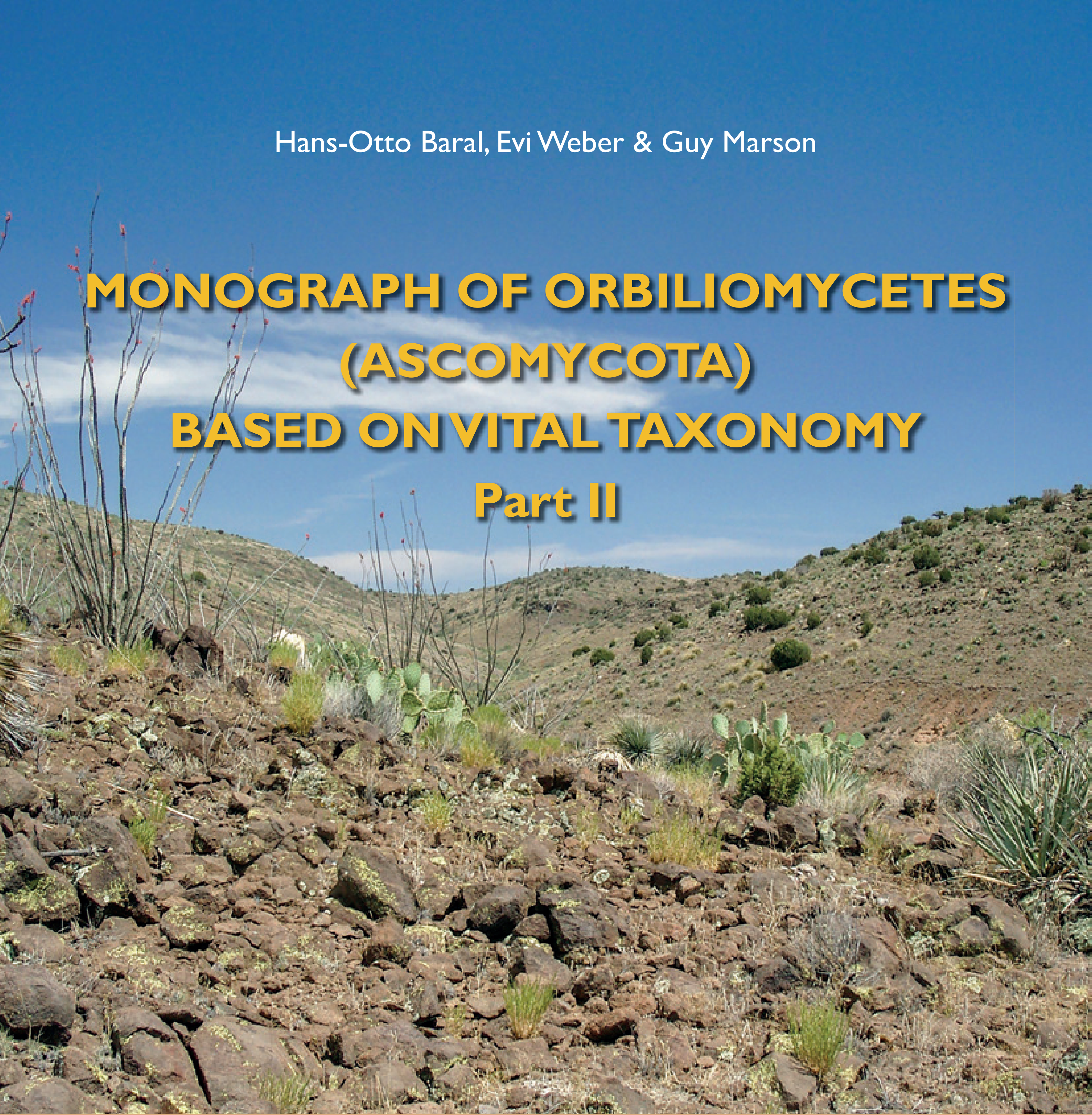
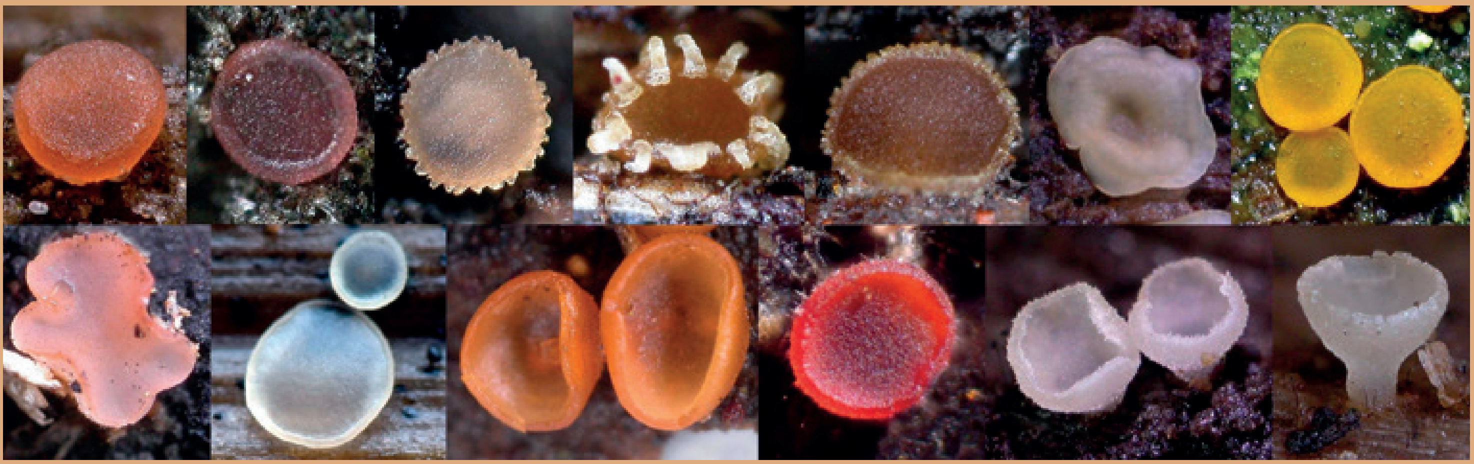
Hans-Otto Baral, Evi Weber & Guy Marson

MONOGRAPH OF ORBILIOMYCETES (ASCOMYCOTA) BASED ON VITAL TAXONOMY

Part II





MONOGRAPH OF ORBILIOMYCETES (ASCOMYCOTA) BASED ON VITAL TAXONOMY

Orbilia xanthostigma drawn by the famous French mycologist Émile Boudier (Icones fungorum 1904–10, pl. 460). Note that Boudier correctly recognized the shape of the tiny ascospores, which resemble a cashew nut, but could not clearly see the warts on their surface and overlooked the small globose spore body contained in one of their ends.

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Cover photo:
Sonoran Desert 20 km SSE of Clifton, Arizona, USA. Mesotemperate semiarid desert scrub with *Yucca elata* (soaptree), *Fouquieria splendens* (ocotillo), and *Opuntia engelmannii* (prickle pear) on felsic volcanic rock (basalt, andesite, rhyolite); collection site of *Orbilia bicknellensis*, *O. denticulata*, *O. lentiformis*, *O. paradoxoides*, and *O. pleiolentiformis* (H.B. 7880) growing on dead xeric inflorescence stem of *Yucca elata*. 1.VI.2003, phot. Guy Marson.

Back cover:
Orbilia luteorubella, *O. martinicensis*, *O. falciformis*, *O. carpoboloides*, *O. flavidorosella*
Orbilia trapeziformis, *O. maeandrina*, *O. flexisoma*, *O. wannerooensis*, *O. vitalbae*

Book spine:
Orbilia auricolor

Front cover:
Orbilia sphaerospora, *O. lilacina*, *O. austrocylindrica*, *O. mirabilis*, *O. myrionanosoma*, *O. umbilicata*, *O. xanthostigma*
Orbilia cejpii, *O. auricolor*, *O. menageshae*, *O. rubrovacuolata*, *O. pilosa*, *O. orientalis*

MONOGRAPH OF ORBILIOMYCETES (ASCOMYCOTA) BASED ON VITAL TAXONOMY

— Part II —

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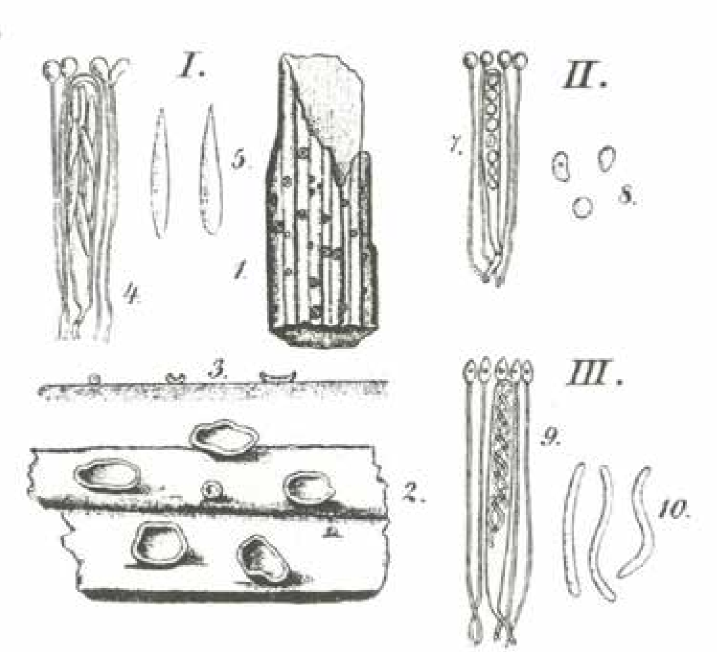

Orbilia spp. drawn by Heinrich Rehm. I. *Orbilia* sp. (as *O. vinosa*), II. *O. eucalypti* s.l. (as *O. coccinella*), III. *O. xanthoguttulata* (as *O. curvatispora*). From Rehm (1891: 447), who generally studied herbarium specimens. Rehm was unaware of the serious changes that living cells undergo when they die, and never mentioned a spore body in *Orbilia*.

National Museum of Natural History Luxembourg (2020)

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The complete monograph, including all supplementary data listed above, is available under the following link:
https://www.mnhn.lu/pub/mono_orb
Scans of all drawings with original annotations and entire set of macro- and microphotographs can be found under the following link:
https://www.in-vivo-veritas.de

Section *Helicoon*

Orbilia subgenus ***Habrostictis*** section ***Helicoon*** (Morgan) Baral & E. Weber, **comb. & stat. nov.**, MB 815017 – Lectotype species: *Helicoon sessile* Morgan [= *Orbilia luteorubella* (Nyl.) P. Karst.], designated by Linder (1929)

Basionym: *Helicoon* Morgan, J. Cincinnati Soc. Nat. Hist. 15: 49 (1892).

Emended diagnosis: **TELEOMORPH**: Apothecia with smooth, rarely crenulate margin, desiccation-sensitive, partially semiaquatic. Asci 8-spored, apex (†) truncate, thin-walled, furcate base almost never H-shaped. Ascospores cylindrical to ± fusiform, rarely lacrimiform, straight, rarely strongly curved; spore bodies filiform to subulate or tear-shaped. — **Anamorph**: Conidia either phragmosporous, straight to strongly curved, or non-septate and then usually with terminal protuberances. Trapping organs absent.

Description: — **TELEOMORPH**: **Apothecia** fresh (0.2–)0.3–1.5(–4) mm diam., whitish or pale to bright rosaceous-lilaceous, yellowish-cream or yellow-orange, margin not or slightly protruding, smooth, rarely with small teeth; sessile or with a ± distinct short stipe, superficial. **Asci** *30–60(–68) × 3.5–5.5 µm, 8-spored, (1–)2–6(–7) lower or upper spores inverted; **apex** (†) medium to strongly truncate, not or slightly to sometimes strongly indented and laterally inflated, hemispherical in profile view, thin-walled; **base** T- to L-, sometimes Y-, exceptionally H-shaped. **Ascospores** *(3.8–)5–14(–17) × (0.8–)1–1.8(–2.2) µm, cylindrical to fusiform or limoniform to obclavate, rarely lacrimiform-ovoid, apex rounded to acuminate, straight to strongly curved, **SBs** attached to apical spore wall, (1–)2–6(–8) × (0.1–)0.2–0.7(–0.9) µm, filiform to subulate or tear-shaped, apically narrowed to a small point. **Paraphyses** slightly to strongly clavate-capitate at the apex, terminal cells 2.5–6× longer than lower cells, unbranched near apex. **Ectal excipulum** of vertically or indistinctly oriented textura globulosa-angularis(-prismatica) from base to margin, thin-walled to slightly gelatinized (common walls †0.3–1 µm), inner region rarely strongly gelatinized (common walls 1–3 µm), cells near base *(9–)15–30(–40)((–45)) × (6–)10–25(–35) µm; **glassy processes** absent, rarely 1–30 µm long (*O. martinicensis*). **SCBs** globose or absent, exceptionally ring-shaped; **VBs** usually present, hyaline, sometimes turning yellow in dead state; **LBs** with carotenoids rarely observed (*O. sarraziniana*). **Exudate** 0.2–2 µm thick, granular to cloddy, rarely cap-like (then up to 5 µm thick), scattered to abundant, loosely or firmly attached, hyaline to bright yellow. — **ANAMORPH**: anguillospora-like, dactylella/vermispora-like, helicoon-like, pseudotripoconidium-like. **Conidiophores** unbranched or branched, 10–165 µm long. **Conidiogenous cells** mono- or polyblastic (?sympodial) and then with denticles. **Conidia** unbranched, either phragmo- to scolecosporous, or amerosporous (clavate to inversely tear-shaped or pyramidal, smooth or with ± distinct protuberances). **Trapping organs**: none observed.

Habitat: on semiaquatic to hygric, rarely mesic wood and bark, exceptionally caulicolous, always desiccation-sensitive.

Recognized series: *Helicoon* and *Pseudotripoconidium*, with 15 recognized, 3 unnamed ('affinis'), and 2 unassigned species.

Taxonomic remarks. Members of section *Helicoon* are characterized by small to medium-sized, mainly elongate, narrow, cylindric-fusoid to fusiform or clavate, rarely lacrimiform-ovoid (*O. martinicensis*), straight or sometimes strongly curved ascospores which are usually without a tail (only in *O. falciformis* the spores are basally sometimes tail-like). The spore bodies are often long and narrow, filiform to subulate, straight or sometimes ± flexuous, but also rather short and comparatively wide, ± tear-shaped.

Similar ascospores and SBs also occur in the two other sections of subgenus *Habrostictis*, and in section *Hemiorbilia* of subgenus *Hemiorbilia*. Members of all these sections differ from section *Helicoon* in a high desiccation tolerance of their apothecia, also in the consistent absence of VBs in the living paraphyses, the frequent presence of crystalloid SCBs, polysporous asci in many taxa (but in section *Aurantiorubrae* mainly 8-spored), and mostly staurosporous or vermispora-like anamorphs. Only taxa of series *Hyalinia* and *Xanthoguttulatae* p.p. break this rule.

Concerning their teleomorph, members of section *Hemiorbilia* are easily distinguished from section *Helicoon* by hemispherical, thick-walled ascus apices and usually not or only slightly inflated paraphysis apices, which are often covered by abundant exudate. Delimitation against the other two sections of subgenus *Habrostictis* is problematic, however, since the three sections do not differ in ascus and paraphysis features. For this reason, a few species are difficult to assign at the sectional level, particularly *O. martinicensis*, *O. aethiopica*, and *O. bannaensis*. The latter two species were at first thought by us to belong to section *Helicoon* until sequences became available which positioned them in section *Aurantiorubrae*, and here with high support in series *Abutilones* and *Piliferae*, respectively.

Several taxa of section *Helicoon* are characterized by an unusual spore orientation (i. e., upper spores with SBs directed downwards, lower spores upwards). In such a case the SB-containing spore end is often the narrower, more tapered end, and the widest part of the obclavate spore is often closer to the spore base (similar cases of spore orientation and/or heteropolar spores occur in sections *Aurantiorubrae* and *Habrostictis*, see also Fig. 62). More or less homopolar, fusoid or sometimes subcylindrical spores are also frequent.

Some of the examined ± subtropical collections possess a more or less bright golden-yellow exudate in the outer parts of the hymenium and ectal excipulum, at least in an advanced stage of development. A similar pigment is found in the dead cytoplasm of some of the paraphyses. The living paraphyses of these species frequently contained hyaline, low- to high-refractive VBs but no yellow pigment. Specimens with a yellow exudate mainly derived from Asia, whereas from temperate zones no such pigment came to our notice.

Series delimitation, **anamorph**. Two series can be distinguished within section *Helicoon*, which sharply differ in their anamorphs: (1) series *Helicoon* with ± curved, vermiform, phragmo- to scolecosporous conidia (dactylella/vermispora-, anguillospora-, helicoon-like), and (2) series *Pseudotripoconidium* with aseptate, inversely pyramidal conidia with several nipple-shaped protuberances (pseudotripoconidium-like). The striking morphological difference between these two types of conidia is difficult to explain in terms of their phylogenetic relationship. As a hypothesis, the latter conidial type might have been derived from microconidia of the former group by suppression of the macroconidial state. A somewhat intermediate species, *O. tianmushanensis*, is placed in series *Helicoon* because its rather unique, straight, fusiform phragmoconidia fit better in that group.

In their teleomorph features the two series are so similar that recognition of the group is virtually impossible. As a tendency, filiform to vermiform SBs which are not or only hardly inflated at their base are typical of species with a pseudotripoconidium-like anamorph, whereas SBs with a more or less tear-shaped basal inflation are so far exclusively found in species with a phragmo- to scolecosporous anamorph. Species with a yellow exudate occur in both sections, and species without this pigment and sometimes also without VBs in the living paraphyses also occur in both groups.

In several species of section *Helicoon* the anamorph is unknown or could not be ascertained in pure culture. When also molecular data were unavailable, these species could not with certainty be assigned to one of the two series. Conidia on the natural substrate have very rarely been seen. In some cases, flooding of apothecia on the natural substrate in an empty Petri dish provoked formation of conidia.

Species delimitation in series *Helicoon* is highly problematic. Some collections assigned to a given taxon appear rather well-defined, based on an extraordinary shape and size of ascospores or spore bodies, or unusual spore orientation. Yet, intermediate collections are frequent and suggest a continuum between some of the taxa. As a further complication, mixed populations of two closely related species were sometimes observed. Such intermingled growth easily causes confusion, e. g., when taking a sequence or when preparing a culture.

Although spore orientation is easily seen in fresh living specimens, herbarium material is very difficult to study in this respect. Even when applying various staining techniques, SBs are generally hardly or not at all to be seen. Sometimes it is necessary to break the asci by strong pressure on the cover slip, so that some spore ends project from the broken lower part of the ascus. In the types of *O. luteorubella* (Pl. 534: 1b), *O. sarraziniana* (Pl. 537: 1b), and *O. juruensis* (Pl. 543: 1b left ascus) the SBs could be discerned in some asci as a faint region but, for instance, in most of Velenovský's type specimens spore orientation could not clearly be seen.

As an example, we were unable to find any convincing features of the teleomorph to permit clear distinction between *O. luteorubella* and *O. rosea*, apart from a tendency in adaptation to stagnant vs. running water and in different apothecial colours (yellowish-orange vs. rose, respectively). Some variation in macro- and microscopical features within each of these species and *O. sarraziniana* complicates identification of most of the examined specimens in which culture and DNA studies were not undertaken. A more comprehensive molecular investigation would be desirable in order to clarify how sharp the molecular limits between the here accepted species are.

Phylogeny. Sequences which include the ITS region and partly also LSU and SSU were available for five species of series *Helicoon* (*O. luteorubella*, *O. rosea*, *O. sarraziniana*, *O. tianmushanensis*, *O. yuanensis*) and six of series *Pseudotripoconidium* (*O.* aff. *fusiformis*, *O. sinensis*, *O. tenuispora*, three unidentified). Although the two series can sharply be distinguished by their anamorph, distinction is less clear in their molecular data, which might reflect the strong morphological similarities in their teleomorphs. The distance in the ITS region between the two series lies in the range of 12.5–18 %, which is hardly higher than between species of series *Helicoon* (12–15 %), though much higher than within series *Pseudotripoconidium* (3–8 %).

When analysing SSU+ITS+LSU, section *Helicoon* formed a highly supported monophyletic clade which clustered unresolved in the genus *Orbilia* (Baral et al. 2017b, Phyl. 7). Within this section, series *Pseudotripoconidium* clustered as a highly supported monophyletic clade, but series *Helicoon* formed a paraphyletic group. Also in the present analyses (Phyls 17–18, S19) only series *Pseudotripoconidium* formed a monophyletic clade with strong (ITS) or medium (ITS+LSU, LSU) bootstrap support. *O. tianmushanensis* (with phragmoconidia) and a strain for which no illustration was available (B.L. X079) clustered intermediate between the two series when analysing ITS, but when analysing LSU *O. tianmushanensis* clustered in the *Pseudotripoconidium* clade (no LSU was available for B.L. X079). Another strain without available documentation (B.L. 730) comprises only LSU and shows, like the other two strains, intermediate combinations of nucleotides (Tabs 70–71). This unsharp delimitation between the two series confirms Yu et al.'s (2011) result of a close molecular relationship between them.

Also the S1506 intron permits to recognize paraphyly of series *Helicoon* (Phyl. S18). It occurs in most species with available SSU though often only in some of the sequences (see also Tab. 26): in four species of series *Helicoon*: *O. sarraziniana* (2 of 6 strains), *O. luteorubella* (2 of 3 strains), *O. rosea* (1 of 8 strains), *O. yuanensis* (2 strains), and in two of series *Pseudotripoconidium*: *O. tenuispora* (1 strain), *O.* aff. *fusiformis* (1 strain). Also here, the latter series forms a strongly supported clade while the other taxa cluster paraphyletically (S18).

Based on the available phylogenetic analyses we may conclude that series *Helicoon* represents the ancestral group of section *Helicoon*, which means that the amerosporous, obpyramidal conidia of series *Pseudotripoconidium* developed from phragmoconidia, a conidial type that is common also in various other groups of subgenus *Habrostictis* and the *Orbiliomycetes* as a whole.

Specific nucleotide positions. No molecular motifs that unequivocally characterize section *Helicoon* have been found. A common characteristic of the entire section is that the ITS2 starts at its 5'-end with ATTT, except for *O. tianmushanensis* which has ATTA. The motif ATTT is also typical of section *Lentiformes* and several series of section *Aurantiorubrae*, and occurs also in *O. carpoboloides* of section *Habrostictis* and a

Table 70. Four nucleotide positions in the ITS1, two in the 5.8S region, and three in the ITS2 which more or less characterize the two series of section *Helicoon*, showing intermediate character combinations for *O. yuanensis*, B.L. X079, and *O. tianmushanensis*. Position numbers evaluated by inclusion of all inserts. A similar table is given in Zhang et al. (2016: tab. 1). D = AGT, R = G (rarely A). At pos. 22–27 the alignment is not unequivocal.

Taxon	ITS1				5.8S		ITS2	
	4–6	22–27	150–155	161–162	298–302	320–323	377–382	441–452
O. rosea	AAA	CTTTTT	TGTCTG	AAA	GCGCC	GGCA	TTGAGC	ACTCTGCCGAAC
O. luteorubella	ATA	CTTTAT	TGTCTT	ACA	GCGCC	GGCA	TTGAGC	ACTCTGCCGAAC
O. sarraziniana	ATA	CTTTTT	TGTCDG	ACA	GCGCC	GGCA	TTGAGC	ACTCTACCRAAC
O. yuanensis	ATA	CTTTTT	TGTCGT	ACA	GCACC	GGTA	TTGAGC	ACTCAGCCGAAC
Orbilia sp. (B.L. X079)	ATA	CTTTTT	TGTCTT	ATT	GCGCC	GGCA	TTGGGC	ACCAAGCCAAAC
O. tianmushanensis	AAA	AACCTT	TGTCTT	ATT	GCGCC	GGCA	TTGGGC	ACCCAGCC-AAC
Pseudotripoconidium p.p.maj.	ACA	CT--TT	AGTCTT	ATT	GCACC	GGTA	TTGGGC	ACCCAGCC-AAC
O. tenuispora (p.p.)	ACA	CT--TT	AGTCTT	ATT	GCACC	GGTA	TTGAGC	ACTCTGCC-AAC
O. aff. *sinensis* (CBS 917.72)	ACA	CT--TT	AGTCTT	ATT	GCACC	GGTA	TTGGGC	ACCCTGCC-AAC

few members of series *Drechslerella* (see Tab. 20).

In the LSU D1–D2 domain, pos. 252 is consistently GTG**A**A, whereas it is GTG**T**A in most other groups of subgenus *Habrostictis*, but GTG**A**A also in *O. albovinosa* and *O. ficicola* (and in most members of section *Arthrobotrys*). Pos. 516 is GGA**T**AAA in series *Pseudotripoconidium* and in *O. sarraziniana* and *O. rosea*, but GGA**C**AAA in *O. luteorubella*, *O. tianmushanensis*, and *O. tenuispora* B.L. 6228, as in most other *Orbilia* spp. However, pos. 516 is also GGA**T**AAA in series *Aurantiorubrae*, *O.* (aff.) *farnesianae*, *O. paracaudata*, and *O. amarilla* of series *Piliferae*, and a few *Arthrobotrys* spp. Pos. 500 is consistently ATC**A**GTT in section *Helicoon* while ATC**G**GTT in many other *Orbilia* spp., yet it is also ATC**A**GTT in series *Aurantiorubrae*, *Rubellae*, and *Commatoideae*, series *Piliferae* p.p. and *Albovinosae* pp., and some members of series *Lentiformes* and most of section *Arthrobotrys*.

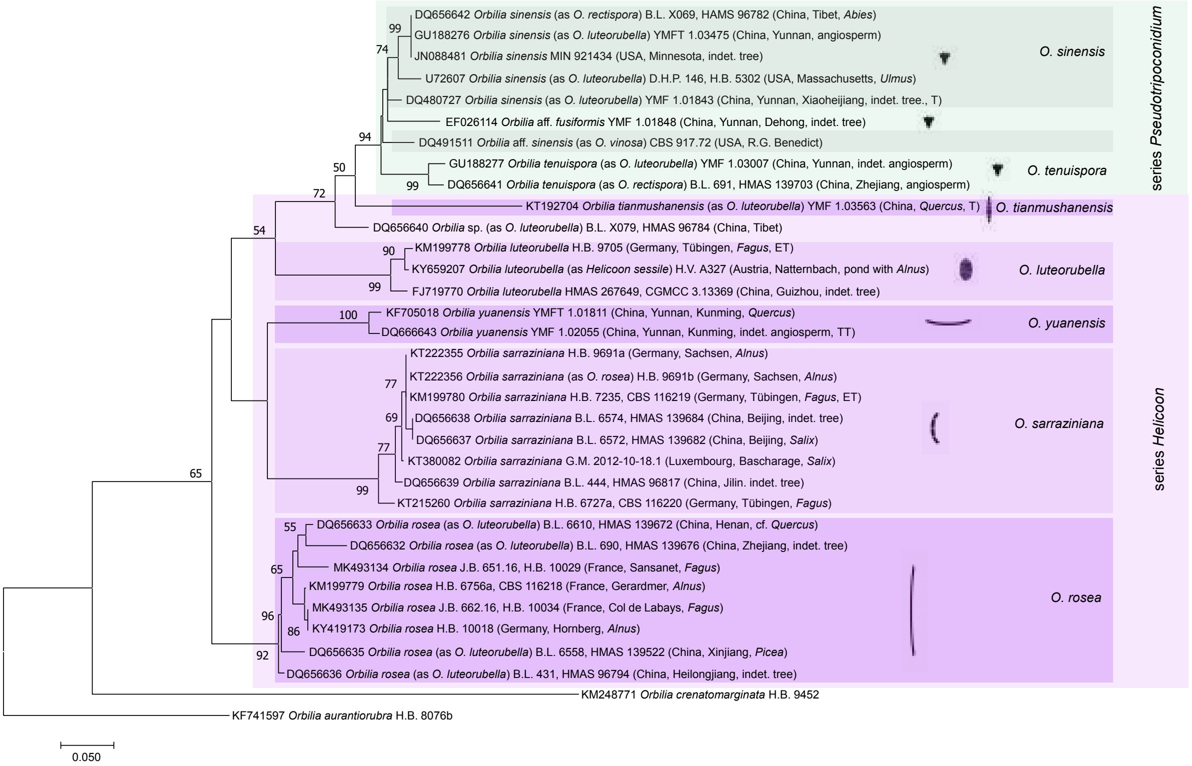
About a dozen of informative positions in the ITS region (Tab. 70) and 3 in the LSU D1–D2 (Tab. 71) permit distinction between the two series. The 5.8S region is almost identical in series *Pseudotripoconidium* and *Helicoon*, except for pos. 300 and 322 (Tab. 70). Two species are problematic: based on their phragmoconidia, *O. yuanensis* and *O. tianmushanensis* clearly belong to series *Helicoon*. Yet, *O. yuanensis* coincides at these two positions and at pos. 445 (ITS2) with series *Pseudotripoconidium*, but at 6 positions of ITS1 and 1 of ITS2 (449) it concurs with series *Helicoon*. *O. tianmushanensis* matches series *Pseudotripoconidium* at pos. 380, 443, and 449 (ITS2), but concurs with series *Helicoon* at pos. 300 and 322 (5.8S). Also strain B.L. X079 shares some characteristic positions with series *Helicoon* and others with series *Pseudotripoconidium*.

At the 3 diagnostic positions in the LSU (176, 577, 582), series *Pseudotripoconidium* has **T**+**A**+**G**, whereas series *Helicoon* has **C**/**A**+**T**+**A**/**C** (Tab. 71). At all 3 position, *O. tianmushanensis* concurs with series *Pseudotripoconidium*, whereas two strains of unknown morphology have intermediate combinations (B.L. 730: **C**+**A**+**T**, CBS 917.72: **C**+**A**+**G**), although the latter is a clear member of series *Pseudotripoconidium* in Phyls 17 and 18.

Table 71. Three nucleotide positions in the LSU D1–D2 (in bold) which characterize the two series of section *Helicoon*, showing intermediate nucelotide combinations for B.L. 730 and CBS 917.72 (Benedict's strain). Position numbers starting with TGACCT by omitting predominant gaps in alignment of all groups of *Orbiliomycetes*.

Taxon	LSU		
	175–178	576–578	582–584
O. rosea	CCTG	CTA	AGA
O. luteorubella	CCTG	CTG	CGA
O. sarraziniana	CATG	CTG	CGA
O. aff. *sarraziniana* (B.L. 730)	CCTA	CAG	TGA
O. tianmushanensis	CTTG	CAG	GGA
Pseudotripoconidium	CTTG	CAG	GGA
O. aff. *sinensis* (CBS 917.72)	CCTG	CAG	GGA

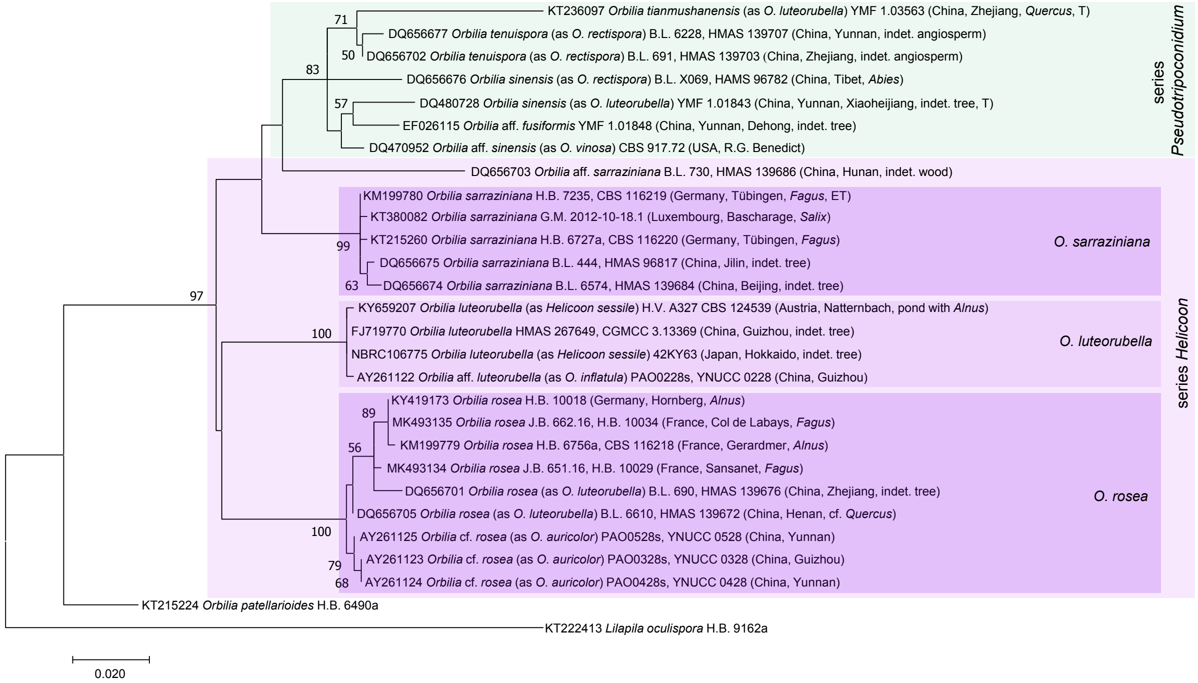
Ecology. Six species are known at present in the temperate to montane-boreal zone of the northern hemisphere: four of series *Helicoon* (*O. rosea*, *O. luteorubella*, *O. sarraziniana*, *O. juruensis*) and two of series *Pseudotripoconidium* (*O. sinensis*, *O. tenuispora*). The three first species of series *Helicoon* are very common in Europe and show a strong preference for semiaquatic habitats very close to running or stagnant water. They form comparatively large apothecia growing almost exclusively on woody substrates, often in large numbers. Their mycelia and apothecia not only withstand but apparently require periodical flooding which induces the formation of conidia. According to the available molecular data it is evident that these three species also occur in eastern Asia, and based on their morphological traits they seem to be also present in North America. *O. sinensis*,



Phylogenetic analysis 17. Phylogram of section *Helicoon* inferred from ML analysis of ITS1-5.8S-ITS2 rDNA dataset (34 sequences, 620 positions, aligned with MUSCLE) using the T2+G model in MEGA7 (500 replicates). The tree is rooted with *O. aurantiorubra* and *O. crenatomarginata*. Asci 8-spored in all taxa; T = type, ET = epitype.

O. tenuispora, and *O. juruensis* occur from cold-temperate to subtropical or tropical regions, being recorded from southeastern Europe (Caucasus), North America, and eastern Asia, but a possible preference for semiaquatic habitats is only known for *O. sinensis*. Because of their adaptation to permanent moisture, the apothecia generally do not survive complete desiccation.

A majority of taxa in the two series of section *Helicoon* emanate from the subtropics or tropics, particularly from southeastern Asia but also middle America. They do not seem to exhibit any preference for running or stagnant water, and in



Phylogenetic analysis 18. Phylogram of section *Helicoon* inferred from ML analysis of LSU (D1–D2) rDNA dataset (28 sequences, 584 positions, aligned with MUSCLE) using the T2+G model in MEGA7 (500 replicates). The tree is rooted with *Lilapila oculispora* and *O. patellarioides*. Asci 8-spored in all taxa; T = type, ET = epitype.

Key to species of section *Helicoon*, based mainly on the teleomorph

1. Spores medium to strongly curved; anamorph unknown; angiosperm bark, subtropical humid eastern Asia 2
1. Spores ± straight or only sometimes slightly curved 3

2. Spores *8–13 × 1.1–1.3 µm .... ***O. arcospora*** (?series *Pseudotripoconidium*), p. 1011
2. Spores *5.5–7.5 × (1.3–)1.5–1.6(–1.8) µm .... ***O. falciformis*** (inc. sed.), p. 994

3. Spores predominantly *1.2–1.3 (†1.1–1.2) µm wide or narrower 4
3. Spores predominantly wider 10

4. Spores *(9–)10–12(–13.5) × 0.9–1.3 µm, apex (sub-)acute; conidia obpyramidal, non-septate, with prominent protuberances; angiosperm wood, cold-temperate to subtropical humid eastern North America & eastern Asia.... ***O. tenuispora*** (series *Pseudotripoconidium*), p. 1007
4. Spores predominantly less than *10 µm long 5

5. Upper spores predominantly inverted; spores †5.5–6.5 × 0.8–1 µm, ± straight, usually subulate; anamorph unknown; angiosperm bark, tropical humid Middle America .... ***O. subuliformis*** (?series *Pseudotripoconidium*), p. 1001
5. Lower spores predominantly inverted; spores *5–7.5 up to 8–11 µm long, straight to slightly curved 6

6. SBs 1.5–3 × 0.3–0.8 µm, ± tear-shaped; conidia elongate, septate; (sub)tropical humid eastern Asia 7
6. SBs (2–)2.5–3 up to 4(–5) × (0.1–)0.2–0.4(–0.5) µm, filiform; conidia obpyramidal, non-septate, with inconspicuous protuberances, cold-temperate to subtropical humid northern hemisphere .... (series *Pseudotripoconidium*) 8

7. Spores *(5–)6–7(–7.3) × 1.2–1.4 µm, subcylindrical or slightly fusoid; living paraphyses containing many globose to shortly elongate VBs, in more aged apothecia with yellow pigment; conidia scolecosporous, multiseptate, containing rather small LBs; bark of angiosperms........ ***O. yuanensis*** (series *Helicoon*), p. 991
7. Spores *7–8.5 × 1–1.3 µm, narrowly clavate, with or without basal tail; VBs unknown; anamorph uncertain; bark of *Broussonetia* .... ***O. bannaensis*** (section *Aurantiorubrae*), p. 930

8. SBs *(2–)2.5–3 × 0.2–0.3 µm; spores *(5–)6–7.5(–8) × 1.2–1.4 µm; bark of angiosperms, warm-temperate to subtropical eastern Asia & southern Africa........ ***O. jinguangsiensis***, p. 1002
8. SBs *(2.3–)3–4.5(–5) × 0.1–0.5 µm; spores *(7–)8–10(–11) µm long; wood & bark of angiosperms, rarely gymnosperms 9

9. Spores with subacute to acute apex, *(7–)7.5–10(–11) × 0.8–1.3 µm, SBs 3–4(–5) µm long; cold-temperate to subtropical eastern Asia, eastern North America, southern Europe .... ***O. sinensis***, p. 1003
9. Spores with obtuse apex, *8–9.5 × 1.2–1.3 µm, SBs 4.5–5.5 µm long; subtropical eastern Asia .... ***O.* cf. *sinensis***, p. 1004

10. Spores *2.6–6.3 µm × (1.6–)1.8–2.2(–2.5) µm wide, length/width ratio 1.5–3; SBs ± flexuous 11
10. Spores min. *(4.5–)5–7 µm long, max. *1.8(–2) µm wide, length/width ratio min. 3–4 13

11. Paraphyses often (sub)lanceolate; spores cylindric-clavate with a broadly subacute tip, *4.8–6.3 × 1.8–2.5 µm; SBs about half as long as spores; apothecia urceolate, with short marginal hairs; angiosperm bark, warm-temperate humid northeastern Africa .... ***O. aethiopica*** (section *Aurantiorubrae*), p. 912
11. Paraphyses consistently capitate or clavate-spathulate; SBs about as long as spores; apothecia ± flat 12

12. Spores broadly lacrimiform, *2.6–3 µm long; SBs filiform, with a strongly inflated basal part; margin with glassy processes; angiosperm bark, tropical humid Middle America .... ***O. martinicensis*** (inc. sed.), p. 995
12. Spores limoniform to fusiform, *3.8–6 µm long; SBs filiform-subulate; margin without glassy processes; wood of *Pinus*, subtropical humid eastern Asia .... ***O. limoniformis*** (?series *Pseudotripoconidium*), p. 998

13. Spores *11.5–17 × 1.4–1.7 µm, cylindric-fusoid; SBs filiform; conidia obpyramidal, non-septate, with ± distinct protuberances; bark & wood of angiosperms, subtropical humid eastern Asia .... ***O. acicularis*** (series *Pseudotripoconidium*), p. 1009
13. Spores *4.5–11 µm long 14

14. Upper spores predominantly inverted (with SB pointing downwards); spores obclavate to fusoid, often basally only slightly to medium tapered, widest part often in the middle of spore or more near base, *(5.5–)6–8.5(–10) × 1.3–1.8(–2) µm 15
14. Lower spores predominantly inverted (with SB pointing downwards); spores usually fusoid, medium to strongly tapered at base, widest part in the middle of spore or often more near apex 17
Compare also *O. tianmushanensis* in which spore orientation is unknown (p. 986).

15. SBs tear-shaped within living asci, *(2–)2.5–3(–3.8) × 0.6–0.8(–1) µm; anamorph unknown; wood of angiosperms, (sub)tropical to cold-continental humid South America, eastern Asia .... ***O. juruensis*** (series *Helicoon*), p. 989
15. SBs predominantly filiform to subulate within living asci, 3–5(–5.5) × (0.2–)0.3–0.5(–0.7) µm, turning tear-shaped only when overmature..16

16. Conidia cylindric-fusoid, falcate to helicoid, 1–3-septate, *~30–50 × 4–7 µm; wood & bark of angiosperms, rarely gymnosperms, oroboreal to submediterranean (semi)humid Europe, Asia, Australasia, North America .... ***O. sarraziniana*** (series *Helicoon*), p. 978
16. Conidia obpyramidal, non-septate, with distinct protuberances; angiosperm bark, subtropical humid eastern Asia (Pl. 556: 3) .... ***O*. aff. *fusiformis*** (series *Pseudotripoconidium*), p. 1000

17. Spores subcylindrical or only slightly fusoid, *5–7.3 × 1.2–1.4 µm; SBs *1.5–2.8 × 0.3–0.6 µm, predominantly straight, usually with distinct filum .... see under 7 (*O. yuanensis*)
17. Spores fusoid to fusiform, mostly larger; SBs mostly longer and/or wider, partly flexuous 18

18. SBs tear-shaped within living asci, (1.8–)2.3–3(–4) × 0.5–0.9 µm; spores often fusiform, *(4.5–)5–8(–9.3) × 1.3–1.8 µm; conidia scolecosporous, multiseptate, with 1 large LB in each cell; wood of angiosperms, subtropical humid eastern Asia .... ***O. hoana*** (series *Helicoon*), p. 987
18. SBs filiform to subulate within living asci, (2.5–)3–4.5(–5.2) × 0.2–0.6 µm 19

19. Spores *(4.5–)5–7(–7.5) × 1.3–1.6(–1.7) µm; SBs narrowly subulate, 3–4.5 × 0.2–0.4(–0.5) µm; conidia obpyramidal (tear-shaped to clavate), non-septate, without protuberances; wood & bark of angio- and gymnosperms, subtropical humid eastern Asia .... ***O. fusiformis*** (series *Pseudotripoconidium*), p. 998
Two collections from southern China and Australia differ in shorter and wider SBs (Pls 555; 556: 1–2).
19. Spores *(5.5–)6.5–10.5(–11) × (1.2–)1.3–1.8(–2) µm; macroconidia scolecosporous, multiseptate, microconidia 1–4(–8)-septate; temperate to subalpine-boreal humid Europe, Asia, North America .... (series *Helicoon*) 20

20. Apothecia whitish to light rose-lilaceous(-cream), sometimes yellow-orange; macroconidia curved under a wide arch; wood and bark of angiosperms, also gymnosperms, semiaquatic at streams, oroboreal to (oro)temperate/orosubmediterranean humid Europe & North America, hemiboreal to subtropical eastern Asia .... ***O. rosea***, p. 959
20. Apothecia pale to light (yellow-)orange(-ochraceous), sometimes with rose component; macroconidia densely coiled by forming a barrel-shaped body; wood and bark of angiosperms, rarely gymnosperms, semiaquatic, mainly at lakes, thermoboreal to cold- or warm-temperate or subtropical Europe, eastern Asia, eastern North America .... ***O. luteorubella***, p. 970

Key to species of section *Helicoon*, based on the anamorph

1. Conidia 4.7–9 × 3–6.5 µm, clavate to inversely tear-shaped or obpyramidal, non-septate, with or without protuberances, containing 1 or a few large LBs .... (series *Pseudotripoconidium*) 2
1. Conidia ~40–450 × 2–10 µm (actual length), vermiform with tapered ends, septate .... (series *Helicoon*) 4

2. Conidia entirely without protuberances .... ***O. fusiformis***, p. 998
2. Conidia with ± conspicuous protuberances 3

3. Conidia with 2–4 inconspicuous to distinct protuberances . ***O. sinensis*** (p. 1003), ***O. jinguangsiensis***, (p. 1002), ***O. acicularis*** (p. 1009)
3. Conidia with 5–8 prominent protuberances .... ***O. tenuispora***, p. 1007

4. Conidia coiled to form a barrel-shaped body of *26–42 × 19–29 µm with 6–8 coils (in a Chinese collection only about †10–20 × 18–22 µm with 1–4 coils); conidia up to 30–45-septate .... ***O. luteorubella***, p. 970
4. Conidia straight or falcate to helicoid but not coiled like a barrel; conidia max. 21-septate 5

5. Conidia *42–74 × 7.7–10.2 µm, fusiform, straight, (1–)3 septate, 2 central cells much wider than terminal cells, with obtuse apex and tail-like base, lipid content low .... ***O. tianmushanensis***, p. 986

5. Conidia cylindric-fusoid (vermiform), ± falcate to helicoid, max. 7.5(–9) µm wide, often multiseptate 6

6. Conidia containing a single, 2–4 µm large LB in the centre of each cell (living state), †(29.5–)39–80(–111) × (4–)4.5–7.5(–9) µm, (3–)5–10(–12)-septate .... ***O. hoana***, p. 987

6. Conidia containing several smaller LBs (max. 1–2 µm diam.), especially near the septa 7

7. Conidia with low to rather high lipid content, macroconidia *80–127 × (5–)6–6.8(–7.3) µm, (10–)11–13(–14)-septate .... ***O. yuanensis***, p. 991

7. Conidia with very low to low lipid content, *(3–)4–5.5(–7) µm wide 8

8. Conidia mainly falcate, sometimes helicoid; macroconidia 9–21-septate, actual length *110–210(–285) µm; microconidia (0–)2–4(–6)-septate, (23–)30–60(–115) µm long .... ***O. rosea***, p. 959

8. Conidia (1–)3-septate, strongly helicoid, actual length *30–50 µm .... ***O. sarraziniana***, p. 978

some collections a distinct desiccation tolerance of apothecial tissues was noted. It would, however, be premature to see an evolutionary centre of section *Helicoon* in these Asian evergreen rainforests, since other parts of the world with similar forests have not or only insufficiently been investigated.

Series *Helicoon*

Orbilia subgenus ***Habrostictis*** section ***Helicoon*** series ***Helicoon*** – Lectotype: *Helicoon sessile* Morgan [= *Orbilia luteorubella* (Nyl.) P. Karst.]

Etymology: referring to the helicoid conidia.

Description: — **TELEOMORPH**: **Apothecia** fresh (0.2–)0.3–1.5(–4) mm diam. **Asci** *(33–)37–60(–68) × 3.5–5.5 µm, (1–)3–6(–7) lower or upper spores inverted. **Ascospores** *(3.8–)4.5–10(–11) × (1–)1.2–1.8(–2) µm, cylindrical to fusiform(-clavate), also obclavate or broadly tear-shaped, apex (rounded to) obtuse to acute (to acuminate), straight or only slightly curved near base; **SBs** (1–)1.5–4.5(–5.5) × (0.2–)0.3–0.8(–0.9) µm, filiform to subulate or tear-shaped. **Ectal excipulum** cells near base *(10–)15–30(–40) × (6–)10–25(–35) µm. — **ANAMORPH**: anguillospora-like, dactylella-like, helicoon-like, vermispora-like. **Conidiophores** 10–65(–100) µm, unbranched or branched below. **Conidiogenous cells** monoblastic. **Conidia** unbranched, vermiform (scolecosporous), 42–210 µm long (actual length), slightly to strongly curved under a wide arch; or up to 300–450 µm long, strongly coiled to form barrel-shaped bodies; (2–)3–7.5(–10) µm wide, (3–)5–17(–21)-septate; rarely fusiform, straight, 3-septate, with two inflated central cells; containing a few to many small LBs or one large LB; **microconidia** often present, sharply delimited or not, (0–)1–6(–8)-septate, straight to strongly curved.

Habitat: on hygric to semiaquatic, also mesic wood and bark, exceptionally caulicolous, desiccation-sensitive or slightly -tolerant, humid, temperate-boreal to (sub)tropical.

Recognized species: 7, plus 1 unnamed species ('affinis'), and 2 species with uncertain affinity.

Taxonomic remarks. Series *Helicoon* is circumscribed here to include taxa with anamorphs forming vermiform, differently curved phragmoconidia. *O. tianmushanensis* with its straight, fusiform conidia stands genetically somewhat intermediate to series *Pseudotripoconidium*. For two species no anamorph and sequence data were available: *O. falciformis* with its falcate conidia could as well belong to series *Pseudotripoconidium*, and *O. martinicensis* with its short, tear-shaped ascospores and long glassy processes might even belong to another section of subgenus *Habrostictis* (the associated conidia are possibly not orbiliaceous). Therefore, we have treated both species as 'incertae sedis'. *O. juruensis* closely resembles *O. hoana* which has anguillospora-like conidia, therefore, both seem well-placed here.

Species delimitation. Very late we have made the necessary split of the obviously heterogeneous taxon *O. luteorubella* in separating *O. rosea* from it, based on the connection to two very distinctive anamorphs (*Helicoon* vs. *Anguillospora*). Problematic is also the delimitation between *O. sarraziniana* and collections of *O. rosea* with short asci and spores. In one of our sequence analyses it came out that *O. sarraziniana* may also occur with the regular spore orientation of *O. rosea*. Further molecular studies are necessary to clarify the meaning of this result which would make our morphological concept rather unfounded. Similar as with *O. sarraziniana*, we propose distinction between *O. hoana* and *O. juruensis* merely because of the deviating spore orientation, but for these taxa molecular data are so far wanting.

Anamorph. The anamorphs of series *Helicoon* form phragmo- to scolecosporous, i.e., unbranched, usually multiseptate conidia. The conidia differ among the species especially in their length and width, number of septa, strength of curvature, and lipid content, but the available data are too scarce to decide whether all of the here accepted species with a known anamorph can be recognized by their conidial morphology.

At least some of the species (*O. rosea*, *O. luteorubella*, *O. yuanensis*, ?*O. sarraziniana*) form two types of vegetative propagules, micro- and macroconidia, that differ in size and number of septa. This rises the question whether differences in conidial characters between two samples are substantial or only a result of absence of one of the two conidial types in a given strain.

Two anamorphs with a published name are known in the literature: *Anguillospora rosea* has very long (scolecosporous) macroconidia that are curved under a wide arch, and much shorter microconidia (Pls 526; 527: 2h). *Helicoon sessile* has similar but strongly coiled macroconidia that form barrel-shaped bodies which function as air traps (Pl. 534) but may also form short, microconidia-like propagules (Pl. 534: 1a, upper left) which resemble microconidia of *A. rosea*.

In *O. martinicensis*, condylospora-like conidia were observed on the natural substrate. They resemble anguillospora-like anamorphs but differ in being sharply bent for ~ 180° in the middle. However, their connection to the associated teleomorph appears to be improbable.

Phylogeny. Series *Helicoon* forms a paraphyletic clade within section *Helicoon*. When analysing the ITS region (Phyl. 17), the five sequenced species clustered in five distant clades by showing comparatively low intraspecific variation. *O. sarraziniana* and *O. rosea* are represented by rather numerous sequences, while only three were available for *O. luteorubella*, two for *O. yuanensis*, and one for *O. tianmushanensis*.

Two of the anamorph-teleomorph connections previously reported from pure culture are confirmed here by molecular data: (1) a conidial isolate of *Anguillospora rosea* (paratype) from GenBank fully agrees in the SSU with our ascospore isolate of *O. rosea* (H.B. 6756a), (2) a conidial isolate of *Helicoon sessile* shows a high similarity in the ITS with a collection of *O. luteorubella* (H.B. 9705). Two earlier isolates of *O. luteorubella* and *H. sessile* (D.H.P. 125, 129) represent contaminations with a hypocrealean species (see under *O. luteorubella*, p. 976).

Specific nucleotide positions. Nucleotides being characteristic of series *Helicoon* are listed in Tab. 70 (ITS) and Tab. 71 (LSU D1–D2). Several dozens of positions in the ITS as well as LSU D1–D2 region permit unequivocal distinction among the four species (for *O. yuanensis* no LSU was available). At the 3'-end of ITS1 *O. luteorubella* coincides with *O. rosea* (C) and *O. sarraziniana* with all remaining sequences of section *Helicoon* including *O. yuanensis* (T), and also in the LSU such more or less consistent concordance exists, while in the remaining ITS1 and ITS2 no such cases could be seen. In the D1–D2 a relationship between *O. luteorubella* and *O. rosea* is supported at 13 positions, between *O. luteorubella* and *O. sarraziniana* at 11 positions, and between *O. rosea* and *O. sarraziniana* at 10 positions. Only at pos. 234 and 235 all three species differ from each other: *O. luteorubella* TT**CA**GGCT, *O. rosea* TG**TG**GGCC, *O. sarraziniana* TG**GT**GGCT.

Ecology. Series *Helicoon* comprises two ecological groups: (1) species growing in a temperate to montane-boreal, humid climate on substrates exposed to an only slightly varying moisture, being periodically flooded, always on banks of stagnant (lentic) or running (lotic) water; (2) species growing in a (sub)tropical, often humid (winter-dry) climate on substrates lying on the moist ground, rarely exposed some 1–2 m above the ground by getting dry after prolonged moisture. In the first group the exudate is sparse and hyaline, whereas in the second group it is more abundant and often turns more or less golden-yellow. According to the hypothesis that desiccation tolerance is a plesiomorphic feature in *Orbilia* (see phylogenetic part), group (2) might form a basal assemblage of hygric taxa within series *Helicoon*, from which those semiaquatic species of group (1) have evolved.

Species with a temperate-boreal distribution

Orbilia rosea (J. Webster & Descals) Baral & E. Weber, **comb. nov.**, MB 813627 — Pls 528–533, Map 88

Basionym: *Anguillospora rosea* J. Webster & Descals, in Descals et al., Can. J. Bot. 76(9): 1651 (1999) ['1998']
≡ *Anguillospora rosea* Descals, in Descals & Chauvet, Nova Hedwigia 54(1–2): 87 (1992), nom. inval., ICN Arts 36.1, 37.1
(?)= *Orbilia spinosae* Velen., Monogr. Discom. Bohem.: 93, pl. 11 fig. 46 (1934)
(?)= *Orbilia juniperi* Velen., Monogr. Discom. Bohem.: 94, pl. 11 fig. 21 (1934)
(?)= *Orbilia verrucosa* Velen., Monogr. Discom. Bohem.: 101 (1934)
?= *Orbilia silvatica* Velen., Monogr. Discom. Bohem.: 96, pl. 11 fig. 15 (1934)
?= *Orbilia pseudorubella* Velen., Monogr. Discom. Bohem.: 400 (1934)
(?)= *Orbilia pseudorubella* var. *alnea* Velen., Monogr. Discom. Bohem.: 401 (1934)

Etymology: *alnea*, *juniperi*, *spinosae*: collected on *Alnus*, *Juniperus* and *Prunus spinosa*; *pseudorubella*: in reference to *Orbilia rubella*; *rosea*: referring to the colony pigment of the mycelium on agar; *silvatica*: found in a forest; *verrucosa*: because of the papillate marginal cells.

Typification: Great Britain, Yorkshire, Bradford, indet. tree, 19.V.1978, J. Webster (MA-Fungi-38569, holotype of ***Anguillospora rosea***); Great Britain, Conway, Bettws-y-Coed, from foam, IV.1983, L. Marvanová (CCM F-18983, epitype, designated here, MBT382107). — Czechia, Hrusice, branch of *Prunus spinosa*, V.1931, J. Velenovský (PRM 152395, holotype of ***Orbilia spinosae***). — Czechia, Mnichovice, branch of *Juniperus communis*, 22.V.1928, J. Velenovský (PRM 152349, holotype of ***O. juniperi***). — Slovakia, Vysoké Tatry, branch of *Pinus mugo* var. *mugo*, VIII.1926, A. Pilát (PRM 151737, lectotype of ***O. verrucosa***, designated here, MBT202376). — Czechia, Strašice, branch of *Carpinus betulus*, VIII.1926, J. Velenovský (PRM 151760, holotype of ***O. silvatica***). — Czechia, Stránčice, branch of *Quercus*, VI.1934, J. Velenovský (PRM 151715, lectotype of ***O. pseudorubella***, designated here, MBT382144). — Czechia, Ondřejov, branch of indet. ?angiosperm, VII.1934, J. Velenovský (PRM 151706, holotype of ***O. pseudorubella* var. *alnea***).

Misapplied names: Breitenbach & Kränzlin (1981, pl. 252), as *O. sarraziniana*; Costantin (1888), as *O. vinosa*; Liu (2006: 82 p.p.maj.), as *O. luteorubella*; Pfister (1997), as *O. ?luteorubella*.

Description: — **TELEOMORPH**: **Apothecia** fresh (0.2–)0.5–1.5(–3) mm diam., in total (0.14–)0.18–0.3(–0.4)((–0.8)) mm high (receptacle 0.1–0.15 mm thick), whitish to usually pale to light rosaceous-lilaceous, also cream-rosaceous(-amber) to salmon-coloured, sometimes pale to bright yellow-orange, slightly to strongly translucent, round, subgregarious to gregarious; disc flat, eventually medium convex, margin even, not rising above disc (only slightly so when very young), exterior glabrous; broadly sessile or with a ± short, thick stipe 0.1–0.3 × 0.3–0.6 mm, superficial; dry whitish-cream to light orange-rose. **Asci** *(30–)35–65(–68) × (3.8–)4–5(–5.5) µm {16}, †30–58(–60) × (3.3–)3.5–4.5(–5) µm {10}, 8-spored, spores 2–4-seriate, pars sporifera *18–24(–29) → 16–18 µm, (2–)3–5(–6) lower spores inversely oriented {37} (not or slightly but also strongly mixed, sometimes in ~5–20% of the asci some or all upper spores inverted and lower spores not inverted); **apex** (†) medium to strongly truncate (not or slightly indented, not or slightly inflated); **base** with short to often very long, thin or thick, flexuous stipe, base L-, Y- to T-shaped. **Ascospores** *((5.5–))(6–)7–10(–11.5)((–14.2)) × (1.2–)1.3–1.7(–1.9) µm {32}, †(6–)7–9(–9.5) × (1.1–)1.3–1.7(–2) µm {5}, narrowly fusoid- to fusiform(-clavate), widest part mostly in the middle or often above, exceptionally obclavate, apex subacute to acute, base slightly to often strongly tapered, straight, rarely slightly curved (especially near base); **SBs** (2.8–)3–4.5(–5.5) × 0.2–0.5(–0.6) {14}, filiform to subulate, sometimes ± inflated at base, often slightly (to strongly) flexuous, overmature tear-shaped to ampulliform, 1.3–3(–4) × 0.5–1 µm {6}. **Paraphyses** apically (cylindrical), slightly to medium but also very strongly clavate-capitate, sometimes ± strongly asymmetrical, terminal cells *(17–)20–30(–34) × (2.5–)3–4.5(–5)((–6)) µm {10}, †14–21 × 2.3–4.5((–6)) µm {1}; lower cells *(4.5–)5.5–8.5(–11) {6} × (1–)1.5–2.5(–3) µm {10}, †7–10 × 1.5–2 µm {1}, rarely branched at upper septum; hymenium subhyaline to rosaceous. **Medullary excipulum** subhyaline, ~30–200 µm thick, of medium dense textura intricata with inflated cells or t. globulosa, very indistinctly delimited from ectal excipulum at flanks but rather distinctly towards margin. **Subhymenium** 15–30 µm thick, hyaline to pale rose-orange, of dense, small-celled or t. intricata. **Ectal excipulum** hyaline, of thin-walled, vertically oriented t. globulosa-angularis-prismatica from base to margin, ~50–100 µm thick near base, cells *(12–)17–35 {5} × (10–)12–20(–25) µm {6}; 30–50 µm thick at lower flanks, 15–25 µm at mid flanks and margin, marginal cortical cells *(8–)10–16(–18) × (5–)6–8(–10)((–11.5)) µm {4}, clavate to pyriform, **glassy processes** absent, rarely forming 1–3 µm thick caps {1}. **Anchoring hyphae** sparse to abundant, *2–3(–4) µm wide {3}, walls smooth, 0.2 µm thick {1}. **SCBs** in paraphyses (usually 4–15 µm below apex) globose or ellipsoid, refractive, one large 1.3–2.8 µm diam. per cell {15}, rarely several smaller (0.5–1 µm) and low-refractive ones in a group {1}; in ectal excipulum globose, 1.5–3 µm diam., sometimes ring-shaped (3–3.5 µm diam.). **VBs** in paraphyses absent {8} or present {2}, low- to medium refractive, globose to elongate, filling entire terminal cell, sometimes also in marginal cortical cells, remaining hyaline in dead state. **Exudate** over paraphyses and margin absent or ± scattered, granular, 0.2–0.7(–1) µm thick, hyaline, loosely attached to the wall, at margin also firmly attached and cap-like. — **ANAMORPH**: macroconidia anguillospora-like, microconidia dactylella/vermispora-like (from ascospore isolate {5} or conidial

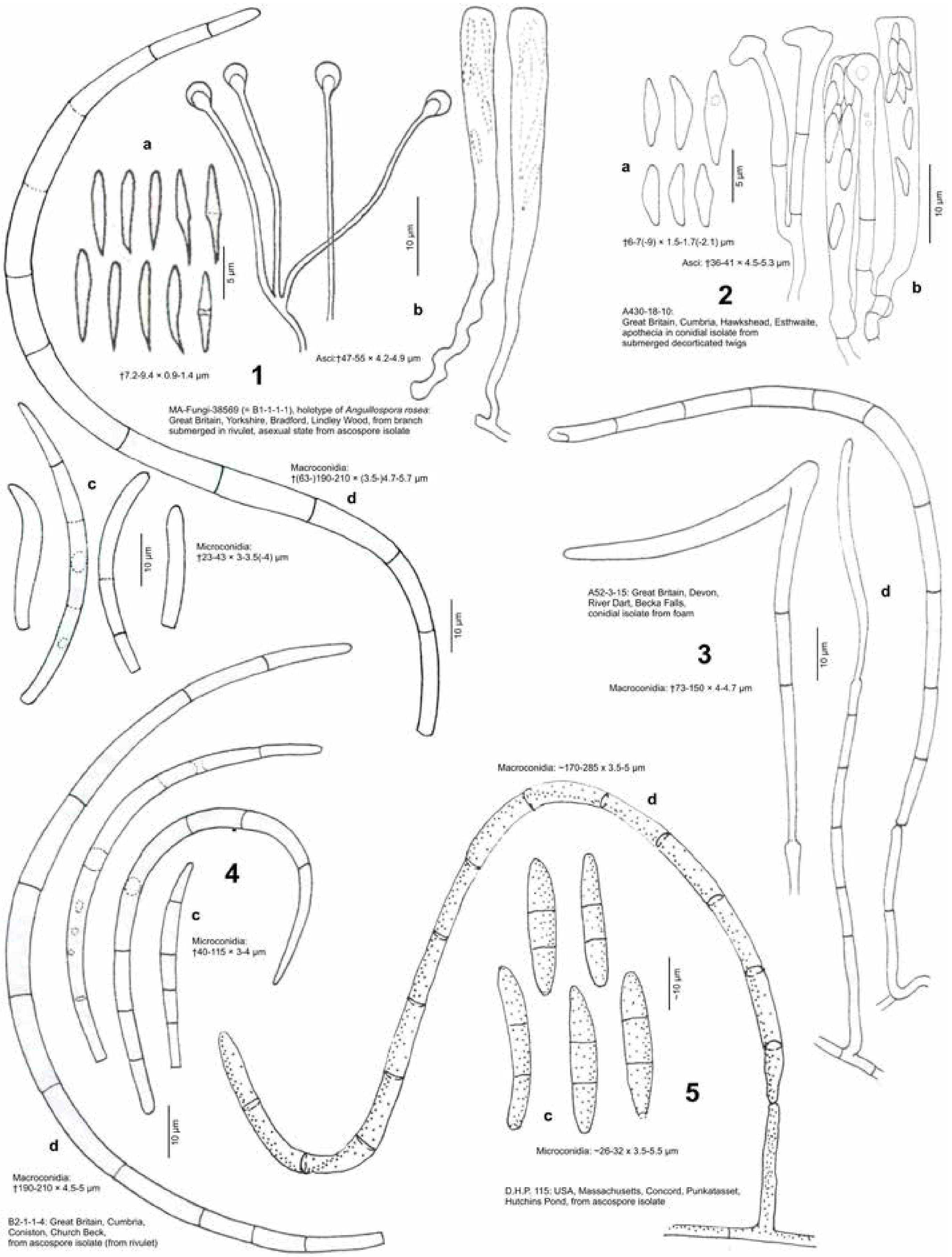


Plate 528. **1–5**: *Orbilia rosea*. – **a**. ascospores; **b**. asci and paraphyses; **c**. microconidia; **d**. macroconidia (both from pure culture). – **1–4** from Webster & Descals (1979) and Descals et al. (1999), **5** from Pfister (1997). – The given conidial size refers to the actual length. The scales in **3** and **5** are corrected according to obvious errors in the original publication: the former by 168 % (see Pl. 1), the latter by 50 %.

isolate {12}, mainly by Descals et al. 1999). **Colonies** typically pink on 2% MEA (Descals et al. 1999). **Macroconidiophores** mononematous, usually unbranched, multiseptate, apically slightly inflated, conidiogenesis terminal, 50–100 × 2–4 µm (Descals et al. 1999), 27 × 3 µm (Pfister 1997). **Macroconidia** *170–210 × 4.2–5.4 µm (always actual length), filiform, always strongly curved under a wide arch (U- or C-shaped, sometimes helicoid), (12–)15–17(–21)-septate, individual cells *7–19 µm long {H.B. 6756a, n = 3}, lipid content very low to low; †~(110–)150–190(–210) × 4.5–6 µm, 9–17-septate, individual cells †10–30 µm long {Descals et al.}; ~170–285 × 3.5–5 µm, 10–17-septate {Pfister}. **Microconidiophores** multibranched, branches †11–38 × 2.5–3 µm, apically 1.5–1.8 µm wide (Liu 2006), †13–45 × 2.5–3.5 µm (M.H. Mo ined.). **Microconidia** ~(23–)30–60(–115) × 3–4 µm (actual length), slightly to strongly curved (C-shaped), (0–)2–4(–6)-septate {Descals et al.}; 26–32 × 3.5–5.5 µm, straight, 2-septate {Pfister}; †18.5–30 × 3.2–4.5 µm, tapered towards both ends, ± straight, 1–2-septate (Liu 2006); †~22–47 × 3.4–5.5 µm, fusiform, straight to slightly curved, 1–4-septate (M.H. Mo ined.). Macro- and microconidia containing a few minute LBs close to the septa.

Habitat: on moist to wet ground, often submerged on wet banks of rivulets, or in periodically flooded areas, corticated or usually decorticated, 11–80 mm thick branches or thick logs (rarely roots) of *Acer* sp. {1/1}, *Alnus* sp. {9}, *A. alnobetula* {2}, *A. glutinosa* {5}, *A. incana* {1}, *Betula* sp. {1}, *B. pubescens* {2}, *Carpinus betulus* {1}, *Corylus avellana* {2/1}, *Fagus sylvatica* {8/3}, *Fraxinus excelsior* {2}, *Picea abies* {3}, *P. obovata* {1}, *Pinus sylvestris* {1}, *Populus tremula* {1}, ?*Quercus* sp. {1}, *Q. petraea* {1}, *Salix* sp. {5}, *S. atrocinerea* {1}, *Sorbus aucuparia* {1}, *Ulmus* sp. {1}, indet. angiosperms {4}, indet. conifers {2}, on 0.1–1 mm deep or entirely slightly to strongly decayed wood {57} and bark {7} (periderm and bast), wood usually grey-brown or blackened, some to many green algae present. **Associated**: *Annulusmagnus triseptatus* {1}, *Arachnopeziza* sp. {1}, *Botryobasidium aureum* {1}, *Brachysporium* sp. {1}, ?*Chaetosphaeria* sp. {1}, *Helicogonium orbiliarum* (parasitic in *O. rosea*) {2}, *Hyaloscypha albohyalina* {1}, *H. tigillaris* {1}, *H.* ?*vitreola* {1}, *Hymenoscyphus ombrophilaeformis* {1}, *H. phiala* {1}, *Mollisia* sp. {1}, *M. cinerea* {1}, *Nectriaceae* {1}, *Ombrophila hemiamyloidea* {1}, *O. pura* {1}, *O. violacea* {1}, *Orbilia rubrovacuolata* {1}, *O. sarraziniana* {2}, *Pachyella babingtonii* {3}, *Peziza granularis* {1}, *Phoma* sp. {1}, *Scutellinia nigrohirtula* {1}, *S.* ?*scutellata* {1}, *S. subhirtella* {1}. **Desiccation tolerance**: some immature asci and paraphyses (and many ascospores) still viable after a few days, a few ascospores survived for up to 1.5 years. **Altitude**: 15–715 m (boreal and atlantic Europe), 50–1796 m (temperate to subalpine subcontinental Europe), 350–1660 m (southern Europe). **Geology**: Cambrian, Ordovician, Devonian & Carboniferous sandstone and grit etc., Buntsandstein, Lower & Upper Jurassic shale & limestone, Cretaceous flysch, Quaternary boulder till, sand, silt & clay; granite, granulite, pegmatite, mica schist, gneiss, amphibolite, dolerite. **Phenology**: (II–)V–XI (teleomorph).

Phenology of *O. rosea* (teleomorph/anamorph)											
Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
0/0	1/1	2/0	0/3	9/3	7/0	5/0	8/0	8/0	12/2	4/7	0/0

Taxonomic remarks. *Orbilia rosea* is distinguished from *O. luteorubella* mainly because of strong differences in conidial shape (anguillospora- vs. helicoon-like). The two species appear to differ also in apothecial colour (rose-lilaceous vs. yellowish-orange) and ecology (preference for streams vs. stagnant waterbodies). Although apothecial colour may show some variability within species of series *Helicoon*, *O. rosea* had quite consistently rosaceous-lilaceous or sometimes whitish or cream to rose(-amber), but never distinctly yellowish-orange colours, except for the orange colour reported for collections from China (but note that the epithet *rosea* refers to the colony colour on MEA agar, not that of the apothecia). In contrast to the similar *O. sarraziniana* which likewise often exhibits rosaceous-lilaceous apothecia, the spores of *O. rosea* and *O. luteorubella* are predominantly fusoid to fusiform with also the basal end ± tapered, and the lower spores are rather consistently inversely oriented within the asci, while the upper spores mostly point with their SBs upwards. A clear difference in spore characters between samples with anguillospora-like and those with helicoon-like anamorph could not be found, though the asci and spores of *O. rosea* were sometimes a bit larger than in *O. luteorubella*. Besides spore shape and orientation, *O. sarraziniana* differs from these two species in its anamorph (see below).

Some more subtropical, extra-European taxa with a spore orientation as in *O. rosea* and *O. luteorubella* distinctly deviate from these in spore characteristics, sometimes also in apothecial pigmentation or in the anamorph. *O. hoana* differs in shorter and much wider SBs and may possess a more or less striking golden-yellow exudate. *O. sinensis*, *O. tenuispora*, and *O. acicularis* sharply differ in the pseudotripoconidium-like anamorph, *O. sinensis* and *O. tenuispora* also in distinctly narrower and *O. acicularis* in longer spores.

Macroscopic variation. Though typically showing a pale rosaceous-lilaceous tint in the fresh state (Pl. 531: 1–4), some collections here assigned to *O. rosea* were colourless (including the type of *O. rosea*) while others showed rose-cream(-yellowish) or rose-amber to salmon colours, sometimes intermingled with rosaceous-lilaceous apothecia within a population (5a–b), apparently as a result of the age of the fruitbodies. The lilaceous component nearly disappears in the dry state in which the apothecia are more yellowish-cream to orange-rose. In older herbarium material they appear whitish-cream to yellowish-ochraceous, even when rehydrated.

Overall 12 records were reported by Liu (2006) under the name *O. luteorubella* from different parts of China. Their apothecial colour was given as 'fresh orange, dry orange-red' (see Pl. 532: 1). This latter collection was here examined 1.5 years later (Pl. 529: 6). The apothecia had a pale cream-orange-ochraceous colour when rehydrated, and a few spores were still alive. Based on anamorph and molecular data, this strain belongs to *O. rosea*. In its teleomorph features it agrees in most respects with European *O. rosea* except for the deviating apothecial colour and an apparent tendency to wider SBs in the mature living spores.

Apothecia of *O. rosea* considerably vary in size. In a collection from Gérardmer (IVV: H.B. 6257) the largest (up to 3 mm) and thickest (up to 0.8 mm) were found. Very small and thin apothecia were noted, e. g., in the type of *O. juniperi* (see below).

Microscopic variation. As in many other species of *Orbilia*, rather high variation in the number of inverted spores within a given apothecium was observed in quite a few collections here referred to *O. rosea*. Also asci with a mixed orientation, or asci with inverted upper spores occurred. For instance, in H.B. 6756a (from Vosges) around 7% of the asci showed an orientation as in *O. sarraziniana*, with most or all lower spores being upwards oriented and some or all upper spores showing inverse orientation. Also in H.B. 6366b (from Luxembourg), H.B. 7109b (from Bretagne), H.B. 7776 (from Denmark), H.B. 9691b (from Sachsen) and some other specimens the asci rarely or infrequently showed an orientation that strongly deviates from the typical case. An ascus with the lower spores pointing with its SBs upwards is figured for H.B. 6366b on p. 151 (under *Helicogonium*, Fig. 123). However, in some

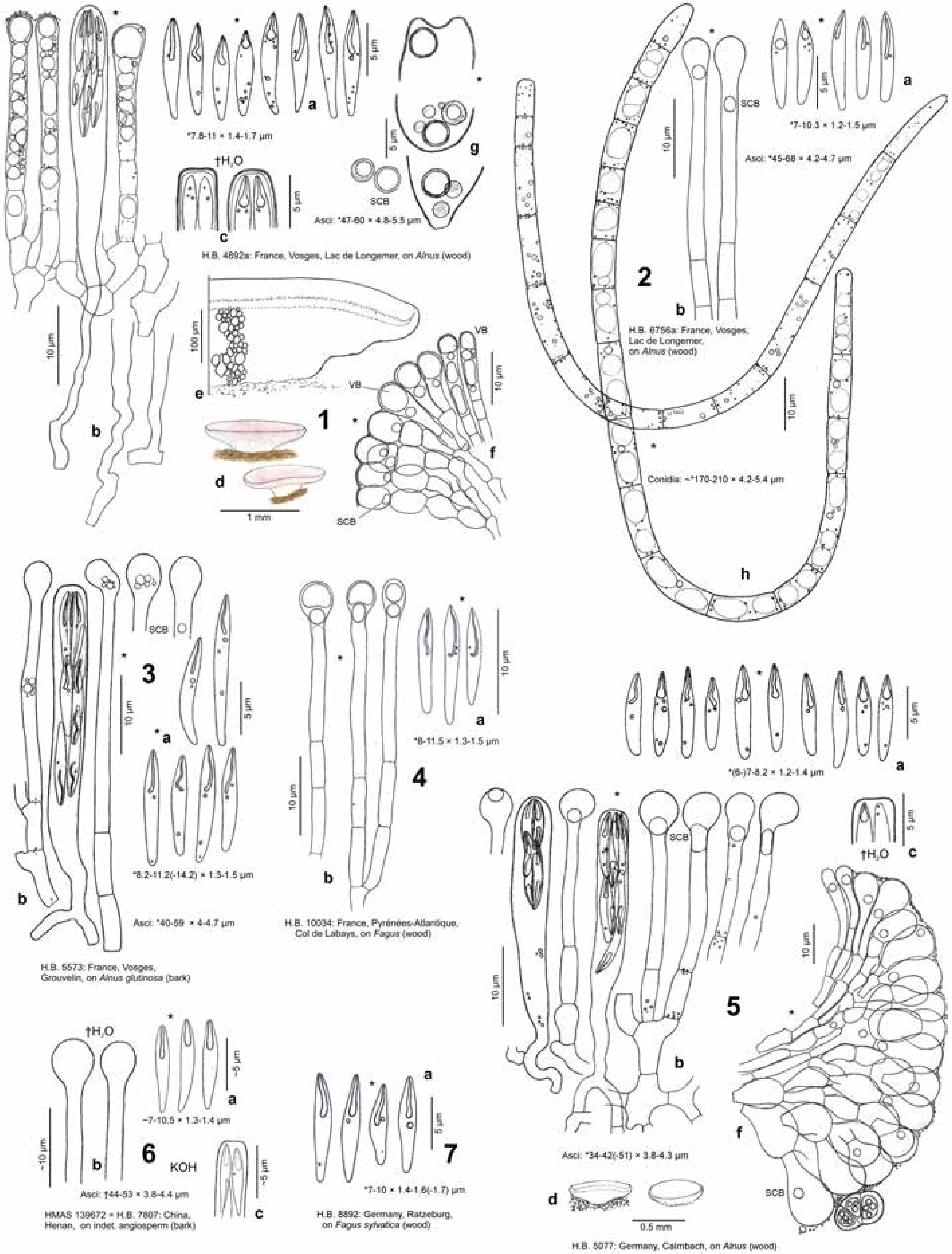


Plate 529. **1–7**: *Orbilia rosea*. – **a**. ascospores; **b**. asci and paraphyses (**5b** left ascus fully turgescent); **c**. ascus apices; **d**. apothecia (in **5d**: left in median section); **e**. apothecium in median section; **f**. id., ectal excipulum (margin and mid flanks); **g**. globose and ring-shaped SCBs in cells of ectal excipulum; **h**. conidia (from pure culture). The given conidial size refers to the actual length.

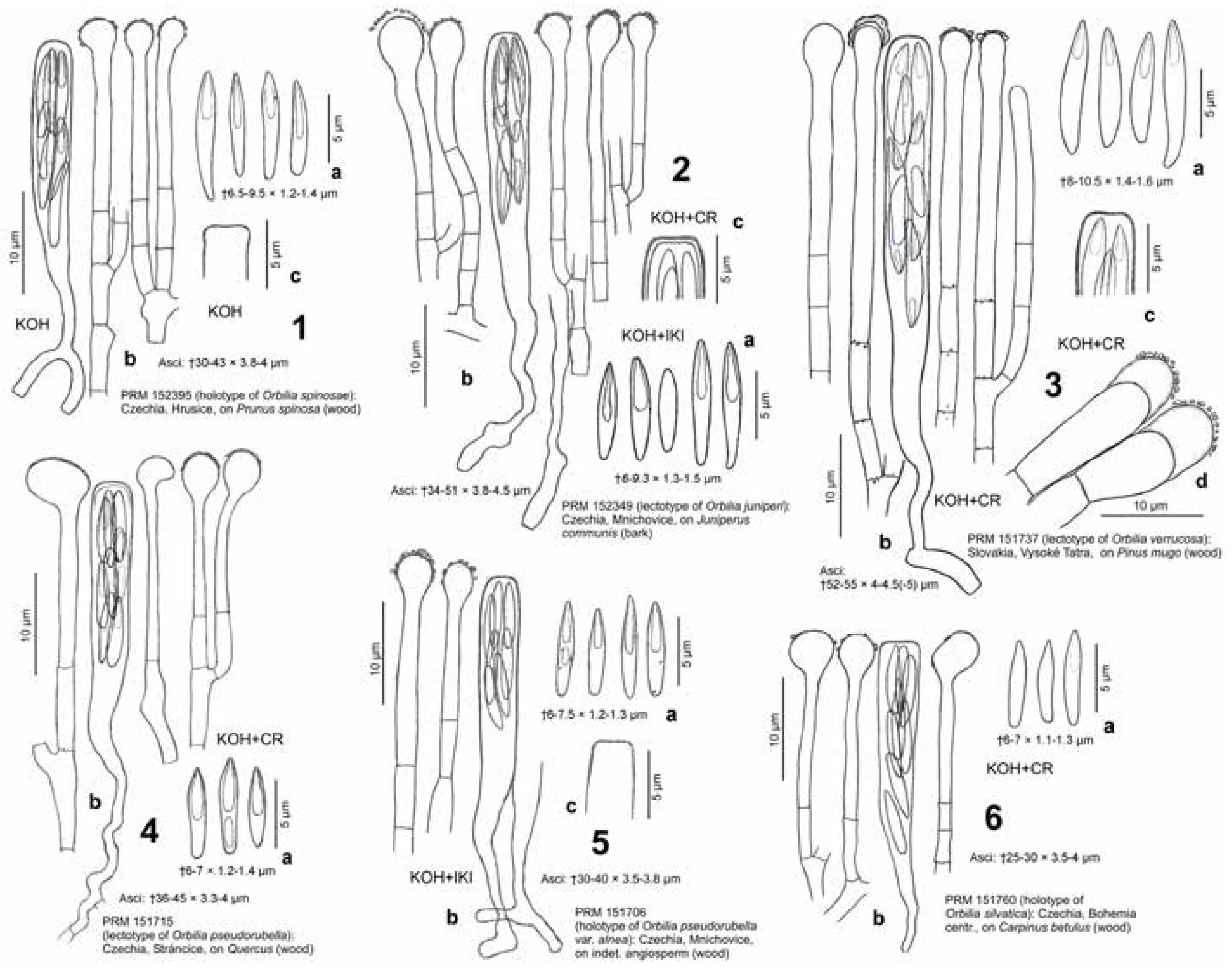


Plate 530. **1–6**: *Orbilia* cf. *rosea*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. marginal ectal excipulum in median section.

collections from different geographical origin (e.g. H.B. 4892, 5077, 5573, 8892) virtually all asci of an apothecium showed the typical orientation.

Ascus and spore size showed rather high variation among the collections and, therefore, much overlap between closely related taxa. For example, some records showed an ascus and spore size and partly also spore shape as in *O. sarraziniana* (e.g., Pls 529: 5; 530: 4–6). Extraordinarily long ascospores occurred in specimens from the Vosges and Pyrénées-Atlantique (Pl. 529: 3–4). In these and some other collections (e.g., Pl. 529: 2) the SBs were rather narrow and filiform, whereas in others they were often wider and more subulate and sometimes basally inflated.

The paraphyses show considerable variation in length of the terminal cells as well as in the strength of apical inflation (a similar variation is noted in *O. sarraziniana*). Usually, one or several globose SCBs occur in the apical inflation or shortly below, and these are also found in the marginal ectal excipulum (Pl. 529: 1–3, 5). Additionally, the paraphyses and cortical cells were rarely filled with large, round to elongate VBs (Pl. 529: 1). A similar variation was noted in *O. luteorubella*, and we conclude that the presence of SCBs and VBs is not species-specific.

A more or less severe asymmetry of the apical inflation was noted in some paraphyses of some specimens (see Pl. 529: 3b, 5b). Also a paratype of *O. rosea* (apothecia grown on agar) was illustrated by Descals et al. (1999: fig. 4) with strongly asymmetrical and deformed paraphysis heads (Pl. 528: 2), whereas the holotype illustration (apothecia from natural substrate) shows consistently symmetrical heads (Pl. 528: 1). Asymmetrical heads were also seen in two of Velenovský's not included type specimens (Pl. 530: 4, 6).

Type studies of teleomorph. Webster & Descals (1979) and Descals et al. (1999) provided a detailed description and illustration of the teleomorph, which they found to be connected to the anamorph ***Anguillospora rosea***. Although the epithet *rosea* suggests a rose or pinkish apothecial colour, only the mycelial colonies on agar had a pink colour (but cream-coloured on 0.1% MEA), while the apothecia formed on agar were reported as 'translucent, watery' (the colour of the apothecia on natural substrate was not mentioned). Although the authors mounted the apothecia in water, they studied only dead asci, ascospores, and paraphyses, therefore, no SBs were observed. The spores were described as eguttulate and, as a consequence, the spore orientation inside the asci remained unclear. Nevertheless, the partially (Pl. 528: 1) or consistently (528: 2) fusoid (homopolar) spores and the anguillospora-like anamorph suggest identity with our ascospore isolate and two further collections from the Vosges (Pl. 529: 1–3). Morphological features were not available for the teleomorph of Pfister's (1997) strain which he tentatively identified as *O. luteorubella*.

Plate 531. **1**, **3–6**: *Orbilia rosea*; **2**. *O.* cf. *rosea*. – **6a**. shady mountain stream over granite; **1a–d**, **2a**, **3a–b**, **4**, **5a–b**, **6b**. fresh apothecia; **3d**. apothecium in median section; **3c**. id., marginal ectal excipulum; **2b**, **5c**, **6d**. asci and paraphyses; **2c**, **3e**, **6c**. ascospores. – Living state except for asci in **6d**. – **5a–c**: phot. M. Bemmann, **6a–d**. P. Schäfer. — **1a–d**. H.B. 8892: Germany, Ratzeburg, on *Fagus*; **2a–c**. H.B. 9356: Germany, Chemnitz, on *Quercus*; **3a–e**. H.B. 9691b: Germany, Chemnitz, on *Alnus*; **4**. H.B. 9410: Sweden, Saxnäs, on *Betula*; **5a–c**. H.B. 7776: Denmark, Brovst, on *Corylus*; **6a–d**: H.B. 10018: Germany, Hornberg, on *Alnus*.

The differences in ascospore size and shape in the British samples between apothecia from natural substrate (Descals et al. 1999: fig. 7A–D, see Pl. 528: 1) and pure culture (Descals et al. 1999: fig. 8, see Pl. 528: 2) are mainly due to the use of a 40× dry objective in the former case. We assume that the spores in the holotype from Yorkshire were wider than can be evaluated from the scale, also the spore bases are certainly not as acute as they were drawn. The difference in symmetrical vs. asymmetrical apices of the paraphyses has probably no taxonomic weight.

The following three taxa erected by Velenovský might well represent synonyms of *O. rosea*, for which they would provide earlier names. We here refrained from adopting any of these names because of the inadequate and partly incorrect diagnoses of this author, and because no anamorph data exists.

The holotype of ***O. spinosae*** (on wood of *Prunus spinosa*) contains 3–4 minute apothecia, although Svrček thought the material to be empty. In spite of rather short asci, some of the fusoid spores attained a length of up to †9.5 µm (Pl. 530: 1). Spore orientation was only seen in a few asci, in which the upper spores were often not inverted. Because of the ascus length the taxon is somewhat intermediate between *O. rosea*/*O. luteorubella* and *O. sarraziniana*, although such short asci occurred also in some other specimens referred to *O. rosea* (Pls 529: 5; 530 5, 6). Velenovský described the fresh apothecia as 0.1–0.3 mm diam., glassy and colourless (present study: rehydrated 0.15–0.2 mm, whitish translucent), and incorrectly reported the spores as narrowly acicular, 4–5 µm long. In his 'Additamenta', Velenovský (1934: 401) added a further collection on *Prunus spinosa*, with likewise 'linear' spores 4–5 × 0.3 µm, but with rose-coloured apothecia.

In the present reexamination of the lectotype of ***O. juniperi*** (Pl. 530: 2), which derives from *Juniperus* branches lying on wet ground, only a single apothecium was found on a fragment of loose bark (rehydrated whitish, 0.25 mm diam., slightly concave). This was used up during examination. The spores are ± fusoid and the SBs clearly discernible in some spores as elongate transparent regions. This permitted to see the spore orientation in the asci which, besides spore shape and ascus length, excludes *O. sarraziniana*. Velenovský described the apothecia as 0.5–0.6 mm diam., lens-shaped, translucent, colourless, rarely with a rose tint, and the acicular spores as 4–6 µm long. He believed that the long and thin, flexuous ascus stipe, which was indistinctly branched only at the very base (L-shaped), was characteristic of this taxon.

Svrček (1954: 15), who did not make a distinction between *O. luteorubella*, *O. rosea*, and *O. sarraziniana* as circumscribed at present, believed that *O. juniperi* was a synonym of *O. luteorubella*, in spite of the reported whitish colour and the rather small asci (30 × 3.5–4 µm) and spores (6–7 × 1 µm) observed by him. Contrary to Velenovský and Svrček who stated that the paraphyses are 'without epithecium', these are found to be covered by a thin, refractive, granular exudate.

A separate decorticated, thin coniferous twig in the type packet bears two small apothecia of a whitish orbilia-like *Mollisia* with IKI-blue asci and light brown excipulum, but no *Orbilia*. Both Velenovský and Svrček stated *O. juniperi* to grow 'on wood'. Velenovský reported abundant apothecia in the lectotype, and referred a collection on *Abies* to this species. Svrček cited a second collection on *Juniperus* (topotype) which was not examined in the present study.

Velenovský (1934) described ***O. verrucosa*** on the basis of two collections on coniferous wood (Vysoké Tatry, *Pinus mugo*, VIII.1926, PRM 151737; Mnichovice, *Picea abies*, 26.VII.1926, PRM 152356). Apparently because Svrček did not find any spores in the *Pinus* specimen, he designated the *Picea* collection as lectotype. However, on Velenovský's two manuscript plates it can be seen that the protologue predominantly includes data of the collection on *Pinus*. Particularly spore length (5–8 µm) is that from the *Pinus* collection, whereas in the *Picea* collection Velenovský gave 8–12 µm long spores. The name *verrucosa* is undoubtedly derived from the thick-walled marginal cortical cells, each being terminated by a papilla. Again, this feature is only illustrated for the *Pinus* collection. Therefore, Svrček's lectotypification must be considered as being against the Code (Art. 9.19, Turland et al. 2018).

When the rich *Picea* collection was reexamined here, indeed no such wall thickenings and papillae could be observed. Svrček (1954: 22) is confirmed here when referring this specimen to *O. auricolor* (as '*O. curvatispora*', see Pl. 950: 3). Reexamination of the *Pinus* collection (Pl. 530: 3) revealed 3–5 × (4–)5–7 µm large glassy caps on the cortical cells at margin and flanks, which undoubtedly correspond to the wall thickenings reported by Velenovský, though distinctly papillate caps could not be seen. In the largest apothecium (rehydrated 0.45 mm diam.) a few mature asci were found. The included spores are fusoid with an acute apex, and only slightly inequilateral or curved, in contrast to the protologue and manuscript plate which report filiform, strongly curved (C-shaped) spores. Since the remaining features agree with Velenovský's manuscript, it is concluded that the C-shaped spores do not belong to the present *Orbilia*. As a consequence, we here designate the collection on *Pinus* (PRM 151737) as **lectotype** of *Orbilia verrucosa*.

The hymenial features of this lectotype specimen, e. g., spore orientation inside the asci, fit quite well *O. rosea*. We did not include *O. verrucosa* in our description because we never saw such prominent glassy caps in *O. rosea*. In the protologue of *O. verrucosa* the apothecia were described as 0.3–0.8 mm diam., glassy rosaceous or pale yellowish. According to Velenovský's manuscript plates, the apothecial data of the lectotype on *Pinus* read '0.3–0.5 mm, glassy translucent, pale with pink or yellow tinge' which would match more or less the present concept of *O. rosea*, while those of the *Picea* collection read '0.5–0.8 mm, translucently apricot', a colour not mentioned in the protologue.

Another collection under the name *O. verrucosa* (PRM 151769, from Vysoké Tatry, VIII.1926) was neither cited by Velenovský (1934) nor treated in his manuscript and also Svrček did not mention it. Except for the host (*Picea abies*), the collection data concur with those of PRM 151737. The apothecia are larger (rehydrated 0.4–0.8 mm diam.), and the hymenial elements appeared senescent. Three apothecia were examined, but no spores could be found. Some of the marginal cells bear small caps but a majority are without. It seems probable that this specimen is conspecific with the lectotype on *Pinus*.

The holotype of ***O. silvatica*** (on wood of *Carpinus*, Pl. 530: 6) was placed by Svrček (1954: 20) in synonymy with *O. luteorubella* var. *pellucida* (= *O. cardui* in the present monograph). This is surprising because Svrček separated that variety from typical *O. luteorubella* by a layer of exudate over the paraphyses, which could not be found in the present reexamination of the type. Yet, Svrček did not mention any observations made on this material. Velenovský's description indeed suggests identity with *O. cardui* (apothecia colourless, paraphyses non-capitate, covered by exudate). Only ± overmature apothecia referable to *O. ?rosea* could be found in the holotype (two apothecia examined), and the material does not look like a mixture. The paraphyses are strongly capitate and covered by minute scattered granules. The rather small spores are often pointed at one end, and their widest part is in the middle or closer to the pointed end. Spore orientation was very difficult to see: the upper spores are perhaps

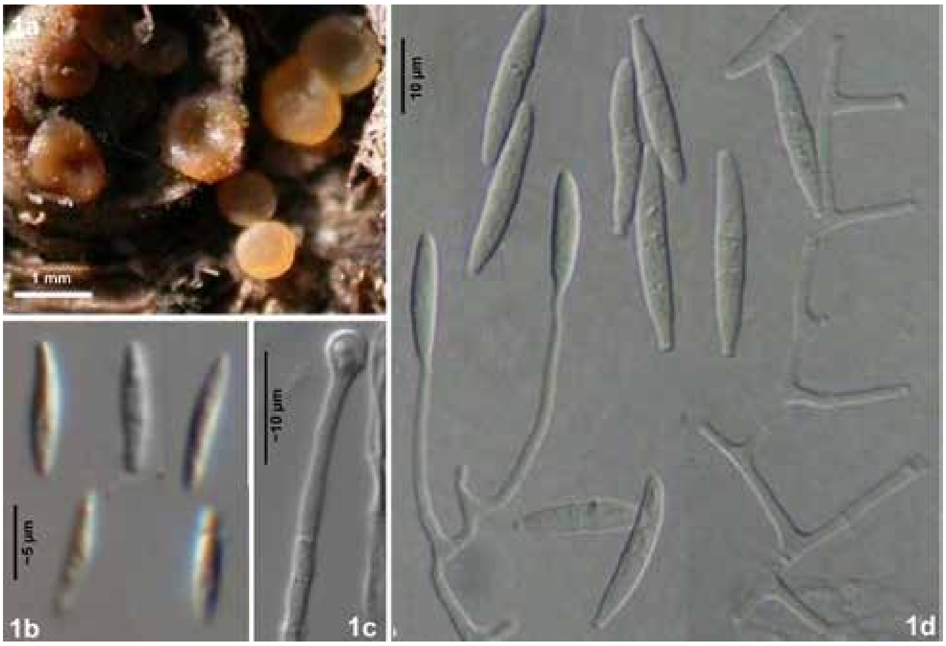


Plate 532. **1**: *Orbilia rosea*. – **1a**. fresh apothecia; **1b**. ascospores; **1c**. paraphysis; **1d**. conidiophores and microconidia (from culture). – Dead state; from Liu (2006, figs 129–130, DIC). — **1**. HMAS 139672: China, Henan, on ?*Quercus*.

predominantly oriented with their pointed ends downwards, but the lower spores sometimes also. Spore orientation better fits *O. sarraziniana*, whereas spore shape better fits *O. rosea*. About 50 scattered apothecia (rehydrated 0.2–0.5 mm diam., convex, pale cream) occur on the wood fragments. Why Velenovský gave the apothecial size as ‘smaller than 0.1 mm (!)’ remains a mystery. Also the spores were given by him much too small (3–4 µm long, very narrowly linear). A confusion of the specimen might have happened, but the wood anatomy fits the host (*Carpinus*) mentioned by Velenovský.

O*. *pseudorubella was placed in synonymy with *O. luteorubella* by Svrček (1954: 19). The examined syntype (PRM 151715, on Quercus wood, Pl. 530: 4) might fit *O. sarraziniana* because of rather small spores and very strongly capitate paraphyses. Also ascus size fits that species. However, spore shape (with the widest part often closer to the acute end) would better fit *O. luteorubella* or *O. rosea*. Svrček found the asci shorter (28–33 × 3.5 µm) and the spores narrower (6–8 × 1 µm) than evaluated here. Spore orientation could clearly be seen in some spores of the well-preserved material (in KOH+CB_L, sometimes the upper spores were inverted but often they were not inverted, and usually the orientation was rather mixed). Velenovský characterized his taxon by large (1–2 mm), carneous-rose apothecia and emphasized the absence of a yellow tint. He erroneously reported the spores as very narrow, linear, 3–5 × 0.3 µm. The protologue mentions five localities and two substrates (*Quercus* and *Carpinus*). Velenovský’s manuscript notes actually contain a lot of records, and a total of six specimens can now be found at PRM (M. Chlebická pers. comm.). The syntype examined here is among those for which Velenovský made unpublished microscopic sketches, and Svrček appears to have considered this material as ‘holotypus’ because it fits for all measurements exactly the data of the protologue. We therefore designate the collection on *Quercus* (PRM 151715) as **lectotype** of *O. pseudorubella*. Svrček mentioned one further specimen under the name *O. pseudorubella* (PRM 151702), which we did not see and which he likewise referred to *O. luteorubella*. Based on the rose apothecial colour in the protologue we tentatively place *O. pseudorubella* in synonymy with *O. rosea*.

The holotype of ***O*. *pseudorubella* var**. ***alnea*** (Pl. 530: 5) now consists of only three small apothecia which certainly did not grow on *Alnus glutinosa* as stated by the author, but perhaps *Tilia*. Svrček (l.c.) considered the taxon to be young *O. luteorubella*. The fusoid ascospores have their widest part in the middle or sometimes closer to the acute end. In some free spores liberated by strong squeezing, SBs could be discerned in the acute end, while within the asci the SBs could hardly be seen. Judging from spore shape, the spore orientation appears to be clearly variable: sometimes the lower spores are inverted and sometimes the upper. Again Velenovský reported much too small spores (3–4 × 0.2 µm) which Svrček corrected to 7–8 × 1 µm. The apothecia were described as glassy translucent, colourless, 0.3–0.6 mm diam., and perhaps this was the reason why Velenovský separated the specimen from *O. pseudorubella* at the variety level. Ascus and spore size fit *O. sarraziniana* as well as *O. rosea* or *O. luteorubella*. Because of the colourless apothecia and the fusoid spores with their widest part closer to the acute end we tentatively place the taxon in synonymy with *O. rosea*.

Misapplication. Costantin’s (1888) detailed description of samples under the name *O. vinosa* (no substrate or other collection data are mentioned) belong to a member of section *Helicoon*, probably *O. rosea*, based on the rose apothecia colour. Costantin illustrated asci with truncate apices, strongly capitate paraphyses, and fusoid-acicular spores 8–11 × 1 µm. For the other cases of misapplication see below (under Not included collections and Anamorph) or above (Type studies).

Not included collections. Due to the difficulty in recognizing *O. rosea* by the teleomorph alone, we refrained from including a number of specimens, partly because the apothecial colour was not clearly pinkish, or because the fresh colour was not documented. Also the spore orientation was sometimes very variable, or it could not clearly be seen in specimens that were studied in the dead state.

In a few specimens both types of spore orientation were rather frequent, though the inverse orientation of the lower spores prevailed. For instance, in a collection from Chemnitz (Pl. 531: 2) around 50% of the asci showed the lower spores inverted, and perhaps 40% the upper spores inversed, while a mixed orientation occurred in a further 10–20% of the asci. Spore shape was here often fusoid, which seems to exclude *O. sarraziniana*. Because of this uncertainty, the collection was not included in either description. Spore orientation was similarly variable in the types of *O. pseudorubella* and *O. pseudorubella* var. *alnea*, though here the spores and their SBs could only clearly be seen in some asci. In the types of *O. verrucosa* and *O. juniperi* exceptions of the typical orientation were not observed, but spores were only seen in a few asci. For the latter four species and the likewise not included *O. silvatica* and *O. spinosae* see also under Type studies.

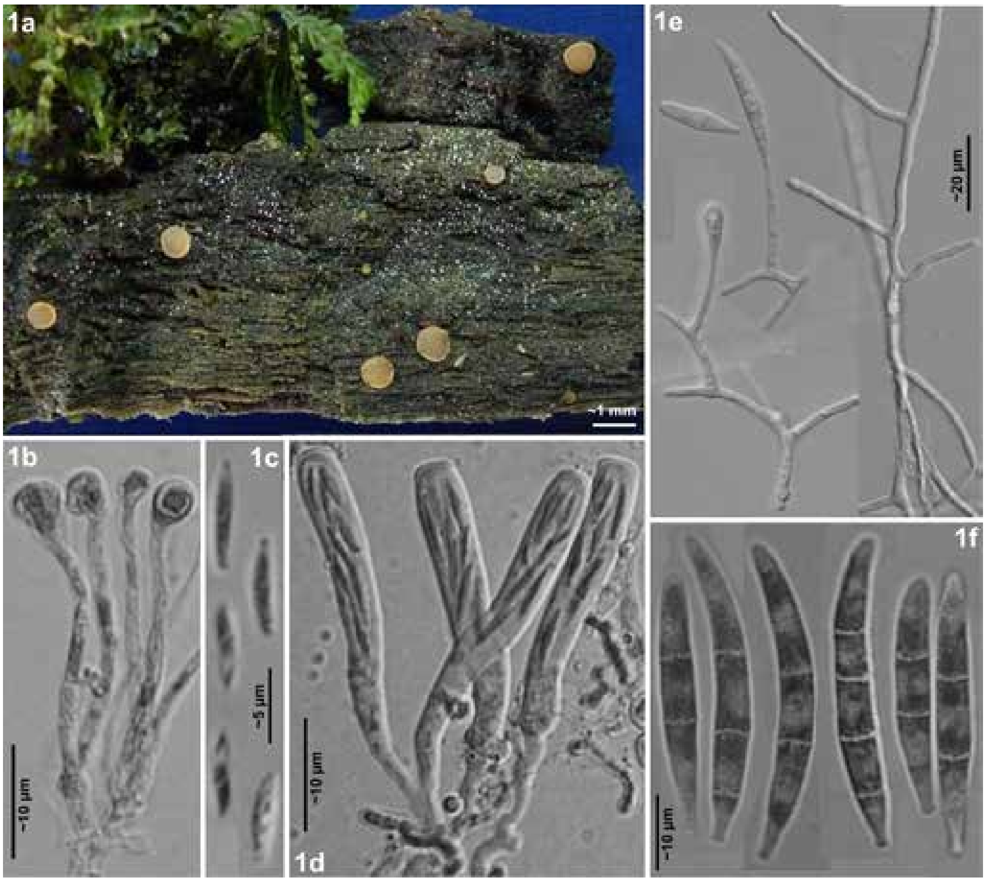


Plate 533. **1**: *Orbilia* cf. *rosea*. – **1a**. fresh apothecia; **1b**. paraphyses; **1c**. ascospores; **1d**. asci; **1e**. conidiophores with young conidia; **1f**. conidia (from culture). – Dead state (in MLZ); phot. M.H. Mo (partly DIC). — **1a–f**. M.H.M. 003: China, Guizhou, on indet. tree.

Two collections from France (Côte-d'Or) with spores *6.5–10.5 × 1.2–1.5 µm were presented under the name *O. luteorubella* by J.P. Priou in Fournier et al. (2010, see also IVV: J.P.P. 29201). The obclavate spore shape is strongly reminiscent of *O. sarraziniana*, but spore orientation appears to exclude this species. The apothecia were grey-cream with a rose but also yellowish component. Collections from Bretagne (IVV: J.P.P. 28085) and Midi-Pyrénées (IVV: J.P.P. 26213) show similar features but deviate in distinctly smaller spores (*6–7 × 1.1–1.2 µm).

Two collections from subalpine Switzerland in an *Alnetum viridis* on calcareous soil are also not included in the description. One on *Alnus alnobetula* from Sörenberg (Luzern) was reported by Breitenbach & Kränzlin (1981: pl. 252) under the name *O. sarraziniana*. According to our reexamination, spore shape and orientation appear to exclude this species. The 'grey-pink' apothecia suggest identity with *O. rosea* while the photo shows an orange colour. The one from Sittlisalp (Uri, IVV: H.B. 8283) grew on a herbaceous stem of *Adenostyles* and concurred quite well with lignicolous specimens, except for rather short SBs (2.5–3.5 × 0.3 µm).

A collection from Guizhou, China, examined and cultured by M.H. Mo (pers. comm., M.H.M. 003) was at first glance considered to be close to *O. bannaensis* because of similar ascospores and conidia, but appears to belong to *O. rosea* s.l. (Pl. 533). Those from Hong Kong and western Russia are only known in the dead state and lack clear data on spore orientation, in the latter also apothecial colour is unknown.

Anamorph. Webster & Descals (1979) obtained various conidial isolates of *Anguillospora* sp. from foam of streams in England (Cumbria, Wales, and Devon). In one from Cumbria, mature apothecia developed which they identified as *Orbilia* sp. (Pl. 528: 2; Descals et al. 1999: fig. 8). Later, Descals et al. described the anamorph as *A. rosea*, which they obtained also in ascospore isolates of two collections of *Orbilia* sp. on submerged branches from streams in Yorkshire (Pl. 528: 1; Descals et al. 1999: fig. 7A–C) and Cumbria (Descals et al.: fig. D). Apparently the same anguillospora-like anamorph was obtained by Pfister (1997: 8) in an ascospore isolate of an *Orbilia* collected near Concord, Massachusetts (Pl. 528: 5), and by us in an ascospore isolate of a collection on an *Alnus* branch from the Vosges (Pl. 529: 2).

According to Descals et al. (1999), the characteristics of *A. rosea* include colonies with a pink colour on 2% MEA (but pale cream on 0.1% MEA), and very long scolecosporous macroconidia which are strongly curved under a wide arch (C- but also S-shaped), with ± tapered apex and truncate base, 120–185(–210) × 3–6 µm (actual length), (0–)9–17-septate. These conidial data agree quite well with ours obtained from the French specimen. We assume, however, that the 100 µm-scale in fig. 4 in Descals et al. is erroneous, while the 50 µm-scale in their fig. 6 might be valid also for fig. 4. With the 100 µm-scale the conidia would have a size of 125–255 × 6–8 µm which is distinctly beyond the above values, while with the 50 µm-scale a reasonable size of 73–150 × 4–4.7 µm is obtained. Pfister (1997) did not provide conidial measurements. According to the given scale a size of 88–108(–142) × 1.8–2.4 µm (actual length) was evaluated for the 10–17-septate macroconidia. However, we assume also here an error in the scale, for which perhaps 40 instead of 20 µm are valid: this would result in a size of about 175–215(–285) × 3.5–5 µm.

Both Descals and Pfister observed also microconidia in their cultures, while no such conidia were observed in our strain. In the strains of Webster & Descals (1979) and Descals et al. (1999: figs 6B, 9) these microconidia were usually curved, 0–2(–4)-septate, 22–43(–63) × 3–4 µm, whereas in Pfister's strain they were straight, 2-septate, ~26–32 × 3.5–5.5 µm (scale corrected as stated above). In an isolate from Cumbria, Descals et al. (l.c.: fig. 6C; Pl. 528: 4c) found intermediate, 3–6 septate conidia of about 40–115 × 3–4 µm (actual length), which resemble the multiseptate macroconidia although their length was not included in the protologue of *A. rosea*. The authors emphasized that the observed macro- and microconidia overlap in length and number of septa by showing a continuum without sharp limits between the two conidial types. However, these intermediate conidia are drawn narrower than the long conidia which are about 4.5–5 µm wide, hence we included them in the microconidial measurements. In different streams in southern France, Descals & Chauvet (1992) found conidia which they referred with hesitation to *A. rosea*. Neither a culture was obtained nor a description provided. According to the scale, the single drawn conidium has a size of ~185 × 5 µm and shows 29 septa.

In one of B. Liu's 12 Chinese strains identified as *O. luteorubella* (Henan, at rivulet, on bark of ?*Quercus*, Pl. 529: 6) an anamorph with ± straight, 1–2-septate conidia was obtained which Liu named *Dactylella* sp., but which appears to represent the microconidial stage of *O. rosea* (Pl. 532: 1d). The absence of macroconidia in this strain might be due to the fact that the culture was not flooded. Similar, but larger, straight to slightly curved, 1–4-septate microconidia were reported by M.H. Mo in his strain of *O.* cf. *rosea* (Pl. 533: 1e–f). The conidia observed in *O. sarraziniana* (Pl. 539) resemble microconidia of *O. rosea* but are partly broader and more strongly curved, comparable to the microconidia observed in the helicoon-like anamorph of *O. luteorubella*.

Dactylella stenomeces Drechsler (1963), a species with long and slender multiseptate conidia isolated from decaying leaves and parasitizing *Pythium* oospores, was transferred to *Brachyphoris* by Chen et al. (2007b). The conidia resemble macroconidia of *A. rosea* but are narrower (2.5–3.2 µm). Also *Anguillospora curvula* S.H. Iqbal (1972), isolated from grass leaves in a stream in Devon (England), has similar-sized conidia (110–187 × 2.7–3.7 µm, but 3.7–4.7 µm according to scale) which are, however, only 2–5 septate and the colonies light greyish- to reddish-brown. For both species no sequences were available in GenBank.

Anamorphs very similar to *Anguillospora rosea* are connected to members of *Phaeohelotium* or *Cudoniella* (*Helotiales*). For instance, the teleomorph of *A. furtiva* Descals, referred to *Pezoloma* by Descals et al. (1999) appears to belong to *Phaeohelotium imberbe* (Bull.) Svrček, a frequent species on dead wood at stream banks. Unlike *A. rosea*, *A. furtiva* possesses a phialidic synanamorph which forms minute, subglobose microconidia.

Since the holotype of *A. rosea* does not appear to have been preserved as living culture, and molecular data were not gained from it, we here designate the paratype isolate CCM F-18983 as **epitype** of *A. rosea*, for which an SSU sequence exists in GenBank (AY357265).

Phylogeny. Sequences of five European strains were available: two ascospore isolates (Vosges, H.B. 6756a; Schwarzwald, H.B. 10018) comprising SSU, ITS, and LSU, two from apothecia (Pyrenees, H.B. 10029, 10034) comprising ITS and LSU, and the epitype isolate of *Anguillospora rosea* (England, CCM F-18983) for which only SSU was available. Sequences were also available for five Chinese strains identified by B. Liu as *O. luteorubella*, comprising ITS, two also LSU. The S1506 intron is present in the epitype (406 nt, mentioned also by Belliveau & Bärlocher 2005), but absent in our two ascospore isolates and those from China.

The connection between teleomorph and anamorph is confirmed by a 100 % similarity in the partial SSU (352 nt, V8–V9, excluding intron) by which the isolate from Vosges overlaps with the British *A. rosea* strain (H.B. 10018 has only V9 where it concurs with H.B. 6756a). In the V9 region of these 352 nt, *O. rosea* differs at 4 nucleotide positions (**A**AG**A**TCGGCAACGA**T**CA**T**) from the available four strains of *O. sarraziniana* (China: HMAS 139684, 96817; Europe: H.B. 7235 & 6727a) and two of *O. luteorubella* (China: gz-08; Europe: H.V. A327) which have **G**AG**G**TCGGCAACGA**C**CA**C**. This paired symmetrical change of nucleotides suggests a stem-loop structure which roughly corresponds to the long loop in the V9 region of the *Escherichia coli* SSU.

The only member of series *Pseudotripoconidium* with SSU V9 (DQ471000, AFTOL-ID 905, CBS 917.72, *Orbilia* aff. *sinensis*, Benedict's strain) concurs at these 4 positions with *O. sarraziniana* and *O. luteorubella*. In fact, this motif is by far the most frequent one across the genus *Orbilia* and occurs even in *Lilapila* and *Bryorbilia*. The *O. rosea* motif, on the contrary, does not occur in any other *Orbiliomycetes* for which the V9 region was available. Further sequences of the SSU V9 within section *Helicoon* are necessary to clarify whether this motif is unique to *O. rosea*. Also it might be worth finding out whether the S1506 intron, which the British epitype strain of *O. rosea* possesses, occurs also in strains of this species from central Europe or elsewhere.

In a phylogenetic analysis of the ITS region by Liu et al. (2006a), all five Chinese strains clustered in a clade, though showing some distance among each other. In our ITS analysis they clustered strongly supported with the four European *O. rosea* strains (one of the Chinese strains, B.L. T540, is not shown), whereas strains with a helicoon-like anamorph appeared distant from those (Phyl. 17). The ITS distance among the Chinese strains lies in the range of (0.2–)2.2–3.5(–6.5) %, and between the four European strains at 0–0.4(–3) %, whereby the Chinese differ from European by (2.5–)3–3.5(–5.5) %. However, although one of the two strains from Pyrenees (H.B. 10034) fully concurs with H.B. 10018, the other deviates from it by 15 nt (3 %) and 4 gaps in the ITS and 3 nt in the LSU D1–D2 as closest match.

We assume that all five Chinese strains are able to produce anguillospora-like macroconidia and belong to *O. rosea* as a genetically variable species. It would be valuable to gain ITS from the ex-type and other cultures of *A. rosea* in order to better explore the molecular variation of *O. rosea* within Europe.

O. rosea differs from *O. luteorubella* in the ITS region by 13–15 % and from *O. sarraziniana* by 14–17 % (*O. luteorubella* differs from *O. sarraziniana* by 15–15.5 %). In the LSU D1–D2 the two *O. rosea* strains concur except for 1 nt (0.2 %), while they differ from the mentioned Chinese '*O. luteorubella*' strains (2 have LSU) and three other Chinese strains uploaded under the name *Orbilia auricolor* (AY261123–5) by 1–1.5 %, from *O. luteorubella* and *O. sarraziniana* by 5–5.5 %, and from series *Pseudotripoconidium* also only by 5–6 % (582 nt).

Ecology. Apothecia of *O. rosea* were found on ± rotten wood (more rarely bark) of periodically submerged branches and logs of various angiosperms, often on *Alnus*, but also gymnosperms. A sparse, not included record was on a herbaceous stem (*Adenostyles*).

The species is adapted to running water (streams and rivulets up to their source), by which the apothecia are sometimes flooded. The included collections are from cold- to warm-temperate humid regions but also from orotemperate and orosubmediterranean (montane to subalpine) or thermo- to oroboreal zones and comprise atlantic to subcontinental regions of Europe. In contrast, *O. luteorubella* is usually not observed in orotemperate zones. Collections are also known from continental, oroboreal and subtropical humid (partly winter-dry) eastern Asia and from cold-temperate humid eastern North America. The vegetation includes *Alnetum glutinosae*, *Alnetum viridis*, *Abieti-Fagetum*, etc.

Besides Descals et al.'s (1999) records of mainly anamorphs, which concentrate on the western part of England and Scotland, the database of the British Mycological Society (FRDBI) lists *A. rosea* also from some other counties of England: South West (Cornwall, West Gloucestershire, South Wiltshire), South East (South Hampshire), and East Midlands (Derbyshire, Leicestershire, Rutland). Apothecia which formed *Anguillospora rosea* in our pure culture were collected from a place where a small rivulet flows into a large lake (Lac de Longemer) in a montane forest of Vosges (eastern France).

The filiform shape of anguillospora-like conidia represent an adaptation to running water by which they are transported, in contrast to the air-enclosing conidia of *Helicoon sessile* which occur in stagnant water (Michaelides & Kendrick 1982), though *H. sessile* was also found at streams (Pfister 1997). Records of *O. rosea* are predominantly from streams that emerge from more or less acidic bedrock. For instance, Descals & Chauvet (1992) observed *Anguillospora* (?)*rosea* in southwest France in three of the four streams, with a pH between 5.5–6.5 and 6.7–7.8, while the species was absent in the fourth stream with a pH of 8. The holotype of *A. rosea* was collected on quite strongly acidic Upper Carboniferous Millstone Grit in West Yorkshire, and on this sandstone were also the two sites where C. Yeates (pers. comm.) detected the teleomorph.

Map 88. Known distribution of *O. rosea* in Europe (yellow = not included collections).

Specimens included (all conidial isolates from foam). **SWEDEN**: **Västerbotten**, Vilhelmina, 4.5 km SW of Saxnäs, Satsfjället, Pojken, 715 m, branch of *Betula pubescens*, on wood, 24.VII.2010, P. Perz (H.B. 9410 ø). — **FINLAND**: **Uusimaa**, 50 km ENE of Helsinki, 5.5 km ESE of Porvoo, log of *Betula*, on wood, 25.VI.2019, J. Äikäs (doc. vid.). — **DENMARK**: **Nordjylland**, 8 km NW of Brovst, 3 km W of Tranum, SSE of Naturcenter Fosdalen, Lien, 15 m, branch of *Corylus avellana*, on wood, ~14.V.2005, C. Lange (H.B. 7776 ø). – ibid., log of ?*Acer*, on wood, ~14.V.2005, C. Lange (ø). — **GREAT BRITAIN** (from foam, if not otherwise stated): **Scotland**, **Highland**, 25 km NW of Inverness, 4 km W of Strathpeffer, River Contin, Falls of Rogie, 60 m, 13. XI.1979, E. Descals (B124-1-6, -9, conid. isol., non vid.). – 34 km NNW of Inverness, Strath Rusdale, River Black Water, Creag Braigh, 180 m, 15.XI.1979, E. Descals (B134-1-12, conid. isol., non vid.). – **Stirling**, ~45 km NNW of Glasgow, Loch Katrine, 120 m, 8.XI.1979, E. Descals (B108-1-1, -2, conid. isol., non vid.). – **Aberdeenshire**, 14 km WSW of Ballater, 8 km ENE of Braemar, A93, Feardan Burn, 300 m, 10.XI.1979, E. Descals (B111-1-1, conid. isol., non vid.). – ~5 km SW of Ballater, River Muick, ~300 m, 10.XI.1979, E. Descals (B114-2-9, conid. isol., non vid.). – 30 km NW of Aberdeen, 10 km W of Inverurie, Benachie Forest, Birks Burn, 220 m, 12.XI.1979, E. Descals (B121-2-4, conid. isol., non vid.). – **North West England**, **Cumbria**, 4 km WNW of Bowness-on-Windmere, 1.4 km E of Hawkshead, Esthwaite, Smooth Beck, 180 m, twig of indet. woody plant, on wood, 23.IV.1976, E. Descals (A430-10B-12, A430-18-8, -10, conid. isol., non vid.). – ibid., twig of *Fraxinus excelsior*, IV.1976, E. Descals (A430-15-8, non vid.). – 10.5 km W of Bowness-on-Windmere, W of Coniston, Church Beck, 100 m, on wood of indet. tree, 17.V.1978, J. Webster (B2-1-1-4, anam. cult., non vid.). – **Yorkshire**, **West Yorkshire**, 17 km NNE of Bradford, ~4 km NNE of Otley, Lindley Wood Reservoir, 100 m, branch of indet. tree, 19.V.1978, J. Webster (MA-Fungi-38569, **holotype**, Descals B1-1-1-1, **isotype**, dried culture, anam. cult., doc. vid.). – 9.5 km W of Halifax, 1.5 km SW of Mytholmroyd, Broadhead Clough, Cragg Vale, 198 m, branch of *Betula pubescens*, on wood, 4.XI.2013, C. Yeates (C.Y. F/2395, doc. vid.). – 5 km WNW of Huddersfield, Longwood Valley, 208 m, branch of *Quercus petraea*, on wood, 14.III.2014, C. Yeates (C.Y. F/2425, doc. vid.). – **Wales**, **Gwynedd**, Snowdonia, 15 km SW of Llandudno, 1 km SE of Abergwyngregyn, Aber Falls, 100 m, 23.X.1976, E. Descals (A487-1-2, -3, -4, conid. isol., non vid.). – **Conway**, 25 km S of Llandudno, 5 km S of Llanrwst, near Bettws-y-Coed, 20 m, 17.V.1976, E. Descals (A450-2-5 ø, conid. isol., non vid.). – ibid., 25.X.1976, E. Descals (A490-2-2, non vid.). – ibid., 21.V.1979, E. Descals (B35-A-4, non vid.). – ibid., IV.1983, L. Marvanová (CCM F-18083; CCM F-18983 [as 08983, later changed to 18983, L. Marvanová pers. comm.], **epitype** of *A. rosea*, doc. vid., sq.: AY357265). – **Powys**, 35 km ENE of Aberystwyth, Llawryglyn, Llawryglyn Woods, 180 m, 28.V.1979, E. Descals (B60-A-1, conid. isol., non vid.). – **Pembrokeshire**, unlocalized, 14.XI.1981, E. Descals (B291-1-11, conid. isol., non vid.). – **South West England**, **Devon**, 20 km SW of Exeter, ~1 km SE of Manaton, River Dart, Becka Falls, 200 m, 21. II.1974, E. Descals (Descals A52-3-15, conid. isol., non vid.). — **FRANCE**: **Bretagne**, **Finistère**, 9 km NW of Crozon, 1 km W of Roscanvel, Men Caër, 50 m, branch of *Salix atrocinerea*, on wood, 8.III.2002, J.P. Priou (H.B. 7109b). – **Côtes-d'Armor**, 9.5 km SW of Rostrenen, 6 km S of Glomel, marais Magoar-Pen Vern, 190 m, branch of *Corylus avellana*, on wood, 6.X.2013, P.Y. Courio (P.Y.C. 13104). – **Île-de-France**, **Yvelines**, 44 km SW of Paris, 2.2 km SE of Rambouillet, NE of Etang d'Or, 167 m, branch of *Carpinus betulus*, on wood, 28.VIII.2018, F. Valade (doc. vid.). – **Lorraine**, **Vosges**, 4 km S of Gérardmer, 1 km SE of Les Bas Rupts, Ruisseau de St.-Nicolas-la-Poussière, 900 m, branch of indet. gymnosperm, on wood, 7.X.1996, J. Deny (H.B. 5627b). – 4 km SE of Gérardmer, Chaume de Grouvelin, Aulnaie, 1060 m, branch of *Alnus glutinosa*, on wood, 5.VIII.1992, J. Deny (H.B. 4733). – ibid., branch of *Alnus glutinosa*, on bark, 4.IX.1996, H.O. Baral (H.B. 5573). – ibid., branch of *A. glutinosa*, on wood & bark, 12.X.1998, J. Deny (H.B. 6257). – 5.5 km E of Gérardmer, 1.7 km SE of Xonrupt-Longemer, Lac de Longemer, 740 m, branch of *Alnus*, on wood, 2. VI.1993, J. Deny (H.B. 4892a). – ibid., branch of *Alnus*, on wood, 12.IX.2000, J. Deny (H.B. 6756a, CBS 116218, anam. cult.; sq.: KM199779). – **Rhône-Alpes**, **Haute-Savoie**, 42 km SE of Albertville, 2 km SSW of Pralognan-la-Vanoise, Les Ruelles, 1577 m, branch of *A. alnobetula*, on wood, 21.VI.2018, B. Capoen (B.C. 380618, doc. vid.). – 16.5 km NE of Albertville, 1.3 km ENE of Les Saisies, 1796 m, branch of *A. alnobetula*, on wood, 10.VIII.2018, F. Valade (doc. vid.). – **Languedoc-Roussillon**, **Aude**, 4.5 km ESE of Quérigut, Forêt du Carcanet, 1390 m, branch of *Picea abies*, on wood, 22.IX.2016, J.P. Priou (J.P.P. 16297, doc. vid.). – **Midi-Pyrénées**, **Hautes-Pyrénées**, ~10 km SSW of Bagnères-de-Bigorre, Bois de Cerétóu, 1260 m, branch of ?*Fagus sylvatica*, on wood, 18.X.2019, J. Castillo (doc. vid.). – **Aquitaine**, **Pyrénées-Atlantique**, 23 km WSW of Oloron-Ste.-Marie, 9 km WNW of Osse-en-Aspe, Col de Labays, 1350 m, log of *Fagus sylvatica*, on wood, 9.X.2016, J. Bometón (J.B. 662/16 ø, H.B. 10034; sq.: MK493135). – 8.5 km S of Urdos, 2.5 km WNW of Candanchú, Sansanet, 1330 m, branch of *F. sylvatica*, on wood, 8.X.2016, J. Bometón (J.B. 651/16 ø, H.B. 10029; sq.: MK493134). — **LUXEMBOURG**: **Gutland**, **Esch-sur-Alzette**, 11 km NNW of Esch-sur-Alzette, 5 km NE of Pétange, Griechten, 335 m, log of *Populus tremula*, on wood, 9.V.1999, B. Schultheis (H.B. 6366b). – **SLOVAKIA**: **Prešov**, 22 km NNW of Prešov, 9.5 km NNE of Sabinov, Majdan-Podbaranie, 700 m, log of *Fagus sylvatica*, on sandy sediment, 22.X.2017, A. Polhorský (A.P. 18/47, doc. vid.). — **GERMANY**: **Nordrhein-Westfalen**, 11 km ESE of Bochum, 1 km S of Witten, Hohenstein, Borbach, 102 m, branch of ?*Alnus*, on wood, 18.II.2017, T. Hülsewig (MSTR AS00317, doc. vid.). – **Mecklenburg-Vorpommern**, 12 km ESE of Ratzeburg, 2 km SW of Kneese, Schaalsee, Dohlen, 50 m, branch of *Fagus sylvatica*, on wood, 14. VI.2008, T. Richter (H.B. 8892 ø). – **Brandenburg**, 9.5 km NW of Belzig, 3 km NE of Werbig, ESE of Verlorenwasser, 95 m, on wood of *Alnus*, 20.VIII.1999, D. Benkert (H.B. 7199). – **Sachsen**, Vogtland, 9.5 km NE of Plauen, 4.7 km WNW of Treuen, Herlasgrüner Forst, Hoffmannsteich, 423 m, branch of *Alnus glutinosa*, on wood, 7.IX.2012, S. & P. Rönsch (H.B. 9727 ø). – 24 km NNE of Chemnitz, 1.2 km ENE of Beerwalde, 260 m, branch of *Alnus*, on wood, 17.VI.2012, B. Mühler (H.B. 9691b; sq.: KT222356). – **Thüringen**, 6 km E of Sonneberg, 1.5 km W of Heinersdorf, Loh, 495 m, branch of *Salix*, on wood & bark, 6.IX.2016, I. Wagner (doc. vid.). – **Baden-Württemberg**, 7 km E of Heidelberg, 2.5 km ESE of Ziegelhausen, Bärenbach, 195 m, branch of *Alnus*, on wood, 6.XI.2010, M. Bemmann (ø, doc. vid.). – ibid., branch of *Fraxinus excelsior*, on wood, 10.X.2010, M. Bemmann (ø, doc. vid.). – Schwarzwald, 15 km SW of Pforzheim, 2.8 km NW of Calmbach, Eyachtal, 425 m, branch of *Alnus*, on wood, 14.V.1994, A. Gminder (H.B. 5077). – 14 km NNW of Freudenstadt, 4.3 km SW of Schönmünzach, Großhahnberg, 743 m, branch of *Fagus sylvatica*, on wood, 28.XI.2016, B. Wergen (doc. vid.). – 3 km SW of Hornberg, 1.5 km W of Niederwasser, Niedergießbach, 600 m, branch of *Alnus*, on wood, 30.VII.2015, P. Schäfer, B. Wergen & L. Wolf (H.B. 10018; sq.: KY419173). – **Bayern**, **Oberpfalz**, 10 km SE of Marktredwitz, 2.5 km WNW of Mitterteich, SW of Kleinbüchlberg, Ziegelhau, 552 m, branch of *Salix*, on wood, 18.V.2019, D. Wächter, vid. M. Reul (grown in moist chamber 12.VI.2019, M.R. 6842, doc. vid.). – **Niederbayern**, Bayerischer Wald, 8.5 km E of Spiegelau, 1.2 km NE of Altschönau, Bärnloch, 867 m, branch of *Fagus sylvatica*, on wood, 22.VIII.2012, B. Fellmann (ø, doc. vid.). – 16 km NE of Regen, NE of Zwieseler Waldhaus, Mittelsteighütte, 750 m, branch of indet. angiosperm, on wood, 24. VIII.2012, B. Fellmann (ø, doc. vid.). — **SWITZERLAND**: **St. Gallen**, 3.5 km W of Mels, 1 km E of Parmort, Chapfensee, 1050 m, branch of ?*Acer*, on wood, 18.X.2018, U. Roffler (U.R. 1020, doc. vid.). – **Graubünden**, 5 km N of Seewis, Ganey, 1305 m, branch of *Alnus incana*, on wood, 19.X.2018, U. Roffler (U.R. 1022, doc. vid.). – 4 km SW of Zernez, 1518 m, branch of indet. gymnosperm, on wood, 23.VI.2018, E. Stöckli (doc. vid.). – 6 km WNW of St. Maria (Val Müstair), 2 km NW of Fuldera, 1660 m, branch of *Sorbus aucuparia*, on wood, 24.VI.2018, E. Stöckli (doc. vid.). – **Ticino**, 26 km ENE of Airolo, 6.5 km N of Blenio, Val Blenio, 1576 m, branch of *Salix*, on wood, 12.X.2018, U. Graf (doc. vid.). — **AUSTRIA**: **Tirol**, 24 km WSW of Lienz, 1 km S of Kartitsch, Winklertal, 1400 m, branch of *Picea abies*, on wood, 2.IX.2000, H. Voglmayr (H.B. 6759). – 3.5 km SSE of Leibnitz, 1.5 km S of Wagna, Sulm, 290 m, indet. angiosperm tree, on bark, 6.V.2015, G. Friebes (G.F. 20150041, doc. vid.). — **ITALY**: **Emilia-Romagna**, **Forli-Cesena**, 7 km WSW of Corniolo, 9 km N of Stia, Monte Falterona, 1550 m, on wood of ?*Fagus sylvatica*, 3.IX.2011, E. Camporesi (E.C. 2011, doc. vid.). — **SPAIN**: **Asturias**, 17.5 km SSW of Cangas del Narcea, 1.1 km NE of Riomolín, branch of *Ulmus*, on wood, 4. & 27. VII.2013, J. Linde (E.R.D. 5925 p.p.). – **La Rioja**, 23.5 km SSW of Nájera, 9 km WSW of Anguiano, ESE of Monasterio de Valvanera, 903 m, branch of ?*Salix*, on wood, 10.IX.2016, R. Martínez Gil (doc. vid.). – ibid., 24.IX.2016 (doc. vid.). – **Navarra**, 23 km N of Pamplona, 2 km NW of Ventas de Arraitz, 650 m, branch of indet angiosperm, on wood, 10.VIII.2013, M. Tapia (E.R.D. 5958, doc. vid.). – ibid., 1 km NNW of Ventas de Arraitz, 613 m, branch of ?*Fagus sylvatica*, on wood, 12.VIII.2015, F.J. Balda (doc. vid.). – 31 km N of Pamplona, 1 km E of Almándoz, 350 m, branch of *F. sylvatica*, on wood, 3.X.2014, F.J. Balda (ø, doc. vid.). – 9 km SE of Almándoz, 2.5 km SE of Puerto de Artesiaga, 890 m, branch of *F. sylvatica*, on wood, 29.VIII.2018, F.J. Balda (doc. vid.). – **Cataluña**, **Lérida**, Pyrenees, 18 km SW of Puigcerdà, 7 km SSE of Bellver de Cerdanya, Refugi dels Cortals d'Ingla, 1610 m, branch of *Pinus sylvestris*, on wood, 17.V.2014, J. Bometón (J.B. 0485/14, doc. vid.). – **Girona**, 4 km NNW of Molló, 1 km WNW of Espinavell, Torrent de la Comalada, 1230 m, log of *Salix*, on wood, 16.VII.2016, J. Bometón (J.B. 648/16, doc. vid.). — **USA**: **Massachusetts**, Middlesex, 27 km NW of Boston, 2.8 km NNE of Concord, Punkatasset Hill, Hutchins Pond, 40 m, on wood, D.H. Pfister (D.H.P. 115, anam. cult., doc. vid.). — **RUSSIA (East)**: **Tyumen**, **Yamalo-Nenets**, 115 km SSW of Shuryshkary, Yamgort, ~20 m, branch of *Salix*, on bark, 31.VII.1976, M. Murdvee (TAAM 110108, H.B. 8720 ø). — **CHINA**: **Xinjiang**, **Ili Kazakh**, Xinyuan, Nalati, 1600 m, *Picea obovata*, on wood, 15.VIII.2003, B. Liu & X.Z. Liu, (B.L. 6558, HMAS 139522, non vid.; sq.: DQ656635). – **Heilongjiang**, 400 m, on wood, 13.IX.2004, B. Liu (B.L. 431, HMAS 96794, non vid.; sq.: DQ656636). – **Henan**, **Xinyang**, 35 km S of Xinyang, 3 km SE of Miaofan, Jigongshan, 700 m, branch of ?*Quercus*, on bark, 14.XI.2003, B. Liu (B.L. 6610, HMAS 139672, H.B. 7807, anam. cult.; sq.: DQ656633, DQ656705). – **Zhejiang**, Tianmushan, 600 m, on wood & bark, 21.IV.2005, B. Liu, H.M. Sun, X.Z. Liu (B.L. 690, HMAS 139676, non vid.; sq.: DQ656632, DQ656701). – **Unlocalized**: B. Liu (B.L. T540, non vid.; sq.: DQ656634).

Not included. **FRANCE**: **Bretagne**, **Morbihan**, 0.3 km WNW of La Gacilly, Ruisseau des Bresles, 25 m, twig of *Salix*, on bark & wood, 1.V.2008, J.P. Priou (J.P.P. 28085, doc. vid.). – **Bourgogne**, **Côte-d'Or**, 33 km NE of Dijon, NW of Fontaine-Française, 230 m, on branch of *Platanus*, on wood, 26.X.2009, J.P. Priou (J.P.P. 29201, doc. vid.). – 3 km NW of Selongey, 1 km SE of Foncegrive, Ruisseau de la Venelle, 310 m, branch of *Populus*, on wood, 30.X.2009, J.P. Priou (ø, doc. vid.). – **Midi-Pyrénées**, **Ariège**, 12 km E of St.-Girons, 1.5 km SE of Rimont, Le Baup, 560 m, branch of *Alnus*, on wood, 26.XI.2006, J. Fournier (J.P.P. 26213, doc. vid.). — **GERMANY**: **Sachsen**, 7.5 km SSW of Chemnitz, 2 km SE of Neukirchen, W of Klaffenbach, Tiergarten, 355 m, branch of *Quercus*, on wood, 5.VII.2010, B. Mühler (H.B. 9356). – **Bayern**, **Oberbayern**, 15 km S of Berchtesgaden, 4 km SE of Salet, Wasseralm, In der Röth, 1450 m, branch of *Alnus alnobetula*, on wood, 28.IX.1982, H. Schmid (Pilze Nationalpark Berchtesg. 2509, M, as *O. leucostigma*). — **SWITZERLAND**: **Luzern**, 8.5 km N of Brienz, 1.5 km NE of Sörenberg, SW of Obere Teufimatt, 1600 m, branch of *A. alnobetula*, on bark, 26.VIII.1978, J. Breitenbach (2608-78 BR3, NMLU, as *O. sarraziniana*). – **Uri**, Glarner Alpen, 9.7 km ESE of Altdorf, 1.7 km SSW of Unterschächen, N of Sittlisalp, 1620 m, stem of *Adenostyles alliariae*, 21.VIII.2006, E. Weber & H.O. Baral (H.B. 8283 ø). — **AUSTRIA**: **Kärnten**, Südliche Ostalpen, 13 km SE of Klagenfurt, ENE of St. Margareten im Rosental, 575 m, branch of *Alnus glutinosa*, on wood, 14.VIII.1995, W. Jaklitsch (H.B. 5323). — **CZECHIA**: **Central Bohemia** (border to Plzeň), 25 km E of Plzeň, ~3 km WSW of Strašice, Brdy Mt., ~500 m, branch of *Carpinus betulus*, on wood, VIII.1926, J. Velenovský (PRM 151760, **holotype** of *O. silvatica*, H.B. 6272 ø). – 23 km SE of Praha, ~2 km NW of Mnichovice, SE of Stránčice, St. Anna, ~450 m, branch of *Quercus*, on wood, VI.1934, J. Velenovský (PRM 151715, **lectotype** of *O. pseudorubella*, H.B. 6268 ø). – Mnichovice, 370 m, branch of *Juniperus communis*, on bark, 22.V.1928, J. Velenovský (PRM 152349, **holotype** of *O. juniperi*, H.B. 6186 ø). – ~3 km SE of Mnichovice, Hrusice, 360 m, branch of *Prunus spinosa*, on wood, V.1931, J. Velenovský (PRM 152395, **holotype** of *O. spinosae*, H.B. 6418 ø). – ~6 km SE of Mnichovice, ~S of Ondřejov, ~420 m, branch of indet. ?angiosperm, on wood, VII.1934, J. Velenovský (PRM 151706, **holotype** of *O. pseudorubella* var. *alnea*, Velenovský 1934 erron. as *Alnus glutinosa*, Svrček 1954 erron. as VIII.1934, H.B. 6419 ø). — **SLOVAKIA**: **Prešov**, Vysoké Tatry, ~800–2000 m, branch of *Pinus mugo* var. *mugo*, on wood, VIII.1926, A. Pilát (PRM 151737, **lectotype** of *O. verrucosa*, as *P. montana*, H.B. 9216a ø). – ibid., branch of *Picea abies*, on wood, VIII.1926, A. Pilát (PRM 151769, **topotype** of *O. verrucosa*, H.B. 9216b ø). — **RUSSIA (West)**: **Adygea**, Caucasus Mts., NE of Guzeripl, Suvorovsky kordon, ~700 m, log of ?*Carpinus*, on wood, 12.VII.1975, M. Väli (TAAM 50322, H.B. 8723 ø). — **CHINA**: **Hong Kong**, 8 km SE of Fanling, SE of Lai Chi Hang, Tai Po Kau, 120 m, branch of indet. angiosperm, on wood, 14.VI.1997, W.H. Ho (HKU(M) 6091, H.B. 5889). – **Guizhou**, **Zunyi**, Suiyang, ~62 km NNE of Zunyi, ~38 km ENE of Tongzi, Kuankuoshui, 1420 m, ~IX.2003, on wood & bark, ?M.H. Mo (M.H.M. 003, anam. substr.).

Orbilia luteorubella (Nyl.) P. Karst., Not. Sällsk. Fauna Fl. Fenn. Förh. 11: 248 (1870) — Pls 534–536, Map 89

≡ *Peziza luteorubella* Nyl., Not. Sällsk. Fauna Fl. Fenn. Förh. 10: 55 (1869)
≡ *Calloria luteorubella* (Nyl.) W. Phillips, Man. Brit. Discomyc.: 333 (1887)
= *Orbilia parvula* Velen., Monogr. Discom. Bohem.: 93 (1934)
= *Orbilia salicina* Velen., Monogr. Discom. Bohem.: 94, pl. 11 fig. 45 (1934)
= *Helicoon sessile* Morgan, J. Cincinnati Soc. Nat. Hist. 15: 49 (1892)
= *Helicoon fairmanii* Sacc., Annls mycol. 4(3): 278 (1906) [as *Fairmani*]

Etymology: *luteorubella*: referring to the yellow-reddish apothecial colour; *parvula*: apparently after the small apothecia; *salicina*: collected on *Salix*; *sessile*: conidia formed on very short conidiophores.

Typification: Finland, Alavus, wood of *Alnus*, 28.VII.1859, P. Karsten (herb. Karsten 5282, H-6003831, lectotype of ***Peziza luteorubella***, designated here, MBT382102); Germany, Tübingen-Pfrondorf, branch & log of *Fagus sylvatica*, 18.VII.2012, H.O. Baral (ex H.B. 9705, M-0291777, epitype, designated here, MBT385122; sq.: KM199778). — Czechia, Liblice, branch of *Quercus*, 15.VII.1925, J. Velenovský (PRM 151750, lectotype of ***Orbilia parvula***, designated by Svrček 1954: 18). — Czechia, Solopisky, wood of *Salix*, VIII.1924, J. Velenovský (holotype of ***O. salicina***, illustration in Velenovský 1934: pl. 11 fig. 45, ICN Art. 40.5). — USA, Ohio, wood of *Ulmus*, undated, A.P. Morgan (FH & NY, syntypes of ***Helicoon sessile***). — USA, New York, Lyndonville, wood of indet. plant, I.1906, Ch.E. Fairman (PAD, holotype of ***H. fairmanii***).

Misapplied name: Breitenbach & Kränzlin (1981, pl. 252), as *O. sarraziniana*; Feltgen (1899: 55), as *O. vinosa*; Jaap (1922: 15), as *O. vinosa*.

Misinterpretation of *O. luteorubella*: Benny et al. (1978), = *O. sarraziniana*; Crouan & Crouan (in sched.), = *Orbilia vinosa*; Feltgen (1901: 36, on *Fagus*), = *O. auricolor*, (1899: 54, p.p.), = *O. xanthostigma*, (1901: 36, 1904: 42), = *O. sarraziniana*; García Alonso (2003: 228), = *O. pilifera*; Gremmen (1960: 273), ?= *O. eucalypti*; (1966: 399), = indet. *Helotiales*; Pfister (1997), = *O. rosea*; Rehm (1891: 455), ?= *O. aprilis* and ?= *Hyalorbilia inflatula*.

Description: — **TELEOMORPH**: **Apothecia** fresh (0.15–)0.3–2(–2.5) mm diam., in total (0.12–)0.2–0.5(–0.63) mm high (receptacle 0.09–0.2 mm), light to bright (yellow-)orange(-ochraceous) to orange(-rose), young pale pinkish-orange, very slightly to medium translucent, round, slightly lobed when large, subgregarious to gregarious; disc flat to medium convex, margin smooth, indistinct, not protruding (but thick and slightly rising above disc when very young), exterior glabrous; broadly sessile or with a thick and short stipe 0.1–0.3(–0.4) × 0.3–0.8(–1.2) mm, superficial; dry bright orange-red to dull orange-brownish. **Asci** *(36–)40–55 × (4–)4.3–4.8(–5) µm {4}, †(32–)43–55(–60)

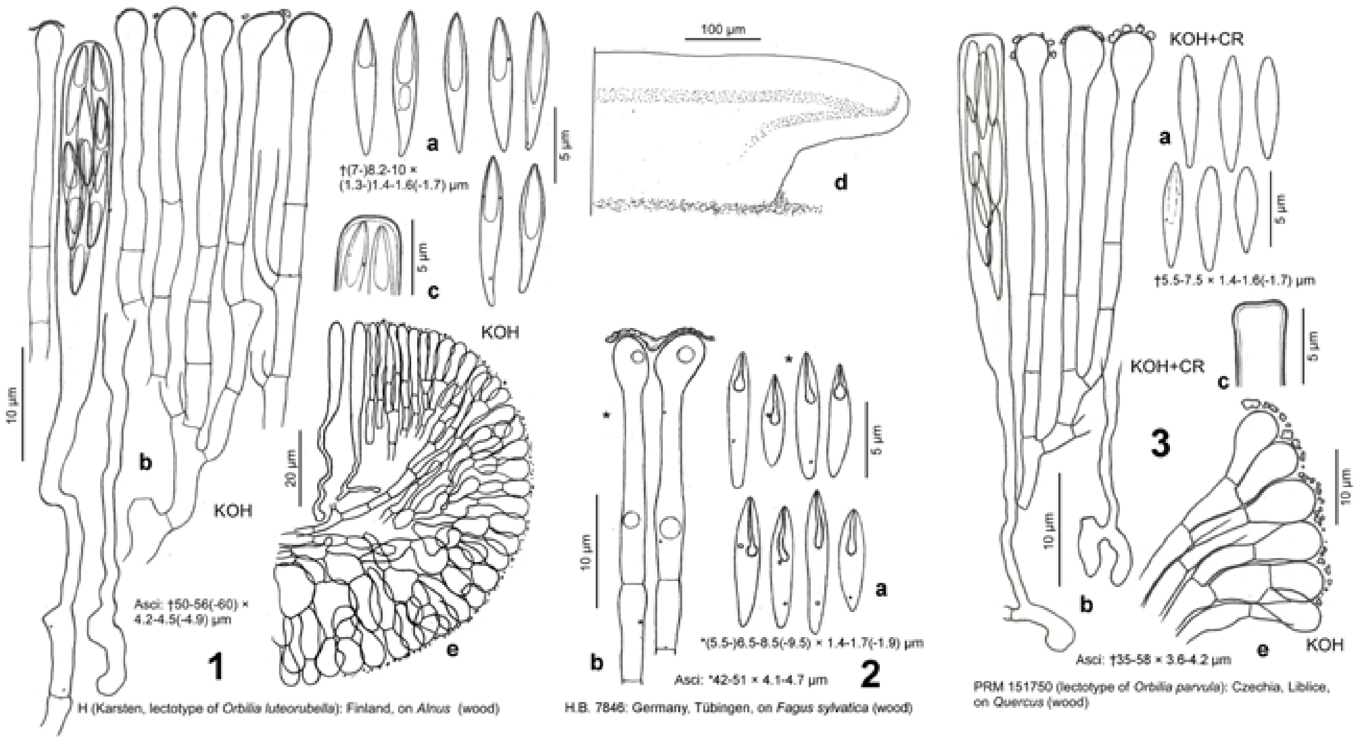


Plate 534. **1–3**: *Orbilia luteorubella*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. apothecium in median section; **e**. marginal ectal excipulum (median section).

{5} × (3.4–)3.6–4.5(–4.9) µm {5}, 8-spored, spores 2–4-seriate, pars sporifera *16–22 µm, (2–)4–5(–6) lower spores inversely oriented {12}, sometimes mixed, exceptionally upper spores inverted; **apex** (†) (medium to) strongly truncate (± not indented, laterally not or very slightly inflated); **base** with medium to very long, thin, flexuous stipe, base L- to T-shaped. **Ascospores** *(5.5–)6.5–10(–11) × (1.3–)1.4–1.8(–2) µm {14}, †(5.5–)6–9(–10.5) × (1.2–)1.3–1.6(–1.7) µm {5}, narrowly (fusoid- to) fusiform(-clavate), widest part mostly in the middle or often above, apex subacute to acute, base slightly to often strongly tapered, straight, rarely slightly curved (especially near base); **SBs** 2.5–4.2 × (0.2–)0.4–0.6 {5}, †(3.3–)4–5 × 0.7–0.9 µm {T}, vermiform to subulate, often inflated at the base, straight or slightly flexuous, overmature tear-shaped to ampulliform, 2–2.5 × 0.7–1 µm. **Paraphyses** apically slightly to medium but also very strongly (clavate-)capitate, sometimes asymmetrical, terminal cells *18–28 {4} × (2.3–)3–4.5(–5) µm {5}, †(17–)19–22(–25) × 2.3–3.5(–4) µm {2}; lower cells *(4–)5–9 × 1.7–2.5(–3) µm {3}, †4.5–10 × 1.3–2.3 µm {2}, branched only at lower septa; hymenium hyaline to pale yellow- or rosaceous-orange in lower part. **Subhymenium** hyaline to pale orange, 20–40 µm thick, medium to sharply delimited. **Medullary excipulum** subhyaline to very pale orange, (30–)100–350 µm thick in centre, of medium to very dense, non-gelatinized textura angularis-globulosa(-intricata), very indistinctly delimited from ectal excipulum but sharply so at flanks and margin (sometimes by a very thin t. porrecta), cells in central part *(10–)15–30(–60) × (8–)12–17(–21) µm {3}. **Ectal excipulum** hyaline, of thin-walled, vertically oriented t. globulosa-angularis-prismatica from base to margin, 60–80 µm thick near base, cells *10–30(–35) × 8–20 µm {2}, †(10–)13–25(–30) × (6–)10–15(–20) µm {2}; 35–60 µm thick at lower flanks, 10–35 µm at mid flanks and margin, oriented at 70–90°, marginal cortical cells *10–16 × 5–8 µm {2}, †7–18 × 3–6.5 µm {2}, clavate to pyriform, **glassy processes** absent. **Anchoring hyphae** very sparse to abundant, *2–4(–6) µm wide, walls smooth, 0.2–0.3(–0.4) µm thick {5}, forming a dense t. intricata up to 100 µm thick. **SCBs** in paraphyses globose, medium- to high-refractive, 1–2 per cell, 1–2 µm diam. {8}; in ectal excipulum only at margin (inner cells), globose, 1–1.8 µm diam. **VBs** in paraphyses absent {1} or low- to medium-refractive {5}, globose to elongate, filling entire terminal cell, also sometimes present in marginal cortical cells; not turning yellow in dead state. **Exudate** over paraphyses and margin granular-cloddy, 0.2–1(–1.5) µm thick, ± scattered, hyaline, ± loosely attached to the wall, but also absent. — **ANAMORPH**: helicoon-like (from ascospore isolate {3} or in wet box or unsterile water culture on natural substrate {3}). **Colonies** distinctively pink on malt extract-yeast extract agar (MEYE, Pfister 1997). **Conidiophores** mononematous, *35–100 × 2–2.5 µm {H.B. 9424a}, †27–60 × 2–2.2 µm {Jiang}, sometimes branched below or in middle part, multiseptate, septa ± equidistant, with a small knob-like inflation at apex, conidiogenesis terminal; conidiophores very short or virtually absent in the type of *H. sessile* and samples from Austria (Voglmayr 1994). **Macroconidia** *((21–))(26–)30–36 × (19–)20–25(–29) µm {2} (Pfister: 36–42 × 18.5–20 µm, Jiang: †~10–20 × 18–22 µm, Voglmayr: 26–42 × 20–27.5 µm), filiform, strongly helicoidally curved under a narrow arch by forming a compact, ellipsoid, barrel-shaped body, with ~6–8 coils (Pfister: ~12, Jiang: ~1–4, Voglmayr 6–8), twisted like a left-hand thread (exceptionally a few conidia like a right-hand thread), actual length ~300–450 µm (Jiang: ~60–200 µm), thread *4–5 µm wide [Pfister: 2.5–3.7 µm, Jiang: †4–5 µm, Voglmayr: 4.5–5(–7.5) µm], multiseptate (~5–7 cells per turn, each cell ~10–15 µm long, in total about 30–45-septate (Pfister: ~5–6 cells per turn, each cell ~5–9 µm long). **Microconidia** *(14–)20–40(–44) × 4.3–4.8 µm, actual length 25–50(–80) µm, slightly to very strongly curved (hook- to spiral-like), with (0–)0.2–1(–2) coils, (1–)3(–8)-septate {2} [Voglmayr: 25–40 × 4.4–6(–7.5) µm, 2–4-septate]. Macro- and microconidia containing a few minute LBs close to the septa, wall surface bright lilac in CRB.

Habitat: lying on or sticking in wet mud, periodically submerged in small ponds, decorticated or partially corticated, 15–150 mm thick branches, logs or roots of *Acer* sp. {1}, *Alnus* sp. {2}, *A. glutinosa* {1}, *Betula* sp. {1}, *Betula pendula* {2}, *Fagus sylvatica* {8/1}, *Fraxinus excelsior* {1}, *Picea abies* {1}, *Populus* sp. {1}, *Prunus padus* {1}, *Quercus* sp. {1}, *Salix* sp. {5/1}, *S. caprea* {2}, on lateral and also upperside, on min. 0.1–1 mm deep medium to strongly decayed wood {27}, rarely bark (periderm) {2}, usually grey-brown or blackened, green algae absent or present in varying abundance. **Associated**: ?*Ascitendus* sp. {1}, *A. austriacus* {2}, *Ascocoryne lilacina* {1}, *Bactridium flavum* {2}, *Bulbillomyces farinosus* {1}, *Cyanophyta* {1}, *Helicogonium orbiliarum* (parasitic in *O. luteorubella*) {2}, *Hyaloscypha* sp. {1}, *Hydropus alpinus* {1}, *Jahnula aquatica* {1}, *Jobellisia saliciluticola* {1}, *Lasiosphaeria ovina* {1}, *Marasmius* *alliaceus* {1}, *Mollisia cinerea* {1}, *Nectria* sp. {1}, *Orbilia leucostigma* {1}, *O. rubrovacuolata* {1}, *O. sarraziniana* {1}, *Pseudaegerita* sp. {1}. **Desiccation tolerance**: a few ascospores survived for 12 days. **Altitude**: 55–525 m (temperate Europe), 40–100 m (eastern North America), 130 m (northern Japan), 1420 m (southern China). **Geology**: Carboniferous greywacke & shale, Buntsandstein, Keuper (gypsum, marl, sandstone), Cretaceous clay & sand, Plio- & Pleistocene boulder till, loess; granite, granodiorite, syenite, basalt, mica schist, gneiss. **Phenology**: (V–)VI–XI (teleomorph).

Phenology of *O. luteorubella* (teleomorph/anamorph)

Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
0/0	0/1	0/0	0/0	1/0	2/0	10/0	8/1	3/0	3/0	1/2	0/0

Taxonomic remarks. *Orbilia luteorubella* is characterized by light or bright yellowish-orange apothecia (Pl. 535: 1–4), spores of a predominantly fusoid to fusiform shape with both ends tapered, and by the lower spores being rather consistently inversely oriented within the asci while most of the upper spores point with their SBs upwards. However, in the here presented concept the species is mainly characterized by a helicoon-like anamorph, a character that was not available in most of the records.

O. sarraziniana differs mainly in spore shape and orientation, whereas *O. rosea* is microscopically nearly indistinguishable from *O. luteorubella* by teleomorph features. Without conidia we were, therefore, unable in many cases to identify with certainty the collections examined. However, we observed some correlation with apothecial colour in the fresh state (compare Pl. 531 with Pl. 535): in strains which were identified as *O. rosea* by conidial and/or molecular data the apothecia were watery-hyaline (Webster & Descals 1979) or very pale to light rose-lilaceous (H.B. 6756a, 9691b, 10018; Pl. 531: 3a–b, 6b), whereas strains with helicoon-like conidia showed bright yellow-ochre(-orange) (D.H. Pfister pers. comm., D.H.P. 79), bright orange-brownish (X.Z. Jiang pers. comm., Pl. 535: 4a), or light to bright yellowish-orange to rose-orange apothecia (Pl. 535: 1b–e & 2a, see also IVV: H.B. 9424a, 9705).

The yellowish-orange pigment in fresh samples of *O. luteorubella* is due to the presence of carotenoids in small LBs in the lower part of the paraphyses and in the subhymenial layer (not clearly seen in the medullary and ectal excipular cells). In larger, more aged, though still fully viable apothecia these carotenoid pigments may get more abundant.

Most literature reports under the name *O. luteorubella* actually refer to yellowish-reddish apothecia, but they probably include also populations of *O. sarraziniana* with similar pigments. Rehm (1891: 455) drew attention to the variable colour of *O. luteorubella* by possibly inlcuding also pale-coloured *O. sarraziniana* and *O. rosea* in his concept of *O. luteorubella*, besides taxa of *Hyalorbilia* and *Orbilia* section *Hemiorbilia* (see under Misapplication).

Macroscopic variation. Mature apothecia of *O. luteorubella* usually range between 0.5 and 1 mm diam., but may sometimes attain a diameter of up to 2(–2.5) mm or sometimes only 0.2–0.5 mm. Depending on the presence and height of the stipe, a maximum total thickness of up to 0.45(–0.63) mm may occur. In the type of *O. luteorubella* the apothecia are of the smaller size (rehydrated 0.3–0.95 mm diam., 0.2 mm thick; Nylander 1869: 0.5–1.2 mm). Very small and thin apothecia were noted in the type of *O. parvula* (0.15–0.45 mm diam., 0.12 mm thick). The colour of fresh adult apothecia varies somewhat in different shades of yellowish-orange, with or without some shade of rose. Young apothecia are usually paler coloured. For instance, at the site in Tübingen the young apothecia were pale pinkish-orange, while the larger ones were more intensely (rose-)orange.

Microscopic variation. Ascospore size and shape varied somewhat in the studied specimens. At the site in Tübingen spore size ranged between *6–8.5 and 9–11 µm in length and between *1.4–1.6 and 1.5–1.8(–2) µm in width, though sometimes the whole range was found within a population. Variation in the spore base between slightly and strongly attenuated regularly occurred within an apothecium. Spore orientation was rather consistent in the included specimens. For instance, in the type of *O. luteorubella* virtually all asci showed the typical orientation (Pl. 534: 1b), and this was also the case at the sites in Tübingen, Hirschau, and Würzburg.

The North-American collection from which Pfister (1997, D.H.P. 79) obtained *Helicoon sessile* was studied by the first author (H.B. 5168a, not illustrated) when it still contained some living elements a week after collecting. The noted features fit well the present concept of *O. luteorubella*, particularly the bright yellow-ochre(-orange) apothecial colour but also spore shape and size (*6.5–10 × 1.4 µm), with filiform SBs of 2.5–4 × 0.4–0.5 µm in the acute end, the lower 3–5 spores being inverted within the asci.

Globose SCBs were observed in three specimens from which a *Helicoon* was obtained (Pls 534: 2; 535: 2b, 4c), and in one of them (Pl. 535: 2b) also VBs were present in the paraphyses. SCBs and VBs were sometimes also present in other samples, but also absent (a similar variation was observed in *O. rosea* and *O. sarraziniana*, especially concerning VBs). The granular exudate varied among the collections, being abundant in the type of *O. parvula* and often also in samples from Tübingen, but sparse in the type of *O. luteorubella*. Yet, such variation was also noted in *O. rosea* and *O. sarraziniana*.

Type studies of teleomorph. The apothecia of *O. luteorubella* were described by Nylander (1869) as ‘pale yellow-reddish or yellow-brownish’ (the epithet *luteorubella* means yellow-reddish). Although the connection to an anamorph is unknown in the type collection, we suspect helicoon-like conidia here because of the observed correlation with apothecial colour. Ascus size and spore orientation in the type (Pl. 534: 1) clearly exclude *O. sarraziniana*, but not *O. rosea*. It would be desirable to isolate this anamorph also in southern Finland, or to collect apothecia there and take a culture or ITS sequence.

Two authentic specimens of ***O. luteorubella*** were received from H. One bears a red label ‘holotype’ given by a curator, and later received the number H 6003831. It contains over 50 apothecia in very good shape, whereas the other is labelled ‘isotype’ (H 6003832) and contains only five apothecia. In both the substrate could be identified as *Alnus* (the protologue says ‘*Populus*?’), and the branch fragment in the ‘isotype’ might well have been broken from that in the ‘holotype’. Both packets bear inside very similar original sketches of paraphyses, asci, and spores with measurements, together with the name *Peziza luteorubella* Nyl., drawn and written by Nylander (T. Ahti pers. comm.), with the difference that the spore size in the ‘holotype’ reads 7–11 × 1.5–2 µm, that in the ‘isotype’ 7–11 × 1–1.5 µm. Nylander obviously examined the whole collection, although only the latter spore measurement was included in the protologue. The holotype carries the name ‘*Peziza cinerea* v. *rubella*’, given by the collector P.A. Karsten, a student of Nylander, before Nylander described it as a new species.

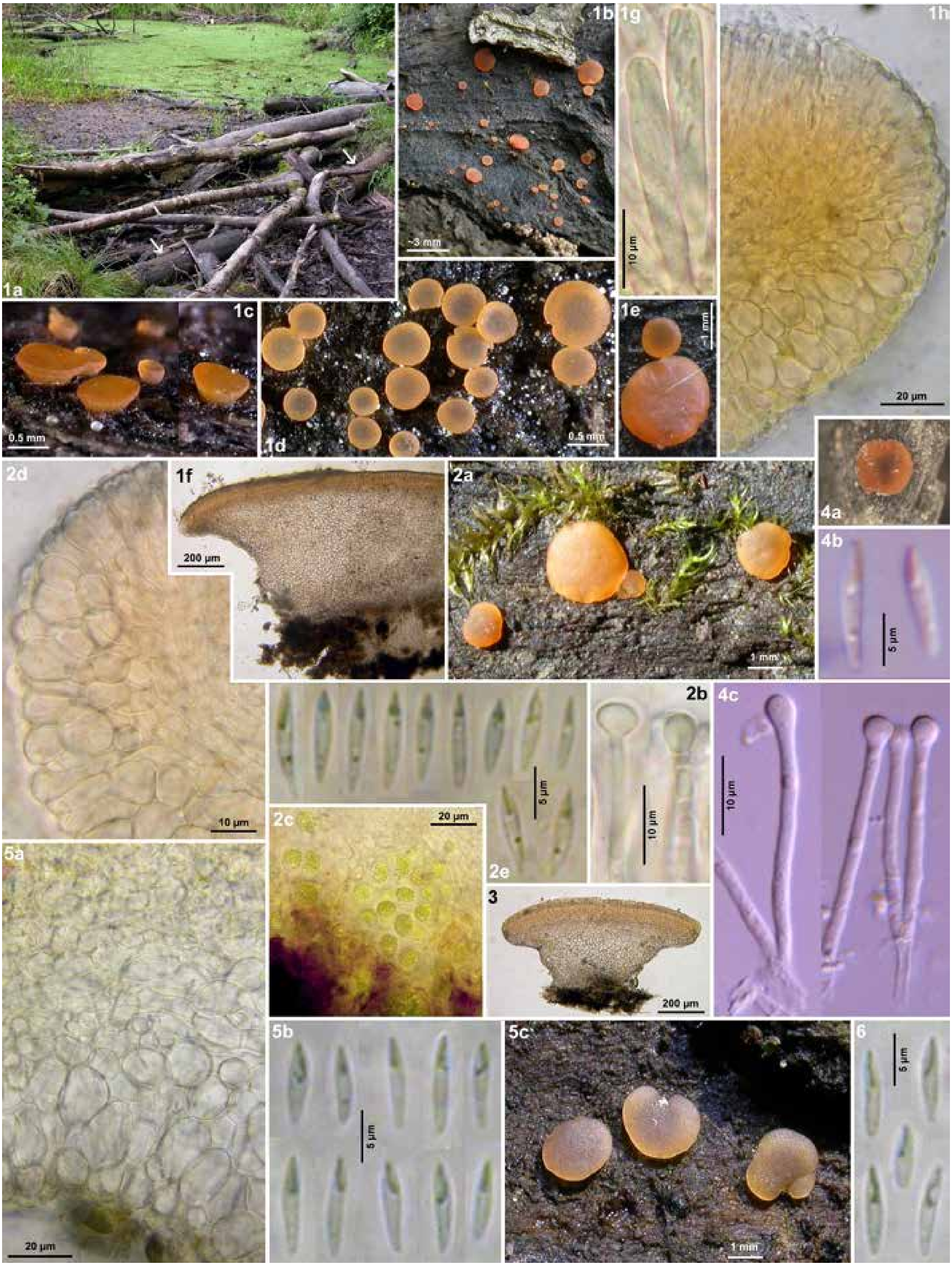


Plate 535. **1–6**: *Orbilia luteorubella*. – **1a**. small forest pond over Knollenmergel in beech forest; **1b–e**, **2a**, **4a**, **5c**. fresh apothecia; **1f**, **3**. apothecia in median section; **1h**, **2d**. id., marginal ectal excipulum; **5a**, id., lower flanks, **2c**. id., basal part with green algae; **1g**, **2b**, **4c**. asci and paraphyses (**2b** with globose SCBs and elongate VBs); **2e**, **4b**, **5b**, **6**. ascospores. – Living state, except for **4c** (in H_2O). – **4a–c**: phot. X.Z. Jiang (DIC). — **1a–h**. H.B. 7846: Germany, Tübingen, on *Fagus*; **2a–e**. H.B. 9424a: ibid.; **3**. H.B. 7941: ibid.; **4a–c**: HMAS 267649: China, Guizhou, on unidentified tree; **5a–c**. H.B. 9711a: Germany, Hirschau (Oberpfalz), on *Salix*; **6**. H.B. 9709: ibid., on *Picea*.

Further data of *O. luteorubella* mentioned in the protologue but not on the sketches concern asci almost 40 µm long, 4 µm wide, and a width of the paraphysis apices of ~2 µm. The apothecia were described as pale yellow-reddish or yellow-brownish, subgelatinous, flat, 0.5–1.2 mm diam. The present reexamination (Pl. 534: 1) is based on the 'holotype', while the apothecia in the 'isotype' were not examined. The asci turned out to be distinctly longer than indicated in the protologue, which is certainly due to Nylander's omission of their long stipes, and the width of the paraphysis apices distinctly wider [2.3–3.4(–3.8) µm].

In ascus and spore size this specimen is at the upper end of the range of the present concept of *O. luteorubella*. We here adopt the epithet *luteorubella* for the taxon associated with a helicoon-like anamorph, mainly because of the apothecial colour given in the protologue. In case that apothecial colour will turn out to be unreliable in this species complex, Karsten's collection might instead be conspecific with *O. rosea*.

According to S. Stenroos (pers. comm.), the holotype specimen remained in Karsten's herbarium, while the isotype was split by Nylander from Karsten's collection for his own herbarium. When writing the protologue, Nylander obviously took the ascospore data only from his 'isotype' specimen. When these specimens came to the herbarium of Helsinki, they were designated as holo- and isotype, perhaps mainly because of their size: the rather small 'isotype' is clearly a fragment taken from the 'holotype', which represents the main specimen. Because it was unusual at Nylander's time to specify a holotype, and a published lectotypification appears to have never been made, we here designate H 6003831 (labelled 'holotype') as **lectotype** of *O. luteorubella*. A German specimen (Tübingen-Pfrondorf, on *Fagus*, IVV: H.B. 9705), from which a sequence was gained, is designated here as **epitype** of *O. luteorubella*.

The present revision of the lectotype of ***O. parvula*** (Pl. 534: 3) confirms Svrček's (1954: 18) suggestion of a probable identity with *O. luteorubella*. Svrček hesitated because of apically encrusted paraphyses and, therefore, also considered a possible identity with *O. cardui*. The abundant material appears to fit quite well the holotype of *O. luteorubella*. The rather long asci often have a very long stipe, the paraphyses are capitate and bear granules. The fusoid ascospores are not strikingly heteropolar and have their widest part a bit closer to that spore end which is slightly more obtuse than the other end. The spores are much shorter compared to the holotype and would better fit *O. sarraziniana*, but the long asci contradict this. The spore body could not be seen with certainty, even when viewed in KOH+CB_L, therefore, it was impossible to clearly recognize spore orientation in *O. parvula*. In many of the asci the lower spores were found to point with their more obtuse end downwards, but sometimes it was the more attenuated end which pointed downwards, and frequently the orientation was unclear due to quite homopolar spores; whether it was generally the more acute end which contained the SB remained unclear.

Velenovský emphasized the amber colour of the rather small apothecia (0.3–0.5 mm diam.) as characteristic to distinguish his taxon 'with certainty' from *O. luteorubella*, for which he also gave an amber apothecial colour, though with a rose tint. He misleadingly described the spores as narrowly acicular, 4–5 µm long. Svrček corrected to 7–8.5 × 1.2–1.5 µm but gave the asci with 30 × 3–4 µm much too short.

During reexamination of the holotype, some eggs of a *Daphnia* were encountered on the very rotten and eroded wood surface. This indicates that the branch was lying at the edge of stagnant water. The long asci and fusoid spores exclude *O. sarraziniana*. The abundant holotype material is in good shape and would require a molecular investigation to better understand its identity.

No material of ***O. salicina*** (Svrček 1954) exists which was said to grow on wet wood of *Salix* in a pond at Solopisky (SW of Praha). In the lack of a voucher specimen, the illustration added to the protologue must serve as holotype (Arts 8.1, 40.4 ICN). The original drawing shows narrowly fusoid ('acicular') spores which, together with the habitat (standing water), suggest synonymy with *O. luteorubella* as was also stated by Svrček. Whether the ochraceous-brown colour of the rather large apothecia (0.5–1 mm diam.) in the protologue arose from senescence is not clear, but it seems to exclude *O. rosea*. Velenovský gave the spores as 6–10 × 1/4 µm (width appearing only on manuscript plate; from the length/width ratio of the drawn spores it lies between 0.5 and 1.2 µm) and the paraphyses strongly capitate.

Misapplication. Reports of *O. luteorubella* in the literature possibly often match the species concept here presented, though some might include the similar *O. sarraziniana*. A few reports refer to desiccation-tolerant species of other sections of *Orbilia* with similar fusoid spores. For example, Rehm's (1891: 455) description comprises collections on 'rotten wood and corticated, dead and dry branches', which suggests a species of series *Hesperideae* (section *Hemiorbilia*): *O. aprilis* might have been mistaken for *O. luteorubella* by Rehm because of a similar spore shape, although species of that section differ from section *Helicoon* in hemispherical, thick-walled ascus apices, a thick exudate, and desiccation-tolerant apothecia. Also P.L. & H.M. Crouan (in sched.) figured and preserved under the name *Peziza luteorubella* a collection with a thick-walled, hemispherical ascus apex (see under *O. vinosa*, p. 607).

On the other hand, early reports under the epithet *vinosa* often appear to represent *O. rosea*, *O. luteorubella*, or *O. sarraziniana*. For instance, Feltgen (1899, 1901) identified collections as *O. vinosa*, *O. rubella*, and *O. luteorubella*, which are affiliated here as *O.* cf. *luteorubella*. In a further, apparently unpublished collection which he named *O. coccinella* (with spores 2 × 0.75–1 µm) also only *O.* cf. *luteorubella* was found. Jaap (1922: 15) reported *O. vinosa* from 'rotten twigs of *Salix*, *Populus* and *Alnus* at the water', and reexamination of the cited specimen (FSE 765, on *Salix*) revealed *O.* cf. *luteorubella*. More difficult to understand is why García Alonso (2003) identified the hairy desiccation-tolerant *O. pilifera* (section *Aurantiorubrae*), being undescribed at that time, as *O. luteorubella*. Even confusion with the genus *Hyalorbilia* ocurred (see under *H. inflatula*, p. 342, 344), and due to a similar colour also with *O. xanthostigma* and pigmented populations of *O. auricolor*. A report on *Adenostyles* by Gremmen (1966: 399) obviously refers to a member of *Helotiales*, according to the reported shape of ascus apex and base.

Not included collections. Some European samples are not included mainly because of insufficient teleomorph data: either the fresh apothecial colour was not stated, or it did not display yellowish-orange colours. In some cases the spore orientation could not be evaluated from the dead material, and *O. sarraziniana* was then excluded by a fusoid spore shape and a spore length exceeding 10 µm in some spores. A record from New Zealand (J.A. Cooper, IVV: 6.III.2010) is not included because it was documented in the dead state and has rather wide, fusiform spores (†6.8–8.7 × 1.6–2 µm).

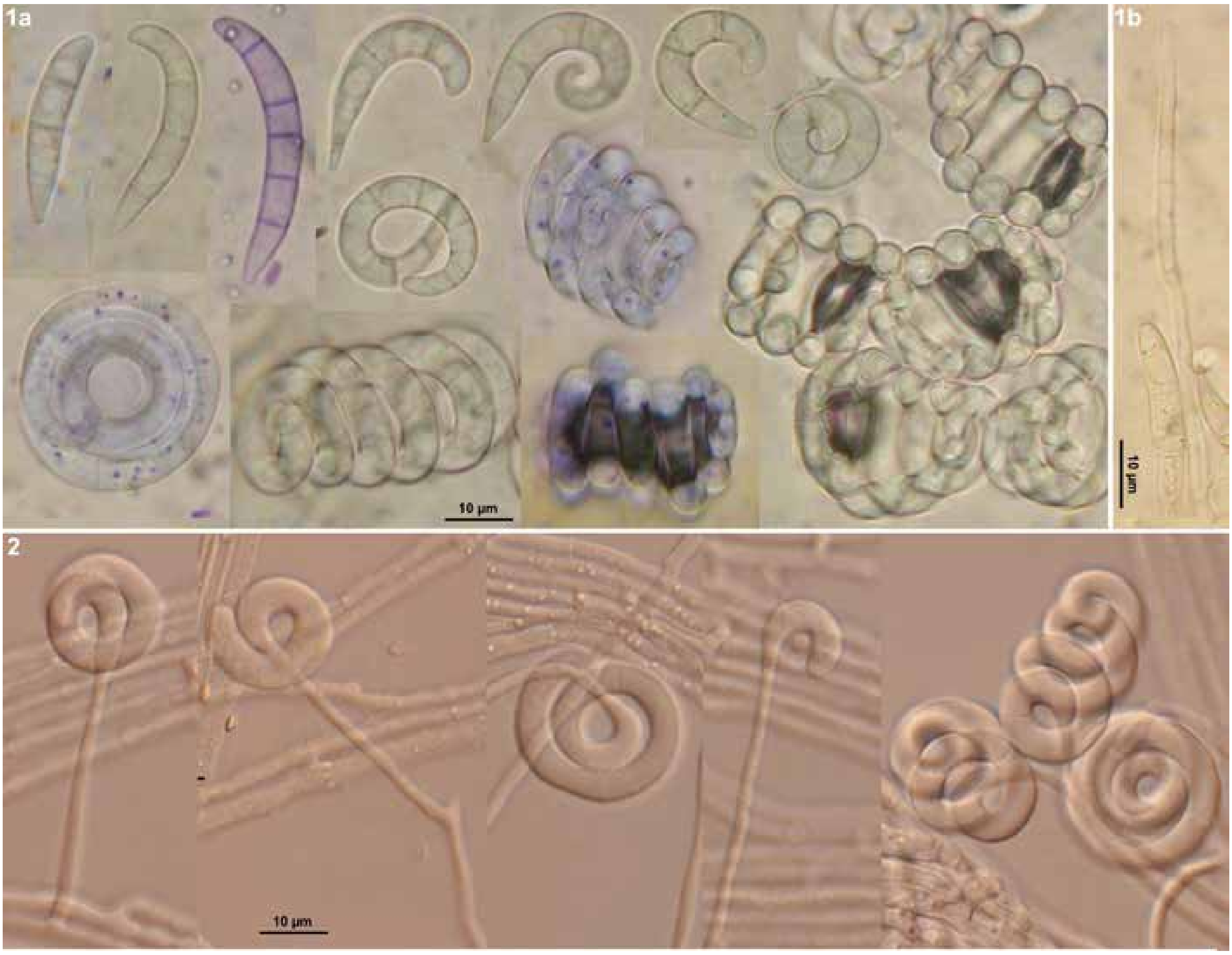


Plate 536. **1–2**: *Helicoon sessile*. – Conidiophores and conidia (from culture). – Living state (**1a–b**), dead state (**2**); **2**: phot. X.Z. Jiang (DIC), — **1a–b**. H.B. 9424a: Germany, Tübingen, on *Fagus*; **2**. HMAS 267649: China, Guizhou, on unidentified tree.

Anamorph. Morgan (1892) described *Helicoon sessile* with 40–48 × 25 µm large conidial bodies with 6–8 coils (thread 5–6 µm wide, septa not illustrated, see Pl. 15). Saccardo's (1906) unillustrated description of *H. fairmanii* with 45 × 28 µm large bodies with 6–8 coils of sparingly septate, 5 µm wide threads appears to differ merely in a pale rose colour of the conidia. Therefore, Linder (1929: 325) placed *H. fairmanii* in synonymy, which he found to differ in no respect. Together with a sample from Massachusetts he redescribed *H. sessile* by conidial bodies of 37–56 × 20–30 µm, with 4.5–6.5 µm wide threads and 5–16 coils. Goos et al. (1986) copied Linder's data but included material from Great Britain by changing the size to 30–59 × 20–30 µm. Voglmayr (2000, fig. 23, from Austria, A327) presented a drawing of *H. sessile* in which a size of 37–42 × 25–27 µm can be evaluated, with 7–8 coils of ~5–7 µm wide threads with only a few septa indicated on the drawing. With this concur data in Voglmayr (1994) which include also smaller conidia with 6 coils and narrower threads (see above).

Conidial states referable to *Helicoon sessile* were obtained in three ascospore isolates. In a collection from Massachusetts tentatively referred to *O. luteorubella*, Pfister (1997) obtained conidial bodies which have a size of 36–42 × 18.5–20 µm (evaluated from his drawing); the multiseptate threads show 12 coils and the individual cells measure 5–9 × 2.5–3.7 µm. Our German collection (Pl. 535: 1–3) formed conidial bodies of predominantly *30–36 × 20–25 µm; the threads show 6–8 coils and individual cells of *10–15 × 4–5 µm. Compared to the above strains, conidial bodies are thus distinctly shorter in the German isolate and narrower in the American isolate. A Chinese isolate by X.Z. Jiang (Pl. 535: 4) produced similar conidia in pure culture, according to photographs kindly provided by X.Z. Jiang (pers. comm., Pl. 536: 1–2), but they show only about 1–4 coils of the †4–5 µm wide threads (septa not shown), resulting in a body size of only †10–20 × 18–22 µm. We presume that these are young stages, because they are still attached to the conidiophore. However, molecular differences to European strains might support that two different species are involved.

Linder (1929) also described *H. farinosum* Linder based on a collection from Massachusetts (Cambridge, Fresh Pond, on decaying wood), which would fit quite well our isolate from Tübingen. However, this species was found to be the anamorph of *Ascotaiwania hughesii* Fallah, J.L. Crane & Shearer in the *Sordariomycetes* (Fallah et al. 1999). Also *Helicodendron tubulosum* (Riess) Linder can very easily be confused with *H. sessile* because of a similar conidial morphology. It occurs on branches and leaves in mountain streams and is the anamorph of '*Lambertella*' *tubulosa* Abdullah & Webster (1981) in the *Helotiales*, a species that belongs to the vicinity of *Cudoniella* or *Phaeohelotium* rather than *Lambertella*.

Voglmayr (1994, 2000) drew attention to the sense of rotation of the barrel-shaped conidia, which was not stressed for *H. sessile* in the literature before, and which he found to be consistent within a strain. Morgan's protologue figure of *H. sessile* shows a right-handed twist whereas Voglmayr (1994) found a left-handed twist in the type material in FH and later confirmed this also for a duplicate in NY (H. Voglmayr pers. comm.). He found conidia with left-handed twist also in the holotype of *H. fairmanii* in PAD and confirmed Linder's synonymisation with *H. sessile*. Also in various of his recent records referred to this species Voglmayr (1994) observed a left-handed twist, so he assumed that the protologue figure was mirror-inverted during reproduction.

According to Voglmayr (2000), strains referable to *H. sessile* exist which deviate in a right-handed twist, but the possibility cannot be excluded that this mirror-symmetric deviation belongs to a different species. From one of his left-handed strains he gained a sequence, while no sequence is available from a right-handed strain (Voglmayr pers. comm., see also p. 236). On Pfister's drawing the three conidia figured in side view are left-handed, whereas those in top view are right-handed, supposed that the chirality was not changed during reproduction. On Jiang's photographs (Pl. 536: 2) the sense of rotation is difficult to assess, but two conidia on the right appear to be left-handed. His culture on PDA formed colonies with distinct concentric zones (IVV: 25.VII.2008) very similar as observed by us in *O. sarraziniana* (Fig. 102: d).

Voglmayr (1994) observed also small falcate conidia with 2–4 septae which also we have twice obtained in our cultures, and he assumed that they are air-transported unlike the barrel-shaped ones. He stressed the fact that *H. sessile* has very short or almost no conidiophores. This is in strong contrast to the Asian isolate with rather long and thin conidiophores (Pl. 536: 2), but also in our German isolate we observed such conidiophores which here possibly produce only the small falcate conidia (Pl. 536: 1b) whereas the barrel-shaped ones are formed on very reduced conidiophores.

Phylogeny. In Pfister's phylogenetic analysis of ITS sequences, a non-sporulating ascospore isolate identified as *O. luteorubella* (D.H.P. 125, U72604) and a culture of *Helicoon sessile* without teleomorph (D.H.P. 129, U72605) clustered together (with a distance of 3 nt), which was also the case in Hagedorn & Scholler's (1999) neighbour joining analysis. However, Hagedorn & Scholler found that these sequences are very distant from the remaining members of *Orbiliaceae*. As a consequence, another of Pfister's ascospore isolate (D.H.P. 79), for which no sequence was available but which formed a *Helicoon sessile* anamorph, was thought by us to be also contaminated. *H. sessile* appeared to be hypocrealean rather than orbiliaceous, since a BLAST search for Pfister's two sequences in GenBank revealed only hypocrealean species (1–2 nt deviation in the complete ITS). The first 100 hits all deviated only by 1(–2) nt when testing D.H.P. 125 or D.H.P. 129, therefore, these BLAST searches do not give hits with 3 nt deviation when restricted to 100 results. Most of these hits were identified as *Sarocladium kiliense* (Grütz) Summerb. but also *S. strictum* (W. Gams) Summerb. (both were formerly placed in *Acremonium*). In a phylogenetic analysis on some members of *Hypocreales* (Collopy et al. 2002), Pfister's sequences clustered with *Acremonium strictum* W. Gams.

In contrast to this, the mentioned Austrian isolate of *Helicoon sessile* (A327, KY659207) identified and sequenced by H. Voglmayr (pers. comm.) as well as a sequence of the mentioned Chinese ascospore isolate with a helicoon-like anamorph (X.Z. Jiang pers. comm., gz-08, FJ719770) turned out to be orbiliaceous. From this we now conclude that the two cultures sequenced by Pfister contained, besides the correct helicoon-like anamorph, a contaminant of a member of *Hypocreales*.

The sequences of Voglmayr and Jiang both comprise SSU, ITS, and LSU. Voglmayr's sequence possesses the S1506 intron (1326 nt) which is absent in Jiang's sequence. The two sequences concur perfectly in the overlapping parts of SSU (119 nt, Phyl. S17). In the ITS the difference is 15 nt (3 %) and in the LSU D1–D3 4 nt (0.4 %). LSU sequences of a Japanese strain of *H. sessile* by K. Yamaguchi (NBRC106775, D1–D2) and one submitted by Li et al. to GenBank in 2003 (AY261122, D1–D3, misnamed as *O. inflatula*) are identical with Jiang's strain in the overlapping part, whereas Voglmayr's strain differs here by 1 nt (see Phyl. 18).

A further sequence comprising S1506 intron (701 nt) and ITS was taken from apothecia (H.B. 9705) later re-collected at the site in Tübingen from where our ascospore isolate with *H. sessile* was gained. This clustered quite close to the Austrian sequence, deviating in the ITS by only 5 nt (1 %) and 1 gap (Phyl. 17). The intron concurs almost perfectly in the two European strains (1 nt difference), except for a large central part which is absent in H.B. 9705.

The obvious difference between European and Chinese strains might indicate that two different species are involved, supporting the above-mentioned difference in conidial morphology. Yet, since the molecular distance between *O. luteorubella*, *O. rosea*, and *O. sarraziniana* lies in the range of 13–17 % (see under *O. rosea*, p. 968), a 3 % distance appears to be an acceptable infraspecific variation.

The name *O. luteorubella* is adopted here with hesitation to the species with a helicoon-like anamorph. It is hoped that future extraction of DNA from the holotype of *O. luteorubella* will settle its identity.

Ecology. *O. luteorubella* was found on hygric to semiaquatic branches and logs of different angiosperms, rarely gymnosperms, mainly from decorticated, rotten and darkened wood. The species occurs rather strictly confined to water (typically ponds and lakes, also swamps, ditches, and rivulets) by which the substrate is periodically flooded. Collections mainly derive from planar and colline, cold- or sometimes warm-temperate humid regions of Europe, comprising atlantic and subcontinental areas. In contrast, the holotype of *O. luteorubella* was from thermoboreal northern Europe, and a record from near Oslo is hemiboreal at the border to thermoboreal. Frequent occurrence of *O. luteorubella* in England is suggested from various collections by P. Thompson (pers. comm.) made in the West and East Midlands; documentation has not been available in most of them, but a ± orange apothecial colour and occurrence in bogs and at ponds would exclude *O. rosea*. Two eastern Asian samples are from cold-temperate humid northernmost Japan and subtropical humid (winter-dry) southern China, and a few records from cold-temperate to ?warm-continental humid eastern North America.

The geology comprises both basic and acidic soil. The area of the type locality of *O. luteorubella*, the town Alavus in Finland, shows a lot of lakes but also streams. The geological situation around Alavus is mainly granodiorite, which produces an acidic soil. To the present knowledge, both *O. luteorubella* and *O. rosea* occur on acidic bedrock. The vegetation includes alder and willow but also other types of deciduous forests.

Various samples from Navarra (Spain) were reported by R. Galán (in Pando & Hernández 2001: 124). Seaver (1951: 159) reported *O. luteorubella* from northeastern to southeastern USA and the Caribbean region, Otani (1990) from Japan, Raitviir (1991: 360) from northeastern Asia, Korf (1992) from Macaronesia, and Thind & Sharma (1980) from northwestern Himalaya. Yet, all these records are unverified to some extent. Karsten (1869: 175), Massee (1895: 149), and Massee & Crossland (1905: 301) found the species to occur also on decaying bracket fungi (*Phellinus igniarius*, *Polyporus squamosus*), but also these reports need confirmation.

Our collections from Tübingen were made in a small forest pond which lies over Knollenmergel in a *Fagus* forest and sometimes completely dries out (Pl. 535: 1a). Here the species was recorded in abundance during July–Oct. in 2005 and 2010–2012 on *Fagus* logs. However, *O. sarraziniana* was also abundantly collected on these logs during July–Sept., though in different years (2000, 2003, 2006).

The type substrate of *Helicoon sessile* was stated by Morgan (1892) to be wood of *Ulmus*. According to Linder (1929), the type was collected by J.B. Ellis, presumably in New Jersey. *H. fairmanii* was collected by C.E. Fairman in New York. Linder further examined a personal collection from Massachusetts on wood of *Acer*. Goos et al. (1986) gave a survey on the occurrence of *H. sessile* ‘on decaying leaves, twigs and wood of *Acer*, *Quercus*, *Fagus*, and coniferous wood’, recorded from Great Britain and USA (Massachusetts, Maryland, New Jersey, Iowa). Voglmayr (2000) reported the species from strains from Austria (Sauwald), but isolated it also from near Oslo (pers. comm.). The database of the British Mycological Society (FRDBI) lists three records of *H. sessile* (Scotland, Wales, Devon).

According to Voglmayr (pers. comm.), typical left-handed *Helicoon sessile* is mostly encountered in shallow, temporarily flooded ponds or marshes with *Alnus* and *Salix*, also ditches at the margin of peat bogs, though these included also conidia with right-handed threads. A record by Voglmayr (pers. comm.) from Norway (near Oslo) was on bark of *Betula* in a peaty boreal conifer forest. All his conidial strains from Europe and also USA derive from submerged leaves or mostly deciduous wood at usually medium oligotrophic water bodies, always on acidic bedrock, at altitudes up to 700–800 m.

The barrel-shaped conidia of *H. sessile* function as air traps (Pl. 536: 1a lower right). They are formed above water, and when the water level raises they float on the water surface by means of internal air bubbles (Michaelides & Kendrick 1982, Pfister 1997, Pl. 536: 1a). Fungi with air-trapping conidia are mainly encountered at stagnant water bodies without noticeable water flow (so-called aero-aquatic fungi), while the scolecosporous conidia of *O. rosea* are adapted to running water. Such elongated filiform conidia are classified as aquatic or Ingoldian (Michaelides & Kendrick l.c.), though also *H. sessile* was found at running water (Pfister l.c.). The ability to float appears to support propagation, for instance by birds.

Map 89. Known distribution of *O. luteorubella* in Europe (yellow = not included collections).

Specimens included. **GREAT BRITAIN**: **West Midlands**, **Shropshire**, 4.5 km NNE of Telford, S of Muxton, Muxton Marsh, 85 m, branch of *Salix*, on wood, 16.VII.2018, P. Thompson (doc. vid.). – **Staffordshire**, 15 km NE of Wolverhampton, 1 km SSW of Chasetown, Chasewater Country Park, 150 m, branch of *Salix*, on wood, 12.VII.2013, P. Thompson (non vid.). – **Birmingham**, 8 km NNE of Birmingham, Longmoor Pool, 130 m, branch of *Betula pendula*, on wood, 18.VIII.2016, P. Thompson (non vid.). – 17 km NNW of Birmingham, Sneyd Reservoir, 155 m, branch of *Salix caprea*, on wood, 17.VIII.2015, P. Thompson (non vid.). – **Herefordshire**, 10.5 km SW of Ludlow, 8.5 km NNW of Leominster, NE of Croft Castle Estate, Fishpool Valley, 168 m, branch of *Fraxinus excelsior*, on wood, 14.VIII.2016, P. Thompson (non vid.). – **East Midlands**, **Leicestershire**, 6 km SSE of Leicester, 1 km SSW of Oadby, Lucas’ Marsh, 92 m, branch of *S. caprea*, on wood, 17.VII.2013, P. Thompson (non vid.). — **NORWAY**: **Oslo**, 8.5 km SE of Oslo, ESE of Skullerud, bark of *Betula* at rivulet, 14.VIII.2002, H. Voglmayr (anam. only, as *Helicoon sessile*, non vid.). — **FINLAND**: **South Ostrobothnia**, 120 km N of Tampere, Alavus, ~100 m, branch of *Alnus*, on wood, 28.VII.1859, P.A. Karsten (herb. Karsten 5282, as *Peziza cinerea* var. *rubella*, H-6003831, **lectotype** of *O. luteorubella*, H.B. 5222 ø; H-6003832, **isolectotype**). — **CZECHIA**: **Central Bohemia**, 28 km NNE of Praha, 8 km SE of Mělník, Liblice, ~190 m, branch of *Quercus*, on wood, 15.VII.1925, J. Velenovský (PRM 151750, **lectotype** of *O. parvula*, H.B. 6273 ø). – 9 km SW of Praha, Solopisky, ~270 m, wood of *Salix*, VIII.1924, J. Velenovský (**holotype** of *O. salicina* [illustration], doc. vid.). – **Olomouc**, 9 km NNW of Olomouc, 1.5 km ESE of Hynkov, Panenský les, 220 m, branch of indet. angiosperm, on wood, 10.VI.2018, V. Halasů (V.H. 877, doc. vid.). – 3.2 km NNE of Olomouc, 1 km NE of Černovír, Černovírske slatiniste, 225 m, branch of indet. angiosperm, on wood, 30.V.2019, V. Halasů (doc. vid.). — **GERMANY**: **Mecklenburg-Vorpommern**, 13.5 km N of Schwerin, 1.5 km WSW of Zickhusen, branch of *Fagus sylvatica*, on wood, 29.VI.2018, C. Ehmke, vid. I. Wagner (doc. vid.). – **Nordrhein-Westfalen**, 2.5 km SE of Mönchengladbach, Bresgespark, 55 m, branch of *Populus*, on wood, 2.VIII.2012, H. Bender (ø, doc. vid.). – **Hessen**, 12 km ESE of Gießen, 3.3 km NE od Lich, Kohlstrauch, 226 m, branch of ?*Fagus sylvatica*, on wood, 6.IX.2019, R. Freitag & W. Schößler, vid. I. Wagner (doc. vid.). – **Baden-Württemberg**, Tübingen, 6 km ENE of Tübingen, 1 km ESE of Pfrondorf, Hinterpfand, 420 m, branches and logs of *Fagus sylvatica*, on wood, 23.VII.2005, E. Weber & H.O. Baral (H.B. 7846). – ibid., 22.X.2005, E. Weber & H.O. Baral (H.B. 7941 ø). – ibid., 25.VIII.2010, H.O. Baral (H.B. 9424a, anam. cult. ø). – ibid., 30.IX.2011, H.O. Baral (H.B. 9633a ø). – ibid., 2.VII.2012, H.O. Baral & E. Weber (H.B. 9697, anam. from substrate in water, ø). – ibid., 18.VII.2012, H.O. Baral (ex H.B. 9705, M-0291777, **epitype**; sq.: KM199778). – **Bayern**, **Unterfranken**, 11 km SW of Würzburg, 2.3 km SSW of Kist, W of Limbachshof, Blutsee, 360 m, log of *Fagus sylvatica*, on wood, 23.VIII.1995, L.G. Krieglsteiner (L.K., H.B. 5325). – **Oberfranken**, 5 km ENE of Marktredwitz, E of Brand, Weidersberg, 525 m, branch of ?*Salix*, on wood, 10.XI.2018, M. Reul (anam. only, doc. vid.). – **Oberpfalz**, 11.5 km NNE of Amberg, 1.3 km SW of Hirschau, Kreuzweiher, 420 m, branch of *Salix*, on wood, 3.VIII.2012, H.O. Baral (H.B. 9711a ø). – ibid., Schindelweiher, 420 m, board of *Picea abies*, on wood, 3.VIII.2012, H.O. Baral (H.B. 9709, TU(M) 104742). — **AUSTRIA**: **Salzburg**, 3 km NE of Salzburg, Samer Mösl, 433 m, root of *Prunus padus*, on bark, 14.X.1991, W. Dämon (W.D., as *O. sarraziniana*). – **Oberösterreich**, 19 km NNW of Grieskirchen, 2.5 km SW of Natternbach, SW of Obertresleinsbach, Sauwald, 445 m, isolated from a pond in an *Alnus* forest, 5.II.2004, H. Voglmayr (H.V. A327, as *H sessile*, conid. isol., CBS 124539, non vid.; sq.: KY659207). — **FRANCE**: **Basse-Normandie**, **Orne**, 3 km NNW of Bellême, La Herse, 190 m, branch of *Salix*, on wood, 23.IX.2005, J.P. Priou

(J.P.P. 25139, doc. vid.). — **SPAIN**: **País Vasco**, **Vizcaya**, 11 km SE of Bilbao, 3.7 km SSW of Usansolo, SSW of Lekubaso Embalse, 163 m, branch of *Alnus glutinosa*, on wood, 13.XI.2017, R. Ibarretxe (R.I. 171113, anam. substr., doc. vid.). — **CHINA**: **Guizhou**, **Zunyi**, Suiyang, 62 km NNE of Zunyi, 38 km ENE of Tongzi, Kuankuoshui, 1420 m, on wood of unidentified plant, 25.VII.2008, X.Z. Jiang & B. Liu (gz-08, HMAS 267649, CGMCC 3.13369, anam. cult.; sq.: FJ719770, doc. vid.). – **Guizhou**, unlocalized, Li et al. 2003 ined. (PAO0228s, YNUCC 0228, as *O. inflatula*, non vid.; sq.: AY261122). – For further 12 Chinese samples (including Beijing, Heilongjiang, Zhejiang, Henan, Hunan, and Xinjiang) see Liu (2006). — **JAPAN**: **Hokkaido**, Rishiri island, 3 km SE of Rishiri-fuji-cho, Himenuma pond, 130 m, on indet. twig, 2008, K. Yamaguchi (42KY-6-3; sq.: NBRC106775, non vid.). — **USA**: **Massachusetts**, Middlesex, 27 km NW of Boston, 2.8 km NNE of Concord, Punkatasset Hill, Hutchins Pond, 40 m, on branch of *Acer*, on wood, 15.X.1994, D.H. Pfister (D.H.P. 79, FH 00458177, H.B. 5168a, anam. cult.). – **New York**, Lyndonville, ~100 m, on wood, I.1906, C.E. Fairman (PAD, **holotype** of *H. fairmanii*, doc. vid.). – **Ohio**, unlocalized, wood of *Ulmus*, undated, A.P. Morgan, revid. H. Voglmayr (FH, herb. Morgan; NY, herb. J.B. Ellis; as '*Helicosporium conchoides* E. & E.' ined., **syntypes** of *Helicoon sessile*, doc. vid.).

Not included. **LUXEMBOURG**: **L'Oesling**, **Clervaux**, 5 km S of Clervaux, Siebenaler, ~330 m, of *Fagus sylvatica*, on wood, 12.IX.1898, J. Feltgen (LUX 42441). – **Gutland**, **Esch-sur-Alzette**, 6 km WSW of Luxembourg, N of (Leudelange-)Schléiwenhaff, railway station, 315 m, on wood of *Salix*, 3.IX.1902, J. Feltgen (LUX 42522, as *O. rubella*). – **Luxembourg**, 4.3 km ESE of Luxembourg, 2 km NE of Itzig, 'Igelsmoor' (Steckelter Muer), 320 m, of ?*Salix*, on wood, 3.XI.1898, J. Feltgen (LUX 42454, as *O. vinosa*). – ~10 km ESE of Luxembourg, Moutfort, 250 m, on wood of *Salix*, 25.X.1900, J. Feltgen (LUX 42516, as *O. coccinella*). — **GERMANY**: **Mecklenburg-Vorpommern**, 8.5 km NE of Zarrentin, 1.3 km E of Neuenkirchen, Altes Moor, 45 m, log of *Betula*, on wood, 4.IX.1993, T. Richter (ø). – **Brandenburg**, Ost-Prignitz, 8 km NW of Pritzwalk, Triglitz, 60 m, branch of *Salix*, on bark, 3.X.1915, O. Jaap (FSE 765, M, as *Orbilia vinosa*). — **NEW ZEALAND**: **South island**, Canterbury, 7 km NE of Christchurch, 1 km SW of Parklands, Travis Wetland, 2 m, branch of indet. tree, on wood, 6.III.2010, J.A. Cooper (PDD 95695, J.A.C. 11273, doc. vid.).

Orbilia sarraziniana Boud., in Roumeguère, Rev. Mycol. (Toulouse) 7: 221 (1885) — Pls 537–539, Map 90

(?)= *Orbilia luteorubella* f. *microspora* (Sacc.) Sacc., Syll. Fung. 8: 624 (1889)
≡ *Calloria luteorubella* f. *microspora* Sacc., Michelia 2: 614 (1882)

Etymology: *sarraziniana*: from the collector, F. Sarrazin; *microspora*: referring to the smaller spores compared to *O. luteorubella*.

Typification: France, Oise, Senlis, log of (?)*Fraxinus excelsior*, 21.VII.1885, F. Sarrazin (PC, herb. Sarrazin, holotype of ***Orbilia sarraziniana***); Germany, Baden-Württemberg, Tübingen, Pfrondorf, branch of *Fagus sylvatica*, 29.X.2002, E. Weber (ex H.B. 7235, M-0291764, epitype, designated here, MBT385123, ex-epitype culture: CBS 116219; sq.: KM199780). — France, Seine-et-Marne, Fontainebleau, on rotten wood, undated, J. Therry (herb. Therry 6025, Fungi Gall. no. 1897, holotype of ***O. luteorubella* f. *microspora***).

Misapplied names: Benny et al. (1978), as *O. luteorubella*; Feltgen (1899: 54), as *O. rubella*, (1901: 36, 1903: 42), as *O. luteorubella*; Fuckel (1871: 57), as *O. vinosa*;

Misinterpretation of *O. sarraziniana*: Breitenbach & Kränzlin (1981, pl. 252), (?)= *O. luteorubella*; Liu (2006: 104 p.p., HMAS 96784), = *Orbilia* sp.

Description: — **TELEOMORPH**: **Apothecia** fresh 0.2–1.3(–2.5) mm diam., 0.12–0.4(–0.5) mm high (receptacle 0.1–0.2 mm), pale to light rosaceous-lilaceous {~36} or pale to bright (amber-)orange {~24}, more rarely yellowish-ochraceous {5} or whitish {8}, translucent, round, sometimes strongly undulating when large, scattered to gregarious in large numbers, sometimes in dense clusters; disc slightly concave to flat, finally slightly to distinctly convex, margin indistinct, thin, not or scarcely protruding, smooth; sessile or often with a distinct, broad, ± obconical stipe 0.02–0.3 × 0.2–0.8(–1.3) mm, superficial; dry pale cream-ochraceous to bright amber-reddish-brown or ochre-orange(-rose). **Asci** *(30–)35–45(–50)((–57)) × (3.5–)4–4.5(–5)((–5.3)) µm {16} → *4.7–5.3 µm wide, †(28–)34–45(–50)((–60)) × (3–)3.3–4(–4.5)((–5)) µm {32}, 8-spored, spores 4-seriate, (1–)3–5(–6) of the upper spores inverted {94} (not or slightly mixed, sometimes a few asci with 1(–2) upper spores not inverted, lower spores regularly not inverted but exceptionally in very few asci all lower spores inverted), pars sporifera *(15–)17–22 → 12–16 µm long; **apex** (†) strongly truncate (not or slightly indented, laterally sometimes inflated); **base** with short to very long, thin, flexuous stalk, T- to L-shaped. **Ascospores** *(5.5–)6–8.5(–9)((–10)) × (1.2–)1.3–1.6(–1.7)((–2)) µm {43}, †(5.5–)6–8(–9)((–9.3)) × (1.1–)1.3–1.6(–1.7) µm {23}, (fusiform-)obclavate (to fusiform), widest part often below the middle, rarely above, apex acute (to acuminate), base slightly to medium attenuated (obtuse to subacute), rarely acute, straight, sometimes slightly inequilateral or curved; **SBs** *3–5(–5.5) × (0.2–)0.3–0.5(–0.7) µm {14}, filiform to subulate, mostly not inflated at base, straight to ± flexuous, in aged spores 2–3.5 × 0.6–1.1 µm, tear-shaped to ampulliform. **Paraphyses** apically (uninflated to) slightly to strongly (rarely very strongly) (clavate-)capitate, sometimes asymmetrical, terminal cells *16–24 × (2.3–)3–5.3 µm {6}, †14–21 × 1.7–2.8 µm {1}, lower cells *4–8 × (1.4–)1.8–2.7(–3) µm {4}, †3.5–7 × 1.7–2 µm {1}, near base *(2–)3–6 × 2.7–4 µm; rarely branched at upper septum. **Medullary excipulum** 30–150(–200) µm thick, of medium dense textura globulosa(-intricata), with many sometimes strongly inflated cells in centre, medium sharply delimited from ectal excipulum mainly towards margin by an indistinct 10–15 µm thick t. porrecta. **Ectal excipulum** of thin-walled, vertically oriented t. globulosa-angularis(-prismatica) from base to margin, (25–)60–100(–150) µm thick near base, cells *11–30(–40) × 9–25(–35) µm {4}, †(10–)13–25(–30) × (6–)10–15(–20) µm {1}; 15–60 µm thick at flanks, 10–20 µm near margin, oriented at a 70–90° angle to the surface, marginal cortical cells *6–18 × 4–8.5(–10.5) µm {5}, †8.5–12 × (3–)4–6 µm {1}; **glassy processes** absent. **Anchoring hyphae** sparse to abundant, */†2–3.5(–5) µm wide, walls (0.1–)0.2(–0.3) µm thick {5}, forming a dense t. intricata up to 50–100 µm thick. **SCBs** globose, in paraphyses 1.4–2.2 µm diam., 1(–2) per cell; in ectal excipulum 1.5–2.5 µm {16}. **VBs** in paraphyses often abundant, large, low- to medium refractive {16}, hyaline, not turning yellow in dead state, but also often absent {7}, inflated cells of medullary and basal ectal excipulum sometimes with small, trembling, pale golden-yellow aggregates {2}. **LBs** in lower part of paraphyses and in subhymenium hyaline or sometimes pale to light golden-orange (carotenoids), minute. **Exudate** over paraphyses 0.2–0.5 µm thick, granular, ± loosely attached, hyaline; over margin and flanks thin, granular. — **ANAMORPH**: vermispora- to helicoon-like (from ascospore isolate {3} or from non-sterile culture {1}). **Conidiophores** 15–150 × 1.6–2.5 µm {2}, septate, erect, solitary, apparently unbranched, conidiogenesis terminal. **Conidia** *19–50 × 4.8–7 µm in situ {3, Germany}, †21.5–40.5 × 3.2–4.2 µm in situ {1, China}, actual length ~30–50 µm {4}, strongly curved, helicoid, C-shaped in profile view, (1–)3-septate.

Habitat: on moist or mostly wet soil, often semi-immerged, sometimes 5–20 cm above water or soil but occasionally flooded, rarely up to 6 m above low water level, on water-soaked, decorticated or sometimes ± corticated, 4–10 mm up to 2–35 cm thick branches and logs, rarely conifer cones, of *Acer* sp. {2}, *Alnus* sp. {4/1}, *A. glutinosa* {9/2}, *Betula* sp. {3}, *B. pendula* {1}, *Carpinus betulus* {2/1}, ?*Corylus* sp. {1}, *Cupressus* sp. {1} *Fagus* ?*crenata* {1}, *F. sylvatica* {28/2}, *Fraxinus angustifolia* {1}, *F. excelsior* {6/1}, ?*Phyllostachys* sp. {1}, *Picea abies* {2}, *Pinus* sp. {2/1}, *P. uncinata* {1}, *Populus* sp. {2}, *Quercus* sp. {6/1}, *Ribes rubrum* {1}, *Rubus fruticosus* {1}, (?)*Rosaceae* {1}, *Salix* sp. {26/5}, *S. alba* {1}, *S.* (?)*atrocinerea* {1}, *S. caprea* {3}, *S. cinerea* {3/1}, *S. fragilis* {1}, *Sambucus nigra* {1}, *Tilia* sp. {2}, *Ulmus* sp. {4}, indet. angiosperms {14}, indet. gymnosperm {1}, indet. woody plant {3}, on wood {108} or bark {29} (periderm {5} and bast {11}); exceptionally on herbaceous stem of *Epilobium hirsutum* {1}, bone of *Sus scrofa* {1}, or fungicolous on old ?*Peniophora* {1}, *Nectria* sp. {1}, old pyrenomycete {1}; on upper or lateral, also on lower side of branches and logs, rarely on inner surface of bark, exceptionally on cut surface of stump, wood 0.2–1 or sometimes 2–5 mm deep (slightly) medium to strongly decayed, partially eroded, grey-brown or often blackened, inner parts usually ± undecayed, green algae absent or medium to very abundant; rarely on pores of indet. polypore {1}, on soil with organic matter {2}, e. g., among *Funaria hygrometrica*, *Bryum bicolor* & *B. argenteum*. **Associated**: *Acrogenospora sphaerocephala* {2}, *Ascocoryne cylichnium* {1}, *Bactrodesmium pallidum* {1}, *Bisporella*

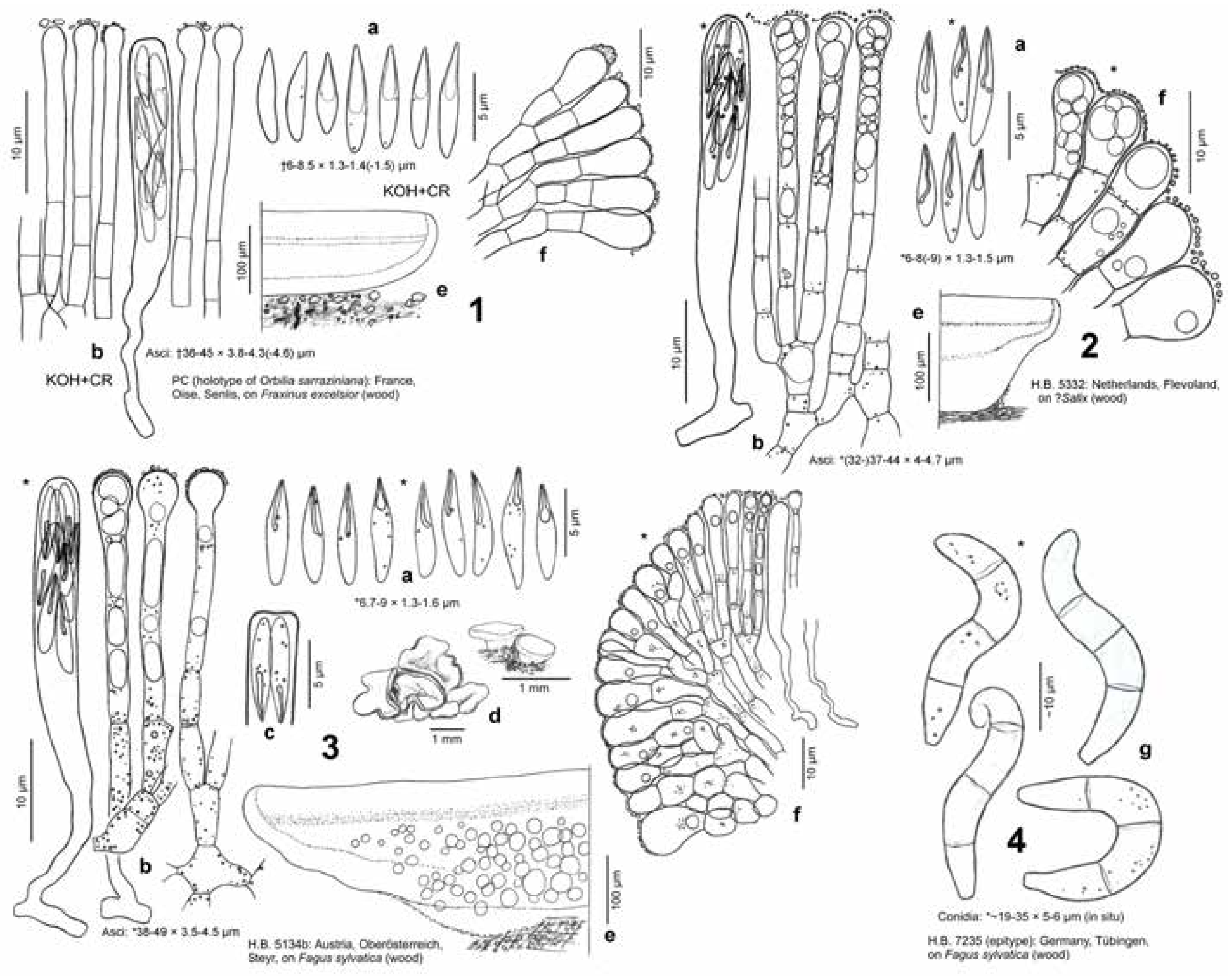


Plate 537. **1–4**: *Orbilia sarraziniana*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apex; **d**. fresh apothecia; **e**. apothecia in median section; **f**. id., ectal excipulum with hymenium at margin and mid flanks; **g**. conidia (from pure culture).

subpallida {1}, *Bulbillomyces* sp. {1}, *Calycina* sp. {1}, *Chalara* sp. {1}, *Coniochaeta velutina* {1}, *Graphium calicioides* {1}, *Helicogonium orbiliarum* (parasitic in *O. sarraziniana*) {3}, *Hydropisphaera peziza* {2}, *Hyalorbilia juliae* {1}, *Hypoxylon howeanum* {1}, *Lachnum brevipilosum* {1}, *L. impudicum* {1}, *Lasiosphaeria hirsuta* {2}, *Miladina lecithina* {4}, *Mollisia albogrisea* {1}, *Nectria* sp. {5}, *Neonectria* ?*coccinea* {1}, *Olla scrupulosa* {1}, *Ombrophila* sp. {1}, *O. violacea* {1/2}, *Orbilia cardui* {1}, *O. crenatomarginata* {1}, *O. eucalypti* {1}, *O. luteorubella* {1}, *O. nemaspora* {1}, *O. rosea* {2}, *O. rubrovacuolata* {1}, *Pachyella babingtonii* {3}, *Peziza granularis* {1}, *Pseudaegerita* sp. {1}, ?*Pseudocosmospora vilior* {1}, *Sclerococcum* sp. {1}, *Stictis* ?*sarothamni* {1}, *Subulicystidium longisporum* {2}, pleurocarpous moss {3}. **Desiccation tolerance**: asci and paraphyses (except for a few excipular cells) do not survive for 5 hours; many spores still viable after up to 10 (H.B. 8483c) or even 21 months (6.VIII.1992), in other cases all spores dead after 4 months. **Altitude**: 0–825 m a.s.l. (central and western Europe), 25–2020 m (southern Europe), 10–970 m (Russia). **Geology**: Ordovician, Devonian & Carboniferous sediments, Permian (Rotliegend, Zechstein dolomite), Buntsandstein, Muschelkalk, Keuper (gypsum, marl, sandstone), Lower Jurassic sandstone & shale, Cretaceous & Tertiary sand, marl-, mud- & limestone, Pleistocene boulder till, silt, sand & gravel; granite, granulite, basalt, mica schist. **Phenology**: (III–)IV–XI(–XII).

Phenology of *O. sarraziniana*											
Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
0	0	1	4	9	18	32	29	20	19	6	1

Taxonomic remarks. *Orbilia sarraziniana* can easily be confused with *O. luteorubella* and *O. rosea*, to which it is closely related. It differs from both in spore orientation within the asci: in the majority of asci the upper ~3–5 spores are inversely oriented (with the SBs pointing downwards) while the lower spores are not inverted. It also differs in a tendency to obclavate spores which are tapered only at the apical end, while the widest part of the spores is either ± in the middle or closer to the lower, mostly obtuse end. When Liu (2006: 48) used our unpublished key of *Orbiliomycetes*, he confirmed the criteria of spore shape and orientation in Chinese specimens as follows: 'Ascospores clavate, upper spores inversely oriented in asci, 5.8–8.7 × 1.3–1.7 µm: *O. sarraziniana*; Ascospores fusoid, lower spores inversely oriented in asci, 7.5–10.5 × 1.3–1.8 µm: *O. luteorubella*'.

Some more tropical taxa distinctly deviate from *O. sarraziniana*. Chinese specimens here referred to *O. juruensis* differ in broader, tear-shaped SBs, a feature seen in *O. sarraziniana* only in overmature spores, also in a tendency to a ± yellow exudate. The type collection of *O. juruensis* closely resembles *O. sarraziniana* in spore size and orientation, but differs in distinctly thick-walled excipular cells and more fusiform spores, also in larger apothecia (the original shape of the SBs is unknown). A Chinese collection mentioned under *O.*

fusiformis (Pl. 556: 3) resembles *O. sarraziniana*, but sharply differs in a pseudotripoconidium-like anamorph.

Macroscopic variation. Apothecial colour varies in *O. sarraziniana* between whitish to pale or light rose-lilaceous and pale to bright yellowish-orange-ochraceous. In quite a lot of collections both colour variants occurred, though in separate populations (H.B. 5134: IVV; 5139a; 5141; 6727a; 7957a: Pl. 538: 2b–c, e; 8225: Pl. 538: 3b–d; TAAM 62408; Sheffield 16.V.2011; J.P.P. 13188/13189). The colour contrast between these populations was not always sharp, however, and the microscopical features were the very same, except for the presence of pigmented LBs in the orange populations. In some collections apothecial colour was somewhere between rose and orange. Such colour variants concern apothecia of equal maturity while, within each such population, young apothecia are often paler than mature ones. Yet, we once had the case that orange *O. sarraziniana* (H.B. 9691a) grew intermingled with rose-coloured apothecia that seemed to belong to *O. rosea* (H.B. 9691b, Fig. 14: d–e), with a sharp and constant colour difference and a clear correlation with a deviating spore orientation (but no difference appeared in the ITS-rDNA, see below). Purely orange populations of *O. sarraziniana* have repeatedly been observed in light-exposed habitats such as unshadowed banks of lakes.

Also Le Gal (1938: 137) and Liu (2006: 104) observed variable colours between different populations of *O. sarraziniana*: from vividly orange to pale greyish-orange, yellow, greyish with lilaceous tint, and pink to violet. These findings question the distinction between *O. luteorubella* and *O. sarraziniana* based on apothecial colour as reported in the literature, e.g., by Dennis (1978: 188, pl. XXV B, E; 'pallid, drying yellowish' vs. 'very pale pink and translucent'). On the other hand, we have noted mostly yellowish-orange apothecia in *O. luteorubella* in comparison to consistently pale rose apothecia in *O. rosea*. In all these species the original pigmentation gradually disappears in herbarium material. Dry or rehydrated apothecia of *O. sarraziniana* are whitish or usually cream to yellowish-ochraceous after some years, by completely obscuring differences observed in the fresh state.

Microscopic variation. Spore orientation was highly consistent in a majority of the included collections, with distinct deviations from the typical case noted in only ~1–2% of the asci, while in 5–10% a single spore at the top or base of the pars sporifera was oriented other than typical. In some collections the upper spores showed a very variable orientation, but the lower spores were mostly not inverted. A very variable orientation was observed in a recent collection (IVV: 10.XI.2018), which is assigned here to *O. sarraziniana* because of its predominantly strongly heteropolar and rather short spores, although conidia referable to *Helicoon sessile* grew abundantly in association.

O. sarraziniana shows considerable variation in ascus and spore size, spore shape, and in the strength of apical inflation of paraphyses. Asci varied among the collections from */†30–40 µm up to *40–50(–60) µm in length and from *3.5–4 µm up to *4.5–5 µm in width, ascospores from */†6–7 up to 7.5–9 µm in length and from */†1.3–1.4 up to 1.5–1.7 µm in width (surprisingly hardly any difference occurred between the living and dead state). In a collection from Caucasus (TAAM 49849a) the asci were exceptionally long (†45–60 µm), but also two specimens from Germany had an extraordinary ascus length (Tübingen, 6.VI.1993, †35–55 µm) and Austria (Leoben, H.B. 7412, *45–57 µm). A western European collection (Le Mans, 10.IV.2008) showed exceptionally wide spores of *6–8 × 1.7–1.8(–2) µm and an unusual habitat (growing inside small holes of bark of a corticated branch of *Ribes rubrum*). Spore shape is usually fusiform-obclavate with acute upper and obtuse lower end, and the widest part of the spores often more towards the base. Yet, also fusiform spores with (sub)acute lower end occurred, with the widest part in the middle or rarely closer to the acute upper end. In *O. luteorubella* and *O. rosea* distinctly obclavate spores were only exceptionally seen, though in a few records from France mentioned under *O. rosea* they prevailed. Therefore, spore orientation needs to be evaluated for identification.

Globose SCBs were quite consistently present in the cells of both paraphyses and marginal ectal excipulum. VBs were often seen in the paraphyses, but they were sometimes also completely absent or only inconsistently present within a collection.

Type studies. Boudier (1885) described ***O. sarraziniana*** without a reference to *O. luteorubella*. The brief unillustrated protologue is based on a collection from near Paris (Forêt d'Halatte – erroneously as 'Hallate'), with translucent, orange (as 'oronge') apothecia, and spores 8–8.5 × 1.2–2 µm. Later, Boudier (1904–10: 267, pl. 462) illustrated under the name *O. sarraziniana* a specimen from a different locality near Paris (bois d'Ecouen) with pale greyish-ochraecous(-rose) apothecia, spores 7–8 × 1.5–2 µm (7.2–8 × 1–1.2 µm evaluated from scale), but without commenting on the different colour in the holotype. In both records the spores are described as fusiform-acicular-acute, but no SBs are reported. In the examined holotype the bright amber red-brown apothecia still showed an orange tint when rehydrated. The spores are distinctly heteropolar in shape, with one end acute to acuminate and the other end obtuse to subacute (Pl. 537: 1). SBs could be discerned in the acute spore end, and the inverse orientation of the upper spores was seen in about 10 asci. The collection from Ecouen was not studied, but judging from Boudier's illustration it might represent *O. rosea* because of consistently fusoid spores and rose-coloured apothecia ('pale ochraceous-grey and slightly rose' in the text).

A German specimen (Tübingen, on *Fagus*, Pl. 537: 4, IVV: H.B. 7235), from which an ascospore isolate (CBS 116219) and a sequence were gained, is designated here as **epitype** of *O. sarraziniana*.

Saccardo described ***O. luteorubella* f. *microspora*** as a small-spored form of *O. luteorubella*. Type material (France, Fontainebleau, on rotten wood, J. Therry 6025, Fungi Gall. no. 1897) could not be located in PAD, PAL, and W. The taxon was considered by Rehm (1891: 456) to be a synonym of *Orbilia luteorubella*. However, the spore size (5–6 × 1–1.5 µm) indicated by Saccardo (1882b) would better fit *O. sarraziniana*.

Literature reports and misapplication. Two TEM studies on *O. sarraziniana* account for the characteristic heteropolar spore shape, the filiform to subulate SBs in the acute end, and the extraordinary orientation within the asci. Benny et al. (1978) treated a collection from Florida (USA, as *O. luteorubella*, see Fig. 71: a). A spore width of 1.3–1.6 µm (length ~6 µm) and a spore body size of 2.6–3 × 0.5–0.6 µm can be evaluated from their micrograph. The figured features fit quite well *O. sarraziniana*, which would be the only certain American record of this species known to us. The anchoring hyphae illustrated by the authors on their fig. 19 appear much too wide for that species, yet it seems that the given magnification of 875× is erroneous, i.e., much too low in comparison to figs 18 and 21.

Based on several Chinese collections, Liu (2006: 22, pl. 1 figs C-D; 48, 104, pl. 41) characterized *O. sarraziniana* by clavate

Plate 538. **1–7**: *Orbilia sarraziniana*. – **1**. Ravine in Knollenmergel where *O. sarraziniana* repeatedly was found; **2a–c**, **e**, **3a–d**, **4a–b**, **5a–c**, **6**, **7**. fresh apothecia; **3f–g**, **5d**. apothecia in median section; **3e**. id., marginal region; **2d**. asci and paraphyses; **4c**. fully turgescent ascus; **5e**. ejected ascospores. – Living state. — **1**. 12.VIII.2000/26.VII.2001/25.VII.2012 (phot. 27.V.2006): Germany, Tübingen-Pfrondorf, Tiefenbach; **2a–e**. H.B. 7957a: ibid., on *Fagus*; **3a–g**. H.B. 8225: ibid., on *Fagus*; **4a–c**. H.B. 8506: Denmark, Sjælland, on *Alnus*; **5a–e**. H.B. 8886: Germany, Chemnitz, on indet. gymnosperm; **6**. H.B. 7619: France, Pays-de-la-Loire, on *Cupressus* (bark); **7**. H.B. 7806: China, Beijing, on *Salix*.

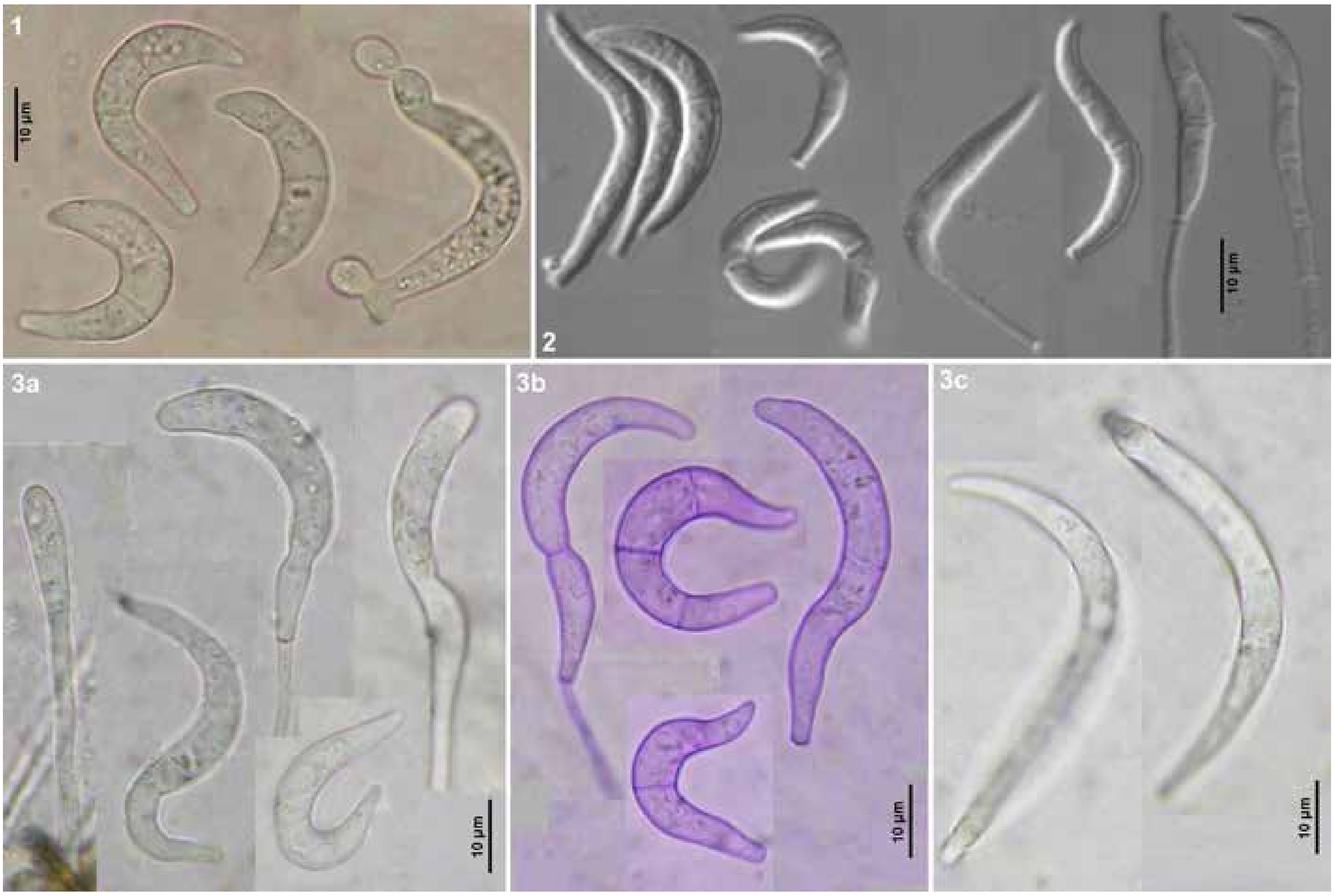


Plate 539. **1–3**: *Orbilia sarraziniana* (**3c** ?*O. rosea*). – **1–3**. microconidia, some adhering to conidiophores (**1–2** from pure culture, **3** from natural substrate flooded with water). – Living state (**3b** in CRB), except for **2** (in H_2O). – **2**: from Liu (2006, fig. 42, DIC). — **1**. H.B. 8225: Germany, Tübingen, on *Fagus*; **2**. HMAS 139684: China, Beijing, on indet. tree; **3a–c**. H.B. 9691a: Germany, Chemnitz, on *Alnus* (**3c** ?*O. rosea*).

ascospores and their extraordinary orientation (upper spores often inverted, see Fig. 71: b). On his TEM micrographs of HMAS 139680 (Beijing, Matsuyama forest) the spore bodies are rather wide (†3–6 × 1–1.2 µm), perhaps because they are artificially inflated in the dead state. In another Chinese specimen collected at the same place and date (HMAS 139684), Liu figured a much narrower spore body (*3 × 0.5 µm), which appears to exclude a possible identity with the similar *O. juruensis*. In his description Liu reported the SBs as 3 × 1 µm.

Reports of *O. sarraziniana* in the literature often give too narrow spores. For example, Dennis (1960a, 1978: 188, followed by Moser 1963, Chmiel 1982, Ellis & Ellis 1985, and Courtecuisse 1988) gave the spores as 6–8 × 0.5 µm, Breitenbach & Kränzlin (1981, pl. 252) as 7 × 0.5–1 µm, Raitviir (1991: 361) as 6–8 × 0.5–0.8 µm. On the contrary, *O. luteorubella* is generally reported with a spore width of 1–1.5 µm or up to 2 µm, although the two species actually do not differ in this detail. The single specimen treated by Breitenbach & Kränzlin (l.c.) was reexamined and found to be probably *O. rosea* (or *O. luteorubella*), showing fusoid spores of †6–7(–9) × 1–1.2 µm. Raitviir's (l.c.) records from northeastern Asia doubtfully belong to this species complex because of partly curved spores (described as 'bent'). Tewari & Pant (1966) reported *O. sarraziniana* on piled up stems of *Cajanus cajan* from Varanasi (Uttar Pradesh, northern India) with rather wide, clavate spores of 3.5–8.5 × 1.5–2.5 µm. They emphasized this as the first record of an identified *Orbilia* from India, but did not provide an illustration.

The holotype of *O. carpathica* Velen. did not contain the described fungus with long and thin spore tails, but instead *O. sarraziniana* (IVV: H.B. 6054; see also p. 1664). This discrepancy might be due to some confusion of the material, since also the substrate does not concur with the protologue. In the lectotype of *O. roseohyalina* Velen. (= *O. crenatomarginata*) two apothecia of *O.* (?)*sarraziniana* occur in association (IVV: H.B. 6265b).

Not included collections. In all those collections listed below as not included, the spore orientation is unknown: either it was neglected when the fresh specimen was studied, or the feature was impossible to see in the dead state. In these cases the identity is assumed mainly because of a clavate spore shape, but in some cases the spore shape was variable by including also fusoid spores. A record from New Zealand studied by J.A. Cooper (pers. comm., as *O. luteorubella*, IVV: 4.I.2010) showed rather small spores (†5.5–6.2 × 1.1–1.5 µm), but in Europe a spore length of †(5–)6–7 µm was also sometimes noted. Regrettably, vital characters including spore orientation were not documented. The collection from Brandenburg by H. Sydow showed a spore size of †6–8 × 1.2–1.7 µm, but is not included because of rather large, especially broad asci of †40–47(–53) × 4.6–5.2 µm.

Anamorph. An anamorph similar to the microconidial state of *O. yuanensis* (Pl. 546: 5b) or *O. rosea* (Pl. 528) was observed in culture of four different collections of *O. sarraziniana*. Liu (2006: 104, fig. 42) obtained it in pure culture of one of his Chinese strains and tentatively called it provisionally '*Anguillospora sarraziniana*'. The 1–3 septate, strongly curved conidia (helicoid, C-shaped in side view, Pl. 539: 2) show an actual length of ~30–43 µm. This type of conidia we have also obtained in three German collections of *O. sarraziniana*, mainly with 3 septa, once in a Petri dish by flooding apothecia on a wood fragment with non-sterilized tap water (Pl. 539: 3a–b), and twice by flooding an agar block from sterile cultures with sterilized water (Pls 537: 4; 539: 1).

Besides these (1–)3-septate conidia, slightly longer, 1-septate, helicoid conidia (*47–52 × 5.5 µm in situ, Pl. 539: 3c) were found in the non-sterile Petri dish. This might indicate a similar dimorphism in conidial size and shape as in the very closely related *O. rosea*. It must be mentioned, however, that the two types of conidia developed on a piece of wood, which carried only pale rose-lilaceous apothecia of what seemed to be *O. rosea* (H.B. 9691b) based on ascospore orientation, while on other pieces of wood rose-lilaceous apothecia grew in mixture with orange apothecia of *O. sarraziniana*. From the similarity with conidia obtained in pure culture (Pl. 539: 1–2) one might conclude that the shorter and wider conidia belong to *O. sarraziniana*, while those in 3c belong to *O. rosea*. However, the two colour variants were identical in their ITS rDNA (see below). A culture from Luxembourg (G.M. 2012-10-18) formed in CMA:2 a colony with distinct concentric zones (see Fig. 102: d), but did not sporulate.

Phylogeny. Molecular phylogenetic analysis of the ITS region by Liu et al. (2006a) in various Chinese strains of series *Helicoon* supports distinction between *O. rosea* (as *O. luteorubella*, 5 sequences) and *O. sarraziniana* (3 sequences). The two species form two highly supported and distant clades. For two strains of *O. sarraziniana* (HMAS 139684 and 96817) also LSU was available, and for the former also SSU.

Another strain, obviously misidentified by Liu (2006) as *O. sarraziniana* (B.L. X079, HMAS 96784, Tibet, in GenBank as *O. luteorubella*), falls intermediate between series *Helicoon* and *Pseudotripoconidium*, and also at the 6 informative positions of the ITS region (Tab. 70) it stands intermediate between both series.

Among our five sequences of *O. sarraziniana*, three were gained from ascospore isolates (H.B. 7235, 6727a, Tübingen, SSU+ITS+LSU; G.M. 2012-10-18, Luxembourg, ITS+LSU) and two from apothecia of a problematic collection (H.B. 9691a/b, Chemnitz, ITS) which consists of two populations growing intermingled by sharply differing in rose vs. orange apothecia and in spore orientation (see below).

The three Chinese strains clustered in the ITS region with our five European strains in a strongly supported clade, showing an internal variation of 0–2.5%. This variation is lower than that observed within *O. rosea* (0.2–6.5%). H.B. 7235, 9691a, and 9691b fully concur in the entire ITS region (except for 1 gap), and strain G.M. 2012-10-18 shows 0.6% distance to them, whereas H.B. 6727a shows a distance of 2.5% (11–13 nt and a few inserts). Surprisingly, one of the available Chinese sequences (HMAS 139684) deviates from H.B. 7235 and 9691 only by 2 nt (0.4%) besides 1 gap and 1 insert. The ITS distance to *O. rosea* (14–17%) and *O. luteorubella* (15–15.5%) is unexpectedly high.

Because of the unexpected result of full identity between H.B. 9691a and 9691b, these strains were resequenced by E. Kuhnert but the result was confirmed. This raises the question whether our concept of *O. sarraziniana* needs to be widened to include populations showing the normal spore orientation of *O. rosea* or *O. luteorubella*, in combination with comparatively short asci and spores. Because this result remained the only exception, we refrained from any reassessment of collections, awaiting further research. The inverse orientation of the upper spores was strongly predominant in four sequenced European collections, and we assume that also Liu (2006) observed this feature in his three sequenced samples.

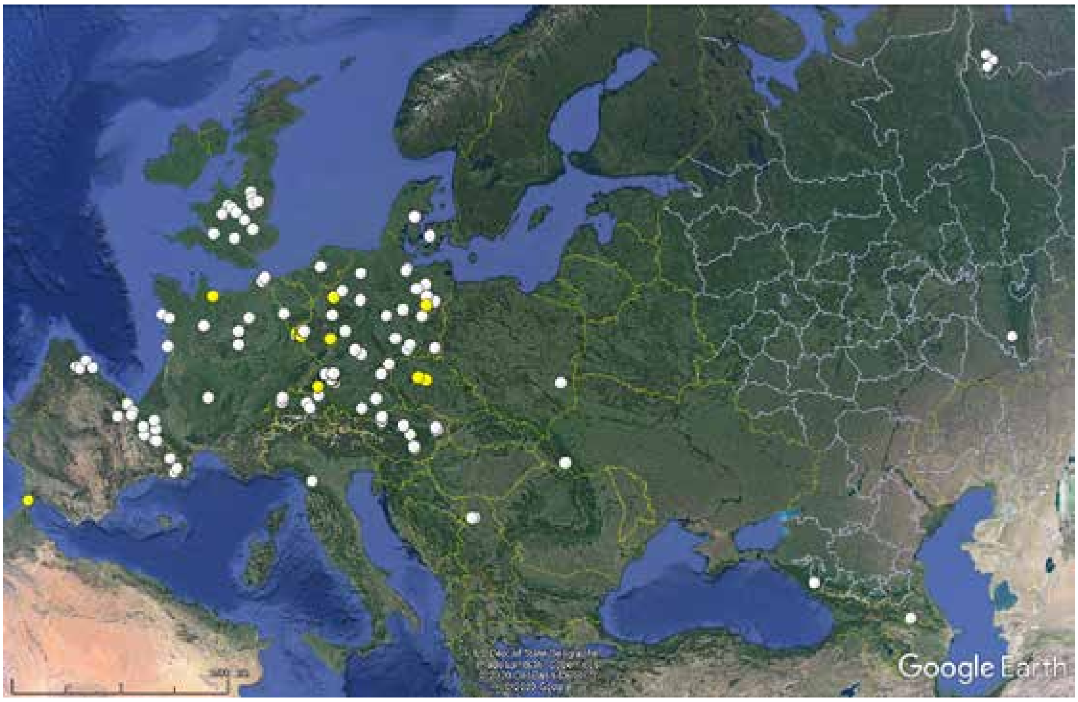
Also when analysing LSU (D1–D2), the five available sequences of *O. sarraziniana* form a strongly supported clade (Phyl. 18), showing 0.2–0.5% distance among each other, while the distance to other members of section *Helicoon* lies at 4–6%. An LSU sequence from an obviously misidentified strain (B.L. 730, DQ656703, as *O. sarraziniana*) deviates from this species by ~5.5% and clustered distantly from identified clades. In the SSU, strains H.B. 6727a and 7235 fully concur in the overlapping region (V8–V9), whereas HMAS 139684 deviates by 1 nucleotide and *O. rosea* (H.B. 6756a) by 5 nt (for further details see under *O. rosea*, p. 968).

Strains H.B. 6727a and G.M. 2012-10-18 of *O. sarraziniana* include the S1506 intron of 442 and min. 432 nt, respectively, which differ by 12 nt and 3 gaps (3%), whereas the distance to other members of section *Helicoon* lies in the range of 20% in this gene region. The intron is absent in H.B. 7235 and H.B. 9691a/b and in the Chinese strain HMAS 139684. Whether it is also absent in HMAS 96817 and 139682 is uncertain.

Ecology. *O. sarraziniana* occurs on ± rotten wood and more rarely bark of hygric, usually wet (semiaquatic) branches and logs (exceptionally twigs) of various angiosperms, mainly *Salix* {~36} and *Fagus* {~31}, also *Alnus* {~15} and *Fraxinus* {~8} etc., sometimes coniferous trees, exceptionally on herbaceous stems etc. Like *O. luteorubella* and *O. rosea*, the species grows close to water (muddy depressions, ponds, lakes, rivulets and streams) by which its substrate is periodically flooded. The vegetation includes grey willow marshes and aggradation zones of lakes (*Salicetum cinereae*), riparian white willow floodplain forests, alder marsh forests, green alder bushes (*Alnetum viridis*), wet ravine forests (*Aceri-Fraxinetum*, *Pruno-Fraxinetum*), sphagnum-rich moorland forests with *Betula* and *Alnus*, lowland sedge swamps adjacent to rivulets, and ponds in *Querco-Carpinetum* or *Fagetum*.

Within Europe *O. sarraziniana* was collected at planar to montane, rarely subalpine, atlantic to continental sites, including oro- to thermotemperate, but also orosub- to mesosubmediterranean or hemi- to oroboreal, humid to semihumid climates. Extra-European collections, however, are from continental oroboreal northern (West Siberian Plain east of Ural) and orotemperate southern Russia (Sayan Mts.), and cold-temperate humid northern China and central Japan, but also from cold-temperate oceanic New Zealand and subtropical humid eastern North America (Florida).

Otani (1990) reported collections under the name *O. sarraziniana* from Japan, and López & García (2001) from Xalapa (Veracruz, Mexico, subtropical humid, 1400 m), both without data on SBs and spore orientation. A report from Michigan (North America) by Kanouse (1934: 95) is without microscopic data, as are those by R. Galán (in Pando & Hernández 2001: 125) from different parts of Spain. Also Sierra López's (1987) record on branches of *Opuntia* in Cataluña (Spain) requires reexamination. The lack of collections from most parts of Scandinavia and eastern Europe is possibly accidental. Two Norway databases (Soppdatabasen, Artsobservasjoner) contain four records under the name *O. sarraziniana* (Oppland, Sør-Trøndelag, Vestfold, K. Homble pers. comm.).



Map 90. Known distribution of *O. sarraziniana* in Europe (yellow = not included collections).

Specimens included. **GREAT BRITAIN**: **England**, **Yorkshire**, **West Yorkshire**, 6 km NNW of Huddersfield, 1,5 km W of Brighouse, Cromwell Bottom, 62 m, twig of *Salix cinerea*, on wood & bark, 13.IX.2015, C. Yeates (C.Y. F/2645, doc. vid.). – **South Yorkshire**, 15.7 km N of Sheffield, 3.5 km S of Barnsley, 1.3 km SW of Worsbrough, Worsbrough Country Park, 70 m, branches of *S. fragilis*, on wood & bark, 20.V.2011, T. Læssøe, M. Parslow & A. Henrici (K(M) 170618). – 38 km ENE of Sheffield, 11 km E of Doncaster, SE of Lindholme, Hatfield Moor, 2 m, branch of *Salix*, on wood, 17.V.2011, C. Yeates (ø). – 18 km ESE of Sheffield, 2 km SE of South Anston, Anston Stones Wood, 70 m, branch of *Fagus sylvatica*, on wood, 16.V.2011, T. Fleming (ø). – 4.5 km NNE of Telford, S of Muxton, Muxton Marsh, 85 m, branch of *Quercus*, on wood, 8.VIII.2013, P. Thompson (non vid.). – ibid., branches of *Salix cinerea*, on wood, 5. & 9.VIII.2018, P. Thompson (doc. vid.). – **West Midlands**, **Shropshire**, Shrewsbury, unlocalized, ~70 m, branch of ?*Quercus*, on bark, undated, W. Phillips (herb. Phillips 185, M, as *Peziza luteorubella*, 'bark of willow'). – **Staffordshire**, 15 km NE of Wolverhampton, 1 km SSW of Chasetown, Chasewater Country Park, 150 m, branch of *Salix caprea*, on wood, 20.VIII.2013, P. Thompson (non vid.). **– Herefordshire**, 10.5 km SW of Ludlow, 8.5 km NNW of Leominster, NE of Croft Castle Estate, Fishpool Valley, 168 m, branch of *Betula pendula*, on wood, 14.VIII.2016, P. Thompson (non vid.). – **East Midlands**, **Leicestershire**, 6 km SSE of Leicester, 1 km SSW of Oadby, Lucas' Marsh, 92 m, twig of *Salix caprea*, on wood, 17.VII.2013, P. Thompson (non vid.). – **East England**, **Cambridgeshire**, 11 km N of Huntingdon, 6 km E of Sawtry, Woodwalton Fen, indet. polypore on branch of ?*Salix*, on pores, 7 m, 17.IV.2017, S. Rogerson (ex H.B. 10061, K(M) 263137). – **South West England**, **Bristol**, 5 km S of Bristol, S of Hengrove Park, Hawkfield Meadow, 68 m, branch of (?)*Rosaceae*, on wood, 30.VI.2011, J. Smith (H.B. 9568). – **South Eest England**, **Oxfordshire**, 5.5 km WSW of Thame, 1.2 km SE of Tiddington, Fernhill Wood, 80 m, stem of *Rubus fruticosus*, 28.VII.2018, P. Thompson (P.T. 28/7/18-13, doc. vid.). — **DENMARK**: **Midtjylland**, Horsens Fjord, 10 km E of Horsens, 2.7 km SSE of Søvind, NE-end of Vorsø island, 3 m, of *Salix*, on wood, 15.IX.2008, T. Læssøe (T.L. 13446, doc. vid.). – **Sjælland**, 7 km S of Sorø, 4 km S of Frederiksberg, Suserup Skov, Tystrup Lake, 15 m, branch of *Alnus glutinosa*, on wood, 25.V.2007, W. Jaklitsch, A. Ryberg & S.Å. Hanson (K [B. Spooner], H.B. 8506 ø). — **NETHERLANDS**: **Flevoland**, ~5 km SW of Lelystad, Hollands Hout, Poldern, 0 m, branch of ?*Salix*, on wood, 6.IX.1995, G. Marson (H.B. 5332). — **BELGIUM**: **Wallonie**, **Namur**, Viroinval, 5.5 km NE of Couvin, 1.2 km NNE of Nismes, Sous St.-Roch, 150 m, branch of *Salix* (?)*cinerea*, wood, 23.V.2014, B. Clesse (B.C. 20140523B, doc. vid.). — **LUXEMBOURG**: **Gutland**, **Diekirch**, Ettelbruck, unlocalized, on wood of *Fagus sylvatica*, 19.IX.1900, J. Feltgen (LUX 42534, as *O. chrysocoma*). – 3.5 km E of Diekirch, 1.7 km SW of Bettendorf, Schoofsboesch, Carrières de Gilsdorf, 313 m, branch of *F. sylvatica*, on wood, 24.VII.2003, R. Collot (ø). – **Echternach**, 9.5 km WNW of Echternach, SE of Beaufort, Hallerbach, 310 m, branch of *F. sylvatica*, on wood, 14.V.1988, H.O. Baral (H.B. 3413 ø). – ibid., 13.IV.1992, E. Weber & H.O. Baral (ø). – **Luxembourg**, ~6 km E of Luxembourg, Sandweiler, unlocalized ('forest swamp'), ~350 m, of *Salix*, on bark, 19.VII.1900, J. Feltgen (LUX 42443, as *O. luteorubella*). – ibid., on wood of *Salix*, 20.IX.1902, J. Feltgen (LUX 42442, as *O. luteorubella*). – **Capellen**, 19 km WSW of Luxembourg, 3 km WNW of Bascharage, Kuerzelt, 344 m, log of *S. caprea*, on wood, 18.X.2012, G. Marson (G.M. 2012-10-18.1 ø, sq.: KT380082). — **FRANCE**: **Bretagne**, **Morbihan**, 24.5 km SE of Quiberon, Île de Hoedic, E of Hoedic, 9 m, branches of *Salix*, on bark, 28.IX.2013, J.P. Priou (J.P.P. 13188, 13189, doc. vid.). – **Nord-Pas-de-Calais**, **Nord**, 8 km WSW of Dunkerque, 2.5 km SW of Grande-Synthe, Puythouk, 4 m, 24.X.2016, branch of *Salix*, on bark, J.P. Priou (J.P.P. 16257, doc. vid.). – 8.5 km NNW of St.-Omer, 1.2 km SSE of Watten, NW of Bois du Ham, 10 m, branch of *Salix*, on bark & wood, 4.VI.2002, R. Courtecuisse (H.B. 7147b). – **Pays-de-la-Loire**, **Loire-Atlantique**, 5.3 km SSE of Herbignac, 1.5 km NE of St.-Lyphard, SE of Marlais, Belle Fontaine, 2 m, branch of *Cupressus*, on bark, 11.XI.2004, J.P. Priou (J.P.P. 24223, H.B. 7619 ø). – **Vendée**, Poitou, 33 km NW of La Rochelle, 1.5 km NW of La Tranche sur Mer, NE of La Savinière, 4 m, branches of *Salix* (?)*atrocinerea*, on bark & wood, 2.VI.2003, J. Fournier & G. Ouvrard (ø). – **Sarthe**, 10 km SW of Le Mans, Étival-lès-le-Mans, rue des Chardonnerets, 52 m, branch of *Ribes rubrum*, on ?wood, 10.IV.2008, A. Février (ø). – **Île-de-France**, **Essonne**, 35 km S of Paris, 1.3 km ESE of St.-Vrain, 52 m, on angiosperm wood, 4.VI.2015, R. Chalange, vid. F. Valade (ø, doc. vid.). – **Centre**, **Loiret**, 6.5 km NNE of Montargis, ~1.5 km NE of Cepoy, Puy la Laude, Loing river, 75 m, branch of *Populus*, on wood and old ?*Peniophora*, 27.VII.1985, A. Reynaud (ø). – **Picardie**, **Oise**, 46 km NNE of Paris, 4 km N of Senlis, Forêt d'Halatte, Fontaine de la Belle-Croix, 120 m, log of (?)*Fraxinus excelsior*, on wood, 21.VII.1885, F. Sarrazin (PC, herb. Sarrazin, **holotype** of *O. sarraziniana*, H.B. 6890 ø). – **Seine-et-Marne**, Fontainebleau, on rotten wood, undated, J. Therry (6025, Fungi Gall. no. 1897, **holotype** of *O. luteorubella* f. *microspora*). – **Limousin**, **Corrèze**, 7.5 km NNW of Bort-les-Orgues, W of Ciaux, 635 m, indet. wood, 20.VII.2015, J.P. Priou (J.P.P. 15158, d.v). – **Midi-Pyrénées**, **Hautes-Pyrénées**, 16 km NW of Tarbes, 2.5 km E of Séron, S of Lac du Louet, 340 m, twig of *Sambucus nigra*, on bark, 12.VII.2011, R. Tena (ø). – 9.3 km ESE of Bagnères-de-Bigorre, 1.7 km S of Asque, Petite Amazonie, 585 m, on wood of *Alnus*, 13.VII.2007, M. Hairaud (M.H. 130707, doc. vid.). – **Aquitaine**, **Pyrénées-Atlantique**, 8.5 km S of Urdos, 2.5 km WNW of Candanchú, Sansanet, 1330 m, branch of *Fagus sylvatica*, on wood, J. Bometón (J.B. 650/16, doc. vid.). — **GERMANY**: **Niedersachsen**, 11 km NNE of Cloppenburg, ~6.5 km NW of Ahlhorn, Ahlhorner Fischteiche, 32 m, branch of *Salix*, on bark, 6.VIII.1992, B. Grauwinkel (B.G.). – **Nordrhein-Westfalen**, 10 km W of Münster, 5 km ESE of Havixbeck, Ameshorst, 72 m, branch of *Carpinus betulus*, on wood, 8.VII.2017, R. Keuker & H. Terlutter (H.B. 10113 ø). – 25 km ESE of Bielefeld, 1.5 km S of Detmold, Schanze, 160 m, branch of indet. angiosperm, on bark, 14.XI.1967, H. Jahn (T.R.L.). – 6.8 km NW of Waldbröl, 1.6 km NNE of Nümbrecht, 232 m, cone of *Picea abies*, 17.VII.2017, H. Homa (doc. vid.). – **Mecklenburg-Vorpommern**, 7 km NW of Rehna, Roduchelstorf, 33 m, branch of *Salix*, on bark, 2.XI.2008, T. Richter (H.B. 8948 ø). – ibid., stems of *Epilobium hirsutum*, 9.VI.2018, T. Richter (H.B. 10166 ø). – 8 km SW of Rehna, 2.7 km NE of Dechow, Staatsforst Rehna, 60 m, branch of *Fraxinus excelsior*, on wood, 1.IX.2007, T. Richter (H.B. 8615b). – 42 km SE of Güstrow, 2.5 km NE of Göhren-Lebbin, Blüchersches Bruch, 65 m, branch of *F. excelsior*, old ?pyrenomycete, 23.VIII.1997, V. Kummer (V.K.). – **Brandenburg**, 13 km SSE of Templin, Groß Väter See, 60 m, branch of ?*Alnus glutinosa*, on wood, 13.IX.2018, M. Schmidt (ø). – 18.5 km NNE of Neuruppin, 2 km S of Rheinsberg, Hellseewiesen, 57 m, branch of *Fagus sylvatica*, on wood, 23.IX.2006, T. Richter (H.B. 8483c). – 36 km SW of Berlin, 14 km S of Potsdam, Fresdorfer Moor, 40 m, branch of *Pinus*, on bark, 29.X.1973, D. Benkert (BHU). – ibid., log of *Salix*, on wood, 28.V.1969, D. Benkert (BHU). – **Sachsen-Anhalt**, 15 km NNE of Magdeburg, 2 km NE of

Hohenwarthe, Taufwiesenberge, 43 m, branch of *Salix*, on wood, 31.X.2018, T. Richter (doc. vid.). – 10 km SE of Wernigerode, 2.7 km WSW of Hüttenrode, Blauer See, 428 m, on sandy soil with *Funaria* and *Bryum*, 1.IX.2012, H. Schubert (H.B. 9728 ø). – 14.5 km SE of Naumburg, 2 km E of Waldau, 270 m, bone of *Sus scrofa*, 24.X.2017, W. Huth (W.H., doc. vid.). – **Sachsen**, 24 km NNE of Chemnitz, 1.2 km ENE of Beerwalde, 260 m, branch of *Alnus*, on wood, 17.VI.2012, B. Mühler (H.B. 9691a; sq.: KT222355, anam. from substrate in water). – 1.6 km ENE of Chemnitz, Sonnenberg, Hammerstraße, 313 m, board of indet. gymnosperm, on wood, 5.VII.2008, P. Welt (H.B. 8886). – 14.5 km NE of Bautzen, 0.6 km SW of Wartha, Guttauer Teiche, 162 m, log of *Carpinus betulus*, on wood, 20.IX.2018, S. Pohlers (H.B. 10175 ø). – ibid., 0.9 km SW of Wartha, 145 m, branch of *Alnus glutinosa*, on wood, 20.IX.2018, I. Wagner (ø, doc. vid.). – 12.5 km NE of Bautzen, S of Guttau, 160 m, log of ?*Carpinus betulus*, on wood, 20.IX.2018, M. Schmidt (ø). – **Baden-Württemberg**, 9.5 km SW of Calw, 2.8 km WSW of Neubulach, Täschacker, 600 m, corticated branch of angiosperm tree, on old *Neonectria* ?*coccinea*, ~1.IX.1993, A. Gminder (H.B. 4949a). – 5.7 km WNW of **Stuttgart**, E of Solitude, Pfaffenwald, ~430 m, branch of *A. glutinosa*, on wood, 9.VI.1975, H.O. Baral (H.B. 270 ø). – 1 km SSW of Bergheim, Rapbach, 380 m, branch of *F. sylvatica*, ~VII.1976, H.O. Baral (ø). – 6 km WSW of Stuttgart, 1.2 km NE of Büsnau, Schattenseen, 420 m, branch of *A. glutinosa*, on wood, 29.VI.1976, H.O. Baral (H.B. 724 ø). – 5.5 km NE of **Tübingen**, NE of Pfrondorf, Gähklinge, 410 m, branch of *Quercus*, on wood, 6.VI.1993, H.O. Baral (ø). – ibid., branch of *F. sylvatica*, on wood, 29.X.2002, E. Weber (ex H.B. 7235, M-0291764, **epitype**, CBS 116219, anam. cult.; sq.: KM199780). – ENE of Pfrondorf, Tiefenbach, 410 m, branch of *F. sylvatica*, on wood, 12.VIII.2000, H.O. Baral (ø). – ibid., branches of *F. sylvatica*, on wood, 26.VII.2001, H.O. Baral & P. Zinth (H.B. 7000). – ibid., branch of *F. sylvatica*, on wood, 25.VII.2012, H.O. Baral (H.B. 9707 ø). – E of Pfrondorf, Tiefenbach, 385 m, log of *F. sylvatica*, on wood, 24.IX.2018, H.O. Baral (ø). – 1 km ESE of Pfrondorf, Hinterpfand, 420 m, branch of *F. sylvatica*, on wood, 15.VII.2000, E. Weber & H.O. Baral (H.B. 6727a, CBS 116220; sq.: KT215260). – ibid., log of ?*F. sylvatica*, on wood, 28.IX.2003, E. Weber & H.O. Baral (ø). – ibid., branch of *F. sylvatica*, on wood, 5.XI.2005, E. Weber (ø). – ibid., 16.VII.2006, H.O. Baral (H.B. 8225 ø, anam. cult.). – 1.4 km SE of Pfrondorf, Poppelesloch, 335 m, branch of *F. sylvatica*, on wood, 28.X.2005, E. Weber & H.O. Baral (H.B. 7957a ø). – 3.5 km NE of Tübingen, 1.3 km SW of Pfrondorf, quarry near Bitzle, 420 m, branch of *Salix caprea*, on wood, 16.XI.2003, H.O. Baral (ø). – **Schwäbische Alb**, 9 km SE of Metzingen, 2 km SW of Urach, Brühlbach NE of waterfall, 520 m, branch of *Fraxinus excelsior*, on wood, 24.X.1999, R. Kirschner (H.B. 6520). – 3.5 km SE of Urach, 1 km WNW of Wittlingen, E of Hohenwittlingen, Wolfschlucht, 570 m, log of *Fagus sylvatica*, on wood, 27.VII.1986, H.O. Baral (ø). – 6.7 km WSW of Singen, 2 km WNW of Gottmadingen, Allmend, Hardtseen, 440 m, cones of *Pinus*, 18.VII.1989, P. Blank & H.O. Baral (ø). – ibid., branch of indet. angiosperm, on wood & bark, 18.VII.1989, H.O. Baral & P. Blank (ø). – **Bayern**, **Unterfranken**, 28 km NNW of Würzburg, 6.5 km NNE of Karlstadt, E of Gössenheim, Ölgrund, 190 m, branch of *Salix cinerea*, on wood, 24.VIII.1996, L.G. Krieglsteiner (L.K.). – 9.3 km SSE of Schweinfurt, 2.4 km SW of Grettstadt, Moor, 215 m, branch of *Alnus glutinosa*, on bark, 26.VIII.1996, L.G. Krieglsteiner (L.K.). – **Oberfranken**, 5 km ENE of Marktredwitz, E of Brand, Weidersberg, 525 m, branch of ?*Salix*, on wood, 10.XI.2018, M. Reul (doc. vid.). – **Oberpfalz**, 11.5 km NNE of Amberg, 1.3 km SW of Hirschau, Kreuzweiher, 420 m, branch of *Acer*, on wood, 3.VIII.2012, H.O. Baral (H.B. 9710 ø). – 0.7 km SW of Hirschau, Mühlweiher, 415 m, branch of *Betula*, on wood, 10.VIII.1992, H.O. Baral (ø). – ibid., branch of *Salix*, on wood, 10.VIII.1992, H.O. Baral (ø). – ibid., branch of *Alnus glutinosa*, on wood, 29.III.1993, H.O. Baral (ø). – **Oberbayern**, 21 km S of München, Eulenschwang, 685 m, on indet. wood, 22.VI.2015, B. Fellmann (ø, doc. vid.). – 7.3 km SE of Waging, 1.3 km S of Petting, Weidsee, 450 m, post of indet. angiosperm, on bark, 4.VII.1014, T.R. Lohmeyer (ø). – 19.5 km NW of Salzburg, 3 km WNW of Laufen, ~W of Straß, Schinderbachtal, 420 m, branch of ?*Alnus*, on bark, 4.X.1991, T.R. Lohmeyer (TL 91/66). – **Niederbayern**, S of Landshut, NE of Burg Trausnitz, Hofgarten, 430 m, on wood of *Fraxinus*, 14.VI.1992, G. Rambold (G.R. 5997, M-0229704, H.B. 4843). — **SWITZERLAND**: **Zug**, 8 km SE of Zug, 2.7 km SSW of Unterägeri, SW of Furen, 825 m, cones of *Picea abies*, 21.VI.2009, U. Graf (ø). – **Luzern**, 23 km N of Luzern, 2 km E of Aesch, Gitzitobel, 640 m, branch of *Fagus sylvatica*, on wood, 3.VIII.2013, U. Graf (ø). – **Fribourg**, 14 km ENE of Yverdon-les-Bains, 2.5 km NE of Cheyres, la Grance Cariçaie, 430 m, branch of ?*Salix*, 30.VII.2010, R. Dougoud (R.D. 29.13.163.10). – **Neuchâtel**, 15 km W of Neuenburg, Les Ponts de Martel, Marais Rouges, 1008 m, branch of *Salix*, on wood, 6.IX.2016, U. Graf (ø, doc. vid.). — **AUSTRIA**: **Niederösterreich (incl. Wien)**, 17.5 km NW of Wien, 0.5 km NW of Hainbuch, 335 m, stump of *Fagus sylvatica*, on wood, 21.X.1995, W. Jaklitsch (ø). – 11 km SW of Wien, 3 km NW of Liesing, Maurer Wald, 340 m, branch of *Carpinus betulus*, on wood, 10.VII.1993, W. Jaklitsch (WU 13303). – 6 km W of Wien, W of Ottakring, 'Kufner'scher Garten', ~280 m, on wood of *Quercus*, IV.1917, T. Kupka (herb. Kupka, M, as *O. luteorubella*). – 11 km SW of Wien, 3 km NW of Liesing W of Mauer, Maurer Wald, 338 m, branch of *Carpinus betulus*, on wood, 10.VII.1993, W. Jaklitsch (WU 13303). – **Oberösterreich**, 18 km SW of Steyr, ~5 km S of Steinbach, ?E of Dorngraben, 600 m, log of *F. sylvatica*, on wood, 17.VIII.1994, K. Helm (H.B. 5134a, b). – ibid., log of *Salix*, on wood, 29.VIII.1994, K. Helm (H.B. 5141). – ibid., log of *Fraxinus excelsior*, on wood, 29.VIII.1994, K. Helm (H.B. 5139a). – ibid., log of *Acer*, on wood, 29.VIII.1994, K. Helm (H.B. 5140a). – **Salzburg**, 7.5 km WSW of Salzburg, 1 km SW of Wals, Saalach-Altarm, 437 m, branch of *Salix*, on wood, 19.V.1991, W. Dämon (W.D. 34/91). – ibid., branches of *Salix*, on wood, 18.VIII.1993, W. Dämon (W.D.). – ibid., log of indet. angiosperm, on wood, 15.V.1993, W. Dämon (W.D. 15/93). – **Steiermark**, 25 km NW of Graz, 3.5 km SW of Rothleiten, E of Altenberg, Ratlosgraben, 620 m, branch of indet. tree, on wood, 8.VII.2010, G. Friebes (G.F. 20100149, doc. vid.). – 19 km NNW of Graz, 5 km SSE of Frohnleiten, SE of Badl, Badlgraben, 515 m, log of indet. angiosperm, on wood, 5.XII.2009, G. Friebes (G.F. 20090140, doc. vid.). – 38 km NNE of Leoben, 9.5 km NE of Hieflau, ENE of Krautgraben, 710 m, branch of *Fagus sylvatica*, on wood, 26.VIII.2003, C. Hahn (H.B. 7412). — **SPAIN**: **Asturias**, 17.5 km SSW of Cangas del Narcea, 1.1 km NE of Riomolín, branch of *Ulmus*, on wood, 27.VII.2013, J. Linde (E.R.D. 5925 p.p.). – 12 km W of Avilés, S of San Juan de la Arena, 25 m, branch of *Salix*, 18.VII.2013, E. Rubio (E.R.D. 5938, doc. vid.). – 4.7 km ENE of Villaviciosa, 1 km S of Espina, Sebrayo, 25 m, stem of ?*Phyllostachys*, 5.X.2018, E. Rubio (E.R.D. 7688, doc. vid.). – 4.5 km N of Somiedo, N of Castro, La Malva, 580 m, log of *Fraxinus excelsior*, on wood, 3.VI.2013, I.I. Yatsiuk (Morozova) (I.M., H.B. 9791). – ?8.5 km ESE of Pola de Somiedo, ?3.5 km ESE of Valle de Lago, ?1330 m, branch of indet. angiosperm, on wood, 4.VI.2013, M. Basley (H.B. 9795 ø). – **País Vasco**, **Gipuzkoa**, 10.5 km SSE of Zarautz, 1.2 km NW of Asteasu, 272 m, branch of indet. angiosperm, on wood, 1.VII.2015, J. Martin (ARAN-F 01455, doc. vid.). – **La Rioja**, 7.5 km E of Logroño, 1.3 km NW of Recajo, Soto de los Americanos, 353 m, branch of *Fraxinus angustifolia*, on wood, 11.VI.2016, R. Martínez Gil (doc. vid.). – **Navarra**, 31 km N of Pamplona, 1 km E of Almándoz, 350 m, branch of *Fagus sylvatica*, on wood, 15.IX.2014, F.J. Balda (J.B.J. 150914, doc. vid.). – **Aragón**, **Huesca**, 10 km E of Sabiñánigo, 4.2 km NE of Yebra de Basa, ESE of Collado de las Tres Cruces, 1445 m, branch of *F. sylvatica*, on wood, 11.X.2009, M.A. Ribes, F. Pancorbo, F. Mateo et al. (M.A.R. 111009 107, doc. vid.). – 8.5 km E of Benasque, Vallibierna, branch of *Pinus uncinata*, on wood, 29.VIII.2016, R. Blasco (R.B. 29-8-16-945, doc. vid.). – 2.3 km SW of Benasque, 200 m SE of Linsoles, 1120 m, branch of ?*Corylus*, on wood, 5.IX.2013, R. Blasco (ø, doc. vid.). – 2.8 km SW of Benasque, 0.8 km SSE of Linsoles, 1220 m, branch of *Betula*, on bark, 2.VIII.2013, R. Blasco (ø, doc. vid.). – **Cataluña**, **Barcelona**, 4 km NNW of Bagà, 1075 m, log of *Salix*, on bark, 20.VI.2015, J. Bometón (J.B. 606/15, doc. vid.). – **Girona**, 11.5 km S of Olot, 2.5 km W of Sant Feliu de Pallerols, Coll d'Uria, 707 m, branch of ?*Fagus sylvatica*, on wood, 26.IX.2015, J. Bometón (J.B. 616/15, doc. vid.). – 8 km WSW of Sant Hilari Sacalm, 1.2 km SSE of Espinelves, 750 m, branch of *F. sylvatica*, on wood, 2.X.2015, J. Bometón (J.B. 620/15, doc. vid.). — **ITALY**: **Emilia-Romagna**, **Reggio Emilia**, 50 km NE of La Spezia, 3.8 km WNW of Busana, Lago di Calamone, 1398 m, on wood of indet. angiosperm, 13.VI.1993, G. Cacialli (F. Doveri 3793). — **POLAND**: unlocalized, branch of indet. angiosperm, 2.VIII.2006, P. Perz (P.P. 20060802-1, doc. vid.). – **Lublin**, 23 km ENE of Lublin, N of Łęczna, Wieprz river, 165 m, branch of *Populus*, on wood, 4.VI.2011, J. Węcławski (ø, doc. vid.). — **SERBIA**: **Vojvodina**, 5 km S of Novi Sad, 2 km W of Sremska Kamenica, Danube river, 72 m, branches of *Salix alba*, on wood & bark, 5.IX.2019, D. Savić (doc. vid.). – 17 km SW of Novi Sad, 6 km WSW of Beočin, Testera, 160 m, branch of *Alnus glutinosa*, on bark, 2.X.2019, D. Savić (doc. vid.). — **UKRAINE**: **Zakarpattia**, Carpathian Mts., Swydiwec (Svitovec) mountain range, unlocalized, ~600–1300 m, log of *Quercus*, on wood, VIII.1930, A. Pilát (PRM 151703, as *Fagus*, in holotype of *O. carpathica*, H.B. 6054 ø). — **AZERBAIJAN**: **Shaki-Zaqatala**, Caucasus Mts., ?N of Zaqatala, 'Kordon', 800 m, log of *Ulmus*, on wood, 9.VIII.1974, B. Kullman (TAAM 68134). — **RUSSIA (West)**: **Adygea**, Caucasus Mts., 55 km NE of Sochi, 3 km SSE of Guzeripl, Filimonovka river, 800 m, log of *Ulmus*, on wood, 2.IX.1975, A.L. Sõmermaa (TAAM 49849a, as *Fagus orientalis*, H.B. 8719 ø). – **Bashkiria**, **Meleuz**, SW-end of Ural Mts., 75 km SSE of Sterlitamak, 35 km ENE of Meleuz, Nugush, ~250 m, branch of indet. angiosperm, on bark, 13.VIII.1974, A. Raitviir (TAAM 63156, as *Tilia* ø). – ibid., branch of *Tilia*, on bark, 14.VIII.1974, A. Raitviir (TAAM 63200, H.B. 8713 ø). – ibid., branch of *Tilia*, on wood, 14.VIII.1974, A. Raitviir (TAAM 63199). — **RUSSIA (East)**: **Tyumen**, **Yamalo-Nenets**, 63 km SSW of Shuryshkary, Muzhi, Ob river, 10 m, branch of *Salix*, on bark, 12.VII.1977, M. Saar (TAAM 111632). – 95 km S of Shuryshkary, between Kushevat and Gorki, Ob river, 15–45 m, branch of *Salix*, on wood, 3.VII.1977, M. Saar (TAAM 111544). – 135 km SSW of Shuryshkary, Ovgort, Synya river, 30 m, branch of *Salix*, on wood, 2.VIII.1976, M. Murdvee (TAAM 110147, 110145, H.B. 8721a ø). – **Tuva**, **Todzha**, Sayan Mts., 160 km ENE of Kyzyl, ~30 km ESE of Toora Khem, Azas lake (Ozero Todzha), ~970 m, branch of *Betula*, on wood, 29.VII.1972, A. Raitviir & B. Kullman (TAAM 62423, 62424). – 140 km NE of

Kyzyl, ~1 km S/W of Toora-Khem, Toora-Khem river flowing in Bolshoy Yenisey, 900 m, branch of *Salix*, on wood & bark, 28.VII.1972, A. Raitviir & B. Kullman (TAAM 62408, 62409, as *Orbilia* sp. and *O. luteorubella*). — **JAPAN**: **Honshu**, **Nagano**, Chiisagata-gun, 11.5 km NE of Ueda, 9 km SSE of Sugadaira, Kakuma Valley, 1245 m, branch of *Fagus ?crenata*, on wood, 21.VII.1990, T. Hosoya (TRL 106, TNS-F-55812, H.B. 9983 ø). — **CHINA**: **Beijing**, **Yanqing**, 83 km NW of Beijing, 14 km WNW of Yanqing, Songshan, Matsuyama forest, 750 m, branch of indet trees (B.L. 6572: *Salix*), on wood, 31.VIII.2003, B. Liu (HMAS 139680–139685: B.L. 6572, HMAS 139682, anam. cult., H.B. 7806; sq.: DQ656637; B.L. 6574, HMAS 139684, non vid.; sq.: SSU ined., DQ656638, DQ656674). – **Jilin**, Changbaishan, 1500 m, on indet. wood, 18. IX.2004, B. Liu (B.L. 444, HMAS 96817, non vid.; sq.: DQ656639, DQ656675). – For further 5 samples (including Hunan and Tibet) see Liu (2006). — **USA**: **Florida**, Alachua, 1.6 km E of Gainesville, Mick Pond, 45 m, on indet. wood, summer 1974, G.L. Benny & J.W. Kimbrough (Benny et al. 1978, as *O. luteorubella*).

Not included. **FRANCE**: **Basse-Normandie**, **Calvados**, Caen, unlocalized, ~20 m, branch of *?Pinus*, on wood, undated, M.R. Roberge (herb. Niessl, M, as *Peziza vinosa*, on bark). — **LUXEMBOURG**: **Gutland**, **Diekirch**, Ettelbruck, Alzette river bank, ~200 m, on wood of *Quercus* (fascine), IX.1898, J. Feltgen (LUX 42523, as *O. rubella*, *Acer campestre*, 'corticated'). – **Capellen**, 6.5 km ESE of Arlon, 1.5 km NW of Steinfort, Barrage de Steinfort, 305 m, branch of *Salix*, on wood, 13.II.1989, G. Marson (G.M. 3857 ø). – **Luxembourg**, 10 km ESE of Luxembourg, NE of Moutfort, Rodenbusch, 270 m, of *Cornus sanguinea*, on ?wood, 16.VII.1898, J. Feltgen (LUX 42524, as *O. rubella*). – ~6 km E of Luxembourg, Sandweiler, 350 m, on wood of *Salix*, 19.VII.1900, J. Feltgen (LUX 42445, as *O. luteorubella*). — **GERMANY**: **Berlin**, ~14 km SW of Berlin, ~NW of Zehlendorf, 40 m, branch of *Alnus glutinosa*, on bark, X.1884, H. Sydow (M, as *Calloria luteorubella*). – **Brandenburg**, 32 km NW of Berlin, ~10 km W of Oranienburg, Schwante, twig & branch of *Ulmus*, on bark & wood, 16.IX.1941, H. Sydow (M, as *O. luteorubella*, *Alnus glutinosa*). – **Nordrhein-Westfalen**, 8 km NNE of Gelsenkirchen, 2 km SSW of Herten, Im Schloßpark, 52 m, branch of indet. angiosperm, on wood, 18.VII.1989, K. Siepe (ø). – **Hessen**, 11 km WNW of Mainz, E of Hattenheim, Grünau, 80 m, branch of *Ulmus minor*, on bark, undated, collector unknown (herb. Fuckel 2569, M, as *Calloria vinosa*/*O. luteorubella*). – 6 km ESE of Gießen, 2 km S of Annerod, Klingelbach, 256 m, branch of *Alnus*, on wood, 7.X.2018, R. Freitag, vid. I. Wagner (doc. vid.). – **Baden-Württemberg**, 5 km NW of Stuttgart, 1.2 km NE of Solitude, Daimlerplatz, 426 m, branch of *Salix*, on wood, 18.VII.1988, H.O. Baral (ø). – 4.7 km NNW of Tübingen, 1.6 km WNW of Bebenhausen, Goldersbach, 380 m, branch of *?Alnus glutinosa*, on wood, 26.X.1976, H.O. Baral (ø). – 7 km N of Reutlingen, 1 km SE of Pliezhausen, Brühl, 300 m, branch of *Salix*, on wood, 4.VI.1989, G. Marson & H.O. Baral (ø). – 6 km WSW of Reutlingen, 1 km S of Ohmenhausen, Kreuzwald, 450 m, branch of *Fagus sylvatica*, on wood, 16.IX.1989 E. Weber & H.O. Baral (REG). – 2 km SW of Schwenningen, ENE of Zollhaus, Kugelmoos, 713 m, branch of *Salix*, on wood, 26.VII.1988, H.O. Baral & G. Marson (ø). – ibid., branch of *?Salix*, on wood (ø). – **Bayern**, **Oberbayern**, 19.5 km NW of Salzburg, 3 km WNW of Laufen, ~W of Straß, Schinderbachtal, 420 m, branch of *?Alnus*, on bark, 4.X.1991, T.R. Lohmeyer (TL 91/66). — **CZECHIA**, **Central Bohemia**, ~8 km ESE of Beroun, Karlštejn, ~300 m, branch of *?Salix*, on wood, X.1926, J. Velenovský (PRM 151742, mixture in lectotype of *O. roseohyalina*, H.B. 6265b ø). — **SPAIN**: **País Vasco**, **Gipuzkoa**, 6 km SSW of Zarautz, 4.5 km ESE of Zestoa, NW of Altzola, 144 m, on branch of *Fagus sylvatica*, on wood, 26.VI.2012, I. Olariaga & J. Terés (ARAN-F A3033952, doc. vid.). – **Andalucía**, **Cádiz**, Sistema Penibético, 12 km W of Algeciras, 9.3 km SW of Los Barrios, 200 m, branch of *?Salix*, on wood, 12.XI.1989, R. Galán, A. Ortega & M. Zea (AH 6794, as '*?Alnus glutinosa*'). — **CHINA**: **Hunan**, **Zhangjiajie**, ~27 km N of Zhangjiajie, Suoxiyu river, 600 m, 14.IX.2005, B. Liu & X.Z. Liu (B.L. 730, HMAS 139686, as *O. sarraziniana*; sq.: DQ656703). — **NEW ZEALAND**: **South Island**, Canterbury, 8 km N of Christchurch, 4 km WNW of Kaiapoi, Ohoka, 9 m, branch of *Salix fragilis*, 4.I.2010, J.A. Cooper (PDD 95637, J.A.C. 11178, doc. vid.).

Species with a (sub)tropical distribution

Orbilia tianmushanensis Baral, Y. Zhang & Z.F. Yu, in Zhang et al., J. Microbiol. 54: 10 (2016) — Pl. 540

Etymology: named after the type locality, Tianmushan in Zhejiang province of China.

Typification: China, Zhejiang, Lin'an, Tianmushan, branch of *Quercus*, 6.IX.2009, J.W. Guo (YMFT 1.03563, holotype; sq.: KT192704, KT236097).

Description: — **TELEOMORPH**: **Apothecia** fresh 0.5–0.9 mm diam., pale yellowish-red, translucent, round or undulating, gregarious; disc flat, margin smooth; sessile, superficial; dry yellow. **Asci** †(28.3–)37–59 × (3.4–)4–4.7 µm, 8-spored, no data about spore arrangement and orientation available; **apex** (†) truncate (not indented, laterally not inflated); **base** with short to long, thin, flexuous stalk, L- to Y-shaped. **Ascospores** †7.2–8(–9.5) × 1.3–1.8 µm, fusoid, apex subacute, base ± attenuated, straight to slightly curved; **SBs** *3–4.5 × 0.5–1 µm, vermiform, straight or slightly curved. **Paraphyses** apically slightly to medium capitate, terminal cells †18.5–21 × (1.8–)2.5–3.8 µm, lower cells †4.5–8 × 1.5–2.3 µm; unbranched at upper septum. **Medullary excipulum** not examined. **Ectal excipulum** examined only near margin: marginal cortical cells †7–12 × 2.5–5.5 µm, thin-walled; without **glassy processes**. **Anchoring hyphae** not examined. **SCBs** and **VBs** not examined. **Exudate** over paraphyses absent or very thin. — **ANAMORPH**: dactylella-like (from ascospore isolate {1}). **Conidiophores** erect, occasionally branched, 114–122 um long. **Conidia** *42–74 × 7.7–10.2 µm, straight, fusiform, two central cells distinctly inflated, tapered towards obtuse apex, below ± abruptly narrowed to a tail-like base, (1–)3-septate, containing a few minute LBs. **Chlamydospores** frequently formed in older cultures, ellipsoidal to subglobose, 6–13 µm in diam., forming chains.

Habitat: branch of *Quercus* lying on moist ground away from water bodies, on rotten wood and bark. **Associated**: none noted. **Desiccation tolerance**: unknown, probably drought-intolerant. **Altitude**: 825 m a.s.l. **Geology**: felsic volcanic rock. **Phenology**: IX.

Taxonomic remarks. *Orbilia tianmushanensis* is mainly characterized by its peculiar anamorph (Zhang et al. 2016). The above description is based on the morphological study by Ying Zhang. Apart from notes on apothecial colour and size and shape of spore bodies, no detailed documentation of the living teleomorph was done, therefore, the spore orientation in the asci is unknown, because this is very difficult to assess in dead material. Also spore size and shape could only tentatively be documented by the authors from the dried specimen. Based on the available data, the teleomorph does not markedly differ from *O. luteorubella* or *O. rosea*.

Anamorph. *Orbilia tianmushanensis* forms characteristic conidia with a swollen central part and a strongly narrowed tail-like base which is rather unique within the *Orbiliomycetes* (Pl. 540: 1d–e). The conidia are reminiscent of members of series *Neodactylella* or *Dactylellina* of section *Arthrobotrys*. No trapping organs were formed when nematodes were added to the culture, and molecular data clearly refer the species to section *Helicoon*.

Phylogeny. A sequence was gained from pure culture, comprising S1506 intron, ITS, and LSU (Zhang et al. 2016). Also SSU, *TUBB*, *RPB2*, and *TEF1* were obtained (Y. Zhang pers. comm.) but so far not uploaded. When observing the alignment of the ITS region at those positions where series *Helicoon* differs from series *Pseudotripoconidium*, the somewhat intermediate *O. yuanensis* and *O. tianmushanensis* concur partially with one series and partially with the other: *O. tianmushanensis* agrees with series *Helicoon* at pos. 150, 300, and 322, and with series *Pseudotripoconidium* at pos. 162, 163, 443, and 449 (Tab. 70, see also Zhang et al. 2016, tab. 1, where, due to a deviating alignment, the position numbers slightly deviate and a match with series *Pseudotripoconidium* at pos. 23–24 was asserted).

In ML analyses of ITS or ITS+LSU, *O. tianmushanensis* nested intermediate between the two series by forming a medium supported clade with series *Pseudotripoconidium* (Phyls 17, S19), but when analysing LSU it clustered in series

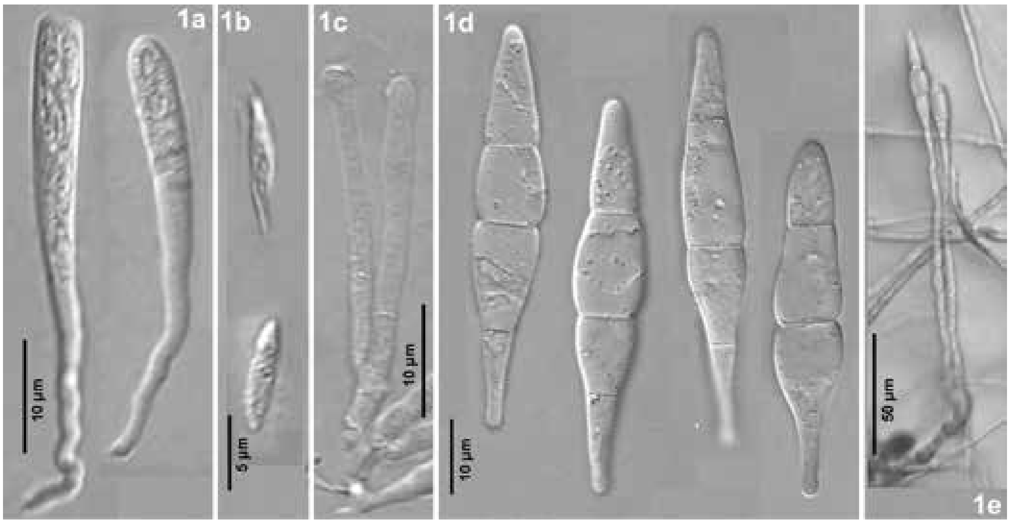


Plate 540. **1**: *Orbilia tianmushanensis*. – **1a**. asci; **1b**. ascospores; **1c**. paraphyses; **1d**. conidia (from culture): **1e**. conidiophores with conidia. – Living state (**1d–e**), dead state (**1a–c**); from Zhang et al. 2016 (DIC). — **1a–e**. YMFT 1.03563: China, Zhejiang, on *Quercus* (holotype).

Pseudotripoconidium, though with a long branch (Phyl. 18). The same result was obtained by Zhang et al. (2016) in their separate ITS and LSU analyses, though without support in the ITS tree. The molecular distance to members of series *Pseudotripoconidium* ranges in the ITS region at 12–15 % (4–7 % in LSU), and to members of series *Helicoon* at 15–18 % (6.5–9 % in LSU). Also in the intron the species shows a rather high distance to other taxa of section *Helicoon*. All these distances are lower compared to those observed between *O. tianmushanensis* and members of section *Arthrobotrys*.

Ecology. *O. tianmushanensis* is only known from the type collection, growing on wood and bark of a hygric branch of *Quercus* in a subtropical humid (winter-dry) oceanic broad-leaved mountain forest in eastern China.

Specimens included. **CHINA**: **Zhejiang**, **Hangzhou**, 30 km WNW of Lin'an, Tianmushan, 825 m, branch of *Quercus*, on bark & wood, 6.IX.2009, J.W. Guo (J.W.G. tms-18, YMFT 1.03563, **holotype**; YMF 1.03563 ex-type culture, anam. cult., doc. vid.; sq.: KT192704, KT236097, as *O.* [aff.] *luteorubella*).

Orbilia hoana Baral, Hong Y. Su & Y.C. Su, **sp. nov.**, MB 813628 — Pls 541–542

Etymology: named after the collector, WaiHong Ho.

Typification: China, Hong Kong, Lai Chi Hang, branch of indet. angiosperm, 28.IX.1997, W.H. Ho (ex H.B. 6012, M-0276493, holotype).

Latin diagnosis: *Apothecia hydratata 0.2–1.5 mm diam.*, *alba vel dilute ochraceo-lutea*, *sessilia vel substipitata*, *margine laevi. Ascosporae *4.5–9.3 × 1.3–1.8 µm*, *fusiformes*, *apice acutae*, *ad basim leniter vel valde attenuatae*, *plus minusve rectae*, *prope apicem in statu vivo corpusculum refringens elongatum lacrimiformem continentes. Paraphyses ad apicem leniter ad valde inflatae. Excipulum marginale exsudato valido pallide luteo tectum. Status anamorphicus: Generi* Anguillosporae *similis. Habitat ad lignum et corticem putridum ramorum uvidorum vel madidorum arborum angiospermarum in zona subtropica humida Asiae meridio-orientalis.*

Description: — **TELEOMORPH**: **Apothecia** fresh (0.2–)0.3–0.8(–1.5) mm diam., (0.11–)0.16–0.23 mm high (receptacle 0.09–0.1 mm), watery white to light dull yellowish-ochraceous, ± translucent, round to slightly irregular, medium scattered to ± gregarious; disc flat (to slightly convex), margin indistinct to distinct, thin, 0–5 µm protruding, ± smooth; sessile or with a ± distinct stipe 0.05–0.1 × 0.13–0.35 mm, superficial; dry pale yellowish-cream to orange. **Asci** *40–47 × 4–4.2(–4.8) µm {1}, †(28–)32–45(–50) × (3.3–)3.5–4(–4.2) µm {4}, 8-spored, spores *3–4-seriate, 4–5(–6) lower spores inverted {13} (rarely to often mixed), pars sporifera *18–19 → 11–15 µm long; **apex** (†) strongly truncate (not or sometimes deeply indented, laterally not inflated); **base** with medium to long, thin, scarcely flexuous stalk, L-, T-, Y- or sometimes H-shaped. **Ascospores** *(4.5–)5–8(–9.3) {13} × 1.3–1.4 {2} or (1.4–)1.5–1.7(–1.8) {10} µm, †5–8 × 1.5–1.7 µm {1}, fusoid or mostly fusiform, sometimes fusiform-clavate or -obclavate, apex acute, rarely acuminate or subacute, base slightly to often strongly attenuated, straight, sometimes slightly curved, especially in lower half; **SBs** *(1.8–)2.3–3(–4) × 0.5–0.9 µm {4}, (narrowly) tear-shaped

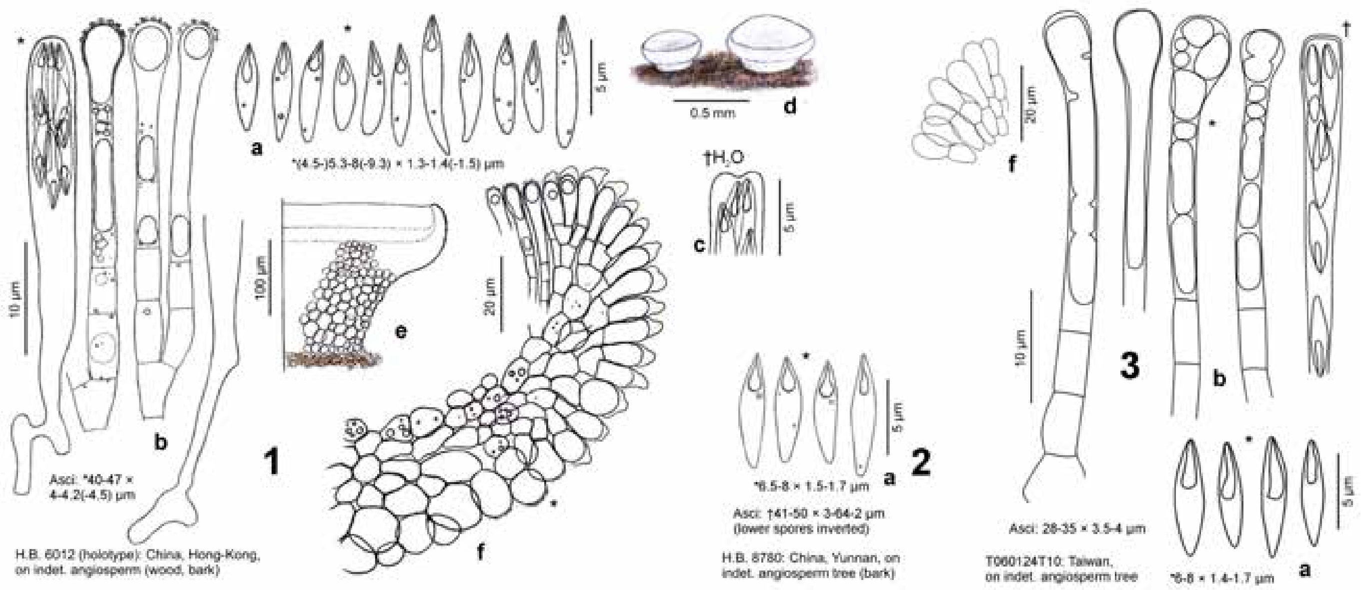


Plate 541. **1–3**: *Orbilia hoana*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apex; **d**. apothecia (fresh); **e**. apothecium in median section; **f**. id., ectal excipulum at margin and mid flanks. – **3**: del. Y.C. Su.

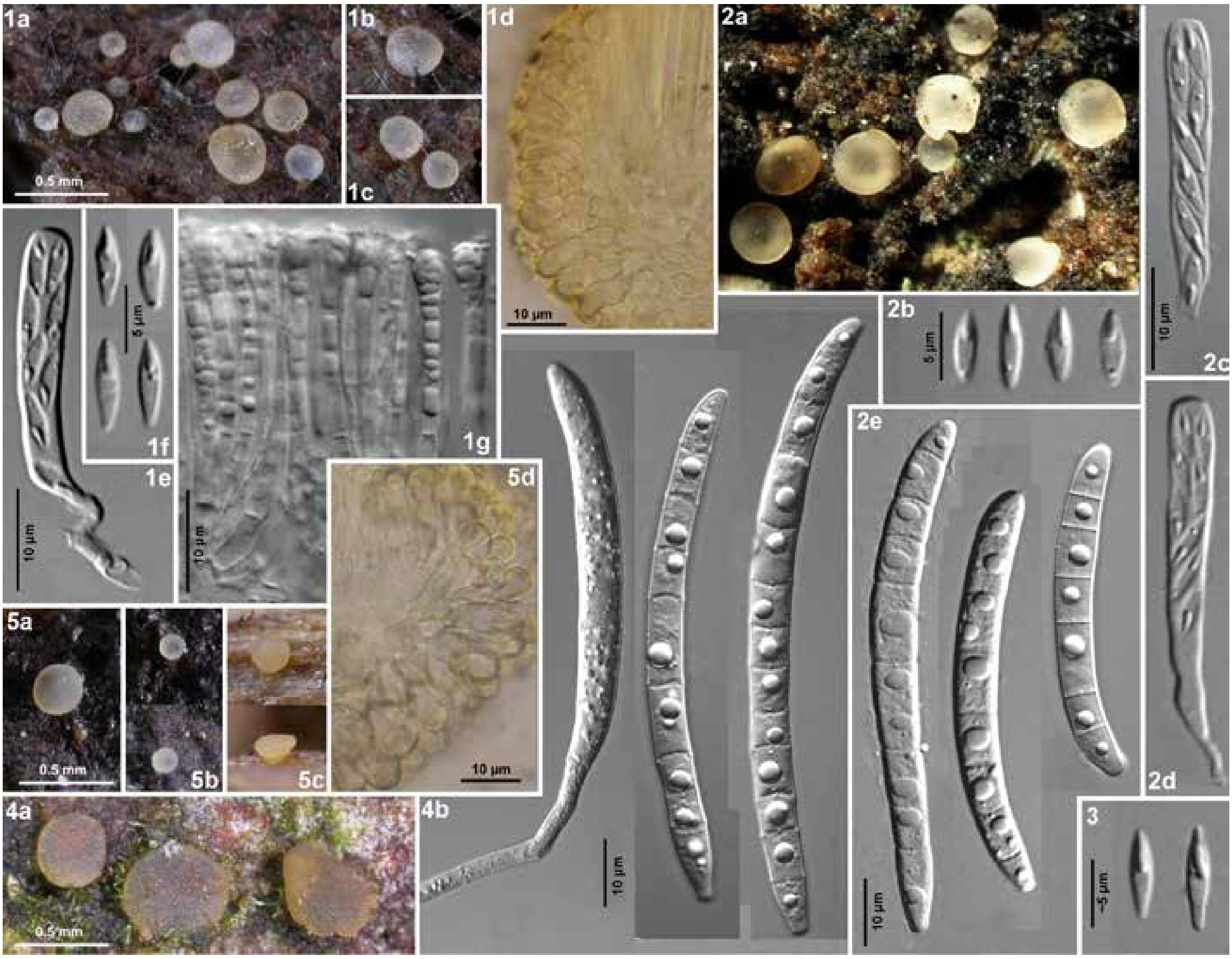


Plate 542. **1–5**: *Orbilia hoana*. – **2a**. fresh apothecia; **1a–c**, **4a**, **5a–c**. rehydrated apothecia; **1d**, **5d**. marginal ectal excipulum in median section; **1e**, **2c–d**. asci; **1g**. paraphyses; **1f**, **2b**, **3**. ascospores; **2e**, **4b**. conidia (from culture). – Living state, except for conidia in **2e** [2 on the left], **4b** (in H_2O); **5d** (in KOH); asci in **1e**, **2c–d**. – **1e–g**, **2a–e**, **3**, **4b**: phot. H.Y. Su (DIC). — **1a–g**. H.B. 8762 (H.Y.S. jgs-10): China, Yunnan, Dali, Jinguangsi, on indet. angiosperm; **2a–d**. H.Y.S. jgs-15: ibid., on indet. ?angiosperm; **3**. H.Y.S. jgs-6: ibid., on indet. angiosperm; **4a–b**. H.B. 8780 (jgs-17): ibid., on indet. angiosperm; **5a–d**. H.B. 6012 (holotype): China, Hong Kong, on indet. angiosperm.

(to ampulliform), sometimes subulate, straight or sometimes slightly flexuous. **Paraphyses** apically slightly to strongly capitate(-clavate), terminal cells *18–22 {1} or 24–28 {1} × 3–4.5(–5.5) µm {2}, lower cells *4–6 × 2–3 µm {2}; unbranched at upper septum. **Medullary excipulum** 20–40 µm thick, of ± dense, not or slightly gelatinized textura intricata, with many inflated cells with some LBs 1–2 µm diam., medium sharply delimited. **Ectal excipulum** of thin-walled († slightly gelatinized), indistinctly oriented t. globulosa-angularis from base to mid flanks or margin, 50–150 µm thick near base, cells in stipe *15–30 × 12–23 µm {T}, †(7–)12–20(–27) × (6–)8–15(–18) µm {3}, common walls †0.3–1 µm thick, hyaline, inner region sometimes of (†) strongly gelatinized t. globulosa, common walls 1–3 µm {T}, intercellular gel light amber-yellow; 20–25 µm thick at lower flanks, cells †10–13 × 6–9 µm, 10–25 µm thick near margin, of t. prismatica(-globulosa) oriented at a 50–90° angle to the surface, marginal cortical cells */†(6–)8–12(–15) × (3–)4–6.5(–8) µm {4}, ± thin-walled; **glassy processes** absent (but sometimes with conical exudate caps). **Anchoring hyphae** very sparse, *2.8–4 µm wide, walls 0.2–0.3 µm thick {1}. **SCBs** in paraphyses and ectal excipulum not observed. **VBs** in paraphyses strongly refractive, hyaline, globose to very elongate, in excipulum absent. **Exudate** over paraphyses 0.2–0.5(–1.5) µm thick, granular(-cloddy) to continuous, ± loosely attached, over margin and mid flanks 0.3–2 or rarely 1–5 µm thick, then forming individual, conical or hemispherical-truncate caps, high-refractive, pale to light golden yellowish-amber. **— ANAMORPH** (fide H.Y. Su): anguillospora-/vermispora-like (from ascospore isolate {3}). **Conidiophores** branched or not, mostly 35–68 um long, 1.5–2.7 µm wide at the base, terminally forming 1 or 2 conidia. **Conidia** (*)/†(29.5–)39–80(–111) × (4–)4.5–7.5(–9) µm, vermiform, slightly curved under a wide arch, both ends usually somewhat tapered, basal end truncate, (3–)5–10(–12)-septate {3}, with a single, 2–4 µm large LB in each cell (living state). **Chlamydospores** present (jgs-14, jgs-17), globose to ellipsoidal, or not observed (jgs-15).

Habitat: on moist or wet (submerged) ground, partially decorticated, min. 18 mm thick branches and ?logs of *Castanopsis orthacantha* {1}, indet. angiosperms {8/}, indet. ?gymnosperm {1}, on wood {3} and bark {7} (periderm), up to 1–2 mm deep medium to strongly decayed, slightly greyed, with or without green algae. **Associated**: *Orbilia juruensis* {1}, *O. latispora* {1}, *O. yuanensis* {2}. **Desiccation tolerance**: probably drought-intolerant, spores still viable after 2 months. **Altitude**: 120–2730 m a.s.l. **Geology**: Proterozoic, Jurassic & Tertiary sedimentary rock; felsic plutonic rock. **Phenology**: I–II, ?VI, VIII–IX, XI (apparently throughout the year).

Taxonomic remarks. *Orbilia hoana* is characterized by fusiform ascospores with rather broad, consistently tear-shaped SBs, also by vermispora-like conidia with a high lipid content. The presence of yellow exudate varies among the populations and possibly depends on their age. The more temperate to subalpine-boreal *O. luteorubella*, *O. rosea* and *O. sarraziniana* differ in narrower, more filiform to subulate SBs when comparing spores inside mature living asci, and in conidia with a different size and without a large central lipid body.

O. yuanensis differs from *O. hoana* in narrower, cylindric(-fusoid) ascospores and smaller SBs, also in conidia without a large central lipid body. *O. juruensis* differs in the upper instead of the lower spores being more or less consistently inverted within the asci, also in a tendency to larger apothecia. *O. fusiformis* and *O.* aff. *fusiformis* (Pls 553–556) differ in narrower, filiform to subulate SBs and a pseudotripoconidium-like anamorph. Their spore length is at the lower end of the range of *O. hoana*.

Variation within *O. hoana* was noted in apothecial size and colour (from white to yellowish-ochraceous, pigment located in the exudate), also in spore size, length of terminal cells of paraphyses, and thickness of the exudate. The type from Hong Kong differs from the remaining collections in narrower spores, a gelatinized, light yellow-amber inner ectal excipulum, and a sometimes rather thick exudate forming glassy caps on the marginal cells (whether the entire cap consists of exudate or the exudate covers glassy processes by a thin layer is not clear). In one of the specimens from Dali (Yunnan) the SBs were exceptionally long (3.3–4 µm, Pl. 542: 3), but also in the collection from Taiwan (Pl. 541: 3) they attained about this length.

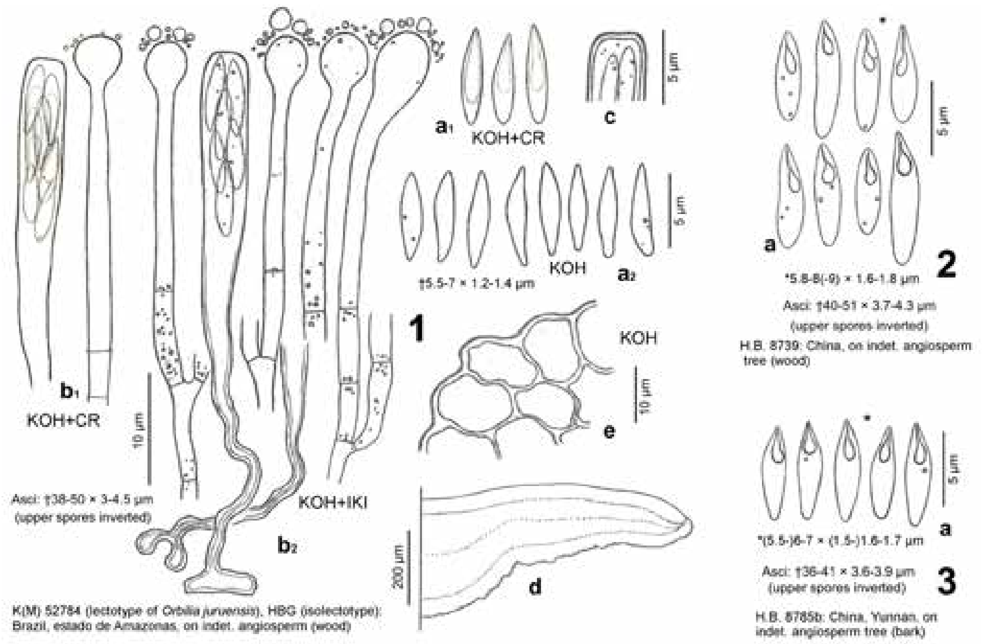


Plate 543. **1–3**. *Orbilia juruensis*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apex; **d**. apothecium in median section; **e**. id., ectal excipulum at margin [$\mathbf{a_1}$, $\mathbf{b_1}$ from HBG; $\mathbf{a_2}$, $\mathbf{b_2}$, **c–e** from K(M) 52784].

Not included collection. A sample from Guizhou (M.H. Mo, IVV: H.B. 9432) formed a tridentaria-like anamorph in pure culture, but otherwise it would fit *O. hoana*. Since comparable anamorphs are unknown in section *Helicoon*, some doubts remain about this strain.

Anamorph. The three ascospore isolates of *O. hoana* were all obtained from samples collected at the same site and day (H.Y. Su pers. comm.). The obtained conidia well concur in their shape and particularly their large oil drops in their cells (Pl. 542: 2e, 4b; see also IVV: jgs-14). However, in one of them (542: 4b) the conidia are distinctly longer (51–110 µm, 5–12-septate) than in the other two (29–79 µm, 4–7-septate). In a further sample of *O. hoana* (jgs-31, H.B. 8984a) an arthrobotrys-like anamorph was obtained, obviously by confusion, as a sequence from it clustered with similar anamorphs gained from a teleomorph with falcate ascospores. This isolate was used as holotype of the new species *A. latisporus* (Su et al. 2011b, as '*latispora*', YMFT 1.03168, see under *O. latispora*, p. 1571).

Ecology. *O. hoana* was found on hygric rotten bark and wood on moist soil or on the banks of streams in subtropical humid (winter-dry), high- to lowland, evergreen broad-leaved forests in southeastern Asia. In four collections, other species of *Orbilia* grew in association. In three of them the portion sent to the first author contained only the associated species (*O. juruensis* & *O. yuanensis*) which are also members of section *Helicoon*.

Specimens included. **CHINA**: **Hong Kong**, 8 km SE of Fanling, 0.3 km SE of Lai Chi Hang, Tai Po Kau, 120 m, branch of indet. angiosperm, on bark & wood, 28.IX.1997, W.H. Ho (ex W.H.H. 528, HKU-M, **isotype**; ex H.B. 6012, M-0276493, **holotype**). – **Yunnan**, **Dali**, Yongping, 35 km ENE of Baoshan, Jinguangsi virgin forest, 2730 m, branch of indet. angiosperm, on bark, 1.II.2008, H.Y. Su (H.Y.S. jgs-6, CBCD, doc. vid. [H.B. 8769a]). – ibid., branch of indet. angiosperm, on bark, 19.I.2008, H.Y. Su, R.X. Bi & J. Li (H.Y.S. jgs-14, CBCD, anam. cult., doc. vid. [H.B. 8785a]). – ibid. (H.Y.S. jgs-15, CBCD, anam. cult., doc. vid.). – ibid. (H.Y.S. jgs-17, CBCD, anam. cult., H.B. 8780). – ibid. (H.Y.S. jgs-18, CBCD, doc. vid. [H.B. 8781b]). – ibid., branch of *Castanopsis orthacantha*, on bark, VIII.2008, H.Y. Su, X.M. Gao & Y.G. Yan (H.Y.S. jgs-31, CBCD, H.B. 8984a ø). – ibid., branch of indet. angiosperm, on wood, 1.II.2008, H.Y. Su (H.Y.S. jgs-10, CBCD, H.B. 8762). – **Baoshan**, Tengchong, 2 km SE of Tengchong, Laifengshan, ~1800 m, indet. ?gymnosperm, VIII.2004, Z.F. Yu, (Z.F.Y. tc-23, doc. vid.). – **Kunming**, 18 km NW of Anning, 6 km NE of Qinglongzhen, Qinglongxia (Yu'an Shan), 1925 m, branch of indet. (?) angiosperm, on bark, 3.XI.2004, Z.F. Yu (Z.F.Y. qlx-4, YMFT, doc. vid.). – **Taiwan**, **Kaohsiung**, 65 km NE of Kaohsiung, 14 km NE of Liouguei, Tengjhih Forestry Recreation Garden, 1325 m, branch of indet. angiosperm, 24.I.2006, Y.C. Su (M.W. T060124T10, TNM, doc. vid.).

Not included. **CHINA**: **Guizhou**, **Qiannan**, Dushan, ~50 km SE of Qiannan, ?7 km S of Sandu, Yaoren Shan, 950 m, on wood of indet. ?angiosperm, 17.VII.2003, M.H. Mo (M.H.M. 004, H.B. 9432; YMF 1.00595, anam. cult., doc. vid.).

Orbilia juruensis Henn., Hedwigia 43: 270 (1904) — Pls 543–544

Etymology: from the type locality, close to Rio Juruá (Amazonas, Brazil).

Typification: Brazil, Marari, log of indet angiosperm, X.1900, E.H.G. Ule (Ule no. 2820, K(M) 52784, lectotype, designated here, MBT202377).

Misinterpretation of *O. juruensis*: Dennis (1954: 297, fig. 6C), = *Orbilia* sp. (from type?); Guzmán (1983), = *Orbilia* sp. (in both cases not *O. juruensis* as here redescribed from the lectotype).

Description: — **TELEOMORPH**: **Apothecia** rehydrated 1.2–1.5 {1} or 1.2–4.5 {T} mm diam., 0.2–0.3 mm {T} or up to 0.5 mm {1} high (receptacle 0.2–0.33 → 0.13 mm), incarnate- to carmine {T} or light rose-orange {1} when fresh or recently rehydrated (now pale to light cream-ochraceous {T}), scarcely translucent, round, slightly lobate and ± umbilicate when large, ± gelatinous, subgregarious; disc flat to strongly convex, margin not protruding, smooth or sometimes crisped {T}; sessile, with or without an obconical stipe 0.15 × 0.4 mm, superficial; dry bright ochre to red-brown. **Asci** †(36–)38–45(–51) × (3–)3.5–4(–4.5) µm {3}, 8-spored, spores †2–3-seriate, 3–5 upper spores inverted {3} (not or slightly to strongly mixed), pars sporifera †13–16.5 µm long; **apex** (†) strongly truncate (very slightly to strongly indented, laterally not or distinctly inflated); **base** with short to long, thin, flexuous stalk, T-, L- to Y-shaped. **Ascospores** *(5.5–)6–

Plate 544. **1–3**. *Orbilia juruensis*; **4**. *O.* cf. *juruensis*. – **1a**. dry apothecia; **1b–c**, **2a–b**. rehydrated apothecia; **2c**. apothecium in median section; **2d**. id., marginal ectal excipulum. – Living state, except for **2d** (in H_2O), asci in **3a**, **c**. – **3a–d**: phot. M.H. Mo (DIC), **4a**: phot. M. Pélissier, **4b–d**: phot. J.P. Priou. — **1a–c**. HBG (isolectotype): Brazil, Estado de Amazonas, on indet. angiosperm; **2a–d**. H.B. 8739: China, Altay, on indet. angiosperm; **3a–d**. M.H.M. 006: China, Yunnan, on *Pinus*; **4a–d**. M.P. 13.169: Comoros, on indet. ?angiosperm.

7.5(–9) × (1.5–)1.6–1.7(–1.8) µm {2}, †5.5–7 × (1.2–)1.3–1.4 µm {T}, fusoid to fusiform, apex acute, base slightly to strongly attenuated, obtuse to subacute or sometimes acute, straight to slightly inequilateral; **SBs** *(2–)2.5–3(–3.8) × 0.6–0.8(–1) µm {2}, tear-shaped, with an often sharply delimited, subulate to filiform upper part, straight to medium flexuous. **Paraphyses** apically (slightly to) medium to strongly (to very strongly) (clavate-)capitate, terminal cells †18–25 × (2.3–)3–4.2(–4.8) µm {T}, lower cells †4–9 × 1.6–2(–2.5) µm wide {T}; unbranched at upper septum. **Medullary excipulum** pale yellowish-ochraceous-orange, 20 {T} or 40–60 {1} µm thick, of dense, small-celled t. angularis. **Ectal excipulum** hyaline, near base 170–270 µm {T} or up to 400 µm {1} thick, hyaline, of (†) non- {1} or slightly gelatinized {T} (common walls ~1 µm thick), indistinctly vertically oriented t. angularis from base to margin, cells at base †11–14 × 6–11 {T} or †13–33 × 10–25 {1} µm, either homogeneously of t. angularis {1} or with a rather sharply delimited, 120–220 µm thick inner part of ± horizontally oriented t. prismatica-angularis {T} made up of †17–25 × 10–16 µm large, slightly gelatinized cells, medium gelatinized towards medullary excipulum, common walls 1–2 µm thick; 40 µm thick near margin {T}, pale yellowish-ochraceous, marginal cortical cells †10–13 × 5–8 {1} or 11–14 × 6–11 µm {T}, thin- {1} or thick-walled {T}. **Anchoring hyphae** medium abundant, †1.5–3 µm wide (4–5 µm at insertion), wall 0.2 µm thick {1}. **SCBs** no data available (but in dead marginal cortical cells globose ?SCBs 1.5–2.2 µm diam. seen), **VBs** in dead terminal cells of paraphyses refractive, yellow {1}. **Exudate** over paraphyses 0.2–2 µm thick, granular (in KOH), loosely attached, pale to light yellow-ochraceous, over margin and flanks thin and inconspicuous or absent. **— ANAMORPH**: unknown.

Habitat: on damp ground, on corticated branches (e.g., 13 mm thick) {2} or decorticated log of unidentified woody angiosperm {3}, *Pinus* sp. {1}, on medium rotten {1} or min. 5 mm deep {T} strongly decayed wood {3}, also on medium rotten bark (periderm) {1}. **Associated**: *Nectria* sp. {1}, *Orbilia hoana* {1}. **Desiccation tolerance**: unknown, probably intolerant. **Altitude**: 90–2730 m a.s.l. **Geology**: Paleozoic & Jurassic sedimentary rock. **Phenology**: I, VIII (northern hemisphere).

Taxonomic remarks. *Orbilia juruensis* closely resembles *O. hoana*, from which it differs in the upper spores being inversely oriented within the asci, also in rather large and thick apothecia. *O. juruensis* differs from *O. sarraziniana* in the SBs which are much wider in their lower part when compared from mature spores inside living asci, and in the more or less abundant yellowish exudate. *O.* aff. *fusiformis* (Pls 555–556, series *Pseudotripoconidium*) deviates in narrower (< 0.6 µm), more flexuous SBs.

Variation. The type of *O. juruensis* features thick-walled (gelatinized) cells in the medullary and ectal excipulum. A pale yellow-ochre pigmentation is now seen in the marginal excipulum and subhymenium. The three included Chinese collections concur with the type in the spores and their orientation, but differ in a thin-walled excipulum (examined in one of them, Pl. 544: 2), also in somewhat less inflated apices of paraphyses. With its rather large apothecia (1.2–1.5 mm) with a convex hymenium, this specimen quite closely resembles the type of *O. juruensis* also macroscopically, even in the reddish colour as reported in the protologue.

Type studies. Hennings' unillustrated protologue of *O. juruensis* describes the apothecia as 2–3 mm diam., umbilicate, incarnate-red ('incarnato-coccineis'), with crisped margin, the capitate apices of paraphyses as containing oil drops, and the spores as needle-shaped, with acute ends, 6–10 × 0.7–0.8 µm. These spore features are in conflict with Spooner's (1987: 180, fig. 24 E–F) detailed description and microscopic drawing of an 'isotype' in K, as well as to the present reexamination of two 'isotypes' (K, HBG, Pl. 543: 1), which revealed much wider, distinctly fusiform spores [Spooner: 6–8 × 1.4–1.6 µm according to scale]. This contradiction, which was not commented by Spooner, is probably due to a bad resolution of Hennings' microscope rather than a mixture of different species. The two duplicates examined here look indeed quite homogeneous. The personal specimen of Hennings in B was destroyed during the Second World War. The specimen in K is designated here as **lectotype** of *Orbilia juruensis* (Art. 9.11, Turland et al. 2018).

In a KOH mount of the specimen from HBG faint remnants of the SBs could be discerned in the more acute spore ends in many of the asci. This permits to conclude that the upper spores are mostly inversely oriented, and only rarely the orientation was in disorder within an ascus. In some asci a part of the lower spores was apparently immature.

O. juruensis was accepted by Spooner (l.c.) as a tropical species different from the north temperate *O. luteorubella*. He found the ectal excipulum to have slightly thickened walls only at the outer surface of the marginal cortical cells, and also emphasized the terminal cells of the paraphyses to differ from *O. luteorubella* in being tapered upwards and there abruptly clavate-subcapitate. However, we observed thickened walls in the type of *O. juruensis* also at the lower flanks and at the inner cells of the ectal excipulum, and subapically narrowed paraphyses partly also in *O. luteorubella*, *O. rosea*, and *O. sarraziniana*.

Dennis (1954) reported *O. juruensis* with spores of a size similar as in the protologue (5–7 × 1 µm), but with a strongly heteropolar shape: narrowly clavate (subulate), slightly curved, with rounded apex and acute base (see Fig. 159: C). The spores are somewhat reminiscent of a member of section *Arthrobotrys* rather than section *Helicoon* (4 spores are drawn inside an ascus, with the acute ends pointing downwards). Dennis also mentioned a report of *O. juruensis* by Cash (1937, without description) from Panama, but did not state on which material his drawing was based. The drawing of a specimen from Yucatán peninsula (Mexico) under the name *O. juruensis* by Guzmán (1983, in tab. 2 as *O. cruenta*) shows narrowly cylindrical spores (no size given). Medel et al.'s (2013) report from Guatemala also concerns a specimen with narrow spores (6–)7–9(–10) × 1–1.5 µm (not illustrated), which might represent *O. sinensis* rather than *O. juruensis*.

From a Chinese collection referred by us to *O. juruensis*, M. Mo (pers comm., Pl. 544: 3) obtained a pure culture but no anamorph. Instead, numerous apothecia were formed on agar.

Not included collections. A specimen from the Comoros (Pl. 544: 4) resembles *O. juruensis* in its large apothecia (~2–4 mm) with a crenulate margin and in the upper spores being inverted in the asci, but deviates in smaller spores (*5–7 × 1.1–1.5 µm). The SBs are ± filiform and shorter than half the spore length.

Spooner (1987: fig. 24 A–D) referred to *O. juruensis* a drawing (see Fig. 163) of a collection from tropical Melanesia (Solomon Islands) with up to 6 mm large apothecia and spores †6.5–8 × 1.6–1.9 µm according to scale. No information on SBs and spore orientation is provided, therefore this collection needs reinvestigation. The same applies to a collection from Taiwan referred by Wang (2002) to *O. juruensis* (spores 'fusoid, 5–7 × 1–2 µm'); the brief, unillustrated description could as well refer to, e. g., *O. sarraziniana* or *O. hoana*.

Ecology. *O. juruensis* was found on ± rotten wood, rarely bark of hygric branches and logs of unidentified angiosperm trees, but also *Pinus*, in tropical and subtropical humid (partly winter-dry) evergreen broad-leaved rainforests of South America and southern China, but also in the cold-continental, orotemperate humid Altay mountain range of western China. The not included collections are from a tropical humid oceanic rainforest on the islands of the Comoros (wet and dry) and Melanesia. The type was collected at the Juruá river in the tropical humid upper part of the Amazonas basin during investigations on the rubber tree genera *Hevea* and *Sapium* (*Euphorbiaceae*) and *Castilla* (*Moraceae*) that are all used for caoutchouc production (see Harms 1916: 158).

Specimens included. **BRAZIL**: **Amazonas**, Lower part of Rio Juruá, 165 km SW of Carauari, 35 km SSW of Marari, Bom Fim, 90 m, log of indet angiosperm, on wood, X.1900, E.H.G. Ule (Ule no. 2820, K(M) 52784, **lectotype**, H.B. 5897 ø: HBG, **isolectotype**). — **CHINA**: **Xinjiang**, **Altay**, 127 km NW of Altay, S-end of Kanas (Kanasi/Kalasi) lake, 1 km ESE of Bo Ouleke, 1390 m, branch of indet. angiosperm, on wood, VIII.2007, Z. Yu (Z.F.Y. xj-4, YMFT, H.B. 8739). – **Yunnan**, **Dali**, Yongping, 35 km ENE of Baoshan, Jinguangsi virgin forest, 2730 m, branch of indet. angiosperm, on bark,19.I.2008, H.Y. Su, R.X. Bi & J. Li (H.Y.S. jgs-14, CBCD, H.B. 8785b). – **Kunming**, ~35 km W of Kunming, ~8 km WNW of Yiliang, Xiaobailong Mt., ~1900 m, on wood of *Pinus*, 15.VIII. 2003, M.H. Mo et al. (M.H.M. 006, doc. vid.).

Not included. **COMOROS**: **Mayotte**, 6 km NW of Bandrele, 2.8 km NE of Poroani, Crête de Benara, 340 m, branch of indet. ?angiosperm, on wood, 20.IV.2013, M. Pélissier, vid. J.P. Priou (M.P. 13.169, doc. vid.). — **MELANESIA**: **Solomon Islands**, Kolombangara island, unlocalized, log of indet. tree, 29.VIII.1965, collector unknown ('RS') (1136, BSIP, doc. vid.). — **CHINA**: **Taiwan**, **Lanyu** (Orchid Island), 87 km SSE of Taitung, Tienchih, on indet. wood, 25.X.1999, C.H. Chung (WAN 749, TNM F10168).

Orbilia yuanensis Baral, Z.F. Yu & H.Y. Su, in Qiao et al., Mycol. Progress 14:1022: 2 (2015) — Pls 545–546

Etymology: named after the type locality, Yu'an mountain (= Qinglongxia).
Typification: China, Yunnan, Qinglongzhen, branch of indet. angiosperm, 3.XI.2004, Z.F. Yu (ex H.B. 7665, M-0257564, holotype).

Description: — **TELEOMORPH**: **Apothecia** fresh or rehydrated (0.25–)0.4–0.6(–0.7) mm diam., 0.11–0.3 mm high (receptacle 0.09–0.1 → 0.06–0.07 mm), fresh whitish, rehydrated light pure or dirty (sulphur-)yellow to chlorinaceous-cream, ± translucent, round, scattered

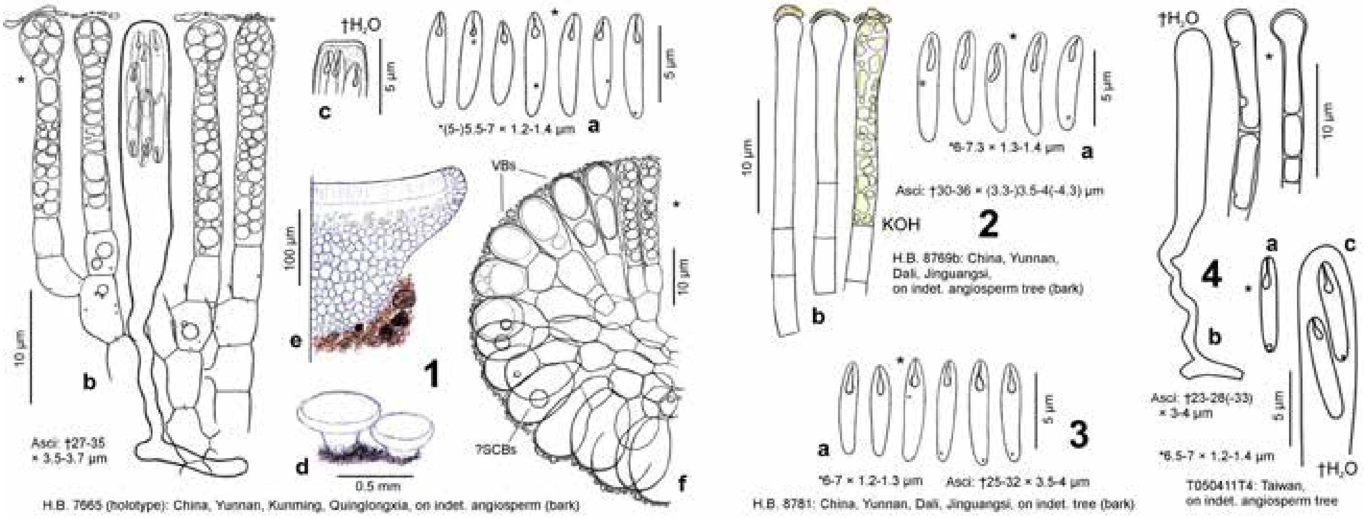


Plate 545. **1–4**: *Orbilia yuanensis*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apices; **d**. apothecia; **e**. apothecium in median section; **f**. id., marginal ectal excipulum. – **4**: del. Y.C. Su.

to gregarious; disc slightly concave to slightly convex, margin distinct, 0–5 µm protruding, smooth; sessile or with obconical to cylindrical stipe 0.06–0.2 × 0.15–0.33 mm, superficial or slightly immersed in detritus, dry pale to light yellow or buff. **Asci** *33–42 × 4–4.5(–5) µm {1}, †(23–)25–36 × (3–)3.3–4(–4.3) µm {4}, 8-spored, spores *4-seriate, (3–)4 lower spores inverted {4} (not or hardly mixed), pars sporifera *13–14 µm long; **apex** (†) strongly truncate (not or slightly indented, laterally sometimes inflated); **base** with short to long, thin, flexuous stalk, L- or T-shaped. **Ascospores** *(5–)6–7(–7.5) × 1.2–1.4 µm {4}, †5.5–7 × 1.1–1.2(–1.3) µm {1}, (sub)cylindrical, rarely narrowly fusoid-ellipsoid or slightly fusoid-clavate, ± homopolar, both ends rounded to obtuse, straight to very slightly inequilateral; **SBs** *1.5–2.2 {2} or 2–2.8 {1} × 0.3–0.6 µm {3}, typically divided into a lower tear-shaped part and a ± thin filum of about the same length, also narrowly pyriform to shortly vermiform and apically narrowed to a very short filum, straight to very slightly, rarely medium flexuous. **Paraphyses** apically (uninflated to) slightly or medium (clavate-)capitate, terminal cells *17–23 × (2.5–)3–4 µm {1}, †13–20 × 2–3.2 µm {1}, lower cells *(2–)3–5(–6) × 2–3 µm {1}, †4–6.5(–8) × 1.5–2 µm {1}; unbranched at upper septum, hymenium hyaline to bright golden-yellow. **Medullary excipulum** hyaline, 15–40 µm thick, of medium dense textura intricata-globulosa, sometimes of pale yellowish t. prismatica in lower part, indistinctly to medium sharply delimited. **Ectal excipulum** of (†) thin-walled, indistinctly oriented t. globulosa-angularis from base to margin, 60–200 µm thick near base, cells */†(12–)15–24(–27) × (9–)10–19(–23) µm {4}; 20–25 µm thick at flanks, 10–25 µm near margin, of t. (prismatica-)globulosa oriented at a 60–90° angle to the surface, marginal cortical cells *8–12(–15) × 6–8.5(–11) µm {1}, †7–12 × (3–)4–6 µm {3}; **glassy processes** absent. **Anchoring hyphae** very sparse, */†2–4(–5) µm wide, walls 0.2–0.3(–0.5) µm thick {3}. **VBs** in paraphyses consistently present {4}, multiguttulate, finally a few large and elongate bodies, rather strongly refractive, hyaline; in marginal cortical cells low-refractive, large; in dead cells turning golden yellow {2}. **SCBs** in paraphyses not seen; in cortical cells of ectal excipulum at flanks and margin globose, (0.5–)1–4 µm diam., strongly refractive, hyaline, singly or in groups {1}. **Exudate** over paraphyses 0.2–1(–1.5) µm thick, granular to small-cloddy, at first loosely, later firmly attached; over margin and flanks 0.2–0.3 or mostly 0.5–1.5 µm thick, rough-cloddy to granular, firmly attached, hyaline to bright golden (ochraceous-)yellow(-orange). — **ANAMORPH**: anguillospora-/vermispora-like (from ascospore isolate {3}). **Macroconidiophores** 25–53 × 2–3 µm, 0–2-septate, erect, unbranched or branched. **Conidiogenous cells** monoblastic. **Macroconidia** *((70–))(80–)90–120(–127)((–135)) × (5–)6–6.8(–7.3) µm {2}, †94–110 × 4.6–5 µm {1}, slightly to medium curved under a wide arch, sometimes somewhat bent near the ends or the middle, (10–)11–13(–14)-septate {2}, with many ± small LBs and sometimes also larger ones (0.3–2 µm diam.) near the septa or in the entire cell (lipid content low to rather high). **Microconidiophores** 22–30 µm long, (0–)2-septate, erect, unbranched, conidia formed terminally, singly. **Microconidia** *(21–)25–40(–60) × (2.3–)2.6–3.5 µm {1}, slightly to strongly curved (sometimes helicoid) or bent, (0–)1–3-septate, lipid content similar as in macroconidia.

Habitat: on the moist ground, corticated, ~12–50 mm thick branches of *Quercus* sp. {1}, unidentified woody angiosperms {6/1}, on medium to strongly decayed bark (periderm) {5} or wood {1}, partially blackened, no algae. **Associated**: *Orbilia hoana* {1}, *O.* ?*rosea* {1}. **Desiccation tolerance**: probably desiccation-sensitive, spores still viable after 2–4 weeks. **Altitude**: 1325–2730 m a.s.l. **Geology**: Proterozoic, Paleozoic, Jurassic & Tertiary sedimentary & metamorphic rock. **Phenology**: XI–II, IV, VII.

Taxonomic remarks. *Orbilia yuanensis* is characterized by cylindrical to cylindric-ellipsoid ascospores with rounded to obtuse apices and comparatively short, typically tear-shaped SBs tapered above into a short filum. The living paraphyses contain abundant small or a few large, rather strongly refractive, hyaline VBs which turn yellow in the dead state.

O. yuanensis is assigned to series *Helicoon* here because of its anguillospora-like anamorph with long and slender macroconidia and much smaller microconidia, reminiscent of the anamorph of *O. rosea*. *O. yuanensis* seems to be closely related to *O. hoana* with which it also shares a similar anamorph. *O. hoana* differs in more fusiform ascospores with (sub)acute apices and longer and wider SBs, also in conidial characters (see below). *O. jinguangsiensis* differs in subacute spore apices and in a pseudotripoconidium-like anamorph. Similar spores with short SBs occur in *O. bannaensis* (series *Piliferae* of section *Aurantiorubrae*, Pls 508–509, for the differences see p. 931).

O. rectispora and *O. cardui* (section *Arthrobotrys*) resemble *O. yuanensis* in spore size and shape, also in the short SBs which are, however, wider and more globose and lack a visible attachment. The two species mainly differ in their much shorter, straight, dactylella-like conidia without microconidia. Also *O. pseudocylindrospora* (section *Aurantiorubrae*) and *O. cylindrospora* (section *Orbilia*) closely resemble *O. yuanensis* in spores and SBs, but have desiccation-tolerant apothecia, paraphyses without VBs, also the marginal excipulum is different. Likewise, *O. quercus* (section *Arthrobotrys*) may easily be confused with *O. yuanensis*, but differs in basally tapered spores and shorter SBs, and particularly in

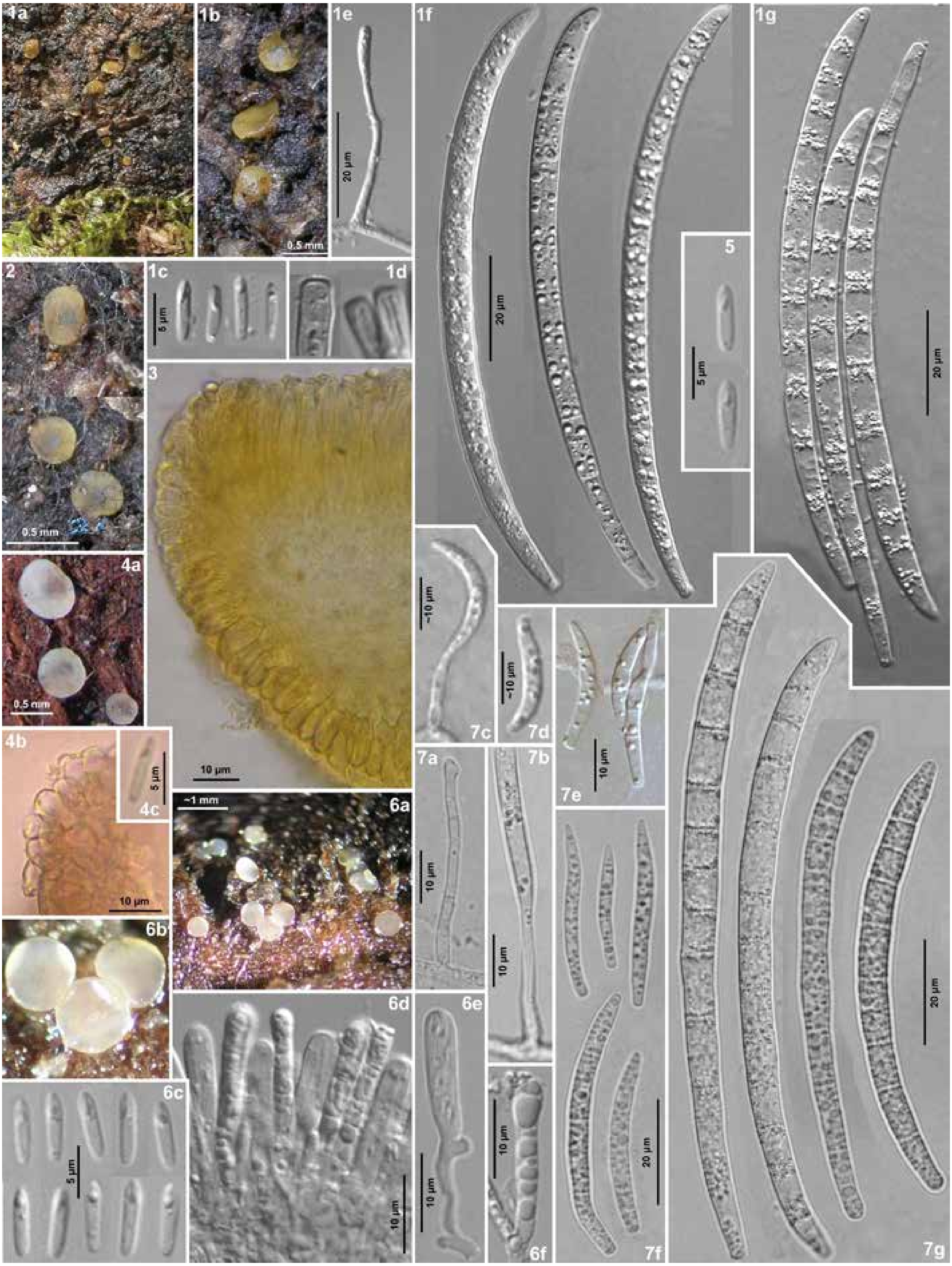


Plate 546. **1–7**: *Orbilia yuanensis*. – **4a**, **6a–b**. fresh apothecia; **1a–b**, **2**. rehydrated apothecia; **3**, **4b**. median section of ectal excipulum at margin and mid flanks; **6d–f**. asci and paraphyses (with VBs); **1d**. ascus apices; **1c**, **4c**, **5**, **6c**. ascospores; **1e**, **7a–b**. macroconidiophores: **7c**. microconidiophores; **1f–g**, **7g**. macroconidia from culture; **7c–f**. microconidia from culture. – Living state, except for **1d–e**, **7c** (in H_2O), asci in **6d–e**. – **1c–g**: phot. H.Y. Su (DIC), **4a–c**: phot. M.L. Wu, **5**, **6a–f** & **7a–g**: from Qiao et al. (2015). — **1a–g**. H.B. 8768: China, Yunnan, Dali, Jinguangsi, on indet. angiosperm; **2**. H.B. 8781a: ibid.; **3**. H.B. 8769b: ibid.; **4a–c**. M.W. T050411T: China, Taiwan, on indet. angiosperm; **5**. YMFT 1.01811 (Y.Z. ya-2): China, Yunnan, Kunming, Qiongzhushi, on *Quercus*; **6a–f**. H.B. 7665 (holotype, Z.F.Y. qlx-3/5): ibid., Qinglongxia, on indet. angiosperm; **7a–g**. YMFT 1.02055 (topotype, Y.Z. qlx-8): ibid.

a dactylellina-like anamorph with much shorter and wider, fusiform conidia.

Variation. *O. yuanensis* varies somewhat in spore shape, some spores being slightly fusoid or fusoid-clavate instead of cylindric-ellipsoid. The spore bodies are rather consistent within a specimen but among the collections they vary a bit in both shape and length. A filum was frequently present in the holotype from Kunming (Pl. 545: 1) and partly also in the paratypes from Dali (3) and Taiwan (4), whereas in other samples from Dali (Pl. 545: 2, apparently also in Pl. 546: 1c), the SBs tend to be longer, vermiform and somewhat flexuous, without distinct filum. Spores with such elongate SBs are very similar to those of *O. jinguangsiensis*.

Apothecial colour was fresh whitish in the specimens from Kunming and Taiwan, while for those from Dali only the yellow colour of the rehydrated apothecia was documented.

Anamorph. The anamorph of *O. yuanensis* (Pl. 546: 1f–g, 5c) resembles that of *O. hoana* in the long, vermiform, slightly curved conidia. In contrast to *O. hoana*, the living conidia contain a very different guttule pattern (medium- to small-sized oil drops aggregated mainly close to the septa). Together with the observed microconidia (Pl. 546: 5b), the anamorph of *O. yuanensis* resembles that of *O. rosea* but its macroconidia are distinctly shorter and wider and possess mainly 11–13 instead of 15–17 septa. Microconidia were only observed in the culture from Kunming but not in that from Dali.

Phylogeny. Sequences of two strains of *O. yuanensis* (topotype qlx-8 and a paratype ya-2) were available, comprising S1506 intron and ITS. They are identical in the entire ITS region except for 4 gaps and a few uncertain nt in the ITS2. In the intron they differ probably by error at the 5'-end by 3 nt and 2 gaps. In our phylogenetic analyses (Phyls 17, S18) the species clustered in section *Helicoon*, though with a rather high distance to other members of series *Helicoon* (ITS 12.5–14.5 %), and a very similar distance (ITS 13.5–14.5 %) to members of series *Pseudotripoconidium*. In the 5.8S region, *O. yuanensis* fully concurs with series *Pseudotripoconidium* (see also Tab. 70), while differing from the remaining members of series *Helicoon* in stem-loop B8 at pos. 117 and 138 (A-T vs. G-C, Tab. 18), whereas the 6 informative positions in the ITS1 region and 3 in the ITS2 (with exceptions in *O. tenuispora*) concur with series *Helicoon* s.str. (see Tab. 70). Possibly, *O. yuanensis* represents some kind of ancestor of both series by showing the plesiomorphic character of the phragmoconidial anamorph.

Ecology. *O. yuanensis* was found on ± rotten hygric wood of *Quercus* and bark of unidentified angiosperm trees in subtropical humid (winter-dry), evergreen broad-leaved mountain forests of southeastern Asia.

Specimens included. **CHINA**: **Yunnan**, **Dali**, Yongping, 35 km ENE of Baoshan, Jinguangsi virgin forest, ~2700 m, branch of indet. angiosperm, on bark, 8.XII.2007, H.Y. Su (H.Y.S. jgs-5, CBCD, anam. cult., H.B. 8768). – ibid., 1.II.2008, H.Y. Su (H.Y.S. jgs-6, CBCD, H.B. 8769b). – ibid., 19.I.2008, H.Y. Su, R.X. Bi & J. Li (H.Y.S. jgs-18, CBCD, H.B. 8781a). – **Kunming**, 35 km W of Kunming, 18 km NW of Anning, 6 km NE of Qinglongzhen, Qinglongxia (Yu'an Shan), 1925 m, branch of indet. angiosperm, on bark, 3.XI.2004, Z.F. Yu (Z.F.Y. qlx-3, qlx-5, ex H.B. 7665, M-0257564, **holotype**). – ibid., IX.2005, Y. Zhang (Y.Z. qlx-8, YMFT 1.02055, **topotype**, anam. cult.; sq.: DQ666643). – 9 km WNW of Kunming, Yu'an Shan, Qiongzhushi (Bamboo temple), 2150 m, on wood of *Quercus*, VII.2005, Y. Zhang (Y.Z. ya-2, YMFT 1.01811, anam. cult.; sq.: KF705018). – **Taiwan**, **Kaohsiung**, 65 km NE of Kaohsiung, 14 km NE of Liouguei, Tengjhih Forestry Recreation Garden, 1325 m, branch of indet. angiosperm, 11.IV.2005, Y.C. Su (M.W. T050411T4, TNM, as *O. querci*, doc. vid.). – ibid., 10.VII.2005, Y.C. Su (M.W. T050710T8-2, TNM, as *O. querci*, non vid.).

Incertae sedis

Orbilia falciformis Z.F. Yu, Baral & K.Q. Zhang, in Y. Zhang et al., Fungal Diversity 36: 142 (2009) — Pls 547–548

Etymology: named after the sickle-shaped ascospores.

Typification: China, Yunnan, Xiaoheijiang, branch of indet. angiosperm, 4.V.2005, M. Qiao (ex H.B. 8696a, M-0140893, holotype).

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.15–0.2 mm diam., 0.07–0.12 mm high, fresh light to bright yellow-orange, rehydrated light amber-yellow-orange, medium translucent, round, scattered to medium gregarious; disc slightly concave to flat, margin thick, not protruding, smooth; sessile, superficial. **Asci** †(25–)30–40 × 3.8–4.3(–4.8) µm, 8-spored, spores †3–4-seriate, ~3–4 lower spores inverted (often mixed), pars sporifera †13–14 µm long; **apex** (†) medium to strongly truncate (not indented, laterally not inflated); **base** with short to long, ± thin, flexuous stalk, T- to L-shaped. **Ascospores** *(5.5–)6–6.7(–7.5) × (1.3–)1.5–1.6(–1.8) µm, †5.5–7.3 × (1–)1.1–1.2 µm, cylindric- to fusoid-clavate, apex obtuse to subacute, base (*) not or slightly to strongly attenuated, (†) medium to strongly attenuated (sometimes tail-like), (*/†) medium to very strongly curved; **SBs** *(1–)1.2–2.6(–3.5) × (0.4–)0.5–0.8 µm, elongate tear-shaped to subulate, straight to slightly curved, partly obliquely oriented. **Paraphyses** apically slightly to strongly clavate-capitate, terminal cells †12.5–15.5 × 2.2–3 µm, lower cells †3.5–6(–7) × 1.3–1.8 µm; never branched at upper septum, hymenium very pale yellowish-ochraceous. **Medullary excipulum** very pale yellowish-ochraceous, 10–50 µm thick, of dense textura intricata-angularis, medium sharply delimited. **Ectal excipulum** hyaline at base, of (†) thin-walled, vertically oriented t. angularis(-prismatica) from base to margin, 20–30 µm thick near base, cells †6–10 × 4–6(–7) µm; light orange-ochre at flanks and margin, 10–15 µm thick near margin, oriented at a 60–80° angle to the surface, marginal cortical cells †6–8 × 3–5 µm; **glassy processes** absent. **Anchoring hyphae** medium abundant at base, †2–3 µm wide, walls 0.2 µm thick. **SCBs** no data available. **VBs** in paraphyses large, refractive, globose to long-cylindrical, hyaline, in cortical ectal excipulum pale brown. **Exudate** over paraphyses 0.2–0.8(–1.3) µm thick, granular, hyaline, loosely attached, over margin and flanks 0.2–0.5(–1) µm thick, rough-granular, pale yellow. **— ANAMORPH**: unknown.

Habitat: on moist ground, ?15 mm thick corticated branch of unidentified woody angiosperm, on medium decayed bark (periderm), strongly blackened, green algae absent. **Associated**: ?*Tubeufia* sp. **Desiccation tolerance**: unknown (probably intolerant). **Altitude**: 1320 m a.s.l. **Geology**: Jurassic-Cretaceous sedimentary rock. **Phenology**: V.

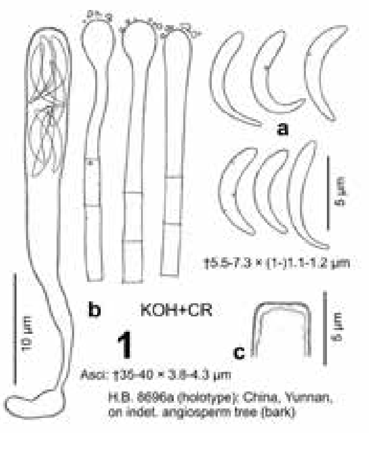


Plate 547. **1**: *Orbilia falciformis*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apex.

Taxonomic remarks. *Orbilia falciformis* might be related to *O.* aff. *fusiformis* (series *Pseudotripoconidium*), or to *O. yuanensis* (series *Helicoon*) based on the yellow pigment and similar though strongly curved ascospores. The spores and SBs of *O. falciformis* resemble also those of *O. curvativitalbae* (section *Habrostictis*). However, the rather long terminal and short lower paraphysis cells, the included

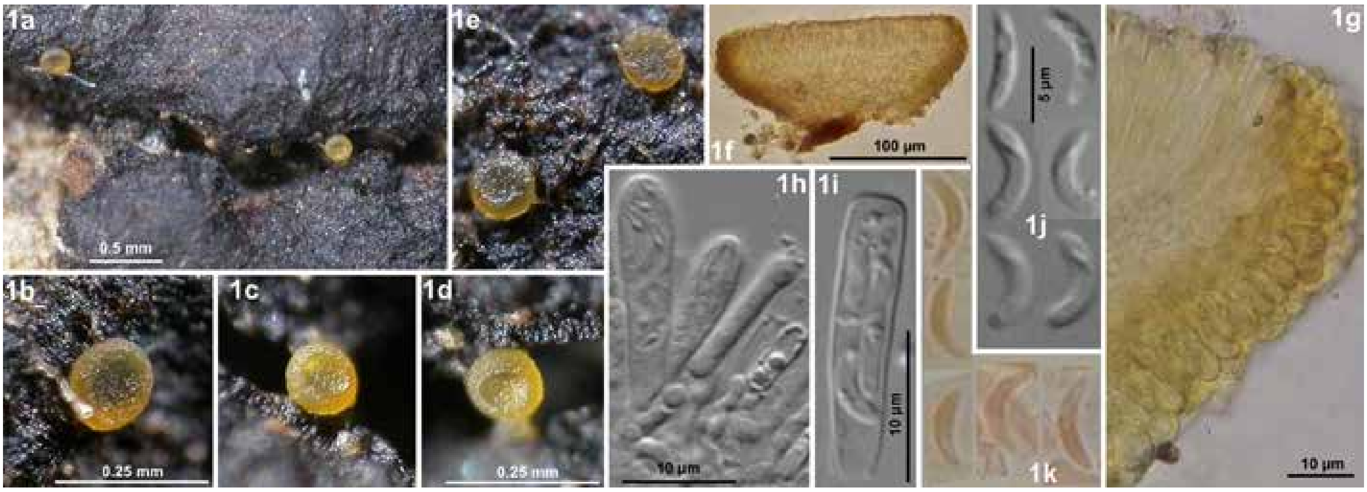


Plate 548. **1**: *Orbilia falciformis*. – **1a–e**. rehydrated apothecia; **1f**. apothecium in median section; **1g**. id., marginal ectal excipulum; **1h–i**. asci and paraphyses; **1j–k**. ascospores. – Living state, except for **1f** (in H_2O), **1g** (in KOH), asci in **1h–i**, **1j** (2 upper spores), **1k** (in KOH+CR). – **1h–j**: from Zhang et al. (2009b, DIC). — **1a–k**. YMFT 030, H.B. 8696a (iso- & holotype): China, Yunnan, on indet. angiosperm.

VBs, and also the thick ascus base from which a thin stalk emerges, are typical of section *Helicoon* but quite unknown in section *Habrostictis*. *O. arcospora* (series *Pseudotripoconidium*) differs in longer spores with longer and narrower SBs, also in a rather hyaline exudate and a rose(-cream) colour of the much larger apothecia.

In the dead state the spores of *O. falciformis* were considerably narrower, also distinctly more tapered at the base, though the curvature remained unchanged. In the fresh state the apothecia were said to have a diameter of 0.2–0.3(–0.5) mm (Zhang et al. 2009b), whereas in the here examined part of the collection (Pl. 548: 1a–d) they measured rehydrated only 0.15–0.2 mm.

Ecology. *O. falciformis* was collected on medium rotten bark of an unidentified woody angiosperm in a shady subtropical humid (winter-dry), evergreen broad-leaved mountain forests in southern China.

Specimens included. **CHINA**: **Yunnan**, **Pu'er**, Ning'er, Xiaoheijiang Forest Park, 1320 m, branch of indet. angiosperm, on bark, 4.V.2005, M. Qiao (YMFT 030, **isotype**; ex H.B. 8696a, M-0140893, **holotype**).

Orbilia martinicensis Baral, Priou & Lechat, **sp. nov.**, MB 813629 — Pls 549–550

Etymology: from the island of Martinique, where the only known collection was made.

Typification: Martinique, Case Pilot, branch of indet. angiosperm, 4.XII.2005, C. Lechat (ex C.L.L. 5525 & ex H.B. 8032, M-0276509, holotype).

Latin diagnosis: *Apothecia rehydratata 1–1.5 mm diam., vivide ochraceo-aurantiaca, subsessilia, margine minute pallide luteo-denticulatae. Ascosporae *2.6–3 × 1.6–2.2 µm, late lacrimiformes, apice acutae vel acuminatae, in statu vivo corpusculum refringens lacrimiformem, filo longo subtenui ad apicem affixum continentes. Paraphyses ad apicem modice clavato-spathulatae, pileo vitreo tectae. Excipulum marginale processis vitreis praeditum. Habitat ad corticem leniter putridum in ramo uvido arboris angiospermae in zona tropica humida Americae centralis.*

Description: — **TELEOMORPH** (mainly from holotype): **Apothecia** rehydrated 1–1.5 mm diam., 0.3–0.45 mm high (receptacle 0.2–0.27 → 0.12–0.15 mm), light ochre-orange {T} with a bright brown translucent centre, or pale cream {1}, round, medium gelatinous, subgregarious; disc flat to slightly convex, margin distinct, 25–30 µm protruding (incl. teeth), finely crenulate by small pale yellowish teeth {T} or smooth {1}; with a distinct short and broad stipe 0.1–0.25 × 0.35–0.8 mm, superficial; dry more convex, bright ochre-orange, centre dark reddish-brown. **Asci** *33–44 × 3.2–3.5 µm {1}, †42–51 × 3–3.5 µm {T}, 8-spored, spores (†) uniseriate, ~4 lower spores inverted (partly some crosswise), pars sporifera †19–21 µm long; **apex** (†) strongly truncate (very slightly indented, laterally not or scarcely inflated); **base** with medium to long, very thin, flexuous stalk, T- to L-shaped. **Ascospores** *2.6–3 × (1.6–)1.9–2.2 µm {2}, †2.5–3 × 1.8–2 µm {T}, broadly tear-shaped (lacrimiform-ovoid), apex acute to acuminate under a rather wide angle, base rounded; often slightly inequilateral, rarely slightly curved; **SBs** *1.8–2.5 × 0.5–0.8 µm in situ {2} (~2.8–3.8 µm actual length), divided into an abruptly swollen, tear- to stomach-shaped lower part and a ± filiform upper part of equal or higher length, strongly flexuous or helicoid to somewhat uncinate. **Paraphyses** apically medium (to strongly) clavate(-spathulate), terminal cells *20–28 × 3.5–4.5(–6.5) µm, †16–30 × 3–3.8 µm {T}, distinctly exceeding the dead asci, lower cells *6–7.5 × 2–2.3(–3) µm {1}, †6–10 × 1.5–2 µm {T}; branched only near base, hymenium pale rose-orange. **Medullary excipulum** hyaline, 25–30 µm thick, of dense textura intricata-angularis, medium sharply delimited. **Ectal excipulum** hyaline, pale orange towards margin, of slightly gelatinized, ambiguously oriented t. globulosa at base and flanks, 250–370 µm thick at base, cells †28–50 × (18–)25–38 µm; vertically oriented towards mid flanks, 40 µm thick at margin, oriented at an 80–90° angle to the surface, submarginal cortical cells †7–17 × 6–8 µm, those at upper margin 10–20 × 4–5 µm; **glassy**

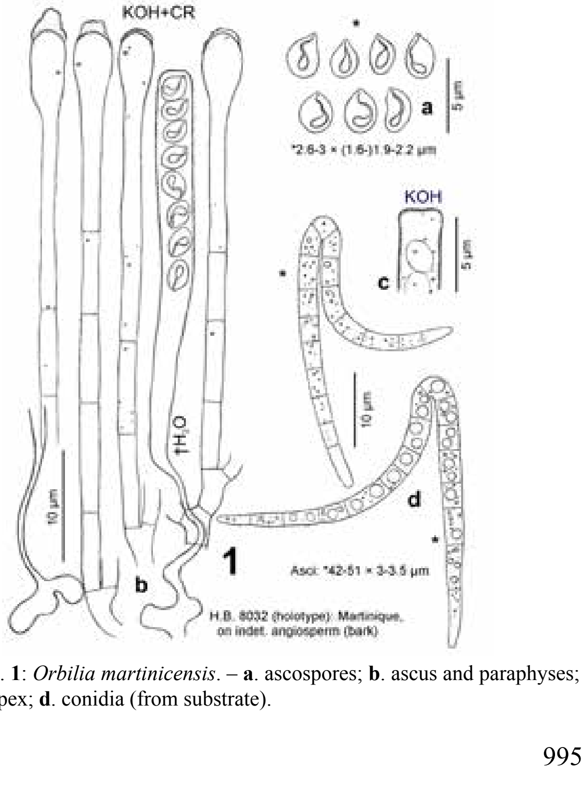


Plate 549. **1**: *Orbilia martinicensis*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apex; **d**. conidia (from substrate).

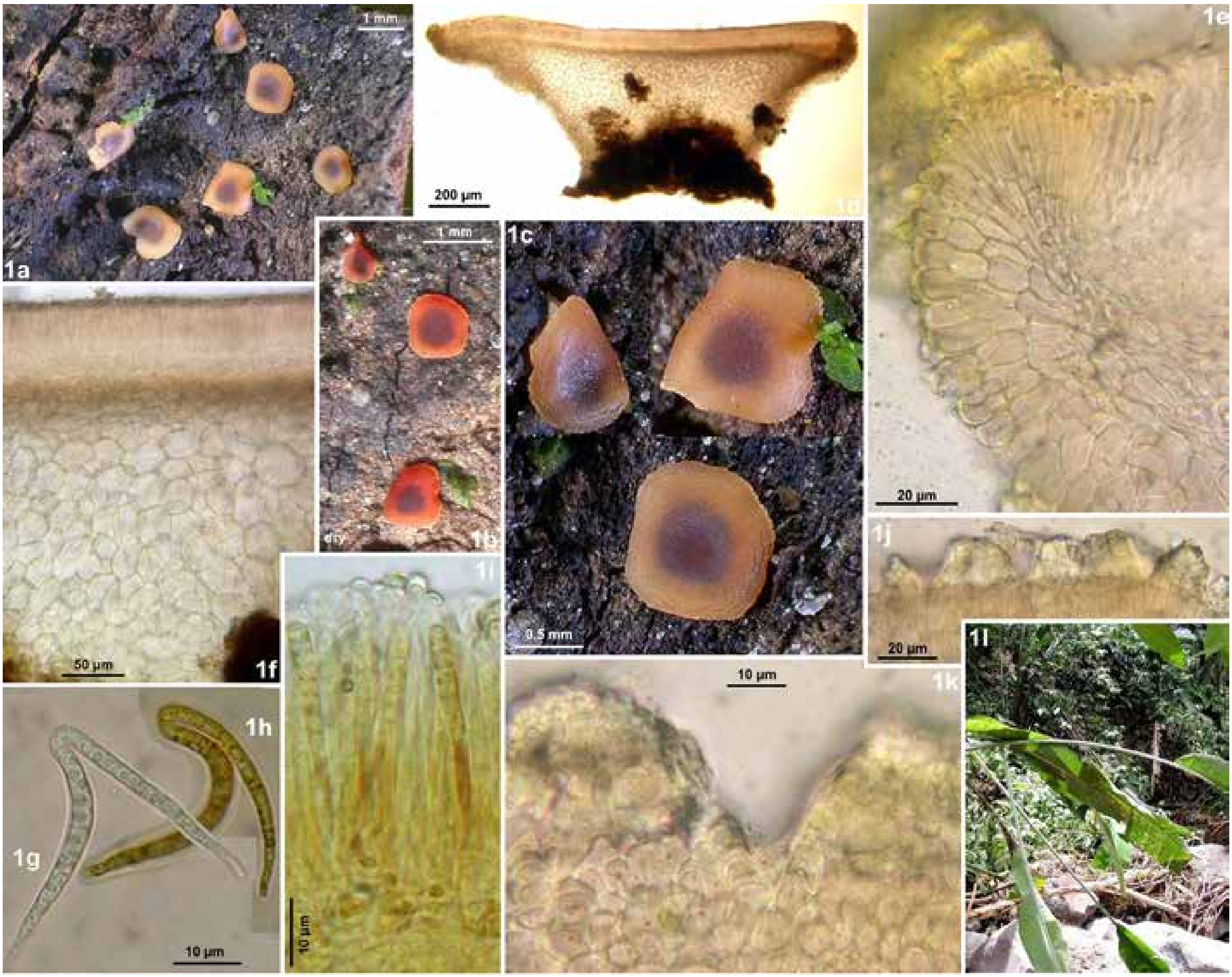


Plate 550. **1**: *Orbilia martinicensis*. – **1a**, **c**. rehydrated apothecia; **1b**. dry apothecia; **1d**. apothecium in median section; **1e**. id., marginal ectal excipulum; **1f**. id., central part of apothecium; **1j–k**. toothed margin (glassy processes, top view); **1i**. asci and paraphyses; **1g–h**. conidia from substrate; **1l**. tropical rainforest at collection site. – Dead state (**1d–f**, **k** in KOH, **1j** in H_2O, **1i** in KOH+IKI, **1h** in IKI), except for **1g**. – **1l**: phot. C. Lechat. — **1a–l**. H.B. 8032 (holotype): Martinique, on indet. angiosperm.

processes at upper margin 8–30 × 3.5–4.5 µm, at submargin only 1–3 µm long, pale yellow, high-refractive, strongly stratified, ± straight, coherent to form distinct teeth, rarely absent {T}. **Anchoring hyphae** sparse (only at base of stipe), †3.5–6(–8.5) µm wide, walls 0.2–0.3 µm thick. **SCBs** not observed; **VBs** in terminal cells of paraphyses low-refractive, elongate, hyaline. **Exudate** over paraphyses forming 0.2–0.5 µm (sometimes 1–3 µm) thick, hyaline, firmly attached caps staining rose in CRB, over margin thin, yellowish. **— ANAMORPH**: unknown (but see below).

Habitat: on moist ground, corticated to ?decorticated, ~1–3 cm thick branches of unidentified broad-leaved trees {2}, on slightly to medium decayed bark (periderm) and ?wood, ungreyed, no algae. **Associated**: *Orbilia aureocrenulata* (on different branch) {1}. **Desiccation tolerance**: only a few spores survived for ~4 weeks in the herbarium. **Altitude**: 345–1475 m a.s.l. **Geology**: volcanic and Mesozoic sedimentary rock. **Phenology**: X, XII (tropical belt).

Taxonomic remarks. *Orbilia martinicensis* is tentatively placed in section *Helicoon* because of its desiccation-sensitive apothecia with a very thick, large-celled ectal excipulum, comparatively long, flexuous SBs, and presence of VBs. Within this group the species is exceptional in its very small, broadly tear-shaped ascospores and in the predominant presence of glassy processes forming teeth at the margin. It resembles at best *O. limoniformis* in which the spores are longer and more fusiform to lemon-shaped, the SBs scarcely inflated below, and the margin without glassy processes.

O. martinicensis might be sought in section *Habrostictis* because of its flexuous, filiform, basally swollen SBs but all known species of this group are desiccation-tolerant and do not possess glassy processes. Glassy processes occur frequently in section *Aurantiorubrae*, but SBs of this type are rather exceptional (e.g., in *O. poitevinica*). The holotype of *O. martinicensis* was received in the dry state with only a few viable ascospores and conidia, therefore, the presence of VBs and absence of SCBs was only observed in the paratype.

The sample from Mexico studied by L. Quijada (pers. comm.) concurs quite well with the holotype except for pale cream apothecia with a smooth margin, and shorter asci. The ascospores measured *2.8–3 × 1.9–2.1 µm according to the scale, and the SBs 2.1–2.5 × 0.6–0.8 µm.

Anamorph. Unbranched, multiseptate conidia were observed on the natural substrate of the holotype, which were extraordinary in their very sharp bend in the middle (~180°) simulating V-shaped dicranidion-like stauroconidia (Pl. 549: 1d, conidia *32–37 × 20–33(–37) µm in situ, *67–80 µm actual length, ~16–17-septate, lower part ± straight to slightly curved, upper part medium to strongly curved, cells *2.5–3 µm wide, containing several small and often 1–2 large LBs). Contrary to dicranidion-like conidia, these were obviously formed at the truncate end of the ± straight arm. They closely match *Condylospora spumigena* Nawawi except for somewhat shorter arms. However, the connection to *O. martinicensis* is improbable because a BLAST search with an LSU sequence (NBRC107639) of *C. vietnamensis* (with twice bent conidia) gave an unclear result (*Leotiomycetes* and *Dothideomycetes*).

Ecology. *O. martinicensis* was collected on slightly to medium decayed hygric angiosperm bark and ?wood in the Caribbean region. The holotype was from a tropical humid lowland rainforest in the centre of Martinique (C. Lechat pers. comm.), and the paratype from a subtropical humid (mesophilic) mountain rainforest (L. Quijada pers. comm.). Considering the large excipular cells, the habitat, and the absence of living asci and vegetative cells in the holotype, the species is obviously desiccation-sensitive like other members of section *Helicoon*.

Specimens included. **LESSER ANTILLES**: **Martinique**, 5 km NNW of Fort de France, 6 km ENE of Case Pilot, Rivière Duclos, 345 m, branch of indet. angiosperm, on bark, 4.XII.2005, C. Lechat, vid. J.P. Priou (ex C.L.L. 5525/H.B. 8032, **holotype**, M-0276509). — **MEXICO**: **Veracruz**, 8.5 km WSW of Xalapa, 1 km SW of Rancho Viejo, Rancho Agüita Fría, 1475 m, branch of indet. angiosperm, on ?wood, 22.X.2018, L. Quijada & R. Medel (doc. vid.).

Series *Pseudotripoconidium*

Orbilia subgenus ***Habrostictis*** section ***Helicoon*** series ***Pseudotripoconidium*** (Z.F. Yu & K.Q. Zhang) Baral & E. Weber, **comb**. **& stat**. **nov**., MB 815018 – Type species: *Pseudotripoconidium sinense* Z.F. Yu & K.Q. Zhang (≡ *Orbilia sinensis* (Z.F. Yu & K.Q. Zhang) Baral, Z.F. Yu & E. Weber)

Basionym: *Pseudotripoconidium* Z.F. Yu & K.Q. Zhang, in Yu et al., Mycologia 103(1): 168 (2011).

Etymology: named after the conidial shape which resembles that in *Tripoconidium* Subram.

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.25–1.3(–1.6) mm diam., margin not protruding, smooth. **Asci** *30–60 × 3.5–5.5 µm, lower (exceptionally upper) (2–)3–5(–6) spores inverted. **Ascospores** *(4–)5–15(–17) × 0.8–1.8(–2.2) µm, cylindric-fusoid to fusiform or limoniform, apex rounded to acute, straight to slightly, in *O. arcospora* strongly curved; **SBs** (2–)2.5–7(–8) × (0.1–)0.2–0.5(–0.6) µm (actual length), filiform to subulate. **Ectal excipulum** cells near base *(9–)15–25(–35)((–45)) × (8–)10–20(–25)((–35)) µm. — **ANAMORPH**: pseudotripoconidium-like. **Conidiophores** erect, 35–165 µm long, bearing 3–8 prominent, mainly laterally projecting denticles at the tip (candelabrelloid). **Conidia** non-septate, *(4.7–)5.5–8(–9) × (3–)3.5–6(–6.5) µm, clavate or inversely tear-shaped to pyramidal, with or without 2–8 indistinct to prominent, nipple-shaped lateral protuberances at the distal end, containing 1–2(–5) rather large LBs; **conidial dimorphism** not observed.

Habitat: on hygric wood and bark of angiosperms, desiccation-sensitive, temperate to subtropical, humid.

Recognized species: 8, plus 2 unnamed species (‘affinis’).

Taxonomic remarks. Series *Pseudotripoconidium* is sharply delimited from series *Helicoon* on the basis of its peculiar anamorph. From the morphology of the teleomorph the two series can hardly be separated, however. Series *Pseudotripoconidium* tends to ascospores with narrower, more often filiform SBs. We have tentatively included in this series also three species (*O. limoniformis*, *O. subuliformis*, *O. arcospora*) in which the anamorph is unknown and molecular data lacking, merely because of their filiform SBs.

Species delimitation. The species here included in series *Pseudotripoconidium* are mainly identified by ascospore and spore body size and shape, and by spore orientation within the asci, while they are otherwise rather similar. However, there is almost a continuum in spore size and shape between many of the species, and the here presented species concept is a rather tentative one. A major part of the species was collected only 1–3 times, therefore, infraspecific variation is little known. As also stated under series *Helicoon*, the important characteristic of inverted spores is almost impossible to study in herbarium material.

Anamorph. Conidia and conidiophores in series *Pseudotripoconidium* are rather uniform, differing among the here accepted species often only slightly, especially in the number and length of protuberances on the conidia. For this reason, a majority of species of series *Pseudotripoconidium* cannot be differentiated from their anamorph alone (see also p. 240). Seifert et al. (2011) described the conidiogenesis in this genus as rhexolytic, obviously based on TEM-images by Yu et al. (2011), but LM photos of living conidia in Yu et al. clearly show that conidial secession is schizolytic.

Phylogeny. Sequences of four Chinese ascospore isolates included by Yu et al. (2011) in *Pseudotripoconidium sinense* comprise the ITS region and partly also LSU, while some of them possess the S1506 intron. In the ITS these isolates show some variation in correlation with considerable differences in ascospore length and slight deviations in conidial size (length) and shape (number of protuberances). In Yu et al.’s phylogenetic analysis they clustered in a highly supported monophyletic clade with one of Pfister’s North American ascospore isolates (D.H.P. 146, as *Orbilia* sp.), in which no anamorph developed, and, as the most basal sequence, a Chinese ascospore isolate (*O. luteorubella*, gz-08), which formed helicoon-like conidia and which is confirmed as belonging to *O. luteorubella*.

Based on our studies of teleomorph morphology and our phylogenetic analyses that include more sequences, we conclude that the four Chinese isolates with a pseudotripoconidium-like anamorph belong to three different species: *O. sinensis* (YMF 1.01843, 1.03475, D.H.P. 146), *O. tenuispora* (YMF 1.03007), and *O.* aff. *fusiformis* (YMF 1.01848). Series *Pseudotripoconidium* formed a highly supported monophyletic clade within section *Helicoon* when analysing ITS or the S1506 intron, or a clade with medium support when analysing LSU or ITS+LSU (Phyls 17–18, S18–S19) *O. tianmushanensis* clustered within the clade only in the latter two phylograms. The three recognized species appear to be heterogeneous, however, showing interspecific ITS distances of 4–8.5%, but 2.8–4% within *O. sinensis* and 2.4% within *O. tenuispora*, which questions the homogeneity of these species.

In the ITS region (Phyl. 17), *O. tianmushanensis* and a strain from Tibet (*Orbilia* sp., B.L. X079) clustered rather distant from the core of series *Pseudotripoconidium*. The two sequences show at some characteristic positions either the character of series *Helicoon* or that of series *Pseudotripoconidium*. Also *O. yuanensis*, which clustered with *O. sarraziniana* in series *Helicoon*, behaves in a similar way (Tab. 70). In the LSU D1–D2 (Phyl. 18), *O. tianmushanensis* concurs at 3 positions (176, 577, 582) with series *Pseudotripoconidium* at which series *Helicoon* deviates, and *O.* aff. *sarraziniana* (B.L. 730) at pos. 577 (Tab. 71).

Specific nucleotide positions. Nucleotides which are characteristic of series *Pseudotripoconidium* are listed in Tab. 70 for ITS and Tab. 71 for LSU. The problems of species delimitation within the series are reflected by the available molecular data showing stronger variation in the two strains of *O. sinensis* which do not cluster in a clade in the LSU phylogram (Phyl. 18), compared to *O. tenuispora*. Nevertheless, several positions in the ITS sharply separate the two species, e.g., in the ITS2 pos. 441–447 *O. tenuispora* has AC**T**C**T**GC (like series *Helicoon* p.p.) but *O. sinensis* AC**C**C**A**GC (like *O. tianmushanensis*), and within the LSU D2 pos. 524 and 562 separate *O. tenuispora* (both positions have the motif CT**C**TG) from the more variable *O. sinensis* (524: TC**T**CG or CG**T**TG, 562: CT**T**GG or CT**T**CG).

Ecology. Most of the known species grow under a (sub) tropical humid (winter-dry) climate on woody substrates lying on the moist ground. Some species were recorded in temperate areas of the northern hemisphere, though so far not in central Europe. In all of them the apothecia appear to be incapable of surviving desiccation, at least regarding the asci. The role of the peculiar shape of conidia in regard to their ecological adaptation is unknown, but we assume that conidial dispersal is different from series *Helicoon*. Series *Pseudotripoconidium* might have evolved from those Asian species of series *Helicoon* that show a golden-yellow exudate and a slight desiccation tolerance of their apothecia.

Orbilia limoniformis Baral & Hong Y. Su, in Su et al., Mycol. Progress 10: 378, fig. 4 (2011) — Pls 551–552

Etymology: named after the lemon-shaped ascospores.

Typification: China, Yunnan, Jinguangsi, branch of indet. angiosperm, 25.X.2008, H.Y. Su, X.M. Gao & Y.G. Yan (CBCD DLXYXJL1, holotype).

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.25–0.5(–0.7) × 0.25–0.45 mm diam., 0.1–0.13 mm high (receptacle 0.08–0.09 → 0.07 mm), pale cream-yellow, translucent in centre, round (to elliptical), scattered to gregarious; disc slightly concave, finally flat, margin distinct, 10 µm protruding, smooth; sessile on a narrowed base, superficial; dry light yellow-orange with somewhat undulating margin. **Asci** †30–42 × (2.8–)3–3.5 µm {2}, 8-spored, spores (†) obliquely uniseriate, (2–)3–5(–6) lower spores inverted {1} (not or somewhat mixed); **apex** (†) medium to strongly truncate (not indented, laterally not inflated); **base** with short to long, thin or thick, flexuous stalk, T- or L-shaped. **Ascospores** *(3.8–)4–5(–6) × (1.7–)1.8–2(–2.2) µm {2}, fusiform to narrowly limoniform, apex acute to acuminate, base obtuse to sometimes strongly attenuated, straight to slightly inequilateral; **SBs** *3–4.2 × 0.2–0.4 µm in situ {1} (~3.5–4.5 µm actual length), filiform to subulate, slightly to strongly flexuous (sometimes uncinate). **Paraphyses** (uninflated to) slightly or medium (rarely strongly) (clavate-)capitate, terminal cells †18–23 {1} × (2–)2.5–3.5 µm {2}, *(2.2–)3–4.2(–4.8) µm wide, lower cells †5–7 × 1.3–1.8 µm {1}; never branched in upper part, hymenium pale yellow. **Medullary excipulum** pale yellowish-cream, 20–30 µm thick, of dense textura prismatica-angularis(-intricata), horizontally oriented, indistinctly to sharply delimited. **Ectal excipulum** subhyaline, cortical region especially at flanks and margin light to bright golden-yellow, of (†) thin-walled, indistinctly vertically oriented t. globulosa-angularis from base to mid flanks, 40–60 µm thick near base, cells */†9–17(–20) × 8–14.5 µm {2}; 20–30 µm thick at flanks, 10–15 µm near margin, of t. prismatica oriented at a 70 → 30–50° angle to the surface, marginal cortical cells †7–12 × 3.5–4 µm {1}; **glassy processes** absent. **Anchoring hyphae** sparse, †2–4 µm wide, walls 0.2(–0.3) µm thick {1}. **SCBs** in cells of basal ectal excipulum globose, 1.5–2.2 µm diam., medium refractive, also absent; **VBs** abundant in terminal cells of paraphyses, globose to elongate, medium refractive, pale yellow, in dead state some cells with light golden-yellow remnants. **Exudate** over paraphyses 0.3–1(–1.5) µm thick, granular-continuous, hyaline to light yellow, loosely attached, over margin and flanks 1–2(–3) µm thick, continuous to cloddy, light to bright golden-yellow. **— ANAMORPH**: unknown.

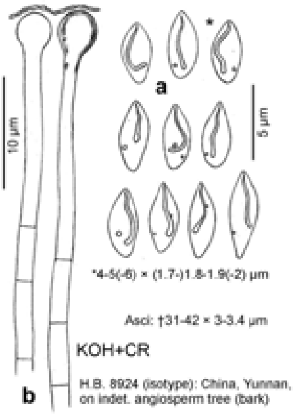


Plate 551. **1**: *Orbilia limoniformis*. – **a**. ascospores; **b**. paraphyses.

Habitat: on moist ground, decorticated or corticated branches of *Pinus* sp. {1}, unidentified woody angiosperm {1}, on medium decayed wood {1} or bark {1} (periderm), partlially blackened, green algae absent. **Associated**: *Farlowiella carmichaeliana* {1}, *Orbilia fusiformis* {1}, *O. jinguangsiensis* {1}. **Desiccation tolerance**: ascospores still viable after 3 weeks and basal excipular cells after 2.5 months. **Altitude**: 2730 m a.s.l. **Geology**: Jurassic sedimentary rock. **Phenology**: X, XII.

Taxonomic remarks. *Orbilia limoniformis* is quite easily recognized by its fusiform to limoniform ascospores with a length/width ratio distinctly below 3, and filiform SBs of almost the length of the spores. *O. fusiformis* appears to be closely related based on its very similar SBs, but differs in longer and narrower spores. Also *O. hoana* (series *Helicoon*) differs from *O. limoniformis* in spores with a length/width ratio distinctly above 3, but also in much wider, usually tear-shaped SBs of half the spore length as a maximum. *O. martinicensis* has much shorter, tear-shaped spores and basally strongly inflated SBs, also larger, ochre-orange apothecia with glassy processes at the margin.

Variation. The two studied collections match each other very well, though they grew on very different substrates.

Ecology. *O. limoniformis* is only known from a single collection site, where it grew on medium rotten wood of *Pinus* and bark of an unidentified angiosperm in a subtropical humid (winter-dry), evergreen broad-leaved mountain forest in southern China.

Specimens included. **CHINA**: **Yunnan**, **Dali**, Yongping, 35 km ENE of Baoshan, Jinguangsi virgin forest, 2730 m, branch of *Pinus*, on wood, 8.XII.2007, H.Y. Su (H.Y.S. jgs-4, CBCD, H.B. 8767). – ibid., branch of indet. angiosperm, on bark, 25.X.2008, H.Y. Su, X.M. Gao & Y.G. Yan (H.Y.S. jgs-25, CBCD DLXYXJL1, **holotype**; H.B. 8924, **isotype**).

Orbilia fusiformis Baral & Hong Y. Su, **sp. nov.**, MB 813650 — Pls 553–556

Etymology: named after the fusoid to fusiform ascospores.

Typification: China, Yunnan, Jinguangsi, branch of *Pinus*, 8.XII.2007, H.Y. Su (ex H.B. 8766a, M-0276488, holotype).

Latin diagnosis: Orbiliae limoniformi *similis sed ascosporae longiores et angustiores, apice partim obtusae, basi partim obtusae. Status anamorphicus:* Pseudotripoconidium *sp. Habitat ad lignum putridum ramorum uvidorum arborum coniferarum vel angiospermarum in zona subtropica humida Asiae meridio-orientalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.35–0.75 mm diam., 0.14 mm high (receptacle 0.1 → 0.06 mm), fresh whitish to pale pink or cream-yellow, rehydrated light honey-yellow to yellowish-orange, slightly gelatinous, (semi)translucent, round, scattered to subgregarious; disc concave to flat, margin thin or thick, not protruding or upwards curved, smooth; sessile on a hidden stipe 0.04 × 0.12 mm, superficial, dry light orange(-ochraceous). **Asci** †(30–)38–44 × 3–4 µm {2}, 8-spored, spores (†) ± biseriate, 3–6 lower spores inverted {2}

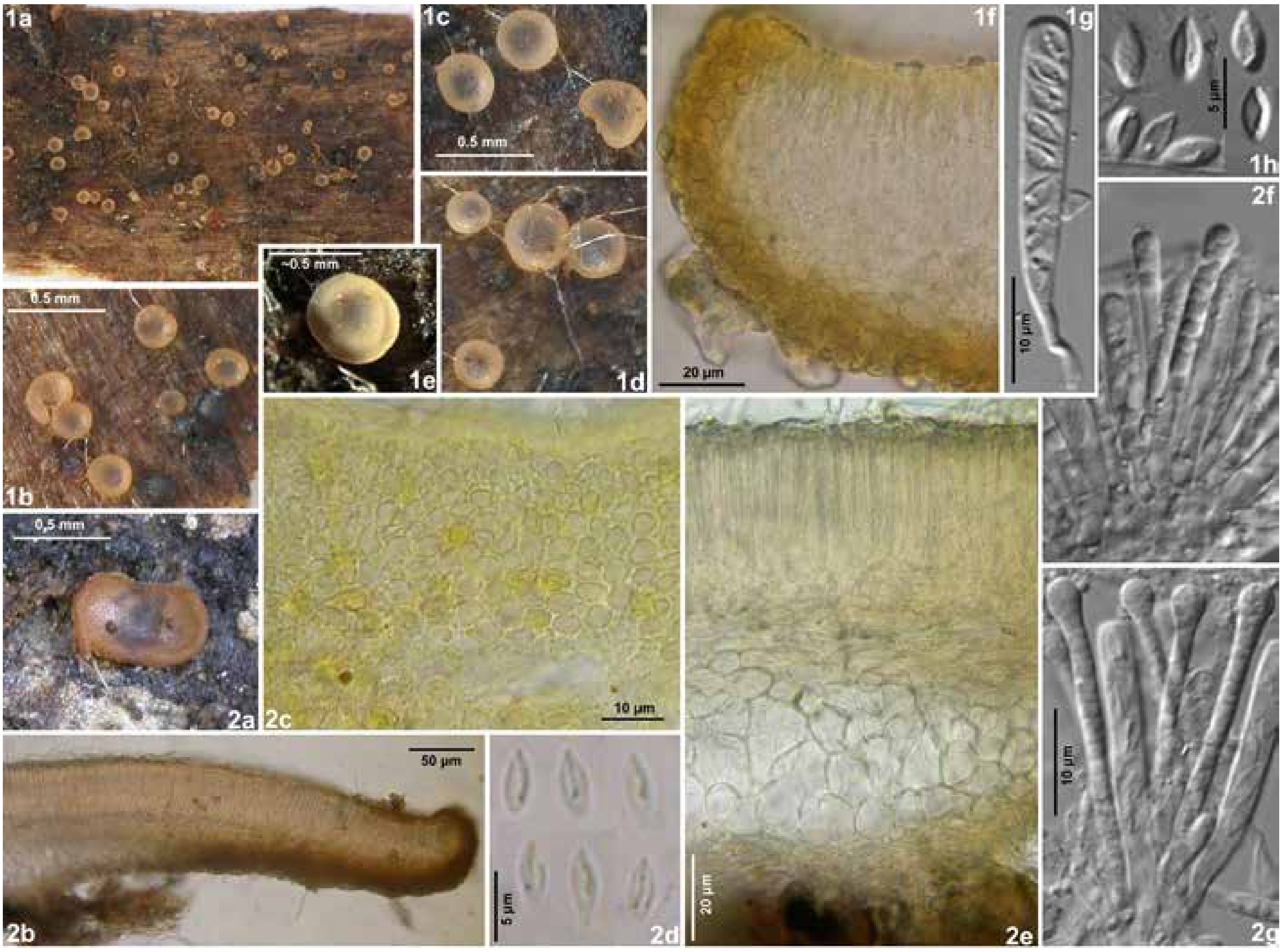


Plate 552. **1–2**: *Orbilia limoniformis*. – **1a–d**, **2a**. rehydrated apothecia; **1e**. fresh apothecium; **2b**. apothecium in median section; **1f**. id., marginal region; **2e**. id., central part of apothecium; **2c**. marginal excipulum in external view; **1g**, **2f–g**. asci and paraphyses; **1h**, **2d**. ascospores. – Living state, except for **2b–c**, **e** (in H_2O), asci in **1g**, **2g**. – **1e**, **g–h**, **2f–g**: phot. H.Y. Su (p.p. from Su et al. 2011c, DIC). — **1a–h**. H.B. 8767 (holo-/isotype): China, Yunnan, Dali, on *Pinus*; **2a–g**. H.B. 8924: ibid., on indet. angiosperm.

(often mixed, sometimes 1 upper spore inverted); **apex** (†) strongly truncate (not indented, laterally not or slightly inflated); **base** with medium to long, thin, flexuous stalk, L-shaped. **Ascospores** *(4.5–)5–7(–7.5) × 1.3–1.6(–1.7) µm {2}, †5–7 × 1.3–1.5 µm {T}, fusoid to sometimes fusiform, homopolar, apex obtuse to acute, base slightly to strongly tapered, rounded to subacute, straight to slightly inequilateral; **SBs** *3–4.5 × 0.2–0.4(–0.5) µm in situ {2} (~4–4.5 µm actual length), narrowly subulate, slightly to medium flexuous or helicoid. **Paraphyses** apically medium to very strongly clavate-capitate, terminal cells †15–22 × 2.5–4 µm {2}, lower cells †5–8 × 1.3–2 µm wide {T} (near base up to 2.5 µm wide); branching not seen, hymenium bright yellow in upper half. **Medullary excipulum** hyaline, 30 µm thick, of medium dense, slightly gelatinized, irregularly horizontally oriented textura ~prismatica, with many inflated cells, sharply delimited from ectal excipulum only towards margin. **Ectal excipulum** pale to bright yellow, of (†) thin-walled, indistinctly oriented t. globulosa-angularis from base to mid flanks, 60–70 µm thick near base, cells *14–25 × 10–20(–23) µm {T}; 40 → 20 µm thick at flanks, 18 µm at margin, of t. prismatica-globulosa oriented at a 80–90° angle to the surface, marginal cortical cells †8–9 × 3.5–5.5 µm {T}; **glassy processes** absent. **Anchoring hyphae** sparse at base, †3–4 µm wide, walls 0.2–0.3 µm thick {T}. **SCBs** not seen; **VBs** unknown. **Exudate** over paraphyses 0.2–1 µm thick, rough-cloddy, light yellow-chlorinaceous, firmly and individually attached, over margin and flanks 1–2(–2.5) µm thick. — **ANAMORPH**: pseudotripoconidium-like (from ascospore isolate {1}). **Conidiophores** not clearly seen. **Conidia** *5.5–9(–11.5) × (3.2–)3.5–3.8 µm {1}, inversely tear-shaped to clavate, without protuberances, containing 1(–2) LBs of 1.3–2 µm diam.

Habitat: on moist ground, decorticated or corticated, 4–5 cm thick branch or thicker log of *Pinus* sp. {1}, indet. angiosperm {1}, on medium decayed wood {1} or bark (periderm) {1}, partly in beetle galleries, partly darkened, without algae. **Associated**: *Farlowiella carmichaeliana* {1}, *Orbilia jinguangsiensis* {1}, *O. limoniformis* {1}, *O. tenuispora* {1}. **Desiccation tolerance**: many excipular cells and ascospores still alive after 3 months. **Altitude**: 2730 m a.s.l. **Geology**: Jurassic sedimentary rock. **Phenology**: X, XII.

Taxonomic remarks. *Orbilia fusiformis* resembles *O. limoniformis* in the shape of the ascospores which are, however, longer and narrower, also in long and narrow SBs. *O. juruensis* (series *Helicoon*) fits well regarding spore size and shape, but differs in wider SBs and in the upper instead of lower spores being inversely oriented. *O. jinguangsiensis* deviates from *O. fusiformis* in shorter SBs and narrower spores. *O. hoana* differs in much wider SBs and a ver-

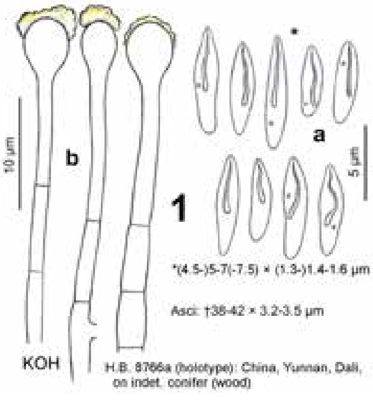


Plate 553. **1**: *Orbilia fusiformis*. – **a**. ascospores; **b**. paraphyses.

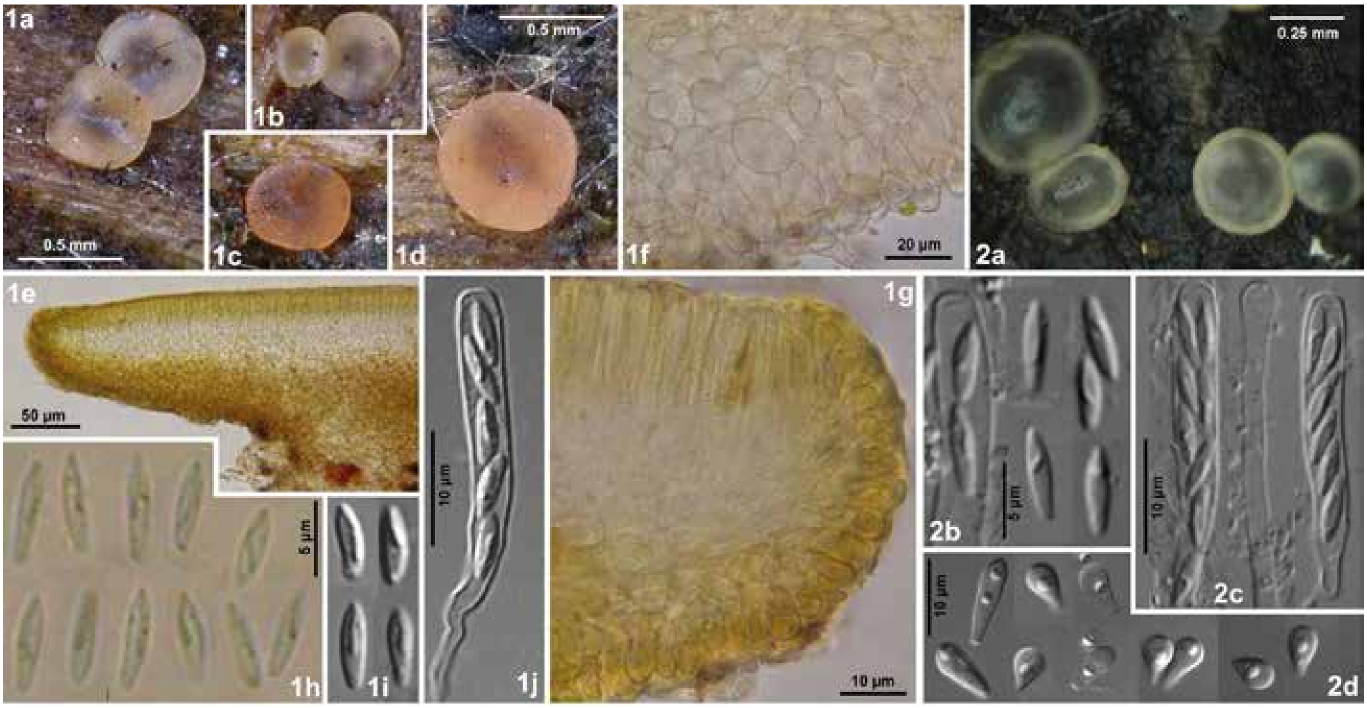


Plate 554. **1–2**. *Orbilia fusiformis*. – **1a–d**. rehydrated apothecia; **2a**. fresh apothecia; **1e**. apothecium in median section; **1g**. id., marginal ectal excipulum; **1f**. id., basal ectal excipulum: **1j**, **2c**. mature asci, paraphysis; **1h–i**, **2b**. ascospores; **2d**. conidia (from culture). – Living state, except for **1g** (in KOH), **1e** (in H_2O), asci and paraphysis in **1j**, **2b–c**. – **1i–j**, **2a–d**: phot. H.Y. Su (DIC). — **1a–j**. H.Y.S. jgs-3, H.B. 8766a (holotype): China, Yunnan, Dali, on *Pinus*; **2a–d**. H.Y.S. jgs-30: ibid., on indet. angiosperm.

mispora-like anamorph. Species of section *Habrostictis*, e.g., *O. jurana* or *O. ungulata*, resemble these collections in spore characters, but possess orange, desiccation-tolerant apothecia, the latter also crystalloid SCBs and a trinacrium-like anamorph.

Variation. Although the two included specimens grew on different substrates (holotype: on wood of conifer, paratype: on bark of angiosperm), differences worth to mention could not be discovered between them.

Not included collections. The three samples shown in Pls 555–556 resemble *O. fusiformis*, but tend to have wider spores and SBs. The one from Yingjiang (Pl. 556: 3), with spores *6–7.5(–10) × 1.4–1.8(–2) µm and SBs 3.3–4.7(–5.5) × 0.4–0.6 µm, differs also in spore orientation (often upper spores inverted and lower spores not), and in the anamorph. The anamorph of the other two is unknown, and the SBs measured here 1.8–3 × (0.2–)0.4–0.6 µm. In the collection from Australia the lower spores were usually inverted, but often also 1–2 upper spores. This collection was on a horizontal branch 0.5–1.5 m above the ground in a tropical forest and seems to exhibit a certain desiccation tolerance (many excipular cells were still viable after 11 months). It differs from *O. fusiformis* also in shorter terminal cells of the paraphyses (8–15 µm), whereas in the third sample (from Yongping) they showed a length of 18–25 µm. A close relationship of the samples from Australia and Yongping to *O. hoana* cannot be excluded.

Anamorph. The clavate conidia obtained in pure culture of the paratype differ from typical species of *Pseudotripoconidium* in the total absence of protuberances (Pl. 554: 2d). In contrast, distinct protuberances characterize the not included specimen from Yingjiang (Pl. 556: 3d–g).

Phylogeny. A sequence from an ascospore isolate of the not included specimen from Yingjiang (YMF 1.01848) comprises SSU V1–V3, S1506 intron, ITS, and LSU. In the ITS region it shows a distance of 5–8.5 % to the other species of series *Pseudotripoconidium*, the lowest percentage to the holotype of *O. sinensis* (YMF 1.01843). In the intron the distance is 8 % to *O. tenuispora* but ~16–20 % to other species of section *Helicoon*. In the LSU the distance to other sequences of series *Pseudotripoconidium* is 2–3.5 % in the D1–D2 domain. The version MH877761 in GenBank (as CBS 121220) is probably a confusion and refers to CBS 121221 by providing a cleaner LSU version of that strain (see under *O. sinensis*, p. 1006).

Ecology. The holo- and paratype of *O. fusiformis* were collected at the same site as the holo- and paratype of *O. limoniformis*, in a subtropical humid (winter-dry), evergreen broad-leaved mountain forest in southern China. Like *O. limoniformis*, *O. fusiformis* grew on medium rotten hygric wood of *Pinus* and bark of an unidentified angiosperm. Also *O.* aff. *fusiformis* grew under similar conditions in southern China, partly at the same site. The Australian collection was on a xeric branch in the tropical humid Daintree Forest in the lowlands of northeastern Australia.

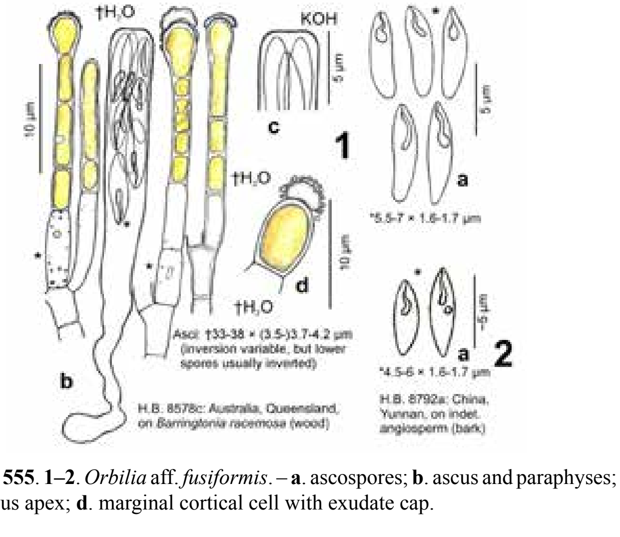


Plate 555. **1–2**. *Orbilia* aff. *fusiformis*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apex; **d**. marginal cortical cell with exudate cap.

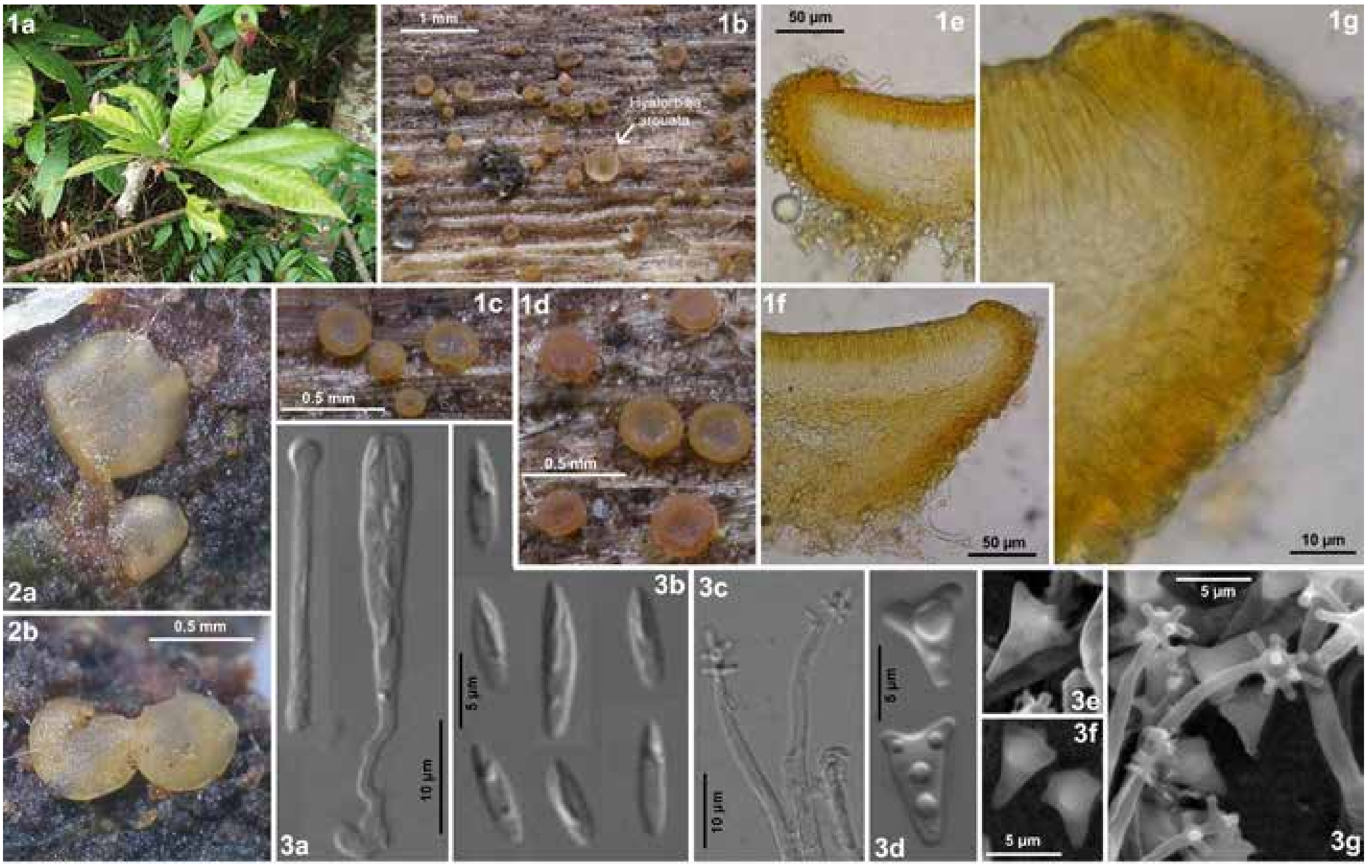


Plate 556. **1–3**: *Orbilia* aff. *fusiformis*. – **1a**. tropical rainforest, leaves of *Barringtonia racemosa*; **1b–d**, **2a–b**. rehydrated apothecia; **1e–f**. apothecia in median section; **1g**. id., marginal ectal excipulum; **3a**. ascus and paraphysis; **3b**. ascospores; **3c**, **g**. conidiophores; **3d–f**. conidia (from culture). – Living state, except for **1e–g** (in KOH), **3c** (in H_2O), ascus and paraphysis in **3a**; **3e–g** (SEM). – **3a–g**: phot. Z.F. Yu (DIC). — **1a–g**. H.B. 8578c: Australia, Queensland, on *Barringtonia*; **2a–b**. H.B. 8792a: China, Yunnan, Dali, on indet. angiosperm; **3a–g**. YMFT 1.01848: China, Yunnan, Dehong, on indet. tree.

Specimens included. **CHINA**: **Yunnan**, **Dali**, Yongping, 35 km ENE of Baoshan, Jinguangsi virgin forest, 2730 m, branch of *Pinus*, on wood, 8.XII.2007, H.Y. Su (H.Y.S. jgs-3, CBCD, **isotype**; ex H.B. 8766a, M-0276488, **holotype**). – ibid., branch of indet. angiosperm, on bark, 25.X.2008, H.Y. Su, X.M. Gao & Y.G. Yan (H.Y.S. jgs-30, CBCD, anam. cult., doc. vid. [H.B. 8961b]).

Not included. **CHINA**: **Yunnan**, **Dali**, Yongping, 35 km ENE of Baoshan, Jinguangsi virgin forest, 2730 m, branch of indet. angiosperm, on bark, 19.I.2008, H.Y. Su, R.X. Bi & J. Li (H.Y.S. jgs-16, H.B. 8792a). – **Dehong**, Yingjiang, 31 km WSW of Yingjiang, Tongbiguan, 1850 m, branch of indet. tree, 25.IV.2006, M. Qiao (Z.F.Y. yj-1, YMFT 1.01848, anam. cult., CBS 121221, doc. vid.; sq.: MH179520, EF026114, EF026115, MH877761 as CBS 121220). — **AUSTRALIA**: **Queensland**, Wet Tropics, Daintree Forest, 21 km N of Mossman, 8 km ESE of Daintree, Cape Tribulation Rd, Daintree Swamp, 5 m, branch of *Barringtonia racemosa*, on wood, 29.VIII.2006, G. Marson (H.B. 8578c).

Orbilia subuliformis Baral, **sp. nov.**, MB 813651 — Pl. 557

Etymology: named after the subulate ascospores.

Typification: Puerto Rico, El Yunque, branch of indet. angiosperm, 18.I.1996, D.H. Pfister & F.A. Harrington (ex D.H.P. PR 43, FH 304919, holotype).

Latin diagnosis: *Differt ab* Orbilia sinensi *ascosporis multo brevioribus, ascosporis superioribus inverse orientatis. Habitat ad corticem putridum rami uvidi arboris angiospermae in zona tropica humida Americae centralis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.4–0.5 mm diam., 0.12 mm high (receptacle 0.095 mm), pale cream(-chlorinaceous), ± scattered; disc flat, margin indistinct, not protruding, smooth; sessile on a very short stipe of 20 × 130 µm, superficial. **Asci** †~28–30 × 3.6–4 µm, 8-spored, spores †~4-seriate, upper spores inverted; **apex** (†) strongly truncate (hardly indented, laterally not inflated), thin-walled; **base** with long, thin, flexuous stalk, basal end never clearly seen. **Ascospores** †5.5–6.5 × 0.8–0.9(–1) µm, cylindric (fusoid-)clavate (subulate), apex obtuse to subacute, base widest, rounded to obtuse, straight to slightly inequilateral; **SBs** †2–2.2 × 0.3 µm, vermiform-subulate, straight. **Paraphyses** apically strongly capitate, terminal cells †14–20 × (2.5–)3–4 µm, lower cells †7–11 × 1.6–2.3 µm wide; unbranched at upper septum, hymenium pale yellow. **Medullary excipulum** 15 µm thick. **Ectal excipulum** of t. angularis from base to mid flanks, 70 µm thick near base, cells †18–28 × 10–16 µm; at margin of vertically oriented t. prismatica-globulosa, marginal cortical cells †8–12 × 4–7 µm; **glassy processes** absent. **Anchoring hyphae** not seen. **VBs** in some paraphyses seen as deformed bodies (†), yellowish, refractive, elongate-angular. **Exudate** over paraphyses 0.3–0.5 µm thick, granular, ?hyaline. — **ANAMORPH**: unknown.

Habitat: on moist ground, ~3.5 cm thick branch (‘log’) of indet. angiosperm, on slightly decayed bark (periderm). **Associated**: *Hyalorbilia citrina*. **Desiccation tolerance**: unknown, probably intolerant. **Altitude**: ~650 m a.s.l. **Phenology**: I (tropical belt).

Taxonomic remarks. *Orbilia subuliformis* is tentatively proposed as a distinct species based on the rather short and narrow ascospores of a subulate shape. The spores were only seen inside the asci, and the SBs only in one ascus when stained in KOH+IKI. Due to the heteropolar spore shape the inverse orientation of the upper spores was seen in several asci.

Ecology. The sparse holotype was collected on slightly decayed bark of a thin hygric log in a tropical humid rainforest of Puerto Rico (Caribbean region).

Specimens included. **PUERTO RICO**: Sierra de Luquillo Mts., El Yunque, trail from Sierra Palm to Mt. Britton, ~650 m, branch of indet. angiosperm, on bark, 18.I.1996, D.H. Pfister & F.A. Harrington (ex D.H.P. PR 43 [mixture with *Hyalorbilia citrina*], FH 304919, **holotype**; H.B. 5953 ø).

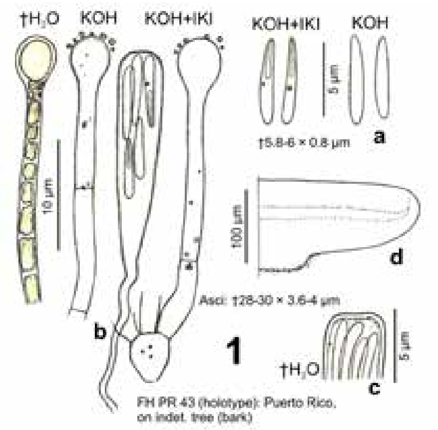


Plate 557. **1**: *Orbilia subuliformis*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apex; **d**. apothecium in median section.

Orbilia jinguangsiensis Baral & H.Y. Su, **sp. nov.**, MB 813652 — Pls 558–559

Etymology: named after the Jinguangsi virgin forest in Dali (Yunnan, China).

Typification: China, Yunnan, Jinguangsi, branch of indet. angiosperm, 8.XII.2007, H.Y. Su, R.X. Bi & J. Li (ex H.B. 8784, M-0276495, holotype).

Latin diagnosis: Orbiliae sinensi *similis sed ascosporae breviores et latiores, corpusculis refringentibus brevioribus. Habitat ad corticem vel lignum putridum ramorum et truncorum uvidorum arborum coniferarum vel angiospermarum in zona mesotemperata ad subtropica humida Asiae orientalis et Africae australis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.27–0.4 {3} or 0.5–1.3(–1.5) {1} mm diam., 0.12–0.3 mm high (receptacle 0.075–0.11 → 0.06–0.07 mm), pale orange when fresh, rehydrated pale cream to light honey-yellowish-amber, hardly translucent, round to irregular, scattered to subgregarious; disc slightly concave {2} or flat {1} to often medium convex {T}, margin rather thick, 7–10 µm protruding, smooth; stipe indistinct {2} or 0.07–0.15 × 0.45 mm {1}, superficial. **Asci** †(22–)27–40(–45) × 3.5–4.5(–4.8) µm {3}, 8-spored, spores †2–4-seriate, lower ~4 spores inverted {2}, pars sporifera †12–20 µm long; **apex** (†) strongly truncate (not {1} or distinctly indented {T}, laterally not inflated), thin-walled; **base** with a medium to very long, thin, flexuous stalk, T- to L-shaped. **Ascospores** *(5–)6–7.5(–8) × 1.2–1.3(–1.4) µm {2}, †(5–)5.5–7(–7.5) × 1–1.2(–1.3) µm {4}, cylindrical to slightly fusoid or fusoid-clavate, apex subacute, base not or slightly attenuated, rounded or obtuse, straight; **SBs** *(2–)2.5–3 × 0.2–0.3 µm {2}, filiform-subulate, slightly to medium flexuous. **Paraphyses** apically uninflated or mostly slightly to medium capitate(-clavate), terminal cells */†15–19 × 2–3.3 µm {2}, lower cells *4–6 × 1.5–2 µm {1}, †3–4.5 × 2–2.5 {1} or †5.5–6 × 1.5–1.8 µm {T}; unbranched at upper septum, hymenium pale yellowish. **Medullary excipulum** hyaline to pale yellow, 20–40 µm thick, of dense textura angularis(-intricata), non- or medium gelatinous, medium to sharply delimited. **Ectal excipulum** pale yellowish, of (†) thin-walled to slightly gelatinized (common walls 0.5–1 µm), indistinctly vertically oriented t. globulosa-angularis-prismatica from base to mid flanks, 60 {1} or 170 {T} µm thick near base, cells †10–16 × 7–13 {1} or 15–35 × 10–25 µm {T}; 60 → 20 µm thick at flanks, 15 µm near margin, of t. prismatica oriented at a 70–90° angle to the surface, marginal cortical cells †7–9 × 3–4 {1} or 9–12 × 4–6 µm {T}; **glassy processes** absent. **Anchoring hyphae** medium abundant, †1.7–2(–3) µm wide, walls 0.2 µm thick {T}, forming a dense, thin, scarcely gelatinized t. porrecta at base of stipe. **VBs** very elongate, filling almost entire terminal cell, (*) medium refractive {T}, (†) pale yellowish. **Exudate** over paraphyses 0.1–0.5 {T} or 0.5–2 {2} µm thick, rough to granular-cloddy, continuous, light yellow-chlorinaceous, loosely or firmly attached, over margin and flanks 0.3–2 µm thick, rough, subhyaline to yellow. **— ANAMORPH**: pseudotripoconidium-like (from ascospore isolate {1}). **Conidiophores** erect, septate, usually unbranched, 43–165 µm high, ~2.5–3.3 µm wide at base, ~1–1.6 µm at apex, bearing (1–)4–8 denticles of 1.8–4 × 1–1.2 µm. **Conidia** *5.5–7.5 × 3.6–4.8 µm, inversely pyramidal, truncate at the narrow base, with 2–4 nipple-shaped lateral protuberances at the distal end, containing 1 large LB and sometimes also a small one. **Chlamydospores** not observed.

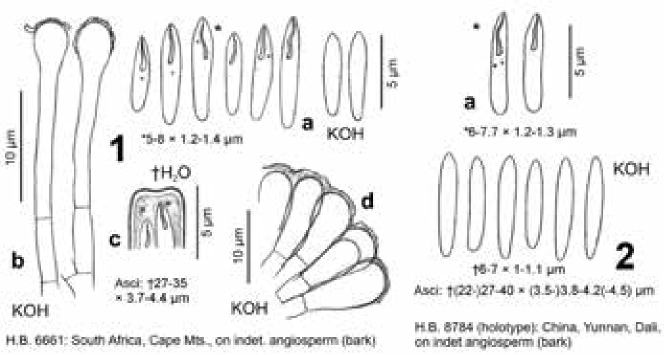


Plate 558. **1–2**: *Orbilia jinguangsiensis*. – **a**. ascospores; **b**. paraphyses; **c**. ascus apex; **d**. marginal ectal excipulum (median section).

Habitat: lying on moist ground, on underside {T} of corticated or decorticated branches or logs of indet. woody angiosperms {1/1}, *Pinus* sp. {1}, on bark {2} (periderm {T}) or wood {1}, medium decayed, partly on old black pyrenomycete, no algae. **Associated**: *Farlowiella carmichaeliana* {1}, *Orbilia fusiformis* {1}, *O. limoniformis* {1}, small moss {1}. **Desiccation tolerance**: only ~20% of ascospores viable after 3 months. **Altitude**: 265–2730 m a.s.l. **Geology**: Jurassic sedimentary rock. **Phenology**: XII.

Taxonomic remarks. *Orbilia jinguangsiensis* is characterized by comparatively small, cylindrical to slightly fusoid ascospores with rather short SBs. The taxon is only tentatively separated from *O. sinensis* (see p. 1004). A collection from Japan referred to *O. sinensis* (Pl. 560: 2) has a spore size similar to *O. jinguangsiensis*, though the SBs are distinctly longer. *O. yuanensis* (series *Helicoon*) differs in obtuse spore apices and shorter SBs, in addition to the vermispora-like anamorph, but in one collection (Pl. 545: 2) the SBs are similar as in *O. jinguangsiensis*. *O. subuliformis* differs in smaller, subuliform spores and in the upper spores being inversely oriented.

Variation. The collections from Yunnan (China) deviate from that from South Africa in much smaller and thinner, more unstalked apothecia which mostly have a concave disc, also in smaller ectal excipular cells and a thicker exudate over the paraphyses, finally in a tendency to more cylindrical spores.

Anamorph. The pseudotripoconidium-like anamorph obtained in the holotype of *O. jinguangsiensis* closely resembles that of *O. sinensis* in its conidia with 2–4 very short protuberances.

Ecology. *O. jinguangsiensis* is known from a subtropical humid (winter-dry), evergreen broad-leaved mountain forest in southern China (type locality), and from a warm-temperate humid afromontane evergreen forest in the coastal Cape Mountains of South Africa.

Specimens included. **CHINA**: **Yunnan**, **Dali**, Yongping, 35 km ENE of Baoshan, Jinguangsi virgin forest, 2730 m, branch of *Pinus*, on wood, 8.XII.2007, H.Y. Su (H.Y.S. jgs-3, CBCD, H.B. 8766b, mixture in M-0276488 [type of *O. fusiformis*]). – ibid., branch of indet. angiosperm, on bark, 8.XII.2007, H.Y. Su, R.X. Bi & J. Li (H.Y.S. jgs-13, CBCD, **isotype**, anam. cult.; ex H.B. 8784, M-0276495, **holotype**). — **SOUTH AFRICA**: **Eastern Cape** (border to Western Cape), Cape Mts., 77 km E of Knysna, Tsitsikamma, Garden Route, 1.5 km NE of Stormsriver, near 'Big Tree', 265 m, log of indet. ?angiosperm, on bark, 17.II.2000, V. Kummer (H.B. 6661).

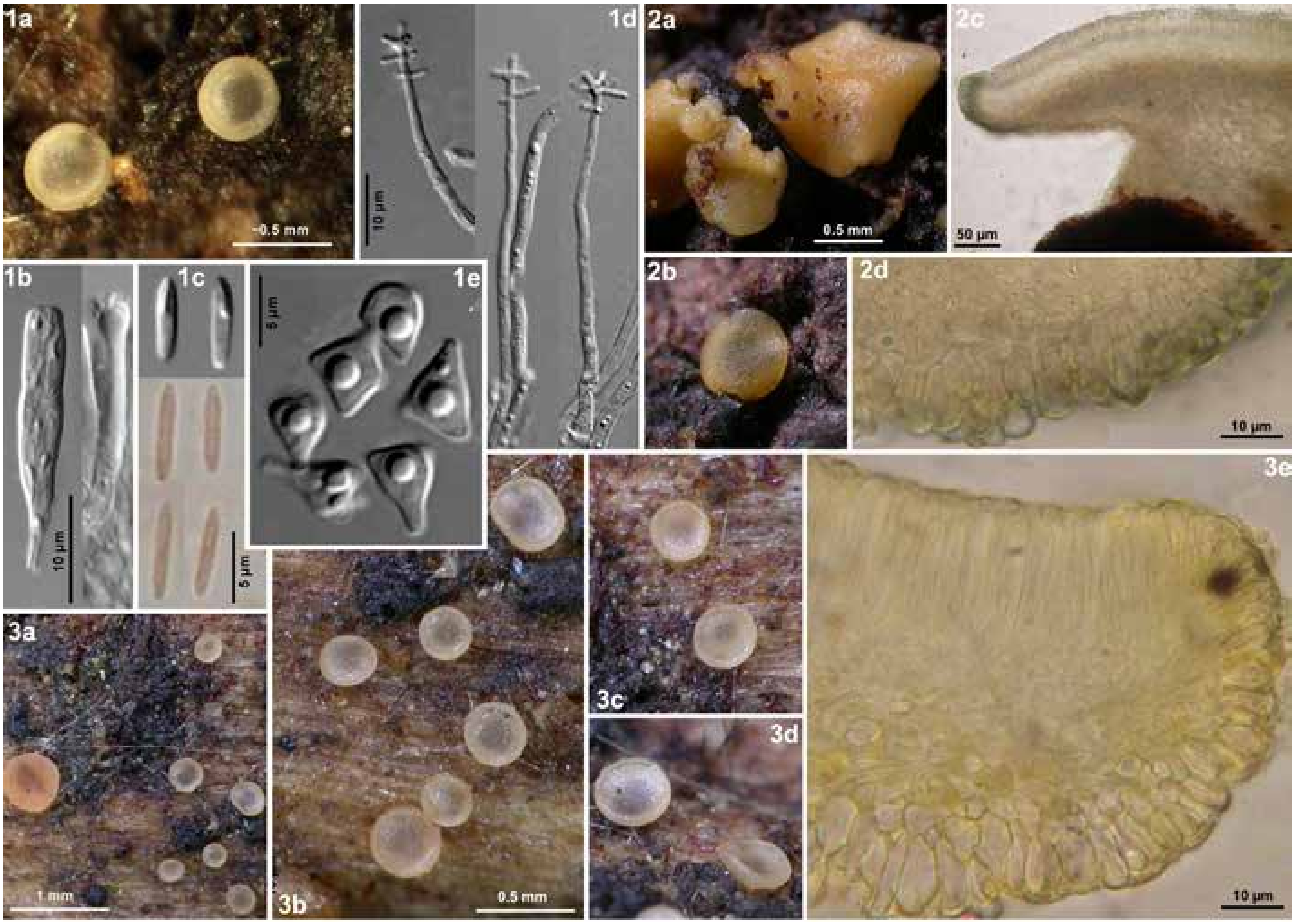


Plate 559. **1–3**: *Orbilia jinguangsiensis*. – **1a**. fresh apothecia; **2a–b**, **3a–d**. rehydrated apothecia; **2c**. apothecium in median section; **2d**, **3e**. id., ectal excipulum (flanks and margin); **1b**. mature ascus and paraphysis; **1c**. ascospores; **1d**. conidiophores (from culture); **1e**. conidia. – Living state, except for **1b** (ascus), **1c** lower spores (in KOH+CR), **2c–d**, **3e** (in KOH), **1d** (in H_2O). – **1a–e** (**1c** upper 2 spores, DIC): phot. H.Y. Su. — **1a–e**. H.B. 8784 (holo/isotype): China, Yunnan, Dali, on indet. angiosperm; **2a–d**. H.B. 6661: South Africa, on indet. angiosperm; **3a–e**. H.B. 8766b: China, Yunnan, Dali, on *Pinus*.

Orbilia sinensis (Z.F. Yu & K.Q. Zhang) Baral, Z.F. Yu & E. Weber, in Zhang et al., Phytotaxa 203: 252 (2015) — Pls 560–561

≡ *Pseudotripoconidium sinense* Z.F. Yu & K.Q. Zhang, in Yu et al., Mycologia 103: 168, figs 1–23 (2011).

Etymology: *sinensis*: after the geographical origin, China.

Typification: China, Yunnan, Xiaoheijiang, branch of indet. tree, 9.VI.2005, M. Qiao (YMF 1.01843, holotype; ex-type culture: CBS 121220; sq.: MH179519, DQ480727).

Misapplied name: Liu (2006: 102, fig. 40, HMAS 96782) and Liu et al. (2006b: 116, fig. 4), as *O. rectispora*.

Description: — **TELEOMORPH**: **Apothecia** fresh 0.35–1(–1.5) mm diam., 0.18–0.28 mm high (receptacle 0.12–0.16 → 0.08–0.1 mm), pale yellowish-cream to usually light carneous-rose pr almost whitish, slightly to strongly translucent, round to somewhat undulating, medium scattered to subgregarious; disc slightly concave to slightly convex, margin thin, not protruding, smooth; sessile or with a ± obconical stipe 0.1–0.13 × 0.15–0.25 mm, superficial; dry light chlorinaceous-yellow to bright orange-rose. **Asci** *33–39 × 4–4.2 µm {1}, †(29–)33–40(–44) × 3–4(–4.8) µm {5}, 8-spored, spores *3–4-seriate, 3–5 lower spores inverted {4} (often mixed, sometimes apical spores inverted and lower spores not {2}), pars sporifera *14–18 µm long; **apex** (†) medium to strongly truncate (not indented, laterally not inflated); **base** with medium to very long, thin, flexuous stalk, L- or T-shaped. **Ascospores** *(7–)7.5–10(–11) × (0.8–)0.9–1.2(–1.3) µm {6}, †(7–)8–9.5 × 0.8–1.1(–1.2) µm {3}, narrowly cylindric-fusoid, apex subacute to acute, base not or slightly (rarely medium) attenuated, straight or slightly (rarely medium) curved or geniculate; **SBs** *(2.3–)3–4(–5) × (0.1–)0.2–0.4(–0.5) µm in situ {4} (~2.5–5.5 µm actual length), filiform to narrowly subulate, slightly to medium flexuous, overmature tear-shaped, ~1.5 × 0.5–0.6 µm wide. **Paraphyses** apically slightly to strongly capitate(-clavate), terminal cells *14–24 × 2.8–3.5(–4) µm {2}, †15–24 × 2–3.5 µm {2}, below apex *(1–)1.5–2 µm wide, lower cells *4–7.5(–10) × 2–2.8 µm {3}, †4–6 × 1.8–2.5 µm {1}; unbranched at upper septum. **Medullary excipulum** 10–15 µm thick, of dense small-celled textura intricata, sharply delimited. **Ectal excipulum** of (†) thin-walled to slightly (near medulla sometimes medium) gelatinized, indistinctly oriented t. globulosa from base to margin, 140–200 µm thick near base, cells of inner part */†(10–)20–30(–45) × (10–)18–25(–35) µm {3}, near cortex *10–17 × 9–14 µm {1}, near medulla †8–18 × 4–8 µm {1}; 20–25 µm thick near margin, oriented at an 80–90° angle to the surface, marginal cortical cells */†9–14(–16) × (5–)6–8(–10) µm {2}; **glassy processes** absent. **Anchoring hyphae** very sparse at base, */†2–3(–4) µm wide, walls 0.2(–0.3) µm thick {2}. **SCBs** not observed. **VBs** in terminal cells of paraphyses subglobose to very elongate, slightly or strongly refractive, hyaline {3}, also absent {1}; in marginal ectal excipulum absent. **Exudate** over paraphyses and margin absent or granular, ± firmly attached, 0.2–1 µm thick, hyaline. **— ANAMORPH**: pseudotripoconidium-like (from ascospore isolate {3}): **Conidiophores** erect, simple or occasionally branched, 110–140 µm high, 2.5–3.0 µm wide at base, gradually tapering to 1 µm near the tip, septate {1}; conidia formed either singly at the apex, or most often on 3–7 denticles, lateral denticles 1.5–2 × 1–2 µm, apical denticle 2.5–5 µm long. **Conidia** *5–9 × 3–4.3 µm {1} (including protuberances), inversely pyramidal, somewhat truncate at the base, with 2–3 nipple-shaped lateral protuberances at the distal end, containing 1–5 globose LBs of 1.3–2.5 µm diam. **Chlamydospores** frequently seen in older

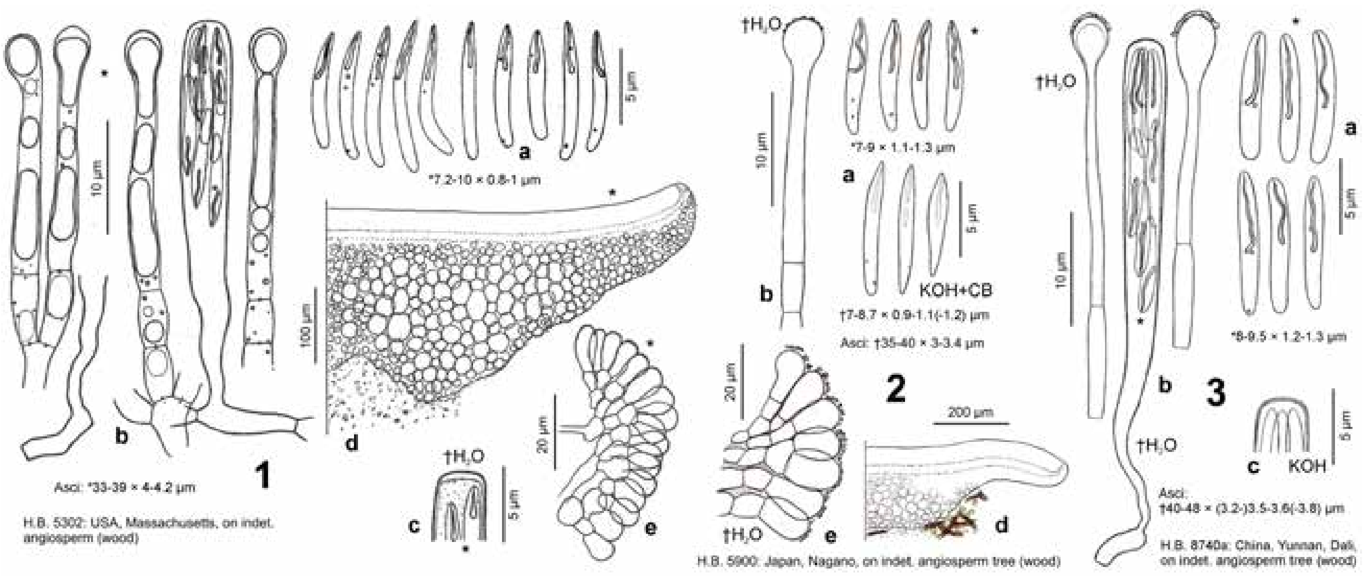


Plate 560. **1–2**: *Orbilia sinensis*; **3**: *O.* aff. *sinensis*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. apothecia in median section; **e**. id., marginal ectal excipulum.

cultures, subglobose to ellipsoid, *7.5–14.5 µm wide, containing 1–3 ± large LBs, forming intercalary chains.

Habitat: on damp ground adjacent to a pond, decorticated, 5–6 cm thick branches or ~20–30 cm thick logs of *Abies* sp. {1}, *Fagus sylvatica* {1/1}, *Populus* {1}, *Ulmus* sp. {2}, indet. woody angiosperms {3}, indet. trees {2}, on wood {6} or bark {2}, partly on underside, wood 1 mm deep or much deeper medium to strongly decayed, strongly greyed, with some or many green algae. **Associated**: *Orbilia epipora* {1}, *O. nemaspora* (on different log of same tree) {1}. **Desiccation tolerance**: fully alive after dry for ~½ day but dead after 8 days, spores viable after 1 month. **Altitude**: 45–1025 m (northern USA, Europe), 720–3100 m (eastern Asia). **Geology**: China: Jurassic-Cretaceous & Tertiary sedimentary and mafic volcanic rock; USA: Archean to Ordovician-Silurian granite; Europe: serpentinite near Cretaceous flysch, Eocene siliceous sandstone & shale. **Phenology**: I, V–VIII.

Taxonomic remarks. *Orbilia sinensis* closely resembles *O. luteorubella* and *O. rosea* from which it differs in distinctly narrower, more cylindrical ascospores and slightly narrower SBs. O. *jinguangsiensis* (Pl. 558–559) is tentatively separated by its shorter and wider spores and shorter SBs. *O. subuliformis* (Pl. 557: 1) differs in smaller, especially shorter spores, and in the upper spores inverted within the asci. For the very similar *O. tenuispora* see below. *O.* aff. *fusiformis* differs in much wider spores and the upper spores being predominantly inverted. *O. sinensis* and also *O. tenuispora* have been confused with *O. rectispora* (section *Arthrobotrys*), although the latter species can easily be distinguished in the living state by globose SBs. Yu et al. (2011) named the teleomorph of the present species *O.* aff. *luteorubella* because of a close similarity in the teleomorph and a very different anamorph.

Variation. *O. sinensis* varies in spore size among the included collections, particularly in width. The E-Asian specimens tend to have wider spores, also the asci are partly wider. The shape of SBs is unknown in the collection from Caucasus (Pl. 561: 2) because it was only studied in the dead state. Spore orientation was variable in two specimens (H.B. 5302, Massachusetts; 15.VIII.2008, Laojunshan), with the upper instead of the lower spores being inverted in some asci. The Japanese specimen (Pl. 560: 2) deviates from the other examined collections in a distinctly gelatinized inner part of the ectal excipulum, also in wider spores, and comes herewith close to *O. jinguangsiensis*.

Yu et al. (2011) described the apothecia in the type specimen as rather large (0.7–2 mm diam.). Yet, they did not add a scale to their macrophoto (Pl. 561: 1a), and the sectioned apothecium on their fig. 2 has a wrong scale. That scale yields a diameter of only 185 µm, hence the correct size of the apothecia remains unclear.

Kumar et al. (2012) investigated with the TEM an *Orbilia* sp. which according to their molecular data clearly belongs to the *O. sinensis* clade. The spores were given as 7.35–8.33 × 1.23 µm, and the SBs 3 × 0.5 µm. However, according to the scale on the TEM images the data would be 5–6 × 0.9–1 µm and 1.8–2.4 × 0.4 µm, respectively. On their LM image (fig. 1) the scale is not 5 µm as indicated in the legend but more probably 10 µm, and spore length would then range around 10 µm.

Two samples on *Fagus* from Spain and Serbia (IVV: 15.V.2017, 20.VIII.2019) represent the only known European records of series *Pseudotripoconidium*. They fit so well the collection from Massachusetts, that we have included them in the description of *O. sinensis*.

Not included collections. A sample from Hong Kong (W.H. Ho, IVV: VI.1997) might be conspecific, but here no spore size is known, therefore it could also be *O. tenuispora*. A record from Taiwan (IVV: H.B. 7258) is only known in the dead state, therefore, spore orientation was difficult to discern (apparently the lower spores are mostly not inverted). Another collection (Pl. 560: 3) which grew in association with the similar *O. tenuispora* deviates in consistently obtuse spore apices.

Spore length in two Spanish collections on *Fraxinus* (Pl. 561: 5–6) is at the upper end of the range (*7.5–11 × 1–1.2 µm), approaching *O. tenuispora*. Since no sequence data could be gained from them and the anamorph is unknown, their identity remains uncertain.

Misapplication. From various provinces of China, Liu (2006: 102) reported 10 collections under the name *Orbilia rectispora*, a species treated by us in series *Neodactylella* of section *Arthrobotrys*. Two of them originate from Tibet (at 3100–3500 m altitude), and the remaining from Beijing, Hunan, Yunnan, Anhui, Hubei, and Zhejiang (at 600–1300 m). Liu (2006) and Liu et al. (2006b) reported a globose SB at one end of the spores, but living spores were seen by B. Liu (pers. comm.) only in a

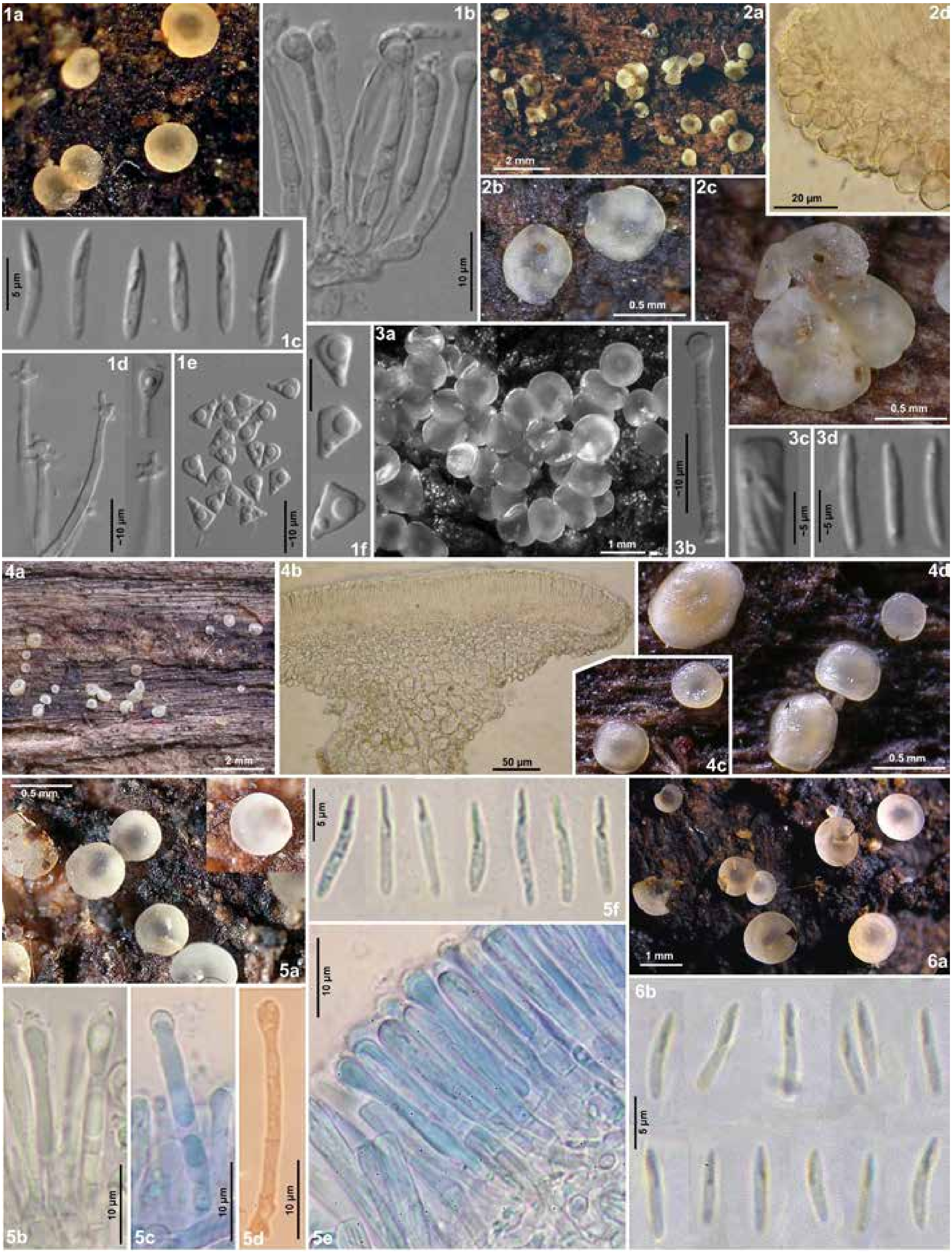


Plate 561. **1–4**: *Orbilia sinensis*; **5–6**: *O*. cf. *sinensis*. – **1a**, **3a**, **5a**, **6a**. fresh apothecia; **2a–c**, **4a**, **c–d**. rehydrated apothecia; **4b**. apothecium in median section; **2d**. id., marginal ectal excipulum; **1b**, **3b**, **5b–d**. paraphyses; **5e**. asci and paraphyses; **3c**. ascus apex; **1c**, **3d**, **5f**, **6b**. ascospores; **1d**. conidiophores (from culture); **1e–f**. conidia. – Living state (**5c**, **e** in CRB), except for **3b–d** (in H_2O), **4b** (in KOH), **5d** (in CR). – **1a–f**: from Yu et al. 2011 (DIC), **3a–d**: from Liu et al. (2006b, DIC), **5a–f**: phot. E. Rubio, **6a–b**: phot. J. Martin. — **1a–f**. YMF 1.01843 (holotype): China, Yunnan, Pu'er, indet. branch; **2a–d**. H.B. 7990: Azerbaijan, on *Ulmus*; **3a–d**. HMAS 96782: China, Tibet, Nyingchi, on *Abies*; **4a–d**. H.B. 5900: Japan, Nagano, on *Populus*; **5a–e**. E.R.D. 6143/H.B. 10043: Spain, Asturias, Obaya, on ?*Fraxinus*; **6a–b**. H.B. 10015: Spain, País Vasco, Tolosa, on *Fraxinus*.

few of the collections, and his photographs of the collection from Tibet show apparently only dead spores of 7–10 × 0.9–1.2 µm. At least one of the Tibet collections (Liu 2006, Liu et al. 2006b fig. 4, HMAS 96782) is treated here as *O. sinensis*, two further as *O. tenuispora* (see p. 1009).

Anamorph. Yu et al. (2011) described the new genus and species *Pseudotripoconidium sinense* based on an anamorph which was at that time very distinctive and unique within *Orbilia* and which the authors obtained in ascospore isolates of four collections from Yunnan, China. However, two of them are regarded here as belonging to other, closely related species (see below). Another collection included by us in *O. sinensis* (ljs-1, from Dali) also produced this type of anamorph, but the culture was contaminated and not documented (H.Y. Su pers. comm.). The conidia of *O. sinensis* as seen in the holotype (YMF 1.01843) and paratype (YMF 1.03475) might be characteristic in showing distinct though not or only slightly protruding protuberances in the living state, whereas in the dead state under the SEM they protrude strongly.

Phylogeny. Within the present concept of *O. sinensis* the available five ITS sequences are remarkably different. Three geographically remote samples (YMF 1.03475 from Yunnan, HMAS 96782 from Tibet, MIN 921434 from Minnesota) are almost identical in the ITS region, differing from each other by only 1–3 gaps, whereas two further samples (YMF 1.01843 from Yunnan [type of *O. sinensis*], D.H.P. 146 from Massachusetts), show about 3% distance to those and even 4% between each other. The S1506 intron is absent in the Minnesota strain, while in the remaining sequences its absence is uncertain. The two available LSU sequences (type of *O. sinensis* D1–D3, strain from Tibet D1–D2) differ in the D1–D2 by 3.5%, although both differ from *O.* aff. *sinensis* (Benedict's strain) and *O.* aff. *fusiformis* (YMFT 1.01848) by only 2.3–2.7%.

For the type of *O. sinensis* also SSU V1–V3 and two LSU D1–D3 sequences exist in GenBank: MH179519 and DQ480728 (as YMF 1.01843), and MH877761 (as CBS 121220). However, the latter two LSU sequences differ by 13 nt (9 in D1–D2). MH877761 is closer to *O.* aff. *fusiformis* (CBS 121221, EF026115, YMF 1.01848), differing by only 7 nt, of which 5 adjacent nt in the D2 of *O.* aff. *fusiformis* are perhaps erroneous. A confusion seems likely and MH877761 probably refers to CBS 121221 and provides a cleaner LSU version of that strain, whereas the true LSU sequence of the type of *O. sinensis* (CBS 121220) does not exist in the CBS database. LSU exists also for D.H.P. 146 (R. Healy pers. comm.) but was not available.

O. sinensis as circumscribed here differs by 5–6.5% from *O. tenuispora* and *O.* aff. *fusiformis*. The sequence from Tibet (ITS+LSU) was obtained by B. Liu from a sample on *Abies* and named *O. rectispora* (illustrated in Liu 2006: fig. 40 and Liu et al. 2006b: fig. 4). It clustered in Liu et al.'s (2006a) ITS analysis with D.H.P. 146 (as *O. luteorubella*) in a clade, whereas another of Liu's strains under the name *O. rectispora* (from Zhejiang, here referred to *O. tenuispora*) and one under the name '*O. vinosa*' (without morphological data, 'Benedict's strain') are found more distantly. In Liu et al.'s analysis of LSU, the Tibet strain clustered sister to two strains referable to *O. tenuispora* by showing a distance of 2.5–3% in that gene region.

Benedict's strain has been deposited in 1972 under the name *O. vinosa* in different culture collections (CBS 917.72, AFTOL-ID 905, CCRC/BCRC 33149), and sequences of it were included in the past in various phylogenetic analyses. This strain shows in the ITS region a distance of 4–5% to *O. sinensis* and 6.5% to *O. tenuispora* and *O.* aff. *fusiformis*. In the LSU (D1–D2) it is closer to *O. tenuispora* (1.8–2%) than to *O. sinensis* (2.3%). Therefore, we hesitate to include it in the scope of either species, but refer to it as *O.* aff. *sinensis* because of the distinctly lower ITS distance to this species. Sequences of it were submitted to GenBank by Liou & Tzean (1997; U51981, ITS), James et al. (2006; DQ491511, ITS), and Spatafora et al. (2006; DQ471000, entire SSU; DQ470952, LSU D1–D3; DQ471071, EF1a; DQ471145, RPB1). The culture was obtained by R.G. Benedict, but its geographical origin could not be clarified. Probably it derives from USA, since Benedict worked at that time at the University of Washington in Seattle (the same applies to a strain which he identified as *O. coccinella*, see under *O. dryadum*, p. 1390).

Ecology. *O. sinensis* was found on rotten wood but also bark of hygric to semiaquatic branches and logs of different angiosperm trees but also *Abies* at lakes or ponds and streams in cold-temperate to suprasubmediterranean humid deciduous forests of midwest North America and southern Europe (Spain, Balkan, Caucasus), and in continental, orotemperate (altimontane) humid (winter-dry) areas in southern and eastern Asia (Himalaya, Japan). Further included but also not included collections are from subtropical humid (winter-dry), evergreen broad-leaved mountain forests of southern China and Taiwan. The two not included European collections on *Fraxinus* are from thermo- to mesotemperate humid atlantic lowlands of northern Spain.

Specimens included. **USA**: **Massachusetts**, Middlesex, 2.8 km NNE of Concord, Punkatasset Hill, Hutchins Pond, 45 m, log of *Ulmus*, on wood, 12.VII.1995, D.H. Pfister & S.H. Goldbarg (D.H.P. 146 [0.126], FH 00458178, H.B. 5302; sq.: U72607). – **Minnesota**, Kittson, ~25 km ESE of Hallock, Lake Bronson, 300 m, wood of indet. tree, 15.VIII.2009, [?T.K.A. Kumar] (MIN 921434; sq.: JN088481, doc. vid.). — **SPAIN**: **Aragón**, **Huesca**, 16.5 km E of Sabiñánigo, E of Bergua, 1025 m, branch of ?*Fagus sylvatica*, on bark, 15.V.2017, J. Castillo (doc. vid.). — **SERBIA**: **Vojvodina**, Fruška Gora, 12 km SSW of Novi Sad, 5.5 km SSE of Racovac, Zmajevac, 472 m, branch of *F. sylvatica*, on wood, 20.VIII.2019, D. Savić (doc. vid.). — **AZERBAIJAN**: **Shaki-Zaqatala**, Caucasus Mts., ?N of Zaqatala, 'Kordon', 800 m, log of *Ulmus*, on wood, 10.VIII.1974, B. Kullman (TAAM 68181, as *Tilia platyphylla*, H.B. 7990 ø). — **JAPAN**: **Honshu**, **Nagano**, Chiisagata-gun, 16.5 km NE of Ueda, 1 km SE of Sugadaira, Arboretum in Sugadaira Montane Research Center, 1325 m, log of *Populus*, on wood, 21.VIII.1997, T. Hosoya (H.B. 5900). — **CHINA**: **Tibet** (Xizang), **Nyingchi** (Linzhi), 35 km ESE of Bomê (Bomi), 0.3 km NE of Songzong, 3100 m, on wood of *Abies*, 18.VI.2004, B. Liu (B.L. X069, HMAS 96782, as *O. rectispora*, doc. vid.; sq.: DQ656642, DQ656676). – **Yunnan**, **Pu'er**, Ning'er, 64 km N of Pu'er, 25 km SE of Jinggu, Xiaoheijiang, ~1100 m, branch of indet. tree, 9.VI.2005, M. Qiao (Z.F.Y. pe-14, YMF 1.01843, **holotype**, CBS 121220, anam. cult., doc. vid.; sq.: MH179519, DQ480727, DQ480728). – **Dali**, Lijiang, 59 km WSW of Lijiang, NW of Jinmugu, Laojunshan, 2700 m, branch indet. angiosperm, on bark, 15.VIII.2008, H.Y. Su, X.J. Su & X.N. Zhao (H.Y.S. ljs-1, CBCD, anam. cult., doc. vid.). – **Kunming**, ~12 km NE of Kunming, Songhuaba, ~2000 m, branch of indet. angiosperm, 15.VIII.2008, S.F. Li (Z.F.Y. k-2, YMF 1.03475, anam. cult.; sq.: GU188276, doc. vid.; in Yu et al. 2011 erroneously as 'Tonghai, Xiushan, 15.IX.2008'). – **Taiwan**, **Kaohsiung**, 54 km NE of Kaohsiung, 6 km ESE of Liouguei, Shanping, 720 m, branch of indet. angiosperm, 24.I.2005, Y.C. Su (TMUE S050124T2, TNM, doc. vid.).

Not included. **SPAIN**: **País Vasco**, **Gipuzkoa**, 7.5 km NNW of Tolosa, 2.3 km W of Asteasu, Zelatun river, 190 m, branch of *Fraxinus*, on bark, 2.VII.2016, J. Teres & J. Martin (ARAN-F 04034, doc. vid., H.B. 10015 ø). – **Asturias**, 36 km ESE of Gijón, 3.7 km SE of Colunga, S of Gobiendes, Obaya, 40 m, branch of *Fraxinus excelsior*, on bark, 8.III.2014, E. Rubio (E.R.D. 6143, H.B. 10043, doc. vid.). — **CHINA**: **Yunnan**, **Kunming**, 12 km SW of Kunming, SW of Bijizhen, Xishan, 2050 m, branch of indet. angiosperm, on wood, 20.VI.2007, S.F. Li, vid. Z.F. Yu (Z.F.Y. tw6-17, H.B. 8740a). – **Hong Kong**, unlocalized, VI.1997, branch of indet. tree, W.H. Ho (doc. vid.). – **Taiwan**, **Kaohsiung**, 50 km NE of Kaohsiung, ~5 km S of Liouguei, 200 m, branch of indet. angiosperm, on wood, 11.IX.2002, R. Kirschner (H.B. 7258).

Orbilia tenuispora E. Weber, Baral, H.Y. Su, M.L. Wu, Y.C. Su & Bin Liu, **sp. nov.**, MB 813653 — Pls 562–563

Etymology: named according to the narrow ascospores.

Typification: China, Yunnan, Jinguangsi, branch of indet. angiosperm, 8.XII.2007, H.Y. Su, R.X. Bi & J. Li (ex H.Y.S. jgs-11, CBCD, holotype).

Misapplied names: Liu (2006: 102, HMAS 139702, 139707), as *O. rectispora*; Schweinitz (1832: 177 p.p.), as *Peziza vinosa*; Seaver (1911: 108), as *O. vinosa*.

Latin diagnosis: Orbiliae aciculari *similis sed ascosporis minoribus, basi plerumque non vel leniter attenuatis, conidiis plures protuberantias mastoideas longiores ferentibus, ab* Orbilia sinensi *ascis et ascosporis longioribus, conidiis plures protuberantias mastoideas multo longiores ferentibus differt.*

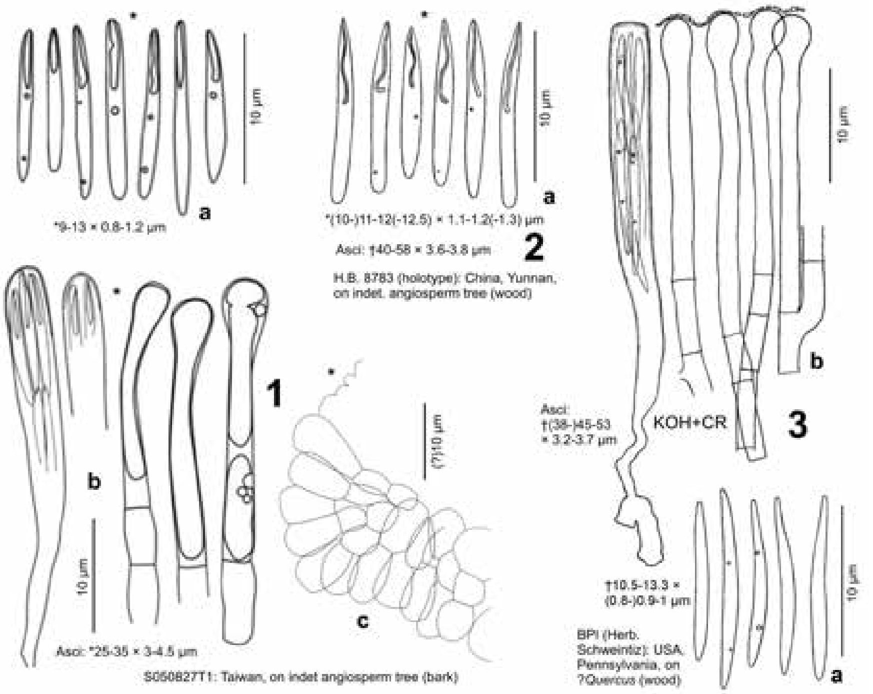


Plate 562. **1–3**: *Orbilia tenuispora*. – **a**. ascospores; **b**. asci and paraphyses; **c**. marginal ectal excipulum in median section. – **1a–c**: del. Y.C. Su.

Description: — **TELEOMORPH**: **Apothecia** fresh or rehydrated (0.25–)0.35–0.9(–1.1) mm diam., 0.1–0.21 mm high (receptacle 0.06–0.1 → 0.05–0.075 mm), whitish to pale or light cream to greyish- or yellowish-ochraceous, sometimes with a reddish tint, translucent, therefore darker in centre, round, scattered to gregarious; disc slightly concave to flat or medium convex, margin thin, not protruding, smooth; sessile on a broad base or with a distinct broad stipe 0.05–0.1 × 0.2–0.4 mm, superficial; dry light yellowish to orange-rose. **Asci** †(36–)38–55(–58) × (3.2–)3.4–3.8(–4) µm {7}, 8-spored, spores †1–4-seriate, ~4 lower spores inverted {4} (often mixed, sometimes some lower spores not inverted), pars sporifera †26–34 µm long; **apex** (†) strongly truncate (sometimes slightly indented, laterally not or slightly inflated), hemispherical in side view, thin-walled; **base** with medium to very long, thin, flexuous stalk, T- to L-shaped. **Ascospores** *(8.5–)10–12(–13) × (0.9–)1–1.2(–1.3) µm {7}, †((7.5–))(9–)9.5–11.5(–13.5) × (0.8–)0.9–1.2(–1.3) µm {6}, narrowly cylindric-fusoid (acicular), apex subacute to acute or obtuse, not or slightly to medium tapered towards base, base rounded to obtuse, sometimes subacute, straight to very slightly curved; **SBs** *(4–)4.5–6(–6.5) × 0.2–0.4(–0.5) µm in situ {3}, filiform, straight or slightly to medium flexuous, rarely uncinate, with a few minute LBs. **Paraphyses** apically slightly to strongly clavate-capitate, terminal cells *17–25 × 2.8–4(–5) µm {2}, †18–25(–29) {3} × (2.2–)2.5–3.7(–4.2) {5} µm, lower cells *4–7 × 1.8–3 µm {2}, †(3.5–)4–6(–7) × 1.4–2.2 µm {2}; unbranched at upper septum. **Medullary excipulum** hyaline, 20–30 µm thick, of dense, small-celled textura globulosa-intricata, medium to very sharply delimited. **Ectal excipulum** hyaline, of (†) ± thin-walled t. globulosa from base to mid flanks or margin, 40–140 µm thick near base, cells *10–30 µm diam., †9–19 × 7.5–10 {1} or 15–25 × 10–25 µm {2}; 15–20 µm thick near margin, of. t. prismatica-globulosa oriented at a 80–90° angle to the surface, marginal cortical cells *7–11 × 5–8 µm {2}, †(6.5–)8–11(–13) × (3.2–)4–6(–7) µm {6}; **glassy processes** absent (but sometimes with exudate caps). **Anchoring hyphae** ± sparse, rarely abundant, †2.5–4(–5) µm wide, walls 0.2(–0.3) µm thick {2}, when abundant forming a 60 µm thick, dense, slightly gelatinized t. intricata. **SCBs** in paraphyses globose, 0.8–1.3 µm diam. {1}; **VBs** in paraphyses and marginal cortical cells rather strongly refractive, large, globose to angular, later very elongate, hyaline, densely filling apical region of paraphyses {1}, or absent {1}. **Exudate** over paraphyses 0.2–0.5(–1) µm thick, rough to granular, also cap-like, very pale yellowish, firmly or more loosely attached, also absent, over margin and flanks 0.3–1.2 or sometimes 1–3 µm thick, cap-like. — **ANAMORPH**: pseudotripoconidium-like (from ascospore isolate {2}): **Conidiophores** erect, septate, unbranched, apically with ~4–6 prominent denticles. **Conidia** *6–8 × 5–6.5 µm {1}, †4.5–6 × 4–5.2 µm {1} (including protuberances), inversely pyramidal, at the distal end with 5–8 prominent lateral or sometimes terminal protuberances, containing 1 or 2 large LBs. **Chlamydospores** not observed.

Habitat: on moist or wet ground, corticated or sometimes decorticated branches of ?*Quercus* sp. {1}, indet. angiosperms {7}, indet. ?gymnosperm {1}, on medium to strongly decayed wood {3} and bark (periderm) {5}, mostly blackened, no algae. **Associated**: *Orbilia fusiformis* {1/1}, *O.* ?*sinensis* {1}. **Desiccation tolerance**: only a few spores alive after 3.5 months. **Altitude**: 100–2730 m a.s.l. **Geology**: Cambrian-Ordovician & Jurassic sedimentary and felsic plutonic rock. **Phenology**: IV, VI, VIII, X–I (probably throughout the year).

Taxonomic remarks. *Orbilia tenuispora* differs from *O. sinensis* mainly in longer asci and ascospores, and from *O. acicularis* in narrower asci and smaller spores. *O. tenuispora* appears to form a transition between the two species. However, differences are noted in the anamorph (see below).

Variation. Spore length was mostly in the range of 9–13 µm. Only in two collections (H.B. 8961a, 9985) a few 7.5 µm long spores were observed. Spore body shape varied from filiform, 0.2–0.3 µm wide (Yunnan: 2a) to vermiform-subulate, 0.4(–0.5) µm wide (Taiwan: Pl. 562: 1a, SBs apparently drawn a bit too wide; Pl. 563: 3b, d). The specimens from Taiwan and apparently also Kunming (qlx-6) differ from the remaining samples in a tendency to obtuse spore apices. The marginal cortical cells were given for the Taiwan sample as 10–20 × 8–15 µm (M.L. Wu pers. comm.), but on a photo of that sample (IVV: 27.VIII.2005) they do not exceed 9.5 × 8 µm, therefore, we assume that the scale in Pl. 562: 1c must be 10 µm rather than 20 µm, which would be in accordance with our data from other specimens. We have also reduced the spores in 1a by 90 %, because they then better fit the size evaluated by Y.C. Su for this collection.

Two collections from Spain with intermediate spore length (*7.5–11 × 1–1.2 µm) mentioned under *O. sinensis* might instead belong to *O. tenuispora*. However, due to the lack of molecular data this is uncertain and they even might belong to series *Helicoon*.

Misapplication. Among the 10 Chinese collections reported by Liu (2006: 102) under the name *O. rectispora*, two were reexamined in the present study (see Pl. 563: 7–8). Although

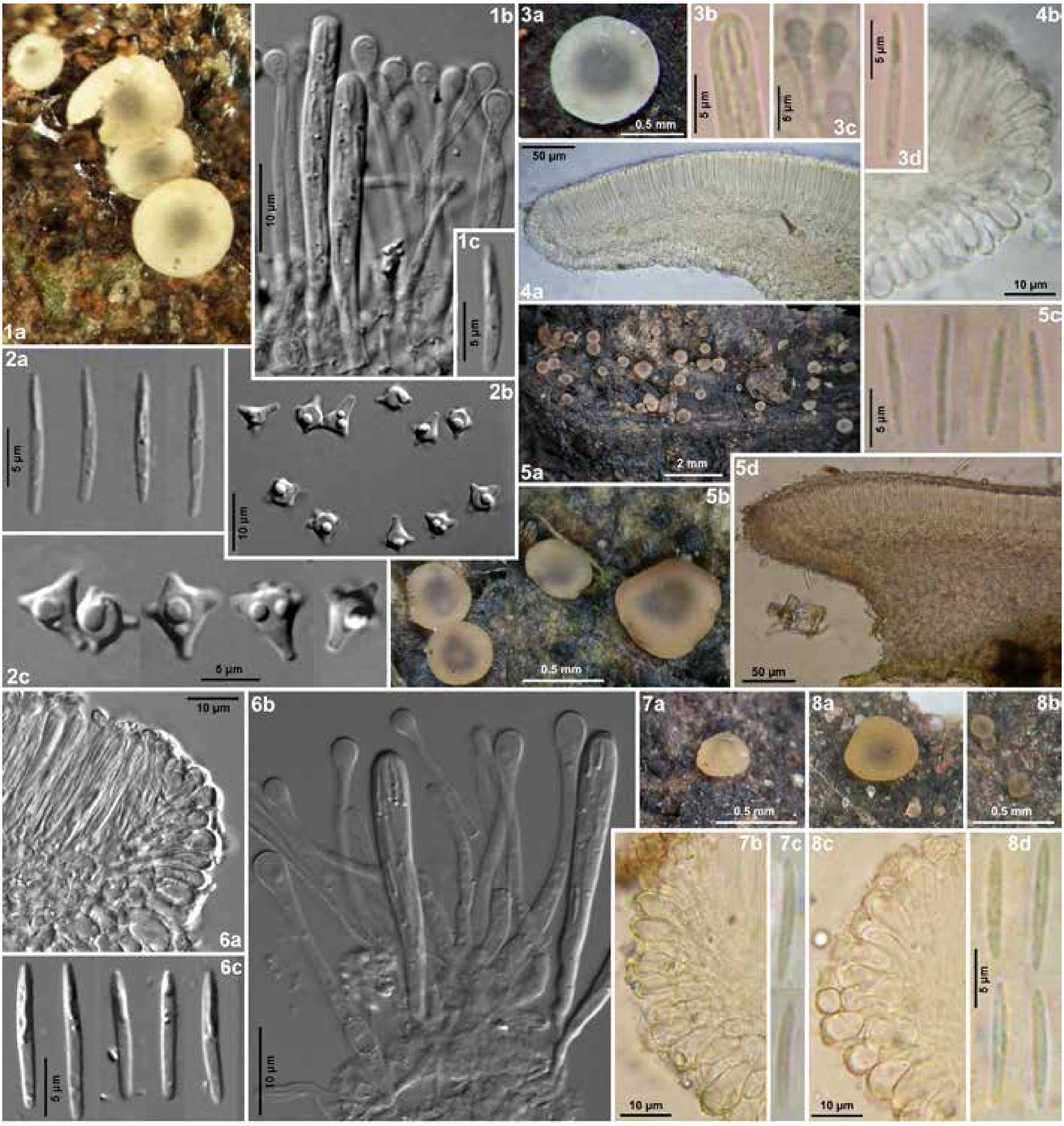


Plate 563. **1–8**: *Orbilia tenuispora*. – **1a**, **3a**. fresh apothecia; **7a**, **8a–b**. rehydrated apothecia (**8b** young); **4a**, **5d**. apothecia in median section; **4b**, **6a**, **7b**, **8c**. id., marginal ectal excipulum; **1b**, **6b**. paraphyses and mature asci; **3b**. ascus apex; **3c**. apices of paraphyses containing VBs; **1c**, **2a**, **3d**, **5c**, **6c**, **7c**, **8d**. ascospores; **2b–c**. conidia (from culture). – Living state, except for **5c–d**, **6a** (in H_2O); **4a–b**, **7b–c**, **8c–d** (in KOH), asci and paraphyses in **1b**, asci in **3b**, **6b**. – **1a–c**, **2a–c**: phot. H.Y. Su (DIC); **3a–d**: phot. Y.C. Su; **6a–c**: phot. S.F. Li (DIC). — **1a–c**. H.B. 8792b (H.Y.S. jgs-16): China, Yunnan, Dali, on indet. angiosperm; **2a–c**. H.Y.S. jgs-11 (holotype): ibid., on indet. angiosperm; **3a–c**. TMUE S050827T1: Taiwan, on indet angiosperm; **4a–b**. BPI (925-182): USA, ?Pennsylvania, on *Quercus*; **5a–d**. H.B. 8961a: China, Yunnan, Dali, on indet. angiosperm; **6a–c**. H.B. 8740b (Z.F.Y. tw6-20): China, Yunnan, Kunming, on indet. angiosperm; **7a–c**. H.B. 9200: China, Zhejiang, Lin'an, on indet. angiosperm; **8a–d**. H.B. 9201: China, Yunnan, Xishuangbanna, on indet. angiosperm.

the two originated from very remote areas of China, they concur morphologically very well and also fit the type of *O. tenuispora*, especially in spore size (†9–11 × 1–1.3 µm). No trustable information on spore body morphology is available for these specimens, however, and this was the reason why they have been confused with the rather distantly related *O. rectispora*. Moreover, these 10 Chinese specimens are heterogeneous and include also *O. sinensis* (see Phylogeny).

A North American collection in the Schweinitz Herbarium under the name *Peziza vinosa* (Pls 562: 3; 563: 4) matches Chinese *O. tenuispora* quite well, but differs in more fusoid spores that are tapered at both ends though the widest part tends to be closer to one end. Spore shape, especially the slight curvature at the somewhat tail-like end, suggests that the SB was located in the broader end, but this is not sure since no traces of SBs could be seen in this old material. Due to the mentioned similarity with other samples, we here assume that the narrower, gradually attenuated spore end represents the spore apex. Spore orientation within the asci appears to be variable, with a possible tendency of the upper spores to point with their broader end upwards, but also the lower spores sometimes showed this orientation. A possibly unimportant difference to Chinese *O. tenuispora* lies in the much more abundant anchoring hyphae that form a thick, slightly gelatinized textura intricata. The specimen also resembles *O. acicularis*, which differs in distinctly wider spores. Seaver (1911: 108) reported under the name *O. vinosa* a specimen with ~10–15 × 1.5 µm large spores and gregarious, bright flesh-red apothecia 1–2 mm diam., which might belong to *O. tenuispora*.

Anamorph. Conidia were obtained in the type of *O. tenuispora* from Dali (H.Y. Su pers. comm.) and in a specimen from Kunming which was wrongfully included in *Pseudotripoconidium sinense* by Yu et al. (2011). They appear to differ from those of *O. sinensis* in having more (5–8 vs. 2–3) and distinctly longer protuberances (Pl. 563: 2b–c).

Phylogeny. Sequences from three ascospore isolates here referred to *O. tenuispora* were available: YMF 1.03007 (Kunming, SSU V1–V3, S1506 intron, ITS, LSU), HMAS 139703 (Zhejiang, ITS & LSU, S1506 intron region not covered), HMAS 139707 (Xishuangbanna, LSU). The Kunming strain was included by Yu et al. (2011) in *O. luteorubella*/*Pseudotripoconidium sinense*, whereas the other two samples were originally identified by Liu (2006) as *O. rectispora*. Another specimen identified by B. Liu as *O. rectispora* (from Tibet, HMAS 96782, Pl. 561: 3) is included here in the scope of *O. sinensis* based on shorter spores and deviating DNA data.

In the ITS region the two former strains show a distance of 2.5 %. In the LSU D1–D2 the three strains differ by 1–2 nt in the D2 domain. From *O. sinensis* these sequences differ by 5–6.5 % in the ITS and 2.5–3 % in the LSU, and from *O.* aff. *fusiformis* (YMF 1.01848) by 7–8.5 % in the ITS and 2.2 % in the LSU. Also Benedict's strain (CBS 917.72) differs from *O. tenuispora* by 6.5 % in the ITS and 1.8–2 % in the LSU.

Ecology. Schweinitz' collection from eastern North America is supposed to derive from a cold-temperate or warm-continental humid lowland climate with an altitude between 50 and 500 m. Collections from southern China are from evergreen broad-leaved forests in subtropical humid (winter-dry) highlands, those from eastern China and Taiwan from comparable subtropical monsoon forests at lower altitude. Also in the lowland collection from Ibaraki (Japan) the climate is humid (winter-dry) and almost subtropical.

Specimens included. **USA**: **?Pennsylvania**, ?Bethlehem, branch of ?*Quercus*, on wood, undated, collector unknown (herb. Schweinitz 925-182, BPI, PH, H.B. 7603 ø). — **JAPAN**: **Honshu**, **Ibaraki**, 9 km WNW of Takahagi, Hananuki-keikoki, 325 m, indet. angiosperm wood, 21.VI.1991, T. Hosoya (TRL 910, TNS-F-56603, H.B. 9985 ø). — **CHINA**: **Zhejiang**, **Hangzhou**, 30 km WNW of Lin'an, Tianmushan, 700 m, branch of indet. angiosperm, on bark, 21.IV.2005, B. Liu, M.H. So & X.Z. Liu (B.L. 691, HMAS 139703, as *O. rectispora*, H.B. 9200 ø; sq.: DQ656641, DQ656702). – **Yunnan**, **Dali**, Yongping, 35 km ENE of Baoshan, Jinguangsi virgin forest, 2730 m, branch of indet. angiosperm, on wood, 8.XII.2007, H.Y. Su, R.X. Bi & J. Li (H.Y.S. jgs-11, CBCD, **holotype**, anam. cult.; H.B. 8783 ø). – ibid., branch of indet. angiosperm, on bark, 25.X.2008, H.Y. Su, X.M. Gao & Y.G. Yan (H.Y.S. jgs-30, CBCD, H.B. 8961a). – ibid., 19.I.2008, H.Y. Su, R.X. Bi & J. Li (H.Y.S. jgs-16, CBCD, H.B. 8792b ø, doc. vid.). – **Baoshan**, Tengchong, 2 km SE of Tengchong, Laifengshan, ~1800 m, indet. ?gymnosperm, VIII.2004, Z.F. Yu, (Z.F.Y. tc-22, doc. vid.). – **Kunming**, 12 km SW of Kunming, SW of Bijizhen, Xishan (in Yu et al. 2011 erroneously as 'Xiushan'), 2050 m, branch of indet. angiosperm, on ?wood, 20.VI.2007, S.F. Li (Z.F.Y. tw6-20, YMF 1.03007, anam. cult., CBS 125670, H.B. 8740b ø, doc. vid.; sq.: GU188277 as *O. luteorubella*, MH179529, MH875100 as *O. sinensis*). – 18 km NW of Anning, 6 km NE of Qinglongzhen, Qinglongxia (Yu'an Shan), 1925 m, branch of indet. (?)angiosperm, on bark, 3.XI.2004, Z.F. Yu (Z.F.Y. qlx-6, YMFT, doc. vid.). – **Xishuangbanna**, 43 km NNE of Jinghong, near Dadugangxiang, 1450 m, branch of indet. angiosperm, on bark, 12.XI.2002, B. Liu, Y. Yang & B. Wang (B.L. 6228, HMAS 139707, as *O. rectispora*, H.B. 9201; sq.: DQ656677). – **Taiwan**, **Kaohsiung**, 54 km NE of Kaohsiung, 6 km ESE of Liouguei, Shanping, 720 m, branch of indet. angiosperm, 27.VIII.2005, Y.C. Su (TMUE S050827T1, TNM, doc. vid.).

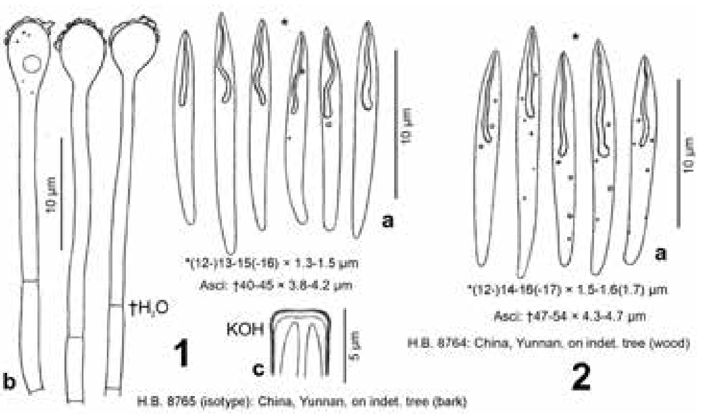


Plate 564. **1–2**: *Orbilia acicularis*. – **a**. ascospores; **b**. paraphyses; **c**. ascus apex.

Orbilia acicularis Baral & Hong Y. Su, **sp. nov.**, MB 831504 — Pls 564–565

≡ *Orbilia acicularis* Baral & Hong Y. Su, in Su et al., Mycol. Progress 10: 374, figs 1–2 (2011), nom. inval., ICN Art. 39.1 (Latin diagnosis missing)

Etymology: named after the straight needle-shaped ascospores.

Typification: China, Yunnan, Jinguangsi, branch of indet. angiosperm, on bark, 1.II.2008, H.Y. Su (ex H.Y.S. jgs-7, CBCD, holotype).

Latin diagnosis: *Apothecia 0.4-1 mm diam., superficialia, dispersa, sessilia, translucentia, pallide flava vel rosea, disco plano, margine laevi, non elevato. Asci in statu emortuo 40–59 × 3.8–5 µm, 8-spori, anguste cylindrico-clavati, basi angustati, furcati, apice truncati. Ascosporae 12–17 × 1.3–1.7 µm in statu vivo, non septatae, aciculares, apicibus acutis, corpusculum filiforme subulatum continentibus. Paraphyses apice valde capitatae. Status anamorphicus:* Pseudotripoconidium *sp. Habitat ad lignum et corticem putridum ramorum uvidorum arborum angiospermarum in zona subtropica humida Asiae meridio-orientalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.3–)0.4–1(–1.6) mm diam., 0.11–0.18 mm high (receptacle 0.1 → 0.08 mm), whitish or pale to light pink, also yellowish-cream (when fresh or rehydrated), translucent in centre, ± round, scattered to gregarious; disc flat, margin indistinct, not protruding, smooth; sessile on a narrow base or with a stipe 0.07–0.09 × 0.3 mm, superficial; dry somewhat undulating and inrolled, pale yellowish-cream or light rose-orange. **Asci** †40–52(–59) × 3.8–4.5(–5) µm {3}, 8-spored, spores (†)3–4-seriate, 2–4 lower spores inverted {1} (sometimes strongly mixed); **apex** (†) strongly truncate (not or very slightly indented, laterally sometimes slightly inflated); **base** with medium to long, thin, flexuous stalk, L-shaped. **Ascospores** *(11.5–)13–16(–17) × (1.3–)1.4–1.6(–1.7) µm {3}, †(10–)12–16(–17) × (1.2–)1.3–1.5(–1.7) µm {2}, narrowly fusoid (acicular), apex subacute to acute, base slightly to strongly attenuated, straight or sometimes slightly curved; **SBs** *(4–)5–6.5(–8) × 0.3–0.6 µm in situ {3} [5–7(–8.5) µm actual length], filiform to subulate, ± straight to often ± flexuous. **Paraphyses** apically medium to mostly (very) strongly clavate-capitate, rarely moniliform, terminal cells †19–28 × (2–)2.7–3.8 µm {2}, lower cells †6–7(–10) × 1.3–1.8 µm {2}; unbranched at upper septum. **Medullary excipulum** 20–30 µm thick, of medium dense textura intricata-globulosa, not or very slightly gelatinized, very indistinctly to sharply delimited. **Ectal excipulum** of (†) thin-walled to slightly gelatinized, indistinctly vertically oriented t. globulosa-angularis from base to margin, near base 50–90 µm thick, cells *10–20(–24) × 9–16 µm {1}, †8–15 × 6–13 µm {T}; 30–40 µm thick at flanks, 15–18 µm near margin, of t. globulosa-prismatica

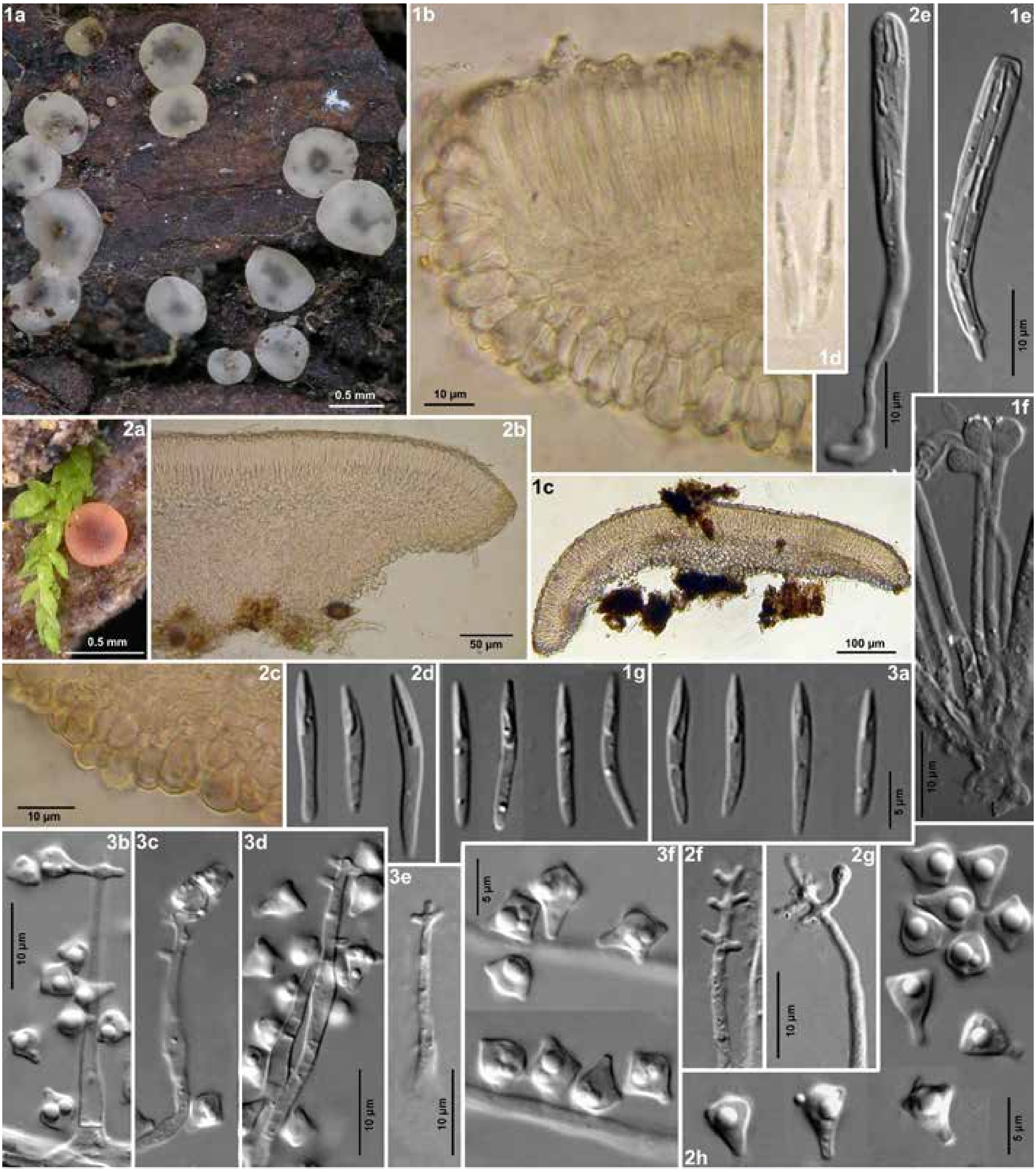


Plate 565. **1–3**: *Orbilia acicularis*. – **1a**, **2a**. rehydrated apothecia; **1c**, **2b**. apothecia in median section; **1b**. id., ectal excipulum near margin; **2c**. id., flanks; **1e**, **2e**. mature asci; **1f**. paraphyses; **1d**, **g**, **2d**, **3a**. ascospores; **2f–g**, **3b–e**. conidiophores with conidia; **2h**, **3f**. conidia (both from culture). – Living state, except for **1b–c**, **2c**, **2f–g**, **3e** (in H_2O); asci and paraphyses in **1e–f**, **2e**. – **1e–g**, **2d–h**, **3a–f**: phot. H.Y. Su (DIC). — **1a–g**. H.B. 8765 (**1e–g** from holotype, **1a–d** from isotype): China, Yunnan, Dali, on indet. angiosperm; **2a–h**. H.B. 8764: ibid., on indet. angiosperm; **3a–f**. H.Y.S. jgs-12: ibid., on indet. angiosperm.

oriented at 70–80°, marginal cortical cells *9–12 × 5–6 µm {1}, †10–14 × 5–8 µm {T}; **glassy processes** absent. **Anchoring hyphae** sparse, †1.5–3(–5.5) µm wide, walls 0.2(–0.3) µm thick {1}. **SCBs** in paraphyses globose. **Exudate** over paraphyses and margin 0.2–1(–2) µm thick, granular-cloddy to cap-like, hyaline, ± firmly attached. — **ANAMORPH**: pseudotripoconidium-like (from ascospore isolate {2}). **Conidiophores**, erect, ± branched, single branches 35–66 µm long {2}, 2.4–2.8 µm wide at base, 1.2–1.8 µm at apex, here with 2–7 denticles of 3.5–6 × 1–1.4 µm {2}. **Conidia** *4.7–7 × 3.6–5(–5.7) µm including protuberances {2}, inversely pyramidal, truncate at the base, with (2–)3–4 nipple-shaped lateral protuberances at the distal end, containing 1(–2) large LBs (~2–2.5 µm) and some small ones. **Chlamydospores** not observed {2}.

Habitat: lying on moist ground, corticated, ~15–20 mm thick branches of unidentified angiosperm trees {3}, on bark (bast and periderm) {1} or wood {2}, 0.5–0.8 mm deep medium to very rotten, partly darkened, green algae sparse or absent. **Associated**: indet. bryophyte. **Desiccation**

tolerance: some ascospores and many cells of ectal and medullary excipulum still viable after 2 weeks. **Altitude**: 2730 m a.s.l. **Geology**: Jurassic sedimentary rock. **Phenology**: XII, II.

Taxonomic remarks. *Orbilia acicularis* closely resembles *O. tenuispora* in having long and narrow, acicular ascospores with rather long, filiform to narrowly subulate SBs, and a pseudotripoconidium-like anamorph. Three samples of *O. tenuispora* (Pls 562: 2; 563: 1–2, 5) emanate from the very same virgin forest (Jinguangsi) where the three of *O. acicularis* have been collected. *O. acicularis* seems readily recognized by its rather long and wide spores. The spore size of *O. tenuispora* hardly overlaps with that of *O. acicularis*. For differences in the anamorph see below.

O. arcospora mainly differs in curved ascospores. The very distantly related *O. vinosa* (section *Hemiorbilia*) has also similar spores but differs in thick-walled, hemispherical ascus apices, apically much less inflated paraphyses, and a thicker exudate.

Variation. The three included collections differ from each other in ascus length and in apothecial colour (whitish vs. light pink), but only slightly in spore size. The spores are often attenuated towards the base, but untapered spore bases also occur.

Anamorph. The conidia of *O. acicularis* are very similar to those of *O. tenuispora* but deviate in shorter protuberances which are less in number. The published description of the anamorph in Su et al. (2011c) was copied by mistake from the protologue of *P. sinense* which deviates in several important details from the true data given above.

Ecology. *O. acicularis* was detected on hygric, ± rotten bark and wood of unidentified angiosperm trees in a subtropical humid (winter-dry), evergreen broad-leaved mountain forest in southern China.

Specimens included. **CHINA**: **Yunnan**, **Dali**, Yongping, 35 km ENE of Baoshan, Jinguangsi virgin forest, 2730 m, branch of indet. angiosperm, on wood, 8.XII.2007, H.Y. Su, R.X. Bi & J. Li (H.Y.S. jgs-12, CBCD, anam. cult., doc. vid.). – ibid., branch of indet. angiosperm, on wood, 1.II.2008, H.Y. Su (H.Y.S. jgs-8, anam. cult., H.B. 8764). – ibid., branch of indet. angiosperm, on bark, 1.II.2008, H.Y. Su (H.Y.S. jgs-7, CBCD, **holotype**; H.B. 8765, **isotype**).

Orbilia arcospora Baral & Hong Y. Su, in Su et al., Mycol. Progress 10: 377, fig. 3 (2011) — Pls 566–567

Etymology: named after the ascospores being curved like an arch.
Typification: China, Yunnan, Jinguangsi, branch of indet. angiosperm, 1.II.2008, H.Y. Su (H.Y.S. jgs-9, CBCD, holotype).

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.3–)0.5–1(–1.2) mm diam., 0.16 mm high (receptacle 0.1 → 0.07 mm), pale pink when fresh, rehydrated light rose-cream, translucent in centre, ± round, subgregarious; disc flat to medium convex, margin indistinct, not protruding, smooth; sessile on a rather narrow base, superficial; dry light rose-orange. **Asci** †41–53 × 3.4–4.4 µm, 8-spored, spores †2–3-seriate, ~3–4 lower spores inverted (mixed or not); **apex** (†) strongly truncate (very slightly indented, laterally sometimes slightly inflated); **base** with long to very long, thin, flexuous stalk, L- to Y-shaped. **Ascospores** *(8–)9–12 × 1.1–1.3 µm in situ (actual length ~10.5–14 µm), †(8–)9–12(–13) × 1–1.2 µm in situ, narrowly fusoid (acicular), apex obtuse to subacute, base slightly to rather strongly attenuated, (slightly to) medium to strongly curved (arcuate) in both living and dead state; **SBs** *4–5 × 0.3–0.4(–0.5) µm, filiform(-subulate), ± straight to often somewhat flexuous. **Paraphyses** apically strongly to very strongly clavate(-capitate), terminal cells */†24–27 × (2.5–)3–4.7 µm, lower cells †5–7.5 × 1.7–2 µm; unbranched at upper septum. **Medullary excipulum** 20 µm thick, of medium dense textura prismatica, horizontally oriented, sharply delimited. **Ectal excipulum** of (†) thin-walled (to slightly gelatinized), indistinctly vertically oriented t. globulosa-angularis(-prismatica) near base, here 50–80 µm thick, cells †13–23(–36) × 8–16(–20) µm; 25–30 µm thick at flanks, of vertical t. prismatica, 15–18 µm thick near margin, of t. prismatica oriented at 70–90°, marginal cortical cells *7–10(–12) × (3–)4–5 µm; **glassy processes** absent. **Anchoring hyphae** not examined. **SCBs** in paraphyses globose, 2–2.8 µm diam., in ectal excipulum not observed. **VBs** absent. **Exudate** over paraphyses and margin 0.3–1 µm thick, cloddy to cap-like, hyaline to very pale yellowish, firmly attached. — **ANAMORPH**: unknown (not formed in pure culture).

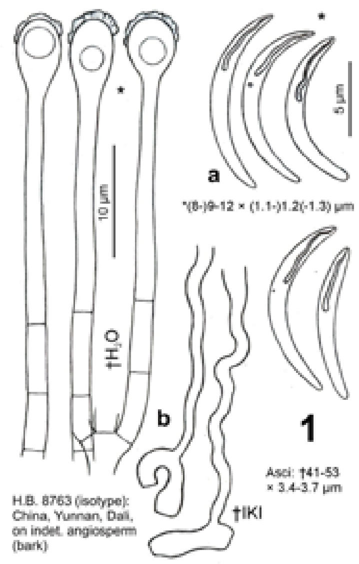


Plate 566. **1**: *Orbilia arcospora*. – **a**. ascospores; **b**. paraphyses and ascus bases.

Habitat: lying on moist ground, corticated, 10 mm thick branch of indet. angiosperm tree, on medium rotten bark (periderm), partially blackened, green algae very sparse. **Associated**: indet. bryophyte. **Desiccation tolerance**: some spores, paraphyses, ectal and medullary excipular cells still viable after 2 weeks. **Altitude**: 2730 m a.s.l. **Geology**: Jurassic sedimentary rock. **Phenology**: II.

Taxonomic remarks. *Orbilia arcospora* is easily recognized in the living state by its narrowly fusoid, strongly curved (arcuate) ascospores with long, filiform SBs. From *O. acicularis* it differs mainly in spore curvature. For the similar *O. falciformis* see p. 994. When studying herbarium material, *O. arcospora* may be confused with species of section *Arthrobotrys*, which differ in a more rounded spore apex, and in much shorter SBs.

In the protologue the apothecia were described as up to 1.9 mm diam., but we believe that this value is erroneous. The macrophoto in Su et al. (2011c: fig. 3a) is without a scale, but the very same apothecia were rediscovered in the isotype and were calibrated accordingly, showing a size of rehydrated 0.55–0.75 mm (Pl. 567: 1a–c).

Anamorph. Conidia were not obtained by H.Y. Su in pure culture of *O. arcospora*, therefore, a possible relation to series *Pseudotripoconidium* is derived from its similarity with *O. acicularis*.

Ecology. *O. arcospora* was detected on hygric bark of an unidentified angiosperm tree in a subtropical humid (winter-dry), evergreen broad-leaved mountain forest in southern China.

Specimens included. **CHINA**: **Yunnan**, **Dali**, Yongping, 35 km ENE of Baoshan, Jinguangsi virgin forest, 2730 m, branch of indet. angiosperm, on bark, 1.II.2008, H.Y. Su (H.Y.S. jgs-9, CBCD, **holotype**; H.B. 8763, **isotype**).

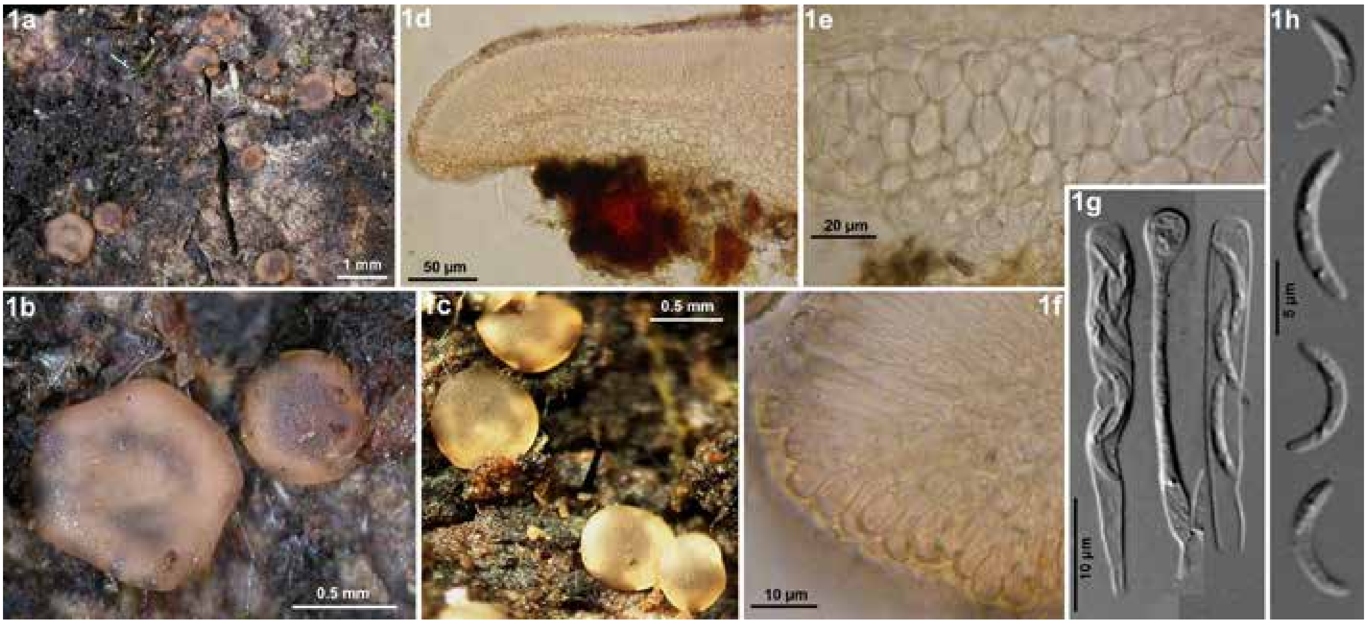


Plate 567. **1**: *Orbilia arcospora*. – **1a–b**. rehydrated apothecia; **1c**. fresh apothecia; **1d**. apothecium in median section; **1e**. id., basal ectal excipulum; **1f**. id., marginal region; **1g**. asci and paraphysis; **1h**. ascospores. – Dead state (in H_2O), except for spores in left ascus of **1g**, **1h**. – **1c**, **g–h**: phot. H.Y. Su (p.p. from Su et al. 2011c, DIC). — **1a–h**. H.B. 8763, H.Y.S. jgs-9 (holo/isotype): China, Yunnan, Dali, on indet. angiosperm.

Section *Habrostictis*

Orbilia subgenus ***Habrostictis*** section ***Habrostictis*** – Lectotype species: *H. rubra* Fuckel (= *Orbilia carpoboloides*)

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.1–)0.2–1(–1.8)((–4)) mm diam., pale to bright rose(-lilaceous) to (ochraceous-) orange-red, margin ± smooth or denticulate to fimbriate, sessile or with a short stipe, partly erumpent. **Asci** 8- up to 128-spored, *(29–)35–90(–123) × (4–)5–10(–12) µm, some or many of the lower (rarely upper) spores inverted; **apex** (†) slightly or mostly medium to strongly truncate, not or distinctly indented and/or laterally inflated, hemispherical in profile view, thin-walled; **base** only exceptionally H-shaped. **Ascospores** *(3.3–)4–17(–19.5) × (1.3–)1.6–4(–5) µm, cylindric, ellipsoid, ovoid, tear- to lemon-shaped, fusiform, or clavate, apex rounded to acuminate, straight to strongly curved, especially near base, **SBs** apically affixed to spore wall, rarely subapically (in a few taxa of series *Ellipsospermae*), (1.5–)3–10(–15) × (0.2–)0.3–1(–1.5) µm (actual length), filiform to vermiform or subulate, sometimes distinctly swollen below, straight to often ± flexuous or helicoid, sometimes uncinate, apically narrowed to a small point, filum absent or present. **Paraphyses** slightly to strongly inflated at the apex (clavate-capitate, spathulate, lageniform, mammiform), terminal cells (0.2–)0.5–1.5(–3)× longer than lower cells, unbranched or sometimes branched near apex. **Ectal excipulum** of vertically or indistinctly, sometimes horizontally oriented textura (globulosa-)angularis(-prismatica), (†) thin-walled or slightly gelatinized (common walls 0.3–1.5 µm thick); **glassy processes** absent, exceptionally with small refractive caps, **hairs** sometimes present. **SCBs** globose or mixed with crystalloid ones, also absent; **VBs** consistently absent; **carotenoids** in LBs rarely observed. — **ANAMORPH**: trinacrium-like, sometimes tridentaria- or rarely vermispora- to anguillospora-like. **Conidiophores** 3–30 µm long, unbranched or sometimes branched. **Conidiogenous cells** sympodial. **Conidia** unbranched (phragmosporous), slightly to medium curved, or often branched (staurosporous), with a stipe and 2–6 arms. **Trapping organs**: none observed.

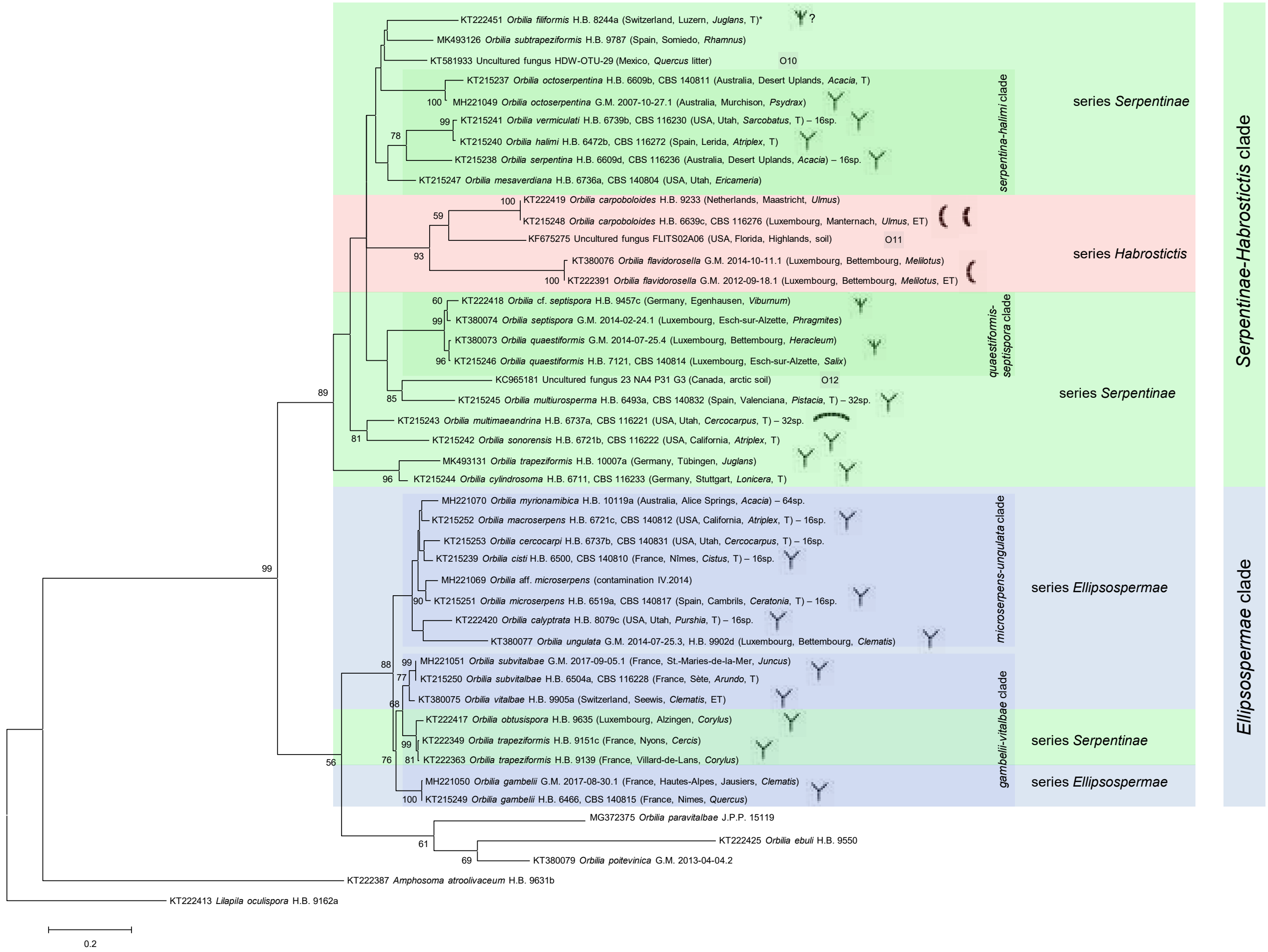
Habitat: all taxa desiccation-tolerant.

Recognized series: *Ellipsospermae*, *Habrostictis*, and *Serpentinae*, with 91 recognized species plus 2 with a provisional name and 18 unnamed species (‘affinis’).

Taxonomic remarks. Section *Habrostictis* includes in the present circumscription three series: *Habrostictis*, *Serpentinae*, and *Ellipsospermae*. Within the genus *Orbilia* it forms the largest section regarding taxa with a known teleomorph. Members of this group are characterized by ascospores containing elongate, usually filiform or vermiform to subulate, flexuous or helicoid, sometimes uncinate SBs which are apically narrowed to a small point and basally often ± inflated. Further characteristics are: always reddish, desiccation-tolerant apothecia, frequently multispored asci, ± equidistantly septate paraphyses being always apically ± inflated in mature apothecia, and the frequent presence of crystalloid SCBs. Glassy processes are consistently absent, though very small glassy caps irregularly occur in *O. jurana* and *O. ophiosoma*. *O. poitevinica*, a species with distinct glassy processes, would otherwise fit section *Habrostictis*, and *O. paravitalbae* closely concurs in its morphology with *O. vitalbae*, but both appear to belong to the paraphyletic section *Aurantiorubrae* based on their rDNA data.

Series delimitation. The three recognized series are largely founded on morphological criteria. Their delimitation is rather complicated because sharp limits are lacking and morphology not always supported by molecular data. The small series *Habrostictis* is characterized by paraphyses with spathulate to mammiform apices, a tendency to have septate hairs at the margin, apothecia that open rather late, and a vermispora-like anamorph. However, in many species of the two large series *Serpentinae* and *Ellipsospermae* a few spathulate paraphyses were often observed among the capitate-clavate ones, and in a few 16- or higher-spored taxa they even predominate. Moreover, a vermispora-like anamorph is connected to *O. multimaeandrina* of series *Serpentinae*.

Series *Serpentinae* and *Ellipsospermae* differ in spore shape. Typical members of series *Serpentinae* have fusiform, apically subacute to acute spores, whereas typical members of series *Ellipsospermae* have ellipsoid to fusoid, apically obtuse to rounded spores. However, a lot of exceptions confirm this rule. For instance, *O. quaestiformis* and *O. septispora* have rounded to obtuse spore apices but acute bases, and are nevertheless



Phylogenetic analysis 19. Phylogram of section *Habrostictis* inferred from ML analysis of ITS1-5.8S-ITS2 rDNA dataset (45 sequences, 726 positions, aligned with MAFFT) using the GTR+G model in MEGA6 (500 replicates). Three environmental strains from GenBank are included representing unidentified species (O10–O12). The tree is rooted with *Lilapila oculispora* and *Amphosoma atroolivaceum* and three members of section *Aurantiorubrae*. Asci 8-spored except when otherwise stated; T = type, ET = epitype, * = without most of ITS1, 5.8S and partial ITS2.

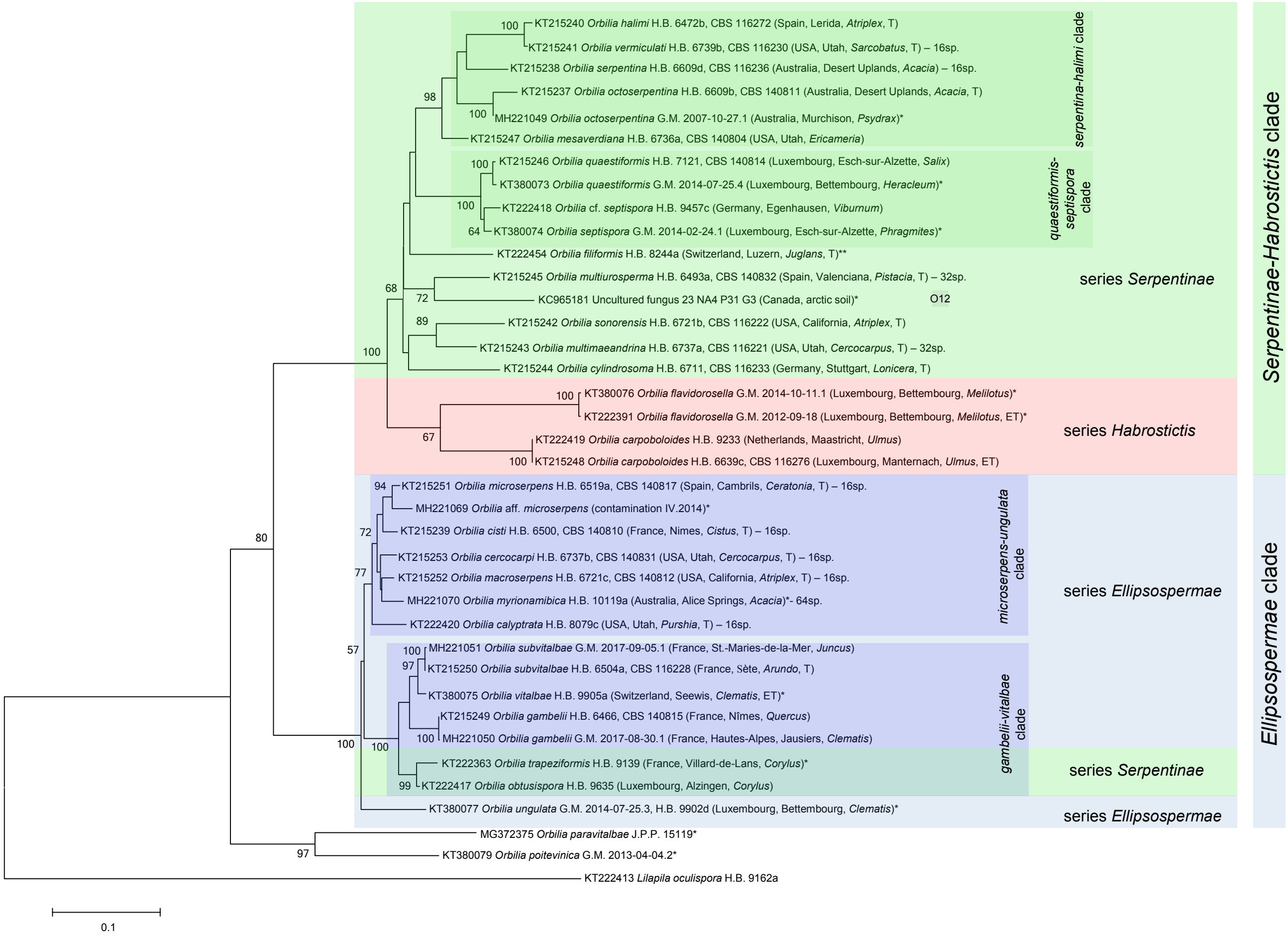
included in series *Serpentinae* (see also under Phylogeny). An option would be to place them in a separate series based on their tridentaria-like anamorph, but also *O. filiformis*, which has fusiform, apically acute spores and clustered in series *Serpentinae*, appears to have a tridentaria-like anamorph.

Anamorphs. Conidia are mostly staurosporous (trinacrium-like, sometimes tridentaria-like), but in series *Habrostictis* and in one species of series *Serpentinae* (*O. multimaeandrina*) they are phragmosporous (vermispora-like). Conidia of series *Serpentinae* and *Ellipsospermae* are very often of the *Trinacrium robustum*-type, being in most of the species quite consistent in shape, usually with tapering arms. Yet, this type of conidia occurs also in section *Hemiorbilia* (e.g., *O. montigena*). Tridentaria-like conidia were only observed in a few members of series *Serpentinae*, whereas two strains from CBS (as *Tridentaria implicans* and *T. subuliphora*) cluster in series *Orbilia*. The conidia of series *Habrostictis* resemble those vermispora-like conidia which occur in sections *Aurantiorubrae* and *Lentiformes*.

Conidiophores were only rarely observed. They are comparatively short, often irregularly flexuous, and usually only with one terminal conidiogenous locus, sometimes also with a few lateral scars. In *O. carpoboloides*, in contrast, conidiophores are remarkable in carrying densely aggregated short denticles.

Phylogeny. Sequences were available for only 31 % of the species of section *Habrostictis* known at present, comprising ITS and mostly also SSU and LSU. Our phylogenetic analyses confirm that the rather easily recognizable section *Habrostictis* forms a natural, strongly supported monophyletic group (Baral et al. 2017b, Phyl. 7). They also confirm that the type species of *Habrostictis* with spathulate to mammiform paraphyses and conspicuous hairs belongs to this group, in spite of its deviating features. Our analyses of SSU+ITS+LSU or LSU (Phyls 20, S22), suggest two sharply delimited, strongly supported, large monophyletic clades within section *Habrostictis*, which represent series *Serpentinae* and *Ellipsospermae* as we have morphologically defined them here, except that three species clustered in the 'wrong' clade, judging from their spore shape, and that the *Serpentinae-Habrostictis* clade, as we call it here, includes also series *Habrostictis*. In such cases, we have maintained our morphology-based system, although the molecular result was contradictory. In fact, many of the species have only once been treated by molecular methods, thus the present results are to be considered as preliminary. Moreover, a majority of species are without molecular data and we have not found a clue to recognize their affiliation in one of the two clades by morphology alone.

The above-mentioned exceptions suggest that the shapes of ascospore apex and paraphysis apex have a limited taxonomic value above species level. For instance, *O. obtusispora* is included in series *Serpentinae* because of the difficulty to separate it from *O. trapeziformis* and *O. subtrapeziformis*, in spite of its unequivocal molecular placement in series *Ellipsospermae*. The latter two species and the very similar *O. cylindrosoma*



Phylogenetic analysis 20. Phylogram of section *Habrostictis* inferred from combined ML analysis of SSU (V8–V9)+ITS1-5.8S-ITS2+LSU (D1–D2) rDNA dataset (38 sequences, 1677 positions, aligned with MAFFT) using the GTR+G+I model in MEGA6 (500 replicates). An environmental strain from GenBank is included representing an unidentified species (O12). The tree is rooted with *Lilapila oculispora* and two members of section *Aurantiorubrae*. Asci 8-spored except when otherwise stated; T = type, ET = epitype, * = SSU incomplete or absent, ** = ITS incomplete.

and *O. filiformis* belong from their morphology and rDNA to series *Serpentinae*. Moreover, our concept of *O. trapeziformis* appears to be heterogeneous because two of our three samples with a sequence clustered very close to *O. obtusispora*, although their spores do not markedly differ from those of the third sample which clustered with *O. cylindrosoma*. Finally, *O. myrioolneyae* clustered in the *Serpentinae-Habrostictis* clade although we treat it in the *Ellipsospermae* clade. Because of this difficulty, we refrained from providing a key for identifying the two large series.

Sequences within the small, morphologically more easily recognizable series *Habrostictis* (with vermispora-like conidia) were only available for two species. Their clade received strong support in Baral et al. (2017b, SSU+ITS+LSU) and our analysis of ITS (Phyl. 19), despite a high ITS distance between them, but medium to weak support in our analyses of SSU+ITS+LSU (Phyls 7, 20) or without support when analysing SSU (Phyl. S20). When analysing LSU alone (S22) the two species did not even group together. In the mentioned combined analyses series *Habrostictis* clustered sister to the medium to weakly supported rest of the *Serpentinae-Habrostictis* clade, while when only analysing ITS or LSU it clustered unresolved within that clade.

The two species which formed tridentaria-like conidia in culture (*O. quaestiformis*, *O. septispora*) clustered in a strongly supported subclade (*quaestiformis-septispora* clade, Phyls 19–20). However, a third species in which tridentaria-like conidia were often observed on the natural substrate (*O. filiformis*), does not cluster with them. Although *O. quaestiformis* and *O. septispora* are very similar in the ITS region, they surprisingly did not form a clade when analysing LSU (S22).

In our combined analysis a further subclade is formed within series *Serpentinae*, the strongly supported *serpentina-halimi* clade. Also within the *Ellipsospermae* clade two more or less supported subclades can be recognized (Phyls 19–20, S20), the *microserpens-ungulata* clade and the *gambelii-vitalbae* clade, the latter containing *O. obtusispora* and *O. trapeziformis* p.p.

Specific nucleotide positions. Nucleotides that unequivocally characterize section *Habrostictis* within *Orbilia* have not been found. In the SSU V8–V9 region pos. 154–166 (starting with CCTTAGATGTT) is consistently **G**AGTCATCAGCT**C**, while **A**AGTCATCAGCT**T** in most other groups of *Orbiliomycetes*, except for a few members of series *Hesperideae* which concur with section *Habrostictis* (see p. 553), and *O. pleistoeuonymi* (section *Lentiformes*) which shows the variant **G**AGTCATCAGTT**C**. Within section *Habrostictis* the two main clades differ in characteristic motifs and gaps in the ITS1 and ITS2 region, leading to sharp differences in the alignment. Also in the LSU D1–D2 domain a number of positions are characteristic (Tab. 72). In the 5.8S region two groups can be recognized based on variance at pos. 121, which recall to some extent the *Serpentinae-Habrostictis* (**C**TTGGTA) and *Ellipsospermae* (**T**TTGGTA) clade, but with a number of species in the wrong group when comparing our phylogenetic analyses of more informative gene regions.

Table 72. Characteristic nucleotides in the LSU D1–D2 domain (highlighted in bold) that differ between the two main clades of section *Habrostictis* or between the two subclades of the *Ellipsospermae* clade (pos. 509). Note intermediate position of *O. multiurosperma* (r). G = *gambelii-vitalbae* clade, M = *microserpens-ungulata* clade, c = *O. carpoboloides*, d = *O. cylindrosoma*, f = *O. flavidorosella*, h = *O. halimi*, i = *O. cisti*, l = *O. filiformis*, m = *O. multimaeandrina*, p = *O. serpentina*, q = *O. quaestiformis*, r = *O. multiurosperma*, s = *O. sonorensis*, t = *O. septispora*, u = uncultured fungi, v = *O. vermiculati*, y = *O. calyptrata*, without annotation = more than three species. Position numbers starting with TGACCT by omitting predominant gaps in alignment of all groups of *Orbiliomycetes*.

sect. *Habrostictis*	123–131	132–139	231–238	507–528	559–564	578–582
Serpentinae-Habrostictis clade	TGATACTTT	TAGTGTCC	CTAACGGT	GCGGTGGGACAAAGACTCTGAG	TCAGTG	GTCCT
	TTAAACTTT^{s}	TAGTTTCC	CTGACGGT	GCGGTGGGACAAAGACTCCGAG^{s}		GTTCT
	TGAGACTTT^{qt}	TAGTTTAC^{fsm}	CTGATGGT^{qv}			
	TGAAGCTTT^{udl}	CAGTGTCC^{p}	CTGACAGT^{dh}	GCGGTGGGACAAAGGCTCTGAG^{d}		
	TTAGACTTT^{m}		CTAACAGT^{u}		TCGGTG^{m}	
	TTAAGCTTT^{f}					GCCCT^{f}
	TGAAACCTT^{c}					
	TGAAGT-TT^{r}	--ACTTCC^{r}				
Ellipsopermae clade	TCAAGT-TT^{y}	--ACTTGC^{y}	CTGTAGGT	ACGGTGGGACAAAGACTCAAGG	CTTGTG	GACCT
	TCAGGTATT	CTACTTGC		ACAGTGGGACAAAGACTCAAGG^{M}		GTACC^{u}
		TTACTTGC^{i}				

In the SSU V8–V9 region the *Serpentinae-Habrostictis* clade differs at 2 positions from the *Ellipsospermae* clade: pos. 244 (GGA**C**TGG vs. GGA**T**TGG) and pos. 281 (CCG**G**AAA vs. CCG**A**AAA), respectively. Even in this gene region the *Ellipsospermae* clade is sharply split into two subclades, a uniform *microserpens-ungulata* clade and a variable *gambelii-vitalbae* clade (S20), based on 6 consistent positions, 2 in V8 and 4 in V9. At pos. 235 of SSU V9, series *Serpentinae* (excluding *O. obtusispora* and *O. trapeziformis* p.p.) sharply differs from any other group of *Orbilia* (including series *Habrostictis*) in having TGAG**A**C vs. TGAG**G**C, respectively. This appears to indicate that this group is apomorphic within section *Habrostictis*, while the *Ellipsospermae* clade and series *Habrostictis* are ancestral. Yet, nucleotides in the LSU suggest that also the *Ellipsospermae* clade could be apomorphic: e.g., at pos. 124 it has C and at 129 A (Tab. 72), whereas any other *Orbiliomycetes* taxa, including the *Serpentinae-Habrostictis* clade, have at pos. 124 G (rarely T or A) and at pos. 129 C, T or G.

Two cases of characteristic gaps occur in a few species across the two main clades of section *Habrostictis*. *O. multiurosperma* concurs with *O. calyptrata* in the LSU D1 domain at pos. 129 and 132–133 by 3 gaps, which any other sequence of section *Habrostictis* does not have (Tab. 72). For *O. multiurosperma* the gaps are affirmed by two independent sequences. When analysing LSU, both species formed a basal sister taxon to the remaining members of their clade (Phyl. S22). A similar coincidence of 2 associated gaps is observed at pos. 542–544 between *O. halimi*/*O. vermiculati* (series *Serpentinae*) and *O. microserpens* (series *Ellipsospermae*).

In conclusion, series *Habrostictis* appears to represent the plesiomorphic (ancestral) group within section *Habrostictis*. If this proves true, we may conclude that series *Habrostictis* unites some plesiomorphic characteristics, such as cleistohymenial apothecial development, marginal hairs, spathulate to mammiform paraphyses, crystalloid SCBs, ± acute spore apices, and vermispora-like conidia. In more advanced groups these features partly disappeared by regression or, in the case of the anamorph, developed from phragmo- to stauroconidia.

Ecology. All species of section *Habrostictis* are desiccation-tolerant and grow on exposed (xeric), woody or herbaceous substrates. The highest species diversity is observed in semihumid to arid regions, but the group is also present with a rather high number of species in humid temperate and montane, rarely subalpine-boreal areas. Species of this group have been recorded worldwide.

Key to series of section *Habrostictis*

1. Paraphyses always or predominantly narrowed above (spathulate, mammiform, lageniform-lanceolate), distinctly protruding beyond dead asci; apothecial margin often protruding beyond disc, often with a conspicuous whitish fringe of short thin-walled hairs; asci 8–16-spored .... **series *Habrostictis***, (p. 1015)

1. Paraphyses predominantly capitate or clavate, in some taxa more ellipsoid, if spathulate then capitate-clavate or ellipsoid apices more abundant or asci > 16-spored, never mammiform; apothecial margin smooth to crenulate, protruding or not, never fringed with thin-walled hairs; asci 8–128-spored .... **series *Serpentinae* & *Ellipsospermae*** (p. 1016)

Key to series *Habrostictis*

1. Asci 32-spored: compare *O. multidelphinus*, *O. multitrapezoidea*, *O. multimaeandrina*, *O. osteospermae*, in which spathulate paraphyses partly occur .... see series *Serpentinae*, Key E (p. 1022)

1. Asci 16-spored 2

1. Asci 8-spored 4

2. Spores *(5.5–)6–10 × (2.4–)2.8–3(–3.3) µm, apex rounded to obtuse; crystalloid SCBs absent; bark & wood of *Lonicera*, orotemperate (sub)humid central Asia .... ***O. mongolica***, p. 1041

2. Spores *1.7–2.5 µm wide 3

3. Spores *9–11 × 2–2.4 µm, apex subacute; paraphyses only slightly spathulate, without glassy caps; crystalloid SCBs absent; wood of *Cupressus*, submediterranean Europe .... ***O. subdelphinus*** (series *Serpentinae*), p. 1111

3. Spores *(4.7–)5.5–9(–11) × 1.7–2.3(–2.5) µm; paraphyses spathulate, often tipped by glassy caps; crystalloid SCBs present; wood of various gymno- and angiosperm shrubs, temperate to subtropical, subhumid to semiarid western North America .... ***O*. *calyptrata*** (series *Ellipsospermae*), p. 1187

4. Paraphyses uninflated or ± lanceolate; spores *4.8–6.3 × (1.8–)2–2.3(–2.5) µm, cylindric-clavate with broadly subacute tips; apothecia 0.3–0.55 mm diam., cup-shaped; angiosperm bark, afromontane humid northeastern Africa .... ***O*. *aethiopica*** (series *Abutilones* of section *Aurantiorubrae*), p. 912

4. Paraphyses mammiform to lageniform, also spathulate to lanceolate but then spore size different 5

5. Spores predominantly < *2(–2.2) µm wide 6

5. Spores predominantly > *(2–)2.2 µm wide 11

6. Spores *1–1.7 µm wide, with or without a basal constriction .... series ***Abutilones*** of section *Aurantiorubrae*, p. 885

6. Spores *1.4–2.2 µm wide 7

7. Spores †5.7–6.7 × 1.7–2 µm, fusiform; paraphyses predominantly broadly mammiform; apothecia 1.5–4 mm diam.; known only from textile, subtropical humid South America .... ***O*. *brasiliensis***, p. 1040

7. Spores *(5.5–)7.3–12(–14) × 1.4–2.5 µm; apothecia < 1.5 mm diam. 8

8. Paraphyses often broadly mammiform, *3–6 µm wide; spore apices rounded to acute; Australia 9

8. Paraphyses predominantly narrowly mammiform to spathulate, *(2.2–)2.5–4(–4.7) µm wide; spore apices mostly (sub)acute; Europe, Macaronesia 10

9. Paraphysis apices mostly with abrupt beak; crystalloid SCBs present; spore apices subacute to acute; bark of climbers, tropical subhumid eastern Australia .... ***O*. *mammifera***, p. 1043

9. Paraphysis apices only sometimes beaked; crystalloid SCBs absent; spore apices rounded to obtuse; bark of *Vachellia* or climbers, subtropical arid western Australia .... see ***O*. *farnesianae*** (section *Aurantiorubrae*), p. 923

10. Spores *(6.8–)7.3–10(–11.3) × (1.5–)1.7–2(–2.2) µm, SBs (3–)4–6.5(–7.5) µm long; paraphyses narrowly spathulate to mammiform; apothecial margin with distinct whitish fringe of short septate hairs; crystalloid SCBs present; herbaceous stems, bark of angiosperms, temperate humid to mediterranean Europe and Macaronesia .... ***O*. *flavidorosella***, p. 1045

An orosubmediterranean sample on *Cytisus* twigs deviates by longer spores of *11.3–14.5(–16) × 1.7–2.2 µm and SBs of (5.5–)7–8.5 µm (p. 1048).

10. Spores *9.5–12(–13) × 1.4–1.6 µm, SBs 3.7–4.5 µm long; paraphyses almost uninflated to narrowly spathulate; apothecial margin not fringed; stems of *Solidago*, temperate humid Europe .... ***O*. *solidaginis***, p. 1048

11. Living spores consistently without SBs, *11.5–20.5 × 2.4–3.5 µm; wood of *Euphorbia*, subtropical (semi)arid Macaronesia .... ***O*. *asomatica*** (section *Arthrobotrys*, series *Neodactylella*), p. 1487

11. Living spores with distinct SBs 12

12. Spores min. *(3.2–)3.4–3.7 µm wide; asci †(5–)5.5–6.5(–7) µm wide 13

12. Spores *2–3.2(–3.5) µm wide; asci †4.2–5.5 µm wide 14

13. Spores *(6–)7–9 × (3.2–)3.6–4.5(–5) µm; wood & bark of gymnosperms, cold-temperate (sub)humid western North America .... ***O*. *ophiosoma*** (series *Serpentinae*, key A), p. 1050

13. Spores *9–11 × 3.2–3.6 µm; bark of *Prosopis*, warm-temperate semiarid western North America .... ***O*. cf. *carpoboloides***, p. 1035

14. Upper spores predominantly inverted within asci; spores *(10–)11–15(–17) × (2.1–)2.3–2.6(–2.8) µm; apothecial margin not hairy; wood & bark of angiosperms, temperate humid to semiarid western North America .... ***O*. *spathulata*** (series *Serpentinae*), p. 1112

14. Lower spores predominantly inverted; spores *(7.7–)8.5–14(–17) × (2–)2.2–3(–3.5) µm 15

15. Apothecia < 0.3 mm diam., with smooth margin; spores with ± obtuse apex; SBs filiform, partly as long as spores; crystalloid SCBs absent; wood of *Castanea*, temperate humid southern Europe .... ***O*. cf. *quercus-ilicis*** (series *Serpentinae*), p. 1162

15. Apothecia 0.4–1.5 mm diam., with lacerate, often hairy margin; spores with (sub)acute apex; SBs about half as long as spores; crystalloid SCBs present, at least in excipulum 16

16. SBs filiform, (0.2–)0.3–0.4(–0.5) µm wide; apothecial margin toothed or lobed, not distinctly hairy; bark of a climber, tropical subhumid Australia .... ***O*. *scandens***, p. 1042

16. SBs vermiform or mostly subulate, often inflated to (0.4–)0.6–1(–1.3) µm at base; apothecial margin toothed or often with a fringe of septate hairs; bark (rarely wood) of various angiosperms, often *Ulmus*, hemiboreal to subtropical (semi)humid Europe, North & South America, ?Australia .... ***O*. *carpoboloides***, p. 1025

Samples with long and narrow spores (including type of *Habrostictis rubra* and *Orbilia lasia*) might be specifically distinct from O. *carpoboloides* s.str.

Key to species of series *Serpentinae* and *Ellipsospermae*

Remark: Although spore numbers are usually very consistent, more or less reduced numbers down to half the normal case may sometimes occur in a few of the asci, but asci with the normal spore number are always present among the aberrant ones. Some species of series *Phanosomates* (subgenus *Hemiorbilia*) resemble members of series *Ellipsospermae* because of a similar spore body shape, but differ in the dead immature asci lacking distinctly shouldered apices which are often thick-walled instead, and in globose SCBs (exception: *O. cercidis*) in contrast to frequently crystalloid SCBs in series *Ellipsospermae*. Members of section *Helicoon* partly resemble the present group in spores and SBs but differ in growing on hygric substrate.

Asci	8-spored	16-spored	32-spored	64–128-spored
Spores predominantly < 9 µm long	key A	key C	key E	key F
Spores predominantly > 9 µm long	key B	key D		

KEY A (asci 8-spored, spores predominantly < 9 µm long)

1. Spores subglobose to ellipsoid-ovoid-fusoid, length/width ratio mainly < 2.5 2
1. Spores more elongate, length/width ratio in most spores > 2.5 3

2. Spore apex predominantly acute to subacute, spores *(6–)7–9 × (3.2–)3.6–4.5(–5) µm; SBs as long as spores or shorter; only globose SCBs present; wood & bark of gymnosperms, cold-temperate (sub)humid western North America .... ***O. ophiosoma***, p. 1050
2. Spore apex predominantly rounded to obtuse, spores *(4.5–)5–8(–9) × (2.2–)2.5–3.5(–3.8) µm; SBs often longer than spores (rarely only half as long); crystalloid SCBs present, at least in ectal excipulum; wood & bark of angiosperms, rarely gymnosperms or stems of herbs, orosubmediterranean to subtropical, humid to semiarid western North America, Europe, Macaronesia .... ***O. gambelii***, p. 1200
Compare also short-spored specimens of the Australian *O. octocercocarpi* (p. 1213).

3. Spores predominantly < *2 µm wide 4
3. Spores predominantly > *2 µm wide 8

4. Spores medium to very strongly curved, *(5–)6–8(–9.5) × 1.8–2.1(–2.3) µm; bark & wood of *Jacksonia*, subtropical semihumid Australia .... ***O. curvativitalbae***, p. 1193
4. Spores straight or only slightly curved near base 5

5. Excipular cells containing very distinct crystalloid SCBs; spores *(4–)5–7.5(–8.5) × 1.6–2.2 µm; apothecial margin not protruding; wood of angiosperms, herbaceous stems, temperate humid to mediterranean Europe .... ***O. ungulata***, p. 1180
Similar collections with longer asci (*47–53 instead of 29–45 µm) and partly also longer spores (*8–9 µm) were on *Krascheninnikovia* (western North America) and *Petteria* (southern Europe, p. 1183). Compare also *O.* aff. *coniferarum* with filiform SBs on *Picea* from Mongolia (p. 1165).
5. Excipular cells consistently without crystalloid SCBs; spores distinctly exceeding 7 µm in length 6

6. SBs 1.3–2(–2.5) µm long; spores *6–8.5(–9) × 1.6–1.9 µm; wood of *Arctostaphylos*, warm-continental subhumid western North America .... ***O*. aff. *dixiensis***, p. 1179
6. SBs > 2.5 µm long 7

7. Spores *5.5–8.8 × 1.4–1.8 µm, narrowly fusoid; SBs 2.5–3.5 × 0.3–0.5 µm, subulate; SCBs absent; apothecial margin protruding for 15–30 µm; bark of *Tilia*, temperate humid montane central Europe .... ***O. jurana***, p. 1190
7. Spores *(5–)5.5–9.5(–11) × (1.5–)1.8–2.5(–2.8) µm, cylindric-ellipsoid(-fusoid); SBs 2.5–6.8 × 0.3–1.3 µm, with abruptly inflated lower part; SCBs globose; apothecial margin protruding for 0–5 µm; wood & bark of angiosperms, herbaceous stems, temperate to mediterranean, also thermoboreal Europe .... ***O. vitalbae***, p. 1172
If SBs subulate compare *O. ungulata* in which crystalloid SCBs were rarely absent (p. 1180).

8. Margin with 10–20 µm long glassy processes; spores *(6–)7–9 × 2.6–2.8(–3) µm; bark of *Fraxinus*, atlantic to subcontinental Europe .... see ***O. poitevinica*** (series *Poitevinicae* of section *Aurantiorubrae*), p. 913
8. Margin without glassy processes 9

9. Excipular cells (and paraphyses) with crystalloid SCBs 10
9. Excipular cells (and paraphyses) without crystalloid SCBs 14

10. Spores *(6–)7.5–11(–13.3) × 2.1–2.7 µm; SBs 1/3–1/2 of spore length, filiform; wood of various angiosperms, petioles of *Livistona*, (sub)tropical subhumid to arid Australia, Africa .... ***O. acaciae***, p. 1072
10. Spores shorter and partly wider 11

11. SBs about as long as spores 12
11. SBs only about half as long as spores 13

12. Spores *6.5–8.5 × (2.2–)2.5–2.8 µm, SBs strongly helicoid, usually much longer than spores .... see under 2 (*O. gambelii*)
See also the Australian *O. octocercocarpi* with *2.8–3.5 µm wide spores (p. 1212).
12. Spores *5.8–8 × 2.2–2.5(–2.7) µm; SBs only slightly flexuous, shorter than spores; branch of *Rosa*, orosubmediterranean Spain .... Pl. 701: 2, ***O*. aff. *subvitalbae***, p. 1180

13. Spores *(5.5–)7.5–8.5(–9.5) × (2.2–)2.7–3(–3.3) µm, base slightly, rarely medium tapered; culms of *Arundo* and *Juncus*, mesomediterranean Europe .... ***O. subvitalbae***, p. 1179
Similar samples on *Amelanchier* from western North America with rather small crystalloid SCBs seen in the excipulum only are mentioned under *O. commarosa* (p. 1198).
13. Spores *(7.3–)8–10.5(–11.3) × 2.8–3.5(–4) µm, base medium to strongly tapered; branches of *Cactaceae*, subtropical semiarid western North America .... ***O. cactacearum***, p. 1143
A collection on *Krascheninnikovia* deviates in longer spores (*11–13 × 3–3.5 µm) and asci (*67–106 vs. *52–70 µm) (p. 1145).

14. SBs ± sharply divided into a short to long, filiform to subulate upper part and an abruptly thickened lower part; spores *(5–)6–9.5(–11.8) × (1.5–)1.8–2.5(–2.8) µm, cylindrical to fusoid 15
14. SBs subulate to vermiform, gradually thicker towards base, only sometimes slightly swollen at base; spores *(6–)8–12 × 2–3.6 µm, fusoid to fusiform 18

15. Spores straight to slightly curved, not or only slightly to medium tapered at base 16
15. Spores usually slightly to strongly curved, predominantly strongly tapered at base 17

16. SBs often longer than half the spore length (but also shorter); spores cylindric to ellipsoid-fusoid, straight; temperate Europe .... see under 7 (*O. vitalbae*)

16. SBs usually shorter than half the spore length; spores subcylindrical, some slightly curved; bark & wood of *Artemisia*, *Ericameria*, *Salix*, boreal humid to temperate semiarid western North America .... ***O. dixiensis***, p. 1177
A Spanish collection on bark of *Berberis* (E.R.D. 7892) appears to be closely related to *O. dixiensis* (p. 1179).

17. Spore apex obtuse, rarely subacute; upper part of SBs filiform; apothecia 0.3–0.8 mm diam., bright (pink-)rose, rarely orange-rose; bark (& wood) of *Acacia*, (sub)tropical semihumid to arid Australia .... ***O. commarosa***, p. 1195
17. Spore apex mostly subacute; upper part of SBs mainly subulate; apothecia 0.2–0.4 mm diam., light orange; petioles of *Livistona*, subtropical subhumid Australia .... ***O.* cf. *commarosa*** (H.B. 6424c), p. 1198

18. Spores *1.8–2.5(–2.7) µm wide 19
18. Spores *2.8–3.5 µm wide 22

19. Spores *(6–)7–8.8 × 1.9–2.1 µm, ± straight; wood of *Picea*, orotemperate (sub)humid central Asia (absence of crystalloid SCBs uncertain; anamorph unknown) .... ***O.* aff. *coniferarum***, p. 1165
19. Spores (1.8–)2–2.5(–2.7) µm wide; anamorph trinacrium-like 20

20. Spores *(6–)7.5–11(–12.5) × (1.8–)2–2.5(–2.8) µm, fusoid, apex (obtuse to) subacute; SBs vermiform to subulate, not or only slightly inflated near base; herbaceous stems, angiosperm wood & bark, temperate to mesomediterranean Europe ...... ***O. cylindrosoma***, p. 1068
20. SBs filiform to subulate, gradually or abruptly slightly to strongly inflated near base; on woody substrates 21

21. Spores *(6.5–)8–13(–14) × (1.8–)2.1–2.5(–2.7) µm, fusoid(-clavate) to subcylindrical; wood & bark of various angiosperms (often *Quercus*), exceptionally gymnosperms, orotemperate to mesomediterranean Europe, temperate subhumid to semiarid western North America .... ***O. obtusispora***, p. 1061
21. Spores *(5–)6.5–9.5(–11) × (2–)2.2–2.8(–3.2) µm, fusoid(-clavate); wood & bark of various angiosperms, rarely gymnosperms, temperate to mesomediterranean Europe .... ***O. trapeziformis***, p. 1055

22. Spore apex rounded to obtuse, spore bases slightly to strongly tapered; anamorph tridentaria-like; wood (& bark) of gymnosperms, orosub- to mesomediterranean Europe, boreal to temperate (sub)humid western North America .... ***O. coniferarum***, p. 1163
22. Spore apex obtuse, subacute or acute 23

23. Spores ± fusiform, *6–11.5 × 2.8–3.5 µm, apex subacute to acute; apices of paraphyses *3–8 µm wide; wood & bark of angiosperms, temperate to subtropical subhumid to arid western North America & Australia .... ***O. macrotrapeziformis***, p. 1098
23. Spores fusoid-clavate, apex obtuse to subacute 24

24. Spore bases sometimes tail-like; anamorph trinacrium-like; wood & bark .... see under 21 (*O. trapeziformis*)
If spores more elongate and/or more subcylindrical compare *O. obtusispora* (p. 1061) and *O. cylindrosoma* (p. 1068).
24. Spore bases mostly tail-like or with short tail; anamorph tridentaria-like; leaves of *Quercus ilex*, supra(sub)mediterranean Europe .... ***O. quercus-ilicis***, p. 1162
A collection on *Humulus* from Belgium referred to *O. trapeziformis* (Pl. 593: 6) differs from *O. quercus-ilicis*, e. g., in more subacute spore apices.

KEY B (asci 8-spored, spores predominantly > 9 µm long)

1. Spore apices mainly rounded to obtuse, only occasionally subacute 2
1. Spore apices subacute to acute or acuminate, if obtuse to subacute then SBs strongly flexuous or curled 14

2. Some or most spores distinctly curved, spore base predominantly strongly tapered 3
2. Spores more or less straight or only a few slightly to medium curved, non-septate 11

3. Spores predominantly 1-septate inside mature living asci, *(10–)11–15(–17) × (2.5–)2.8–3.7(–4.2) µm, often ± tapered and curved at base; culms of larger grasses, also herbaceous stems or angiosperm wood, temperate humid, atlantic to subcontinental Europe........ ***O. septispora***, p. 1158
3. Spores non-septate inside mature living asci, overmature septate or not 4

4. Excipular cells (& paraphyses) without crystalloid SCBs 5
4. Excipular cells (& paraphyses) with crystalloid SCBs 8

5. SBs with filiform upper part and abruptly inflated, 0.5–0.8 µm wide lower part; apothecia 0.3–0.7 mm diam., bright pink-rose; anamorph unknown; Australia .... see key A under 17 (*O. commarosa*)
5. SBs entirely filiform or gradually enlarged towards base, 0.2–0.5 µm wide; apothecia 0.15–0.5 mm diam., light orange-rose; anamorph tridentaria-like 6

6. SBs predominantly shorter than half the spore length (in situ), spores *(7–)9–13(–14.5) × 2.3–3 µm; conidial arms *2.5–4(–4.7) µm wide; herbaceous stems of mono- and dicots, also wood (& bark) of angiosperms, hemiboreal humid to thermomediterranean semihumid Europe .... ***O. quaestiformis***, p. 1151
6. SBs often longer than half the spore length, spores *6.5–13 × 2.5–3 µm 7

7. Spore bases slightly to strongly tapered; conidial arms *4.5–5.5 µm wide; conifer wood & bark.... see key A under 22 (*O. coniferarum*)
7. Spore bases ± strongly tapered; conidial arms *2.5–4 µm wide: *Quercus ilex* leaves .... see key A under 24 (*O. quercus-ilicis*)
A sparse collection on wood of *Castanea* hardly differs herefrom, except for the partly lageniform to moniliform paraphyses (p. 1162).

8. Spores *(6.5–)9–9.5(–11.5) × 2.3–2.6(–2.9) µm; branch of *Rosa*; supramediterranean semihumid Europe........ ***O. rosicola***, p. 1168
8. Spores > 2.8 µm wide 9

9. Spores *(9.5–)10.5–15(–17) × 3–3.5(–4) µm, mostly medium to very strongly curved (often entirely); bark of *Artemisia*, *Ericameria*, temperate subhumid to semiarid western North America .... ***O. mesaverdiana***, p. 1148

9. Spores *8–12 µm long, slightly to sometimes medium curved (only at base) 10

10. SBs 5–7.5 µm long; spores *(7–)8–12 × 2.8–3.2 µm; bark of climber, (sub)tropical (semi)arid Australia .....***O***. ***octocercocarpi***, p. 1212

10. SBs 3.5–4.5 µm long; spores *(7.3–)8–10.5(–11.3) × 2.8–3.5(–4) µm; on *Cactaceae*, subtropical semiarid western North America .... ***O***. ***cactacearum***, p. 1143

11. Spores *(8–)8.5–12(–12.8) × (3.2–)3.5–4.3(–4.8) µm; crystalloid SCBs present; wood of different angiosperm shrubs, warm-temperate to subtropical (semi)arid western North America .... ***O***. ***sonorensis***, p. 1145

A collection on *Juglans* was without crystalloid SCBs and might be distinct.

11. Spores < 3 µm wide 12

12. Excipular cells (& paraphyses) with crystalloid SCBs; spores *(6–)7.5–11(–13.3) × 2.1–2.7 µm; SBs 3–5 µm long, filiform .... see key A under 10 (*O. acaciae*)

12. Excipular cells (& paraphyses) without crystalloid SCBs 13

13. SBs divided into a short to long, filiform to subulate upper part and a ± abruptly thickened lower part; spores *(5–)6–9.5(–11.8) × (1.5–)1.8–2.5(–2.7) µm .... see key A under 16 (*O. dixiensis* & *O. vitalbae*)

13. SBs subulate to vermiform, gradually thicker towards base, only sometimes slightly swollen; spores *(6–)8–14(–18) × (1.8–)2–2.5(–2.7) µm 30

14. Spores predominantly > *2.5 µm wide 15

14. Spores predominantly < *2.5–2.7 µm wide 24

15. Excipular cells (& paraphyses) with crystalloid SCBs 16

15. Excipular cells (& paraphyses) without crystalloid SCBs 18

16. Spores *(12–)13–17 × 3.1–3.8 µm, base strongly tapered and slightly to strongly curved; SBs 8–14 µm long; felty bark of *Solanum lasiophyllum*, subtropical arid Australia .... ***O***. ***urosperma***, p. 1135

16. Spores shorter, or straight and only slightly tapered at base 17

17. SBs 5–7.5 µm long; spores *(9–)10–13.5(–15) × (2.7–)2.9–3.5(–3.7) µm, base mostly medium to strongly tapered and somewhat curved; wood & bark of various angiosperms, herbaceous stems, temperate to subtropical semihumid to arid western North America and southern Europe .... ***O***. ***bicknellensis***, p. 1129

A collection on *Baccharis* from North America differs in 9.5–12 µm long SBs (Pl. 655: 4).

17. SBs 7–11 µm long; spores *(9–)12–15.5(–18.3) × 3.2–3.8(–4.2) µm, base mostly not or only slightly tapered and straight; wood & bark of different angiosperms, (sub)tropical semihumid to arid Australia .... ***O***. ***octoserpentina***, p. 1122

18. Upper spores predominantly inverted within asci; spores *12–19.5 × (2.5–)2.7–3.5(–4.5) µm; bark of *Acacia*, subtropical (semi)humid western Australia .... ***O***. ***wannerooensis***, p. 1104

18. Lower spores predominantly inverted within asci 19

19. Spores strongly curved near base, which is not or only slightly to medium tapered, *(10–)11–13.5(–14.5) × (2.5–)2.7–3.3 µm; bark of *Quercus gambelii*, wood of *Euphorbia balsamifera*, temperate humid western North America, subtropical arid Macaronesia .... ***O***. ***curvatitrapeziformis***, p. 1101

19. Spores ± straight or only slightly curved near base, if more curved then strongly tapered below 20

20. Spores *(10–)12–17(–20.3) × (2.4–)2.6–3.2(–3.8) µm, with obtuse to subacute apices, base partly ± strongly attenuated (tail-like) or with distinct tail; SBs often uncinate to curled; wood of gymno- and angiosperms, temperate (sub)humid western North America .... ***O***. ***flexisoma***, p. 1095

20. Spores with (subacute to) acute apex and slightly to strongly tapered base, never with a distinct tail 21

21. Spores strongly fusiform, often with acute base, *(12.5–)13.5–17 × (2.8–)3–3.7 µm; asci *70–100 µm long; paraphyses without SCBs; wood of *Pinus edulis*, cold-temperate subhumid western North America .... ***O***. ***edulis***, p. 1102

21. Spores with slightly to strongly attenuated base, mainly *2.2–3.3 µm wide; asci max. *80(–92) µm long; paraphyses with globose SCBs 22

22. Actual length of SBs ≥ spore length; spores *11–13.3 × 2.9–3.3 µm; wood of *Fraxinus*, orotemperate humid southern Europe .... ***O***. ***pyrenaica***, p. 1100

22. Actual length of SBs < spore length 23

23. Spores *(8–)9–13(–15.5) × (2.7–)2.8–3.3(–3.8) µm; wood & bark of angiosperms and succulents, temperate to subtropical semihumid to arid western North America, Australia .... ***O***. ***macrotrapeziformis***, p. 1098

23. Spores *(8.5–)9–14.5(–16) × (2.1–)2.2–2.9(–3) µm; wood & bark of angio- & gymnosperms, boreal to orosubmediterranean (sub) humid Europe, North America, Asia .... see under 31 (*O. subtrapeziformis*)

24. Spores *(12–)13–18(–19.3) × 1.8–2.5 µm; SBs (5.5–)7–10.5 µm long; crystalloid SCBs absent; wood of *Amelanchier*, *Cercocarpus*, *Ribes*, temperate to boreal (sub)humid western North America .... ***O***. ***idahoensis***, p. 1094

24. Spores **(6–)**8–16(–18) µm long 25

25. Excipular cells (& paraphyses) with crystalloid SCBs 26

25. Excipular cells (& paraphyses) without crystalloid SCBs; lower spores inverted within asci 28

26. Paraphysis apices ellipsoid to spathulate; upper spores predominantly inverted within asci; spores *(10–)11–15(–17) × (2.1–)2.3–2.6(–2.8) µm; SBs 7–11.5 µm long; wood & bark of *Artemisia*, *Populus*, humid to semiarid western North America ..***O***. ***spathulata***, p. 1112

26. Paraphyses with capitate-clavate apices; lower spores predominantly inverted within asci; spores *2–2.5 µm wide; SBs 5–8 µm long ..27

27. Spores *(7–)8–11 × 2–2.5 µm, medium tapered towards base; SBs 0.5–0.8 µm wide; wood of *Atriplex halimus*, mesomediterranean semiarid Europe .... ***O. halimi***, p.1091
A collection on bark of *Olea* deviates by spores of *10–13(–15) × 2.4–2.7 µm with wider SBs (1–1.2 µm, p. 1092).
27. Spores *12–14.5 × 2–2.4 µm, strongly tapered towards base; SBs 0.7–1(–1.2) µm wide; on *Phragmites*, tropical semihumid Australia .... ***O. phragmitis***, p. 1093
Compare also *O. filiformis* with narrower (0.2–0.4 µm), filiform SBs (paraphyses usually without crystalloid SCBs, p. 1083).

28. Spore apices obtuse to subacute 29
28. Spore apices predominantly subacute to acuminate 31

29. Spores *(10–)11–16(–18) × 2–2.5 µm, often with a tail-like base or tail; SBs vermiform to subulate; wood & bark of angiosperm trees, temperate humid to subtropical semihumid to semiarid Australia .... ***O. austroobtusispora***, p. 1065
29. Spores *(6–)8–12(–14) × 1.8–2.7 µm 30

30. SBs often rather broad up to the apex (vermiform) though upper part also distinctly narrower than below, apically narrowed to a distinct short filum .... see key A under 20 (*O. cylindrosoma*)
30. SBs gradually thinner towards apex (subulate), with ± inflated base.......... see key A under 21 (*O. obtusispora*)

31. Spores *(8.5–)9–14.5(–16) × (1.8–)2–2.7(–3) µm; SBs (4–)5–7.5(–8) × (0.5–)0.6–1(–1.2) µm, subulate; wood & bark of angio- & gymnosperms, alpine-boreal to orosubmediterranean humid Europe, Africa, Asia, North America .... ***O. subtrapeziformis***, p. 1088
31. Spores *(8–)9–13(–14) × 1.8–2.3(–2.5) µm; SBs 5–10(–11) × 0.2–0.3(–0.4) µm, filiform (scarcely thicker towards base); wood of *Acer*, *Populus*, *Salix* etc., orotemperate humid to submediterranean (semi)humid Europe .... ***O. filiformis***, p. 1083
A collection from Africa differs in rather short SBs and only slightly attenuated and curved spore bases, also in less inflated paraphysis apices (p. 1086).

KEY C (asci 16-spored, spores predominantly < 9 µm long)

1. Spores crescent-shaped, *3.3–5 × 1.4–2 µm; on wood of *Acacia*, subtropical semihumid Australia.......... ***O. pleiocrescens***, p. 1227
1. Spores ± straight (if curved and 8–10 µm long see key D) 2

2. Spores subglobose to ellipsoid-ovoid-fusoid, length/width ratio predominantly < 2.5 3
2. Spores more elongate, length/width ratio in most spores > 2.5 14

3. Spore apex predominantly rounded or obtuse 4
3. Spore apex predominantly acute or subacute 12

4. With crystalloid SCBs in ectal excipulum and often also paraphyses.......... 5
4. Without crystalloid SCBs 8

5. Spores *(5–)6–7.5(–8.5) × (3.2–)3.5–4.2(–4.5) µm; wood of *Acacia*, *Atriplex*, climber, tropical arid Australia and apparently also temperate to subtropical semiarid North America .... ***O. barrowensis***, p. 1199
5. Spores < *3.5 µm wide 6

6. SBs ± abruptly inflated at base, 0.4–0.9 µm wide; crystalloid SCBs in paraphyses small, only present in lower part; spores *(4.3–)5.2–7(–8) × (2.3–)2.5–3.3(–3.5) µm; wood & bark of various angiosperms, (oro)mediterranean Europe ....***O. pleiogambelii***, p. 1205
6. SBs only gradually inflated at base, 0.3–0.5 µm wide; crystalloid SCBs in paraphyses large, also in apex 7

7. Spores *(3.8–)4.5–6.5(–7) × 1.9–2.3 µm; SBs only half as long as spores; asci *6–6.5 µm wide; on a climber (*Vitaceae*), subtropical subhumid southern USA .... ***O.* cf. *pleioungulata***, p. 1186
7. Spores *(5–)5.5–8.5(–9) × (2.3–)2.5–3(–3.4) µm; SBs often as long as spores or longer; asci *6.7–10.5 µm wide; wood of *Cercocarpus*, *Coleogyne*, temperate subhumid to semiarid western North America .... ***O. cercocarpi***, p. 1213

8. Spores *(3.5–)4–6.5(–7.7) × (1.8–)2–2.3(–2.5) µm; wood (& bark) of various angiosperms (exceptionally gymnosperms), subtropical (mediterranean) semihumid to arid Europe, Australia .... ***O. microserpens***, p. 1223
8. Spores predominantly > *2.4 µm wide 9

9. Spores *6–9(–9.5) × (2.8–)3–3.7 µm, ellipsoid-clavate; SBs 1/2–3/4 of spore length; wood of *Atriplex*, temperate arid western North America.......... ***O. macroserpens***, p. 1215
9. Spores *(4.6–)5–7.5(–9) × (2.3–)2.6–3.2(–3.5) µm, predominantly (cylindric-)ellipsoid or fusoid; SBs partly as long as spores or even longer 10

10. Spores (cylindric-)ellipsoid(-fusoid), *(4.6–)5–7.5(–8.2) × (2.4–)2.6–3.2(–3.5) µm; SCBs globose or absent; wood & bark of different angiosperms, (sub)tropical sub- or semihumid to arid western North America & western Australia .... ***O. pleioserpens***, p. 1219
10. Spores ± fusoid..........11

11. Spores *4.5–7.5 × 2.2–3.2 µm; with or without globose and crystalloid SCBs; wood of *Shepherdia*, temperate subhumid western North America, ?bark of *Banksia*, subtropical semihumid Australia .... ***O.* cf. *pleioserpens***, p. 1220
11. Spores *6–9 × 2.3–2.9 µm; without any SCBs; wood of *Cistus*, mediterranean Europe.......... ***O. cisti***, p. 1217

12. Crystalloid SCBs present; spores *6.5–8.5 × 3–4 µm; on *Salix* and *Psydrax*, temperate to subtropical semiarid western North America and western Australia.......... ***O.* aff. *lacrimispora***, p. 1053
12. Only globose SCBs present..........13

13. Spores *(6.8–)7.5–10(–11.2) × 3.5–4.4(–4.8) µm; wood of *Ephedra*, *Larrea*, *Canotia*, subtropical semiarid western North America .... ***O. lacrimispora***, p. 1053
13. Spores *(6–)7–9.5(–11) × (2.3–)2.5–3.5(–3.8) µm .... see under 25 (*O. maeandrina*)

14. Crystalloid SCBs present; spores without distinct tails 15
14. Crystalloid SCBs absent 18

15. Spores *(7–)8–12.5(–14) × 2.6–3.7 µm, apex ± acute .... see key D under 12 (*O. serpentina*)
15. Spores *(4.7–)5.5–9(–11) µm long, apex rounded to obtuse 16

16. Spores *(5–)5.5–8.5(–9) × (2.3–)2.5–3(–3.4) µm .... see under 7 (*O. cercocarpi*)
16. Spores *1.7–2.3(–2.5) µm wide 17

17. Paraphyses spathulate with a small glassy cap; apothecial margin pubescent; wood of angio- and gymnosperm shrubs, temperate to subtropical subhumid to semiarid western North America .... ***O. calyptrata***, p. 1187
17. Paraphyses at least partly clavate-capitate, without glassy cap; apothecial margin smooth; wood (rarely bark) of various angiosperm shrubs, also gymnosperms, (sub)tropical semihumid to arid Australia, Macaronesia, Europe .... ***O. pleioungulata***, p. 1184

18. Spores with distinct, ± bent tails, *6.5–9(–10.5) × 2.5–3 µm, apex obtuse to subacute; wood of *Parkinsonia*, subtropical semiarid western North America .... ***O. paloverdensis***, p. 1169
18. Spores without distinct tails 19

19. Spore apex at least partly rounded or obtuse 20
19. Spore apex predominantly acute or subacute 25

20. Spores *4.5–7.7(–8.3) µm long 21
20. Spores *7–9.5 µm long 23

21. SBs ± as long as spores (in situ, partly strongly flexuous), at base only slightly inflated to 0.2–0.4(–0.7) µm; spores *3.5–7.7 × 1.8–2.5 µm; paraphyses without SCBs .... see under 8 (*O. microserpens*)
21. SBs 1/2–3/4 of spore length (in situ, only slightly flexuous); wood of *Allocasuarina*, subtropical arid Australia 22

22. SBs at base not or very slightly swollen to 0.3–0.4 µm; spores *6–7.5(–8.3) × 1.7–1.9(–2) µm .... ***O. pleioobtusispora***, p. 1067
22. SBs at base abruptly inflated to 0.7–0.9 µm; spores *6–7 × 2.3–2.5 µm .... ***O. pleiovitalbae***, p. 1191

23. Spores ± fusoid, *6–9 × 2.3–2.9 µm; SBs 0.2–0.5 µm wide .... see under 11 (*O. cisti*)
23. Spores partly distinctly clavate, *(6.2–)7–9.5(–11) µm long 24

24. Spores *(2–)2.2–2.7(–2.9) µm wide; SBs 0.4–0.7 µm wide; bark of *Acacia*, *Casuarina*, subtropical subhumid to semiarid Australia .... ***O. cf. saguarina***, p. 1223
24. Spores *1.9–2.4(–2.6) µm wide; SBs 0.2–0.4(–0.5) µm wide; branches of *Cactaceae*, subtropical semiarid western North America .... ***O. saguarina***, p. 1221

25. Spores *(6–)7–9.5(–11) × (2.3–)2.5–3.5(–3.8) µm; wood of various angiosperms, rarely gymnosperms, boreal humid to subtropical arid North America, Africa, southern Europe, Asia, Australia .... ***O. maeandrina***, p. 1075
25. Spores *7–10.5 × 2–2.7 µm; wood of *Salix*, boreal humid western North America .... ***O. cf. macrodelphinus***, p. 1116

KEY D (asci 16-spored, spores predominantly > 9 µm long)

1. Spore apex predominantly rounded to obtuse 2
1. Spore apex acute to subacute 8

2. Spores fusoid-clavate, base medium tapered, not or only slightly curved, *6.2–11 × 1.9–2.9 µm .... see key C under 24 (*O. saguarina*)
2. Spore base predominantly strongly tapered, some or most spores distinctly curved 3

3. Spores †8–10 × 1.6–1.8 µm; bark of *Dodonaea*, subtropical arid Australia .... ***O. pleiovirgula***, p. 1238
3. Spores *(8–)9–15(–16.5) × 2.2–3.5 µm 4

4. Spores *2.2–2.5 µm wide; bark of *Chrysothamnus*, temperate subhumid western North America .... ***O. aff. delphinus***, p. 1108
4. Spores *2.6–3.5 µm wide 5

5. Ectal excipulum and paraphyses with crystalloid SCBs (living state!); spores with rounded to obtuse apex and only slightly to medium tapered base, *10.5–13.5 × 2.8–4 µm; SBs partly longer than half the spore length; wood of *Parkinsonia*, *Atriplex*, temperate to subtropical (semi)arid western North America .... ***O. aff. pleiomesaverdiana***, p. 1150
5. Ectal excipulum and paraphyses without crystalloid SCBs 6

6. Spores often with distinct tails with slight basal inflation; paraphyses without SCBs; bark of ?*Vachellia*, subtropical arid southeastern Africa .... ***O. caudimaeandrina***, p. 1168
6. Spores with gradually tapered, slightly to strongly curved base; paraphyses with globose SCBs 7

7. Spores *(2.8–)3–3.5(–3.7) µm wide; SBs vermiform, 0.6–1.2 µm wide; wood of *Sarcobatus*, *Atriplex*, temperate semiarid western North America .... ***O. vermiculati***, p. 1166
7. Spores *2.6–3.2(–3.4) µm wide; SBs filiform, 0.3–0.4 µm wide; bark of *Acacia*, subtropical semihumid Australia .... ***O. pleioquaestiformis***, p. 1157

8. Spores *9–13(–15) × 1.8–2.3(–2.5) µm; asci up to *7.5 µm wide ... 9

8. Spores often or consistently exceeding *2.5 µm in width; asci > *7.5 µm wide (but in *O. macrodelphinus* partly not exceeding *7.5 µm) ... 10

9. Excipulum and paraphyses without crystalloid SCBs (rarely a few in paraphyses); SBs 5–8 × 0.7–1 µm; wood (rarely bark) of gymno- and angiosperms, boreal to cold-temperate (montane to subalpine) humid to semiarid western North America, southern Europe, Asia (also warm-temperate atlantic Europe?) ... ***O. delphinus***, p. 1105

9. Excipulum and paraphyses with crystalloid SCBs; SBs 6–9 × 0.4–0.6 µm; wood and bark of *Cupressus*, mesosubmediterranean semihumid Europe ... ***O. subdelphinus***, p. 1111

10. Spores *6.8–10(–11.2) × 3.6–4.4(–4.8) µm; crystalloid SCBs absent ... see key C under 13 (*O. lacrimispora*)

10. Spores less than *3.5 µm wide ... 11

11. Paraphyses & excipular cells with crystalloid SCBs ... 12

11. Paraphyses & excipular cells without crystalloid SCBs ... 14

12. Spores *(7–)8–12.5(–14) × (2.6–)2.8–3.5(–3.7) µm, with slightly to strongly tapered base, straight or only slightly (to medium) curved; wood & bark of various angiosperms, inflorescence stems of *Agave*, *Yucca*, temperate to tropical humid to arid southern Europe, Macaronesia, Africa, North America, Australia ... ***O. serpentina***, p. 1124

Collections from western North America on *Artemisia* and *Opuntia* differ in spores with basal tails (Pl. 652: 8–9). A sample from Australia on *Acacia* differs in narrower spores (*2.4–2.8 µm, Pl. 652: 10).

12. Spores *(9–)11–14(–16.5) × (2.5–)2.8–3.2(–3.5), base consistently strongly tapered and strongly curved ... 13

13. Spore apex subacute, base medium to strongly tapered; SBs distinctly shorter than half the spore length; wood & bark of *Koeberlinia*, ?*Chrysothamnus*, temperate to subtropical semiarid to arid western North America ... ***O. pleiomesaverdiana***, p. 1149

13. Spore apex acute to acuminate, base mostly with a distinct, abrupt and strongly curved tail; wood & bark of indet. angiosperm, subtropical (semi)arid North America ... ***O. pleiourosperma***, p. 1136

14. Spores *(6–)7–9.5(–11) × (2.3–)2.5–3.5(–3.8) µm, usually only slightly tapered and curved at base; SBs 4–9 µm long ... see key C under 25 (*O. maeandrina*)

14. Spores *(9–)10–12.5(–13.5) × (2–)2.4–2.8(–3) µm, often strongly tapered and ± curved at base; SBs 4.5–12 µm long; bark & wood of angio- and gymnosperms, boreal to subtropical humid to semiarid western North America ... ***O. macrodelphinus***, p. 1113

A collection on *Larrea* deviates by larger spores (*11.5–16.5 × 2.5–3.5 µm).

KEY E (asci 32-spored)

1. Spores > *3.7 µm or < 2 µm wide ... 2

1. Spores *2–3.8 µm wide ... 3

2. Spores *6–9.7(–11.2) × 1.4–1.8(–2) µm, apex rounded, base often ± attenuated in a long and strongly curved tail; SBs filiform, 1/3–1/2 of spore length; wood of *Larrea*, temperate semiarid western North America ... ***O. multivirgula***, p. 1236

2. Spores *6–8(–9) × 3.7–4.2(–4.5) µm, lemon-shaped, broadly ovoid; SBs vermiform, much longer than spores; bark of *Juniperus*, temperate subhumid western North America ... ***O. multihamulata***, p. 1054

3. Spores ellipsoid or cylindrical, apex predominantly rounded to obtuse; often with crystalloid SCBs ... 4

3. Spores broadly to narrowly fusoid, apex predominantly acute to subacute (rarely predominantly obtuse); nearly always without crystalloid SCBs ... 9

4. Spores always with a ± strongly attenuated, more or less bent tail-like base, *(6–)7–10(–10.5) × (2.5–)2.7–3.5 µm; crystalloid SCBs present; wood of *Atriplex*, *Pistacia*, *Larrea*, warm-temperate to subtropical/thermomediterranean semihumid to semiarid southern Europe & western North America ... ***O. multiurosperma***, p. 1137

4. Spores only partly somewhat tapered at base ... 5

5. Spores *(5.3–)6–8.5(–9.5) × 2.3–2.9 µm, predominantly cylindrical; SBs usually subapically inserted; crystalloid SCBs present; wood of ?*Vachellia*, subtropical arid Africa ... ***O. namibica***, p. 1238

5. Spores ellipsoid(-clavate) to fusoid, if cylindrical then crystalloid SCBs absent; SBs mainly apically inserted ... 6

6. Without crystalloid and almost without globose SCBs; spores cylindrical to mostly ellipsoid, *(3.3–)4–5.7(–6.7) × 1.8–2.4(–2.7) µm; wood & bark of various angiosperms, petioles of *Livistona*, subtropical subhumid to arid Australia & North America, mediterranean semihumid southern Europe ... ***O. multiserpens***, p. 1227

Similar Australian collections on *Eucalyptus* have larger, ellipsoid-fusoid spores *5.2–7.2 × 2–2.8 µm (Pl. 744: 7–8). If paraphyses contain globose SCBs see abnormal records of *O. multigambelii* (p. 1209).

6. With crystalloid SCBs (rarely only globose); spores *2.2–3.3 µm wide ... 7

7. Spores *~5–7 × 2–2.5 µm; on wood of *Fouquieria*, subtropical semiarid western North America ... ***O*. aff. *multicercocarpi***, p. 1215

7. Spores *(2.4–)2.6–3.2(–3.6) µm wide ... 8

8. Spores *(5.5–)6.5–7.5(–8.7) µm long; wood of *Larrea*, *Parkinsonia*, subtropical semiarid western North America ***O. multicercocarpi***, p. 1214

8. Spores *(4.2–)4.7–6.5 µm long; wood (& bark) of various angiosperms, temperate to tropical semiarid to arid western North America, Australia ... ***O. multigambelii***, p. 1209

9. Spores > *2.7 µm wide ... 10

9. Spores < *2.7 µm wide; generally without crystalloid SCBs ... 16

10. Spores with obtuse apex, heteropolar (fusoid-clavate) 11
10. Spores with predominantly subacute to acute apex, homo- or heteropolar; without crystalloid SCBs 12

11. SBs about as long as spores; crystalloid SCBs absent; spores often with attenuated but never tail-like base, *(6–)6.5–8.8 × 2.8–3(–3.2) µm; bark of *Acacia*, subtropical semiarid western Australia .... ***O.*** **aff.** ***multitrapezoidea*** (Pl. 645: 4), p. 1119
11. SBs max. half as long as spores; crystalloid SCBs present; spores always with ± strongly attenuated, more or less bent tail-like base, *6–10.5 × 2.5–3.5 µm .... see under 4 (*O. multiurosperma*)

12. SBs mostly longer than spores; spores *(4.8–)5.5–7(–8) × 2.7–3.4 µm, fusiform (amygdaliform), ± homopolar; paraphyses ellipsoid-spathulate; wood & bark of *Juniperus*, temperate subhumid western North America .... ***O. osteospermae***, p. 1082
12. SBs predominantly shorter than spores; spores longer 13

13. Spores spermoid, with abrupt tail, †6.5–10 × 3–3.5(–3.8) µm; wood of *Fraxinus*, temperate semiarid western North America .... ***O.*** **aff.** ***paloverdensis***, p. 1170
13. Spores without a distinct tail 14

14. SBs 0.8–1.2 µm wide; globose SCBs 0.5–1.3 µm diam.; spores *(5.5–)6.5–9.5(–10.5) × 2.8–3.5 µm, often heteropolar; wood & bark of various angiosperms, temperate humid to arid western North America .... ***O. multimaeandrina***, p. 1078
14. SBs 0.4–0.7 µm wide; globose SCBs 1–2.5 µm diam. 15

15. Spores *6.5–8.2 × 3–3.3(–3.5) µm; SBs 6–7.5 µm long; *Atriplex* branch, subtropical arid Australia ***O.*** **cf.** ***livistonae*** (Pl. 647: 3), p. 1121
15. Spores *8–12(–14) × (2.6–)2.8–3.2(–3.4) µm; SBs 5.5–9.5 µm long; *Livistona* petioles, subtropical (sub)humid eastern Australia .... ***O. livistonae*** (Pl. 647: 1), p. 1120

16. SBs constistently shorter than half the spore length 17
16. SBs predominantly longer than half the spore length 18

17. Spores *6.7–9.3(–10.4) × (1.8–)2–2.4 µm, straight or slightly curved at ± medium tapered base; paraphyses with capitate to clavate apices; wood of *Larrea*, temperate semiarid western North America .... ***O.*** **aff.** ***multidelphinus*** (Pl. 644: 3), p. 1116
17. Spores *8–13 × (2–)2.2–2.5 µm, often ± strongly curved at ± strongly tapered base; paraphyses with ellipsoid to spathulate apices; wood & bark of (?)*Chrysothamnus*, temperate subhumid western North America .... ***O.*** **aff.** ***multidelphinus*** (Pl. 644: 2), p. 1116

18. Spores predominantly > *7–7.5 µm long 19
18. Spores predominantly < *7–7.5 µm long 21

19. Spores *(9.5–)11–14.7 × 2.3–2.6 µm, base consistently strongly tapered and ± curved; SBs 7–9.5 µm long; SCBs absent; bark of *Juniperus*, temperate subhumid western North America .... ***O. multidelphinus***, p. 1116
19. Spores mainly *7–11 × 2.2–2.7 µm 20

20. SBs ± subulate, 0.6–1.2 µm wide, always inflated at base; wood & bark of angiosperm shrubs and coniferous trees, temperate subhumid to arid western North America .... ***O. multitrapezoidea***, p. 1117
20. SBs ± filiform, 0.4–0.7 µm wide, ± not inflated at base; wood of *Pittosporum*, subtropical subhumid eastern Australia .... ***O.*** **cf.** ***livistonae*** (Pl. 647: 2), p. 1121

21. SBs almost as long as spores or even longer; spores ellipsoid-fusoid, with obtuse apex, *5.2–7.2 × 2–2.8 µm; wood & bark of *Eucalyptus* .... see under 6 (*O.* cf. *multiserpens*)
21. SBs 1/2–2/3 of spore length; spores fusoid, with subacute apex, *(5–)6–7.5(–8.5) × 2–2.3 µm; wood of *Atriplex*, subtropical arid central Australia .... ***O.*** **aff.** ***multitrapezoidea*** (Pl. 645: 5), p. 1119

KEY F (asci 64–128-spored)

1. Spores > *2.8 µm wide; asci 64-spored; paraphyses and excipular cells with crystalloid SCBs 2
1. Spores < *2.8 µm wide 3

2. Spores *5.2–8 × (2.8–)3–3.8(–4.2) µm, fusiform, straight, sometimes with tail-like base; wood & bark of *Parkinsonia*, *Larrea*, *Quercus*, temperate humid to subtropical semiarid western North America .... ***O. sedonensis***, p. 1142
2. Spores *(6–)7–9.5(–11) × (2.7–)2.9–3.3(–3.5) µm, fusiform or fusoid-ovoid, often with distinct, ± bent tail, also with tail-like or attenuated base; wood & bark of angiosperm shrubs, subtropical semiarid to arid western North America . ***O. myriourosperma***, p. 1141

3. Asci 128-spored; SBs with strongly inflated basal part; SCBs absent; spores *4.5–5.5(–6) × 1.7–2 µm; bark of *Eremaea*, subtropical semihumid Australia .... ***O. pleistovitalbae***, p. 1192
3. Asci 64-spored; SBs filiform to vermiform, rarely basally inflated 4

4. Spores *6–8.5 µm long, ellipsoid- or fusoid-clavate, consistently slightly to strongly curved near base; SBs filiform 5
4. Spores *3.6–8 µm long, straight or only slightly curved 6

5. Crystalloid SCBs absent; spores mainly *6–7.5 µm long, medium to strongly curved; SBs 0.3–0.5 µm wide; bark of *Acacia*, subtropical semiarid Australia .... ***O. curvatimyriella***, p. 1234
5. Crystalloid SCBs present; spores mainly *7.2–8.5 µm long, slightly to medium curved; SBs 0.2–0.3 µm wide; wood of *Acacia*, tropical arid Australia .... ***O. myriofusoidea***, p. 1236

6. SBs 5–7 µm long (actual length), occupying min. 3/4 of spore length; crystalloid SCBs present 7
6. SBs 1.2–3 µm long (actual length), occupying 1/4–2/3 of spore length 8

7. Spores *4.2–6.5 × (2.2–)2.4–2.6 µm, ellipsoid-clavate; SBs filiform, 0.2–0.3 µm wide, often longer than spore length, always apically inserted; wood of ?*Vachellia*, subtropical arid Africa.. ***O*. *myrioflexa***, p. 1211
7. Spores *6–8 × 2.2–3 µm, cylindric(-clavate); SBs vermiform-subulate, 0.3–0.6 µm wide, rarely longer than spore length, often subapically inserted; wood of *Acacia*, subtropical arid Australia.. ***O*. *myrionamibica***, p. 1239

8. Crystalloid SCBs present, distinct, orange; spores *4–5.7 × 1.8–2.1 µm, hardly tapered at base; SBs 1/4 of spore length, with inflated base; wood of *Vachellia*, subtropical arid Australia.. ***O*. aff. *myriella*** (Pl. 748: 3), p. 1234
8. Crystalloid SCBs absent 9

9. Spores *(4–)4.3–6(–6.5) × (1.3–)1.5–2 µm, cylindric(-ellipsoid), rarely slightly tapered at base; SBs 0.2–0.3 µm wide; wood of *Acacia*, subtropical (semi)arid Australia .... ***O*. *myriella***, p. 1233
9. Spores predominantly > *1.8 µm wide; SBs 0.3–0.5 µm wide 10

10. Spores *(4.5–)5–6.5(–7.5) × 1.8–2.2(–2.5) µm, cylindric-ellipsoid, partly distinctly tapered at base, some with short tail; SBs 1/4–1/3 of spore length; wood & bark of *Olneya*, subtropical semiarid western North America ....***O*. *myrioolneyae*** (Pl. 746: 1–2), p. 1231
10. Spores *3.6–4.6 × 2–2.3 µm, ellipsoid; SBs 1/2–2/3 of spore length; bark of *Pittosporum*, subtropical subhumid eastern Australia
.... ***O*. aff. *myrioolneyae*** (Pl. 746: 3), p. 1232

Series *Habrostictis*

Orbilia subgenus ***Habrostictis*** section ***Habrostictis*** series ***Habrostictis*** – Lectotype species: *H. rubra* Fuckel (= *Orbilia carpoboloides*), designated by Höhnel (1917: 330)

= *Cheilodonta* Boud., Bull. Soc. Mycol. Fr. 1: 114 (1885) – Lectotype species: *Peziza carpoboloides* P. & H. Crouan (≡ *Orbilia carpoboloides*), indirectly designated by Höhnel (1917: 333)

= *Orbilia* subgroup VI *Ascophorae* Velen., Opera Bot. Čech. 4: 104 (1947, unranked) – Type species: *O. vacini* Velen. (= *Orbilia carpoboloides*)

Etymology: *Ascophorae*: referring to the extraordinarily large asci; *Cheilodonta*: a toothed lip; *Habrostictis*: a delicate or soft derivative of a *Stictis* (*Ostropales*).

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.2–)0.3–1(–1.5)((–4)) mm diam., light to bright rose-orange to yellow-ochraceous, margin usually distinctly protruding, whitish to yellowish pruinose, crenulate to lacerate or fimbriate, rarely smooth, sessile or with a distinct short stipe, superficial or often ± erumpent. **Asci** *(48–)55–95(–123) × (4–)4.5–6.8 µm, 8- to 16-spored, (2–)3–5(–6) lower spores inverted if 8-spored, 6–8 spores inverted if 16-spored; **base** never H-shaped. **Ascospores** *(5.5–)7–14(–17) × (1.4–)1.6–2.8(–3.3) µm, fusiform or fusiform-clavate, also ellipsoid-fusoid(-clavate) to subcylindrical, apex subacute to acuminate, also rounded to obtuse, straight to slightly or medium curved near base, **SBs** apically attached to spore wall, (3–)4–8(–8.5) × (0.2–)0.3–0.9 µm (actual length), filiform to subulate. **Paraphyses** slightly to strongly inflated at the apex, spathulate to mammiform or lageniform to lanceolate, terminal cell (0.7–)1–2(–3)× longer than lower cells. **Ectal excipulum** of (†) thin-walled to slightly gelatinized (common walls 0.3–1.2 µm), vertically to horizontally oriented textura prismatica-angularis, cells near base *(5.5–)8–25(–36) × (5–)7–16(–22) µm, **hairs** often present, *20–50(–80) × (2.5–)3.5–6.5(–8.5) µm, septate, thin- to firm-walled, agglutinated or ± free, also as indistinct hair-like hyphae. **SCBs** globose, often mixed with crystalloid ones. **Exudate** 0.1–1.5(–4) µm thick, continuous to granular, firmly attached, hyaline or yellowish, also absent. **— ANAMORPH**: vermispora-like (data only from *O. carpoboloides*). **Conidiophores** 2–30 × 1.5–4 µm, irregularly shaped, partly proliferating, 0–1-septate. **Conidiogenous cells** sympodial, with 1–15 nodules or short denticles. **Macroconidia** phragmosporous, */†19–44 × 2.8–5.7 µm, slightly to medium curved (C-shaped or curved mainly near the ends), 3–7-septate. **Microconidia** */†9–14.5 × 2–3.5 µm, strongly curved (c-shaped), (0–)1-septate.

Habitat: on bark and wood of angiosperms (rarely gymnosperms), also caulicolous or on textile, temperate to subtropical, humid to semiarid.

Recognized species: 7.

Taxonomic remarks. Series *Habrostictis* is defined here by paraphyses with spathulate to mammiform or lageniform apices in combination with curved phragmosporous conidia, and apothecia with a ± protruding, fimbriate or crenulate to lacerate margin due to ± agglutinated septate hairs, though a smooth, non-protruding margin may occasionally occur. These characteristics might turn out unsuitable to define a monophyletic group, because they could have developed convergently in different lineages from capitate paraphyses and smooth apothecia, particularly in those four species in which the anamorph is unknown. A remarkable characteristic of the type species of series *Habrostictis*, *O. carpoboloides*, is a cleistohymenial apothecial development (see p. 38), which probably occurs also in some other members of this series.

High diversity is noted in the spore apices which are typically subacute to acuminate, but in *O. mongolica* rounded to obtuse, and it remains unclear whether spore shape should be given a higher taxonomic value than paraphysis shape and *O. mongolica* be placed instead in series *Ellipsospermae*. In the comparable case of *O. calyptrata*, which has spathulate paraphyses similar to series *Habrostictis* and obtuse spore apices as in series *Ellipsospermae*, sequence data refers this species to the latter group. On the other hand, series *Serpentinae* comprises also some species with rounded apices, according to our phylogenetic analysis, and quite a few taxa show intermediate spores with obtuse to subacute apices.

Members of series *Piliferae* may easily be misplaced in series *Habrostictis* due to their similar paraphysis shape and hairy margin. They are affiliated in section *Aurantiorubrae*, although their rDNA data are intermediate to section *Habrostictis*, to which they would better fit by their trinacrium-like conidia. From section *Habrostictis* they differ in short, tear-shaped to globose SBs, but some species have rod-shaped to subulate SBs similar to that section. Also *O. asomatica* may be taken as a member of series *Habrostictis*, but its molecular data places it in series *Neodactylella* of section *Arthrobotrys*.

Asci in series *Habrostictis* are mainly 8-, rarely 16-spored (*O. mongolica*). Apothecia are generally medium to large-sized. Usually they exceed 0.5, often also 1 mm in diam., with the largest found in *O. brasiliensis* (1.5–4 mm). Only *O. mongolica* featured very small apothecia of 0.25–0.3 mm.

Species delimitation. Most of the included species are taxonomically problematic at the species level. *O. carpoboloides* shows high variation particularly in spore size, and its present circumscription, which includes also North American collections, must be considered as tentative. Yet, it was surprising that the two available sequences were identical, though being gained from two sites in Europe with a distance of 135 km from each other. The question of spore length applies also to the Australian *O. scandens*, which is separated from *O. carpoboloides* only with some hesitation. *O. solidaginis* possibly represents merely an atypical form of *O. flavidorosella*.

Anamorph. Within series *Habrostictis*, vermispora-like conidia are known in *O. carpoboloides* and *O. flavidorosella*, and are presumed for *O. mongolica*. In *O. carpoboloides* two types of conidia may simultaneously occur on the natural substrate: didymosporous micro- and phragmosporous macroconidia. However, only didymoconidia were so far obtained in pure culture.

Conidiophores in series *Habrostictis* were only seen in *O. carpoboloides*. They are remarkable in being irregularly bent and carrying short, densely aggregated denticles, comparable to the arthrobotryoid nodes of series *Arthrobotrys*, or the conidiophores of *O. pleistoeuonymi* (section *Lentiformes*).

Phylogeny. Sequence data were only available for two of the seven included species of series *Habrostictis*, *O. carpoboloides* and *O. flavidorosella*. In analyses of SSU+ITS+LSU (Baral et al. 2017b) or ITS (Phyl. 19), they clustered in a strongly supported clade but with a high ITS distance between each other. The position of the clade within the *Serpentinae-Habrostictis* clade remained somewhat unclear, although a sister position to series *Serpentinae* received medium or low support in the combined analyses (Baral et al. 2017b, Phyls 7, 20). Its phylogenetic affiliation in the *Serpentinae-Habrostictis* clade is supported by characteristic nucleotides (Tab. 72) and in concordance with very similar, apically acute ascospores in the two series, whereas the deviating anamorph supports recognition as a series of its own.

Specific nucleotide positions. Motifs in the rDNA that characterize series *Habrostictis* have not been found. Informative positions in the LSU D1–D2 either concur with those of the *Serpentinae-Habrostictis* clade or sometimes the *Ellipsospermae* clade, or differ between *O. carpoboloides* and *O. flavidorosella*. Under section *Habrostictis* the hypothesis is expressed that series *Habrostictis* represents the ancestral group of section *Habrostictis*.

Orbilia carpoboloides (P. & H. Crouan) Baral, Syst. Ascomycetum 13: 120 (1994) — Pls 568–575, Map 91

≡ *Peziza carpoboloides* P. & H. Crouan, Florule Finistère: 50, pl. suppl. fig. 10 (1867)
≡ *Cheilodonta carpoboloides* (P. & H. Crouan) Boud., Bull. Soc. Mycol. Fr. 1: 114 (1885)
≡ *Humaria carpoboloides* (P. & H. Crouan) Sacc., Syll. Fung. 8: 135 (1889)
≡ *Habrostictis carpoboloides* (P. & H. Crouan) Boud., Hist. Class. Discom. Eur.: 102 (1907)
?= *Peziza ulmicola* P. & H. Crouan, Florule Finistère: 52 (1867)
≡ *Lachnea ulmicola* (P. & H. Crouan) Gillet, Champ. Fr., Discomyc.: 86 (1881 [1882?])
≡ *Trichopeziza ulmicola* (P. & H. Crouan) Sacc., Syll. Fung. 8: 412 (1889)
= *Habrostictis rubra* Fuckel, Jahrb. Nassau. Ver. Naturkd. 23–24: 249 (1870)
≡ *Ocellaria rubra* (Fuckel) Sacc., Syll. Fung. 8: 656 (1889)
= *Orbilia lasia* (Berk. & Broome) Sacc., Syll. Fung. 8: 625 (1889)
≡ *Peziza lasia* Berk. & Broome, Ann. Mag. Nat. Hist. 4, 11: 347, pl. 8 f. 10 (1873)
≡ *Cheilodonta lasia* (Berk. & Broome) Boud., Bull. Soc. Mycol. Fr. 1: 114 (1885)
≡ *Calloria lasia* (Berk. & Broome) W. Phillips, Man. Brit. Discomyc.: 327 (1887)
≡ *Habrostictis lasia* (Berk. & Broome) Boud., Hist. Class. Discom. Eur.: 102 (1907)
= *Peziza fibriseda* Berk. & M.A. Curtis in Berkeley, Grevillea 3 (28): 157 (1875)
≡ *Pseudohelotium fibrisedum* (Berk. & M.A. Curtis) Sacc., Syll. Fung. 8: 298 (1889)
= *Calloria rubrococcinea* Rehm in Winter, Hedwigia 22: 72 (1883)
≡ *Orbilia rubrococcinea* (Rehm) Sacc., Syll. Fung. 8: 622 (1889)
(?)= *Calloria decipiens* W. Phillips in Cooke, Grevillea 16: 5 (1887)
≡ *Orbilia decipiens* (W. Phillips) Sacc., Syll. Fung. 8: 623 (1889)
≡ *Habrostictis decipiens* (W. Phillips) Spooner, Bibl. Mycol. 116: 194 (1987)
= *Helotium marmolense* Speg., An. Mus. Nac. Buenos Aires, Ser. 3, 12: 445 (1909)
(?)= *Helotium chordicola* Speg., An. Mus. Nac. Buenos Aires, Ser. 3, 12: 445 (1909)
?= *Orbilia ulicis* (Chenant.) Trotter, Syll. Fung. 24: 1238 (1928)
≡ *Hyalinia ulicis* Chenant., Bull. Trimest. Soc. Mycol. Fr. 34: 39 (1918)
= *Orbilia vacini* Velen., Opera Bot. Čech. 4: 104 (1947)
= *Orbilia piloboloides* J.H. Haines & Egger, Mycotaxon 16: 108 (1982)

Etymology: *carpoboloides*: referring to a similarity of the apothecia with *Sphaerobolus stellatus* (earlier named *Carpobolus stellatus*); *chordicola*: growing on a rope; *decipiens*: deceiving (to be easily confused); *fibriseda*: referring to the growth of the apothecia among fibres of rotten bark; *lasia*: after the hairy apothecial margin; *marmolense*: after the type locality, José Mármol (suburb of Buenos Aires); *piloboloides*: after the apices of paraphyses resembling fructifications of *Pilobolus*; *rubra*; *rubrococcinea*: after the (scarlet-) red hymenial colour; *ulicis*, *ulmicola*: referring to the host; *vacini*: after the collector V. Vacek (latinized '*Vacinus*' by Velenovský).

Typification: France, Finistère, unlocalized, on twine in an orchard, 20.III.1866, collector unknown (CO, herb. Crouan, holotype of ***Peziza carpoboloides***); Luxembourg, Grevenmacher, Manternach, branch of *Ulmus*, 4.V.2000, H.O. Baral (H.B. 6639c ø, illustration Pl. 568: 3, epitype, designated here, MBT385127, ex-epitype culture: CBS 116276; sq.: KT215248). — France, Finistère, on *Ulmus* bark, spring, collector unknown (type of ***P. ulmicola***, unlocated). — Germany, Oestrich, branch of *Ulmus minor*, undated, L. Fuckel (herb. Fuckel 1894, G, lectotype of ***Habrostictis rubra***, designated here, MBT382103). — Great Britain, Bath, branch of [*Ulmus*], on *Diatrype stigma*, [16.III.1870,] C.E. Broome (M-0206370, lectotype of ***P. lasia***, designated here, MBT382104). — USA, Virginia, unlocalized, branch of *Ulmus americana*, undated, collector unknown (K, M.J. Berkeley 3311, holotype of ***P. fibriseda***). — USA, Kentucky, ?Lexington, bark of *Gleditsia triacanthos*, ?1882, W.A. Kellerman (S-F9979, lectotype of ***Calloria rubrococcinea***, designated here, MBT382105). — Australia, Brisbane, unlocalized, on a twine, undated, F.M. Bailey (herb. Bailey 516, K(M) 36052, holotype of ***C. decipiens***). — Argentina, Buenos Aires, branch of *Maclura pomifera*, 16.V.1905, C.L. Spegazzini (LPS 24442, holotype of ***Helotium marmolense***, as *Maclura aurantiaca*). — Argentina, La Plata, on a rope, 7.VII.1906, E. Spegazzini (LPS 24443, holotype of ***Helotium chordicola***). — France, Nantes, bark of *Ulex*, undated, [J. Chenantais] (type of ***Hyalinia ulicis***). — Czechia, Srbsko, branch of *Ulmus*, 15.IV.1941, V. Vacek (PRM 151691, holotype of ***O. vacini***). — Canada, Ottawa, Cantley, trunk of *Ulmus americana*, 22.IV.1980, J.H. Ginns (DAOM 176753, holotype of ***O. piloboloides***).

Misapplied names: Nannfeldt (1932: 252), as ?*Hyalinia rubella*.

Misinterpretation of *O. carpoboloides*: Breitenbach & Kränzlin (1981 p.p.: colour photo fig. 261), = *O. comma*.

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.35–)0.5–1.5(–1.8) mm diam., 0.16–0.4(–0.55) mm high (receptacle 0.12–0.28 mm), (pale to) light to deep rose-carneous to mostly yellow-ochraceous or orange(-red), not or slightly translucent, round to broadly elliptical or somewhat undulating, scattered to gregarious, sometimes in clusters; disc strongly to slightly concave (urceolate), finally flat, margin thin or thick, with mostly prominent, whitish(-ochraceous), fimbriate hair vesture or distinct tufts or teeth up to 100–150 × 80–120 µm, also only powdered, protruding 10–130 µm beyond disc, exterior furfuraceous or often with ± distinct squamules, partly covered by a distinct yellow pruina-like exudate; broadly sessile or with ill-defined stipe-like base or obconical to cylindrical stipe 0.05–0.35 × 0.15–0.6(–1.15) mm, erumpent through cracks from beneath periderm, or immersed to nearly superficial; dry deep yellowish-orange-ochre, ± closed by the incurved teeth, becoming rather inconspicuous. **Asci** *(58–)65–95(–123) × 4.8–6.2(–6.8) µm {14}, †(50–)55–90(–105) × (3.8–)4.2–5.3(–5.7) µm {21}, 8-spored, spores 2(–3)-seriate, (1–)3–5(–6) lower spores inverted {21} (not or often mixed), pars sporifera *(25–)30–45(–60) → 32–45 µm long, †31–54 µm; **apex** (†) medium to strongly truncate (slightly indented, laterally sometimes inflated); **base** with short to

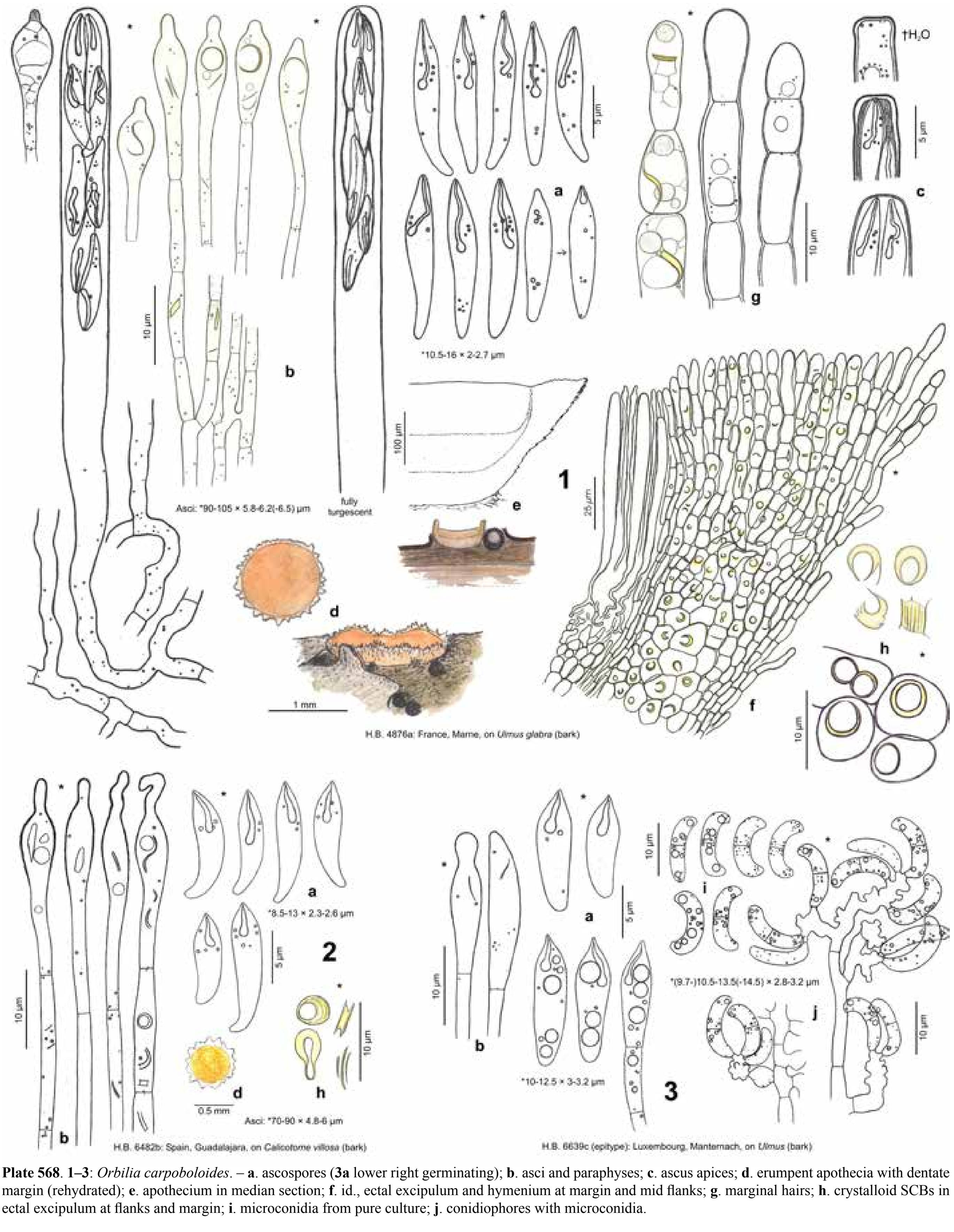


Plate 568. **1–3**: *Orbilia carpoboloides*. – **a**. ascospores (**3a** lower right germinating); **b**. asci and paraphyses; **c**. ascus apices; **d**. erumpent apothecia with dentate margin (rehydrated); **e**. apothecium in median section; **f**. id., ectal excipulum and hymenium at margin and mid flanks; **g**. marginal hairs; **h**. crystalloid SCBs in ectal excipulum at flanks and margin; **i**. microconidia from pure culture; **j**. conidiophores with microconidia.

very long, thin, flexuous stalk, T-, L-, Y- or h-shaped. **Ascospores** *((7–))(7.7–)8.5–14(–17)((–19)) × ((1.6–))(2–)2.2–2.8(–3.5) µm {32}, †(6.5–)7.5–14.5(–15.3) × (1.7–)2–2.7 µm {17}, †2.6–2.8 µm wide when artificially flattened, fusiform (with partly ± cylindrical middle part) to fusiform-clavate or fusoid, apex subacute to acuminate, base slightly to strongly attenuated, straight or often slightly to medium curved at base; **SBs** *(3–)4–6(–8.5) × (0.4–)0.6–1(–1.3) µm {16} (in situ and actual length), vermiform or mostly subulate, often slightly to strongly inflated at base, mostly ± flexuous; germinating spores *3–3.4(–3.8) µm wide {1}, 0–1-septate, with large LBs. **Paraphyses** apically (slightly to) medium to strongly lageniform to mammiform, also spathulate, beak straight or flexuous, 2–4 µm or 5–6(–7) µm long [rarely up to 10(–15) µm, H.B. 5145a], (1–)1.2–2(–2.8) µm wide, sometimes intermingled with young, cylindrical to slightly clavate paraphyses, terminal cells *(10–)13–28(–33) × (2–)3–5(–6.3) µm {13}, †14–31(–35) × (1.2–)2–4(–5) µm {6}, exceeding the dead asci by (0–)3–10 µm, lower cells *7.5–20 × 1.5–2.5(–3) µm {6}, †5–17(–19.5) × 1–2 µm {4}; very rarely branched at upper septum; hymenium/subhymenium hyaline to pale orange or rose. **Medullary excipulum** hyaline or pale orange, (0–)30–150(–200) µm thick, of ± loose or dense textura intricata with scattered or copious inflated cells, scarcely to sharply delimited from ectal excipulum (partly by a 10–20 µm thick layer of t. porrecta). **Ectal excipulum** hyaline, pale to light orange-rose near margin, of thin-walled to slightly gelatinized, vertically to horizontally oriented t. prismatica-angularis(-intricata) from base to mid flanks; 25–170(–250) µm thick near base, cells *(8–)10–25(–36) × (5–)9–15(–20) µm {6}, †8–21 × 5–15 µm {3}; 20–45 µm thick at lower and mid flanks, cells *8–20 × 5–14 µm {2}, †8–13 × 3–6 µm {2}, (10–)30–80 µm near margin, of t. prismatica-angularis to t. prismatica-porrecta oriented at a 0–45° angle to the surface; marginal cortical cells running out into agglutinated or ± free **hairs** *20–60 × (2.5–)3.5–6.5 µm {5}, †3–4.5(–6.5) µm wide {3}, ± cylindrical with rounded ends, 2–4(–6)-celled, walls */†0.2–0.6(–0.8) µm thick, straight, inner hairs curved inwards; whole exterior often covered by a 10–20 µm thick, ± yellowish t. porrecta of narrow hyphae {5} which may project as squamules. **Anchoring hyphae** nearly absent to abundant, */†1.5–4(–7) µm wide {11}, walls *0.2–0.3 µm thick {7}, †0.2–0.6 µm {4}, ± gelatinized, forming a dense or loose t. intricata-porrecta 40–100 µm thick, sometimes delimited from ectal excipulum at base by an up to 150 µm thick t. intricata of 3.5–8 µm wide cells. Globose **SCBs** often present in paraphyses, 1–2.2 µm diam; crystalloid SCBs present {37}, rarely absent {2}, in paraphyses ring- to spool-/S-shaped, hyaline to pale yellow; in ectal excipulum at flanks and margin C-, spool-, ring-, horseshoe- to keyhole-shaped, or rhomboid, pale yellow-orange, 4–9(–10) × (2–)3–5 µm, abundant, near base hyaline and smaller. **Exudate** over paraphyses absent or 0.1–0.3(–1) µm thick, hyaline or sometimes bright yellow, finely rough to granular, rarely cloddy, firmly attached to beak and inflated part, exceptionally forming ~1 µm thick glassy caps {H.B. 5619b}; on marginal excipulum or cortical hyphae absent or sparse to abundant, rough-granular or homogeneous, loosely or firmly attached, up to 0.5–1 µm thick, hyaline or light to bright yellow(-chlorinaceous), colour unchanged in KOH. — **ANAMORPH**: vermispora-like (from ascospore isolate {3, microconidia}, including data of Haines & Egger 1982 and Pfister 1997; from natural substrate {13× macro-, 4× microconidia}). **Microconidiophores** *9–17 × 2.5–4 µm {1}, †(2–)5–20(–30) × 1.5–3 µm {2}, 0–1-septate, cylindrical to lageniform or moniliform, sometimes branched by proliferation, with 1–4 {2} up to 6–15 {1} distinct nodules or short denticles. **Macroconidia** */†19–32(–35) × (3–)4.5–5.5 µm {7}, C-shaped or curved especially near ends (canoe-shaped), (3–)5–7-septate {6}. **Microconidia** *((7.5–))(9–)10–13.5(–14.5) × (2.2–)2.5–3.2(–3.5) µm {2}, †9–13(–14) × 2–3.2 µm {3}, strongly curved (c-shaped), (0–)1-septate.

Habitat: collected 0–3 m above the ground, or 'in top 3rd of trees that have been dead over 1 year' (J. Ginns in sched., type of *O. piloboloides*), corticated or partially decorticated, 6–30 mm thick branches, sometimes thick trunks, of living to completely dead, standing trees or shrubs of ?*Ailanthus altissima* {1}, *Albizia julibrissin* {1}, *Alnus* sp. {1}, *Calicotome villosa* {1}, *Cercis siliquastrum* {4}, *Colutea arborescens* {1}, *Cytisus scoparius* {2/1}, *Gleditsia triacanthos* {1}, *Lupinus arboreus* {1}, *Maclura pomifera* {2}, *Malus domestica* {1}, *Morus* sp. {1}, *M. rubra* {1}, *Passiflora caerulea* {3}, *Prunus dulcis* {1}, *P. padus* {1}, *Robinia pseudoacacia* {1}, *Rosa* sp. {1}, *Salix* sp. {8}, *Ulex europaeus* {2}, *Ulmus* sp. {29}, *U. americana* {3}, *U. glabra* {1}, *U. laevis* {4}, *U. minor* {6/1}, indet. angiosperm {2}; herbaceous stems of *Melilotus* sp. {1}, indet. herb {1}, twine or textile of plant fibres {3}; on slightly to strongly decayed bark {72} (often loosely attached), on periderm {8} or bast {26}, periderm locally removed, on outer, rarely inner surface of bast, but mostly breaking through small holes in periderm caused by dark hyphomycetes (often *Diplodia*), partly hidden beneath detaching periderm, rarely on 0.5–1.5 mm deeply rotten wood {6}, also on living to very old *Vuilleminia comedens* {1}, *Cyclothyriella rubronotata* {1}, *Diatrype stigma* {1}, *Valsaria insitiva* {1}, indet. pyrenomycete {2}, or on boring dust in beetle galleries, ± strongly greyed, green algae absent or sparse to very abundant. **Associated**: *Aglaospora profusa* {1}, ?*Bacidia* sp. {1}, *Baggea* sp. {1}, *Bionectria pallidula* {1}, *Cucurbitaria elongata* {1}, *Dacrymyces* sp. {1}, *Diaporthe eres* {1}, *Didymosphaeria oblitescens* {1}, *Diplodia* sp. {5}, *Durella* ?*compressa* {1}, *Eutypella stellulata* {1}, *Hyalorbilia orbiliicola* (on *O. aurantiorubra*) {2}, *Lachnella villosa* {1}, *Melanelixia* ?*subaurifera* {1}, *Mollisia* sp. {1}, *Nectria pseudopeziza* {2}, *Nitschkia* sp. {1}, *N. broomeana* {1}, *N. cupularis* {1}, *Orbilia siculispora* {1}, *O. aurantiorubra* {10}, *O. caulicola* {1}, *O. cercidicola* {2}, *O. comma* {2}, *O. eucalypti* {1}, *O. flavidorosella* {1}, *O. gambelii* {1}, *O. maeandrina* {1}, *O. myriosphaera* {1}, *O. phragmotricha* {1}, *O. pleiogambelii* {1}, *O. polyspora* {1}, *O. subaristata* {2}, *O. trapeziformis* {1}, *Parmelia* sp. {1}, *Patellaria atrata* {1}, *Phragmiticola* sp. {1}, *Physcia* sp. {4}, *Schizoxylon compositum* {1}, *Stictis radiata* {1}, *Trichopeziza perrotioides* {1}, *Unguiculella eurotioides* {1}, *Valsaria insitiva* {1}, *Xanthoria parietina* {2}, old undetermined pyrenomycete {1}, foliose lichens. **Desiccation tolerance**: fully tolerant for at least 7.5 months, paraphyses and ascospores still viable after 16 months, some excipular cells and macroconidia after 32 months. **Altitude**: 1–737 m (central and western Europe), 215–1650 m (southern Europe), 20–300 m (America). **Geology**: Proterozoic, Cambrian, Ordovician, Devonian & Permian greywacke, shale, silt, sand- & limestone, Muschelkalk, Lower Jurassic limestone, Cretaceous marl & flysch, Tertiary molasse, sand & calcareous marl, Pleistocene loess, clay, silt & sand; volcanic mafic basaltic rock, serpentinite. **Phenology**: throughout the year (long-lived).

Phenology of *O. carpoboloides* (northern hemisphere)											
Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
6	8	9	9	11	5	3	3	8	3	5	6

Taxonomic remarks. *Orbilia carpoboloides* is characterized by rather large apothecia with a protruding, whitish, lacerate to fimbriate margin and ochraceous-orange disc, paraphyses with spathulate or lageniform to mammiform apices, comparatively large, fusiform-clavate to cylindric-fusiform ascospores with acute apices and often slightly curved bases, striking crystalloid SCBs in the cells of excipulum and partly in paraphyses, finally by a vermispora-like anamorph with c-shaped, 1-septate microconidia and apparently also multiseptate macroconidia. American (and Australian) collections are very similar to European ones, even in their ecology, growing often on bark of *Ulmus* or in association with pycnidia of *Diplodia*.

O. carpoboloides resembles *O. pilifera* in many characteristics of its teleomorph. *O. pilifera* sharply differs in subglobose spore bodies, in the absence of crystalloid SCBs, and in a trinacrium-like anamorph. Our molecular data suggest for *O. pilifera* a marginal placement in section *Aurantiorubrae*.

For the differences to the very closely related *O. brasiliensis* (p. 1040) and *O. scandens* (p. 1042) see under these species.

Variation. *O. carpoboloides* has sometimes distinctly stipitate, almost superficial apothecia, especially in American collections (type of *O. piloboloides*, collections on *Albizia* and *Morus*), whereas in the majority of collections they are broadly sessile and partly erumpent (including the types of *O. decipiens*, *O. fibriseda* and *H. marmolense*). However, immersed stipes are easily overlooked. Haines & Egger (1982) reported the stipes to be only partly present in the type of *O. piloboloides*. The fimbriate margin varies between slightly crenulate to distinctly lacerate or dentate, but in some apothecia it may be not incised at all. The thickness of the rather dense textura intricata on

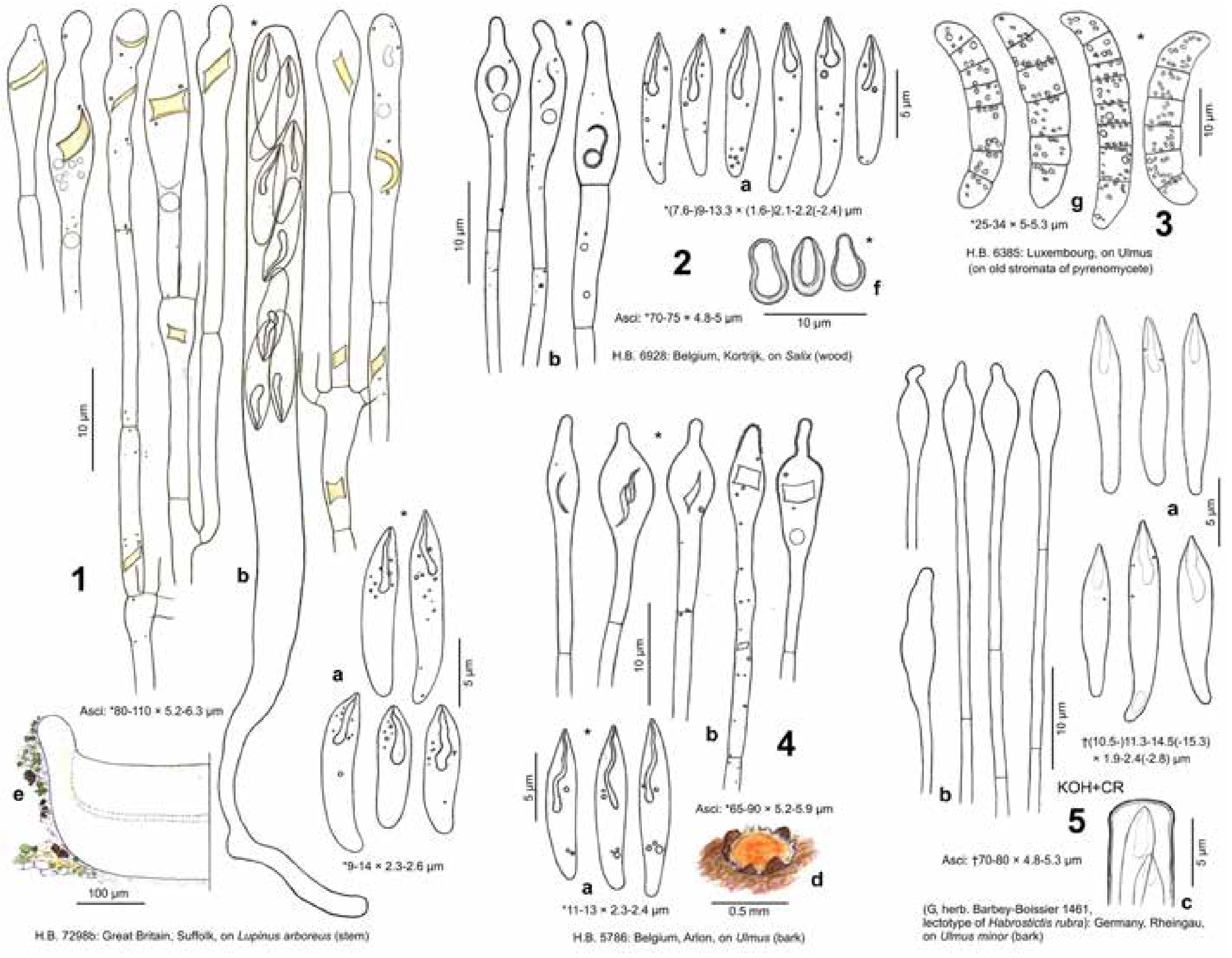


Plate 569. **1–5**: *Orbilia carpoboloides*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apex; **d**. erumpent apothecium (rehydrated); **e**. apothecium in median section; **f**. crystalloid SCBs; **g**. macroconidia on natural substrate.

the exterior, formed by the anchoring hyphae, varied strongly among the collections, attaining near the base a maximum of 150 µm in the topotype of *O. piloboloides*.

The presence and length of the beak on the swollen tips of paraphyses varies strongly, often within a collection. There are also usually young paraphyses with uninflated cylindrical apices present in mature apothecia among the typical ones, and sometimes only uninflated paraphyses were found although some mature asci already occurred. In the holotype of *O. carpoboloides* on twine (Pl. 570: 2) the inflated apices were consistently spathulate (without beaks) whereas beaks were mostly present in the examined types of *Habrostictis rubra* (Pl. 569: 5), *O. lasia* (Pl. 570: 1), *O. piloboloides* (Pl. 573: 1), *O. decipiens* and *Helotium marmolense* (Pl. 573: 3–4), *Peziza fibriseda* (Pl. 574: 2), and *O. rubrococcinea* (Pl. 575: 3), all on bark, often of *Ulmus*. Also records on *Passiflora* (from La Gacilly, Bretagne) partly had no beaks on the paraphyses.

The present concept of *O. carpoboloides* includes a high variation in spore size and shape. The spore apex varies among the different collections from subacute to acuminate (see also under Type studies). Asci and ascospores of the extra-European samples are usually slightly to considerably shorter than in many European ones, and the spores more fusiform. Within Europe, the holotype of *O. carpoboloides* has rather short and broad spores, whereas the spores of the *Habrostictis rubra* and *O. lasia* types are longer and narrower. Yet, the broad spores in the former type are partly due to strong artificial flattening and were probably narrower in the living state. Whether all three types belong to a single species remained uncertain. Some of the recent European collections examined show spores similar as in the *O. carpoboloides* type although having beaked paraphyses and growing on bark (e. g., Pl. 568: 2–3). On the other hand, Boudier (1904–10: pl. 459) figured a collection on rotten fabric with long and narrow spores and beaked paraphyses. Long and narrow spores were encountered in mediterranean (e. g., Pl. 571: 10) as well as temperate regions (e. g., Pls 568: 1; 569: 2; 570: 1). The longest spores of *14–18(–19) × 2–2.8 µm were observed in a recent sample from Portugal (on *Salix*), the shortest (*7–9 × 3–3.5 µm) in a recent one from New York (on *Ulmus*). In long-spored populations the spores often tend to be curved at the base, but also those with a medium spore length may show a pronounced curvature (Pl. 568: 2), whereas extra-European specimens but also, e. g., that from Netherlands (near Maastricht) showed only straight or basally slightly curved spores. Since a sharp limit between the available long- and short-spored collections could not be drawn, a split into two taxa seemed impracticable (but see under Phylogeny).

Differences in the presence of SCBs were observed among collections studied in the living state, but these did not clearly correlate with other features such as ascospore size and shape. Within the European collections, crystalloid SCBs occurred

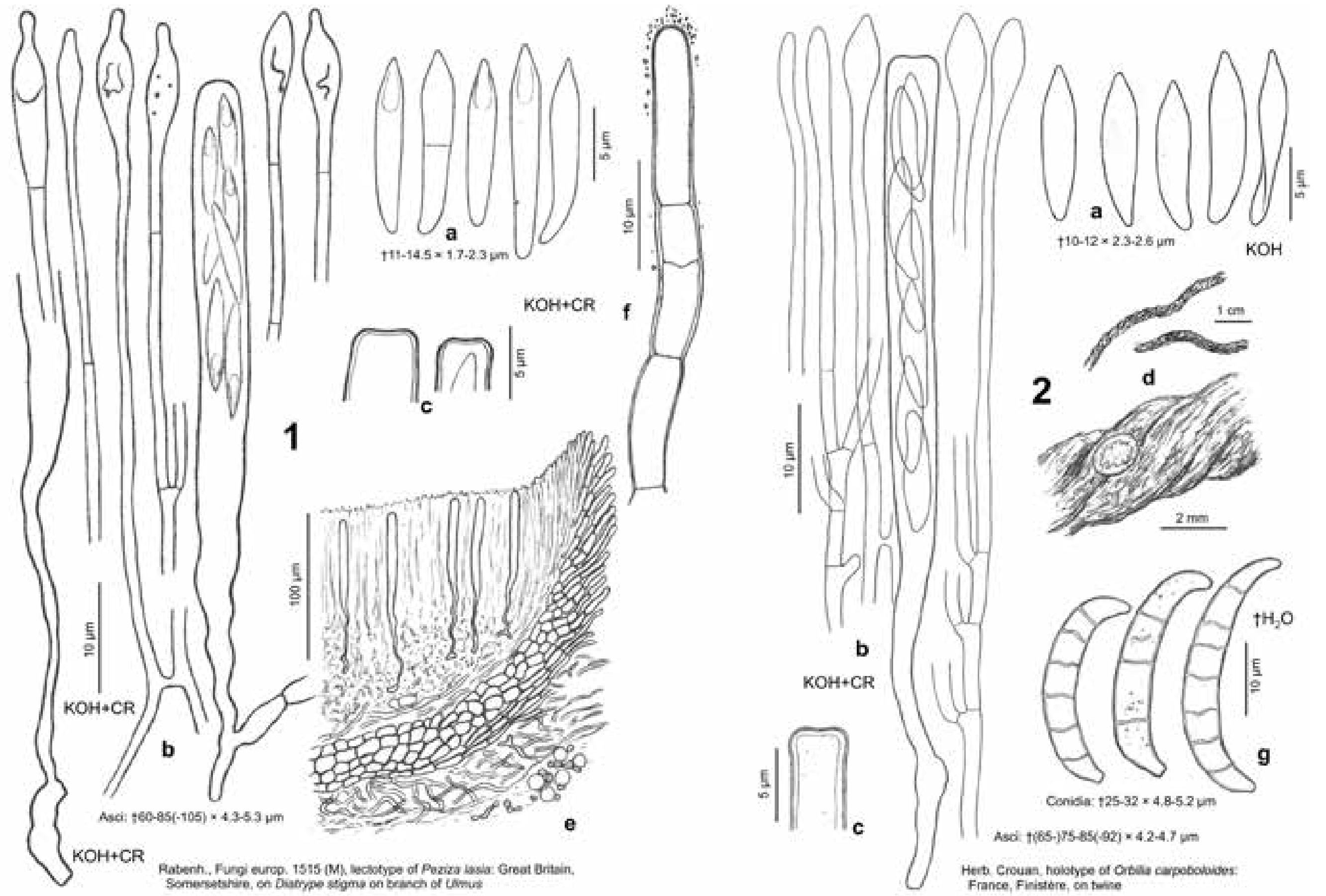


Plate 570. **1–2**: *Orbilia carpoboloides*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. rehydrated apothecium on a twine; **e**. apothecium in median section; **f**. marginal hair; **g**. macroconidia from substrate. The rod-shaped structures in the inflated paraphysis apices in **1b** are a result of shrunken plasma rather than remnants of SCBs.

with a remarkable consistency in both paraphyses and excipulum, though in some specimens they were rather thin and inconspicuous. In one of the c. 20 European collections studied in the living state (H.B. 5126b, *Salix*, Briançon, montane, unillustrated) only globose SCBs were seen in the living paraphyses, while the excipular cells did not contain SCBs at all. Crystalloid SCBs were observed in both specimens from which sequences were taken.

Among the three American collections studied in the living state, that from Tennessee showed crystalloid SCBs in the basal ectal excipulum but not in the paraphyses (Pl. 574: 3b). No SCBs at all were seen in the topotype of *O. piloboloides* from Québec (Pl. 573: 1). On the other hand, in the not included sample from Arizona on *Prosopis* distinct crystalloid SCBs occurred in paraphyses and ectal excipulum.

A distinctly yellow, KOH-inert exudate was observed on the exterior of the apothecia but also on the beaks of the paraphyses in a specimen from near Maastricht (Pl. 572), in the topotype of *O. piloboloides* (Pl. 573: 1), in the specimens from Louisiana (Pl. 574: 1) and Tennessee (Pl. 575: 1h–i), and in the type of *O. rubrococcinea* (Pl. 575: 3e), also in some apothecia of a collection from Austria (Fernitz, IVV: 16.X.2010). This pigment is stable in the herbarium over many decades, and is recognizable under natural as well as LED light, but especially striking when illuminated by the Luxeon LED.

Type studies. The protologue of ***Peziza carpoboloides*** (Finistère, Bretagne, on decayed twine in a garden) includes a small sketch with microscopic elements (Crouan & Crouan 1867: pl. suppl. fig. 10; Fig. 169), but lacks any ascus and spore measurements. This somewhat rough sketch fits rather well the holotype specimen examined here (Pl. 570: 2), except that it shows oblong-ellipsoid, homopolar spores with ± obtuse ends. The spores were obviously drawn in the dead state because they do not contain spore bodies and, therefore, spore apex and base are not clearly differentiated (see Fig. 169 left). The original watercolour sketch preserved at the herbarium CO shows similar ellipsoid-fusoid spores with more subacute apices (see Fig. 169 right).

Another collection identified as *P. carpoboloides* (Paris, Bois de Vincennes, on rotten fabric) is very briefly described and illustrated by Patouillard (1886: 210, pl. 484), likewise without microscopic measurements. According to the scale of Patouillard's illustration, Saccardo (1889: 135, as *Humaria carpoboloides*) evaluated the asci as 40–45 × 5 µm and the spores as 6–7 × 2 µm. These data would point to another species, perhaps the South American *Orbilia brasiliensis*, the type of which also grew on textile. However, obviously the same specimen was depicted in detail by Boudier (1904–10: 265, pl. 459; Fig. 167), who gave the spores as 15–20 × 2–3 µm (15–19 × 2–2.9 µm evaluated from the scale), and his report clearly fits the present concept of *O. carpoboloides*, though spore length exceeds what we observed in any of the studied specimens.

This discrepancy in spore length was also noted by Le Gal (1953: 92) and Gremmen (1955). Le Gal reexamined Crouan's type material and found the spores 10–12(–16) × 1.5–2 µm, which is distinctly narrower than here found, perhaps due to artificial flattening. She stated to have seen two original convolutes of *Peziza carpoboloides*, but only one such specimen was received from CO in the present study, which is considered

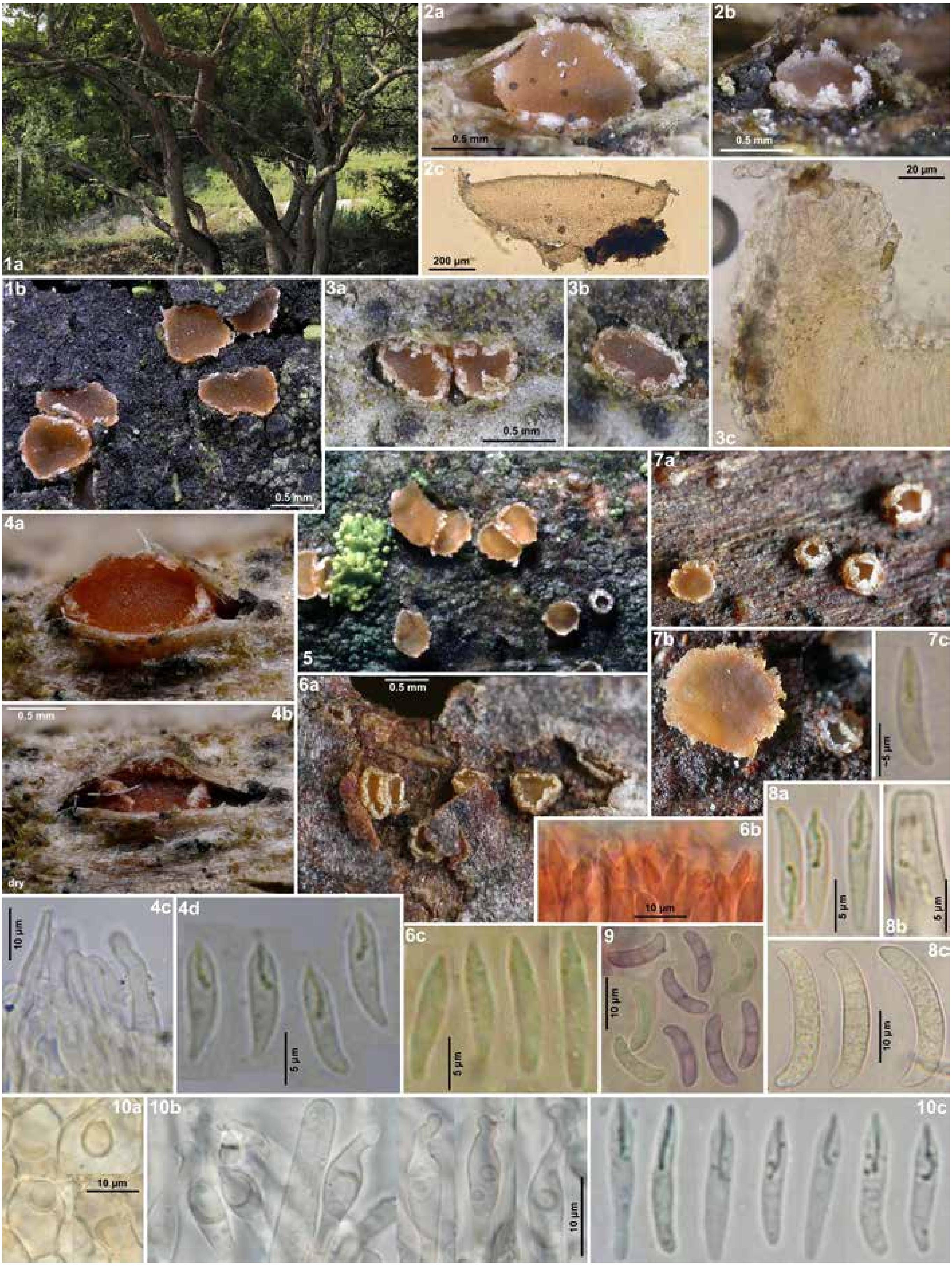


Plate 571. **1–10**: *Orbilia carpoboloides*. – **1a**. mesosubmediterranean woodland with *Cercis* trees with some dead attached branches; **1b**, **2a–b**, **3a–b**, **4a**, **5**, **6a**, **7a–b**. rehydrated apothecia; **4b**. dry apothecium; **2c**. apothecium in median section; **3c**. id., marginal excipulum; **4c**. marginal hairs; **10a**. crystalloid SCBs in cells of ectal excipulum; **8b**. ascus apex; **6b**, **10b**. paraphyses; **4d**, **6c**, **7c**, **8a**, **10c**. ascospores; **8c**. macroconidia (from substrate); **9**. microconidia (from culture). – Living state, except for **6a–c** (**6b** in KOH+CR, **6c** in KOH), **8b** (ascus). – **7a–c**: phot. M. Hairaud, **8a–c**: G. Friebes. — **1**. H.B. 9238c: France, Provence, Montélimar, on *Cercis*; **2a–c**. H.B. 9083a: ibid., Aix-en-Provence, on *Cytisus*; **3a–c**. H.B. 9086b: ibid., Porquerolles, on *Ulmus*; **4a–d**. 13.VI.2009: France, Lorraine, Audun-le-Tiche, on *Melilotus*; **5**. H.B. 5824: Germany, Zwiefalten, on *Ulmus*; **6a–c**. H.B. 7800a (lectotype of *H. rubra*): Germany, Rüdesheim, on *Ulmus*; **7a–c**. M.H. 80306: France, Deux-Sèvres, on *Ulmus*; **8a–c**. G.F. 20090147: Austria, Steiermark, on *Ulmus*; **9**. H.B. 6639c (epitype): Luxembourg, Manternach, on *Ulmus*; **10a–c**. R.T.L. 10122201: Spain, Teruel, on *Prunus*.

here to be the holotype. Gremmen studied a collection from the Netherlands (on *Ulmus* bark) and Boudier's specimen (on textile), and found spores of (11.5–)12.5–13.4(–15.4) × 2.8–3 µm, with one end broader than the other, 'often with a small central oil droplet'. Regrettably, no trace of SBs can be seen in the drawings of Crouan, Patouillard, and Boudier, even though these authors were used to work with fresh collections, and no trace of them could be discerned in the present study. The acute spore apex is clearly seen in Pl. 570: 2 as well as on Boudier's drawing.

The illustration of a specimen from Luxembourg (Manternach, on *Ulmus*, H.B. 6639c ø, Pls 568: 3; 571: 9), from which a pure culture (CBS 116276) and a sequence were gained, is designated here as **epitype** of *O. carpoboloides*.

The protologue of ***Peziza ulmicola*** (under dead *Ulmus* bark, spring, dépt. Finistère, Bretagne, France) is without illustration, and no type material could be located at CO. According to J.P. Priou (pers. comm.) there exist two documents: (1) a watercolour sketch which bears the signature '*Peziza ulmicola* Crn. mscr.' but no date, and (2) an authentic specimen [Brest, Coataudon ('Coatodon'), in cracks of *Ulmus* bark, IVV: 9.IX.1869] which includes a microscopic pencil drawing with the same date. Both sketches obviously represent *Orbilia carpoboloides* as redescribed here from the holotype. Reexamination of this specimen by J.P. Priou (spores †12–15 × 2–2.5 µm, fusoid, with partly visible vermiform SBs) confirms this identity. The specimen cannot, however, be designated as lectotype because it was collected about 2 years after *P. ulmicola* was published.

The protologue of *P. ulmicola* describes the paraphyses as 'filiform, longer than the asci', and the spores as 'ovoid with 2 sporidioles' (Saccardo 1889 as 'binucleate'). These rather severe microscopical differences to the collection from 1869 appear to hint at two different species. Spore shape would fit *O. pilifera*, a species growing exclusively on *Ulmus* bark. However, *O. pilifera* was so far not detected in the northwest of France but only in sub- to eumediterranean regions in western France, Spain, and southern Austria (see Map 85). The spathulate paraphyses and uniguttulate spores of *O. pilifera* also hardly fit the protologue of *P. ulmicola*. Perhaps the apothecia in the type of *P. ulmicola* were rather young and the paraphyses still filiform.

Nevertheless, it remains a mystery why the Crouan brothers named the collection from Coataudon *P. ulmicola*, although their sketches show a striking similarity with their watercolour sketch of *P. carpoboloides* in regard to paraphyses with strongly swollen spathulate-lanceolate apices and narrowly fusoid spores without inclusions, The habit of the apothecia differs, however: those of *P. carpoboloides* are depicted as cupulate and bright orange (yellow ferruginous in the protologue), whereas those of *P. ulmicola* are flat, light rose to orange. Both drawings concur in showing a dentate margin. Because the watercolour sketch of *P. ulmicola* does not fit the protologue but concurs well with the microscopic drawing inside the authentic specimen, it also cannot be considered as holotype of this species.

Fuckel's (1870) unillustrated protologue of ***Habrostictis rubra*** (Germany, Hessen, Oestrich, on bark of *Ulmus minor*, as *U. campestris*, spores 12 × 2.5 µm) well agrees with that of *O. carpoboloides*, in spite of the different substrate. The presumed synonymy between *H. rubra* and *O. carpoboloides* is confirmed in the present reexamination of type material of *H. rubra* in G (herb. Barbey-Boissier 1461 ex herb. Fuckel 1894, 'isotype', Pls 569: 5; 571: 6). This shows apothecia with a strongly protruding and distinctly lacerate whitish margin. Already Gremmen (1955) could not find any differences between Boudier's specimen on textile and his collection on *Ulmus* bark, both showing a distinctly toothed margin.

Verkley (1999: 151) examined the 'holotype' of *H. rubra* in G (herb. Fuckel 1894) and three 'isotypes', among them Barbey-Boissier 1461. Verkley regarded these specimens as holo- and isotype according to the original handwritten description and drawing in the 'holotype'. The 'holotype' was not examined in the present study because only 1–2 apothecia were seen inside. We here designate one of the 'isotypes', i. e., Fuckel's collection (Fuckel 1894) as **lectotype** of *H. rubra* (Art. 9.11, Turland et al. 2018).

Berkeley & Broome's (1873) detailed illustration (Great Britain, Somersetshire, *Ulmus*, Fig. 168) leaves no doubt that ***Peziza lasia*** is conspecific with *O. carpoboloides* (spore size was given as 0.0005 × 0.0001 inch = 12.7 × 2.5 µm). The presumed synonymy of *P. lasia* with *O. carpoboloides* is confirmed in the present study from the syntype in M (herb. Rabenh., Fungi europ. 1515, 'isotype', Pl. 570: 1). The margin is distinctly protruding (Pl. 570: 1e). No substrate and date was indicated in this specimen, but the location is that of the protologue, and the bark fragment may well be *Ulmus* as mentioned in the protologue. Whether a syntype of *O. lasia* exists at K is not clear, since the British checklist of fungi (FRDBI) does not list the type collection. Fungi europ. 1515 (M) is designated here as **lectotype** of *Peziza lasia*.

When Boudier (1885) erected *Cheilodonta* for two species, *Peziza carpoboloides* and *P. lasia*, he overlooked Fuckel's genus *Habrostictis* with the type *H. rubra*. It was apparently Rehm (1891: 456) who first suggested synonymy of *O. lasia* and *H. rubra* based on the examination of type material of *H. rubra* (Fungi Rhen. Exs. 2554) and a specimen of W. Phillips (Elvell. brit. 117). Rehm named the species *O. lasia* although *H. rubra* has priority over Berkeley & Broome's taxon. Also Höhnel (1917: 331) confirmed the identity of *O. lasia* with *H. rubra*. However, he doubted the description and illustration of a lacerate-fimbriate margin by Berkeley & Broome as well as Saccardo (1883: pl. 1365, *H. rubra*) and obviously also Fuckel, because he found the margin in Fungi Rhen. Exs. 2554 and a specimen by H. Sydow (Mycoth. germ. 613, on bark of '*Malus*', according to Höhnel perhaps *Phellodendron amurense*) to be neither dentate nor fimbriate, and only slightly protruding. The erumpent growth of the apothecia of *H. rubra* on bark was a further argument for him to keep *Peziza carpoboloides* separate based on a strongly toothed margin and a superficial growth on textile. Thus, Höhnel retained *P. carpoboloides* in *Cheilodonta* and accepted *O. lasia* as a synonym of *H. rubra* in a separate genus *Habrostictis*. Nannfeldt (1932: 96) did not study the type of *P. carpoboloides*, but followed Boudier (1907) in synonymising *Cheilodonta* under *Habrostictis* (see p. 201).

The holotype of ***Peziza fibriseda*** in K (USA, Virginia, on *Ulmus americana*, Pl. 574: 2) was examined. It concurs macroscopically with the unillustrated protologue which is very brief and devoid of microscopic features. The label shows an ascus probably drawn by the authors, but no spores which they apparently did not see. Massee (1894b: 100) examined the seemingly same specimen from K and found the micromorphology not different from *Peziza cruenta* Schwein. (the identity of this taxon could not be clarified in the present monograph, see p. 1668). In a combined description, Massee

Plate 572. **1**: *Orbilia carpoboloides*. – **1a–b**, **d–g**, **i–k**. rehydrated apothecia; **1c**, **h**. dry apothecia; **1j**. fragment of apothecium in external view showing whitish stipe and yellow pruina at margin; **1i**, **k**. apothecia in median section (**1k** young apothecium with covering layer), **1l**. id., marginal region; **1m**. id., ectal excipulum at flanks; **1n**. crystalloid SCBs in cells of ectal excipulum at flanks; **1o–q**. asci; **1r–t**. paraphyses; **1u**. ascospores; **1v**. macroconidium (from substrate); **1w**. microconidia (from substrate). – Living state, except for **1o** (ascus), **1p** (right ascus), **1v** (in H_2O). — **1a–w**. H.B. 9233: Netherlands, Maastricht, Bemelen, on *Ulmus*.

reported the spores of *P. cruenta* as 'cylindric-oblong, ends obtuse, 4–5 × 1.5 µm', and the paraphyses as 'clavate or lanceolate at the tips'. However, Massee synonymised also some other taxa with *P. cruenta* and did not specify from which material the spore characters were obtained (see also under Misapplication).

The present type study of *P. fibriseda* revealed the spores to be much larger than indicated by Massee. The specimen appears to fit the type of *O. carpoboloides* better than that of *O. piloboloides* concerning ascus length and spore length and shape, although the host is *Ulmus americana* in *O. fibriseda* and *O. piloboloides*. The examined specimen was annotated as 'part of type', but no further duplicate appears to exist at K.

The type of ***Calloria rubrococcinea*** in S (USA, Kentucky, bark of *Gleditsia triacanthos*) consists of two convolutes. One (S-F9979) bears the diagnosis in Rehm's handwriting and is designated here as **lectotype**. The other (S-F88326) seems to represent the same undated collection and can thus be considered as isolectotype. Rehm's (in Winter 1883) brief diagnosis includes scarlet-red apothecia of 1–3 mm diam., asci 40–50 × 5 µm, clavate, apically thickened, 8-spored, spores 12–15 × 3 µm, clavate, and paraphyses apically hardly inflated to 3 µm. The present reexamination revealed mammiform paraphyses with ± strongly inflated, clavate to fusoid apices [terminal cell 18–32 × 2.5–4(–5) µm] with distinct beaks covered by a thin cap of yellow exudate (Pl. 575: 3e–f). The spores are distinctly smaller [in KOH 8–10(–11.8) × (2–)2.2–2.5 µm] and vary between fusiform and fusiform-clavate (3g–i). The asci have long and slender stipes and measured (45–)50–55(–60) × 4–5 µm. Rehm's statement 'Asci ... apice incrassati' refers to the lateral inflation of the truncate, thin-walled apex (Pl. 575: 3d). The hairs at the protruding, only slightly crenulate margin are ±

appressed and agglutinated by a yellow exudate.

C. rubrococcinea was described without specification of a collection date and site. The specimen possibly derives from Lexington where W.A. Kellerman worked at the Agricultural College and where he repeatedly collected on *Gleditsia*, e. g., in June 1882 the type of *Pleonectria denigrata* G. Winter. *C. rubrococcinea* fits in all relevant respects the description of *Orbilia piloboloides* and, except for shorter asci, also more or less the revised holotypes of *O. fibriseda* and *O. carpoboloides*.

Thind et al. (1983: 252) described under *O. rubrococcinea* a fungus growing on decaying cotton cloth, with much smaller, basally strongly tapered spores (4–7 × 1.4–1 7 µm). Judging from their illustration this could be *O. caudata* Starbäck.

The type of ***Calloria decipiens*** (Australia, Brisbane, on old twine) was described by W. Phillips (in Cooke 1887) with apothecia of 1.3–1.8 mm diam. (evaluated from original drawing in sched.), with a 'pale flesh-coloured, orange-red or pale brown' disc and protruding denticulate margin, ascospores 'fusiform, 5–7 × 1–2 µm', and paraphyses 'apically abruptly inflated'. The species was compared with *Calloria lasia* but was said to differ in the enlarged paraphysis apices with a more irregular outline, in the spores being only half as long and more obtuse at the ends, and in the glabrous exterior of the cups.

Reexamination of the holotype at K revealed distinctly larger spores (6.7–8 × 2–2.8 µm), and consistently mammiform paraphysis apices (Pl. 573: 4). In spore characters the taxon approaches *O. brasiliensis* which, however, seems to be sharply delimited by its shorter and narrower spores. Because of the rather short spores with slightly less acute apices we refrained from including *O. decipiens* in the description of *O. carpoboloides*. However, Spooner's (1987: 194) type study of *O. decipiens* revealed in the same material distinctly larger spores (7–9.5 × 2–3.5 µm). Spooner explained the high variation in spore width in this material by a flattening effect. Therefore, the living spores were probably narrower than those figured by him.

Spooner (1987: 196) stated that the type of *Habrostictis carpoboloides* differs from the type of *H. decipiens* in 'its much more conspicuously laciniate margin, much narrower ascospores and in the acute tips to its paraphyses'. Our specimens of *O. carpoboloides* actually appear to show a stronger tendency to a deeply lacerate margin than in the type of *O. decipiens*, but the difference in spore width noted by Spooner is not confirmed: the spores in the type of *O. carpoboloides* (Pl. 570: 2) are found here to be much longer than in the type of *O. decipiens* (Pl. 573: 4), but virtually not narrower. This applies also to the specimen figured by Boudier (1904–10: pl. 459) under the name *H. carpoboloides*, to which Spooner probably referred. The apices of paraphyses are indeed different between the two type specimens, but we found them too variable in all the specimens studied in order to supply valuable differences at the species level.

Helotium marmolense was described by Spegazzini (1909) from Argentina on dry decayed branches of *Maclura aurantiaca* (= *M. pomifera*), with concave, deeply carmine apothecia 2–3 mm diam., asci 40–45 × 5 µm, spores 8–10 × 3–4 µm, with small polar droplets, and filiform paraphyses with slightly clavate apices (*Schizoxylon argentinum* Speg. was reported from the same locality and substrate, perhaps in association). Dennis (1954) supplied a small sketch of the holotype (without scale and description) which includes a single apically clavate paraphysis (Fig. 159: G). In the present reexamination (LPS 24442) the spores were found to be distinctly narrower than indicated in the protologue, and the paraphyses consistently mammiform (Pl. 573: 3). The specimen appears to fit well the present concept of *O. carpoboloides*, except that the spore apices are subacute rather than acute. A recent collection on the very same host from a park in Wien (Austria) showed longer and rather narrow spores (*11.5–12 × 2–2.1 µm) with acute apices and cylindrical middle part (B. Wergen, IVV: 24.XII.2015).

Helotium chordicola, described by Spegazzini (1909) from Argentina on a decayed rope, was placed in synonymy with *Habrostictis decipiens* by Spooner (1987: 194), based on an unpublished note and sketch taken by Dennis from the type, leaving 'little doubt of the synonymy'. The type of *H. chordicola* was not studied by us, but we had the opportunity to see a copy of the handwritten and illustrated original diagnosis as well as a sketch of Dennis' revision (IVV: 7.VII.1906). Spegazzini described the apothecia as 2–3 mm diam., indistinctly saturn-red, with smooth margin, the spores 6–8 × 3–3.5 µm, fusoid with subacute ends, and the filiform paraphyses with 'clavate-capitate' apices (however, both Spegazzini's and Dennis' drawings show strongly inflated, spathulate to lageniform apices). The rather short spores and the smooth apothecial margin are reminiscent of *O. decipiens* as redescribed here, and we preferred not to include the types of both taxa in the description of *O. carpoboloides*.

Orbilia ulicis might be a further synonym of *O. carpoboloides* (which was twice recorded on *Ulex*), according to the original illustration, except for the apically rounded spores. Type material of this taxon, which was described on bark of *Ulex* in Nantes (France) under the name *Hyalinia ulicis*, could not be located in PAD and NTM. According to J.P. Priou (pers. comm.), the herbarium of J.E. Chenantais (Musée des Sciences naturelles de Nantes) contains only pyrenomycetes but no discomycetes. In addition to the illustration reproduced in black & white, a watercolour sketch exists in the library of the Société Mycologique de France (Paris, J.P. Priou pers. comm.), which corresponds to the published figure (see Fig. 151: 3). Chenantais illustrated living ascospores (cylindric-clavate with a tapered base, comma-like curved, 12–13 × 2 µm) with a short, vermiform, straight spore body in the rounded end. Judging from his drawing the spores are wider than indicated, perhaps 2.5–3 µm. The spores would closely match *O. quaestiformis*, but the strongly lacerate margin and the apically non-capitate paraphyses forbid that synonymy. The lacerate margin of the young urceolate apothecia (0.5–1 mm diam., 'lilaceous or flesh-coloured', but bright rose-orange on the watercolour sketch) and the stated ascus size (70 × 6 µm) point to synonymy with *O. carpoboloides*. However, the spores of *O. carpoboloides*, which are indeed sometimes curved at the base, are always more or less acute at the distinctly conical apex. Possibly, Chenantais' drawing is inexact herein. The two figured paraphyses are apically only slightly inflated and only partly very indistinctly lanceolate (especially the right paraphysis on the watercolour sketch), a feature also observed in young apothecia of *O. carpoboloides*.

The holotype of ***Orbilia vacini*** contains several fragments of *Ulmus* bark (as '*Quercus*'), on which only a single strongly overmature apothecium could be discovered. This contained only a few asci, no ascospores, and a few strongly mammiform paraphyses. Svrček (1954) already suggested synonymy with *Habrostictis rubra* and the substrate to be *Ulmus*.

O. piloboloides was described by Haines & Egger (1982) based on several collections on bark of *Ulmus americana* from the provinces of Québec and Ontario (Canada). The taxon

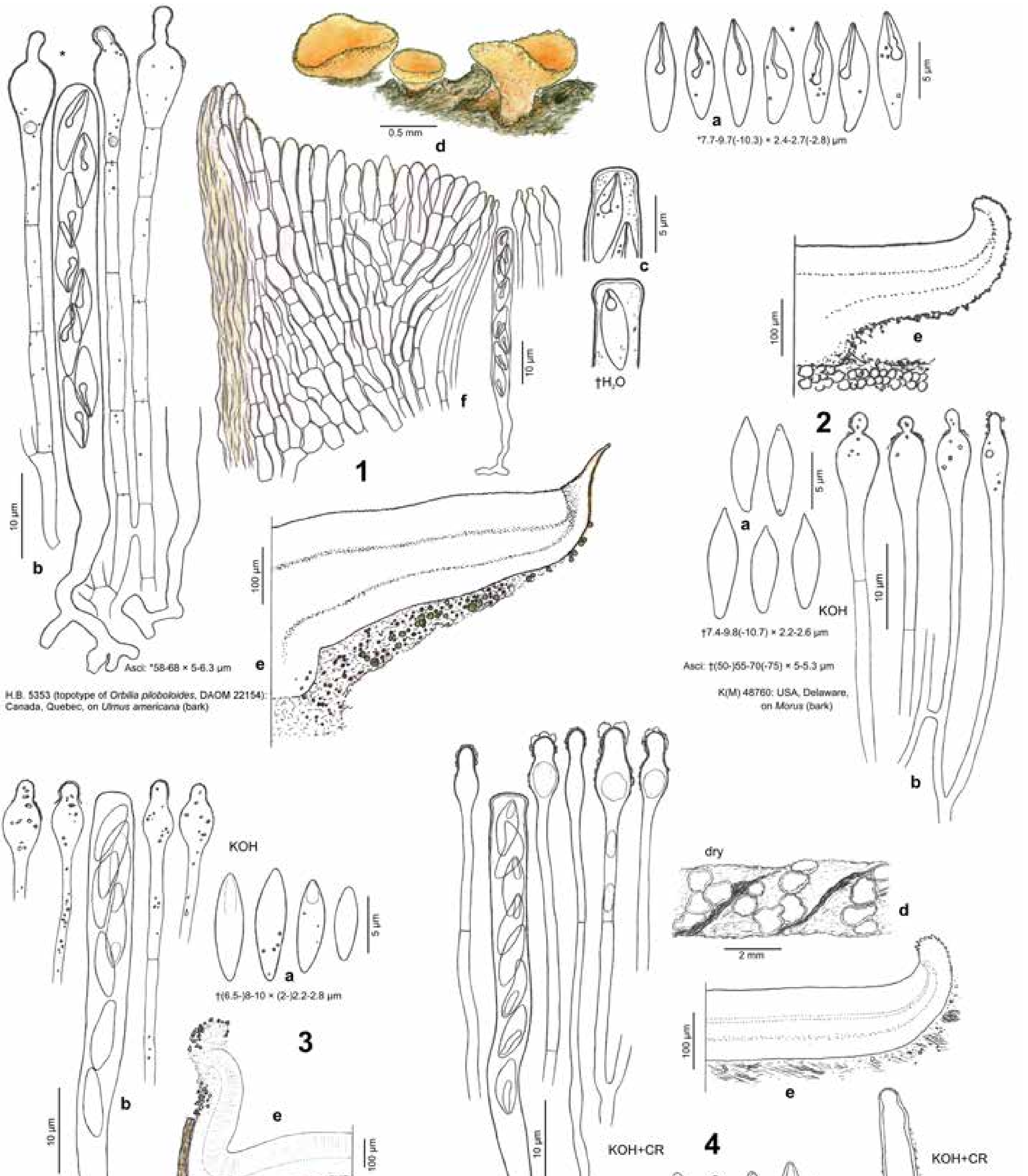


Plate 573. **1–3**: *Orbilia carpoboloides*; **4**: *O.* cf. *carpoboloides*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. rehydrated apothecia; **e**. apothecia in median section; **f**. id., marginal ectal excipulum and part of hymenium; **g**. id., marginal hairs.

was considered to be remarkable in its strongly mammiform ('subapically swollen') paraphyses and fusiform ('fusoid'), short-navicular spores, also in its occurrence on comparatively undecayed bark attached to the upper parts of standing dead trees. A recent viable collection from the type locality was kindly sent by J.H. Ginns and D.H. Pfister (Pl. 573: 1). This concurs very well with the protologue which reports orange-yellow apothecia with a white fringe at the margin, asci †(33–)40–52(–56) × 3–4 µm and spores of †8–10 × 2–2.5 µm. The short ascus length is apparently due to broken ascus bases (see Fig. 162), but the dead asci were here with †54–64 × 4–4.7 µm also distinctly wider. Apart from slight differences in ascus and spore length, *O. piloboloides* well corresponds to the type of *O. fibriseda* which grew on the same host species.

Misapplication. When doing a redescription of type specimens, Massee (1894b) concluded that *Peziza fibriseda*, *P. regalis*, *P. rufula* and *P. saccharifera* are synonyms of *P. cruenta*. Based on this result but without personal studies, Nannfeldt (1932: 252) believed that all these taxa represented possible synonyms of *Hyalinia rubella* (s. Nannfeldt, = *Orbilia phragmotricha*). However, none of these synonymies were confirmed in the present study, except for *P. cruenta*, for which no authentic specimen could be located.

Breitenbach & Kränzlin's (1981, fig. 261) report of *Habrostictis rubra* represents a mixture of three species: the microscopic drawing shows the elements of *Orbilia carpoboloides* (= *H. rubra*), but the colour photo illustrates *O. comma*, according to a reexamination of the cited specimen in LU. Besides *O. comma*, a further species, *O. phragmotricha*, was detected, whereas no trace of *O. carpoboloides* could be found.

Not included collections. A North American sample on bark of *Prosopis velutina* (Pls 574: 4; 575: 2) differs in distinctly wider spores (*9.5–11 × 3.4–3.7 µm) and asci (†63–84 × 5.7–6.5(–7) µm), also in smaller macroconidia and a deviating substrate, therefore it is not included in the description. For the not included *Hyalinia ulicis*, *Peziza ulmicola*, *Helotium chordicola*, and *O. decipiens*, see under Type studies.

Anamorph. The anamorph obtained by us in pure culture of *O. carpoboloides* (Pls 568: 3j; 571: 9) matches very well that described by Haines & Egger (1982) from pure culture of the holotype of *O. piloboloides*. Both isolates show 1-septate, c-shaped conidia of a very similar size, formed sympodially on distinct nodules or denticles. Haines & Egger's description includes conidiophores with 1–3 denticles at the apex and conidia of †9–12 × 2–3 µm. From a topotype (D.H.P. 192) Pfister (1997: fig. 10) obtained the same anamorph in pure culture with 1–4 denticles on unbranched or branched conidiophores, but figured the conidia without septa, *~7.5–13 × 2.3–3.5 µm as evaluated from scale. Our isolate deviates from both in conidiophores with ~6–15 denticles being rather densely arranged on the ± swollen conidiogenous cells.

This anamorph was compared by Haines & Egger (l.c.) with genera such as *Diplorhinotrichum* Höhn. (= *Dactylaria* Sacc.), *Idriella* P.E. Nelson & S. Wilh., and *Microdochium* Syd. These are, however, morphologically more or less strongly different from the anamorphs of *Orbilia*, and belong from their molecular data in *Sordariomycetes* (Hernández-Restrepo et al. 2015).

The same type of microconidia was observed on the natural substrate close to the apothecia of four collections here identified as *O. carpoboloides* (Pls 574: 1i, 3i, 572: 1w, IVV: 12.V.2019), often together with similar but larger, (3–)5–7-septate macroconidia. Such C-shaped macroconidia were observed on the natural substrate in various other samples of *O. carpoboloides* (Pls 569: 3g; 570: 2g; 571: 8c; 572: 1v), including G.F. 20090147 and LE 248299, and the type of *P. ulmicola* (IVV: 9.IX.1869). They resemble the conidia of *O. aurantiorubra* (section *Aurantiorubrae*), which sometimes grew in association. However, the closely related *O. flavidorosella* formed in culture comparable C-shaped, 3-septate, but narrower conidia, and in addition also one 1-septate microconidium (Pl. 583: 6).

The assumption that the two types of curved conidia might represent the same fungus is supported by a further collection. Abundant conidia still attached to conidiophores were found on xeric bark of (?)*Pseudotsuga* (Pl. 574: 5, among apothecia of *O. lentiformis* and *O. magnifica*). Two types of conidia were observed: (1) strongly curved, 0–1-septate, c-shaped conidia formed on swollen conidiogenous cells *5–6.5 × 3–3.5 µm with a single denticle, and (2) (1–)3-septate, nearly straight to medium curved, C-shaped conidia formed intermingled on the same hyphal texture. This conidial state appears to be very similar to that here reported for *O. carpoboloides*, thus possibly represents a closely related species on a coniferous host. However, no apothecia of series *Habrostictis* were detected in this collection. A connection to the associated species of *Orbilia* seems less probable, although the anamorph of *O. lentiformis* forms similar macroconidia.

In this collection as well as in the sample on *Albizia* (Pl. 574: 1) the conidia were formed inside black old pycnidia-like fruitbodies of unidentified fungi. In A. Polhorský's documentation (IVV: 12.V.2019) the macroconidiophores emerged from the wall of living pycnidia of *Cyclothyriella rubronotata* in vicinity of apothecia of *O. carpoboloides*.

Distinctly longer, medium curved phragmoconidia with 5–8 septa, which were observed on the natural substrate in two collections, are of doubtful connection and, therefore, not shown on the plates: on herbaceous stems of *Melilotus* (Lorraine, Pl. 571: 4, conidia *38–44 × 5.4–5.7 µm, IVV: 13.VI.2009) and on bark of *Morus* (Tennessee, Pl. 574: 3, conidia *48–53 × 4.5–5.3 µm, IVV: H.B. 7406). In the deviating collection on *Prosopis* (H.B. 8683a) some C-shaped, distinctly smaller (†16–17 × 3–3.5 µm), 3-septate conidia were found on the natural substrate (Pl. 575: 2j).

Höhnel (1915: 209) reported *Tuberculariella sanguinea* (Fuckel) Höhn. as anamorph of *Habrostictis rubra*. Nannfeldt (1932) and Korf (1973: 290) referred to Höhnel when stating that *H. rubra* is connected to *Cryptosporiopsis*, the anamorph of *Pezicula*. According to Verkley (1999: 152, 155), *T. sanguinea* appears to belong to the *Dermateaceae*, as *Cryptosporiopsis sanguinea* (Fuckel) Petrak, in which family *Habrostictis* had been placed by Höhnel, Nannfeldt, Korf, and others. Verkley did not see the type material of *T. sanguinea* but examined a collection under that name in the Petrak herbarium, which he tentatively referred to *Cryptosporiopsis grisea* (Pers.) Petr., the anamorph of *Pezicula cinnamomea* (DC.) Sacc.

Phylogeny. The two available sequences of *O. carpoboloides* on *Ulmus* (Manternach, from pure culture; Maastricht, from apothecia) comprise SSU (with S1506 intron), ITS, and LSU. They are completely identical in the overlapping part (1912 nt), which supports the here presented hypothesis that *O. piloboloides* from North America (which resembles the Maastricht collection) is conspecific with *O. carpoboloides* from Europe. The apothecia from Maastricht concur with those from the type of *O. piloboloides* in showing a yellow exudate on their outside, but also the Manternach sample was externally yellowish. The Maastricht sample showed slightly smaller ascospores [*9.5–11.7(–13) × 2.7–3(–3.5) µm] compared to

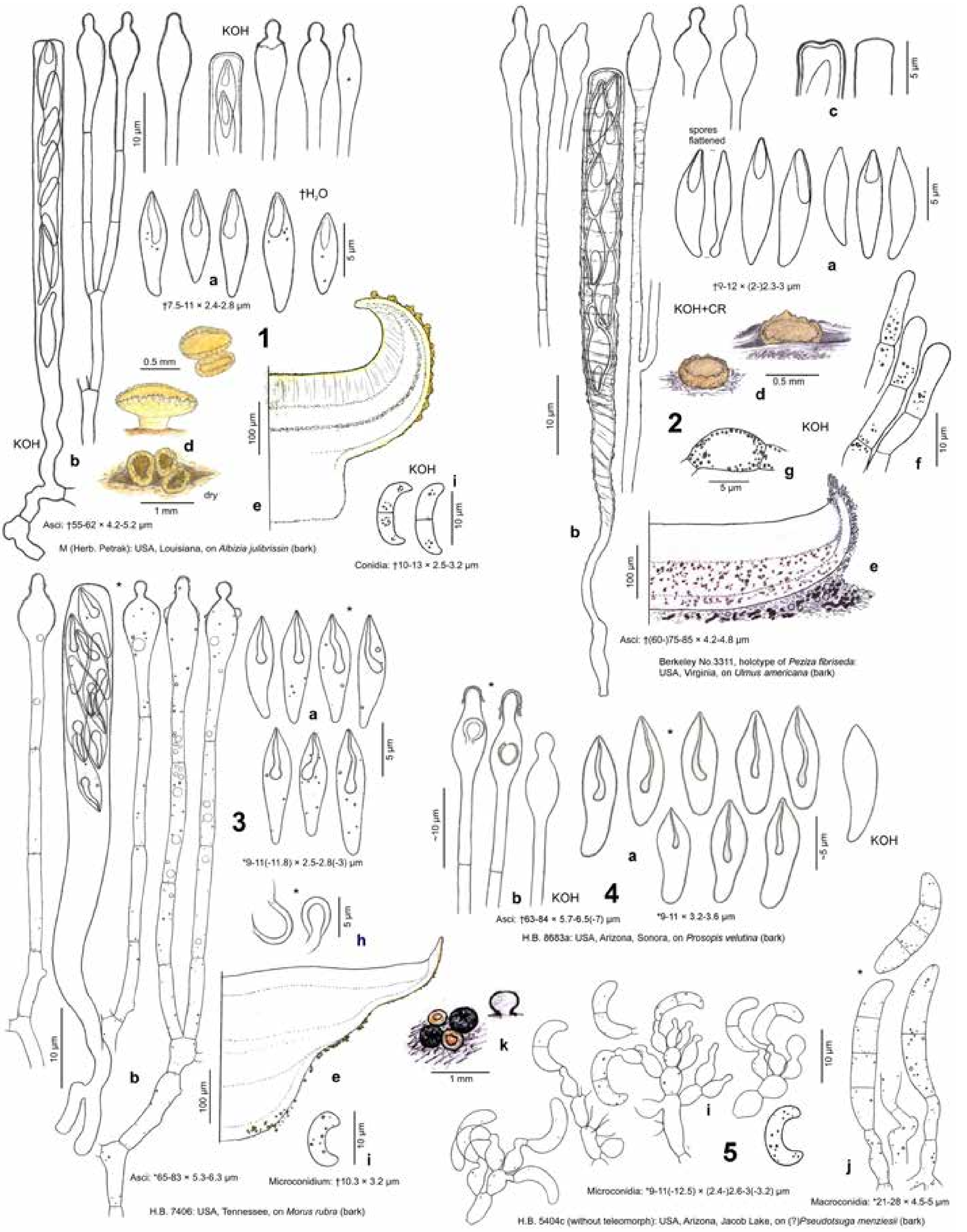


Plate 574. **1–3**: *Orbilia carpoboloides*; **4–5**: *O.* cf. *carpoboloides*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. rehydrated apothecia with denticulate margin; **e**. apothecia in median section; **f**. id., marginal hairs; **g**. cell in medullary excipulum with dark ochre-brown granulation; **h**. crystalloid SCBs in cells of ectal excipulum near base; **i**. microconidia and conidiophores; **j**. macroconidia and conidiophores (both formed inside black ?pycnidia); **k**. black ?pycnidia with star-like aperture near orange apothecia of either *O. lentiformis* or *O. magnifica*.

Plate 575. **1**, **3**: *Orbilia carpoboloides*; **2**: O. cf. *carpoboloides*. – **2a**. dead xeric branch of *Prosopis velutina*; **1a–e**, **g**, **2b–g**, **3a–c**. rehydrated apothecia; **1f**. dry apothecia; **1h**, **2h**. apothecia in median section; **1i**. id., marginal region with yellow covering tissue; **1j**, **2i**, **3e–f**. apices of paraphyses; **1k**, **3g–i**. ascospores; **2j**. macroconidia from substrate. – Dead state (**1h–i**, **k**, **3h–i** in KOH, **1j**, **3d**, **f** in KOH+CR, **2h–j**, **3e**, **g** in H$_2$O). — **1a–k**. H.B. 7406: USA, Tennessee, on *Morus*; **2a–j**. H.B. 8683a: USA, Arizona, on *Prosopis*; **3a–i**. S-F88326 (**a–b**, **d–h**: isolectotype of *O. rubrococcinea*), S-F9979 (**c**, **i**: lectotype of *O. rubrococcinea*): USA, Kentucky, on *Gleditsia*.

Manternach [*10–14 × 3–3.4(–3.8) µm]. A sequence of the type culture of *O. piloboloides* in DAOM would create clarity about this taxon.

A recently gained ITS sequence of the Portugal sample (on *Salix*, intron region not covered) differs from *O. carpoboloides* s.str. by 14% while being much closer to *O. flavidorosella* (4.5–4.7%). A similar but narrower-spored sample on *Cytisus* from the same area, mentioned under *O. flavidorosella*, is without sequence. Various collections included here in *O. carpoboloides* might in fact be conspecific with the *Salix* sample but are without sequence data, while a clear morphological delimitation from short-spored populations was not possible.

When analysing ITS or SSU+ITS+LSU, *O. carpoboloides* clustered with *O. flavidorosella* in a clade (Phyls 19, 20), though with a 13.5–14% distance in the ITS and 1.4% in the LSU (D1–D2). However, the distance to some other species of the *Serpentinae-Habrostictis* clade is comparably high (e.g., 16.5% to *O. mesaverdiana*, 1.3% in LSU). In the intron the distance to other members of section *Habrostictis* is also rather high, in spite of a full identity of the two sequenced strains of *O. carpoboloides* also in this region (the two *O. flavidorosella* strains deviate from *O. carpoboloides* in lacking the intron).

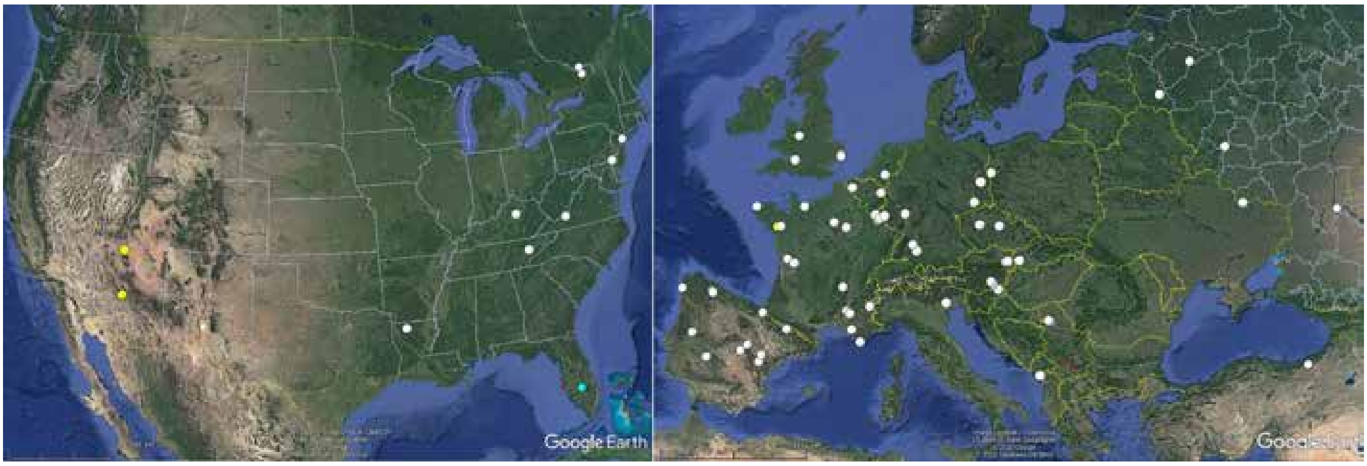
An environmental DNA soil isolate (ITS) from Florida (FLITS02A06) clustered in the series *Habrostictis* clade (Phyl. 19), but with a distance of 15% to *O. carpoboloides* (s.str.) and 16% to *O. flavidorosella*.

Ecology. *O. carpoboloides* occurs on slightly to strongly rotten bark (rarely wood) of xeric branches and trunks of various angiosperm trees and shrubs, rarely herbaceous stems. In the specimens examined by us this species showed a strong preference for *Ulmus* {44} and various genera of *Fabales* {14}, but it occurred also on some other genera of different relationships. According to Haines & Egger (1982), the standing *Ulmus* trees on which *O. piloboloides* was collected have been killed by the Dutch elm disease, and this was also the case at many of the European sites. A report from supramediterranean Sierra Nevada, Granada (Spain) was on bark of ?*Ficus* (Malençon & Llimona 1980: 55, R. Galán in Pando & Hernández 2001: 123).

The included records mainly derive from atlantic to continental, oro- to mesotemperate or rarely hemi- to thermoboreal humid western to eastern Europe, but also from orosub- to meso-, rarely thermomediterranean humid to semihumid southern Europe. In the nemoral zone the natural vegetation is mainly represented by moist, partly shady floodplain (*Querco-Ulmetum minoris*) and boulder forests (*Fraxino-Aceretum pseudolatani*). In southern Europe it was, e.g., a supramediterranean *Quercus pyrenaica* forest with *Castanea sativa* etc. *O. carpoboloides* occurs also in the Caspian Volga floodplain forests in warm-continental subhumid steppic southwestern Russia.

The extra-European collections derive from hemiboreal humid northeastern North America (around Ottawa), cold-temperate humid Virginian Appalachian mountains, warm-temperate humid lowlands of the east and south of Northern America, and subtropical humid lowlands of South America (La Plata, Buenos Aires). The not included collections comprise a warm-temperate semiarid riparian mesquite scrub (*Prosopis*) in the Sonoran Desert and a cold-temperate humid ponderosa pine forest (*Pseudotsuga*) in the Colorado Plateau in the southwest of Northern America, and subtropical humid sites in the southeast of Northern America and in eastern Australia.

Specimens included. **GREAT BRITAIN**: **East England**, **Suffolk**, 4 km ESE of Halesworth, NNW of Wenhaston, path from Chapel to Bicker's Heath, 20 m, branch of *Ulmus*, on bark and old pycnidium, 4.IV.2004, E. Batten (E.B. 4506). – 9.5 km SW of Southwold, 5.5 km NNE of Leiston, Minsmere Haven, 12 m, branch of *Ulex europaeus*, on bark, 3.VII.2004, E. Batten (ø). – 4.5 km NE of Leiston, Minsmere Haven, S of Sluice, 1 m, twig of *Lupinus arboreus*, on wood, 15.II.2003, E. Batten (E.B. 4391-1 ø, H.B. 7298b). – **West Midlands**, **Shropshire**, Shrewsbury, unlocalized, on bark of *Ulmus*, undated, collector unknown (herb. W. Phillips, Elvell. brit. 117, M, as *Peziza lasia*). – **South West England**, **Somerset**, ~5 km N of Bath, Langridge, ~100 m, branch of *Ulmus*, corticated, on *Diatrype stigma*, [16.III.1870,] C.E. Broome (Rabenh. Fungi Eur. Exs. 1515, M-0206370, **lectotype** of *Peziza lasia*, H.B. 5075 ø). — **GERMANY**: **Brandenburg**, Unterspreewald, 21 km N of Lübben, S of Münchehofe, 55 m, on bark of *Ulmus*, 1.VI.2010, R. Jarling (RS 1.6.2010, non vid.). – 18.5 km N of Lübben, Neuendorf am See, 45 m, branch of *Alnus*, on bark and black hyphomycete, 30.V.1995, V. Kummer (V.K.). – **Sachsen**, 15 km W of Dresden, 1.5 km NNW of Wilsdruff, S of Klipphausen, Saubachtal, 255 m, branch of *Ulmus*, on bark, 29.III.2019, N. Heine, vid. M. Reul (M.R. 6803, doc. vid.). – ibid., 17.V.2019, N. Heine (doc. vid.). – 5 km SW of Wilsdruff, W of Herzogswalde, park around hunting lodge, 295 m, branch of *Robinia pseudoacacia*, on bark, 16.II.2007, N. Heine (ø, doc. vid.). – **Hessen**, Rheingau, 11 km WNW of Mainz, E of Hattenheim, Grünau, 80 m, branch of *Ulmus minor*, on bark, undated, L. Fuckel (Fuckel Fungi Rhen. Exs. 2554, M). – 9 km ENE of Rüdesheim, 1.5 km ENE of Oestrich, W of Hattenheim, Schlosspark Reichartshausen, 90 m, branch of *Ulmus minor*, on bark, undated, L. Fuckel (herb. Barbey-Boissier 1461, ex herb. Fuckel 1894, G, **lectotype** of *Habrostictis rubra*; H.B. 7800a ø). – **Baden-Württemberg**, Schwäbische Alb, 3 km WNW of Zwiefalten, 1.7 km SE of Huldstetten, 737 m, branch of *Ulmus*, on bark, 28.VI.1997, G. Marson (H.B. 5824). – 2 km SE of Tübingen, N of Französisches Viertel, 322 m, branch of *Ulmus*, on bark, 4.IX.1994, H.O. Baral (H.B. 5145a). — **POLAND**: **Lubusz**, Dąbroszyn (Tamsel), ~25 m, trunk of *Malus domestica*, on bark, 15.XII.1906, P. Vogel (Sydow Myc. germ. 613, M, MPI, as *Orbilia lasia*). — **CZECHIA**: **Central Bohemia**, 5 km SE of Beroun, W of Srbsko, Koda, ~330 m, branch of *Ulmus*, on bark, 15.IV.1941, V. Vacek (PRM 151691, **holotype** of *O. vacini*). – **Pardubice**, 12 km SW of Pardubice, E of Heřmanův Městec, near gas station, 275 m, branches of *Ulmus*, on bark and indet. pyrenomycete, 19.II.2017, H. Horová, vid. V. Halasů (HR 102061, doc. vid.). — **SLOVAKIA**: **Bratislava**, 23 km NE of Bratislava, 3.5 km NW of Senec, Martinský les, 153 m, branch of indet. angiosperm, on bark & pyrenomycete, 13.I.2018, I. Vašícková, vid. A. Polhorský (A.P. 18/46, doc. vid.). – ibid., 3 km NNW of Senec, 148 m, branch of *Ulmus*, on bark and on pycnidia of *Cyclothyriella rubronotata*, 12.V.2019, A. Polhorský (A.P. 19/15, anam. substr., doc. vid.). — **AUSTRIA**: **Wien**, 7 km SSW of Wien, Inzersdorf, Draschepark, 190 m, branch of *Maclura pomifera*, on bark, 24.XII.2015, R. Moosbeckhofer, vid. B. Wergen (B.W., doc. vid.). – 10 km ESE of Wien, Lobau at Donau river, Panozzalacke, 155 m, branch of *Ulmus minor*, on bark, 10.III.2001, W. Jaklitsch (W.J., non vid.). – ibid., branch of (?)*Ailanthus altissima*, on bark, 10.IV.1994, W. Jaklitsch (W 13307). – **Steiermark**, 10 km WNW of Graz, 2 km E of St. Oswald, Burg Plankenwarth, 600 m, branch of *Ulmus*, on bark, 19.I.2014, I. Wendelin, vid. G. Friebes (G.F. 20140012). – ibid., 15.II.2014, G. Friebes (G.F. 20140022). – 12 km SSE of Graz, 1.2 km SW of Fernitz, Mur, Kalsdorfer Au, 320 m, branch of *Ulmus*, on bark, 16.I.2010, G. Friebes (G.F. 20100035, non vid.). – ibid., trunk of *Prunus padus*, on bark, 1.IV.2010, G. Friebes (G.F. 20100100, doc. vid.). – 8 km WNW of Bad Radkersburg, 4 km W of Halbenrain, SW of Unterpurkla, Donnersdorfer Au, 218 m, branch of *Ulmus laevis*, on wood, 12.XII.2009, G. Friebes (G.F. 20090147, anam. substr., doc. vid.). — **SERBIA**: **Vojvodina**: Fruška Gora, 14.5 km WSW of Novi Sad, 1 km S of Čerević, 123 m, stem of indet. dicot, 20.V.2019, D. Savić (doc. vid.). – 13 km SW of Novi Sad, 2 km SSW of Beočin, Erdelj, 235 m, twig of *Colutea arborescens*, on bark, 6.V.2014, D. Savić (FG-80, doc. vid.). – 12 km S of Novi Sad, 7 km NNW of Irig, Iriški venac, 2.5 km NW of WWII memorial, 347 m, branch of *Cytisus scoparius*, on bark, 21.I.2019, D. Savić (doc. vid.). – ibid., 4.II.2019 (FG-987, 993, doc. vid.). – ibid., 1 km SW of WWII memorial, 425 m, branch of *Ulmus*, on bark, 6.II.2019, D. Savić (FG-996, doc. vid.). — **MONTENEGRO**: 17 km SSW of Podgorica, 1 km W of Bistrice, 8 m, branch of *Salix*, on bark, 20.II.2016, B. Perić (B.P. Dgf/C7D-20-02-16, doc. vid.). — **NETHERLANDS**: **Gelderland**, 5.5 km SW of Nijmegen, W of Meijhorst, Staddijkpark, 12 m, branch of *Ulmus*, on bark, 18.XII.2011, S. Helleman (doc. vid.). – **Limburg**, 5 km E of Maastricht, NE of Bemelen, Bemelerberg, 90 m, branch of *Ulmus*, on bark, 29.XI.2009, N. Dam (H.B. 9233, anam. substr.; sq.: KT222419). — **BELGIUM**: **Vlaanderen**, **West-Vlaanderen**, 3.5 km SE of Kortrijk, Leuven Campus, 35 m, branch of *Salix*, on wood, 18.IV.2001, L. Vannieuwerburgh & C. Hanssens (H.B. 6928). – **Wallonie**, **Luxembourg**, 8 km W of Arlon, S of Sampont, Marais de Sampont, branch of *Ulmus*, on bark and old *Vuilleminia*, 9.V.1997, H.O. Baral (H.B. 5786). — **LUXEMBOURG**: **Gutland**, **Luxembourg**, 5 km SSW of Luxembourg, N of Kockelscheier, Weier, 300 m, branch of *Ulmus*, on bark and old pycnidia,



Map 91. Known distribution of *O. carpoboloides* in North America and Europe (yellow = not included collections, cyan = genetically aberrant).

26.V.1999, G. Marson (H.B. 6385, anam. substr.). – **Grevenmacher**, 3.5 km N of Grevenmacher, 1.5 km E of Manternach, W of Fielsmillen, valley of Syre, Kaleberg, 190 m, branch of *Ulmus*, on bark, 4.V.2000, H.O. Baral (H.B. 6639c ø, **epitype** of *O. carpoboloides* [illustration], CBS 116276, anam. cult.; sq.: KT215248). — **FRANCE**: **Lorraine**, **Moselle** (border to Luxembourg), 3 km WSW of Rumelange, 3 km SE of Audun-le-Tiche, Héisingerbierg, Origerbësch, 420 m, stem of *Melilotus*, 13.VI.2009, G. Marson (ø, anam. substr.). – **Champagne-Ardenne**, **Marne**, 14 km W of Sézanne, 2.3 km WSW of Esternay, Bois de Nogentel, 185 m, branch of *Ulmus glabra*, on bark, 15.V.1993, H.O. Baral & G. Marson (H.B. 4876a). – **Basse-Normandie**, **Calvados**, Caen, unlocalized, ?20 m, branch of indet. angiosperm, on bark, undated, M.R. Roberge (herb. Niessl, M, as *Peziza vinosa*). – **Bretagne**, **Finistère**, unlocalized, on twine, 20.III.1866, collector unknown (herb. Crouan, CO, **holotype** of *O. carpoboloides*, H.B. 6601 ø, anam. substr.). – NE of Brest, Coatodon, ~70 m, of *Ulmus*, on bark, 9.IX.1869, H. & P. Crouan (herb. Crouan, CO, as *Helotium ulmicola*, anam. substr., doc. vid.). – **Ille-et-Vilaine**, 5 km NE of Pipriac, NE of Courbouton, 40 m, branch of *Ulex europaeus*, on bark, 15.III.2001, J.P. Priou (J.P.P. 21053, doc. vid.). – 1 km WNW of La Gacilly, Gazeau, rue de Picardie, 24 m, branch of *Passiflora caerulea*, on wood, 9.III.2011, J.P. Priou (J.P.P. 11040, anam. substr., doc. vid.). – ibid., on bark, 20.X.2011 (J.P.P. 11148, doc. vid.). – ibid., 19.V.2013 (H.B. 13114). – **Poitou-Charentes**, **Deux-Sèvres**, 13 km ESE of Melle, Coudré, centre ville, 158 m, trunk of *Ulmus* (?)*minor*, on bark, ~28.II.2006, B. Coué (M.H. 80306, doc. vid.). – 12.5 km WSW of Niort, ENE of Le Vanneau-Irleau, Marais Poitevin, 3 m, branch of *Ulmus*, on bark, 15.IV.2008, B. Coué (H.B. 8825 ø). – **Île de France**, **Paris**, 7 km ESE of Paris, S of Vincennes, Bois de Vincennes, 50 m, on fabric (textile), II., M. Patouillard, vid. É. Boudier (doc. vid.). – **Rhône-Alpes**, **Loire**, 26 km NNW of St.-Étienne, Montrond-les-Bains, 340 m, *Ulmus*, 28.I.1985, A. Ayel (doc. vid.). – ibid., 5.V.1988 (doc. vid.). – **Drôme**, 13 km SE of Montélimar, SW of Abbaye d'Aiguebelle, 215 m, branch of *Cercis siliquastrum*, on bark, 22.IX.2009, G. Marson (H.B. 9238c ø). – 1 km N of Nyons, Col du Pontias, 460 m, branch of *C. siliquastrum*, on bark, 22.VIII.1996, G. Marson (H.B. 5619b). – ibid., 18.VIII.2001 (H.B. 7077i). – ibid., 11.X.2002 (ø, anam. substr.) – **Provence-Alpes-Côte d'Azur**, **Hautes-Alpes**, 11.5 km NW of Briançon, 1.6 km SE of Le-Monêtier-les-Bains, NW of les Guibertes, 1445 m, branch of *Salix*, on bark, 14.VII.1994, G. Marson (H.B. 5126b, G.M. 5212). – **Bouches-du-Rhône**, N of Aix-en-Provence, ~270 m, branch of *Cytisus* ?*scoparius*, on bark, 1.XI.2006, H. Aeberhard (H.B. 9083a). – **Var**, Îles d'Hyères, Île de Porquerolles, centre of island, ~40 m, branch of *Ulmus*, on bark, 1. XI.2006, H. Aeberhard (H.B. 9086b, anam. substr.). — **ITALY**: **Veneto**, **Treviso**, ~16 km NW of Treviso, Selva del Montello, ~120 m, branch of *Ulmus minor*, on bark, autumn 1874 & 1876, P.A. Saccardo (Saccardo 1887: 61, 1883: pl. 1365, as *H. rubra*, doc. vid.). — **SPAIN**: **Galicia**, 2.3 km SW of O Grove, SE of Estonllo, 60 m, on textile, 27.X.2019, M.A. Delgado, vid. J. Castillo (doc. vid.). – **Asturias**, 22 km NE of Villablino, 10.5 km ESE of Pola de Somiedo, 1.8 km SE of Saliencia, 1240 m, branch of *Salix*, 5.IX.2008, E. Rubio (E.R.D. 4574, doc. vid.). – ibid., 5 km SE of Saliencia, La Farrapona, 1650 m, twig of *Cytisus scoparius*, on bark, 4.VI.2017, H.O. Baral (H.B. 10083a ø). – 4 km NE of Pola de Somiedo, NNE of La Falguera, 1300 m, branch of *Ulmus minor*, on bark, 9.IV.2010, E. Rubio (E.R.D.-5521, doc. vid.). – **Navarra**, 28.5 km N of Pamplona, 2.6 km SSW of Almandoz, Mendiola, highway, 527 m, branch of *Salix*, on bark, 6. XI.2019, F.J. Balda (F.J.B. 61119, doc. vid.). – **Aragón**, **Huesca**, 2.7 km NE of Benasque, 1245 m, branch of indet. angiosperm, on bark, 14.IV.2018, R. Blasco (doc. vid.). – **Teruel**, 1.2 km NW of Teruel, junction of Calle Viñas San Cristóbal and Leocadio Brun, 937 m, twig of *Prunus dulcis*, on bark, 22.XII.2010, R. Tena (R.T.L. 10122201). – 21 km WSW of Montalbán, N of Pancrudo, 1237 m, branch of *Salix*, on bark, 29.III.2013, R. Tena (R.T.L. 13032901, doc. vid.). – **Castilla-La Mancha**, **Guadalajara**, 36 km ESE of Guadalajara, SSE of Alocén, Pantano de Entrepeñas, 930 m, branch of *Calicotome villosa*, on bark, 25.IX.1999, G. Marson & H.O. Baral (H.B. 6482b, in M-0276558[*O. pleiogambelii*]). – 6 km W of Maranchón, 2.2 km N of Luzón, 1241 m, branch of *Rosa*, on bark & wood, 26.IV.2015, J.P. Priou (J.P.P. 15099, doc. vid.). – **Extremadura**, **Cáceres**, 9 km SW of Guadalupe, N of Cañamero, bridge over Ruecas river, 620 m, twig of *Ulmus*, on bark, 6.III.1995, M. Lizárraga (AH 6959). — **PORTUGAL**: **Guarda**, 4 km ENE of Sabugal, 2.3 km S of Rendo, Quinta dos Prados, 843 m, branch of *Salix*, on bark, 23.XI.2019, M.A. Ribes (M.A.R. 231119 926, doc. vid., sq.: MT431224). — **TURKEY**: **Gümüşhane**, 10.5 km NNE of Torul, 5.5 km NW of Zigana, Zigana Mt. 1440 m, trunk of *Ulmus*, on bark, 26.I.2014, Y. Uzun (doc. vid.). — **RUSSIA (West)**: **Novgorod**, **Borovichi**, 15 km SE of Borovichi, 1.5 km NNW of Mańinskoye, Msta river, 123 m, twig of *Ulmus laevis*, on bark, 23.IX.2011, E.S. Popov (LE 247944, non vid.). – **Pskov**, Loknya, 42.5 km NNW of Velikiye Luki, 9 km N of Nasva, N of Bashovo, 126 m, branch of *U. laevis*, on bark, 7.VIII.2011, E.S. Popov (LE 247490 = E.S.P.-11-0043, LE 247558 = E.S.P.-11-0044, non vid.). – **Oryol**, **Znamenskoye**, Orlovskoye Polesiye, 75 km ENE of Bryansk, 63 km NW of Oryol, 2.3 km NE of Elenka, Vytebet river, 174 m, twig of *U. laevis*, on bark, 19.X.2012, E.S. Popov (LE 248002, non vid.). – **Volgograd**, **Svetly Yar**, Volga-Akhtuba floodplain, 33 km SE of Volgograd, 9 km NE of Svetly Yar, E of Sotovo lake, -7 m, twig of *U. minor*, on bark, 21. IX.2012, E.S. Popov (LE 248299, anam. substr., doc. vid.). — **UKRAINE**: **Kharkiv**, Zolochiv, 39 km NNW of Kharkiv, 3.2 km NE of Zolochiv, 1 km S of Svitlychne, 207 m, twig of *Ulmus*, 21.V.2002, A. Akulov, vid. E. Popov (CWU Myc AS73, LE 248023, doc. vid.). — **CANADA**: **Québec**, Gatineau, 17 km NNW of Ottawa, Cantley, St. Elizabeth Road, Ginns' Farm, trunk of *U. americana*, on bark, 22.IV.1980, J.H. Ginns (DAOM 176753, **holotype** of *O. piloboloides*, anam. cult., doc. vid.; NYS, **isotype**, non vid.). – ibid., 26.X.1980 (DAOM 177611, **topotype**, non vid.). – ibid., branch of *U. americana*, on bark and old *Diplodia melaena*, 4.VI.1995 (Ginns 10213, DAOM 221154, M-0229606, M-0229607, H.B. 5353, D.H.P. 192, anam. cult.; **topotypes**). – **Ontario**, 32 km S of Ottawa, North Gower, 90 m, log of *U. americana*, on bark, 16.VII.1979, G.P. White (White 169, DAOM 176754, non vid.). — **USA**: **New York**, Central Park, 5th avenue, 20 m, branch of *Ulmus*, on bark and ?*Nitschkia*, 15.XII.2019, E. Crenson (doc. vid.). – **Delaware**, Wilmington, unlocalized, ~50 m, trunk of *Morus*, on bark, IX.1889, A. Commons (Ellis & Everh. NAF 2: 2326, K(M) 48760, as *Peziza cruenta*, H.B. 5751 ø). – **Virginia**, Virginian (Appalachian) Mts., unlocalized, branch of *U. americana*, on bark, undated, collector unknown (herb. Berkeley 3311, K, **holotype** of *Peziza fibriseda*, H.B. 5342 ø). – **Kentucky**, ?Lexington, ?300 m, on bark of *Gleditsia triacanthos*, ?1882, W.A. Kellerman (S-F9979, **lectotype** of *O. rubrococcinea*; S-F88326, **isolectotype**, H.B. 9754 ø). – **Tennessee**, 4.5 km WSW of Knoxville, Third Creek Greenway, 280 m, branch of *Morus rubra*, on bark, 23.V.2003, W. Jaklitsch (ex W.J. 2200, H.B. 7406, anam. substr.). – **Louisiana**, 85 km W of Monroe, Athens, Denmark Farm Campus, 100 m, branch of *Albizia julibrissin*, on bark, III.1942, R. Grogan & J.H. Miller (Hebr. Petrak, M, as *Orbilia rubrococcinea*, H.B. 5051 ø, anam. substr.). — **ARGENTINA**: **Buenos Aires**, Almirante Brown, 20 km S of Buenos Aires, José Mármol suburb, 20 m, branch of *Maclura pomifera*, on bark, 16.V.1905, C.L. Spegazzini (LPS 24442, **holotype** of *Helotium marmolense*, as *Maclura aurantiaca*, H.B. 6943 ø).

Not included. **FRANCE**: **Pays de la Loire**, **Loire-Atlantique**, ~4 km NW of Nantes, La Bouvardière, 45 m, on bark of *Ulex*, undated, [J. Chenantais] (unlocated, **type** of *Hyalinia ulicis*, doc. vid.). – **Bretagne**, **Finistère**, on *Ulmus* bark, spring, collector unknown (unlocated, **type** of *Peziza ulmicola*). — **USA**: **Arizona**, Grand Canyon, Kaibab Plateau, 37 km SE of Fredonia, S of Jacob Lake, 2415 m, branches of (?)*Pseudotsuga menziesii*, on bark, 17.V.1995, G. Marson (H.B. 5404c, anam. substr.). – Sonoran Desert, 84 km N of Phoenix, 15 km NNE of Black Canyon City, Sunset Point, 1060 m, branch of *Prosopis velutina*, on bark, 27.V.1996, G. Marson (H.B. 8683a, anam. substr.). – **Florida**, Highlands, Archbold Biological Station, 45 m, uncultured soil isolate, C.B. Glinka & C.V. Hawkes (FLITS02A06, mol. extr.; sq.: KF675275). — **ARGENTINA**: **Buenos Aires**, ~40 km SE of Buenos Aires, La Plata, ?10 m, on a rope, 7.VII.1906, E. Spegazzini (LPS 24443, **type** of *Helotium chordicola*, doc. vid.). — **AUSTRALIA**: **Queensland**, South Eastern Queensland, Brisbane, unlocalized, on a twine, undated, F.M. Bailey (herb. Bailey 516, K(M) 36052, **holotype** of *O. decipiens*, H.B. 5452 ø).

Orbilia brasiliensis (Speg.) Sacc., Syll. Fung. 8: 631 (1889) — Pl. 576

≡ *Calloria brasiliensis* Speg., Bol. Acad. Nac. Cienc. Córdoba 11: 209, n. 393 (1889)

Etymology: collected in Brazil.
Typification: Brazil, Apiaí (Apiahy), on textile, X.1888, J. Puiggari (Puig. 2781, LPS 28075, lectotype, designated here, MBT202378).
Misinterpretation of *O. brasiliensis*: Liu (2006: 59), = *O.* aff. *farnesianae*.

Description: — **TELEOMORPH**: **Apothecia** rehydrated 1.5–4 mm diam., 0.12 mm high, now light cream-ochre to reddish (Spegazzini: dry orange-red), round or somewhat undulating, ± scattered; disc flat, margin distinct, 50 µm protruding, ± crenulate; broadly sessile, superficial; dry bright orange-red, only slightly contracted. **Asci** †50–65 × 3.4–3.8(–4.2) µm, 8-spored, spores †1–2-seriate; **apex** (†) strongly truncate (slightly indented, laterally somewhat inflated); **base** with long, thin, flexuous stalk, L-shaped. **Ascospores** †5.7–6.7 × 1.7–2 µm, fusoid-fusiform, apex subacute (to acute), base medium to strongly attenuated, straight or slightly inequilateral; **SBs** visible as a transparent region, seemingly tear-shaped, †~1.7–2.5 µm long, straight; **Paraphyses** apically spathulate to lageniform, beak 2 × 2 µm, terminal cells †14–22 × 2.5–4(–5.3) µm, exceeding the dead asci by 4–5 µm, lower cells †8–18 × 1–2 µm. **Medullary excipulum** 50 µm thick. **Ectal excipulum** of thin-walled, horizontally oriented textura prismatica-angularis from base to margin, 25–30 µm thick near base, cells †10–15 × 7–9 µm; at margin ~40–100 µm thick, oriented at a 0–20° angle to the surface. **Anchoring hyphae** abundant, †1.5–2.5(–3) µm wide, walls †0.2–0.5 µm thick, forming a dense hyaline t. intricata ~50–80 µm thick. **SCBs** no data available. **Exudate** over paraphyses 0.1–0.2 µm thick, finely rough, firmly attached; over margin and flanks 0.3–1.5 µm thick, granular. **— ANAMORPH**: unknown.

Habitat: on remnants of textile (probably cotton) lying on ground, slightly decayed. **Associated**: *Orbilia neocomma* (in the type convolute, but on different kind of fabric). **Desiccation tolerance**: unknown (probably desiccation-tolerant). **Altitude**: 900 m a.s.l. **Phenology**: X (southern hemisphere).

Taxonomic remarks. *Orbilia brasiliensis* differs from *O. carpoboloides* in distinctly smaller spores and narrower asci. The margin was described as completely smooth in the protologue, but here it is found to be somewhat crenulate in the dry state and also strongly protruding. With its rather smooth margin, *O. brasiliensis* resembles the type of *O. decipiens* in which the margin is also not strongly lacerate, in contrast to *O. carpoboloides*.

The spore body in *O. brasiliensis* is only faintly seen as a ± tear-shaped area (Pl. 576: 1a) which is slightly shorter than in the type of *O. decipiens*. In the other characters the types of these two taxa strongly resemble the European *O. pilifera* which is sharply separated in the living state from *O. carpoboloides* in having broad, ± subglobose spore bodies. According to morphological and molecular data, *O. pilifera* belongs rather in section *Aurantiorubrae*. Based mainly on SB shape in dead spores, *O. brasiliensis* and also *O. decipiens* are tentatively placed in section *Habrostictis*.

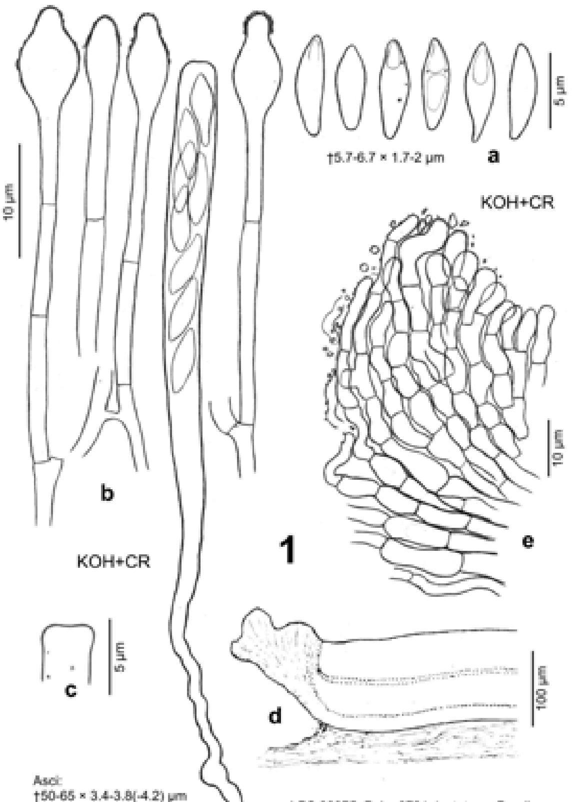


Plate 576. **1**: *Orbilia brasiliensis*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apex. **d**. apothecium in median section; **e**. id., marginal ectal excipulum.

Liu (2006: 59) assigned to *O. brasiliensis* a Chinese specimen found on a xeric twig (HMAS 139700), based on the present drawing of the type collection (in Baral & Marson 2005). However, the spores in Liu's specimen are distinctly larger. The original shape of the SBs is also unknown in this collection which was studied by Liu only in the dead state. This collection appears to represent an undescribed species close to *O. farnesianae*, with a characteristic trinacrium-like anamorph and sequence data which refer it in series *Piliferae*.

Type studies. The type of *O. brasiliensis* in LPS (Speg. Col. micol. 28075) represents a mixture of two different species. This is already obvious from Spegazzini's original sketches on the two convolutes, into which the material was early divided, apparently by the finder J. Puiggari who gave them two different numbers. Both contain fragments of textile, but the type of textile differs between the two convolutes. One (Puig. 2781, IVV: H.B. 6951a) contains the specimen illustrated in Pl. 576 (original data: asci 45–50 × 4 µm, spores fusoid, 5 × 1–1.5 µm). The other (Puig. 2335, Pl. 424: 4) contains *O. neocomma* (original data: asci 30 × 2–3 µm, spores rod-shaped, no size given). Spegazzini's (1889) protologue gives exactly the measurements of asci and spores of the former convolute. Therefore, this convolute (Puig. 2781) is designated here as **lectotype** of *O. brasiliensis*. The apical inflation of the paraphyses was overlooked by Spegazzini, perhaps because he studied a submature apothecium.

Ecology. *O. brasiliensis* is only known with certainty from the type collection on slightly decayed textile collected in a garden in subtropical humid eastern South America.

Specimens included. **BRAZIL**: **São Paulo**, ~110 km NNE of Curitiba, Apiaí (as Apiahy), ~900 m, on textile, X.1888, J. Puiggari (Puig. 2781, LPS 28075, **lectotype**, H.B. 6951a ø).

Orbilia mongolica Baral, **sp. nov.**, MB 813654 — Pls 577–578

Etymology: named after the occurrence in Mongolia.

Typification: Mongolia, Tsengel, branch of *Lonicera altaica*, 9.VIII.2005, P. Karasch (ex H.B. 7893a, M-0276516, holotype).

Latin diagnosis: *Similis* Orbiliae carpoboloidi *sed ascosporae ellipsoideo-clavatae, apice obtusae, asci 16-spori. Habitat ad corticem et lignum rami putridi sicci* Lonicerae altaicae *in zona orotemperata (sub)humida Asiae centralis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.25–0.3 mm diam., 0.11 mm high, pale cream-orange, round; disc strongly concave, margin 40–50 µm protruding, somewhat fimbriate to crenulate; broadly sessile, superficial. **Asci** *65–83 × 6–6.7 µm, †53–70 × 5–6 µm, 16-spored, spores *2–3-seriate, ~6–8 lower spores inverted (somewhat mixed), pars sporifera *44 µm long; **apex** (†) strongly truncate (very slightly indented, laterally not or scarcely widened); **base** with or without short, thin or thick, flexuous stalk, T- to Y-shaped. **Ascospores** *(5.5–)6–10 × (2.4–)2.8–3(–3.3) µm, ellipsoid-fusoid-clavate, apex rounded to obtuse, rarely subacute, base slightly to medium attenuated, straight or up to medium curved near base; **SBs** *4.2–5.7 × 0.2–0.4 µm in situ (total length ~4.5–6.5 µm), filiform to vermiform, partly subulate, straight to medium flexuous, rarely slightly uncinate. **Paraphyses** apically mammiform to lageniform, beak 1–5 × 1.6–1.8 µm, terminal cells *18–33 × 3–3.5 µm, scarcely exceeding the living asci, lower cells *9–15.5 × 1.5–2 µm; never branched at upper septum. **Medullary excipulum** very pale orange, 25 µm thick, of dense textura intricata with many inflated cells, unsharply delimited. **Ectal excipulum** very pale orange, of thin-walled, irregularly horizontally oriented t. globulosa-angularis(-prismatica), 20 µm thick near base, cells *5.5–13 × 5–10 µm; 25 µm thick near margin, of t. prismatica-angularis oriented at a 0–10° angle to the surface, marginal cells forming fascicles of ± coherent hyphae (†3–5.5 µm thick, walls 0.2–0.4 µm) protruding as indistinct teeth or hairs. **Anchoring hyphae** abundant, †2–4 µm wide, walls 0.2–0.8 µm thick. **SCBs** in paraphyses globose, 1–2 µm diam.; in ectal excipulum not observed. **Exudate** over paraphyses and margin absent. — **ANAMORPH**: vermispora-like (presumed, from natural substrate {1}). **Conidiophores** not observed. **Conidia** unbranched, *24–31.5(–39?) × 2.8–3 µm {1}, 3-septate, slightly curved.

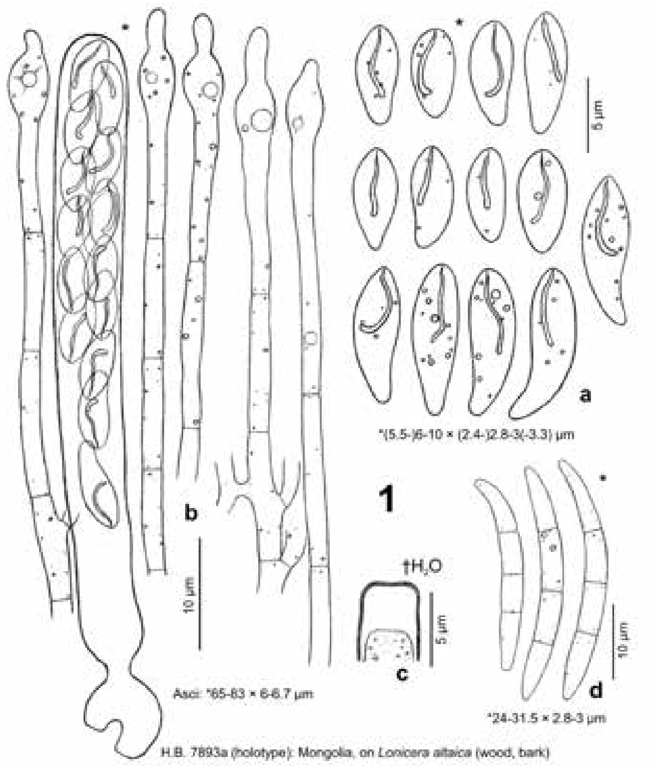


Plate 577. **1**: *Orbilia mongolica*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apex; **d**. conidia from substrate.

Habitat: xeric, corticated branch of *Lonicera altaica*, on 24 mm thick node, on medium rotten bark (periderm), also on wood of broken side twig, greyed, with some green algae. **Associated**: ?*Hypoxylon* sp., *Orbilia delphinus*, *O. ocellata*. **Desiccation tolerance**: fully tolerant for at least 1 month. **Altitude**: 2200 m a.s.l. **Geology**: Paleozoic sediment. **Phenology**: VIII (probably long-lived).

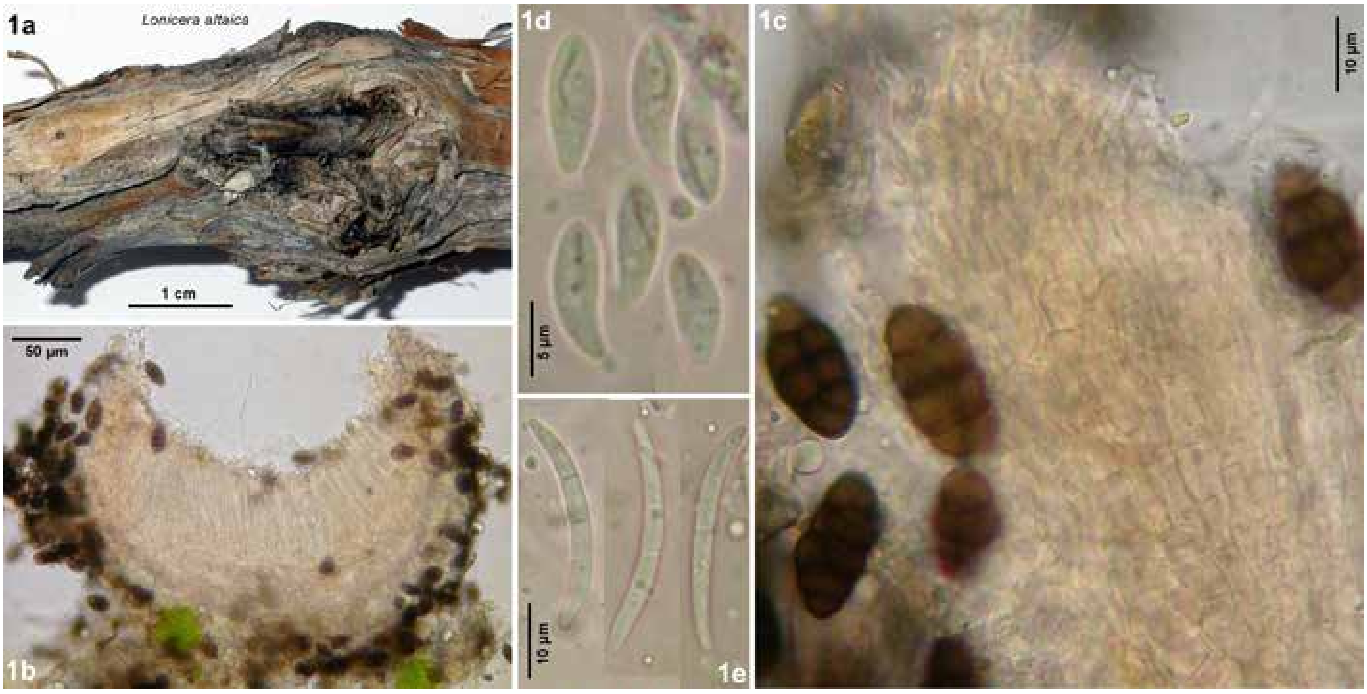


Plate 578. **1**: *Orbilia mongolica*. – **1a**. dead corticated branch of *Lonicera altaica*; **1b**. apothecium in median section; **1c**. id., marginal ectal excipulum (with brown conidia of a coelomycete); **1d**. ascospores; **1e**. conidia from substrate. – Living state. — **1a–e**. H.B. 7893a (holotype): Mongolia, on *Lonicera altaica*.

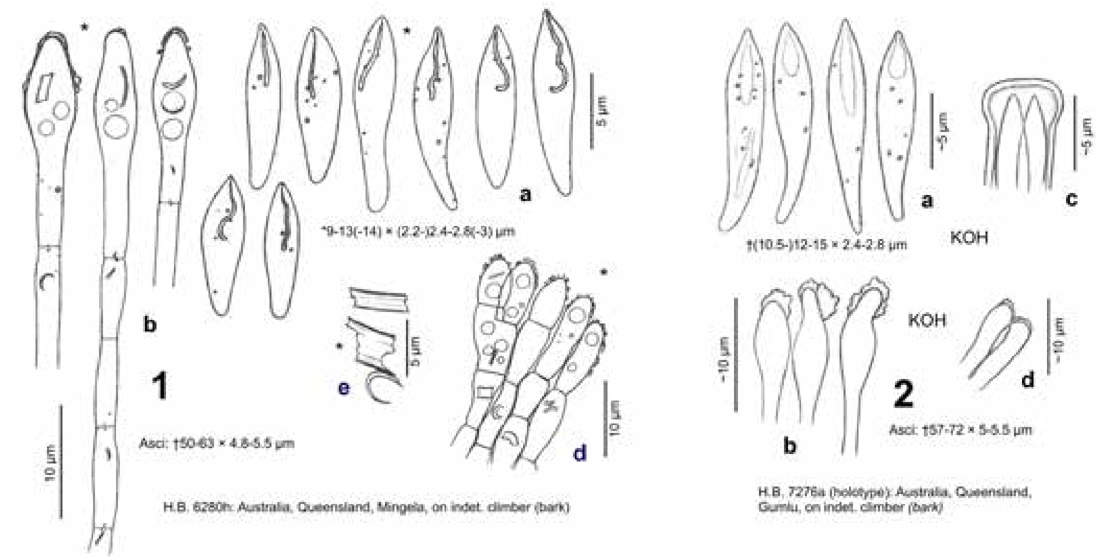


Plate 579. **1–2**: *Orbilia scandens*. – **a**. ascospores; **b**. paraphyses; **c**. ascus apex; **d**. marginal ectal excipulum in median section; **e**. crystalloid SCBs in ectal excipulum.

Taxonomic remarks. *Orbilia mongolica* resembles *O. carpoboloides* in the mammiform paraphyses and fimbriate margin of the apothecia. The species is well characterized by ascospores with rounded to obtuse apices, and particularly by 16-spored asci. The spores of the 16-spored *O. calyptrata* (series *Ellipsospermae*) may show a similar shape, but are much smaller, also the paraphysis apices are never mammiform and mostly bear glassy caps.

Anamorph. The vermispora-like conidia found on the natural substrate near apothecia of *O. mongolica* are distinctly narrower than the presumed macroconidia of *O. carpoboloides*, but they resemble those of *O. flavidorosella*.

Ecology. *O. mongolica* was found on medium rotten bark and wood of a xeric branch of *Lonicera altaica* in a grazed moist-mossy mountain taiga (*Laricetum*) with *Betula rotundifolia* and *Salix* on the northern slope of a side valley of the Khod river in continental, orotemperate (sub)humid, subalpine western Mongolia.

Specimens included. **MONGOLIA**: **Bayan Ölgii**, Altay Mts., 10 km SW of Tsengel, side valley of Khovd river, 2200 m, branch of *Lonicera altaica*, on bark & wood, 9.VIII.2005, P. Karasch (ex H.B. 7893a, M-0276516, **holotype**, anam. substr.).

Orbilia scandens Baral & G. Marson, **sp. nov.**, MB 813655 — Pls 579–580

Etymology: named after the occurrence on stems of a climber.

Typification: Australia, Queensland, Gumlu, branch of indet. climber, 19.X.1998, G. Marson (ex H.B. 7276a, BRI AQ799190, holotype).

Latin diagnosis: *Similis* Orbiliae carpoboloidi *sed ascosporae in statu vivo corpusculum refringens filiforme, multo angustius continentes, margines apotheciorum absque pilis. Habitat ad corticem in caulibus ligneis volubilibus putridis siccis angiospermarum in zona tropica subhumida Australiae septentrio-orientalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.3–1 mm diam., 0.16–0.27 mm high, pale to bright orange(-ochraceous), scarcely translucent, round to elliptical, scattered to subgregarious; disc slightly to medium concave, margin 20–50 µm protruding as ± distinct whitish teeth or lobes, finely powdered to indistinctly fimbriate; broadly sessile, slightly to deeply erumpent; dry light orange-ochraceous. **Asci** †50–75(–85) × 4.5–5.5 µm {2}, 8-spored, spores *2–3-seriate, 4–5 lower spores inverted {1} (sometimes mixed), pars sporifera †35–42 µm long; **apex** (†) (medium to) strongly truncate (not or distinctly indented, laterally not or often ± strongly inflated); **base** with or without short to long, thin or thick, ± flexuous stalk, T-, L- or Y-shaped. **Ascospores** *(9–)11–14(–15.2) × (2.2–)2.4–2.8(–3) µm {2}, †10.5–15 × 2.4–2.8 µm {1}, (fusoid-)fusiform to fusiform-clavate, apex subacute to acute (to acuminate), base medium to strongly attenuated, partly tail-like, straight to slightly curved below; **SBs** *4–5.5 × (0.2–)0.3–0.4(–0.5) µm in situ {1} (~4–6 µm actual length), filiform to subulate, straight to strongly flexuous. **Paraphyses** apically medium to strongly spathulate, rarely mammiform, terminal cells *12.5–20 × 3–6 µm {2}, †(2.5–)3–4(–5) µm wide {1}, rarely with a distinct beak up to 2.5 µm long, exceeding the dead asci by 5–8 µm, lower cells *6–13.5 × 2–2.3(–2.8) µm {2}; not branched at upper septum. **Medullary excipulum** 30–40 µm thick, of dense textura intricata with many inflated cells, medium to sharply delimited. **Ectal excipulum** of (†) ± thin-walled, vertically oriented t. angularis(-prismatica) from base to mid flanks, 40–100 µm thick near base, cells †10–21 × 7–12 µm {1}; 30–35 µm thick near margin, of t. porrecta oriented at a 10–40° angle to the surface, marginal cortical cells */†6.5–13 × 3–5 µm {2}, partly running out into hyphae agglutinated by exudate. **Anchoring hyphae** medium to very abundant, †2–3 µm wide, walls 0.2–0.3 µm thick {1}, forming an up to 60 µm thick gelatinized t. intricata at base and a 5–10 µm thick layer at flanks and margin. **SCBs** in paraphyses and ectal excipulum (near margin) globose, 1–2.5 µm diam., also angular, rod- or C-shaped {2}. **Exudate** over paraphyses 0.2–1 µm thick, finely rough to cloddy, firmly attached, forming individual caps; over margin and flanks ~0.2 µm thick. — **ANAMORPH**: unknown.

Habitat: collected 0.2–3.5 m above the ground, corticated or partially decorticated, 7–16 mm thick woody stems of indet. climber {2}, on strongly decayed bark {2} (bast & periderm), greyed, green algae lacking. **Associated**: *Hyalorbilia ?erythrostigma* {2}, *Hysteropatella ?prostii* {2}, *Orbilia brachychitonis* {1}, *O. mammifera* {2}, *O. neocomma* {2}, *O. paracaudata* {1}, *O. subfabacearum* {1}, *Rhytidhysteron ?rufulum* {1}. **Desiccation tolerance**: after 2 months only spores, paraphyses and excipular cells viable. **Altitude**: 12–286 m a.s.l. **Geology**: granite. **Phenology**: X (southern hemisphere, probably long-lived).

Taxonomic remarks. *Orbilia scandens* is very similar to *O. carpoboloides* but differs in consistently filiform, much narrower SBs which are not distinctly inflated at the base, also in the absence of free marginal hairs. In the type of *O. decipiens* from eastern Australia the spores are much shorter than in *O. scandens*. *O. acaciae* seems to be closely related to *O. scandens* but has somewhat shorter spores with more obtuse (to subacute) apices, never distinctly spathulate paraphysis apices, and smaller apothecia with a less protruding, hardly lacerate margin. For the similar *O. mammifera* which grew in association in both samples see below.

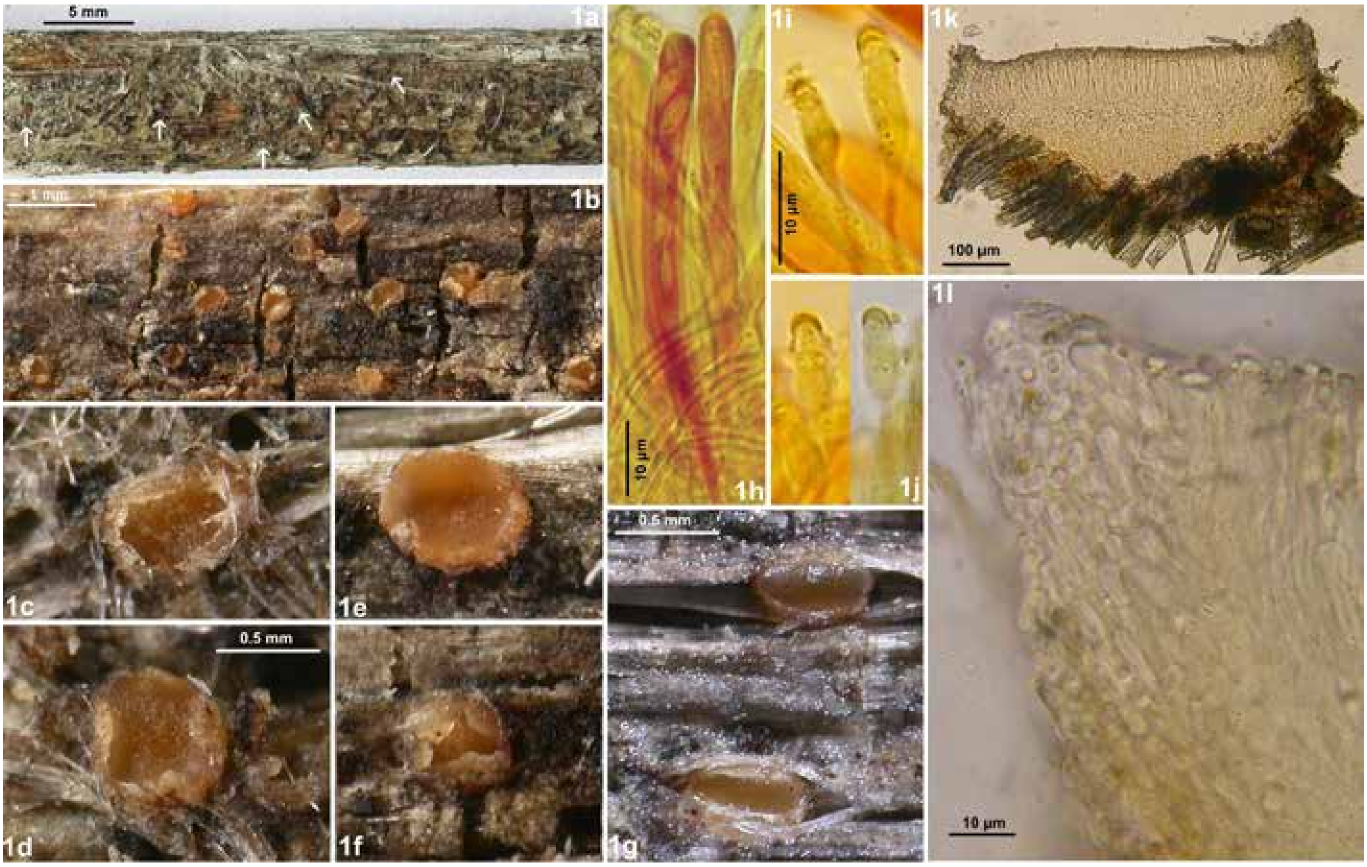


Plate 580. **1**: *Orbilia scandens*. – **1a**. dead xeric stem; **1b–g**. rehydrated apothecia; **1k**. apothecium in median section; **1l**. id., marginal ectal excipulum; **1h**. asci; **1i–j**. paraphyses. – Dead state (**1h–j** in KOH+IKI, **1k–l** in KOH). — **1a–l**. H.B. 7276a (holotype): Australia, Queensland, Gumlu, on indet. climber.

Variation was only noted in the marginal ectal excipulum which was oriented at a low angle in the holotype but at a moderate angle in the paratype.

Ecology. *O. scandens* was collected on rotten bark of branches of apparently two different unidentified climbers in eucalypt open woodlands with a tropical subhumid savannah climate, 5 and 75 km away from the coastline of northeastern Australia east of Great Dividing Range. The two collection sites are only about 120 km from each other (roughly the same latitude). In both samples the less abundant *O. mammifera* grew in close association.

Specimens included. **AUSTRALIA**: **Queensland**, Einasleigh Uplands, 75 km SSW of Townsville, 2 km WSW of Mingela, 286 m, branch of indet. climber, on bark, 17.X.1998, G. Marson (H.B. 6280h). – 49 km SE of Ayr, 4 km ESE of Gumlu, 12 m, branch of indet. climber, on bark, 19.X.1998, G. Marson (ex H.B. 7276a, BRI AQ799190, **holotype**).

Orbilia mammifera Baral, **sp. nov.**, MB 813657 — Pls 581–582

Etymology: named after the mammiform apices of paraphyses.

Typification: Australia, Queensland, Gumlu, branch of indet. climber, 19.X.1998, G. Marson (ex H.B. 7276d, BRI AQ799191, holotype).

Latin diagnosis: *Similis* Orbiliae flavidorosellae *sed paraphyses ad apicem multo magis inflatae, mammiformes. Habitat ad corticem in caulibus ligneis volubilibus putridis siccis angiospermarum in zona tropica subhumida Australiae septentrio-orientalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.3–)0.5–1.3 mm diam., 0.12–0.22 mm high, pale to bright orange(-ochraceous), scarcely translucent, round to elliptical, scattered to medium gregarious; disc slightly concave to slightly (or medium) convex, margin ± distinct, thin or thick, smooth or finely crenulate or fringed, 0–15 µm protruding; broadly sessile, slightly to deeply erumpent between bast fibres or over cracks in periderm; dry light to bright orange-ochraceous. **Asci** †47–68 × (3.5–)4–4.5(–4.7) µm {2}, 8-spored, spores †2–3-seriate, ~3–5 lower spores inverted {2} (sometimes mixed), pars sporifera †35–44 µm long; **apex** (†) strongly truncate (not or with distinctly indented, laterally often inflated); **base** with medium to long, thin, flexuous stalk, L-shaped. **Ascospores** *8–10 × 1.8–2 µm {1}, †8–11.5(–14) × 1.5–2 µm {2}, narrowly fusoid-fusiform-clavate, apex subacute to acute, base slightly to medium attenuated (partly somewhat tail-like), nearly straight or slightly to strongly curved near base; **SBs** *2.5–4.2 × 0.3–0.5 µm {1}, filiform to subulate, straight to slightly flexuous. **Paraphyses** apically medium to mostly strongly mammiform, terminal cells *11–22 × 4–5.2 µm {1}, †20–23 × (2.7–)3–5(–6) µm {T}, beak 2–3.5 × 1.7–2.3 µm, exceeding the dead asci by 5–10 µm, lower cells *9–16 × 1.3–1.6(–2.5) µm {1}, †10 × 1.3–1.7 µm {T}; not branched near apex. **Medullary excipulum** 30–50 µm thick, of dense textura intricata with many inflated cells, very sharply delimited from ectal excipulum, at flanks partly by a 10 µm thick t. porrecta. **Ectal excipulum** of (†) slightly gelatinized (common walls 0.7–1.2 µm), indistinctly oriented t. globulosa-angularis from base to margin, 60–100 µm thick near base, cells */†11–25 × 9–19(–22) µm {2}; 20–40 µm thick at flanks, cells †10–28 × 8–16 µm, 20–30(–100) µm thick near margin, of t. angularis oriented at a 70–80° angle to the surface, marginal cortical cells †6–11(–14) × 3–7 µm {2}, sometimes forming short free **hairs**. **Anchoring hyphae** abundant, †1.5–2.7 µm wide, walls 0.2(–0.4) µm thick {2}, forming a 20–40 µm thick gelatinized t. intricata {2} that partly covers also the flanks. **SCBs** in paraphyses globose {1}, mixed with crystalloid ones (angular- or C-shaped) {1}. **Exudate** over paraphyses 0.1–0.2(–1.5) µm thick, finely rough, sometimes forming firmly attached apical caps; over excipulum 0.2 µm thick, continuous. — **ANAMORPH**: unknown.

Habitat: collected 0.5–3 m above the ground, corticated, 7–8 mm thick woody stems of indet. climbers {2}, strongly decayed bark {2} (periderm and bast), greyed, with a few to many green algae. **Associated**: *Hyalorbilia ?erythrostigma* {2}, *Hysteropatella ?prostii*

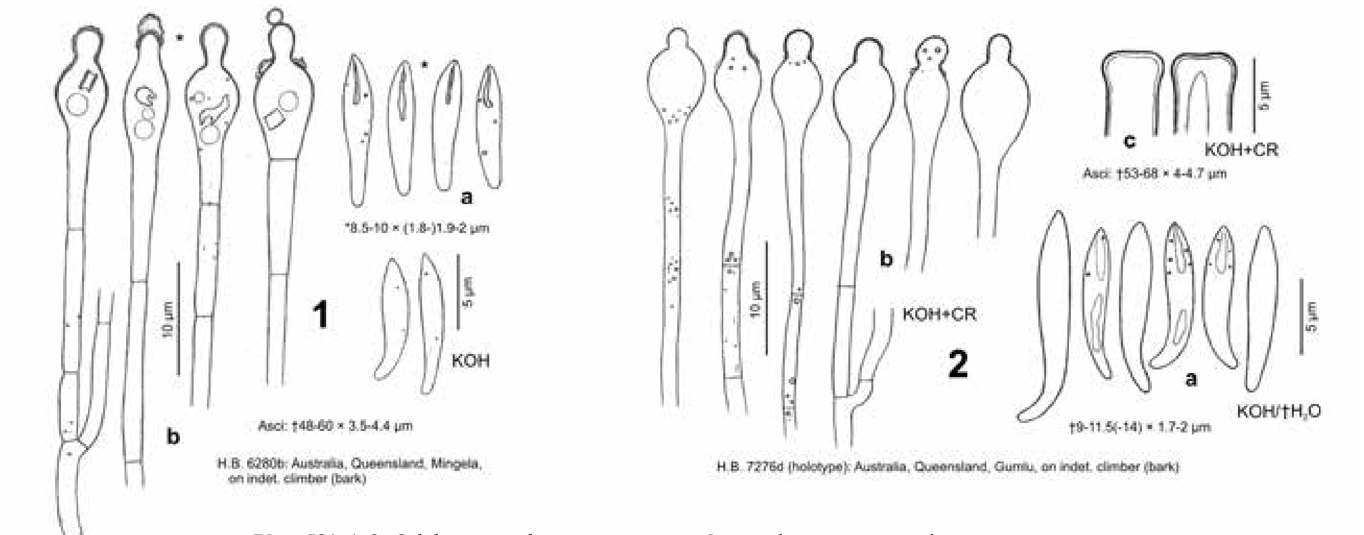


Plate 581. **1–2**: *Orbilia mammifera*. – **a**. ascospores; **b**. paraphyses; **c**. ascus apices.

{2}, *Orbilia brachychitonis* {1}, *O. neocomma* {2}, *O. paracaudata* {1}, *O. scandens* {2}, *O. subfabacearum* {1}, *Rhytidhysteron ?rufulum* {1}. **Desiccation tolerance**: fully drought-tolerant for at least 2 months. **Altitude**: 12–286 m a.s.l. **Geology**: granite. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia mammifera* closely resembles the European *O. flavidorosella* in size and shape of the ascospores. The spore bodies are shorter and thinner in *O. mammifera*, but this might be an accidental difference. *O. mammifera* mainly differs in much more inflated paraphysis apices with often very abrupt beaks (very similar to *O. carpoboloides*). *O. scandens* differs in distinctly wider spores and in paraphyses with only rarely mammiform apices, also in apothecia with an often lacerate margin.

The similar western Australian *O. farnesianae* (section *Aurantiorubrae*) differs in obtuse spore apices and in paraphysis apices mostly without abrupt beaks (predominantly capitate-clavate but also spathulate to lageniform), apparently also in wider SBs and somewhat narrower marginal cortical cells (†6–12 × 2.5–4.2 µm). The species is closely related to *O. pilifera*, and its presumed anamorph is trinacrium incurvum-like very similar as in *O. pilifera*.

Variation. The apothecial margin was either fringed (H.B. 6280b, collection consisting of only one apothecium) similar as in *O. flavidorosella*, or smooth to finely crenulate (holotype). The spores in the holotype are longer and the paraphyses a bit more inflated than in the paratype.

Ecology. *O. mammifera* was collected on rotten bark of woody stems of unidentified climbers in eucalypt open woodlands with

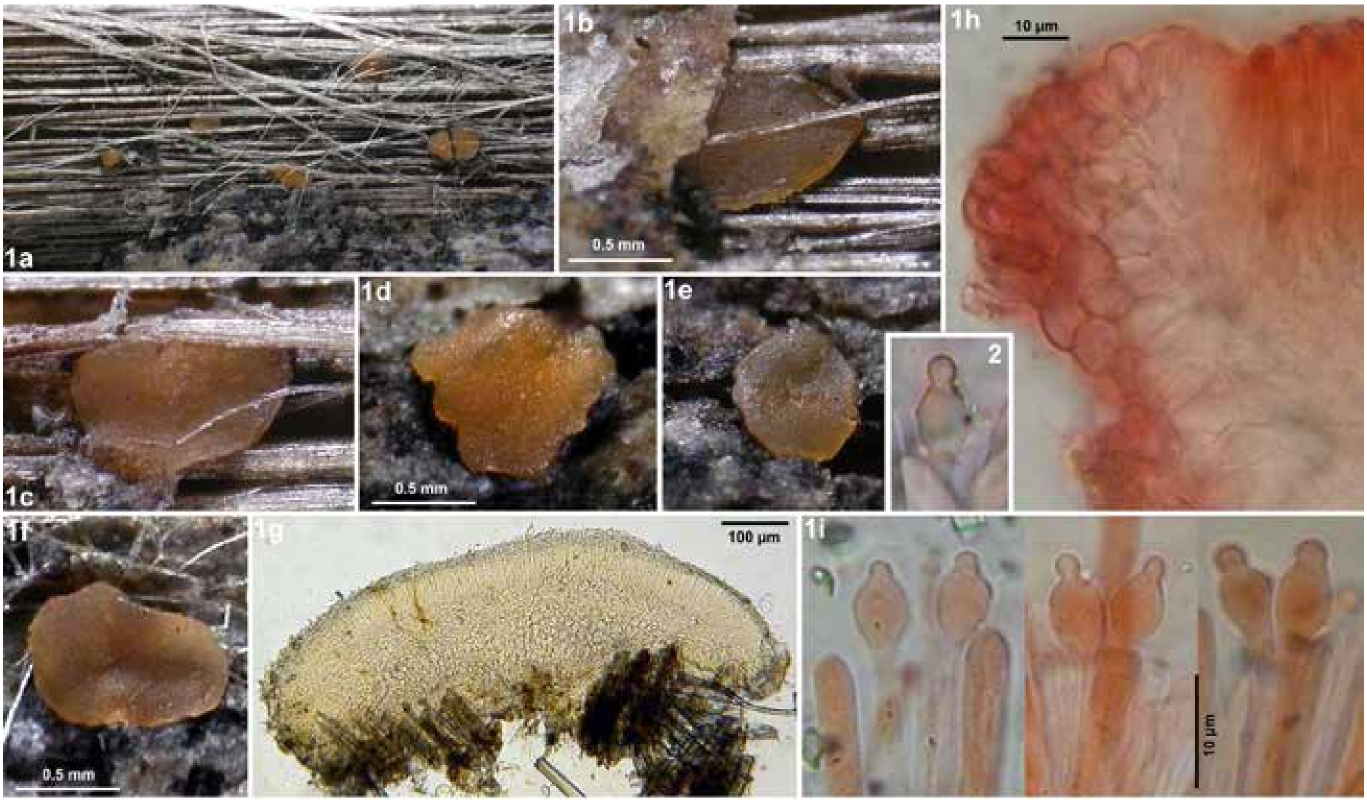


Plate 582. **1–2**: *Orbilia mammifera*. – **1a–f**. rehydrated apothecia; **1g**. apothecium in median section; **1h**. id., marginal ectal excipulum; **1i**, **2**. apices of paraphyses (and asci). – Dead state (**1g** in KOH, **1h–i**, **2** in KOH+CR). — **1a–i**. H.B. 7276d (holotype): Australia, Queensland, Gumlu, on indet. climber; **2**. H.B. 6280b: ibid., Mingela, on indet. climber.

a tropical subhumid (winter-dry) savannah climate, 5 and 75 km away from the coastline of northeastern Australia east of the Great Dividing Range. The two collection sites are about 120 km from each other (roughly the same latitude). The paratype consists of only one apothecium, while about 15 were seen in the holotype. In both samples the more abundant *O. scandens* grew in close association (in the holotype the two species were found fruiting on opposite sides of the same branch).

Specimens included. **AUSTRALIA**: **Queensland**, Einasleigh Uplands, 75 km SSW of Townsville, 2 km WSW of Mingela, 286 m, branch of indet. climber, on bark, 17.X.1998, G. Marson (H.B. 6280b). – Brigalow Belt North, 49 km SE of Ayr, 4 km ESE of Gumlu, 12 m, branch of indet. climber, on bark, 19.X.1998, G. Marson (ex H.B. 7276d, BRI AQ799191, **holotype**).

Orbilia flavidorosella Rehm in Sydow, Hedwigia 33, Beibl.: 31 (1894) — Pls 583–584, Map 92

≡ *Orbilia flavidorosella* Rehm, in Sydow, Mycotheca marchia, cent. 39: no. 3846 (1893), nom. inval., ICN Art. 38.1 (diagnosis missing)

≡ *Hyalinia flavidorosella* (Rehm) Svrček, Česká Mykol. 9: 113 (1955, as *flavideroseola*)

Etymology: named after the apothecial colour described as yellowish-rose in the protologue.

Typification: Germany, Nauen, stem of *Vincetoxicum hirundinaria*, VI.1893, H. Sydow (S-F6405, holotype); Luxembourg, Bettembourg, stem of *Melilotus*, 18.IX.2012 (ex G.M. 2012-09-18.1, illustration [Pl. 584: 5], epitype, designated here, MBT385128; sq.: KT222391).

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.25–)0.3–0.9(–1.2) mm diam., 0.1–0.2 mm high (receptacle 0.09–0.12 mm), light to bright (yellowish-)orange(-ochraceous), more rarely whitish to pale (cream-)rose, ± round, scattered or somewhat gregarious, partly in clusters; disc young medium concave (urceolate), finally slightly concave to flat or even convex, margin whitish, finely to distinctly fimbriate or with distinct teeth (30–80 × 30–100 µm), hairs or teeth protruding 20–50 µm beyond disc; sessile or with a distinct stalk 0.05 × 0.1 mm, ± erumpent to superficial; dry bright ochraceous-orange or greyish-cream, margin incurved, sometimes almost entirely closing the disc (± hysteriform). **Asci** *48–61 × 4–4.8(–5) µm {4}, †(33–)38–56 × 3.3–4.3(–4.6) µm {4}, 8-spored, (2–)3–5(–6) lower spores inverted {7} (sometimes mixed), pars sporifera *24–32 µm, **apex** (†) medium to strongly truncate (sometimes slightly indented, laterally not widened), **base** with rather short or often long, flexuous stalk, L- to h-shaped. **Ascospores** *(6.8–)7.3–10.5(–12.3) × (1.5–)1.7–2(–2.2) µm {9}, †(7–)7.5–9.5(–10.3) × 1.5–1.8 µm {2}, fusoid(-fusiform) to fusoid-clavate, with or without cylindrical middle part, apex subacute to acute, rarely obtuse, base very slightly to medium (rarely strongly) attenuated, straight or slightly curved near base; **SBs** (3–)4–6.5(–7.5) × (0.3–)0.5–0.8(–1.1) µm in situ {8}, ~4.5–6.5(–8) µm actual length, subulate to vermiform, base often slightly to medium (rarely strongly) inflated, mostly ± flexuous to helicoid. **Paraphyses** apically uninflated or mostly (sub)lageniform to obtusely lanceolate or spathulate, sometimes mammiform, beak 2–5 × 1.5–2.8 µm, terminal cells *11–28 × (2.2–)2.5–4(–4.7) µm {6}, †14.5–20 × 2.2–3.2 µm {1}, protruding 2–5 µm beyond dead asci, lower cells (6–)8–12(–15) × 1.3–2.7(–5) µm {5}, †7–12.5 × 1.5–2.5(–2.8) µm {T}, rarely branched at upper septum. **Medullary excipulum** hyaline, 30–60 µm thick, of ± dense textura intricata with some or many inflated cells, ± sharply delimited. **Ectal excipulum** hyaline, partly light orange-rose towards margin, of ± thin-walled, vertically (to horizontally) oriented t. (globulosa-)angularis(-prismatica), 30–60(?–100) µm thick near base, cells *10–23 × 8–16 µm {4}; from lower flanks to margin 20–40(–75) µm thick, of t. prismatica-angularis(-globulosa) oriented at a 0–30° angle, cells *6–18 × 5–18 µm {2}; marginal protruding part 30–35 µm thick, consisting of (1–)2–3-celled **hairs** */†20–50(–80) × (3–)4–6(–8.5) µm {7} (individual cells 7.5–15 µm long), terminal cells cylindrical, also clavate or spathulate to ± lageniform, walls *0.2–0.5(–0.8) µm thick, hairs ± free or agglutinated to form distinct triangular teeth. **SCBs** globose, in paraphyses 1.3–2.5 µm diam., 1–2 per cell, in ectal excipulum (1.5–)2.5–3.5(–4.5) µm diam., 1–3 or more per cell; cells of paraphyses, margin and mid flanks also with crystalloid SCBs {10}, 2.5–6 × 1.7–4.5 µm, spool- to sickle-, ring-, or horseshoe-shaped, hyaline to light yellowish-orange. **Exudate** over paraphyses lacking or finely granular, rarely cap-like, firmly attached to apical beak, 0.2–0.4(–1) µm thick; over margin and flanks absent. **Anchoring hyphae** sparse to abundant, *2–3(–4) µm wide, walls 0.2–0.5(–0.7) µm thick {4}, forming a 5–20 µm thick, ± gelatinized layer on base and flanks, partly up to the margin. — **ANAMORPH**: vermispora-like (from lid of Petri dish {1}). **Conidiophores** not observed. **Conidia** unbranched, slightly to medium curved (C-shaped), *22–34 × 3–3.2 µm {1}, 3-septate; a single microconidium seen: *15 × 2.5 µm, 1-septate.

Habitat: 0.1–3(–9) m above the ground, on ~1–2 years dead, standing, herbaceous stems of *Ephedra gerardiana* {1}, *Melilotus* sp. {6}, *M. albus* {1}, *Vincetoxicum hirundinaria* {1}, indet. dicot {1}, epidermis ± removed; on 7–10 mm thick, partially corticated twigs and branches of *Cytisus scoparius* {1}, *Prunus dulcis* {1}, *Salix* (?)*caprea* {1}, *Spartocytisus supranubius* {2}, on medium decayed bark {5} (periderm and bast); also on remnants of cotton textile {1}; ± greyed, with or without many algae, sometimes very close to old pycnidia of ?*Phoma* {2}. **Further associated**: *Cistella grevillei* {1}, *Cyathicula cacaliae* {1}, *Karstenia rhopaloides* {1}, *Orbilia carpoboloides* {1}, *O. caulicola* {2}, *O. flavida* {2}, *O. quaestiformis* {4}, *O. vitalbae* {1}. **Desiccation tolerance**: fully viable for min. 3–4 weeks, excipular cells still viable after 2.5 months. **Altitude**: 40–440 m (central Europe), 937–1300 m a.s.l. (southern Europe), 2090–2190 m (Macaronesia). **Geology**: Neoproterozoic shale & greywacke, Keuper (peat over Stubensandstein), Lower Jurassic sandstone & shale, dolomite; phonolite. **Phenology**: III–XII (throughout the year, long-lived).

Taxonomic remarks. *Orbilia flavidorosella* is very similar to *O. carpoboloides* in the shape of paraphyses and hairs, but differs in narrower ascospores and shorter asci, narrower paraphysis apices, also in paler-coloured apothecia. For the closely related *O. mammifera* and *O. solidaginis* see p. 1043 and p. 1048. The similar 16-spored North American *O. calyptrata* (series *Ellipsospermae*) turned out to be not closely related. *O. subtrapeziformis* (series *Serpentinae*) has spores similar to *O. flavidorosella* but differs in capitate paraphyses and the absence of crystalloid SCBs.

Variation. *O. flavidorosella* seems to be a rather constant species. The type specimen (on *Vincetoxicum*, Pl. 583: 2) deviates in paraphyses with lanceolate-spathulate apices from many of the recent collections which instead often showed lageniform apices. However, paraphysis shape often varied considerably within a sample or an apothecium, and both types occurred in varying frequency in Pls 583: 1b; 584: 1e and in many other samples. A collection on *Vincetoxicum* from Czechia is described with lageniform apices (see Svrček 1955, fig. 2). Also spore length varies somewhat, between *7–9 (*Ephedra*, *Melilotus*, 1 & 3) and *8.5–12.5 µm (*Cytisus*, IVV: E.R.D. 7600), the latter having also the longest SBs.

Nomenclature, **type studies and literature reports**. There are three different orthographic variants of this taxon: (1) *Orbilia flavidorosella* was used by Sydow in sched., Mycotheca Marchica Nr. 3846 (1893, 'Rehm, nov. sp. in litt. ad me') and by Sydow (1894: 31), and as *O. flavido-rosella* by Saccardo (1895: 426) who referred to Sydow Nr. 3846; (2) *O. flavide-roseola* was used by Rehm (1895: 1224); (3) *O. flavido-roseola* was used by Saccardo (1896: XXXVIII, 1899: 803) who referred to Rehm (1895). It seems to have been intention that Saccardo corrected Rehm's (1895) variant *flavide-roseola* to *flavidoroseola*, the former being grammatically against the Code (ICN Art.

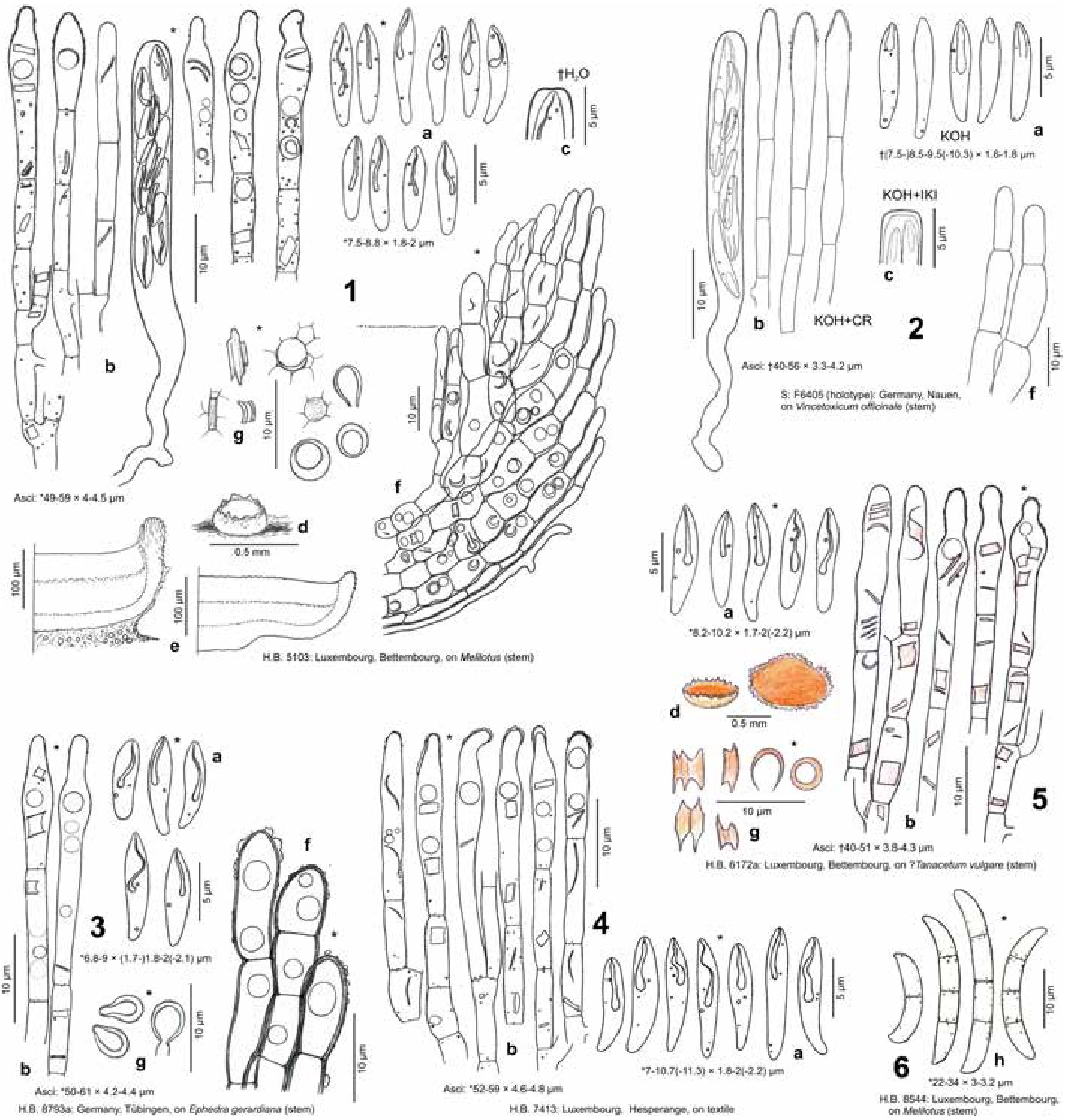


Plate 583. **1–6**: *Orbilia flavidorosella*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. rehydrated apothecia with denticulate margin; **e**. apothecia in median section; **f**. id., marginal ectal excipulum; **g**. crystalloid SCBs in excipular cells at mid flanks and margin; **h**. conidia from culture.

60.10, 60G.1(b), Turland et al. 2018). We are convinced that Sydow (1894) represents the first valid publication (the label of Mycotheca Marchica Nr. 3846 is without a diagnosis). Therefore, the spelling *flavidorosella* must be adopted which is grammatically correct.

O. flavidorosella was originally described by Rehm (in Sydow 1894) with erumpent, pale yellow-rose apothecia (interestingly as '*flavido-roseola*') of 0.3–0.8 mm diam., asci 45 × 5 µm, 6-spored, with rounded apex, straight or slightly curved, oblong or subfusiform ascospores 7–9 × 2 µm, and filiform paraphyses with a widened apex up to 3 µm, sometimes subcurvate. In correspondence to his sketch in the type convolute in S, Rehm described the spore apices as obtuse, whereas the present reexamination revealed subacute to acute apices, also the paraphyses were found to be distinctly (sub)lanceolate (Pl. 583: 2). A yellowish component of the fresh apothecial colour as mentioned by Rehm could only partly be observed in the recent material studied.

In addition to Rehm's protologue of 1894, which is also found with some alterations in Rehm (1895) and Saccardo (1896), only one further published record of *O. flavidorosella* came to our notice: Svrček (1955) provided a detailed description in Czech, based on a collection from around Praha, and combined the species in *Hyalinia*, apparently because of the marginal hairs. The paraphyses were depicted by him with distinctly lageniform apices. Like Rehm, Svrček did not report spore bodies or SCBs.

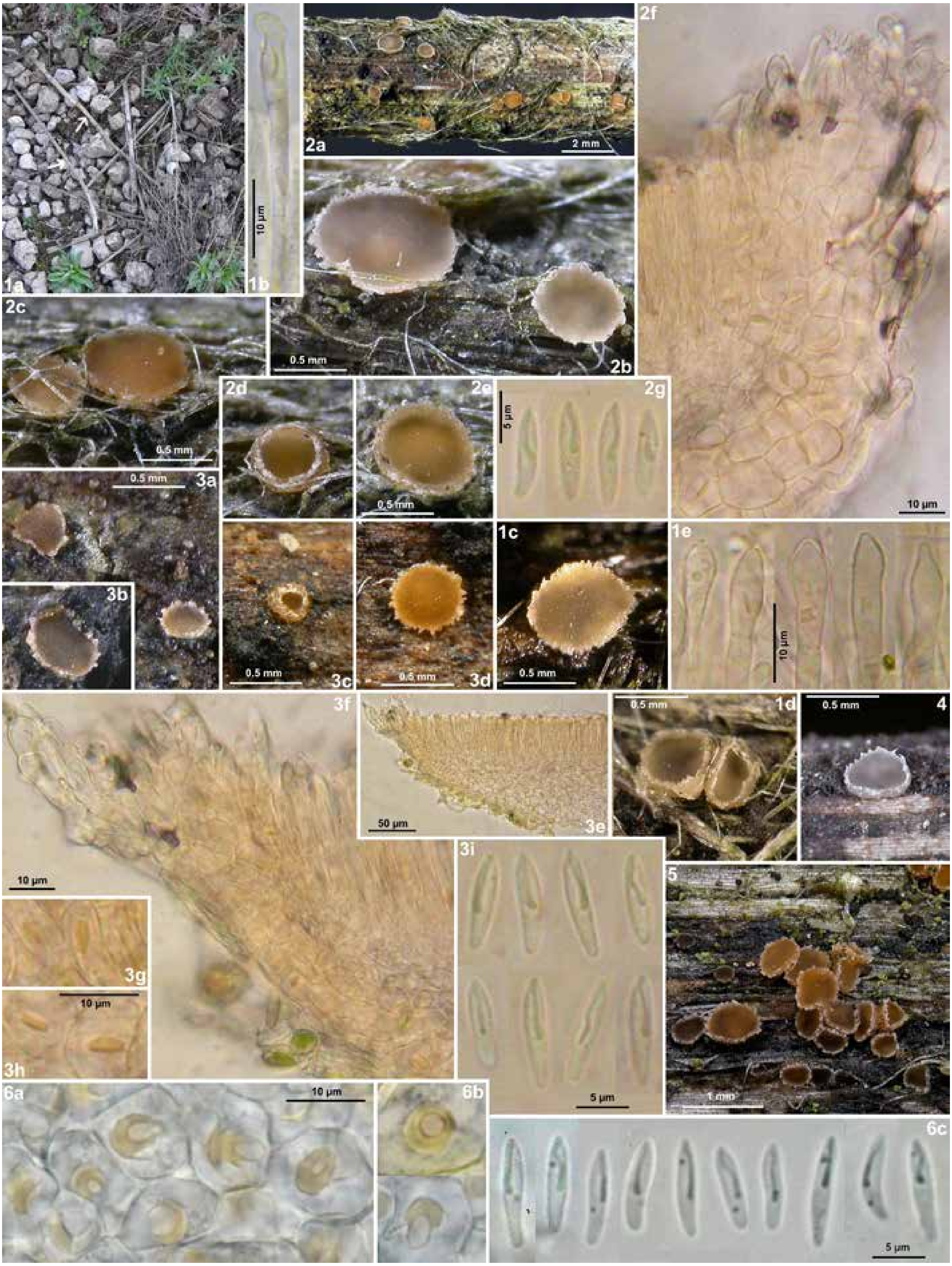


Plate 584. **1–6**: *Orbilia flavidorosella*. – **1a**. ruderal place along a railway track; **1c–d**, **2a–e**, **3a–d**, **4**. rehydrated apothecia; **5**. dry apothecia; **3e**. apothecia in median section; **2f**, **3f**. id., marginal ectal excipulum; **3g–h**, **6a–b**. crystalloid SCBs in ectal excipulum at flanks and margin; **1b**, **e**. paraphyses; **2g**, **3i**, **6c**. ascospores. – Living state. – **6a–c**: phot. R. Tena. — **1a–e**. H.B. 8544: Luxembourg, Bettembourg, on *Melilotus*; **2a–g**. H.B. 8539a: ibid., on *Melilotus*; **3a–i**. H.B. 8234a: ibid., on *Melilotus*; **4**. H.B. 8793a: Germany, Tübingen, on *Ephedra*; **5**. G.M. 2012-09-18.1 (epitype): Luxembourg, Bettembourg, on *Melilotus*; **6a–c**. R.T.L. 10122202: Spain, Teruel, on *Prunus*.

Spooner (1987: 196) doubted placement in *Hyalinia* because the hairs are described as simple, non-glassy, and suggested that the species might belong to *Habrostictis*.

A collection from Ukraine was reported by Yatsiuk (2018). It was originally misidentified as *O. carpoboloides* (Prylutskyi & Akulov 2017), but micrographs sent by I.I. Yatsiuk (pers. comm.), which included some living asci, ascospores, and paraphyses, suggested identity with *O. flavidorosella*.

The macrophoto of a specimen from Luxembourg (Bettembourg, on *Melilotus*, G.M. 2012-09-18.1, Pl. 584: 5), from which an unpreserved ascospore isolate and a sequence were gained, is designated here as **epitype** of *O. flavidorosella*. Samples from the same site and substrate but without a sequence are illustrated in Pl. 583: 1 and Pl. 584: 1–3.

Not included collections. A recent sample from an orosubmediterranean site in Portugal on 1–2 mm thick corticated *Cytisus* twigs (IVV: 22.XI.2019) has much longer spores of *11.3–14.5(–16) × 1.7–2.2 µm with longer SBs of (5.5–)7–8.5 × 0.4–0.7 µm but otherwise fits *O. flavidorosella*. An unpreserved sample from South America (Colombia, on indet. angiosperm) consisted of only a single apothecium. It was examined in the living state but only briefly documented and not illustrated. The microfeatures concurred rather well with *O. flavidorosella*, but no crystalloid SCBs could be found and the marginal hairs were slightly narrower.

Anamorph. Vermispora-like conidia were formed on the mycelium which grew out of an apothecium inside a Petri dish (Pl. 583: 6h). Most of them were 3-septate and resemble the macroconidia reported for *O. carpoboloides*, though being distinctly narrower. A single 1-septate conidium (583: 6h left, IVV: H.B. 8544) closely concurs with the microconidia of *O. carpoboloides*.

Phylogeny. Sequences of two samples of *O. flavidorosella* on *Melilotus* from Luxembourg (G.M. 2012-09-18.1, epitype, from pure culture; G.M. 2014-10-11.1, from apothecia) comprise ITS and LSU. In contrast to *O. carpoboloides*, the S1506 intron is absent in both. The two sequences deviate from each other by only 1 nt and 2 gaps in ITS1 (or 4 nt and no gap under a compact alignment), but show a high distance to *O. carpoboloides* (ITS 13.5–14 %), and even higher distances are noted to other members of section *Habrostictis* (e.g., 19.5 % to *O. mesaverdiana*). In LSU (D1–D2) the lowest distance was 1 % to *O. filiformis* and *O. mesaverdiana*, but 1.4 % to *O. carpoboloides*.

Ecology. *O. flavidorosella* was collected on old xeric, predominantly herbaceous stems of different dicotyledons (mainly *Melilotus*) but also on bark of thin branches of different angiosperm trees. In one collection the fruitbodies grew on a cleaning cloth that was hanging several years outside the window 9.5 m above the ground. The holotype was collected on *Vincetoxicum* in northeastern Germany (Osthavelland, Märkische Tiefebene). A sample on *Ephedra* was from the Chinese Alpinum in the Botanical Garden of Tübingen. Most specimens originate from thermophilous ruderal places, e.g., along railway tracks where the stems were partly lying on the gravel (Pl. 584: 1a). The present data suggest a subcontinental, cold-temperate humid distribution. Yet, two Spanish collections were from a montane, orotemperate humid (on *Cytisus*) and a supramediterranean semihumid climate (abandoned almond plantation with *Cupressus arizonica*), and two upper mesomediterranean semihumid (dry) sites in Macaronesia, in a *Pinus canariensis* woodland with summit brooms (*Sideritido solutae-Pinetum canariensis*) and in the Cañadas del Teide in a summit broom scrub without trees (*Spartocytisetum supranubii*). The not included record from Colombia was in a subtropical humid forest with planted tropical fruit trees.

Map 92. Known distribution of *O. flavidorosella* in Europe and Macaronesia.

Specimens included. **GERMANY**: **Brandenburg**, Havelland, 26 km WNW of Berlin, ~10 km ESE of Nauen, Bredower Forst, ~40 m, stem of *Vincetoxicum hirundinaria*, VI.1893, H. Sydow (Mycotheca Marchica Cent. 39, n. 3846, S-F6405, **holotype**, H.B. 6428 ø). – **Baden-Württemberg**, Schönbuch, 2 km NNW of Tübingen, Morgenstelle, Botanical Garden, 440 m, stem of *Ephedra gerardiana*, 1.IV.2008, H.O. Baral (H.B. 8793a). — **LUXEMBOURG**: **Gutland**, **Luxembourg**, 5 km SSE of Luxembourg, Hesperange, rue de Bettembourg, 300 m, on textile, 17.VIII.2003, G. Marson (H.B. 7413). – **Esch-sur-Alzette**, 1 km S of Bettembourg, railway, 276 m, stem of *Melilotus*, 11.X.2014, G. Marson (G.M. 2014-10-11.1; sq.: KT380076). – 1.5 km S of Bettembourg, railway, 275 m, branch of *Salix* ~*caprea*, on bark, 15.VI.1994, G. Marson (H.B. 5119c). – ibid. stem of *Melilotus*, 20.VI.1998 (H.B. 6172a). – ibid., stems of *Melilotus albus*, 29.VII.2006 (H.B. 8234a). – ibid., stems of *Melilotus* sp., 15.VI.1994 (H.B. 5103). – ibid., 27.V.2007 (H.B. 8544, anam. apoth.). – ibid., 5.VI.2007 (H.B. 8539a). – ibid., 18.IX.2012 (G.M. 2012-09-18.1 ø, **epitype** [illustration]; sq.: KT222391). — **CZECHIA**: **Central Bohemia**, 13 km SE of Praha, S of Průhonice, Gloriet park, 295 m, stems of *Vincetoxicum hirundinaria*, 1.VI.1955, M. Svrček (Svrček 1955, as *Cynanchum vincetoxicum*, doc. vid.). — **UKRAINE**: **Kharkiv**, 52 km SE of Kharkiv, E of Homilsha forest, 3.2 km S of Blagodatne, 122 m, stem of indet. herbaceous dicot, 3.IV.2012, I.I. Yatsiuk (CWU Myc D339, doc. vid.). — **SPAIN**: **Asturias**, 5.8 km S of Pola de Somiedo, SSW of La Peral, 1300 m, twig of *Cytisus scoparius*, on bark, 6.VI.2018, M. González & E. Rubio (E.R.D. 7600, doc. vid.). – **Aragón**, **Teruel**, 1.2 km NW of Teruel, junction of Calle Viñas San Cristóbal and Leocadio Brun, 937 m, branch of *Prunus dulcis*, on bark, 22.XII.2010, R. Tena (R.T.L. 10122202, doc. vid.). — **MACARONESIA**: **Canary Islands**, **Tenerife**, Adeje, 5 km NW of Vilaflor, 9.5 km SSW of Teide, Lomo el Dornajito, 2090 m, branch of *Spartocytisus supranubius*, on bark, 9.III.2013, L. & C. Quijada (TFC Mic. 23925, doc. vid.). – La Orotava, 6 km SSE of Teide, Cañada de la Mareta, 2190 m, branch of *S. supranubius*, on bark, 5.XI.2012, L. & C. Quijada (TFC Mic. 23738, doc. vid.).

Not included. **PORTUGAL**: **Guarda**, 27 km SW of Guarda, 2 km SE of Manteigas, Serra da Estrela, 1048 m, twig of *Cytisus*, on bark, 22.XI.2019, I. Olariaga (ARAN-F 13120, doc. vid.). — **COLOMBIA**: **Cundinamarca**, Cordillera oriental, 60 km N of Bogotá, Pacho, ~1800 m, branch of indet. angiosperm, on bark, 1.I.1994, W. Jaklitsch (H.B. 5117d ø).

Orbilia solidaginis Baral, **sp. nov.**, MB 813658 — Pl. 585

Etymology: named after the substrate, stems of *Solidago*.

Typification: Germany, Stuttgart, stem of *Solidago*, 14.III.1999, A. Gminder (ex H.B. 6335, M-0276586, holotype).

Latin diagnosis: *Differt ab* Orbilia flavidorosella *ascosporis longioribus et angustioribus, paraphyses et cellulae marginales excipuli exsudato granuloso copioso tectae.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.5–0.7 mm diam., 0.1–0.16 mm high, pale dirty cream-ochraceous(-reddish), round, very scattered to subgregarious; disc flat, margin thin, not protruding, finely crenulate, rarely smooth; broadly sessile, superficial. **Asci** †40–61 × 3.8–4.7 µm, 8-spored, spores †2–3-seriate, ~4 lower spores inverted (sometimes mixed); **apex** (†) slightly to medium truncate (not indented, laterally not widened); **base** with medium to very long, thin, flexuous stalk, L- to Y-shaped. **Ascospores**

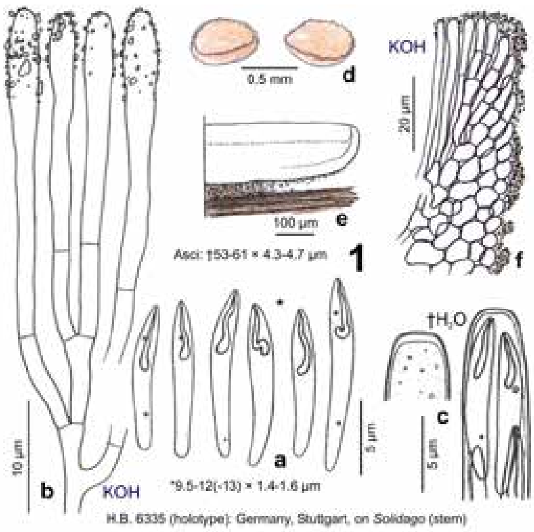


Plate 585. **1**: *Orbilia solidaginis*. – **a**. ascospores; **b**. paraphyses; **c**. ascus apices; **d**. rehydrated apothecia with crenulate margin; **e**. apothecium in median section; **f**. id., marginal ectal excipulum.

*9.5–12(–13) × 1.4–1.6 µm, †8.5–11.5 × 1.5–1.7 µm, narrowly (cylindric-)fusoid, apex subacute, base slightly attenuated, straight to slightly curved; **SBs** *3.7–4.5 × 0.5–0.7 µm in situ (~4–4.7 µm actual length), vermiform to subulate, base ± distinctly inflated, straight to mostly slightly to strongly flexuous. **Paraphyses** apically only slightly inflated, narrowly spathulate-clavate, terminal cells †19–29 × 2–3.5 µm, exceeding the dead asci by 5–10 µm, lower cells †7–10 × 1.6–1.8 µm; unbranched at upper septum. **Medullary excipulum** 40–70 µm thick, of dense textura intricata, medium sharply delimited from ectal excipulum only towards flanks. **Ectal excipulum** of thin-walled, partly horizontally oriented t. angularis from base to submargin, 30 µm thick near base, cells †9–15 × 5–10 µm; 15–25 µm thick near margin, of t. prismatica oriented at a 30° angle to the surface, marginal cortical cells †8–11 × 2.7–3.5(–4) µm, not forming free hairs. **Anchoring hyphae** medium abundant, †1.5–2.7 µm wide, walls 0.15–0.2 µm thick. **SCBs** no data available. **Exudate** over paraphyses 0.2–0.5 µm thick, granular, firmly attached, covering also the lateral wall; over margin and flanks forming a 2–4 µm thick, granular, very pale yellowish layer. — **ANAMORPH**: unknown.

Habitat: lying close to ground, 6 mm thick previous year's stem of *Solidago* sp., on medium decayed epidermis-free area, slightly greyed, no algae. **Associated**: on separate stems *Cyathicula cyathoidea*, *Trichopeziza* aff. *mollissima*. **Desiccation tolerance**: after 2 weeks only ascospores viable. **Altitude**: 450 m a.s.l. **Geology**: Keuper (Stubensandstein). **Phenology**: III.

Taxonomic remarks. *Orbilia solidaginis* differs from *O. flavidorosella* in longer and narrower spores, in paraphyses with narrowly spathulate, roughly warted apices, also in the margin lacking distinct hairs but being, instead, abundantly covered by granular exudate. Also the anchoring hyphae are more thin-walled than in *O. flavidorosella*. The species may also be confused with *O. ebuli* (section *Aurantiorubrae*), which differs in strongly capitate paraphyses and an often strongly inflated lower part of the SBs. *O. luteorubella* (section *Helicoon*) differs in a smooth apothecial margin composed of usually broader, more clavate cells, and in ± capitate paraphyses. Only the spores were viable in the type collection when studied, therefore, it is unknown which kind of SCBs occurred in paraphyses and excipulum.

Ecology. The single known collection grew on a previous year's stem of *Solidago* in an old quarry in a rather moist valley in the Glemswald forest near Stuttgart in subcontinental, cold-temperate humid central Europe.

Specimens included. **GERMANY**: **Baden-Württemberg**, Glemswald, 7 km W of Stuttgart, 2 km S of Gerlingen, Schillerhöhe, Banwald, 450 m, stem of *Solidago*, 14.III.1999, A. Gminder (ex H.B. 6335, M-0276586, **holotype**).

Series *Serpentinae*

Orbilia subgenus ***Habrostictis*** section ***Habrostictis*** series ***Serpentinae*** Baral & E. Weber, **ser. nov.**, MB 815019 – Type species: *Orbilia serpentina* Pat.

Etymology: named after the type species, *O. serpentina*.

Latin diagnosis: *Ascosporae *5–19.5 × 1.6–4.2 µm, fusiformes vel ellipsoideo-clavatae, apice obtuso ad acuminato, raro rotundatae, intus corpusculo refringenti, longe filiformi, flexuoso, ad apicem affixo. Paraphyses ad apicem leniter vel fortiter inflatae, clavato-capitatae. Status anamorphicus typo* Trinacrium, *raro* Tridentaria *vel* Vermispora.

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.1–)0.2–0.7(–1.2) mm diam., pale to bright rose to (yellowish-)orange(-ochre), margin smooth to finely rough or crenulate, partly protruding, sessile or with an ill-defined stipe. **Asci** 8- up to 64-spored, *(35–)40–85(–90) × (4.5–)5–8.5(–9.5) µm when 8-spored, up to *75–100(–120) × 9–11(–12) µm when 16- up to 64-spored, lower ((1–))(2–)3–5(–6)((–7)) spores inverted when 8-spored, (3–)6–10(–12) spores inverted when 16-spored, 9–18 spores inverted when 32-spored; **base** exceptionally H-shaped. **Ascospores** *(5–)6–17(–19.5) × (1.6–)1.8–4.2(–5) µm, fusiform-clavate to cylindric-ellipsoid or tear- to lemon-shaped or ovoid, apex obtuse to acuminate (rarely rounded), straight to slightly, sometimes strongly curved near base, non-septate (but sometimes becoming septate during germination), **SBs** apically affixed to spore wall, *(2.5–)3.5–12(–15) × (0.2–)0.3–1.2(–1.5) µm (actual length), filiform to vermiform or subulate, distinctly swollen at base or not, straight or often slightly to strongly flexuous or helicoid to uncinate, apically narrowed to a small point, without or with a very short filum. **Paraphyses** slightly to strongly clavate-capitate at the apex (rarely predominantly spathulate), terminal cells (0.2–)0.3–1.5(–2)× longer than lower cells. **Ectal excipulum** (†) thin-walled to slightly gelatinized (common walls †0.3–1.5 µm), vertically or sometimes horizontally or indistinctly oriented textura (globulosa-)angularis(-prismatica), cells near base *(5–)7–20(–32) × (4–)6–15(–20) µm; near margin exceptionally with **glassy caps** (*O. ophiosoma*), **hairs** absent. **SCBs** globose or mixed with crystalloid ones, also absent. **Exudate** (0.1–)0.3–1(–2)((–3)) µm thick, continuous to cloddy-granular, loosely to usually firmly attached, hyaline or pale yellowish, sometimes sparse or thin (especially at margin). — **ANAMORPH**: trinacrium-, rarely tridentaria- or vermispora-like. **Conidiophores** 3–25 µm long, unbranched or branched. **Conidiogenous cells** monoblastic or sympodial. **Conidia** mostly staurosporous, trinacrium-like, 2-armed, Y-, rarely T-shaped, *18–50 × 12.5–71 µm, arms tapering; sometimes tridentaria-like, 3–6-armed, *23–70 × 18–83 µm; rarely phragmo- to scolecosporous, vermispora- to anguillospora-like: *75–107 × 5.5–6 µm (actual length), 9–26-septate, straight or slightly to strongly curved {*O. multimaeandrina*}.

Habitat: on wood and bark of both gymno- and angiosperms, sometimes on herbaceous stems or petioles of palms, humid to arid, temperate to subtropical.

Recognized species: 51, plus 1 species with a provisional name and 11 unnamed species ('affinis').

Taxonomic remarks. Series *Serpentinae* is circumscribed here in a rather broad sense, comprising quite different shapes of ascospores and spore bodies. Typical are fusoid to fusiform spores with subacute to acuminate apices and tapered, straight to more or less curved bases. Obtuse to rounded apices in combination with often strongly tapered bases occur, e.g., in *O. obtusispora* and *O. multiurosperma*, and particularly in species around *O. cactacearum* and *O. quaestiformis*. Some of the included species have limoniform to ovoid spores with ± acute apices. Some species might better be affiliated in series *Ellipsospermae*, but various intermediate taxa make a decision highly difficult which is merely based on spore morphology. Further morphological traits that are correlated with our molecular data have not been found, and alternative groupings would also be difficult to establish. Future molecular investigations will hopefully lead to a clearer series concept within section *Habrostictis*.

O. multimaeandrina and *O. osteospermae* are somewhat extraordinary within series *Serpentinae* in their often spathulate paraphyses. A relation to series *Habrostictis* would be supported by a vermispora-like anamorph obtained in *O. multimaeandrina*. In two further species, *O. multidelphinus* and *O. multitrapezoidea*, a similar variation in paraphysis shape between capitate and spathulate was noted, but their anamorph is unknown. Except for *O. multimaeandrina*, molecular data are wanting for these 32-spored taxa which do not appear to be closely related to each other. More probably, some of them are related to 16-spored taxa with a similar spore shape but predominantly capitate paraphyses. Also in a 16-spored collection (*O.* aff. *subdelphinus*, Pl. 638: 3) most of the paraphyses were spathulate.

Species delimitation. Difficulties in separating species frequently occurred in series *Serpentinae*. For instance, various intermediate collections have been observed between the following 10 morphologically very similar 8-spored species: *O. trapeziformis*, *O. cylindrosoma*, *O. obtusispora*, *O. flexisoma*, *O. subtrapeziformis*, *O. macrotrapeziformis*, *O. curvatitrapeziformis*, *O. edulis*, *O. pyrenaica*, and *O. filiformis*. Separation between *O. serpentina* and *O. maeandrina*, based mainly on the presence vs. absence of crystalloid SCBs, was not clear in every case and proved almost impossible with dead material, leaving the identity of the type of *O. serpentina* a little uncertain. Species limits between the species are actually often subtle and blurred, for instance, between the 16-spored *O. delphinus*, *O. subdelphinus* and *O. macrodelphinus*, between the 64-spored *O. myriourosperma* and *O. sedonensis*, or between the 8-spored *O. quaestiformis* and *O. septispora*. In any case, the few available sequences confirm a high species diversity in series *Serpentinae*.

Anamorph. The known anamorphs within series *Serpentinae* are very often trinacrium robustum-like and quite similar among each other. For instance, conidial morphology does not substantially differ between *O. serpentina*, *O. trapeziformis*, *O. cylindrosoma*, *O. halimi*, and *O. vermiculati*. But also some taxa of series *Ellipsospermae* have quite the same type of anamorph (e. g., *O. gambelii*, *O. multigambelii*, *O. cisti*).

O. quaestiformis and some other species with obtuse spore apices (*O. septispora*, *O. quercus-ilicis*, *O. coniferarum*) are associated with a tridentaria-like anamorph (obtained in pure culture, except for *O. coniferarum*). But also in *O. filiformis*, a species with acute spore apices, tridentaria-like conidia were frequently observed, though only on the natural substrate.

The vermispora- to anguillospora-like anamorph of *O. multimaeandrina* appears to be quite out of the ordinary within this series and suggests affinities with series *Habrostictis*. Yet, similar cases in series *Lentiformes* question the taxonomic value of branched vs. unbranched conidia.

Phylogeny. Sequences were available for 30%, i. e., 15 of the 50 accepted species of series *Serpentinae* (excluding two typical members of series *Serpentinae*, *O. obtusispora* and *O. trapeziformis* p.p., which nevertheless clustered in the *Ellipsospermae* clade). Most of these sequences belong to species with trinacrium-like conidia, which represent the typical anamorph of series *Serpentinae*. However, the *Serpentinae-Habrostictis* clade includes also three taxa with vermispora-like conidia (*O. multimaeandrina* and two species of series *Habrostictis*) and three with tridentaria-like conidia (*O. quaestiformis*, *O. septispora*, *O. filiformis*). The present molecular data do not support recognition of groups based on these anamorphs. Also the shape of the ascospore apex does not permit to recognise groups: *O. mesaverdiana* and *O. vermiculati* closely resemble *O. quaestiformis* in having obtuse spore apices, but they clustered in our combined analysis of SSU+ITS+LSU instead in a strongly supported subclade with three species with acute apices (*O. halimi*, *O. serpentina*, *O. octoserpentina*, Phyl. 20), whereby *O. vermiculati* shows a very low ITS distance to *O. halimi*.

Specific nucleotide positions. Various nucleotide positions in the ITS and LSU D1–D2 (Tab. 72) characterize series *Serpentinae*, but these positions mostly include also series *Habrostictis* and exclude *O. obtusispora* and *O. trapeziformis* p.p. The only observed nucleotide that separates series *Habrostictis* from series *Serpentinae* is pos. 235 of SSU V9 (see under section *Habrostictis*, p. 1015).

Orbilia ophiosoma Baral & G. Marson, **sp. nov**., MB 813659 — Pls 586–587, Map 93

Etymology: referring to the meandering, snake-like SBs within the ascospores.

Typification: USA, Utah, Cedar City, branches of *Juniperus osteosperma*, 24.VIII.1994, G. Marson (ex H.B. 5175a, M-0276544, holotype).

Latin diagnosis: *Apothecia rehydratata 0.15–0.7 mm diam., aurantiaca, margine subglabro. Asci octospori. Ascosporae *6–9 × 3.2–5 µm, lacrimiformes vel limoniformes, in statu vivo corpusculum refringens vermiforme, flexuosum vel uncinatum continentes. Habitat ad corticem vel lignum putridum ramorum siccorum coniferarum in zona temperata subhumida ad humida Americae septentrionalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.15–)0.2–0.5(–0.7) mm diam., 0.11–0.19(–0.21) mm high, light to bright (rose-) orange(-ochre), scarcely translucent, round, ± scattered; disc medium concave to flat, margin ± thin, 0–15 µm protruding, smooth to finely rough; broadly sessile, erumpent to nearly superficial; dry deep orange-red. **Asci** *62–82 × 6.2–8.2(–9.3) µm {4}, †(55–)60–75(–80) × (5–)5.5–6.5(–7) µm {4}, 8-spored, spores *1(–2)-seriate, (2–)3–5(–6) lower spores inverted {3} (sometimes strongly mixed), pars sporifera *35–44 µm long; **apex** (†) strongly truncate (very slightly indented, laterally sometimes inflated); **base** with short to long, thick, flexuous stalk, T-, L- or h-shaped. **Ascospores** *(6–)7–9((–11)) × (3.2–)3.6–4.5(–5) ((–5.5)) µm {6}, †5.5–9.2 × 3.3–4.1(–4.4) µm {3}, ovoid or mainly tear-shaped to fusiform (limoniform or amygdaliform), apex subacute to acuminate, exceptionally obtuse, base rounded or ± tapered; straight to slightly inequilateral, rarely medium curved at the very base; **SBs** *(4–)5.5–7(–7.7) × (0.7–)0.9–1.1(–1.3) µm in situ {4} (~5–9 µm actual length), vermiform to subulate, not or slightly inflated at base, straight or mostly flexuous, partly uncinate; in aged spores globose with short filum. **Paraphyses** apically slightly to very strongly capitate-clavate or sometimes spathulate, rarely moniliform, terminal cells *6–25 × 3–5(–6) µm {5}, †2.5–3.5 µm wide {1}, partly tipped by 0.5–1.5 µm thick **glassy caps**, lower cells *8–15 × 1.2–2.5(–3) µm {5}; occasionally or frequently branched near apex, hymenium in upper part pale orange. **Medullary excipulum** subhyaline, 20–60 µm thick, of ± loose to dense textura intricata with a few to many inflated cells, ± sharply delimited. **Ectal excipulum** hyaline to light orange (mainly at margin), of (†) ± thin-walled, vertically to horizontally oriented t. angularis(-prismatica) from base to margin or mid flanks, (10–)15–40(–50) µm

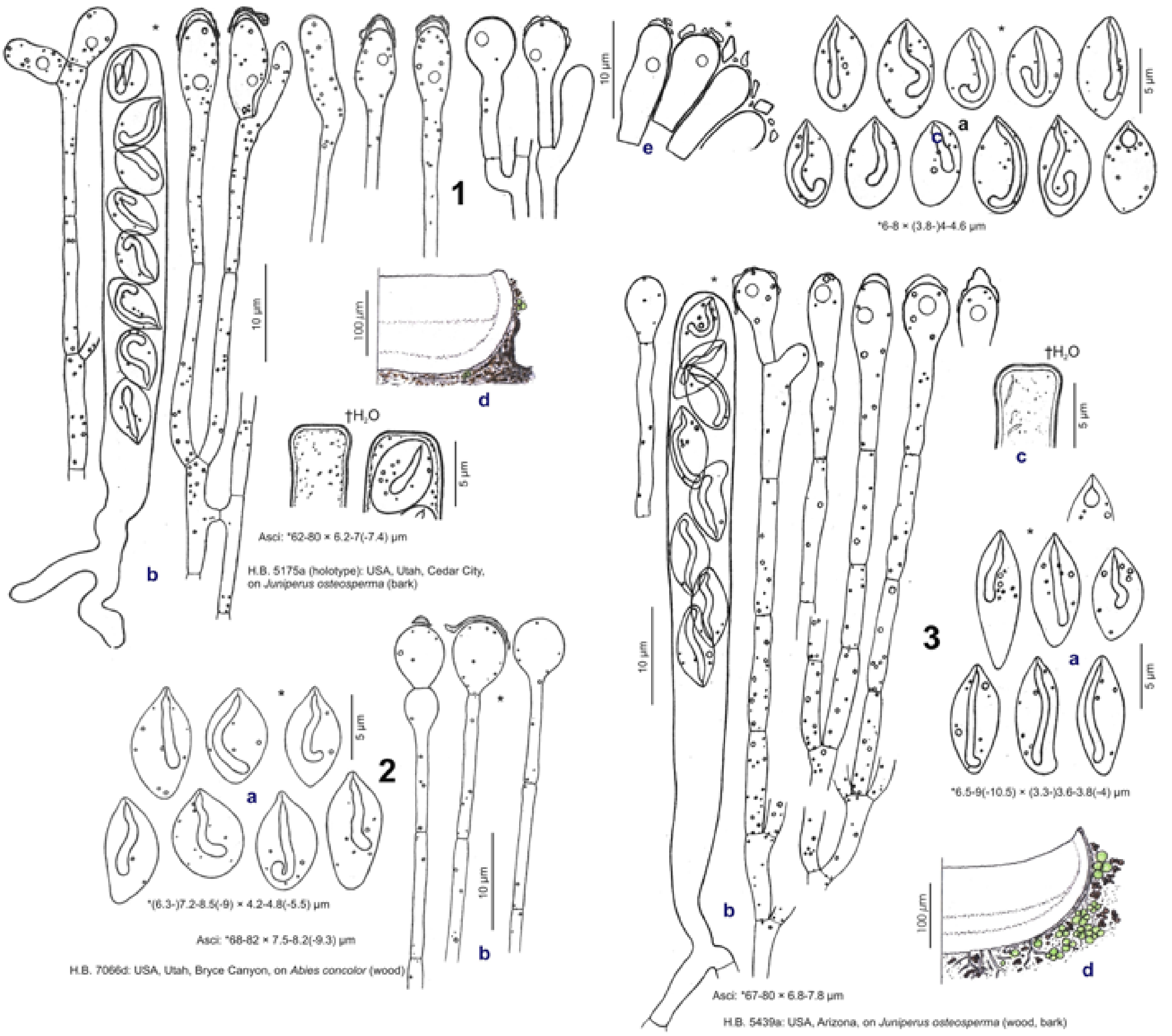


Plate 586. **1–3**: *Orbilia ophiosoma*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. apothecia in median section; **e**. id., cortical cells of ectal excipulum at uppermost margin.

thick near base, cells *(5–)8–17 × (4–)5–10(–12) µm {3}; 20–35 µm thick at lower flanks, 12–20(–40) µm at mid flanks and margin, of t. globulosa-angularis or t. prismatica(-porrecta), at margin oriented at a 10–60° angle, marginal cortical cells *8–16 × 2.7–5 µm {2}, partly tipped by 0.5–1.5 µm thick **glassy caps**. **Anchoring hyphae** sparse to medium abundant, *1.5–4.3 µm wide, walls 0.2–0.5(–0.8) µm thick {3}, sometimes or regularly forming an up to 10–15 µm thick hyaline layer at flanks and margin. **SCBs** in paraphyses and ectal excipulum (near margin) globose, 1–2 µm diam. {4}, or absent {1}. **Exudate** over paraphyses absent or 0.2–1.2(–2) µm thick, ± loosely attached, cloddy-continuous or granular; over margin and flanks 0.2–1.5 µm thick, granular-crystalloid. **— ANAMORPH**: unknown.

Habitat: collected 0.5–3 m above the ground, corticated or decorticated, 4–50 mm thick twigs and branches of *Abies concolor* {2/1}, *Juniperus osteosperma* {3}, on 0.2–1 mm deep medium to strongly decayed wood {5} and partially detached bark (periderm and bast) {3}, ± strongly greyed, without or with a few to many green algae. **Associated**: *Caloplaca* sp. {1}, *Carestiella ?schizoxyloides* {1}, *Hypogymnia* sp. {1}, *Lachnellula* sp. {1}, ?*Melanelixia* sp. {1}, *Melaspilea emergens* {2}, *Orbilia calyptrata* {1}, *O. clavipisca* {1}, *O. coniferarum* {2}, *O. cucumispora* {1}, *O. delphinus* {2}, *O. flexisoma* {2}, *O. macrodelphinus* {1}, *O. maeandrina* {1/1}, *O. multidelphinus* {1}, *O. multihamulata* {1}, *O. multitrapezoidea* {1}, *O. navajoana* {1}, *O. octosporoides* {1}, *O. osteospermae* {1}, *O. pisciculus* {1}, *Sclerococcum* sp. {1}, *Tryblidaria fenestrata* {1}, *Xanthoria* sp. {1} and other lichens. **Desiccation tolerance**: fully tolerant for at least 19 months, paraphyses, excipular cells and some ascospores still viable after 33 months. **Altitude**: 1815–2778 m a.s.l. **Geology**: Permian and Upper Cretaceous sand- & limestone. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia ophiosoma* is well characterized by its rather large, tear- to lemon-shaped ascospores containing long and thick, flexuous to uncinate SBs, and 8-spored asci, also by growing on coniferous substrate. *O. lacrimispora* mainly differs in 16-spored asci, and *O. macrotrapeziformis* in longer and narrower spores; both appear to occur exclusively on angiosperm hosts.

Variation. The collections vary among each other in spore width, also in the paraphysis apices (partly in shape and width, partly in the presence of small glassy caps), but these differences are not clearly correlated with the host genus. In two collections on *Abies* (e.g., Pl. 586: 2) the paraphyses are predominantly strongly capitate while spathulate apices are rather rare. On the contrary, in two samples on *Juniperus* (e.g., Pl. 586: 1) spathulate apices are predominant.

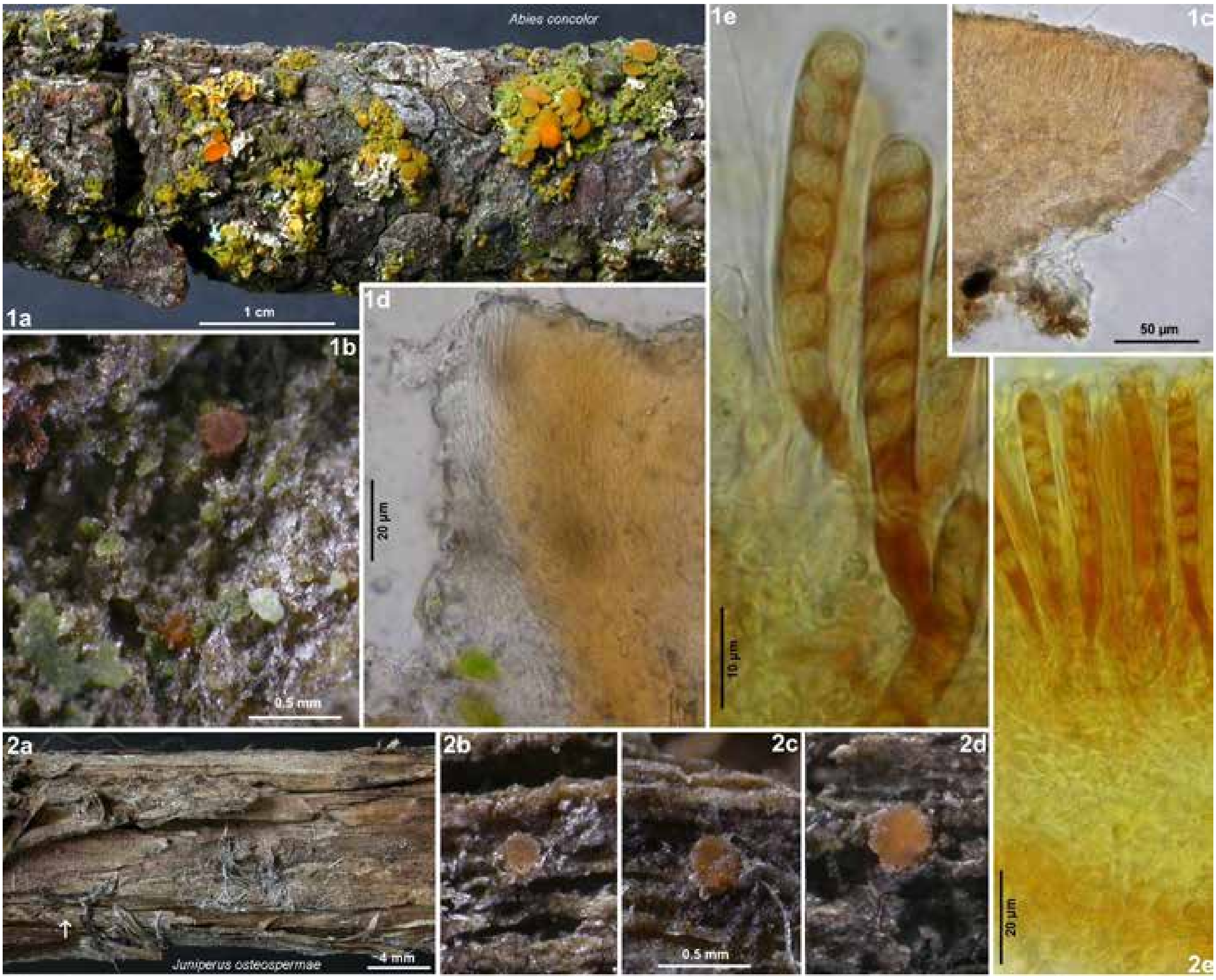


Plate 587. **1–2**: *Orbilia ophiosoma*. – **1a**, **2a**. dead corticated branches (**1a** with *Xanthoria* and other lichens); **1b**, **2b–d**. rehydrated apothecia; **1c**. apothecium in median section; **1d**. id. marginal ectal excipulum (orange) with hyaline covering layer; **2e**. id., hymenium, medullary and ectal excipulum; **1e**. asci. – Dead state (**1c** in H_2O, **1d** in KOH, **1e**, **2e** in KOH+IKI). — **1a–e**. H.B. 8095d: USA, Utah, Bryce Canyon, on *Abies concolor*; **2a–e**. H.B. 5175a (holotype): ibid., Cedar City, on *Juniperus osteosperma*.

Not included collection. A briefly studied unillustrated sample on *Populus tremuloides* resembles *O. ophiosoma* in the spores (*8–11 × 3.3–4 µm, with acuminate apex, helicoid SBs) but is not included because of the deviating substrate, also because of rather long SBs.

Ecology. *O. ophiosoma* was found on ± rotten wood and bark of xeric twigs and branches of gymnosperms in cold-temperate to boreal subhumid pinyon-juniper woodlands and humid Douglas fir and Engelmann spruce forests of the Utah Mountains, Coconino Plateau, and Sacramento Mountains at the northeastern border of the Chihuahuan Desert in western North America. The not included collection on *Populus* was in a boreal humid Engelmann spruce forest in the Utah Mountains.

Specimens included. **USA**: **Utah**, Utah Mts., Dixie Forest, 1.5 km ESE of Cedar City, 1815 m, branches of *Juniperus osteosperma*, on bark, 24.VIII.1994, G. Marson (M-0276544, **holotype**; **isotype** in H.B. 5175a). – Bryce Canyon, 42 km SSE of Panguitch, Rainbow Point, 2778 m, branch of *Abies concolor*, on wood, 20.VI.2000, G. Marson (H.B. 7066d ø). – 32 km SE of Panguitch, 13 km WSW of Tropic, near Trough Spring, 2500 m, branch of *A. concolor*, on bark & wood, 13.VI.2003, G. Marson (H.B. 8095d). – **Arizona**, Grand Canyon, Coconino Plateau, 3.5 km N of Tusayan, 2075 m, branch of *J. osteosperma*, on wood, 17.VI.2003, G. Marson (H.B. 8097f). – 3 km S of Tusayan, 2033 m, branches of *Juniperus osteosperma*, on bark & wood, 28.VIII.1994, G. Marson (H.B. 5439a). – **New Mexico**, Sacramento Mountains, 21 km ENE of Alamogordo, Cloudcroft, 2650 m, branches of *A.* ?*concolor* on wood, 25.V.1996, G. Marson (H.B. 5670).

Not included. **USA**: **Utah**, Utah Mts., Dixie Forest, 22 km ESE of Cedar City, 18 km WNW of Duck Creek Village, Zion Overlook, 2980 m, branch of *Populus tremuloides*, on wood, 24.VIII.1994, G. Marson (H.B. 5230e).

Map 93. Known distribution of *O. ophiosoma* in western North America.

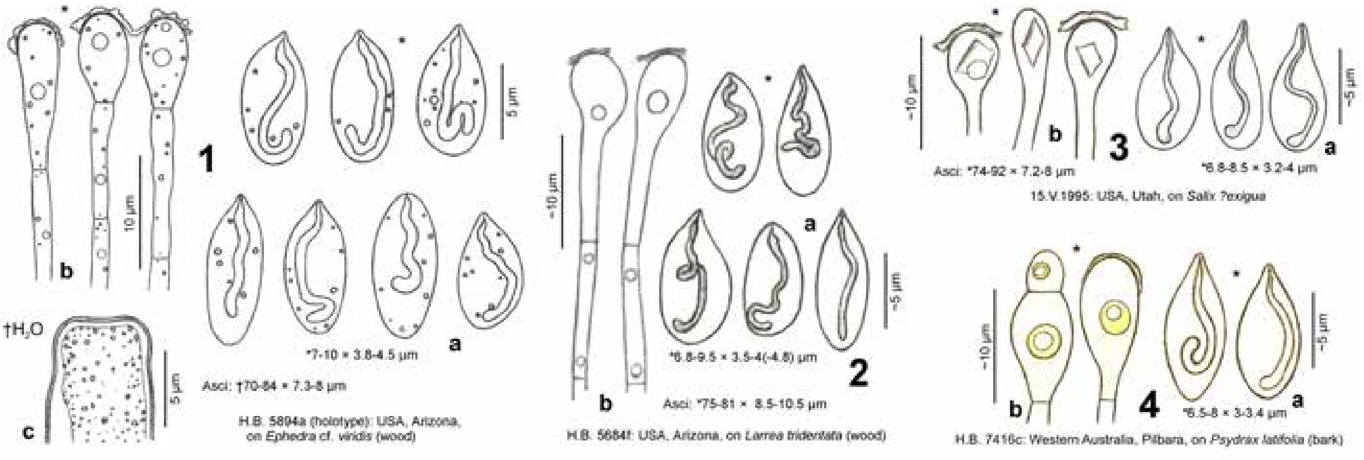


Plate 588. **1–2**: *Orbilia lacrimispora*; **3–4**: *O*. aff. *lacrimispora*. – **a**. ascospores; **b**. apices of paraphyses; **c**. ascus apex.

Orbilia lacrimispora Baral & G. Marson, **sp. nov.**, MB 813660 — Pls 588–589

Etymology: named after the tear-shaped ascospores.

Typification: USA, Arizona, Wickenburg, branch of *Ephedra ?viridis*, 4.V.1995, G. Marson (ex H.B. 5894a, M-0276497, holotype).

Latin diagnosis: *Similis* Orbiliae ophiosomati *sed asci 16-spori*, *lignum putridum fruticum angiospermarum inhabitans in zona temperata ad subtropica semiarida Americae septentrionalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.15–0.3(–0.5) mm diam., 0.14–0.15 mm high, light to bright (rose-)orange(-ochraceous), round, ± scattered; disc flat, margin distinct, 0–20 µm protruding, finely rough; broadly sessile, immersed in host fibres. **Asci** *75–87 × 8.5–9.6(–10.5) µm {2}, †(58–)70–90 × 7–8.5(–9.3) µm {3}, 16-spored, spores *4-seriate, ~8 lower spores inverted {3} (sometimes strongly mixed), pars sporifera †54–63 µm; **apex** (†) strongly truncate (± distinctly indented, laterally sometimes distinctly widened); **base** with short, thick stalk, Y- to h-shaped. **Ascospores** *(6.8–)7.5–10(–11.2) × 3.5–4.4(–4.8) µm {3}, †6.5–9(–10) × 3.5–4 µm {2}, ellipsoid-lacrimiform or amygdaliform, apex acute to acuminate, exceptionally obtuse, base ± rounded, rarely very slightly attenuated, straight to slightly inequilateral; **SBs** *6–9 × (0.5–)0.7–1(–1.4) µm in situ {2} (~9–11 µm actual length), vermiform (to subulate), not or slightly inflated at base, strongly flexuous or helicoid, partly uncinate. **Paraphyses** apically (slightly to) medium to strongly clavate-capitate or slightly spathulate, terminal cells *7–17 × (2.5–)3–4.5 µm {2}, †(1.5–)2–3 µm wide, lower cells *9–13 × 1.5–2 µm {1}; unbranched at upper septum, hymenium pale rose-orange. **Medullary excipulum** pale rose-orange, 30 µm thick, of ± dense textura intricata with inflated cells, medium sharply delimited. **Ectal excipulum** pale rose-orange, of (†) slightly gelatinized t. angularis from base to margin, 30 µm thick near base, cells †6–11 × 5–7 µm {1}; 20 µm thick near margin, oriented at a 70–90° angle to the surface, marginal cortical cells †6–10 × 2.8–3.7 µm {1}. **Anchoring hyphae** medium abundant, */†(2–)2.5–3(–3.5) µm wide, walls 0.2–0.4 µm thick {1}, extending ± to the margin as a thin layer. **SCBs** in paraphyses and ectal excipulum (near margin) globose, 1–1.5 µm diam. {3}. **Exudate** over paraphyses 0.3–0.8(–2) µm thick, rough, firmly attached; over margin and flanks rather thin. — **ANAMORPH**: unknown.

Habitat: collected 1–2 m above the ground, decorticated, 14–25 mm thick branches of *Canotia holacantha* {1}, *Ephedra ?viridis* {1}, *Larrea tridentata* {1}, on 0.5–1 mm deep strongly decayed wood {3}, eroded, greyed, green algae sparse. **Associated**: ?*Baggea* sp. {1}, *Hysterobrevium mori* {3}, *Melaspilea emergens* {1}, *Orbilia arizonensis* {2}, *O. bicknellensis* {1}, *O. calyptrata* {3}, *O. cryptogena* {1}, *O. macrodelphinus* {2}, *O. macrohesperidea* {1}, *O. maeandrina* {1}, *O. multigambelii* {1}, *O. multiserpens* {1}, *O. sonorensis* {1}, *O. trapeziformis* {1}, *O. ?vitalbae* {1}, *Patellaria* '*andina*' {1}, *P. atrata* {2}, *Schizoxylon* sp. {1}, crustose lichen. **Desiccation tolerance**: fully tolerant for at least 1 year; some immature asci and paraphyses and many ascospores still viable after 39 months. **Altitude**: 615–1073 m a.s.l. **Geology**: Triassic and Oligo- to Miocene sand-, lime- & mudstone. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia lacrimispora* is easily recognised by its rather large, tear-shaped to amygdaliform ascospores containing long and thick, flexuous to helicoid SBs, and by 16-spored asci. The similar *O. ophiosoma* differs in 8-spored asci and in growing typically on coniferous hosts. *O. serpentina* and *O. maeandrina* both differ in narrower, less tear-shaped spores, the former also in crystalloid SCBs. Nevertheless, the narrowest spores of *O. lacrimispora* concur with the widest spores of *O. maeandrina*.

Not included collections. Two briefly illustrated samples with spores very similar to *O. lacrimispora* (Pl. 588: 3–4) differ in the presence of crystalloid SCBs and in narrower spores and

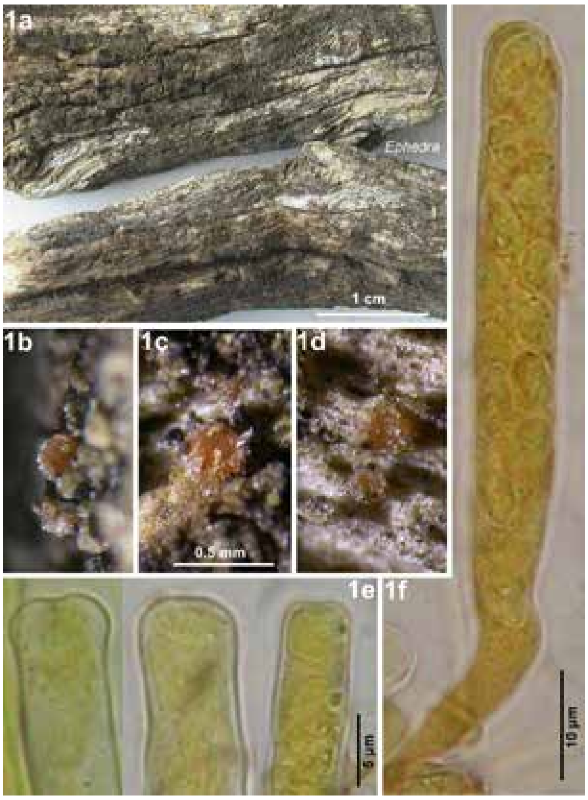


Plate 589. **1**: *Orbilia lacrimispora*. – **1a**. decorticated branches; **1b–d**. rehydrated apothecia; **1e**. ascus apices; **1f**. ascus. – Dead state (in KOH+IKI). — **1a–f**. H.B. 5894a (holotype): USA, Arizona, on *Ephedra ?viridis*.

asci, therefore they might represent a separate species.

Ecology. *O. lacrimispora* grew on rotten wood of xeric branches of angiosperm shrubs in warm-temperate to subtropical semiarid paloverde-mixed cacti desert scrubs of the Sonoran Desert in the southwest of Northern America. The not included collections were from a cold-temperate semiarid sagebrush desert scrub with *Salix* on Triassic calcareous sand in the Utah Mountains and a subtropical semiarid acacia shrubland (mulga) on Archean to Paleoproterozoic sedimentary rock in the Pilbara desert in western Australia.

Specimens included. **USA**: **Arizona**, Sonoran Desert, 82 km NW of Phoenix, ~1.5 km SE of Wickenburg, 615 m, branch of *Ephedra ?viridis*, on wood, 4.V.1995, G. Marson (ex H.B. 5894a, M-0276497, **holotype**). – 68 km SSW of Flagstaff, 5.5 km NNE of Camp Verde, Montezuma Castle, 975 m, branch of *Larrea tridentata*, on wood, 8.V.1995, G. Marson (H.B. 5684f ø). – ibid., 9 km NNE of Camp Verde, 4 km NE of Montezuma Castle, 1073 m, branch of *Canotia holacantha*, on wood, 12.VI.2000, G. Marson (ø).

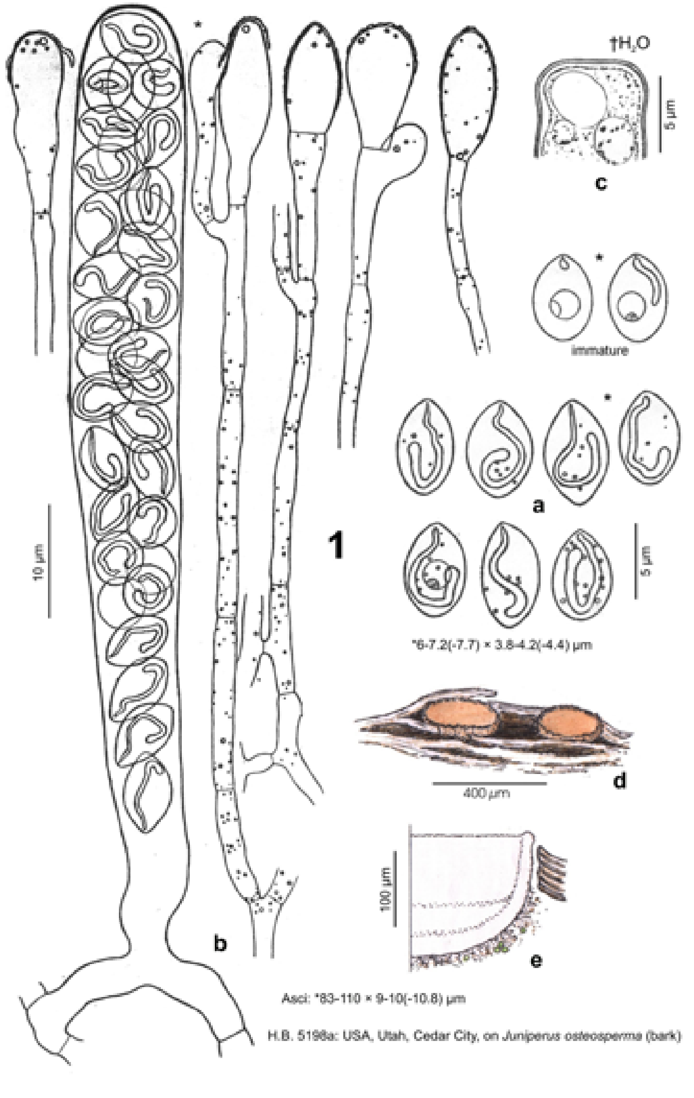
Not included. **USA**: **Utah**, Utah Mts., 13 km ESE of Bicknell, ~1.5 km ESE of Torrey, ~2075 m, on *Salix ?exigua*, 15.V.1995, G. Marson (ø). — **AUSTRALIA**: **Western Australia**, centre of Pilbara, 30 km NW of Newman, 706 m, twigs of *Psydrax latifolia*, on bark, 27.XI.2001, G. Marson (H.B. 7416c).

Orbilia multihamulata Baral & G. Marson, **sp. nov.**, MB 813661 — Pls 590–591

Etymology: with 32-spored asci and uncinate (hamulate) spore bodies.
Typification: USA, Arizona, Page, branch of *Juniperus osteosperma*, 27.VIII.1994, G. Marson (ex H.B. 5224b, M-0276522, holotype).

Latin diagnosis: *Similis* Orbiliae ophiosomati *sed asci 32-spori. Habitat ad corticem putridum ramorum siccorum* Juniperi osteospermae in z*ona temperata subhumida Americae septentrionalis.*

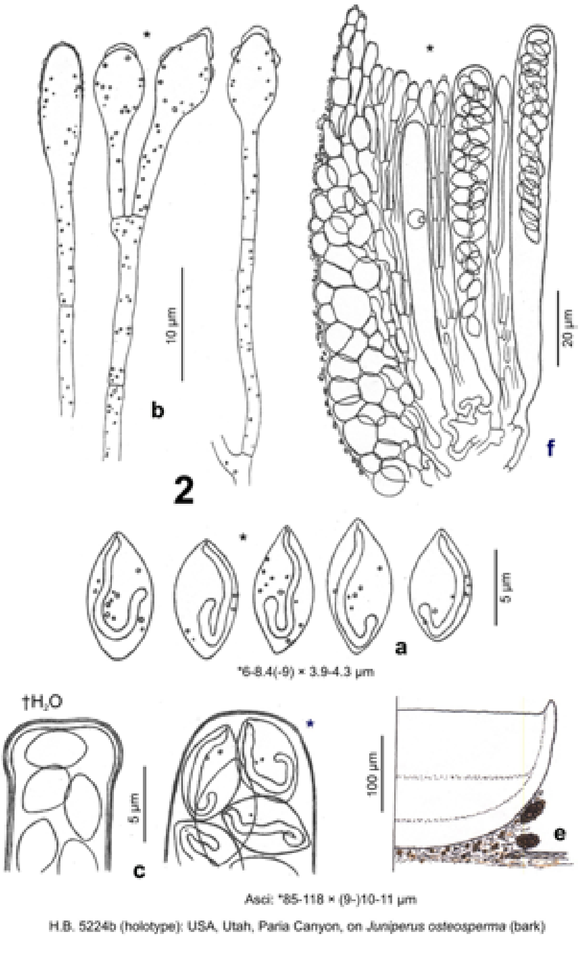
Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.25–0.4 mm diam., 0.16–0.18 mm high, light orange-ochraceous, round, scattered to medium gregarious or in small clusters; disc flat, margin 5–20 µm protruding, finely whitish puberulent-crenulate; broadly sessile, mostly erumpent through slits in the outer layers of bark; dry apothecia bright orange. **Asci** *(83–)90–100(–120) × 9–11 µm {2} → 110–118 × 10–11 µm, †83–98 × 8–9.5 µm {2}, 32-spored, lower spores inverted, some of upper spores oriented in all directions, pars sporifera *65–77 → 50–56 µm, †75–85 µm; **apex** (†) medium to strongly truncate (very slightly indented, laterally inflated); **base** without or with very short, slightly flexuous stalk, Y- to h-shaped. **Ascospores** *6–8(–9) × 3.7–4.2(–4.5) µm {2}, †5.5–7.8 × (3.3–)3.8–4.2 µm {2}, broadly (ellipsoid-)ovoid to fusiform (lemon-shaped or amygdaliform), apex subacute to acute, rarely obtuse, base rounded or often ± acute, straight. **SBs** *5.5–7.5(–8.5) × 0.7–1 µm in situ {2} (~9–11 µm actual length), vermiform to subulate, not or slightly swollen at base, flexuous to helicoid, mostly strongly uncinate. **Paraphyses** apically medium to strongly clavate(-capitate) or spathulate, rarely slightly mammiform, terminal cells (5–)9–26(–32) × (3.5–)4–5.5(–6.5) µm {2}, †3–4.7 µm wide {2}, lower cells *(9.5–)14–20 × 1.2–2.4 µm {2}, †1–1.4 µm wide, near base *2.5–3 µm, sometimes branched near apex. **Medullary excipulum** hyaline, 40–50 µm thick, of ± loose textura intricata with many ± distinct inflated cells, sharply delimited. **Ectal excipulum** hyaline to pale rose-orange, of firm-walled, seemingly horizontally oriented (though cells also vertically elongate) t. angularis from base to margin, 20–35 µm thick



*6-7.2(-7.7) × 3.8-4.2(-4.4) µm

Asci: *83-110 × 9-10(-10.8) µm

H.B. 5198a: USA, Utah, Cedar City, on *Juniperus osteosperma* (bark)



*6-8.4(-9) × 3.9-4.3 µm

Asci: *85-118 × (9-)10-11 µm

H.B. 5224b (holotype): USA, Utah, Paria Canyon, on *Juniperus osteosperma* (bark)

Plate 590. **1–2**: *Orbilia multihamulata*. – **a**. ascospores; **b** (& **f**). ascus and paraphyses (**2f** right ascus fully turgescent); **c**. ascus apices; **d**. rehydrated apothecia; **e**. apothecia in median section; **f**. id., marginal ectal excipulum and hymenium.

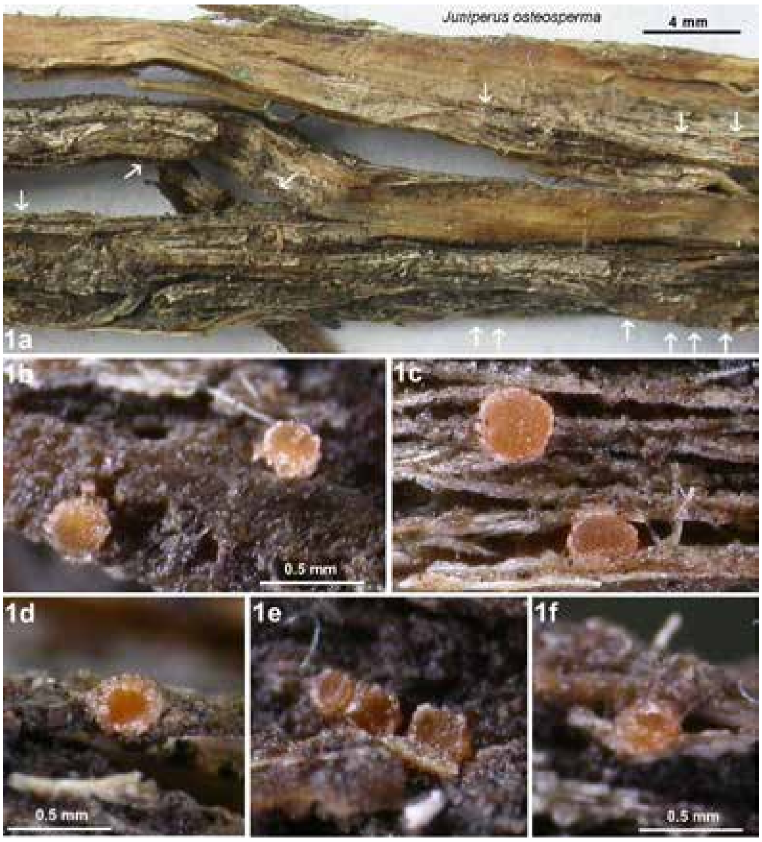


Plate 591. **1**: *Orbilia multihamulata* (holotype). – **1a**. detached bark; **1b–f**. rehydrated apothecia. — **1a–f**. H.B. 5224b: USA, Utah, on *Juniperus*.

near base, cells *7–13 × 7–12 µm {2}; 15–20 µm thick at mid flanks, cells *7–11 × 7–10 µm, 15–20 µm thick at margin, marginal cortical cells *5–14 × 3–6.5 µm {2}. **Anchoring hyphae** abundant, *2.5–4 µm wide {2}, walls *0.2–0.4 µm thick, †0.2–0.6(–1.2) µm {2}, forming a thin layer from base to flanks. **SCBs** absent. **Exudate** over paraphyses 0.2–0.8 µm thick, ± warted, hyaline to very pale rose-orange, firmly attached and restricted to each paraphysis tip; over margin and flanks thin, granular. **— ANAMORPH**: unknown.

Habitat: collected 1.5 m above the ground, ± corticated, undecayed, dead, 12–?40 mm thick branches of *Juniperus osteosperma* {2}, on medium decayed, loosely attached, or detached hanging bark {2}, on thin layers of bark, greyed, green algae sparse or absent. **Associated**: *Orbilia cucumispora* {2}, *O. ?maeandrina* {1}, *O. multidelphinus* {1}, *O. octosporoides* {1}, *O. ophiosoma* {1}, *O. osteospermae* {1}, *O. pisciculus* {1}, *Ostropales* {1}. **Desiccation tolerance**: fully tolerant for at least 5 months. **Altitude**: 1225–1815 m a.s.l. **Geology**: Triassic-Jurassic-Cretaceous sedimentary rock. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia multihamulata* is well characterized by its rather large, broadly ovoid-fusiform ascospores with very long, thick, always uncinate SBs and by 32-spored asci. The species appears to be closely related to the 8-spored *O. ophiosoma* (on gymnosperms) and 16-spored *O. lacrimispora* (on angiosperms). *O. multimaeandrina* (on angiosperms) differs from *O. multihamulata* in narrower spores with shorter, not uncinate SBs. *O. osteospermae* grew with *O. multihamulata* on the same host; its spores are similar in shape but much smaller.

Variation. The rich holotype collection slightly deviates in more lemon-shaped spores from the sparse paratype in which ovoid spores predominated.

Ecology. *O. multihamulata* was collected on ± rotten bark of xeric branches of *Juniperus osteosperma* in ravines or broad valleys near small rivers in the warm-temperate semiarid to cold-temperate subhumid pinyon-juniper woodlands of the Great Basin adjacent to Utah Mountains and Canyonlands section of Colorado Plateau adjacent to Grand Canyon in western North America.

Specimens included. **USA**: **Utah**, Utah Mts., 1.5 km ESE of Cedar City, Dixie Forest, 1815 m, branch of *Juniperus osteosperma*, on bark, 24.VIII.1994, G. Marson (H.B. 5198a). – **Arizona**, Canyonlands, 35 km WNW of Page, Paria Canyon, ~1225 m, branch of *J. osteosperma*, on bark, 27.VIII.1994, G. Marson (ex H.B. 5224b, M-0276522, **holo- & isotype**).

Orbilia trapeziformis Baral & G. Marson, **sp. nov.**, MB 814375 — Pls 592–594, Map 94

Etymology: referring to the trapezoid (rhomboid) ascospore shape.

Typification: France, Ancerville, branch of *Quercus robur*, 10.V.1993, H.O. Baral (ex H.B. 4874a, M-0276601, holotype).

Latin diagnosis: *Apothecia rehydratata 0.2–1 mm diam., aurantiaca, margine laevi vel subcrenulato. Asci 8-spori. Ascosporae *5–11 × 2–3.2 µm, fusoideae vel fusoideae-clavatae, in statu vivo corpusculum refringens subulatum flexuosum continentes. Paraphyses ad apicem modice vel valde capitato-clavatae. Habitat ad lignum putridum, interdum corticem, ramorum siccorum arborum angiospermarum, raro coniferarum, in zona temperata humida vel mediterranea semihumida Europae.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.2–0.4 or 0.3–0.8(–1.1) mm diam., 0.12–0.32 mm high (receptacle 0.1–0.16 mm), (pale to) light to bright orange(-rose), ± translucent or not, round to broadly ellipsoid, scattered to ± gregarious; disc slightly concave to flat, finally medium convex, margin distinct or not, 0–15 µm protruding, smooth to finely rough or (sub)crenulate; sessile or with an ill-defined hidden stipe up to 0.2 × 0.35 mm, slightly immersed or erumpent between fibres; dry bright orange(-red). **Asci** *(45–)50–75(–80) × (4.4–)4.8–6(–7)((–7.5)) µm {21}, †(40–)49–70(–75) × (3.7–)4.4–5.2(–5.4) µm {5}, 8-spored, spores *obliquely (1–)2-seriate, ((1–))(2–)3–5(–6)((–7)) lower spores inverted {26} (not or sometimes mixed), pars sporifera *(20–)23–36(–39) → 18–29 µm long; **apex** (†) (medium to) strongly truncate (slightly indented, laterally sometimes inflated); **base** with medium long, ± thin, flexuous stalk, T-, L-, Y- or h-, exceptionally H-shaped. **Ascospores** *(5–)6.5–9.5(–11) × (2–)2.2–2.8(–3.2) µm {53}, †6–9(–9.5) × 1.8–2.7 µm {4}, (ellipsoid-)fusoid (amygdaliform) to fusoid-clavate (to fusiform), apex obtuse to subacute, rarely acute, base medium to usually strongly attenuated (rarely slightly), sometimes with a 1–2 µm long tail-like base, straight to slightly, rarely medium to strongly curved near base; **SBs** *(2.5–)4–6(–8)((–9)) × (0.3–)0.5–0.7(–0.9) µm in situ {29} [~(4–)5–7(–8) µm actual length], subulate, slightly to medium inflated at base, slightly to medium flexuous, rarely uncinate; germinating spores non-septate. **Paraphyses** apically (slightly to) medium to strongly capitate-clavate, terminal cells *(4.5–)7.5–20(–25) × (2.5–)3–5(–6) µm {10}, lower cells *7–16 × 1.4–2.2(–2.6) µm {8}; usually very rarely but sometimes more often branched at upper septum. **Medullary excipulum** hyaline, 50–100 µm thick, of ± dense textura intricata with many inflated cells, medium to quite sharply delimited from ectal excipulum at flanks (towards mid flanks by a 10 µm thick t. porrecta). **Ectal excipulum** hyaline or very pale to light rose-orange (especially near margin), of (*) thin-walled to slightly gelatinized, vertically oriented t. angularis-prismatica from base to mid flanks or margin, 25–100 µm thick near base, cells *(6–)10–22(–32) × (5–)8–16(–20) µm {8}; 30–40 µm thick at flanks, (12–)20–30(–50) µm near margin, cells *6–12 × 5–10 µm, oriented at a 45–90° angle to the surface, uppermost margin also of t. porrecta oriented at 25–40°, marginal cortical cells *7–12(?–20) × (1.5–)3–4(–4.5) µm {3}. **Anchoring hyphae** sparse to often abundant, */†1.8–3(–3.5) µm wide, walls 0.2–0.3(–0.4) µm thick {4}, extending to the margin as scattered hyphae or an up to 15–20 µm thick, ± gelatinized, hyaline or yellowish layer. **SCBs** in paraphyses and marginal cortical cells globose {20}, 0.8–2(–3) µm diam., more rarely absent {5}. **Exudate** over paraphyses

0.3–2 µm thick, rough to cloddy, ± hyaline to yellow-chlorinaceous, loosely or firmly attached; over margin and flanks 1–2 µm thick, granular-cloddy. — **ANAMORPH**: trinacrium-like (presumed, from natural substrate {8}). **Conidiophores** not seen. **Conidia** Y-shaped, total size */†18–32 × 22–34 µm, stipe */†10–15 × 4–5 µm, 2-septate, arms tapering, */†11–21 × 4–5.5 µm, 2–4-septate {6}.

Habitat: collected (0–)0.8–4(–16) m above the ground, corticated to decorticated, 8–35(–150) mm thick branches, rarely trunks, of *Acer* sp. {1}, *A. campestre* {1}, *Carpinus betulus* {3}, *Castanea sativa* {1}, *Cercis siliquastrum* {3}, *Corylus avellana* {2/1}, *Cytisus scoparius* {1}, *Euonymus europaeus* {1}, *Fagus sylvatica* {3}, *Fraxinus excelsior* {2}, *Juglans nigra* {1}, *J. regia* {10}, *Juniperus oxycedrus* {1}, *J. thurifera* {1/1}, *Malus domestica* {2}, *Pinus sylvestris* {1}, *Populus ?canadensis* {1}, *Prunus avium* {2}, *P. mahaleb* {1}, *P. spinosa* {1}, *Quercus* sp. {7}, *Q. cerris* {2}, *Q. ilex* {1}, *Q. pubescens* {3}, *Q. robur* {4}, *Q. suber* {1}, *Rhus typhina* {1}, *Robinia pseudoacacia* {1}, *Rosa* sp. {1}, *Rubus fruticosus* {1}, *Salix ?alba* {1}, *S. caprea* {3/1}, *Sorbus domestica* {1}, *S. torminalis* {1}, *Tilia* sp. {1}, *T. cordata* {1}, *T. platyphyllos* {1}, on herbaceous stem of *Humulus lupulus* {1}, on 0.3–2 mm deep slightly to mostly strongly decayed wood {58} and bark {20} (periderm {3} and bast {9}), sometimes on very old *Vuilleminia ~comedens* {6} or in beetle galleries on boring dust, wood often white-rotten, (strongly) greyed, often eroded, with a few to many green algae. **Associated**: *Baggea* sp. {1}, *Claussenomyces* sp. {1}, *Coniochaeta* sp. {2}, *C. ?pulveracea* {1}, *Cryptocoryneum condensatum* {1}, *Dacrymyces* sp. {3}, *Diplodia* sp., {1}, *Durella ?compressa* {1}, *D. connivens* {2}, *Frullania dilatata* {1}, *Hyalorbilia juliae* {1}, *H. subfusispora* {2}, *Hypogymnia physodes* {1}, *Hypoxylon fuscum* {1}, *H. udum* {2}, *Hysterium angustatum* {1}, *Hysteropatella elliptica* {1}, *Karstenia* sp. {1}, *K. rhopaloides* {1}, *Lasiobelonium variegatum* {1}, *Lecanora* sp. {1}, *Lophiostoma myriocarpum* {1}, *Melanelia glabratula* {2}, *Nitschkia broomeana* {1}, *Orbilia aprilis* {1}, *O. aristata* {1}, *O. aurantiorubra* {1}, *O. carpoboloides* {1}, *O. cejpii* {1}, *O. cercidicola* {2}, *O. clavuliformis* {1}, *O. eucalypti* {2}, *O. ?ficicola* {1}, *O. filiformis* {2}, *O. flagellispora* {2}, *O. gambelii* {1}, *O. myriolentiformis* {1}, *O. myriosphaera* {2}, *O. patellarioides* {1}, *O. pleioeuonymi* {1}, *O. polyspora* {1}, *O. quaestiformis* {1}, *O. septispora* {1}, *O. sphaerospora* {1}, *O. subaristata* {3}, *O. subclavuliformis* {1}, *O. subocellata* {1}, *O. subvinosa* {1}, *O. ?tremulae* {1}, *O. vinosa* {2}, *O. vitalbae* {1}, *Orthotrichum* sp. {1}, *Ostropales* {2}, *Parmelia sulcata* {1}, *Patellaria atrata* {8}, *P.* '*crassispora*' {5}, *Peniophora* sp. {1}, *Phragmiticola* sp. {1}, *Pseudevernia furfuracea* {1}, *Physcia* sp. {3}, *Proliferodiscus tricolor* {1}, *Propolis farinosa* {1}, *Trichopeziza* sp. {2}, '*Tympanis*' *xylophila* {1}, *Xanthoria parietina* {3}, various crustose lichens. **Desiccation tolerance**: fully tolerant for at least 3 months; immature asci still viable after 13 months, some spores after 32 months. **Altitude**: 4–720 m (central and western Europe), 21–1385 m (southern Europe). **Geology**: Cambrian, Ordovician & Devonian quartzitic or calcareous greywacke and clayey silt, Permian (Rotliegend), Muschelkalk, Keuper (Gipskeuper, Schilfsandstein, Knollenmergel), Lower to Upper Jurassic and Cretaceous clay, marl, sand- & limestone, Minette, flysch, dolomite, Tertiary sand, marl & molasse, Quaternary loess, sand, silt & clay; granite. **Phenology**: throughout the year (long-lived).

Phenology of *O. trapeziformis*

Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
5	4	8	8	9	6	7	7	8	4	4	5

Taxonomic remarks. *Orbilia trapeziformis* is characterized by fusoid(-trapezoid) to fusoid-clavate, rather short, often almost homopolar ascospores with obtuse to mostly subacute apices and ± attenuated bases, 8-spored asci, and the absence of crystalloid SCBs. Delimitation from *O. obtusispora* and *O. cylindrosoma*, which mainly differ in more elongate spores (the latter also in vermiform SBs), is not very clear-cut, though a majority of collections could rather clearly be assigned. *O. vitalbae* differs in spores with more obtuse apices and only slightly tapered bases, also in abruptly swollen spore bodies. The more montane *O. subtrapeziformis* differs in longer spores with more acute apices. The mediterranean *O. bicknellensis* has similar fusiform-clavate but distinctly larger and apically acute spores, and also differs in the presence of distinct crystalloid SCBs. The also mediterranean foliicolous *O. quercus-ilicis* differs in more rounded spore apices and more strongly attenuated, tail-like bases, basally non-inflated SBs, somewhat wider asci, and a tridentaria-like anamorph.

Two further taxa closely resemble *O. trapeziformis* in ascospore characters: *O. maeandrina* differs in 16-spored asci, and the Australian and American *O. macrotrapeziformis* in longer and/or wider spores, and in wider asci. One of them, the sample on *Mahonia fremontii* from Utah mentioned under *O. macrotrapeziformis* (Pl. 625: 6) differs from *O. trapeziformis* merely in wider spores. Australian populations referred to *O. commarosa* (Pl. 715: 3, 4, 6) resemble *O. trapeziformis* in spore shape but differ in a tendency to strongly curved spore bases and SBs with wider, more abrupt basal inflation. Their homogeneity and delimination from *O. trapeziformis* is not certain, however. The type of the Australian *O. octocercocarpi* (on *Atriplex*, Pl. 727: 2) resembles *O. tapeziformis*, particularly the *Humulus* sample, except for its crystalloid SCBs.

Variation. *O. trapeziformis* varies somewhat in spore size (especially in length) and shape among the collections, but such variation is also often observed within a collection. Spore length is mostly *6.5–9.5 µm, often also *7.5–11 µm, but rarely only *5–7.5 µm. The spore apex is predominantly subacute but also obtuse and rarely acute. The spore base varies from medium to usually strongly attenuated and then often tail-like and ± curved.

A collection on herbaceous stem of *Humulus* from Belgium (Pl. 593: 6) appears to belong to *O. trapeziformis*, in spite of its consistently curved, tail-like spore bases and rather narrow SBs. It was associated with a tridentaria-like anamorph similar as in *O. filiformis* or *O. quaestiformis* and might in fact belong to one of these species.

In a sparse collection on *Cercis* (Pl. 594: 6d–e) the two small groups of apothecia differed distinctly among each other in spore size and shape, though both were full mature and the SBs of a similar length. Nevertheless, the two groups are considered here as belonging to a single species, especially because a third collection from the same substrate and site (Pl. 592: 3) shows somewhat intermediate spores (short but with more tapered spore base), and a fourth (H.B. 7077g, unillustrated) shows long and basally tapered but not strongly curved spores.

Ascus width was usually in the range of *4.8–5.7 µm, but in the collections on *Robinia* and *Humulus* (Pl. 593: 1, 6) it measured *6–7.5 µm, although the spores were here hardly larger.

Not included collections. A specimen from Pakistan on a twig of *Hibiscus* (Pl. 592: 8) deviates in slightly smaller asci and spores and more obtuse spore apices. It somewhat resembles *O. vitalbae*, but the spores are quite consistently fusoid-clavate, with a strongly tapered base, the SBs not abruptly inflated, and the terminal cells of paraphyses rather long (†17–24 µm). Only the spores were alive when the apothecia were studied.

A sample from southwestern Canada on *Arbutus* studied by O. & A. Ceska (pers. comm.) matches *O. trapeziformis* in the spores and 8-spored asci, but no further data were taken from the single collected apothecium. For the not included conidial sample from Luxembourg see under Anamorph.

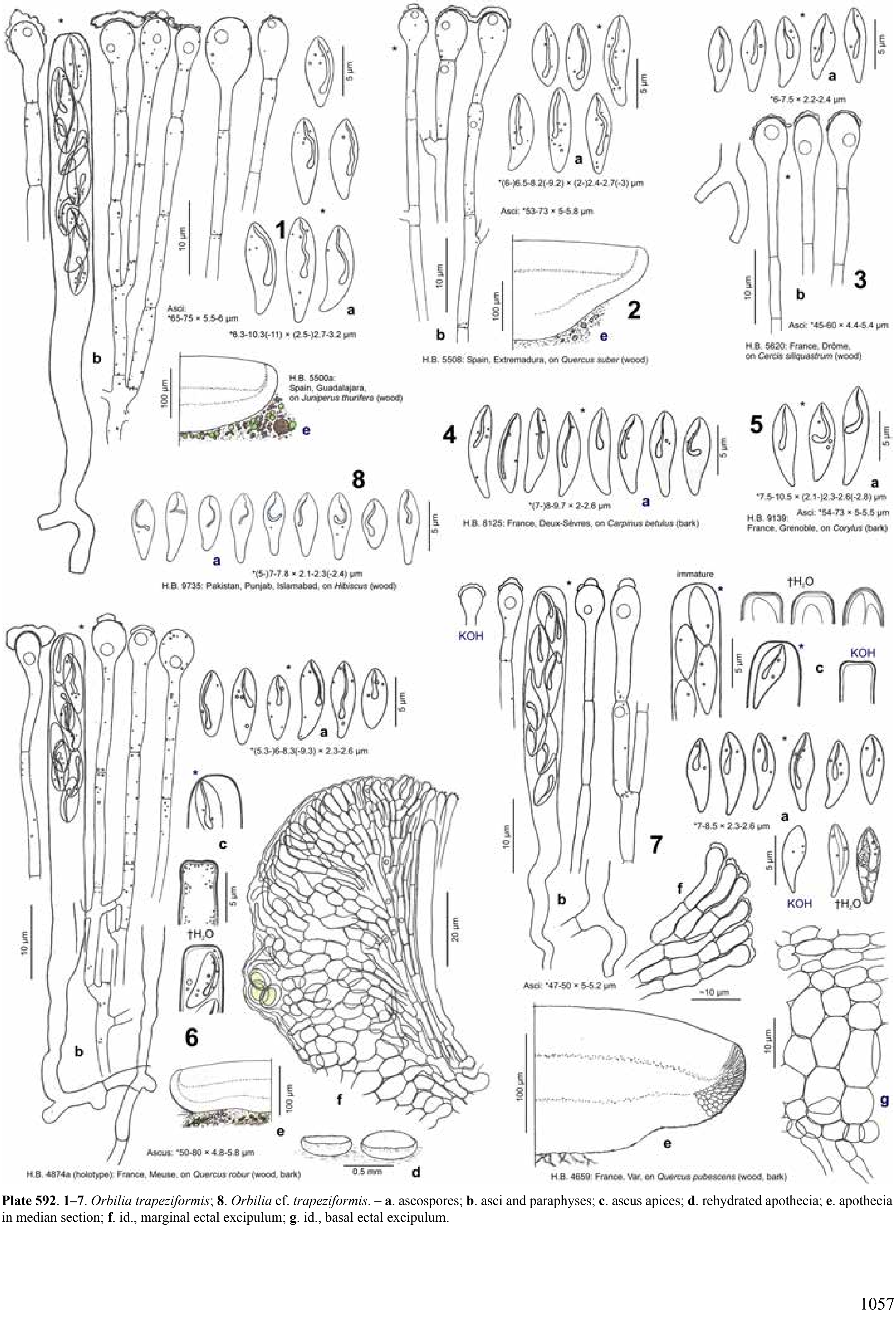


Plate 592. **1–7**. *Orbilia trapeziformis*; **8**. *Orbilia* cf. *trapeziformis*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. rehydrated apothecia; **e**. apothecia in median section; **f**. id., marginal ectal excipulum; **g**. id., basal ectal excipulum.

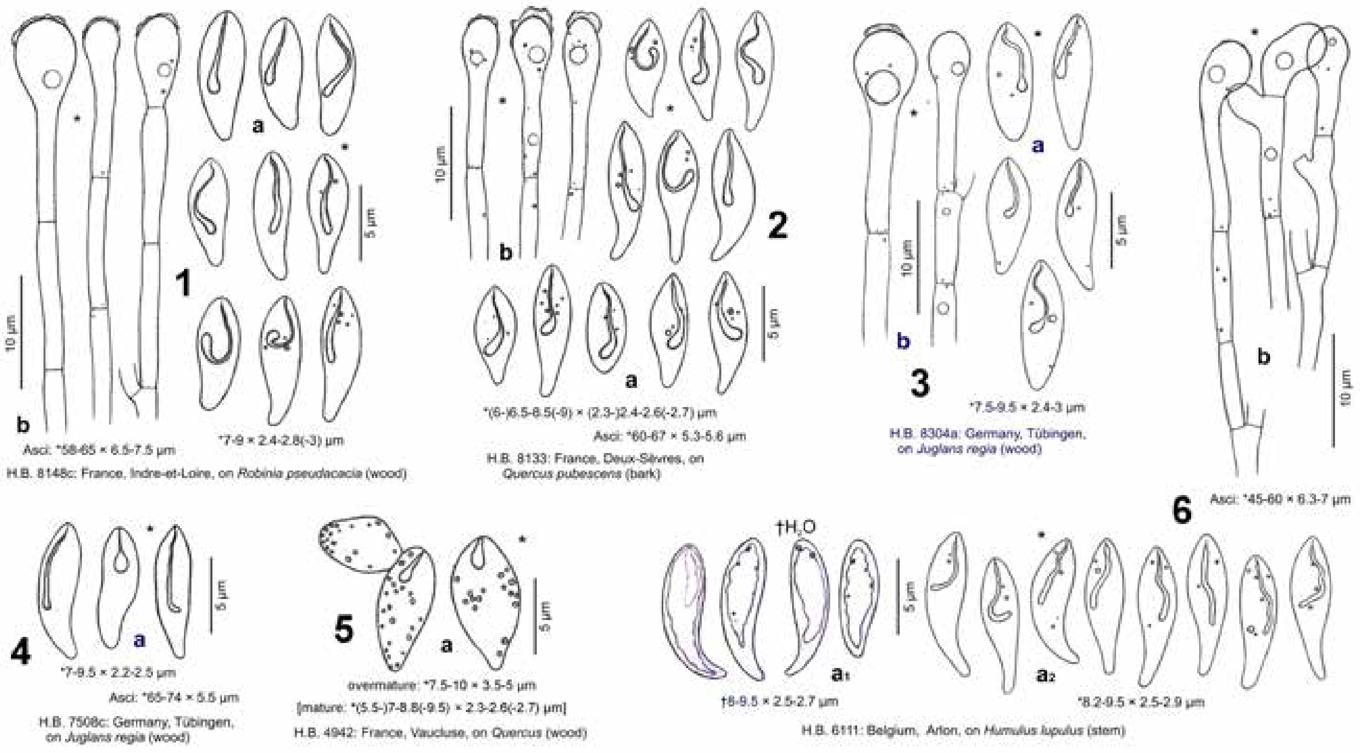


Plate 593. **1–6**. *Orbilia trapeziformis*. – **a**. ascospores (**5a** during germination); **b**. asci and paraphyses.

Anamorph. The trinacrium robustum-like conidia observed on the natural substrate hardly differ from those observed in the very closely related *O. obtusispora*, whereas in much more distant *O. cylindrosoma* they show a clear tendency to longer arms and stipes. In association with the conidia figured in Pl. 594: 12 no apothecia of *O. trapeziformis* were recorded, therefore, they could instead belong to *O. obtusispora*.

Phylogeny. Sequences were gained from apothecia of two samples from southern France (on *Cercis*, H.B. 9151c; on *Corylus*, H.B. 9139), one from Slovakia (on *Quercus*, A.P. 18/55), and one from southern Germany (on *Juglans*, H.B. 10007a), comprising ITS, that on *Corylus* also LSU. The S1506 intron is present in the three former but absent in the *Juglans* sample. In the ITS region the three former strains differ by 0.2 % (each 1 nt) and 3 gaps, while the distance to *O. obtusispora* is 0.8–1.2 %. This raises the question whether they might be conspecific with *O. obtusispora*, although the spores are distinctly longer in the *O. obtusispora* sample (see also under that species, p. 1063). The *Juglans* sample shows a high distance of 19 % to the three other *O. trapeziformis* samples, but only 6 % to *O. cylindrosoma*.

In the LSU region *O. trapeziformis* (H.B. 9139) and *O. obtusispora* are identical (540 nt) and show a minimum distance of 0.4–0.7 % to *O. subvitalbae*, *O. vitalbae*, *O. gambelii*, and *O. ungulata*. In the intron the three sequences of *O. trapeziformis* differ by 1–1.6 % in the overlapping 314 nucleotides, whereas *O. obtusispora* and the *Juglans* sample do not possess the intron.

In our analysis of the ITS region (Phyl. 19), the strain from *Juglans* clustered strongly supported with *O. cylindrosoma* in the *Serpentinae-Habrostictis* clade, whereas the two strains from France and *O. obtusispora* clustered in the *Ellipsospermae* clade. *O. trapeziformis* shows indeed morphological similarities to *O. cisti*, *O. gambelii*, *O. ungulata*, and *O. vitalbae*, which all belong in the *Ellipsospermae* clade, and its spore apices sometimes vary between acute and obtuse. Although *O. trapeziformis* appears to be heterogeneous according to these DNA data, we here treat *O. trapeziformis* and *O. obtusispora* in series *Serpentinae* because of the strong morphological similarity between these two species and *O. cylindrosoma*, *O. filiformis*, and *O. subtrapeziformis*.

Ecology. *O. trapeziformis* grew on ± rotten wood and bark of xeric branches (rarely trunks) of various angiosperm (sometimes gymnosperm) trees and shrubs, often on *Quercus*. Contrary to the similar *O. cylindrosoma* and *O. obtusispora*, *O. trapeziformis* was so far never encountered on herbaceous substrates (with one exception on *Humulus lupulus*). Its distribution comprises warm- to cold-temperate, rarely hemiboreal humid regions of atlantic western and subcontinental central Europe, from planar to montane altitudes. In southern Europe it occurs from orosubmediterranean to mesomediterranean, ± semihumid zones. The vegetation is often thermophilous and includes various temperate humid (e. g., *Querco-Carpinetum*, *Fagetum*, *Alno-Fraxinetum*) forests but also mesosub- to mesomediterranean semihumid shrublands (e. g., *Quercetum ilicis*, or *Juniperetum thuriferae*). The not included collections are from a *Hibiscus* twig in subtropical humid southern Asia (Punjab) and an *Arbutus* branch in mild-maritime humid southwestern Canada.

Specimens included. **GREAT BRITAIN**: **East England**, **Suffolk**, 9.5 km SW of Southwold, 5.5 km NNE of Leiston, Minsmere Haven, 12 m, branch of *Quercus robur*, on wood, 3.VII.2004, S.M. Francis & E. Batten (E.B. 4537, K(M) 227404). — **POLAND**: **Lower Silesia**, 12.5 km SW of Kłodzko, 7 km NW of Bystrzyca Kłodzka, Szczawina, 435 m, trunk of *Prunus avium*, on wood, 15.I.2008, P. Perz (P.P. 20080115-1, H.B. 8755a). – 10 km SSE of Bystrzyca Kłodzka, 1.5 km E of Domaszków, Polna ulica, 445 m, branch of *Tilia cordata*, 14.X.2007, P. Perz (P.P. 20071014-5, doc. vid.). — **CZECHIA**: **South Moravia**, 35 km S of Brno, 20.5 km NW of Březlav, W of Pavlov, Pálava hills, 390 m, branch of *Prunus mahaleb*, on wood, 18.IX.2008, S. Helleman (S.H. 566, doc. vid.). — **SLOVAKIA**: **Žilina**, 11 km SSE of Martin, Folkušová, 512 m, trunk of *Juglans nigra*, on wood, 30.III.2017, A. Polhorský (A.P. 18/53, doc. vid.). – **Bratislava**, 10.5 km WNW of Bratislava, 1.4 km N of Devín, Sandberg, 283 m, branch of *Quercus*, on wood, 15.VI. 2018, A. Polhorský (A.P. 18/55, anam.

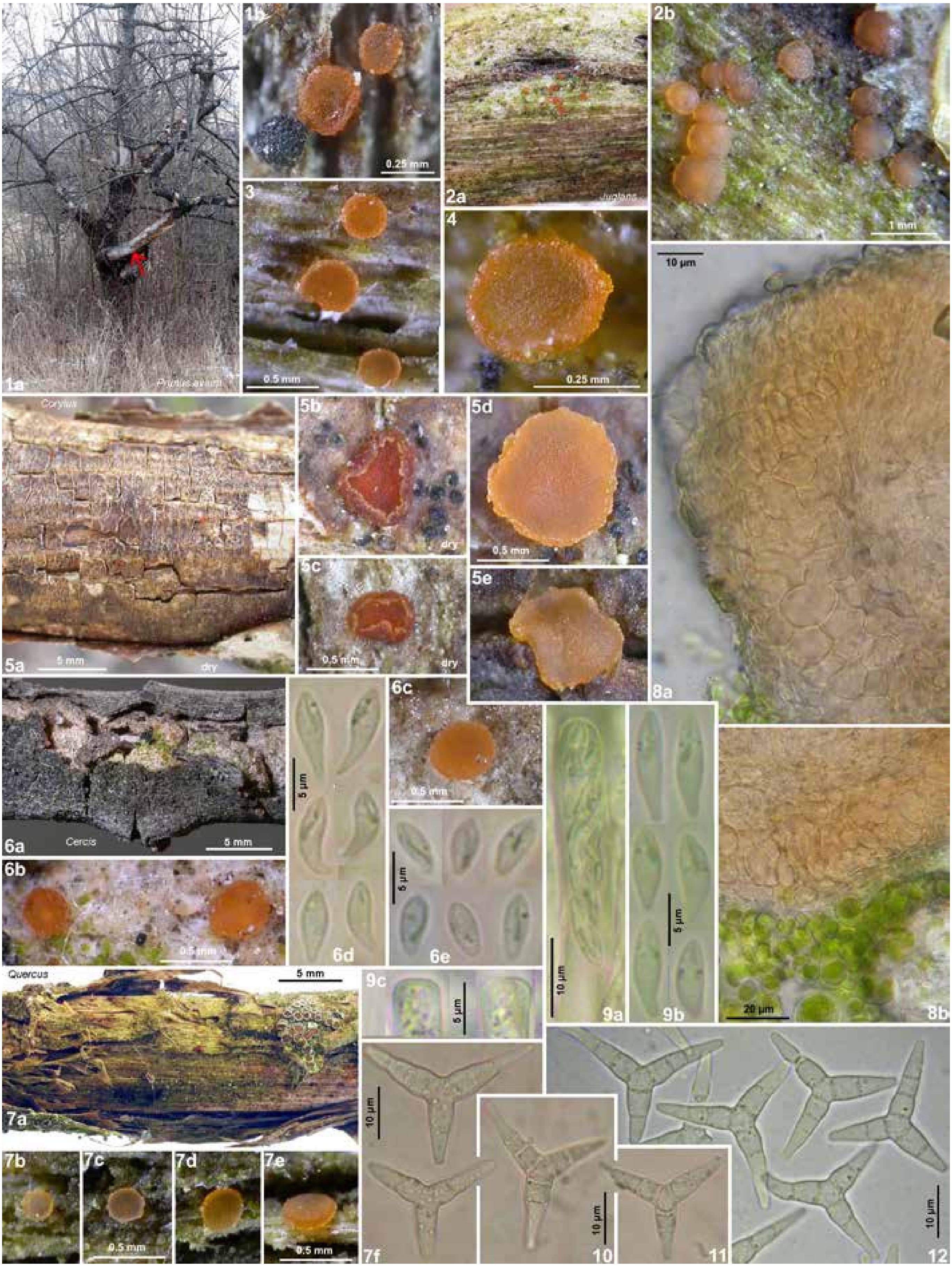


Plate 594. **1–11**: *Orbilia trapeziformis*; **12**. *O*. cf. *trapeziformis*. – **1a**. cherry tree with dead branches; **5a**. *Corylus* branch with *Vuilleminia*; **6a**. Cercis branch with boring dust; **7a**. *Quercus* branch with *Lecanora*; **2a**, **1b**, **2b**, **3**, **4**, **5d–e**, **6b–c**, **7b–e**. rehydrated apothecia; **5b–c**. dry apothecia; **8a**. marginal ectal excipulum in median section; **8b**. id., at base; **9a**. ascus; **9c**. ascus apices; **6d–e**, **9b**. ascospores (**6e** short-spored form); **7f**, **10**, **11**, **12**. conidia from substrate. – Living state; **1a**, **9a–c**: phot. P. Perz. — **1a–b**. H.B. 8755a: Poland, Szczawina, on *Prunus avium*; **2a–b**. H.B. 7508c: Germany, Tübingen, on *Juglans*; **3**. H.B. 8148c: France, Indre-et-Loire, on *Robinia*; **4**. H.B. 8729a: Germany, Tübingen, on *Salix*; **5a–e**. H.B. 9139: France, Grenoble, on *Corylus*; **6a–e**. H.B. 9151c: France, Drôme, on *Cercis*; **7a–f**. H.B. 8133: France, Deux-Sèvres, on *Quercus*; **8a–b**. H.B. 8188a: Germany, Tübingen, on *Quercus*; **9a–c**. P.P. 20071014: Poland, Bystrzyca Kłodzka, on *Tilia*; **10**. H.B. 5508: Spain, Extremadura, on *Quercus*; **11**. H.B. 4659: France, Var, on *Quercus*; **12**. 21.VII.2008: Luxembourg, Fentange, on *Acer*.

Map 94. Known distribution of *O. trapeziformis* in Europe.

substr., doc. vid.; sq.: MK028716). — **SERBIA**: **Vojvodina**, Fruška Gora, 12 km SSW of Novi Sad, 5.3 km SSE of Racovac, Zmajevac, 448 m, trunk of *Fagus sylvatica*, on bark, 7.III.2019, D. Savić (FG-1018, doc. vid.). – 11.5 km S of Novi Sad, 5.7 km NNW of Irig, Iriški venac, SW of WWII memorial, 445 m, branch of *Sorbus torminalis*, on bark, D. Savić (doc. vid.). – 13 km SSE of Novi Sad, 4 km SE of Bukovac, Banstol, 230 m, trunk of *Prunus avium*, on bark, D. Savić (doc. vid.). — **GERMANY**: **Thüringen**, 3 km SW of Saalfeld, 1.8 km N of Eyba, 483 m, branch of *Malus domestica*, on wood, 10.VIII.2009, S. Helleman (ø, non vid.). – 9 km SE of Sonneberg, SE of Lindenberg, 355 m, branch of *Quercus*, on wood & bark, 17.II.2017, I. Wagner (ø, doc. vid.). – **Baden-Württemberg**, 3.5 km NW of **Stuttgart**, 1.5 km SW of Feuerbach, Heimberg, 360 m, branch of *Quercus*, on wood & bark, 13.III.2003, H.O. Baral (ø). – 5 km NW of Stuttgart, 1.8 km S of Weilimdorf, Neue Burg Dischingen, 405 m, branch of *Tilia*, on wood, 18.V.1997, H.O. Baral (ø). – 3.2 km SE of Altensteig, 1.1 km EE of Egenhausen, Egenhäuser Kapf, 620 m, branch of *Salix* ?*caprea*, on wood, 22.XI.2010, H.O. Baral (H.B. 9459a ø). – 3.7 km NE **Tübingen**, 1,8 km W of Pfrondorf, Hägnach, 455 m, branch of *Fagus sylvatica*, on wood, 27.II.2000, H.O. Baral (ø). – Pfrondorf, Blaihofstraße, 430 m, branch of *Juglans regia*, on wood, 28.VI.1997, H.O. Baral & G. Marson (H.B. 5825, anam. substr.). – ibid., 7.IV.2004, H.O. Baral (H.B. 7508c). – ibid., 17.XI.2004 (ø). – ibid., 10.VII.2011 (H.B. 9569a ø). – ibid., 22.IX.2006, E. Weber & H.O. Baral (H.B. 8304a ø). – ibid., 11.VI.2016, H.O. Baral (H.B. 10007a; sq.: MK493131) – ibid., 1.VI.2018, H.O. Baral & E. Weber (H.B. 10146a ø). – ibid., branch of *Tilia platyphyllos*, on wood, 27.VII.2007, H.O. Baral (H.B. 8587b ø, anam. substr.). – 0.5 km ENE of Pfrondorf, Tiefenbach, 410 m, branch of *Quercus robur*, on wood, 26.V.2006, H.O. Baral (H.B. 8188a ø). – 1.5 km NNE of Pfrondorf, Brand, 460 m, branch of *Salix caprea*, on wood, 21.VII.2002, H.O. Baral (ø). – 0.6 km S of Pfrondorf, Mähder, 395 m, branch of *Malus domestica*, on wood, 4.X.1994, H.O. Baral & K. Siepe (ø). – SE of Pfrondorf, Höhberg, 400 m, branch of *Salix caprea*, on wood, 27.I.2001, H.O. Baral (ø). – Neckaraue, 6.3 km ENE of Tübingen, NW of Kirchentellinsfurt, 305 m, branch of *S.* (?)*alba*, on wood, 24.XII.2007, H.O. Baral (H.B. 8729a ø). – 5.5 km ENE of Tübingen, 1.6 km SE of Pfrondorf, Neckar river, 320 m, branch of *Fraxinus excelsior*, on wood, 19.III.2003, H.O. Baral & G. Marson (H.B. 7312). – ibid., branch of *Populus* (?)× *canadensis*, on wood, 19.III.2003, H.O. Baral & G. Marson (ø). – **Bayern**, **Oberbayern**, Fünfseenland, 8 km NW of Tutzing, 3.5 km S of Andechs, ENE of Hartschimmel, Goaslweide, 720 m, trunk of *Quercus robur*, on wood, 7.III.2003, P. Karasch (H.B. 7306b ø). — **AUSTRIA**: **Wien**, Wienerwald, 7.5 km NW of Wien, 2 km NW of Grinzing, Cobenzl, 400 m, trunk of *Quercus cerris*, on wood, 11.II.1995, W. Jaklitsch (H.B. 5232). – 9.5 km SSE of Wien, SE of Unterlaa, 190 m, branch of *Juglans regia*, on wood, 22.XII.2018, R. Moosbeckhofer, vid. B. Wergen (doc. vid.). – **Steiermark**, 3.8 km NNW of Gratwein, 3.3 km WSW of Unterfriesach, E of Hörgasgraben, 560 m, branch of *Fagus sylvatica*, on wood, 9.XII.2017, G. Friebes (ø, doc. vid.). – 3 km WNW of Gratwein, N of Stift Rein, Lechnerhof, 492 m, branch of *Juglans regia*, on wood, 24.XI.2018, G. Friebes (G.F. 20180341, doc. vid.). – **Burgenland**, 8.5 km SE of Eisenstadt, 3 km E of Siegendorf, Siegendorfer Puszta und Heide, 170 m, branch of *Rosa*, on wood, 28.XI.2009, G. Friebes (G.F. 20090126, doc. vid.). — **BELGIUM**: **Wallonie**, **Luxembourg**, 4.5 km SE of Arlon, S of Clairefontaine, quarry, 333 m, stem of *Humulus lupulus*, 7.V.1998, B. Declercq (B.D. 98045, H.B. 6111). — **LUXEMBOURG**: **Gutland**, **Luxembourg**, 5 km S of Luxembourg, 1.8 km SW of Hesperange, Fennerholz, 292 m, branch of *Carpinus betulus*, on bark, 24.II.2003, G. Marson (ø). – **Capellen**, 11 km NNW of Esch-sur-Alzette, 5 km NE of Pétange, Griechten, 335 m, branch of *Prunus spinosa*, on old *Vuilleminia*, 9.V.1999, H.O. Baral (ø). – **Esch-sur-Alzette**, 3 km E of Esch-sur-Alzette, 2 km NW of Kayl, Brucherbierg, 375 m, branch of *Quercus*, on bark, 12.VI.1994, G. Marson (ø). — **FRANCE**: **Bretagne**, **Ille-et-Vilaine**, 15 km W of Bruz, 1.8 km WSW of St.-Thurial, Barrage Chèze, 94 m, branch of *Castanea sativa*, on wood, 12.III.2003, J.P. Priou (J.P.P. 26061, non vid.). – **Morbihan**, La Gacilly (centre), Hotel de France, Jardin du Boulanger, 20 m, branch of *Juglans regia*, on wood, 14.XII.2003, J.P. Priou (J.P.P. 23130, doc. vid.). – 8 km NW of La Gacilly, N of St.-Nicolas-du-Tertre, La Vallée, 43 m, branch of *Quercus cerris*, on bark, 24.I.2005, J.P. Priou (J.P.P. 25023, doc. vid.). – 33 km ENE of Vannes, 3 km NE of Pluherlin, le Gachot, 70 m, branch of *Cytisus scoparius*, on wood, 29.I.2009, J.P. Priou (J.P.P. 29003, doc. vid.). – **Poitou-Charentes**, **Charente-Maritime**, 4.5 km NW of Chizé, 1.3 km SSE of Villiers-en-Bois, Forêt de Chizé, 72 m, stem of *Rubus fruticosus*, on wood, 27.IV.2011, V. Baral (H.B. 9500 ø). – ibid., branch of *Carpinus betulus*, on wood & bark, 27.IV.2011, E. Weber (H.B. 9501 ø, R.T.L.). – ibid., branch of *Acer campestre*, on wood, 27.IV.2011, M. Bemmann (ø, doc. vid.). – 3 km E of Villiers en Chizé, Forêt de Chizé, 78 m, trunk of *C. betulus*, on bark, 24.IV.2006, G. Marson & H.O. Baral (H.B. 8125, anam. substr.). – 7 km ESE of Beauvoir-sur-Niort, E of Villiers-en-Bois, W-end of Virollet, 89 m, branch of *Rhus typhina*, 23.IV.2006, H.O. Baral (H.B. 8178 ø). – 21 km W of Niort, 4 km NW of St.-Hilaire-La-Palud, Marais Poitevin, 4 m, branch of *Quercus pubescens*, on bark & wood, 25.IV.2006, H.O. Baral (H.B. 8133, anam. substr.). – **Centre**, **Indre-et-Loire**, 40 km S of Tours. 2 km N of la Celle-St.-Avant, 70 m, branch of *Robinia pseudoacacia*, on wood, 29.IV.2006, H.O. Baral (H.B. 8148c ø). – **Île-de-France**, **Yvelines**, 19.5 km WNW of Paris, NE of St.-Germain-en-Laye, Terrasse de St.-Germain, 79 m, branch of *Acer*, on wood, 26.I.2008, J.P. Priou (J.P.P. 28016, doc. vid.). – **Lorraine**, **Meuse**, 6 km E of St.-Dizier, 1 km NE of Ancerville, Forêt Valtièremont-Jovilliers, 205 m, branch of *Quercus robur*, on wood & bark, 10.V.1993, H.O. Baral (M-0276601, **holotype**; **isotype** in H.B. 4874a). – **Rhône-Alpes**, **Drôme**, 1 km N of Nyons, Col du Pontias, 460 m, branch of *Cercis siliquastrum*, on wood, 22.VIII.1996, G. Marson (H.B. 5620 ø). – ibid., branches of *C. siliquastrum*, on wood & bark, 18.VIII.2001, G. Marson (H.B. 7077g). – ibid., branch of *Cercis siliquastrum*, on bark and boring dust, 13.VIII.2009, G. Marson, H.O. Baral & B. Liu (H.B. 9151c, anam. substr.; sq.: KT222349). – **Isère**, 19 km SW of Grenoble, 2 km SE of Villard-de-Lans, N of Les Glovettes, 1240 m, branch of *Corylus avellana*, on old *Vuilleminia*, 11.VIII.2009, B. Liu, H.O. Baral & G. Marson (H.B. 9139; sq.: KT222363). – **Provence-Alpes-Côte d'Azur**, **Alpes-de-Haute-Provence**, 6 km NW of Manosque, NE of St.-Martin-les-Eaux, 632 m, branch of *Quercus*, on wood, 29.IX.1993, G. Marson (H.B. 5173a). – 12.5 km NNE of Digne-les-Bains, N of Esclangon, south end of Clues de Barles, 778 m, branch of *Q. pubescens*, on wood, 14.IX.2009, B. Liu & H.O. Baral (ø). – **Bouches-du-Rhône**, 13 km NE of Aix-en-Provence, 5 km NE of Venelles, ~300 m, branch of *Quercus*, on wood & bark, 31.X.2006, H. Aeberhard (H.B. 9082). – **Var**, 13 km NNE of Hyères, 1.8 km NE of Pierrefeu-du-Var, le Défens de Bécasson, 78 m, branch of *Q. pubescens*, on bark & wood, 13.VI.1991, C. Roux (H.B. 4659, anam. substr.). – **Vaucluse**, 17 km NE of Carpentras, 5.5 km E of Malaucêne, 6 km W of Mt. Ventoux summit, Les Ramayettes, 980 m, branches of *Quercus*, on wood, 13.VIII.1993, G. Marson (H.B. 4942). – 1.5 km NW of Mt. Ventoux, Mt. Serein, 1385 m, branch of *Pinus sylvestris*, on wood, 13.VIII.2009, G. Marson & H.O. Baral (H.B. 9173d ø). – 9 km SE of Apt, 2.5 km SSE of Auribeau, Mourre Nègre, 1100 m, branches of *Corylus avellana*, on bark and old ?*Vuilleminia*, 28.IX.1993, G. Marson (ø). – **Languedoc-Roussillon**, **Gard**, Languedoc, 11 km ENE of Nîmes, near Bezouce, 65 m, branch of *Juniperus oxycedrus*, on bark, 26.IX.1993, G. Marson (ø). — **ITALY**: **Emilia-Romagna**, **Reggio Emilia**, Northern Apennines, 57 km NE of La Spezia, 2.5 km NNW of Ligonchio, WNW of Caprile, 710 m, branch of *Sorbus domestica*, on wood, 2.X.2004, J.P. Priou (J.P.P. 24152 ø, H.B. 7586 ø). — **SPAIN**: **Asturias**, 15 km SSW of Avilés, 9.7 km ENE of Grado, Trascañedo, Las Regueras, 205 m, branch of *Quercus ilex*, on bark, 21.XII.2013, J. Linde, vid. E. Rubio (E.R.D. 6080, doc. vid.). – 3.5 km ESE of Gijón, Jardín Botánico Atlántico, 21 m, twig of *Euonymus europaeus*, on wood, 27.III.2015, E. Rubio (E.R.D. 6414, doc. vid.). – **Aragón**, **Huesca**, 3 km NE of Benasque, 1258 m, branch of ?*Corylus avellana*, on bark, 10.V.2019, R. Blasco (anam. substr., doc. vid.). **– Cataluña**, **Girona**, eastern Pyrenees, 26 km NE of Ripoll, 2.3 km NE of Molló, WSW of Col d'Ares, 1310 m, branch of *Salix caprea*, on wood, 28.IX.1999, H.O. Baral (ø). – **Castilla-La Mancha**, **Cuenca**, Sierra de Cuenca, 16 km ENE of Cuenca, 3 km E of Buenache de la Sierra, Vía del Saca, 1370 m, branch of *Juniperus* ?*thurifera*, on wood, 25.IX.1999, G. Marson (ø). – **Guadalajara**, Sierra de Guadarrama, 43 km NNW of Guadalajara, 2 km NNW of Tamajón, Ermita de los Enebrales, 1040 m, branches of *Juniperus thurifera*, on wood, 14.V.1996, H.O. Baral (H.B. 5500a). – **Extremadura**, **Cáceres**, Sierra de Guadalupe, ~12.5 km WNW of Guadalupe, ~NE of Solana de Cabañas, ~780 m, branch of *Quercus suber*, on wood, 19.V.1996, V. González, F. Arenal & A. Martínez (H.B. 5508, anam. substr.). — **PORTUGAL**: **Portalegre**, 12 km NNE of Portalegre, Marvão, centre ville, 840 m, twig of *Fraxinus excelsior*, on wood, 7.V.2009, J.P. Priou (J.P.P. 29107, doc. vid.).

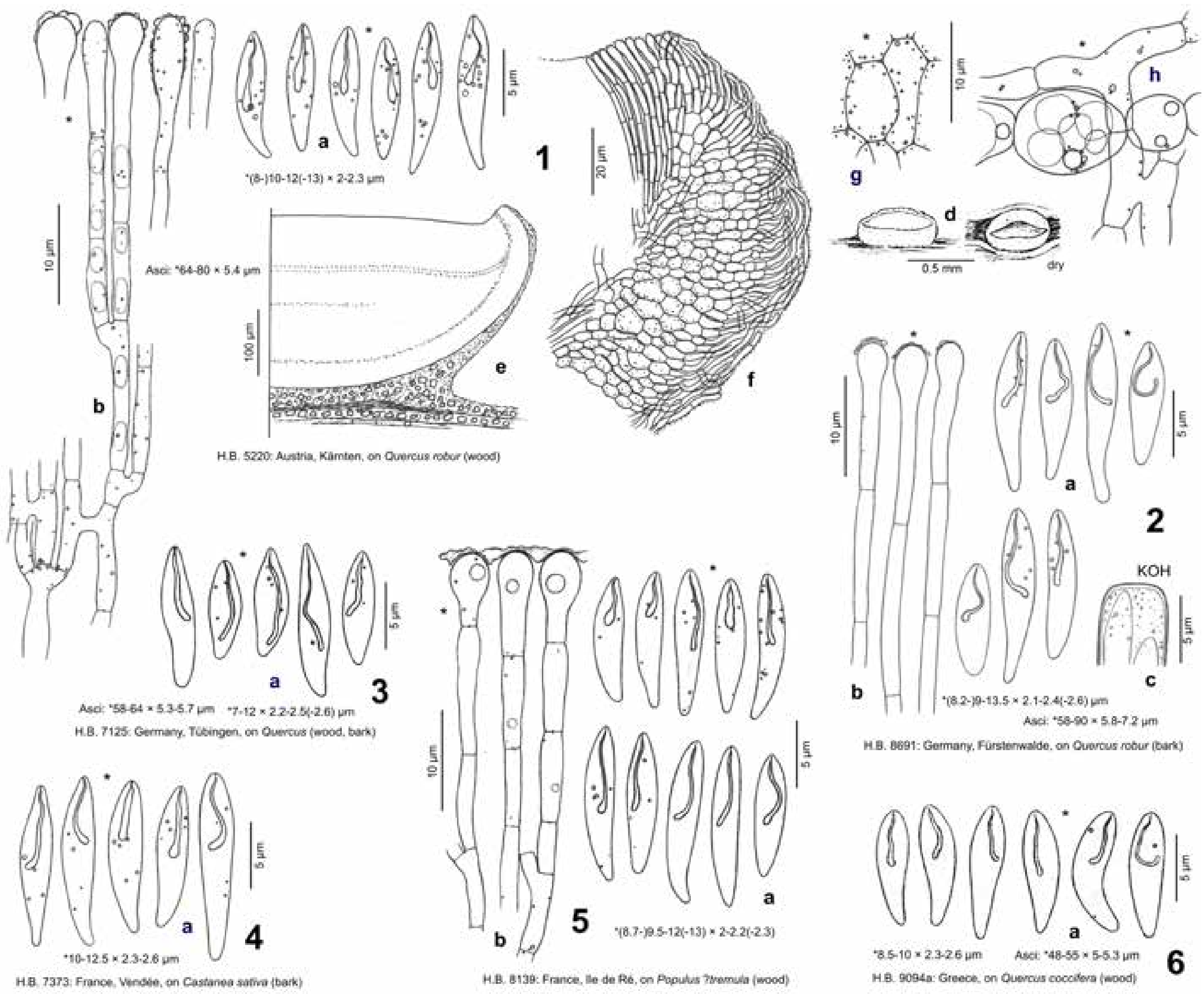


Plate 595. **1–5**: *Orbilia obtusispora*; **6**. *O.* cf. *obtusispora*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apex; **d**. rehydrated and dry apothecium; **e**. apothecium in median section; **f**. id., ectal excipulum at margin and mid flanks; **g**. id., ectal excipular cells near base; **h**. hyphoid elements and inflated cells in medullary excipulum.

Not included. **LUXEMBOURG**: **Gutland**, 6 km S of Luxembourg, 1.5 km WSW of Fentange, Mierchesfeld, 283 m, branch of *Acer pseudoplatanus*, 21.VII.2008, G. Marson (ø, anam. only). — **PAKISTAN**: **Punjab**, Islamabad, centre of city, F7-1, Street 31, 568 m, twig of *Hibiscus*, on wood, 7.IX.2012, M. Bemmann (H.B. 9735). — **CANADA**: **British Columbia**, 11 km NNW of Victoria, Observatory Hill, SE of planetarium, 195 m, branch of *Arbutus menziesii*, on wood, 16.III.2017, O. & A. Ceska (ø, doc. vid.).

Orbilia obtusispora Baral & E. Weber, **sp. nov.**, MB 813662 — Pls 595–597, Map 95

Etymology: derived from the predominantly obtuse ascospore apices.
Typification: France, La Tranche-sur-Mer, branches of *Quercus ilex*, 3.VI.2003, E. Weber & H.O. Baral (ex H.B. 7359a, M-0276539, holotype).

Latin diagnosis: *Similis* Orbiliae *trapeziformi sed ascosporae saepe longiores, apice obtusiores. Habitat ad lignum vel corticem putridum ramorum siccorum arborum angiospermarum*, *raro coniferarum vel ad caules herbarum*, *in locis thermophilis in zona temperata ad mediterranea Europae et Macaronesiae.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.2–)0.3–0.9(–1) mm diam., 0.13–0.26 mm high, pale to usually bright (yellow-) orange(-apricot), rarely rose-orange or ochraceous, non- or medium translucent, round, sometimes elliptical, scattered to gregarious; disc slightly concave when young, soon ± flat, margin distinct, ± thick, 5–30 µm protruding (saucer-shaped), including exterior smooth to finely or strongly rough to crenulate; broadly sessile, rarely with an indistinct stipe up to 0.08 × 0.2 mm, superficial or slightly erumpent; dry light to deep orange–red, ± contracted, often distinctly cupulate with thick margin. **Asci** *(40–)50–80(–90) × ((4.5–))(5–)5.5–6.5(–7.5) µm {17}, †(48–)53–68(–78) × 4.5–5.3 µm {4}, 8-spored, spores *3–4-seriate, ((1–))(2–)3–5 lower spores inverted {16} (not or sometimes mixed), pars sporifera *24–39 → 18–24 µm long, †36–45 µm; **apex** (†) medium to strongly truncate (rarely indented, without lateral inflation); **base** with short to long, thin or thick, flexuous stalk, L- to Y-shaped. **Ascospores** *((5.5–))(6.5–)8–13(–14)((–15)) × (1.8–)2.1–2.5(–2.7) ((–3)) µm {30}, †(7–)8.5–11(–12.7) × 1.8–2.5 µm {4}, fusoid to fusoid-clavate, also narrowly ellipsoid to subcylindrical, apex obtuse to subacute, sometimes rounded, exceptionally acute, base slightly to strongly, rarely not attenuated, sometimes with a tail-like base, straight to slightly curved near base; **SBs** *((3–))(3.5–)4–7(–8.3) × (0.2–)0.3–0.8(–0.9) µm in situ {21} (~4–8.5 µm actual length), filiform to subulate, not or slightly to distinctly inflated towards base, straight to strongly flexuous, rarely uncinate; germinating spores *10.5–12.3 × 2.3–3.7 µm, with 1(–2) septa {1}. **Paraphyses** apically slightly to (very) strongly clavate-capitate, sometimes moniliform, terminal cells *(5–)7–20(–23) {8} × (2–)2.8–4.3(–4.8) µm {11}, lower cells *(5–)7–15(–17) × 1.2–2.2(–2.6) µm {7}; never branched at upper septum. **Medullary excipulum** subhyaline to light rose, 40–80 µm thick, of loose or dense textura intricata with many inflated cells, indistinctly delimited from ectal excipulum (at flanks partly very sharply by a horizontal t. porrecta), subhymenium pale to light orange.

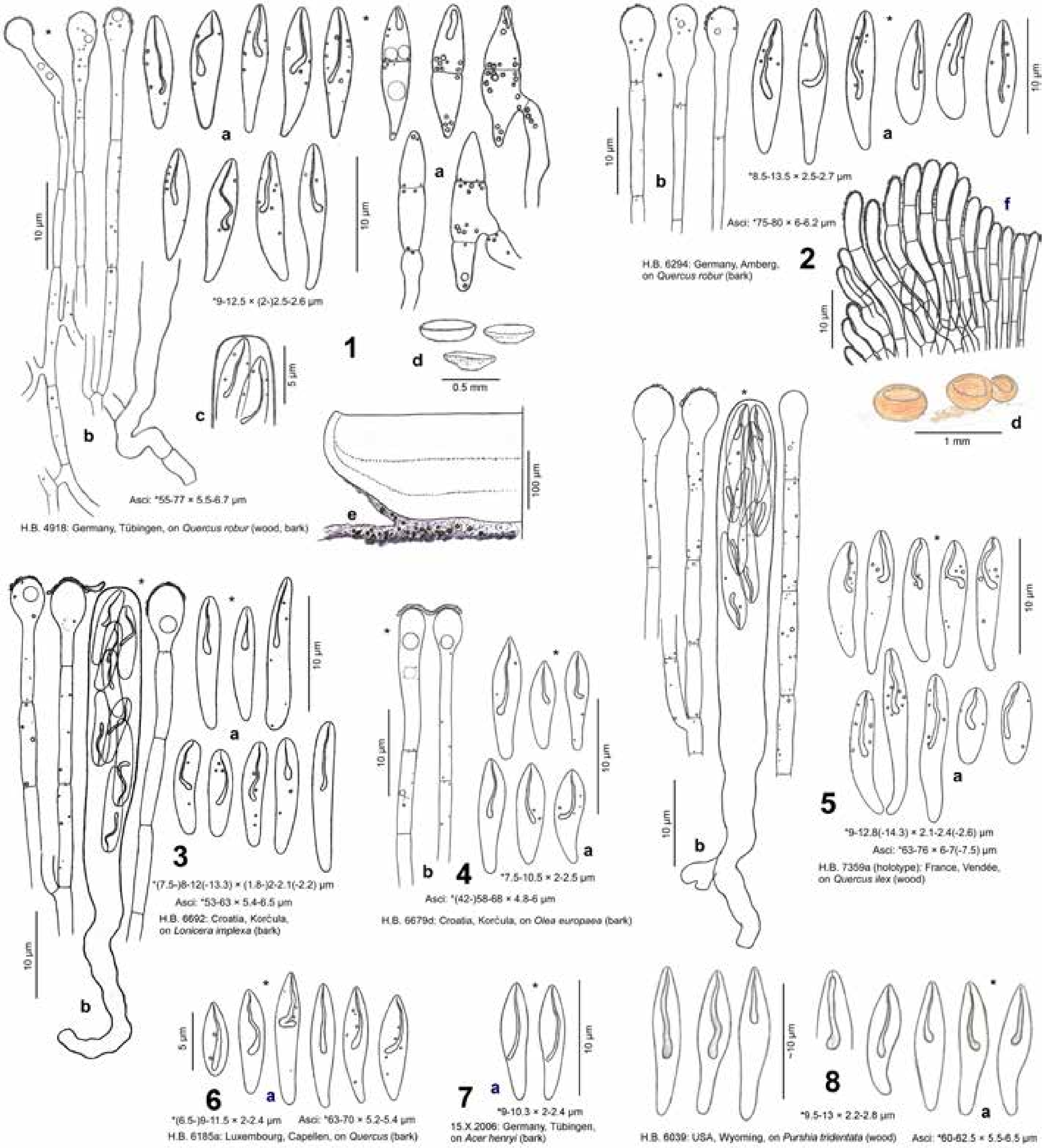


Plate 596. **1–7**: *Orbilia obtusispora*; **8**: *O.* cf. *obtusispora*. – **a**. ascospores (**1** right: germinating); **b**. asci and paraphyses; **c**. ascus apices; **d**. rehydrated apothecia; **e**. apothecia in median section; **f**. id., ectal excipulum at upper margin.

Ectal excipulum subhyaline to light rose, of (†) thin-walled (to very slightly gelatinized), vertically (or horizontally) oriented t. angularis(-prismatica) from base to mid flanks, 25–70(–100) µm thick near base, cells *(6–)7–16(–22) × 5–11(–16)((–20)) µm {7}; 20–25(–30) µm thick at flanks, 15–30 µm thick at margin, at mid flanks and margin of t. globulosa-angularis oriented at a 60–90° angle to the surface, cells *5–11 × 4–7 µm {2}, marginal cortical cells *4–12 × 2–4.4 µm {4}, thin- or firm-walled. **Anchoring hyphae** very abundant, *2–3(–4) µm wide, walls 0.2–0.3(–0.5)((–0.7)) µm thick {7}, forming a dense or loose hyaline t. intricata 20–90 µm thick at base, often also covering flanks and margin by a 5–20 µm thick layer of ± gelatinized hyphae. **SCBs** in paraphyses and ectal excipulum (near margin) globose {8}, 1–2 µm diam., or consistently absent {6}. **Exudate** hyaline to pale yellowish-cream, over paraphyses (0.1–)0.2–0.5(–1.3) µm thick, granular-cloddy or finely rough, soon firmly attached; over margin and flanks forming a 0.1–0.3 µm thick continuous or granular layer. — **ANAMORPH**: trinacrium-like (presumed, from natural substrate {4}). **Conidiophores** not seen. **Conidia** Y-shaped, total size */†23–40 × 26–36 µm, stipe */†12–19 × 4–5 µm, 2–4-septate, arms */†18–25 × 4–5 µm, 3–5-septate, arms and stipe strongly tapering {4}; very rarely unbranched phragmoconidia observed.

Habitat: collected (0–)1–5 m above the ground, corticated or often half to entirely decorticated (often with the periderm rolling aside), 7–40 mm thick branches of *Acer henryi* {1}, *A. negundo* {1}, *Artemisia thuscula* {1}, *Atriplex hastata* {1}, *Castanea sativa* {2}, *Clematis vitalba* {1}, *Corylus avellana* {1}, *Cupressus macrocarpa* {1}, *Euphorbia balsamifera* {1}, *E. canariensis* {1}, *Ficus carica* {1}, *Fraxinus excelsior* {2}, *Hedera helix* {1}, *Laburnum anagyroides* {1}, *Lonicera implexa* {1}, *Olea europaea* {2}, *Populus* sp. {3}, *Prunus dulcis* {1}, *P. spinosa* {1}, *Quercus* sp. {10}, *Q. ilex* {2}, *Q. robur* {5}, *Rhamnus alpina* {1}, *Rubia fruticosa* {1}, stems of *Rubus fruticosus* agg. {1}, *Salix alba* {1}, on 0.1–3 mm (or even deeper) medium to mostly strongly decayed wood {28} and bark {17} (on bast, rarely periderm), if corticated then often on old *Vuilleminia* {9} or *Colpoma quercinum* {1} (with the periderm rolling apart), sometimes on boring dust of bark beetles, ± greyed or not (wood often white-rotten), with a few to many green algae. **Associated**: *Acanthostigma minutum* {1}, *Claussenomyces ?dacrymycetoideus* {1}, *Coenogonium* sp. {1}, *Colpoma quercinum* {1}, *Cryptodiscus foveolaris* {2}, *Dacrymyces* sp. {1}, *Frullania dilatata* {1}, *Hyalorbilia fusispora* {1}, *H. juliae* {1}, *H. latispora* {1}, *H. subfusispora* {1}, *Hyaloscypha minuta* {1}, *Hyphodiscus* sp. on *Vuilleminia* {1}, *Hysterium angustatum* {3}, *Lecanora* sp. {1}, *Lecophagus ellipsoideus* {1}, *Melanelia ?glabratula* {2}, *Mellitiosporiella pulchella* {1}, *Mollisia ligni* {1}, *?Monodictys* sp. {1}, *Orbilia eucalypti* {3}, *O. euonymi* {1}, *O. gambelii* {1}, *O. hesperidea* {1}, *O. myriosphaera* {1}, *O. pleioeuonymi* {1}, *O. subaristata* {1}, *O. ?tremulae* {1}, *O. vinosa* {4}, *O. vitalbae* {2}, *Orthotrichum* sp. {1}, *Parmelia caperata* {1}, *P. sulcata* {2}, *Patellaria atrata* {1}, *Physcia* sp. {3}, *Proliferodiscus pulveraceus* {1}, *Propolis farinosa* {3/1}, *P. viridis* {1}, *Sclerococcum* sp. {3}, *S. stygia* {1/1}, *Stictis* sp. {1}, *Xanthoria* sp. {3}. **Desiccation tolerance**: fully tolerant for at least about 1 month. **Altitude**: 5–880(–1650) m a.s.l. **Geology**: Devonian, Carboniferous & Permian (calcareous) sandstone, Keuper (clay, marl, sandstone), Lower to Upper Jurassic (sand- & limestone, Minette), Cretaceous limestone, Tertiary marl & molasse, Quaternary sand, silt & loess, peat; granite, gneiss, basaltic flow. **Phenology**: throughout the year (long-lived).

Phenology of *O. obtusispora*											
Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
3	2	0	12	7	8	1	0	1	2	3	4

Taxonomic remarks. *Orbilia obtusispora* is similar to *O. trapeziformis*, from which it differs in ascospore shape: the spores of *O. obtusispora* tend to be subcylindrical with obtuse apices, though fusoid(-clavate) spores with subacute apices are also frequent. Typically, the apothecia are bright orange and rather large, with a thick protruding margin. The morphological distinction from the predominantly herbicolous *O. cylindrosoma* (p. 1068) and the subalpine *O. subtrapeziformis* (p. 1088) is also not very sharp. Also the distinction from *O. trapeziformis* and *O. filiformis* is sometimes difficult to draw, due to a variability in size and shape of spores and SBs. The few available sequence data indicate, however, that all these taxa merit distinction at the species level, except that the distance between *O. obtusispora* and samples of *O. trapeziformis* from France is very low.

The extra-European *O. macrotrapeziformis* and *O. flexisoma* differ from *O. obtusispora* in wider spores and SBs, whereas the Australian *O. acaciae* sharply differs in the presence of crystalloid SCBs. *O. vinosa* (section *Hemiorbilia*) may be confused with narrow-spored collections of *O. obtusispora* on account of somewhat similar spores and SBs, but is readily distinguished by hemispherical, thick-walled ascus apices, non-capitate paraphyses, and by narrower spores with straight, cylindrical SBs with a broader attachment. Five Australian specimens differ in longer spores and are described below as *O. austroobtusispora*.

Variation. Like *O. trapeziformis*, *O. obtusispora* varies in size (particularly length) and shape of the ascospores. Particularly collections from (sub)mediterranean western and southern Europe tend to have somewhat longer and/or narrower, more cylindrical spores with obtuse to rounded apices and only slightly attenuated bases (especially Pl. 596: 3) but specimens with more subacute apices and more tapered bases, or with short spores, also occur there. Moreover, some long-spored collections were also made in central Europe. Further variation of *O. obtusispora* was noted in the paraphyses, being apically only slightly to medium inflated in many of the collections, but partly strongly so in others. Also the presence of globose SCBs and their size vary among the populations.

Not included collections. A few collections were problematic in deciding whether they represent *O. obtusispora* or *O. trapeziformis*. Two from France (IVV: H.B. 8144) and Greece (Pl. 595: 6) have rather short spores of *7–10 × 2.3–2.7 µm, which are too obtuse to belong to *O. trapeziformis*. One from Germany (Pl 595: 3) is included in the above description despite its apically subacute spores. An old German record from Erlach (Oberfranken, mixture in lectotype of *O. vitalbae*, see p. 1176 and IVV) is somewhat uncertain because the morphology of the spore body is unknown.

Four North American samples on *Purshia* (Pl. 596: 8), *Cercocarpus* (IVV: 10.V.1995, 12.VI.1996), and *Shepherdia* (H.B. 7154a, unillustrated) appear to fit quite well European *O. obtusispora*, while differing from North American *O. flexisoma* and *O. macrotrapeziformis* in slightly narrower, from the former also in shorter spores. However, the limits between these taxa are not clear, and we prefer not to include extra-European samples in *O. obtusispora* at present. Another specimen (on *Larrea*, IVV: H.B. 5684g), resembles *O. obtusispora*, but the spores are a bit too small (~8–10 × 2 µm) and the apothecia rose-violaceous, therefore, it resembles also *O. vitalbae*.

Anamorph. The trinacrium-like conidia observed on the natural substrate hardly differ from those of the very closely related *O. trapeziformis*, whereas in *O. cylindrosoma* they show a tendency to longer arms and stipes.

Phylogeny. A sequence comprising SSU (without S1506 intron), ITS, and LSU was gained from apothecia of a sparse specimen of *O. obtusispora* from Luxembourg (IVV: H.B. 9635), showing a spore size of *(9–)11–13(–14) × 2.2–2.5(–3) µm. The rather low ITS distance of 1–1.2% to the two French collections of *O. trapeziformis* (0% in LSU) questions distinction of these two species, although spore length in the French collections was only *5–9 µm in H.B. 9151c (Pl. 594: 6d–e) and *7.5–10.5 µm in H.B. 9139 (Pls 592: 5). In our analyses of ITS and SSU+ITS+LSU, *O. obtusispora* and *O. trapeziformis* from France formed a strongly supported subclade which surprisingly clustered within the *Ellipsospermae* clade. However, a further collection of *O. trapeziformis* (from Germany) clustered in the *Serpentinae-Habrostictis* clade, far away from the former (Phyl. 19). Despite the morphological similarity, the ITS distance between *O. obtusispora* and *O. subtrapeziformis* lies at 16%.

Ecology. *O. obtusispora* grows on ± rotten wood and bark of xeric branches of various angiosperm trees and shrubs, often *Quercus*, exceptionally conifers, often on old fructifications of *Vuilleminia*, also on woody branches of *Euphorbia* spp. Its distribution within Europe is atlantic to subcontinental, warm- to cold-temperate or orotemperate humid but also mesosub- to thermomediterranean semihumid, occurring from

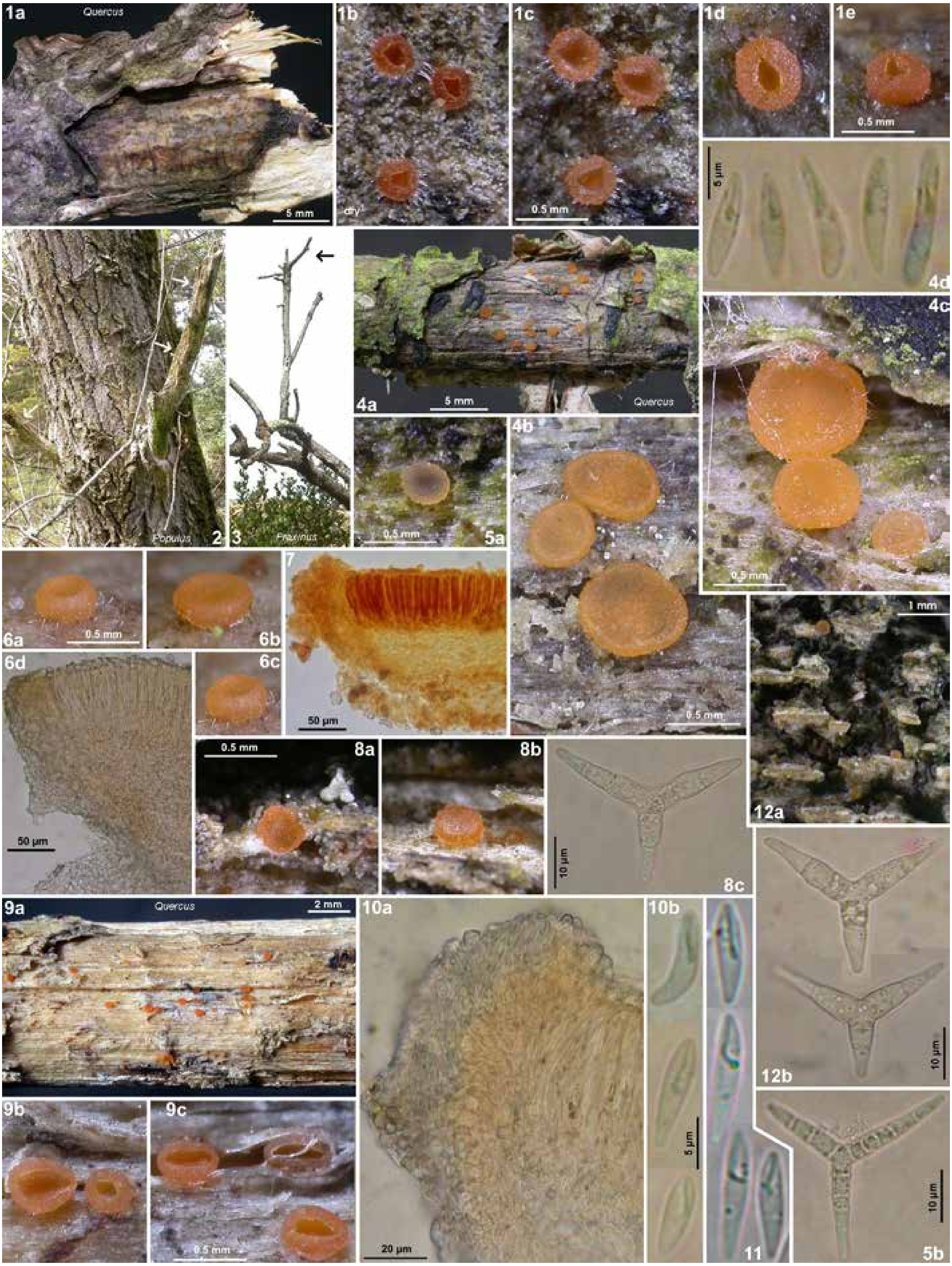


Plate 597. **1–11**. *Orbilia obtusispora*; **12**. *O.* cf. *obtusispora*. – **1a**, **2–3**, **4a**, **9a**. xeric decorticated or corticated branches; **12a**. inner surface of *Fagus* bark; **1c–e**, **4a–c**, **5a**, **6a–c**, **8a–b**, **9a–c**. rehydrated apothecia; **1b**. dry apothecia; **6d**, **7**. apothecia in median section; **10a**. id., marginal ectal excipulum; **4d**, **10b**, **11**. ascospores; **5b**, **8c**, **12b**. conidia from substrate. – Living state, except for **5b** (in H_2O), **7** (in KOH+IKI), some cells in **8c**, **12b**. — **1a–e**. H.B. 6294: Germany, Amberg, on *Quercus*; **2**. H.B. 8821: France, Ile de Ré, on *Populus*; **3**. H.B. 8820: ibid., on *Fraxinus*; **4a–d**. H.B. 8691: Germany, Fürstenwalde, on *Quercus*; **5a–b**. H.B. 8139: France, Ile de Ré, on *Populus*; **6a–d**. H.B. 9042a: Germany, Nürnberg, on *Quercus*; **7**. H.B. 4918: Germany, Tübingen, on *Quercus*; **8a–c**. H.B. 7359a (holotype): France, Vendée, on *Quercus*; **9a–c**. H.B. 5220: Austria, Kärnten, on *Quercus*; **10a–b**. H.B. 9289: France, Loire, on *Castanea*; **11**. 28.IV.2011: France, Île de Ré, on *Atriplex*; **12a–b**. H.B. 8144: France, Forêt d'Aulnay, on *Fagus*.

planar to montane altitudes, once even subalpine (Asturias). In Macaronesia it occurred on *Euphorbia* in the lower meso- and inframediterranean (semi)arid Tabaibal-Cardonal. The not included collections from western North America were in a boreal humid Douglas fir mixed forest of the Middle Rocky Mountains (*Purshia*) and cold-temperate subhumid pinyon-juniper woodlands of the Colorado Plateau (*Cercocarpus*, *Shepherdia*), also in a warm-temperate semiarid paloverde-mixed cacti desert scrub of the Sonoran Desert adjacent to Mogollon Rim (*Larrea*).

Specimens included. **GERMANY**: **Brandenburg**, 8.5 km NW of Fürstenwalde, 3 km NE of Hangelsberg, Forst Hangelsberg, 55 m, branch of *Quercus robur*, on bark & wood, 24.XI.2007, R.K. Schumacher (R.S., H.B. 8691). – **Thüringen**, 17 km NE of Coburg, 2 km W of Sonneberg, Schillings-Sandgrube, 370 m, branch of *Quercus*, on wood, 13.I.2010, I. Wagner (I.W. 100113 ø, doc. vid.). – **Baden-Württemberg**, 7 km NNW of Tübingen, 3.3 km NW of Bebenhausen, Glashau, 500 m, branch of *Quercus*, on wood & bark, 1.V.2002, H.O. Baral (H.B. 7125). – 2.7 km NW of Tübingen, Wanne, Arboretum, 470 m, branch of *Acer henryi*, on bark, 15.X.2006, H.O. Baral (ø). – 4 km N of Tübingen, 1 km WSW of Bebenhausen, Goldersbach, Schwefelbrünnele, 380 m, branch of *Prunus spinosa*, on wood & bark, 27.II.1992, H.O. Baral & E. Weber (ø). – 6.5 km NE of Tübingen, 1.5 km NNE of Pfrondorf, Brand, 460 m, branch of *Quercus robur*, on bark & wood, 18.VII.1993, H.O. Baral (H.B. 4918). – 0.5 km E of Pfrondorf, Auchtert, 400 m, branch of *Laburnum anagyroides*, on wood, 24.V.2003, H.O. Baral (H.B. 7350 ø). – **Bayern**, **Oberpfalz**, 13 km NE of Amberg, 1 km W of Hirschau, Moosweiher, 415 m, branch of *Q. robur*, on bark and old *Vuilleminia*, 27.XII.1998, H.O. Baral (H.B. 6294). – **Mittelfranken**, 14.5 km SE of Nürnberg, 2.5 km SSW of Feucht, S of canal bridge over Schwarzachklamm, branch of *Quercus*, on bark, 16.IV.2009, H.O. Baral (H.B. 9042a). — **AUSTRIA**: **Kärnten**, 12 km SE of Klagenfurt, NNE of St. Margareten im Rosental, 582 m, branch of *Q. robur*, on wood, 9.I.1995, W. Jaklitsch (W.J., H.B. 5220). – **Burgenland**, 5.5 km WNW of Rechnitz, 1.5 km N of Althodis, Baumwipfelweg, 550 m, branch of *Quercus*, on bark, 27.II.2016, G. Friebes (G.F. 20160024, doc. vid.). — **LUXEMBOURG**: **Gutland**, **Capellen**, 2.5 km SW of Capellen, 2 km NNE of Garnich, Melzer-Schilzenheck, 315 m, branch of *Quercus*, on bark and old *Vuilleminia*, 6.V.1998, G. Marson (H.B. 6185a ø). – 11 km NNW of Esch-sur-Alzette, 5 km NE of Pétange, Griechten, 335 m, branch of *Q. robur*, on old *Vuilleminia*, 9.V.1999, H.O. Baral (H.B. 6365a). – **Luxembourg**, 5 km S of Luxembourg, 1.5 km W of Hesperange, Biersak/Géisselbierg, 290 m, branch of *Quercus*, on wood, 3.V.2004, G. Marson (ø). – 7 km SE of Luxembourg, 2 km ESE of Alzingen, Héid, 300 m, branch of *Corylus avellana*, on bark and old *Vuilleminia*, 26.XI.2011, G. Marson (H.B. 9635 ø; sq.: KT222417). – **Esch-sur-Alzette**, 4.2 km S of Bettembourg, 1.5 km E of Dudelange, railway, 290 m, twigs of *Clematis vitalba*, on wood & bark, 16.XI.2013, G. Marson (ø). – 3 km E of Esch-sur-Alzette, 2 km NW of Kayl, Brucherbierg, 375 m, branch of *Quercus*, on wood and old ?*Vuilleminia*, 25.IV.1994, G. Marson (H.B. 5079). – ibid., branch of *Quercus*, on old *Vuilleminia*, 12.VI.1994, G. Marson (H.B. 5111, G.M. 5192). — **FRANCE**: **Bretagne**, **Finistère**, 3.5 km SW of Quimperlé, Kerjacques, 61 m, twig of *Ficus carica*, on wood, 31.V.2019, P.Y. Courio, vid. J.P. Priou (J.P.P. 19185, doc. vid.). – **Morbihan**, 1.4 km WNW of La Gacilly, SW of Talhuart, Buhan, 50 m, branch of *Quercus*, on wood, 7.I.2004, J.P. Priou (J.P.P. 24010, doc. vid.). – **Pays-de-la-Loire**, **Vendée**, 33 km NW of La Rochelle, 2.5 km WNW of La Tranche-sur-Mer, Plage de la Terrière, 10 m, branches of *Q. ilex*, on wood, 3.VI.2003, E. Weber & H.O. Baral (ex H.B. 7359a, M-0276539, **holotype**, anam. substr.). – 21 km SSW of La Roche-sur-Yon, 2.3 km NNW of Avrillé, Bois de la Garde, 35 m, branch of *Castanea sativa*, on bark, 5.VI.2003, H.O. Baral (H.B. 7373). – **Poitou-Charentes**, **Charente-Maritime**, Île de Ré, 2.5 km NNE of St.-Clément-des-Baleines, Forêt de St.-Clément, 7 m, branch of *Fraxinus excelsior*, on bark, 26.IV.2006, G. Marson & H.O. Baral (H.B. 8163 ø). – ibid., on wood of *F. excelsior*, 16.IV.2008, H.O. Baral (H.B. 8820 ø). – ibid., branch of *Quercus ilex*, on bark, 26.IV.2006, H.O. Baral (ø). – ibid., branch of *Populus*, on wood, 26.IV.2006, H.O. Baral (H.B. 8139, anam. substr.). – ibid., 16.IV.2008 (H.B. 8821 ø). – ibid., stem of *Rubus fruticosus*, 16.IV.2008, H.O. Baral (ø). – ibid., branch of *Atriplex hastata*, on wood, 28.IV.2011, M. Bemmann (ø, doc. vid.). – 1.5 km SSE of St.-Clément-des-Baleines, 2 km WNW of Ars-en-Ré, Forêt de la Combe à l'Eau, 5 m, branch of *Cupressus macrocarpa*, on wood, 28.IV.2011, E. Weber (H.B. 9486). – ibid., 1.5 km WNW of Ars-en-Ré, SE of sewage plant, 8 m, branch of *Populus*, on wood, 28.IV.2011, U. Lindemann (ø). – **Île-de-France**, **Essonne**, 28 km SW of Paris, W of Mulleron, 167 m, trunk of *Acer negundo*, on wood, 30.IV.2011, S. Helleman & M. Pennanen (S.H. 699, doc. vid.). – **Auvergne**, **Cantal**, 12 km S of St.-Flour, 3 km ESE of Lavastrie, S of Grandval, 748 m, branch of *Quercus*, on wood, 8.IX.2009, J.P. Priou (J.P.P. 29175, doc. vid.). – **Rhône-Alpes**, **Loire**, 16 km WNW of Boën, 1.5 km S of St.-Jean-la-Vêtre, Ventuel, 880 m, branch of *Castanea sativa*, on wood, 6.V.2010, N. Van Vooren (H.B. 9289 ø). — **SPAIN**: **Asturias**, 13.5 km ESE of Pola de Somiedo, 5 km SE of Saliencia, La Farrapona, 1650 m, branch of *Rhamnus alpina*, on wood, 4.VI.2017, R. Dougoud (H.B. 10110, anam. substr.). – **PORTUGAL**: **Santarém**, 10 km NNW of Santarém, 2.5 km SW of Achete, Val de Flores, 50 m, branch of *Olea europaea*, on wood, 29.XII.2004, J.P. Priou (H.B. 7657 ø). — **SERBIA**: **Vojvodina**, 10 km WSW of Novi Sad, N of Beočin, 75 m, branch of *Salix alba*, on bark, 31.X.2019, D. Savić (doc. vid.). — **CROATIA**: **Dubrovnik-Neretva**, **Korčula**, 11.5 km W of Korčula, 2 km W of Račišće, below Samograd cave, 40 m, branch of *Olea europaea*, on bark, 4.VI.2000, H.O. Baral (H.B. 6679d ø). – 8 km W of Korčula, Pupnat, bus station, 320 m, branch of *Hedera helix*, on wood, 11.VI.2000, H.O. Baral (ø). – 3 km W of Korčula, 1.3 km NW of Žrnovska Banja, 10 m, branch of *Prunus dulcis*, on wood, 10.VI.2000, H.O. Baral (ø). – 2.5 km ESE of Korčula, Badija island, NE of Turističkosportski centar, 40 m, branch of *Lonicera implexa*, on bark, 8.VI.2000, H.O. Baral (H.B. 6692). — **MACARONESIA**: **Canary Islands**, **Tenerife**, Tacoronte, 2.7 km NNE of El Sauzal, SSW of Mesa del Mar, Hoya las Higueras, 60 m, branch of *Euphorbia balsamifera*, 26.XI.2009, L. Quijada (TFC Mic. 22621, doc. vid.). – ibid., 90 m, branch of *E. canariensis*, 26.XI.2009, L. Quijada (TFC Mic. 22620, non vid.). – Punta de Hidalgo, 345 m, branch of *Rubia fruticosa*, on wood 29.XII.2013, L. Quijada & E.V. Rodríguez (TFC Mic. 24440, non vid.). – ibid., branch of *Artemisia thuscula*, on wood (TFC Mic. 24441, doc. vid.).


Map 95. Known distribution of *O. obtusispora* in Europe and Macaronesia (yellow = not included collections).

Not included. **GERMANY**: **Bayern**, **Oberfranken**, northern Frankenalb, 14 km SE of Lichtenfels, ~2 km SW of Weismain, Erlach, ~350 m, branch of *Clematis vitalba*, on bark, 30.III.1912, A. Ade (S, mixture in lectotype of *O. vitalbae*; H.B. 6348b ø). — **FRANCE**: **Poitou-Charentes**, **Charente-Maritime**, 25 km SSE of Niort, 2.5 km ESE of la Villedieu, Forêt d'Aulnay, 115 m, branch of *Fagus sylvatica*, on bark, 28.IV.2006, H.O. Baral (H.B. 8144, anam. substr.). — **GREECE**: **Peloponnese**, 8 km SW of Epidauros, 3.7 km ESE of Asklipieio, NW of amphitheatre, 335 m, branch of *Quercus coccifera*, on wood, 10.VI.2009, S. Helleman (H.B. 9094a). — **USA**: **Wyoming**, Middle Rocky Mountains, 18.5 km N of Jackson, Grand Teton, 1960 m, twig & branches of *Purshia tridentata*, on wood, 6.VI.1996, G. Marson (H.B. 6039). – **Colorado**, Uinta Basin, 50 km ESE of Vernal, 6 km NE of Dinosaur, 2100 m, on *Cercocarpus intricatus*, 12.VI.1996, G. Marson (ø). – **Utah**, Canyonlands, NW of Valley of the Gods, 16 km NNW of Mexican Hat, Cedar Mesa, N of Mokee Dugway, 1965 m, branch of *Shepherdia rotundifolia*, on wood, 14.VI.2000, G. Marson (H.B. 7154a). – **Arizona**, Grand Canyon, Coconino Plateau, 2.3 km NW of Grand Canyon Village, Hopi Point, 2140 m, on *Cercocarpus ledifolius*, 10.V.1995, G. Marson (ø). – Sonoran Desert, 68 km SSW of Flagstaff, 5.5 km NNE of Camp Verde, Montezuma Castle, 975 m, branch of *Larrea tridentata*, on wood, 8.V.1995, G. Marson (H.B. 5684g ø).

Orbilia austroobtusispora Baral, **sp. nov.**, MB 813663 — Pls 598–599, Map 96

Etymology: named after the similarity to *O. obtusispora* and the occurrence in Australia.

Typification: Western Australia, Nerren Nerren, trunk of *Lamarchea hakeifolia*, 8.XI.2007, G. Marson (ex H.B. 9020c, MEL 2389275A, holotype).

Latin diagnosis: *Similis* Orbiliae obtusisporae *sed ascosporae longiores. Habitat ad lignum et corticem putridum rami sicci* Acaciae *et* Myrtacearum *in* *zona temperata humida ad subtropica semiarida Australiae occidentalis et orientalis.*

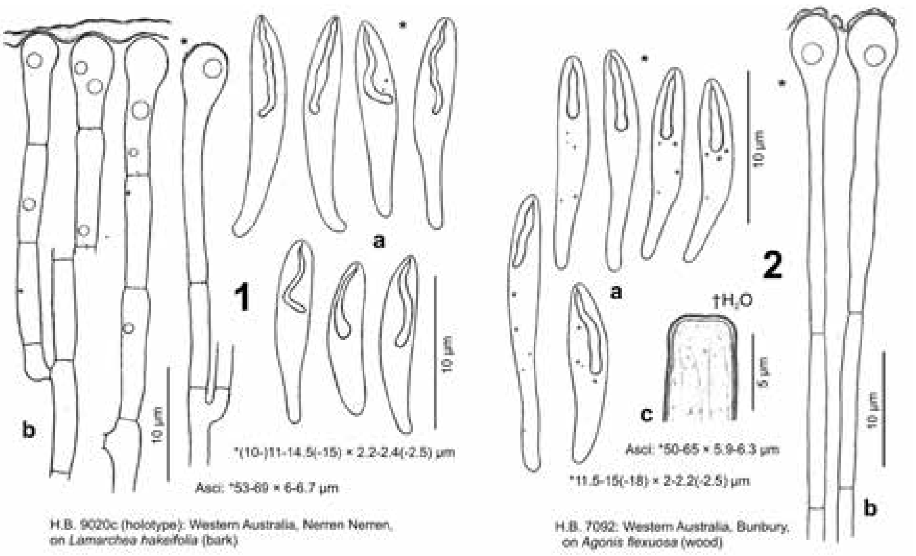


Plate 598. **1–2**: *Orbilia austroobtusispora*. – **a**. ascospores; **b**. paraphyses; **c**. ascus apex.

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.22–0.55 mm diam., 0.11–0.17(–0.2) mm high, (pale to) light orange(-red) or orange-rose, hardly translucent, round, scattered or in small groups; disc flat, margin distinct, (0–)5–20(–30) µm protruding (saucer-shaped), including exterior smooth to finely rough; broadly sessile or with a hidden stipe 40–60 × 60–90 µm, ± superficial. **Asci** *50–69 × 6–7(–8) µm {3}, †43–59 × 5.2–5.6(–6) µm {3}, 8-spored, spores †3–4-seriate, 2–6 lower spores inverted {5} (± mixed), pars sporifera *27–30 µm long; **apex** (†) strongly truncate (not or slightly indented and laterally inflated); **base** with short to medium long, thick, flexuous stalk, L- to h-shaped. **Ascospores** *(10–)11–16(–18) × 2–2.5 µm {4}, †(11–)12–15(–16.7) × (1.8–)2–2.2 µm {2}, cylindric- to fusoid-clavate, apex obtuse or partly subacute, base medium to mostly strongly attenuated, often with a tail-like base or distinct tail, straight to slightly curved; **SBs** *4–7.5 × (0.3–)0.4–0.8 µm in situ or actual length {4}, vermiform to subulate, not inflated at base, straight to medium or strongly flexuous; overmature 1–2-septate, apical cell swollen to *4.5 µm in width {T}. **Paraphyses** apically slightly to very strongly clavate-capitate, terminal cells *(7–)8–15(–21) {T} or 25–28 {1} × 3–4.3(–4.7) µm {2}, †3–4.7 µm wide {1}, lower cells *(5–)8–12(–15) × 1.4–2.3 µm {2}; exceptionally branched at upper septum. **Medullary excipulum** subhyaline to pale rose, 30–60 µm thick, of dense textura intricata with many inflated cells, medium to sharply delimited from ectal excipulum. **Ectal excipulum** subhyaline, of thin-walled, irregularly oriented t. globulosa-angularis from base to submargin, 25–45 µm thick near base, cells *(7–)8–14(–16) × (6–)8–11(–13) µm {2}; 15–30 µm thick at margin, of t. prismatica(-porrecta) oriented at a 10–50° angle to the surface, marginal cortical cells *5–10 × 2.5–4 µm {T}, †8–12 × 3–4.5 µm {1}. **Anchoring hyphae** medium abundant, *2–3.5 µm wide, walls 0.2–0.3 µm thick {T}. **SCBs** in paraphyses and often also ectal excipulum (near margin) globose {4}, 1–2 µm diam., rarely absent {1}. **Exudate** over paraphyses (0.2–)0.5–2 µm thick, cloddy-continuous, loosely to firmly attached, over margin and flanks 1–3 µm thick, forming large clods, hyaline to pale yellowish. — **ANAMORPH**: unknown.

Habitat: collected 1–3 m above the ground, corticated to decorticated, 7–13 mm thick branches of *Acacia* sp. {1}, *Agonis flexuosa* {1}, *Eucalyptus* sp. {1}, *Lamarchea hakeifolia* {1}, *Melaleuca* sp. {1}, on 0.1 mm deep strongly decayed wood {3} or bark (bast & periderm) {4}, on outer and sometimes inner surface of bark {T}, ± strongly greyed, without or with sparse to abundant green algae. **Associated**: *Capronia* sp. {1}, *Claussenomyces* sp. {1}, *Frullania* sp. {1}, *Gloniopsis praelonga* {1}, *Hyalorbilia pleioerythrostigma* {1}, *Hysterium angustatum* {1}, *Ionomidotis ?australis* {1}, *Opegrapha ?varia* {1}, *Orbilia acaciae* {1}, *O. amberina* {1}, *O. australiensis* {1/1}, *O. austrocylindrica* {1}, *O. aviflagellata* {1}, *O. ?cejpii* {1}, *O. gemma* {1}, *O. helicoobliqua* {1}, *O. hesperidea* {1}, *O. kingsiana* {1}, *O. lamarcheae* {1}, *O. microserpens* {2}, *O. multiserpens* {1}, *O. myriolilacina* {2}, *O. myrioobliqua* {1}, *O. nothovinosa* {2}, *O. paraobliqua* {1}, *O. pleioaustraliensis* {1}, *O. pleioaustrocylindrica* {1}, *O. pseudoflagellispora* {1}, *O. pubescens* {1}, *Ostropales* {2}, *Patellaria ?andina* {1}, *?Triblidium* sp. {1}, *Symbiotaphrina desertorum* {1}, *?Xerotrema* sp. {1}, foliose lichen {1}. **Desiccation tolerance**: fully viable for at least 2 years, after 7.5 years many excipular cells still alive. **Altitude**: 10–1073 m a.s.l. **Geology**: Archean, Permian-Triassic and Cretaceous sedimentary rock, Cenozoic regolith. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia austroobtusispora* closely resembles the European (and North American) *O. obtusispora* and *O. cylindrosoma* in spore shape, concerning *O. cylindrosoma* also in tending to vermiform SBs. It differs from both in a strong tendency to longer spores. Although in *O. obtusispora* rarely a few extraordinarily long spores were encountered (Pl. 596: 5), each of the five Australian specimens included in *O. austroobtusispora* showed some spores of at least 15 µm in length. Often the spores have a tail-like base, while such spores are only exceptionally seen in *O. obtusispora* from Europe and USA. *O. obtusispora* usually differs also in a thinner exudate.

Variation. The sample on *Agonis* shows vermiform SBs similar to *O. cylindrosoma*, while in other records the SBs are partly (holotype) or consistently subulate. In the *Agonis* sample the cells of the paraphyses are much longer than in the type. The paraphysis apices are only slightly to medium inflated in the type while often (very) strongly inflated in the other specimens.

Ecology. *O. austroobtusispora* grew on wood and bark of xeric branches of *Acacia* and different *Myrtaceae*, mainly in subtropical semiarid to semihumid eucalypt open woodlands in southwestern and eastern Australia, and in a warm-temperate humid eucalypt open forest in southeastern Australia (Great Dividing Range).

Map 96. Known distribution of *O. austroobtusispora* in Australia.

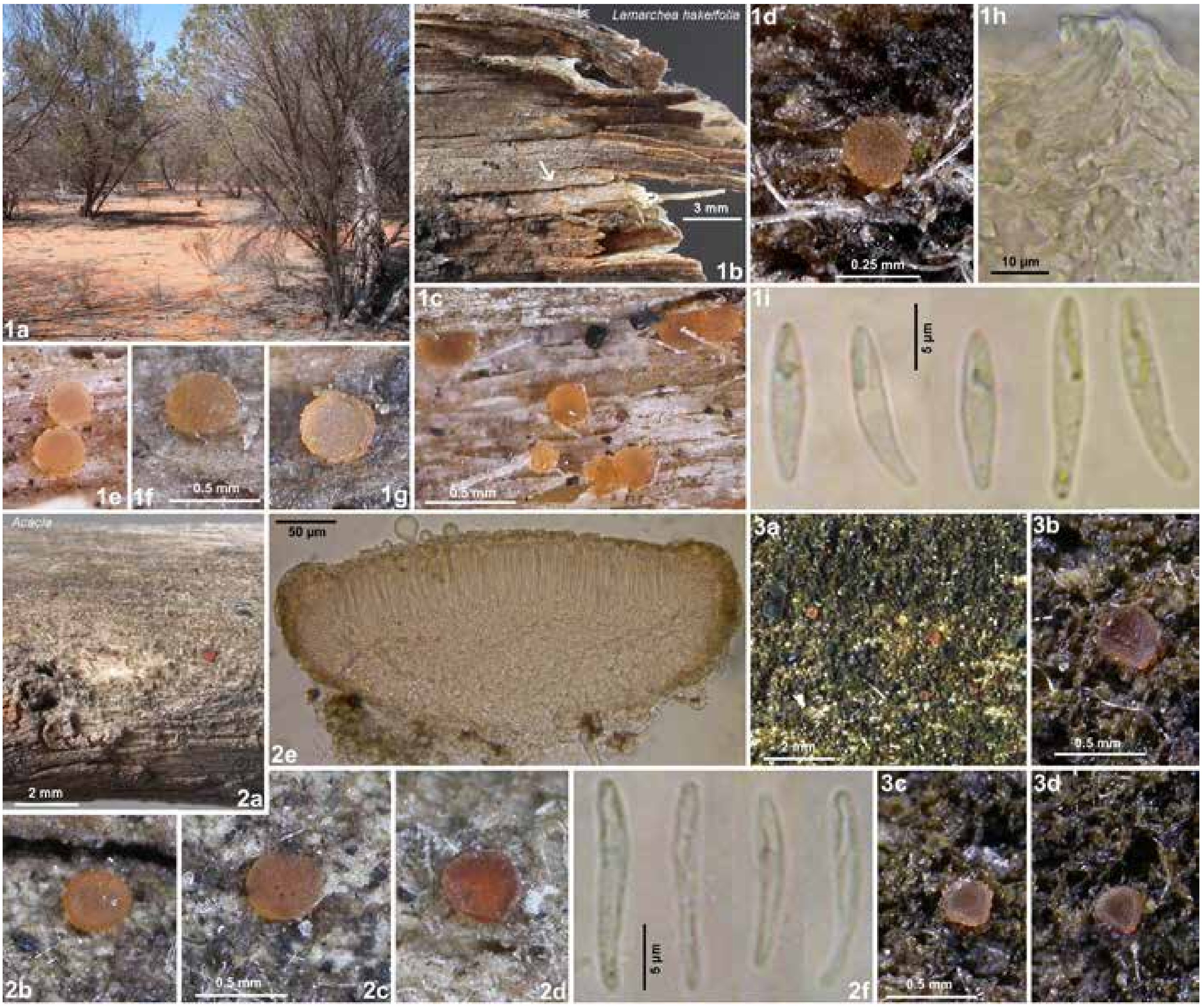


Plate 599. **1–3**: *Orbilia austroobtusispora*. – **1a**. semiarid acacia shrubland; **1b**. detached bark of *Lamarchea*; **2a**. decorticated branch of *Acacia*; **1c–g**, **2b–d**, **3a–d**. rehydrated apothecia; **2e**. apothecium in median section; **1h**. marginal ectal excipulum in external view; **1i**, **2f**. ascospores. – Living state, except for **2f** (in H_2O). — **1a–i**. H.B. 9020c (holotype): Western Australia, Nerren Nerren, on *Lamarchea*; **2a–f**. H.B. 7204n: ibid., Wubin, on *Acacia*; **3a–d**. H.B. 7092: ibid., Bunbury, on *Agonis*.

Specimens included. **AUSTRALIA**: **Western Australia**, Avon Wheatbelt, 78 km NE of Wubin, 18 km W of Mt. Singleton, 380 m, branch of *Acacia*, on wood & bark, 24.XI.2001, G. Marson (H.B. 7204n). – Yalgoo, 187 km N of Geraldton, W of Toolonga, Nerren Nerren, 190 m, trunk of *Lamarchea hakeifolia*, on bark, 8.XI.2007, G. Marson (ex H.B. 9020c, MEL 2389275A, **holotype**). – Swan Coastal Plain, 14 km NNE of Bunbury, 6 km S of Binningup, 10 m, branch of *Agonis flexuosa*, on wood, 17.XII.2001, G. Marson (H.B. 7092 ø). – **Queensland**, Brigalow Belt South, 80 km N of Goondiwindi, 10 km S of Moonie, 278 m, branch of *Melaleuca*, on wood & bark, 23.X.1998, G. Marson (ø). – **New South Wales**, Sydney Basin, 95 km WNW of Sydney, 11.5 km SE of Lithgow, SE of Mt. York, 1073 m, branch of *Eucalyptus*, on bark, 26.X.1998, G. Marson (H.B. 6782 ø).

Orbilia pleioobtusispora Baral, **sp. nov.**, MB 813664 — Pl. 600

Etymology: named after the 16-spored asci and the ascospores resembling *O. obtusispora*.

Typification: Australia, Northern Territories, Yulara, branch of *Allocasuarina decaisneana*, 12.X.1998, G. Marson (ex H.B. 6617e, MEL 2389214A, holotype).

Latin diagnosis: *Similis* Orbiliae obtusisporae *sed asci 16-spori*, *ascosporae multo minores. Habitat ad lignum putridum rami sicci* Allocasuarinae decaisneanae *in zona subtropica arida Australiae centralis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.2–0.35 mm diam., 0.09 mm high, pale rose-cream-greyish, round, subgregarious in a small group; disc flat, margin thin, 10 µm protruding, smooth; broadly sessile, superficial. **Asci** *40–54 × 5.4–5.8 µm, †42–54 × 4.8–5.6 µm, 16-spored, spores *4–5-seriate, lower spores inverted (± mixed), pars sporifera *25–28 µm long; **apex** (†) medium to strongly truncate (not indented, laterally not inflated); **base** with short to medium long, ± thin stalk, L-shaped. **Ascospores** *6–7.5(–8.3) × 1.7–1.9(–2) µm, †5.5–7.5 × 1.5–2 µm, subcylindrical, sometimes slightly clavate or slightly fusoid, apex rounded to obtuse, base rounded, not or only very slightly attenuated, straight or very slightly inequilateral; **SBs** *2.8–3.5(–3.8) × 0.3–0.4 µm, ± subulate, not or very slightly swollen at base, straight to slightly flexuous. **Paraphyses** apically slightly to medium (rarely strongly) clavate-capitate, terminal cells *5.5–15.5 × 3.8–5 µm, lower cells *8–11 × 1.8–2.5(–3) µm; unbranched at upper septum. **Medullary excipulum** 15 µm thick, of ± dense textura intricata with some inflated cells, medium sharply delimited. **Ectal excipulum** of (†) thin-walled, irregularly oriented t. angularis from base to submargin, 20 µm thick near base, cells †6–10 × 5–8 µm; 10–15 µm thick near margin, of t. prismatica oriented at a 10–30° angle to the surface, marginal cortical cells †8–10 × 2–4 µm. **Anchoring hyphae** ± sparse, †1.6–3.3 µm wide, walls 0.2 µm thick. **SCBs** in paraphyses globose, 1–2.7 µm diam. **Exudate** over paraphyses 0.5–1 µm thick, granular-cloddy, firmly attached to each paraphysis; over margin and flanks 0.2–1 µm thick scattered granules. **— ANAMORPH**: unknown.

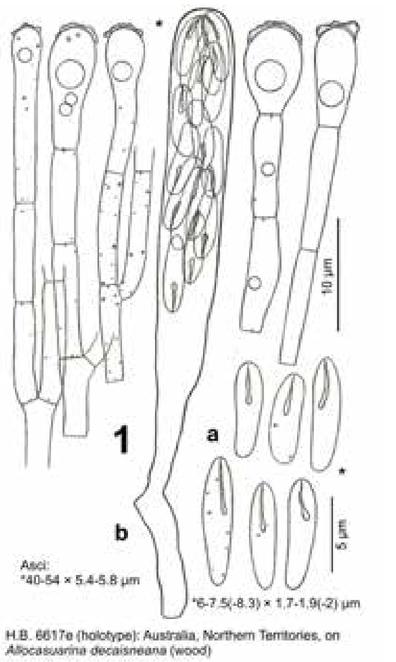


Plate 600. **1**: *Orbilia pleioobtusispora*. – **a**. ascospores; **b**. ascus and paraphyses.

Habitat: collected 3–4 m above the ground, decorticated, 8 mm thick branch of *Allocasuarina decaisneana*, on 0.2 mm deep strongly decayed wood, strongly greyed, no algae. **Associated**: *Orbilia macrotrapeziformis*, *O. multivinosa*, *O. phanosoma*, *O. pleiolentiformis*, *O. pleiovitalbae*, *O. pluristomachia*, *O. serpentina*, *Teichosporella dura*, *Symbiotaphrina desertorum*. **Desiccation tolerance**: fully tolerant for at least 20 months. **Altitude**: 500 m a.s.l. **Geology**: Cenozoic regolith (red-brown sand). **Phenology**: long-lived.

Taxonomic remarks. *Orbilia pleioobtusispora* is very similar to *O. pleioungulata*, from which it mainly differs in the absence of crystalloid SCBs. It deviates from *O. obtusispora*, besides 16-spored asci, in distinctly smaller ascospores and narrower spore bodies.

Ecology. Only a few apothecia were found in the type collection, which grew on rotten wood of a xeric branch of *Allocasuarina decaisneana* in a subtropical arid acacia open shrubland northeast of Ayers Rock at the southeastern end of the Great Sandy Desert of central Australia.

Specimens included. **AUSTRALIA**: **Northern Territories**, Great Sandy Desert, 11.5 km ENE of Yulara, 14 km NNE of Ayers Rock (Uluru), 500 m, branch of *Allocasuarina decaisneana*, on wood, 12.X.1998, G. Marson (ex H.B. 6617e, MEL 2389214A, **holotype**).

Orbilia cylindrosoma Baral, E. Weber & G. Marson, **sp. nov.**, MB 813665 — Pls 601–603, Map 97

Etymology: named after the predominantly cylindrical spore bodies.

Typification: Germany, Stuttgart, branch of *Lonicera*, 23.VI.2000, H.O. Baral (ex H.B. 6711, M-0276469, holotype; ex-type culture: CBS 116233; sq.: KT215244).

Latin diagnosis: *Similis* Orbiliae obtusisporae *sed corpuscula refringentia ascosporarum vermiformia, apothecia caules siccos herbarum sed etiam lignum, raro corticem putridum ramorum arborum vel fruticum deciduarum incolentes, in locis thermophilis in zona temperata humida et mediterranea semihumida ad semiarida Europae centralis et meridionalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.1–)0.15–0.4(–0.5) mm diam., 0.1–0.16 mm high, very pale to light cream-rose-orange to orange, rarely pure rose, slightly or medium translucent, round, very scattered to subgregarious, rarely gregarious in small groups; disc flat, sometimes slightly convex, margin distinct or not, 0–5 µm protruding, smooth to finely rough; broadly sessile, superficial to slightly erumpent; dry light to bright (rose-)orange. **Asci** *(37–)40–60(–65) × (4.4–)5–6(–6.5) µm {8}, †33–55 × 4.5–5.2(–5.5) µm {3}, 8-spored, spores *3-seriate, ((2–))3–5(–6) lower spores inverted {11} (rarely mixed), pars sporifera *18–26(–29) µm long; **apex** (†) strongly truncate (not or slightly to distinctly indented, laterally sometimes inflated); **base** with short to medium long, ± thick, flexuous stalk, L- to T-shaped. **Ascospores** *((5.5–))(6–)7.5–11(–12.5)((–13.5)) × (1.8–)2–2.5(–2.8)((–3.1)) µm {17}, †(6.5–)7.5–9(–10) × (1.5–)1.7–2(–2.2) µm {2}, fusoid to fusoid-clavate, sometimes narrowly ellipsoid or subcylindrical, apex obtuse to subacute, sometimes acute, exceptionally rounded, base slightly to medium (rarely strongly) attenuated, straight to slightly curved at base; **SBs** *(3–)3.5–5(–5.5)((–6)) × ((0.2–))(0.3–)0.4–0.8(–0.9) µm in situ or actual length {13}, vermiform to subulate, base not or slightly inflated, sometimes slightly constricted, straight to slightly, exceptionally strongly flexuous, overmature 1.5–4 × 0.8–1.2 µm, pear-shaped to globose. **Paraphyses** apically medium to very strongly capitate(-clavate), terminal cells *(4.5–)7–17(–19) × (2–)3–5(–5.5) µm {9}, lower cells *((4–))(5.5–)7–12 × 1.3–2(–2.3) µm {8}; exceptionally branched at upper septum. **Medullary excipulum** 10–40 µm thick, of dense textura intricata with many inflated cells, hardly to sharply delimited. **Ectal excipulum** subhyaline, of thin-walled, irregularly oriented t. globulosa-angularis(-prismatica) from base to mid flanks, 30–60 µm thick near base, cells *7–20 × 6–15(–18.5) µm {2}; 20–30 µm at margin, of t. prismatica(-angularis) oriented at a 40–80° angle to the surface, marginal cortical cells */†5–10(–12) × 3–4.5 µm {3}, inner cells *10–12 × 4–6.5 µm. **Anchoring hyphae** sparse to abundant, *2–3 µm wide, walls 0.2 µm thick {2}, not covering flanks and margin. **SCBs** in paraphyses and often also ectal excipulum (near margin) globose {10}, rarely absent {1}, (1–)1.5–2(–3) µm diam., in excipulum 1.5–3.5 µm. **Exudate** over paraphyses 0.2–1(–2) µm thick, granular-cloddy, soon firmly attached; over margin and flanks 0.3–2 µm thick, rough-cloddy to continuous. **— ANAMORPH**: trinacrium-like (from ascospore isolate {2} and natural substrate {7}). **Conidiophores** *16 × 2–2.2 µm, conidia formed terminally. **Conidia** Y-shaped, total size *28–45 × 30–50 µm, †26–33 × 22–41 µm, stipe *12–22 × 4–6 µm, †13–18 × 3.8–4 µm, (1–)2–4-septate, arms *20–30(–38) × (3.2–)4–5.5 µm, †(14–)16–24 × 3.5–4 µm, 2–4-septate {11}, arms and stipe strongly tapering.

Habitat: collected 0.5–2 m above the ground or ± close to sun-exposed ground, partially to almost decorticated, 9–23 mm thick branches of *Acer* sp. {1}, *Ficus carica* {1}, *Juglans regia* {1}, *Lonicera xylosteum* {1}, *Malus domestica* {1}, *Robinia pseudoacacia* {1}, *Sambucus nigra* {1}, on 0.1–0.5 mm deep (slightly to) strongly decayed wood {6}, rarely bark {1}, on herbaceous stems of *Althaea ?ficifolia* {1}, *Artemisia vulgaris* {1}, *Euphorbia cyparissias* {1}, *Heracleum sphondylium* {1}, *Sambucus ebulus* {3}, *Urtica dioica* {2}, indet. *Apiaceae* {1}, culms of *Phragmites australis* {1}, slightly to medium greyed, with sparse to abundant green algae. **Associated**: *Cistella grevillei* {3}, *Cyathicula cacaliae* {1}, *C. cyathoidea* {1}, *Deltopyxis triangulispora* {1}, *Diaporthe arctii* {1}, *D. eres* {1}, *Eutypella ?scoparia* {1}, *Hydropisphaera arenula* {1}, *Karstenia macer* {1}, *K. rhopaloides* {1}, *Lachnella alboviolascens* {1}, *?Laetinaevia* sp. {1}, *Leptospora rubella* {1}, *Lophiostoma caulium* {1}, *Merismodes* sp. {1}, ?*Nectria* sp. {1}, *Olla millepunctata* {2}, *Ophioceras leptosporum* {1}, *Orbilia albovinosa* {1}, *O. caulicola* {4}, *O. eucalypti* {1}, *O. flavida* {5}, *O. filiformis* {1}, *O. pleiolentiformis* {1} *O. quaestiformis* {1}, *O. ungulata* {2}, *O. vitalbae* {2/1}, *Patellaria atrata* {2}, *Peyronelia* sp. {1}, *Phoma* sp. {1}, *Phragmocephala atra* {1}, *Physcia* sp. {1}, *Pseudolachnea hispidula* {1}, *Psilachnum rubrotinctum* {1}, *Pyrenopeziza ?rubi* {1}, *Ramichloridium ?schulzeri* {1}, *Trichopeziza mollissima* {3/2}, *T. lizonii* {1}, *T. ?perrotioides* (immature) {1}, *T. sulphurea* {1}, *Trichopezizella ?rubroguttata* {1}, ?*Unguiculella* sp. {1}, *Urceolella crispula* {1}, *U. ?pani* {1}, *Xanthoria* sp. {1}. **Desiccation tolerance**: fully viable for at least 1 month, after 3 months excipular cells, ascospores and some paraphyses still viable, conidia viable for 1 month. **Phenology**: I–X (possibly throughout the year). **Altitude**: 35–500 m (central Europe), 160–1253 m (southern Europe).

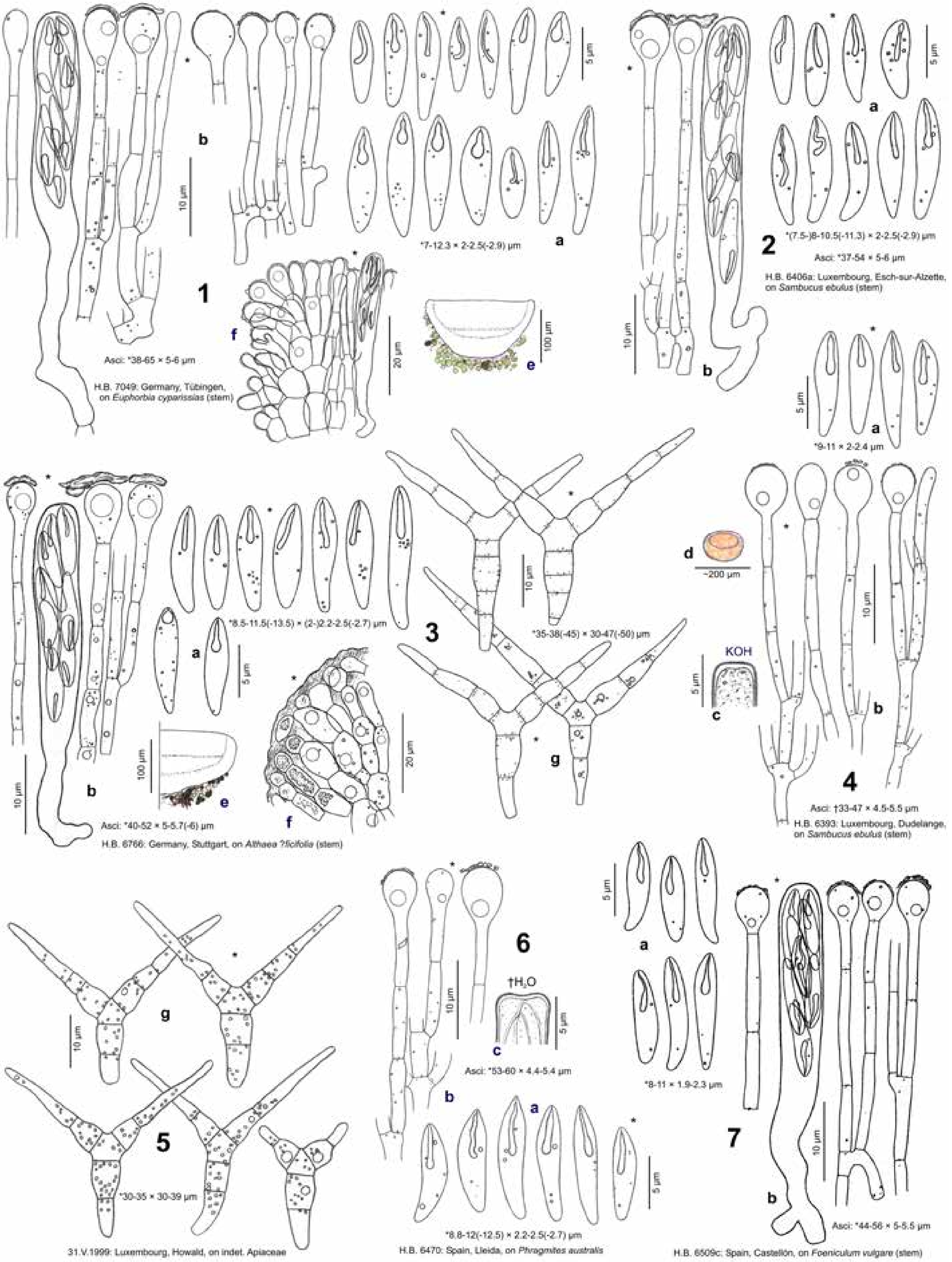


Plate 601. **1–6**: *Orbilia cylindrosoma*; **7**: *O.* cf. *cylindrosoma* (all on herbaceous substrates). – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. rehydrated apothecium; **e**. apothecia in median section; **f**. id., marginal ectal excipulum; **g**. conidia (**3** from culture, **5** from natural substrate).

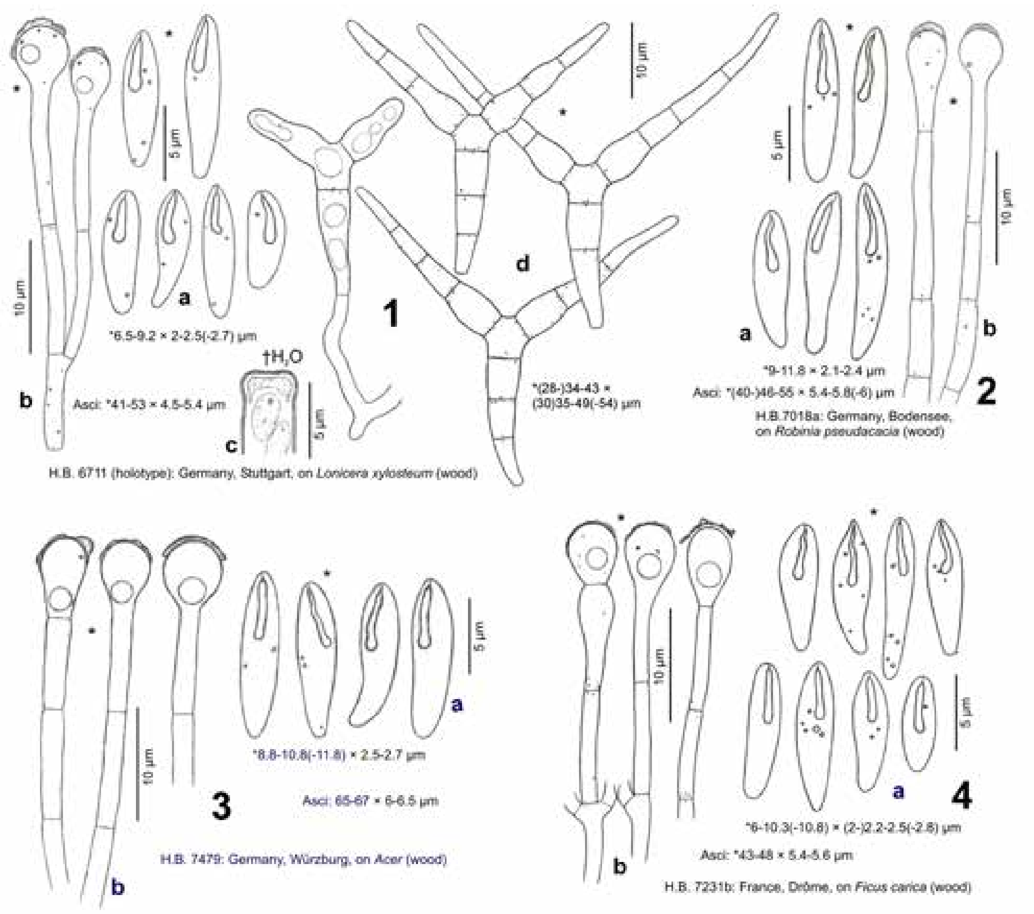


Plate 602. **1–4**: *Orbilia cylindrosoma* on woody substrates. – **a**. ascospores; **b**. paraphyses; **c**. ascus apex; **d**. conidia from culture.

Geology: Keuper (gypsum), Lower Jurassic sandstone & shale, Tertiary molasse, Quaternary silt & sand; gabbro & basalt. **Phenology**: I–II, IV–X (throughout the year, long-lived).

Taxonomic remarks. *Orbilia cylindrosoma* closely resembles *O. obtusispora* in ascospore shape and size. The taxon is tentatively separated because of the spore bodies being more vermiform instead of subulate or filiform, i. e., predominantly rather broad up to the subapex and only slightly inflated at the lower end. This difference is not sharp, however, especially since in some collections the spore body shape was not very constant, perhaps as a result of different degrees of maturity, or of external influence (Pl. 601: 1a), and in some of the spores the SBs were distinctly subulate. In any case, the frequent cylindrical, vermiform shape was correlated with the rather frequent occurrence on herbaceous substrates, whereas in only one sample of *O. obtusispora* the SBs were rarely cylindrical (Pl. 595: 4). Collections on woody substrates are considered as conspecific with samples on herbaceous stems. As a tendency, *O. cylindrosoma* has basally slightly less tapered spores and smaller, paler coloured apothecia with less protruding margins in comparison to *O. obtusispora*. Further possible characteristics of *O. cylindrosoma* are a less differentiated marginal excipulum of wider cells oriented at a high angle, the absence of hyphae covering flanks and margin, also a tendency to more inflated paraphyses with larger SCBs. *O. trapeziformis* differs in somewhat shorter and wider spores, and in SBs being consistently narrowed towards apex (subulate) and abruptly inflated at the base. For the similar Australian *O. austroobtusispora* see below.

Variation. Differences between specimens from woody and herbaceous substrates could not be found. The ascospore apex varies rather strongly between obtuse and subacute, sometimes acute, even within a collection (see especially Pls 601: 6; 602: 4). As already stated above, the observed variation in SB shape occurs occasionally within a collection and has obviously no molecular origin. Variation between vermiform and subulate SBs was noted in most of the specimens, though the vermiform (cylindrical) shape predominated. In addition to this, spore length and also width vary considerably within several of the included specimens (e. g., Pl. 601: 1a).

Not included collections. In two samples on herbaceous stems (*Foeniculum*, Pl. 601: 7; ?*Cirsium*, IVV: 27.V.1999) only subulate SBs were seen, therefore these are not included in the description. Spores and SBs resemble also *O. obtusispora*, but this species was not yet found with certainty on herbs.

Anamorph. The trinacrium robustum-like conidia of *O. cylindrosoma* resemble those observed in the very close *O. obtusispora* and *O. trapeziformis* but differ in longer arms and stipes. *O. cylindrosoma* frequently grows in association with *O. flavida* (section *Lentiformes*). Both species have similar conidia, but those of *O. flavida* have distinctly shorter arms.

Phylogeny. A sequence was taken from the ex-type culture, comprising SSU (without S1506 intron), ITS, and LSU. When analysing the ITS region, *O. cylindrosoma* clustered with a 6 % distance with the German collection of *O. trapeziformis* in a highly supported subclade that stands unresolved in the *Serpentinae-Habrostictis* clade (Phyl. 19). However, *O. cylindrosoma* strongly deviates in this region from the morphologically similar *O. obtusispora* and the two French collections of *O. trapeziformis* (17 % distance and many gaps and indels) which fell in the *Ellipsospermae* clade. *O. cylindrosoma* showed a rather high distance to any further species of series *Serpentinae*: min. 12 % in the ITS to *O. multimaeandrina* (2.7 % in LSU) and min. 1.4 % in the LSU to *O. carpoboloides* (20 % in ITS).

Ecology. *O. cylindrosoma* was collected on xeric herbaceous stems of dicot (rarely monocot) plants and on rotten wood (and bark) of xeric branches of different angiosperms. The collections are mainly from subcontinental, cold-temperate humid central Europe, but also from suprasub- to mesosubmediterranean and mesomediterranean semihumid to semiarid southwestern Europe (thermomediterranean for the not included collection

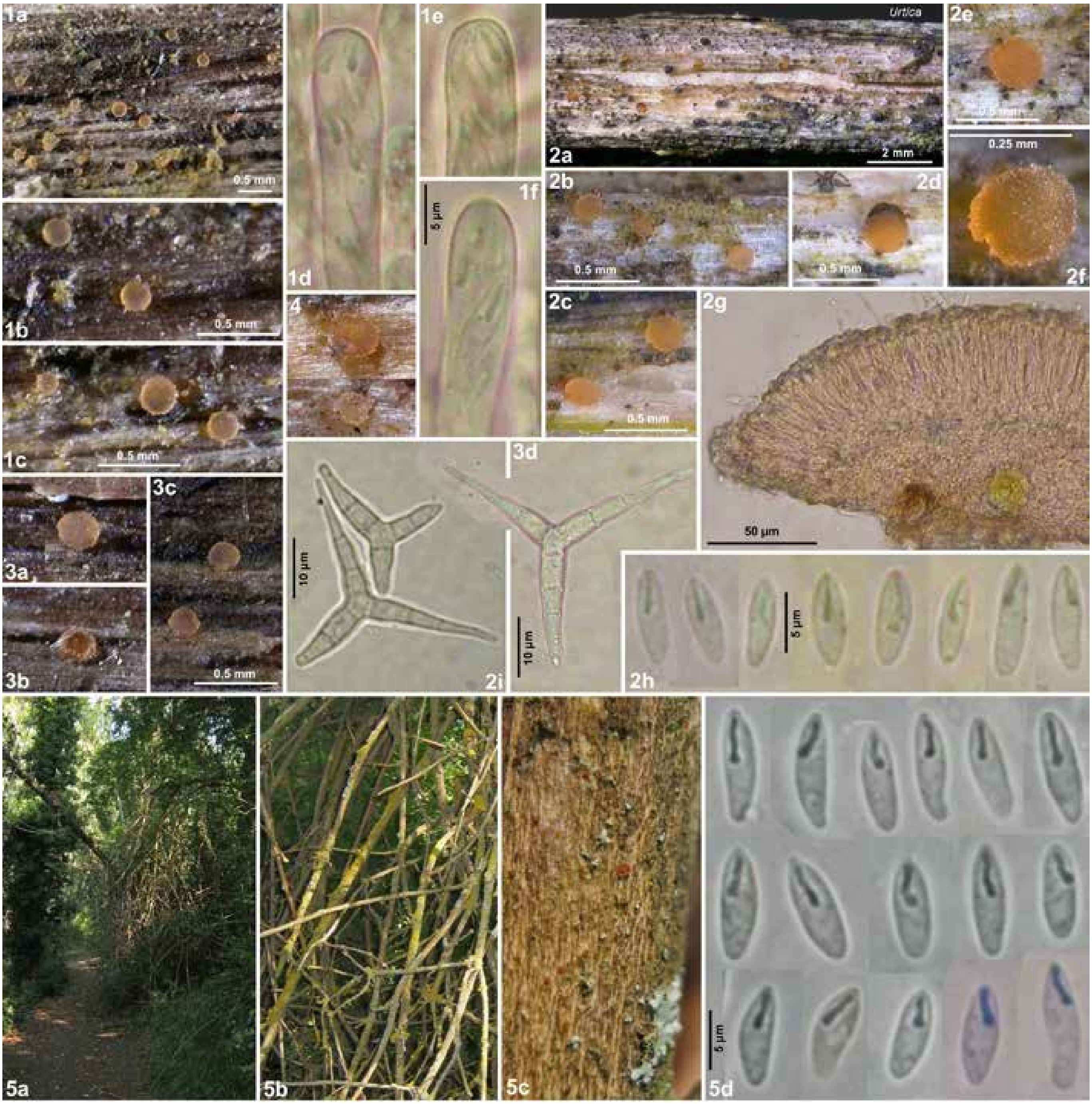


Plate 603. **1–5**: *Orbilia cylindrosoma* on herbaceous substrates. – **5a**. shady path near rivulet in suprasubmediterranean eastern Spain; **5b**. dead twigs of *Sambucus nigra* with *Xanthoria* and *Physcia*: **1a–c**, **2a–f**, **3a–c**, **4**. rehydrated apothecia; **5c**. dry apothecia on decorticated branch; **2g**. apothecium in median section; **1d–f**. asci; **2h**, **5d**. ascospores; **2i**, **3d**. conidia from substrate. – Living state, except for **3d** (in H_2O). – **5a–d**: phot. R. Tena. — **1a–f**. H.B. 7869a: Luxembourg, Bonnevoie, on *Heracleum*; **2a–i**. H.B. 9209a: ibid., Dudelange, on *Urtica*; **3a–d**. H.B. 6406a: ibid., Esch-sur-Alzette, on *Sambucus ebulus*; **4**. H.B. 7049: Germany, Tübingen, on *Euphorbia*; **5**. R.T.L. 13083101: Spain, Aragón, on *Sambucus nigra*.

from Castellón). The Russian sample is from a hemiboreal forest. The vegetation is mainly thermophilous on south-exposed slopes and includes ruderal sites, vineyards, and dry grasslands. The holotype on *Lonicera* was from a planted shrub on a north-exposed earth wall along a bypass road.

Specimens included. **GERMANY**: **Nordrhein-Westfalen**, 4 km E of Duisburg, 1 km NW of Raffelberg, near Solbad, 35 m, stem of *Urtica dioica*, 25.IV.2012, K. Müller (H.B. 9674a ø). – **Baden-Württemberg**, 5.5 km NW of Stuttgart, 1.8 km WNW of Feuerbach, Lemberg, vine yard, 360 m, stem of *Althaea ?ficifolia*, 1.X.2000, H.O. Baral (H.B. 6766, [CBS 140806 - not survived], anam. cult., anam. substr.). – 0.7 km S of Weilimdorf, SW of Köstlinschule, 335 m, branch of *Lonicera*, on wood, 23.VI.2000, H.O. Baral (ex H.B. 6711, M-0276469, **holotype**, CBS 116233, anam. cult.; sq.: KT215244). – 6 km WSW of Tübingen, 1 km WNW of Hirschau, Wurmlinger Kapelle, 400 m, stem of *Euphorbia cyparissias*, 3.X.2001, H.O. Baral (H.B. 7049). – 15 km NW of Freiburg, 3.3 km W of Eichstetten, Kaiserstuhl, N of Eichelspitze, 500 m, stem of *Sambucus ebulus*, 8.VIII.2013, K. Müller (H.B. 9835a ø). – 8 km NE of Radolfzell, 1.5 km SE of Bodman, 400 m, branch of *Robinia pseudoacacia*, on wood, 29.VIII.2001, H.O. Baral (H.B. 7018a). – **Bayern**, **Unterfranken**, 2.4 km WNW of Würzburg, Main river, Friedensbrücke, 173 m, branch of *Acer*, on wood, 15.II.2004, H.O. Baral (H.B. 7479). — **AUSTRIA**: **Wien**, 9.5 km SSE of Wien, S of Unterlaa, 185 m, stem of *Artemisia vulgaris*, 2.I.2014, R. Moosbeckhofer, vid. B. Wergen (B.W. C000072, doc. vid.). — **SERBIA**: **Vojvodina**, Fruška Gora, 10.7 km E of Šid, 3.5 km WNW of Erdevik, Vorovo, 130 m, branch of *Juglans regia*, on bark, 22.X.2019, D. Savić (doc. vid.). — **LUXEMBOURG**: **Gutland**, **Luxembourg**, 2.5 km S of Luxembourg, 1 km SW of Bonnevoie, railway depot, 282 m, stem of *Heracleum sphondylium*, 4.VIII.2005, G. Marson (H.B. 7869a). – 3.5 km S of Luxembourg, 0.7 km SW of Howald, railway depot, 285 m, stem of *Apiaceae*, 31.V.1999, G. Marson (ø, anam. substr.). – **Esch-sur-Alzette**, 2.5 km NNE of Dudelange, 1.5 km S of Bettembourg, railway, 277 m, stems of *Urtica dioica*,

Map 97. Known distribution of *O. cylindrosoma* in Europe (yellow = not included collection).

19.VII.2009, G. Marson (H.B. 9209a, anam. substr.). – 1 km S of Dudelange, railway, 290 m, stem of *Sambucus ebulus*, 17.V.1999, G. Marson (H.B. 6393, anam. substr.). – 2.5 km W of Esch-sur-Alzette, Belval Usines, 303 m, stem of *S. ebulus*, 10.VI.1999, G. Marson (H.B. 6406a, anam. substr.). — **FRANCE**: **Rhône-Alpes**, **Drôme**, 1 km N of Nyons, W of Col du Pontias, 415 m, branch of *Ficus carica*, on wood, 11.X.2002, G. Marson (H.B. 7231b, anam. substr.). — **SPAIN**: **Cataluña**, **Lérida**, 10 km WSW of Lérida, 2.5 km NW of Alcarràs, 160 m, leaf sheath of *Phragmites australis*, 21.IX.1999, G. Marson (H.B. 6470, anam. substr.). – **Aragón**, **Teruel**, 13.5 km SW of Montalbán, 1.1 km NE of Son del Puerto, Camino hacia el Molino viejo, 1253 m, branch of *Sambucus nigra*, on wood, 31.VIII.2013, R. Tena (R.T.L. 13083101, doc. vid.). — **RUSSIA (West)**: **Pskov**, **Loknya**, 43 km NW of Velikiye Luki, 4 km W of Samolukovo, Isakovo, 160 m, branch of *Malus domestica*, on wood, 20.VII.2011, E.S. Popov (LE 304402, doc. vid., anam. substr.).

Not included. **LUXEMBOURG**: **Gutland**, **Luxembourg**, 2.5 km S of Luxembourg, 1 km SW of Bonnevoie, railway depot, 282 m, stem of ?*Cirsium*, 27.V.1999, G. Marson (ø, anam. substr.). — **SPAIN**: **Com**. **Valenciana**, **Castellón**, 13.5 km NNW of Castellón, 3.2 km WSW of Vilafamés, Camí Costur, 400 m, stem of *Foeniculum vulgare*, 27.IX.1999, H.O. Baral & G. Marson (H.B. 6509c ø).

Orbilia acaciae Baral & G. Marson, **sp. nov.**, MB 813666 — Pls 604–605, Map 98 [non *Orbilia acaciae* Gaikwad, nom. nud., ?section *Helicoon*]

Etymology: named after the substrate of the type, *Acacia georginae*.

Typification: Australia, Queensland, Karoon Station, branches of *Acacia georginae*, 16.X.1998, G. Marson (ex H.B. 6615b, BRI AQ799189, holotype).

Latin diagnosis: *Similis* Orbiliae obtusisporae *et* O. cylindrosomati *sed cellulae excipuli et paraphysium in statu vivo corpuscula crystalloidea continentes. Habitat ad lignum putridum ramorum siccorum arborum angiospermarum, etiam ad petiolos* Livistonae *et caules* Euphorbiae, *in zona tropica vel subtropica subhumida ad hyperarida Australiae, Africae australis et Macaronesiae.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.15–)0.2–0.5(–0.7) mm diam., (0.12–)0.14–0.21(–0.25) mm high, (pale to) light (to bright) (rose-)orange(-ochraceous), not or slightly translucent, round (to elliptical), scattered to subgregarious; disc slightly concave to flat, margin distinct, 0–20 µm protruding, smooth or often (very) finely rough to crenulate or fimbriate; broadly sessile, superficial to slightly or strongly erumpent; dry bright orange, slightly to strongly contracted. **Asci** *(35–)40–65(–72) × (5–)5.5–6.5(–7) µm {6}, †40–60 × 4.7–5.7 µm {3}, 8-spored, spores *2–3-seriate, (2–)3–5(–7) lower spores inverted {6} (sometimes mixed), pars sporifera *(19–)23–28(–31) µm long; **apex** (†) medium to strongly truncate (not indented, laterally distinctly inflated or not); **base** without or with short to long, thin or thick, flexuous stalk, T-, L-, Y- or h-shaped. **Ascospores** *(6–)7.5–11(–13.3) × ((1.8–))2.1–2.7((–2.8)) µm {7}, subcylindric to narrowly ellipsoid or often fusoid-clavate, apex obtuse, sometimes rounded or subacute, base mostly slightly to medium (exceptionally strongly) attenuated, sometimes forming a short and thick tail, straight or slightly (rarely medium) curved, especially near base; **SBs** *(2–)2.5–4.5(–5.2) {6} × 0.2–0.5(–0.6) {5} or (0.5–)0.6–0.9 {1} µm (in situ and actual length), filiform to subulate, not or slightly inflated at base, straight to slightly flexuous, rarely uncinate. **Paraphyses** apically slightly to medium clavate-capitate, in some collections (not) rarely ellipsoid to subspathulate, terminal cells */†5.5–18 × (2–)2.5–4.2(–5) µm {7}, lower cells *(5.5–)7–12(–15) × 1.3–2.5(–3.3) µm {6}; rarely branched at upper septum. **Medullary excipulum** very pale orange, 25–60 µm thick, of dense textura intricata with many inflated cells, sharply delimited only at flanks. **Ectal excipulum** pale orange, of (†) thin-walled, indistinctly to vertically oriented t. angularis or t. prismatica from base to margin, (40–)60–80(–105) µm thick near base, cells *8–17 × 7–12 µm {2} or (10–)15–35(–45) × (8–)10–17(–20) µm {1}; 15–30 µm thick near margin, oriented at a (0–)10–45° angle to the surface, marginal cortical cells */†7–11(–13) × (2–)2.5–4(–5) µm {5} or *6–8 × 5–6 µm {1}, often protruding as 10–20 µm long 1-septate hairs which converge by forming small teeth {4}, also hairless {2}. **Anchoring hyphae** ± sparse, *2–3 µm wide, walls 0.2 µm thick {2}, sometimes also covering the margin. **SCBs** in paraphyses and ectal excipulum (near margin) globose, 1–3 µm diam.; also rod- or ring- to horseshoe-shaped {6}, hyaline to very pale orange, in excipulum at flanks 3–9 × 2–4.5 µm. **Exudate** over paraphyses 0.2–1(–2) µm thick, rough, firmly attached; over margin and flanks ± absent or usually 0.1–0.3 µm {2} up to 0.2–1.5(–4) µm {4} thick, rough to cloddy, very pale to light yellow-chlorinaceous. **— ANAMORPH**: unknown.

Habitat: collected 0.2–5 m above the ground, decorticated, 4–25 mm thick twigs and branches of *Acacia georginae* {1}, *Brachychiton gregorii* {1}, *Euphorbia canariensis* {5}, *Geijera parviflora* {1}, *Melaleuca* sp. {1}, *Vachellia erioloba* {1}, 0.2–1 mm deep strongly decayed wood {6}, also on petioles of *Livistona nitida* {1}, slightly to strongly greyed, no algae. **Associated**: *Capronia* sp. {1}, *Diatrypaceae* {1}, *Frullania* sp. {1}, *Gloniopsis* sp. {1}, *Hyalorbilia ?orbiliicola* (parasitic on *O. acaciae*) {1}, *Hysteropatella* sp. {1}, *Mellitiosporiella* sp. {1}, *Orbilia albidorosea* {1}, *O. asomatica* {1}, O. ?*australiensis* {2}, *O. austroobtusispora* {1}, *O. brachychitonis* {1}, *O. cejpii* {1}, *O.* ?*commarosa* {1}, *O. corculispora* {1}, *O. coronohesperidea* {1}, O. ?*dixiensis* {1}, *O. geijerae* {1}, *O. livistonae* {1}, *O. microserpens* {1}, *O. multiserpens* {1}, *O. myrioeuonymi* {1}, *O. nothovinosa* {1}, *O. palmicola* {1}, *O. parviclava* {1}, *O.* ?*pleiogambelii* {1}, *O. pleiohesperidea* {1}, *Rhytidhysteron* sp. {1}, *Thyronectria* sp. {1}. **Desiccation tolerance**: fully tolerant for at least 25 months. **Altitude**: 10–570 m a.s.l. **Geology**: Permian & Jurassic sedimentary rock, Cenozoic regolith. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia acaciae* resembles European *O. obtusispora* and *O. cylindrosoma* in the ascospores and a slightly crenulate or hairy margin, but differs in abundant crystalloid SCBs in paraphyses and excipulum which are absent in those species. Because of its spore shape *O. acaciae* might better be placed in series *Ellipsospermae*. For instance, it can be compared with the southern European *O. subvitalbae* on monocots, sharing similar spores and crystalloid SCBs. *O. subvitalbae* differs in shorter and wider spores, basally inflated SBs, and a smooth margin (though *O. acaciae* has sometimes a smooth margin too). Also the Australian *O. octocercocarpi* (p. 1212) differs from *O. acaciae* in wider spores and appears to show closer affinities to *O. gambelii*. *O. ungulata* differs in distinctly smaller spores and is so far only known from Europe, and *O. pleioungulata* mainly differs in 16-spored asci and slightly smaller spores while showing a similar distribution as *O. acaciae*.

Variation. The collection on petioles of *Livistona* differs from the six on woody substrates (including that on *Euphorbia*)

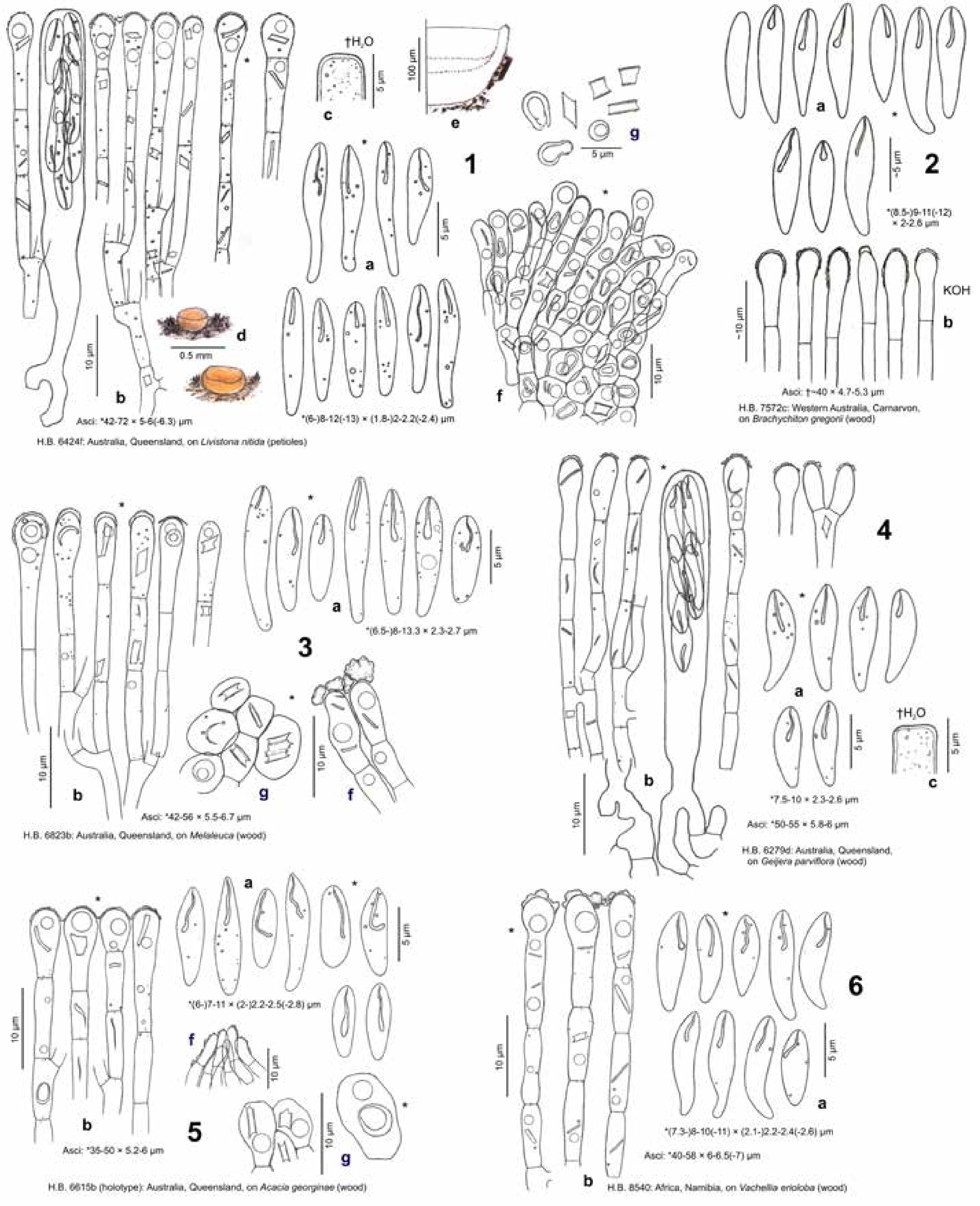


Plate 604. **1–6**: *Orbilia acaciae*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. rehydrated apothecia; **e**. apothecium in median section; **f**. id., marginal ectal excipulum (but surface view in **5f**); **g**. crystalloid SCBs in cells of ectal excipulum.

in slightly narrower spores, but the other collections also vary in spore length and width. The southwestern African and Macaronesian collections here referred to *O. acaciae* are without hair-like protrusions at the margin, and also in most of the Australian collections some of the apothecia had rather smooth margins. In the only collection from western Australia (Pl. 604: 2, on *Brachychiton*) merely the spores were viable when studied, therefore, its identity remains a bit unsure.

In the Macaronesian collections on *Euphorbia* (Pl. 605: 3) the SBs were distinctly wider (0.5–0.9 instead of 0.2–0.6 µm),

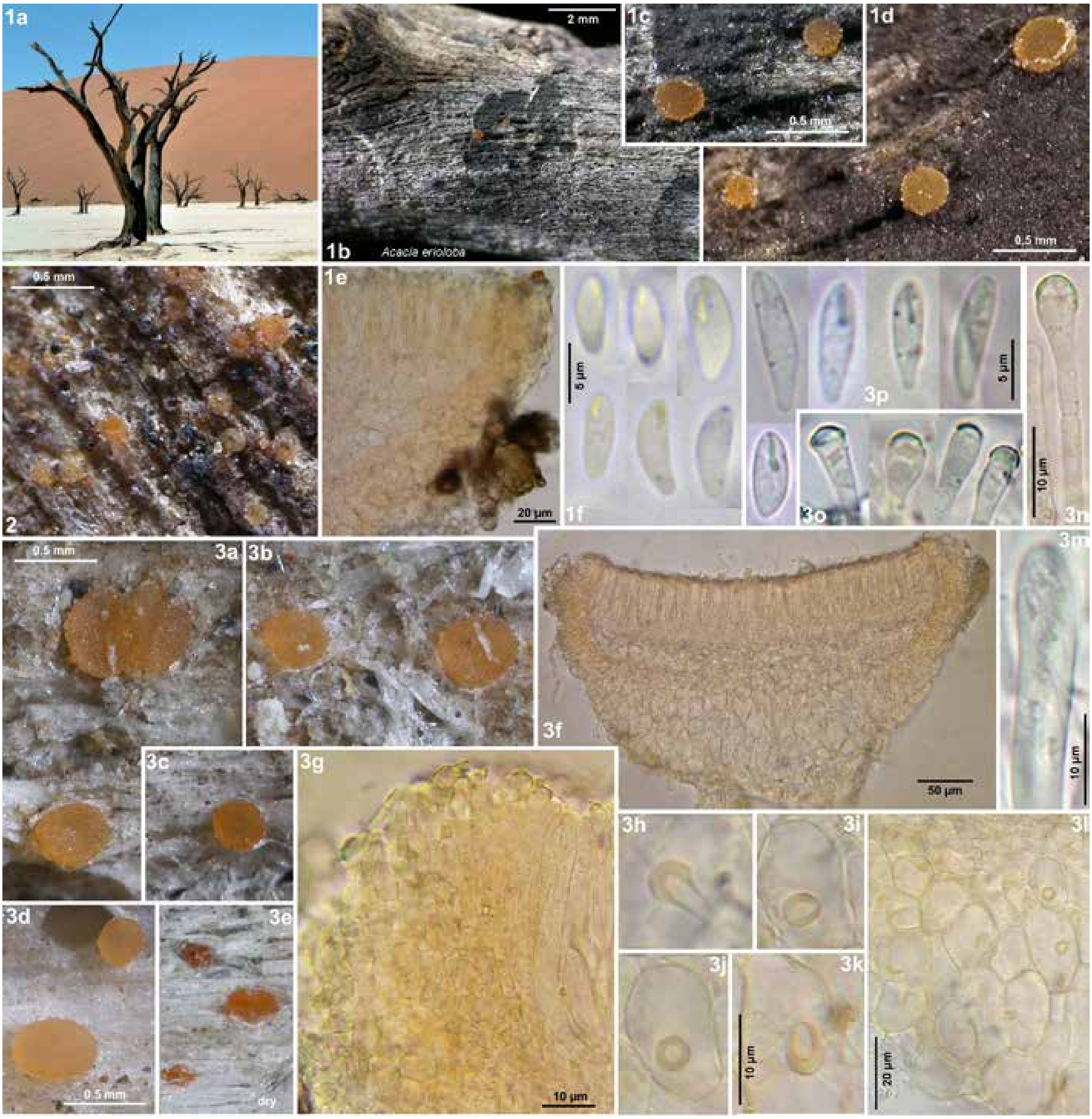


Plate 605. **1–3**: *Orbilia acaciae*. – **1a**. dead *Vachellia* trees in Namib Desert; **1b–e**, **2**, **3a–d**. rehydrated apothecia; **3e**. dry apothecia; **1e**, **3f**. apothecia in median section; **3g**. id., marginal ectal excipulum; **3l**. id., basal ectal excipulum with crystalloid SCBs; **3h–k**. id., closeup; **3m**. ascus; **3n–o**. upper part of paraphyses; **1f**, **3p**. ascospores. – Living state; **1a**: phot. C. Traving (from internet), **3m**, **o–p**: phot. L. Quijada. — **1a–f**. H.B. 8540: Africa, Namibia, on *Vachellia*; **2**. H.B. 6615b (holotype): Australia, Queensland, on *Acacia*; **3a–p**. H.B. 9153a: Macaronesia, Tenerife, on *Euphorbia*.

the basal excipular cells much larger (10–45 × 8–20 instead of 8–17 × 7–12 µm), and the apothecia thicker (160–250 instead of 120–170 µm), nevertheless, we believe that they are conspecific. The apothecia were usually rather small (0.15–0.4 mm diam., including holotype), but in that from Macaronesia they measured 0.3–0.6 mm and in that on *Brachychiton* 0.35–0.7 mm.

Ecology. *O. acaciae* was found on rotten wood of xeric twigs and branches of angiosperms including succulents, also on petioles of a palm. The species appears to occur worldwide in the subtropical and tropical belt. In northeastern and eastern Australia (Great Dividing Range) and in western Australia near the coastline it occurred in tropical to subtropical semiarid to subhumid acacia shrublands, eucalypt woodlands, and savannahs. The site in southwestern Africa is a subtropical hyperarid dry riverbed ('Deadvlei') that did not get groundwater since over 500 years because it was cut off by a sand dune, and *O. acaciae* grew there on the attached twig of a tree of *Vachellia erioloba* which had died since about that time; the place is not far from the salt pan where the active though also mostly dry riverbed ends in the Namib Desert. In Macaronesia *O. acaciae* was repeatedly discovered in three areas of Tenerife on *Euphorbia canariensis* in subtropical (inframediterranean) semi- to hyperarid xerophytic scrublands, mainly in the tabaibal dulce (*Ceropegio fuscae-Euphorbietum balsamiferae*) but also in the *Artemisio thusculae-Rumicion lunariae* (Quijada, 2010).

Map 98. Known distribution of *O. acaciae* in Australia.

Specimens included. **AUSTRALIA**: **Western Australia**, Carnarvon, 160 km SSE of Carnarvon, Peron Peninsula, 18 km SE of Shell Beach, 48 m, branch of *Brachychiton gregorii*, on wood, 8.XII.2001, G. Marson (H.B. 7572c). – **Queensland**, Desert Uplands, 57 km E of Hughenden, 3 km WSW of Karoon Station, 437 m, branches of *Acacia georginae*, on wood, 16.X.1998, G. Marson (ex H.B. 6615b, BRI AQ799189, **holotype**). – Brigalow Belt South, 80 km N of Goondiwindi, 10 km S of Moonie, 278 m, branches of *Melaleuca*, on wood, 23.X.1998, G. Marson (H.B. 6823b). – 138 km SSW of Rockhampton, 11 km SW of Banana, 136 m, branch of *Geijera parviflora*, on wood, 22.X.1998, G. Marson (H.B. 6279d). – 69 km SSW of Theodore, 15 km N of Taroom, Palm-Tree Creek, Roy Staines Bridge, 200 m, leaves of *Livistona nitida*, on petioles, 22.X.1998, G. Marson (H.B. 6424f). — **NAMIBIA**: **Hardap**, Namib-Naukluft, 300 km SW of Windhoek, Sossusvlei, Deadvlei, 570 m, branch of *Vachellia erioloba*, on wood, 19.V.2007, G. Parisot (H.B. 8540). — **MACARONESIA**: **Canary Islands**, **Tenerife**, Arico, 1 km WSW of Abades, Barranco la Vera, 50 m, branch of *Euphorbia canariensis*, on wood, 5.VI.2009, L. Quijada, R. Castro & E.V. Rodríguez (TFC Mic. 22165, 22242, H.B. 9153a). – San Miguel de Abona, 4 km SSW of Las Chafiras, 1.5 km NE of Costa del Silencio, Montaña Amarilla, 30 m, on *E. canariensis* (TFC Mic. 22674, 22675, 22677, 22861, non vid.). – ibid. 1.2 km ENE of Costa del Silencio, 10 m, on *E. canariensis* (TFC Mic. 22167, 22170, 22171, non vid.). – Buenavista del Norte, 7 km WSW of Buenavista del Norte, ~4 km W of Teno Alto, Punta de Teno, 20–200 m, on *E. canariensis*, TFC Mic. 22258, 22274, 22279, 22285, 22287, 22293, 22295-6, non vid.). – ibid., 2.8 km WNW of Teno Alto, Punta de Teno, 130 m, on *E. canariensis* (TFC Mic. 22861, non vid.).

Orbilia maeandrina Baral & G. Marson, **sp. nov.**, MB 813667 — Pls 606–607, Map 99

Etymology: named after the flexuous, meandering spore bodies.

Typification: USA, Utah, Dixie Forest, Zion Overlook, branch of *Populus tremuloides*, 24.VIII.1994, G. Marson (ex H.B. 5230a, M-0276506, holotype).

Latin diagnosis: *Similis* Orbiliae trapeziformi *sed asci 16-spori, locis subtropicis aridis ad borealibus humidis Americae, Africae et Asiae.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.15–)0.25–0.6(–0.8) mm diam., 0.13–0.23 mm high, light to bright orange (to dirty brick-red), round, scattered to often medium gregarious; disc (slightly concave to) flat, margin distinct, thin, 5–40 µm protruding, ± smooth or finely rough by covering hyphae; sessile, superficial or mostly distinctly erumpent from beneath outer host tissue or immersed in biofilm. **Asci** *(50–)60–84(–95)((–108)) × (6–)7–8.5(–9.7) µm {13}, †(50–)55–75(–88) × (5–)5.5–7.5(–8) µm {10}, 16-spored, spores *2–4-seriate, (3–)6–9(–10) lower spores inverted {7} (not or slightly mixed), pars sporifera *(29–)35–45(–50) µm long, †40–60 µm; **apex** (†) (slightly to) medium or strongly truncate (sometimes slightly or strongly indented, laterally strongly inflated or not); **base** with short to long, thick, flexuous stalk, T-, L- or h-shaped. **Ascospores** *(6–)7–9.5(–11) × (2.3–)2.5–3.5(–3.8)((–4)) µm {21}, †(6–)7–9(–10) × (2–)2.2–3.3 µm {7}, fusoid to fusiform, also fusoid-clavate, amygdaliform or tear-shaped, apex subacute to acute (to acuminate), rarely obtuse, base not or slightly to strongly attenuated, never with a distinct tail-like base; straight to slightly inequilateral, sometimes slightly curved at base; **SBs** *(4–)5–8(–9) × 0.6–1.2 µm in situ {13} (~4.5–9.5 µm actual length), vermiform to subulate, base not or very slightly inflated, slightly to strongly flexuous, sometimes uncinate. **Paraphyses** apically medium to (very) strongly clavate-capitate, sometimes moniliform, terminal cells *(4.5–)8–21 × (2.5–)3–5(–6) µm {9}, †(2.5–)3–5 µm wide {2}, lower cells *7–19 × (1–)1.5–2(–2.5) µm {6}, †0.8–2 µm wide; rarely or not infrequently branched at upper septum, hymenium pale orange-rose. **Medullary excipulum** very pale orange, 20–50 µm thick, of loose to dense textura intricata, partly horizontally oriented, with many inflated cells, sharply delimited. **Ectal excipulum** hyaline († pale rose), of thin-walled, (†) slightly to medium gelatinized (common walls 0.7–1.3 µm), vertically or indistinctly oriented t. (globulosa-)angularis(-prismatica) from base to margin, 30–50(–100) µm thick near base, cells *8–25(–32) × 6–14(–17) µm {7}; 25–30 µm thick at flanks, 20–35 µm near margin, irregularly oriented at a 70–90° or 10–40° angle to the surface, marginal cortical cells *5–11 × (2–)3–5(–6) µm {3}, †6–10 × 2.5–4 µm {2}. **Anchoring hyphae** very sparse to abundant, */†2–3.8 µm wide, walls *0.2–0.4 µm thick, †0.2–0.7 µm {5}, forming an up to 50 µm thick dense, medium gelatinized t. intricata, partly covering flanks and margin as a 10–20 µm thick layer. **SCBs** in paraphyses and ectal excipulum (near margin) globose {16}, (0.6–)1–2.5(–3) µm diam. (up to 3.7 µm in excipulum). **Exudate** over paraphyses and excipulum (margin and flanks) 0.2–2 µm thick, granular-cloddy, hyaline to very pale yellowish, loosely attached, often lacking. — **ANAMORPH**: trinacrium-like (presumed, from natural substrate {1}). **Conidiophores** not observed. **Conidia** Y-shaped, total size †(20–)25–30 × (12.5–)32–33 µm, stipe †14–20 × 4.5–6 µm, 2-septate, arms †(5–)16–17 × 4.5–5 µm, 2–3-septate {1}, arms and stipe more or less abruptly tapering.

Habitat: collected (0–)0.1–3 m above the ground, partially to entirely decorticated, 4–30 mm thick twigs and branches of *Abies concolor* {1}, *Acacia* sp. {1}, *Amelanchier ?alnifolia* {1}, *A. utahensis* {2}, *Cercocarpus betuloides* {1}, *C. ledifolius* {1}, *Ephedra ?viridis* {1}, *Lonicera microphylla* {1}, *Olneya tesota* {2}, *Parkinsonia microphylla* {1/1}, *Picea* sp. {1}, *P. sitchensis* {1}, *Populus tremuloides* {3}, *Prunus virginiana* {1}, *Purshia stansburyana* {4}, *Ribes cereum* {1}, *Salix* sp. {1}, *Sarcobatus vermiculatus* {1}, *Ulmus* sp. {1}, ?*Vachellia* sp. {1}, indet. angiosperms {2}, on 0.3–1.5 mm deep (medium to) strongly decayed wood {21}, rarely bark {4}, partly eroded, sometimes in galleries and on boring dust of bark beetles, medium to strongly greyed, green algae absent or sparse. **Associated**: *Acanthostigma ellisii* {1}, ?*Baggea* sp. {1}, ?*Calloriaceae* {1}, *Caloplaca* sp. {1}, *Candelariella* sp. {1/1}, *Capronia* sp. {1}, *Carestiella schizoxyloides* {1}, '*Chlorosplenium*' *viridulum* {1}, *Crumenulopsis* sp. {1}, *Cyathicula* sp. {1}, *Dothideales* {1}, *Durella* sp. {2/2}, *D.* ?*atrocyanea* {1}, *Hypogymnia* sp. {1}, *Hysterobrevium mori* {3}, *Hysteropatella* sp. {1}, ?*Melanelia* sp. {1}, *Melaspilea emergens* {4}, *Mellitiosporiella macrospora* {1}, *M. pulchella* {3}, *Odontotrema oregonensis* {1}, *Orbilia aristata* {1}, *O. arizonensis* {3}, *O. barrowensis* {1/1}, *O. basiflexa* {1}, *O. calyptrata* {2}, *O. carpoboloides* {1}, *O. clavipisca* {1}, *O.* ?*commarosa* {1}, *O. concoloris* {1}, *O. coniferarum* {2}, *O. delphinus* {12}, *O. euonymi* {1}, *O. flexisoma* {1/3}, *O.* ?*gambelii* {1}, *O. idahoensis* {1}, *O. lacrimispora* {1}, *O. lentiformis* {2/2}, *O. macrodelphinus* {3}, *O. macrohesperidea* {1}, *O. magnifica* {2}, *O. microsoma* {1}, *O. multicercocarpi* {1}, *O. multicreosoteris* {2}, *O. multigambelii* {2}, *O. multimaeandrina* {3}, *O.* ?*multiphanosoma* {1}, *O. multiserpens* {1}, *O. myrioflexa* {1}, *O. myrioolneyae* {3}, *O. myriourosperma* {3}, *O. namibica* {1}, *O. ocellata* {1}, *O. ophiosoma* {1/1}, *O. paloverdensis* {1}, *O. pleionavajoana* {1}, *O. pleioserpens* {1}, *O. pleiostomachia* {1}, *O. pleioungulata* {1}, *O. pluristomachia* {3}, *O. pubescens* {1}, *O. purshiae* {4}, *O. sedonensis* {1}, *O. serpentina* {1}, *O. sonorensis* {2}, *O. stansburyanae* {1}, *O. subovoidea* {1}, *Patellaria atrata* {3}, *P. andina* {4}, ?*Peniophora* sp. {1}, *Perrotia flammea* {4}, *Propolis farinosa* {1}, ?*Schizoxylon* sp. {1}, *S.* ?*argentinum* {2}, *Sclerococcum* sp. {1}, *Stenocybe* sp. {1},

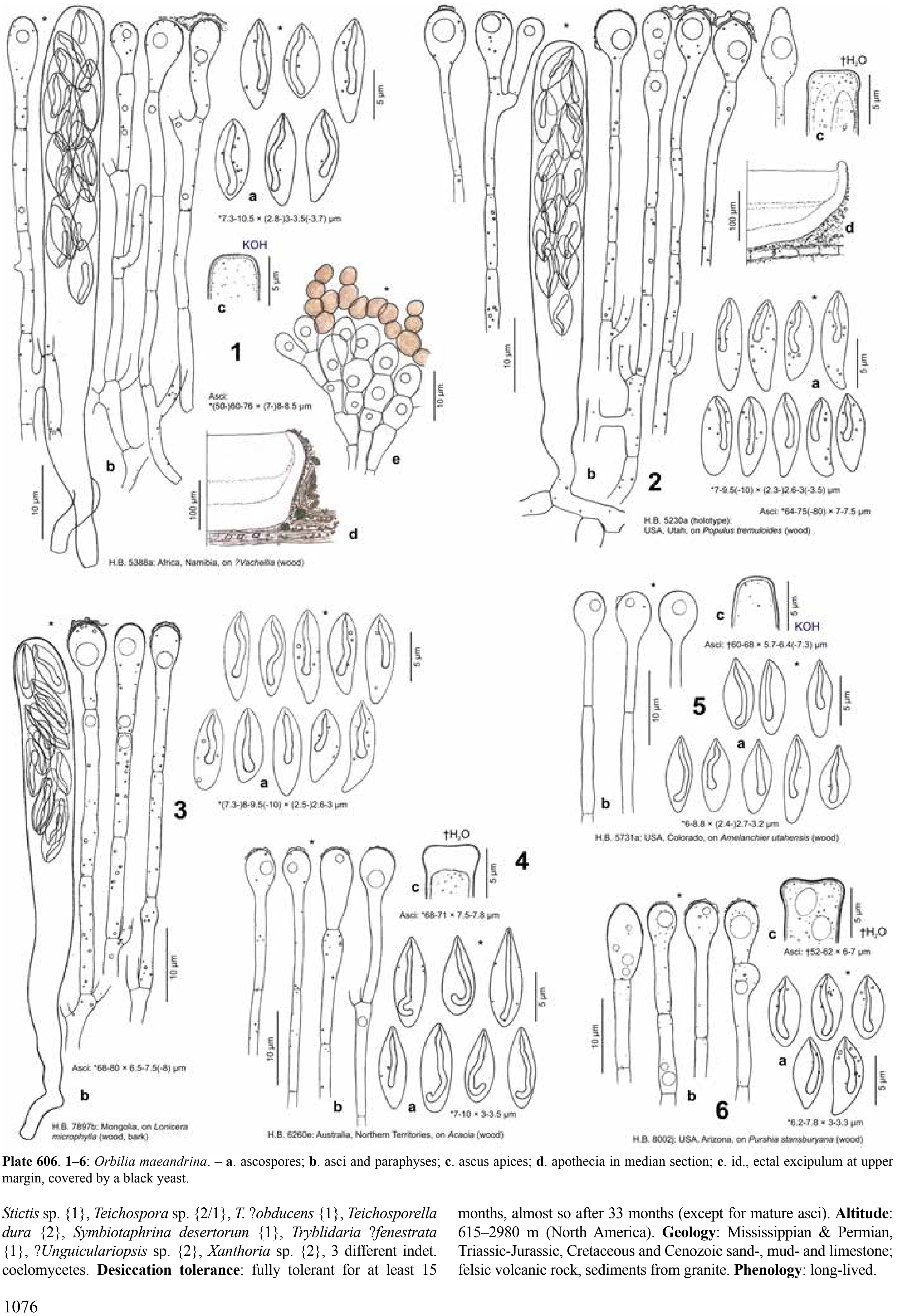


Plate 606. **1–6**: *Orbilia maeandrina*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. apothecia in median section; **e**. id., ectal excipulum at upper margin, covered by a black yeast.

Stictis sp. {1}, *Teichospora* sp. {2/1}, *T.* ?*obducens* {1}, *Teichosporella dura* {2}, *Symbiotaphrina desertorum* {1}, *Tryblidaria* ?*fenestrata* {1}, ?*Unguiculariopsis* sp. {2}, *Xanthoria* sp. {2}, 3 different indet. coelomycetes. **Desiccation tolerance**: fully tolerant for at least 15 months, almost so after 33 months (except for mature asci). **Altitude**: 615–2980 m (North America). **Geology**: Mississippian & Permian, Triassic-Jurassic, Cretaceous and Cenozoic sand-, mud- and limestone; felsic volcanic rock, sediments from granite. **Phenology**: long-lived.

Plate 607. **1–6**: *Orbilia maeandrina*. – **4**. *Abies concolor* and *Pseudotsuga menziesii* in a montane conifer forest in the Douglas fir mixed forest; **1a–e**, **2a–b**, **3a**, **5a**, **6a**. rehydrated apothecia; **1g**. apothecium in median section; **3b**, **6b**. id., marginal ectal excipulum; **1h**. id., basal excipulum and layer of algae and black yeasts beneath; **1j**, **3c–d**. ascospores inside asci; **5b**. conidia from substrate. – Living state, except for **1i**, **5b** (in H_2O). — **1a–j**. H.B. 8056a: USA, Arizona, on *Amelanchier*; **2a–b**. H.B. 8061d: USA, Utah, on *Purshia*; **3a–d**. H.B. 7573a: USA, Arizona, Sells, on *Olneya*; **4**. H.B. 8095e: Bryce Canyon, on *Abies concolor*; **5a–b**. H.B. 9086a: France, Ile de Porquerolles, on *Ulmus*; **6a–b**. H.B. 7897b: Mongolia, on *Lonicera*.

Taxonomic remarks. *Orbilia maeandrina* is characterized by 16-spored asci, medium-sized, amygdaliform to rhomboid ascospores with ± long, vermiform SBs, and globose SCBs. It resembles the 8-spored European *O. trapeziformis* especially in the spores and absence of crystalloid SCBs. The very close 16-spored *O. serpentina* can be segregated from *O. maeandrina* mainly based on the consistent presence of crystalloid SCBs, also on very slightly longer spores. *O. delphinus* differs from *O. maeandrina* in narrower, usually longer spores and appears to be sharply delimited although often growing in association. *O. macrodelphinus* differs from *O. maeandrina* in longer and/or narrower, partly basally distinctly curved spores, but the distinction is not sharp. *O. cisti* (series *Ellipsospermae*) differs in more obtuse spore apices, much narrower SBs, narrower asci, and absence of any kind of SCBs. A collection mentioned under *O. pleioserpens* (Pl. 736: 4) differs in shorter, apically more obtuse spores.

Variation. Some of the included specimens (Pl. 606: 5, and H.B. 6037c) have partly tear-shaped spores with acuminate apices, and particularly the single Australian collection (Pl. 606: 4) also rather long, basally hooked SBs similar as in *O. lacrimispora*. Great variation in apothecial size and colour was noted among the collections, but the microscopical features support that only one species is involved. Spores and paraphyses in the collection from southern France (IVV: H.B. 9086a) fit well those of the extra-European ones, particularly Pl. 606: 5.

Anamorph. The trinacrium-like conidia observed on the natural substrate are similar to those of *O. trapeziformis* or *O. serpentina*.

Ecology. *O. maeandrina* grew on rotten wood (rarely bark) of xeric twigs and branches of various angiosperm trees and shrubs, rarely gymnosperms. The species was mainly collected in western North America in subtropical semiarid Sonoran paloverde-mixed cacti desert scrubs, cold-temperate subhumid pinyon-juniper woodlands of the Great Basin and Colorado Plateau, and in cold-temperate to boreal humid ponderosa pine, Douglas fir, and Engelmann spruce forests of Middle and Southern Rocky Mountains. Single records are from the hot, subtropical arid (winter-dry) Kalahari highland thornbush savannah in southwestern Africa, a continental, orotemperate (sub)humid (winter-dry), south-exposed subalpine scrub with *Juniperus sabina* in central Asia, and a tropical arid acacia open shrubland in central Australia. In southern France it occurred on *Ulmus* in the thermomediterranean zone.

Specimens included. **FRANCE**: **Provence-Alpes-Côte d'Azur**, **Var**, Îles d'Hyères, Île de Porquerolles, centre of island, ~40 m, branch of *Ulmus*, on wood, 1.XI.2006, H. Aeberhard (H.B. 9086a, anam. substr.). — **MONGOLIA**: **Bayan Ölgii**, Sagsai, Altay Mts., Tavan Bogd, 25 km SE of Dayan lake, 8.5 km NE of Chinese border, Songino Gol river valley, 2095 m, branch of *Lonicera microphylla*, on wood & bark, 16.VIII.2005, P. Karasch (H.B. 7897b). — **NAMIBIA**: **Khomas**, 60 km S of Windhoek, 25 km N of Rehoboth, Central Plateau, Auas Mts., 1560 m, branch of ?*Vachellia*, on wood, 25.VIII.1995, R. Reuter (ex H.B. 5388a, in M-0276529 [*O. myrioflexa*]). — **AUSTRALIA**: **Northern Territories**, Burt Plain, 31 km SW of Barrow-Creek Hotel, 3.7 km WSW of Wilora, 480 m, branch of *Acacia*, on wood, 8.X.1998, G. Marson (H.B. 6260e). — **USA**: **Idaho**, Columbia Plateau, 60 km E of Idaho Falls, 47 km W of Jackson, Swan Valley, 1750 m, branch of *Amelanchier* ?*alnifolia*, on wood, 5.VI.1996, G. Marson (H.B. 6037c ø). – Great Basin, 30 km SE of Pocatello, McCammon, 1440 m, branch of *Prunus virginiana*, on wood, 3.VI.1996, G. Marson (ø). – **Colorado**, Southern Rocky Mountains, 65 km SW of Denver, 7.5 km WNW of Shawnee, Santa Maria, 2615 m, branch of *Ribes cereum*, on wood, 14.VI.1996, G. Marson (H.B. 5705i ø). – Uinta Basin, 50 km ESE of Vernal, 6 km NE of Dinosaur, 2100 m, on *Cercocarpus betuloides*, 12.VI.1996, G. Marson (ø). – Canyonlands, 15.5 km SSE of Cortez, Mesa Verde, 5 km NNW of Spruce Tree House, 2290 m, branch of *Amelanchier utahensis*, on wood, 31.V.1996, G. Marson (H.B. 5731a). – **Utah**, Uinta Mts., 34 km NNE of Vernal, 34 km SE of Manila, 2570 m, on *Populus tremuloides*, 11.VI.1996, G. Marson (ø). – Canyonlands, 33 km W of Blanding, 2 km NNE of Bears Ears East, 2600 m, branches of *P. tremuloides*, on wood, 14.VI.2000, G. Marson (H.B. 7180c). – Utah Mts., Dixie Forest, 22 km SSE of Torrey, 13 km S of Grover, 1 km N of Pleasant Creek Campground, 2650 m, branch of *Picea sitchensis*, on bark, 19.VI.2000, G. Marson (ø). – 10 km N of Boulder, 3.5 km W of Deer Mt., 2433 m, branch of *Purshia stansburyana*, on wood, 11.VI.2003, G. Marson (H.B. 7918g ø). – 22 km ESE of Cedar City, 18 km WNW of Duck Creek Village, Zion Overlook, 2980 m, branch of *Populus tremuloides*, on wood, 24.VIII.1994, G. Marson (ex H.B. 5230a, M-0276506, **holotype**). – 19 km ENE of Springdale, 11 km WNW of Mt. Carmel Junction, 1880 m, branch of *Purshia stansburyana*, on wood, 14.VI.2003, G. Marson (H.B. 8061d). – 11 km NNE of Glendale, 6.5 km WSW of Alton, 2095 m, branch of *Salix*, on wood, 21.VI.2000, G. Marson (H.B. 7220b). – Bryce Canyon, 32 km SE of Panguitch, 13 km WSW of Tropic, near Trough Spring, 2500 m, branch of *Abies concolor*, on wood, 13.VI.2003, G. Marson (H.B. 8095e ø). – **Arizona**, Grand Canyon, Kaibab Plateau, 28 km ESE of Fredonia, 13 km NNW of Jacob Lake, 2115 m, branch of *P. stansburyana*, on wood, 15.VI.2003, G. Marson (H.B. 8002j). – 93 km SSE of Fredonia, S of North Rim, 2500 m, branch of *Cercocarpus ledifolius*, 17.V.1995, G. Marson (ø). – 3 km N of Kaibab Lodge, 2680 m, branch of *Picea*, on bark, 17.V.1995, G. Marson (ø). – Coconino Plateau, 15 km ESE of Grand Canyon Village, Grandview Point, 2260 m, branches of *Amelanchier utahensis*, on wood, 16.VI.2003, G. Marson (H.B. 8056a). – 7.5 km ESE of Grand Canyon Village, close to South Rim, 2205 m, branch of *P. stansburyana*, on wood, 16.VI.2003, G. Marson (ø). – Sonoran Desert, 40 km NNE of Tucson, 11 km NE of Catalina, Casa del Oro, Biosphere, 1165 m, of *Parkinsonia microphylla*, 7.V.1995, G. Marson (ø). – 100 km WSW of Tucson, 10 km NW of Sells, 683 m, twig & branch of *Olneya tesota*, on wood, 28.V.2003, G. Marson (H.B. 7573a). – 19 km W of Tucson, W of Old Tucson Studios, 810 m, branch of *P.* (?)*microphylla*, on wood, 6.V.1995, G. Marson (H.B. 5671f). – 25 km WNW of Tucson, 5 km S of Picture Rocks, Saguaro, 745 m, branch of *O. tesota*, on bark, 30.V.2003, G. Marson (H.B. 8085c). – 17.5 km NNE of Lukeville, Organ Pipe, Ajo Mountain Trail, 710 m, branch of *Sarcobatus vermiculatus*, 5.V.1995, G. Marson (H.B. 5806c ø). – 82 km NW of Phoenix, ~1.5 km SE of Wickenburg, 615 m, branch of *Ephedra* ?*viridis*, on wood, 4.V.1995, G. Marson (H.B. 5894e). – ibid., branch of indet. angiosperm, 4.V.1995, G. Marson (H.B. 8579b ø).

Map 99. Known distribution of *O. maeandrina* in North America.

Orbilia multimaeandrina Baral & G. Marson, **sp. nov.**, MB 813668 — Pls 608–609, Map 100

Etymology: named after the resemblance to *O. maeandrina* in the teleomorph but differing in 32-spored asci.

Typification: USA, Utah, Moab, branches of *Cercocarpus betuloides*, 16.VI.2000, G. Marson (ex H.B. 6737a, M-0276523, holotype; ex-type culture: CBS 116221; sq.: KT215243).

Latin diagnosis: *Similis* Orbiliae maeandrinae *sed asci 32-spori*, status anamorphicus *conidiis multiseptatis, plus minusve curvatis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.2–0.5(–0.7) mm diam., 0.16–0.21 mm high, light to bright orange(-ochraceous), hardly translucent, round, scattered to gregarious; disc

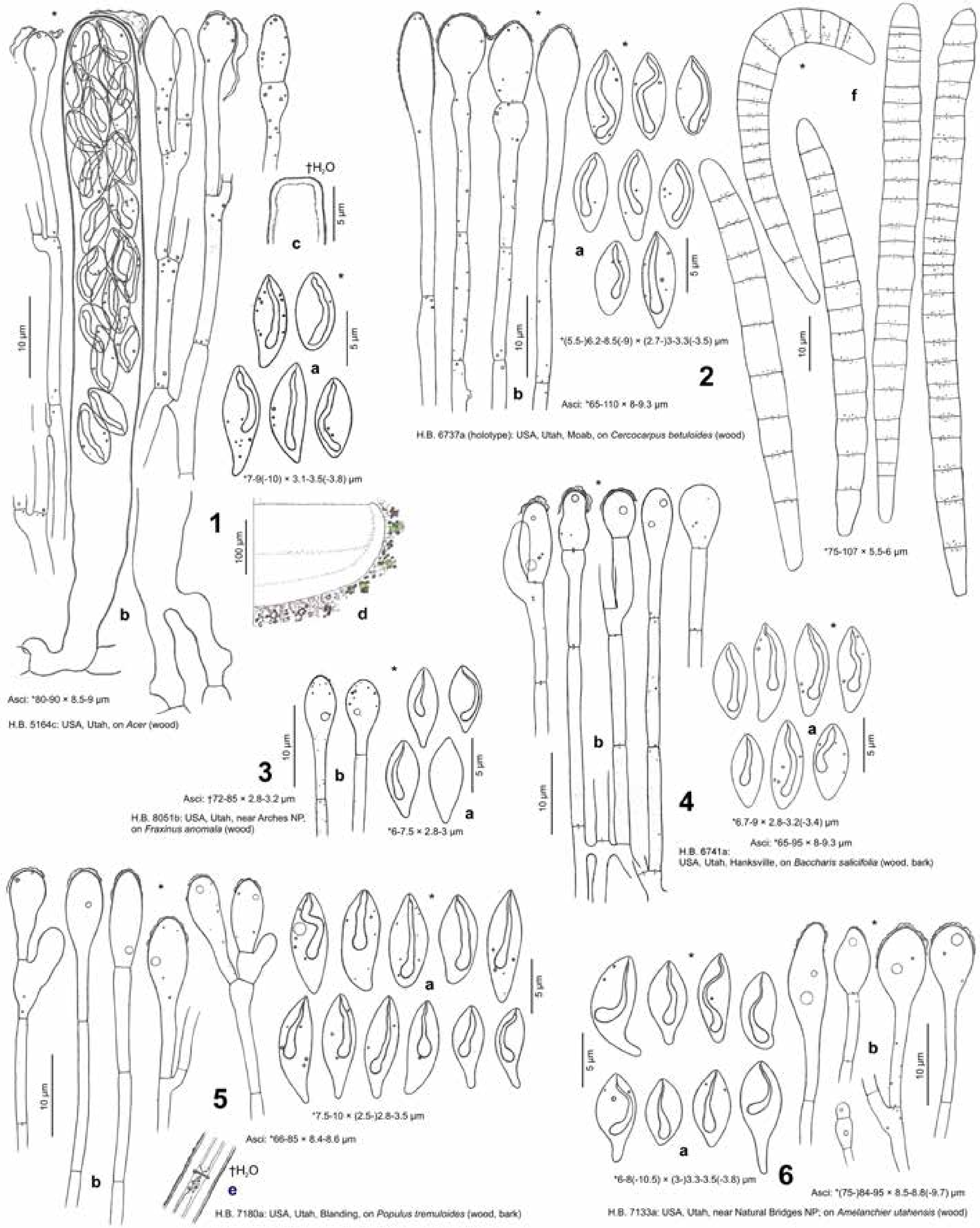


Plate 608. **1–6**: *Orbilia multimaeandrina*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apex; **d**. apothecium in median section; **e**. detail of anchoring hypha; **f**. conidia from culture.

flat, margin thin or thick, 0–10 µm protruding, mostly finely pruinose to crenulate; broadly sessile, nearly superficial or slightly to entirely immersed in substrate. **Asci** *65–95(–110) × (8–)8.5–9(–9.7) µm {8}, †(60–)70–90(–103) × (6.3–)7–8(–9.2) µm {9}, 32-spored, spores (*) ~4-seriate, 9–16 lower spores inverted {2} (± strongly mixed), pars sporifera *52–70(–74) µm long; **apex** (†) medium to strongly truncate (not or very slightly indented, laterally scarcely to distinctly inflated); **base** with very short to medium long, thin or thick stalk, T-, L-, Y- or h-shaped. **Ascospores** *(5.5–)6.5–9.5(–10.5) × ((2.5–))2.8–3.5((–3.8)) µm {9}, †(5–)6–9(–9.5) × (2.3–)2.8–3.2(–3.5) µm {4}, fusiform to

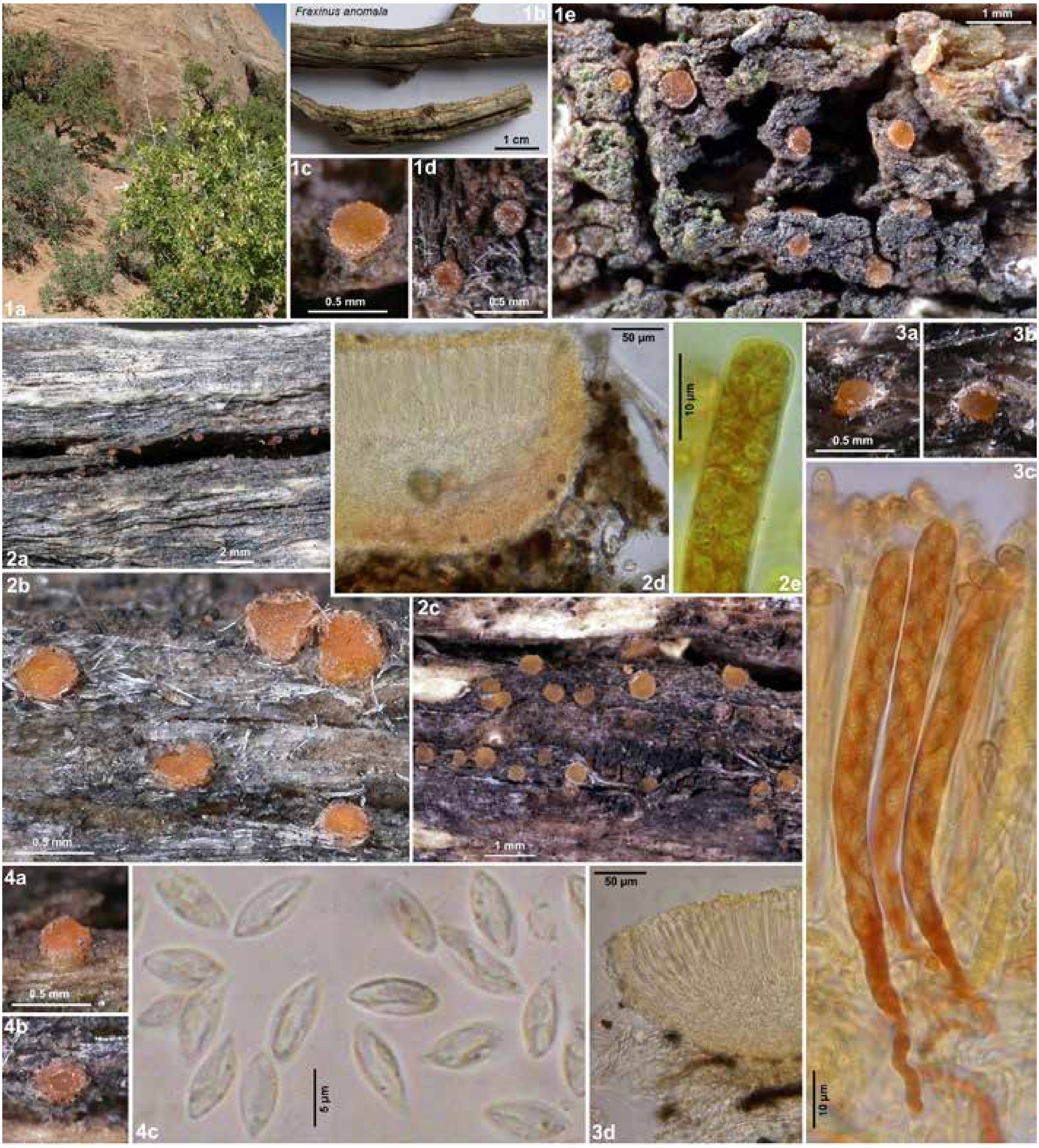


Plate 609. **1–4**: *Orbilia multimaeandrina*. – **1a**. Desert scrub with *Fraxinus anomala* in foreground; **1b**. decorticated xeric branches of *Fraxinus*; **1c–e**, **2a–c**, **3a–b**, **4a–b**. rehydrated apothecia; **2d**, **3d**. apothecia in median section; **2e**, **3c**. asci and paraphyses (in IKI); **4c**. ascospores. – Dead state (**2d**, **3d** in KOH, **2e**, **3c** in KOH+IKI, **4c** in H_2O). — **1a–e**. H.B. 8051b: USA, Utah, near Arches, on *Fraxinus*; **2a–e**. H.B. 7133a: USA, Utah, near Natural Bridges, on *Amelanchier*; **3a–d**. H.B. 6741a: USA, Utah, Hanksville, on *Baccharis*; **4a–c**. H.B. 6737a (holotype): USA, Utah, Moab, on *Cercocarpus*.

amygdaliform or lemon-shaped, apex subacute to acute, rarely obtuse, base slightly to strongly attenuated, sometimes with a tail-like base, straight to slightly inequilateral, also slightly (to strongly) curved at base; **SBs** *(4–)5–7(–8.3) × 0.8–1.2(–1.3) µm in situ {6} [~5–8(–9) µm actual length], vermiform to subulate, mostly slightly to strongly swollen at base, slightly to strongly flexuous to helicoid, never distinctly uncinate. **Paraphyses** apically (slightly to) medium to (very) strongly clavate-capitate or equally often spathulate (to lageniform), terminal cells *(4.5–)8–22(–35) × (2.2–)3–5(–6.3) µm {6}, lower cells *8.5–22 × 1.3–2.3 µm {4}; occasionally or infrequently branched at apical septum. **Medullary excipulum** hyaline, 30–60 µm thick, of loose or dense textura intricata with many inflated cells, very sharply delimited. **Ectal excipulum** subhyaline, of (†) thin-walled or distinctly gelatinized (common walls up to †0.5–1.5 µm thick), irregularly or usually vertically oriented t. prismatica-angularis-globulosa from base to margin, 15–50 µm thick near base, cells */†(6–)9–22 × (4–)7–16 µm {3}; 15–25 µm thick at flanks, cells *8–20 × 5–12 µm, 10–25 µm near margin, oriented at a 0–45° angle to the surface, marginal cortical cells *5–16 × 4–8 µm {2}; margin sometimes covered by conglutinate hyphoid processes †10–25 × 2–2.5 µm. **Anchoring hyphae** sparse to very abundant, */†(2–)2.5–4(–4.8) µm wide, walls */†(0.2–)0.4–1(–1.5) µm thick {5}, forming a loose t. intricata, partly also an up to 10 µm thick covering layer of dead hyphae up to the margin. **SCBs** in paraphyses and ectal excipulum (near margin) absent {2} or globose {4}, 0.5–1.3 µm diam. **Exudate** over paraphyses 0.2–1(–2) µm thick, ± rough, firmly attached; over margin and flanks as scattered granules 0.2–0.7 µm thick. — **ANAMORPH**: anguillospora-/vermispora-like (from ascospore isolate {1}). **Conidiophores** not observed. **Conidia** unbranched, *75–107 × 5.5–6 µm (actual length, in situ partly only 53 µm long), 9–26-septate, straight or slightly to very strongly curved, slightly tapering towards both ends, conidia in masses pale orange-coloured {1}.

Habitat: collected 0–3 m above the ground, partly buried in ground, ± corticated to decorticated, 7–22 mm thick branches of (?)*Acer* sp. {1}, *Amelanchier utahensis* {1}, *Artemisia filifolia* {1}, *Baccharis salicifolia* {1}, *Cercocarpus betuloides* {2}, *Coleogyne ramosissima* {1}, *Ericameria nauseosa* {1}, *Fraxinus anomala* {1}, *Populus tremuloides* {1}, *Purshia stansburyana* {3}, indet. angiosperm {1}, on 0.1–0.5 mm deep (slightly to) strongly decayed wood {10} and bark {4} (bast, sometimes ± detached and hanging), partly strongly eroded, greyed, without or with a few green algae, with or without internal beetle galleries. **Associated**: *Caloplaca* sp. {1}, *Candelariella* sp. {1}, *Carestiella schizoxyloides* {2}, *Dothideales* {1}, *Hysteropatella* sp. {1}, *Melaspilea emergens* {1}, *Mellitiosporiella macrospora* {1}, *M. pulchella* {1}, *Odontotrema oregonense* {1}, *Orbilia arizonensis* {1}, *O. bicknellensis* {1/1}, *O. calyptrata* {1}, *O. cercocarpi* {1}, *O. ?commarosa* {1}, *O. cupularis* {1}, *O. delphinus* {2}, *O. dixienis* {1}, *O. ?flexisoma* {1}, *O. lentiformis* {4/1}, *O. macrodelphinus* {3}, *O. macroserpens* {1}, *O. maeandrina* {3}, *O. mesaverdiana* {1}, *O. microsoma* {1}, *O. multiphanosoma* {2}, *O. multitrapezoidea* {3}, *O. myriophanosoma* {1}, *O. navajoana* {1}, *O. ocellata* {5}, *O. ?paloverdensis* {1}, *O. plurilentiformis* {3}, *O. purshiae* {1}, *O. serpentina* {2}, *Patellaria ?atrata* {1}, *Psiloglonium lineare* {1}, *Schizoxylon* sp. {1}, *Stictis* sp. {1}, *Teichospora* sp. {1}, *Symbiotaphrina desertorum* {1}, *Tryblidaria* sp. {1}, *Xanthoria* sp. {2}. **Desiccation tolerance**: fully tolerant for at least 1 year, after 2 years some mature asci and many paraphyses, after 28 months some spores, paraphyses and excipular cells still viable. **Altitude**: 1315–2600 m a.s.l. **Geology**: Proterozoic-Cambrian sedimentary rock, Pennsylvanian-Permian to Triassic-Jurassic red carbonate sandstone. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia multimaeandrina* is characterized by 32-spored asci and lemon-shaped to amygdaliform ascospores similar as in the 16-spored *O. maeandrina*. The paraphyses deviate from *O. maeandrina* in being quite often spathulate and in containing smaller SCBs. The probably closely related *O. multitrapezoidea* differs from *O. multimaeandrina* in narrower spores, and *O. multiurosperma* in always showing some spores with a distinct, curved basal tail and in the presence of crystalloid SCBs. *O. osteospermae* (on *Juniperus osteosperma*) is very similar to *O. multimaeandrina* (on angiosperms) but has distinctly smaller spores. The Australian *O. livistonae* deviates in longer spores with narrower SBs, and in capitate (to spathulate) paraphyses with much larger globose SCBs. A specimen tentatively assigned to *O. livistonae* (Pl. 647: 2) concurs with *O. multimaeandrina* in spore size and shape, but in the other characters it better fits *O. livistonae*.

Not included collection. A sample on *Purshia* (IVV: ~13. VI.2000) deviates in spores with untapered, predominantly rounded bases.

Variation. The collections of *O. multimaeandrina* showed little variation. They were mostly rather sparse, except for that on *Amelanchier* (Pls 608: 6; 609: 2): in 3 out of 19 apothecia examined in that specimen, some spores possessed distinct basal tails (Pl. 608: 6a); yet, also in the collection on *Populus* (Pl. 608: 5) some of the apothecia contained spores with tail-like bases.

Anamorph. An anamorph was only obtained in pure culture on CMA:2 when fragments of sterilized filter paper were added. At the border of these fragments abundant conidia were formed. This type of anamorph with its consistently unbranched conidia is exceptional within series *Serpentinae*, in which Y-shaped conidia are typical, while phragmoconidia occur only in small quantities among the branched ones, but it resembles that observed in series *Habrostictis*, except for its much longer conidia.

Phylogeny. A sequence taken from the ex-type culture comprises SSU, ITS and LSU, another from apothecia ITS+LSU. The S1506 intron is absent in both. The two samples have a 2.7 % ITS distance while in the overlapping part of LSU (D1) they are identical.

In our ITS or combined analyses, *O. multimaeandrina* clustered medium supported with *O. sonorensis* in the *Serpentinae-Habrostictis* clade (Phyls 19, 20), though with a rather high distance in both ITS (8–9 %) and LSU D1–D2 (2.4 %), in accordance with the different morphology of *O. sonorensis*. In the LSU the lowest distance is 2.2 % to *O. carpoboloides*, although the ITS distance to this species is 16–16.5 %.

Ecology. *O. multimaeandrina* was collected on rotten wood and bark of xeric branches of various angiosperm trees and shrubs in western North America, where it occurs in warm- to cold-temperate semiarid to subhumid pinyon-juniper woodlands, warm-continental semiarid sagebrush and warm-temperate arid saltbush desert scrubs, and cold-temperate subhumid to humid ponderosa pine and Douglas fir mixed forests in the Colorado Plateau (mainly in the Canyonlands section, also Grand Canyon, Uinta Basin, Utah Mts.) and Mojave Desert.

Specimens included. **USA**: **Colorado**, Uinta Basin, 50 km ESE of Vernal, 6 km NE of Dinosaur, 2100 m, on *Cercocarpus betuloides*, 12.VI.1996, G. Marson (ø). – **Utah**, Canyonlands, 33 km W of Blanding, 2 km NNE of Bears Ears East, 2600 m, branch of *Populus tremuloides*, on bark & wood, 14.VI.2000, G. Marson (H.B. 7180a). – 41 km W of Blanding, Natural Bridges, 2097 m, branches of *Amelanchier utahensis*, on wood, 14.VI.2000, G. Marson (H.B. 7133a). – 22.5 km W of Moab, 1779 m, branches of *Coleogyne ramosissima*, on wood, 9.III.2003, G. Marson (G.M. 2003-06-09.1, sq.: MT358338). – 36 km S of Moab, 5 km WNW of Hatch Rock, 1813 m, branch of *Ericameria nauseosa*, on bark, 16.VI.2000, G. Marson (H.B. 6736b, in holotype of *O.*

Map 100. Known distribution of *O. multimaeandrina* in North America (yellow = not included collection).

mesaverdiana). – ibid., 35 km SSW of Moab, E of Needles Overlook, Hatch Point, 1905 m, branches of *Cercocarpus betuloides*, on wood, 16.VI.2000, G. Marson (ex H.B. 6737a, M-0276523, **holotype**, anam. cult., CBS 116221; sq.: KT215243). – ibid., 20 km SW of Moab, Dead Horse Point, 1810 m, branch of *Purshia stansburyana*, on wood, 10.VI.2003, G. Marson (H.B. 8079b ø). – 20 km NNW of Moab, Arches, Salt Valley Wash, 1427 m, branch of *Artemisia filifolia*, on bark, 18.VI.2000, G. Marson (H.B. 6740b). – 25 km NNW of Moab, Devils Garden, Landscape Arch, 1590 m, branch of *Fraxinus anomala*, on wood, 8.VI.2003, G. Marson (H.B. 8051b). – 40 km WSW of Hanksville, 23 km E of Torrey, Capitol Reef, 1555 m, branch of *Baccharis salicifolia*, on wood & bark, 19.VI.2000, G. Marson (H.B. 6741a). – Utah Mts., Bryce Canyon, 33 km SE of Panguitch, 8 km WSW of Tropic, Navajo Trail SE of Sunset Point, 2300 m, branch of *Acer*, on wood, 25.VIII.1994, G. Marson (H.B. 5164c). – **Arizona**, Grand Canyon, Kaibab Plateau, 28 km ESE of Fredonia, 13 km NNW of Jacob Lake, 2115 m, branch of *Purshia stansburyana*, on wood, 15.VI.2003, G. Marson (H.B. 8002k). – **California** (border to Nevada), Mojave Desert, 20 km SW of Beatty, 16 km SW of Rhyolite, E of Death Valley, Daylight Pass, 1315 m, branch of indet. angiosperm, on wood, 2.V.1995, G. Marson (H.B. 8528c ø).

Not included. **Utah** (border to Arizona): Utah Mts., ~4 km WNW of Colorado City, S of Zion, ~1510 m, on *Purshia stansburyana*, ~13.VI.2000, G. Marson (ø).

Orbilia osteospermae Baral & G. Marson, **sp. nov.**, MB 813669 — Pls 610–611

Etymology: named after the host species, *Juniperus osteosperma*.

Typification: USA, Utah, Cedar City, branches of *Juniperus osteosperma*, 24.VIII.1994, G. Marson (ex H.B. 5175c, M-0276545, holotype).

Latin diagnosis: *Similis* Orbiliae multimaeandrinae *sed ascosporae minores*, *corpuscula refringentia longiora quam ascospora*, *ergo valde helicoidea*, *interdum uncinata. Habitat ad lignum vel corticem ramis siccis* Juniperi osteospermae *in zona temperata subhumida Americae septentrionalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.2–0.5 mm diam., 0.12–0.19 mm high, light to bright orange(-ochraceous), scarcely translucent, round, scattered; disc slightly concave to flat, margin distinct, 0–20 µm protruding, finely whitish powdered; broadly sessile, superficial but deeply immersed in biofilm. **Asci** *68–105 × 7.7–8.3(–9) µm, †69–94 × 6–7.2 µm, 32-spored, spores *4-seriate, lower spores inverted (mixed in middle part), pars sporifera *40–59(–67) µm long; **apex** (†) medium to strongly truncate (not indented, laterally scarcely inflated); **base** without or with short to medium long, thick stalk, L-, Y- or h-shaped. **Ascospores** *(4.8–)5.5–7(–8) × 2.7–3.4 µm, broadly fusoid to fusiform (amygdaliform), apex subacute to acute, rarely obtuse, straight to very slightly inequilateral; **SBs** *(4–)5–6.5(–7.5) × (0.4–)0.6–0.9 µm in situ [~(5–)6–8.5 µm actual length], vermiform to subulate, with slightly to strongly inflated base, medium to strongly helicoid, sometimes uncinate. **Paraphyses** apically medium to strongly spathulate, rarely clavate or lageniform, terminal cells *8–22 × 3.3–5(–5.5) µm, †2.5–4.5 µm wide, lower cells *(6–)9–19 × 1.3–1.8 µm (near base 2.5–3.2 µm, near apex up to 4.2 µm wide); sometimes branched near apex, hymenium very pale rose. **Medullary excipulum** subhyaline, 40–60 µm thick, of dense textura intricata with many inflated cells, sharply delimited. **Ectal excipulum** pale rose, of (†) thin-walled to slightly gelatinized, vertically oriented t. angularis from base to submargin, 50–60 µm thick near base, cells *7–13 × 6–12 µm; 30 µm thick at flanks and margin, at margin of t. prismatica-angularis oriented at a 10–30° angle to the surface, cells †8–9 × 4–5 µm, marginal cortical cells *9–12 × 3–4.5 µm. **Anchoring hyphae** sparse to medium abundant, *2.5–4.5 µm wide, walls 0.3–0.8 µm thick, partly extending to the margin as a thin layer. **SCBs** in paraphyses and ectal excipulum near margin absent. **Exudate** over paraphyses 0.2–1.5 µm thick, cloddy, mostly firmly attached to each apex; over margin and flanks 0.2 µm thick, continuous. **— ANAMORPH**: unknown.

Habitat: ± corticated to decorticated, 10–22 mm thick branches of *Juniperus osteosperma*, on strongly decayed wood and ± detached bark (bast & periderm), medium to strongly greyed, with sparse green algae. **Associated**: *Carestiella schizoxyloides*, *Orbilia cucumispora*, *O. ?maeandrina*, *O. multidelphinus*, *O. multihamulata*, *O. octosporoides*, *O. ophiosoma*, *O. pisciculus*. **Desiccation tolerance**: fully tolerant for at least 4 months. **Altitude**: 1815 m a.s.l. **Geology**: Upper Cretaceous sedimentary rock. **Phenology**: long-lived.

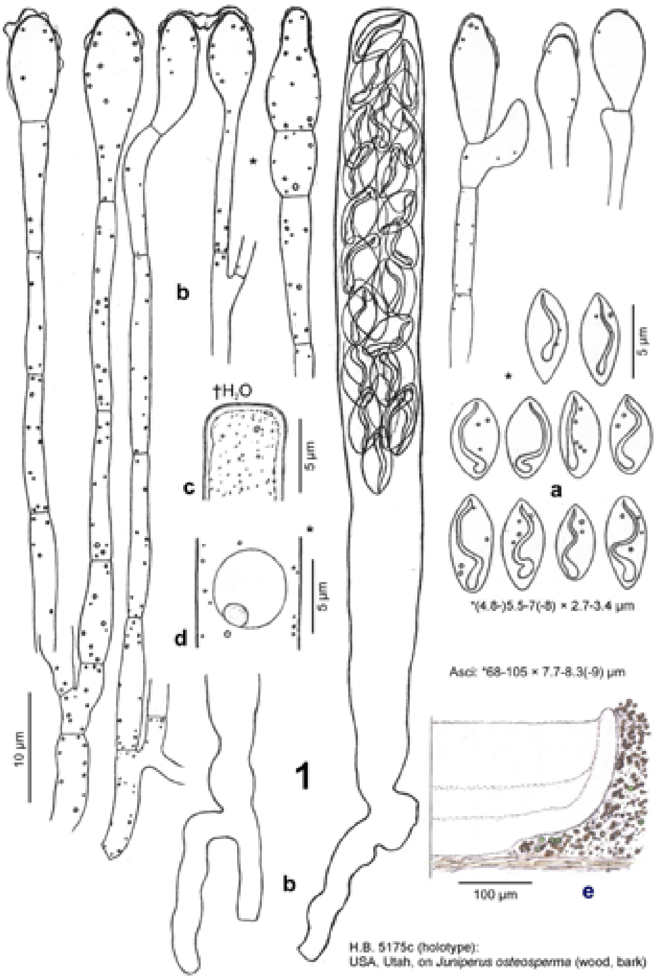


Plate 610. **1**: *Orbilia osteospermae*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apex; **d**. fusion nucleus in young ascus; **e**. apothecium in median section.

Taxonomic remarks. *Orbilia osteospermae* is very close to *O. multimaeandrina*, from which it differs in smaller ascospores, also in spore bodies being mostly longer than the spore length and, therefore, medium to strongly helicoid or uncinate, finally in growing on coniferous substrate.

Variation. In some apothecia of the rather rich type collection a few 16-spored asci were observed among the 32-spored ones, with slightly larger spores of *(5–)6–8 × 3–3.8 µm. However, a single apothecium studied much later in the dead state had consistently 16-spored asci with †5–6.5 × (2–)2.5–3 µm large spores (IVV: H.B. 5175f). It could belong to *O. maeandrina*, but in the absence of vital characters its identity remains unclear. From 16-spored *O. lacrimispora* this apothecium deviates in much smaller spores.

Ecology. *O. osteospermae* is only known from a single collection on ± rotten wood and bark of xeric branches of *Juniperus osteosperma* in a dry riverbed in a cold-temperate subhumid pinyon-juniper woodland of Utah Mountains in western North America.

Specimens included. **USA**: **Utah**, Utah Mts., Dixie Forest, 1.5 km ESE of Cedar City, 1815 m, branches of *Juniperus osteosperma*, on wood & bark, 24.VIII.1994, G. Marson (M-0276545, **holotype**; **isotype** in H.B. 5175c).

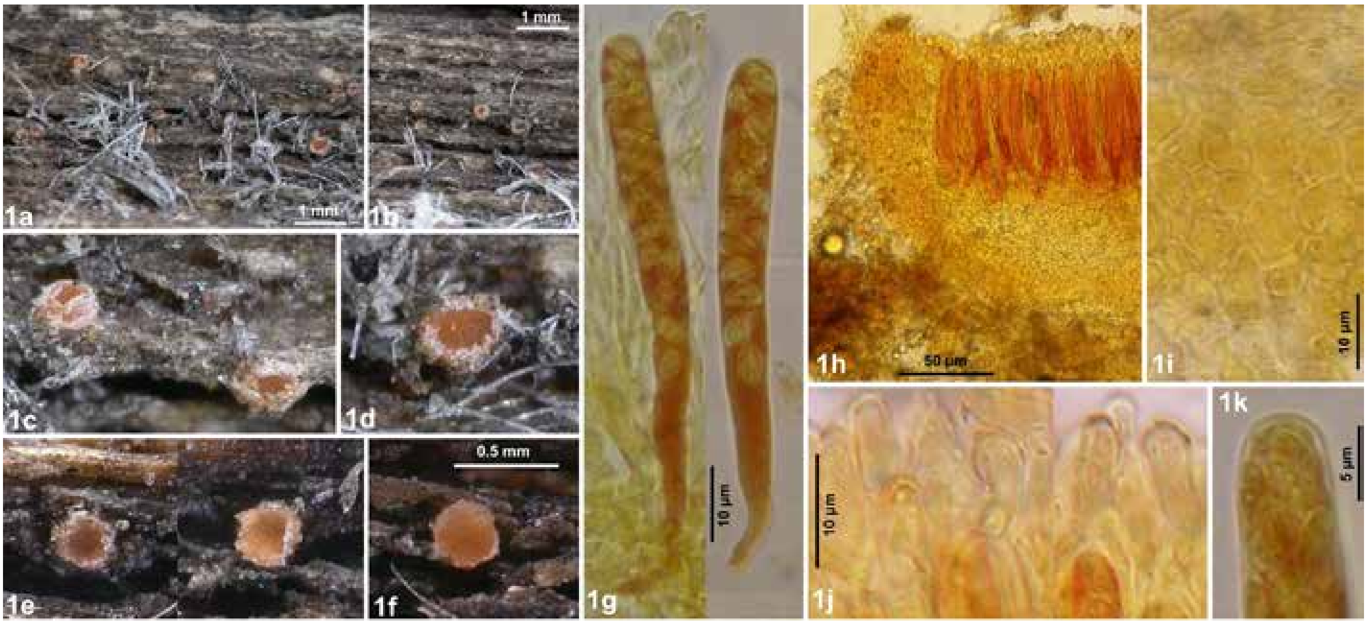


Plate 611. **1**: *Orbilia osteospermae*. – **1a–f**. rehydrated apothecia on detached bark of *Juniperus osteosperma*; **1g**. asci; **1h**. median section of apothecium; **1i**. id., basal ectal excipulum; **1j**. apices of paraphyses; **1k**. ascus apex. – Dead state (in KOH+IKI). — **1a–g**. H.B. 5175c (holotype): USA, Utah, on *Juniperus*.

Orbilia filiformis Baral, E. Weber & P. Perz, **sp. nov.**, MB 813670 — Pls 612–614, Map 101

Etymology: named according to the filiform spore bodies.

Typification: Switzerland, Hergiswil, branch of *Juglans regia*, 18.VIII.2006, E. Weber (ex H.B. 8244a, M-0276480, holotype; sq.: KT222451, KT222454).

Latin diagnosis: *Similis* Orbiliae subtrapeziformi *sed ascosporae angustiores, corpuscula refringentia longiora et multo angustiora. Habitat ad lignum vel corticem ramorum siccorum arborum angiospermarum, raro in caulibus ligneis volubilibus, in zona (oro)temperata ad submediterranea vel hemiboreale humida Europae.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.15–)0.2–0.5(–0.7) mm diam., 0.1–0.2(–0.3) mm thick, pale to light (or bright) (yellowish-)rose to orange(-cream), ± translucent or not, round, very scattered to subgregarious; disc young somewhat urceolate, soon flat to slightly, rarely medium convex, margin ± indistinct, thin, 0–15 µm protruding, smooth or very finely crenulate; broadly sessile, young somewhat erumpent, soon superficial; dry light to bright orange. **Asci** *(40–)45–67(–86) × (5–)5.3–6(–6.5) µm {6}, †(36–)45–60(–62) × (4–)4.5–5.2(–6) µm {5}, 8-spored, spores *(2–)3-seriate, (2–)3–5(–6) lower spores inverted {7} (often mixed), pars sporifera *17–32 µm long; **apex** (†) strongly truncate (slightly to distinctly indented, laterally scarcely or distinctly inflated); **base** with medium to long, thin or thick, ± flexuous stalk, T-, L-, Y- or h-shaped. **Ascospores** *((6.5–))(8–)9–13(–14)((15.5) × 1.8–2.3(–2.5)((–2.7)) µm {40}, †(8.5–)9–13(–14) × (1.5–)1.6–2.1(–2.2) µm {8}, narrowly fusiform to fusiform-clavate, sometimes cylindrical in middle part, apex acute (to acuminate), exceptionally obtuse, base mostly medium to strongly attenuated, rarely or often with a tail-like base, straight or mostly slightly to medium curved near base; **SBs** *((4.5–))5–10(–11)((–12)) × 0.2–0.3(–0.4) µm in situ {30} (~5–12 µm actual length), filiform, sometimes slightly subulate, not or only very slightly inflated near base, straight to strongly flexuous, exceptionally uncinate; SBs in aged spores shorter, with a 0.5–1 µm wide basal inflation. **Paraphyses** apically (slightly to) medium to very strongly capitate(-clavate), terminal cells *(7–)15–26(–29) × (2.5–)3.5–4.5(–5.2) µm {5}, †3–5.3 µm wide {2}, lower cells *7–13(–16) × 1.2–2.2 µm {4} (near base 4–8 µm long); rarely branched at upper septum. **Medullary excipulum** subhyaline to very pale rose, 20–50, rarely 60–200 µm thick, of dense textura globulosa-intricata, indistinctly to medium sharply delimited. **Ectal excipulum** subhyaline, of thin-walled, irregularly or vertically oriented t. globulosa-angularis-prismatica from base to submargin, (20–)30–50(–70) µm thick near base, cells *(7–)9–18(–21) × (5–)7–14(–17) µm {7}; 20(–40) µm thick near margin, upper margin of t. globulosa-angularis or mostly prismatica-porrecta oriented at a (10–)20–50(–70)° angle to the surface, marginal cortical cells *5–10 × 3–4.5(–5) µm {5}. **Anchoring hyphae** sparse to abundant, *1.8–3(–3.5) µm wide, walls 0.2(–0.4) µm thick {3}, covering flanks and margin as a thin layer. **SCBs** in paraphyses and ectal excipulum absent {14}, rarely in some paraphysis apices rod-shaped {2} or large globose SCBs {2} observed. **Exudate** over paraphyses 0.2–1 µm thick, continuous to granular, hyaline, firmly attached; over margin (0.2–)1–2 µm thick, mostly continuous. **— ANAMORPH**: tridentaria-like (presumed, from natural substrate {17}). **Conidiophores** not seen. **Conidia** 3–4(–5)-armed, total size *45–70 × 24–75 µm, stipe *(5.5–)16–22 × (2.5–)3–3.5(–4.3) µm, (0–)1–2(–3)-septate, arms tapering, *(21–)28–48 × 3–4.5 µm, 3–6(–7)-septate {10}.

Habitat: collected (0–)1–4 m above the ground, corticated to decorticated, 5–35 mm thick twigs and branches (rarely a 30 cm thick trunk) of *Acer* sp. {2}, *A. campestre* {3}, *A. pseudoplatanus* {6}, *Aesculus hippocastanum* {1}, *Berberis vulgaris* {1}, *Carpinus betulus* {1}, *Clematis vitalba* {5}, *Cornus sanguinea* {1}, *Corylus avellana* {3}, *Fagus sylvatica* {2}, *Fraxinus excelsior* {2}, *Gleditsia sinensis* {1}, *Juglans regia* {2}, *Juniperus communis* {2}, *Lonicera xylosteum* {2}, *Malus domestica* {1}, *Populus* × *canadensis* {1}, *P. tremula* {2}, *Prunus spinosa* {1}, *Quercus rotundifolia* {1}, *Robinia pseudoacacia* {1}, *Salix* sp. {2}, *S. appendiculata* {1}, *S. caprea* {4/1}, *S. ?caprea* × *aurita* {1}, *Sambucus nigra* {3}, *S. racemosa* {1}, *Sorbus aria* {1}, *S. domestica* {1}, *Tilia platyphyllos* {2}, stems of *Rubus ?bifrons* {1}, on 0.2–1(–2) mm deep (slightly to) strongly decayed wood {50} and bark {12} (bast), partly on splitted wood or below detaching bark, rarely on inner surface of bark; rarely on herbaceous stems of *Atropa belladonna* {1}, *Rumex* sp. {1}; slightly to strongly greyed, green algae sparse to very abundant. **Associated**: *Ascotaiwania limnetica* {1}, *Dothideales* {1}, *Durella connivens* {1}, *Echinosphaeria strigosa* {1}, *Eichleriella deglubens* {1}, *Eutypa maura* {1}, *Glyphium elatum* {2}, '*Helotium*' *uvidulum* {1}, *Hyalorbilia fusispora* {1}, *H. juliae* {1}, *H. latispora* {1}, *H. subfusispora* {2}, *Hyaloscypha minuta* {2}, *Hypogymnia physodes* {1}, *Hysteropatella elliptica* {1}, *H. prostii* {1}, *Karstenia rhopaloides* {3}, *Lecanora* sp. {1}, *Lecophagus ellipsoideus* {1}, *Lophiostoma* sp. {1}, *Melanelia glabratula* {1}, *Merismodes* sp. {2}, *Olla millepunctata* {1}, *O. scrupulosa* {1}, *O. transiens* {2}, *Orbilia arachnovinosa* {1}, *O. aristata* {7}, *O. breviaristata* {1}, *O. cylindrosoma* {1}, *O. eucalypti* {2}, *O. euonymi* {1}, *O. flagellispora*

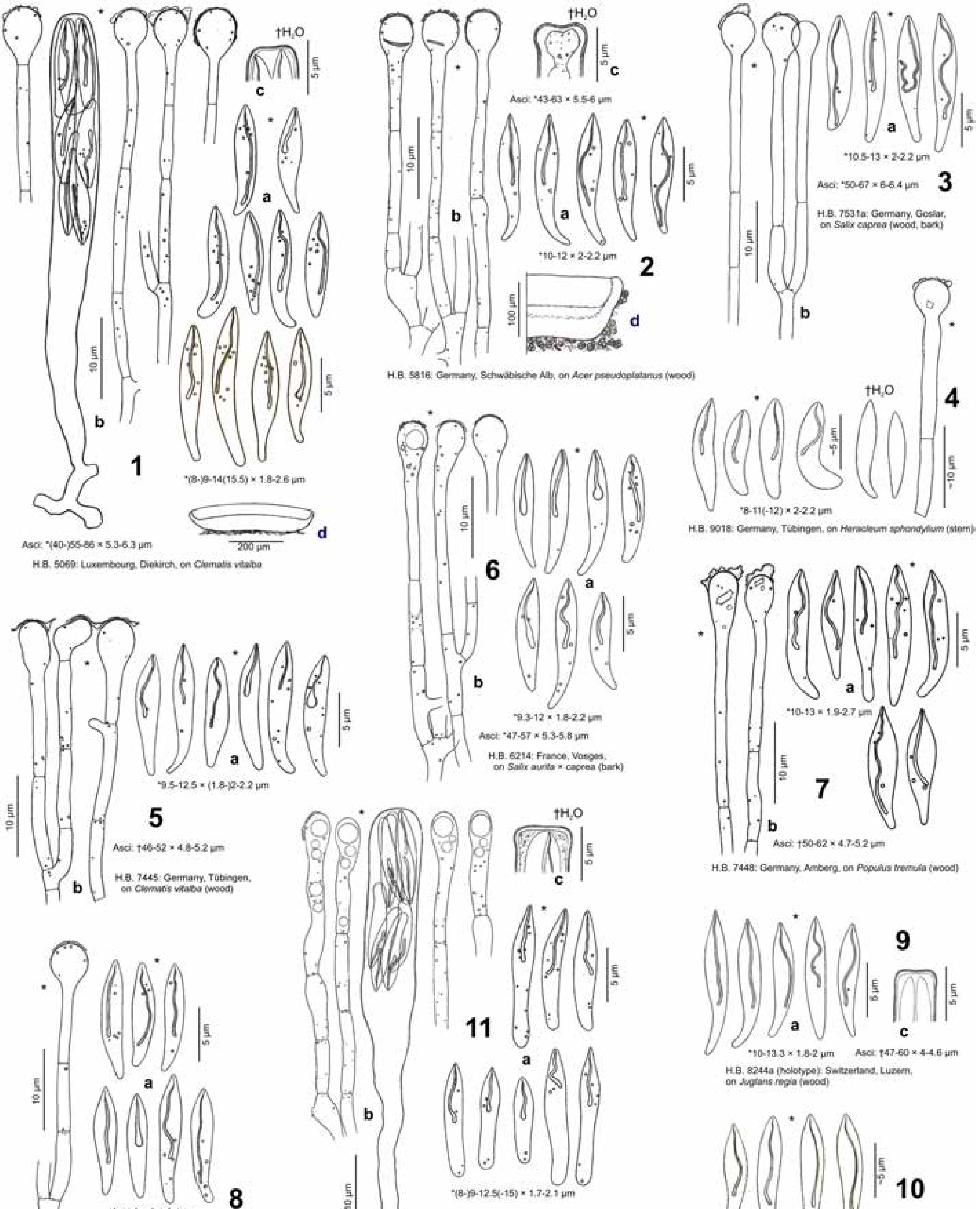


Plate 612. **1–10**: *Orbilia filiformis*; **11**: *O.* cf. *filiformis*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. apothecia in median section.

{1}, *O. ocellata* {1}, *O. quaestiformis* {2}, *O. subclavuliformis* {1}, *O. trapeziformis* {2/1}, *O. ungulata* {1}, *O. vinosa* {3}, *O. vitalbae* {4}, *Orthotrichum* sp. {1}, *Parmelia glabratula* {1}, *P. sulcata* {2}, *Patellaria* '*crassispora*' {1}, *Peniophora* sp. {1}, *Physcia stellaris* {1}, *Pirottaea* ?*imbricata* {1}, *Pyrenopeziza rubi* {1}, *Radula complanata* {1}, *Strangospora ochrophora* {1}, *Tubeufia cerea* {1},

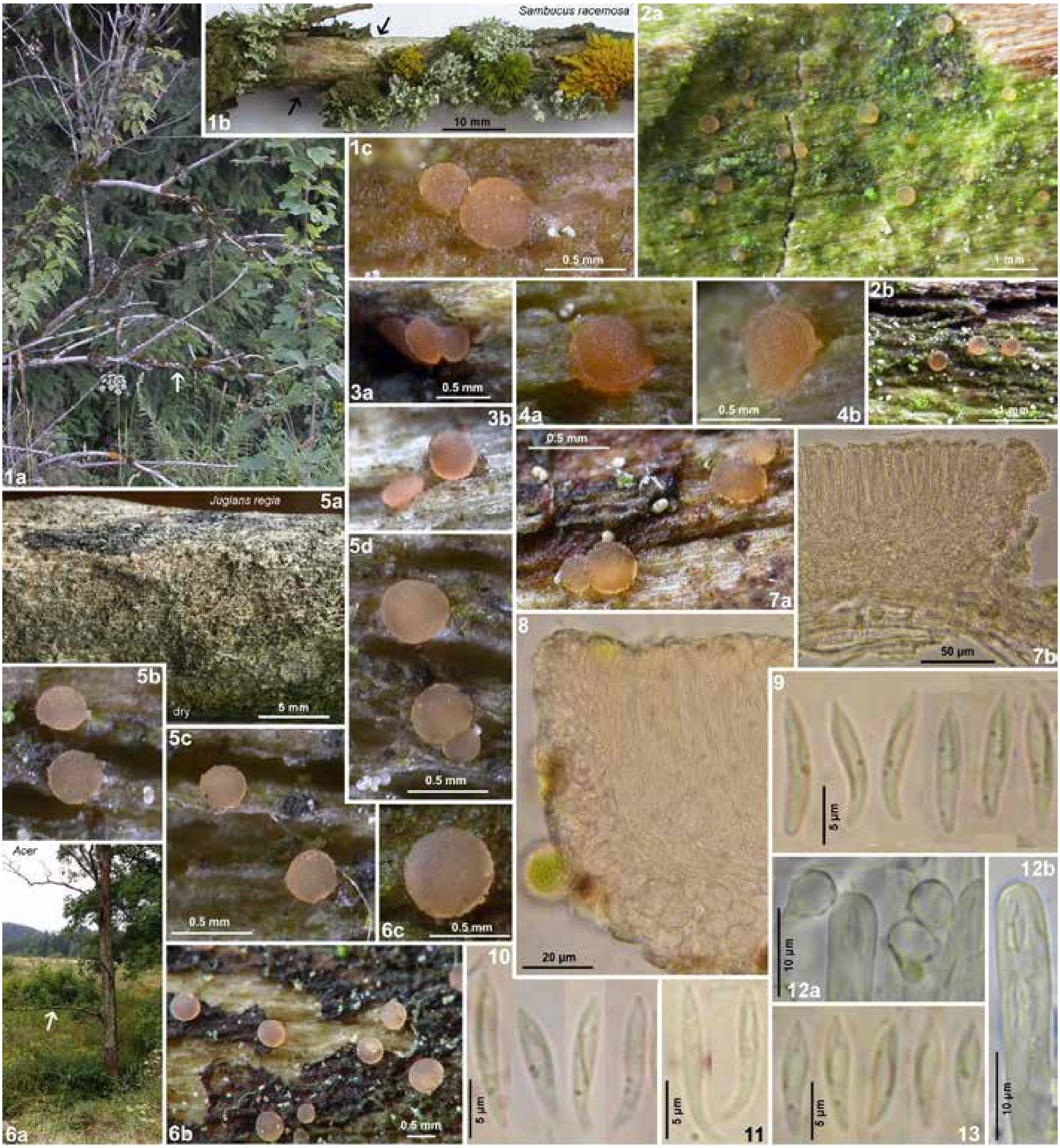


Plate 613. **1–13**: *Orbilia filiformis*. – **1a**. border of *Picea* mountain forest, dead *Sambucus racemosa*; **6a**. dead *Acer* tree; **1b**, **5a**. dead xeric branches of *Sambucus* and *Juglans*; **1c**, **2a–b**, **3a–b**, **4a–b**, **5b–d**, **6b–c**, **7a**. rehydrated apothecia; **7b**. apothecium in median section; **8**. id., marginal region; **12a–b**. apices of asci and paraphyses; **9**, **10**, **11**, **13**. ascospores. – Living state, except for **10** (right spore), **11** (in H_2O). – **6a–c**: phot. P. Perz. — **1a–c**. H.B. 9126a: Germany, Furtwangen, on *Sambucus*; **2a–b**. H.B. 7531a: Germany, Goslar, on *Salix*; **3a–b**. H.B. 7584: Italy, Northern Apennines, on *Sorbus*; **4a–b**. H.B. 7448: Germany, Amberg, on *Populus*; **5a–d**. H.B. 8244a (holotype): Switzerland, Luzern, on *Juglans*; **6a–c**. P.P. 20060813: Poland, Kłodzko, on *Acer*; **7a–b**. H.B. 8248b: Switzerland, Luzern, on *Salix*; **8**. H.B. 9018: Germany, Tübingen, on *Rumex*; **9**. H.B. 8950: ibid., on *Juglans*; **10**. H.B. 9120: Germany, Villingen, on *Sambucus*; **11**. H.B. 8001a: Luxembourg, Senningerberg, on *Atropa*; **12a–b**. 21.VII.2008: Luxembourg, Fentange, on *Acer*; **13**. H.B. 9459c: Germany, Egenhausen, on *Salix*.

Unguiculariopsis sp. {1}, *Xanthoria* sp. {1}. **Desiccation tolerance**: fully tolerant for at least 1 week, excipular cells, paraphyses and conidia still viable after 4 months. **Altitude**: 45–1200 m a.s.l. (central and western Europe), 233–1495 m (southern Europe). **Geology**: Devonian & Carboniferous sediments, Buntsandstein, Muschelkalk, Keuper (sandstone, marl), Lower & Upper Jurassic sand- & limestone, dolomite, Minette, Cretaceous & Tertiary chalk, flysch & molasse, Quaternary loess, sand & gravel; granite, diorite, gneiss, quartzite, amphibolite, basalt. **Phenology**: throughout the year (long-lived).

Phenology of *O. filiformis*											
Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
2	2	3	8	3	9	3	12	10	4	2	3

Taxonomic remarks. *Orbilia filiformis* is very similar in ascospore shape to *O. subtrapeziformis*, from which it differs in much narrower, filiform, often very long spore bodies, also in slightly narrower spores and in the predominant absence of any kind of SCBs. *O. obtusispora* and *O. cylindrosoma* differ

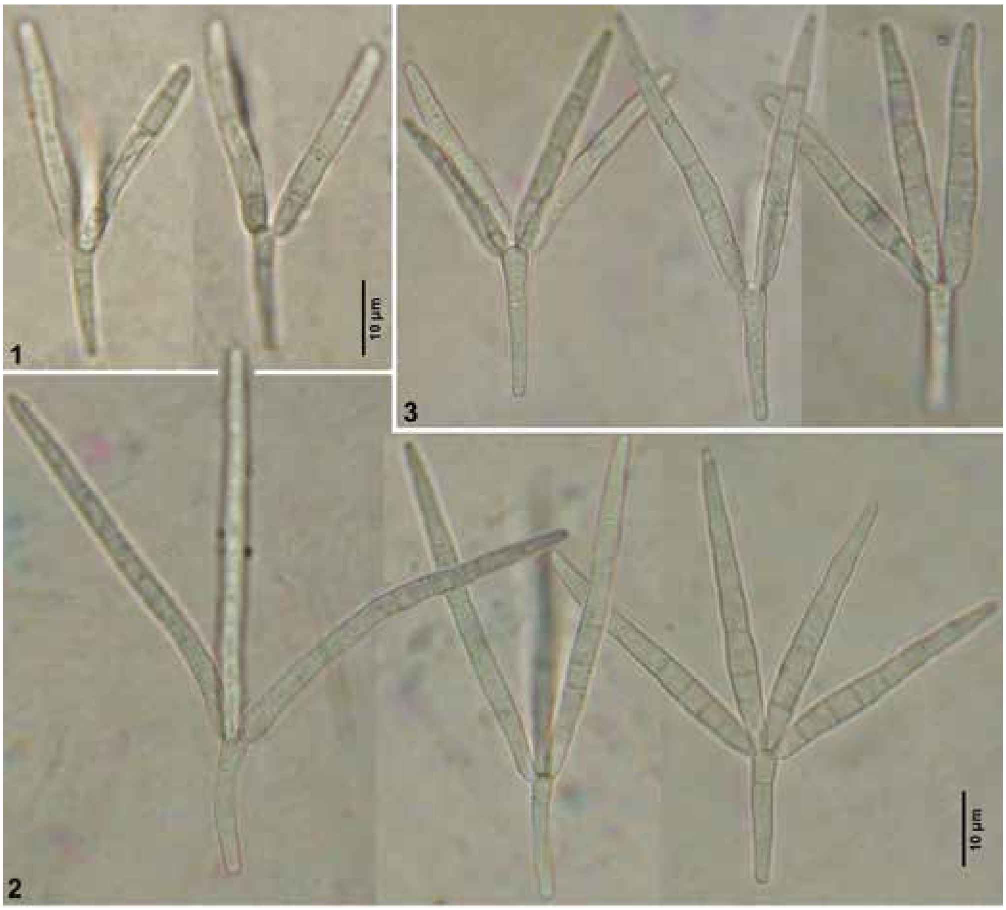


Plate 614. **1–3**: *Orbilia filiformis*. – Conidia of presumed anamorph, from substrate (living state). — **1**. H.B. 9007a: Germany, München, on *Clematis*; **2**. H.B. 8244a (holotype): Switzerland, Luzern, on *Juglans*; **3**. H.B. 8517: Denmark, Ringsted, on *Corylus*.

in more obtuse spore apices and thicker spore bodies, also in slightly wider spores (separation from *O. obtusispora* is not always clear). Although *O. filiformis* and *O. subtrapeziformis* are quite common in mountainous areas of central Europe, they have so far never been found growing in association. However, in one collection (Pl. 612: 8) *O. filiformis* grew intermingled with *O. cylindrosoma* and *O. vitalbae*, and recognition of the three also macroscopically very similar species required careful microscopic examination of the living spores. With its filiform SBs *O. filiformis* resembles *O. quaestiformis* which, however, sharply differs in wider spores with rounded to obtuse apices. Even the tridentaria-like anamorph of the two taxa are very similar, but that of *O. filiformis* is so far not ascertained in pure culture.

Variation. *O. filiformis* shows some variation in spore size and shape, and in SB length. Especially the spore bases vary from straight to medium curved and from (rarely) slightly to (mostly) strongly attenuated and partly tail-like. Three collections (Denmark, on *Corylus*, H.B. 8517; southern Germany, on *Salix*, H.B. 9459c, Pl. 613: 13; ibid., on *Heracleum*, Pl. 612: 4) deviate in rather short spores of *(6.5–)7–11(–12) × 2–2.4 µm, reminiscent of *O. trapeziformis* or *O. obtusispora*, but similar spores were exceptionally also seen in other collections (e. g., Pl. 612: 7, lower spores).

Not included collections. A sparse African sample (Pl. 612: 11) differs in rather short SBs (3.5–6.2 µm), spores with consistently only slightly attenuated and curved bases, and less swollen paraphysis apices which consistently contain globose SCBs. However, the specimen was immature when collected, and its maturation in a moist chamber was possibly incomplete. two environmental DNA isolates are too distant from our sequence to be considered as conspecific.

Anamorph. In 17 collections of *O. filiformis* tridentaria-like conidia were found on the substrate near the apothecia, in three of them also trinacrium-like ones. The observed trinacrium-like conidia resemble the presumed anamorph of *O. trapeziformis* or *O. obtusispora*, whereas the frequently observed tridentaria-like conidia very probably represent the anamorph of *O. filiformis*. Such conidia were otherwise only observed in a small group of species around *O. quaestiformis* in which the ascospores have obtuse apices.

Phylogeny. SSU (without S1506 intron), partial ITS1 (23 nt), partial ITS2 (102 nt), and LSU were gained from apothecia of the holotype on *Juglans* from Switzerland. *O. filiformis* clustered in our analyses of ITS, LSU, and SSU+ITS+LSU unresolved in the *Serpentinae-Habrostictis* clade (Phyls 19–20, S22), although it shows to *O. flavidorosella* and *O. carpoboloides* the lowest LSU D1–D2 distances of 1.1 % and 1.4 %, respectively, whereas in comparison, the distance to *O. cylindrosoma* is 1.7 %, to *O. quaestiformis* 2.5 %, and to *O. trapeziformis* and *O. obtusispora* at 3.9–4 %. In the partial ITS2 the distance to other species of series *Serpentinae* is very high, but the alignment clearly shows that *O. filiformis* is a member of the *Serpentinae-Habrostictis* clade. This result is also confirmed when analysing the SSU (S20).

Two environmental DNA isolates (*Picea* stump, Sweden, KP887834, ITS2; *Quercus* litter, Mexico, HDW-OTU-29, KT581933, ITS) formed with *O. filiformis* a medium supported clade when analysing the ITS2 region (NJ tree, not shown), though with a high distance among each other.

Ecology. *O. filiformis* was collected on xeric twigs and branches of various angiosperm trees and shrubs, the most often recorded being *Acer* {11} and *Salicaceae* {10}, rarely also conifers (*Juniperus*), stems of *Rubus*, and herbaceous stems. It was found in colline to altimontane and atlantic to subcontinental, oro- to supratemperate humid central Europe but also in hemi- to thermoboreal Scandinavia and in supra- or especially mesosubmediterranean, rarely supramediterranean (semi)humid southern Europe. The vegetation includes various thermophilous or shady forest types. The not included samples were from a tropical humid (winter-dry) coastal open woodland in Senegal (western Africa), a subtropical, possibly semiarid oak forest in central Mexico, and a (?hemi)boreal humid spruce forest in Sweden.

Map 101. Known distribution of *O. filiformis* in Europe.

Specimens included. **NORWAY**: **Hedmark**, 17 km NE of Elverum, 3 km ENE of Sørskogbygda, Galgebakken, 342 m, branch of *Juniperus communis*, on bark, 7.IV.2016, P. Vetlesen (O, doc. vid.). — **SWEDEN**: **Södermanland**, 32 km S of Stockholm, 9.7 km NE of Ösmo, Häringe, 45 m, branch of *Corylus avellana*, on wood, 6.X.2013, H.G. Thoresson & I. Olariaga (UPS F-639446, doc. vid.). — **DENMARK**: **Sjælland**, 8 km NNW of Ringsted, 1 km S of Allindelille, Fredskov, 65 m, branch of *C. avellana*, on wood, 26.V.2007, H.O. Baral (H.B. 8517). — **POLAND**: **Lower Silesia**, Central Sudetes, 22.5 km WSW of Kłodzko, 3.5 km SW of Duszniki Zdrój, 810 m, on wood of *Salix*, 7.IX.2006, P. Perz (P.P. 20060907-1, doc. vid.). – 18 km SSE of Bystrzyca Kłodzka, 5 km E of Międzylesie, SW of Jodlow 750 m, branch of *Acer*, on wood, 13.VIII.2006, P. Perz (P.P. 20060813-3, doc. vid., anam. substr.). – 8 km ENE of Międzylesie, NE of Jodlow, 820 m, branch of *Acer*, on wood, 15.VIII.2006, P. Perz (P.P. 20060815-1, anam. substr., doc. vid.). – **SLOVAKIA**: **Prešov**, Carpathian Mts., Vysoké Tatry, 2 km S of Tatranská Lomnica, Stará Lesná, 803 m, branch of *Salix caprea*, on wood, 19.VIII.2019, A. Polhorský (A.P. 19/32a, doc. vid.). — **GERMANY**: **Niedersachsen**, Harz, 5,5 km WSW of Goslar, SW-end of Granestausee, 320 m, branch of *Salix caprea*, on wood & bark, 2.VI.2004, H.O. Baral (H.B. 7531a, anam. substr.). – 0.9 km SW of Goslar, hill SW of Kloster Frankenberg, 315 m, branch of *Tilia platyphyllos*, on wood & bark, 2.IV.2004, H.O. Baral (H.B. 7532, anam. substr.). – **Baden-Württemberg**, 3.2 km SE of Altensteig, 1.1 km EE of Egenhausen, Egenhäuser Kapf, 620 m, branch of *S. ?caprea*, on wood, 22.XI.2010, H.O. Baral (H.B. 9459c ø). – 2.5 km NW of **Tübingen**, Morgenstelle, Arboretum, 480 m, branch of *Gleditsia sinensis*, on wood, 5.IX.2003, H.O. Baral (ø). – 2.5 km SW of Tübingen, Spitzberg, N of Ödenburg, 420 m, branch of *Clematis vitalba*, on wood, 21.XII.2003, H.O. Baral (H.B. 7445). – 5.5 km NE of Tübingen, Pfrondorf, Blaihofstraße, 430 m, branch of *Juglans regia*, on wood, 6.XI.2008, H.O. Baral (H.B. 8950b ø). – 0.6 km S of Pfrondorf, Obere Mähder, 390 m, stem of *Rumex*, 14.III.2009, H.O. Baral (H.B. 9018a ø, anam. substr.). – **Schwäbische Alb**, 2.5 km of Reutlingen, NW of Eningen, Achalm, 685 m, branch of *Acer campestre*, on bark, 25.VII.1999, H.O. Baral (ø). – ibid., branch of *Cornus sanguinea*, on wood, 25.VI.2011, H.O. Baral (ø). – 6.3 km E of Reutlingen, 2.5 km ENE of Eningen, Hännersteigfels, 750 m, branch of *Fagus sylvatica*, on wood, 3.III.2002, H.O. Baral (ø). – 9 km SE of Metzingen, 2 km SW of Urach, Brühlbach NE of Uracher Wasserfall, 520 m, branch of *Acer pseudoplatanus*, on wood, 15.VI.1997, H.O. Baral (H.B. 5816). – **Schwarzwald**, 7.5 km WNW of Villingen, Unterkirnach, Kirnacher Höhe, 842 m, branch of *Sambucus nigra*, on wood, 5.VIII.2009, H.O. Baral (H.B. 9120 ø, anam. substr.). – 6.3 km NE of Furtwangen, 2.3 km N of Rohrbach, N of Stöcklewaldturm, 1033 m, branches of *S. racemosa*, on wood, 5.VIII.2009, H.O. Baral & B. Liu (H.B. 9126a). – **Bodensee**, 8 km NE of Radolfzell, 1.5 km SE of Bodman, 400 m, branch of *Robinia pseudoacacia*, on wood, 29.VIII.2001, H.O. Baral (H.B. 7018c, anam. substr.). – 4.5 km SE of Bodman, NW of Marienschlucht, 405 m, branch of *Acer pseudoplatanus*, on wood, 30.VIII.2001, H.O. Baral (ø). – **Bayern**, **Oberfranken**, 3.8 km E of Marktredwitz, S of Brand, Kleeschlag, 570 m, branch of *Acer pseudoplatanus*, on wood, 17.III.2019, M. Reul (M.R. 6768, anam. substr., doc. vid.). – **Oberpfalz**, 14 km NNE of Amberg, 1.2 km NNW of Hirschau, Frühmeß, 455 m, twig of *Salix caprea*, on wood, 27.XII.2005, H.O. Baral (H.B. 8026c). – 1.5 km W of Hirschau, W of Moosweiher, 420 m, branch of *Populus tremula*, on wood, 29.XII.2003, H.O. Baral (H.B. 7448, anam. substr.). – **Oberbayern**, 8.5 km SE of München, 1 km ESE of Neuperlach, 543 m, branch of *Clematis vitalba*, on wood, 10.II.2009, B. Fellmann (MAMU 1031, H.B. 9007a ø, anam. substr.). — **SWITZERLAND**: **Nidwalden**, 8.2 km SSW of Luzern, 3.2 km W of Hergiswil, N of Gschwänd, 1200 m, branch of *Salix appendiculata*, on wood & bark, 18.VIII.2006, H.O. Baral (H.B. 8248b, anam. substr.). – 2 km WSW of Hergiswil, Renggeli, 840 m, branch of *Juglans regia*, on wood, 18.VIII.2006, E. Weber (ex H.B. 8244a, M-0276480, **holotype**, anam. substr.; sq.: KT222451, KT222454). – 1 km NW of Hergiswil, Bruustried, 600 m, branches of *Fraxinus excelsior*, on wood, 22.VIII.2006, U. Graf & H.O. Baral (H.B. 8276, anam. substr.). – ibid., branch of *Acer pseudoplatanus*, on wood, 22.VIII.2006, H.O. Baral (ø). – ibid., branch of *Tilia platyphyllos*, on wood, 22.VIII.2006, H.O. Baral (H.B. 8278 ø). – **Jura**, 13 km NW of Biel, 1.5 km SE of Tramelan, 1035 m, branch of *Sorbus aria*, on wood, 17.VI.2018, H.O. Baral (H.B. 10161). – ibid., 1045 m, branch of *Corylus avellana*, on wood, 17.VI.2018, H.O. Baral (H.B. 10159). – ibid., branch of *Lonicera xylosteum*, on wood, 17.VI.2018, H.O. Baral (H.B. 10163). – 12 km NW of Biel, 5 km ENE of Tramelan, NE of Orange, 860 m, branch of *Malus domestica*, on wood, 16.VI.2018, H.O. Baral & J. Gilgen (H.B. 10158 ø). – ibid., branch of *Sambucus nigra*, on wood, 16.VI.2018, U. Graf (H.B. 10164). — **LUXEMBOURG**: **Gutland**, **Diekirch**, 3.5 km E of Diekirch, 1.7 km SW of Bettendorf, Schoofsboesch, Carrières de Gilsdorf, 313 m, branch of *Clematis vitalba*, on bark, 26.IV.1994, G. Marson & H.O. Baral (H.B. 5069, anam. substr.). – **Luxembourg**, 7 km NE of Luxembourg, 1.5 km WSW of Senningerberg, W of Kiem, 388 m, stem of *Atropa belladonna*, 2.X.2005, G. Marson (H.B. 8001a ø). – 7 km W of Luxembourg, 1 km NW of Bertrange, Brill, 300 m, branch of *Prunus spinosa*, on wood & bark, 23.V.1999, G. Marson (ø, anam. substr.). – 6 km S of Luxembourg, 1.5 km WSW of Fentange, Mierchesfeld, 283 m, branch of *Acer pseudoplatanus*, 21.VII.2008, G. Marson (ø). – **Esch-sur-Alzette**, 4.2 km S of Bettembourg, bridge 2.8 km NW of Zoufftgen, along railway, 290 m, twigs of *Clematis vitalba*, on bark, 25.VII.2014, G. Marson (ø). – 6 km SE of Esch-sur-Alzette, SSW of Rumelange, former train station, 305 m, twig *C. vitalba*, on bark, 23.IX.1994, G. Marson (ø). – 6.5 km ESE of Esch-sur-Alzette, 1.5 km SW of Dudelange, Haard, 375 m, branch of *Populus tremula*, on wood, 2.I.2005, G. Marson (H.B. 7649c ø). – **Remich**, 8.5 km S of Remich, SW of Schengen, Stréimchen, 225 m, stem of *Rubus* (?)*bifrons*, on bark, 11.II.2007, G. Marson (ø). — **FRANCE**: **Poitou-Charentes**, **Deux-Sèvres**, 4.5 km NW of Chizé, 1.3 km SSE of Villiers-en-Bois, Forêt de Chizé, 72 m, twig of *Acer campestre*, on wood, 27.IV.2011, H.O. Baral (H.B. 9496 ø). – ibid., branch of *Carpinus betulus*, on wood, 27.IV.2011, M. Bemmann (ø). – 17 km SSE of Niort, 3 km N of Villiers-en-Bois, Forêt de Chizé, Les Essarts, 85 m, on splitted wood of *Corylus avellana*, 14.IV.2008, A. Gminder (ø). – **Lorraine**, **Vosges**, 2 km NNW of Gérardmer, E of Pépinière des Xettes, la Chennezelle, 925 m, trunk of *Salix ?aurita × caprea*, on bark, 6.IX.1998, G. Marson (H.B. 6214). – 1 km NNW of Gérardmer, La Basse de la Mine, 750 m, branch of *Acer pseudoplatanus*, on wood, 7.IX.1996, G. Marson (H.B. 5588, anam. substr.). – **Franche-Comté**, **Jura**, 8.3 km ENE of Poligny, 3.5 km SSE of Mesnay, La Cascade des Tufs, 360 m, 2.V.2017, J.P. Priou (J.P.P. 17073, doc. vid.). – **Bourgogne**, **Nièvre**, 6 km ESE of Château-Chinon-Ville, 1 km WSW of Arleuf, 605 m, branch of *Fraxinus excelsior*, on wood, 30.IV.2011, E. Weber & V. Baral (ø). – **Auvergne**, **Cantal**, 4.5 km SSE of Le Falgoux, S of Le Pont des Eaux, 1140 m, twig of *Lonicera xylosteum*, on wood, 29.IX.2016, J.P. Priou (J.P.P. 16243, doc. vid.). – **Puy-de-Dôme**, 14 km SSE of La Bourboule, 0.7 km E of Picherande, chemin de Gayme, 1170 m, branch of *Salix*, on wood, 1.IX.2011, J.P. Priou (J.P.P. 11087, doc. vid.). – **Rhône-Alpes**, **Isère**, 13 km N of La-Tour-du-Pin, 1 km NW of Morestel, 233 m, branch of *Populus ?× canadensis*, on wood, 29.IX.1999, G. Marson (H.B. 6499). – **Provence-Alpes-Côte d'Azur**, **Alpes-de-Haute-Provence**, 12 km WSW of Briançon, 2.7 km NNE of Vallouise, E of Pelvoux, l'Adret, 1495 m, branch of *Juniperus communis*, on wood, 11.IX.2008, J.P. Priou (J.P.P. 28203, anam. substr., doc. vid.). – ibid., branches of *Acer campestre*, on wood, 11.IX.2008, J.P. Priou (J.P.P. 28204, doc. vid.). – **Aquitaine**, **Pyrénées-Atlantique**, 23 km WSW of Oloron-Ste.-Marie, 9 km WNW of Osse-en-Aspe, Col de Labays, 1350 m, branch of *Fagus sylvatica*, on wood, 9.X.2016, H.O. Baral (H.B. 10032). — **SPAIN**: **Asturias**, 2.4 km N of Pola de Somiedo, 2 km S of Castro, 703 m, branch of *Berberis vulgaris*, on wood, 7.VI.2013, H.O. Baral (ø). – **Castilla y León**, **León**, 7.5 km E of Villablino, Villaseca de Laciana, SW of Carrasconte, 1296 m, branch of *Aesculus hippocastanum*, on wood, 27.IV.2019, E. Rubio (E.R.D. 7911, doc. vid.). – **Andalucía**, **Granada**, Sierra Nevada, 43 km SW of Granada, 4 km SW of Alhama de Granada, Cortijo del Navazo, 1145 m, branch of *Quercus rotundifolia*, on bark, 19.I.1982, A. Ortega & R. Galán (AH 6022, as *O. ?luteorubella*, H.B. 5098 ø). — **ITALY**: **Emilia-Romagna**, **Reggio Emilia**, Northern Apennines, 57 km NE of La Spezia, 2.5 km NNW of Ligonchio, WNW of Caprile, 710 m, branch of *Sorbus domestica*, on wood, 2.X.2004, J.P. Priou (J.P.P. 24152, H.B. 7584).

Not included. **SENEGAL**: **Ziguinchor**, 54 km WSW of Ziguinchor, 1 km S of Kabrousse, Cap Skirring, 5 m, branch of ?*Vachellia*, on wood, 2.I.2000, R. Reuter (H.B. 6560a). — **MEXICO**: central Mexico (unlocalized), *Quercus deserticola* litter, IX.2014 (HDW-OTU-29, mol. extr.; sq.: KT581933). — **SWEDEN**: unlocalized, *Picea abies* stump, Kubart et al. 2016 (mol. extr., sq.: KP887834).

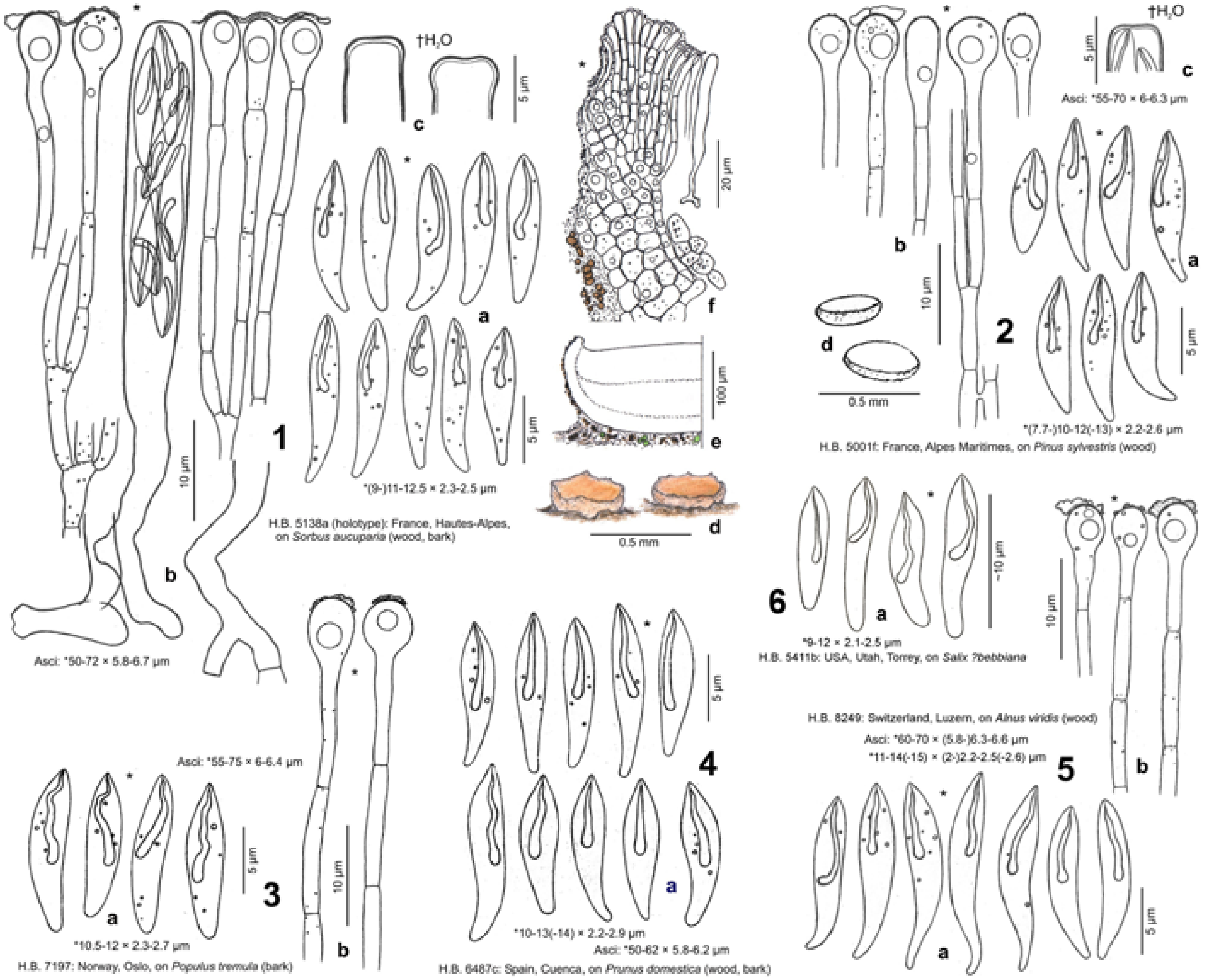


Plate 615. **1–6**: *Orbilia subtrapeziformis*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apices; **d**. rehydrated apothecia; **e**. apothecium in median section; **f**. id., ectal excipulum at margin and mid flanks.

Orbilia subtrapeziformis Baral, E. Weber & G. Marson, **sp. nov.**, MB 813671 — Pls 615–616, Map 102

Etymology: in reference to the similar *O. trapeziformis*.

Typification: France, Hautes-Alpes, Villar-d'Arêne, branches of *Sorbus aucuparia*, 14.VII.1994, G. Marson (ex H.B. 5138a, M-0276599, holotype).

Latin diagnosis: *Similis* Orbiliae trapeziformi *sed ascosporae distincte longiores. Habitat in locis borealibus ad orosubmediterraneis (sub)humidis Europae*, *Macaronesiae*, *Asiae et Americae septentrionalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.15–)0.2–0.5(–0.8) mm diam., (0.085–)0.1–0.15(–0.22) mm high, (pale to) light (to bright) orange(-ochraceous), more rarely rose, non- or slightly to medium translucent, round, sometimes slightly elliptical, scattered to medium, sometimes densely gregarious; disc young slightly concave, soon flat, finally slightly convex, margin indistinct or distinct, 0–25 µm protruding, smooth to finely or sometimes strongly rough to crenulate; broadly sessile, rarely with a stipe 0.03 × 0.07 mm, superficial or slightly immersed; dry light to bright orange. **Asci** *(45–)53–75((–90)) {9} or 85–100 {1} × 5.7–7(–7.2)((–7.7)) µm {10}, †(40–)45–70(–79) {7} or 82–96(–100) {1} × 5–6.3 µm {8}, 8-spored, spores *3–4-seriate, (1–)3–5(–6) lower spores inverted {13} (rarely mixed), pars sporifera *27–35 → 20 µm long; **apex** (†) strongly truncate (very slightly to distinctly indented, laterally inflated or not); **base** with short to very long, thin or thick, flexuous stalk, T-, L-, Y- or h-, exceptionally H-shaped. **Ascospores** *((7.7–))(8.5–)9–14.5(–16) × (1.8–)2–2.7(–3) µm {26}, †8.5–13.5(–15.5) × 2–2.5 µm {4}, (fusoid to) fusiform, also fusiform-clavate, apex acute, rarely obtuse to subacute or acuminate in some spores, base mostly strongly, rarely slightly to medium attenuated, with or without a tail-like base, slightly to medium curved especially near base, rarely straight; **SBs** *(4–)5–7.5(–8) × (0.5–)0.6–1(–1.2) µm in situ {16} (~5–8 µm actual length), subulate (to vermiform), not or sometimes distinctly swollen at base, ± flexuous, sometimes ± uncinate, rarely straight; in aged spores 2.5–4.5 × 1.2–1.5 µm, globose with long filum, germinating spores not observed. **Paraphyses** apically (slightly to) medium to very strongly (clavate-)capitate, rarely moniliform, terminal cells *(5–)10–19(–25) × (2.5–)3.3–5(–6) µm {6}, †3–4 µm wide {1}, lower cells *(5.7–)9–14(–17) × 1.2–2.3 µm {3}; never branched at upper septum, hymenium subhyaline. **Medullary excipulum** pale orange, 30–50 µm thick, of dense textura intricata with many inflated cells, indistinctly to medium sharply delimited. **Ectal excipulum** subhyaline to pale orange, of thin-walled, (indistinctly) vertically or horizontally oriented t. prismatica-angularis(-globulosa) from base to mid flanks, 20–40 µm thick near base, cells *(5–)7–16 × 5–11 µm {3}; 25 µm thick at flanks, 15–25(–30) µm at margin, oriented at a 10–45° angle to the surface at mid flanks (t. globulosa-angularis) and 0–10° at margin (t. prismatica-porrecta), cortical cells *6–7 × 4–5 µm {1} at submargin, *7–12 × 3–4 µm at upper margin {2}. **Anchoring hyphae** ± abundant, */†2–3.3(–4) µm wide, walls 0.2–0.3(–0.5) µm thick {3}, with or without gel sheath, forming a loose t. intricata up to 40 µm thick at base, partly also covering flanks and margin as a thin layer. **SCBs** in

Plate 616. **1–13**: *Orbilia subtrapeziformis*. – **1a**. living planted birch tree along road with large wound; **2a**, **5a**. dead xeric branches of *Sorbus aucuparia*; **1b**, **2b**, **3a–d**, **4a**, **5b–d**, **6a–b**, **7a–c**, **8b**, **11a**. rehydrated apothecia; **8a**. dry apothecia; **7d**, **9**. apothecia in median section; **10a**. ascus apex; **1c**, **10b**, **11c**. apices of paraphyses; **1d**, **2c**, **4b**, **7e**, **10c**, **11b**, **12**, **13**. ascospores. – Living state, except for **7e** 2 left spores, **10a**. – **10a–c**: phot. P. Perz, **11a–c**: phot. E. Rubio. — **1a–d**. H.B. 9368b: Sweden, Lapland, on *Betula*; **2a–c**. H.B. 9406b: ibid., on *Sorbus*; **3a–d**. H.B. 9166a: Switzerland, Wallis, on *Alnus*; **4a–b**. H.B. 9165b: ibid., on *Sambucus*; **5a–d**. H.B. 5138a (holotype): France, Hautes-Alpes, on *Sorbus*; **6a–b**. H.B. 7156b: France, Rhône-Alpes, on *Prunus*; **7a–e**. H.B. 8269a: Switzerland, Uri, on *Alnus*; **8a–b**. H.B. 8249: ibid., Luzern, on *Alnus*; **9**. H.B. 8916a: ibid., Bern, Thun, on *Alnus*; **10a–c**. P.P. 20071028: Poland, Kłodzko, on *Salix*; **11a–c**. E.R.D. 4497: Spain, Asturias, on *Ribes*; **12**. H.B. 9225: Tenerife, Teide, on *Spartocytisus*; **13**. H.B. 7889: Mongolia, Altay, on indet. angiosperm.

paraphyses and ectal excipulum (near margin) globose {11}, (1–)1.5–2.5(–3) µm diam. **Exudate** over paraphyses (0.2–)0.5–1.5(–2) µm thick, hyaline, granular-cloddy or finely rough, soon firmly attached; over margin and flanks 0.2–1.5 µm thick. **— ANAMORPH**: unknown.

Habitat: collected (0.1–)0.3–2.5(–4) m above the ground, corticated to decorticated, 4–30 mm thick twigs and branches, rarely ~8–25 cm thick trunks, of *Acer* sp. {1}, *Alnus alnobetula* {6}, *Berberis vulgaris* {1}, *Betula pubescens* {1}, *Cytisus scoparius* {1/1}, *C. supranubius* {1}, *Fagus sylvatica* {1}, *Laburnum alpinum* {1}, *Pinus sylvestris* {1}, *Populus tremula* {1}, *Prunus* sp. {1}, *P. domestica* {1}, *Pyrus caucasica* {1}, *Rhamnus alpina* {3}, *Ribes petraeum* {3}, *Robinia pseudoacacia* {1}, *Rosa* sp. {2}, *R. canina* {1}, *Salix* sp. {2}, *S. ?bebbiana* {1}, *S. cantabrica* {1}, *S. ?caprea* {1}, *S. ?herbacea* {1}, *Sambucus racemosa* {1}, *Sorbus aucuparia* {2}, *S. domestica* {1}, *Ulmus* sp. {1}, indet. angiosperm shrub {1}, on 0.1–0.2 mm deep slightly to strongly decayed wood {32} and bark {8} (bast), also on pith {1}, scarcely to strongly greyed, covered by a few to many green algae. **Associated**: *Baggea* sp. {1}, *Cenangiopsis alpestris* {1}, *Crumenulopsis* sp. {1}, *Cyathicula* sp. {1}, *C. hysterioides* {1}, *C. nigrofusca* {1}, *Durella connivens* {1}, *Godronia fuliginosa* {1}, *Hymenoscyphus infarciens* {1}, *Hyphodiscus ?hymeniophilus* {1}, *Karstenia* sp. {1}, *K. idaei* {1}, *Lindgomyces griseosporus* {1}, *Mellitiosporiella pulchella* {1}, *Mollisia rosae* {2}, *Neodasyscypha cerina* {1}, *Orbilia arachnovinosa* {1}, *O. aristata* {4}, *O. asturiensis* {1}, *O. coniferarum* {1}, *O. delphinus* {4}, *O. eucalypti* {1}, *O. fabacearum* {1}, *O. flagellispora* {1}, *O. flexisoma* {1}, *O. gambelii* {1}, *O. multiphanosoma* {1}, *O. ovalis* {3}, *O. patellarioides* {1}, *O. phragmotricha* {1}, *O. pleiogambelii* {1}, *O. somedana* {2}, *O. vinosa* {1}, *O. vitalbae* {1}, *Ostropa barbara* {1}, *Otthia spiraeae* {1}, *Parmelia sulcata* {1}, *Patinellaria sanguinea* {1}, *Perrotia flammea* {2}, *Physcia* sp. {1}, *Pleurosticta acetabulum* {1}, *Propolis farinosa* {1}, *Pseudohelotium ?sordidulum* {1}, *Pyrenopeziza aquosa* {1}, *Sarea resinae* {1}, *Sclerococcum* sp. {1}, *Usnea* sp. {1}, crustose lichens. **Desiccation tolerance**: fully tolerant for at least 2 months, some spores still viable after 10 months. **Altitude**: 470–550 m a.s.l. (Scandinavia), (928–)1385–1950 m (European Alps), 1350–1650 m (Spain). **Geology**: America: Proterozoic to Cambrian-Ordovician sediments; Europe: Middle & Upper Jurassic and Cretaceous marl, limestone & siliceous chalk, dolomite, Eocene flysch; granite, diorite, gneiss, migmatite, andesite, quartz, mica schist, amphibolite, (trachy-) basaltic flow. **Phenology**: (II–)VI–X (probably throughout the year, long-lived, but difficult to collect during winter).

Phenology of *O. subtrapeziformis*											
Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
0	1	0	1	1	14	7	13	2	2	0	0

Taxonomic remarks. *Orbilia subtrapeziformis* is characterized by medium-sized, fusiform ascospores having acute apices and mostly strongly tapered, often ± curved bases, and subulate, somewhat flexuous spore bodies being basally ± distinctly inflated. *O. filiformis* has a very similar spore shape, but the spores tend to be slightly narrower and the often distinctly longer SBs are distinctly narrower. *O. obtusispora* differs in less fusiform spores with more obtuse apices, and a colline to atlantic or mediterranean distribution. The Australian *O. phragmitis* differs in the presence of crystalloid SCBs and a subtropical habitat. *O. idahoensis* resembles *O. subtrapeziformis* in the spores which have, however, a considerably higher length/width ratio. For the similar *O. macrotrapeziformis*, known from warm-temperate to subtropical semihumid to semiarid Australia and North America, see p. 1098. *O. delphinus* resembles *O. subtrapeziformis* in spore shape but differs in 16-spored asci.

Variation. The collections from the Alps show some variation in spore size (especially length), shape, and curvature, but this variation was observed to a considerable extent also within a population. In the sample from Norway (Pl. 615: 3) the spores were only slightly to medium tapered and hardly curved at the base, reminiscent of *O. macrotrapeziformis*, but such spores occurred also in other collections together with the more typical ones. Two samples from North America (Pl. 615: 6; IVV: H.B. 6234c) and one from Mongolia (Pl. 616: 13) fit rather well those from central Europe. Their spore length is at the lower end of the range: H.B. 6234c †9.5–11 × 2.3–2.4 µm, Mongolia *(8.3–)9–11(–12.5) × 2.3–3 µm. The apothecia in the Mongolian specimen are remarkable in having a short stipe. On the contrary, spore length in the Macaronesian specimen (Pl. 616: 12) is at the upper end of the range (*12.5–16 × 2.3–2.6 µm). One of the two samples from Lapland (Pl. 616: 1) deviates in extraordinarily long asci (*85–100 µm), also in unusually large and thick apothecia (0.5–0.8 mm diam., 1b), measurements which do not even overlap with most of the other collections.

Phylogeny. A somewhat incomplete sequence of the ITS region was gained from apothecia of a collection on *Rhamnus* from Asturias. It clustered unresolved and with high distance in the *Serpentinae-Habrostictis* clade (~15% to *O. trapeziformis* from Germany, on *Juglans*) (Phyl. 19). The similar *O. obtusispora* (distance 16%) and two samples identified as *O. trapeziformis* (from France, on *Corylus* and *Cercis*) surprisingly clustered with high support in the *Ellipsospermae* clade.

Ecology. *O. subtrapeziformis* was collected on ± rotten wood and bark of xeric twigs and branches of various angiosperm (exceptionally gymnosperm) trees and shrubs. The species appears to be restricted within Europe to hemi- to oroboreal, orotemperate (altimontane to subalpine) and orosubmediterranean humid areas. One of the more frequently recorded vegetation types is the subalpine green alder dwarf shrub (*Alnetum viridis*). However, sparse records suggest a wide, possibly worldwide distribution, which includes orotemperate humid southeastern Europe (Caucasus), continental, orotemperate (sub)humid (winter-dry), alpine central Asia (Mongolia), the supramediterranean semihumid summit broom scrub (*Spartocytisetum supranubii*) in the caldera of the volcano Teide in Tenerife (Macaronesia), and boreal humid Douglas fir forests with *Salix*, *Populus* and *Acer* in the Canadian Rocky Mountains and Utah Mountains of western North America.

Specimens included. **NORWAY**: **Oslo**, 8 km NW of Oslo, 1.8 km NNE of Holmenkollen, N of Frognerseteren, 470 m, branch of *Populus tremula*, on bark, 14.VIII.2002, G. Marson (H.B. 7197). — **SWEDEN**: **Västerbotten**, Vilhelmina, 0.5 km SW of Saxnäs, Fjällgarden, 550 m, trunk of *Betula pubescens*, on wood, 26.VII.2010, P. Perz & H.O. Baral (H.B. 9368b). – 6 km ESE of Saxnäs,

Map 102: Known distribution of *O. subtrapeziformis* in Europe and Macaronesia (yellow = not included collection).

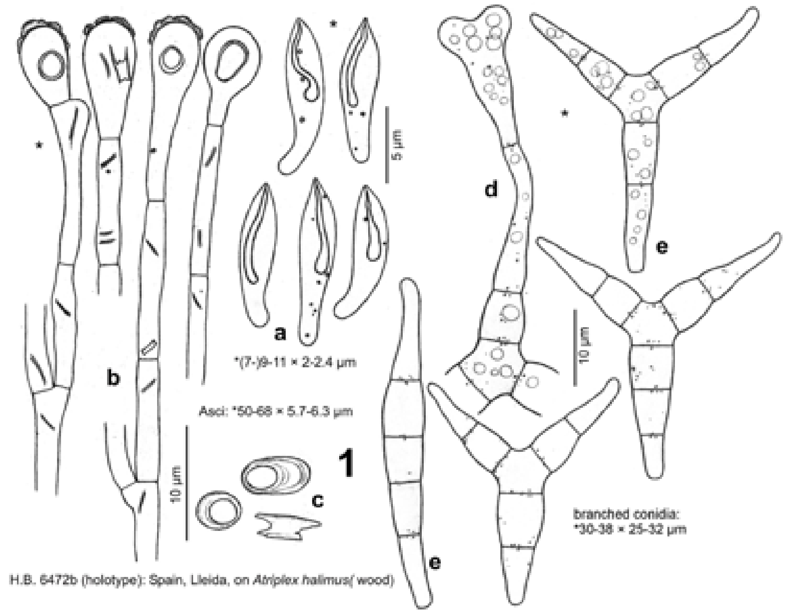


Plate 617. **1**: *Orbilia halimi* (holotype). – **a**. ascospores; **b**. paraphyses; **c**. crystalloid SCBs in ectal excipulum; **d**. conidiophore with young conidium from culture; **e**. conidia.

Trappstegsforsen, 525 m, branch of *Sorbus aucuparia*, on wood, 28.VII.2010, H.O. Baral (H.B. 9406b). — **POLAND**: **Lower Silesia**, 13 km SE of Bystrzyca Kłodzka, 2 km SE of Miedzygorze, 5 km WNW of Śnieżnick, 790 m, branch of *Salix*, on wood, 28.X.2007, P. Perz (P.P. 20071028-05, doc. vid.). — **SWITZERLAND**: **Luzern**, 15.5 km W of Luzern, 2.5 km S of Werthenstein, Staldigwald, 928 m, branch of *Ulmus*, on wood, 9.VI.2018, U. Graf (H.B. 10148). – **Obwalden**, 10 km SSW of Luzern, 3.5 km NNW of Alpnach, Pilatus, E of Matthorn, W of Ämsigen, 1500 m, branch of *Alnus alnobetula*, on wood, 19.VIII.2006, H.O. Baral (H.B. 8249). – Uri, 9 km ESE of Altdorf, 1.2 km SW of Unterschächen, N of Sittlisalp, E of Obsaum, 1650 m, branch of *A. alnobetula*, on wood, 21.VIII.2006, H.O. Baral (H.B. 8269a). – **Bern**, 11 km E of Thun, 3.8 km E of Schwanden, Sigriswilergrat, NW of Rothorn, 1620 m, branch of *A. alnobetula*, on wood, 27.VIII.2008, H.O. Baral (H.B. 8916a). – 15 km E of Innertkirchen, 10 km E of Gadmen, Steinsee, 1945 m, branch of *Salix ?herbacea*, on wood, 16.VII.2018, E. Stöckli (doc. vid.). – **Wallis**, 14.5 km ENE of Brig, 2.7 km SSW of Binn, SW of Heiligkreuz, 1480 m, branch of *Sambucus racemosa*, on wood, 18.VIII.2009, H. Aeberhard (H.B. 9165b). – 21.5 km SW of Andermatt, NE of Oberwald, S of Grimselpass, 1385 m, branch of *A. alnobetula*, on wood, 17.VIII.2009, H. Aeberhard (H.B. 9167). – 19.3 km WSW of Andermatt, E of Gletsch/Grimselpass, 1830 m, branches of *A. alnobetula*, on wood, 17.VIII.2009, H. Aeberhard (H.B. 9166a). — **AUSTRIA**: **Tirol**, Hohe Tauern, 5.7 km WNW of Tauer, 2.2 km WNW of Innergschlöß, Ochsenwald, 1900 m, branch of *A. alnobetula*, on wood, 15.VI.2013, G. Friebes (ø, doc. vid.). – **Steiermark**, 13 km ESE of Wolfsberg, 3.3 km W of Glashütten, NE of Koralpe, 1500 m, branch of *Salix ~caprea*, on wood, 5.IV.2014, G. Friebes (G.F. 20140045, doc. vid.). — **MONTENEGRO**: 33 km NE of Podgorica, Komovi Massif, Širokar, 1725 m, branch of *Rosa*, on bark, 7.VI.2016, B. & I. Perić (B.P. Dgf-C7D-07-06-16, doc. vid.). — **FRANCE**: **Auvergne**, **Cantal**, 31 km ENE of Aurillac, 4 km SW of Albepierre-Bredons, N of Prat de Bouc, 1378 m, stem of *Rosa canina*, 7.IX.2009, J.P. Priou (J.P.P. 29168, doc. vid.). – **Rhône-Alpes**, **Isère**, 10 km W of Grenoble, 5 km NE of Autrans, la Molière, 1605 m, twig & branch of *Prunus*, on wood & bark, 12.VIII.2001, G. Marson (H.B. 7156b). – **Savoie**, 46 km SSW of Aosta, ~5 km S of Col de l'Iseran, WSW of Bonneval-sur-Arc, 1900 m, on *Salix*, 5.VIII.1995, G. Marson (ø). – **Provence-Alpes-Côte d'Azur**, **Alpes-de-Haute-Provence**, 8 km SE of St.-Julien-du-Verdon, 3 km NW of Soleilhas, Vauplane, 1595 m, branch of *Cytisus ?scoparius*, on wood, 16.VII.1994, G. Marson (H.B. 5129). – 9.7 km ESE of St.-André-les-Alpes, 3.2 km WSW of Annot, Colle Basse, 1475 m, branch of *Laburnum alpinum*, on bark, 17.VIII.2001, G. Marson (H.B. 7025c ø). – **Hautes-Alpes**, 25 km NW of Briançon, 4 km ESE of Villar-d'Arêne, Col du Lautaret, 1950 m, branches of *Sorbus aucuparia*, on wood & bark, 14.VII.1994, G. Marson (**holotype**, M-0276599; **isotypes** in G.M. 5204 & H.B. 5138a). – **Alpes Maritimes**, Mercantour, 33 km ENE of Digne-les-Bains, SE of Colmars-les-Alpes, 1250 m, branch of *Robinia pseudoacacia*, on wood, 5.VI.2010, J.P. Priou (J.P.P. 10121, non vid.). – 8 km NNE of Colmars-les-Alps, 3.5 km ENE of Allos, Valplane, 1780 m, branch of *Sorbus domestica*, on wood, 7.VI.2010, J.P. Priou (J.P.P. 10127, doc. vid.). – 19 km NNE of Grasse, 4 km NNE of Gréolières, Gréolières les Neiges, 1405 m, branch of *Pinus sylvestris*, on wood, 1.X.1993, G. Marson (H.B. 5001f). — **SPAIN**: **Asturias**, 11 km SE of Pola de Somiedo, 6 km SE of Valle de Lago, Lago de Valle, 1560 m, branch of *Rosa*, on wood & pith, 6.VI.2017, B. Capoen (H.B. 10098). – 13.5 km ESE of Pola de Somiedo, 5 km SE of Saliencia, La Farrapona, 1650 m, branch of *Ribes petraeum*, on wood, 15.VI.2008, J. Linde, vid. E. Rubio (E.R.D. 4497, doc. vid.). – ibid., 4.VII.2009, J. Linde & E. Rubio (ø, non vid.). – ibid., 18.VI.2011, J. Linde (E.R.D. 5316 ø, doc. vid.). – ibid., branch of *Rhamnus alpina*, on wood, 4.VI.2017, H.O. Baral (H.B. 10084d). – 3 km SSE of Pola de Somiedo, 1.3 km SSW of Coto de Buenamadre, Braña de Mumián, 1390 m, branch of *R. alpina*, on wood, 2.VI.2013, H.O. Baral (H.B. 9787; sq.: MK493126). – 6 km SW of Pola de Somiedo, 5 km SSE of Vilar de Vildas, Braña Los Cuartos, 1410 m, branch of *Cytisus scoparius*, on wood, 8.VI.2017, H.O. Baral (H.B. 10099a ø). – ibid., branch of *Rhamnus alpina*, on wood, 8.VI.2017, H.O. Baral (ø). – 6 km S of Pola de Somiedo, SW of La Peral, 1350 m, trunk of *Fagus sylvatica*, on bark, 7.VI.2017, H.O. Baral {H.B. 10104b}. – 7 km S of Pola de Somiedo, 1.6 km W of El Puerto, N of Vega Cimera, 1505 m, branch of *Berberis vulgaris*, on wood, 5.VI.2013, E. Rubio (H.B. 9802 ø). – ibid., branch of *Salix cantabrica*, on bark, 7.VII.2017, E. Rubio (E.R.D. 7116, doc. vid.). – **Castilla-La Mancha**, **Cuenca**, Sierra de Albarracín, 43 km NE of Cuenca, 8 km SW of Guadalaviar, S of Mt. Mogorrit, 1600 m, branch of *Prunus domestica*, on bark & wood, 26.IX.1999, H.O. Baral & G. Marson (H.B. 6487c). — **MACARONESIA**: **Canary Islands**, **Tenerife**, La Orotava, Las Cañadas del Teide, 8.5 km ENE of Teide, SSE of El Portillo, Montaña de las Arenas Negras, 2110 m, branch of *Cytisus supranubius*, on wood, 13.II.2009, L. Quijada, J. Diaz Armas & E. Beltrán-Tejera (TFC Mic 21507, H.B. 9225). — **RUSSIA (West)**: **Karachayevo-Cherkesiya**, Caucasus Mts., 93 km SSW of Tscherkessk, 4 km S of Teberda, 1340 m, branch of *Pyrus caucasica*, on wood, 6.VIII.2009, E.S. Popov (LE 222576, doc. vid.). — **MONGOLIA**: **Bayan Ölgii**, Tolbo, Altay Mts., ~20 km E of Tolbo, between Khökh Serkh Uul and Tsambagarav Uul Mts., ~2900 m, branch of indet. angiosperm, on wood, 5.VIII.2005, P. Karasch (P.K. 05082005-15, H.B. 7889 ø). — **CANADA**: **British Columbia**, Canadian Rocky Mountains, 61 km SE of Golden, 1 km SE of Spillimacheen, 830 m, branch of *Acer*, on wood, 20.VIII.1997, G. Marson (H.B. 6234c). — **USA**: **Utah**, Utah Mts., Dixie Forest, 23 km SSE of Torrey, 14 km S of Grover, N of Pleasant Creek Campground, 2600 m, branch of *Salix ?bebbiana*, 15.V.1995, G. Marson (ø).

Orbilia halimi Baral & E. Weber, **sp. nov.**, MB 813672 — Pls 617–618

Etymology: named after the specific epithet of the host species.
Typification: Spain, Lérida, branch of *Atriplex halimus*, 21.IX.1999, H.O. Baral (ex H.B. 6472b; M-0276491, holotype; ex-type culture: CBS 116272; sq.: KT215240).

Latin diagnosis: *Similis* Orbiliae subdelphino *sed asci octospori, ab* Orbilia phragmitis *sporis brevioribus differt. Habitat ad lignum vel corticem putridum ramorum siccorum* Atriplicis halimi *in zona mesomediterranea semiarida Europae meridionalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.15–0.3(–0.45) mm diam., 0.11–0.15 mm high, pale to light (yellowish-)orange, hardly translucent, round, scattered to subgregarious; disc flat, margin distinct, thin or thick, not protruding, ± smooth; broadly sessile, almost superficial to entirely immersed between fibres. **Asci** *50–68 × 5.7–6.3 µm, †39–58 × 4.3–5.5 µm, 8-spored, spores (†) biseriate, 3–5 lower spores inverted (often mixed, sometimes upper spores inverted) {2}; **apex** (†) medium to strongly truncate (not indented, laterally not inflated); **base** with short to medium long, ± thick, flexuous stalk, L- to h-shaped. **Ascospores** *(7–)8–11 × 2–2.5 µm {2}, †7–11 × 1.9–2.3 µm, fusoid- to fusiform-clavate, apex acute to acuminate, base medium attenuated to a rounded, partly tail-like end, straight to often slightly or medium curved at base; **SBs** *5–6.7 × 0.5–0.8 µm in situ (~5–7.5 µm actual length), vermiform to subulate, usually slightly to medium swollen at base, straight to medium flexuous. **Paraphyses** apically medium to strongly clavate-capitate, terminal cells *6–16 × 4–5 µm, †3–5(–5.5) µm wide, lower cells *11–14 × 1.5–2.2 µm; rarely branched near apex. **Medullary excipulum** 20–40 µm thick, of dense textura intricata with many inflated cells, medium sharply delimited. **Ectal excipulum** of thin-walled, indistinctly oriented t. angularis from

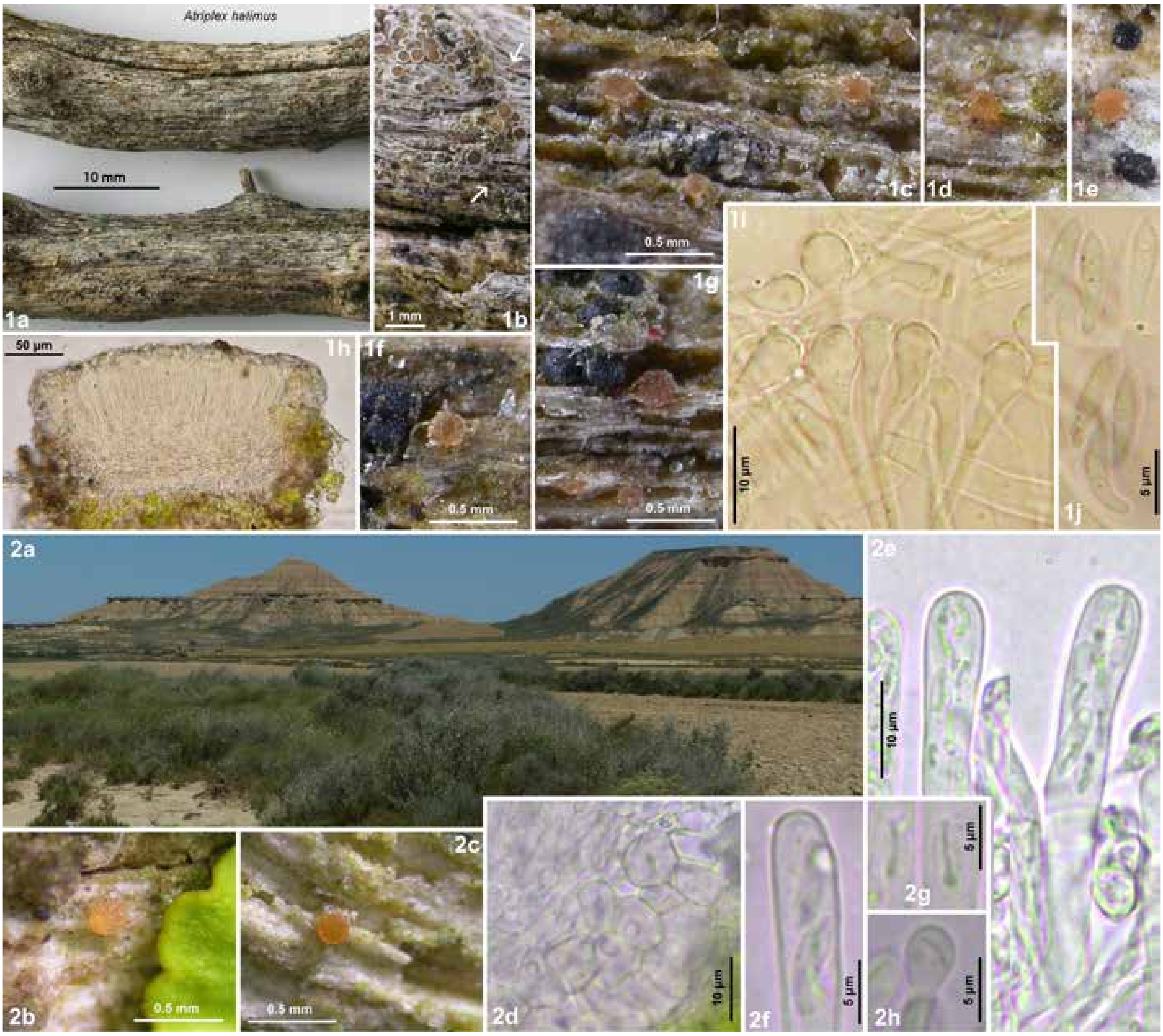


Plate 618. **1–2**: *Orbilia halimi*. – **2a**. halophilous mediterranean scrub with *Atriplex halimus*; **1a**. decorticated xeric branches; **1b**. apothecia growing near *Lecanora* sp.; **1c–g**, **2b–c**. rehydrated apothecia (**2b** with thallus of *Xanthoria*); **1h**. apothecium in median section; **2d**. id., ectal excipulum at flanks, with crystalloid SCBs; **2e**. asci; **2f**. ascus apex; **1i**, **2h**. paraphysis apices; **1j**, **2f**. ascospores; **2g**. spore apices with SBs. – Living state, except for **1h–j** (in KOH), **2f** (ascus). — **1a–j**. H.B. 6472b (holotype): Spain, Lérida, on *Atriplex*; **2a–h**. J.P.P. 15108: Spain, Navarra, on *Atriplex*.

base to mid flanks, 30–40 µm thick near base, cells †8–14 × 6–13 µm; 20–25 µm thick near margin, of t. prismatica-porrecta oriented at a 10–40° angle to the surface, marginal cortical cells †7–10 × 2.5–5 µm. **Anchoring hyphae** rather sparse, †2–3 µm wide, walls 0.2 µm thick, extending to the margin as a thin layer. **SCBs** in paraphyses and ectal excipulum (near margin) crystalloid {2}, hyaline, also globose {1}. **Exudate** over paraphyses and margin 0.2–0.7 µm thick, cloddy-granular, firmly attached, hyaline. — **ANAMORPH**: trinacrium-like (from ascospore isolate and natural substrate {1}). **Conidiophores** not observed. **Conidia** Y-shaped, total size *30–38 × 25–36 µm, stipe *16–20 × (4.5–)5.5–6.7 µm, 2-septate (exceptionally 3–4-septate), arms *15–20 × 4.7–5.5(–6) µm, 2-septate, arms and stipe always more or less abruptly tapering; unbranched phragmoconidia very sparse, e. g. *44 × 5.5 µm, 4-septate.

Habitat: collected 2–80 cm above the ground, corticated or decorticated, 9–17 mm thick branches of *Atriplex halimus* {2}, on 0.1–0.2 mm deep strongly decayed wood {2} and bark (bast) {1}, somewhat greyed, with many green algae. **Associated**: *Eutypella* sp. {1}, *Lecanora* sp. {1}, *Orbilia multiurosperma* {2}, ?*Phoma* sp. {1}, *Xanthoria* sp. {1}. **Desiccation tolerance**: fully viable for at least 5 months. **Altitude**: 160–283 m a.s.l. **Geology**: Quaternary clay, sand & gravel. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia halimi* appears to be closely related to *O. bicknellensis*, from which it markedly differs in smaller, particularly narrower ascospores, also in narrower SBs. *O. subdelphinus* differs from *O. halimi* mainly in 16-spored asci. An Australian collection on *Atriplex nummularia* here assigned to *O. bicknellensis* (Pl. 655: 2) has spores very similar to *O. halimi* though distinctly wider, and may well form a transition between the two species. The Australian *O. phragmitis* also appears to be closely related to *O. halimi*, but differs in much longer spores with more strongly attenuated bases. The montane *O. subtrapeziformis* differs from *O. halimi* in the consistent absence of crystalloid SCBs and in slightly larger spores.

Not included collection: A mediterranean collection from Portugal on bark of *Olea* (IVV: H.B. 9114) deviates from *O. halimi* in larger spores of *10–13(–15) × 2.4–2.7 µm with wider SBs (5.5–7 × 1–1.2 µm). In spore morphology this specimen resembles *O. obtusispora*, and particularly *O. subtrapeziformis*. However, crystalloid SCBs were observed in many of the paraphyses, though not in the excipular cells. Spore morphology and crystalloid SCBs are reminiscent of *O. subdelphinus*, a species with 16-spored asci.

Phylogeny. A sequence was gained from the ex-type culture which comprises SSU (without S1506 intron), ITS, and LSU. This sequence differs only slightly from that of *O. vermiculati* (1.5% in ITS, 0.8% in LSU), with which it formed a strongly supported clade (Phyls 19–20), although the two species have very different spore apices and SCBs. The two clustered with *O. serpentina* in a medium (ITS) or unsupported clade (SSU+ITS+LSU).

Ecology. *O. halimi* was collected on rotten wood and bark of xeric branches of *Atriplex* in desertic halophilous ruderal *Atriplex* scrubs (*Agrostio-Tamaricetum canariensis*) in mesomediterranean semiarid southwestern Europe. In both collections *O. multiurosperma* grew in association. The not included sample was from a mesomediterranean semihumid *Quercetum ilicis*.

Specimens included. **SPAIN**: **Navarra**, 19 km SSW of Carcastillo, 7 km NE of Arguedas, Bardenas Reales, 283 m, branches of *Atriplex halimus*, on wood, 17.V.2015, J.P. Priou (J.P.P. 15108, doc. vid.). – **Cataluña**, **Lérida**, 10 km WSW of Lérida, 2.5 km NW of Alcarràs, 160 m, branch of *A. halimus*, on wood & bark, 21.IX.1999, H.O. Baral (M-0276491, **holotype**; **isotype** in H.B. 6472b; anam. cult., anam. substr., CBS 116272; sq.: KT215240).

Not included. **PORTUGAL**: **Santarém**, 10 km NNW of Santarém, 2.3 km NE of Romeira, Val de Flores, 60 m, branch of *Olea europaea*, on wood, 5.V.2009, J.P. Priou (J.P.P. 29080 ø, H.B. 9114 ø).

Orbilia phragmitis Baral, sp. nov., MB 813673 — Pls 619–620

Etymology: named after the host, *Phragmites australis*.

Typification: Australia, Queensland, Mossman, leaves of *Phragmites australis*, 28.VIII.2006, G. Marson (ex H.B. 8501b, BRI AQ799194, holotype).

Latin diagnosis: *Similis* Orbiliae subtrapeziformi *sed cellulae excipuli in statu vivo corpuscula crystalloidea pallide aurantiaca continentes. Habitat ad culmos siccos* Phragmitis australis *in zona tropica humida Australiae septentrio-orientalis.*

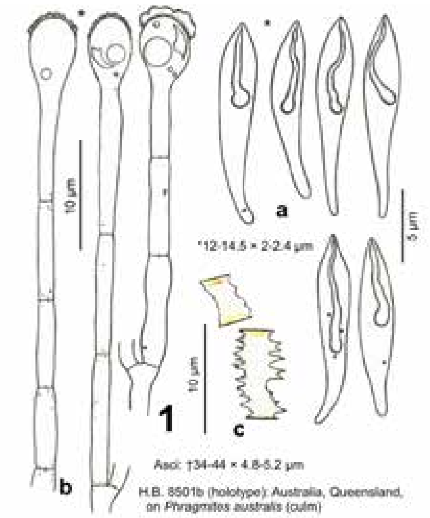


Plate 619. **1**: *Orbilia phragmitis*. – **a**. ascospores; **b**. paraphyses; **c**. crystalloid SCBs in basal cells of ectal excipulum.

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.22–0.33 mm diam., 0.09–0.12 mm high, light orange, somewhat translucent, round, scattered; disc flat, margin distinct, not protruding, ± smooth; broadly sessile, superficial. **Asci** †34–44 × 4.8–5.2 µm, 8-spored, spores (†) ± biseriate, 3–4 lower spores inverted (not mixed); **apex** (†) medium to strongly truncate (not indented nor inflated); **base** with short to medium long, ± thick, flexuous stalk, T-, L-, Y- to h-shaped. **Ascospores** *12–14.5 × 2–2.4 µm, †11–13.5 × 1.9–2.2 µm, (strongly) fusiform to fusiform-clavate, apex acute to acuminate, base (very) strongly attenuated (often tail-like), straight to slightly curved, especially at base; **SBs** *(5–)6–7(–8) × 0.7–1(–1.2) µm in situ (~6–8.5 µm actual length), subulate, in aged spores 3 × 1.5 µm, ampulliform. **Paraphyses** apically medium to strongly clavate-capitate, terminal cells *13–20 × 3.5–4.6 µm, lower cells *7.5–12 × 1.3–1.7 µm (near base 6–8 × 1.8–2 µm); unbranched at upper septum, hymenium pale orange.

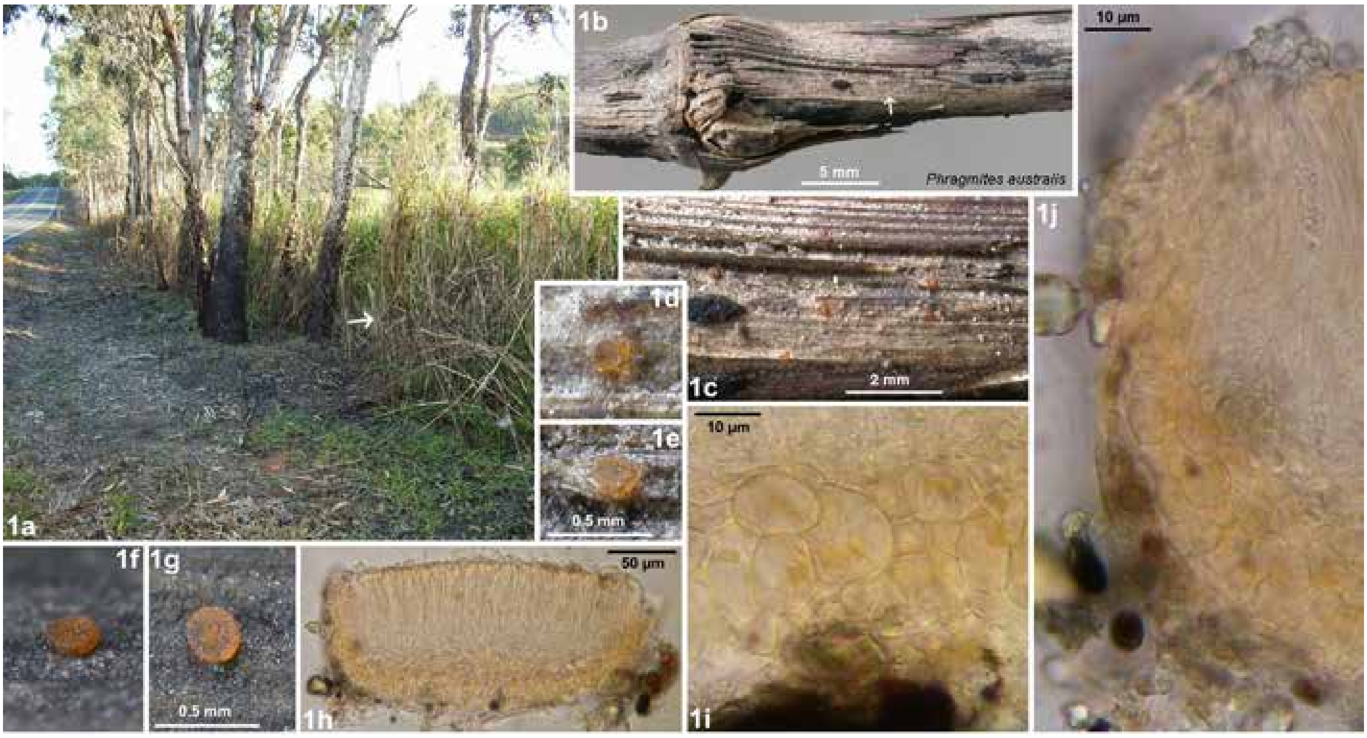


Plate 620. **1**: *Orbilia phragmitis*. – **1a**. tropical humid *Phragmites* stand; **1b**. dead (originally) standing culm; **1c–g**. rehydrated apothecia; **1h**. apothecium in median section; **1i**. id., basal ectal excipulum with SCBs; **1j**. id., marginal ectal excipulum. – Living state. — **1a–j**. H.B. 8501b (holotype): Australia, Queensland, on *Phragmites*.

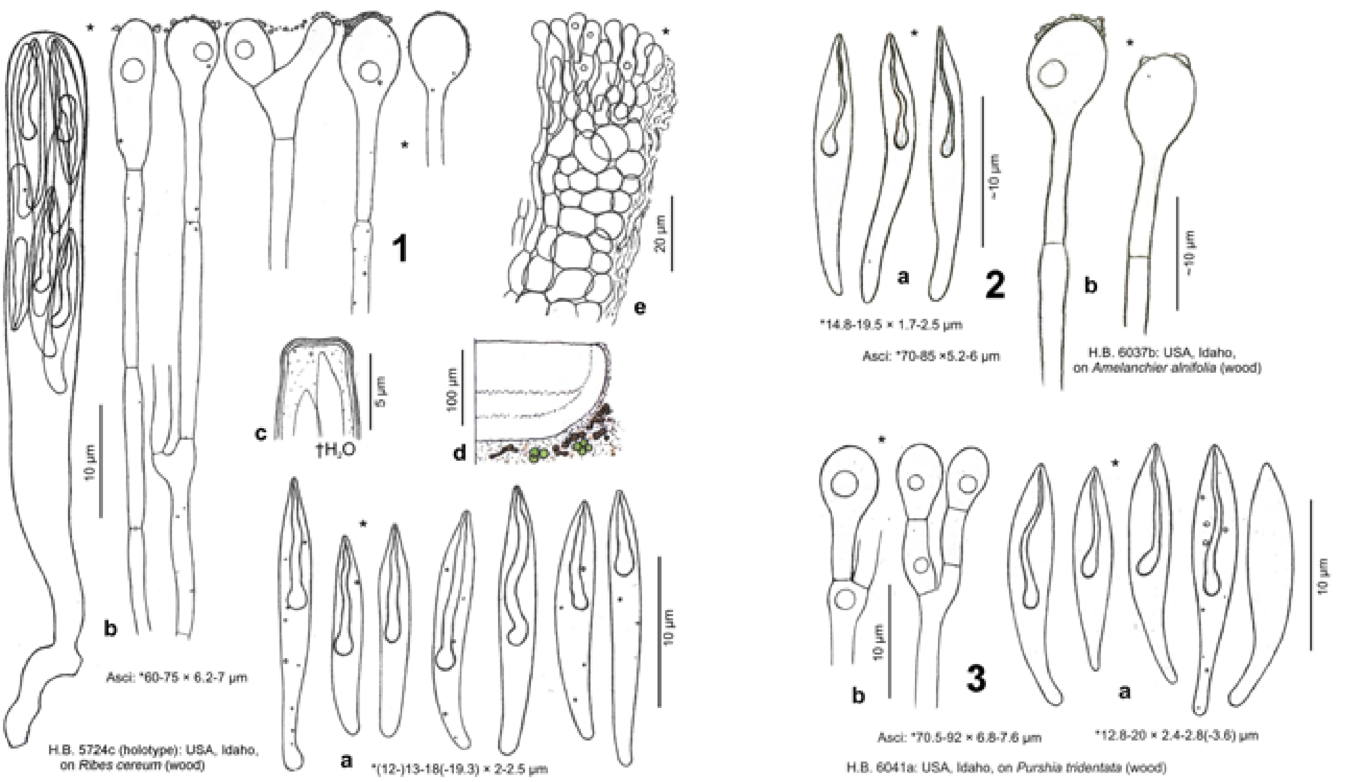


Plate 621. **1–2**: *Orbilia idahoensis*; **3**: *O.* cf. *idahoensis*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apex; **d**. apothecium in median section; **e**. id., marginal ectal excipulum.

Medullary excipulum pale orange, 10–20 µm thick, of dense textura intricata with many inflated cells, sharply or indistinctly delimited. **Ectal excipulum** light orange, of (†) thin-walled, vertically oriented t. angularis-prismatica from base to mid flanks, 25–40 µm thick near base, cells *8–19 × 6–11(–13) µm; 15–20 µm thick near margin, of t. prismatica oriented at a 40–70° angle to the surface, marginal cortical cells *7–10 × 3–3.5 µm. **Anchoring hyphae** medium abundant, †2–2.8 µm wide, walls 0.2(–0.3) µm thick. **SCBs** in paraphyses globose, 0.8–2.3 µm diam., also crystalloid, subhyaline, in ectal excipulum from lower flanks to margin crystalloid, pale to light orange, 3–8 × 3–4(–6) µm. **Exudate** over paraphyses 0.2–0.3(–1) µm thick, granular-cloddy, hyaline, firmly attached, over margin and flanks 0.2–2 µm thick, rough-cloddy. **— ANAMORPH**: unknown.

Habitat: collected 0.1–0.5 m above the ground, on dead, standing, 7–9 mm thick culms of *Phragmites australis*, in region of node at the base of the medium strongly rotten leaf sheaths, greyed, no algae. **Associated**: *Arthrinium arundinis*, *Orbilia* ?*atlantis*, *O.* ?*breviaristata*, *O.* ?*puyae*, *O. stilbospora*. **Desiccation tolerance**: fully tolerant for at least 9 months (except for asci). **Altitude**: 390 m a.s.l. **Geology**. Devonian sedimentary rock. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia phragmitis* closely resembles European *O. subtrapeziformis*, from which it markedly differs in the living state in the presence of crystalloid SCBs, particularly in the ectal excipulum. Also *O. halimi* on *Atriplex halimus* from Spain is very similar, differing mainly in distinctly shorter ascospores.

Ecology. The only known collection of *O. phragmitis* was on standing, dead, xeric culms of *Phragmites* which was covered over large areas by a black conidial layer of *Arthrinium arundinis*. The floodplain bordering the road is located between savannah and rainforest in tropical (sub)humid northeastern Australia.

Specimens included. **AUSTRALIA**: **Queensland**, Einasleigh Uplands (border to Wet Tropics), 22 km SSW of Mossman, 2 km N of Mount Molloy, Mossman Mt. Molloy Rd, 390 m, leaves of *Phragmites australis*, 28.VIII.2006, G. Marson (ex H.B. 8501b, BRI AQ799194, **holotype**).

Orbilia idahoensis Baral & G. Marson, **sp. nov.**,

MB 813674 — Pls 621–622

Etymology: named after the state Idaho (USA) in which the type was collected. **Typification**: USA, Idaho, Arco, twig of *Ribes cereum*, 4.VI.1996, G. Marson (ex H.B. 5724c, M-0276494, holotype).

Latin diagnosis: *Similis* Orbiliae subtrapeziformi *sed ascosporae distincte longiores et paulo angustiores. Habitat ad lignum putridum ramulorum et ramorum siccorum fruticum angiospermarum* in *zona temperata subhumida ad boreali humida Americae septentrionalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.18–0.43 mm diam., 0.12–0.13 mm high, light to bright orange to brick-red, scarcely translucent, round, ± scattered; disc slightly concave to flat, margin distinct, 0–10 µm protruding, ± smooth; broadly sessile, superficial to slightly erumpent. **Asci** *(60–)70–75(–85) × (5.4–)6–7 µm {2}, †(45–)55–70 × 5.3–6 µm {2}, 8-spored, spores *3–4-seriate, 3–5 lower spores inverted {1} (often mixed), pars sporifera *30–37 µm long; **apex** (†) strongly truncate (slightly indented, laterally slightly widened); **base** with short, thick, ± flexuous stalk, T-, L- or Y-shaped. **Ascospores** *(12–)13–18(–19.3) × 1.8–2.5 µm {3}, narrowly fusiform(-clavate), apex acute (to acuminate), base medium attenuated (tail-like), slightly curved near base; **SBs** *(5.5–)7–10.5 × (0.8–)1–1.3(–1.5) µm {2}, vermiform to subulate, with slightly to strongly swollen base, straight to medium flexuous. **Paraphyses** apically (slightly to) medium to very strongly clavate-capitate, rarely moniliform or lageniform, terminal cells *7.5–19 × (3–)4–5.3 µm {1}, lower cells *14–19 × 1.3–2(–3) µm {1}; rarely branched at upper septum. **Medullary excipulum** subhyaline, 30–40 µm thick, of loose textura intricata with many inflated cells. **Ectal excipulum** pale rose, of medium gelatinized (common walls †0.5–1.3 µm), vertically oriented t. globulosa-angularis from base to submargin, 20–35 µm thick near base, cells *12–21 × 10–15 µm {1}; 20 µm thick near margin, upper margin of t. prismatica oriented at a 10° angle to the surface, marginal cortical cells *10–15 × 3.5–5 µm {1}. **Anchoring hyphae** abundant, *2.5–3 µm wide, walls 0.2–0.4 µm thick {1}, forming a dense, ± gelatinized, hyaline t. intricata up to 40 µm thick, covering flanks and margin as a 5–12 µm thick layer. **SCBs** in paraphyses and ectal excipulum (upper margin) globose, 1.5–2 µm diam. **Exudate**

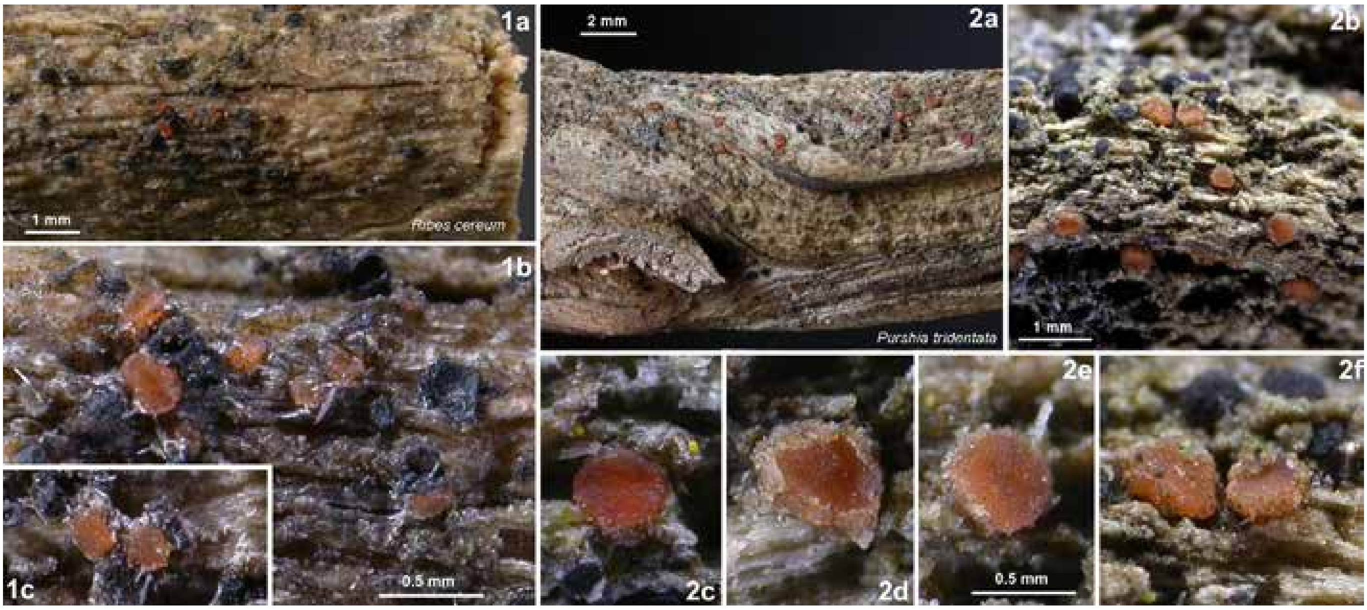


Plate 622. **1**: *Orbilia idahoensis*; **2**: *O.* cf. *idahoensis*. – **1a**, **2a**. decorticated xeric branches; **1b–c**, **2b–f**. rehydrated apothecia. — **1a–b**. H.B. 5724c (holotype): USA, Idaho, on *Ribes*; **2a–f**. H.B. 6041a: USA, Idaho, on *Purshia*.

over paraphyses and marginal excipulum 0.2–0.7 µm thick, granular-cloddy, firmly attached. **— ANAMORPH**: unknown.

Habitat: partially to entirely decorticated, 4–16 mm thick twigs and branches of *Amelanchier* (?)*alnifolia* {1}, *Cercocarpus* sp. {1}, *Ribes cereum* {1}, on 0.2–0.5 mm deep strongly decayed wood {2}, greyed, no algae. **Associated**: *Cyathicula* sp. {1}, *Melaspilea emergens* {1}, *Mellitiosporiella macrospora* {2}, *Orbilia delphinus* {2}, *O. maeandrina* {1}, *Pyrenopeziza* sp. {1}, *Teichospora* sp. {2}. **Desiccation tolerance**: fully tolerant for at least 9 months. **Altitude**: 1750–2570 m a.s.l. **Geology**: Mississippian & Permian carbonate sedimentary rock; volcanic mafic basaltic rock. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia idahoensis* appears to be well characterized by its long and narrow, fusiform ascospores and rather wide, subulate spore bodies with a ± bulbous basal inflation. European *O. subtrapeziformis* differs in shorter and slightly wider spores, also the extra-European *O. macrotrapeziformis* and *O. flexisoma* differ in shorter and/or wider spores. *O. idahoensis* might be confused with *O. vinosa* (section *Hemiorbilia*), from which it differs in distinctly longer SBs and more acute spore apices, besides thin-walled truncate ascus apices.

Not included collection. A sample on *Purshia* (Pls 621: 3; 622: 2) appears to be intermediate to *O. flexisoma* in its wider spores and is, therefore, not included in either description.

Ecology. *O. idahoensis* was found on rotten wood of xeric twigs and branches of different angiosperm shrubs in the cold-temperate subhumid pinyon-juniper woodland at Craters of the Moon and Snake River Plain of the Columbia Plateau, and in boreal humid Douglas fir mixed forests of the Uinta Mountains in the Middle Rocky Mountains in western North America.

Specimens included. **USA**: **Idaho**, Columbia Plateau, 28 km SW of Arco, Craters of the Moon, 1752 m, twig of *Ribes cereum*, on wood, 4.VI.1996, G. Marson (ex H.B. 5724c, M-0276494, **holotype**). – 60 km E of Idaho Falls, 47 km W of Jackson, Swan Valley, 1750 m, twig & branch of *Amelanchier ?alnifolia*, on wood, 5.VI.1996, G. Marson (H.B. 6037b). – **Utah**, Uinta Mts., 34 km NNE of Vernal, 34 km SE of Manila, 2570 m, on *Cercocarpus*, 11.VI.1996, G. Marson (ø).

Not included. **USA**: **Idaho**, Columbia Plateau, 28 km SW of Arco, Craters of the Moon, 1752 m, twigs & branches of *Purshia tridentata*, on wood, 5.VI.1996, G. Marson (H.B. 6041a).

Orbilia flexisoma Baral & G. Marson, **sp. nov**., MB 813675 — Pls 623–624, Map 103

Etymology: named after the flexuous spore bodies.

Typification: USA, Arizona, Grand Canyon, Tusayan, branches of *Juniperus osteosperma*, 28.VIII.1994, G. Marson (ex H.B. 5438a, M-0276482, holotype).

Latin diagnosis: *Differt ab* Orbilia obtusispora *ascosporis majoribus. Habitat ad lignum putridum ramorum siccorum arborum angiospermarum vel coniferarum in zona temperata (sub)humida Americae septentrionalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.25–0.7(–0.9) mm diam., 0.14–0.21 mm high (receptacle 0.14 mm), light to bright (yellowish-)orange, non-translucent, round (to elliptical), scattered to subgregarious; disc ± concave, soon flat, margin distinct, 0–80 µm protruding, finely rough to somewhat denticulate, whitish-powdered; broadly sessile, slightly to deeply immersed; dry brick-red. **Asci** *(60–)75–100(–113) × (6–)6.5–7.5(–8)((–8.8)) µm {3}, †(55–)60–90 × 5.5–6.5(–7) µm {3}, 8-spored, spores *2–3-seriate, (2–)3–5(–6) lower spores inverted {3} (often mixed), pars sporifera *(30–)40–60(–80) µm long; **apex** (†) strongly truncate (not or very slightly indented, laterally sometimes inflated); **base** with short to medium long, thick, flexuous stalk, T-, Y- to h-shaped. **Ascospores** *((9–))(10–)12–17(–20.3) × (2.4–)2.6–3.2(–3.8) µm {5}, †(9–)11–15(–17.3) × (2.5–)2.7–3.2(–3.5) µm {3}, fusoid- to fusiform-clavate, rarely also narrowly ellipsoid-obclavate, apex subacute, also acute or obtuse, base not or slightly to mostly medium to strongly attenuated in a tail-like base or a distinct, sometimes basally inflated tail, straight or slightly to sometimes strongly curved near base; **SBs** (4–)5–9 × 0.5–1(–1.2) µm in situ {2} (~6–11 µm actual length), vermiform to subulate, not or slightly (also distinctly) swollen at base, mostly strongly flexuous, sometimes uncinate; with or without some medium-sized LBs, hymenium pale rose. **Paraphyses** apically slightly to medium clavate, exceptionally spathulate, terminal cells *4.5–13 × (2–)2.8–4(–?5) µm {2}, lower cells *9.5–17 × 1.3–2(–2.3) µm {1}; unbranched at upper septum. **Medullary excipulum** pale rose, 30–70 µm thick, of dense textura intricata with many inflated cells, sharply delimited. **Ectal excipulum** pale rose, of (†) thin-walled to distinctly gelatinized, irregularly vertically oriented t. globulosa-angularis from base to mid flanks or submargin, 30–100 µm thick near base, cells *6–16(–20) × 6–13(–15) µm {2}; 20 µm thick at flanks, 15–30 µm near margin, of t. porrecta oriented at a 10–30° angle to the surface, upper margin up to 50 µm thick if protruding, with incurved, periphyses-like marginal cortical cells †8–14 × 2–3 µm {1}. **Anchoring hyphae** medium abundant, */†2.5–4 µm wide, walls 0.2–0.4 µm thick {1}, partly covering flanks and margin as a gelatinized layer. **SCBs** in paraphyses and ectal excipulum absent {2} or present

Plate 623. **1–5**: *Orbilia flexisoma*; **6–7**: *O.* cf. *flexisoma*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. apothecium in median section.

{3}, globose. **Exudate** over paraphyses 0.2–0.8 µm thick, finely rough, ± continuous, ± firmly attached, over margin and flanks 0.2 µm thick, granular to continuous. **— ANAMORPH**: unknown.

Habitat: collected 1–2.5 m above the ground, decorticated, 7–19 mm thick branches of *Acer* sp. {1}, *Cercocarpus ledifolius* {1}, *Juniperus osteosperma* {2}, *Quercus gambelii* {2}, on 0.5–1 mm deep very

Plate 624. **1–3**: *Orbilia flexisoma*; **4–5**: *O.* cf. *flexisoma*. – **1a–d**, **2b–e**, **3**, **4a–d**, **5a–d**. rehydrated apothecia; **2g**, **4e**. apothecia in median section; **2f**, **4g**. id., marginal ectal excipulum; **4f**. id., basal excipulum with abundant green algae; **2h**. asci. – Living (**4e–g**) or dead state (**2f–g** in KOH, **2h** in KOH+IKI). — **1a–d**. H.B. 5438a (holotype): USA, Arizona, near Grand Canyon, on *Juniperus*; **2a–h**. H.B. 8682c: ibid., Flagstaff, on *Quercus*; **3**. H.B. 5287d: ibid., Grand Canyon Village, on *Quercus*; **4a–g**. H.B. 8002e: ibid., on *Purshia*; **5a–d**. H.B. 8061c: Utah, on *Purshia*.

decayed wood {5}, strongly greyed, with sparse to abundant green algae. **Associated**: *Baggea* sp. {1}, *Caloplaca* sp. {1}, *Crumenulopsis* sp. {1}, *Dothideales* {1}, *Durella* sp. {1}, *Melanohalea subolivacea* {1}, *Mellitiosporiella* sp. {1}, *Odontotrema* sp. {1}, *Orbilia arizonensis* {2}, *O. calyptrata* {1}, *O. curvatitrapeziformis* {1}, *O. delphinus* {2}, *O. euonymi* {1}, *O. gambelii* {2/1}, *O. macrodelphinus* {1}, *O. maeandrina* {2}, *O. multiphanosoma* {1}, *O. multitrapezoidea* {1}, *O. navajoana* {1}, *O. ocellata* {1}, *O. ophiosoma* {2}, *O. ovalis* {1}, *O. purshiae* {1}, *O. subovoidea* {1}, *O. subtrapeziformis* {1}, *Patellaria atrata* {1}, *Perrotia flammea* {2}, *Sclerococcum* sp. {1}, *Tryblidaria ?fenestrata* {1}, crustose lichens. **Desiccation tolerance**: fully viable for at least 20 months, many excipular and paraphysis cells still viable after almost 3 years. **Altitude**: 830–2500 m a.s.l. **Geology**: USA: Mississippian & Permian carbonate sand-, shale- & limestone, rarely basaltic lava & cinders; Canada: alluvial deposits from Proterozoic-Cambrian-Ordovician sediments. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia flexisoma* is tentatively segregated from *O. obtusispora* based on slightly wider and mostly also longer ascospores, and from *O. macrotrapeziformis* based on mostly longer spores with more strongly flexuous SBs, somewhat less acute spore apices, and the partial presence of distinct spore tails, though spore tails were rarely also seen in *O. macrotrapeziformis*, and finally on much larger apothecia. *O. spathulata* resembles *O. flexisoma* in spores and SBs, but deviates in the apical spores being inversely oriented within the asci, paraphyses with predominantly spathulate apices, and presence of crystalloid SCBs. For the similar *O. edulis* (p. 1102) and *O. pyrenaica* (p. 1100) see there. In one of the two samples on *Quercus* (Pl. 623: 4) a separate population deviated in basally always medium to strongly curved spores and in growing on bark instead of wood. We have segregated this population as a distinct species, *O. curvatitrapeziformis* (Pl. 629: 2).

Variation. *O. flexisoma* strongly varies in spore shape from fusoid-clavate (slightly to strongly attenuated, with or without a distinct tail) to ellipsoid-obclavate. Globose SCBs are completely absent in the holotype and in the sample on *Cercocarpus*, but they were seen in other specimens, at least in some of the paraphyses. In one of the *Quercus* collections the spores were consistently provided with a tail (Pl. 623: 3). However, another examined apothecium showed such tails only in some of the spores, which was also the case in the other *Quercus* collection and in those on *Juniperus* (1–2, 4). Likewise, in the collection on *Cercocarpus* (Pl. 623: 5) variation in spore length and shape was noted between different apothecia.

Not included collections. Two samples on *Purshia* (Pls 623: 6–7; 624: 4–5) resemble both *O. flexisoma* and *O. macrotrapeziformis* in the spores, but the large apothecia of (0.3–)0.4–0.8(–1.2) mm diam., 0.16–0.31 mm high, with a whitish powdered-crenulate margin that protrudes about 20 µm, closely concur with those seen in, e. g., *O. flexisoma* and *O. idahoensis*. A third sample on *Purshia* (IVV: H.B. 7462c) featured small apothecia of 0.25–0.3 mm diam. just as in *O. macrotrapeziformis*, but was studied only in the dead state. We refrain here from including these three collections on *Purshia* in the description. Also a collection on *Larrea* was only studied in the dead state (IVV: H.B. 8477e); its apothecia strongly resemble those of *O. flexisoma*, but the spores are too short (†8.5–9.5 × 3.3–3.8 µm) to be included in that species.

Ecology. *O. flexisoma* was found on rotten wood of xeric branches of mainly *Juniperus* and *Quercus*, in the cold-temperate subhumid pinyon-juniper woodlands and humid ponderosa pine forests in the Grand Canyon and Mogollon Rim of Colorado Plateau the southwest of Northern America, also in a boreal humid conifer forest with *Populus tremuloides* and *Acer* in the Canadian Rocky Mountains. The not included collections on *Purshia* were from similar sites, while that on *Larrea* was from the warm-temperate arid Mojave creosotebush desert scrub.

Map 103. Known distribution of *O. flexisoma* in North America (yellow = not included collections).

Specimens included. **CANADA**: **British Columbia**, Canadian Rocky Mountains, 61 km SE of Golden, 1 km SE of Spillimacheen, 830 m, branch of *Acer*, on wood, 20.VIII.1997, G. Marson (H.B. 6234d). — **USA**: **Arizona**, Grand Canyon, Kaibab Plateau, 93 km SSE of Fredonia, S of North Rim, 2500 m, branch of *Cercocarpus ledifolius*, 17.V.1995, G. Marson (ø). – Coconino Plateau, 3.5 km N of Tusayan, 2075 m, branch of *Juniperus osteosperma*, on wood, 17.VI.2003, G. Marson (H.B. 8097e ø). – 3 km N of Tusayan, 2068 m, branch of *Quercus gambelii*, on wood, 28.VIII.1994, G. Marson (H.B. 5287d). – 3 km S of Tusayan, 2033 m, branches of *Juniperus osteosperma*, on wood, 28.VIII.1994, G. Marson (ex H.B. 5438a, M-0276482, **holotype**). – Mogollon Rim, 28 km WNW of Flagstaff, 23 km E of Williams, SE of Parks, 2166 m, branches of *Quercus gambelii*, on wood, 29.VIII.1994, G. Marson (H.B. 8682c).

Not included. **USA**: **Utah**, Utah Mts., 19 km ENE of Springdale, 11 km WNW of Mt. Carmel Junction, 1880 m, branch of *Purshia stansburyana*, on wood, 14.VI.2003, G. Marson (H.B. 8061c). – **Arizona**, Grand Canyon, Kaibab Plateau, 28 km ESE of Fredonia, 13 km NNW of Jacob Lake, Rte. 89, 2115 m, branch of *P. stansburyana*, on wood, 15.VI.2003, G. Marson (H.B. 8002e). – Coconino Plateau, 7.5 km ESE of Grand Canyon Village, 2205 m, branch of *P. stansburyana*, on wood, 16.VI.2003, G. Marson (H.B. 7462c). – **Nevada**, Mojave Desert, 18.5 km WSW of Las Vegas, 4.5 km ESE of Blue Diamond, 960 m, branch of *Larrea tridentata*, on wood, 1.V.1995, G. Marson (H.B. 8477e).

Orbilia macrotrapeziformis Baral & E. Weber, **sp. nov.**, MB 813678 — Pls 625–626

Etymology: similar to *O. trapeziformis* and *O. subtrapeziformis* but with a tendency to larger asci and spores.

Typification: USA, Arizona, Wickenburg, branch of *Cylindropuntia versicolor*, 4.V.1995, G. Marson (ex H.B. 8678, M-0281050, holotype).

Latin diagnosis: *Similis* Orbiliae subtrapeziformi *sed ascosporae latiores, corpuscula refringentia longiora. Habitat ad lignum vel corticem putridum ramorum siccorum arborum vel fruticum angiospermarum* in *zona temperata ad subtropica semihumida ad arida Americae septentrionalis et Australiae.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.12–)0.2–0.35(–0.5) mm diam., 0.15–0.16 mm high, pale to bright (yellow-) orange(-rose), slightly translucent, round, very scattered to subgregarious; disc flat to slightly convex, margin ± indistinct, concolorous, not or very

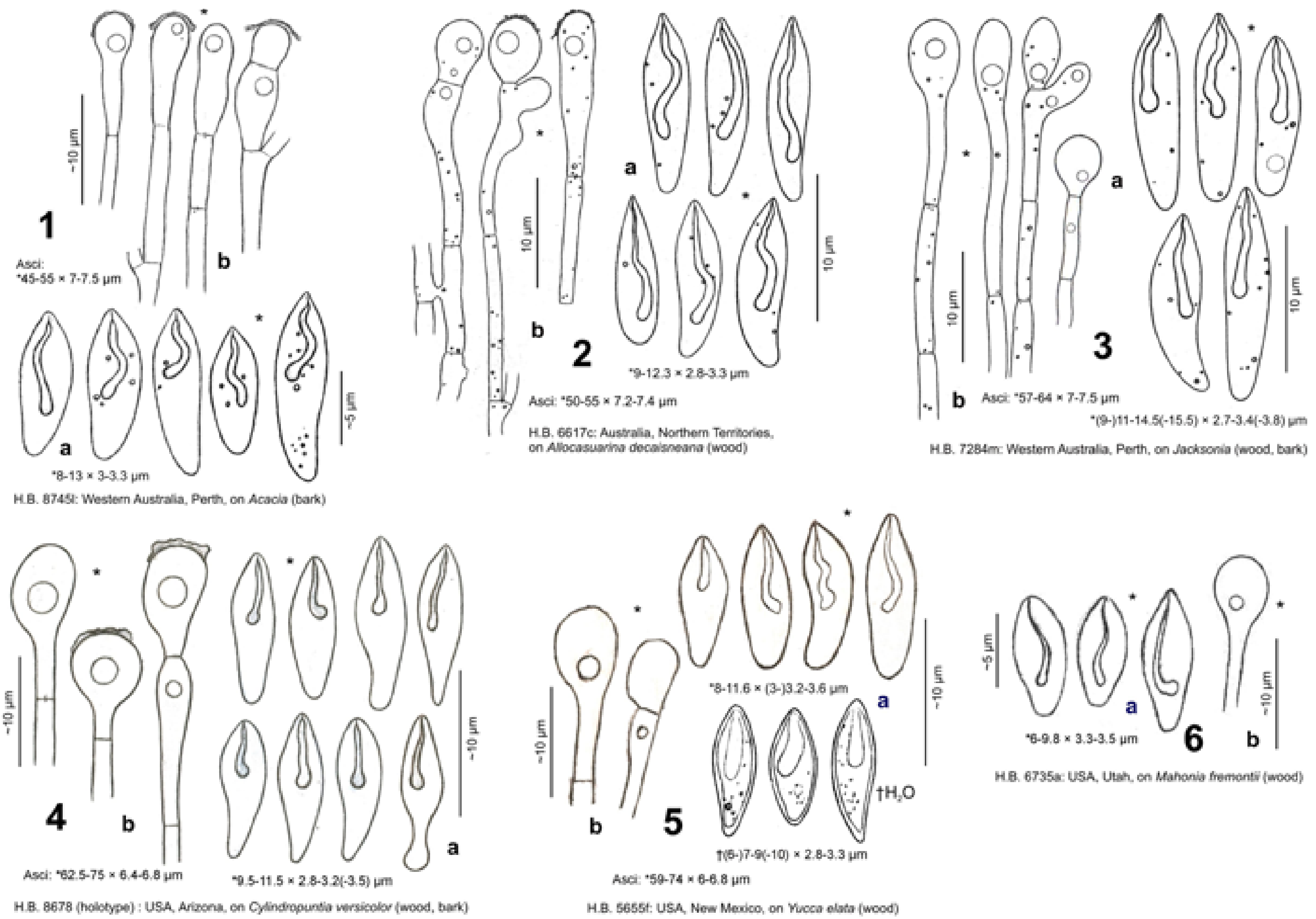


Plate 625. **1–5**: *Orbilia macrotrapeziformis*; **6**. *O.* cf. *macrotrapeziformis*. – **a**. ascospores; **b**. paraphyses.

slightly protruding, ± smooth; broadly sessile, superficial or immersed between fibres or in biofilm. **Asci** *(45–)50–65(–75) × (6–)6.5–7.5 µm {5}, †(48–)55–65 {2} × 5–5.8 {1} or 6–6.5(–7) µm {1}, 8-spored, spores *(obliquely) 2-seriate, (2–)3–5 lower spores inverted {5} (often mixed); **apex** (†) strongly truncate (partly distinctly indented and laterally inflated); **base** with short to medium long, ± thick, flexuous stalk, L- or h-shaped. **Ascospores** *(8–)9–13(–15.5) × (2.7–)2.8–3.3(–3.8) µm {5}, †(6–)8–10(–11) × 2.8–3.3 µm {2}, fusiform(-clavate), apex subacute to acute, rarely obtuse or acuminate, base slightly or medium, rarely strongly attenuated, straight or slightly curved; **SBs** *(4–)5–7.5(–10) × (0.6–)0.8–1(–1.2) µm in situ {4} [~5–11 µm actual length], vermiform to subulate, very slightly to medium inflated at base, slightly to strongly flexuous. **Paraphyses** apically medium to very strongly clavate-capitate, rarely moniliform, terminal cells *(4–)6–13(–25) {3} × (2–)3–4.5(–5) {3} or 5–7 {2} µm, †7–13 × 5–8 µm {T}, lower cells *7.5–16.5 × 1.3–2 µm {2} (subapically rarely up to 4 µm wide); not or rarely to often branched at upper septum, pale orange. **Medullary excipulum** pale orange, 35 µm thick, of dense textura intricata-angularis, sharply delimited. **Ectal excipulum** pale orange, of (†) ± thin-walled, indistinctly oriented t. angularis from base to margin, 30–45 µm thick near base, cells †6–11 × 5–10 µm {1}; 35–40 µm thick near margin, oriented at a high angle to the surface, marginal cortical cells not examined. **Anchoring hyphae** medium abundant, †2–2.7 µm wide, walls †0.2 µm thick {1}. **SCBs** in paraphyses and partly also in ectal excipulum (near margin) globose {4}, 1–3 µm diam.; **LBs** in ectal excipular cells pale yellow-orange {1} (carotenoids). **Exudate** over paraphyses, margin and flanks absent or 0.2–0.8 µm thick, rough, firmly attached. **— ANAMORPH**: unknown.

Habitat: collected 0–2 m above the ground, partially corticated to decorticated, 9–35 mm thick branches of *Acacia* sp. {1}, *Allocasuarina decaisneana* {1}, *Cylindropuntia versicolor* {1}, *Jacksonia* sp. {1}, on 0.1 mm deep strongly decayed wood {4} or bark {3}, inflorescence

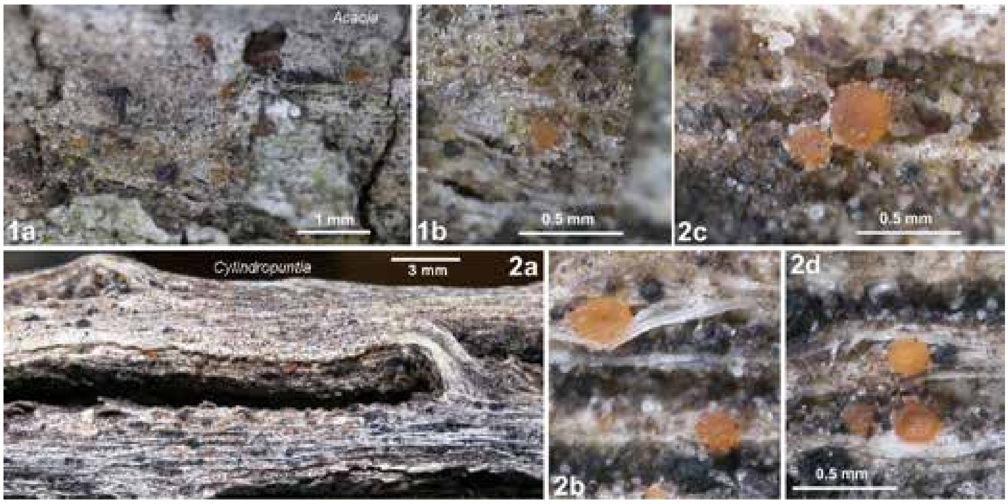


Plate 626. **1–2**: *Orbilia macrotrapeziformis*. – Rehydrated apothecia. — **1a–b**. 8745l: Western Australia, Wanneroo, on *Acacia*; **2a–d**. H.B. 8678 (holotype): USA, Arizona, on *Cylindropuntia*.

stem of *Yucca elata* {1}, very greyed, without or with many green algae. **Associated**: *Amandinea* sp. {1}, *Baggea* sp. {1}, *Caloplaca* sp. {1}, *Claussenomyces* sp. {1}, *Cyathicula nigrofusca* {1}, *Durella* sp. {1}, *D.* aff. *connivens* {1}, *Gloniopsis praelonga* {1}, ?*Hysteropatella* sp. {1}, *Hypoxylon* sp. {1}, *Muellerella lichenicola* {1}, *Orbilia albidorosea* {1}, *O. australiensis* {1}, *O. bicknellensis* {1}, *O. commarosa* {1}, *O. curvativitalbae* {1}, *O. eucalypti* {1}, *O. kingsiana* {1}, *O. microserpens* {2}, *O. multigambelii* {1}, *O. multivinosa* {1}, *O. myriofusiclava* {2}, *O. myrioobliqua* {1}, *O. nothovinosa* {1}, *O. phanosoma* {1}, *O. pleiolentiformis* {1}, *O. pleioobtusispora* {1}, *O. pleioquaestiformis* {1}, *O. pleiovitalbae* {1}, *O. pluristomachia* {2}, *O. serpentina* {2/1}, *O. wannerooensis* {1}, *O. yuccae* {1}, *Patellaria atrata* {1}, *Schizoxylon* sp. {1}, *Teichosporella dura* {2}, *Symbiotaphrina desertorum* {1}. **Desiccation tolerance**: fully viable for 18 months. **Altitude**: 37–500 m (Australia), 615–1120 m (North America). **Geology**: Cretaceous sedimentary rock, Cenozoic sand-, lime- and mudstone. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia macrotrapeziformis* differs from the three predominantly European species *O. trapeziformis*, *O. subtrapeziformis* and *O. obtusispora* in wider asci and ascospores, from *O. trapeziformis* also in longer spores. The North American *O. bicknellensis* and *O. spathulata* differ from *O. macrotrapeziformis* in the presence of crystalloid SCBs, the latter also in the upper spores being predominantly inverted, and in spathulate paraphysis apices. The Australian *O. wannerooensis* deviates from *O. macrotrapeziformis* in consistently inverted upper spores. *O. idahoensis* differs in longer and narrower, basally tapered spores and larger apothecia, but a collection on *Purshia* (Pl. 621: 3) appears to be somewhat intermediate to *O. macrotrapeziformis* (or *O. flexisoma*?) because of wider spores. *O. edulis*, *O. flexisoma* and *O. pyrenaica* are only tentatively separated from *O. macrotrapeziformis*.

Variation. *O. macrotrapeziformis* varies only slightly in spore size and shape and in SB size. The spore bases vary between slightly and strongly attenuated, but this variation occurs usually within an apothecium. The three Australian samples certainly belong to a single species, whereas the two North American ones deviate from those in slightly longer and narrower asci, rather short spores with partly obtuse apices, partly rather short SBs, and apically more strongly capitate, much wider paraphyses of around *5–7 compared to *3–4.5 µm. Macroscopically they concur well with the samples from Australia.

Not included collection. A North American sample on *Mahonia fremontii* (Pl. 625: 6), which somewhat resembles *O.* cf. *sonorensis* (Pl. 671: 3), is not included in the description because of rather short spores.

Ecology. *O. macrotrapeziformis* was found on different angiosperms in a subtropical semihumid banksia-eucalypt woodland and acacia mixed shrubland of southwestern Australia and in a subtropical arid acacia open shrubland of central Australia (Ayers Rock area). The samples from western North America derive from warm-temperate semiarid mixed grass-scrubland in the Chihuahuan Desert and a subtropical semiarid Sonoran paloverde-mixed cacti desert scrub, the not included sample from the warm-continental semiarid pinyon-juniper woodland in the Colorado Plateau.

Specimens included. **AUSTRALIA**: **Western Australia**, Swan Coastal Plain, 30 km NE of Perth, 4 km N of Upper Swan, W of Walyunga, 37 m, branch of *Jacksonia*, on wood & bark, 23.XI.2001, G. Marson (H.B. 7284m ø). – 30 km NNW of Perth, 1 km NW of Kinross, Tamala Park, 40 m, branch of *Acacia*, on bark, 23.X.2007, G. Marson (H.B. 8745l ø). – **Northern Territories**, Great Sandy Desert, 11.5 km ENE of Yulara, 14 km NNE of Ayers Rock, 500 m, branch of *Allocasuarina decaisneana*, on wood, 12.X.1998, G. Marson (H.B. 6617c). — **USA**: **Arizona**, Sonoran Desert, 82 km NW of Phoenix, ~1.5 km SE of Wickenburg, 615 m, branch of *Cylindropuntia versicolor*, on wood & bark, 4.V.1995, G. Marson (ex H.B. 8678, M-0281050, **holotype**). – **New Mexico**, Chihuahuan Desert, ~13 km W of Artesia, ~1120 m, inflorescence stem of *Yucca elata*, on wood, 25.V.1996, G. Marson (H.B. 5655f).

Not included. **USA**: **Utah**, Canyonlands, 35 km WSW of Moab, Upheaval Dome, Whale Rock, 1745 m, branch of *Mahonia fremontii*, on wood, 17.VI.2000, G. Marson (H.B. 6735a ø).

Orbilia pyrenaica Baral, Priou & E. Weber, **sp. nov.**, MB 813679 — Pls 627–628

Etymology: named after the geographical origin, eastern Pyrenees.

Typification: France, Font-Romeu-Odeillo-Via, branch of *Fraxinus excelsior*, 18.X.2008, J.P. Priou (ex H.B. 8945, M-0276575, holotype).

Latin diagnosis: *Similis* Orbiliae macrotrapeziformi *sed corpuscula refringentia multo longiora, apothecia majores, margine crenulata. Habitat ad lignum putridum rami sicci* Fraxini excelsioris in *zona orotemperata humida Europae meridio-occidentalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.2–0.5 mm diam., 0.15 mm high, light to bright dull orange, slightly translucent, ± round, scattered to subgregarious; disc flat, margin whitish to pale orange, 5–10 µm protruding, distinctly crenulate; broadly sessile, immersed between fibres and biofilm, dry medium contracted, with dark orange to brick-red disc. **Asci** *65–80(–85) × 6.3–7 µm, †65–72 × 5.5–6.5 µm, 8-spored, spores *(obliquely) 2-seriate, 2–6(–7) lower spores inverted (rarely mixed), pars sporifera *36–45 µm long; **apex** (†) strongly truncate (hardly indented, laterally not inflated); **base** with short to long, ± thick, flexuous stalk, T- or L-shaped. **Ascospores** *11–13.3 × 2.9–3.3 µm, fusoid to fusiform, apex acute (to acuminate), base slightly or medium attenuated, straight or slightly inequilateral; **SBs** *8–12.7 × 0.7–1 µm in situ (~12–15 µm actual length), vermiform-subulate, slightly to medium inflated at base, strongly flexuous. **Paraphyses** apically medium to very strongly clavate-capitate, rarely spathulate, terminal cells *6–17.5(–20) × (3.5)4.5–5.5(–6) µm, lower cells *(8–)11–16 × 1.5–2 µm (subapically up to 3.3 µm wide); unbranched at upper septum, hymenium pale orange. **Medullary excipulum** pale orange, 40 µm thick, of ± loose textura intricata with many inflated cells, medium sharply delimited. **Ectal excipulum** pale orange, of (†) thin-walled, irregularly oriented t. angularis-prismatica from base to submargin, 25–40 µm thick near base, cells *10–16 × 7–9 µm; 30–40 µm thick near margin, of t. prismatica-angularis oriented at

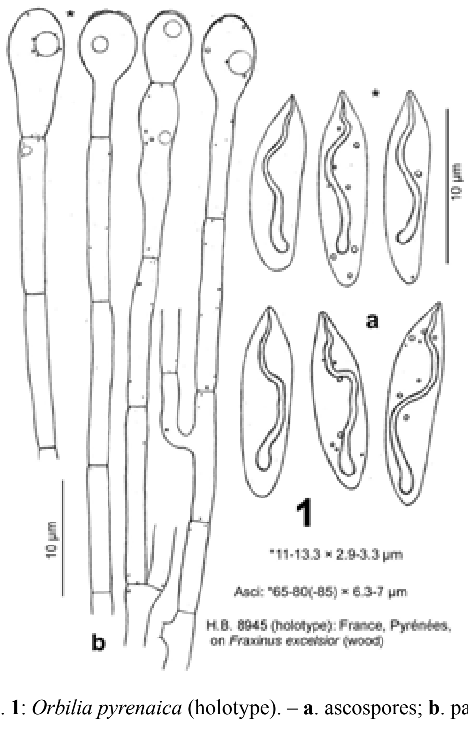


Plate 627. **1**: *Orbilia pyrenaica* (holotype). – **a**. ascospores; **b**. paraphyses.

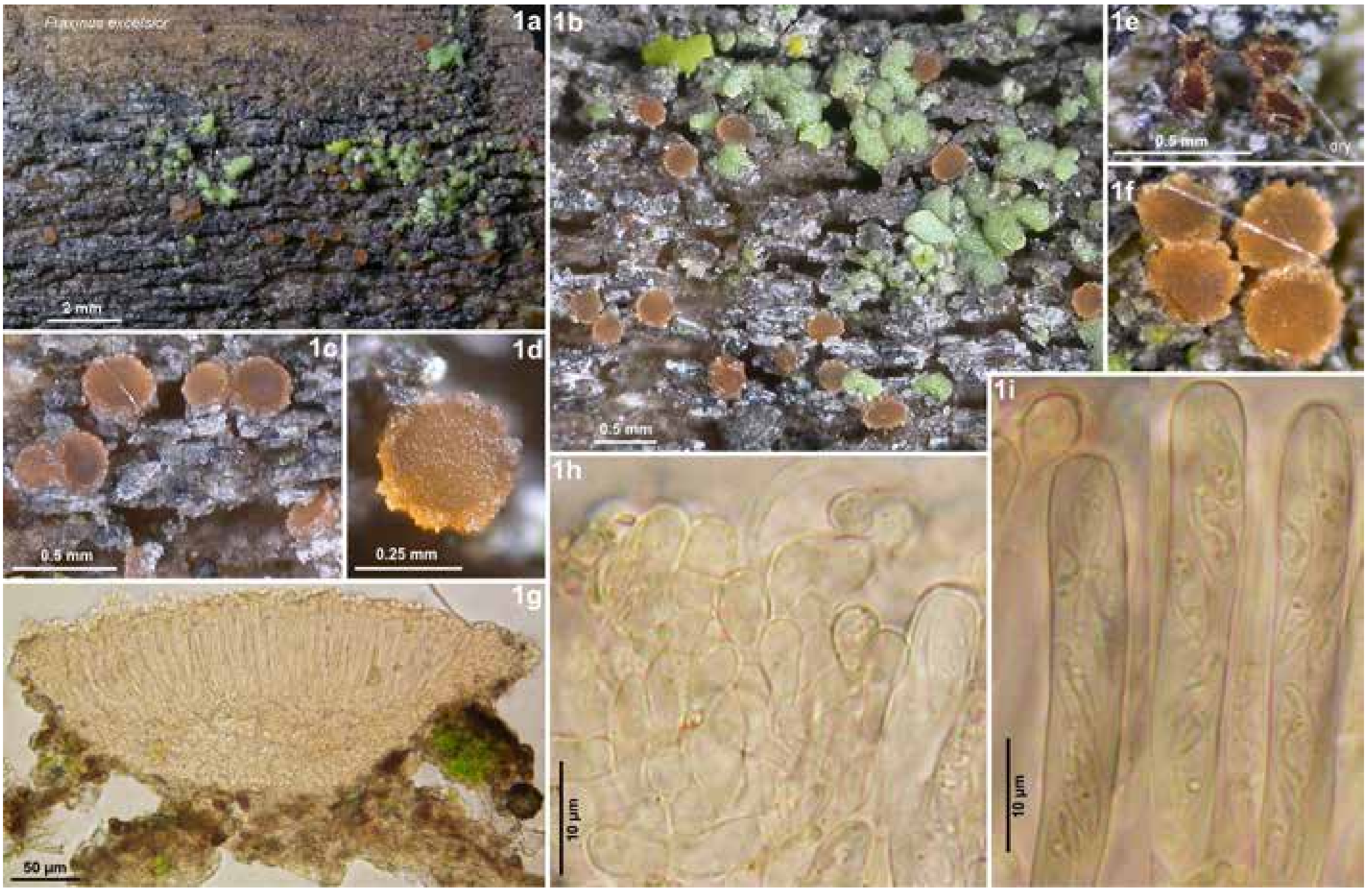


Plate 628. **1**: *Orbilia pyrenaica*. – **1a–d**, **f**. rehydrated apothecia; **1e**. dry apothecia; **1g**. apothecium in median section; **1h**. id., marginal ectal excipulum; **1i**. asci. – Living state; **1e–f**: phot. J.P. Priou. — **1a–i**. H.B. 8945 (holotype): France, Pyrenees, on *Fraxinus*.

a 0–20° angle to the surface, marginal cortical cells *8–12 × 4.5–6(–7) µm. **Anchoring hyphae** sparse, *2–3.3 µm wide, walls 0.2 µm thick. **SCBs** in paraphyses and ectal excipulum (near margin) globose, 1.3–3 µm diam. **Exudate** over paraphyses and margin 0.1–0.3 µm thick, rough, firmly attached. **— ANAMORPH**: unknown.

Habitat: collected 2.5 m above the ground, decorticated, 15 mm thick branch of *Fraxinus excelsior*, on wood, outer 0.2–0.5 mm strongly decayed and greyed, with many green algae. **Associated**: *Orbilia ?obtusispora*, *?Physcia* sp., *Xanthoria* sp. **Desiccation tolerance**: fully viable for 2 weeks, after 30 months still some excipular cells, paraphyses and ascospores alive. **Altitude**: 1540 m a.s.l. **Geology**: granite. **Phenology**: long-lived.

Taxonomic remarks. With its medium-sized apothecia with a light orange disc and a whitish crenulate margin, *O. pyrenaica* closely resembles *O. flexisoma*, from which it is separated by ascospores with acute apices and without tail-like bases or distinct tails, and by longer SBs. The extra-European *O. macrotrapeziformis* differs from *O. pyrenaica* in shorter SBs, while a North American collection with very long SBs mentioned under *O. bicknellensis* (Pl. 655: 4) differs in having crystalloid SCBs in the paraphyses; both deviate also in smaller apothecia with a ± smooth margin. The Australian *O. livistonae* with very similar ascospores differs in 32-spored asci.

A few associated, minute, carmine-red apothecia with an indistinct margin were briefly studied by J.P. Priou (IVV: J.P.P. 28166 p.p.) and might belong to *O. obtusispora*. Their fusoid-clavate spores (*10–12 × 3 µm) with a strongly attenuated lower part and SBs only half as long as the spores are quite different from those of *O. pyrenaica*.

Ecology. *O. pyrenaica* grew on rotten wood of xeric, attached branches of *Fraxinus* in an orotemperate humid high plateau on acidic soil in the eastern Pyrenees in southwestern Europe, at the road side of a solar power station in a cut grassland with planted old ash trees.

Specimens included. **FRANCE**: **Languedoc-Roussillon**, **Pyrénées-Orientales**, 4 km N of Saillagouse, 1.5 km SW of Font-Romeu-Odeillo-Via, Four Solaire d'Odeillo, 1540 m, branch of *Fraxinus excelsior*, on wood, 18.X.2008, J.P. Priou (ex H.B. 8945, M-0276575, **holotype**; **isotypes** in J.P.P. 28195, 28166 p.p.).

Orbilia curvatitrapeziformis Baral, G. Marson & Quijada **sp. nov.**, MB 813704 — Pls 629–630

Etymology: named after the curved ascospores and the resemblance to *O. macrotrapeziformis*.

Typification: USA, Arizona, Parks, branch of *Quercus gambelii*, 29.VIII.1994, G. Marson (ex H.B. 8682b, M-0276468, holotype).

Latin diagnosis: *Differt ab* Orbilia macrotrapeziformi *et* O. flexisomati *ascosporis magis curvatis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.23-0.75 mm diam., 0.2–0.25 mm high, light to bright brick-orange, ± non-translucent, round (to ellipsoid), scattered to subgregarious; disc flat, margin distinct, thick, (5–)10–25 µm protruding, rough, partly whitish pulverulent; sessile on an obconical base, ± erumpent from cracks or between fibres. **Asci** *60–72 × 6.5–8 µm {T} or *85–98(–117) × 6.7–7.5 µm {1}, †57–70 × 6–7.7 {T} or †(53–)65–80 × 5.7–6.3 µm {1}, 8-spored, spores *2–3-seriate, 2–5 lower spores inverted {2}, pars sporifera *30–45 µm long; **apex** (†) strongly truncate (distinctly indented, laterally inflated); **base** with short to long, thick, gradually tapered, slightly flexuous stalk, L- to Y-, rarely H-shaped. **Ascospores** *(10–)11–13.5(–14.5) × (2.5–)2.7–3(–3.3) µm {2}, †9–12.3 × 2.5–2.7 µm {1}, cylindric to fusoid-clavate, apex (subacute to) acute, base not or slightly to medium attenuated but also slightly thickened, slightly to very strongly curved near base; **SBs** *(4–)5–7(–8) × 0.7–1 µm in

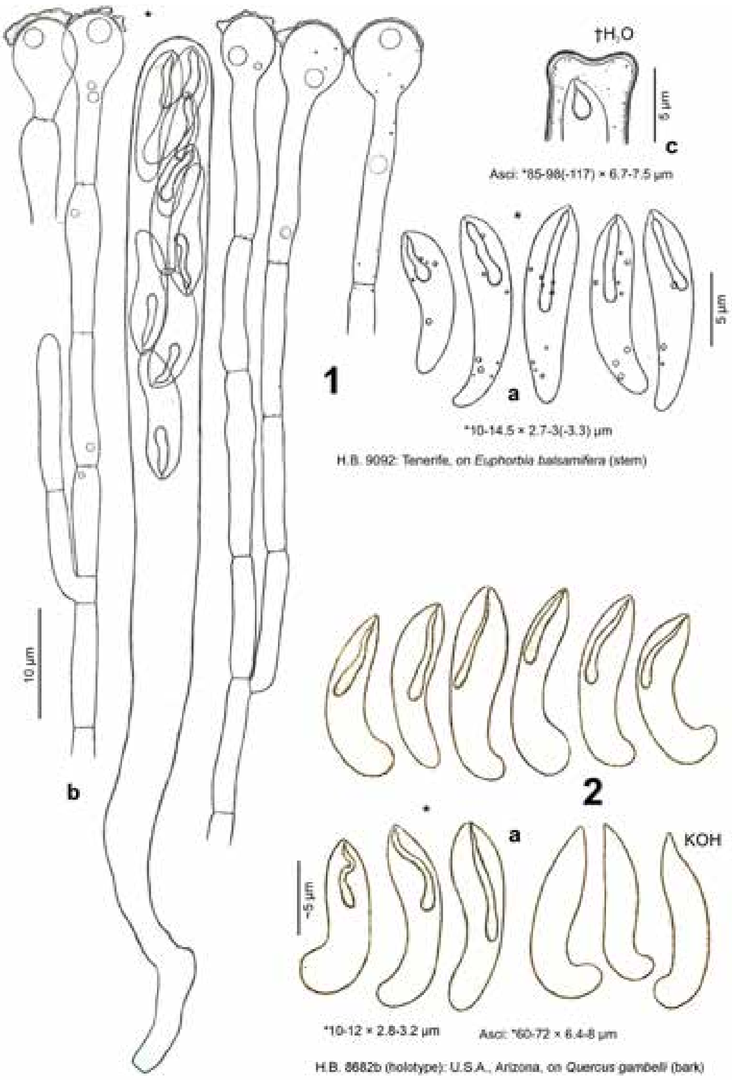


Plate 629. **1–2**: *Orbilia curvatitrapeziformis*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apex.

situ {2} → 3–5 × 1.1–1.3 µm, vermiform to subulate, partly distinctly inflated at base, straight to slightly, rarely strongly flexuous. **Paraphyses** apically medium to (very) strongly (clavate-)capitate, terminal cells *(9–)12–24(–33) × (3–)4–6.2 µm {1}, lower cells *8–17 × 2–3 µm {1}; unbranched at upper septum. **Medullary excipulum** pale orange, 40–90 µm thick, of dense textura intricata, with distinct inflated cells only near margin, indistinctly to medium sharply delimited. **Ectal excipulum** subhyaline, of (†) slightly gelatinized, very indistinctly oriented t. globulosa-angularis from base to submargin, 40–60 µm thick near base, cells *9–20 × 7–14(–18) µm {1}; 30–40 µm thick at mid flanks and margin, at margin of t. prismatica-angularis, oriented at a 10–20° angle to the surface, marginal cortical cells *10–17 × 4–5(–6) µm {1}. **Anchoring hyphae** sparse, †2–4 µm wide, walls 0.2–0.3 µm thick {1}, covering flanks and margin as a thin layer. **SCBs** in paraphyses globose, 0.7–2.5 µm diam. {2}; **Exudate** over paraphyses and margin 0.2–2 µm thick, cloddy-tuberculate, hyaline, firmly attached. — **ANAMORPH**: unknown.

Habitat: attached, corticated, 10–14 mm thick branch of *Quercus gambelii* {1}, on strongly decayed bark (bast) {1}, rotten decorticated branches of *Euphorbia balsamifera* {1} lying on ground, ± greyed, green algae sparse. **Associated**: *Durella* sp. {1}, *Orbilia flexisoma* {1}, *O. gambelii* {1}, *Patellaria atrata* {1}, *Perrotia flammea* {1}. **Desiccation tolerance**: fully viable for at least 3 months. **Altitude**: 2165 m a.s.l. (USA), 17 m (Macaronesia). **Geology**: USA & Tenerife: Basaltic lava and cinders with andesite & rhyolite. **Phenology**: long-lived.

Taxonomic remarks. The holotype of *O. curvatitrapeziformis* closely resembles *O. macrotrapeziformis* and *O. flexisoma*, from which it differs in distinctly curved ascospores. However, some slightly curved spores also occur in these latter taxa, though never in the strength of the holotype of *O. curvatitrapeziformis*.

Variation. The Macaronesian collection on *Euphorbia* differs from the North American holotype in much longer asci, less curved and basally more strongly tapered spores, slightly shorter, hardly subulate SBs, and larger apothecia. Possibly, these differences warrant recognition as a separate species, but with only two collections the morphological variation of *O. curvatitrapeziformis* remains unknown. Because the holotype was only briefly studied when it was alive, the description of paraphyses and excipular characters is mainly based on the paratype.

Ecology. The holotype of *O. curvatitrapeziformis* was collected on bark of a xeric branch of *Quercus gambelii* in the cold-temperate humid ponderosa pine forest in the Mogollon Rim (southwest of Northern America), whereas the paratype was on a xeric decorticated branch of *Euphorbia balsamifera* in the subtropical (inframediterranean) hyperarid tabaibal dulce (*Ceropegio fuscae-Euphorbietum balsamiferae*) at the southernmost part of Tenerife (Macaronesia).

Specimens included. **USA**: **Arizona**, Mogollon Rim, 28 km WNW of Flagstaff, 23 km E of Williams, SE of Parks, 2165 m, branch of *Quercus gambelii*, on bark, 29.VIII.1994, G. Marson (ex H.B. 8682b, M-0276468, **holotype**). — **MACARONESIA**: **Canary Islands**, **Tenerife**, San Miguel de Abona, 9.5 km SSW of San Miguel de Abona, 1.1 km ENE of Costa del Silencio, Montaña Amarilla, 17 m, branch of *Euphorbia balsamifera*, on wood, 12.IV.2009, L. Quijada, R. Castro & E.V. Rodríguez (TFC Mic. 22038, H.B. 9092).

Orbilia edulis Baral & E. Weber, **sp. nov.**,
MB 813680 — Pls 631–632

Etymology: named after the host species, *Pinus edulis*.

Typification: USA, Utah, Mexican Hat, branches of *Pinus edulis*, 14.VI.2000, G. Marson (ex H.B. 7149a, M-0276477, holotype).

Latin diagnosis: *Differt ab* Orbilia macrotrapeziformi *ascosporis valde fusiformibus et basi attenuatis, cellulis vivis excipuli et paraphysium corpusculis globosis carentibus, apotheciis majoribus. Habitat ad lignum putridum ramorum siccorum* Pini edulis *in zona temperata subhumida Americae septentrionalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.3–0.6 mm diam., 0.16–0.25 mm high, light orange to brick-red, scarcely translucent, round, scattered; disc slightly concave to flat, margin distinct, 5–10 µm protruding, smooth or whitish powdered; broadly sessile, immersed in fibres or biofilm. **Asci** *(70–)80–100 × 6.5–7.5 µm, †65–95 × 5.8–7 µm, 8-spored, spores *obliquely biseriate, 4–5 lower spores inverted (not mixed), pars sporifera *47–55 µm long; **apex** (†) strongly truncate (sometimes slightly indented and/or laterally inflated); **base** with short to long, ± thick and flexuous stalk, Y- or L-shaped. **Ascospores** *(12.5–)13.5–17 × (2.8–)3–3.7 µm, †14.5–16 × 3.3–4 µm (flattened), strongly fusiform (to fusiform-clavate), apex acute to acuminate, base (very) strongly attenuated, mostly slightly curved; **SBs** *(7.5–)10–12(–13) × 1–1.4 µm in situ [~(8–)11–15 µm actual length], vermiform to subulate, not or slightly inflated at base, slightly to strongly flexuous. **Paraphyses** apically slightly to strongly clavate-capitate, terminal cells *7.5–18 × 3.5–5.5 µm, lower cells *8.5–18 × 1.6–2.5 µm (near apex sometimes up to 4.5 µm wide); rarely branched near apex. **Medullary excipulum** 50–60 µm thick, of loose or dense textura intricata with many inflated cells, sharply delimited from ectal excipulum by a 10 µm thick layer of t. porrecta. **Ectal excipulum** of (†) distinctly gelatinized, irregularly vertically oriented t.

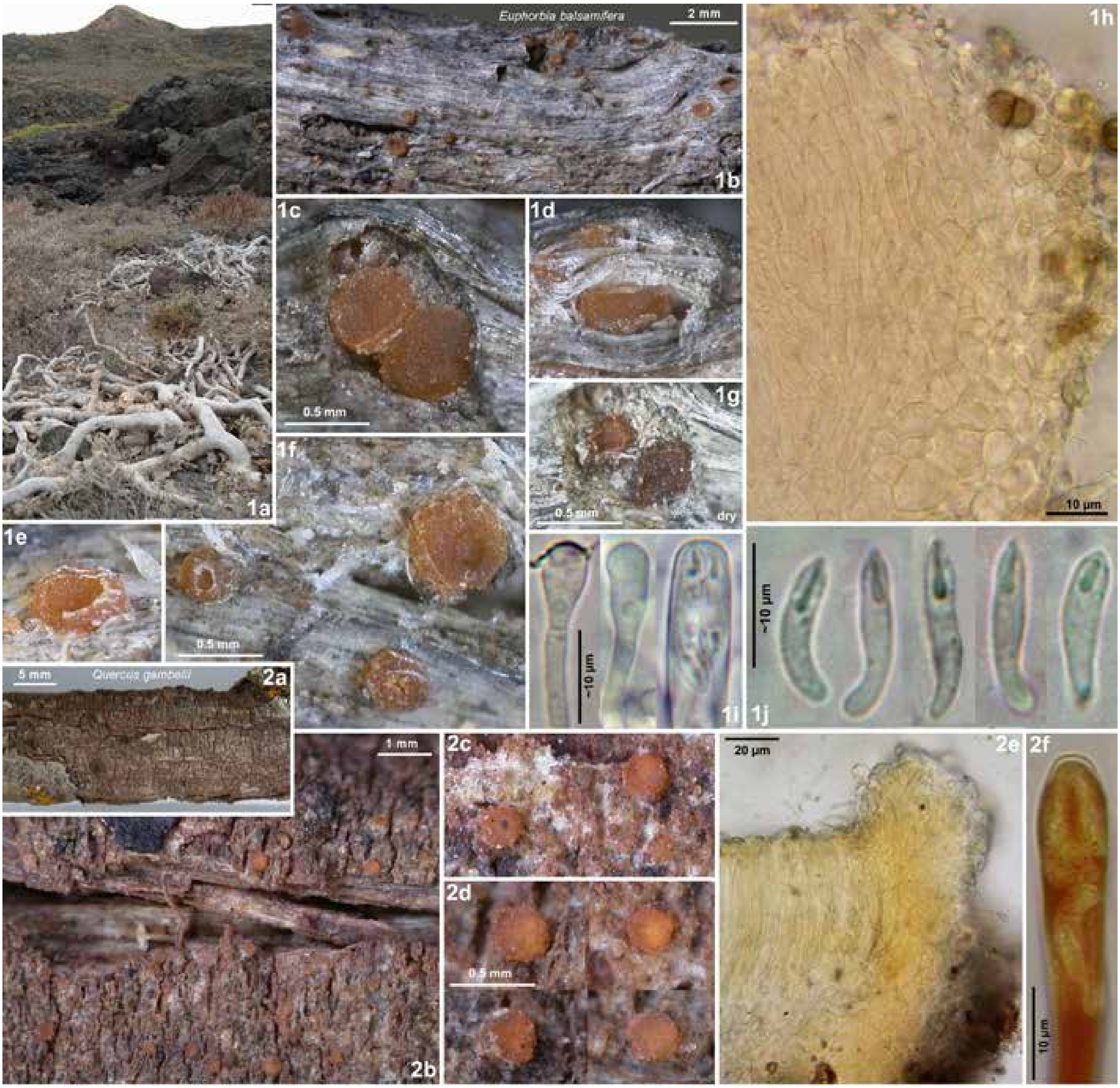


Plate 630. **1–2**: *Orbilia curvatitrapeziformis*. – **1a**. Hyperarid tabaibal dulce with dead branches of *Euphorbia balsamifera*; **2a**. dead corticated xeric branch of *Quercus gambelii*; **1b–f**, **2b–d**. rehydrated apothecia; **1g**. dry apothecia (same as **1c**); **1h**, **2e**. marginal ectal excipulum in median section; **1i**, **2f**. apices of paraphyses and asci; **1j**. ascospores. – Living state, except for **2e** (in KOH), **2f** (in KOH+IKI). – **1a**, **1i–j**: phot. L. Quijada. — **1a–j**. H.B. 9092: Tenerife, on *Euphorbia*; **2a–f**. H.B. 8682b (holotype): USA, Arizona, on *Quercus*.

globulosa-angularis from base to submargin, 30–45 µm thick near base, cells *8–20 × 5–15 µm; 30 µm thick near margin, upper margin of t. prismatica oriented at a 40–70° angle to the surface, marginal cortical cells *8–10 × 3–5 µm. **Anchoring hyphae** medium abundant, *2–3.3(–4) µm wide, walls †(0.2–)0.3–0.5(–1) µm thick. **SCBs** in paraphyses and ectal excipulum (near margin) absent. **Exudate** over paraphyses 0.1–0.3 µm thick, over margin and flanks 1–1.5 µm, granular-cloddy, ± firmly attached. **— ANAMORPH**: unknown.

Habitat: decorticated, 13–24 mm thick branches of *Pinus edulis*, on 0.2–0.5 mm deep very decayed and furrowed wood, strongly greyed, with green algae. **Associated**: *Amandinea* sp., *Orbilia clavipisca*, *O. multitrapezoidea*, *Tryblidaria* ?*fenestrata*. **Desiccation tolerance**: fully viable for at least 2 years. **Altitude**: 1965 m a.s.l. **Geology**: Pennsylvanian-Permian mixed carbonate clastic sedimentary rock. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia edulis* is very similar to *O. macrotrapeziformis* but is tentatively separated by the consistent absence of SCBs in paraphyses and excipular cells, rather long asci, strongly fusiform and somewhat larger ascospores with very attenuated, often acute bases, slightly larger spore bodies, larger apothecia, and occurrence on coniferous substrate. *O. flexisoma* differs in more obtuse spore apices and differently shaped spore bases, and *O. pyrenaica* in smaller spores with only slightly tapered bases and in the presence of globose SCBs.

Ecology. *O. edulis* was found in a woodland with *Pinus edulis* and *Shepherdia rotundifolia* in a cold-temperate subhumid (almost semiarid) pinyon-juniper woodland in the Colorado Plateau at the border of Canyonlands and Navajo section in western North America.

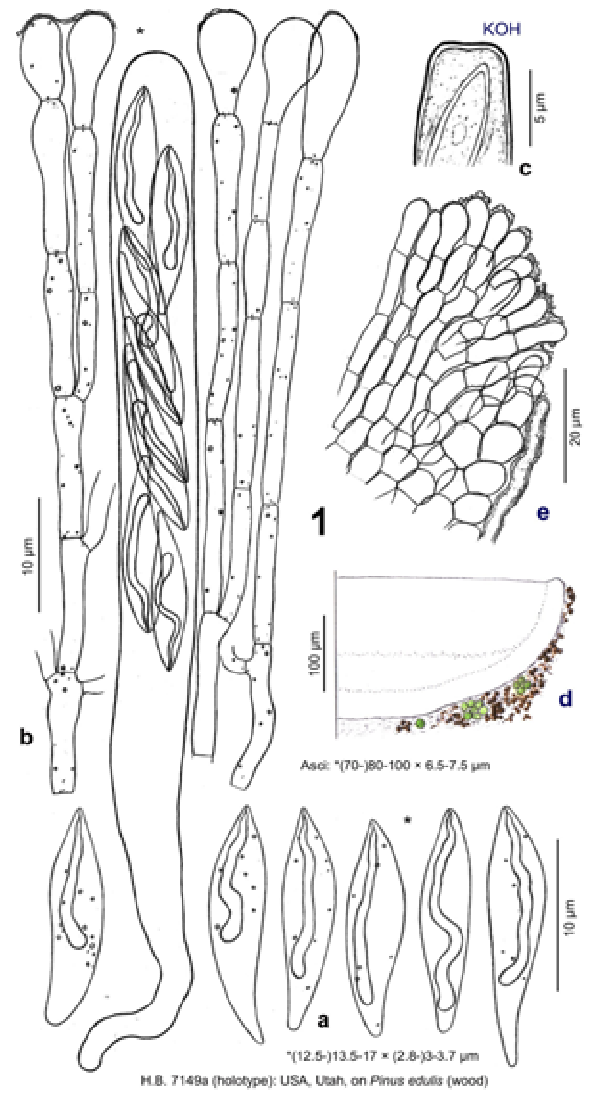


Plate 631. **1**: *Orbilia edulis*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apex; **d**. apothecium in median section; **e**. id., marginal ectal excipulum.

Specimens included. **USA**: **Utah**, Canyonlands, 16 km NNW of Mexican Hat, 1 km N of Mokee Dugway, Cedar Mesa, 1965 m, branches of *Pinus edulis*, on wood, 14.VI.2000, G. Marson (ex H.B. 7149a, M-0276477, **holotype**).

Orbilia wannerooensis Baral & G. Marson, **sp. nov.**,
MB 813681 — Pls 633–634

Etymology: named after the type locality, Wanneroo, Western Australia
Typification: Western Australia, Kinross, branch of *Acacia*, 23.X.2007, G. Marson (ex H.B. 8745d, MEL 2389253, holotype).

Latin diagnosis: *Differt ab* Orbilia macrotrapeziformi *ascosporis superioribus inverse orientatis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.15–0.35 mm diam., 0.11–0.19 mm high, light to bright orange, non-translucent, round, scattered; disc flat, margin distinct, 5–30 µm protruding, smooth but partly crowned by irregular teeth of whitish remnants of substrate; broadly sessile, superficial to slightly erumpent. **Asci** *63–80 × 7.5–8.5 µm {1}, †51–75 × 6–7(–7.7) µm {2}, (6–)8-spored, spores *2–4-seriate, 3–4 upper spores inverted {2} (sometimes mixed), pars sporifera *37–50 µm long; **apex** (†) strongly truncate (often distinctly indented, laterally slightly to strongly inflated); **base** with short, thick, flexuous stalk, L-, Y- to h-shaped. **Ascospores** *(12–)13–18(–19.5) × (2.5–)2.7–3.5(–4.5) µm {2}, cylindric-fusiform, apex acute to acuminate, base not or slightly to medium attenuated, rounded, straight to slightly inequilateral or curved near base; **SBs** *8–14 × 1–1.3 µm in situ {2} (~9–15 µm actual length), vermiform-subulate, not or with ± distinct globose inflation at base, flexuous, never uncinate. **Paraphyses** apically slightly to strongly clavate-capitate, sometimes spathulate or moniliform, terminal cells *5–16 × 2.5–5.5 µm {2}, lower cells *(5.5–)7.5–14(–19.5) × 1.5–2.5 µm {2} (near apex 3–5 µm wide); frequently branched at upper septum, hymenium pale orange. **Medullary excipulum** pale orange, 20–50 µm thick, of dense textura intricata with many inflated cells, medium sharply delimited from ectal excipulum only at flanks. **Ectal excipulum** pale orange, of (†) ± thin-walled, irregularly vertically oriented t. angularis(-prismatica) from base to (sub)margin, 20–40 µm thick near base, cells *6–14 × 4–9 µm {1}; 20–25 µm thick near margin, of indistinctly oriented t. angularis, upper margin of t. prismatica(-angularis) at a 10–20° angle to the surface, marginal cortical cells *6–10(–13) × 3.5–5.5 µm {1}. **Anchoring hyphae** abundant, *2–3.5 µm wide, walls 0.2 µm thick {1}, covering the marginal excipulum as a hyaline, medium gelatinized, 5–10 µm thick layer. **SCBs** globose, in paraphyses 1–2 µm diam., in marginal excipulum 1.5–2.5 µm. **Exudate** over paraphyses 0.2–1(–2) µm thick, rough, loosely to firmly attached, over margin and flanks sparse, 0.2–1 µm thick. **— ANAMORPH**: unknown.

Habitat: collected 1–2 m above the ground, corticated, 8–20 mm thick branches of *Acacia* sp. {1}, *Casuarina cunninghamiana* {1}, on ~0.2 mm deep medium to very decayed bark (bast, sometimes periderm) {2} and wood {1}, slightly to strongly greyed, with sparse to medium abundant green algae. **Associated**: *Baggea* sp. {1}, *Hypoxylon* sp. {1}, ?*Hysteropatella* sp. {1}, *Muellerella lichenicola* {1}, *Orbilia commarosa* {1}, *O. livistonae* {1}, *O. macrotrapeziformis* {1}, *O. microserpens* {1}, *O. myriofusiclava* {1}, *O. pleioquaestiformis* {1}, *O. pluristomachia* {1}, *O.* ?*serpentina* {1}, *Schizoxylon* sp. {1}. **Desiccation tolerance**: fully viable for at least 3 months. **Altitude**: 40–537 m a.s.l. **Geology**: Devonian to Carboniferous sedimentary rock, Cenozoic regolith (whitish sand). **Phenology**: long-lived.

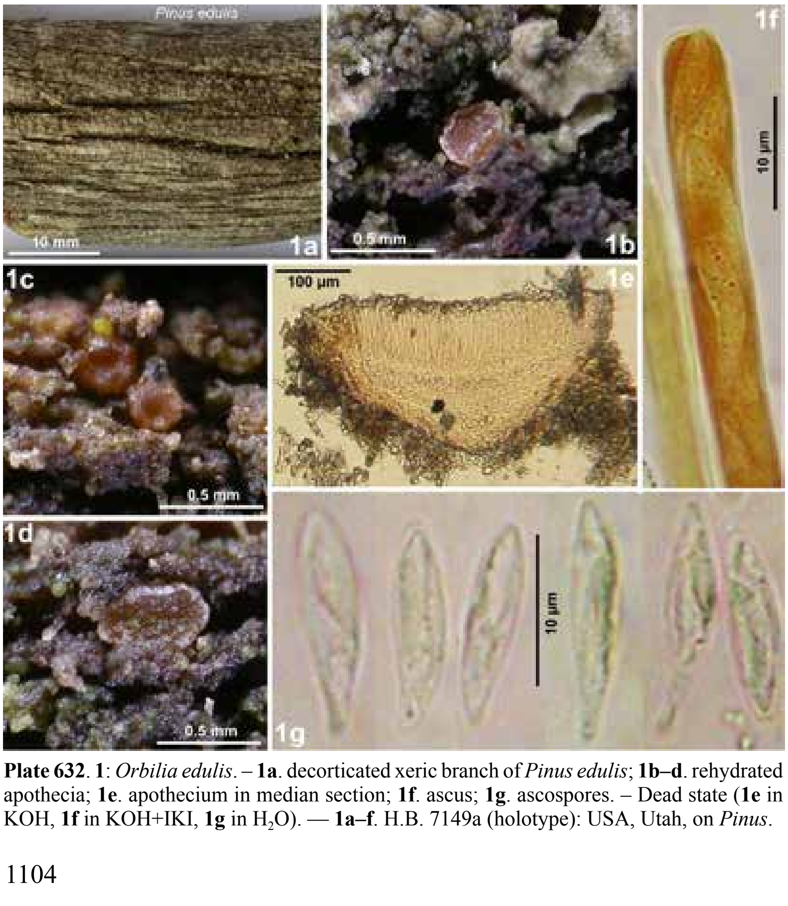
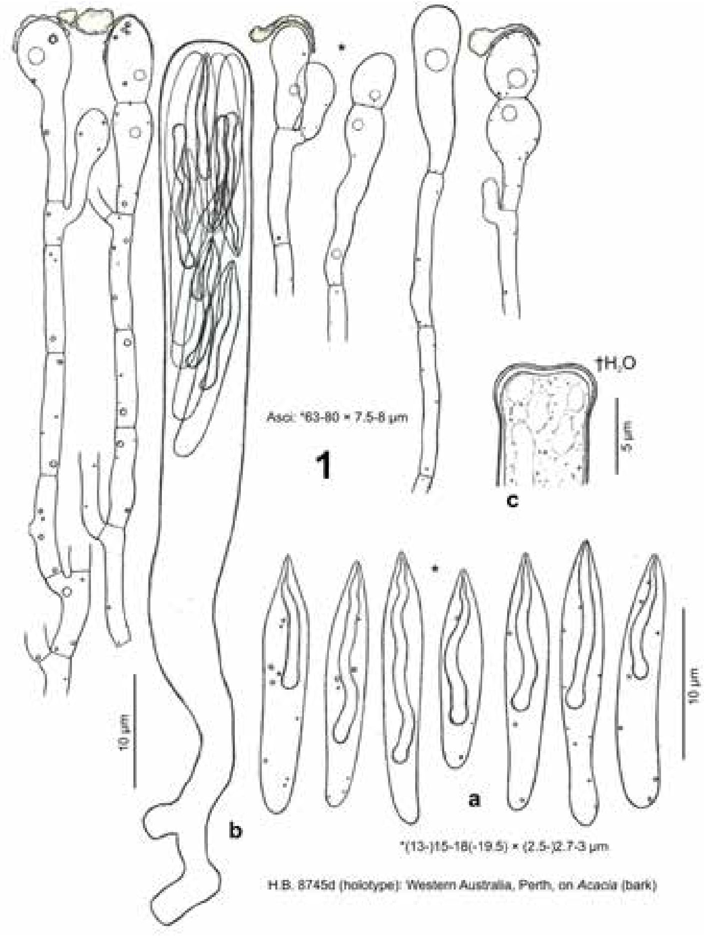


Plate 632. **1**: *Orbilia edulis*. – **1a**. decorticated xeric branch of *Pinus edulis*; **1b–d**. rehydrated apothecia; **1e**. apothecium in median section; **1f**. ascus; **1g**. ascospores. – Dead state (**1e** in KOH, **1f** in KOH+IKI, **1g** in H_2O). — **1a–f**. H.B. 7149a (holotype): USA, Utah, on *Pinus*.



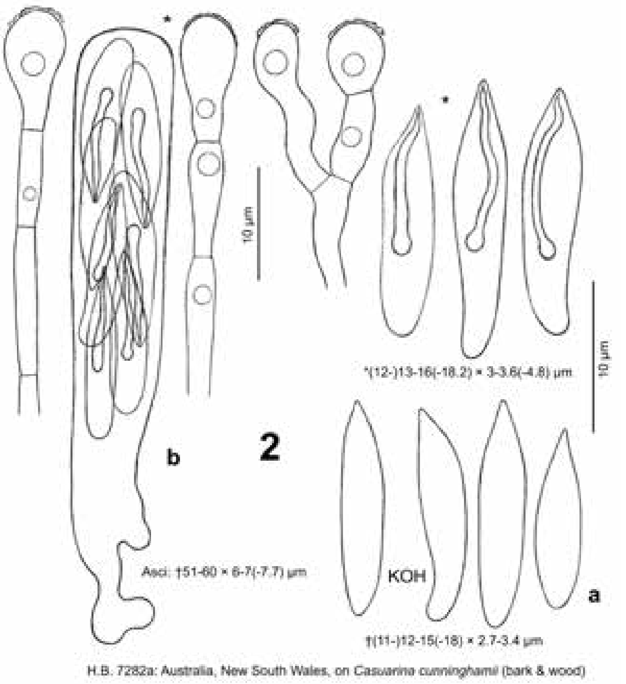


Plate 633. **1–2**: *Orbilia wannerooensis*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apex.

Taxonomic remarks. *Orbilia wannerooensis* is very similar to *O. macrotrapeziformis* and *O. edulis* regarding ascospore characteristics, but differs in the upper instead of lower spores being consistently inversely oriented (*O. edulis* also differs in basally tapered spores and in lacking SCBs). A comparable case of apically inverted spores was observed in a 32-spored collection treated under *O. livistonae* (Pl. 646: 2), which much resembles the *Casuarina* collection of *O. wannerooensis* in spore size and shape, but which was only studied in the dead state.

Variation. The two known collections of *O. wannerooensis* are from very remote sites of Australia and show some Variation. the paratype from southeastern Australia (on *Casuarina*) has wider, slightly shorter spores and more inflated paraphysis apices compared to the holotype from southwestern Australia (on *Acacia*).

Ecology. *O. wannerooensis* grew on rotten bark but also wood of xeric branches of *Acacia* in a subtropical semihumid acacia mixed shrubland on sand dunes in southwestern Australia and of *Casuarina* in a subtropical humid eucalypt woodland in the Great Dividing Range of southeastern Australia.

Specimens included. **AUSTRALIA**: **Western Australia**, Swan Coastal Plain, 30 km NNW of Perth, 1 km NW of Kinross, Tamala Park, 40 m, branch of *Acacia*, on bark, 23.X.2007, G. Marson (ex H.B. 8745d, MEL 2389253, **holotype**). – **New South Wales**, South Western Slopes, 183 km NW of Sydney, 20 km SE of Mudgee, 537 m, branches of *Casuarina cunninghamiana*, on bark & wood, 25.X.1998, G. Marson (H.B. 7282a).

Orbilia delphinus Baral & G. Marson, **sp**. **nov**.,
MB 813682 — Pls 635–637, Map 104

Etymology: named after the ascospores which partly resemble a dolphin.

Typification: USA, Colorado, Denver, branches of *Ribes cereum*, 14.VI.1996, G. Marson (ex H.B. 5705e, M-0276472, holotype).

Latin diagnosis: *Differt ab* Orbilia subtrapeziformi *ascis 16-sporis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.12–)0.25–0.45(–0.6) mm diam., 0.12–0.2 mm high, (pale) light (bright) rose-orange to orange(-ochraceous), ± translucent, round, very scattered to ± gregarious; disc slightly concave to flat, finally slightly to medium convex, margin ± distinct, 0–20 µm protruding, smooth or often finely rough to crenulate; sessile, superficial or slightly to completely immersed among fibres or biofilm; dry light to deep orange. **Asci** *(52–)60–80(–92) × (5.5–)6–7(–7.6) µm {18}, †(48–)55–75(–80) × (5–)5.2–6.5(–7) µm {9}, 16-spored, spores *(3–)4-seriate, (5–)7–9(–10) lower spores inverted {14} (mostly strongly mixed), pars sporifera *(30–)35–47(–50) µm long; **apex** (†) (medium to) strongly truncate (very slightly indented, laterally distinctly inflated or not); **base** with short to medium long, ± thick, flexuous stalk, T-, L- or h- (exceptionally H-)shaped. **Ascospores** *(8–)9–13(–15) × ((1.7–))(1.8–)1.9–2.3(–2.5)((–2.6)) µm {30}, †8–12 × (1.6–)1.8–2.2(–2.3) µm {4}, narrowly fusiform to fusiform-clavate, sometimes with ± cylindrical middle part, apex acute to acuminate, base slightly to medium attenuated (rarely not or strongly so), straight to slightly (or medium) curved; **SBs** *(4–)5–8(–10.5) × (0.6–)0.7–1(–1.3) {17} → 4–6(–7.5) × 1–1.4 µm in situ (actual length hardly longer), (vermiform to) subulate, base not or slightly to medium, rarely strongly inflated, slightly to strongly flexuous, very rarely uncinate; overmature 4.5–5.5 × 1–1.5 µm {1}, globose with a long filum. **Paraphyses** apically (slightly to) medium to very strongly capitate-clavate, rarely spathulate or lageniform, terminal cells *(6–)10–24 {9} × (2.5–)3–5(–5.8) µm {12}, †2.8–4 µm wide, lower cells *(7–)8.5–17(–19) × (1–)1.3–2(–2.3) µm {5}; rarely branched at

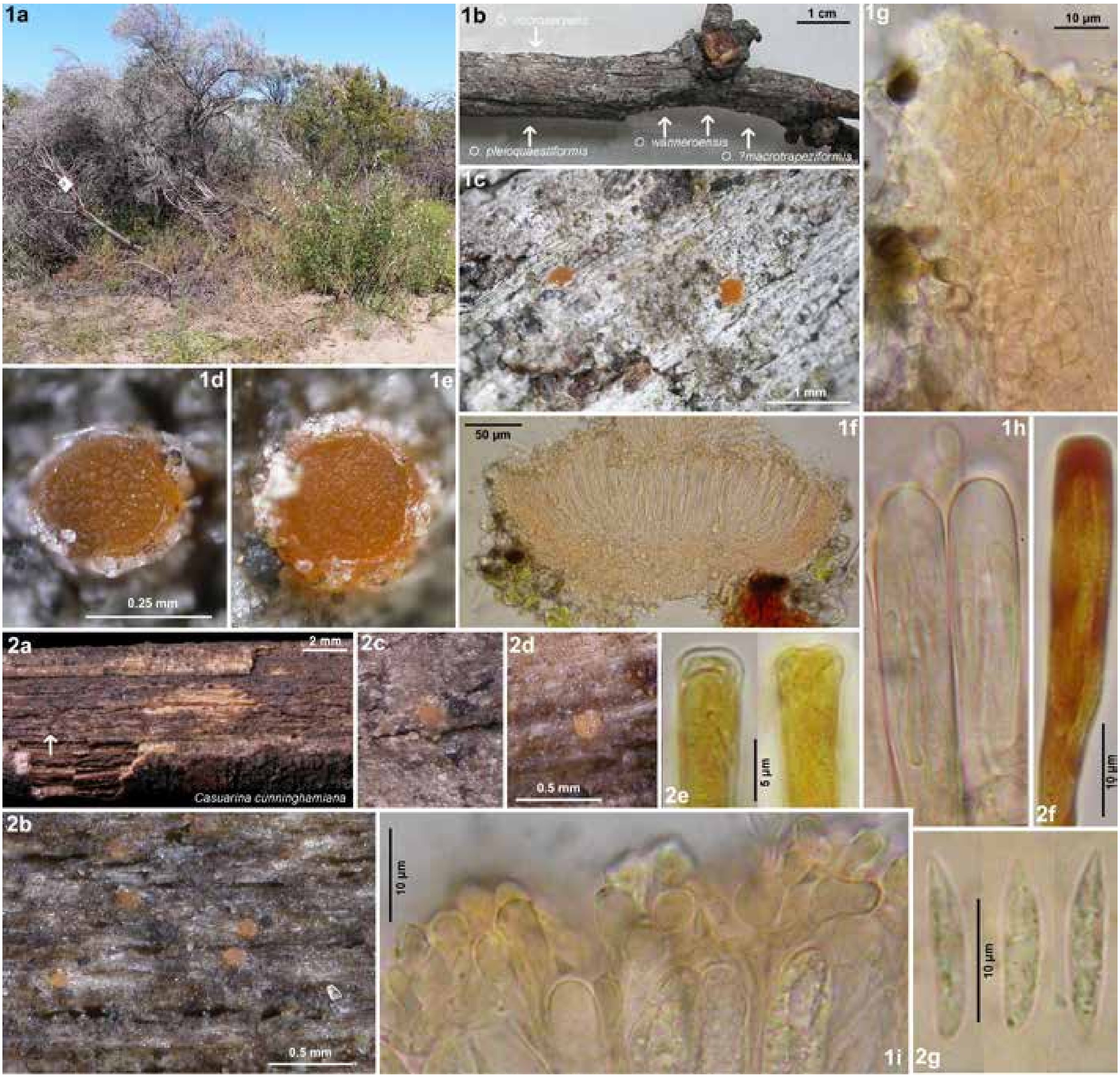


Plate 634. **1–2**: *Orbilia wannerooensis*. – **1a**. semiarid acacia shrubland; **1b**, **2a**. dead (partly) decorticated xeric branches; **1c–e**, **2b–d**. rehydrated apothecia; **1f**. apothecium in median section; **1g**. id., marginal ectal excipulum; **1h–i**, **2e–f**. apices of asci and paraphyses; **2g**. ascospores. – Living state, except for **2e–f** (in KOH+IKI), **2g** (in KOH). — **1a–i**. H.B. 8745d (holotype): Western Australia, Perth, on *Acacia*; **2a–g**. H.B. 7282a: Australia, New South Wales, on *Casuarina*.

upper septum. **Medullary excipulum** hyaline to pale rose, 15–50 µm thick, of loose to ± dense textura intricata with many inflated cells, sharply delimited. **Ectal excipulum** hyaline to pale rose-orange, of (†) thin-walled to slightly gelatinized, vertically oriented t. angularis(-prismatica) from base to mid flanks, 20–60 µm thick near base, cells *7–21(–30) × 6–10.5(–16) µm {3}; 25–30 µm thick at flanks and margin, near margin of pale to light orange t. prismatica(-porrecta) oriented at a 10–45° angle to the surface, marginal cortical cells *6.5–16 × 2.5–5 µm {3}. **Anchoring hyphae** more or less abundant, *2–3.8(–4.5) µm wide, walls 0.2–0.8 µm thick {8}, sometimes forming an up to 12 µm thick covering layer of glassy, undulating hyphae up to the margin. **SCBs** in paraphyses and ectal excipulum (near margin) globose {14}, 1–2.5 µm diam., partly absent {5}, rarely very few rod-shaped SCBs present {2}. **Exudate** over paraphyses 0.2–1(–1.5) µm thick, rough, hyaline to pale yellowish-reddish, firmly attached, forming a 0.2–0.5 µm thick layer over margin and flanks. **— ANAMORPH**: unknown.

Habitat: collected 0.1–3 m above the ground, corticated or more often ± decorticated, 4–25(–80) mm thick twigs and branches of *Abies concolor* {2}, *Amelanchier ?alnifolia* {1}, *A. utahensis* {2}, *Betula ?fusca* {1}, *Cercocarpus* sp. {1}, *C. betuloides* {1}, *C. ledifolius* {1}, *Cistus laurifolius* {1}, *Corylus cornuta* {1}, *Ericameria nauseosa* {1}, *Larix sibirica* {1}, *Lonicera altaica* {2}, *L. microphylla* {1}, *L. periclymenum* {1}, *Pinus sylvestris* {1}, *Populus tremuloides* {5}, *Potentilla fruticosa* {1}, *Prunus domestica* {1}, *P. virginiana* {1}, *Quercus gambelii* {2}, *Ribes cereum* {1}, *Rosa* sp. {3}, *Salix* sp. {4}, *S. ?bebbiana* {1}, on 0.1–1 mm deep (medium to) strongly decayed wood {24}, more rarely bark {10} (periderm {4} or bast {4}, partly ± detaching), sometimes eroded, rarely in beetle galleries, slightly to strongly greyed, green algae sparse or abundant. **Associated**: *Baggea* sp. {1}, ?*Calloria* sp. {2}, ?*Candelariella* sp. {1}, *Carestiella schizoxyloides* {2/1}, '*Chlorosplenium*' *viridulum* {1}, *Claussenomyces* sp. {1}, *Crumenulopsis* sp. {1}, *Cyathicula* sp. {1}, *Diplolaeviopsis* sp. {1}, *Dothideales* {1}, ?*Durella* sp. {4}, *D. atrocyanea* {2/2}, *Gloniopsis* aff. *praelonga* {1}, *Glyphium corrugatum* {1}, *Hypogymnia* sp. {1}, ?*Hypoxylon* sp. {1}, *Hysterium* sp. {2/1}, *H. ?angustatum* {1}, *Hysteropatella* spp. {3}, *Lachnellula arida* {1}, *L. suecica* {1}, *Lasiobelonium sublonicerae* {1}, ?*Melanelia*

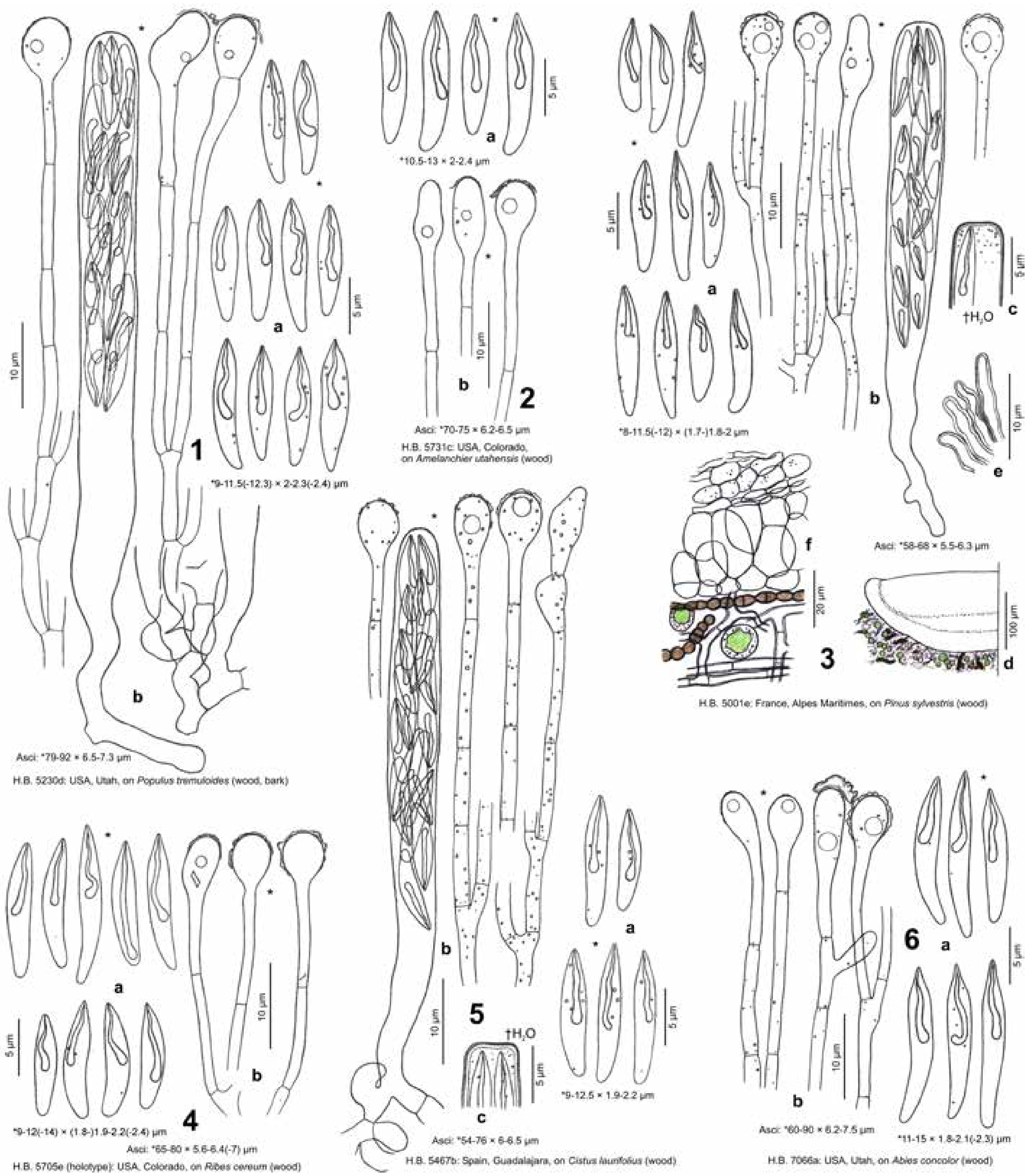


Plate 635. **1–6**: *Orbilia delphinus*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. apothecium in median section; **e**. marginal hair-like cells; **f**. ectal excipulum (near base, median section), with green alga and black yeast.

sp. {1}, *Melanohalea subolivacea* {1}, *Melaspilea emergens* {4}, *Mellitiosporiella* sp. (spores 1-septate) {1}, *M. macrospora* {1}, *M. pulchella* {6}, *Mytilinidion gemmigenum* {1}, *Odontotrema oregonensis* {1}, *Orbilia arizonensis* {1}, *O. basiflexa* {1}, *O. clavipisca* {1}, *O. ?commarosa* {1}, *O. concoloris* {2}, *O. coniferarum* {3}, *O. dixienis* {1}, *O. euonymi* {2}, *O. flexisoma* {2}, *O. gambelii* {5/1}, *O. idahoensis* {2}, *O. lentiformis* {3}, *O. maeandrina* {12}, *O. mesaverdiana* {1}, *O. microsoma* {1}, *O. mongolica* {1}, *O. multimaeandrina* {2}, *O. multiphanosoma* {3}, *O. multitrapezoidea* {1}, *O. myriophanosoma* {2}, *O. navajoana* {1}, *O. ocellata* {4}, *O. ophiosoma* {2/1}, *O. ovalis* {1}, *O. patellarioides* {1}, *O. pleiogambelii* {1}, *O. plurilentiformis* {1}, *O. pubescens* {1}, *O. purshiae* {1}, *O. subaristata* {3}, *O. subovoidea* {1}, *O. subtrapeziformis* {4}, *O. tremuloidis* {1}, *Ostropa barbara* {1}, *Parmelia* sp. {1}, *Patellaria* '*andina*' {1}, *P. atrata* {1}, *Perrotia flammea* {8}, *Phragmiticola* sp. {2}, ?*Pleospora* sp. {1}, *Propolis farinosa* {3}, *Pseudohelotium sordidulum* {1}, *Rosellinia* sp. {1}, *Sarea resinae* {1}, *Sclerococcum* sp. {1}, *Stenocybe* sp. {1}, *Teichospora* sp. {2/2}, *Teichosporella dura* {3}, *Tryblidaria* ?*fenestrata* {1}, ?*Unguiculariopsis* sp. {2}, foliose and crustose lichens {3}, e. g. *Xanthoria* sp. **Desiccation tolerance**: fully viable for at least 17 months, paraphyses and many

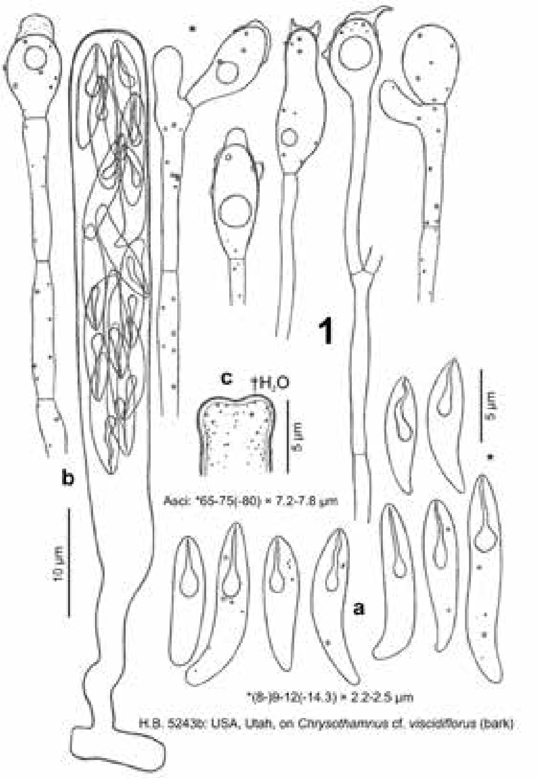


Plate 636. **1**: *Orbilia* aff. *delphinus*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apex.

excipular cells still viable after 28 months. **Altitude**: 1083–1900 m a.s.l. (Europe), 2100–2500 m (Asia), 1440–2980 m (USA). **Geology**: Paleo- to Mesozoic calcareous sand- & limestone, slate, dolomite; gneiss, basalt, rhyolite-andesite lava. **Phenology**: V–X (but certainly throughout the year, long-lived).

Taxonomic remarks. *Orbilia delphinus* is characterized by 16-spored asci and narrowly fusiform-clavate ascospores with subulate, ± flexuous spore bodies, also by the general absence of crystalloid SCBs, and a montane distribution. The very similar, likewise subalpine-boreal but mainly European *O. subtrapeziformis* mainly differs in 8-spored asci, and the North American montane/boreal *O. multidelphinus* in 32-spored asci.

O. subdelphinus (Pls 638–639) differs merely in the consistent presence of crystalloid SCBs and an atlantic-mediterranean distribution. *O. maeandrina* sharply differs in wider, also slightly shorter, more amygdaliform ascospores (with a markedly lower length/width ratio). Based on wider asci and spores, *O. macrodelphinus* is tentatively segregated from *O. delphinus* (see p. 1113).

Variation. There is some variation in ascus length, also in spore length and width, but such deviations are not clearly linked to ecological or geographical data and even occur within a collection. Due to the variation in spore width, a sharp delimitation from *O. macrodelphinus* proved to be very difficult. One of the North American collections (Pl. 635: 6) has extraordinary long spores. In another sample, asci and spores had the typical size of *O. delphinus* in all ~10 apothecia examined by the first author (Pl. 635: 4), whereas the third author (IVV: H.B. 5705e) found much larger spores (*13.5–15 × 2.4–2.8 µm) though only slightly larger asci (*70–90 × 6.4–7 µm). Crystalloid SCBs were inconsistently seen in a few of the paraphysis and excipular cells in three North American collections (Pl. 633: 4, on *Ribes*; 9.V.1995, 11.VI.1996, on *Populus*) but never in the few European specimens.

For a mediterranean collection on *Cupressus* (Pl. 638: 3) with spathulate paraphyses see under *O. subdelphinus* (p. 1111).

Not included collections. A North American sample on *Chrysothamnus* (Pl. 636: 1) differs in a strong tendency to subacute or obtuse spore apices, basally partly more strongly inflated SBs, and wider asci. It might form a transition to *O. macrodelphinus*, and grew together with a 32-spored variant that deviates in similar features from typical *O. multidelphinus*. However, a collection on a similar *Asteraceae* (*Ericameria*, IVV: H.B. 6736e) has acute spore apices and represents quite typical *O. delphinus*.

Two records from Bretagne (France) on *Malus* and *Quercus* are not included because of the low altitude. Since crystalloid SCBs were not observed and the substrate is not coniferous, identity with *O. subdelphinus* seems improbable.

Ecology. *O. delphinus* was recorded from rotten wood, more rarely bark, of xeric twigs and branches of angiosperm or more rarely gymnosperm trees and shrubs. The species occurs in the cold-temperate to boreal, subhumid to humid, ± montane

Map 104. Known distribution of *O. delphinus* (white, yellow = not included collection), *O. subdelphinus* (blue) and *O.* aff. *subdelphinus* (orange) in North America, Europe, and central Asia (western Mongolia).

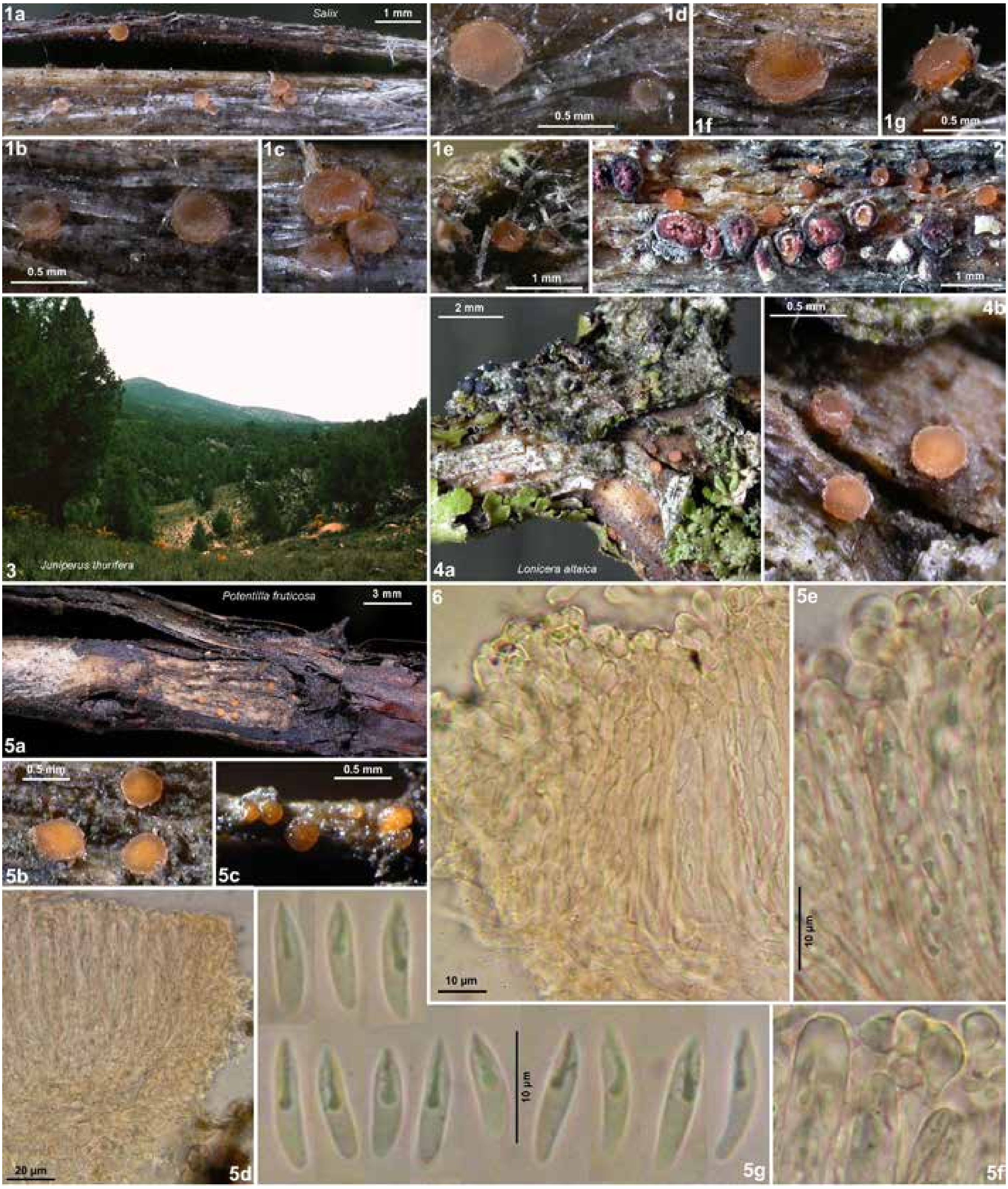


Plate 637. **1–6**: *Orbilia delphinus*. – **3**. montane *Juniperetum thuriferae* on calcareous soil; **1a–g**, **2**, **4a–b**, **5a–c**. rehydrated apothecia (**1e** with '*Chlorosplenium*' *viridulum*, **2** with *Perrotia flammea*); **5d**. apothecium in median section; **6**. id., marginal ectal excipulum; **5e–f**. asci and paraphyses; **5g**. ascospores. – Living state. — **1a–g**. H.B. 7220a: USA, Utah, on *Salix*; **2**. H.B. 8056c: USA, Arizona, on *Amelanchier*; **3**. H.B. 5467b: Spain, Guadalajara, on *Cistus*; **4a–b**. H.B. 7887b: Mongolia, Songino Gol, on *Lonicera*; **5a–f**. H.B. 7892a: Mongolia, Borata valley, on *Potentilla*; **6**. H.B. 7888a: Mongolia, Hoton lake, on *Betula*.

pinyon-juniper woodlands and ponderosa pine, Douglas fir, and Engelmann spruce forests, rarely in warm-continental semiarid to cold-temperate subhumid sagebrush desert scrubs of Middle and Southern Rocky Mountains and Colorado Plateau in western North America. It was also found in continental, orotemperate (sub)humid (winter-dry), subalpine western Mongolia (central Asia) and in orotemperate or oro- to suprasubmediterranean humid Southern French Alps and different mountain ranges of Spain (southern Europe). *O. delphinus* appears to be absent in temperate to boreal Eurasia as well as from subtropical to tropical regions. The not included collections from Bretagne, however, were from an atlantic warm-temperate lowland area.

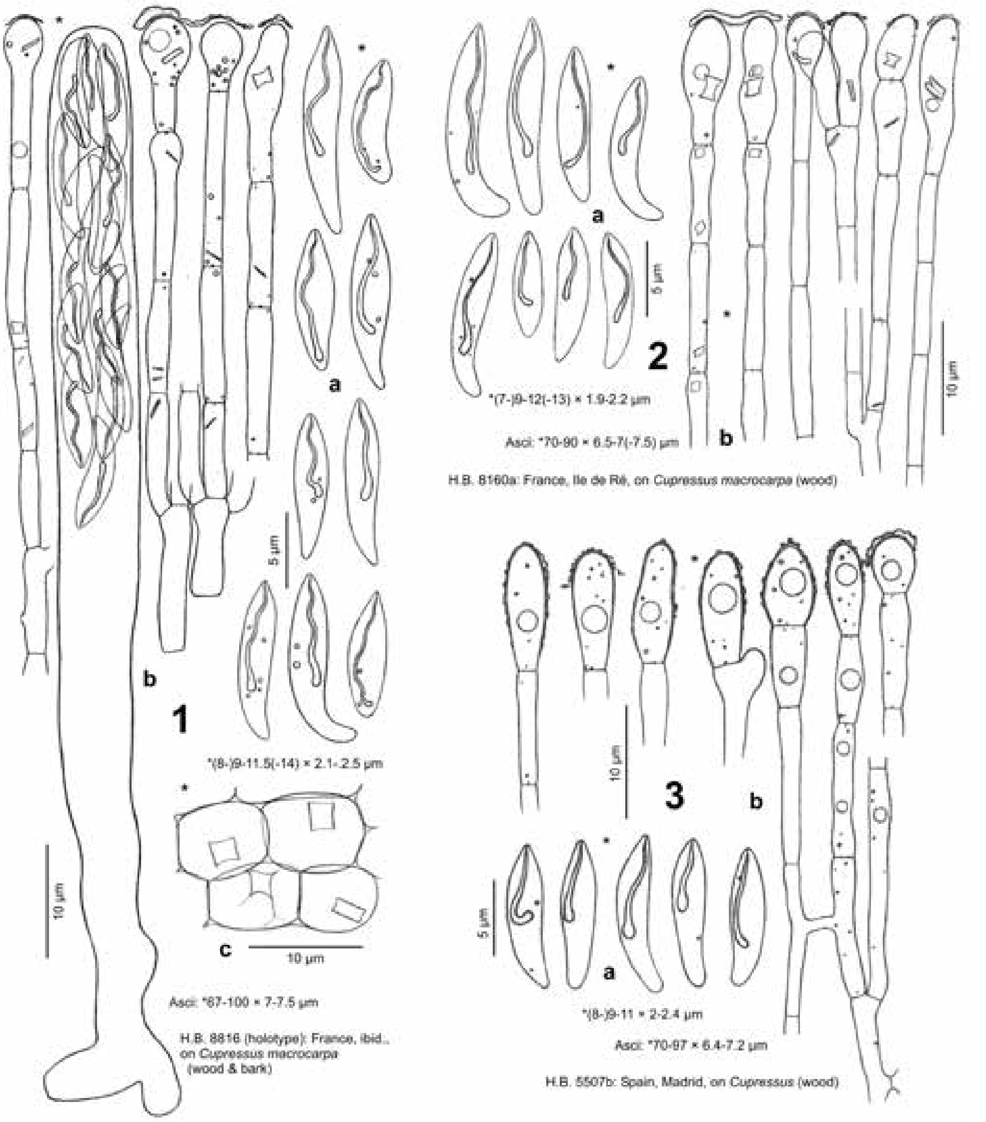


Plate 638. **1–2**: *Orbilia subdelphinus*; **3**: *O.* aff. *subdelphinus*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. crystalloid SCBs in excipular cells.

Specimens included. **FRANCE**: **Provence-Alpes-Côte d'Azur**, **Alpes Maritimes**, 19 km NNE of Grasse, 4 km NNE of Gréolières, Gréolières les Neiges, 1405 m, branch of *Pinus sylvestris*, on wood, 1.X.1993, G. Marson (H.B. 5001e). – **Rhône-Alpes**, **Savoie**, 46 km SSW of Aosta, ~1.5 km WSW of Bonneval-sur-Arc, 5 km S of Col de l'Iseran, 1900 m, on *Salix*, 5.VIII.1995, G. Marson (ø). – **Languedoc-Roussillon**, **Pyrénées-Orientales**, 7 km NE of Mont-Louis, Ayguatébia, Corral de Castanyet, 1514 m, branch of *Rosa*, 21.IX.2016, J.P. Priou (J.P.P. 16195, doc. vid.). — **SPAIN**: **Castilla y León**, **Palencia**, Montaña Palentina, 6 km N of Cervera de Pisuerga, N of Vañes, 1083 m, branch of *Rosa*, 7.V.2012, J.P. Priou (J.P.P. 12114 ø, doc. vid.). – ibid., W of Vañes, 1078 m, branch of *Salix*, on wood, 7.V.2012, J.P. Priou (J.P.P. 12113 ø, doc. vid.). – **Castilla-La Mancha**, **Cuenca**, Sierra de Albarracín, 43 km NE of Cuenca, 8 km SW of Guadalaviar, S of Mt. Mogorrit, 1600 m, twig & branch of *Prunus domestica*, on bark & wood, 26.IX.1999, H.O. Baral & G. Marson (H.B. 6487b). – 28 km NE of Cuenca, 1 km SW of Beamud, 1320 m, branch of *Rosa*, 25.IX.1999, G. Marson (ø). – **Guadalajara**, Sierra de Guadarrama, 55 km NNW of Guadalajara, NW of Majaelrayo, Arroyo La Matilla, 1180 m, branch of *Cistus laurifolius*, on wood, 14.V.1996, H.O. Baral (H.B. 5467b). – ibid., branch of *Salix*, on wood, 14.V.1996, H.O. Baral (ø). – ibid., branch of *Lonicera periclymenum*, on wood, 14.V.1996, H.O. Baral (ø). — **MONGOLIA**: **Bayan Ölgii**, Sagsai, Altay Mts., Tavan Bogd, ~2 km SW of Dayan lake, ~2450 m, twig of *Larix sibirica*, on bark, 12.VIII.2005, J. Christan & P. Karasch (H.B. 7899b). – 25 km SE of Dayan lake, 8 km NE of Chinese border, Songino Gol river valley, 2100 m, twig & branch of *Lonicera altaica*, on wood, 15.VIII.2005, P. Karasch (H.B. 7887b). – ibid., branch of *Lonicera microphylla*, on wood, 16.VIII.2005, P. Karasch (H.B. 7897d ø). – Tolbo, 13 km N of Tolbo, Borata valley, 2500 m, twigs of *Potentilla fruticosa*, on wood & bark, 7.VIII.2005, P. Karasch (P.K. 07082005-5, H.B. 7892a). – Tsengel, ~1.5 km SW of Khoton lake, ~2200 m, twig of *Betula* (?)*fusca*, on wood, 18.VIII.2005, P. Karasch (P.K. 18082005-1, H.B. 7888a). – 10 km SW of Tsengel, Khovd river valley, 2200 m, branch of *Lonicera altaica*, on wood, 9.VIII.2005, P. Karasch (ø). — **USA**: **Idaho**, Columbia Plateau, 60 km E of Idaho Falls, 47 km W of Jackson, Swan Valley 1750 m, branches of *Amelanchier ?alnifolia*, on wood, 5.VI.1996, G. Marson (H.B. 6037a). – Great Basin, 30 km SE of Pocatello, McCammon, 1440 m, branch of *Prunus virginiana*, on wood, 3.VI.1996, G. Marson (ø). – **Utah**, Uinta Mts., 34 km NNE of Vernal, 34 km SE of Manila, 2570 m, on *Populus tremuloides*, 11.VI.1996, G. Marson (ø). – ibid., on *Cercocarpus*, 11.VI.1996, G. Marson (ø) – Utah Mts., 14 km S of Grover, N of Pleasant Creek Campground, 2600 m, branch of *Salix ?bebbiana*, 15.V.1995, G. Marson (ø). – 1.5 km ESE of Cedar City, NW-border of Dixie Forest, 1815 m, branch of *Quercus gambelii*, on bark, 24.VIII.1994, G. Marson (ø). – 22 km ESE of Cedar City, 18 km WNW of Duck Creek Village, Zion Overlook, 2980 m, branch of *Populus tremuloides*, on bark & wood, 24.VIII.1994, G. Marson (H.B. 5230d). – Bryce Canyon, 42 km SSE of Panguitch, Rainbow Point, 2778 m, branch of *Abies concolor*, on wood, 20.VI.2000, G. Marson (ex H.B. 7066a, in M-0276461 [H.B. 7066b, type of *O. coniferarum*]). – 32 km SE of Panguitch, 13 km WSW of Tropic, near Trough Spring, 2500 m, branch of *Abies concolor*, on bark, 13.VI.2003, G. Marson (H.B. 8095g ø). – 11 km NNE of Glendale, 6.5 km WSW of Alton, 2095 m, branches of *Salix*, on wood & bark, 21.VI.2000, G. Marson (H.B. 7220a). – Canyonlands, 33 km W of Blanding, 2 km NNE of Bears Ears East, Bears Ears, 2600 m, branch of *Populus tremuloides*, 14.VI.2000, G. Marson (H.B. 7180b). – Canyonlands, 36 km S of Moab, 5 km WNW of Hatch Rock, 1813 m, branch of *Ericameria nauseosa*, on bark, 16.VI.2000, G. Marson (H.B. 6736e ø) – **Colorado**, Canyonlands, 15.5 km SSE of Cortez, Mesa Verde, 5 km NNW of Spruce Tree House, 2290 m, branch of *Amelanchier utahensis*, on wood, 31.V.1996, G. Marson (H.B. 5731c). – 22.5 km SSE of Cortez, Mesa Verde, W of Cliff Ruins, 2100 m, branch of *Cercocarpus betuloides*, on wood, 31.V.1996, G. Marson (ø). – Southern Rocky Mountains, 25 km SW of Denver, 11.5 km NE of Conifer, around Tiny Town, 2100 m, branches of *Corylus cornuta*, on wood, 14.VI.1996, G. Marson (H.B. 6028a). – 65 km SW of Denver, 7.5 km WNW of Shawnee, Santa Maria, 2615 m, branches of *Ribes cereum*, on wood, 14.VI.1996, G. Marson (M-0276472, **holotype**; **isotype** in H.B. 5705e). – **Arizona**, Grand Canyon, Kaibab Plateau, 93 km SSE of Fredonia, S of North Rim, branch of *Cercocarpus ledifolius*, 17.V.1995, G. Marson (ø). – Coconino Plateau, 15 km ESE of Grand Canyon Village, Grandview Point, 2260 m, branch of *Amelanchier utahensis*, on wood, 16.VI.2003, G. Marson (H.B. 8056c). – 3 km N of Tusayan, 2068 m, branch of *Quercus gambelii*, on wood, 28.VIII.1994, G. Marson (ø). – Mogollon Rim, 23 km NW of Flagstaff, 2450 m, branches of *Populus tremuloides*, on wood & bark, 12.VI.2000, G. Marson (H.B. 7086k). – 9 km NW of Flagstaff, San Francisco Peaks, 9 km SSW of Humphreys Peak, Rte. 180, 2250 m, branch of *Populus tremuloides*, on bark & wood, 9.V.1995, G. Marson (H.B. 5775d).

Not included. **FRANCE**: **Bretagne**, **Finistère**, 5 km NW of Audierne, SSE of Penn ar Run, 64 m, branch of *Malus pumila*, on wood, 28.VI.2013, J.P. Priou (J.P.P. 13172, doc. vid.). – **Morbihan**, Île de Houat, 16 km SE of Quiberon, WNW of Houat, Begar Gorlay, 15 m, branch of *Quercus*, on wood (old *Vuilleminia*), 8.V.2017, J.P. Priou (J.P.P. 17083, doc. vid.). — **USA**: **Utah**, Utah Mts., Bryce Canyon, 30 km SE of Panguitch, 7.5 km WNW of Tropic, near Visitor Center, 2410 m, twig and branch of (?)*Chrysothamnus viscidiflorus*, on bark, 24.VIII.1994, G. Marson (H.B. 5243b).

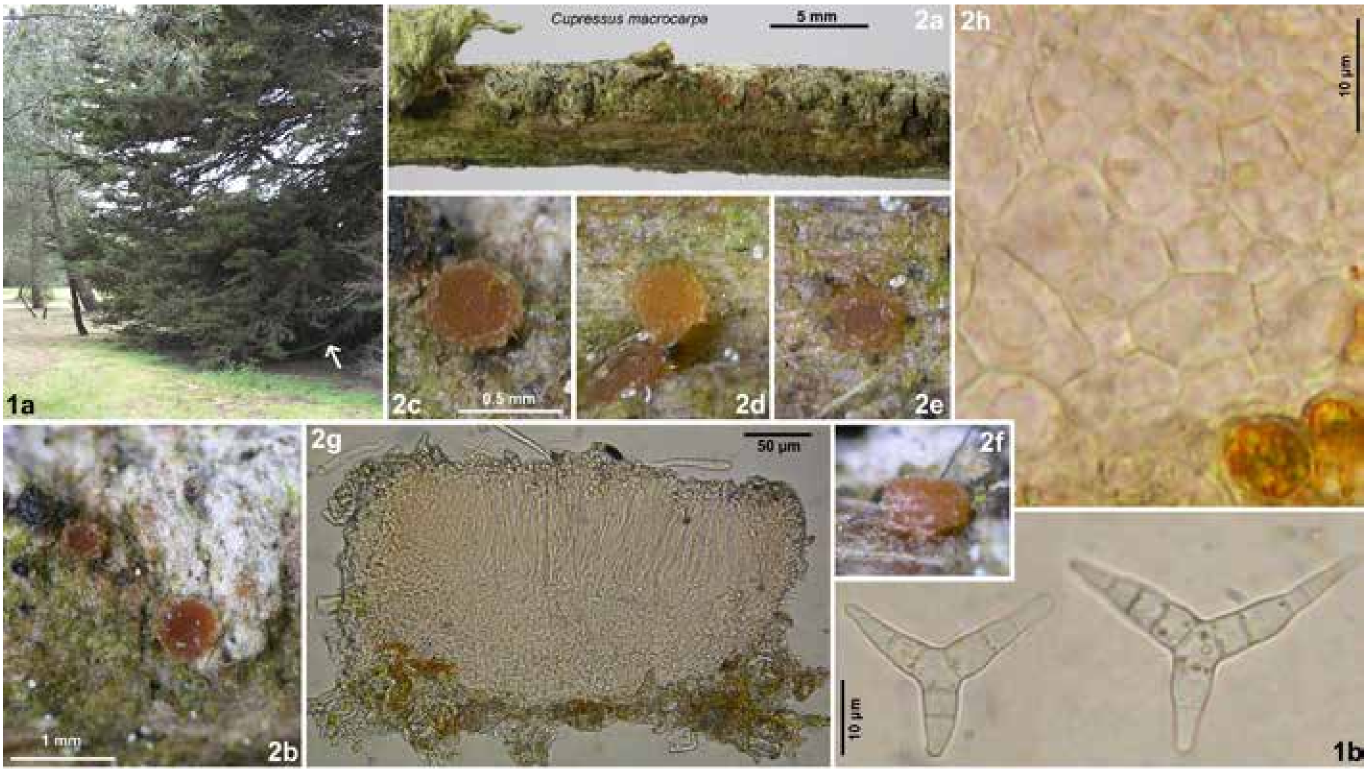


Plate 639. **1–2**: *Orbilia subdelphinus*. – **1a**. atlantic submediterranean open forest with *Cupressus macrocarpa*; **2a**. xeric decorticated branch (rehydrated); **2b–f**. rehydrated apothecia; **2g**. apothecium in median section; **2h**. basal ectal excipulum (median section, outside with ?*Trentepohlia*), cells containing SCBs; **1b**. conidia from substrate. – Living state. — **1a–b**. H.B. 8160a: France, Ile de Ré, on *Cupressus*; **2a–h**. H.B. 8816 (holotype): ibid., on *Cupressus*.

Orbilia subdelphinus Baral, **sp. nov.**, MB 813683 — Pls 638–639

Etymology: named according to the strong similarity with *O. delphinus*.
Typification: France, Ile de Ré, branch of *Cupressus macrocarpa*, 16.IV.2008, H.O. Baral (ex H.B. 8816, M-0276595, holotype).

Latin diagnosis: *Differt ab* Orbilia delphino *cellulis vivis excipuli et paraphysium corpuscula crystalloidea continentibus. Habitat ad lignum et corticem putridum ramorum siccorum Cupressi macrocarpi in zona atlantica mesosubmediterranea Europae occidentalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.3–0.6 mm diam., 0.16–0.22 mm high, light to bright brick-orange, hardly translucent, round, scattered; disc flat, margin distinct, 10–30(–70) µm protruding, ± rough to irregularly crenulate; broadly sessile, ± superficial; dry slightly contracted, bright (dirty) brick-red. **Asci** *67–100 × 6.5–7.5 µm {2}, †(56–)65–83 × 5.7–6.7 µm {1}, 16-spored, spores *3–4-seriate, 8–9 lower spores inverted {1}, pars sporifera *35–52 µm long (slightly mixed); **apex** (†) medium to strongly truncate (not indented, laterally not inflated); **base** with short to long, ± thick, flexuous stalk, L-, Y- or h-shaped. **Ascospores** *(7–)9–12(–14) × 1.9–2.5 µm {2}, †8–11 × 2–2.4 µm {1}, fusoid- to fusiform(-clavate), apex subacute to acute, base medium to strongly (rarely only slightly) attenuated, ± inequilateral to mostly slightly to strongly curved near base; **SBs** *(5–)6–9(–10) × (0.3–)0.4–0.6 µm in situ {1} (~6–11 µm actual length), filiform-subulate, somewhat inflated at base, ± flexuous to helicoid. **Paraphyses** apically slightly to strongly clavate-capitate, also somewhat spathulate, exceptionally lageniform, terminal cells *(5–)10–15 × (2.5–)3–4(–4.5) µm {2}, lower cells *8–14 × 1.5–2.3(–3) µm {2}; rarely branched at upper septum. **Medullary excipulum** very pale rose, 40–100 µm thick, of dense textura intricata with some inflated cells, medium sharply delimited. **Ectal excipulum** very pale rose, of (†) thin-walled to slightly gelatinized, irregularly to vertically oriented t. globulosa(-prismatica), 30–50 µm thick near base, cells *7–12 × 6–10 µm {1}; at lower and mid flanks of vertical to indistinctly horizontal t. angularis, 25–40 µm thick near margin, of. t. porrecta oriented at a 0–40° angle to the surface, marginal cortical cells †7–9 × 2–3 µm {1}. **Anchoring hyphae** medium abundant, †1.7–3.3 µm wide, walls 0.2–0.3(–0.7) µm thick {1}, extending to the margin as a thin layer. **SCBs** in paraphyses globose, 1–2 µm diam., also crystalloid, in ectal excipulum (at flanks and margin) crystalloid, medium refractive, 2–3(–4) × (1–)1.5–2.3 µm, hyaline to very pale orange. **Exudate** over paraphyses 0.2–2 µm thick, granular-cloddy, hyaline, ± firmly attached, over margin 0.2–1 µm thick. — **ANAMORPH**: trinacrium-like (presumed, from natural substrate {1}). **Conidiophores** not seen. **Conidia** Y-shaped, total size *18–28 × 23–38 µm, stipe *10–13 × 4.5–5 µm, 2-septate, arms tapering, *14–21.5 × 4–5.5 µm, 2–4-septate {1}.

Habitat: collected ~1 m above the ground, partially to entirely decorticated, 4.5–30 mm thick, still-attached branches of *Cupressus macrocarpa* {2}, on 0.1–0.2 mm deep medium to strongly decayed wood {2} and bark {1} (bast), partly in beetle galleries, somewhat greyed, with many green algae. **Associated**: *Opegrapha* sp. {1}, *Orbilia cupressi* {1}, ?*Parmelia* sp. {1}. **Desiccation tolerance**: fully viable for at least 2 weeks, submature asci, paraphyses and excipular cells viable for 2 months. **Altitude**: 7–19 m a.s.l. **Geology**: Quaternary marine sand over Upper Jurassic limestone. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia subdelphinus* closely resembles *O. delphinus*. The taxon is tentatively separated because of the consistent presence of crystalloid SCBs in paraphyses and ectal excipulum, narrower spore bodies, and occurrence at very low altitude in an atlantic-mediterranean climate on a single host (*Cupressus*).

Not included collection. A sparse mediterranean collection on wood of *Cupressus* (Pl. 638: 3, one apothecium) is not included in either taxon as it deviates in predominantly spathulate (to sublageniform) paraphyses, with the exudate attached also on the sides of the apices, from *O. subdelphinus* also in the absence of crystalloid SCBs. In the shape of its paraphyses and spores this sample resembles the 8-spored *O. flavidorosella* (series *Habrostictis*) and *O. spathulata*.

Anamorph. The conidia observed on the natural substrate are similar to *Trinacrium robustum* which is typical for many species of section *Habrostictis*.

Ecology. *O. subdelphinus* is only known from rotten wood and bark of xeric twigs and branches of *Cupressus macrocarpa* in mesosubmediterranean semihumid (atlantic) open cypress forests in western Europe. *Cupressus macrocarpa* was introduced from California to Île de Ré over a hundred years ago for wind protection (M. Hairaud pers. comm.). *O.* aff. *subdelphinus* was collected in a park at Aranjuez in the mesomediterranean semihumid centre of Spain.

Specimens included. **FRANCE**: **Poitou-Charentes**, **Charente-Maritime**, Île de Ré, 2 km SE of St.-Martin-de-Ré, 1.8 km W of La Flotte, Les Maraises, 19 m, branch of *Cupressus macrocarpa*, on wood, 26.IV.2006, S. Helleman & G. Marson (H.B. 8160a, anam. substr.). – 2.5 km NNE of St.-Clément-des-Baleines, Forêt de St.-Clément, 7 m, branch of *C. macrocarpa*, on bark & wood, 16.IV.2008, H.O. Baral (ex H.B. 8816, M-0276595, **holotype**).

Not included. **SPAIN**: **Madrid**, 43 km SSE of Madrid, 2 km NE of Aranjuez, Jardín del Príncipe, 500 m, twig of *Cupressus* sp., on wood, 31.V.1996, H.O. Baral (H.B. 5507b).

Orbilia spathulata Baral & G. Marson, **sp. nov.**, MB 814434 — Pls 640–641

Etymology: named after the spathulate paraphyses.

Typification: USA, Utah, Page, branches of *Artemisia tridentata*, 25.VIII.1994, G. Marson (ex H.B. 5197c, M-0276587, holotype).

Latin diagnosis: *Similis* Orbiliae subtrapeziformi *sed paraphysibus apice interdum spathulatis, corpuscula crystalloidea continentibus, ascosporis superioribus plerumque inverse orientibus.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.2–0.45 mm diam., 0.13–0.17 mm high, light (yellowish-)orange-ochraceous, ± translucent, round, scattered to subgregarious in small groups; disc slightly concave to flat, margin distinct, 10–20 µm protruding, nearly smooth or finely rough; sessile, partly distinctly erumpent between fibres. **Asci** *60–79 × 6.2–7.5 µm {3}, †60–95(–105) × 5.8–6.3 µm {2}, 8-spored, spores *2–4-seriate, 3–5 spores inverted (predominantly the upper spores, but sometimes strongly mixed and sometimes only the lower spores) {3}, pars sporifera *(26–)30–38 µm long (†39–55 µm); **apex** (†) medium to strongly truncate (not indented, somewhat conical or laterally slightly widened); **base** with short to medium long, thin or thick, flexuous stalk, T- to L-shaped. **Ascospores** *(10–)11–15(–17) × (2.1–)2.3–2.6(–2.8) µm {2}, †10–14.3 × 2.3–2.7(–2.9) {1}, fusoid with ± cylindrical middle part, apex subacute to acute, base not or slightly attenuated {T}, or fusiform with acute (to acuminate) apex, base medium to strongly attenuated {1}, mostly slightly to medium curved at base; **SBs** *(7–)8–10.5(–11.5) × 0.7–1(–1.3) µm in situ {2} (actual length ~8–12 µm), vermiform to subulate, mostly slightly to medium inflated at the base, straight to mostly ± flexuous, rarely uncinate. **Paraphyses** apically spathulate to lageniform, terminal cells *(8–)10–15(–20) × (3.5–)4–4.7(–5.5) µm {2}, †2.8–4.8 µm wide, lower cells *(6–)9.5–17(–20) × 1.3–2(–2.5) µm {1}; unbranched at upper septum. **Medullary excipulum** pale orange, 40–60 µm thick, of ± loose textura intricata with many inflated cells, sharply delimited. **Ectal excipulum** light orange, of (†) thin-walled, vertically oriented t. angularis(-prismatica) from base to margin, 25 µm thick near base, cells *9–19 × 7–11 µm {1}; 15–20 µm thick at flanks, 20–25 µm near margin, marginal cortical cells †8–15 × 4–4.5 µm {1}. **Anchoring hyphae** medium abundant, *2.2–4 µm wide (†1.7–3 µm), walls 0.2–0.4(–0.6) µm thick {1}. **SCBs** in paraphyses and ectal excipulum (near margin) globose, 1.5–2.3 µm diam., associated with rod- or ring-shaped SCBs 2–4.5 µm diam. {1}, hyaline. **Exudate** over paraphyses and uppermost excipular cells forming 0.1–2 µm thick, firmly attached, finely rough, refractive (glassy) caps. **— ANAMORPH**: trinacrium-like (presumed, from natural substrate {1}). **Conidiophores** not observed.

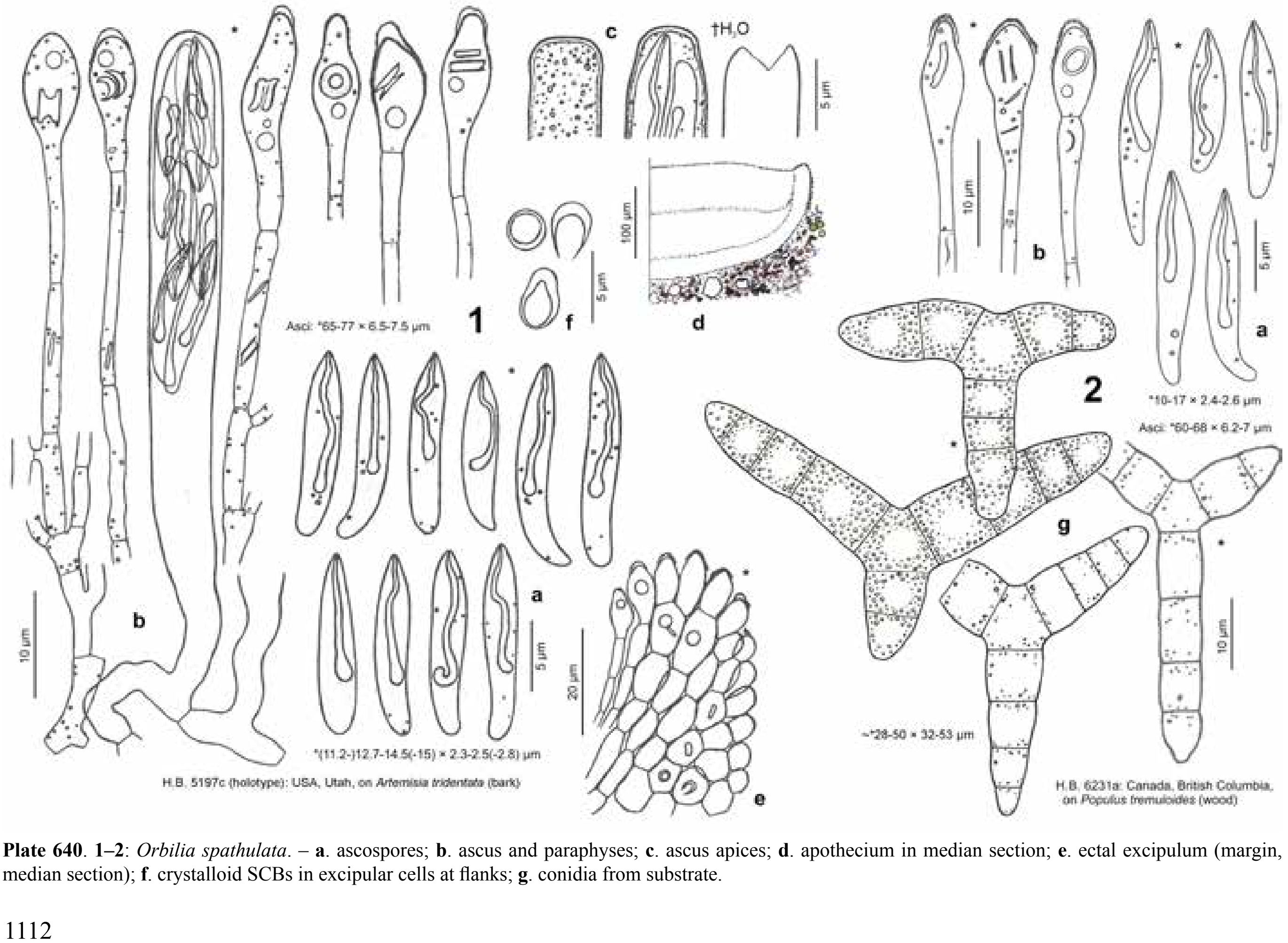


Plate 640. **1–2**: *Orbilia spathulata*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apices; **d**. apothecium in median section; **e**. ectal excipulum (margin, median section); **f**. crystalloid SCBs in excipular cells at flanks; **g**. conidia from substrate.

Conidia Y-shaped, total size *~28–50 × 32–53 µm, with *13–32 × (6.5–)7.5–8.3(–9) µm wide stipes and arms {1}. **Habitat**: collected 0.3–0.5–?2 m above the ground, corticated or decorticated, 12–20 mm thick branches of *Artemisia tridentata* {2}, *Populus tremuloides* {1}, on 0.3–1 mm deep strongly decayed wood {1} and bark {1} (bast), partly in small clefts, greyed, with a few green algae. **Associated**: *Caloplaca* sp. {1}, *Orbilia dixiensis* {1}, *O. mesaverdiana* {2}, *Patellaria atrata* {1}, *Schizoxylon ?argentinum* {1}. **Desiccation tolerance**: fully viable for at least 13 months. **Altitude**: 830 m a.s.l. (Canada), 1700–1795 m (USA). **Geology**: Canada: alluvial deposits from Paleozoic sedimentary rock, USA: Mesozoic sandstone. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia spathulata* is characterized by rather long ascospores and SBs, and by spathulate to lageniform paraphysis apices which contain crystalloid SCBs. Spore orientation in the 8-spored asci is rather variable but shows, as a tendency, the upper spores inverted in all three collections examined. This feature is rather rare in subgenus *Habrostictis*, where it was otherwise only seen in *O. wannerooensis* and in a 32-spored specimen mentioned under *O. livistonae*.

O. spathulata might be confused with *O. carpoboloides* (series *Habrostictis*), which has very similar spores but differs in having a hairy margin and usually more lageniform to mammiform heads of paraphyses. Some similar taxa (*O. flexisoma*, *O. subtrapeziformis*, *O. idahoensis*) mainly differ in the absence of crystalloid SCBs and in capitate paraphyses, whereas *O. bicknellensis* and *O. octoserpentina* differ in wider spores and capitate paraphyses. All mentioned species differ from *O. spathulata* in the consistent inverse orientation of the lower spores.

Variation. The sample on wood of *Populus* somewhat deviates in more fusiform spores with more acute apices and a tendency to more tapered spore bases from those on *Artemisia* in which the spores often have a cylindrical middle part.

Anamorph. The trinacrium-like conidia observed on the natural substrate have extraordinarily wide stipes and arms, distinctly wider than in similar anamorphs of section *Habrostictis*, and also wider than described in *Trinacrium robustum*. The stipe appears to be often much shorter than the arms, but due to their very similar shape it was very difficult to distinguish between arms and stipe.

Ecology. *O. spathulata* grew on xeric branches of angiosperm trees and shrubs, and is so far only known from three sites of North America with two quite different climatic regions. The record on wood of *Populus* derives from a boreal humid conifer forest with *Populus tremuloides* and *Acer* in a valley in the Canadian Rocky Mountains, while the other two are from bark of *Artemisia* in cold-temperate to warm-continental semiarid sagebrush and saltbush desert scrubs in the eastern part of the Colorado Plateau in the southwest of Northern America.

Specimens included. **CANADA**: **British Columbia**, Canadian Rocky Mountains, 61 km SE of Golden, 1 km SE of Spillimacheen, 830 m, branch of *Populus tremuloides*, on wood, 20.VIII.1997, G. Marson (H.B. 6231a ø, anam. substr.). — **USA**: **Utah**, Canyonlands, 60 km NW of Page, Cottonwood Canyon, ~1700 m, branches of *Artemisia tridentata*, on bark, 25.VIII.1994, G. Marson (M-0276587, **holotype**; **isotype** in H.B. 5197c). – 16 km WNW of Blanding, 1795 m, on *A. tridentata*, 14.V.1995, G. Marson (ø).

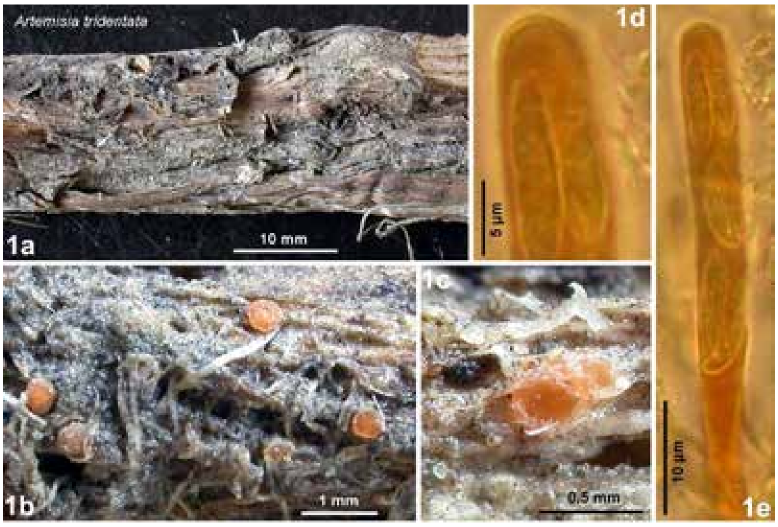


Plate 641. **1**: *Orbilia spathulata*. – **1a**. dead corticated branch; **1b–c**. rehydrated apothecia; **1d–e**. asci with ascospores. – Dead state (in KOH+IKI). — **1a–e**. H.B. 5197c (holotype): USA, Utah, on *Artemisia*.

Orbilia macrodelphinus Baral & G. Marson, **sp. nov.**, MB 813684 — Pls 642–643, Map 105

Etymology: similar to *O. delphinus* but with wider ascospores.

Typification: USA, Utah, Torrey, branch of *Baccharis salicifolia*, 19.VI.2000, G. Marson (ex H.B. 6741c, M-0276503, holotype).

Latin diagnosis: *Differt ab* Orbilia macrotrapeziformi *ascis 16-sporis*, *ab* O. delphinus *ascis et ascosporis latioribus*, *ascosporis magis fusiformibus*.

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.15–)0.2–0.6(–0.9) mm diam., 0.11–0.14 mm up to 0.19–0.23 mm high, pale to bright yellowish-orange to orange, rarely rose, scarcely translucent, round, scattered to subgregarious; disc medium concave to flat, rarely finally convex, margin distinct, 0–20 or sometimes 30–60 µm protruding, smooth to finely rough or crenulate (partly whitish); (broadly) sessile, ± immersed but also superficial; dry bright to dark orange. **Asci** *65–82(–88) {4} × 6–7 {1} or (6.5–)7.5–8(–8.5) {2} or 8–9.5 {1} µm, †(54–)60–81(–90) × (5.3–)5.5–7.5(–8)((–8.7)) µm {9}, 16-spored, spores *3–4-seriate, 6–12 lower spores inverted {2} (rarely mixed), pars sporifera *46–55 µm long; **apex** (†) strongly truncate (not or distinctly indented, laterally not or scarcely widened); **base** with short to medium long, ± thin, flexuous stalk, T-, L-, Y- or h-shaped. **Ascospores** *((8–))(9–)10–12.5(–13.5)((–16.5)) × (2–)2.4–2.8(–3)((–3.5)) µm {7}, †(8.5–)9–13(–14) × 2.1–2.8 µm {7}, fusiform to fusiform-clavate or fusoid-clavate, apex subacute to acute, rarely obtuse, base mostly (medium to) strongly attenuated, rarely with a tail-like base, here mostly slightly to medium (rarely strongly) curved; **SBs** *4.5–6 {2} or 6–7 {1} or 6–12 {2} × 0.8–1.3(–1.5) µm in situ {4} (~5–13 µm actual length), vermiform to subulate, not or often distinctly inflated at base, straight to ± strongly flexuous. **Paraphyses** apically (slightly to) medium to very strongly clavate-capitate, rarely spathulate, terminal cells *5–23 × (2.5–)3.3–5(–6) µm {3}, lower cells *8–19.5 × 1.3–2.3 µm {2}; rarely branched at upper septum. **Medullary excipulum** 30–80 µm thick, of dense textura intricata with many inflated cells, sharply delimited. **Ectal excipulum** pale to light orange, of (†) thin-walled to slightly gelatinized, irregularly oriented t. angularis from base to (sub) margin, 15–60 µm thick near base, cells *7–13(–19) × (4–)5–10.5 µm {2}, †5–10 × 4–5 µm {1}; 15–30 µm thick near margin, of t. prismatica-angularis or t. porrecta oriented at a 10–40° angle to the surface, marginal cortical cells †(4–)8–10 {1} × 2.3–4 µm {2}, at upper margin sometimes protruding as very short hairs. **Anchoring hyphae** rather abundant, */†2–3 µm wide, walls 0.2(–0.3) µm thick {2}, partly covering flanks and extending beyond margin. **SCBs** in paraphyses and ectal excipulum (near margin) globose {9}, 1–2.7 µm diam., rarely absent {3}, sometimes a few crystalloid SCBs present {2}. **Exudate** over paraphyses and marginal excipulum 0.3–2 µm thick, granular-cloddy, firmly attached. **— ANAMORPH**: unknown.

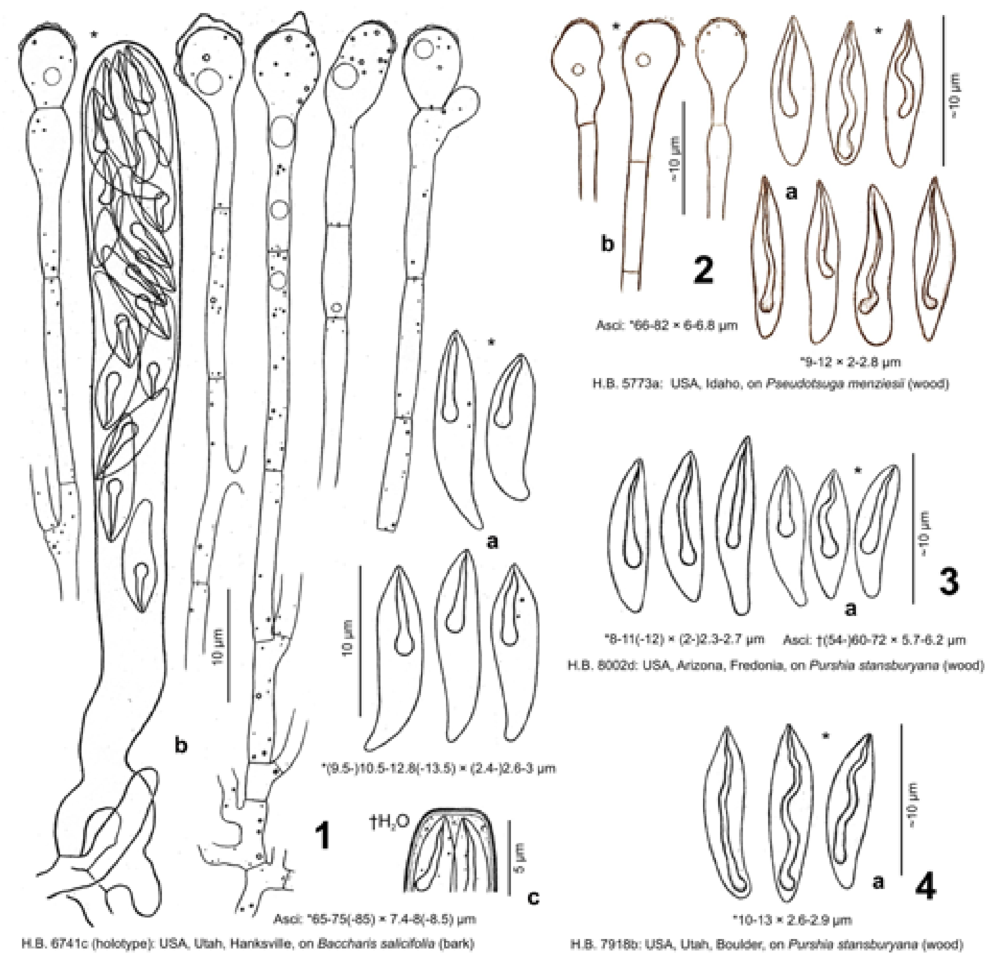


Plate 642. **1–4**: *Orbilia macrodelphinus*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apex.

Habitat: collected 0.5–2.5 m above the ground, decorticated or ± corticated, 4–14 mm thick twigs and branches of *Baccharis salicifolia* {1}, *Canotia holacantha* {1}, *Cytisus supranubius* {1}, *Juniperus osteosperma* {1}, *Larrea tridentata* {1}, *Picea sitchensis* {1}, *Pseudotsuga menziesii* {2}, *Purshia stansburyana* {4}, on 0.2–1 mm deep (medium to) strongly decayed wood {9} and bark {2} (bast), strongly greyed, a few or many green algae. **Associated**: *Caloplaca* sp. {1}, *Candelariella* sp. {1}, ?*Cryptodiscus* sp. {1}, *Dothideales* {1}, *Durella* sp. {1}, *Hysterobrevium mori* {2}, *Mellitiosporiella pulchella* {2}, *Odontotrema* sp. {1}, *O. oregonensis* {1}, *Orbilia arizonensis* {4}, *O. bicknellensis* {2/1}, *O. calyptrata* {3}, *O. coniferarum* {2}, *O. cryptogena* {1}, *O. flexisoma* {1/1}, *O. lacrimispora* {2}, *O.* ?*lentiformis* {1}, *O. maeandrina* {3}, *O. magnifica* {1}, *O. stansburyanae* {1}, *O. microsoma* {1}, *O. multigambelii* {1}, *O. multimaeandrina* {2/1}, *O. navajoana* {1}, *O. ocellata* {1}, *O. ophiosoma* {1}, *O. plurilentiformis* {1}, *O. purshiae* {2}, *O. serpentina* {2}, *O.* ?*vitalbae* {1}, *Patellaria* '*andina*' {1}, *P. atrata* {2/1}, ?*Phaeophyscia* sp. {1}, *Propolis farinosa* {1}, ?*Schizoxylon* sp. {1}, *Teichospora* sp. {1}, *Teichosporella dura* {1}, *Sclerococcum* sp. {1}, *Symbiotaphrina desertorum* {1}, various crustose (*Caloplaca*) and foliose (*Parmelia* s.l.) lichens. **Desiccation tolerance**: fully viable for at least 9 months, after nearly 3 years many excipular cells and paraphyses and some ascospores, and after 39 months paraphyses still viable. **Altitude**: 975–2650 m a.s.l. **Geology**: USA: Paleo- to Cenozoic lime-, mud- & sandstone, rarely granite or basalt; Tenerife: phonolitic eruptive fissure. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia macrodelphinus* resembles *O. delphinus* and *O. maeandrina* in its 16-spored asci, ascospores with ± acute apices, thick and medium long, subulate SBs, and in the predominant absence of crystalloid SCBs. Those collections assigned to the latter two species are very different from each other concerning their spores, whereas *O. macrodelphinus* forms an intermediate taxon which is only tentatively separated from both of them. It differs from *O. delphinus* in a tendency to wider asci and spores, and more distinctly fusiform spores, and from *O. maeandrina* in longer, basally more tapered and curved spores. However, spore and ascus size overlaps in some of the collections. *O. pleiourosperma* and *O. serpentina* differ in wider spores and the consistent presence of crystalloid SCBs, the former also in the spores having always distinct tail-like bases. *O. macrodelphinus* appears to be closely related to *O. macrotrapeziformis* and *O. flexisoma*, which differ in 8-spored asci and somewhat larger spores.

Variation. *O. macrodelphinus* shows considerable variation in both length and width of the spores, and especially in length of the SBs. In most collections (especially Pl. 642: 4) the SBs are rather long, partly almost as long as the spores, whereas in the holotype (but also in those one in 2–3) they are distinctly shorter. Due to this variation the taxon is very difficult to delimit from both *O. delphinus* and *O. maeandrina*.

Great variation among the collections is observed in apothecial size, ranging from 0.2–0.3 mm up to 0.4–0.9 mm in diameter and from 0.11 mm up to 0.23 mm in height, consequently also in the height of the ectal and medullary excipulum and in cell size of the former, finally in the margin varying from smooth and not protruding to rough or crenulate and strongly protruding. In the case of protruding margins, the hymenia of young apothecia are covered by the marginal hyphal texture except for a very small central pore.

Map 105. Known distribution of *O. macrodelphinus* in North America.

Plate 643. **1–6**: *Orbilia macrodelphinus*. – **4a**. Retamar with *Cytisus supranubius* and *Adenocarpus viscosus*; **1a**. decorticated xeric branch with (?)*Physcia*; **3a**. corticated branch with ?*Phaeophyscia*; **1b–d**, **2**, **3a–f**, **4b–c**, **6a–b**. rehydrated apothecia; **1e**, **5**. apothecia in median section; **1f**, **6c**. id., marginal ectal excipulum; **3g**. ascus; **4e**. ascus apex; **4d**. paraphyses; **4f–g**. ascospores. – Living state, except for **3g**, **5b** (in KOH+IKI), **4e** (in H_2O), **4f** (3 right spores), **4g** (ascus). – **4a**, **d–g**: phot. L. Quijada. — **1a–f**. H.B. 8097d: USA, Arizona, Grand Canyon village, on *Juniperus osteosperma*; **2**. H.B. 8002d: USA, Arizona, Fredonia, on *Purshia*; **3a–g**. H.B. 5773a: USA, Idaho, on *Pseudotsuga*; **4a–g**. H.B. 9223: Tenerife, Teide, on *Cytisus*; **5a–b**. H.B. 5605: USA, Idaho, on *Pseudotsuga*; **6a–c**. H.B. 8545d: USA, Utah, on *Picea*.

A collection on *Larrea tridentata* (IVV: H.B. 5684c) from a hot semidesert environment has rather large, especially wide asci [*78–88 × 8.5–9(–9.5) µm] and large spores (*11.5–16.5 × 2.5–3.5 µm). The specimen is somewhat heterogeneous, varying in spore length among the collected branches between *11.5–13.5 and 13–16.5 µm. One (on *Canotia holacantha*, only seen in the dead state, IVV: H.B. 7218e) fits *O. macrodelphinus* in spore size (†10–14.5 × 2.1–2.6 µm) though their shape would also match *O. delphinus*, but it has extraordinarily wide asci [†60–73 × (7–)7.5–8(–8.7) µm].

Not included collection. A North American sample on *Salix* (IVV: H.B. 5411) has rather short spores (*7–11 × 2–2.7 µm) and narrow asci (†60–75 × 5–6 µm). In association grew the similar *O. delphinus* in which the spores did not overlap in length (*12–14 × 2.2–2.4 µm), therefore, the two populations are obviously not conspecific.

Ecology. *O. macrodelphinus* was found on rotten wood, rarely bark (*Baccharis*), of xeric twigs and branches of both angio- and gymnosperm trees and shrubs. In western North America it occurred in cold-temperate subhumid to warm-temperate semiarid pinyon-juniper woodlands and boreal humid Douglas fir mixed forests of the Middle Rocky Mountains and adjacent Columbia Plateau and mainly in the Colorado Plateau, also in warm-temperate semiarid paloverde-mixed cacti desert scrubs in the Sonoran Desert adjacent to Mogollon Rim. The Macaronesian collection was in the supramediterranean semihumid summit broom scrub (*Spartocytisetum supranubii*) in the caldera of the volcano Teide in Tenerife. The not included sample on *Salix* is from a boreal humid open woodland in the Middle Rocky Mountains.

Specimens included. **MACARONESIA**: **Canary Islands**, **Tenerife**, La Orotava, Las Cañadas del Teide, 3.5 km SE of Teide, Mirador del Tabonal Negro, 2333 m, branches of *Cytisus supranubius*, on wood, 13.II.2009, L. Quijada, J. Diaz Armas & E. Beltrán-Tejera (TFC Mic. 21458, 21460, H.B. 9223). — **USA**: **Idaho**, Middle Rocky Mountains, Grand Teton, 67 km ENE of Idaho Falls, 9 km WSW of Victor, Pine Creek Pass, 2080 m, branches of *Pseudotsuga menziesii*, on wood, 5.VI.1996, G. Marson (H.B. 5773a). – Columbia Plateau, 60 km E of Idaho Falls, 47 km W of Jackson, Swan Valley 1750 m, branches of *P. menziesii*, on wood, 5.VI.1996, G. Marson (H.B. 5605). – **Utah**, Canyonlands, Capitol Reef, 40 km WSW of Hanksville, 23 km E of Torrey, 1557 m, branch of *Baccharis salicifolia*, on bark, 19.VI.2000, G. Marson (ex H.B. 6741c, M-0276503, **holotype**). – Utah Mts., Dixie Forest, 22 km SSE of Torrey, 13 km S of Grover, 1 km N of Pleasant Creek Campground, 2650 m, branch of *Picea sitchensis*, on bark & wood, 19.VI.2000, G. Marson (H.B. 8545d). – 10 km N of Boulder, 3.5 km W of Deer Mt., 2433 m, branch of *Purshia stansburyana*, on wood, 11.VI.2003, G. Marson (H.B. 7918b ø). –border to Arizona, ~4 km WNW of Colorado City, S of Zion, ~1520 m, on *Purshia stansburyana*, ~13. VI.2000, G. Marson (ø). – **Arizona**, Grand Canyon, Kaibab Plateau, 28 km ESE of Fredonia, 13 km NNW of Jacob Lake, 2115 m, branch of *P. stansburyana*, on wood, 15.VI.2003, G. Marson (H.B. 8002d ø). – ibid., branch of *P. stansburyana*, 17.V.1995, G. Marson (H.B. 5295c ø). – Coconino Plateau, 3.5 km N of Tusayan, 2075 m, branch of *Juniperus osteosperma*, on wood, 17.VI.2003, G. Marson (H.B. 8097d). – Sonoran Desert, 68 km SSE of Flagstaff, 5.5 km NNE of Camp Verde, Montezuma Castle, 975 m, branches of *Larrea tridentata*, on wood, 8.V.1995, G. Marson (H.B. 5684c ø). – ibid., 9 km NNE of Camp Verde, 4 km NE of Montezuma Castle, 1073 m, branch of *Canotia holacantha*, on wood, 12.VI.2000, G. Marson (H.B. 7218e).

Not included. **USA**: **Utah**, Utah Mts., Dixie Forest, 30 km SSE of Torrey, 20 km S of Grover, 2980 m, branches of *Salix ?bebbiana*, on wood, 15.V.1995, G. Marson (H.B. 5411).

Orbilia multidelphinus Baral, **sp. nov.**, MB 813685 — Pl. 644

Etymology: named after the 32-spores asci and after the ascospores resembling *O. delphinus*.

Typification: USA, Utah, Cedar City, branch of *Juniperus osteosperma*, 24.VIII.1994, G. Marson (ex H.B. 5198b, M-0276520, holotype).

Latin diagnosis: *Differt ab* Orbilia delphino *ascis 32-sporis*, *ascosporis basi multo attenuatis*, *paraphysibus vivis ad apicem absque corpusculis globosis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.25–0.3 mm diam., 0.17–0.2 mm high, light orange, round, gregarious in a small group; disc flat, margin thin, not protruding, slightly rough, whitish; sessile, slightly to entirely immersed. **Asci** *78–93 × (7.6–)8–8.5 µm {1}, †72–93 × 6.5–7.5 µm {1}, 32-spored, spores *4-seriate, 14–18 lower spores inverted (± strongly mixed), pars sporifera *55–65(–70) µm long; **apex** (†) medium to strongly truncate conical (partly very slightly indented, laterally not inflated), hemispherical-subconical in profile view, thin-walled; **base** with rather short and thick, flexuous stalk, L- to Y-shaped. **Ascospores** *(9.5–)11–14.7 × 2.3–2.6 µm {1}, †9.5–11.5 × 2–2.3(–2.4) µm {1}, narrowly fusiform-clavate, apex acute, base strongly attenuated (tail-like), here slightly curved; **SBs** *(4–)7–9.5 × (0.6–)0.8–1(–1.4) µm in situ {1} (~7.3–10 µm actual length), vermiform-subulate to almost filiform, base not or slightly to strongly inflated, slightly to strongly flexuous. **Paraphyses** apically medium clavate to spathulate (rarely moniliform), terminal cells *(5–)8–20(–22) × (3.3–)4–5.7 µm {1}, lower cells *7–20 × 1.3–2(–2.5) µm {1} (near base 2–2.7 µm wide); very frequently branched near apex. **Medullary excipulum** pale orange, 40–60 µm thick, of textura intricata with ± abundant inflated cells, medium sharply delimited. **Ectal excipulum** very pale orange, of ± thin-walled, inconclusively oriented t. angularis from base to margin, 15–30 µm thick near base, cells *7–14 × 7–11 µm {1}; 20 µm thick at flanks, 10–15 µm near margin, of t. porrecta oriented at a 0–10° angle to the surface, marginal cortical cells */†8–14 × 3–5 µm {1}. **Anchoring hyphae** medium abundant, */†2–3.7 µm wide, walls 0.2–0.3(–0.8) µm thick {1}. **SCBs** in paraphyses and ectal excipulum (near margin) absent. **Exudate** over paraphyses 0.3–0.5 µm thick, cap-like, firmly attached, sparse (often lacking); over margin and flanks very sparse, granular. **— ANAMORPH**: unknown.

Habitat: corticated, 12 mm thick branch of *Juniperus osteosperma* {1}, on medium decayed, detaching bark {1}, greyed, without or with many green algae. **Associated**: *Orbilia cucumispora*, *O. ?maeandrina*, *O. multihamulata*, *O. octosporoides*, *O. ophiosoma*, *O. osteospermae*, *O. pisciculus*, *Ostropales*. **Desiccation tolerance**: fully viable for at least 4 months. **Altitude**: 1815 m a.s.l. **Geology**: Upper Cretaceous calcareous sedimentary rock. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia multidelphinus* is characterized by 32-spored asci and comparatively long, narrowly fusiform-clavate ascospores with acute apices and distinct, slightly curved tail-like bases, containing very long, cylindric-subulate spore bodies. Remarkable are also the consistently truncate-conical ascus apices in the dead state. From *O. delphinus* the species differs not only in 32-spored asci, but also in much more attenuated spore bases, a tendency to more spathulate paraphyses, and the absence of SCBs.

Not included collections. A sample from the Colorado Plateau (Bryce Canyon) on *Chrysothamnus* (Pl. 644: 2) resembles *O. multidelphinus*. It is not included in the description because of partly obtuse spore apices, shorter asci and spores, much shorter SBs, and the presence of globose SCBs. This population grew in association with a very similar 16-spored taxon (*O.* cf. *delphinus*, Pl. 636: 1), to which it seems to be more closely related than to *O. multidelphinus*. A collection from the Chihuahuan desert on *Larrea* (Pl. 644: 3) resembles that on *Chrysothamnus* concerning SBs and SCBs, though the spores are shorter and hardly curved. This collection also resembles *O. multitrapezoidea* in size and shape of the spores, but differs in much shorter SBs.

Ecology. The sparse holotype of *O. multidelphinus* grew on medium rotten bark of a xeric branch of *Juniperus* in a cold-temperate subhumid pinyon-juniper woodland of the Dixie Forest (Utah Mountains) in western North America. The not included collection on *Chrysothamnus* was from a similar climate and geology in a ponderosa pine forest of the Bryce Canyon (Utah Mountains), that on *Larrea* from the warm-temperate semiarid Chihuahuan creosotebush-tarbush at the border to Mesa and Plains.

Specimens included. **USA**: **Utah**, Utah Mts., Dixie Forest, 1.5 km ESE of Cedar City, 1815 m, branch of *Juniperus osteosperma*, on bark, 24.VIII.1994, G. Marson (ex H.B. 5198b, M-0276520, **holotype**).

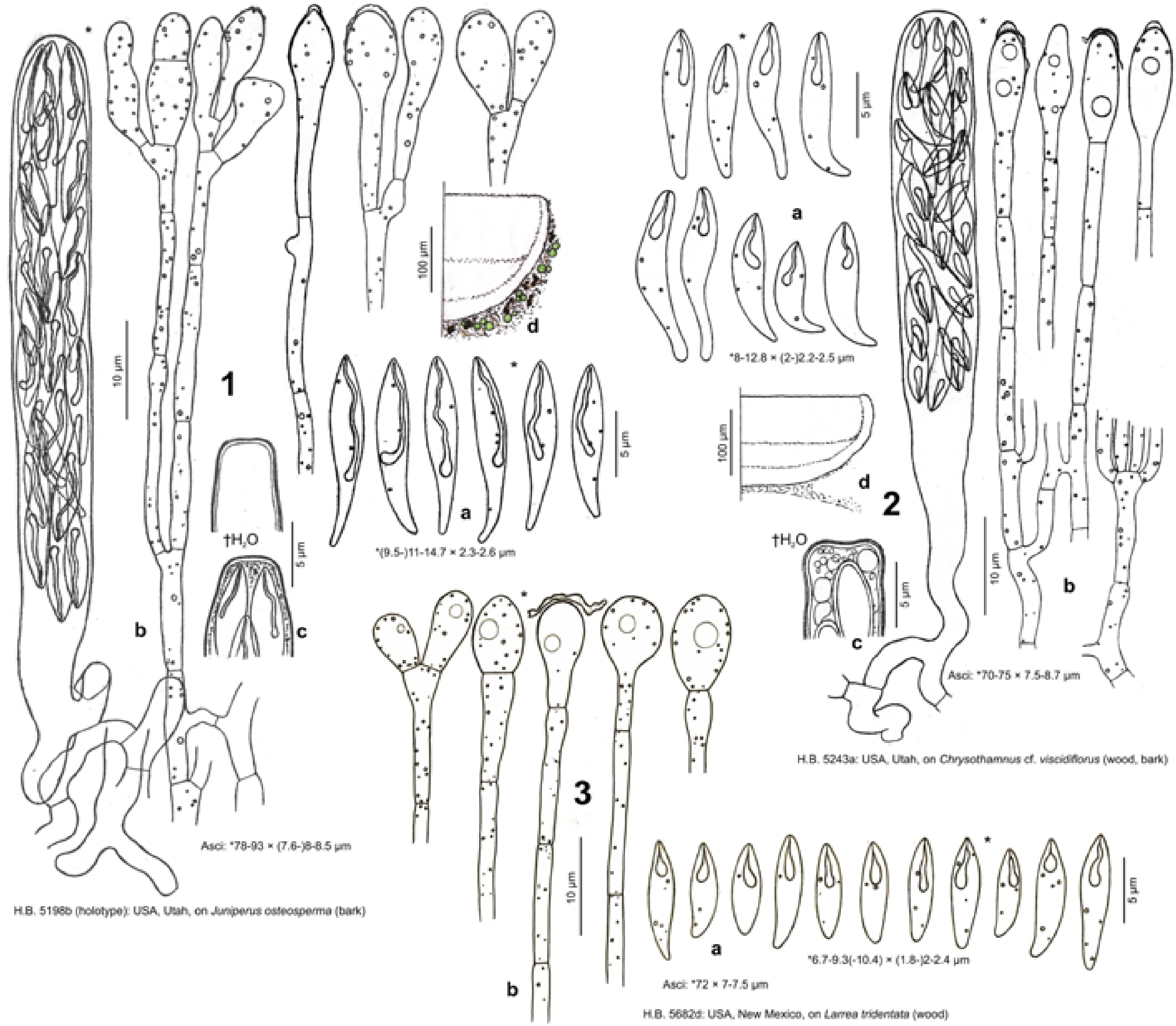


Plate 644. **1**: *Orbilia multidelphinus*; **2–3**: *O.* aff. *multidelphinus*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. apothecia in median section.

Not included. **USA**: **Utah**, Utah Mts., Bryce Canyon, 30 km SE of Panguitch, 7.5 km WNW of Tropic, 2410 m, twigs of *Chrysothamnus ?viscidiflorus*, on wood & bark, 24.VIII.1994, G. Marson (H.B. 5243a). – **New Mexico**, Chihuahuan Desert, 25.5 km SE of Carlsbad, Malaga, Hwy 285 (S), 915 m, branch of *Larrea tridentata*, on wood, 17.VI.1996, G. Marson (H.B. 5682d).

Orbilia multitrapezoidea Baral & G. Marson, **sp. nov.**, MB 813686 — Pls 645–646, Map 106

Etymology: referring to the 32-spored asci and somewhat trapezoid (rhomboid) ascospores.

Typification: USA, Arizona, Grand Canyon, Tusayan, branches of *Juniperus osteosperma*, 28.VIII.1994, G. Marson (ex H.B. 5439b, M-0276526, holotype).

Latin diagnosis: Orbiliae multimaeandrinae *similis sed ascosporae angustiores.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.2–0.45 mm diam., 0.14–0.2 mm high, light to bright orange(-ochraceous), round, scattered to medium gregarious; disc slightly concave, margin 5–20 µm protruding, ± smooth or very finely crenulate-pubescent; sessile, somewhat immersed in biofilm. **Asci** *(60–)70–90 × (7–)8–9(–10) µm {3}, †(60–)65–80(–100) × 6.3–7.5 µm {3}, 32-spored (30 spores counted), spores (*) ~4-seriate, lower spores inverted {3} (strongly mixed), pars sporifera *44–63 µm long; **apex** (†) strongly truncate, (very) slightly indented, laterally scarcely inflated; **base** with short, thick stalk, L-, Y- or h-shaped. **Ascospores** *(5–)7–10.5(–12.5) × 2.1–2.7(–3.3) µm {4}, †7–12.5 × 2.2–2.4 µm {2}, fusoid to fusoid-clavate, apex subacute to acute, base medium to strongly tapered (sometimes tail-like), straight or slightly to medium curved near base; **SBs** *4.5–8.5 × 0.6–1.2 µm in situ {4} (~5.5–9 µm actual length), vermiform to subulate, base not or often slightly to medium inflated, almost straight to medium flexuous or helicoid. **Paraphyses** apically slightly to strongly (clavate-)capitate but some or many ± distinctly spathulate or lageniform, terminal cells *7–21 × 3–5.7(–6.5) µm {3}, lower cells *9–17.5 × 1.5–2(–2.6) µm {2}; sometimes branched near apex. **Medullary excipulum** hyaline, 20–80 µm thick, of ± dense or loose textura intricata with many inflated cells, (medium) sharply delimited. **Ectal excipulum** hyaline to pale orange, of (†) thin- or firm-walled, vertically oriented t. angularis from base to submargin, 30–80 µm thick near base, cells *9–20 × 8–13(–17) µm {2}; 15 µm thick near margin, at upper margin of t. prismatica-porrecta oriented at a 0–40° angle to the surface, marginal cortical cells *7–13 × 4–8 µm {1}, †8–14 × 3–3.5 µm {1}. **Anchoring hyphae** medium abundant, *2.5–3.5 µm wide (†1.7–3 µm), walls 0.2–0.4(–0.8) µm thick {2}, covering receptacle as hyaline hyphae †2–2.8 µm wide, partly forming somewhat protruding 1–2-celled hairs at margin. **SCBs** in paraphyses and ectal excipulum (near margin) absent {2} or globose, ~1–1.5 µm diam. {3}. **Exudate** over paraphyses 0.2–1 µm thick, finely rough; over margin and flanks indistinct. **— ANAMORPH**: unknown.

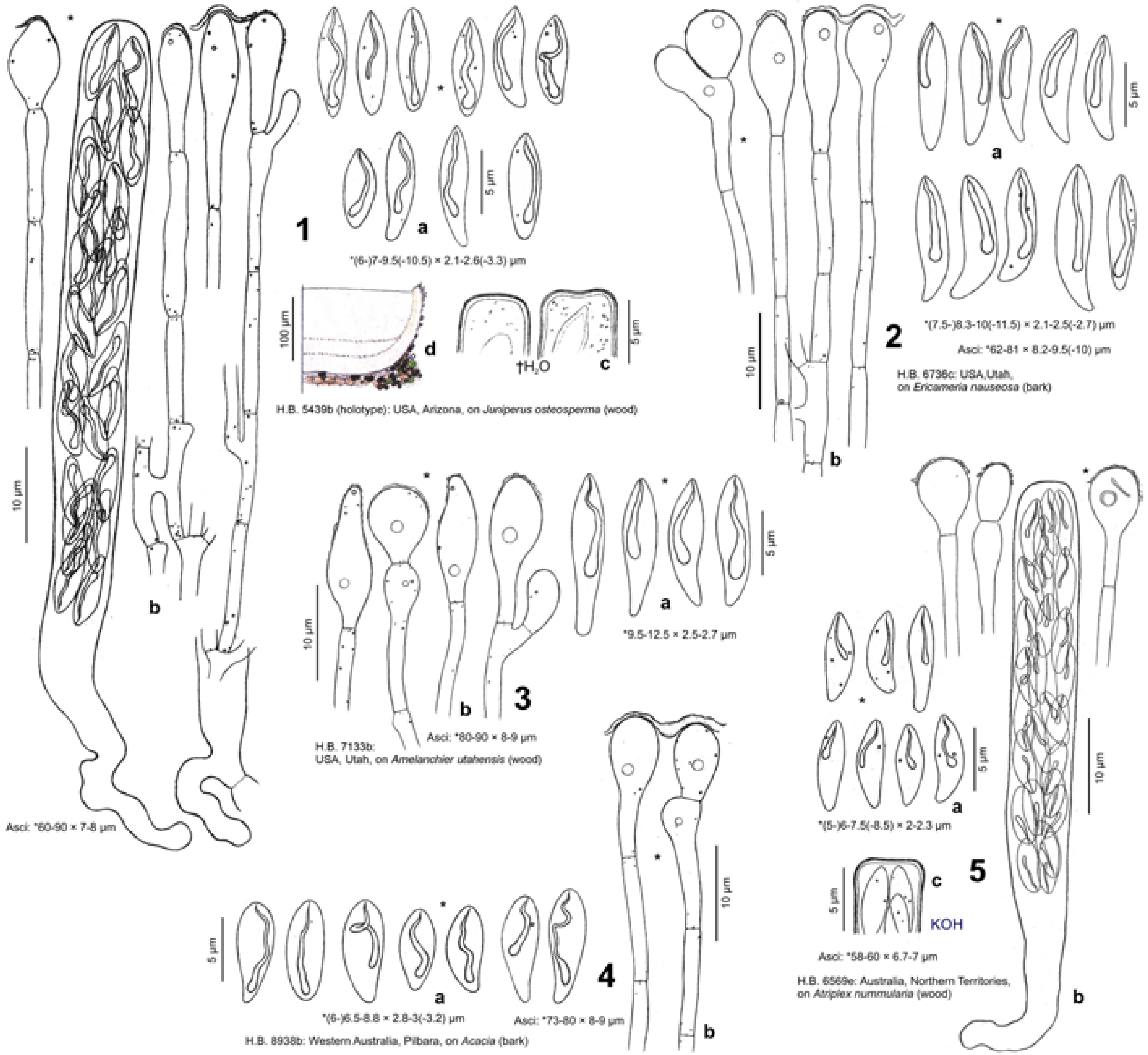


Plate 645. **1–3**: *Orbilia multitrapezoidea*; **4–5**. *O.* aff. *multitrapezoidea*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. apothecium in median section.

Habitat: collected 0.1–0.5 m above the ground, corticated or decorticated, 8–24 mm thick branches of *Amelanchier utahensis* {1}, *Ericameria nauseosa* {1}, *Juniperus osteosperma* {1}, *Pinus edulis* {1}, indet. angiosperm {1}, on 0.5 mm deep strongly decayed wood {4} and bark {1}, strongly greyed, with a few or many green algae. **Associated**: *Carestiella schizoxyloides* {1}, *Hysteropatella* sp. {1}, *Mellitiosporiella pulchella* {1}, *Orbilia clavipisca* {1}, *O. ?commarosa* {1}, *O. delphinus* {1}, *O. dixienis* {1}, *O. edulis* {1}, *O. flexisoma* {2}, *O. lentiformis* {2}, *O. macroserpens* {1}, *O. mesaverdiana* {1}, *O. multimaeandrina* {3}, *O. multiphanosoma* {2}, *O. myriophanosoma* {1}, *O. ocellata* {2}, *O. ophiosoma* {1}, *O. plurilentiformis* {1}, *Stictis* sp. {1}, *Teichospora* sp. {1}, *Tryblidaria* sp. {1}, *Tryblidaria ?fenestrata* {2}. **Desiccation tolerance**: fully viable for about 23 months. **Altitude**: 1315–2097 m a.s.l. **Geology**: Proterozoic-Cambrian sedimentary rock, Pennsylvanian-Permian to Triassic-Jurassic red carbonate sandstone. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia multitrapezoidea* is characterized by 32-spored asci, ± fusoid (trapezoid), medium-sized ascospores, and a strong tendency to a mixed presence of spathulate paraphyses among the capitate ones. Merely the width of the spores separates *O. multitrapezoidea* (mainly *2.1–2.7 µm) from *O. multimaeandrina* (*2.8–3.5 µm). Some collections resemble *O. multitrapezoidea* in spore shape, but deviate too much to be included in the description. A North American

Map 106. Known distribution of *O. multitrapezoidea* in North America.

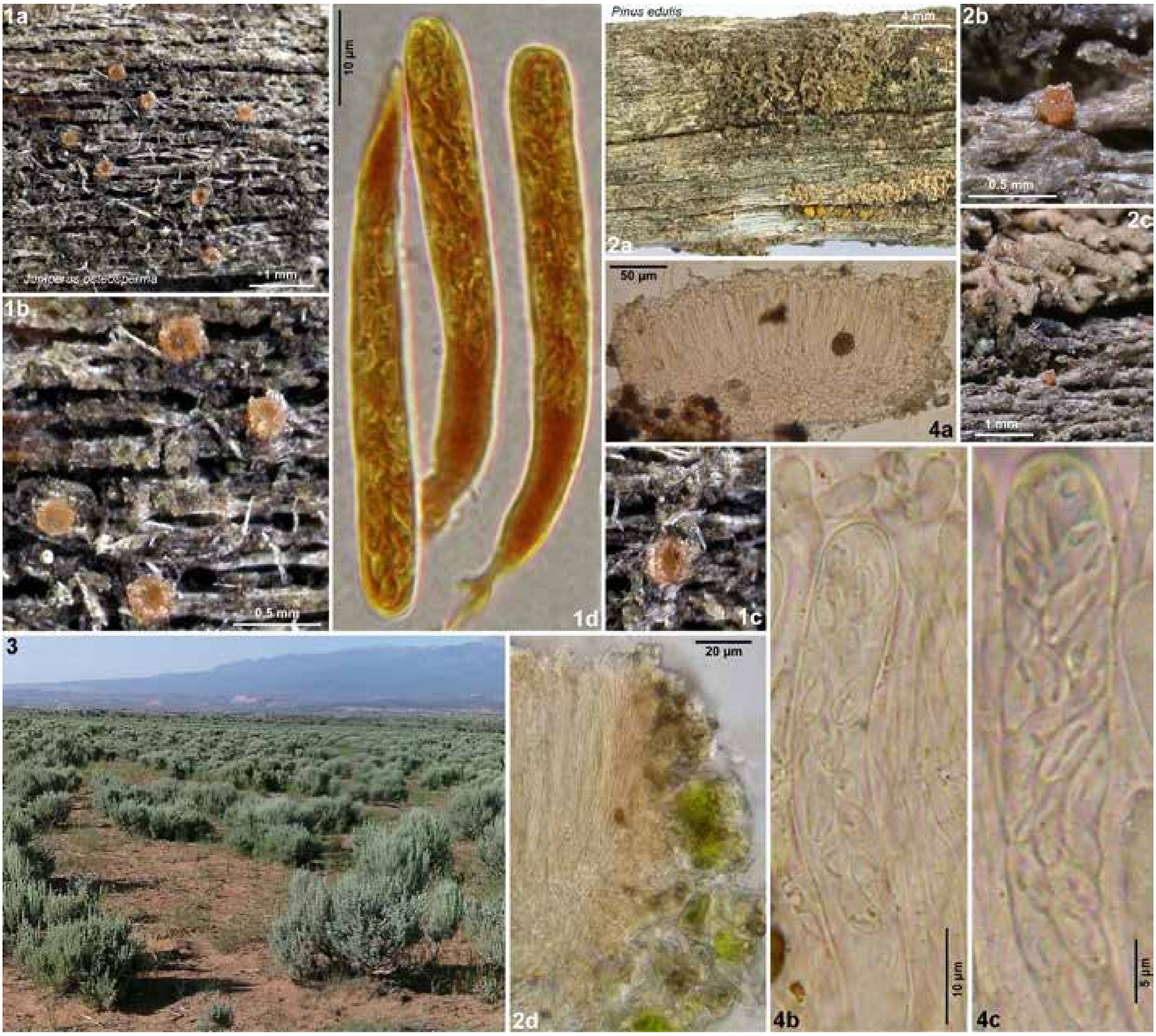


Plate 646. **1–3**. *Orbilia multitrapezoidea*; **4**. *O.* aff. *multitrapezoidea*. – **3**. semiarid sagebrush (*Artemisia tridentata*) desert scrub 2.5 km away from site with *Ericameria nauseosa*; **2a**. decorticated xeric branch (with various lichens); **1a–c**, **2b–c**. rehydrated apothecia (**2c** with *Phaeophyscia*); **4a**. apothecium in median section; **2d**. id., marginal region; **1d**, **4b**. asci and paraphyses; **4c**. ascospores in dead ascus. – Living state, except for **1d** (in KOH+IKI), **2d** (in KOH), **4c** (ascus). — **1a–d**. H.B. 5439b (holotype): USA, Arizona, on *Juniperus*; **2a–d**. H.B. 7149c: USA, Utah, Snow Flat, on *Pinus*; **3**. H.B. 6736c: USA, Utah, Canyon Lands, on *Ericameria*; **4a–c**. H.B. 8938b: Western Australia, Pilbara, on *Acacia.*

collection on *Larrea* (Pl. 644: 3) differs in distinctly shorter SBs, consistently capitate paraphyses, and larger SCBs, but might as well be related to *O.* aff. *multidelphinus* (on *Chrysothamnus*, Pl. 644: 2). The Australian *O. livistonae*, particularly the collection on *Pittosporum* (Pl. 647: 2), likewise differs in more consistently capitate paraphyses and larger SCBs but also in wider spores, and is somewhat intermediate to *O. multimaeandrina*.

The two collections of *O. multitrapezoidea* on coniferous hosts differ from those three on angiosperm shrubs in very slightly shorter spores and less inflated paraphysis apices which consistently lack globose SCBs. Further collections are needed to clarify whether these differences are merely accidental.

Not included collections. An Australian sample on *Acacia* (Pls 645: 4; 646: 4) differs from *O. multitrapezoidea* in wider spores with obtuse apices, and one on *Atriplex* (Pl. 645: 5) in distinctly shorter asci and smaller spores, and apparently also in the presence of crystalloid SCBs. The latter appears to represent a distinct species, but it consisted of only one minute apothecium and is, therefore, not recorded by a separate description.

Ecology. *O. multitrapezoidea* was found on rotten wood (rarely bark) of angiosperm shrubs and gymnosperm trees in the southwest of Northern America, in cold-temperate subhumid pinyon-juniper woodlands and warm-continental semiarid sagebrush desert scrub of the Colorado Plateau, also in a warm-temperate arid Mojave saltbush desert scrub. The two not included collections are from subtropical arid acacia open shrublands on Precambrian sedimentary rock in central and western Australia.

Specimens included. **USA**: **Utah**, Canyonlands, 36 km S of Moab, 5 km WNW of Hatch Rock, 1813 m, branches of *Ericameria nauseosa*, on bark, 16.VI.2000, G. Marson (H.B. 6736c). – 41 km W of Blanding, Natural Bridges, 2090 m, branch of *Amelanchier utahensis*, on wood, 14.VI.2000, G. Marson (H.B. 7133b ø). – 16 km NNW of Mexican Hat, 1 km N of Mokee Dugway, Cedar Mesa, 1965 m, branch of *Pinus edulis*, on wood, 14.VI.2000, G. Marson (H.B. 7149c). – **Arizona**, Grand Canyon, Coconino Plateau, 3 km S of Tusayan, 2033 m, branches of *Juniperus osteosperma*, on wood, 28.VIII.1994, G. Marson (ex H.B. 5439b, M-0276526, **holotype**). – **California** (border to Nevada), Mojave Desert, 20 km SW of Beatty, 16 km SW of Rhyolite, E of Death Valley, Daylight Pass, 1315 m, branch of indet. angiosperm, on wood, 2.V.1995, G. Marson (H.B. 8528i ø).

Not included. **AUSTRALIA**: **Western Australia**, centre of Pilbara, 49 km NW of Newman, northern border of Ophthalmia Range, 690 m, branch of *Acacia*, on bark, 28.X.2007, G. Marson (H.B. 8938b). – **Northern Territories**, northeast of MacDonnell Ranges, 15 km WNW of Alice Springs, N of Honey Moon Gap, 586 m, twig of *Atriplex nummularia*, on wood, 9.X.1998, G. Marson (H.B. 6569e).

Orbilia livistonae Baral, **sp. nov.**, MB 813687 — Pls 647–648

Etymology: named after the substrate of the type, *Livistona*.

Typification: Australia, Queensland, Taroom, leaves of *Livistona nitida*, 22.X.1998, G. Marson (ex H.B. 6424b, BRI AQ799185, holotype).

Latin diagnosis: *Similis* Orbiliae multitrapezoideae *sed corpuscula refringentia angustiora*, *basi non inflata*, *paraphyses ad apicem capitatae*. *Habitat ad petiolos putridos siccos* Livistonae nitidae *et lignum vel corticem putridum rami sicci* Casuarinae cunninghamianae *in zona subtropica subhumida ad humida Australiae orientalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.15–0.3 mm diam., 0.12–0.15 mm high, pale to light orange, scarcely translucent, round, scattered; disc slightly concave to flat, margin thin, 0–5 µm protruding, smooth; broadly sessile, superficial or somewhat immersed. **Asci** *70–99 × 9–10.7 µm {1}, †65–89 × 7.5–9(–10) µm {2}, 32-spored, spores *4–5-seriate, lower spores inverted (scarcely mixed), pars sporifera *47–64 µm long; **apex** (†) medium to strongly truncate (not indented, laterally sometimes distinctly inflated); **base** with very short, thick, flexuous stalk, h-shaped. **Ascospores** *8–12(–14) × (2.6–)2.8–3.2 µm {1}, †8.5–11(–12) × (2.5–)2.7–3(–3.2) µm {2}, (fusoid to) fusiform(-clavate), apex acute, (†) also acuminate, base medium attenuated, straight or only slightly inequilateral, exceptionally slightly curved at base; **SBs** *(5.5–)6–8.5(–9.5) × 0.5–0.7 µm in situ {1} (~6–10.5 µm actual length), vermiform to subulate or filiform, base not or only very slightly inflated, medium to strongly flexuous, sometimes uncinate. **Paraphyses** apically medium to strongly capitate, terminal cells *7–22 × 3–5.2 µm {1}, lower cells *7–19 × 1.2–2(–2.8) µm {1} (basal cells 8–12 × 2–3 µm); branched or unbranched at upper septum. **Medullary excipulum** ~15–30 µm thick, of dense textura intricata with many inflated cells, sharply delimited. **Ectal excipulum** of (†) ± thin-walled, vertically or irregularly oriented t. globulosa-angularis-prismatica from base to mid flanks, 20–30 µm thick near base, cells *9–15 × 6–10 µm {1}; 15–20 µm thick near margin, of t. prismatica-angularis or prismatica-porrecta oriented at a 0–45° angle to the surface, marginal cortical cells *7–12(–16) × 3–5.2 µm {1}. **Anchoring hyphae** ± abundant, †1.7–3 µm wide, walls 0.2–0.5 µm thick {1}, distinctly gelatinized, partly covering the margin. **SCBs** globose, in paraphyses 1–2 µm diam., in ectal excipulum (near margin) 1.5–2.5 µm. **Exudate** over paraphyses 0.2–1 µm thick, granular to continuous, ± loosely attached; over margin and flanks 0.2–1(–1.5) µm thick, firmly attached. **— ANAMORPH**: unknown.

Habitat: collected 0.2–3 m above the ground, on petioles of *Livistona nitida* {1}, on strongly decayed and greyed upperside, on 8–12 mm thick, ± corticated branch of *Casuarina cunninghamiana* {1}, on wood and bark, with some green algae. **Associated**: *?Gloniopsis*

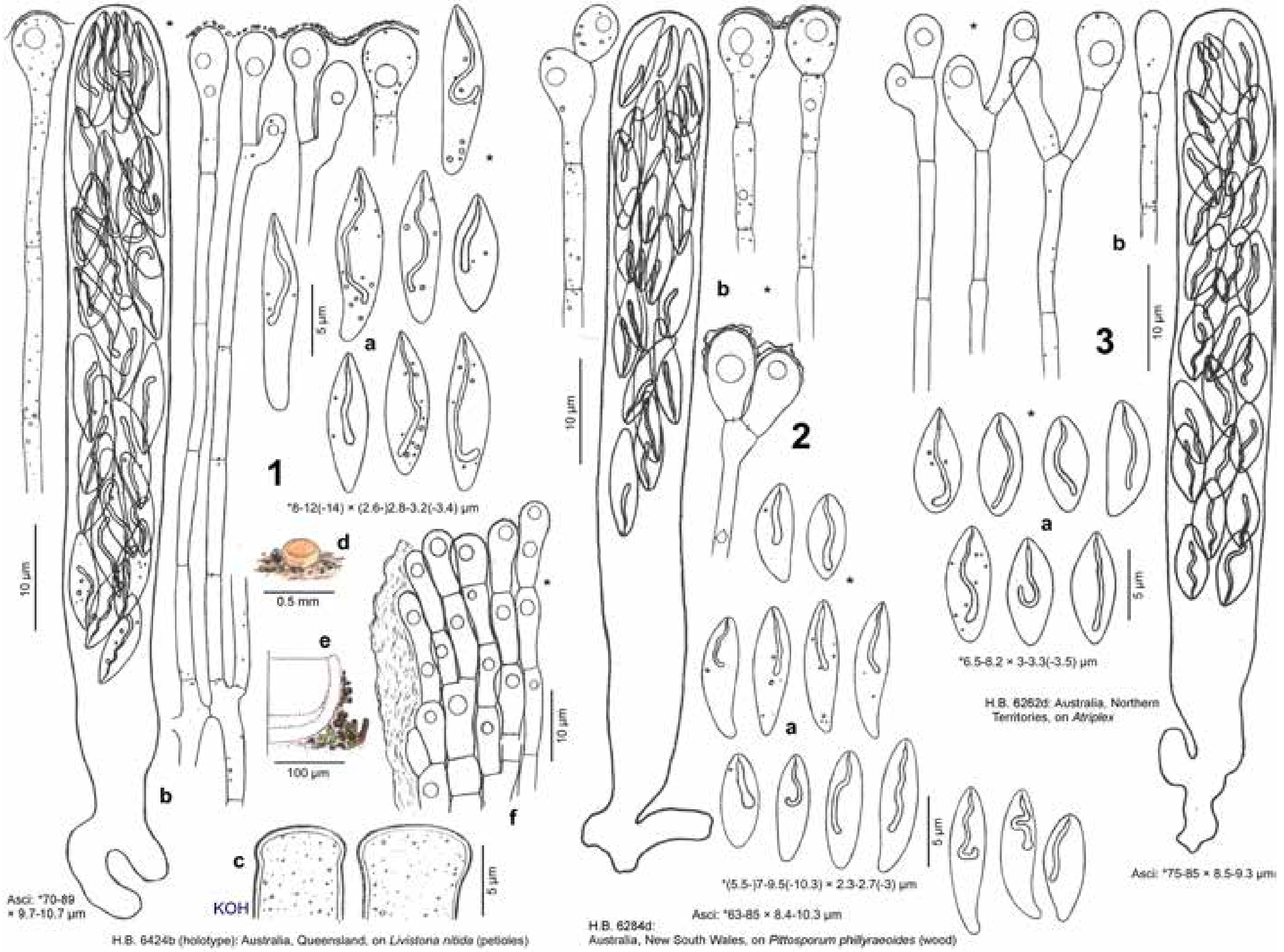


Plate 647. **1**: *Orbilia livistonae*; **2–3**: *O.* cf. *livistonae*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. rehydrated apothecium; **e**. apothecia in median section; **f**. ectal excipulum (margin, median section).

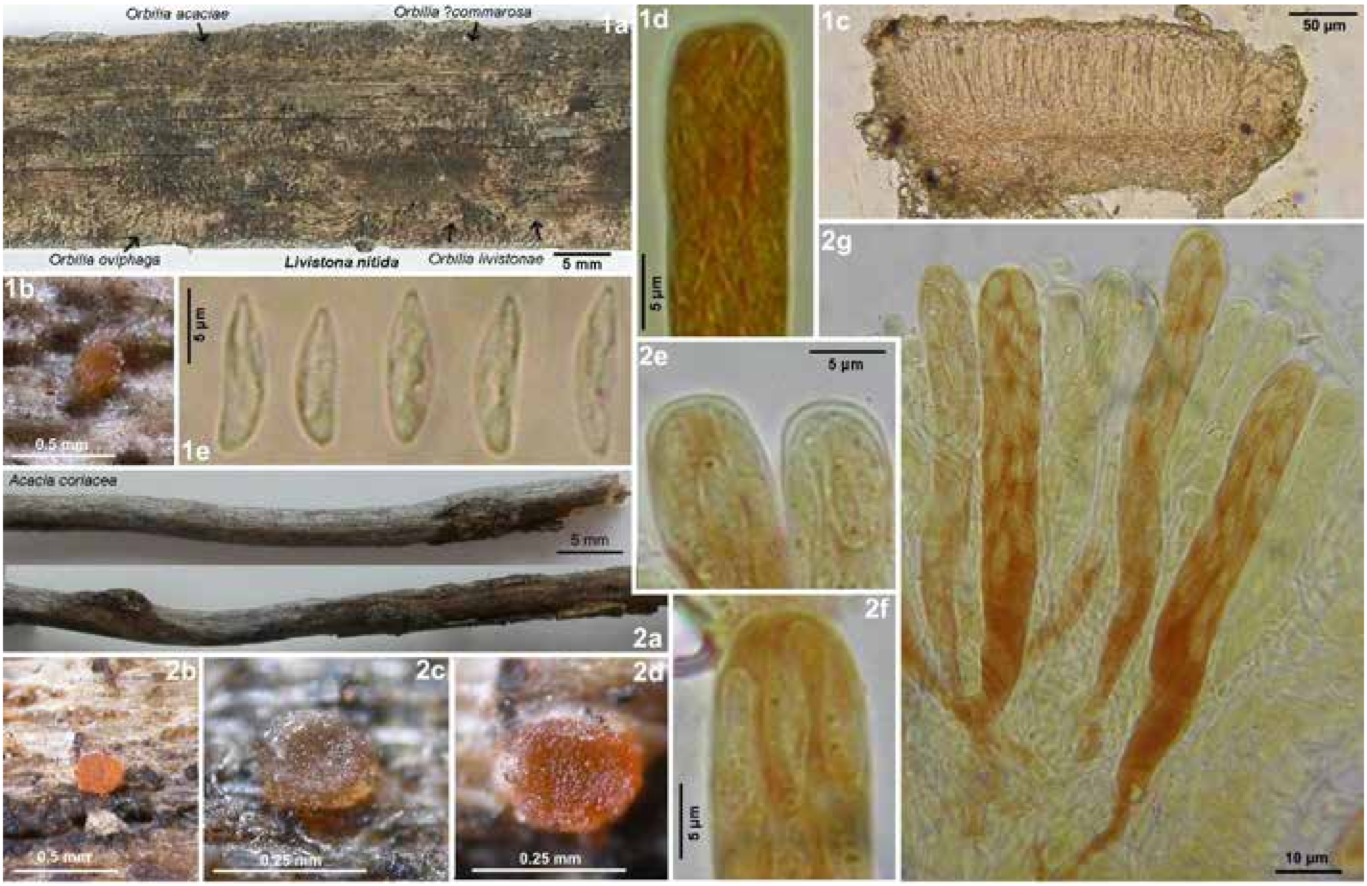


Plate 648. **1**. *Orbilia livistonae*; **2**. *O.* aff. *livistonae*. – **1a**. upperside of dead petiole; **2a**. decorticated xeric branches; **1b**, **2b–d**. rehydrated apothecia; **1c**. apothecium in median section; **2g**. asci and paraphyses; **1d**, **2e–f**. ascus apices; **1e**. ascospores. – Dead state (**1d**, **2e–g** in KOH+IKI, **1e** in KOH). — **1a–e**. H.B. 6424b (holotype): Australia, Queensland, on *Livistona nitida*; **2a–g**. H.B. 7226d: Australia, Northern Territories, on *Acacia*.

praelonga {1}, *Mellitiosporiella* sp. {1}, *Orbilia acaciae* {1}, *O.* ?*australiensis* {1}, *O.* (?)*commarosa* {1}, *O. coronohesperidea* {1}, *O.* (?)*dixienis* {1}, *O. multiserpens* {1}, *O. myrioeuonymi* {1}, *O. palmicola* {1}, *O. parviclava* {1}, *O.* ?*pleiohesperidea* {1}, *O. wannerooensis* {1}. **Desiccation tolerance**: fully viable for at least 9 months. **Altitude**: 200–537 m a.s.l. **Geology**: Proterozoic and Jurassic sedimentary rock, Cenozoic regolith; volcanic mafic basaltic rock. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia livistonae* is characterized by 32-spored asci, medium-sized fusiform ascospores with rather long and narrow spore bodies, and by the absence of crystalloid SCBs. The species differs from the similar North American *O. multitrapezoidea* and *O. multimaeandrina* mainly in narrower SBs with hardly inflated bases, but also in the absence of spathulate paraphyses, and from the latter species in longer and narrower spores.

Variation. The collection on *Casuarina* (IVV: H.B. 7282b) was only examined in the dead state. It appears to fit well the holotype, with the fusiform spores slightly shorter (†8.5–10 × 3–3.2 µm).

Not included collections. Four Australian samples are not included in the description. two of them differ in spore size: the collection on *Atriplex* (Pl. 647: 3) has distinctly shorter spores, while that on *Pittosporum* (2) mainly deviates in narrower spores. In both the spore apices are more subacute or sometimes even obtuse. No vital characters are known from a collection on twigs of *Acacia coriacea* (Pl. 648: 2, see also IVV: H.B. 7226d), except for some living paraphyses which contained globose SCBs. This specimen matches *O. livistonae* in spore size [†9–11 × 2.3–2.8(–3) µm] and shape, but it differs in the upper spores being always inversely oriented while the lower spores are oriented with their acute end upwards. Likewise, no vital characters are known from a specimen from the Pilbara desert (on *Ipomoea*, IVV: H.B. 8726a), with rather short spores [†7–9(–10) × 2.8-3 µm] with consistently obtuse apices.

Ecology. The holotype of *O. livistonae* was collected on rotten xeric petioles of *Livistona* in a subtropical subhumid (winter-dry, savannah) eucalypt woodland in the Palm-Tree Creek, the paratype on rotten wood and bark of a xeric branch of *Casuarina* in a subtropical humid eucalypt woodland (both in the Great Dividing Range, eastern and southeastern Australia). The three not included collections are from more arid areas from northwestern, central and eastern Australia: those on *Acacia* and *Atriplex* in subtropical arid central Australia northeast of Macdonnell Ranges in acacia open shrublands, that on *Ipomoea* in a similar climate in northwestern Australia, and that on *Pittosporum* in a eucalypt woodland in subtropical humid eastern Australia.

Specimens included. **AUSTRALIA**: **Queensland**, Brigalow Belt South, 69 km SSW of Theodore, 15 km N of Taroom, Palm-Tree Creek, Roy Staines Bridge, 200 m, leaves of *Livistona nitida*, on petioles, 22.X.1998, G. Marson (ex H.B. 6424b, BRI AQ799185, **holotype**; **isotype** in MEL 2389208). – **New South Wales**, South Western Slopes, 183 km NW of Sydney, 20 km SE of Mudgee, 537 m, branch of *Casuarina cunninghamiana*, on wood & bark, 25.X.1998, G. Marson (H.B. 7282b).

Not included. **AUSTRALIA**: **Northern Territories**, Burt Plain, 48 km NNW of Alice Springs, 15 km SW of Yambah, 711 m, branch of *Acacia coriacea*, on wood & bark, 13.X.1998, G. Marson (H.B. 7226d). – 31 km SW of Barrow-Creek Hotel, 3.7 km WSW of Wilora, 480 m, branch of *Atriplex*, on wood, 8.X.1998, G. Marson (H.B. 6262d). – **New South Wales**, Brigalow Belt

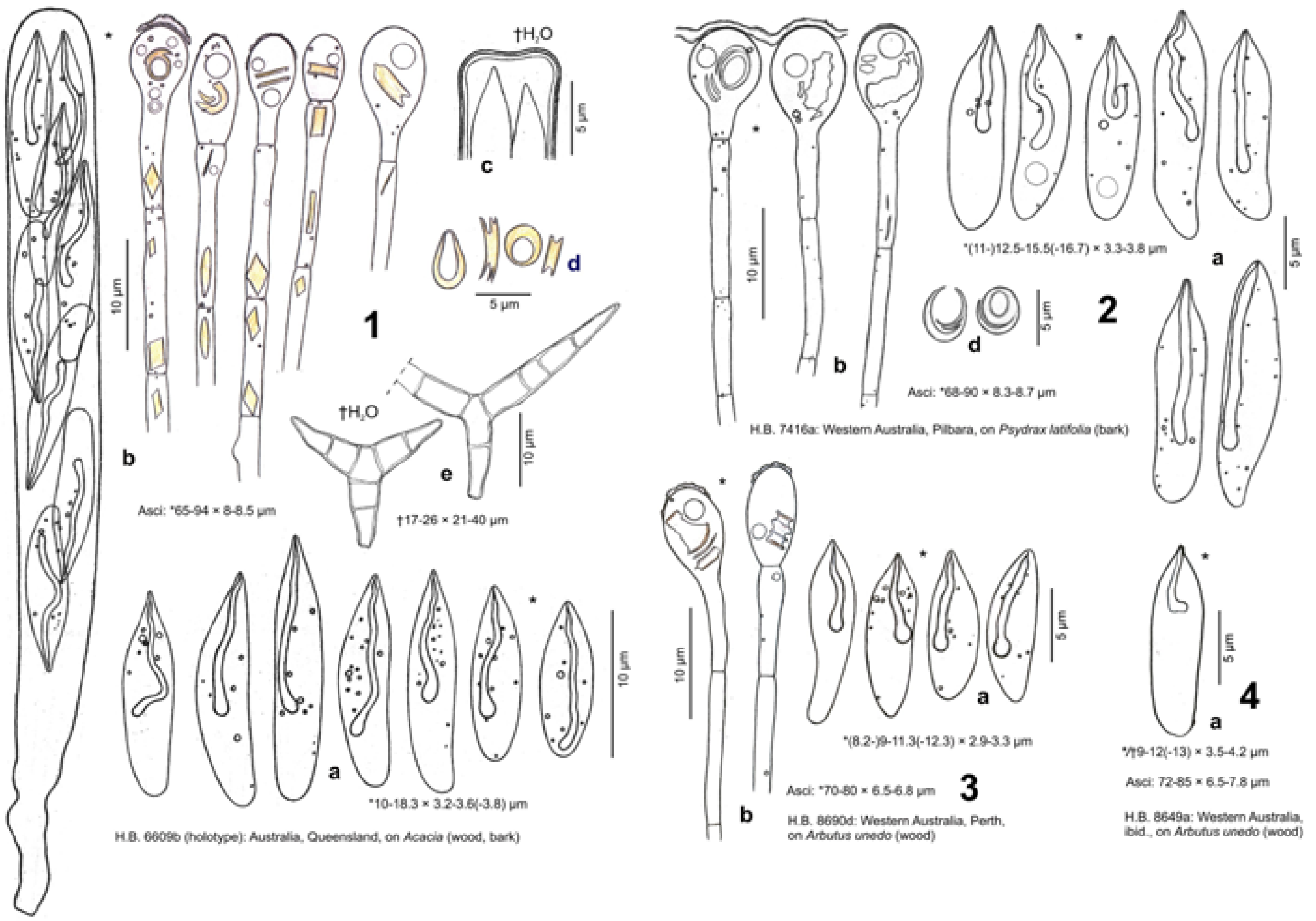


Plate 649. **1–4**: *Orbilia octoserpentina*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apex; **d**. crystalloid SCBs in ectal excipulum near margin; **e**. conidia from substrate.

South, 20 km SW of Narrabri, 248 m, branch of *Pittosporum phillyreoides*, on wood, 24.X.1998, G. Marson (H.B. 6284d). – **Western Australia**, Pilbara, 58 km WSW of Karratha, 37 km NE of Fortescue River Roadhouse, 46 m, twig & branch of *Ipomoea costata*, on bark & wood, 4.XII.2001, G. Marson (H.B. 8726a).

Orbilia octoserpentina Baral & G. Marson, **sp. nov.**, MB 813688 — Pls 649–650

Etymology: an 8-spored derivative of *O. serpentina*.

Typification: Australia, Queensland, Hughenden, branches of *Acacia*, 16.X.1998, G. Marson (ex H.B. 6609b, BRI AQ799187, holotype; ex-type culture: CBS 140811; sq.: KT215237, MH878183).

Latin diagnosis: *Similis* Orbiliae bicknellensi *sed ascosporae basi non vel leniter attenuatae, ascosporae partim longiores, corpuscula refringentia partim longiora, asci partim latiores. Habitat ad lignum vel corticem putridum ramorum siccorum angiospermarum in zona subtropica semihumida ad tropica arida Australiae occidentalis et orientalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.2–0.6 mm diam., 0.13–0.2 mm high, light to bright orange(-rose), slightly translucent, round, scattered to subgregarious; disc flat, margin distinct, 5 µm protruding, smooth to distinctly whitish crenulate; broadly sessile, superficial or slightly to deeply immersed in fissures. **Asci** *(63–)70–85(–94) {4} × 6.2–8 {2} or 8–8.7 µm {2}, †(50–)60–70 × 6–7 µm {2}, 8-spored, spores *(2–)3-seriate, 3–5 lower spores inverted {3} (not mixed), pars sporifera *50–58 µm long; **apex** (†) (medium to) strongly truncate (sometimes slightly indented and laterally somewhat inflated); **base** with short to medium long, ± thick and flexuous stalk, Y-to h-shaped. **Ascospores** *(9–)12–15.5(–18.3) × 3.2–3.8(–4.2) µm {4}, †(9–)10–13(–15) {2} or 14.8–16.5(–17.7) {1} × 3–4 µm {3}, fusiform to narrowly amygdaliform, often with cylindric middle part, apex acute to acuminate, exceptionally obtuse, base not or only slightly attenuated, rounded, straight to slightly inequilateral, at the very base sometimes medium tapered and slightly curved; **SBs** *(5.5–)7–11(–12.7) × 0.8–1(–1.2) µm in situ {1} (~7.5–13 µm actual length), vermiform (to subulate), base scarcely to medium inflated, straight to strongly flexuous, rarely uncinate. **Paraphyses** apically medium to often very strongly capitate, rarely spathulate, terminal cells *6–23 × 4–6.5(–7.5) µm {2}, lower cells *9–16 × 1.3–2.5(–3) µm {2}; not branched near apex. **Medullary excipulum** 20–50 µm thick, of ± loose textura intricata with many inflated cells, medium sharply delimited. **Ectal excipulum** of (†) thin-walled to slightly gelatinized t. globulosa-angularis from base to submargin, 20–50 µm thick near base, cells *10–19 × 8–12 µm {1}; 15–20 µm thick near margin, of t. prismatica-globulosa oriented at a 20–50° angle to the surface, marginal cortical cells †5–10 × 2.5–5 µm {2}. **Anchoring hyphae** abundant, †2–2.8(–3.3) µm wide, walls 0.2–0.3(–0.4) µm thick {1}, forming a ~5 µm thick covering layer at flanks and margin. **SCBs** in paraphyses and ectal excipulum (near margin) globose, 1–2.3 µm diam., and rod- or ring-shaped {3}, pale to bright orange, 3.5–6 × 1–4 µm. **Exudate** over paraphyses and marginal excipulum 0.3–1 µm thick, cloddy, finely rough, or continuous, hyaline, partially detaching. **— ANAMORPH**: trinacrium-like (presumed, from natural substrate {1}). **Conidiophores** not seen. **Conidia** Y-shaped, total size †17–26 × 21–40 µm, stipe †10–10.5 × 3.2–4 µm, 1–2-septate, arms tapering, †10–23 × 3.2–4 µm, 2–4-septate {1}.

Habitat: collected 0.1–2 m above the ground, ± corticated, 4–35 mm thick twigs and branches of *Acacia* sp. {1}, *Arbutus andrachne* {2}, *Psydrax latifolia* {2}, *Quercus robur* {1}, on (medium to) very decayed wood {3} and bark (bast) {3}, strongly greyed, no algae. **Associated**: *Gloniopsis* sp. {1}, *Hyalorbilia ?orbiliicola* (parasitic on *O. octoserpentina*) {1}, *Nectria* sp. {1}, *Orbilia corculispora* {1}, *O. coronohesperidea* {1}, *O. curvativitalbae* {2}, *O. ?lacrimispora* {1}, *O.*

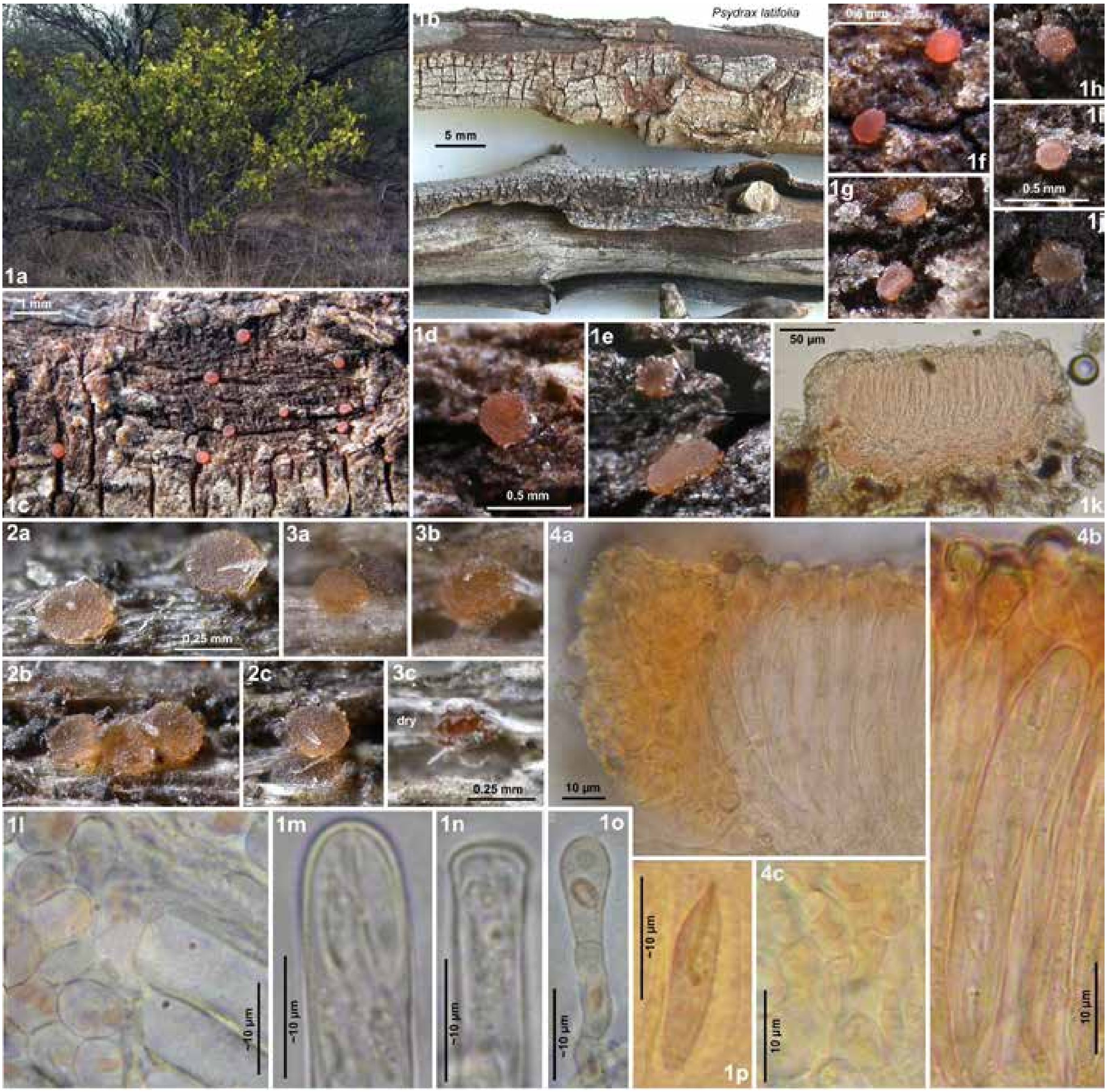


Plate 650. **1–4**: *Orbilia octoserpentina*. – **1a**. tropical arid acacia shrubland with *Psydrax* shrub; **1b**. partly decorticated xeric branches; **1c–j**, **2a–c**, **3a–b**. rehydrated apothecia; **3c**. dry apothecium; **1k**. apothecium in median section; **4a**. marginal ectal excipulum and hymenium in median section; **4b**. asci and paraphyses; **1m–n**. apices of asci; **1l**, **o**. apices of paraphyses with reddish SCBs; **4c**. crystalloid SCBs at margin; **1p**. ascospore. – Living state, except for **1n** (in H_2O). — **1a–p**. H.B. 7416a: Western Australia, Pilbara, on *Psydrax*; **2a–c**. 18.XII.2001: Western Australia, Perth, on *Quercus*; **3a–c**. H.B. 8649a: ibid., on *Arbutus*; **4a–c**. H.B. 8690d: Western Australia, Perth, on *Arbutus*.

multiserpens {1}, *O. octocercocarpi* {1}, *O. serpentina* {3}, *Patellaria* ‘*andina*’ {1}, *P. atrata* {2}, ?*Stictis* sp. {1} *Trichopeziza perrotioides* {2}. **Desiccation tolerance**: fully viable for at least 22 months. **Altitude**: 45–706 m a.s.l. **Geology**: Archean to Paleoproterozoic and Cretaceous sedimentary rock, Cenozoic regolith. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia octoserpentina* is characterized by large, ± fusiform ascospores with acute to acuminate apices, an often cylindrical middle part and at the base mostly only slightly tapered and almost straight, also by rather long spore bodies and by the presence of crystalloid SCBs. For the very similar *O. bicknellensis* (especially the collection on *Baccharis*, Pl. 655: 4) see p. 1129. *O. serpentina* differs in 16-spored asci and shorter spores.

Variation. The three collections from southwestern Australia differ from those from Pilbara/Murchison (on *Psydrax*) and Queensland (on *Acacia*) in shorter spores, also in narrower asci, but are thought to belong in the scope of this species.

Anamorph. The sparse trinacrium robustum-like conidia observed in *O. octoserpentina* are very similar to those of the closely related *O. serpentina*.

Phylogeny. Sequences were gained from the ex-type culture from Queensland (on *Acacia*) and from apothecia of a sample from Western Australia (Murchison, on *Psydrax*). Both comprise the S1506 intron, ITS, and LSU, the holotype also SSU. In the ITS2 region they deviate by 5 % (10 nt and 7 gaps) and in entire ITS by 3 % (the ITS1 of the *Psydrax* strain is incomplete), but in the LSU (D1–D2) only by 1 nt (0.2 %). Although these sequences are rather close to *O. serpentina* in the LSU D1–D2 (0.5–0.6 %), a high ITS distance of 12.5–13.5 % is noted. Lower distances are observed to *O. mesaverdiana* (10.5–11 %) or *O. halimi* and *O. vermiculati* (10–12.5 %). Despite such high distances to other species of the *Serpentinae-Habrostictis* clade, *O. octoserpentina* clustered in the combined analysis with these four species in a highly supported clade (Phyl. 20), in the LSU with three of them in a medium supported clade (Phyl. S22), and unresolved in the ITS analysis (Phyl. 19).

In the ITS and LSU the two *O. octoserpentina* strains clustered in a strongly supported clade due to the comparatively low distance. In the intron region a high distance of 13 % is observed between them. Apparently therefore, they did not cluster in a clade but the *Psydrax* strain with weak support with *O. mesaverdiana* and the *Acacia* strain unresolved (Phyl. S21).

Ecology. *O. octoserpentina* was collected on ± rotten wood and bark of xeric twigs and branches of different angiosperm trees. The holotype was on *Acacia* in a tropical semiarid eucalypt open woodland in northeastern Australia (west of Great Dividing Range), while the paratypes derive from southwestern Australia on introduced trees (*Arbutus* and *Quercus*) planted in a subtropical semihumid botanical garden in the Swan Coastal Plain, and from western Australia on *Psydrax* in a tropical arid acacia shrubland (mulga) of the Pilbara desert and subtropical semiarid acacia woodland in the Murchison ecoregion.

Specimens included. **AUSTRALIA**: **Western Australia**, Swan Coastal Plain, Perth, Kings Park, 45 m, branch of *Quercus robur*, on wood, 18.XII.2001, G. Marson (ø). – ibid., branches of *Arbutus andrachne*, on wood, 18.XII.2001, G. Marson (H.B. 8649a). – ibid., branch of *A. andrachne*, on bark, 19.X.2007, G. Marson (H.B. 8690d). – centre of Pilbara, 30 km NW of Newman, northern end of Ophthalmia Range, 706 m, branches of *Psydrax latifolia*, on bark, 27.XI.2001, G. Marson (H.B. 7416a). – Murchison, 105 km NNE of Meekatharra, 557 m, branch of *Psydrax latifolia*, on wood & bark, 27.X.2007, G. Marson (G.M. 2007-10-27.1; sq.: MH221049). – **Queensland**, Desert Uplands, 29 km E of Hughenden, 13 km W of Prairie, 390 m, branches of *Acacia*, on wood & bark, 16.X.1998, G. Marson (ex H.B. 6609b, BRI AQ799187, **holotype**, **isotype** in MEL 2389211, anam. cult. & anam. substr., CBS 140811; sq.: KT215237, MH878183).

Orbilia serpentina Pat., Énum. champ. Tunisie: 11, Illustr. esp. Tunisie: pl. II fig. 6 (1892) — Pls 651–653, Map 107

Etymology: referring to the shape of the spore bodies being flexuous like a snake. **Typification**: Tunisia, Kasserine, Sbeitla, twig of *Artemisia herba-alba*, 17.III.1891, N. Patouillard (FH 00304812, holotype).

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.1–)0.2–0.4(–0.65) mm diam., 0.12–0.2 mm high, (pale to) light or bright orange(-rose), round, rarely elliptical, very scattered to subgregarious; disc flat, margin indistinct to distinct, 0–10(–20) µm protruding, smooth or finely rough; sessile, nearly superficial to entirely erumpent. **Asci** *(52–)60–100(–115) × (7–)7.5–9(–10.5) µm {12}, †(55–)60–88(–94) × (5.6–)6.5–8.2 µm {6}, 16-spored, spores *3–4-seriate, (4–)6–10(–12) lower spores inverted {11} (not or sometimes mixed), pars sporifera *40–67 µm long, †48–63 µm; **apex** (†) (medium to) strongly truncate (sometimes very slightly indented, laterally sometimes distinctly inflated); **base** with short to long, ± thick, flexuous stalk, T-, L- or Y-shaped. **Ascospores** *(7–)8–12.5(–14) × (2.6–)2.8–3.5(–3.7) ((–4.2)) µm {14}, †(7.5–)9–10.7 × 2.8–3.5 µm {2}, fusoid to fusiform (narrowly amygdaliform), also ellipsoid-fusoid or fusiform-clavate, apex (subacute to) acute (to acuminate), exceptionally obtuse, base very slightly up to sometimes strongly attenuated (rarely tail-like), straight to slightly inequilateral, sometimes slightly to medium curved at base; **SBs** *((4–))(4.5–)5–8(–9) × (0.6–)0.8–1.2(–1.4) µm in situ {8} (~5–9 µm actual length) → 3–3.5 × 1–1.4 µm, vermiform to subulate, base often slightly to medium inflated, mostly slightly to strongly flexuous. **Paraphyses** apically (slightly to) medium to very strongly capitate-clavate, sometimes spathulate-sublageniform or moniliform, terminal cells *(4.5–)9–21(–27) × (2–)4–6.5(–7.5) µm {11}, †(2–)3–5.5 µm wide {3}, lower cells *8.5–20 × 1.3–2.2(–2.8) µm {9}, †1–1.7 µm wide; unbranched or branched at upper septum. **Medullary excipulum** pale rose, 25–50 µm thick, of ± dense textura intricata with many inflated cells, indistinctly or, especially at flanks, sharply delimited. **Ectal excipulum** subhyaline to light orange, of (†) not or slightly gelatinized (common walls 0.5–1 µm thick), irregularly to ± vertically oriented t. angularis(-prismatica) from base to mid flanks, 20–80 µm thick near base, cells *8–24 × 6–15 µm {4}, †8–17 × 7–12 µm {2}; 10–20 µm thick near margin, of t. prismatica oriented at a 10–30° up to 50–60° angle to the surface, marginal cortical cells *(5–)7–10(–12) × (3–)3.5–5(–7) µm {3}. **Anchoring hyphae** medium abundant, */†2–3.5(–4) µm wide, walls 0.2–0.4(–0.7) µm thick {4}, partly somewhat gelatinized, covering the excipulum at flanks and sometimes up to margin as a 5–15 µm thick hyaline layer. **SCBs** in paraphyses and ectal excipulum (from base or flanks up to margin) globose, 1–3 µm diam., and rod- or ring- to keyhole-shaped {15}, subhyaline to pale orange, 1.5–11 × 1.5–5 µm. **Exudate** over paraphyses 0.2–1 µm thick, rough-granular to cloddy, ± continuous, hyaline, ± firmly attached, over marginal excipulum 0.5–2 µm thick. — **ANAMORPH**: trinacrium-like (from ascospore isolate {2} and natural substrate {1}). **Conidiophores** rather short, branched. **Conidiogenous cells** *8–14 × 3–3.5 µm. **Conidia** Y-shaped, total size *(21–)25–34(–38) × (13–)18–25(–32) µm, stipe *15–22 × 5.2–6(–7) µm, 2–5(–7)-septate, arms partly tapering, partly lageniform, also nearly cylindrical with obtuse ends, *9–17 × 3.5–4.8(–6) µm, 1–2(–3)-septate {2}; sometimes unbranched phragmoconidia observed {1}.

Habitat: collected 0–5 m above the ground, corticated or often partially or entirely decorticated, 3–25 mm thick twigs and branches of *Acacia* sp. {2}, *A. aneura* {1}, *A. ?saligna* {1}, *Allocasuarina decaisneana* {1}, *Arbutus andrachne* {2}, *Artemisia herba-alba* {1}, *A. tridentata* {1}, *Baccharis salicifolia* {1}, *B. sarothroides* {1}, *Ericameria nauseosa* {1}, *Juglans major* {1}, *Myrtus communis* {1}, *Olea europaea* {1}, *Purshia stansburyana* {1}, *Ulex parviflorus* {1}, on 0.2–0.5 mm deep (medium to) strongly decayed wood {13} and bark {8} (periderm and bast), on 20–35 mm thick inflorescence stems of *Agave americana* {1}, *Yucca elata* {1}, not or mostly strongly greyed, without or with sparse to abundant green algae. **Associated**: *Baggea* sp. {1}, *Caloplaca* sp. {1}, *Candelariella* sp. {1}, *Coniochaeta sarothamni* {1}, *Cyathicula nigrofusca* {1}, *Didymosphaeria futilis* {1}, *Dothideales* {1}, *Eutypa* sp. {1}, *Gloniopsis* sp. {1}, *Hypoxylon* sp. {1}, *Hysterographium fraxini* {1}, *?Hysteropatella* sp. {1}, *Lophiostoma caulium* {1}, *Muellerella lichenicola* {1}, *Nectria* sp. {1}, *Odontotrema oregonensis* {1}, *Orbilia arizonensis* {1}, *O. bicknellensis* {5/1}, *O. commarosa* {1}, *O. corculispora* {1}, *O. coronohesperidea* {1}, *O. curvativitalbae* {2}, *O. flavida* {1}, *O. ?flexisoma* {1}, *O. ?lentiformis* {1}, *O. macrodelphinus* {2}, *O. macrotrapeziformis* {3}, *O. maeandrina* {1}, *O. microserpens* {3}, *O. multigambelii* {1}, *O. multimaeandrina* {2}, *O. multiphanosoma* {1}, *O. multivinosa* {1}, *O. myriofusiclava* {1}, *O. ocellata* {3}, *O. octocercocarpi* {1}, *O. octoserpentina* {3}, *O. phanosoma* {2}, *O. pleiolentiformis* {2}, *O. pleiomicrosoma* {1}, *O. pleioobtusispora* {1}, *O. pleioquaestiformis* {1}, *O. pleiovitalbae* {1}, *O. plurilentiformis* {1}, *O. pluristomachia* {3}, *O. purshiae* {1}, *O. ?sonorensis* {1}, *O. subclavuliformis* {1}, *O. wannerooensis* {1}, *O. yuccae* {1}, *Patellaria* ‘*andina*’ {1}, *P. atrata* {3/1}, *Pragmopora* sp. {1}, *Schizoxylon* sp. {1}, *?Stictis* sp. {1}, *Teichosporella dura* {3}, *Trichopeziza perrotioides* {2}, *Symbiotaphrina desertorum* {2}, *Tryblidaria fenestrata* {1}, crustose lichen {1}. **Desiccation tolerance**: mature asci still viable after 19 or even 34 months, paraphyses and ectal excipulum still viable after 30–34 months. **Altitude**: 12–563 m a.s.l. (southern Europe), 1060–2115 m (western North America), 45–515 m (Australia). **Geology**: USA: Proterozoic to Ordovician and Permian to Jurassic sandstone, Miocene mafic volcanic rock, basalt lava flow; Europe: limestone (micrite), sand, marl & clay; Australia: Cretaceous

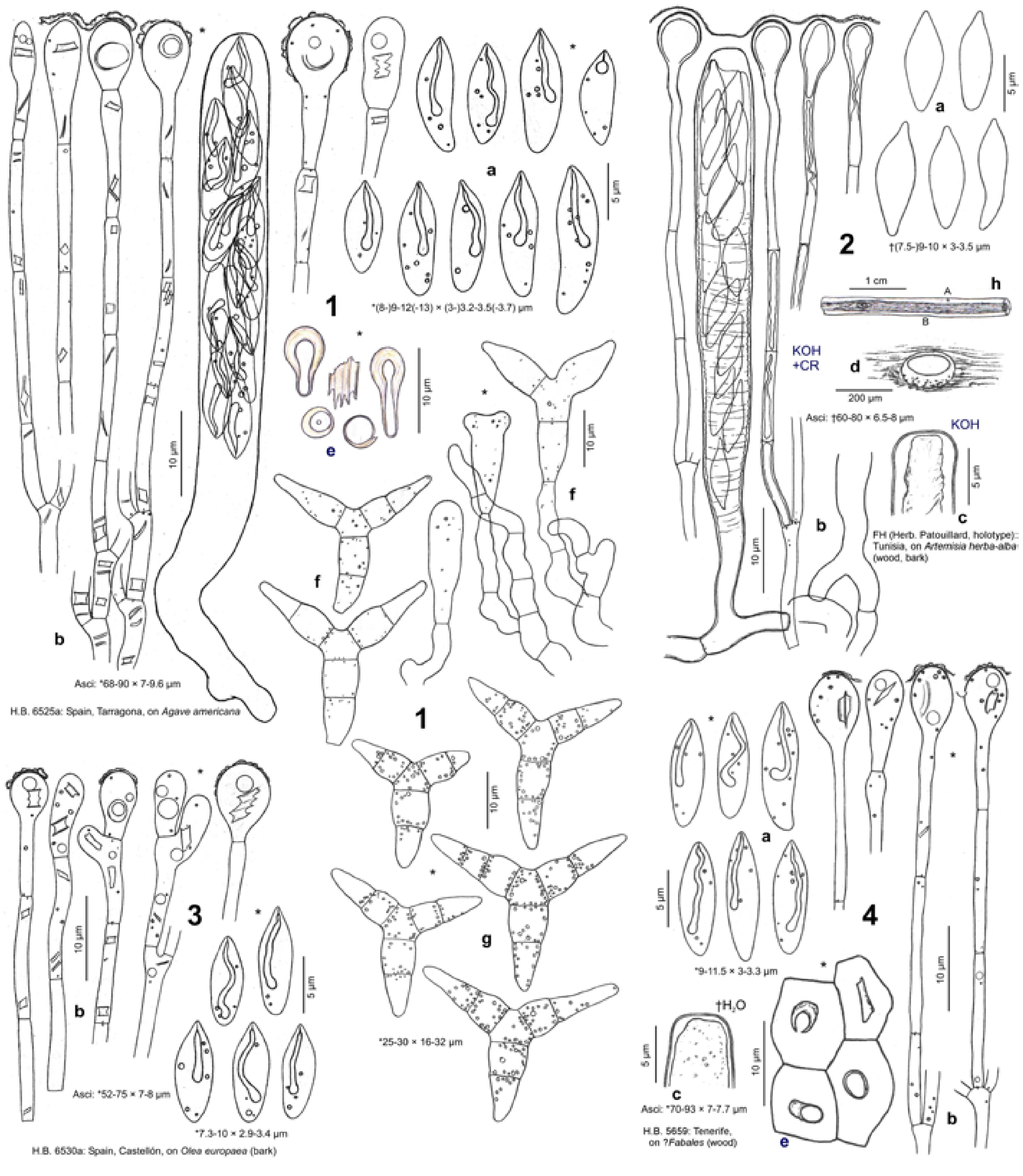


Plate 651. 1–4: *Orbilia serpentina*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. rehydrated apothecium (on wood); **e**. crystalloid SCBs in cells of ectal excipulum at flanks and margin; **f**. conidiophores with conidia from culture; **g**. conidia from substrate; **h**. twig fragment of *Artemisia herba-alba* (**A**: apothecium on bark, **B**: on wood).

sedimentary rock, Cenozoic regolith (sand); Tenerife: trachybasalt and phonolite. **Phenology**: certainly throughout the year (long-lived).

Taxonomic remarks. *Orbilia serpentina* is characterized by 16-spored asci and medium-sized, more or less fusiform (amygdaliform) ascospores with rather long and wide, flexuous SBs, and by the presence of crystalloid SCBs. The close *O. maeandrina* mainly differs in the absence of these SCBs, besides very slightly shorter spores. *O. serpentina* is very close to the 8-spored *O. bicknellensis* or *O. octoserpentina* which sometimes grew in association. *O. pleiourosperma* and the somewhat heterogeneous *O. pleiomesaverdiana* are tentatively separated by their strongly tapered spore bases being almost always distinctly curved, the latter species also by obtuse to subacute spore apices. *O. lacrimispora* differs in wider spores with often acuminate apices and rounded bases, and absence of crystalloid SCBs. However, two collections with similar

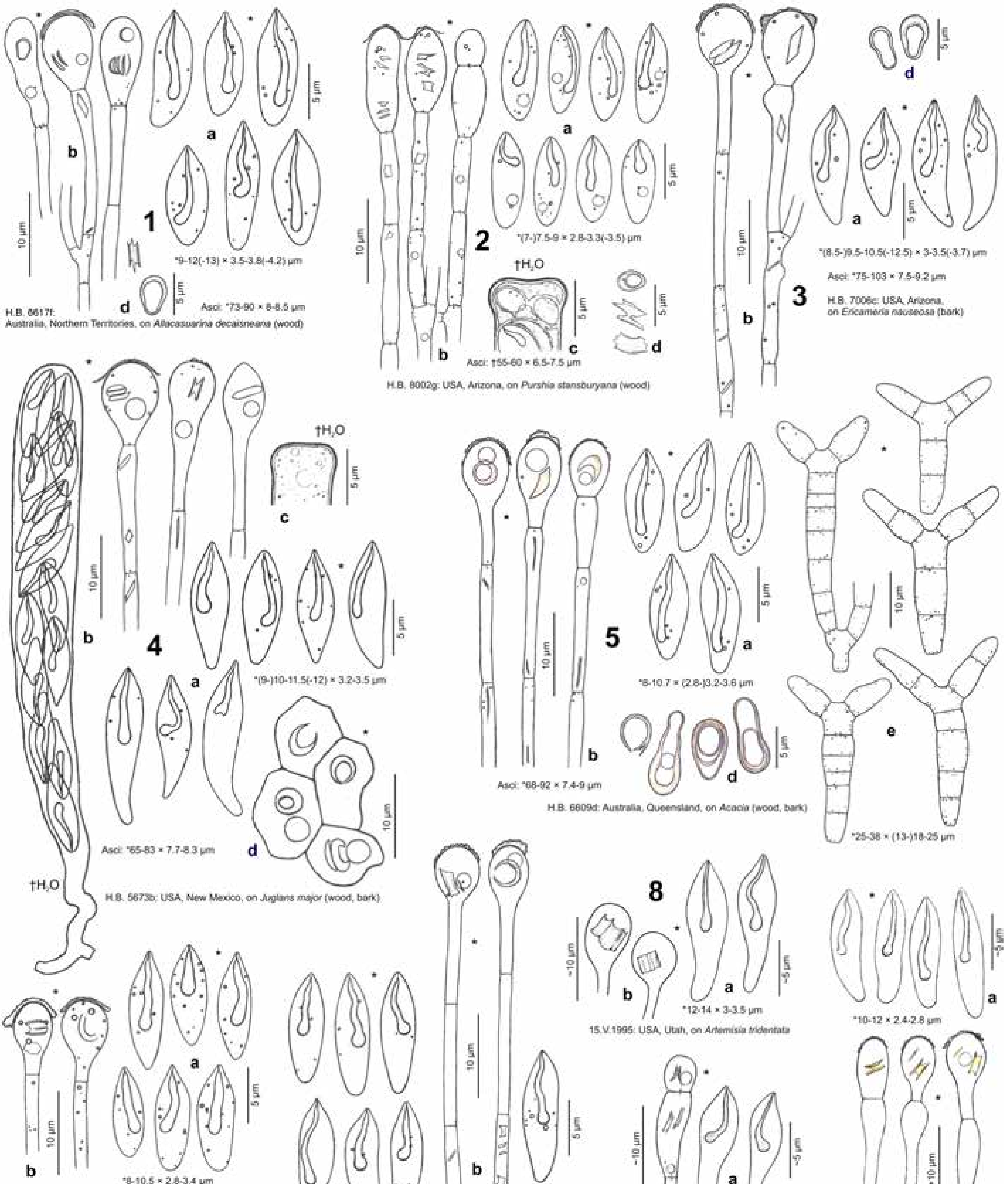


Plate 652. **1–7**: *Orbilia serpentina*; **8–10**. *O.* cf. *serpentina*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apices; **d**. crystalloid SCBs in ectal excipulum; **e**. conidia from culture.

lacrimiform spores mentioned under *O. lacrimispora* (Pl. 588: 3–4) have distinct crystalloid SCBs and rather short spores and are, therefore, not included in either species. *O. macrodelphinus* differs in narrower spores and absence of crystalloid SCBs.

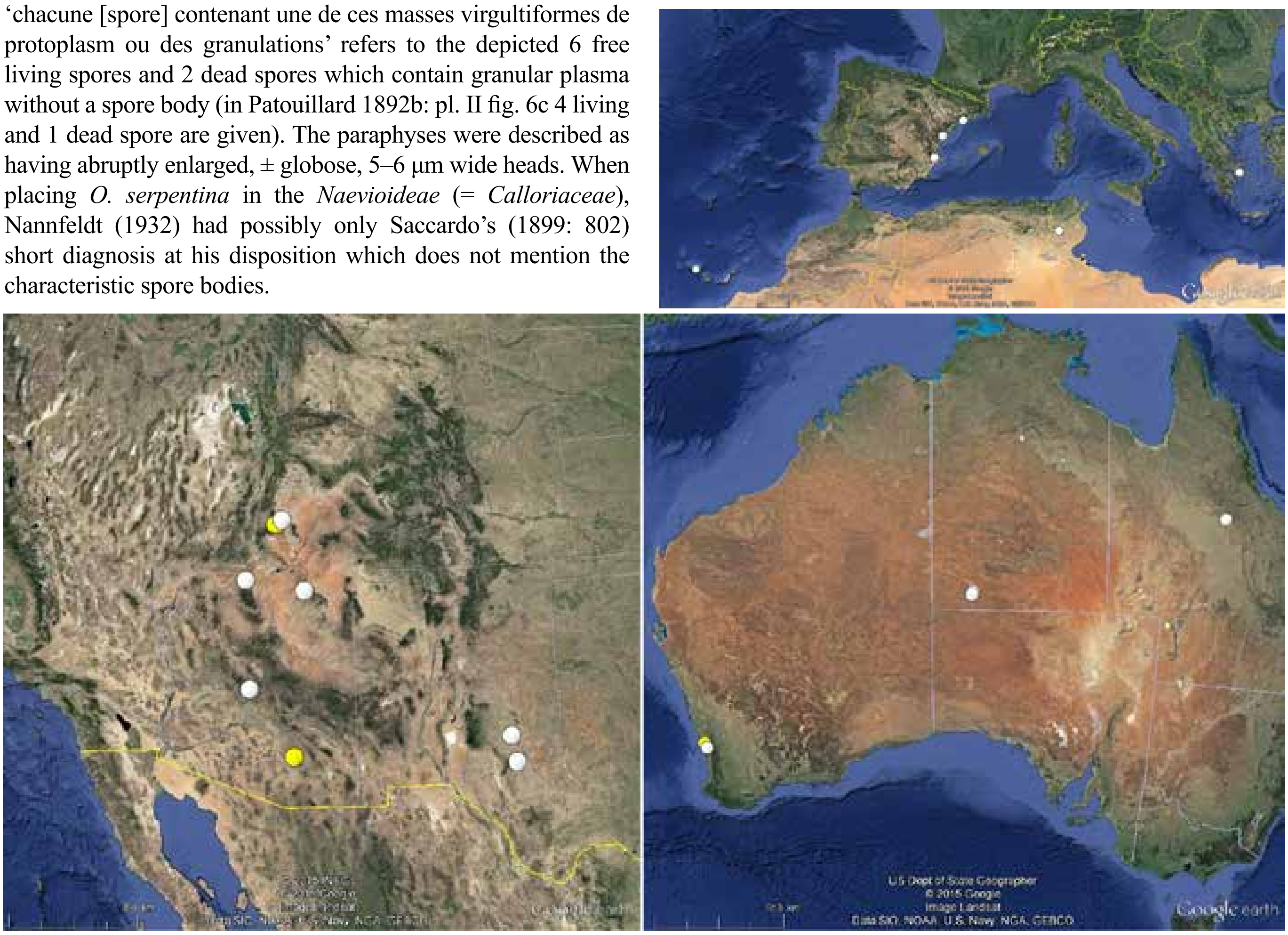
Variation. The ascospore base of *O. serpentina* varies in shape and curvature between slightly and strongly attenuated (with or without a tail-like base) and between straight and medium curved. This variation is partly observed within a collection: both slightly and strongly tapered spore bases occur, e. g., in Pl. 652: 6), and both straight and curved spore bases in Pl. 652: 3–4. In the type of *O. serpentina* the spores showed mainly strongly tapered, straight spore bases (Pl. 651: 2a, see also Fig. 151). Likewise, spore size varies among the collections. Longer spores were especially noted in those having tail-like bases, and these tend to occur at higher altitudes. The collection on *Purshia* (Pls 652: 2; 653: 4) deviates in rather short spores with partly obtuse apices. The asci also vary somewhat in length and width among the collections, but this variation is not found to be correlated with spore size.

Type studies. Patouillard (1892a, b) described and illustrated living spores that contain very elongate, gradually enlarged (subulate), somewhat flexuous spore bodies (see also original drawing at PC, Fig. 151: 1). His measurement of 10–12 × 3–4 µm is at the upper end of the range of the present scope of *O. serpentina*, and the SBs were about half as long as the spores. Patouillard erroneously believed the asci to be finally 8-spored, although his remark 'Thèques ... contenant d'abord 14–16 masses virgultiformes de protoplasma, réfringentes' undoubtedly indicates that they were 16-spored. On his drawing 12–14 SBs per ascus can be counted, and their length which is ± equal to that of the paraphyses indicates that these asci were mature, not immature as he believed. Patouillard depicted dead asci that contain living spores; this can be concluded from the fact that the spores are dispersed down to the ascus base and only the SBs are visible while the spore walls are mostly invisible. His remark 'chacune [spore] contenant une de ces masses virgultiformes de protoplasm ou des granulations' refers to the depicted 6 free living spores and 2 dead spores which contain granular plasma without a spore body (in Patouillard 1892b: pl. II fig. 6c 4 living and 1 dead spore are given). The paraphyses were described as having abruptly enlarged, ± globose, 5–6 µm wide heads. When placing *O. serpentina* in the *Naevioideae* (= *Calloriaceae*), Nannfeldt (1932) had possibly only Saccardo's (1899: 802) short diagnosis at his disposition which does not mention the characteristic spore bodies.

In the present reexamination of the holotype only two apothecia could be discerned on the single, partially decorticated twig fragment (Pl. 651: 2). One (on bark) was in bad condition, with ± empty asci, but the other (on wood) was in good shape, with the asci and spores matching the protologue. The holotype material quite well concurs with the collections here assigned to *O. serpentina*, with a single exception: the spore bases in the type are partly more strongly attenuated, causing a fusiform (trapezoid) spore shape, but they are never distinctly curved as in *O. pleiourosperma*. Patouillard did not report the presence of crystalloid SCBs, therefore, the identity of *O. serpentina* remains somewhat uncertain in respect to the otherwise very similar *O. maeandrina*. Spore size as evaluated in the holotype fits the here presented concept of *O. serpentina* a bit better than that of *O. maeandrina*, therefore, we tentatively adopt Patouillard's taxon for the species with crystalloid SCBs.

Not included collections. Three records were not included in the description. In two from North America on *Artemisia* and *Opuntia* (Pl. 652: 8–9) the spores have more or less distinct tails; yet, only a few spores have been documented and the samples were not preserved. A very sparse collection from Australia (bark of *Acacia*, Pl. 652: 10) deviates in distinctly narrower spores. In the collection on *Opuntia* the apothecia were comparatively large (0.4–0.8 mm diam).

Anamorph. In pure culture *O. serpentina* formed a trinacrium robustum-like anamorph. Slight differences between our two strains were noted: the Spanish strain (Pl. 651: 1f) differs from the Australian one (Pl. 652: 5e) in



Map 107. Known distribution of *O. serpentina* North America Australia, and in Europe (including Macaronesia, yellow = not included collections).

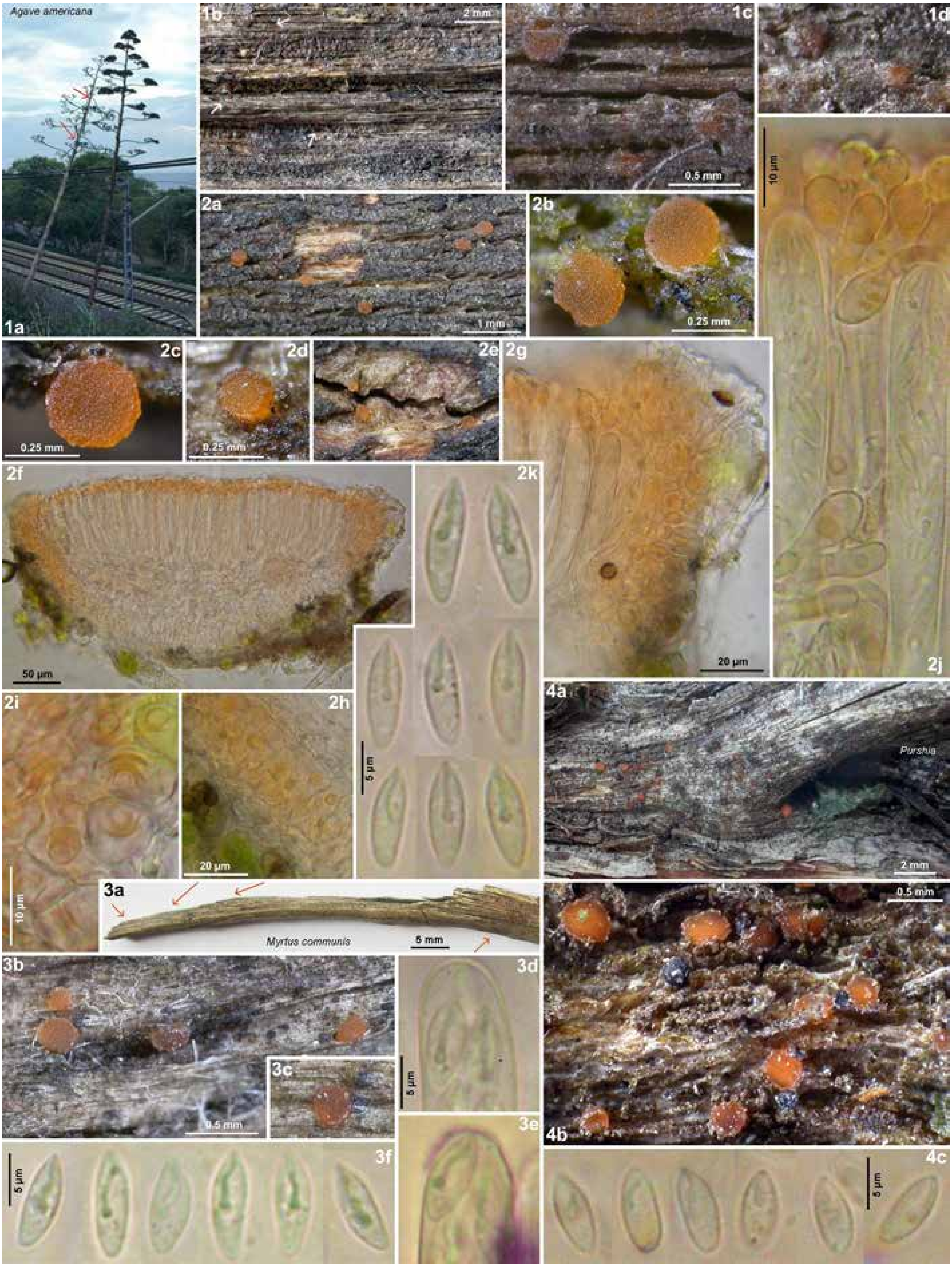


Plate 653. **1–4**: *Orbilia serpentina*. – **1a**. alive and dead inflorescence of *Agave americana* between road and railway at mediterranean sea shore (arrows = collected parts); **1b**. closeup of inflorescence stem; **3a**. xeric, still-attached branch stub of *Myrtus*; **1c–d**, **2a–e**, **3b–c**, **4a–b**. rehydrated apothecia; **2f**. apothecium in median section; **2g**. id., marginal ectal excipulum; **2h–1**. id., at flanks, with orange crystalloid SCBs; **2j**. asci and paraphyses (with SCBs); **3d–e**. ascus apices; **2k**, **3f**, **4c**. ascospores. – Living state. – **3d–e**, **3f** p.p.: phot. S. Helleman. — **1a–d**. H.B. 6525a: Spain, Tarragona, on *Agave*; **2a–k**. H.B. 8690b: Western Australia, Perth, on *Arbutus*; **3a–f**. H.B. 9102: Greece, Athens, on *Myrtus*; **4a–c**. H.B. 8002g: USA, Arizona, on *Purshia*.

shorter stipes with consistently two septa, also in somewhat longer, more tapered arms. This difference was also evident in the abundant conidia on the natural substrate in the Spanish collection (Pl. 651: 1g).

Phylogeny. A sequence was gained from pure culture of the specimen from Queensland, comprising SSU (without S1506 intron), ITS, and LSU. *O. serpentina* shows a rather high distance of 12.5–13.5 % in the ITS region to *O. octoserpentina*, although in the LSU D1–D2 the distance is only 0.5–0.6 %. The minimum distance is 11–12.5 % (ITS) and 1–1.3 % (LSU) to *O mesaverdiana*, *O. halimi*, and *O. vermiculati*. *O. serpentina* forms with these four species a strongly supported clade (Phyl. 20).

Ecology. *O. serpentina* was collected on rotten wood and bark of xeric twigs and branches of various angiosperm trees and shrubs, but also on inflorescence stems of *Agave* and *Yucca*. The small apothecia often occur rather scattered and sparse. The records emanate from subtropical, thermomediterranean semihumid to semiarid southern Europe and northern Africa, e. g., from the maquis (*Ulex*), ruderal places (*Agave*), parks (*Myrtus*), old olive tree plantations, or the semihumid pine forest (*Sideritido solutae-Pinetum canariensis*) in Tenerife (Macaronesia). The western North American collections derive from cold- to warm-temperate semiarid to subhumid sagebrush and saltbush scrubs and riparian scrubs and woodlands in the Sonoran and Chihuahuan Desert, and pinyon-juniper woodlands in the Colorado Plateau. A single record from western North America comes from a cold-temperate humid site (B. Liu, IVV: VIII.2011). The only subtropical North American sample (on *Opuntia* from semiarid Sonoran paloverde-mixed cacti desert scrub) is morphologically deviating, as is one from the border of a boreal humid Douglas fir forest (on *Artemisia tridentata*). Those from Australia were in subtropical semihumid banksia-eucalypt-acacia open wood- and shrublands in the southwest, subtropical arid acacia open shrublands in the centre, and a tropical semiarid eucalypt open woodland in the northeast.

Specimens included. **SPAIN**: **Cataluña**, **Tarragona**, 3.7 km E of Tarragona, 7 km WSW of Altafulla, Cala Romana, 12 m, inflorescence stem of *Agave americana*, 28.IX.1999, G. Marson & H.O. Baral (H.B. 6525a, [CBS 116237, not survived], anam. cult., anam. substr.). – **Com. Valenciana**, **Castellón**, 50 km N of Alicante, 3.5 km NNW of Muro de Alcoy, Puerto de Benicadell, 563 m, branch of *Ulex parviflorus*, on wood, 4.I.2008, J.P. Priou (J.P.P. 28005, doc. vid.). – 13.5 km NNW of Castellón, 3.2 km WSW of Vilafamés, Camí de Costur, 400 m, branch of *Olea europaea*, on bark, 27.IX.1999, H.O. Baral (H.B. 6530a). — **GREECE**: **Attika**, Athens, 0.6 km NW of Akropolis, Stoà di Attalo, 65 m, twig of *Myrtus communis*, on wood, 12.VI.2009, S. Helleman (H.B. 9102). — **TUNISIA**: **Kasserine**, W of Sbeitla, ~600 m, twig of *Artemisia herba-alba*, on wood & bark, 17.III.1891, N.T. Patouillard no. 82b (FH 00304812, **holotype**, H.B. 5455 ø). — **MACARONESIA**: **Canary Islands**, **Tenerife**, Vilaflor, ~7 km NW of Granadilla de Abona, Vilaflor, ~1400 m, branch of *Acacia ?saligna*, on wood, 20.IV.1996, B. Fernand (H.B. 5659). — **USA**: **Massachusetts**, 8 km NE of Boston, Revere Beach Boulevard, 2 m, data on substrate unavailable, ~VIII.2011, B. Liu (doc. vid.). – **Utah**, Canyonlands, Capitol Reef, 40 km WSW of Hanksville, 23 km E of Torrey, 1555 m, branch of *Baccharis salicifolia*, on wood & bark, 19.VI.2000, G. Marson (H.B. 6741h ø). – **Arizona**, Navajo, 85 km SW of Mexican Hat, 27 km SW of Kayenta, Klethla Valley, 2015 m, branch of *Ericameria nauseosa*, on bark, 13.VI.2000, G. Marson (H.B. 7006c). – Grand Canyon, Kaibab Plateau, 28 km ESE of Fredonia, 13 km NNW of Jacob Lake, 2115 m, branches of *Purshia stansburyana*, on wood, 15.VI.2003, G. Marson (H.B. 8002g). – Sonoran Desert, 84 km N of Phoenix, 15 km NNE of Black Canyon City, Sunset Point, 1060 m, on *Baccharis sarothroides*, 27.V.1996, G. Marson (ø). – **New Mexico**, Chihuahuan Desert, 30 km SW of Carlsbad, ~4 km NW of Whites City, ~3 km NE of Carlsbad Caverns, 1200 m, twig & branch of *Juglans major*, on bark & wood, 24.V.1996, G. Marson (H.B. 5673b). – ~13 km W of Artesia, 1120 m, inflorescence stem of *Yucca elata*, on wood, 25.V.1996, G. Marson (H.B. 5655d). — **AUSTRALIA**: **Western Australia**, Swan Coastal Plane, Perth, Kings Park, 45 m, twig of *Arbutus andrachne*, on wood, 18.XII.2001, G. Marson (H.B. 8649b). – ibid., twig & branch of *A. andrachne*, on wood & bark, 19.X.2007, G. Marson (H.B. 8690b). – **Northern Territories**, Great Sandy Desert, 12 km SE of Yulara, N of Ayers Rock, 515 m, branch of *Acacia aneura*, on wood, 11.X.1998, G. Marson (H.B. 7129c). – 11.5 km ENE of Yulara, 14 km NNE of Ayers Rock, 500 m, branches of *Allocasuarina decaisneana*, on wood, 12.X.1998, G. Marson (H.B. 6617f). – **Queensland**, Desert Uplands, 29 km E of Hughenden, 13 km W of Prairie, 390 m, twig & branch of *Acacia*, on wood & bark, 16.X.1998, G. Marson (H.B. 6609d, CBS 116236, anam. cult.; sq.: KT215238).

Not included. **USA**: **Utah**, Utah Mts., Dixie Forest, 15 km SSE of Torrey, 5.5 km S of Grover, Lion Mt., 2450 m, on *Artemisia tridentata*, 15.V.1995, G. Marson (ø). – **Arizona**, Sonoran Desert, 40 km NNE of Tucson, 11 km NE of Catalina, Casa del Oro, Biosphere, 1165 m, on *Opuntia*, 7.V.1995, G. Marson (ø). — **AUSTRALIA**: **Western Australia**, Swan Coastal Plain, 30 km NNW of Perth, 1 km NW of Kinross, Tamala Park, 40 m, branch of *Acacia*, on bark, 23.X.2007, G. Marson (H.B. 8745k ø).

Orbilia bicknellensis Baral & G. Marson, **sp. nov.**, MB 813689 — Pls 654–656, Map 108

Etymology: named according to the town Bicknell (Utah), near which the first sample was recorded.

Typification: Spain, Alcalá de Henares, stem of *Foeniculum vulgare*, 23.IX.1999, H.O. Baral & G. Marson (ex H.B. 6480a, M-0276442, holotype).

Latin diagnosis: *Similis* Orbiliae serpentinae *sed asci octospori. Habitat ad lignum vel corticem siccum angiospermarum vel caules in zona temperata ad subtropica subhumida ad arida.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.13–)0.2–0.4(–0.6) mm diam., 0.12–0.17 mm high, pale to bright orange(-rose), round, very scattered to (sub)gregarious; disc flat (to slightly convex), margin thin, 0–10 µm protruding, ± smooth; broadly sessile, superficial or distinctly erumpent from beneath outer tissue; dry bright orange to brick-red. **Asci** *(50–)55–82(–95) × (5.6–)6–7.5(–8) µm {12}, †48–75 × 5–7(–7.5) µm {4}, 8-spored, spores *2–3-seriate, (2–)3–5(–6) lower spores inverted {11} (rarely slightly to strongly mixed), pars sporifera *36–43 µm long; **apex** (†) medium to strongly truncate (not or very slightly indented, laterally not or partly inflated); **base** with short to medium long, thick, flexuous stalk, T-, L- or h-shaped. **Ascospores** *(9–)10–13.5(–15) × ((2.5–))(2.7–)2.9–3.5(–3.7)((–4.3)) µm {20}, †(9–)10–13(–15) × 2.5–3.4 µm {4}, fusiform to fusiform-clavate, sometimes with short-cylindrical middle part (navicular), apex acute to acuminate, sometimes subacute, base (slightly to) medium to strongly attenuated, partly tail-like, mostly inequilateral or slightly to medium curved near base; **SBs** *(4–)5–7.5(–9)((–10.5)) × (0.7–)0.9–1.3(–1.6) µm {11} in situ, (vermiform to) subulate, base mostly slightly to medium inflated, straight to medium flexuous; overmature divided into an abruptly swollen, subglobose lower part and a short filum, 2.5–3.3 × 1.3–1.7 µm. **Paraphyses** apically medium to (very) strongly clavate-capitate, sometimes spathulate, rarely sublageniform or moniliform, terminal cells *(6–)8–19(–23) × (3–)4.5–6.3(–7) µm {9}, †(3–)4–5.8 µm wide {2}, lower cells *7.5–18 × (1.3–)1.6–2(–3) µm {4}; rarely branched at upper septum. **Medullary excipulum** pale rose, 40–50 µm thick, of ± dense textura intricata with many inflated cells, sharply delimited. **Ectal excipulum** pale rose, of thin-walled, irregularly oriented t. globulosa-angularis from base to margin, 30–45 µm thick near base, cells *(5–)8–20(–27) × 5–13(–18) µm {3}; 20 µm thick at flanks, 15–20 µm near margin, oriented at a 20–30° angle to the surface, marginal cortical cells *5–13 × 4–6 µm {1}. **Anchoring hyphae** sparse to abundant, */†(1.5–)2–3.5(–5) µm wide, walls 0.2–0.5 µm thick {2}, partly covering the excipulum up to the margin. **SCBs** in paraphyses and ectal excipulum (near margin) rod- or ring- to keyhole-shaped {17}, hyaline to pale yellowish-orange, partly also globose, 2–3 µm diam. **Exudate** over paraphyses 0.2–1.5(–3) µm thick, rough to granular-cloddy, loosely attached; over margin and flanks 0.2–0.5 µm thick, granular. — **ANAMORPH**: unknown (but see below).

Habitat: collected 0–5 m above the ground, corticated to often decorticated, 3–30(–70) mm thick twigs and branches of *Atriplex nummularia* {1}, *Baccharis salicifolia* {1}, *B. sarothroides* {1}, *Canotia holacantha* {1}, *Coleogyne ramosissima* {1}, *Ericameria nauseosa*

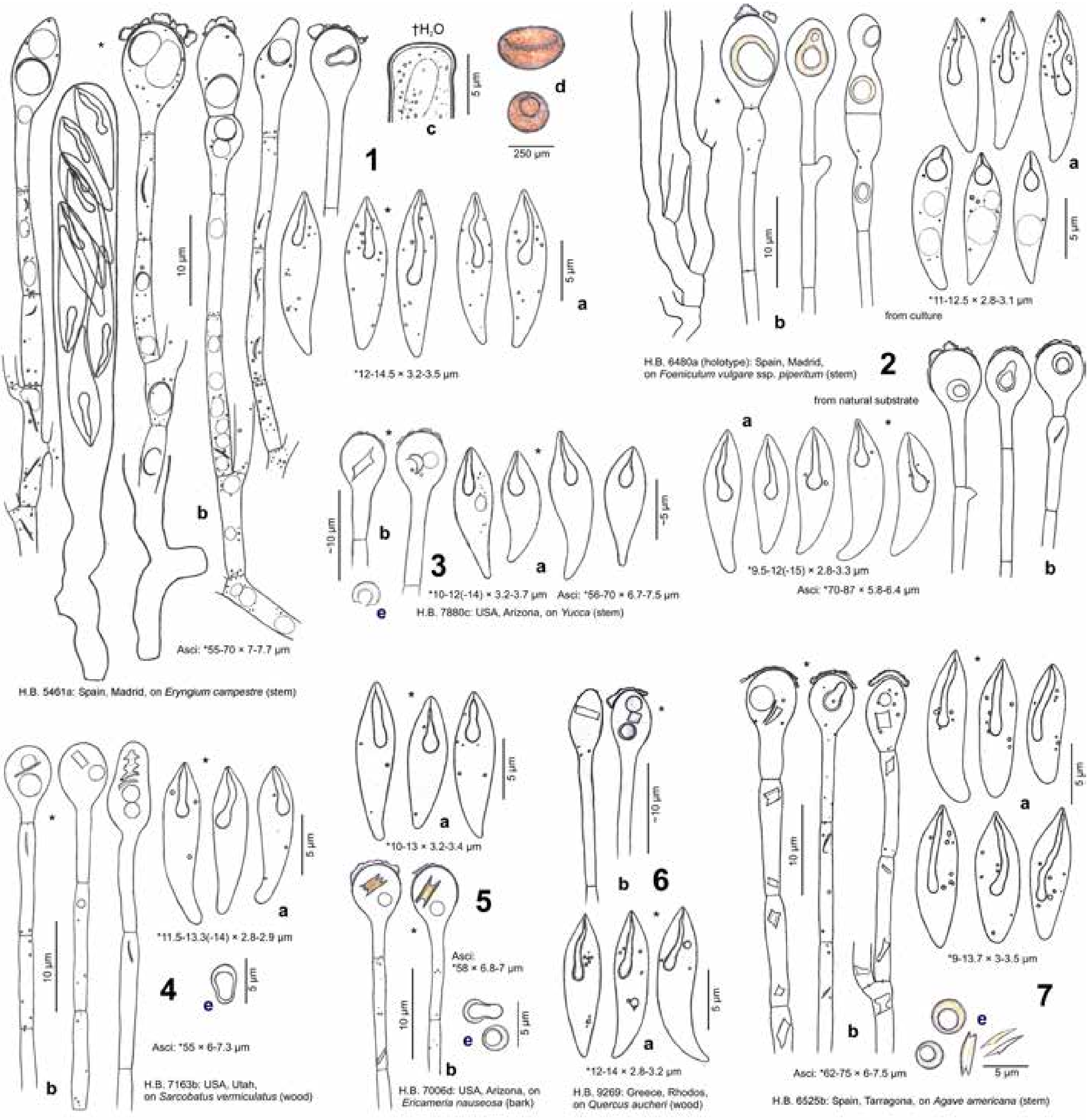


Plate 654. **1–7**: *Orbilia bicknellensis*. – **a**. ascospores (middle row in **2a** immature); **b**. ascus, ascus bases, paraphyses; **c**. ascus apex; **d**. rehydrated apothecia; **e**. crystalloid SCBs in ectal excipulum.

{1}, *Krascheninnikovia lanata* {2}, *Nicotiana glauca* {1}, *Opuntia* sp. {1}, *Pistacia terebinthus* {1}, *Populus × canadensis* {1}, *Quercus aucheri* {1}, *Robinia pseudoacacia* {1}, *Salix ?exigua* {1}, *Sarcobatus vermiculatus* {2}, *Thymelaea hirsuta* {1}, on 0.1–0.5 mm deep (medium) strongly decayed wood {12} and bark {3} (bast), stems of *Rubus fruticosus* {1}, previous year's herbaceous, partly inflorescence stems of *Agave americana* {1}, *Cichorium intybus* {1}, *Eryngium campestre* {1}, *Foeniculum vulgare* {1}, *Yucca elata* {2}, indet. angiosperm {1}, ungreyed to strongly greyed, green algae sparse to many, partly in old beetle galleries, sometimes exclusively on boring dust of bark beetles {1}. **Associated**: *Caloplaca* sp. {2}, *Cyathicula cyathoidea* {1}, *C. nigrofusca* {1/1}, *Dothideales* {1}, *Hysterobrevium mori* {1}, *Melaspilea emergens* {1}, *Orbilia arizonensis* {1}, *O. atriplicis* {1}, *O. ?bicknellensis* {1}, *O. ?cactacearum* {1}, *O. calyptrata* {3}, *O. cercocarpi* {1}, *O. denticulata* {1}, *O. flavida* {2}, *O. lacrimispora* {1/1}, *O. lentiformis* {2}, *O. macrodelphinus* {2}, *O. macrotrapeziformis* {1}, *O. multigambelii* {3}, *O. multimaeandrina* {1}, *O. multiphanosoma* {1}, *O. ?multitrapezoidea* {1}, *O. myriostomachia* {1}, *O. ocellata* {2}, *O. paradoxoides* {1}, *O. pleiolentiformis* {2}, *O. pleiomicrosoma* {2}, *O. pleistoeuonymi* {1}, *O. plurilentiformis* {2}, *O. pluristomachia* {1}, *O. sarcobati* {1}, *O. serpentina* {5}, *O. ?ungulata* {1}, *O. vermiculati* {2}, *O. yuccae* {1}, *Patellaria* '*andina*' {1}, *P. atrata* {4/1}, *Pragmopora* sp. {1}, *Schizoxylon* sp. {1}, *Teichospora* sp. {1}, *Teichosporella dura* {2}, *Symbiotaphrina desertorum* {1}. **Desiccation tolerance**: many mature asci still viable after 28 months. **Altitude**: 3–610 m a.s.l. (southern Europe), 975–2075 (western North America). **Geology**: Australia: Neoproterozoic sedimentary rock; Meso- to Cenozoic sand-, lime- & mudstone, basaltic lava and felsic volcanic rock, andesite & rhyolite; Spain: Tertiary calcareous sand, gravel, marl & clay. **Phenology**: long-lived.

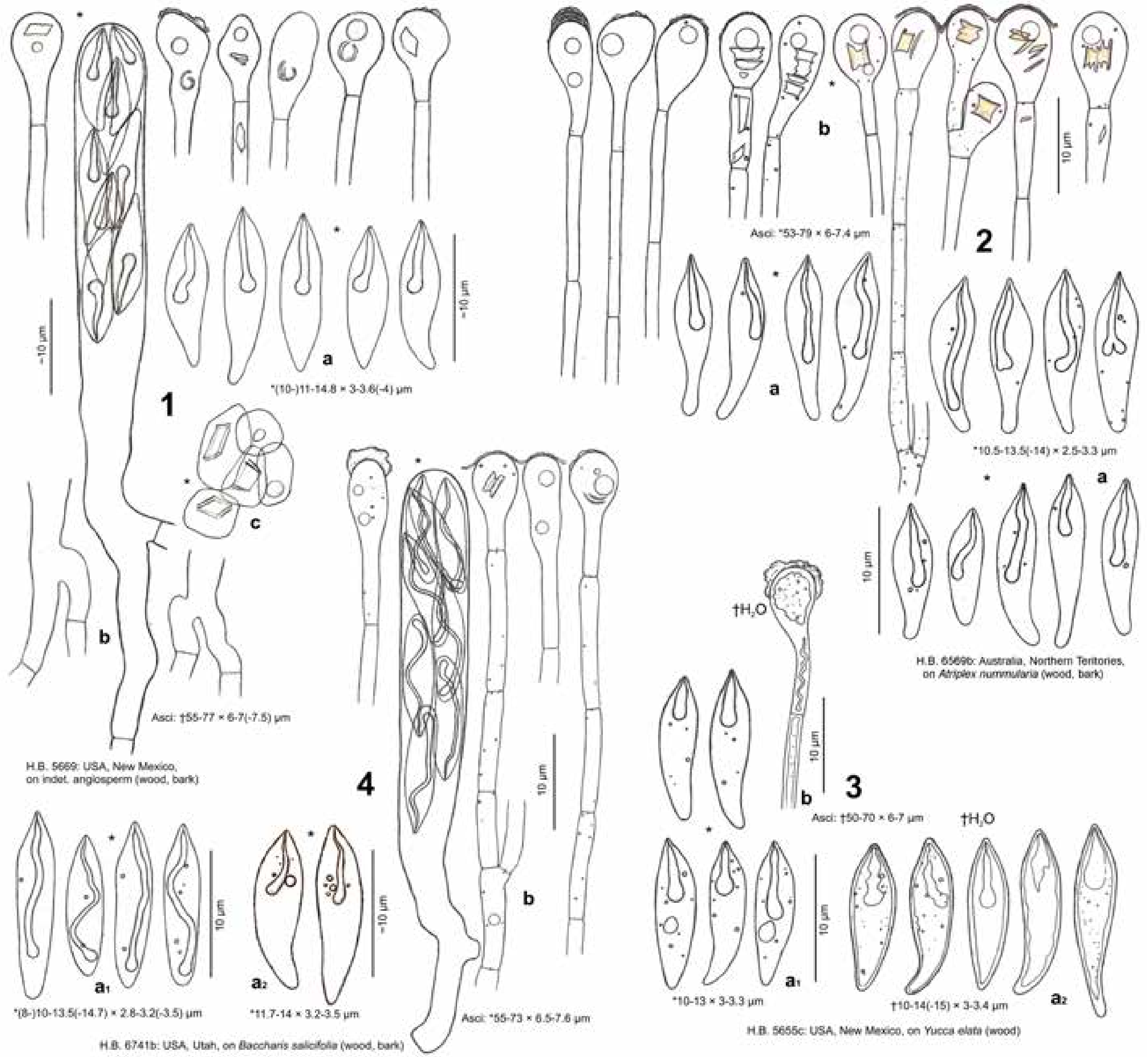


Plate 655. **1–3**: *Orbilia bicknellensis*; **4**: *O.* cf. *bicknellensis*. – **a**. ascospores (**4a$_2$**: kept in Petri dish for some time); **b**. asci and paraphyses (with crystalloid SCBs); **c**. ectal excipular cells with crystalloid SCBs.

Taxonomic remarks. *Orbilia bicknellensis* is characterized by 8-spored asci, rather large, fusiform, basally often attenuated and ± curved ascospores, subulate, comparatively wide spore bodies, and by the presence of crystalloid SCBs. *O. trapeziformis* and especially *O. macrotrapeziformis* have similarly shaped spores but always lack crystalloid SCBs, the former also differs in distinctly smaller spores with less acute apices. The Australian *O. octoserpentina* is only tentatively separated by the spores being often only scarcely tapered and only rarely curved at the base, also by partly longer spores with longer SBs, and by a tendency to wider asci.

O. serpentina mainly differs in 16-spored asci, but also in somewhat shorter and basally usually less attenuated spores. *O. serpentina* grew sometimes in association with *O. bicknellensis*, e.g. in the Spanish collection on *Agave* (Pls 651: 1, 654: 6). Here the two taxa had very similar spores, both with only slightly attenuated bases, therefore, with the spores alone their distinction is hardly possible. In a North American sample on *Yucca* (Pls 652: 6, 655: 3), in which the two taxa grew together, *O. serpentina* differed from *O. bicknellensis* in much less tapered spore bases.

Variation. *O. bicknellensis* strongly varies in spore shape, especially in the spore bases which were usually strongly attenuated but sometimes only slightly or medium so (e.g., Pl. 654: 7, *Agave*). The Australian sample on *Atriplex* (Pl. 655: 2) and the mentioned North American ones on *Yucca* and *Salix* deviate in more tail-like spore bases and form a transition to *O. urosperma*. *O. halimi* is similar to the collection on *Atriplex*, but has much narrower spores and is, therefore, separated at the species level.

Not included collections. Two samples on *Euphorbia* from Macaronesia (Pl. 656: 7–8) have slightly smaller, especially narrower spores of *8.7–12(–13.5) × 2.3–3.3(–3.6) µm. They appear to be intermediate between *O. bicknellensis* and *O. halimi* and are not included in either description.

With its very long SBs (Pl. 655: 4a$_1$), the not included North American sample on *Baccharis* closely resembles *O. pyrenaica*.

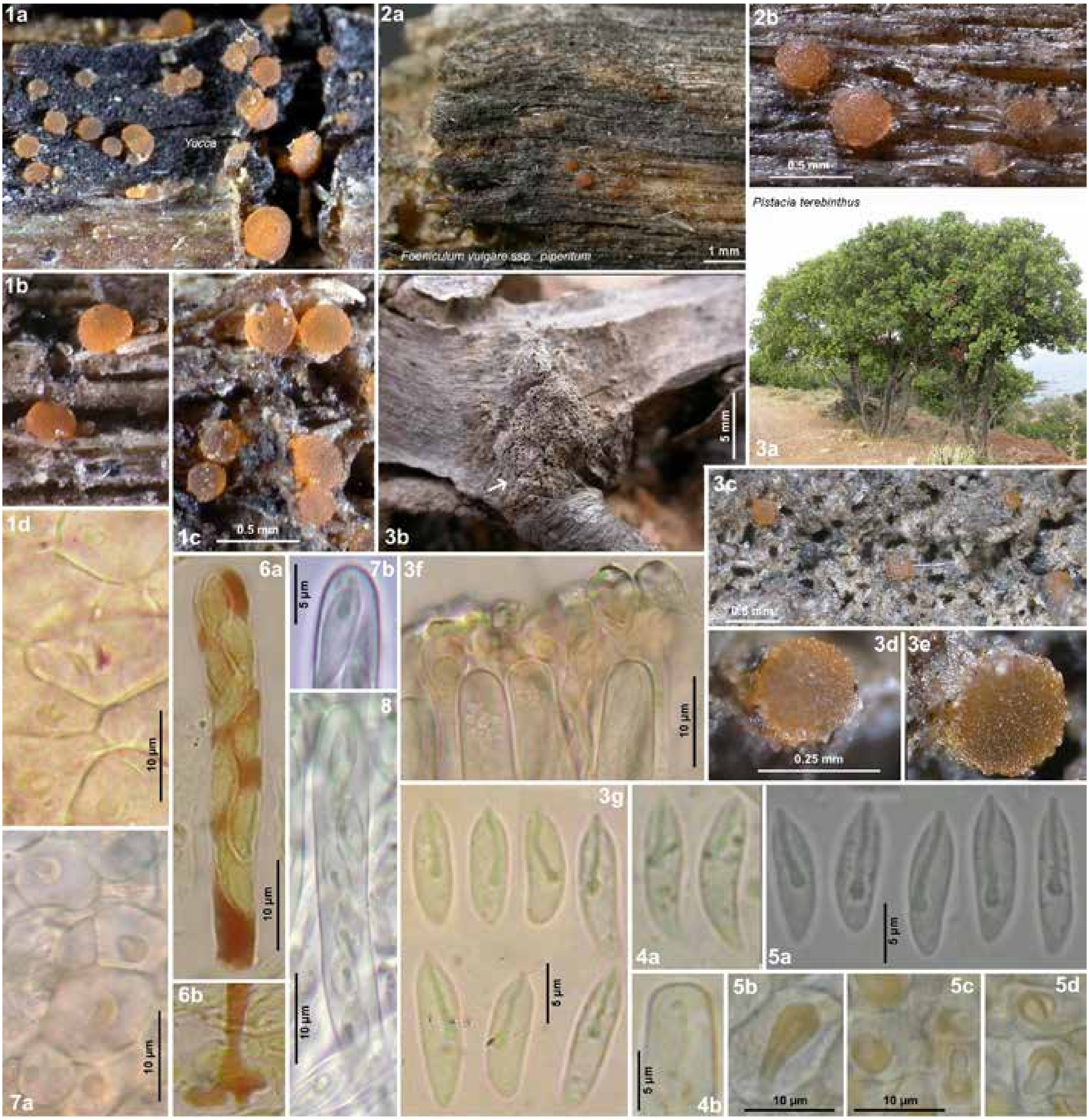


Plate 656. **1–6**: *Orbilia bicknellensis*; **7–8**: *O.* cf. *bicknellensis*. – **3a**. *Pistacia terebinthus* trees in a mediterranean maquis; **3b**. decorticated xeric branch of *Pistacia*, with boring dust; **1a–c**, **2a–b**, **3c–e**. rehydrated apothecia; **1d**, **5b–d**, **7a**. crystalloid SCBs in basal ectal excipulum; **3f**, **6a**, **8**. asci and paraphyses; **6b**. ascus base; **4b**, **7b**. ascus apices; **3g**, **4a**, **5a**. ascospores. – Living state, except for **6a–b** (in KOH+IKI). – **3a**: phot. S. Helleman, **5a–d**: phot. R. Tena, **7a–b**, **8**: phot. L. Quijada. — **1a–d**. H.B. 7880c: USA, Arizona, on *Yucca*; **2a–b**. H.B. 6480a (holotype): Spain, Madrid, on *Foeniculum*; **3a–g**. H.B. 9093a: Greece, on *Pistacia*; **4a–b**. H.B. 9269: Greece, Rhodos, on *Quercus*; **5a–d**. R.T.L. 12111001: Spain, Valencia, on *Populus*; **6a–b**. H.B. 5669: USA, New Mexico, on indet. angiosperm; **7a–b**. TFC Mic. 22684: Tenerife, on *Euphorbia*; **8**. TFC Mic. 22657: Tenerife, on *Euphorbia*.

Yet, some of the paraphyses contained crystalloid SCBs, contrary to *O. pyrenaica*. When trying to cultivate the associated *O. multimaeandrina*, an apothecium which was fixed to the lid of a Petri dish was reexamined after some time: it turned out to be 8-spored but showed typical *O. bicknellensis* spores (4a$_2$), being slightly broader and with much shorter SBs compared to the doubtful collection of 4. The question whether these spores developed from those with long SBs, or the two examined apothecia belonged to two different taxa could not be answered.

Anamorph. In the single available pure culture of *O. bicknellensis* (Pl.654: 2) no conidia developed, neither on CMA:2 nor on water agar. However, apothecia were formed on water agar to which wood fragments were added (2, upper row). Two times, trinacrium robustum-like conidia were found on the substrate near apothecia of *O. bicknellensis* (IVV: H.B. 6739a, 1 conidium of *28 × 18 µm; unillustrated: H.B. 6525b, 2 conidia), but other *Orbilia* species grew intermingled, so it is not certain that the conidia belonged to *O. bicknellensis*.

Ecology. *O. bicknellensis* was collected on rotten wood and bark of xeric twigs and branches of various angiosperm shrubs (and trees), and on herbaceous stems of different mono- and dicotyledons, including inflorescence stems of *Agave* and *Yucca*.

Map 108. Known distribution of *O. bicknellensis* in North America and Europe (including Macaronesia, yellow = not included collections).

The records are from meso- to thermomediterranean, semihumid to semiarid areas of southern Europe, e. g. in ruderal places and maquis. Samples from the southwest of Northern America are from cold- to warm-temperate but also subtropical, subhumid to mainly semiarid paloverde-mixed cacti, blackbrush, sagebrush, saltbush and winterfat desert scrubs or mixed grassland or riparian scrubs, but also in the pinyon-juniper woodland of the Sonoran and Chihuahuan Desert and Colorado Plateau. A single record was in a subtropical arid acacia open shrubland northeast of Macdonnell Ranges in central Australia.

The two not included collections from Tenerife were in infra- to thermomediterranean arid to hyperarid xerophytic scrublands in the south and west of the island.

Specimens included. **SPAIN**: **Cataluña**, **Tarragona**, 20 km WSW of Tarragona, 3 km W of Cambrils, Carrer Gotic, La Dorada, 15 m, branches of *Robinia pseudoacacia*, on wood and boring dust, 27.IX.1999, G. Marson & H.O. Baral (H.B. 6518). – 3.7 km E of Tarragona, 7 km WSW of Altafulla, Cala Romana, 12 m, inflorescence stem of *Agave americana*, 28.IX.1999, G. Marson & H.O. Baral (H.B. 6525b). – **Aragón**, **Zaragoza**, 16.3 km SSW of Fraga, 1 km E of Mequinenza, 90 m, stem of *Rubus fruticosus*, 24.X.2012, B. Fellmann (ø, doc. vid.). – **Madrid**, 3.5 km NE of Alcalá de Henares, University Campus, 610 m, stem of *Foeniculum vulgare*, 23.IX.1999, H.O. Baral & G. Marson (ex H.B. 6480a, **holotype**, M-0276442). – SW of Campus, Calle de Severo Ochoa, 600 m, stem of *Eryngium campestre*, 12.V.1996, H.O. Baral (H.B. 5461a). – ibid., stem of *Cichorium intybus*, 28.V.1996, H.O. Baral (H.B. 5461b). – **Com**. **Valenciana**, **Valencia**, 11.5 km SSE of Valencia, SE of El Saler, Tallafoc de la Rambla, 3 m, branch of *Populus* × *canadensis*, on wood, 10.XI.2012, R. Tena & J. Ormad (R.T.L. 12111001, J.O. 121110.1, doc. vid.). – ibid., 23.XII.2012, R. Tena & J. Ormad (non vid.). – **Alicante**, 3.3 km N of Torrevieja, 1 km E of El Chaparral, Laguna La Mata, 20 m, branch of *Thymelaea hirsuta*, on wood, 29.IV.2015, J.P. Priou (J.P.P. 15114, doc. vid.). – ibid., branch of *Nicotiana glauca*, on wood, 29.IV.2015, J.P. Priou (J.P.P. 15115, doc. vid.). — **GREECE**: **Peloponnese**, 7.5 km SW of Skala, 6 km NE of Gytheio, 20 m, branch of *Pistacia terebinthus*, on boring dust, 7.VI.2009, S. Helleman (H.B. 9093a). – **Rhodos**, 3.5 km NE of Archangelos, 1.2 km NE of Monastery of Tsambika, 190 m, branch of *Quercus aucheri*, on wood, 18.III.2010, V. Kummer (H.B. 9269 ø). — **USA**: **Utah**, Utah Mts., 13 km ESE of Bicknell, ~1.5 km ESE of Torrey, ~2075 m, on *Salix ?exigua*, 15.V.1995, G. Marson (ø). – Canyonlands, 40 km WSW of Hanksville, 23 km E of Torrey, Capitol Reef, 1557 m, branch of *Baccharis salicifolia*, 19.VI.2000, G. Marson (H.B. 6741d ø). – 45 km NNE of Blanding, 16 km N of Monticello, Peters Canyon, 1902 m, branches of *Sarcobatus vermiculatus*, on wood, 15.VI.2000, G. Marson (H.B. 6739a). – 5.8 km SSW of Blanding, Bicentennial Highway, Westwatercreek, 1700 m, branch of *S. vermiculatus*, on wood, 15.VI.2000, G. Marson (H.B. 7163b). – **Arizona**, Navajo, 85 km SW of Mexican Hat, 27 km SW of Kayenta, Klethla Valley, 2015 m, branch of *Ericameria nauseosa*, on bark, 13.VI.2000, G. Marson (H.B. 7006d). – 27 km ESE of Holbrook, Petrified Forest, 1645 m, branch of *Krascheninnikovia lanata*, 29.V.1996, G. Marson (H.B. 6134e ø). – Sonoran Desert, 52 km WNW of Flagstaff, 16 km NNE of Williams, 1975 m, on *Coleogyne ramosissima*, 11.V.1995, G. Marson (ø). – 65 km SSW of Flagstaff, 9 km NNE of Camp Verde, NE of Montezuma Castle, 1073 m, branch of *Canotia holacantha*, on wood, 12.VI.2000, G. Marson (ø). – ibid., 975 m, branch of *K. lanata*, on wood, 8.V.1995, G. Marson (H.B. 6085a). – 31 km ENE of Safford, 20 km SSE of Clifton, 1510 m, inflorescence stem of *Yucca elata*, 1.VI.2003, G. Marson (H.B. 7880c). – 84 km N of Phoenix, 15 km NNE of Black Canyon City, Sunset Point, 1060 m, on *Baccharis sarothroides*, 27.V.1996, G. Marson (ø). – 40 km NNE of Tucson, 11 km NE of Catalina, Casa del Oro, Biosphere, Rte. 89, 1165 m, on *Opuntia*, 7.V.1995, G. Marson (ø). – **New Mexico**, Chihuahuan Desert, ~13 km W of Artesia, 1120 m, inflorescence stem of *Yucca elata*, on wood, 25.V.1996, G. Marson (H.B. 5655c). – ~26 km SW of Alamogordo, White Sands, ~1220 m, twig of indet. angiosperm, on wood & bark, 25.V.1996, G. Marson (H.B. 5669). — **AUSTRALIA**: **Northern Territories**, northeast of MacDonnell Ranges, 15 km WNW of Alice Springs, N of Honey Moon Gap, 586 m, twig & branch of *Atriplex nummularia*, on bark & wood, 9.X.1998, G. Marson (H.B. 6569b).

Not included. **MACARONESIA**: **Canary Islands**, **Tenerife**, San Miguel de Abona, south part, 4.5 km SSW of Las Chafiras, 1.2 km ENE of Costa del Silencio, Montaña Amarilla, 15 m, branch of *Euphorbia balsamifera*, 27.XII.2009, L. Quijada (TFC Mic. 22684, doc. vid.). – Guía de Isora, 4 km WSW of Vera de Erques, 3 km SW of Tejina, 1.7 km NW of Tijoco Bajo, 225 m, branch of *Euphorbia lamarckii*, 26.XII.2009, L. Quijada (TFC Mic. 22657, doc. vid.). — **USA**: **Utah**, Canyonlands, 40 km WSW of Hanksville, 23 km E of Torrey, Capitol Reef, 1557 m, branch of *Baccharis salicifolia*, on wood & bark, 19.VI.2000, G. Marson (H.B. 6741b).

Orbilia jacaensis Baral, Priou & E. Weber, **sp. nov.**, MB 825648 — Pls 657–658

Etymology: named after the geographical origin, Jaca (Huesca, Spain).

Typification: Spain, Jaca, twigs of *Clematis vitalba*, 9.X.2016, H.O. Baral (ex H.B. 10026, AH 52846, holotype).

Latin diagnosis: *Similis* Orbiliae bicknellensi *sed corpuscula crystalloidea carentes. Habitat ad lignum et corticem siccum angiospermarum in zona suprasubmediterranea semihumida et orosubmediterranea humida Europae meridionalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.2–0.4 mm diam., light yellow-orange to orange-rose, round, scattered to gregarious in small groups; disc flat, margin ± distinct, hardly protruding, smooth to rough or finely crenulate; broadly sessile, superficial to slightly

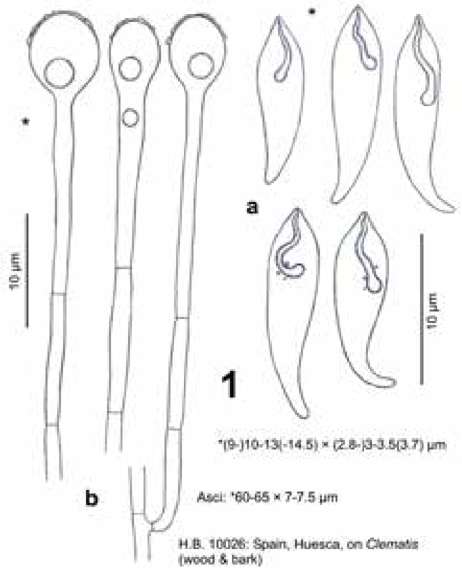


Plate 657. **1**: *Orbilia jacaensis*. – **a**. ascospores; **b**. paraphyses.

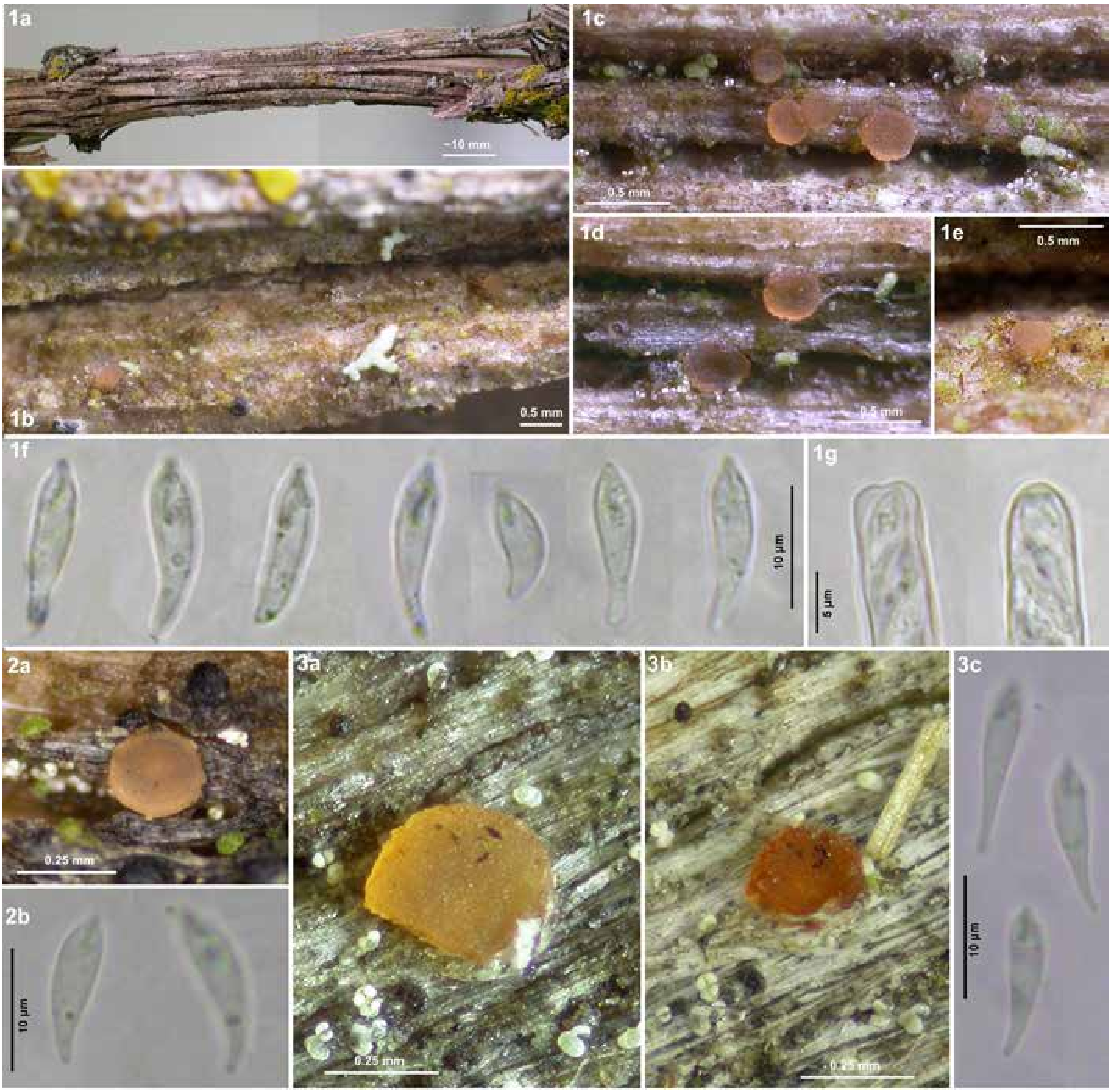


Plate 658. **1–3**: *Orbilia jacaensis*. – **1a**. dead corticated xeric twig of *Clematis vitalba*; **1b–e**, **2a**, **3a**. rehydrated apothecia; **3b**. dry apothecium; **1g**. ascus apices in different viewing direction; **1f**, **3a**, **3c**. ascospores. – Living state, except for asci in **1g**. – **2** & **3**: phot. J.P. Priou. — **1a–g**. H.B10026: Spain, Jaca, on *Clematis*; **2a–b**. J.P.P. 16196: France, Puigcerdà, on *Fraxinus*; **3a–c**. J.P.P. 16239: France, Les Angles, on *Corylus*.

erumpent or immersed; dry slightly retracted, bright orange to orange-rose. **Asci** *60–72 × 7–7.5 µm {2}, †48–68 × 5–6.5 µm {3}, 8-spored, spores *2–3-seriate, 2–4 lower spores inverted {3}; **apex** (†) strongly truncate (slightly to distinctly indented, laterally hardly inflated); **base** with short to long, ± thin, flexuous stalk, L-shaped. **Ascospores** *(9–)10–14(–15) × (2.6–)3–3.5(–3.7) µm {4}, fusiform-clavate, apex acute to acuminate, base strongly attenuated, often with a tail-like base, slightly to strongly curved especially near base; **SBs** *(3–)4–5.3 × 0.7–1.2 µm in situ {4} (actual length ~4–6 µm), subulate (to vermiform), medium to strongly flexuous, attached by a small point. **Paraphyses** apically medium to very strongly capitate (rarely clavate), terminal cells *(15–)20–27 {T} × (4–)4.5–6(–7) µm {3}, lower cells *9.5–13 × 1.3–1.7(–2.2) µm {T}; never branched at upper septum. **Medullary excipulum**, **Ectal excipulum** and **Anchoring hyphae** not examined. **SCBs** in paraphyses and ectal excipulum (near margin) globose {3}, 1.7–2.5 µm diam. **Exudate** over paraphyses 0.2–0.4 µm thick, hyaline, rough-granular, firmly attached. **— ANAMORPH**: unknown.

Habitat: collected ~1–2 m above the ground, 3.5–20 mm thick, corticated to decorticated twigs and branches of *Berberis vulgaris* {1}, *Clematis vitalbae* {1}, *Corylus avellana* {1}, *Fraxinus excelsior* {1}, on strongly rotten wood {4} and bark {1}. **Associated**: *Caloplaca* sp. {1}, *Lecanora* sp.{1}, *Physcia* sp. {1}. **Desiccation tolerance**: fully alive after at least 2.5 months. **Altitude**: 985–1775 m a.s.l. **Geology**: Spain: Tertiary calcareous marl breccia; France: granite & black schist with pyrite; Switzerland: amphibolite. **Phenology**: VI–X (but certainly long-lived).

Taxonomic remarks. *Orbilia jacaensis* differs from *O. bicknellensis* in lacking crystalloid SCBs, and from *O. subtrapeziformis* in wider ascospores with often acuminate apex, from both also in consistently strongly tapered, often more curved spore bases and in a tendency to shorter SBs.

Variation. The collection from les Angles differs from the other two in narrower and slightly longer spores of *12–

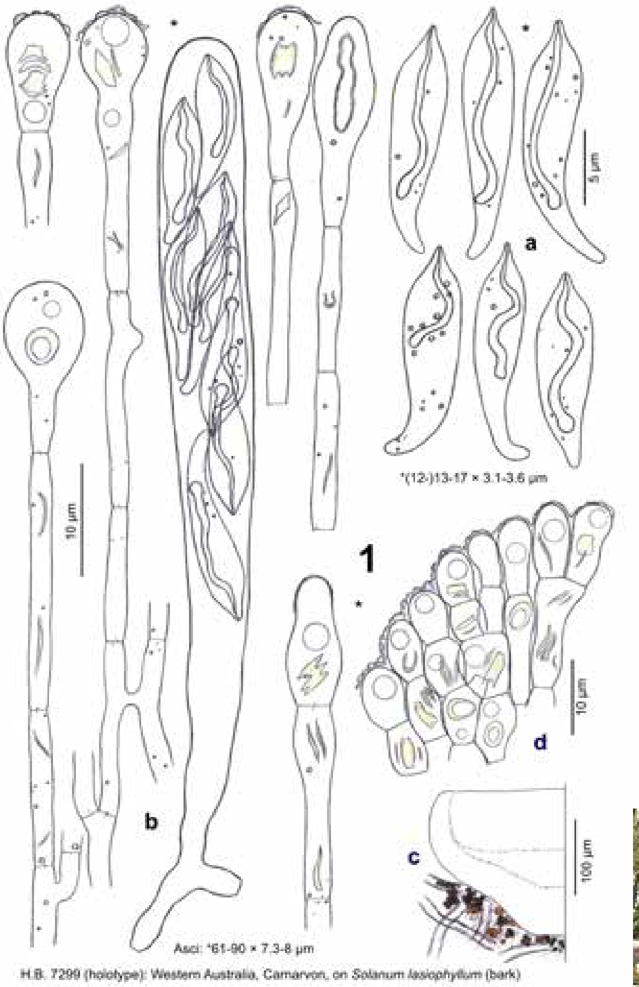


Plate 659. **1**: *Orbilia urosperma* (holotype). – **a**. ascospores; **b**. ascus and paraphyses; **c**. apothecium in median section; **d**. id., marginal ectal excipulum.

15 × 2.6–3.1 µm vs. mainly *10–14 × 3–3.3(–3.5) µm in the other two samples.

Ecology. *O. jacaensis* was found on xeric rotten wood and bark of different angiosperms in a suprasubmediterranean semihumid *Quercetum rotundifoliae* (holotype) in the western Pyrenees and orotemperate humid open woodlands in the eastern Pyrenees and Swiss Alps in southwestern Europe. In comparison, *O. bicknellensis* shows a thermo- to mesomediterranean distribution.

Specimens included. **SPAIN**: **Aragón**, **Huesca**, 12.7 km N of Jaca, NNE of Villanúa, 985 m, twigs of *Clematis vitalba*, on wood & bark, 9.X.2016, H.O. Baral (H.B. 10026, AH 52846, **holotype**). — **FRANCE**: **Languedoc-Roussillon**, **Pyrénées-Orientales**, 4 km N of Saillagouse, 1.5 km SW of Font-Romeu-Odeillo-Via, Four Solaire d'Odeillo, 1540 m, branch of *Fraxinus excelsior*, on wood, 22.IX.2016, J.P. Priou (J.P.P. 16196, doc. vid.). – 2 km NW of Les Angles, S of Estany de Vallsera, Lac de Balcère, 1775 m, branch of *Corylus avellana*, on wood, 20.IX.2016, J.P. Priou (J.P.P. 16239, doc. vid.). — **SWITZERLAND**: **Graubünden**, 1 km SE of Zernez, 1507 m, branch of *Berberis vulgaris*, on wood, 23.VI.2018, B. Senn-Irlet (B.S.I. 18/80, doc. vid.).

Orbilia urosperma Baral & G. Marson, **sp. nov.**, MB 813690 — Pls 659–660

Etymology: named after the ascospores being strongly curved at the base.

Typification: Western Australia, Mia Mia, stems of *Solanum lasiophyllum*, 6.XII.2001, G. Marson (ex H.B. 7299, MEL 2389234, holotype).

Latin diagnosis: *Similis* Orbiliae bicknellensi *sed asci et ascosporae longiores*, *corpuscula refringentia longiora*, *ascosporae apice acuminatae*, *basi magis curvatae. Habitat ad caules ligneos siccos* Solani lasiophylli *in zona subtropica arida Australiae occidentalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.3–0.45 mm diam., 0.16–0.2 mm high (receptacle 0.15–0.16 mm), light to bright orange-red, scarcely translucent, round, scattered to subgregarious; disc slightly concave, margin distinct, 0–10 µm protruding, smooth; sessile on a ± distinct stipe-like base, superficial but immersed in dense hair felt of host periderm; dry deep carmine. **Asci** *61–90 × 7.3–8(–8.6) µm, †65–77 × 6.5–7.5(–8.5) µm, 8-spored, spores *2–3-seriate, 3–6 lower spores inverted (not mixed), pars sporifera *(34–)45–55 µm long; **apex** (†) strongly truncate (slightly indented and laterally widened); **base** with short, thick, flexuous stalk, Y- or h-shaped. **Ascospores** *(12–)13–17 × 3.1–3.8 µm, †12–17 × 3–3.6 µm, fusiform-clavate, apex consistently acuminate, base strongly attenuated (mostly tail-like), slightly to strongly curved at base; **SBs** *(6.5–)8–13.3 × 0.7–1 µm in situ (~8–14.5 µm actual length), vermiform to somewhat subulate, slightly inflated at base, medium to strongly flexuous or helicoid. **Paraphyses** apically medium to very strongly clavate-capitate, rarely sublageniform, terminal cells *10–25 × (4–)5–7 µm, lower cells *13–23 × 1.6–2.3 µm, near base 9–13 × 3–3.5 µm; unbranched near apex.

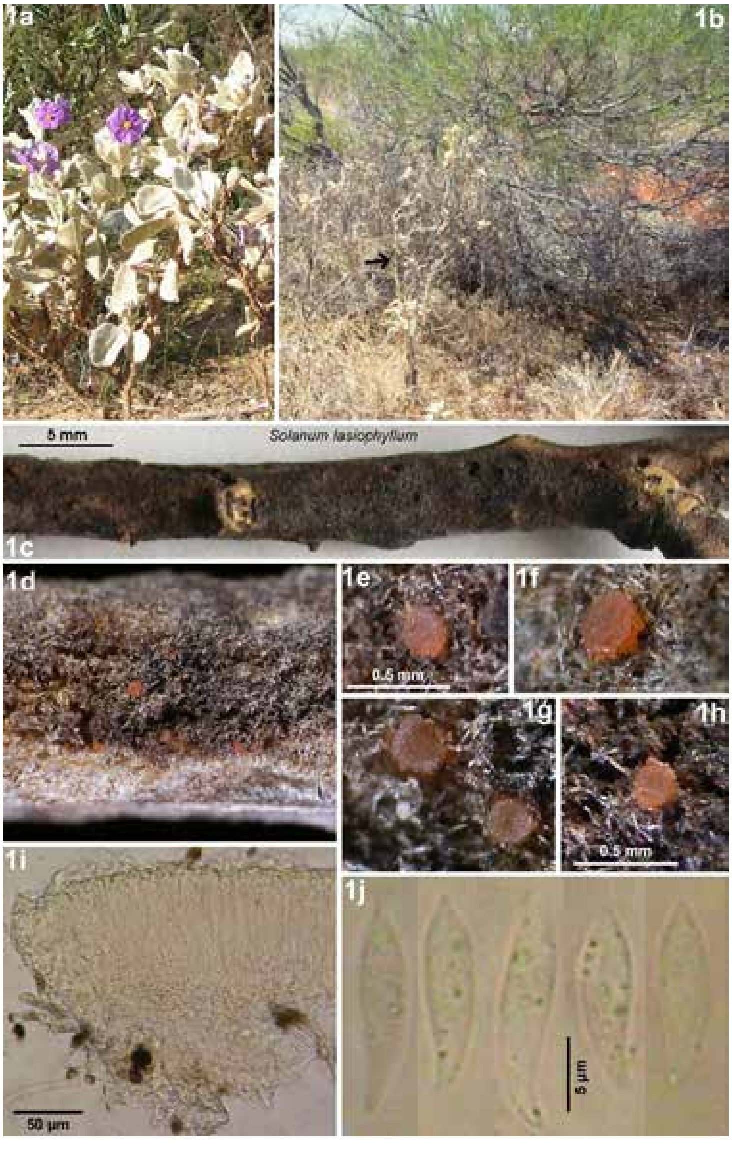


Plate 660. **1**: *Orbilia urosperma*. – **1a**. living *Solanum lasiophyllum*; **1b**. hummock grassland with *Acacia* and dead *Solanum*; **1c**. dead stem of *Solanum* with felty bark; **1d–h**. rehydrated apothecia; **1i**. apothecium in median section; **1j**. ascospores. – Dead state (**1i–j** in KOH). — **1a–j**. H.B. 7299 (holotype): Western Australia, Carnarvon.

Medullary excipulum 30–50 µm thick, of dense textura globulosa-angularis, at least on upper flanks sharply delimited from ectal excipulum by a distinct, narrow, parallel layer of t. porrecta. **Ectal excipulum** of (*) thin-walled, indistinctly vertically oriented t. globulosa-angularis from base to mid flanks, 40–70 µm thick near base, cells *11–21 × 8–17 µm; 15–30 µm thick near margin, of t. prismatica-angularis oriented at a 50–60° angle to the surface, at upper margin also of t. porrecta oriented at 10°, marginal cortical cells *7–11(–14) × 3.5–6(–7) µm. **Anchoring hyphae** abundant, */†2–3.5(–4.5) µm wide, walls 0.2–0.4 µm thick. **SCBs** in terminal cells of paraphyses and ectal excipulum (near margin) globose, 1–2.5 µm diam., in all cells of paraphyses and ectal excipulum rod- to angular or ring-shaped SCBs, pale yellow-orange. **Exudate** granular-cloddy, firmly attached, over paraphyses 0.2–0.5 µm thick, over margin and flanks 0.5–1 µm. — **Anamorph**: unknown.

Habitat: collected 0.2–1 m above the ground, corticated, 3–6 mm thick twigs of *Solanum lasiophyllum*, on medium decayed bark (periderm), greyed, no algae. **Associated**: none observed. **Desiccation tolerance**: fully viable for at least 15 months. **Altitude**: 35 m a.s.l. **Geology**: Cenozoic regolith (red-brown gravel). **Phenology**: long-lived.

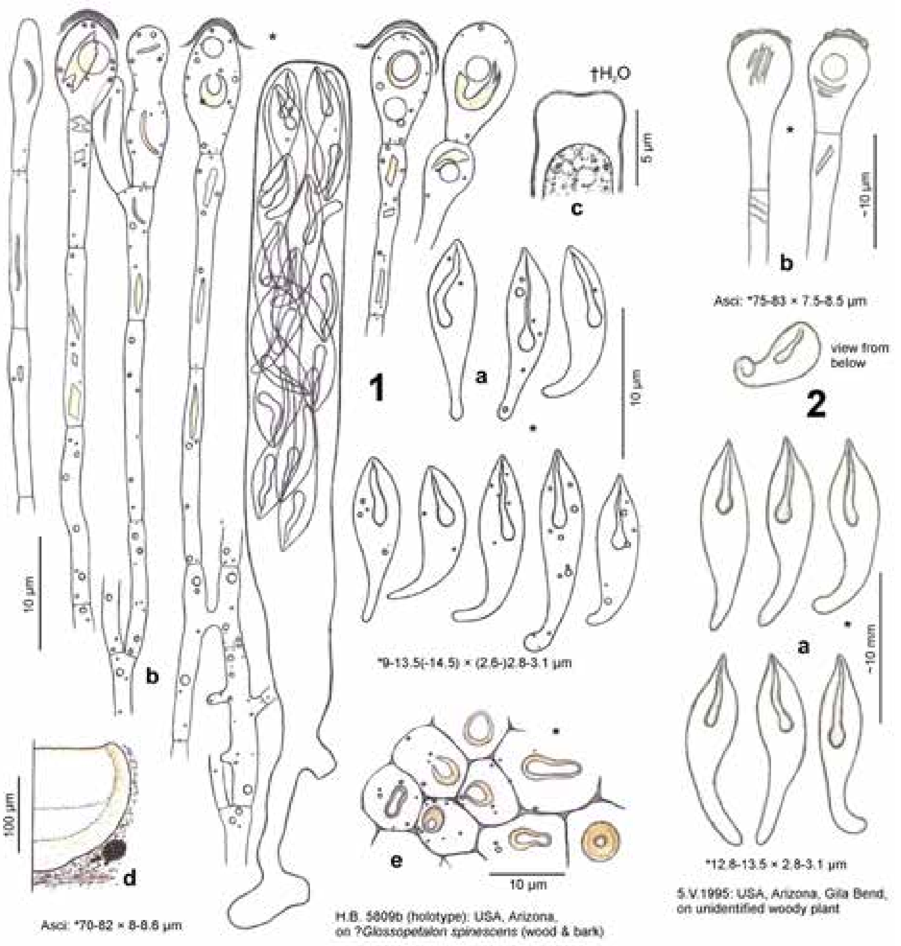


Plate 661. **1–2**: *Orbilia pleiourosperma*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apex; **d**. apothecium in median section; **e**. crystalloid SCBs in ectal excipulum at flanks.

Taxonomic remarks. *Orbilia urosperma* is characterized by large ascospores with strongly acuminate apices and very tapered, partly strongly curved bases. The species resembles *O. bicknellensis*, particularly the Australian collection (on *Atriplex*, Pl. 655: 2), from which it differs in longer asci, spores and spore bodies, and in more strongly curved spore bases. A North American collection tentatively referred to *O. bicknellensis* (on *Baccharis*, Pl. 655: 4) resembles *O. urosperma* in the spores which, however, are basally not curved. The North American *O. pleiourosperma* differs in 16-spored asci and smaller spores with shorter SBs.

Ecology. The single collection of *O. urosperma* was made on bark of xeric woody stems of *Solanum lasiophyllum*, a herbaceous plant growing near sand dunes in a subtropical arid hummock grassland with scattered acacia shrubs in western Australia west of the Pilbara desert.

Specimens included. **AUSTRALIA**: **Western Australia**, Carnarvon, 159 km NNE of Carnarvon, 28 km SW of Mia Mia, 35 m, woody stems of *Solanum lasiophyllum*, on bark, 6.XII.2001, G. Marson (ex H.B. 7299, MEL 2389234, **holotype**).

Orbilia pleiourosperma Baral & G. Marson, **sp. nov.**, MB 813691 — Pls 661–662

Etymology: a 16-spored derivative of *O. urosperma*.

Typification: USA, Arizona, Lukeville, branches of ?*Glossopetalon spinescens*, 5.V.1995, G. Marson (ex H.B. 5809b, M-0276563, holotype).

Latin diagnosis: *Similis* Orbiliae urospermae *sed asci 16-spori, ascosporae breviores, in statu vivo corpuscula refringentia breviora. Habitat ad lignum et corticem putridum ramorum siccorum angiospermarum in zona subtropica (semi)arida Americae septentrionalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.2–0.35 mm diam., 0.13–0.17 mm high, light to deep orange (apricot), scarcely translucent, round, scattered to subgregarious; disc slightly concave to flat, margin distinct, 15 µm protruding, ± smooth; broadly sessile, slightly to strongly erumpent between fibres. **Asci** *70–83 × (7.5–)8–8.6 µm {2}, †60–75 × 6–7.5(–8.5) µm {1}, 16-spored, spores *4-seriate, 8–9 lower spores inverted {1} (often mixed), pars sporifera *48 µm long; **apex** (†) strongly truncate (distinctly indented, laterally inflated); **base** with short to medium long, thin or thick, flexuous stalk, T- to L-shaped. **Ascospores** *(9–)11–13.5(–14.5) × (2.6–)2.8–3.1 µm {2}, †8–12.5 × 2.7–3(–3.3) µm {1}, fusiform-clavate, apex acute to acuminate, base strongly attenuated in a tail-like end or short tail, here slightly to often strongly geniculate; **SBs** *4–6.5 × 0.8–1.3 µm {1}, vermiform to mostly subulate, base slightly to medium inflated, straight to slightly flexuous. **Paraphyses** apically (medium to) strongly clavate-capitate, sometimes spathulate or moniliform, terminal cells *(6–)8–20 × (2.8–)3.8–7 µm {1}, lower cells *11–19 × 1.7–2.3 µm {1}; rarely branched at upper septum, hymenium light orange. **Medullary excipulum** hyaline, 35–40 µm thick, of dense textura globulosa-intricata, sharply delimited. **Ectal excipulum** pale to light orange, of thin-walled, vertically oriented t. angularis-prismatica from base to mid flanks, 25–40 µm thick near base, cells *10–20 × 9–12 µm {1}; 15–20 µm thick near margin, of t. prismatica-angularis oriented at a 10–40° angle to the surface, marginal cortical cells */†5–12 × 3–4 µm {1}, ± thick-walled (0.3–0.5 µm). **Anchoring hyphae** medium abundant, *2–3.5 µm wide, walls 0.2–0.4 µm thick {1}, sometimes forming a loose, hyaline, 20 µm thick layer that covers flanks and margin. **SCBs** in apex of paraphyses globose, 1.5–1.7 µm diam.; in paraphyses and ectal excipulum (from base to margin) rod- or ring- to horseshoe- or keyhole-shaped {2}, pale to bright orange, 3–5(–8) × 2.5–4(–5.2) µm.

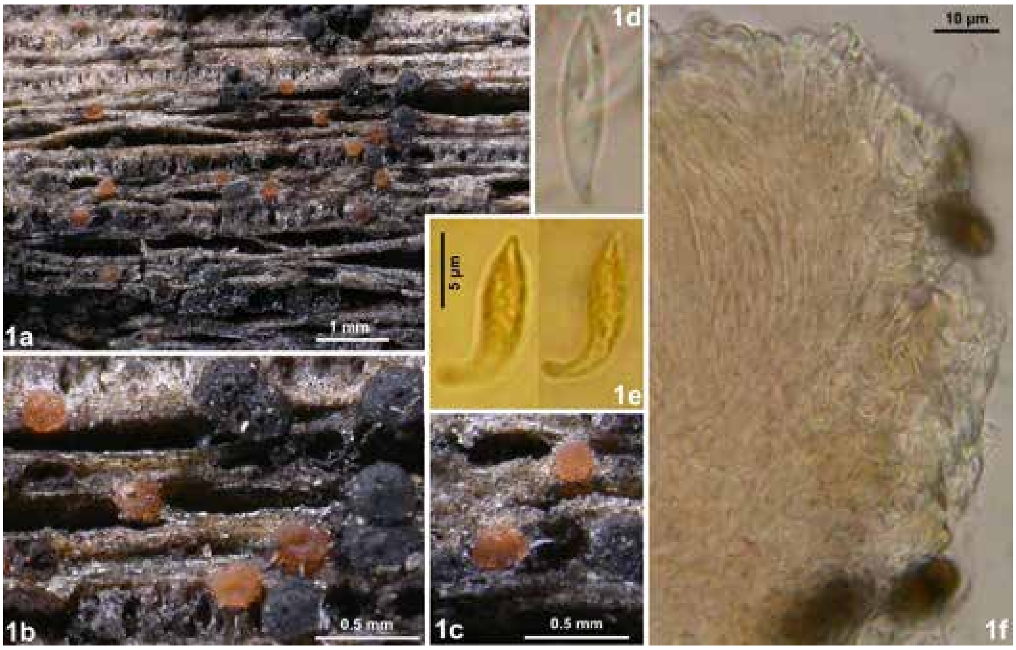


Plate 662. **1**: *Orbilia pleiourosperma*. – **1a–c**. rehydrated apothecia (with *Teichosporella dura*); **1d–e**. ascospores; **1f**. median section of marginal ectal excipulum. – Dead state (**1d**, **f** in H_2O, **1e** in IKI). — **1a–f**. H.B. 5809b (holotype): USA, Arizona, on ?*Glossopetalon*.

Exudate over paraphyses 0.3–0.6 µm thick, finely rough, continuous, ± firmly attached; over margin and flanks 0.2 µm thick, continuous. — **ANAMORPH**: unknown.

Habitat: collected above the ground, partially to entirely decorticated, 7–10 mm thick branches of ?*Glossopetalon spinescens* {1}, unidentified woody angiosperm {1}, on 0.2 mm deep strongly decayed wood {1} and bark {1}, often along clefts, medium greyed, algae very sparse. **Associated**: *Orbilia lentiformis* {1}, *O. myriourosperma* {1}, *O. pluristomachia* {1}, *Schizoxylon* sp. {1}, *Teichosporella dura* {1}. **Desiccation tolerance**: fully viable for at least 25 months. **Altitude**: 250–710 m a.s.l. **Geology**: alluvial sand, silt and clay; felsic volcanic rock. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia pleiourosperma* resembles the Australian *O. urosperma*, from which it mainly differs in 16-spored asci and in shorter ascospores and spore bodies. *O. pleiomesaverdiana* is tentatively segregated from *O. pleiourosperma* based on subacute spore apices. Collections of *O. serpentina* with tapered spore bases differ from *O. pleiourosperma* in that they are only tail-like and much less curved. For the separation from higher-spored taxa see under *O. myriourosperma*, p. 1141.

Ecology. *O. pleiourosperma* is known from two collections on rotten wood and bark of xeric branches of angiosperm shrubs in subtropical semiarid to arid Sonoran paloverde-mixed cacti (in Gila Bend riparian, adjacent to creosotebush-bursage desert scrub) in the southwest of Northern America.

Specimens included. **USA**: **Arizona**, Sonoran Desert, 17.5 km NNE of Lukeville, Organ Pipe, Ajo Mountain Trail, 710 m, branches of ?*Glossopetalon spinescens*, on wood & bark, 5.V.1995, G. Marson (M-0276563, **holotype**: **isotype** in H.B. 5809b). – ~5 km SSW of Gila Bend, Rte. 85, 250 m, on indet. angiosperm, 5.V.1995, G. Marson (ø).

Orbilia multiurosperma Baral & G. Marson, **sp. nov.**, MB 814439 — Pls 663–664

Etymology: named after the 32-spored asci and resemblance to *O. pleio- and myriourosperma*.
Typification: Spain, Alcanar, branches of *Pistacia lentiscus*, 27.IX.1999, H.O. Baral (ex H.B. 6493a, M-0276527, holotype; ex-type culture: CBS 140832; sq.: KT215245, MH878192).

Latin diagnosis: *Similis* Orbiliae pleiourospermae *sed asci 32-spori, sed ascosporae breviores, apice minus acutae, basi minus attenuatae et caudatae, corpusculis refringentibus brevioribus continentes.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.15–)0.2–0.35(–0.5) mm diam., 0.12–0.18 mm high, pale to light orange, round, sometimes compressed, scattered to gregarious; disc slightly concave to flat, margin thin, not protruding, ± smooth; sessile, slightly erumpent. **Asci** *63–87(–92) × (7–)8–9.7(–10.3) µm {4}, †(55–)60–85(–98) {4} × 5.7–7 {1} or 7.5–9.5(–10.2) {3} µm, 32-spored (28–32 counted), spores (*) ~4-seriate, lower spores inverted {2} (somewhat mixed), pars sporifera *40–59 µm long; **apex** (†) medium to strongly truncate (not or distinctly indented, laterally inflated or not); **base** without or with medium short, ± thick and flexuous stalk, L-, Y- or h-shaped. **Ascospores** *(6–)7–10(–10.5) {4} × (2.5–)2.7–3(–3.2) {4} or 3–3.5 {1} µm, †(6–)7–10(–11) × 3–3.7(–4) µm {3}, ellipsoid- to fusoid-clavate, apex obtuse to subacute, base strongly attenuated in a tail-like end or short tail, mostly slightly to medium curved near base; **SBs** *(2.5–)3–3.5(–4) × 0.5–0.9 µm in situ {3} (~2.5–5 µm actual length), rod-shaped to subulate with uninflated or slightly to strongly swollen base, or divided into an abruptly swollen, subglobose to tear-shaped lower part and a fine filum of ± equal length, straight to medium flexuous, rarely uncinate. **Paraphyses** apically (slightly to) medium to strongly capitate(-clavate), terminal cells *(4–)5–16 × (3–)4–6(–6.7) µm {3}, †3–6(–7) µm wide, lower cells *(5–)8–17(–18.5) × 1.5–3 µm {3}; sometimes branched near apex. **Medullary excipulum** 10–50 µm thick, of dense, horizontally oriented textura porrecta-intricata with many inflated cells, ± indistinctly delimited. **Ectal excipulum** hyaline to pale rose-orange, of thin-walled, indistinctly oriented t. globulosa-angularis from base to submargin, 10–40 µm thick near base, cells *6–11 × 5–9.5 µm {2}; 10–30 µm thick near margin, not or slightly gelatinized, of t. prismatica-porrecta oriented at a 10–40° angle to the surface {1}, or of t. angularis-prismatica at 40–90° {3}, marginal cortical cells *10–14 × 3–3.5(–5) {1} or *7–9 × 4–7 µm {1}. **Anchoring hyphae** sparse, †1.7–3.3 µm wide, walls 0.2–0.3(–0.4) µm thick {2}, forming a thin layer that partly covers also the margin. **SCBs** in paraphyses and ectal excipulum (near margin) globose, 1–3 µm diam., and rod- or ring-shaped {4}, very pale orange. **Exudate** over paraphyses 0.2–0.8(–1.5) µm thick, rough to granular, ± loosely attached, partly lacking; over margin and flanks thin, pale yellowish. — **ANAMORPH**: trinacrium-like (from ascospore isolate {1} and natural substrate {2}). **Conidiophores** not observed. **Conidia** Y- to T-shaped, total size */†21–30(–37) × 17–32(–35) µm, stipe *15–19 × 5.2–5.5 µm, 2(–3)-septate, arms tapering, *(5.5–)8.5–15.5 × 4.5–6 µm, (0–)1–2(–3)-septate {2}; exceptionally 3-armed (cross-like), with one arm dichotomously branched.

Habitat: collected 0–1.5 m above the ground, entirely or only upper side decorticated, 4–16 mm thick twigs and branches of *Atriplex halimus* {2}, *Larrea tridentata* {4}, *Pistacia lentiscus* {1}, on 0.2–1 mm deep strongly decayed wood {7}, eroded, bleached or medium to strongly greyed, without or with some green algae, partly along longitudinal cleft. **Associated**: *Carestiella ?schizoxyloides* {2}, *Eutypella* sp. {1}, *Coniochaeta* sp. {1}, ?*Muellerella* sp. {1}, *Lecanora* sp. {1}, *Orbilia ?breviclava* {1}, *O. cryptogena* {3}, *O. halimi* {2}, *O. multicercocarpi*

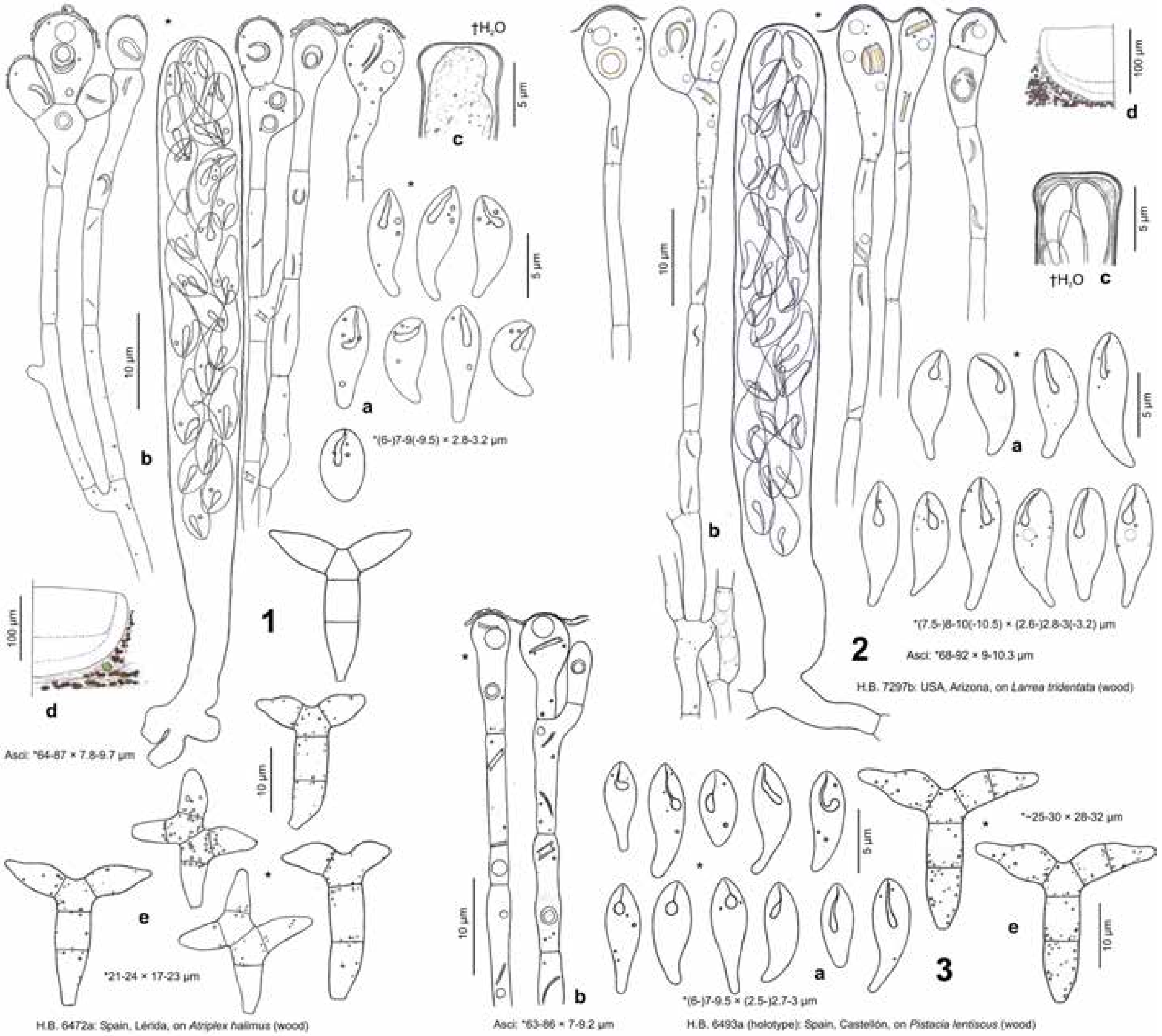


Plate 663. **1–3**: *Orbilia multiurosperma*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. apothecia in median section; **e**. conidia from substrate.

{1}, *O.* ?*navajoana* {1}, *O. pluristomachia* {3}, *O. sedonensis* {1}, *O. sonorensis* {1}, *Patellaria atrata* {1}, ?*Phoma* sp. {1}, *Symbiotaphrina larreae* {2}. **Desiccation tolerance**: fully viable for at least 10 months. **Altitude**: 3–283 m a.s.l. (Spain), 500–1145 m (Arizona). **Geology**: Cenozoic sand-, lime- and mudstone, marl, sand & gravel, silt & clay; alluvial deposits from granite. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia multiurosperma* is characterized by 32-spored asci and ellipsoid-clavate ascospores with obtuse to subacute apices, curved tail-like bases or short tails, and rather short spore bodies. *O. multimaeandrina* differs in more acute spore apices, mostly absent spore tails, longer SBs, and in lacking crystalloid SCBs. For the differences to *O. myriourosperma* see p. 1141.

An Australian collection mentioned under *O. multivirgula* (Pl. 755: 2) was only studied in the dead state and possibly represents a species of its own. The spores are distinctly narrower compared to *O. multiurosperma*, but they are too wide to be included in *O. multivirgula*. A collection from Utah (Pl. 693: 2) mentioned under *O. paloverdensis* deviates from *O. multiurosperma* in longer, more abrupt spore tails and longer asci, but its vital characters are largely unknown. Only a few living paraphyses were seen which did not contain any crystalloid SCBs

Variation. The four North American collections of *O. multiurosperma* on *Larrea* match quite well the three European ones. In one of them (H.B. 7397b), the marginal excipulum deviated in a t. prismatica-porrecta oriented at a low angle, but in another (H.B. 9573c) it was of t. angularis-prismatica oriented at 50–80°, similar as in the European specimens. The North American collections showed a tendency to longer or wider spores and especially larger asci. In a Spanish collection a single abnormal ascus with mostly broadly ellipsoid spores was observed (Pl. 663: 1a below).

Anamorph. The trinacrium robustum-like conidia of *O. multiurosperma* resemble those of *O. serpentina* in shape, but the arms tend to project more laterally (T-shaped). A single conidium was obtained in pure culture of the holotype. It was larger than all conidia observed on the substrate near apothecia (total size †37 × 35 µm, 3-septate arms and stipe).

Phylogeny. A sequence was gained from the ex-type culture which comprises SSU (without S1506 intron), ITS, and LSU.

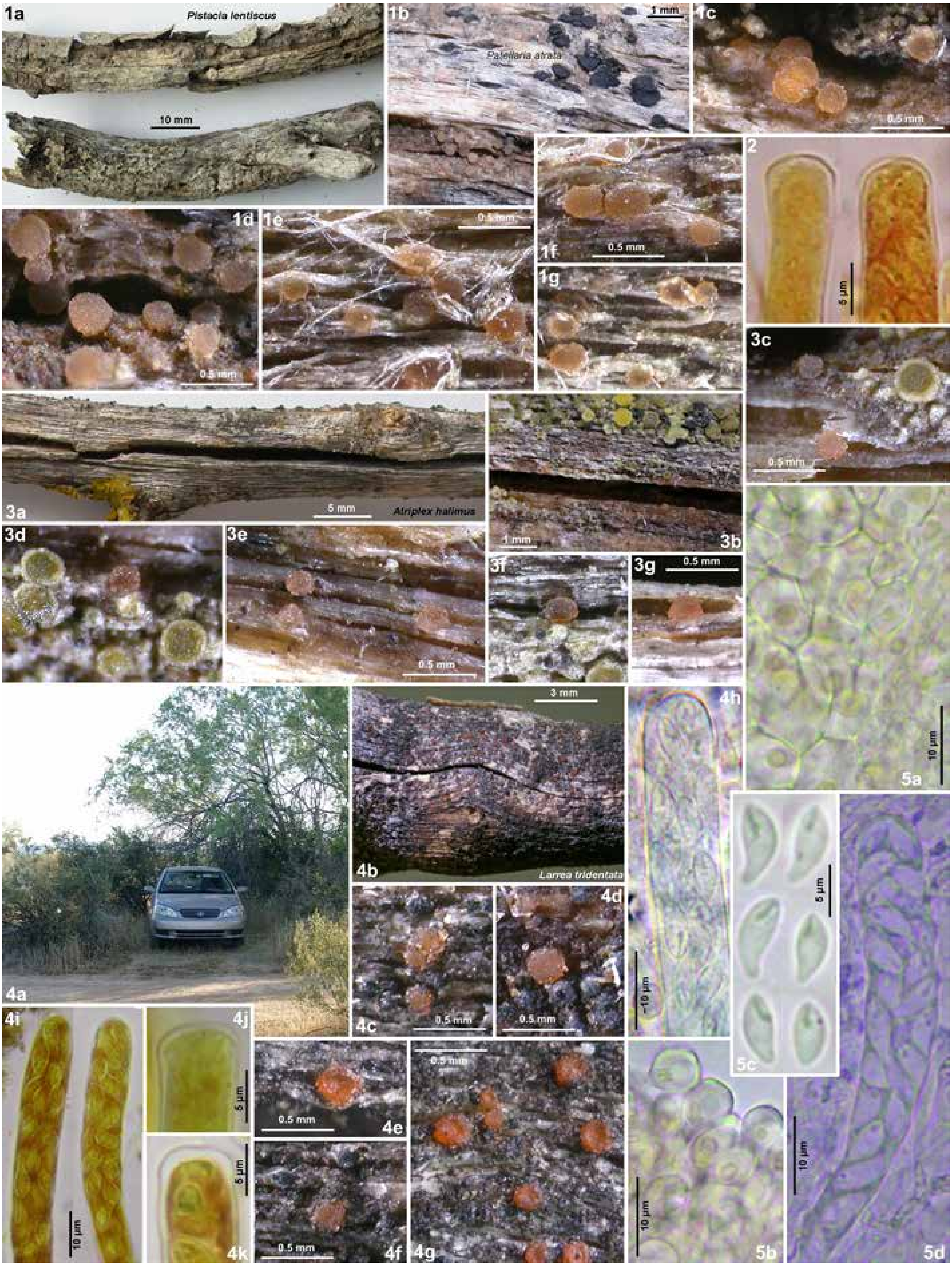


Plate 664. **1–4**: *Orbilia multiurosperma*. – **4a**. *Larrea tridentata* desert scrub with *Prosopis glandulosa* and *Coleogyne ramosissima* in dry riverbed of Sonoran Desert; **1a**, **3a**, **4b**. decorticated xeric branches; **1b–g**, **3b–h**, **4c–h**. rehydrated apothecia (**1b** with *Patellaria atrata*, **3** with *Lecanora*); **2**. apices of asci, **4i–j**. upper part of asci with ascospores. – Dead state (**2**, **4i** in KOH+IKI), except for **4j**. — **1a–g**. H.B. 6493a (holotype): Spain, Castellón, on *Pistacia*; **2**. H.B. 5658g: USA, Arizona, Wickenburg, on *Larrea*; **3a–h**. H.B. 6472a: Spain, Lérida, on *Atriplex*; **4a–j**. H.B. 7397b: USA, Arizona, Phoenix, on *Larrea*.

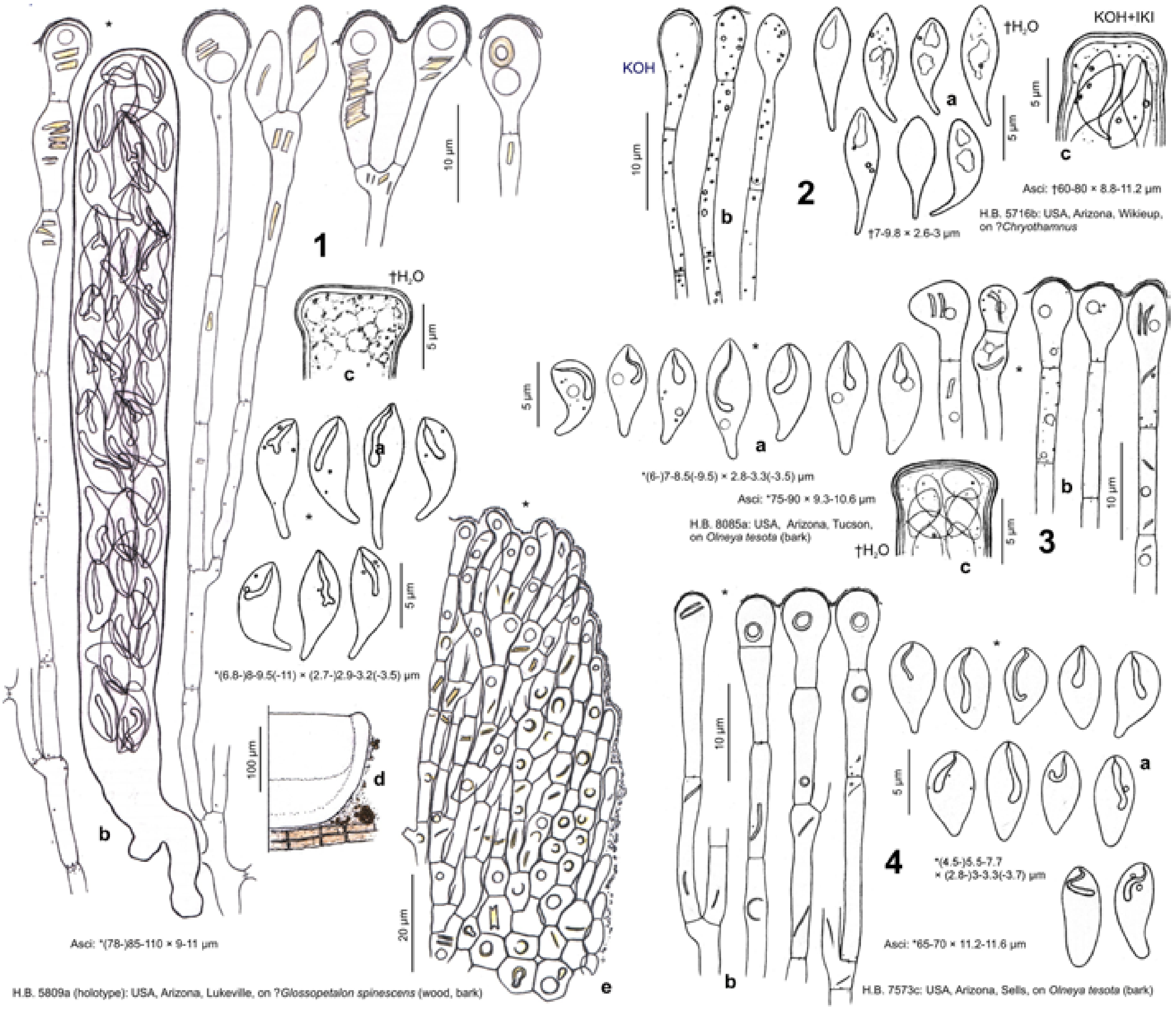


Plate 665. **1–4**: *Orbilia myriourosperma*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apices; **d**. apothecium in median section; **e**. id., marginal ectal excipulum (with crystalloid SCBs).

O. multiurosperma clustered unresolved in the *Serpentinae-Habrostictis* clade, even when including all three gene regions in the analysis (Phyl. 20). The lowest distance in the LSU was 1.6% to *O. carpoboloides* (despite a 17.5% ITS distance to this species), and the lowest ITS distance was 14% to *O. halimi* (LSU 2.9%). Although its affiliation in series *Serpentinae* is confirmed, a few dignostic nucleotides in the LSU D1 (128–129, 132–135) concur with members of series *Ellipsospermae* (Tab. 72).

An environmental sequence from Canadian arctic soil (Prince Patrick Island, KC965181, ITS & LSU) clustered in the analyses of ITS or SSU+ITS+LSU in a medium supported clade with *O. multiurosperma* (Phyls 19–20), but with a 13% ITS distance. Another environmental sequence from there (Banks Island, KC965560, ITS2 & LSU) clustered in a strongly supported clade with KC965181 when analysing LSU D1–D2 (S22), with a 1.3% distance in this domain, but with a minimum distance of 2.2–2.5% to *O. flavidorosella* and *O. filiformis* and 2.5–3% to *O. multiurosperma*.

Ecology. *O. multiurosperma* was collected on rotten wood (and bark) of xeric twigs and branches of different angiosperm shrubs in desertic halophilous ruderal *Atriplex* scrubs (*Agrostio-Tamaricetum canariensis*) and other ruderal places in meso- to thermomediterranean semiarid to semihumid southwestern Europe. Collections from western North America were in subtropical semiarid to arid paloverde-mixed cacti and creosotebush-bursage desert scrubs in the Sonoran Desert but also in the adjacent warm-temperate semiarid Chihuahuan creosotebush-tarbush desert scrub in the Mogollon Rim.

Specimens included. **SPAIN**: **Navarra**, 19 km SSW of Carcastillo, 7 km NE of Arguedas, Bardenas Reales, 283 m, branches of *Atriplex halimus*, on wood, 17.V.2015, J.P. Priou (J.P.P. 15107, doc. vid.). – **Cataluña**, **Lérida**, 10 km WSW of Lérida, 2.5 km NW of Alcarràs, 160 m, branches of *A. halimus*, on wood, 21.IX.1999, G. Marson & H.O. Baral (H.B. 6472a, anam. substr.). – **Com. Valenciana**, **Castellón**, 11 km NE of Vinaròs, 5 km NE of Alcanar, NNE of Les Cases d'Alcanar, sea shore, 3 m, branches of *Pistacia lentiscus*, on wood, 27.IX.1999, H.O. Baral (M-0276527, **holotype**; **isotype** in H.B. 6493a; anam. substr. & anam. cult., CBS 140832; sq.: KT215245, MH878192). — **USA**: **Arizona**, Sonoran Desert, 200 km NW of Phoenix, Wikieup, ~600 m, branches of *Larrea tridentata*, on wood, 3.V.1995, G. Marson (H.B. 9573c). – 82 km NW of Phoenix, ~1.5 km SE of Wickenburg, 615 m, branch of *L. tridentata*, on wood, 4.V.1995, G. Marson (H.B. 5658g). – 32 km NNW of Phoenix, 13 km SW of New River, 500 m, branch of *L. tridentata*, on wood, 19.VI.2003, G. Marson (H.B. 7397b). – Mogollon Rim, 39 km ENE of Safford, 11.3 km S of Clifton, Rte. 191, 1145 m, branch of *L. tridentata*, on wood, 2.VI.2003, G. Marson (H.B. 10118c).

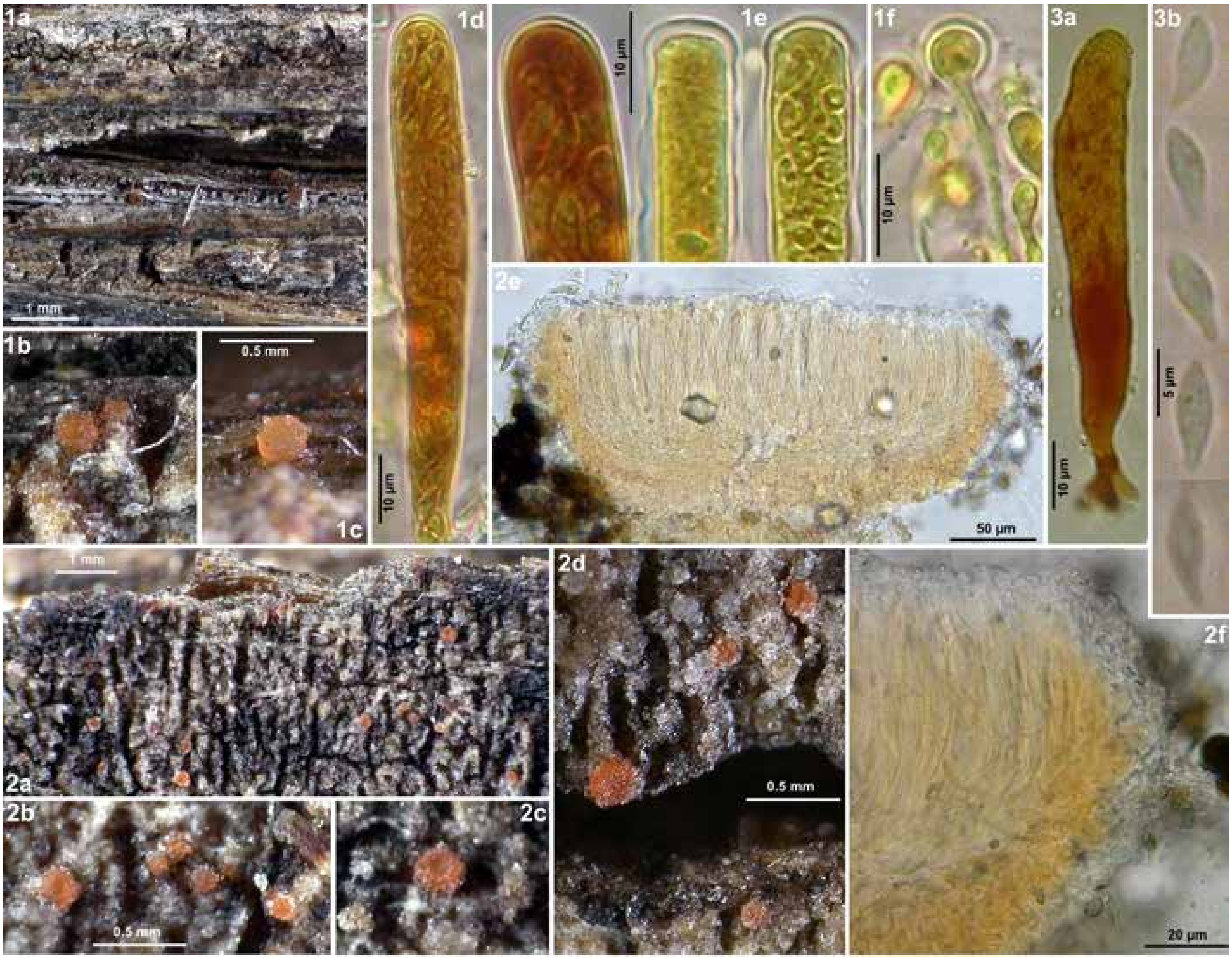


Plate 666. **1–3**: *Orbilia myriourosperma*. – **1a–c**, **2a–d**. rehydrated apothecia; **2e**. apothecia in median section; **2f**. id., marginal region; **1d**, **3a**. asci; **1e**. ascus apices; **1f**. paraphyses; **3b**. ascospores. – Dead state (**2e–f**, **3b** in KOH; **1d–f**, **3a** in KOH+IKI). — **1a–f**. H.B. 5809a (holotype): USA, Arizona, on ?*Glossopetalon*; **2a–f**. H.B. 8085a: USA, Arizona, Tucson, on *Olneya*; **3a–b**. H.B. 8579a: USA, Arizona, Wickenburg, on indet. angiosperm.

Orbilia myriourosperma Baral & G. Marson, **sp. nov.**, MB 813692 — Pls 665–666, Map 109

Etymology: named after the 64-spored asci and a close resemblance to *O. multiurosperma*.

Typification: USA, Arizona, Lukeville, branches of ?*Glossopetalon spinescens*, 5.V.1995, G. Marson (ex H.B. 5809a, M-0276534, holotype).

Latin diagnosis: *Similis* Orbiliae multiurospermae *sed asci 64-spori.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.15–0.35(–0.55) mm diam., 0.12–0.18 mm high, pale to light pure orange(-rose), round, ± scattered; disc flat, margin distinct, 0–10 µm protruding, smooth or finely rough; broadly sessile, slightly to half immersed; dry deep orange-red. **Asci** *65–70 {1} or (74–)85–100(–110) {4} × 8.8–11(–12) µm {5}, †(60–)65–85(–105) × (7.7–)8.5–10(–11)((–12)) µm {5}, 64-spored (50–60 spores counted), spores (*) ~4-seriate, lower spores inverted (strongly mixed), pars sporifera *48–74 µm long; **apex** (†) medium to strongly truncate (rarely slightly indented, laterally ± inflated or not); **base** without or with a short to medium long, thick, flexuous stalk, Y-, L- or h-shaped. **Ascospores** *((4.5–))(6–)7–9.5(–11) × (2.7–)2.9–3.3(–3.5)((–4)) µm {5}, †6.5–9(–10) × (2.4–)2.6–3(–3.3) µm {3}, broadly fusoid- to fusiform-clavate, also ellipsoid-fusoid, apex subacute to acute {3}, also obtuse or rounded {2}, base usually strongly attenuated in a tail-like end or distinct tail *1–3 × 0.5–0.7(–1) µm, †0.3–0.5 µm wide, slightly to strongly geniculate near base; **SBs** *(2–)3–4.5(–5.5) × (0.3–)0.4–0.8(–1.1) µm in situ {3} (~3–6.5 µm actual length), vermiform to subulate, base sometimes slightly inflated, straight to medium flexuous, rarely uncinate. **Paraphyses** apically (slightly to) medium to (very) strongly clavate-capitate, rarely moniliform or spathulate to mammiform, terminal cells *(4.5–)7–19(–27) × (3–)4–5.5(–6.7) µm {3}, †6–13 × 2–4.8 µm {1}, lower cells *(6–)9–18(–22) × 1.5–2.5(–3) µm {3}, †8–18 × 1–2 µm wide {1}; rarely to often branched at upper septum. **Medullary excipulum** 25–60 µm thick, of ± dense textura globulosa-intricata, sharply delimited from ectal excipulum mainly towards margin. **Ectal excipulum** very pale to light orange-rose (especially towards margin), of (†) thin-walled (partly slightly gelatinized), indistinctly oriented t. (globulosa-)angularis from base to mid flanks, 20–30 µm thick near base, cells */†7–12 × (4–)6–10(–11) µm {3}; 20–25 µm thick at mid flanks, 20–30 µm near margin, of t. angularis to t. (prismatica-)porrecta oriented at a 10–20° angle to the surface, marginal cortical cells */†6–13 × 2.5–5(–6) µm {3}, partly firm-walled (wall 0.2–0.4 µm). **Anchoring hyphae** sparse, */†1.3–4 µm wide, walls 0.2–0.3(–0.8) µm thick {3}. **SCBs** in paraphyses and ectal excipulum (near margin) globose, 1–3(–4) µm diam., and rod-, ring- or keyhole-shaped {5}, 2–4.5 × 2–3 µm, hyaline or pale to light yellowish-orange-rose. **Exudate** over paraphyses 0.1–0.4 µm thick, finely rough, closely attached; over margin a 0.1–2 µm thick finely granular layer, partly almost absent. **— ANAMORPH**: unknown.

Habitat: collected 1–2 m above the ground, corticated or partially to almost entirely decorticated, 6–14 mm thick branches of ?*Chrysothamnus* sp. {1}, ?*Glossopetalon spinescens* {1}, *Olneya tesota* {2}, indet. angiosperm {1}, stem of indet. herbaceous (slightly woody) dicotyledonous plant {1}, on 0.2–0.3 mm deep (medium to) strongly decayed wood {2} and bark {4} (bast), often along (partly in)

Map 109. Known distribution of *O. myriourosperma* in North America.

longitudinal or transversal clefts, ± strongly greyed, with some green algae. **Associated**: *Hysterobrevium mori* {1}, *Orbilia ?barrowensis* {1}, *O. lentiformis* {2}, *O. maeandrina* {3}, *O. multicreosoteris* {1}, *O. multigambelii* {2}, *O. ?multiphanosoma* {1}, *O. myrioolneyae* {2}, *O. pleiomesaverdiana* {1/1}, *O. pleiourosperma* {1}, *O. pluristomachia* {1}, *O. sonorensis* {1}, *Patellaria* '*andina*' {3}, *Schizoxylon* sp. {1}, *S. ?argentinum* {1}, *Teichosporella dura* {1}, *Symbiotaphrina desertorum* {1}. **Desiccation tolerance**: fully viable for at least 25 months, after 33.5 months most paraphyses and excipular cells still viable. **Altitude**: 600–745 m a.s.l. **Geology**: Oligo- to Miocene sand-, lime- and mudstone, silt and clay, volcanic rock. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia myriourosperma* is easily recognized by its 64-spored asci and broadly fusoid ascospores which terminate at the base in more or less strongly bent and abrupt tails and contain rather short spore bodies in their apex, also by the presence of crystalloid SCBs. *O. pleiourosperma* is very similar but mainly differs in 16-spored asci and longer spores with consistently acute apices. *O. multiurosperma* differs from these two taxa mainly in 32-spored asci, from the latter also in more obtuse spore apices and less pronounced spore tails.

Variation. The collections here included in *O. myriourosperma* are somewhat heterogeneous. Only in the type collection and that on a herbaceous plant (Pl. 665: 1–2) the spores are consistently provided with distinct, more or less strongly bent tails. In the samples on *Olneya* (Pl. 665: 3–4) and indet. angiosperm (Pl. 666: 3) the tails are somewhat shorter and thicker and mostly only slightly bent. In the two collections on *Olneya* the spore apices are more obtuse than in those on the other substrates, and in one of them (Pl. 666: 4) the spores are mostly tailless and the asci shorter compared to the others though rather wide. This specimen approaches *O. myrioolneyae*, with which it grew in association, but which differs in much narrower spores and in lacking crystalloid SCBs. In their more indistinct tails the collections on *Olneya* and indet. angiosperm also appear to form a transition to *O. sedonensis*, in which the spores are wider and either without tails or only with thick tail-like bases.

Ecology. *O. myriourosperma* was collected on rotten wood and bark of xeric branches of different angiosperm shrubs in subtropical semiarid (to arid) Sonoran paloverde-mixed cacti desert scrubs in the southwest of Northern America.

Specimens included. **USA**: **Arizona**, Sonoran Desert, 200 km NW of Phoenix, Wikieup, ~600 m, branch of *?Chrysothamnus*, on wood, 3.V.1995, G. Marson (H.B. 5716b). – 82 km NW of Phoenix, ~1.5 km SE of Wickenburg, 615 m, branch of indet. angiosperm, on bark, 4.V.1995, G. Marson (H.B. 8579a). – 25 km WNW of Tucson, 5 km S of Picture Rocks, Saguaro, 745 m, branches of *Olneya tesota*, on bark, 30.V.2003, G. Marson (H.B. 8085a). – 17.5 km NNE of Lukeville, Organ Pipe, Ajo Mountain Trail, 710 m, branches of ?*Glossopetalon spinescens*, on wood & bark, 5.V.1995, G. Marson (M-0276534, **holotype**; **isotype** in H.B. 5809a). – 100 km WSW of Tucson, 10 km NW of Sells, 683 m, branch of *Olneya tesota*, on bark, 28.V.2003, G. Marson (H.B. 7573c).

Orbilia sedonensis Baral & G. Marson, **sp. nov.**, MB 813693 — Pls 667–668

Etymology: named after the collection from Oak Creek Canyon north of the town Sedona (Arizona).

Typification: USA, Arizona, Tucson, branch of *Parkinsonia* (?)*microphylla*, 6.V.1995, G. Marson (ex H.B. 5671a, M-0276584, holotype).

Latin diagnosis: *Similis* Orbiliae myriourospermae *sed ascosporae basi non vel breviter caudatae*, *subrectae*.

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.12–0.4(–0.8) mm diam., 0.15 mm high, light to bright orange, translucent, round, scattered to subgregarious; disc flat, margin thin, not protruding, smooth; sessile, ± half immersed in host tissue; dry deep orange. **Asci** *83–112 × 9.2–11(–12) µm {3}, †78–88 × 7.2–9.2 µm {1}, 64-spored (49–58 spores counted), spores *4–6-seriate, lower spores inverted (strongly mixed), pars sporifera *67–80 µm long; **apex** (†) medium to strongly truncate (not indented, laterally distinctly inflated); **base** without or with very short, thick, flexuous stalk, L- or h-shaped. **Ascospores** *5.2–8 × (2.8–)3–3.8(–4.2) µm {3}, †5–7 × (2.6–)3–3.2(–3.8) µm {1}, broadly fusiform (to fusiform-clavate), rhomboid, apex subacute, also acute, base strongly attenuated, also with a thick

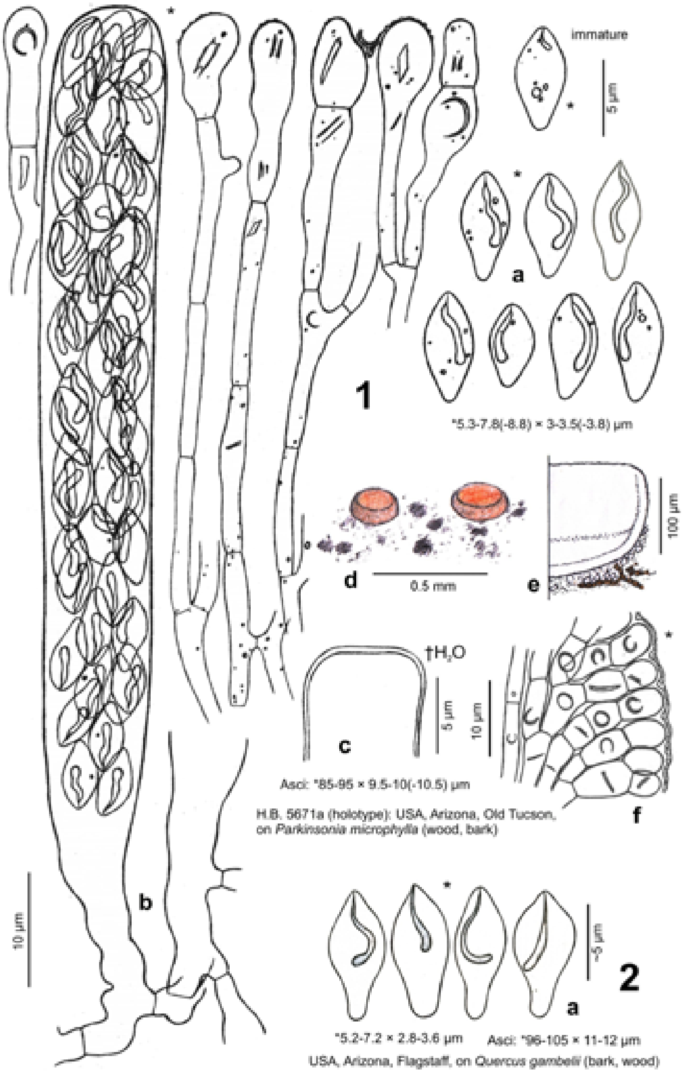


Plate 667. **1–2**: *Orbilia sedonensis*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apex; **d**. rehydrated apothecia; **e**. apothecium in median section; **f**. id., marginal ectal excipulum (with crystalloid SCBs).

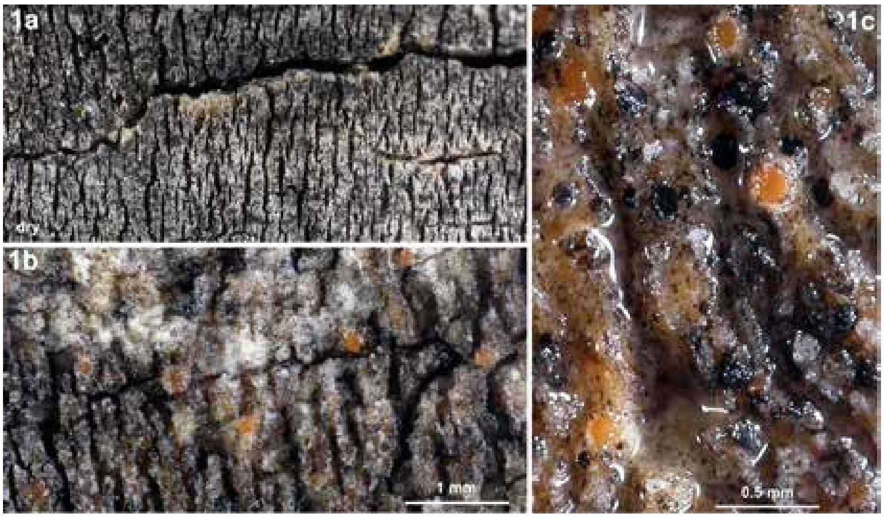


Plate 668. **1**: *Orbilia sedonensis*. – **1a**. clefty outer surface of dead corticated xeric branch (dry state); **1b–c**. rehydrated apothecia. — **1a–c**. H.B. 5671a (holotype): USA, Arizona, on *Parkinsonia* (?)*microphylla* (paloverde).

and short tail-like base, straight or scarcely inequilateral; **SBs** *4–5(–6) × 0.6–0.8(–1) µm in situ {1} (~4–7 µm actual length), vermiform to subulate, base not or slightly inflated, slightly to strongly flexuous, rarely uncinate. **Paraphyses** apically slightly to strongly clavate-capitate, sometimes spathulate-lageniform, terminal cells *(4–)8–22 × 3–5.3 µm {1}, lower cells *11–17 × 1.3–2 µm {1}; sometimes branched at upper septum. **Medullary excipulum** hyaline, 30–40 µm thick, of dense textura angularis, medium sharply delimited. **Ectal excipulum** pale orange-rose, of slightly gelatinized, horizontally oriented t. (globulosa-)angularis(-prismatica) from base to margin, 10–15 µm thick near base, cells *5–9 × 5–7.5 µm {1}; 10–15 µm thick at mid flanks and margin, oriented at a 10–80° angle to the surface, marginal cortical cells *5–10 × 4–5.5 µm {1}. **Anchoring hyphae** medium abundant, *2–4 µm wide, walls 0.2–0.3 µm thick {1}. **SCBs** in paraphyses and ectal excipulum (near margin) pale yellow-orange, rod- or ring-shaped {3}. **Exudate** over paraphyses 0.3–1 µm thick, finely granular, partly absent; over margin and flanks 1–2 µm thick, continuous. **— ANAMORPH**: unknown.

Habitat: collected 1.5–2.5 m above the ground, ± corticated, 18–19 mm thick branches of *Parkinsonia* (?)*microphylla* {1}, *Larrea tridentata* {1}, *Quercus gambelii* {1}, on 0.2–0.5 mm deep very decayed wood {3} and bark {2} (bast), greyed, no algae. **Associated**: *Orbilia ?breviclava* {1}, *O. calyptrata* {1}, *O. cryptogena* {1}, *O. gambelii* {1}, *O. maeandrina* {1}, *O. multicercocarpi* {1}, *O. multiurosperma* {1}, *O. ?navajoana* {1}, *O. paloverdensis* {1}, *O. pleioserpens* {1}, *O. pluristomachia* {1}, *O. sonorensis* {1}, *Patellaria* '*andina*' {1}. **Desiccation tolerance**: fully viable for at least 19 months. **Altitude**: 615–1955 m a.s.l. **Geology**: Permian and Triassic sand-, lime- & mudstone; volcanic rock. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia sedonensis* is characterized by 64-spored asci, broadly fusiform (trapezoid) ascospores, and by the presence of crystalloid SCBs. The spores of the 32-spored *O. multimaeandrina* are partly similar, but in this species crystalloid SCBs are absent. *O. myriourosperma* differs from *O. sedonensis* in the spores having pronounced and partly distinctly bent tails. However, collections on *Olneya* (Pl. 665: 3–4) approach *O. sedonensis* in having more or less indistinct spore tails.

Variation. The three collections of *O. sedonensis* varied only slightly in spore shape. Particularly in the record on *Quercus* (Pl. 667: 2) the spore bases are partly tail-like though rather thick.

Ecology. *O. sedonensis* is only known from western North America where it was recorded on rotten bark and wood of xeric branches of angiosperm shrubs (paloverde and creosotebush) in subtropical semiarid Sonoran paloverde-mixed cacti desert scrubs but also on *Quercus gambelii* in a cold-temperate humid ponderosa pine forest of the Mogollon Rim.

Specimens included. **USA**: **Arizona**, Mogollon Rim, 22 km SSW of Flagstaff, 17.5 km N of Sedona, Oak Creek Viewpoint, 1955 m, branch of *Quercus gambelii*, on wood & bark, 8.V.1995, G. Marson (ø). – Sonoran Desert, 82 km NW of Phoenix, ~ 1.5 km SE of Wickenburg, 615 m, branch of *Larrea tridentata*, on wood, 4.V.1995, G. Marson (H.B. 5658b). – 19 km W of Tucson, W of Old Tucson Studios, 810 m, branch of *Parkinsonia* (?)*microphylla*, on bark & wood, 6.V.1995, G. Marson (ex H.B. 5671a, M-0276584, **holotype**).

Orbilia cactacearum Baral & G. Marson, **sp. nov.**, MB 813694 — Pls 669–670

Etymology: named after the occurrence on *Cactaceae*.

Typification: USA, Arizona, Lukeville, stems of *Stenocereus thurberi*, 5.V.1995, G. Marson (ex H.B. 5686, M-0276446, holotype).

Latin diagnosis: *Similis* Orbiliae coniferarum *sed ascosporae paulo latiores, corpusculum refringens brevius, cellulae vivae excipuli et paraphysium corpuscula crystalloidea continentes. Habitat ad lignum siccum, leniter vel valde putridum* Cactacearum *in zona subtropica semiarida Americae septentrionalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.12–)0.2–0.45(–0.65) mm diam., 0.12–0.22 mm high, pale to bright orange, medium translucent, round, subscattered to subgregarious; disc medium concave to flat, margin distinct, 0–20 µm protruding, ± smooth; broadly sessile, slightly erumpent between fibres; dry bright orange. **Asci** *52–60 × (5.7–)6–7(–7.5) µm {2}, †47–66 × 5.5–6.5(–7) µm {2},

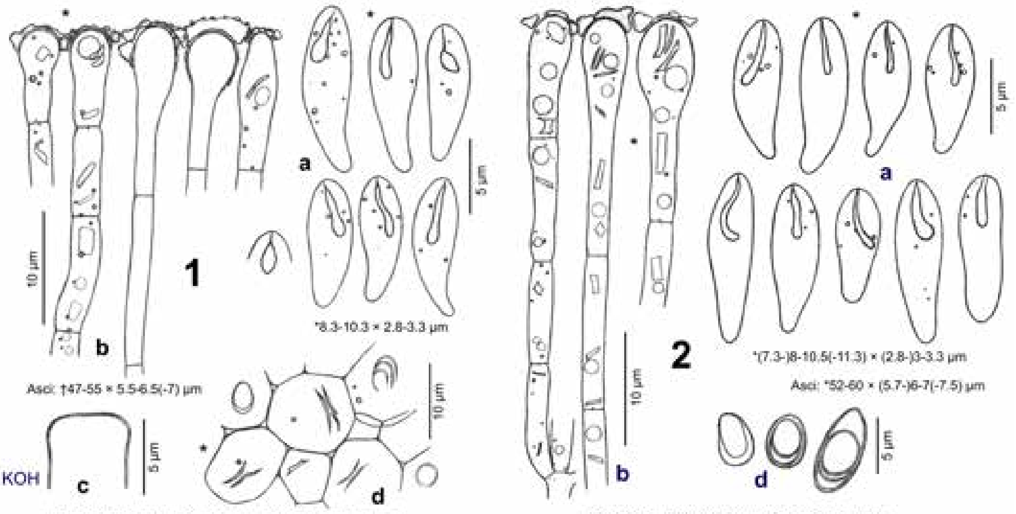


Plate 669. **1–2**: *Orbilia cactacearum*. – **a**. ascospores; **b**. paraphyses; **c**. ascus apex; **d**. crystalloid SCBs in cells of ectal excipulum.

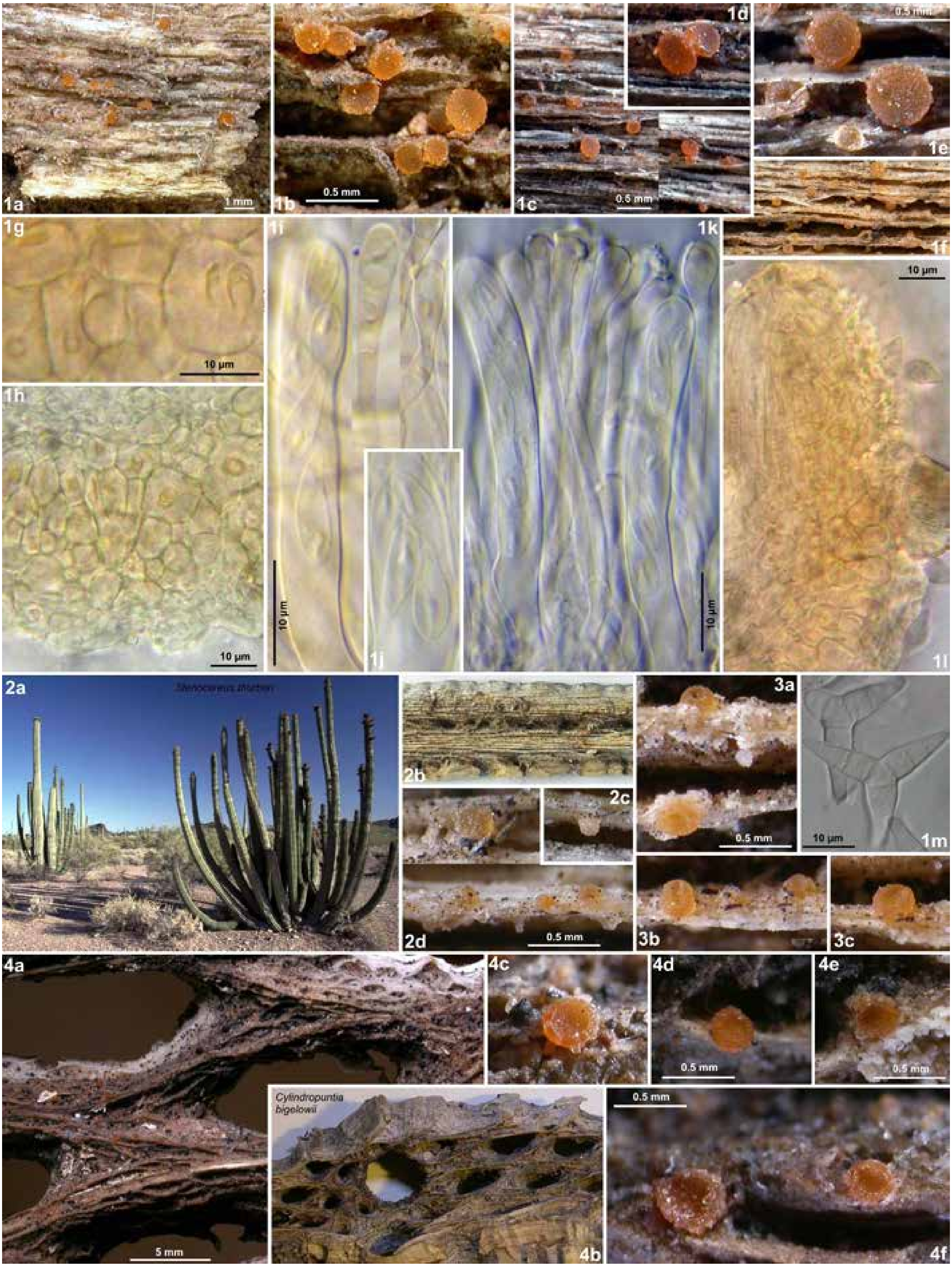


Plate 670. **1–4**: *Orbilia cactacearum*. – **2a**. semiarid cacti desert scrub with *Stenocereus thurberi* and *Carnegiea gigantea*; **2b**, **4a–b**. rotten skeleton parts of *Stenocereus thurberi* and *Cylindropuntia bigelovii*; **1a–f**, **2c–d**, **3a–c**, **4c–f**. rehydrated apothecia; **1l**. median section of marginal ectal excipulum (with conidia of *Acremonium limoniforme*); **1g–h**. id. but near base, with crystalloid SCBs; **1i–k**. paraphyses and asci with mature spores; **1m**. conidia from substrate. – Living state. — **1a–m**. H.B. 7764c: USA, Arizona, Lukeville, on *Carnegiea*; **2a–b**. H.B. 5686 (holotype): ibid., on *Stenocereus*; **3a–c**. H.B. 7217a: ibid.; **4a–f**. H.B. 8355b: ibid., on *Cylindropuntia*.

8-spored, spores (*) biseriate, (2–)3–4(–5) lower spores inverted {3} (not mixed), pars sporifera *23–28 µm long; **apex** (†) medium (to strongly) truncate (not indented, laterally not or distinctly widened); **base** with short to medium long, thick or thin, flexuous stalk, T-, L- or Y-shaped. **Ascospores** *(7.3–)8–10.5(–11.3) × 2.8–3.5(–4) µm {3}, †7–11 × 2.5–3.3 µm {2}, ellipsoid-clavate, apex rounded to obtuse, base medium to strongly attenuated, sometimes tail-like, straight or slightly curved at base; **SBs** *(3–)3.5–4.5(–5) × (0.3–)0.5–0.8(–1.1) µm in situ {3} (~3.5–5 µm actual length), subulate, sometimes narrowly pear-shaped, base not or slightly inflated, straight to medium flexuous; SBs in aged spores ~3 × 1–1.1 µm, with a broadly fusoid lower part and a distinct filum. **Paraphyses** apically slightly to medium (to strongly) clavate-capitate, sometimes spathulate, rarely sublageniform, terminal cells *6–23 × 3–5 µm {2}, †2.7–4 µm wide, lower cells *8–15 × 1.8–2.5(–3.3) µm {2}; never branched near apex. **Medullary excipulum** hyaline to pale orange, 40–90 µm thick, of ± loose or dense textura intricata with a few or many inflated cells, sharply delimited from ectal excipulum (at flanks by a 5–10 µm thick t. porrecta). **Ectal excipulum** subhyaline to pale rose, of slightly gelatinized, vertically oriented t. angularis(-prismatica) from base to mid flanks or margin, 25–60 µm thick near base, cells *8–22 × 6–16 µm {3}; 15–30 µm thick near margin, of t. porrecta oriented at a 0–30° angle to the surface, or of t. angularis oriented at 70°, marginal cortical cells *5–11 × 2.8–4 µm {2}. **Anchoring hyphae** medium to abundant, */†2–4.2 µm wide, walls 0.2–0.5 µm thick {3}, partly covering flanks and margin as a thin layer. **SCBs** in paraphyses and ectal excipulum (near margin) globose, 1–2.5 µm diam., together with rod- or ring-shaped ones {4}, 3–7.5 × 2.5–3.8 µm, hyaline to pale orange. **Exudate** over paraphyses, margin and flanks 0.3–2 µm thick, cloddy, ± firmly attached. **— ANAMORPH**: unknown (but see below).

Habitat: lying on dry ground or up to 0.5 m above the ground, 15–30 mm thick branches of *Carnegiea gigantea* {1}, *Cylindropuntia bigelovii* {1}, *Stenocereus thurberi* {2}, on slightly to strongly decayed wood {4} (outer layers removed), on outer and inner side, greyed, no algae. **Associated**: *Acremonium limoniforme* (parasitic in *O. cactacearum*) {1}, *Orbilia carnegieae* {1/1}, *O. saguarina* {2}, *Teichosporella dura* {1}, ?*Trichopeziza* sp. {1}. **Desiccation tolerance**: fully viable for at least 28 months. **Altitude**: 710–750 m a.s.l. **Geology**: felsic volcanic rock, lava breccia of basalt, andesite, dacite & rhyolite. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia cactacearum* is similar to *O. coniferarum*, from which it differs in shorter spore bodies, slightly wider ascospores, and the presence of crystalloid SCBs. For the similar *O. sonorensis* see p. 1145. Also *O. multiurosperma* seems to be very similar, except for 32-spored asci and more tailed and curved spore bases.

Variation. The collections on *Stenocereus* and *Carnegiea* fit very well in shape of ascospores and SBs, also in size of asci and spores; that on *Cylindropuntia* was insufficiently documented but appears to match this species.

Not included collection. A very similar collection on *Krascheninnikovia* (IVV: H.B. 6085g) featured much longer asci (*67–106 × 6.5–7.5 µm, †65–88 × 6.5–7 µm) and longer spores (*11–13 × ~3–3.5 µm) and is, therefore, not included in the description. It grew in association with *O. bicknellensis*, from which it merely differs in rounded spore apices.

Anamorph. Some trinacrium robustum-like conidia were found near the apothecia on the natural substrate (Pl. 670: 1m), partly even in the hymenium. Their arms and stipes are narrower (5.2–6 µm wide) than those found near the associated *O. saguarina*. Yet, also some tridentaria-like conidia were found intermingled, and also a few unbranched conidia occurred.

Ecology. *O. cactacearum* was so far only found within a small area of the Sonoran Desert in the southwest of Northern America, where it grew on xeric branches of different large *Cactaceae* (cholla, organ pipe, saguaro) in the subtropical semiarid (almost arid) Sonoran paloverde-mixed cacti desert scrub. The not included collection on a *Krascheninnikovia* shrub (*Amaranthaceae*) was in a similar but warm-temperate vegetation with *Larrea* etc. in a valley at the border to the Mogollon Rim.

Specimens included. **USA**: **Arizona**, Sonoran Desert, 17.5 km NNE of Lukeville, Organ Pipe, Ajo Mountain Trail, 710 m, branches of *Cylindropuntia bigelovii*, on wood, 5.V.1995, G. Marson (H.B. 8355b). – ibid., branches of *Stenocereus thurberi*, on wood, 5.V.1995, G. Marson (M-0276446, **holotype**; **isotype** in H.B. 5686). – ibid., 11.VI.2000, G. Marson (H.B. 7217a). – ibid., 750 m, branches of *Carnegiea gigantea*, on wood, 28.V.2003, G. Marson (H.B. 7764c).

Not included. **USA**: **Arizona**, Sonoran Desert, 68 km SSE of Flagstaff, 5.5 km NNE of Camp Verde, Montezuma Castle, 975 m, branch of *Krascheninnikovia lanata*, 8.V.1995, G. Marson (H.B. 6085g ø).

Orbilia sonorensis Baral & G. Marson, **sp. nov.**, MB 813695 — Pls 671–672, Map 110

Etymology: named after the Sonoran Desert in which the species was repeatedly found.

Typification: USA, California, branches of *Atriplex confertifolia*, 23.VI.2000, G. Marson (ex H.B. 6721b, M-0276505, holotype; ex-type culture: CBS 116222; sq.: KT215242).

Latin diagnosis: *Similis* Orbiliae cactacearum *sed ascosporae latiores. Habitat ad lignum siccum valde putridum fruticum in zona temperata ad tropica (semi) arida Americae septentrionalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.12–)0.2–0.4(–0.6) mm diam., 0.12–0.15 mm high, pale to bright (greyish- or yellowish-)orange, non-translucent, round to broadly elliptical, subgregarious; disc flat, margin distinct, 10–15 µm protruding, rough, with or without irregular teeth; broadly sessile, distinctly erumpent between fibres (half to entirely immersed). **Asci** *(57–)60–75(–84) × (6.8–)7.2–8.5(–8.8) µm {7}, †50–68 × 6.8–7.8 µm {3}, 8-spored, spores *(1–)2(–3)-seriate, 2–4(–6) lower spores inverted {4} (often mixed), pars sporifera *35 µm long (†37–44 µm); **apex** (†) medium to strongly truncate (sometimes slightly indented, laterally distinctly inflated or not); **base** with very short to medium long, thick, flexuous stalk, T-, L- or Y-shaped. **Ascospores** *(8–)8.5–12(–12.8) × (3.2–)3.5–4.3(–4.8) µm {7}, †8–11 × 3.5–4 µm {3}, ellipsoid to fusoid or fusoid-clavate, ± amygdaliform, apex obtuse (to subacute), rarely rounded, base not or slightly, sometimes medium attenuated, straight to slightly inequilateral, base rarely slightly curved; **SBs** *(5–)6–7(–8.5) × 0.8–1.2 µm in situ {2} (~5.5–8.5 µm actual length), vermiform to subulate, base slightly to strongly inflated, slightly to medium flexuous; aged spores *7.5–11 × 3.7–4.3 µm, SBs 1.7–2.5 × 1.3–1.4 µm. **Paraphyses** apically slightly to strongly clavate-capitate, often moniliform, terminal cells *(3.5–)5–12(–15) × (2.5–)3.5–5(–5.5)((–7.5)) µm {3}, lower cells *5–10(–15) × 1.7–2.3 µm {1} (subapical cells often 3–4.5 µm wide); frequently branched at upper septum. **Medullary excipulum** hyaline, 15–40 µm thick, of dense textura intricata with many inflated cells, sharply delimited. **Ectal excipulum** hyaline, of (†) slightly gelatinized, ± vertically oriented t. angularis from base to submargin, 30–45 µm thick near base, cells *10–20 × 8–13 µm {1}, †8–13 × 6–8.5 µm {1}; 15 µm thick near margin, of t. prismatica-porrecta oriented at a 20–30° angle to the surface, marginal cortical cells *6–8 × 3.5–4 µm {1}. **Anchoring hyphae** abundant, †2–3 µm wide, walls 0.1–0.5 µm thick {1}, covering flanks and margin as a ± thick layer. **SCBs** in paraphyses and ectal excipulum (near margin) globose, 0.6–1.2 µm diam., and rod- or ring-shaped {5}, hyaline. **Exudate** over paraphyses 0.2–0.5 µm thick, finely rough, continuous, firmly attached. **— ANAMORPH**: trinacrium-like (from ascospore isolate and natural substrate {1}). **Conidiophores** not seen. **Conidia** Y-shaped, total size †23–25 × 19–26 µm, stipe †13–15 × 5–5.5 µm, 1–2-septate, arms tapering, †10–14 × 4–5 µm, 1–2-septate {1}.

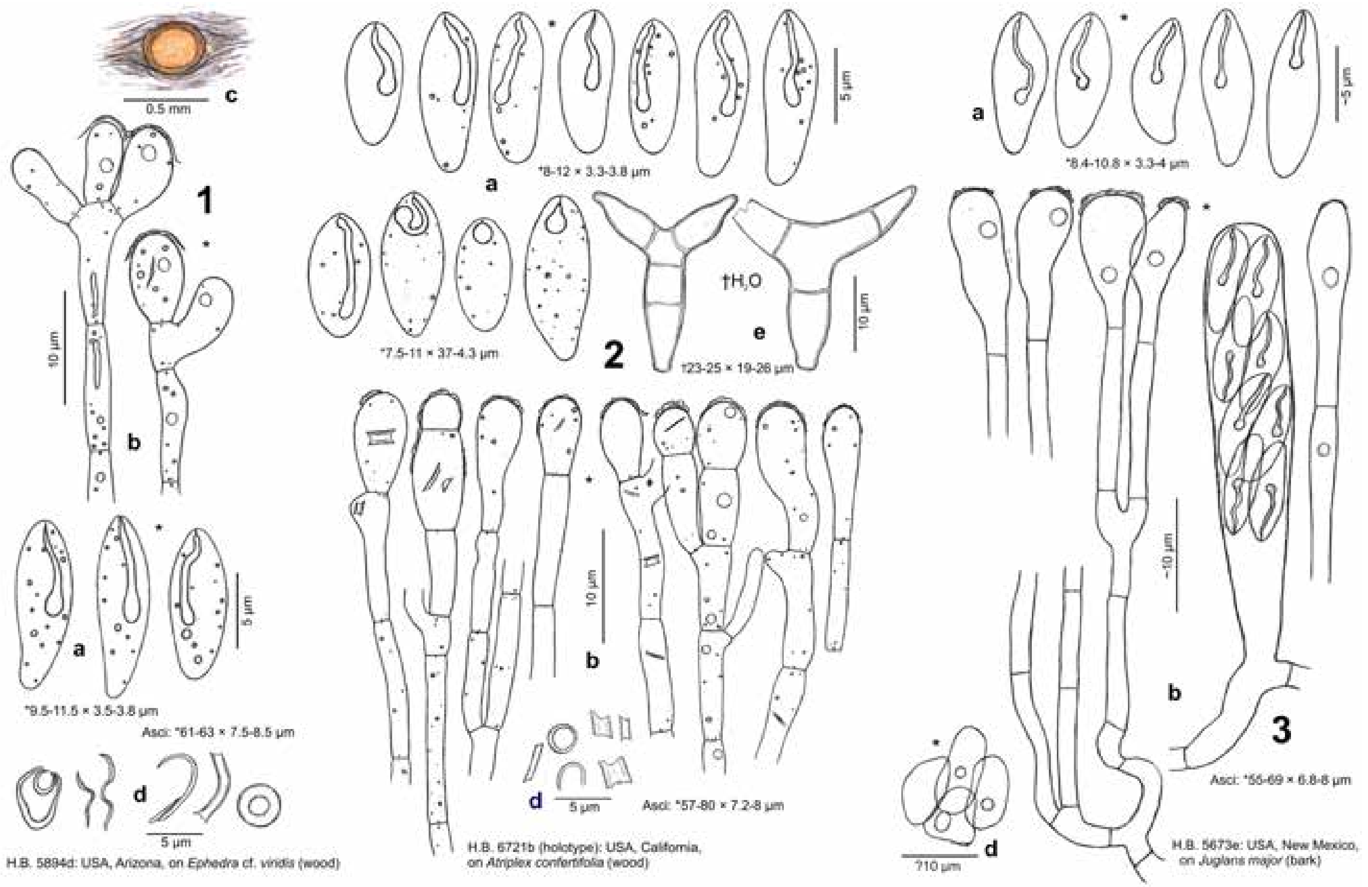


Plate 671. **1–2**: *Orbilia sonorensis*; **3**: *O.* cf. *sonorensis*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. rehydrated apothecium; **d**. crystalloid SCBs in basal (**1d**) or marginal (**2d**) ectal excipulum; **e**. conidia from substrate.

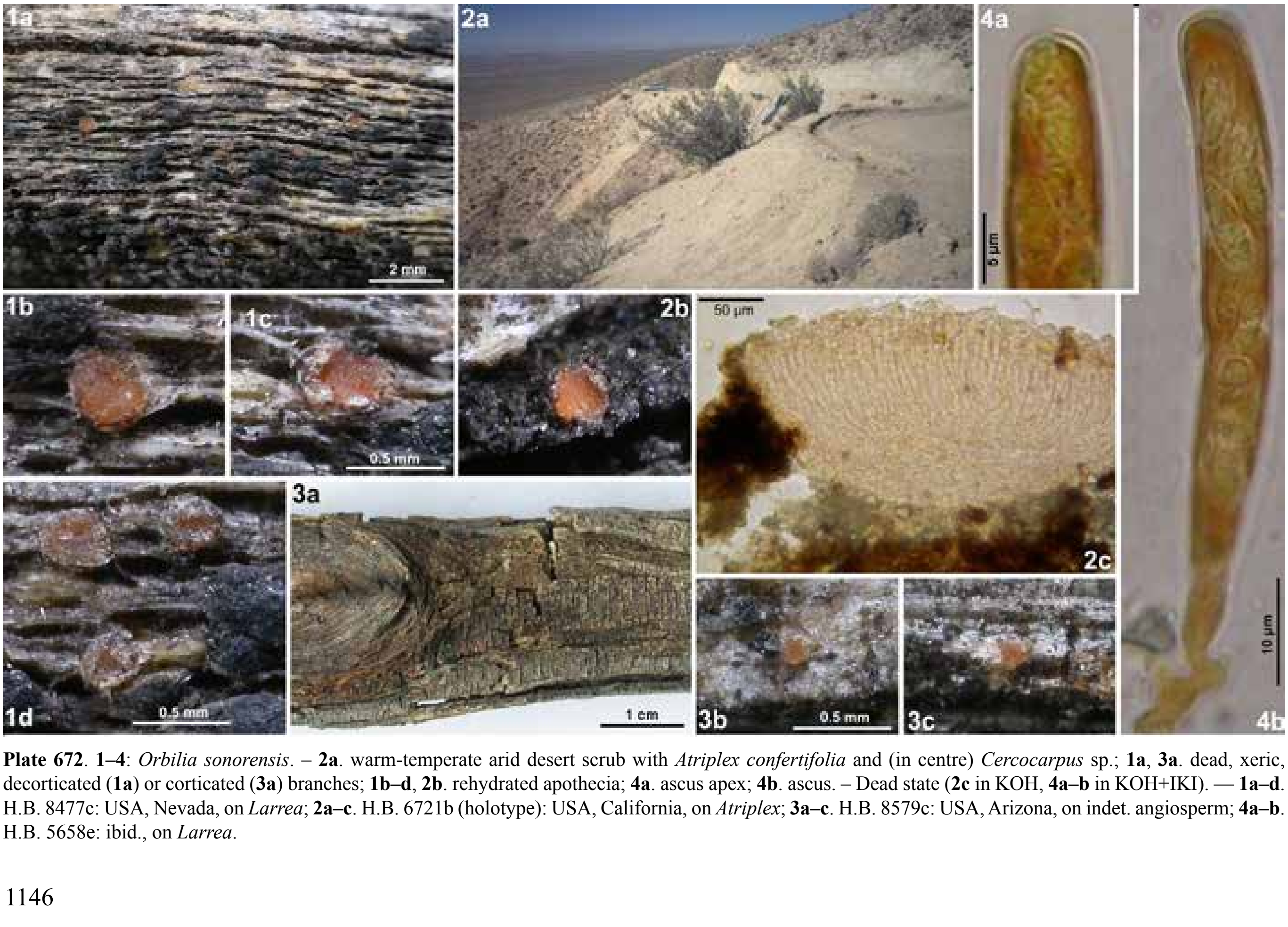


Plate 672. **1–4**: *Orbilia sonorensis*. – **2a**. warm-temperate arid desert scrub with *Atriplex confertifolia* and (in centre) *Cercocarpus* sp.; **1a**, **3a**. dead, xeric, decorticated (**1a**) or corticated (**3a**) branches; **1b–d**, **2b**. rehydrated apothecia; **4a**. ascus apex; **4b**. ascus. – Dead state (**2c** in KOH, **4a–b** in KOH+IKI). — **1a–d**. H.B. 8477c: USA, Nevada, on *Larrea*; **2a–c**. H.B. 6721b (holotype): USA, California, on *Atriplex*; **3a–c**. H.B. 8579c: USA, Arizona, on indet. angiosperm; **4a–b**. H.B. 5658e: ibid., on *Larrea*.

Map 110. Known distribution of *O. sonorensis* in North America (yellow = not included collection).

Habitat: partially to entirely decorticated, 10–25 mm thick branches of *Atriplex confertifolia* {1}, ?*Chrysothamnus* sp. {1}, *Ephedra* ?*viridis* {1}, *Larrea tridentata* {4}, indet. angiosperm shrub {1}, on 0.2–1 mm deep strongly decayed wood {6}, very greyed, no algae. **Associated**: ?*Baggea* sp. {1}, *Carestiella schizoxyloides* {1/1}, *Hysterobrevium mori* {2}, *Hysteropatella* sp. {1}, *H. oregana* {1}, *Melaspilea emergens* {1}, *Odontura rhaphidospora* {1}, *Orbilia* ?*breviclava* {1}, *O. calyptrata* {2}, *O. cryptogena* {1}, *O.* ?*flexisoma* {1}, *O. lacrimispora* {1}, *O. lentiformis* {2}, *O. macrohesperidea* {1}, *O. macroserpens* {1}, *O. maeandrina* {2}, *O. multigambelii* {1}, *O.* ?*multiphanosoma* {1}, *O. multiserpens* {1}, *O. multiurosperma* {1}, *O. myriourosperma* {1}, *O.* ?*navajoana* {2}, *O. pleiocreosoteris* {1}, *O.* ?*pleionavajoana* {1}, *O. pluristomachia* {1}, *O. sedonensis* {1}, *O. vermiculati* {1}, *Patellaria* '*andina*' {1}, ?*Schizoxylon* sp. {1}, ?*Teichospora* sp. {1}, *Symbiotaphrina larreae* {3}. **Desiccation tolerance**: a few nearly mature asci still viable after 28 months. **Altitude**: 250–960 m a.s.l. **Geology**: Mississippian & Permian sand-, mud- & limestone; Oligocene felsic volcanic rock. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia sonorensis* is characterized by rather large, ellipsoid to fusoid ascospores with medium long, vermiform-subulate spore bodies and by the presence of crystalloid SCBs. *O. cactacearum* differs in narrower spores with more rounded apices and more strongly tapered and curved bases. *O. bicknellensis* has narrower spores with acute apices. The European *O. cylindrosoma* has much narrower spores and lacks crystalloid SCBs.

Variation. The spores of *O. sonorensis* vary somewhat in shape between ellipsoid and fusoid-clavate, also the SBs vary in the strength of their basal inflation.

Not included collection. A montane sample on *Juglans* (Pl. 671: 3) differed in lacking crystalloid SCBs and the deviating substrate.

Anamorph. A few trinacrium robustum-like conidia were obtained in pure culture of the holotype, but were not documented. They concurred with those found on the natural substrate in the same collection (Pl. 671: 2e).

Phylogeny. A sequence taken from the ex-type culture comprises SSU (without S1506 intron), ITS, and LSU. It clustered in our ITS and combined analyses medium supported with *O. multimaeandrina* (Phyls 19–20), though with rather high distance in both ITS (9%) and LSU D1–D2 (2.4%). The lowest LSU distance was 1.7% to *O. carpoboloides*, but here the ITS distance is 15%.

Ecology. *O. sonorensis* was collected on strongly rotten wood of different angiosperm shrubs in subtropical semiarid (to arid) Sonoran paloverde-mixed cacti and warm-temperate arid Mojave creosotebush and saltbush desert scrubs in western North America. The not included collection on *Juglans* was in a riparian grove in the warm-temperate semiarid Chihuahuan Desert.

Specimens included. **USA**: **California**, Mojave Desert, 130 km NNE of Los Angeles, 14 km NW of California City, 830 m, branches of *Atriplex confertifolia*, on wood, 23.VI.2000, G. Marson (M-0276505, **holotype**; **isotype** in H.B. 6721b;

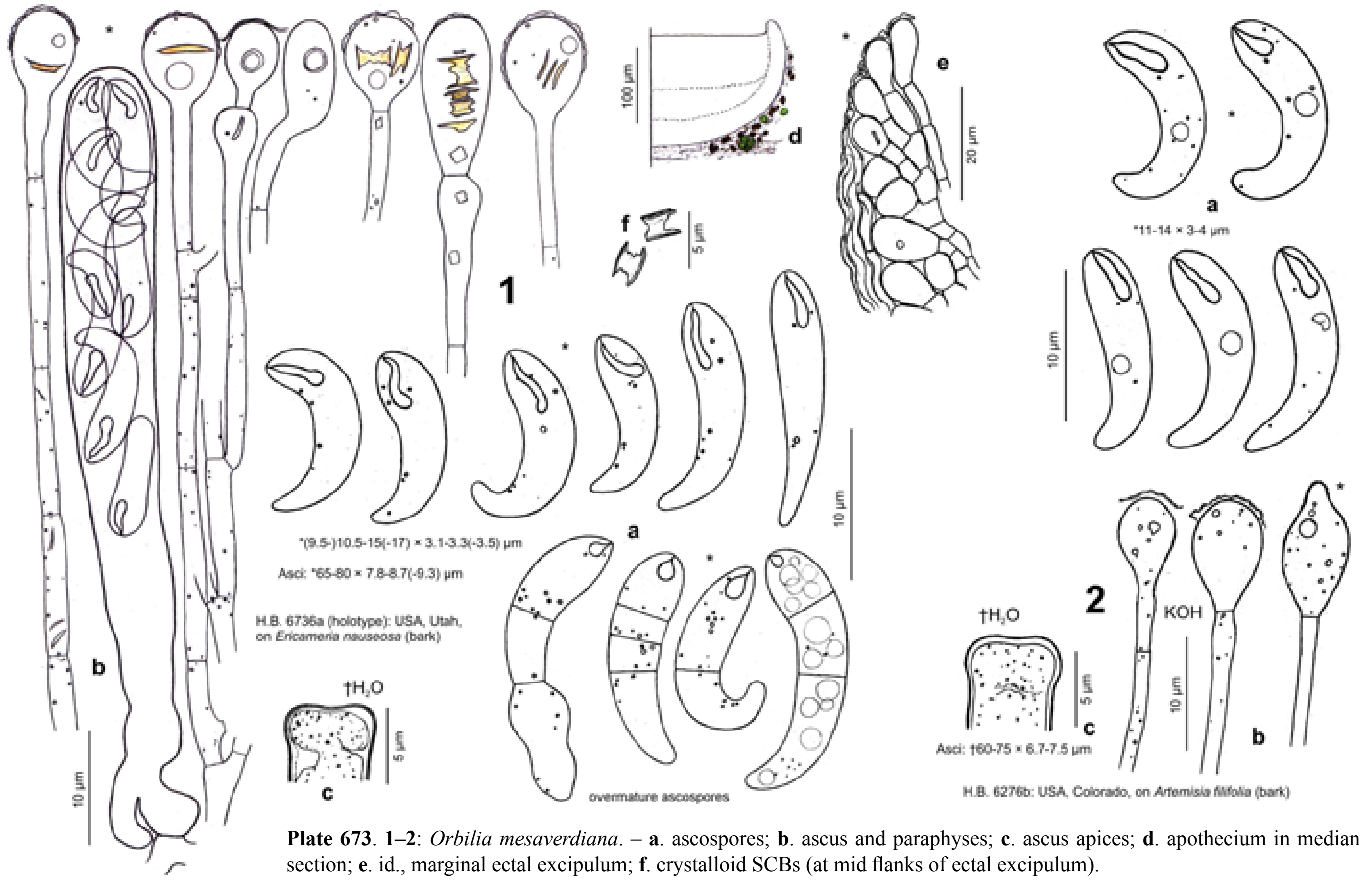


Plate 673. **1–2**: *Orbilia mesaverdiana*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apices; **d**. apothecium in median section; **e**. id., marginal ectal excipulum; **f**. crystalloid SCBs (at mid flanks of ectal excipulum).

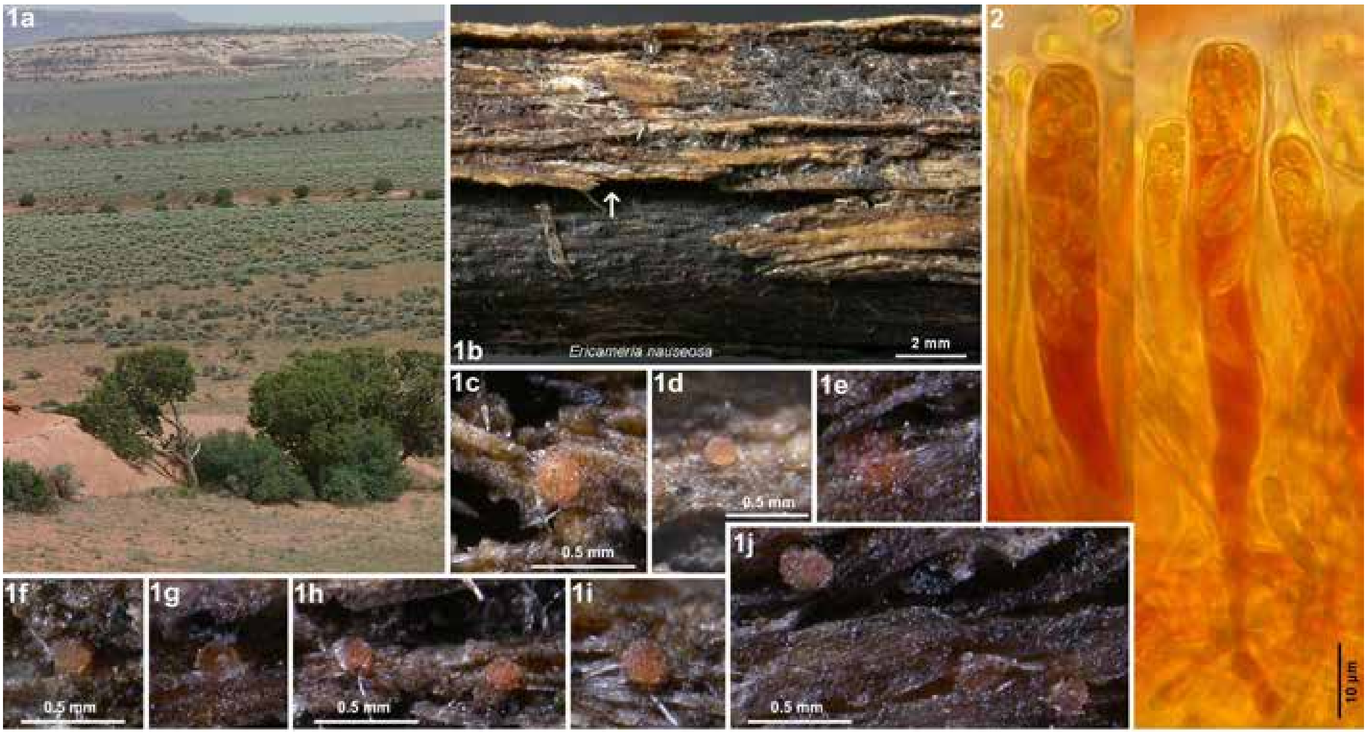


Plate 674. **1–2**: *Orbilia mesaverdiana*. – **1a**. semiarid sagebrush scrub (*Artemisia* spp.), ?*Pinus edulis* in foreground, not far from site with *Ericameria nauseosa*; **1b**. dead corticated xeric branch of *Ericameria*; **1c–j**. rehydrated apothecia; **2**. asci and paraphyses (in KOH+IKI). — **1a–j**. H.B. 6736a (holotype): USA, Utah, Canyonlands, sagebrush desert scrub (*Artemisia tridentata*, 2.5 km away from site with *Ericameria*); **2**. H.B. 5197b: USA, Utah, Cottonwood Canyon, on *Artemisia tridentata*.

CBS 116222, anam. cult., anam. substr.; sq.: KT215242). – **Nevada**, Mojave Desert, 18.5 km WSW of Las Vegas, 4.5 km ESE of Blue Diamond, 960 m, branches of *L. tridentata*, on wood, 1.V.1995, G. Marson (H.B. 8477c). – 30 km SE of Las Vegas, 7 km W of Boulder, Railroad Pass, 675 m, branch of *Larrea tridentata*, on wood, 8.VI.2000, G. Marson (H.B. 10117b) – **Arizona**, Sonoran Desert, 82 km NW of Phoenix, ~1.5 km SE of Wickenburg, 615 m, branch of indet. angiosperm, on wood, 4.V.1995, G. Marson (H.B. 8579c). – ibid., branch of *Larrea tridentata*, on wood, 4.V.1995, G. Marson (H.B. 5658e). – ibid., branch of *Ephedra* ?*viridis*, on wood, 4.V.1995, G. Marson (H.B. 5894d). – ~5 km SSW of Gila Bend, 250 m, of ?*Chrysothamnus*, 5.V.1995, G. Marson (ø). – 17.5 km NNE of Lukeville, Organ Pipe, Ajo Mountain Trail, 710 m, branch of *Larrea tridentata*, 5.V.1995, G. Marson (H.B. 5687h ø).

Not included. **USA**: **New Mexico**, Chihuahuan Desert, 30 km SW of Carlsbad, ~4 km NW of Whites City, ~3 km NE of Carlsbad Caverns, 1200 m, branch of *Juglans major*, on bark, 24.V.1996, G. Marson (H.B. 5673e ø).

Orbilia mesaverdiana Baral & G. Marson, **sp. nov.**, MB 813696 — Pls 673–674

Etymology: named after the locality of the first studied specimen, Mesa Verde (Colorado).

Typification: USA, Utah, Hatch Rock, branches of *Ericameria nauseosa*, 16.VI.2000, G. Marson (ex H.B. 6736a, M-0276511, holotype; ex-type culture: CBS 140804; sq.: KT215247, MH878179).

Latin diagnosis: *Asci octospori*, *ascosporae *9.5–17 × 3–4 µm*, *clavatae*, *valde arcuatae*, *apice rotundatae vel obtusae*, *in statu vivo corpusculum refringens breviter vermiforme continentes*, *paraphyses vivae valde capitatae*, *corpuscula crystalloidea continentes. Habitat ad corticem putridum ramorum siccorum fruticum* Artemisiae *et* Ericameriae *in zona temperata subhumida ad semiarida Americae septentrionalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.15–)0.2–0.4(–0.5) mm diam., 0.12–0.16 mm high, light to bright pure orange, round, very scattered; disc slightly concave to flat, margin thin, 0–20 µm protruding, smooth to very finely crenulate; sessile, slightly to strongly immersed. **Asci** *65–80 × 7.8–9.6 µm {2}, †60–75 × 6.7–8.5(–9.2) µm {2}, 8-spored, spores (*) biseriate, (2–)3–5 lower spores inverted {3} (very rarely mixed), pars sporifera *31–41(–55) µm long, †(26–)32–37 µm; **apex** (†) strongly truncate (distinctly indented, laterally inflated); **base** with short and thick, or long, thin and flexuous stalk, L- or h-shaped. **Ascospores** *(9.5–)10.5–15(–17) × 3–3.5(–4) µm {2}, †(8–)10–13.5(–14) × 2.7–3.3(–3.5) µm {3}, (cylindric-)clavate, apex rounded to obtuse (rarely subacute), base medium to strongly attenuated, (slightly to) medium to very strongly curved (falcate, partly mainly curved near base); **SBs** *3–4.8 × 0.7–1.2 µm {2}, rod-shaped to subulate or narrowly tear- to pear-shaped, straight or sometimes ± flexuous; aged spores with 1–3 septa, SBs 1.7–2.5 × 1.5 µm, broadly tear-shaped to subglobose. **Paraphyses** apically strongly to very strongly capitate(-clavate), rarely spathulate, terminal cells *7–21 × (3–)4–7.3 µm {1}, †3.5–6.2 µm wide {2}, lower cells *12–17 × 1.5–2.2 µm {1}; sometimes branched at upper septum. **Medullary excipulum** very pale rose, 50 µm thick, of dense textura intricata with many inflated cells, sharply delimited. **Ectal excipulum** pale rose, of thin-walled, vertically oriented t. angularis-prismatica from base to submargin, 35 µm thick near base, cells *10–16 × 7–9 µm {1}; 15–25 µm thick near margin, oriented at a 30–45° angle to the surface, marginal cortical cells *8–12 × 5–8 µm {1}. **Anchoring hyphae** medium abundant, */†2–3.5 µm wide, walls 0.2–0.3 µm thick {1}, forming a thin hyaline layer of dead hyphae up to submargin. **SCBs** in paraphyses and ectal excipulum (near margin) globose and mainly rod- or ring-shaped, hyaline to pale orange {2}, 2–5 µm diam. **Exudate** over paraphyses and marginal excipulum 0.2–1 µm thick, rough. **— ANAMORPH**: unknown.

Habitat: collected 0.1–0.6 m above the ground, corticated, 6–20 mm thick branches of *Artemisia filifolia* {1}, *A. tridentata* {2}, *Ericameria nauseosa* {1}, on strongly decayed, loosely attached bark {3} (periderm and bast), greyed, with many green algae. **Associated**: *Orbilia delphinus* {1}, *O. dixienis* {2}, *O. lentiformis* {1}, *O. multimaeandrina* {1}, *O. multiphanosoma* {1}, *O. multitrapezoidea* {1}, *O. myriophanosoma* {1}, *O. ocellata* {2}, *O. plurilentiformis* {2}, *O. spathulata* {2}, *O. subsiculispora* {1}, *Schizoxylon* ?*argentinum* {1}. **Desiccation tolerance**: fully viable for at least 1.5 months, a few ascospores and paraphyses viable for 29 months. **Altitude**: 1700–2290 m a.s.l. **Geology**: Triassic to Upper Cretaceous (red) sandstone. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia mesaverdiana* is easily recognized by its large, clavate, strongly curved (falcate) ascospores. It differs from *O. quaestiformis* in the presence of crystalloid SCBs and in the spores which are partly curved also in their upper part, finally in rather wide spore bodies. Contrary to *O. quaestiformis*, in which only rarely 1-septate overmature spores were seen (Pl. 678: 1), those of *O. mesaverdiana* got 1–3 septa when incubated at the lid of a Petri dish. *O. pleiomesaverdiana* differs in 16-spored asci and subacute spore apices.

Variation. Spore curvature varies rather considerably in *O. mesaverdiana* in all three collections for which spore measurements were taken. The typical spores when seen in profile view are strongly curved as a whole, but some were rather straight, especially in their upper part. Spores with subacute apices were only exceptionally observed.

Phylogeny. A sequence taken from pure culture of the holotype comprises SSU (with S1506 intron), ITS, and LSU. *O. mesaverdiana* clustered in a strongly supported clade with *O. serpentina*, *O. octoserpentina*, *O. halimi*, and *O. vermiculati* when analysing SSU+ITS+LSU (Phyl. 20). It shows a rather high difference in the ITS region to members of the *Serpentinae*-*Habrostictis* clade, the lowest percentage being 10% to *O. halimi* and *O. vermiculati* (1.6–1.8% in LSU). In the LSU the minimum distance is 1% to *O. flavidorosella*, though 19.5% in the ITS.

Ecology. *O. mesaverdiana* inhabits rotten bark of xeric branches of angiosperm shrubs in the cold-temperate to warm-continental subhumid to semiarid sagebrush and saltbush desert scrubs in the Colorado Plateau of western North America.

Specimens included. **USA**: **Utah**, Canyonlands, 60 km NW of Page, Cottonwood Canyon, ~1700 m, branch of *Artemisia tridentata*, on bark, 25.VIII.1994, G. Marson (H.B. 5197b ø). – 36 km S of Moab, Canyonlands, 5 km WNW of Hatch Rock, 1813 m, branches of *Ericameria nauseosa*, on bark, 16.VI.2000, G. Marson (M-0276511, **holotype**; **isotype** in H.B. 6736a, CBS 140804; sq.: KT215247, MH878179). – 16 km WNW of Blanding, 1795 m, branch of *Artemisia tridentata*, 14.V.1995, G. Marson (ø). – **Colorado**, Canyonlands, 15.5 km SSE of Cortez, Mesa Verde, 5 km NNW of Spruce Tree House, 2290 m, branch of *A. filifolia*, on bark, 31.V.1996, G. Marson (H.B. 6276b).

Orbilia pleiomesaverdiana Baral & G. Marson, **sp. nov.**, MB 813697 — Pls 675–676

Etymology: named after the 16-spored asci and the resemblance to *O. mesaverdiana*

Typification: USA, Arizona, Wikieup, branches of ?*Chrysothamnus*, 3.V.1995, G. Marson (ex H.B. 5716a, M-0276560, holotype).

Latin diagnosis: *Similis* Orbiliae mesaverdianae *sed asci 16-spori, ascosporae apice subacutae.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.2–0.45(–0.6) mm diam., 0.18–0.25 mm high, (light to) bright orange(-red), scarcely translucent, round, somewhat gelatinous, very scattered to subgregarious; disc slightly concave to flat, margin distinct, 20–60 µm protruding, ± smooth; broadly sessile, slightly to half immersed (erumpent); dry bright to deep orange-red. **Asci** *(69–)80–95(–102) × 7.5–9(–9.5) µm {2}, †(66–)75–100(–110) × (6–)6.5–8(–8.7) µm {2}, 16-spored, spores *3–4-seriate, 7–9 lower spores inverted {2} (slightly to strongly mixed), pars sporifera *45–50 µm long (†50–60 µm); **apex** (†) medium to strongly truncate (partly distinctly indented, laterally distinctly inflated or not); **base** with short to long, thin or thick, flexuous stalk, T-, L- or Y-shaped. **Ascospores**

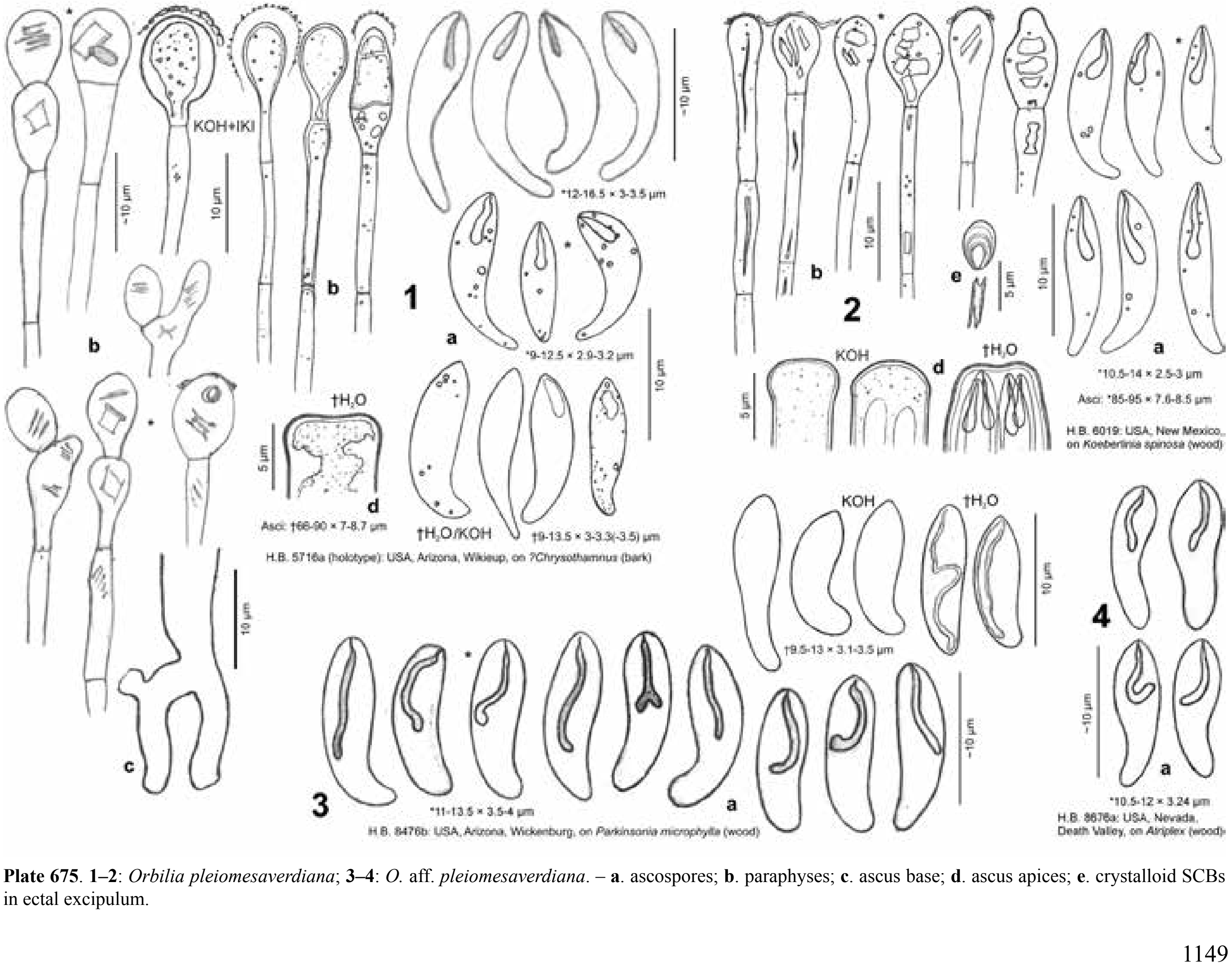


Plate 675. **1–2**: *Orbilia pleiomesaverdiana*; **3–4**: *O.* aff. *pleiomesaverdiana*. – **a**. ascospores; **b**. paraphyses; **c**. ascus base; **d**. ascus apices; **e**. crystalloid SCBs in ectal excipulum.

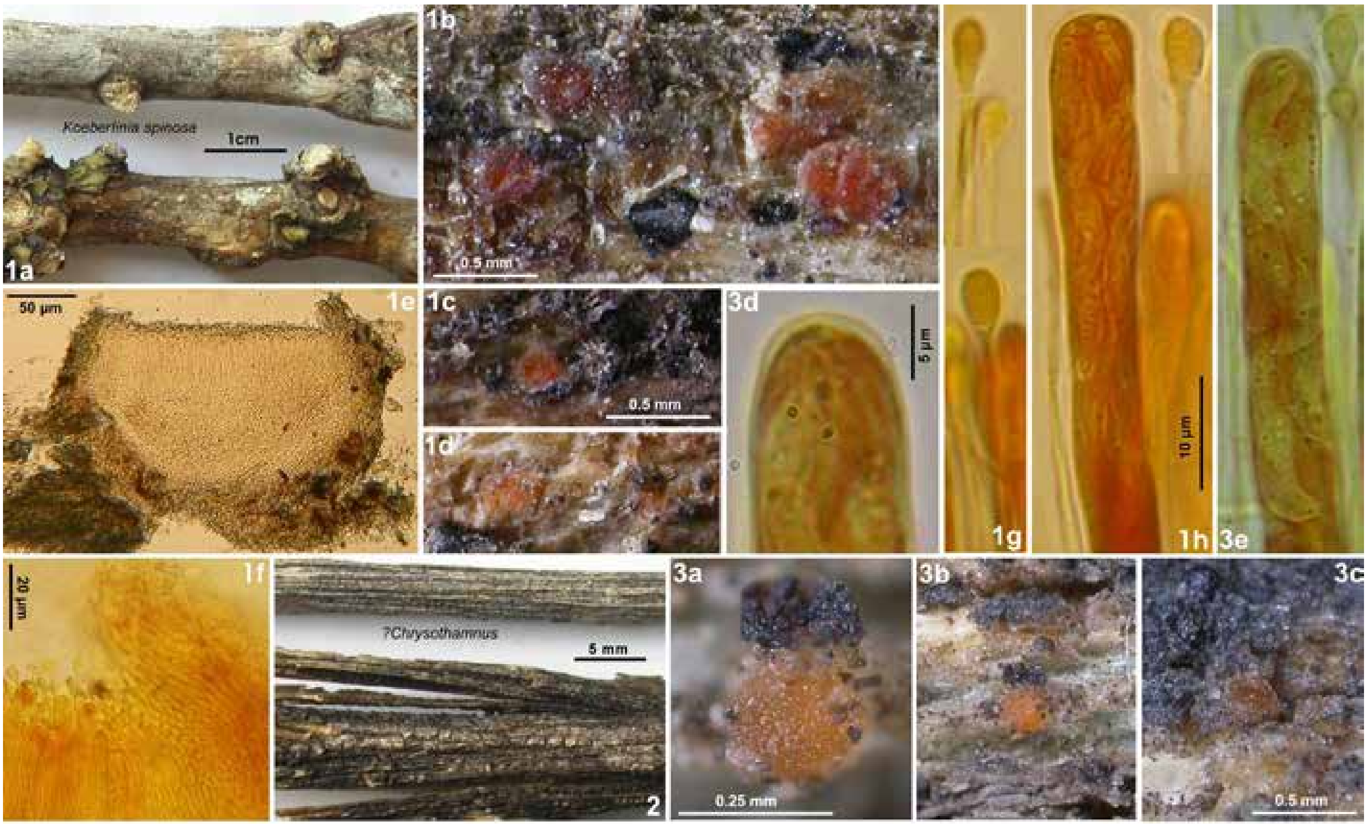


Plate 676. **1–2**: *Orbilia pleiomesaverdiana*; **3**: *O.* aff. *pleiomesaverdiana*. – **1a**. decorticated xeric branches; **2**. greyed xeric bark of branches; **1b–d**, **3a–c**. rehydrated apothecia; **1e**. apothecium in median section; **1f**. id., protruding margin; **1g–h**, **3e**. asci and paraphyses; **3d**. ascus apex. – Dead state (**1e** in KOH, **1f–h**, **3d–e** in KOH+IKI). — **1a–g**. H.B. 6019a: USA, New Mexico, on *Koeberlinia spinosa*; **2**. H.B. 5716a (holotype): USA, Arizona, Wikieup, on ?*Chrysothamnus*; **3a–e**. H.B. 8476b: ibid., Wickenburg, on *Parkinsonia microphylla*.

*(10–)11–14(–16.5) × (2.5–)2.8–3.2(–3.5) µm {2}, †9–13.5 × 3–3.3 µm {1}, fusoid-clavate, apex subacute (to acute), base medium to often strongly attenuated in a tail-like end or short tail, medium to strongly curved mainly near base; **SBs** *3.5–5.5(–6) × 0.8–1.2 µm {2}, (rod-shaped to) subulate, sometimes narrowly pyriform, straight to somewhat flexuous. **Paraphyses** apically medium to very strongly (clavate-)capitate, sometimes spathulate to lageniform, terminal cells *8–22 × (2–)3.7–6 µm {T}, †8–14 × (3–)4.3–7.7 µm {1}, lower cells *11–18 × 1.3–1.8(–2.4) µm {T}, †10–18 × 1.2–1.5(–2.5) µm {1} (basal cells †5–10 × 2–2.3 µm); not or rarely, sometimes frequently branched at upper septum. **Medullary excipulum** 60–100 µm thick, of loose textura intricata with many inflated cells, sharply delimited. **Ectal excipulum** of (†) thin-walled to slightly gelatinized, indistinctly oriented t. angularis from base to submargin, 40–60 µm thick near base, cells *7–16 × 8–10 µm {1}; 20 µm thick near margin, upper part of t. prismatica-porrecta oriented parallel to the surface, marginal cortical cells †8–10 × 2.5–3.5 µm {1}. **Anchoring hyphae** medium abundant, */†2–4 µm wide, walls 0.2–0.6 µm thick {2}, somewhat gelatinized, sometimes forming a t. prismatica near basal excipulum, hyphae covering receptacle up to margin. **SCBs** in paraphyses and ectal excipulum (near margin) sometimes globose, mainly crystalloid, rod- or rectangular {2}, ?hyaline. **Exudate** over paraphyses 0.2–0.7 µm thick, granular-cloddy, loosely attached, also absent; over margin 0.2–1 µm thick, granular, sparse. **— ANAMORPH**: unknown.

Habitat: collected 1.5–2.5 m above the ground, corticated to decorticated, 3.5–9 mm thick twigs and branches of *Koeberlinia spinosa* {1}, ?*Chrysothamnus* {T}, on 0.2–0.3 mm deep slightly to strongly decayed wood {1} or bark {T}, slightly to strongly greyed, no algae. **Associated**: *Helicogermslita celastri* {1}, *Orbilia lentiformis* {1}, *O. myriourosperma* {1}, *O.* ?*pleiomesaverdiana* {1}, *Symbiotaphrina desertorum* {1}. **Desiccation tolerance**: many mature asci still viable after 20 months. **Altitude**: 600–915 m a.s.l. **Geology**: Quaternary sand, silt & clay sediments. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia pleiomesaverdiana* differs from *O. serpentina* in somewhat longer, more strongly curved ascospores with less acute apices and partly distinct tails, also in shorter spore bodies. *O. pleiourosperma* differs in spores with acute apices and abruptly narrowed and geniculate tails, also in longer SBs.

Variation. The collection on *Koeberlinia* (Pl. 675: 2) is only tentatively included. It differs from the holotype in slightly narrower asci and spores, less curved spores, and in growing on wood.

Not included collections. Three samples (Pls 675: 3–4; 676: 3, IVV: H.B. 5716d, 8476a/b) differ in slightly shorter and wider spores with partly more rounded apices and much less tapered bases, also in a tendency to longer SBs. One of them grew in association with the type of *O. pleiomesaverdiana*. These collections appear to represent a separate species which differs from *O. pleiomesaverdiana* and *O. serpentina* in predominantly ± obtuse spore apices, from the latter also in often curved spore bases.

Ecology. *O. pleiomesaverdiana* was found on slightly to strongly rotten xeric wood and bark of warm-temperate semiarid Chihuahuan creosotebush-tarbush and subtropical arid Sonoran paloverde-mixed cacti desert scrub in the southwest of Northern America. The holotype location is a broad dry riverbed with a dense scrub of *Larrea tridentata*, *Chrysothamnus* (or *Ericameria*) and *Cylindropuntia versicolor*, surrounded by an area of very scattered shrubs. The not included collections were on similar substrates and habitats.

Specimens included. **USA**: **Arizona**, Sonoran Desert, 200 km NW of Phoenix, Wikieup, ~600 m, branches of ?*Chrysothamnus*, on bark, 3.V.1995, G. Marson (ex H.B. 5716a, M-0276560, **holotype**). – **New Mexico**, Chihuahuan Desert, 25.5 km SE of Carlsbad, Malaga, 915 m, branches of *Koeberlinia spinosa*, on wood, 17.VI.1996, G. Marson (H.B. 6019a).

Not included. **USA**: **Nevada**, Mojave Desert, 6 km SW of Beatty, 2.6 km SSE of Rhyolite, E of Death Valley, S of Ladd Mt., 1030 m, branch of *Atriplex*, on wood, 2.V.1995, G. Marson (H.B. 8676a). – **Arizona**, Sonoran Desert, 200 km NW of Phoenix, Wikieup, ~600 m, branch of ?*Chrysothamnus*, on wood, 3.V.1995, G. Marson (H.B. 5716d ø). – 82 km NW of Phoenix, ~1.5 km SE of Wickenburg, 615 m, branch of *Parkinsonia microphylla*, on wood, 4.V.1995, G. Marson (H.B. 8476b).

Orbilia quaestiformis Baral & G. Marson, **sp. nov.**, MB 813699 — Pls 677–680, Map 111

Etymology: named after the long and narrow spore bodies forming an inverted question mark in a part of the spores.

Typification: Luxembourg, Wasserbillig, branches of *Rhus typhina*, 9.III.1994, G. Marson (ex H.B. 5035a, M-0276576, holotype).

Latin diagnosis: *Asci octospori*, *ascosporae *9–14.5 × 2.3–3 µm*, *clavatae*, *apice rotundatae vel obtusae*, *ad basim valde attenuatae vel breviter caudatae et leniter vel valde curvatae*, *corpusculum refringens filiforme vel subulatum*, *flexuosum vel uncinatum*, *paraphyses modice vel valde capitatae*, *in statu vivo*

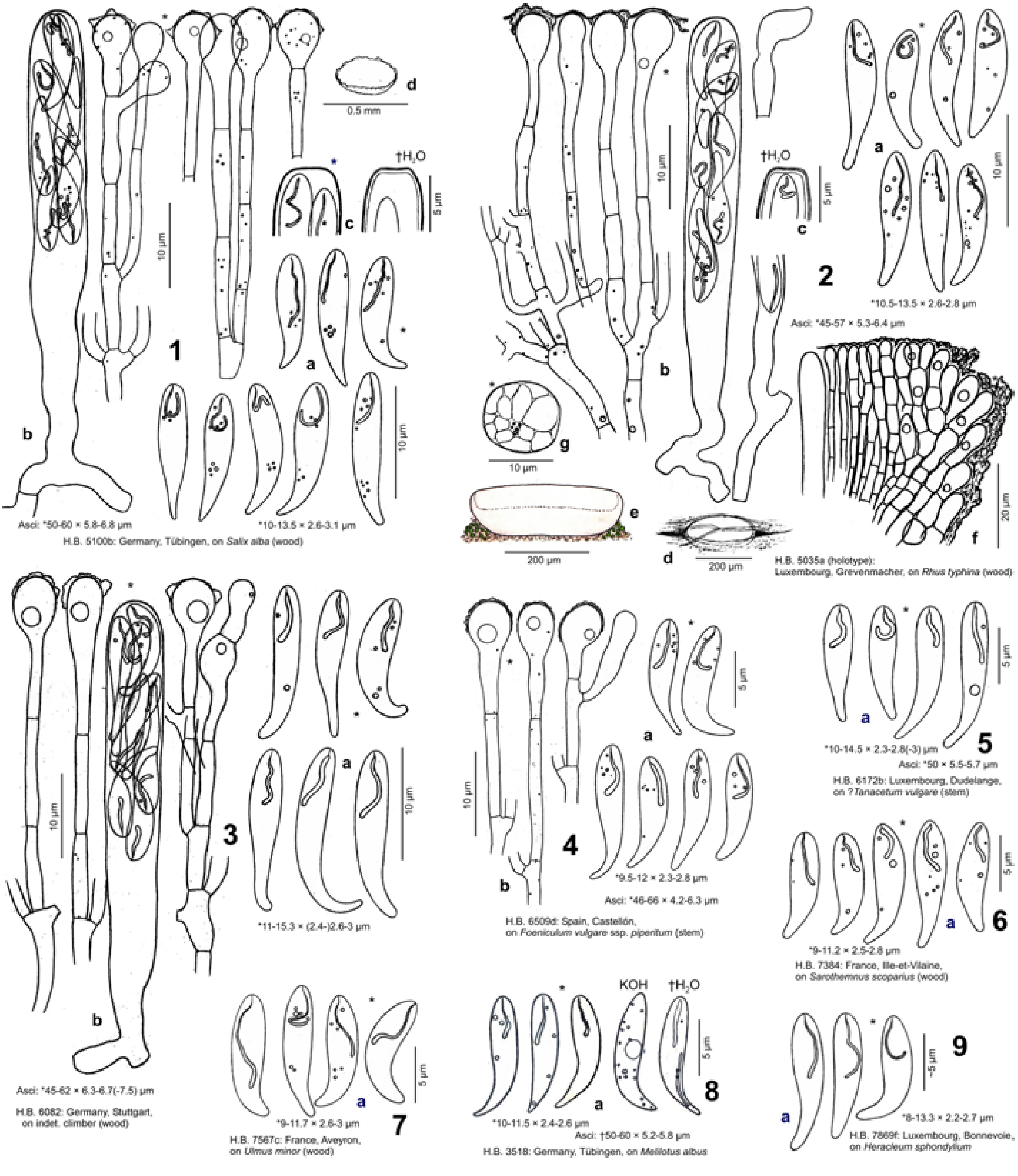


Plate 677. **1–9**: *Orbilia quaestiformis*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. rehydrated apothecia; **e**. apothecia in median section; **f**. id., ectal excipulum at margin; **g**. inflated cell of medullary excipulum.

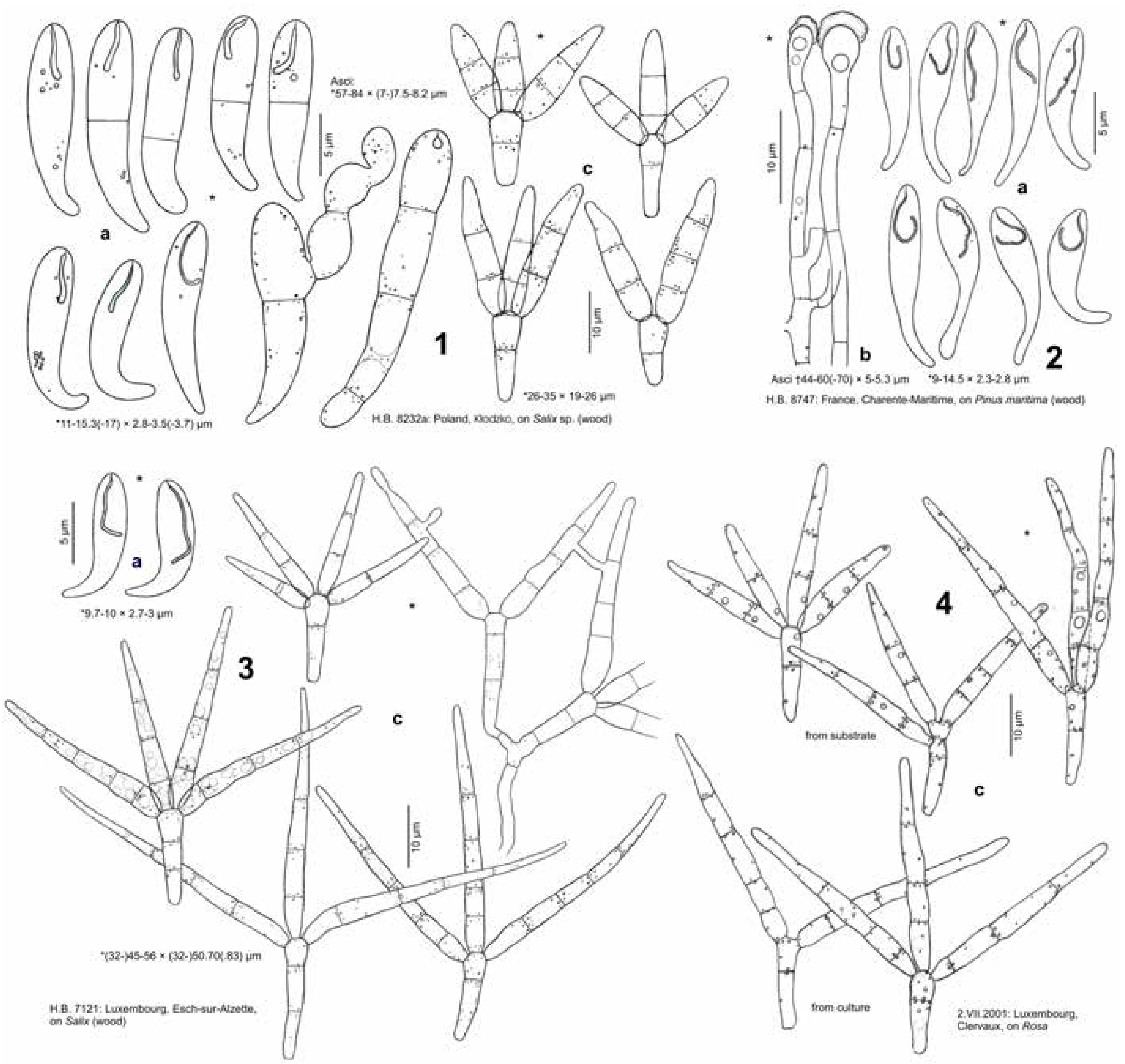


Plate 678. **1–4**: *Orbilia quaestiformis*. – **a**. ascospores (overmature 1-septate, 2 germinating); **b**. paraphyses; **c**. conidia (**1c**, **4c** from substrate; **3c** from culture).

corpuscula globosa continentes. Habitat ad lignum siccum putridum, etiam corticem ramorum fruticum vel arborum angiospermarum, raro coniferarum, saepe ad caules siccos putridos, in zona hemiboreale et temperata humida vel submediterranea semihumida, atlantica ad continentali Europae.

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.15–0.45(–0.6) mm diam., 0.09–0.16 mm high, pale to light rose-orange, not or medium translucent, round to broadly elliptical, very scattered to medium gregarious; disc slightly concave to flat, finally often slightly (to strongly) convex, margin indistinct to distinct, thin or thick, 0–20 µm protruding, smooth or finely crenulate; broadly sessile, superficial or mostly erumpent from beneath epidermis or outer layers of wood or bark, often immersed in biofilm; dry light to bright orange-red. **Asci** *45–65(–73) × (5.2–)5.5–7.2(–7.7) µm {13} → 80 × 7–7.5 µm, †(40–)45–55(–63)((–70)) × (4.5–)5–5.7(–6) µm {8}, 8-spored, spores *2–3-seriate, (2–)3–5(–6) lower spores inverted {17} (not or sometimes mixed), pars sporifera *(22–)25–35(–42) µm long (†32–39 µm); **apex** (†) (slightly to) medium to strongly truncate (not or very slightly indented, laterally not widened); **base** without or with short to long, ± thick, flexuous stalk, T-, L- or h-shaped. **Ascospores** *(6.7–)8–9(–11) {3} or mostly *((8–))9–13(–14.5)((–16)) {31} × ((2–))2.3–3(–3.3) ((–3.7)) µm {24}, †8.5–12.5 × 2–2.8 µm {2}, strongly clavate (to fusoid-clavate), apex rounded to obtuse, towards base medium to mostly strongly attenuated (tail-like, rarely with a distinct tail), slightly to strongly curved near base; non-septate within living asci, rarely turning 1-septate when overmature {2}, *14–15.3(–17) × 3.2–3.5(–3.7) µm, germinating *3.8–4.5 µm wide; **SBs** *(3–)4–6(–7)((–8.2)) × 0.2–0.4(–0.6) µm in situ {16} [~4–7(–8)((–9.5)) µm actual length], filiform to vermiform, often subulate, base never inflated, slightly to strongly flexuous or helicoid, sometimes or often uncinate; immature spores with 1–3 LBs of 0.3–1 µm diam. {7}. **Paraphyses** apically (slightly to) medium to (very) strongly capitate(-clavate), rarely moniliform, terminal cells *(6.5–)8–17(–21) × (2–)3–5(–5.3) µm {6}, †2.5–4.3 µm wide {1}, lower cells *6–13(–17) × 1.2–2(–2.3) µm {4} (near base or apex sometimes 3–4.5 µm wide); unbranched or often branched near apex, hymenium pale rose. **Medullary excipulum** pale rose, 20–50 µm thick, of ± dense textura intricata with a few to many indistinct to strongly inflated cells, very indistinctly delimited from ectal excipulum near base, ± sharply at flanks. **Ectal excipulum** pale rose, of thin-walled, indistinctly or horizontally oriented t. angularis-prismatica from base to margin, 25–45(–60) µm thick near base, cells *6–13(–16) × (4–)5–11(–

16) µm {6}; 15–30 µm thick at mid flanks and margin, oriented near margin at a 10–45° angle to the surface, marginal cortical cells *(4–)6–12(–15) × (2.5–)3–6(–8) µm {6}; thin-walled or sometimes slightly gelatinized [walls †0.2–0.5(–1.2) µm], partly agglutinated to form minute squamules. **Anchoring hyphae** sparse or often abundant, partly forming projecting strands of agglutinated hyphae near base, *1.8–3.5 µm wide, walls 0.2–0.3(–0.4) µm thick {5}, sometimes forming a thin hyaline layer of dead hyphae covering flanks and margin. **SCBs** in paraphyses and ectal excipulum (near margin) globose {23}, 1–2.8 µm diam., rarely entirely lacking {3}. **Exudate** over paraphyses 0.2–1.2(–2.5) µm thick, rough-cloddy, firmly attached; over margin 0.3–2.5 µm thick, rough-cloddy. — **ANAMORPH**: tridentaria-like (from ascospore isolate {2} and natural substrate {8}). **Conidiophores** short. **Conidia** with (2–)**3**–4(–5) arms, total size *32–59.5 × (32–)50–70(–83) µm {5}, stipe *(10–)12.5–23 × 2–4.4 µm, 1–2(–3)-septate (if 1-septate then septum often close to the branching point), arms gradually tapering or cylindrical and only terminally tapering, *18–44 × 2.5–4(–4.7) µm, 2–5-septate, constricted and movable at the base.

Habitat: collected 0–3 m above the ground, corticated to decorticated, 6–80 mm thick twigs and branches of *Acacia* sp. {1}, *Acer pseudoplatanus* {2}, *Clematis vitalba* {1}, *Cytisus scoparius* {3}, *Lonicera periclymenum* {1}, *Picea abies* {1}, *Pinus pinaster* {1}, *Populus tremula* {1}, *Quercus robur* {1}, *Rosa canina* {1}, *Rhus typhina* {1}, *Robinia pseudoacacia* {2}, *Rosa* sp. {1}, *Salix* sp. {5}, *S. alba* {1}, *S.* (?)*caprea* {1}, *Sambucus nigra* {2}, *S. racemosa* {1}, *Tamarix ramosissima* {1}, *Ulmus minor* {1}, *Viburnum lantana* {1}, on 0.1–1 mm deep (medium to) strongly decayed wood {29}, rarely bark {5} (bast), exceptionally on resin, sometimes in beetle galleries; also on stems of *Rubus armeniacus* {1}, *R. fruticosus* agg. {3}, 1–2 years old herbaceous, sometimes inflorescence stems or culms, rarely leaves, of *Ammophila arenaria* {3}, *Apiaceae* {1/1}, *Atropa belladonna* {1}, *Digitalis purpurea* {1}, *Echinops sphaerocephalus* {3}, *Epilobium ?angustifolium* {1}, *Foeniculum vulgare* {1}, *F. vulgare* subsp. *piperitum* {1}, *H. sphondylium* {4}, *Melilotus* sp. {4/2}, *M. albus* {3}, *Phragmites australis* {1}, *Pooideae* {2}, *Reynoutria* sp. {1}, *R. japonica* {1}, *Senecio* sp. {1}, *Tanacetum vulgare* {2}, *Typha* sp. {3}, *T.* (?)*latifolia* {1}, *Verbascum densiflorum* {1}, *Yucca* sp. {4} ± obliquely standing or lying on dry ground, exceptionally on textile (rope) {1} or dung of *Equus caballus* {1}; sometimes eroded, strongly greyed or not, very few to many green algae. **Associated**: *Bulbillomyces* sp. {1}, *Capronia ?pilosella* {1}, *Cistella grevillei* {1}, *Cyathicula cacaliae* {1}, *C. cyathoidea* {2/1}, *Diaporthe* sp. {1}, *D. arctii* {1}, *Durella connivens* {1}, *Eutypa maura* {1}, *Hyalorbilia erythrostigma* {1}, *H. fusispora* {1}, *H. latispora* {1}, *Hydropisphaera arenula* {1}, *Lachnella alboviolascens* {1}, *L. ?villosa* {1}, *Lophodermium arundinaceum* {1}, *Mollisia ligni* {1}, *M. ?prunicola* {1}, *Mollisina rubi* {1}, *Neodasyscypha cerina* {1}, *Olla millepunctata* {1}, *O. scrupulosa* {1}, *Orbilia aristata* {2}, *O. caulicola* {8}, *O. cylindrosoma* {1}, *O. eucalypti* {2}, *O. euonymi* {1}, *O. filiformis* {2}, *O. flavida* {12}, *O. flavidorosella* {4}, *O. gambelii* {1}, *O. ?obtusispora* {1}, *O. pilifera* {1}, *O. septispora* {3}, *O. subclavuliformis* {2}, *O. trapeziformis* {1/2}, *O. ungulata* {2}, *O. vitalbae* {6}, *Patellaria atrata* {4}, *Phoma* sp. {2}, *Phyllactinia guttata* {1}, *Physcia* sp. {4}, *Pirottaea* sp. {1}, *Propolis farinosa* {2}, *Pseudolachnea hispidula* {1}, *Pyrenopeziza* sp. {1}, *P. ?escharodes* {1}, *Ramichloridium ?schulzeri* {1}, *?Stictis* sp. {1}, *Stereum sanguinolentum* {1}, *Trichopeziza lizonii* {1}, *Unguiculariopsis ilicincola* {2}, *Urceolella ?pani* {1}, *Xanthoria parietina* {4}, crustose lichens. **Desiccation tolerance**: fully viable for at least 3 weeks. **Altitude**: 1–620 m a.s.l. **Geolog**: Ordovician, Devonian & Permian siltstone & schist, Rotliegend, Muschelkalk, Keuper (Gipskeuper, Rhätsandstein), Lower Jurassic sandstone & shale, Minette, Cretaceous & Tertiary lime-, clay-, sand- & marlstone, tuff, Pleistocene loess, sand; granite, gneiss & migmatite. **Phenology**: throughout the year (long-lived).

Phenology of *O. quaestiformis*											
Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	1	5	7	7	14	11	6	6	11	7	3

Taxonomic remarks. *Orbilia quaestiformis* is characterized by clavate, comma-shaped ascospores with rounded to obtuse apices and strongly attenuated, slightly to strongly curved bases, further by rather narrow, filiform to vermiform, basally not inflated, flexuous spore bodies which are sometimes uncinate like a question mark, finally by the tridentaria-like anamorph.

O. quaestiformis resembles *O. septispora* concerning both teleomorph and anamorph features. The ascospores of the two species have a similar shape, but spores and asci of *O. septispora* are somewhat larger, and a majority of spores 1(–2)-septate while still inside the living asci, whereas in the many studied collections of *O. quaestiformis* septate spores have almost never been observed, and never inside living asci. The spores of *O. quaestiformis* contain longer and thinner SBs, also smaller and fewer LBs. Concerning substrate preferences both species inhabit a very wide range of hosts, but with the difference that most of the records of *O. septispora* were on *Phragmites*.

Also *O. quercus-ilicis*, a foliicolous eumediterranean species, is very similar to *O. quaestiformis*. It differs in shorter, more fusoid-clavate spores, spore bodies which are partly even longer than in *O. quaestiformis*, and in the tridentaria-like conidia having shorter arms. The North American *O. coniferarum* differs from *O. quaestiformis* in slightly shorter spores with less tapered and curved bases, partly slightly longer spore bodies, and in the occurrence on coniferous substrates. Its presumed tridentaria-like anamorph has mostly 4, much thicker, more upwards oriented arms. The North American *O. vermiculati* has spores very similar to *O. quaestiformis* but differs in 16-spored asci, thicker SBs, and a trinacrium-like anamorph. *O. mesaverdiana* deviates in the spores being more strongly curved as a whole, and in the presence of crystalloid SCBs. *O. rosicola* (Pl. 692) differs in rather short spores with distinct tails, and in the presence of crystalloid along with globose SCBs.

An anamorph very similar to that of *O. quaestiformis* was frequently observed in association with *O. filiformis* on the natural substrate. This species has also filiform SBs but differs in narrowly fusiform, less curved spores with acute apices.

Variation. Among the many collections of *O. quaestiformis* studied, variation was especially noted in spore size, which ranges from *9–11.5 µm up to *10–13.5 µm in length (rarely up to 15 µm) and from *2.3–2.5 up to *2.5–3 µm in width, but also in shape and curvature of the spore bases, and in size and curvature of the SBs. In at least two collections (Luxembourg, 21.VII.2008, on *Acer*; Germany, 22.XI.2010, on *Viburnum*) the spores measured only *(6.7–)8–9(–11) × 2.5–2.7 µm, but spore shape and other features suggest that these belong in the scope of *O. quaestiformis*. The texture of the ectal excipulum at the flanks varies between a horizontally oriented textura prismatica or a t. angularis. All this variation did not show a clear correlation with the inhabited host.

A population on a *Salix* pole from Poland seemed to be somewhat intermediate between *O. quaestiformis* and *O. septispora*. When first collected and examined, it showed many septate, partly germinating spores (Pl. 678: 1), though, in contrast to *O. septispora*, the spores within the living asci were always non-septate (Pl. 680: 1l–m). After hanging the branch outside over a year, new apothecia developed in which no septate spores were observed (IVV: H.B. 8232b), and this was also the case in a later collection from the same place in Poland (Pl. 680: 2a). In the latter two populations the non-septate spores had with *(9–)10–13(–15) × 2.8–3 µm the typical size of *O. quaestiformis* and the asci were with *62–73 × 7.3–7.5 µm at the upper end of the

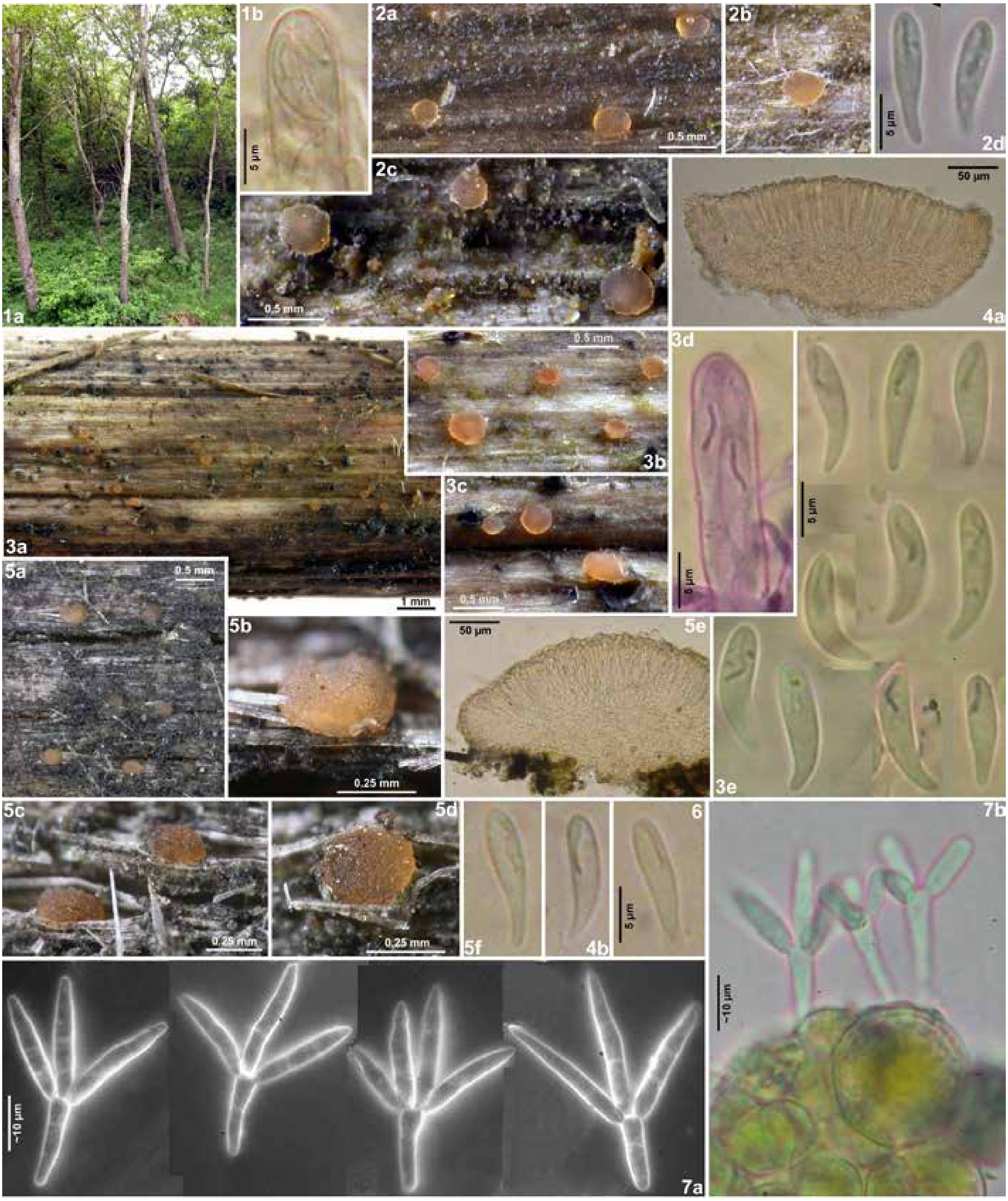


Plate 679. **1–7**: *Orbilia quaestiformis*. – **1a**. Aspen trees along road in hemiboreal northern Europe (from attached branch 1.7 m above the ground); **2a–c**, **3a–c**, **5a–d**. rehydrated apothecia; **4a**, **5e**. apothecia in median section; **1b**, **3d**. apices of mature asci; **2d**, **3e**, **4b**, **5f**, **6**. ascospores; **7a–b**. conidia from substrate. – Living state, except for ascus in **3d** (in CRB). — **1a–b**. H.B. 8218a: Sweden, Skåne, on *Populus*; **2a–d**. H.B. 7869f: Luxembourg, Bonnevoie, on *Heracleum*; **3a–e**. H.B. 7592a: Netherlands, Tilburg, on *Senecio*; **4a–b**. H.B. 8346c: Germany, Tübingen, on ?*Apiaceae*; **5a–f**. H.B. 8747: France, Charente-Maritime, on *Pinus*; **6**. H.B. 8539b: Luxembourg, Dudelange, on *Melilotus*; **7a–b**. 14.V.2002: Luxembourg, Angelsbierg, on *Heracleum*.

range of the typical ascus length, whereas the population with septate spores was intermediate to *O. septispora* in both spore size and ascus width. Also a sparse sample on *Picea* bark at the same site did not differ from typical *O. quaestiformis* (IVV: P.P. 20061028). In all the remaining collections of *O. quaestiformis*, septate spores have never been seen, except for a single spore inside a dead ascus observed by M. Hairaud (pers. comm.) in a sample from Île d'Oléron (27.XI.2010).

Anamorph. The anamorph of *O. quaestiformis* with its mostly 3-armed conidia, which hardly differs from that of

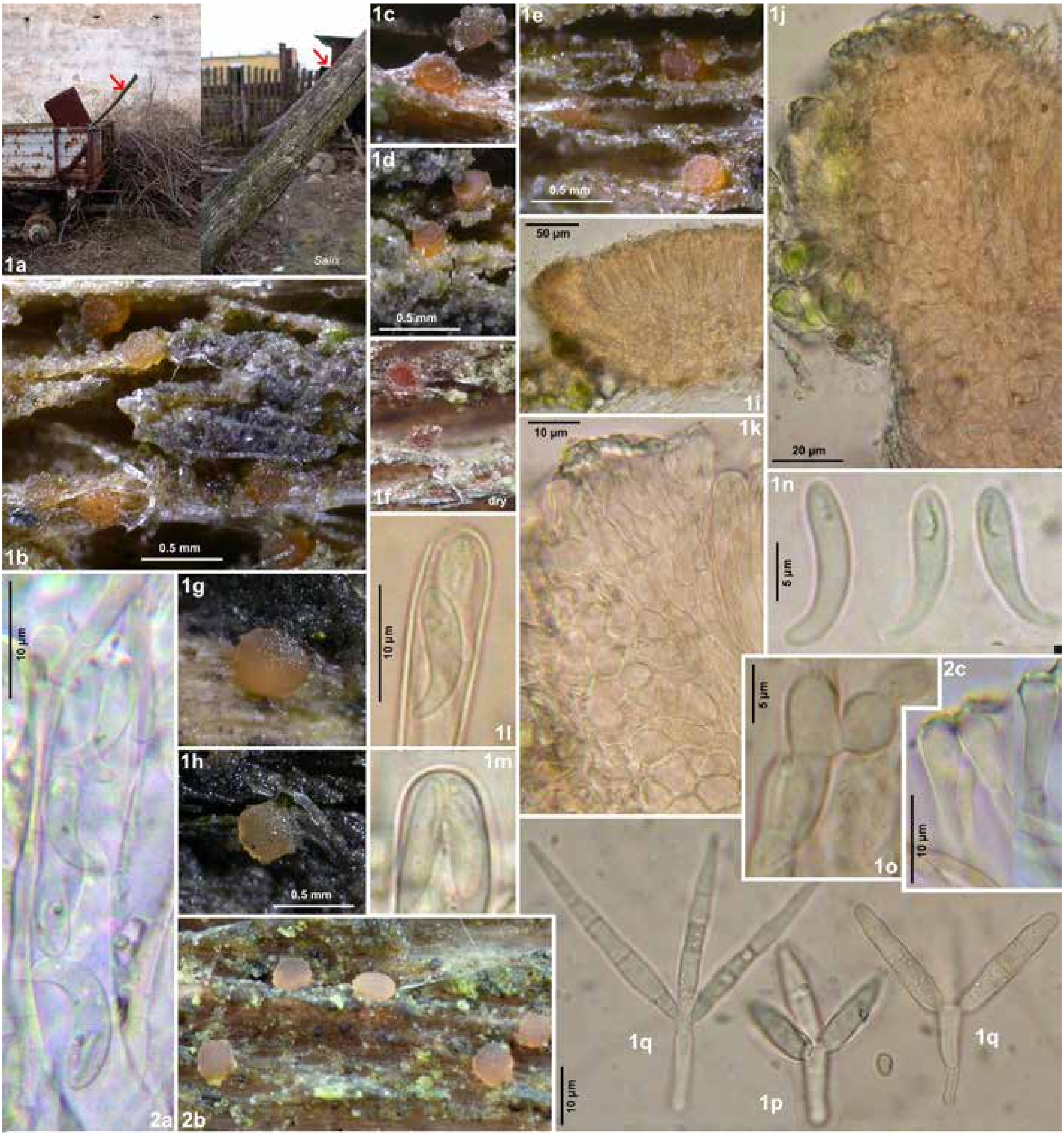


Plate 680. **1–2**: *Orbilia quaestiformis*. – **1a**. decorticated *Salix* pole on a trailer; **1b–e**, **g–h**, **2b**. rehydrated apothecia; **1f**. dry apothecia; **1i**. apothecium in median section; **1j–k**. id., marginal ectal excipulum; **2a**. ascus with ascospores; **1l–m**. apices of mature asci; **1n**. ascospores; **1o**. germinating ascospore; **2c**. tips of paraphyses; **1p–q**. 1 long-armed and 2 short-armed conidia from substrate. – Living state. – **1a**, **f**, **2a–c**: phot. P. Perz. — **1a–f**, **i–j**, **m–p**. H.B. 8232a: Poland, Kłodzko, on *Salix*; **1g–h**, **k–l**, **q**. H.B. 8232b: id.; **2a–c**. P.P. 20070923: id.

O. septispora, closely resembles *Tridentaria subuliphora* as described from decaying leaves in Australia. However, the arms of *T. subuliphora* are less diverging (see Fig. 21: a), and a strain under this name in CBS 700.93, gained from conifer litter in Europe, clusters in series *Orbilia*. Descals (1997: 461) figured a similar fungus as *Tridentaria* sp., which was isolated from streams in the Catalan Pyrenees and might belong to either *O. quaestiformis* or *O. septispora*. The similar *T. glossopaga* and *T. implicans* are ruled out by their very long conidiophores and, together with the also similar *T. tylota*, in preying on nematodes or rhizopods.

In H.B. 7121 (Pl. 678: 3) masses of conidia were obtained by flooding the culture with water, whereas conidia were only sparsely produced without flooding. Due to motility of the conidial arms at the branching point, the arms move upwards when the preparation is about to dry out and the cover slip exerts pressure on them. The conidia germinate at the tips of arms and stipes and form anastomoses among each other.

The conidia observed on the *Salix* branch (Pls 678: 1c, 680: 1p) differ from typical anamorphs of *O. quaestiformis* and *O. septispora* in having rather short and thick arms. In this character they somewhat resemble the anamorph of *O. coniferarum*.

Map 111. Known distribution of *O. quaestiformis* in Europe.

However, a year later also long-armed conidia were found on this branch along with the short-armed ones (Pl. 680: 1q).

Phylogeny. Sequences of *O. quaestiformis* were taken from two specimens from Luxembourg (H.B. 7121, on *Salix*, ascospore isolate; G.M. 2014-07-25.4, on *Heracleum*, from apothecia) comprising S1506 intron, ITS, and LSU, the former also SSU. They deviate by 0.7 % (4 nt and 1 gap) in the ITS and 0.3 % (2 nt) in the LSU (D1–D2). When analysing ITS or SSU+ITS+LSU, *O. quaestiformis* formed with *O. septispora* a highly supported subclade that stands unresolved in the *Serpentinae-Habrostictis* clade (Phyls 19–20). The distance to this species in the ITS region is only 2.8 %, but 1.9 % in the LSU (D1–D2, 635 nt), which correlates with the result that in the LSU analysis the two species cluster distantly and unresolved (S22).

The S1506 intron of *O. quaestiformis* is much longer in the *Salix* strain (641 nt) than in that on *Heracleum* (~435 nt). The two strains show here an extraordinary distance of 18.5 % in the overlapping region (409 nt but with various gaps). Here *O. septispora* differs by 22 % from the *Heracleum* strain and 25 % from that on *Salix*. When analysing the intron region, the *Heracleum* strain clustered strongly supported with *O. septispora* but the *Salix* strain nested distantly hereof in a medium supported clade which contains members of both series of section *Habrostictis* (S21). All these results raise the question whether *O. quaestiformis* could be a species aggregate.

Ecology. *O. quaestiformis* inhabits a wide range of substrates: rotten wood (rarely bark) of xeric twigs and branches of various angiosperm trees and shrubs, as well as herbaceous stems of various mono- and dicotyledonous perennial plants. two collections were on coniferous hosts. *O. quaestiformis* was recorded in atlantic to continental Europe, mainly in cold- to warm-temperate humid, also meso- (or supra-)submediterranean semihumid, preferably thermophilous western and central Europe. Sometimes it was found in hemi- or thermoboreal northern Europe or in thermomediterranean semihumid southern or warm-continental subhumid steppic eastern Europe. The altitude was planar to colline, rarely submontane. The vegetation includes borders of forests, ruderal places, dry grasslands, hedges and heaths, old quarries, old plantations (*Olea*, *Vitis* etc.), and wetlands (*Salicetum*, *Typhetum*).

Specimens included. **NORWAY**: **Oslo**, 3.5 km NW of Oslo, Marienlyst, Blindern University, 88 m, branch of *Acer pseudoplatanus*, on wood, 13. VIII.2002, G. Marson (H.B. 7186a). — **SWEDEN**: **Skåne**, 10.5 km NNW of Höganäs, N of Mölle, Kullaberg, 63 m, branch of *Populus tremula*, on wood, 8.VI.2006, H.O. Baral (H.B. 8218a ø). – 10 km SW of Malmö, 1 km S of Klagshamn, Klagshamns udda, 13 m, on culms of *Pooideae* in dung of *Equus caballus*, 26.IX.2014, S.Å. Hanson (H.B. 9939 ø). — **RUSSIA (West)**: **Pskov**, **Loknya**, 43 km NNW of Welikije Luki, 17 km S of Loknya, Golenishchevo, 134 m, twig of *Quercus robur*, on wood, 25.VII.2011, E.S. Popov (LE 247949, non vid.). – **Novgorod**, **Staraja Russa**, 43 km SSW of Weliki Nowgorod, 2 km ESE of Korostyn, Lake Ilmen, 33 m, twig of *Salix*, on wood, 7.IX.2011, E.S. Popov (LE 247943, non vid.). – **Astrakhan**, **Akhtubinsk**, 191 km ESE of Volgograd, 36.5 km ENE of Bolkhuny, NE of Zeleny Sad, S of Baskunchak salt lake, 1 m, twig of *Tamarix ramosissima*, on wood, 28.IV.2009, E.S. Popov (LE 248024, as *Orbilia* sp., doc. vid.). — **POLAND**: **Lower Silesia**, 10 km SSE of Bystrzyca Kłodzka, 1.5 km E of Domaszków, Polna ulica, 445 m, pole of *Salix*, on wood, 1.IV.2006, P. Perz (P.P. 20060401-1, H.B. 8232a, anam. substr.). – ibid., after 1 year deposit in our garden in Tübingen-Pfrondorf 1.5 m above the ground, 13.X.2007, H.O. Baral (H.B. 8232b ø). – ibid. (Polna ulica), 23.VII.2007, P. Perz (P.P. 20070923, doc. vid.). – ibid., branch of *Picea abies*, on bark, 28.X.2006, P. Perz (P.P. 20061028-3a, doc. vid.). — **SLOVAKIA**: **Bratislava**, 10.5 km WNW of Bratislava, 1.1 km N of Devín, Sandberg, 280 m, branch of *Rosa canina*, on wood, 15.VI. 2018, A. Polhorský (A.P. 18/56, doc. vid.). — **SERBIA**: **Vojvodina**, Fruška Gora, 7 km SSW of Novi Sad, NNW of Ledinci, 217 m, culm of *Pooideae*, 18.V.2016, D. Savić (FG-303, doc. vid.). — **GREAT BRITAIN**: **East England**, **Norfolk**, 37 km NE of King's Lynn, 3 km NW of Wells-next-the-Sea, Holkham Meols, 2 m, leaves of *Ammophila arenaria*, 26.X.2003, S.M. Francis (E.B. 4454, K(M) 145651, doc. vid.). – **Suffolk**, 9 km SE of Halesworth, Dunwich Forest, 3 m, branch of *Lonicera periclymenum*, on wood, 13.I.2006, E. Batten (E.B. 4663 ø, non vid.). – 5 km NNE of Leiston, Minsmere Haven, 1 m, leaves of *Ammophila arenaria*, 23.III.2002, E. Batten & S.M. Francis (E.B. 4281, K(M) 145650, H.B. 7264). – **Wales**, **Anglesey**, 8 km W of Caernarfon, 3 km SW of Newborough, Newborough Warren, 5 m, leaf of *A. arenaria*, 25.IX.2001, S.M. Francis & E. Batten (E.B. 4204, K(M) 138491, H.B. 7265, doc. vid.). – **South East England**, **West Sussex**, 4.5 km NNE of Crawley, SE of Gatwick Airport, 62 m, culm of *Typha*, 18.VI.2016, N. Aplin (N.A. 346, doc. vid.). — **NETHERLANDS**: **Zeeland**, 25 km SW of Rotterdam, 5.5 km NE of Schouwen-Duiveland, Bommenede harbour, 1 m, branch of *Sambucus racemosa*, on wood, 26.X.2010, S. Helleman (S.H. 673, doc. vid.). – **Noord-Brabant**, 6 km SW of Tilburg, 5 km E of Gilze, Kaaistoep, 12 m, stem of *Senecio*, 11.X.2004, L. Rommelaars (H.B. 7592a, in M-0276413 [*Hyalorbilia latispora*]). — **GERMANY**: **Baden-Württemberg**, 3.2 km SE of Altensteig, 1.1 km EE of Egenhausen, Egenhäuser Kapf, 620 m, branch of *Viburnum lantana*, on wood, 22.XI.2010, H.O. Baral (H.B. 9457b ø; sq.: KT222418). – 5.5 km NW of Stuttgart, 1.8 km WNW of Feuerbach, Lemberg, 360 m, stem of ?*Melilotus*, on wood, 5.IV.1998, H.O. Baral (H.B. 6082). – 7.5 km NW of Stuttgart, 1.5 km WSW of Korntal, train station, 305 m, stem of *Rubus fruticosus*, on bark, 18.VIII.2002, H.O. Baral (H.B. 7189). – 3 km W of Tübingen, 2 km SSE of Hagelloch, Schweigbrühl, 335 m, branch of *Salix alba*, on wood, 21.VI.1994, H.O. Baral (H.B. 5100b). – 3.5 km NE of Tübingen, 1.3 km SW of Pfrondorf, Bitzle, 420 m, stem of *Melilotus albus*, 10.VIII.1988, H.O. Baral (H.B. 3518b). – 1 km SSE of Pfrondorf, Neckar river, 313 m, stem of ?*Apiaceae*, 22.X.2006, H.O. Baral (H.B. 8346c). – Pfrondorf, Blaihofstraße, 430 m, branch of *Sambucus nigra*, on wood, 3.X.2002, E. Weber (ø). – ibid., 31.VII.2009, H.O. Baral & B. Liu (H.B. 9112 ø, anam. substr.). – ibid., on a rope, 24.XI.2009, H.O. Baral (H.B. 9226g ø, anam. substr.). — **LUXEMBOURG**: **L'Oesling**, **Clervaux**, 7.5 km NNW of Clervaux, Troisvierges, railway station, 430 m, stem of *Verbascum densiflorum*, 23.VII.1999, G. Marson (H.B. 6439b, anam. substr.). – ibid., branch of *Rosa*, on wood, 2.VII.2001, G. Marson (ø, anam. cult., anam. substr.). – **Diekirch**, 9 km NNW of Ettelbruck, 1.5 km NNW of Bourscheid, Goebelsmühle, railway station, 250 m, stem of *Tanacetum vulgare*, 10.VII.2004, G. Marson (ø). – ibid., stem of *Apiaceae* (ø). – **Gutland**, **Diekirch**, 4.5 km SW of Diekirch, W of Ettelbruck, railway station, 197 m, stem of *T. vulgare*, 6.VII.2002, G. Marson (H.B. 7175b). – **Mersch**, 4.3 km S of Larochette, 1.2 km N of Koedange, below Folkend, Mäschpesch, 300 m, branch of *Acacia* (attached to a rope some time ago), on wood, 23.VI.2005, G. Marson (ø). – **Capellen**, 2.5 km SW of Capellen, 2 km NNE of Garnich, Melzer-Schilzenheck, 315 m, stem of *Typha* (?)*latifolia*, 7.V.1997, H.O. Baral (ø). – **Luxembourg**, 7 km NE of Luxembourg, 1.5 km WSW of Senningerberg, W of Kiem, 388 m, stem of *Atropa belladonna*, 2.X.2005, G. Marson (H.B. 8001b ø, anam. substr.). – 2.5 km S of Luxembourg, 1 km SW of Bonnevoie, railway depot, 282 m, stem of *Melilotus*, 15.VIII.1998, G. Marson (H.B. 6210a). – ibid., stem of *Heracleum sphondylium*, 4.VIII.2005, G. Marson (H.B. 7869f). – 4.5 km SW of Luxembourg, 1.5 km SW of Cessange, Brichen, 295 m, culms & leaf sheaths of *Phragmites australis*, 10.V.1994, G. Marson (H.B. 5080a). – 5 km S of Luxembourg, 1.5 km W of Hesperange, Biersak/Géisselbierg, 290 m, stem of *Rubus fruticosus*, 20.XI.1994, G. Marson (H.B. 5190b). – 1.2 km SSW of Hesperange, Fentange, Wéineguecht, 272 m, stem of *Echinops sphaerocephalus*, 28.IV.1994, G. Marson & H.O. Baral (ø). – ibid., stem of *Reynoutria japonica*, 28.IV.1994, G. Marson & H.O. Baral (ø). – 1.5 km WSW of Fentange, Mierchesfeld, 283 m, branch of *Acer pseudoplatanus*, 21.VII.2008, G. Marson (ø, anam. substr.). – 0.8 km SE of Fentange, Wénkel, 265 m, branch of *Clematis vitalba*, on bark, 20.III.1994, G. Marson (ø). – **Esch-sur-Alzette**, 1 km NNE of Bivange, Lëschebann, 265 m, stem of *Echinops sphaerocephalus*, 15.VI.1994, G. Marson (H.B. 5105a). – ibid., 17.II.1994 (H.B. 5113b, G.M. 5196). – 7 km SSW of Luxembourg, 2 km SW of Kockelscheier, Nonneboesch, Neieweier, 285 m, branches of *Rubus armeniacus*, on bark, 30. XII.2006, G. Marson (ø). – 1.5 km SE of Kockelscheier, Laanguecht, 283 m, leaf sheath of *Typha*, 14.V.2002, G. Marson (ø). – 7 km S of Luxembourg, 1.5 km NW of Berchem, Angelsbierg, 295 m, stem of *Heracleum sphondylium*, 14.V.2002, G. Marson (ø, anam. substr.). – 2 km NNE of Dudelange, 1.5 km S of Bettembourg, railway station, 275 m, stems of ?*Melilotus*, 15.VI.1994, G. Marson (H.B. 5106). – ibid., stem of *Epilobium* ?*angustifolium*, 15.VI.1994, G. Marson (H.B. 5110b). – ibid., branches of *Salix* (?)*caprea*, on wood & bark, 15.VI.1994, G. Marson (H.B. 5119a, G.M. 5197). – ibid., stems of *Melilotus*, 20.VI.1998, G. Marson (H.B. 6172b). – ibid., stem of ?*Melilotus*, on wood, 9. VII.2002, G. Marson (H.B. 7170). – ibid., stem of *Melilotus*, 27.V.2007, G. Marson (ø). – ibid., stem of *Melilotus*, 5.VI.2007, G. Marson (H.B. 8539b). – ibid., stem of *Heracleum sphondylium*, 14.X.2009, G. Marson (ø). – ibid., Hela Baumarkt, stem of *H. sphondylium*, 25.VII.2014, G. Marson (G.M. 2014-07-25.4, sq.: KT380073) – 1.7 km NNW of Esch-sur-Alzette, 1.3 km SE of Ehrlange, Lankelzer Boesch, 300 m, leaf of *Typha*, 11.IV.1994, G. Marson (H.B. 5057b). – 3 km SE of Differdange, 1.3 km SW of Belvaux, Metzerbierg, 393 m, stem of *Melilotus albus*, 24.IV.2005, G. Marson (ø). – 2.5 km W of Esch-sur-Alzette, Belval Usines, 303 m, branch of *Salix*, on wood, 26.IX.2000, G. Marson (H.B. 7121 ø, anam. cult., CBS 140814; sq.: KT215246). – 4 km SE of Esch-sur-Alzette, 1.5 km W of Tétange, E of Holleschbierg, Minières, 355 m, stem of *Melilotus albus*, 11.III.1994, G. Marson (ø). – **Grevenmacher**, 6 km NE of Grevenmacher, Wasserbillig, railway station, Mosel river, 135 m, branches of *Rhus typhina*, on wood, 9.III.1994, G. Marson (ex H.B. 5035a, M-0276576, **holotype**). — **FRANCE**: **Bretagne**, **Ille-et-Vilaine**, 12 km E of La Gacilly, 1 km W of St.-Just, Moulin de Cojoux, 67 m, branch of *Cytisus scoparius*, on wood, 9.VI.2003, E. Weber (H.B. 7384). – **Morbihan**, 1.8 km S of Vannes, SE of harbour, 4 m, branch of *Rubus fruticosus*, 12.VI.2003, H.O. Baral (ø). – 9.5 km SE of Malestroit, 2.7 km WNW of St.-Martin-sur-Oust, Beauvais, 8 m, branch of *Cytisus scoparius*, on wood, 28.V.2007, A. Delannoy (J.P.P. 27094, doc. vid.). – ibid., 25.X.2010, J.P. Priou (J.P.P. 10188, doc. vid.). – 3.3 km SE of Malestroit, ESE of Nazareth, 60 m, stem of *Digitalis purpurea*, 28.III.2008, J.P. Priou (J.P.P. 28047, doc. vid.). – 5.3 km S of La Gacilly, 2 km N of St.-Vincent-sur-Oust, La Provostaie, 4 m, stem of *Reynoutria*, 4.XII.2006, J.P. Priou (J.P.P. 26220, doc. vid.). – Île de Houat, 16 km SE of Quiberon, 0.7 km E of Houat, Tréac'h er Gourèd, 2 m, stem of *Foeniculum vulgare*, 14.XI.2008, J.P. Priou (J.P.P. 28226, doc. vid.). – **Centre**, **Indre-et-Loire**, 40 km S of Tours, 2 km N of la Celle-St.-Avant, 70 m, branch of *Robinia pseudoacacia*, on wood, 29.IV.2006, H.O. Baral (H.B. 8148b ø). – **Pays-de-la-Loire**, **Loire-Atlantique**, 9 km SE of St.-Nazaire, W of Villemomble, La Pierre Attelée, 8 m, stem of *Yucca*, 13.XI.2008, J.P. Priou (J.P.P. 28220, doc. vid.). – **Vendée**, 38 km SW of Nantes, 2.3 km SW of Bourgneuf-en-Retz, Port du Collet, 1 m, inflorescence stem of *Yucca*, 20.X.2008, J.P. Priou (J.P.P. 28189, doc. vid.) – **Poitou-Charentes**, **Charente-Maritime**, 19 km S of Rochefort, 3 km WSW of Ste.-Gemme, NW of la Petite Vergne, 17 m, branch of *Pinus pinaster*, on wood, 30.XII.2007, P. Tanchaud (H.B. 8747, anam. substr.). – Île d'Oléron, 6 km E of St.-Pierre-d'Oléron, 3.2 km SSE of Boyardville, La pointe de Bellevue, 1 m, stem of *Yucca*, 27.XI.2010, B. Rivault (M.H., doc. vid.). – **Aquitaine**, **Gironde**, 12 km SW of Royan, 1.5 km NE of Soulac-sur-Mer, Tourterelles, 20 m, leaves of *Yucca*, 19.XI.2011, J.P. Priou (J.P.P. 11218, non vid.). – **Midi-Pyrénées**, **Aveyron**, 8 km ENE of Rodez, NE of Canabols, 560 m, branch of *Ulmus minor*, on wood, 25.VIII.2004, G. Marson (H.B. 7567c ø). – **Rhône-Alpes**, **Ain**, 22 km ENE of Lyon, 1.4 km SE of Balan, 190 m, branch of *Robinia pseudoacacia*, on wood, 20.IX.1999, H.O. Baral (ø). — **SPAIN**: **Com. Valenciana**, **Castellón**, 13.5 km NNW of Castellón, 3.2 km WSW of Vilafamés, Camí de Costur, 400 m, stem of *Foeniculum vulgare*, 27.IX.1999, H.O. Baral & G. Marson (H.B. 6509d ø).

Orbilia pleioquaestiformis Baral & G. Marson, **sp. nov.**, MB 814374 — Pls 681–682

Etymology: after the 16-spored asci and a strong similarity with *O. quaestiformis*. **Typification**: Western Australia, Perth, Kinross, branch of *Acacia*, 23.X.2007, G. Marson (ex H.B. 8745h, MEL 2389254, holotype).

Latin diagnosis: *Differt ab* Orbilia quaestiformi *ascis 16-sporis. Habitat ad corticem siccum Acaciae in zona subtropica semihumida Australiae meridio-occidentalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.2–0.28 mm diam., 0.1–0.14 mm high, bright orange-rose, hardly translucent, round, scattered; disc slightly concave, margin distinct, 10 µm protruding, finely rough; broadly sessile, erumpent from bast fibres. **Asci** *(64–)68–88 × 7–8.6 µm, †61–75 × 6.5–7.3 µm, 16-spored (often only 11–13 spores developed), spores *~2–3-seriate, 6–9 lower spores inverted (± mixed or not), pars sporifera *37–48 µm long; **apex** (†) strongly truncate (slightly indented, laterally slightly inflated); **base** with short to medium long, thick, ± flexuous stalk, L- or Y-shaped. **Ascospores** *(8.5–)9.5–12.3(–13) × 2.6–3.2(–3.4) µm, †8–11 × (2–)2.5–3 µm, ellipsoid-clavate, apex obtuse, base strongly attenuated (partly tail-like), medium to strongly curved near base; **SBs** *4.2–5.5 × 0.3–0.4 µm in situ (~5–6.5 µm actual length), vermiform, flexuous to helicoid or almost uncinate, with a few small LBs. **Paraphyses** apically medium to strongly clavate-capitate, rarely moniliform, terminal cells *7–18 × 3–4.3 µm, lower cells *9–14 × 1.5–2 µm {near apex up to 3–3.8 µm}; unbranched in upper part, hymenium pale (in uppermost part light) orange. **Medullary excipulum** pale to light orange, 15–30 µm thick, of dense textura intricata with many large inflated cells, medium sharply delimited from ectal excipulum. **Ectal excipulum** pale (near margin light) orange, of (†) slightly gelatinized, vertically oriented textura prismatica-globulosa from base to mid flanks, 25–35 µm thick near base, cells *8–18(–22) × 6–12(–14) µm; 25 µm thick near margin, of t. globulosa-angularis, at upper margin of very irregularly oriented t. globulosa-prismatica at a 10–80° angle to the surface, marginal cortical cells *7–12 × 3–4 µm. **Anchoring hyphae** medium abundant, †2–3 µm wide, walls 0.2–0.3 µm thick, forming a 5–10 µm thick hyaline layer of interwoven hyphae at flanks and margin. **SCBs** globose, in paraphyses (1–)1.5–2.8 µm diam., in ectal excipulum (near margin) 2.3–3 µm. **Exudate** 0.2–1 µm thick, over paraphyses cloddy-continuous, loosely attached, cortical hyphae agglutinated by exudate. — **ANAMORPH**: unknown.

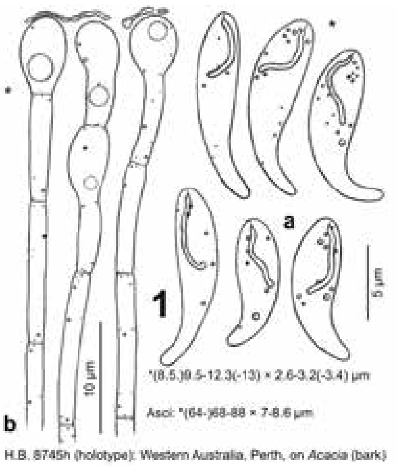


Plate 681. **1**: *Orbilia pleioquaestiformis*. – **a**. ascospores; **b**. paraphyses.

Habitat: collected 1 or 2 m above the ground, on inner surface of bark detached from a 15 mm thick branch of *Acacia* sp., slightly to strongly decayed, slightly greyed, without algae. **Associated**: *Baggea* sp., *Hypoxylon* sp., *?Hysteropatella* sp., *Muellerella lichenicola, Orbilia commarosa, O. macrotrapeziformis, O. microserpens, O. myriofusiclava, O. pluristomachia, O. serpentina, O. wannerooensis, Schizoxylon* sp. **Desiccation tolerance**: fully viable for at least 3 months. **Altitude**: 40 m a.s.l. **Geology**: Cenozoic regolith (whitish sand). **Phenology**: long-lived.

Taxonomic remarks. *Orbilia pleioquaestiformis* closely resembles European *O. quaestiformis*, from which it sharply differs in the (11–)16-spored asci.

Ecology. The single sparse collection was made on xeric bark of *Acacia* in a subtropical semihumid acacia mixed shrubland in southwestern Australia.

Specimens included. **AUSTRALIA**: **Western Australia**, Swan Coastal Plain, 30 km NNW of Perth, 1 km NW of Kinross, Tamala Park, 40 m, branch of *Acacia*, on bark, 23.X.2007, G. Marson (ex H.B. 8745h, MEL 2389254, **holotype**).

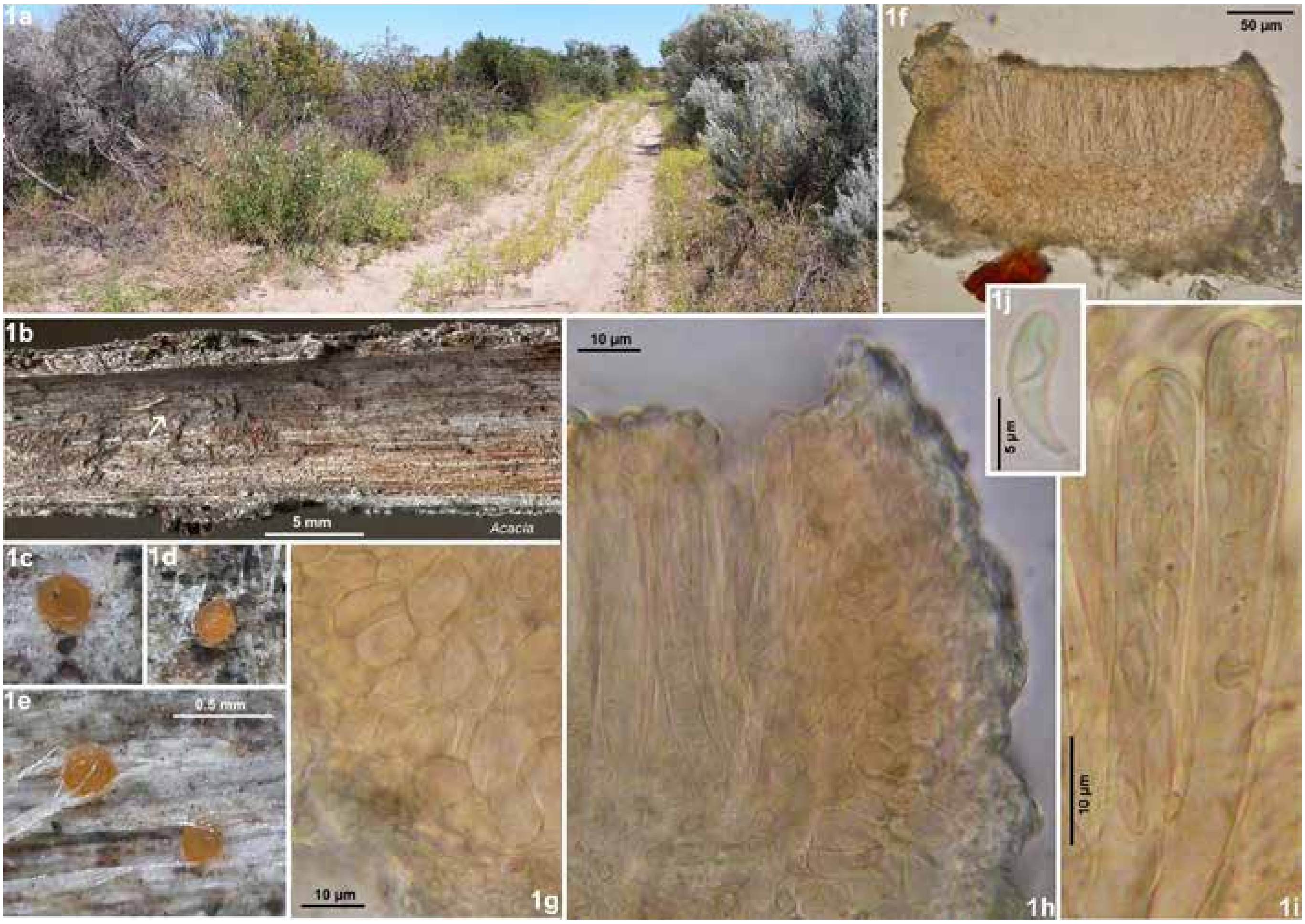


Plate 682. **1**: *Orbilia pleioquaestiformis*. – **1a**. acacia shrubland on white sandy soil; **1b**. inner surface of detached bark; **1c–e**. rehydrated apothecia; **1f**. apothecium in median section; **1h**. id., marginal ectal excipulum; **1g**. basal excipular cells; **1i**. asci (and paraphyses); **1j**. ascospore. – Living state. — **1a–j**. H.B. 8745h (holotype): Western Australia, Perth, on *Acacia*.

Orbilia septispora Baral, Z. Mykol. 55: 126 (1989) — Pls 683–684, Map 112

Etymology: named after the ascospores that get 1(–2)-septate within the living asci.

Typification: Germany, Tübingen, stem of *Melilotus albus*, 29.VII.1988, G. Marson & H.O. Baral (ex H.B. 3490, M-0276585, holotype).

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.1–0.3(–0.5) mm diam., 0.11–0.12 mm high, pale or light orange-rose, round, scattered to ± gregarious; disc slightly concave to slightly convex, margin thin, 0–20 µm protruding, smooth; broadly sessile, rarely with an indistinct immersed stipe, erumpent from beneath epidermis; dry light ochraceous-orange. **Asci** *((45–))(50–)55–75(–90) × 7.3–9(–9.3) µm {9}, †(44–)50–65(–68) × (5.5–)6.2–7.5 µm {4}, 8-spored, in some asci only 4–6 spores reaching maturity, (1–)3–5(–6) lower spores inversely oriented {9} (sometimes mixed), pars sporifera *(24–)30–40(–45) µm; **apex** (†) slightly to strongly truncate (slightly indented, laterally not or scarcely widened); **base** with a short to medium long, flexuous stalk, L-, T-, Y- or h-shaped. **Ascospores** *((9–))(10–)11–15(–17) × (2.5–)2.8–3.7(–4.2) µm {11}, 19–21.5 µm long in 4-spored asci {1}, †10.5–17 × 2.7–3(–3.2) µm {2}; (0–)1(–2)((–3))-septate within living asci prior to discharge {9}; cylindric-clavate, apex rounded, base slightly to strongly attenuated and geniculate, rarely straight; **SBs** only in apical cell, (2–)3–4(–5.8) × (0.3–)0.4–0.7(–0.9) µm {7}, rod-shaped to subulate, straight or slightly curved, often obliquely oriented, with a small number of LBs up to 0.7–1.5(–2) µm diam. grouped in each cell. **Paraphyses** apically medium to strongly capitate-clavate, sometimes lageniform or moniliform, terminal cells *(5–)8–21 × (2–)3–4.8(–5.3) µm {6}, †(1.5–)2–4.2 µm wide {1}; lower cells *(5–)7–15.5 × 1.2–2(–2.3) µm {4}, sometimes branched at upper septum. **Medullary excipulum** ± hyaline, 30–40 µm thick, of ± dense textura intricata with many inflated cells, medium delimited from ectal excipulum only towards margin. **Ectal excipulum** subhyaline, of thin-walled, vertical or horizontal t. globulosa-angularis(-prismatica) from base to mid flanks or margin; 15–35 thick near base, cells *(5–)7–13(–16) × (4–)6–9(–11) µm {5}, with or without 1 lipid body of 1.2–3.3 µm in each cell; 15–30 µm thick at flanks and margin, cells *6–15 × 6–10 µm, oriented at a very low or irregular angle, marginal cortical cells (*) thin-walled, (†) distinctly gelatinized, *4–12 × 2.5–6 µm {4}. **Anchoring hyphae** sparse to medium abundant, */†2–3 µm wide, wall 0.2(–0.4) µm thick {2}, covering the exterior by a thin layer up to submargin. **SCBs** in apices of paraphyses and excipulum globose, 1.2–3 µm diam. {6}. **Exudate** over paraphyses and marginal excipulum 0.2–1 µm thick, hyaline, granular-cloddy to continuous, loosely to firmly attached. — **ANAMORPH**: tridentaria-like (from ascospore isolate {2} and natural substrate {5}). **Conidiophores** not observed. **Conidia** with (2–)3(–4–5) arms, total height */†23–35 × 18–27 µm {4}, stipe *9.5–15 × 2.5–4.8 µm {3}, †9–10 × 3–4 µm {2}, 1–2-septate, arms *14–32 × 2.7–5 µm {4}, †15–18 × 3–4 µm, gradually or only terminally tapering, 2–4-septate (including basal septum), constricted at base.

Habitat: collected near ground or up to 0.4–1.5 m above the ground, on ~ 1–2 years old, lying or often standing culms {18} and leaf sheaths {5} of *Phragmites australis* {27}, leaves of *Typha* sp. {1}, stem of *Melilotus albus* {1}; also on 6–10 mm thick decorticated twigs or branch stubs of *Juglans regia* {1}, *Lonicera periclymenum* {1}, *Rosa* sp. {1}, on medium to very rotten wood {3}; at areas covered with green algae, often greyed. **Associated**: ?*Cryptodiscus* sp. {1}, *Lachnum controversum* {2}, *Orbilia clavuliformis* {1}, *O. eucalypti* {1}, *O. graminis* {2}, *O. quaestiformis* {3}, *O. trapeziformis* {1}, *O. vitalbae*

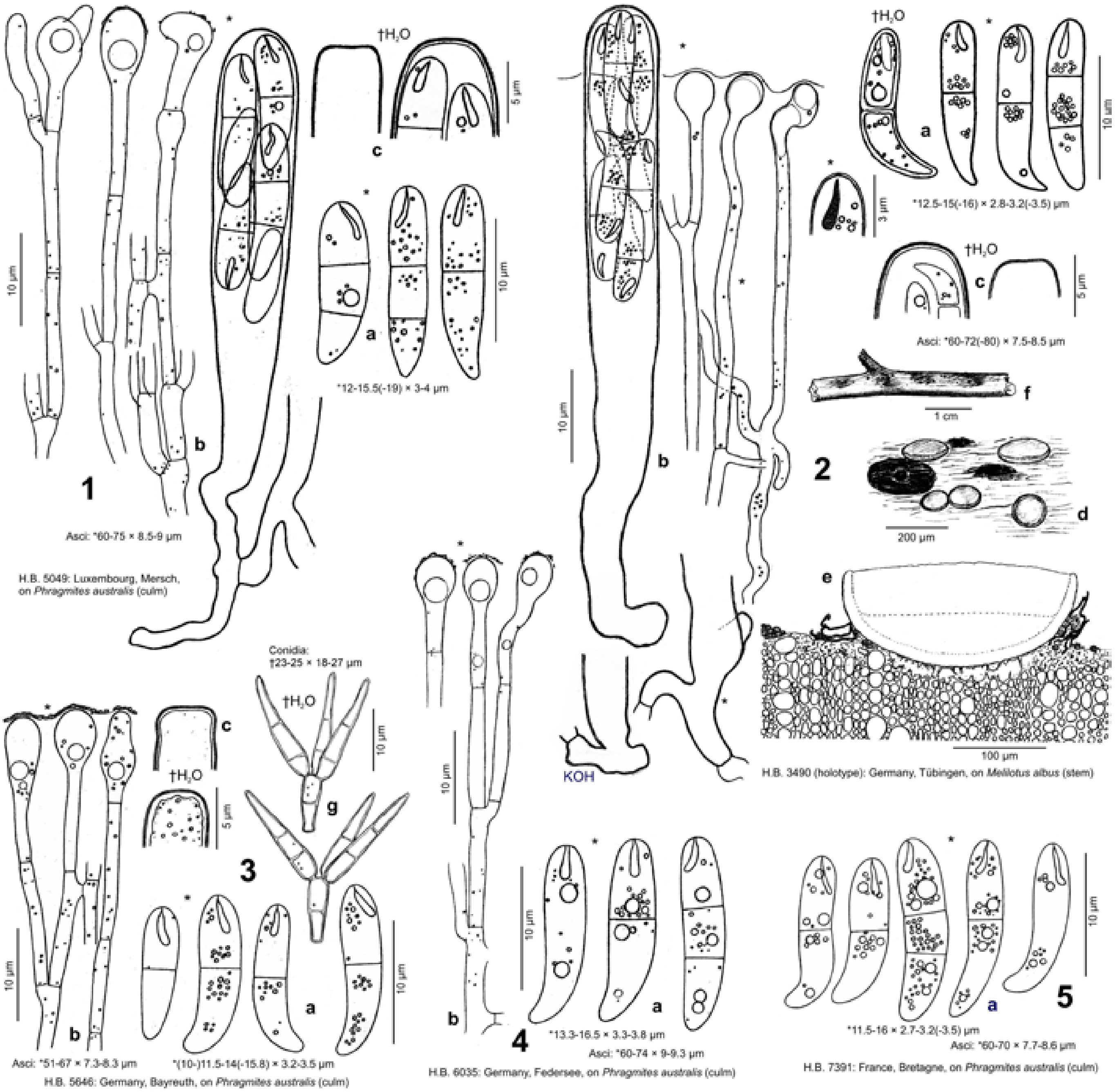


Plate 683. **1–5**: *Orbilia septispora*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. rehydrated apothecia; **e**. apothecia in median section; **f**. dead stem of *Melilotus*; **g**. conidia from substrate.

{2}, ‘*Pezizella*’ *nigrocorticata* {1}, ?*Stictis* sp. {1}, ?*Scirrhia* sp. {1}, *Unguiculariopsis* sp. {1}. **Desiccation tolerance**: fully viable for at least 3.5 months. **Altitude**: 1–578 m a.s.l. **Geology**: Buntsandstein, Muschelkalk, alluvial deposits from Keuper (gypsum, clay), Lower & Middle Jurassic shale, sand- & limestone, Cretaceous calcareous clay- & marlstone, Tertiary molasse, sand & marl, Quaternary loess, silt & sand, peat. **Phenology**: throughout the year (long-lived).

Phenology of *O. septispora*											
Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
3	3	4	5	3	1	3	0	2	1	2	4

Taxonomic remarks. *Orbilia septispora* is easily recognized by its large, septate, cylindric-clavate, basally usually ± attenuated and geniculate ascospores. It is the only known species within the *Orbiliomycetes* which forms predominantly septate spores within the living asci prior to discharge. A description of one of the here studied specimens (Pl. 683: 3) was also illustrated by Beyer (1997: 52, 1998: 192). *O. septispora* closely resembles *O. quaestiformis* in spore shape and in the tridentaria-like anamorph. In a collection referred to *O. quaestiformis* (Pl. 678: 1) and in the similar *O. mesaverdiana* the spores were likewise partly septate, but such spores have never been observed within the living asci. *O. mesaverdiana* further differs in spores being strongly curved as a whole.

Variation. A certain variation in spore size and in spore bases was noted among the collections. The spores possess usually 1 septum when mature. However, single non-septate spores are sometimes found in some of the living asci, but also 2-septate spores may occur, and in one collection a few 3-septate spores were found. As a very rare exception, a few of the living asci contained 6 non-septate and only 2 1-septate spores, though the SBs were fully developed in all of them. The septa are rather delicate and easily overlooked. They are formed at a very late

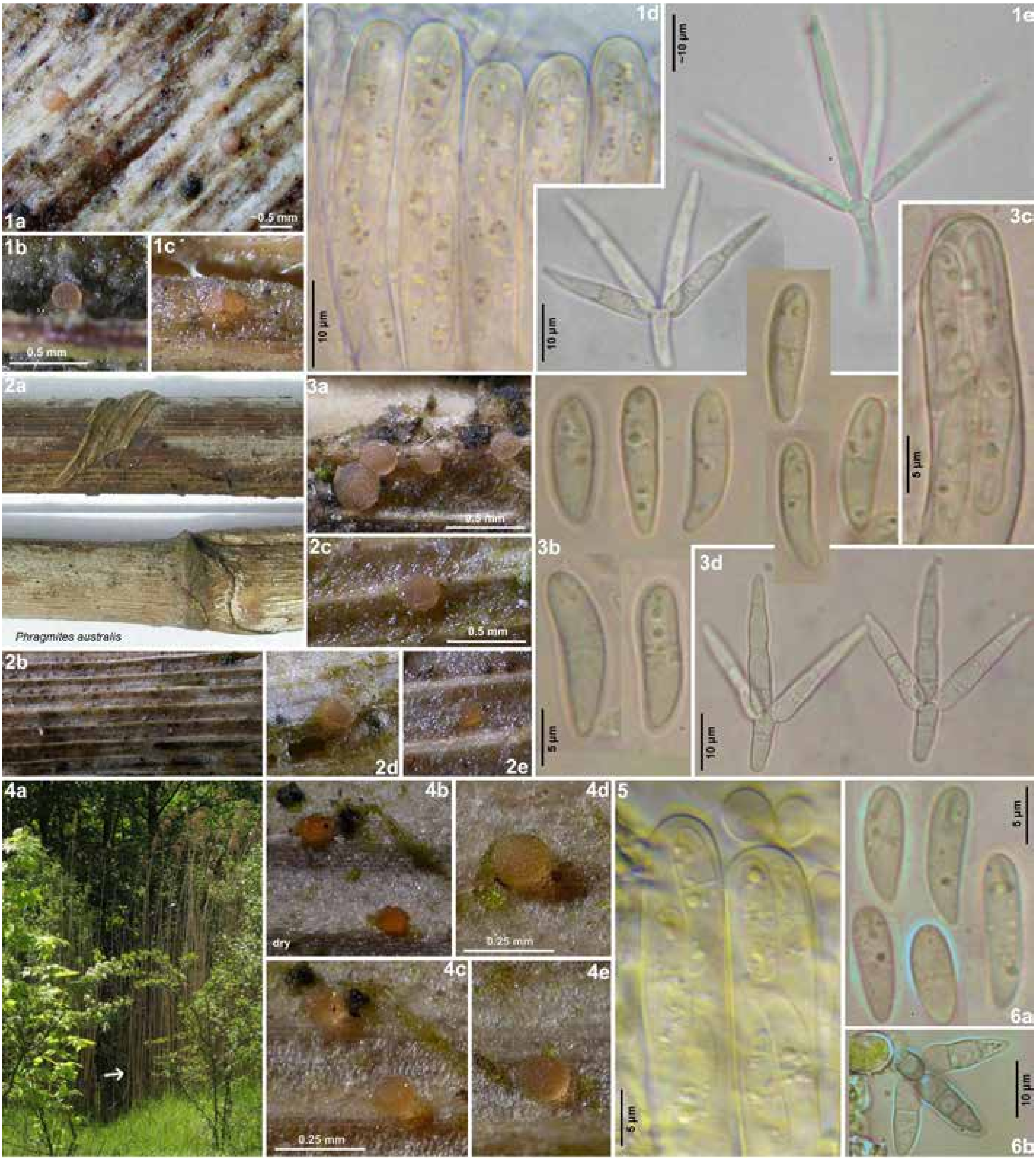


Plate 684. **1–6**: *Orbilia septispora* (on *Phragmites*, except for **6** on *Juglans*). – **4a**. wet *Phragmitetum* with *Fraxinus*; **2a**. dead standing culms of *Phragmites*; **1a–c**, **2b–e**, **3a**, **4c–e**. rehydrated apothecia; **4b**. dry apothecia; **1d**, **3c**, **5**. asci; **3b**, **6a**. ascospores; **1e**, **3d**, **6b**. conidia from substrate. – Living state. – **6a–b**: phot. P. Perz. — **1a–e**. H.B. 7267a: Luxembourg, Sandweiler; **2a–e**. H.B. 7391: France, Bretagne; **3a–d**. H.B. 8398: Germany, Amberg; **4a–e**. 15.IV.2009: Luxembourg, Oberkorn; **5**. 20.IV.2008: Luxembourg, Rodange; **6a–b**. P.P. 20090918: Poland.

stage of spore maturation, after the SBs started to develop. Only the apical cell contains the spore body. In the rare case of 3-septate spores, however, the SB penetrated the pore of the uppermost septum.

Anamorph. *O. septispora* and *O. quaestiformis* have very similar anamorphs which both closely resemble *Tridentaria subuliphora* (see under *O. quaestiformis*, p. 1154).

Phylogeny. Sequences from three samples on *Phragmites* from Luxembourg were available: two from Lankelzerwues (ascospore isolate, G.M. 2014-02-24.1; from apothecia, G.M. 2016-09-20.1), and an inofficial sequence in the CBS database from Aire-de-Berchem (ascospore isolate, G.M. 2012-03-12.1, CBS 133219). The former two comprise S1506 intron, ITS, and LSU, that from 2016 also the entire SSU and LSU D1–D10, while the CBS sequence only ITS. In the ITS region the three strains fully concur, except for 2–3 ambiguous positions in the ITS1 which appear to vary within a population. The intron of the 2014 sample was incompletely obtained, and the few deviations from the complete intron of the 2016 sample are uncertain. The two strains with LSU are identical in the overlapping D1–D3 domain.

O. septispora clustered in a highly supported clade with *O. quaestiformis* (see p. 1156, Phyls 19–20), from which it differs by ~15 nt (2.8%) in the ITS region and by 19 nt and 2 gaps (1.9%) in the overlapping region of LSU (D1–D3) when compared to G.M. 2014-07-25.4. The S1506 intron of *O. septispora* shows to *O. quaestiformis* in the overlapping region a distance of 22–25% (for more details see under *O. quaestiformis*).

A further sequence comprising SSU (without intron), ITS, and LSU was gained from apothecia on *Viburnum* from Baden-Württemberg (H.B. 9457). It was thought to belong to *O. vitalbae* (H.B. 9457a), but the obtained sequence clustered in the *quaestiformis-septispora* clade. At first we assumed that it derived from the associated *O. quaestiformis* (H.B. 9457b), which had rather short spores (*8–9 µm) but seemed otherwise typical *O. quaestiformis*. Only a single apothecium was found to belong to this species during microscopic examination. However, in the ITS region this sequence is closer to *O. septispora* (3.5%; 4.2–4.5% to *O. quaestiformis*), whereas a confidental sequence of *O. vitalbae* (H.B. 9905a) is very distant from all of them (~21%). Also in the LSU (D1–D2) the sequence is closer to *O. septispora* (0.4%, 2 nt), compared to 1.3–1.5% to *O. quaestiformis*, whereas the two available sequences of *O. vitalbae* differ in this domain by 4.7–5.5% from *O. quaestiformis* and *O. septispora*, and by 3.3% from the doubtful sequence. Therefore, we identified this sequence as *O.* cf. *septispora* and gave it the number H.B. 9457c. In the SSU no differences occur among all these sequences, except for a deviation in the ITS1 primer in *O.* cf. *septispora*.

Ecology. The first collection of *O. septispora* (holotype) was exceptional in growing on a stem of *Melilotus albus* together with *Lachnum controversum*, which is known to be confined to *Phragmites*. There is no doubt about the identity of the host species, although the place was only about 2 m away from a pond with a *Phragmitetum*. Most later collections of *O. septispora* were made on monocotyledonous substrate, mainly *Phragmites*. However, some samples were on wood of trees and shrubs. The species is so far only known from cold- to warm-temperate humid, atlantic to subcontinental Europe. Typically it occurs on standing, xeric, perhaps often 2 year's old, greyed and algae-covered culms, though usually with rather sparse apothecia, in undisturbed *Phragmites* stands in moist places or near rivulets and lakes, e.g., with *Alnus*, *Fraxinus*, *Salix*, *Populus*, or *Prunus spinosa*, but also in tree- and shrubless vegetation, e.g., at the Atlantic coastline. In the holotype the stem was lying on gravel in a sun-exposed ruderal area with *Pastinaca sativa*, *Melilotus albus*, and *Solidago canadensis*. Van Ryckegem (2005: 319) reported *O. septispora* during his study on fungi on *Phragmites* in the Scheldt estuarine ecosystem near Antwerpen (Belgium), and Olariaga et al. (2015: 80) in their study of *Phragmitetum* formations in Gipuzkoa (País Vasco).

Specimens included. **GREAT BRITAIN**: **Yorkshire**, **South Yorkshire**, 11 km E of Doncaster, 1.8 km SSE of Lindholme, Hatfield Moor, 1 m, culm of *Phragmites australis*, 17.V.2011, B.M. Spooner (K(M) 170691). – **East England**, **Suffolk**, 9 km SE of Halesworth, Dunwich Forest, 5 m, branch of *Lonicera periclymenum*, on wood, 13.I.2006, E. Batten (E.B. 4663 ø, doc. vid.). — **DENMARK**: **Sjælland**, 0.5 km S of Vordingborg, 4 m, culm of *P. australis*, 31.V.2007, H.O. Baral (ø). — **BELGIUM**: **Vlaanderen**, **West-Vlaanderen**, 13 km N of Brügge, 4 km WSW of Knokke-Heist, SW of Molenhoek, Kleiputten, 2 m, culm of *P. australis*, 2.IV.2000, B. Declercq (ø, non vid.). – **Oost-Vlaanderen**, 5 km SW of Antwerpen, 2 km N of Hoboken, Hobokense Polder, 5 m, culm of *P. australis*, 21.VII.2000, B. Declercq (ø, non vid.). – 16 km NE of Gent, ESE of Wachtebeke, De Reepkens, 10 m, culms of *P. australis*, 15.II.1998, G. Van Ryckegem (G.v.R. 4, non vid.). – ibid., culms of *P. australis*, 20.XII.1998, B. Declercq (B.D. 98135, non vid.). — **LUXEMBOURG**: **L'Oesling**, **Redange**, Ardennes, 5 km NNE of Redange, 1.7 km E of Folschette, Frilscht, 360 m, culms & leaf sheaths of *P. australis*, 24.VII.2003, G. Marson (ø). – **Gutland**, **Mersch**, 4.3 km S of Larochette, 1.2 km N of Koedange, Folkend, Mäschpesch, 300 m, culms of *P. australis*, 10.IV.1994, G. Marson (H.B. 5049). – **Luxembourg**, 7.5 km E of Luxembourg, 1.2 km ENE of Sandweiler, Neimillen, 305 m, culms of *P. australis*, 2.XII.2002, G. Marson (ø). – ibid., culms & leaf sheaths of *P. australis*, 1.XII.2002, G. Marson (H.B. 7267a, anam. substr.). – 4.5 km SW of Luxembourg, 1.5 km SW of Cessange, Brichen, 295 m, culms of *P. australis*, 10.V.1994, G. Marson (H.B. 5080d). – **Esch-sur-Alzette**, 8 km S of Luxembourg, 1.3 km NNW of Livange, W of Aire-de-Berchem, 284 m, culms & leaves of *P. australis*, 12.III.2012, G. Marson (G.M. 2012-03-12.1, anam. cult., CBS 133219, sq.: CBS ined.). – Terres rouges, 6.3 km W of Esch-sur-Alzette, 1.5 km S of Obercorn, Katzeboesch, 380 m, culm of *P. australis*, ~15.IV.2009, G. Marson (ø). – 1.7 km NNW of Esch-sur-Alzette, 1.3 km SE of Ehlerange, Lankelzer Boesch, 300 m, leaf base of *Typha*, 11.IV.1994, G. Marson (H.B. 5057a). – ibid., Lankelzerwues, 290 m, stems of *P. australis*, 24.II.2014, G. Marson (G.M. 2014-02-24.1; sq.: KT380074). – ibid., *P. australis*, 20.IX.2016 (G.M. 2016-09-20.1; sq.: MK473417). – 3.7 km NE of Esch-sur-Alzette, 1.7 km NE of Schifflange, SW of Schilzbierg, 277 m, culms (leaf sheath) of *P. australis*, 11.IV.1994, G. Marson (ø, anam. cult.). – ibid., 25.XI.2000, G. Marson (H.B. 6845). — **GERMANY**: **Baden-Württemberg**, 3 km W of Tübingen, 2 m SSE of Hagelloch, Schweigbrühl, 335 m, stem of *Melilotus albus*, 29.VII.1988, G. Marson & H.O. Baral (ex H.B. 3490, M-0276585, **holotype**). – Oberschwaben, 4 km NE of Bad Buchau, WNW of Tiefenbach, eastern end of Federsee, 578 m, leaf sheaths of *P. australis*, 8.II.1998, H.O. Baral (H.B. 6035, anam. substr.). – **Bayern**, **Oberfranken**, 11 km NNW of Bayreuth, 3 km NW of Harsdorf, Trebgasttal, E of Fohlenhof, 333 m, culms of *P. australis*, 20.X.1996, W. Beyer (H.B. 5646, anam. substr.). – **Oberpfalz**, Amberg-Sulzbach, 13 km NE of Amberg, 1 km W of Hirschau, Moosweiher, 415 m, culms of *P. australis*, 23.XII.2006, H.O. Baral (H.B. 8398, anam. substr.). — **CZECHIA**: **Hradec Králové**, 23 km ENE of Hradec Králové, 1.8 km SW of Dobruška, 300 m, branch of *Juglans regia*, on wood, 18.IX.2009, P. Perz (P.P. 20090918-1-CR, anam. substr., doc. vid.). — **AUSTRIA**: **Burgenland**, 8.5 km SE of Eisenstadt, 3 km E of Siegendorf, W of Neusiedler See, Siegendorfer Puszta und Heide, 170 m, branch of *Rosa*, on wood, 28.XI.2009, G. Friebes (G.F. 20090125, doc. vid.). — **SERBIA**: **Vojvodina**, 10 km SW of Novi Sad, 1 km E of Beočin, 75 m, leaves of *Phragmites australis*, 20.III.2019, D. Savić (FG-1022, doc. vid.). – 16 km S of Novi Sad, 2.7 km N of Irig, Novo Hopovo, Manastirsko jezero, leaves of *P. australis*, 220 m, 15.III.2019, D. Savić (FG-1023, non vid.). – 4.5 km ESE of Irig, jezero Međeš, 143 m, leaf of *P. australis*, 12.III.2019, D. Savić (FG-1023, doc. vid.). — **FRANCE**: **Bretagne**, **Morbihan**, 17 km S of Vannes, 3.5 km SE of Sarzeau, SSW of Suscinio, 1 m, culms of *P. australis*, 12.VI.2003, H.O. Baral (H.B. 7391). — **SPAIN**: **País Vasco**, **Gipuzkoa**, 10.5 km WSW of San Sebastián, 6 km E of Zarautz, Itzao, 2 m, culm of *P. australis*, 7.I.2013, I. Olariaga (ARAN-F A3025085, doc. vid.). – ibid., 0.8 km E of Zarautz, Ihidieta, 3 m, culm of *P. australis*, 3.I.2013, J.L. Albizu & I. Olariaga (ARAN-F A3078193, doc. vid.).

Map 112. Known distribution of *O. septispora* in Europe.

Orbilia quercus-ilicis Baral & E. Weber, **sp. nov.**, MB 813700 — Pls 685–686

Etymology: named after the occurrence on dead leaves of *Quercus ilex* agg.

Typification: Spain, Almadrones, leaves of *Quercus rotundifolia*, 24.IX.1999, H.O. Baral (ex H.B. 6477b, M-0276577, holotype).

Latin diagnosis: *Similis* Orbiliae quaestiformi *sed ascosporae breviores, magis fusoideo-clavatae, corpusculum refringens partim longius. Habitat ad folia coriacea, sicca, leniter putrida* Quercus ilicis *in zona supramediterranea semihumida Europae meridio-occidentalis.*

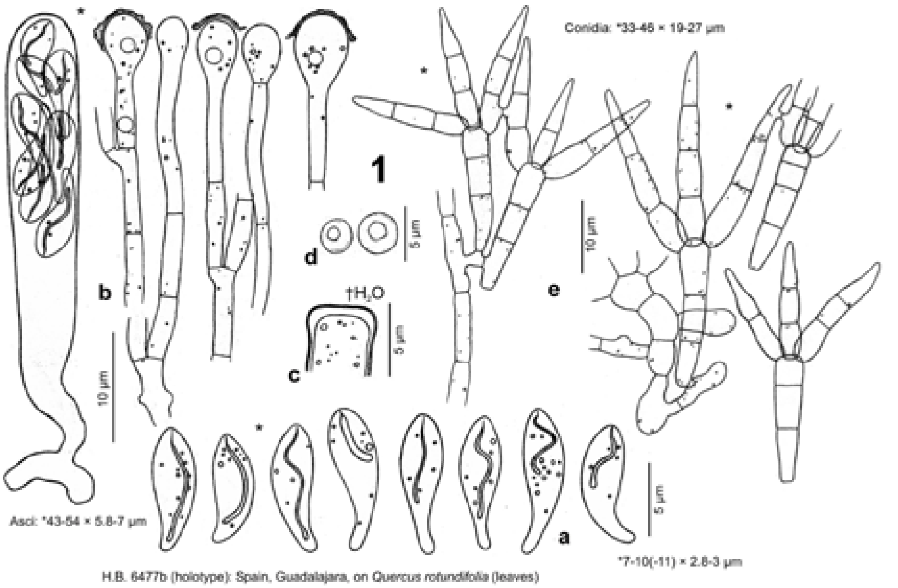


Plate 685. **1**: *Orbilia quercus-ilicis*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apex; **d**. ring-shaped SCBs in ectal excipulum; **e**. conidiophores and conidia from culture.

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.15–0.3(–0.5) mm diam., 0.09–0.12 mm high, light orange(-rose), slightly translucent, round, scattered to subgregarious; disc flat, margin indistinct, not protruding, smooth; broadly sessile, superficial; dry light apricot. **Asci** *43–54 × 5.8–7 µm {T}, †40–53(–61) × 5.2–7 µm {2}, 8-spored, spores *2–3-seriate, 2–5 lower spores inverted {2}, pars sporifera *20–23 µm long; **apex** (†) medium to strongly truncate (not indented, laterally sometimes inflated); **base** with short to medium long, thick, flexuous stalk, T-, L- or Y-shaped. **Ascospores** *7–10(–11) × 2.8–3 µm {1}, †7.5–8.5 or sometimes 11–13 × 2.5–3 µm {1}, fusoid-clavate, apex obtuse (to subacute), rarely rounded, base strongly attenuated, mostly tail-like or sometimes with a short tail, slightly to medium curved near base; **SBs** *4–8 × 0.2–0.3(–0.5) µm in situ {1} (~5–9.5 µm actual length), filiform to vermiform, partly subulate, not enlarged at base, slightly to strongly flexuous or helicoid, LBs sparse to medium abundant, ± small. **Paraphyses** apically medium to strongly capitate, terminal cells *5.5–18 × 2.5–5.2 µm {1}, lower cells *5.5–13 × 1.4–2(–2.4) µm {1}; sometimes branched at upper septum. **Medullary excipulum** hyaline, 20 µm thick, of ± dense textura intricata-angularis, medium sharply delimited. **Ectal excipulum** hyaline, of (†) thin-walled, ± horizontally oriented t. angularis-prismatica from base to margin, 20 µm thick near base, cells †5–9 × 4–5 µm {1}; 10 µm thick near margin, oriented at a 20–30° angle to the surface, marginal cortical cells */†5–10 × 3–4 µm {1}. **Anchoring hyphae** †1.7–3 µm wide, walls 0.2(–0.3) µm thick {2}. **SCBs** in paraphyses globose, 1.3–1.5 µm diam.; in ectal excipulum globose, 2.5–3.8 µm diam., low-refractive, hyaline, also ring-shaped or absent. **Exudate** over paraphyses 0.3–0.6(–1) µm thick, slightly rough, firmly attached; over margin and flanks 0.3–1 µm thick, cloddy, pale yellowish. **— ANAMORPH**: tridentaria-like (from apothecium on agar {1}). **Conidiophores** very short. **Conidia** with 3 arms, *33–46 × 19–27 µm, stipe *16–20 × 3.5–4 µm, 2(–3)-septate, arms *(11–)20–26 × 2.5–4 µm, gradually tapering or cylindrical and abruptly tapering only near apex, 2–4-septate, constricted at base {1}.

Habitat: collected 0.4–1.5 m above the ground, still-attached dead leaves of *Quercus ilex* {1}, *Q. rotundifolia* {1}, on medium decayed lower surface, among the host's hairs, strongly greyed, with a few green algae. **Associated**: *Calycellina* aff. *albida* {2}, ?*Durella* sp. {1}, ?*Micraspis* sp. {1}, *Micropeziza mollisioides* {1}, *Orbilia foliicola* {1}, *Rutstroemia coracina* {1}. **Desiccation tolerance**: fully viable for at least 10 months. **Altitude**: 485–1065 m a.s.l. **Geology**: Cretaceous lime- & marlstone. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia quercus-ilicis* is characterized by fusoid-clavate ascospores with very long, ± filiform spore bodies. The species is undoubtedly closely related to *O. coniferarum* (p. 1163) and *O. quaestiformis* (p. 1151). The presence of ring-shaped (?crystalloid) SCBs in the ectal excipulum might be a further difference but needs confirmation from further collections.

A subatlantic collection on stems of *Humulus* (Pl. 593: 34 Fig. 6) included in *O. trapeziformis* matches *O. quercus-ilicis* to some extent, from which it differs in the substrate, more subacute spore apices, and apothecia with a more distinct and rough margin.

Variation. In the rather sparse paratype which was only studied in the dead state, a single apothecium deviated in distinctly longer spores (†11–13 µm, asci 8-spored) compared to the other apothecia examined (†7.5–8.5 µm), while no further differences could be observed.

Not included collection. A submediterranean sample on wood of *Castanea* (Pl. 686: 3) is not included because of the deviating habitat and the partly lageniform to moniliform paraphyses.

Anamorph. The tridentaria-like anamorph of *O. quercus-ilicis* resembles that of *O. quaestiformis* but differs in shorter conidial arms. As a consequence, in *O. quercus-ilicis* the arms are only slightly longer than the stipes. In the collection on *Humulus*, conidia similar as in *O. quercus-ilicis* but with shorter stipes and longer arms were found in association, which might instead belong to *O. quaestiformis* or *O. filiformis*.

Ecology. *O. quercus-ilicis* grew on the greyed hairy lower surface of dead, xeric, coriaceous leaves of *Quercus ilex* agg. in the suprasub- to supramediterranean semihumid maquis (*Quercetum ilicis*) of southern Europe. The only further *Orbilia* found in this extraordinary habitat, *O. foliicola*, is macroscopically indistinguishable and grew in association in the holotype, though on separate leaves. Both were so far only found on still-attached leaves but not on leaves lying on the ground. The not included collection on *Castanea* wood was from a temperate humid region at the southern foothills of the Italian Alps.

Specimens included. **FRANCE**: **Provence-Alpes-Côte d'Azur**, **Vaucluse**, Préalpes du Dauphiné, 14 km SE of Carpentras, 4 km SE of Venasque, Aire de Pic-Nique de Venasque, 485 m, leaves of *Quercus ilex*, 9.X.2002, G. Marson (H.B. 8388b ø). — **SPAIN**: **Castilla-La Mancha**, **Guadalajara**, Sistema Central, 18 km SW of Sigüenza, 2.5 km NE of Almadrones, 1065 m, leaves of *Quercus rotundifolia*, 24.IX.1999, H.O. Baral (M-0276577, **holotype**; **isotypes** in H.B. 6477b, K(M) 64409 and J.T.P. [with *Rutstroemia coracina* & *O. foliicola*]; anam. apoth.).

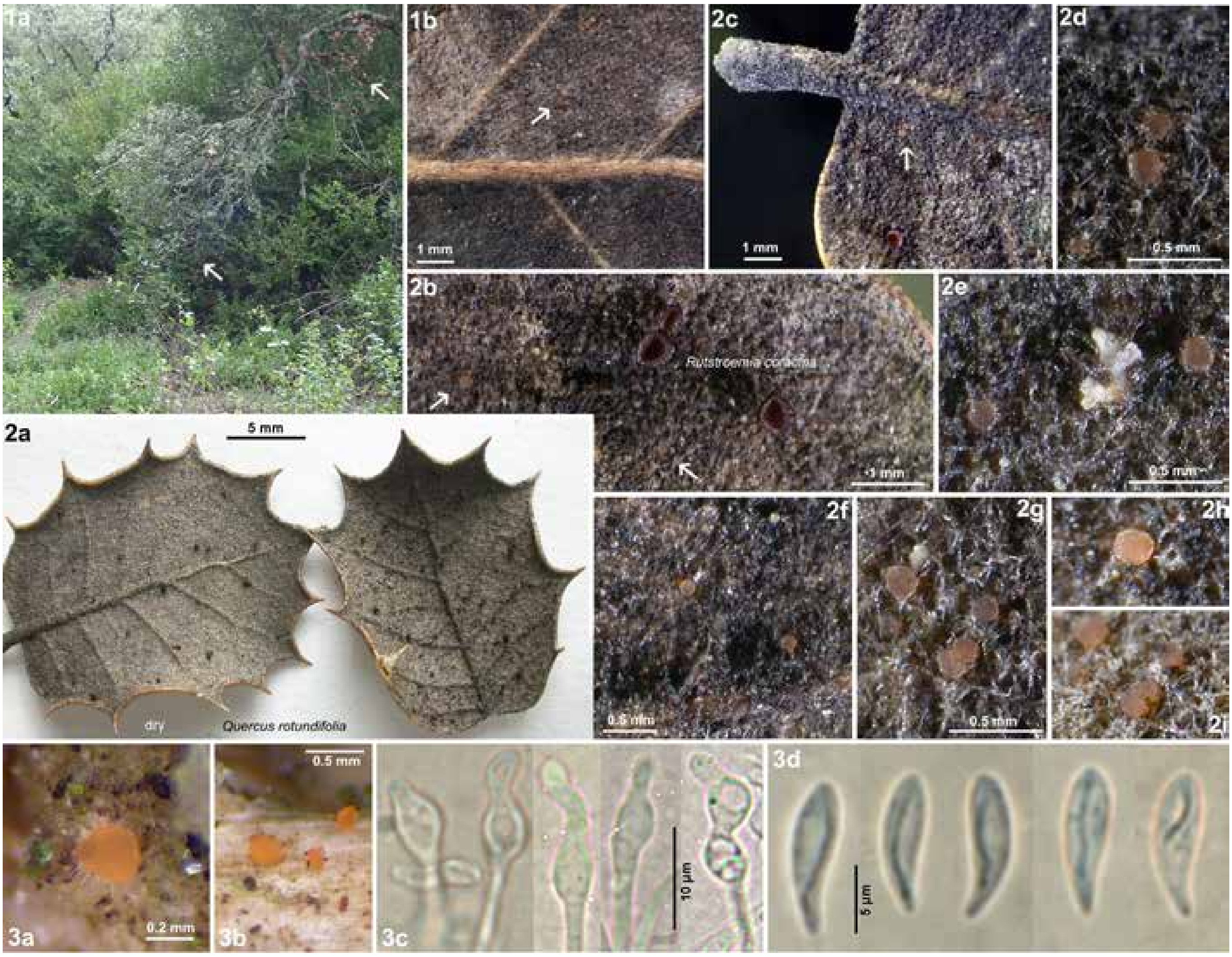


Plate 686. **1–2**: *Orbilia quercus-ilicis*; **3**: *O.* cf. *quercus-ilicis*. – **1a**. mediterranean maquis, *Quercus ilex* with dead attached leaves; **1b**, **2a–c**. rehydrated lower surface of dead leaves with apothecia of *Rutstroemia coracina* and *O. quercus-ilicis*; **2d–i**, **3a–b**. rehydrated apothecia; **3c**. paraphyses; **3d**. ascospores. – Living state. – **3a–d**: phot. M. Bemmann. — **1a–b**. H.B. 8388b: France, Provence, on *Quercus ilex*; **2a–i**. H.B. 6477b (holotype): Spain, Guadalajara, on *Quercus rotundifolia*; **3a–d**. 1.VI.2012: Italy, Piemont, Lago Maggiore, on *Castanea*.

Not included. **ITALY**: **Piemonte**, **Verbano-Cusio-Ossola**, Lago Maggiore, 17 km SSW of Locarno, S of Trarego Viggiona, 730 m, branch of *Castanea sativa*, on wood, 1.VI.2012, M. Bemmann (ø, doc. vid.).

Orbilia coniferarum Baral & E. Weber, **sp. nov.**, MB 813701 — Pls 687–688, Map 113

Etymology: named after the occurrence on coniferous hosts.

Typification: USA, Utah, Panguitch, branches of *Abies concolor*, 20.VI.2000, G. Marson (ex H.B. 7066b, M-0276461, holotype).

Latin diagnosis: *Similis* Orbiliae quaestiformi *sed ascosporae breviores*, *basi minus attenuatae et curvatae*, *corpusculum refringens partim longius*, *conidia brachiis multo latioribus. Habitat ad lignum vel corticem leniter vel valde putridum siccum ramorum coniferarum in zona mediterranea ad boreali semihumida ad humida Americae septentrionalis et Europae meridionalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.2–0.5(–0.7) mm diam., 0.11–0.19 mm high, light to bright orange(-rose), not or slightly translucent, round, scattered to subgregarious; disc flat, margin indistinct to distinct, slightly thickened, 0–5 µm protruding, finely rough; ± broadly sessile, slightly erumpent or immersed; dry bright orange-red. **Asci** *(38–)50–65(–70) × (5.3–)6–7(–7.3) µm {4}, †(41–)50–60(–65) × 4.8–5.7(–6.3) µm {4}, 8-spored, spores *3(–4)-seriate, (2–)3–5 lower spores inverted {5} (often mixed), pars sporifera *24–27 µm long; **apex** (†) medium to strongly truncate (partly very slightly indented, laterally distinctly inflated or not); **base** with short to medium long, ± thick, flexuous stalk, L-, T-, Y- or h-shaped. **Ascospores** *(6.5–)8–10(–11.5)((–13)) × (2.3–)2.5–3(–3.2) µm {6}, †(7–)8–10(–11) × 2.4–3(–3.2) µm {4}, ellipsoid- to fusoid-clavate, apex rounded to obtuse, base mostly medium to strongly attenuated, straight or slightly to medium curved near base; **SBs** *(3–)4–7.5(–10) × (0.2–)0.3–0.5((–0.8)) µm in situ {3} (~4–10 µm actual length), filiform to vermiform, partly subulate, not or sometimes very indistinctly swollen at base, slightly to strongly flexuous or helicoid, sometimes uncinate; LBs sparse, small. **Paraphyses** apically slightly to strongly clavate-capitate, sometimes slightly spathulate, terminal cells *(6–)10–19 × (2–)2.7–4.5(–5.3) µm {2}, †2.5–4 µm wide {1}, lower cells *10.5–14(–17.5) × 1.3–2.2 µm {2}, †1–1.5 µm wide {1}; rarely or sometimes branched at upper septum. **Medullary excipulum** subhyaline, 40–60 µm thick, of dense textura intricata with slightly inflated cells, indistinctly to very sharply delimited from ectal excipulum by an inconsicuous t. porrecta. **Ectal excipulum** subhyaline to pale orange, of thin-walled, (irregularly) vertically oriented t. angularis(-prismatica) from base to mid flanks, 30–70 µm thick near base, cells *8–16 × 5–10(–16.5) µm {2}; 30 µm thick at flanks, 20–25 µm near margin, of t. prismatica-porrecta oriented at an 80–90° angle to the surface, marginal cortical cells */†8–15 × 2–5.5 µm {1}, thick-walled (†0.3–1 µm), somewhat free and agglutinated as indistinct minute teeth. **Anchoring hyphae** medium sparse to abundant, */†2.2–3.5(–4.2) µm wide, walls (0.2–)0.3–0.6 µm thick {2}, forming a thin covering layer at flanks. **SCBs** in paraphyses globose, 1–1.5 µm diam., in excipulum not observed. **Exudate** over paraphyses 0.2–0.7 µm thick, granular-cloddy, firmly attached; over margin and flanks thin, granular. **— ANAMORPH**: tridentaria-like (presumed,

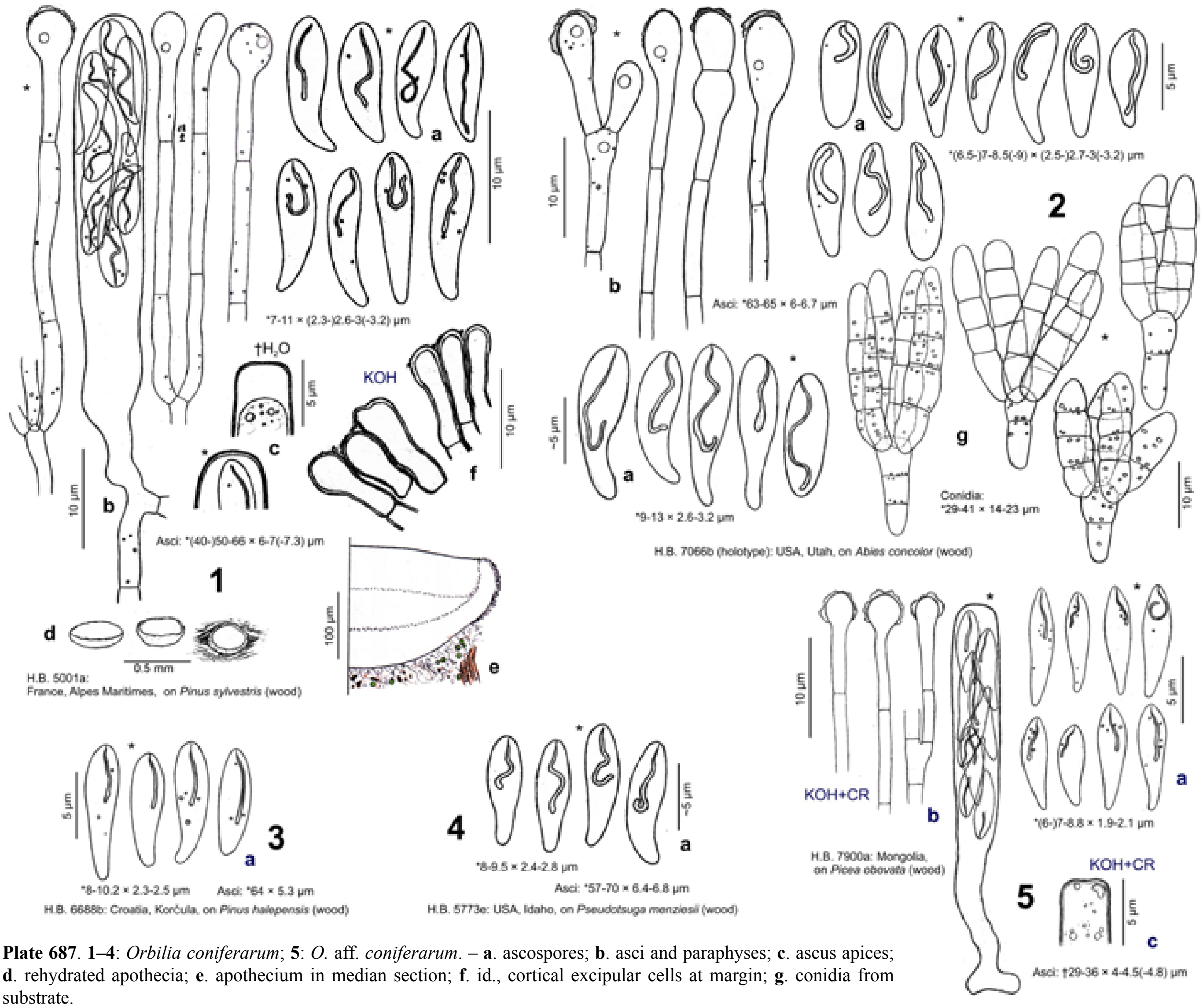


Plate 687. **1–4**: *Orbilia coniferarum*; **5**: *O.* aff. *coniferarum*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. rehydrated apothecia; **e**. apothecium in median section; **f**. id., cortical excipular cells at margin; **g**. conidia from substrate.

from natural substrate {2}). **Conidiophores** not seen. **Conidia** with (3–)4–5(–6) arms, *29–40 × 11.5–17 µm, stipe *10–13.5 × 4–5.5 µm, †11 × 3.2 µm, 1(–2)-septate, arms *14–28.5 × 4.5–5.5 µm, †24–25 × 4 µm, (2–)4–5-septate, cylindrical, apically mostly slightly to strongly tapering {2}.

Habitat: collected 0.5–3 m above the ground, decorticated, 8–80 mm thick branches of *Abies concolor* {2}, *Juniperus* (?)*occidentalis* {1}, *Picea sitchensis* {1}, *Pinus halepensis* {1}, *P. sylvestris* {1}, *Pseudotsuga menziesii* {1}, on 0.1–0.4 mm deep medium to strongly decayed wood {6} or bark {2}, partly in beetle galleries or close to resin, slightly to strongly greyed, green algae sparse to medium abundant. **Associated**: ?*Cryptodiscus* sp. {1}, *Dacrymyces* sp. {1}, *Diplolaeviopsis* sp. {1}, *Hypogymnia* sp. {1}, *Melaspilea emergens* {2}, *Mellitiosporiella pulchella* {1}, *Orbilia clavipisca* {1}, *O. delphinus* {3}, *O.* ?*gregorii* {1}, *O. hesperidea* {1}, *O. macrodelphinus* {2}, *O. maeandrina* {2}, *O. magnifica* {1}, *O. ophiosoma* {2}, *O. patellarioides* {1}, *O. subtrapeziformis* {1}, ?*Phaeophyscia* sp. {1}, *Pseudohelotium* ?*sordidulum* {1}, *Sarea resinae* {1}, ?*Schizoxylon* sp. {1}, *Teichospora* sp. {1}. **Desiccation tolerance**: fully viable for at least 17 months, after 33 months a few spores and paraphyses still alive. **Altitude**: 1–1405 m a.s.l. (southern Europe), 380–2778 m (North America). **Geology**: Triassic-Jurassic-Cretaceous lime- and calcareous sandstone. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia coniferarum* is characterized by rather long, filiform, basally uninflated, flexuous spore bodies and medium-sized ascospores of somewhat variable, ellipsoid- to fusoid-clavate shape (often basally attenuated and curved), also by the occurrence on coniferous substrate. The foliicolous *O. quercus-ilicis* has similar spores and SBs, but differs in more consistently strongly tapered spore bases and a tridentaria-like anamorph with narrower arms. A marginal

Map 113. Known distribution of *O. coniferarum* in North America.

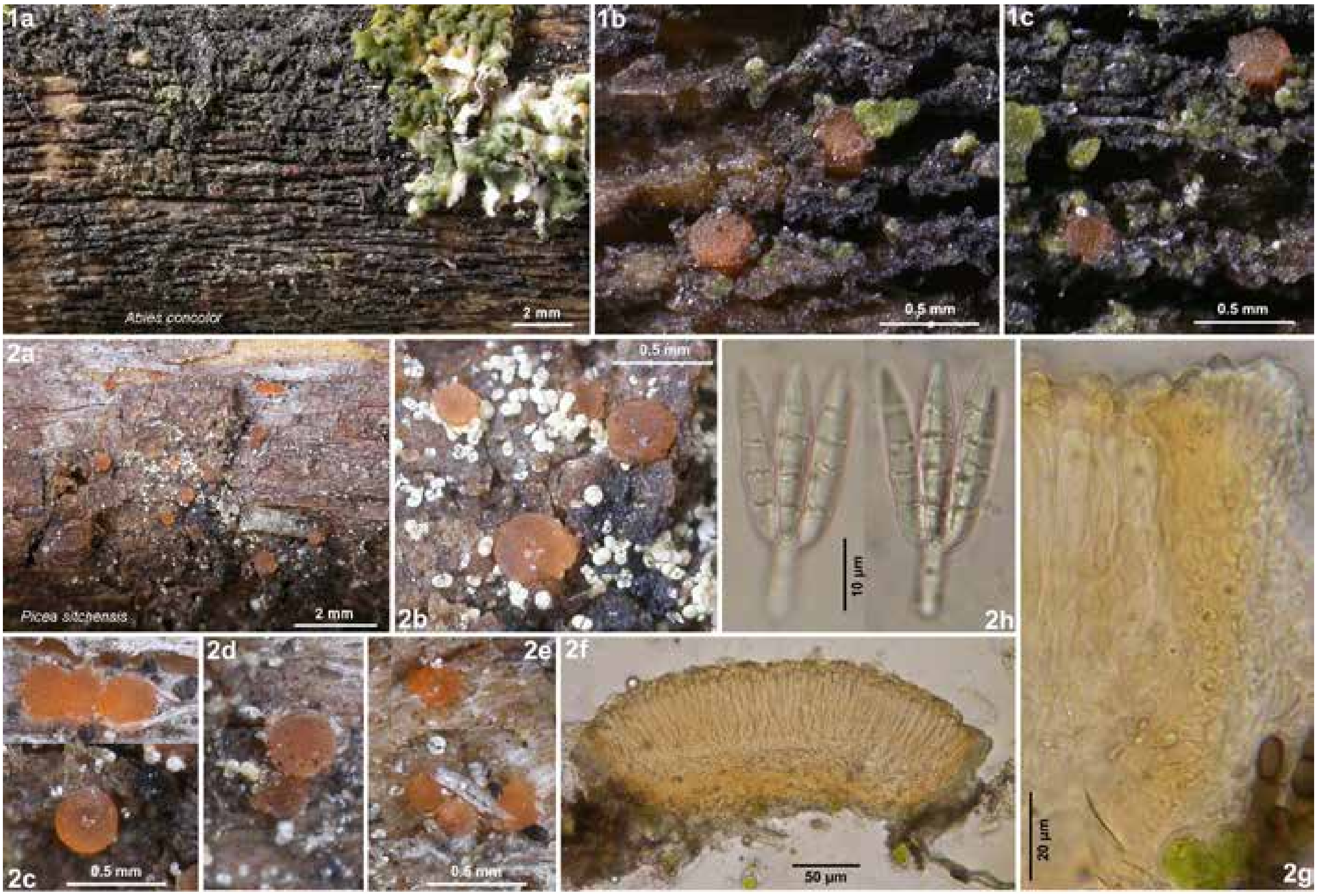


Plate 688. **1–2**: *Orbilia coniferarum*. – **1a**. decorticated branch of *Abies concolor*, with *Hypogymnia*; **2a**. corticated branch of *Picea sitchensis*; **1a–c**, **2a–e**. rehydrated apothecia (**2b** with *Pinus* pollen); **2f**. apothecium in median section; **2g**. id., marginal ectal excipulum; **2h**. conidia from substrate. – Dead state (**2f**, **h** in H_2O, **2g** in KOH). — **1a–c**. H.B. 8095a: USA, Utah, Tropic, on *Abies*; **2a–h**. H.B. 8545b: id., Torrey, on *Picea*.

collection of *O. trapeziformis* (Pl. 593: 6) differs from both taxa in subacute spore apices. For the difference between *O. coniferarum* and *O. quaestiformis* or *O. cactacearum* see p. 1151 and p. 1143.

Variation. In the holotype, spore length varied between 6.5–9 and 9–13 µm depending on the apothecium examined (Pl. 687: 2). In European collections (1, 3) the SBs were slightly thinner (0.2–0.4 µm) than in those from America (mainly 0.3–0.5 µm, 2, 4). In the sample from Texas (on *Juniperus*, IVV: H.B. 6027a), a deviating variant with consistently long SBs was observed in which the spores were mainly ellipsoid, reminiscent of *O. gambelii*, and their bases only sometimes tapered (IVV: H.B. 6027b). A similar variation in spore shape, coupled with SBs only half as long as those spores with a tapered base, was noted in *O. octocercocarpi*.

Not included collection. A Mongolian collection on *Picea* (Pl. 687: 5) deviates in much narrower, almost straight spores, and resembles *O. ungulata* in spore shape; no living paraphyses and excipular cells were seen, therefore, no information on SCBs is available.

Anamorph. The conidia observed in *O. coniferarum* are only slightly shorter than those of *O. quaestiformis*, but differ in having thicker arms and stipes, also in having predominantly 4–5 instead of 3–4 arms.

Ecology. *O. coniferarum* inhabits slightly to strongly rotten wood or bark of xeric branches of different coniferous trees and shrubs. In southern Europe it was rarely found in orosubmediterranean humid and thermomediterranean semihumid pine forests. In Northern America it occurred in the west in boreal humid Douglas fir mixed forests of the Middle Rocky and Utah Mountains, and in the south in warm-temperate subhumid woodland with *Quercus virginiana* in the Edwards Plateau (Oaks and Prairies). The not included sample derives from a north-exposed mountain taiga (*Larix* and *Picea*) in a continental, orotemperate (sub)humid (winter-dry) western Mongolia of central Asia.

Specimens included. **FRANCE**: **Provence-Alpes-Côte d'Azur**, **Alpes Maritimes**, Préalpes de Grasse, 19 km NNE of Grasse, 4 km NNE of Gréolières, Gréolières les Neiges, 1405 m, branch of *Pinus sylvestris*, on wood, 1.X.1993, G. Marson (H.B. 5001a). — **CROATIA**: **Dubrovnik-Neretva**, **Korčula**, 2.5 km ESE of Korčula, Badija island, turističko-sportski centar, 1 m, branch of *Pinus halepensis*, on wood, 8.VI.2000, H.O. Baral (H.B. 6688b ø). — **USA**: **Idaho**, Middle Rocky Mountains, Grand Teton, 67 km ENE of Idaho Falls, 9 km WSW of Victor, Pine Creek Pass, 2080 m, branch of *Pseudotsuga menziesii*, on wood, 5.VI.1996, G. Marson (H.B. 5773e ø). – **Utah**, Utah Mts., Dixie Forest, 22 km SSE of Torrey, 13 km S of Grover, 1 km N of Pleasant Creek Campground, 2650 m, branch of *Picea sitchensis*, on wood & bark, 19.VI.2000, G. Marson (H.B. 8545b, anam. substr.). – Bryce Canyon, 32 km SE of Panguitch, 13 km WSW of Tropic, near Trough Spring, 2500 m, branch of *Abies concolor*, on wood, 13.VI.2003, G. Marson (H.B. 8095a). – 42 km SSE of Panguitch, Rainbow Point, 2778 m, branches of *Abies concolor*, on wood, 20.VI.2000, G. Marson (ex H.B. 7066b, M-0276461, **holotype**, anam. substr.). – **Texas**, Edwards Plateau, 65 km W of Austin, ~2 km WSW of Johnson City, 380 m, branch of *Juniperus* (?)*occidentalis*, on bark, 18.VI.1996, G. Marson (H.B. 6027a/b).

Not included. **MONGOLIA**: **Bayan Ölgii**, Sagsai, Altay Mts., Tavan Bogd, 25 km SE of Dayan lake, 8 km NE of Chinese border, Songino Gol river valley, 2100 m, branch of *Picea obovata*, on wood, 15.VIII.2005, P. Karasch (P.K. 15082005-19, H.B. 7900a).

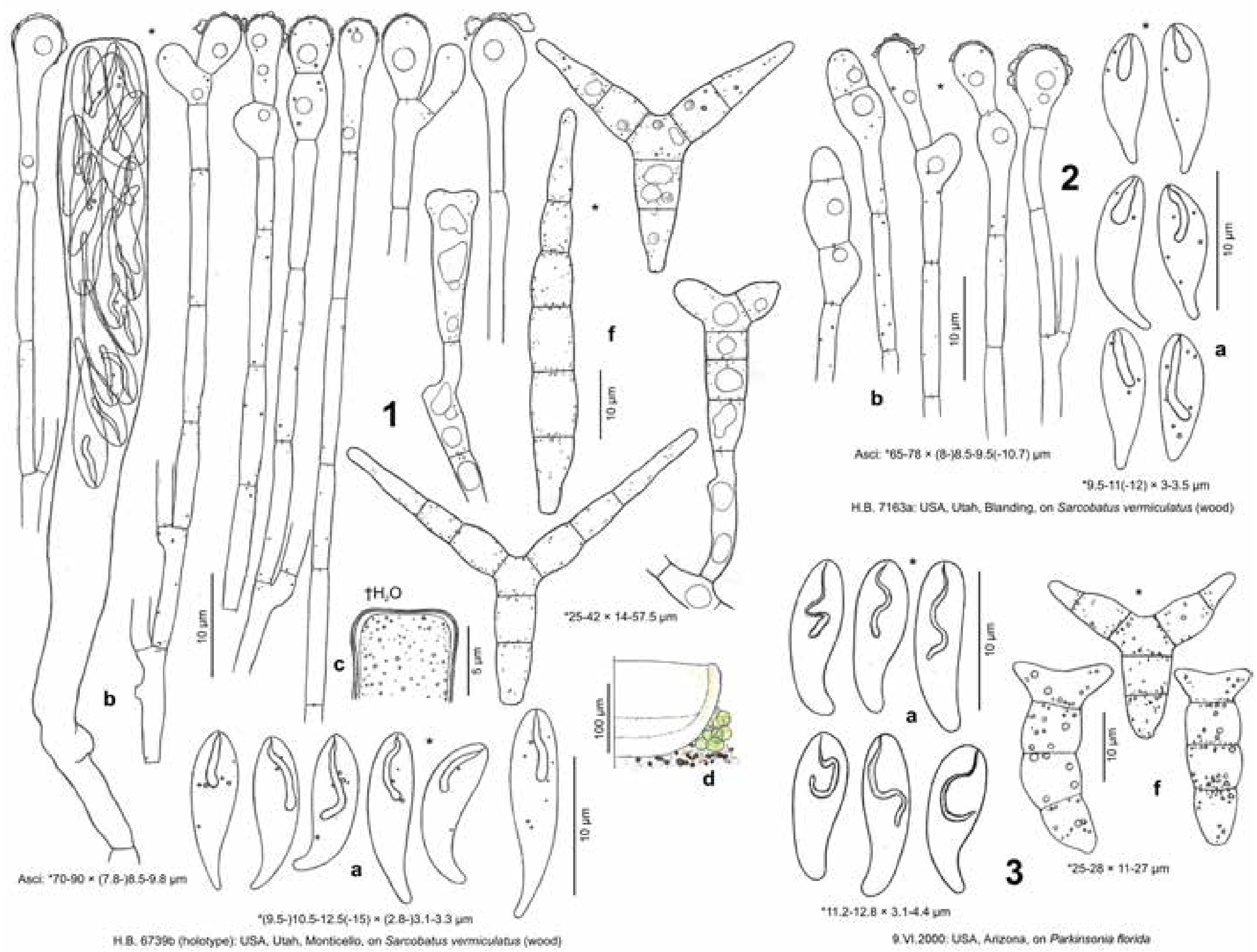


Plate 689. **1–2**: *Orbilia vermiculati*; **3**: *O.* cf. *vermiculati*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apex; **d**. apothecia in median section; **e**. id., marginal ectal excipulum; **f**. conidiophores and conidia (**1f** from culture, **3f** from substrate).

Orbilia vermiculati Baral & G. Marson, **sp. nov.**, MB 813702 — Pls 689–690, Map 114

Etymology: named after the substrate of the type, *Sarcobatus vermiculatus*.

Typification: USA, Utah, Monticello, branches of *Sarcobatus vermiculatus*, 15.VI.2000, G. Marson (ex H.B. 6739b, M-0276605, holotype; ex-type culture: CBS 116230; sq.: KT215241).

Latin diagnosis: *Similis* Orbiliae quaestiformi *sed asci 16-spori*, *conidia triradiata. Habitat ad lignum putridum ramorum siccorum* Sarcobati vermiculati *in zona temperata semiarida Americae septentrionalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.15–0.3(–0.5) mm diam., 0.13–0.17 mm high, light to bright pure orange, round, scattered to subgregarious; disc flat, margin thin, protruding for 5–30 µm, smooth to finely rough; sessile, ± superficial to half immersed. **Asci** *65–97 × 7.8–9.5(–10.7) µm {3}, †50–93 × (7–)8–9 µm {2}, 16-spored, spores *4-seriate, (3–)6–10(–12) lower spores inverted (scarcely or somewhat mixed) {3}, pars sporifera *39–56 µm long; **apex** (†) strongly truncate (very slightly indented, laterally sometimes inflated); **base** unstalked or with short to medium long, thick, ± flexuous stalk, L- or T-shaped. **Ascospores** *(9–)9.5–12.5(–15) × (2.8–)3–3.5(–3.7) µm {4}, clavate to ellipsoid-clavate, apex obtuse, sometimes rounded or subacute, base slightly to strongly attenuated, often tail-like, here slightly to strongly curved; **SBs** *3–6.5 × 0.6–1.2 µm {4}, vermiform to somewhat subulate, not or slightly inflated at base, straight to medium, also strongly flexuous, in more aged spores pyriform narrowed to a ± wide point. **Paraphyses** apically (slightly to) medium to (very) strongly clavate-capitate, sometimes moniliform, terminal cells *(3.5–)6–12(–20) × (2–)3–5(–5.7) µm {3}, lower cells *8–13(–16.5) × 1.6–2.4 µm {2}, near apex often 4–9 × 3–5 µm; sometimes branched near apex. **Medullary excipulum** hyaline, 30–50 µm thick, of textura intricata with many inflated cells, sharply delimited. **Ectal excipulum** very pale rose, of (†) slightly gelatinized, irregularly oriented t. (globulosa-)angularis(-prismatica) from base to margin, 20–30 µm thick near base, cells *7–14(–18) × 6–9(–11) µm {2}; 10–20 µm thick near margin, oriented at a 10–45° angle to the surface, inner part of t. prismatica-porrecta, marginal cortical cells *5–11 × 3.8–5.5(–6.5) µm {2}. **Anchoring hyphae** medium abundant, *2–3(–4.5) µm wide, walls 0.2(–0.3) µm thick {2}, forming a thin layer of dead hyphae up to the margin. **SCBs** in paraphyses and ectal excipulum (near margin) globose, 1–2 µm diam. **Exudate** over paraphyses 0.2–0.5 µm thick, rough, firmly attached, partly absent; over margin and flanks thin, rough. — **ANAMORPH**: trinacrium-like (from ascospore isolate {1}). **Conidiophores** *~19–25 × 3.8–4.5 µm. **Conidiogenous cells** sympodial. **Conidia** Y-shaped, total size *25–42 × (14–)37–57.5 µm, stipe *17–18 × 5.5–7.5 µm, 2(–3)-septate, usually shorter than arms, arms gradually to somewhat abruptly tapering, *20–30.5 × 5–6 µm, 2–3-septate; a single unbranched conidium seen: *58.5 × 6.7 µm, 5-septate.

Habitat: collected 0.05–0.8 m above the ground, partially to nearly decorticated, 4–16 mm thick twigs and branches of *Sarcobatus vermiculatus* {4}, on 0.1–0.3 mm deep strongly decayed wood {4}, slightly to strongly greyed, with a few to many green algae. **Associated**: *Caloplaca* sp. {1}, *Orbilia bicknellensis* {2}, *O. lentiformis* {1}, *O. sarcobati* {2}, *Schizoxylon ?argentinum* {1}, *Teichospora* sp. {2}, foliose and crustose lichens. **Desiccation tolerance**: some mature asci

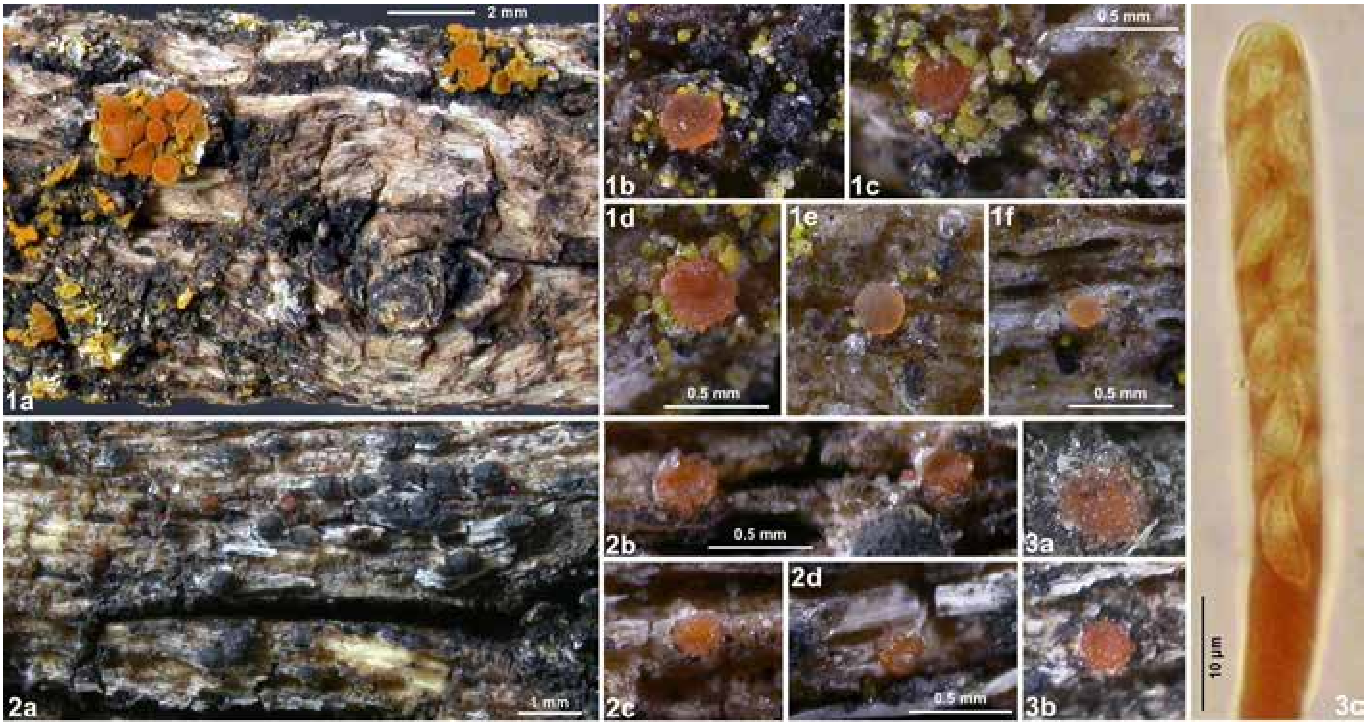


Plate 690. **1–2**: *Orbilia vermiculati*; **3**: *O.* cf. *vermiculati*. – **1a**, **2a**. decorticated, eroded xeric branches, with *Xanthoria* (**1**), *Teichospora* (**2**); **1b–f**, **2a–d**, **3a–b**. rehydrated apothecia; **3c**. ascus (dead state, in KOH+IKI). — **1a–f**. H.B. 7163a: USA, Utah, Blanding, on *Sarcobatus vermiculatus*; **2a–d**. H.B. 6739b (holotype): ibid., Monticello, on *S. vermiculatus*; **3a–c**. H.B. 6721e: USA, California, on *Atriplex*.

and all paraphyses still viable after 26 months. **Altitude**: 1475–1905 m a.s.l. **Geology**: Pennsylvanian-Permian and Jurassic-Cretaceous (carbonate) red sandstone; alluvial deposits from granite & gneiss. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia vermiculati* is characterized by 16-spored asci and (ellipsoid-)clavate, rather large ascospores with attenuated, curved, tail-like bases and comparatively short, ± vermiform spore bodies. Concerning spore shape the species resembles the 8-spored European *O. quaestiformis*, but a close relationship seems improbable based on the deviating anamorph. *O. pleiomesaverdiana* and *O.* aff. *pleiomesaverdiana* (Pls 675–676) differ in having crystalloid SCBs, the former also in more acute spore apices, the latter in less tapered spore bases. *O. sarcobati* (section *Ovoideae*) occurs with *O. vermiculati* on the same host and sometimes in mixed association (e. g., in the holotype), but differs in rounded or rarely only shortly attenuated spore bases, and in short, globose to tear-shaped SBs.

Map 114. Known distribution of *O. vermiculati* in North America (yellow = not included collections).

The Australian *O. pleioquaestiformis* (on bark of *Acacia*, Pls 681–682) closely resembles *O. vermiculati*. It differs in slightly narrower asci and spores, and particularly in much narrower SBs (4.2–5.5 × 0.3–0.4 µm). Apart from its 16-spored asci this species matches the 8-spored European *O. quaestiformis*, to which it is probably closely related. The African *O. caudimaeandrina* differs from *O. vermiculati* in spores with distinct tails and with SBs being mostly longer than half the spore length, and in lacking SCBs. Surprisingly, a close molecular relationship with *O. halimi* is observed (see below), which differs in spores with acute apices, 8-spored asci, and in possessing crystalloid SCBs.

Variation. The four collections on *Sarcobatus* here referred to *O. vermiculati* vary somewhat in spore shape. Sometimes the spores contained much shorter and thicker SBs (Pl. 689: 2), which strongly resemble those of *O. sarcobati* (section *Ovoideae*), but which might represent overmature stages.

Not included collections. A sparse specimen on wood of *Atriplex* (Pl. 690: 3) was only studied in the dead state. In its persistent characters (spores †10–11 × 3–3.3 µm) it closely resembles *O. vermiculati*, but is not included in the description, as was a collection on *Parkinsonia florida* (Pl. 689: 3) which differs from samples on *Sarcobatus* in spores with less tapered bases and longer, strongly flexuous SBs. Both samples are geographically distant from those on *Sarcobatus* (Map.).

Anamorph. Although the ascospores of *O. vermiculati* resemble *O. quaestiformis*, trinacrium-like conidia developed in pure culture in contrast to *O. quaestiformis* which has a tridentaria-like anamorph. In the collection on *Parkinsonia* (Pl. 689: 3f) conidia were found on the natural substrate which resemble those obtained in pure culture of the holotype, but differ in shorter arms and longer and thicker stipes.

Phylogeny. A sequence was gained from pure culture of the holotype which comprises SSU (with S1506 intron), ITS and LSU. *O. vermiculati* clustered in the *Serpentinae-Habrostictis* clade very close to *O. halimi* by showing only 1.5 % ITS distance (3 nt difference in ITS1, 5 nt and 1 gap in ITS2) and 0.8 % in LSU. Contrary to *O. vermiculati* the sequence of *O. halimi* lacks the intron.

Ecology. *O. vermiculati* grew on rotten wood of xeric twigs and branches of *Sarcobatus vermiculatus* (greasewood), to which it might be restricted. It was found in cold-temperate to warm-continental semiarid (to subhumid) saltbush desert scrubs in a small area around the Abajo Mountains in the Canyonlands section of the Colorado Plateau in the southwest of Northern America. The not included samples on *Atriplex* (saltbush) and *Parkinsonia* (blue paloverde) originate from warm-temperate to subtropical arid saltbush and creosote desert scrubs of the Mojave and Sonoran Desert.

Specimens included. **USA**: **Utah**, Canyonlands, 15.5 km N of Monticello, Peters Canyon, 1905 m, branches of *Sarcobatus vermiculatus*, on wood, 15.VI.2000, G. Marson (M-0276605, **holotype**; **isotype** in 6739b; CBS 116230, anam. cult.; sq.: KT215241). – 67 km NNW of Blanding, 48 km SSW of Moab, Salt Creek, near Cave Spring Trail, 1475 m, branch of *S. vermiculatus*, on wood, 15.VI.2000, G. Marson (ø). – 15 km WSW of Blanding, Cottonwood Road, Brushy Basin Wash, 1602 m, branch of *S. vermiculatus*, on wood, 15.VI.2000, G. Marson (H.B. 7183b). – 5.8 km SSW of Blanding, Westwatercreek, 1700 m, branches of *S. vermiculatus*, on wood, 15.VI.2000, G. Marson (H.B. 7163a).

Not included. **USA**: **Arizona**, Mojave Desert, 15 km SE of Havasu Lake City, N of Aubrey Hills, 355 m, branch of *Parkinsonia florida*, 9.VI.2000, G. Marson (ø, anam. substr.). – **California**, Mojave Desert, 130 km NNE of Los Angeles, 14 km NW of California City, 830 m, branch of *Atriplex confertifolia*, on wood, 23.VI.2000, G. Marson (H.B. 6721e, in M-0276505 [*O. sonorensis* & *O. macroserpens*]).

Orbilia caudimaeandrina Baral & G. Marson, **sp. nov.**, MB 813703 — Pl. 691

Etymology: named after the resemblance to *O. maeandrina* and the distinct spore tails.

Typification: Namibia, Rehoboth, branch of indet. angiosperm, 25.VIII.1995, R. Reuter (ex H.B. 5389, M-0276450, holotype).

Latin diagnosis: Orbiliae maeandrinae *similis, sed ascosporae caudis praeditae, cellulae vegetativae absque corpusculis globosis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.15–0.2 mm diam., 0.1 mm high, light orange-rose, round, very scattered; disc flat, margin 0–5 µm protruding, smooth; sessile, ± superficial. **Asci** *(53–)57–76 × 8.3–10.3 µm {1}, †48–60 × 8–9 µm, (13–)16-spored, spores *2–3-seriate, (4–)7–9 lower spores inverted, pars sporifera *38–40(–56) µm long; **apex** (†) strongly truncate (not or very slightly indented, laterally uninflated), hemispherical in side view, thin-walled; **base** without or with very short, thick stalk, Y-shaped. **Ascospores** *9–14 × 3–3.6(–3.8) µm, †8–12 × 2.8–3.2 µm, ellipsoid-fusoid, mostly with a distinct tail, apex obtuse to subacute, tail *1–4 × 1–1.2(–1.6) µm, straight to slightly, rarely medium curved near base; **SBs** *5–7.8 × 0.7–0.9 µm in situ (~5.5–9 µm actual length), vermiform, slightly to strongly flexuous. **Paraphyses** apically slightly to medium clavate-spathulate, rarely lageniform, terminal cells *4–9(–14) × (2.5–)3–4(–4.8) µm, †2.2–3.2 µm wide, lower cells *(6–)8–15 × 1.5–2.5(–3) µm (near base 2.3–2.8 µm); frequently branched near apex. **Medullary excipulum** 20 µm thick, with inflated cells. **Ectal excipulum** of (†) indistinctly oriented textura angularis from base to mid flanks, 20 µm thick near base, 10–15 µm thick at flanks and margin, cells at flanks *7–9 × 5–7 µm; at margin of t. prismatica oriented at a 10–20° angle to the surface, marginal cortical cells *6–10 × 3–4.5 µm. **Anchoring hyphae** not examined. **SCBs** in paraphyses and ectal excipulum absent. **Exudate** over paraphyses 0.5–1.2 µm thick, continuous, finely rough, ± loosely attached, over margin 1.5–3 µm thick, hyaline, indistinctly layered. **— ANAMORPH**: unknown.

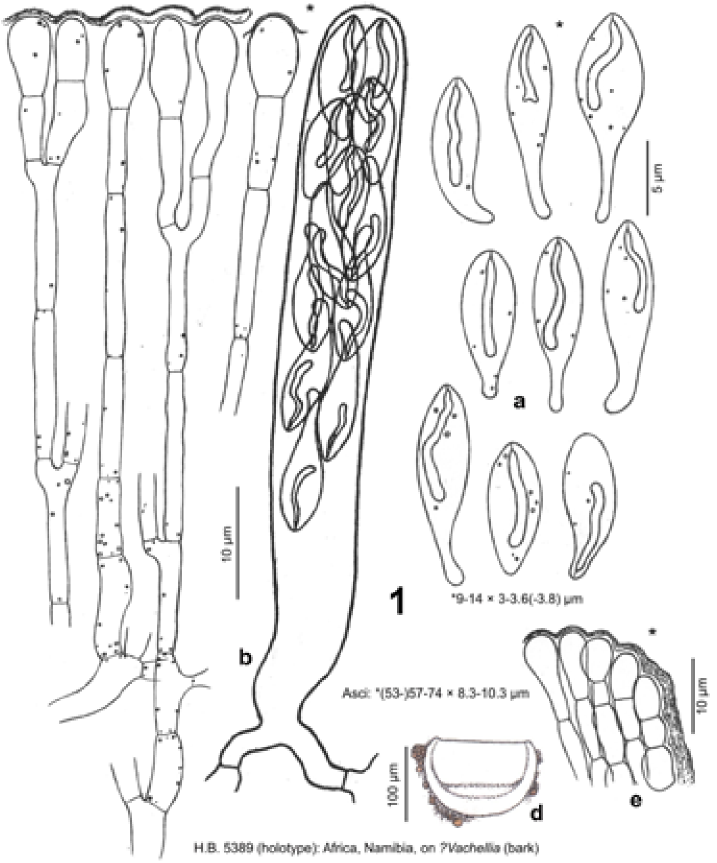


Plate 691. **1**: *Orbilia caudimaeandrina*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apex; **d**. apothecia in median section; **e**. id., marginal ectal excipulum.

Habitat: attached, mainly corticated, 18 mm thick branch of unidentified angiosperm (?*Vachellia*), on medium decayed bark (bast), medium greyed, no algae. **Associated**: *Dothideales*. **Desiccation tolerance**: fully viable for at least 4 months. **Altitude**: 1560 m a.s.l. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia caudimaeandrina* resembles *O. maeandrina* in the ascospores and 16-spored asci, but sharply differs in having distinct spore tails in most of the spores, and in lacking SCBs. For the similar *O. vermiculati* and *O. paloverdensis* see p. 1166 and p. 1169.

Variation. Usually all spores of an ascus had distinct tails. However, some asci were encountered in which the tails were absent or very short in all spores or only in the apical spores (see Pl. 689: 1b).

Ecology. *O. caudimaeandrina* grew on medium rotten bark of a xeric angiosperm branch (?*Vachellia*) in the hot, subtropical arid (winter-dry) Kalahari highland thornbush savannah about 150 km away from the Namib Desert in southwestern Africa.

Specimens included. **NAMIBIA**: **Khomas**, 60 km S of Windhoek, 25 km N of Rehoboth, Central Plateau, Auas Mts., 1560 m, branch of ?*Vachellia*, on bark, 25.VIII.1995, R. Reuter (ex H.B. 5389, M-0276450, **holotype**).

Orbilia rosicola Baral & E. Weber, **nom. prov.** — Pl. 692

Etymology: according to the substrate, *Rosa* sp.

Typification: Spain, Guadalajara, Tamajón, branch of *Rosa*, 14.V.1996, H.O. Baral (H.B. 5511g, unpreserved).

Latin diagnosis: *Differt ab* Orbilia quaestiformi *ascosporis plerumque caudatis, corpuscula refringentia filo breve affixa continentibus, paraphysibus apice interdum spathulatis, corpuscula crystalloidea continentibus.*

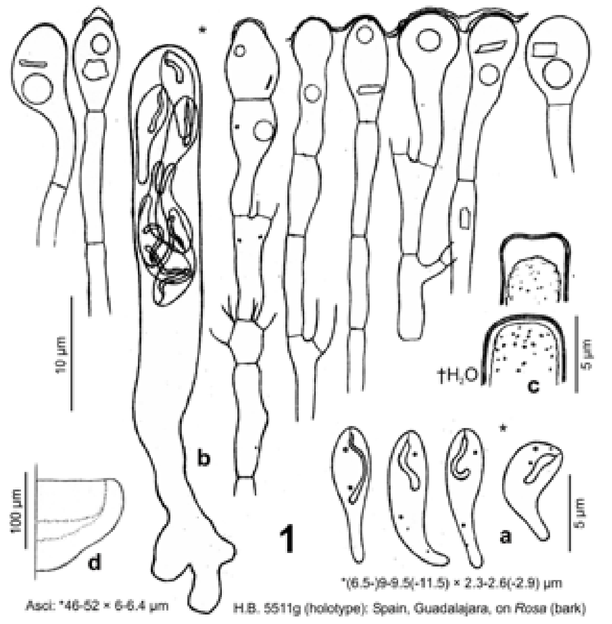


Plate 692. **1**: *Orbilia rosicola*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apices; **d**. apothecium in median section.

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.18–0.22 mm diam., 0.12 mm high, light to bright pure orange, round, scattered; disc flat, margin smooth, not protruding; sessile on a narrowed base. **Asci** *46–52 × 6–6.4 µm, 8-spored, spores *3–4-seriate, 4 lower spores inverted (not or slightly mixed), pars sporifera *23 µm long; **apex** (†) medium to strongly truncate (partly distinctly indented, laterally sometimes slightly inflated), hemispherical in side view, thin-walled; **base** with short, thick, flexuous stalk, Y- to h-shaped. **Ascospores** *(6.5–)9–9.5(–11.5) × 2.3–2.6(–2.9) µm, with an ellipsoid-fusoid head and a ± distinct tail, apex obtuse (to subacute), tail *2–3.2(–5) × 0.7–0.8 µm, straight to ± strongly curved near base; **SBs** *3–5 × 0.3–0.5(–0.7) µm in situ (~3.2–6 µm actual length), vermiform (to subulate), medium to strongly flexuous, helicoid, or uncinate. **Paraphyses** apically medium to strongly clavate-capitate, also spathulate, terminal cells *7–15 × (2.3–)3.3–5.5 µm, lower cells *7–13 × 1.8–2.3 µm; sometimes branched near apex. **Medullary excipulum** 25 µm thick, indistinctly delimited. **Ectal excipulum** of (*) thin-walled, indistinctly vertically oriented textura angularis from base to margin, 40 µm thick near base, cells *8–14 × 5–8 µm; 25 µm thick near margin, marginal cortical cells *6–8 × 4–5 µm. **Anchoring hyphae** not studied. **SCBs** in paraphyses and ectal excipulum (near margin) globose, (1–)1.5–2.5 µm diam., in paraphyses also trapezoid to rod-shaped, low-refractive. **Exudate** over paraphyses 0.3–1(–2) µm thick, finely rough, continuous or sometimes forming small caps, firmly attached, over margin and flanks thin. — **ANAMORPH**: unknown.

Habitat: collected 1 m above the ground, ± decorticated, 11 mm thick branch of *Rosa* sp. {1}, on patches of medium decayed, fissured bark (bast), slightly detaching, ungreyed. **Associated**: *Baggea* sp., *B. pachyascus*, ?*Calloria* sp., '*Chlorosplenium*' *viridulum*, *Mellitiosporiella pulchella*, *Mollisia rosae*, *Orbilia gambelii*, *O. pleiogambelii*, *O. subaristata*, *O. subclavuliformis*, *O. subovoidea*, *Schizoxylon* sp. **Desiccation tolerance**: fully viable for at least 6 weeks. **Altitude**: 1040 m a.s.l. **Geology**: Tertiary dolomite with sand & marl. **Phenology**: long-lived.

Taxonomic remarks. The sparse and only collection of *O. rosicola* consisted of two apothecia, in which only a few asci were mature. Because these were used up during examination and the branch was not preserved, also because the limits against other species could not enough be explored, *O. rosicola* is not validly described here.

Based on the available characteristics, the species differs from *O. quaestiformis* in the frequent presence of a spore tail, spore bodies with a distinct short filum, and paraphyses with a tendency to spathulate apices that mostly contain besides globose also angular (crystalloid) SCBs. In spore shape *O. rosicola* resembles the 16-spored North American *O. paloverdensis* and the central African *O. caudimaeandrina*, but here the living paraphyses do not contain any SCBs, also the apothecia of the former are much larger. In ascospore and paraphysis characters *O. rosicola* resembles also the 32-spored *O. multiurosperma*.

Ecology. *O. rosicola* was collected on medium decayed bark of a xeric branch of *Rosa* in a supramediterranean semihumid juniper shrubland with *Cistus ladanifer* (*Juniperetum thuriferae*) in central Spain (southwestern Europe).

Specimens included. **SPAIN**: **Castilla-La Mancha**, **Guadalajara**, Sistema Central, 43 km NNW of Guadalajara, 2 km NNW of Tamajón, Ermita de los Enebrales, 1040 m, branch of *Rosa*, on bark, 14.V.1996, H.O. Baral (H.B. 5511g ø).

Orbilia paloverdensis Baral & G. Marson, **sp. nov**.,

MB 813705 — Pls 693–694

Etymology: named after the substrate, *Parkinsonia* (= paloverde).

Typification: USA, Arizona, Tucson, branches of *Parkinsonia* (?)*microphylla*, 6.V.1995, G. Marson (ex H.B. 5671e, M-0276549, holotype).

Latin diagnosis: *Differt ab* O. caudimaeandrina *ascosporis multo minoribus, paraphysibus apice valde inflatis. Habitat ad lignum putridum siccum ramorum* Parkinsoniae *in zona subtropica semiarida Americae septentrionalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.2–)0.4–0.8(–1) mm diam., 0.15–0.2 mm high, light to bright brick-red, non-translucent, round, gregarious; disc ± flat, margin ± thick, 0–10 µm protruding, indistinctly rough; broadly sessile, superficial or often ± immersed in clefts. **Asci** *56–77.5 × 5.5–6.8 µm {1}, †58–66 × 5–6 µm {1}, 16-spored, spores *~3-seriate, ~8 lower spores inverted (± mixed), pars sporifera †36–48 µm long; **apex** (†) medium to strongly truncate (partly distinctly indented and laterally inflated), hemispherical in side view, thin-walled; **base** with short to medium long, thick,

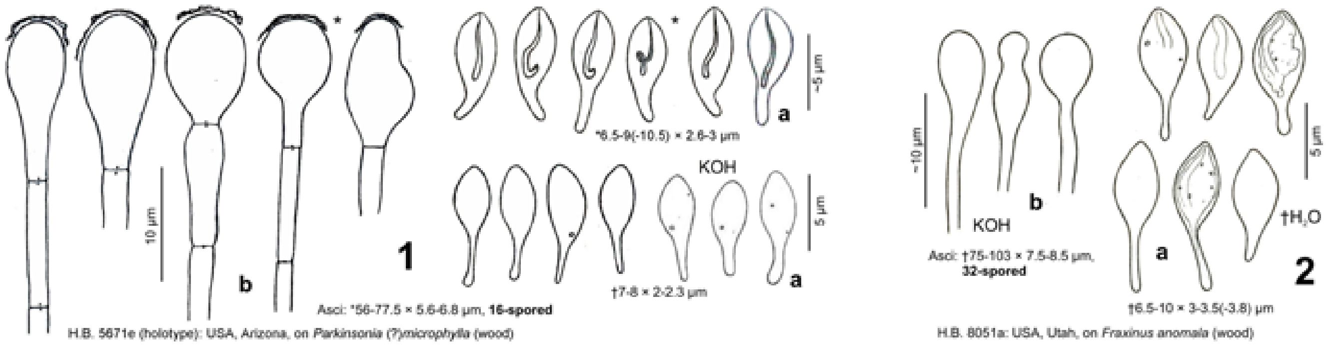


Plate 693. **1**: *Orbilia paloverdensis*; **2**. *O.* aff. *paloverdensis*. – **a**. ascospores; **b**. paraphyses.

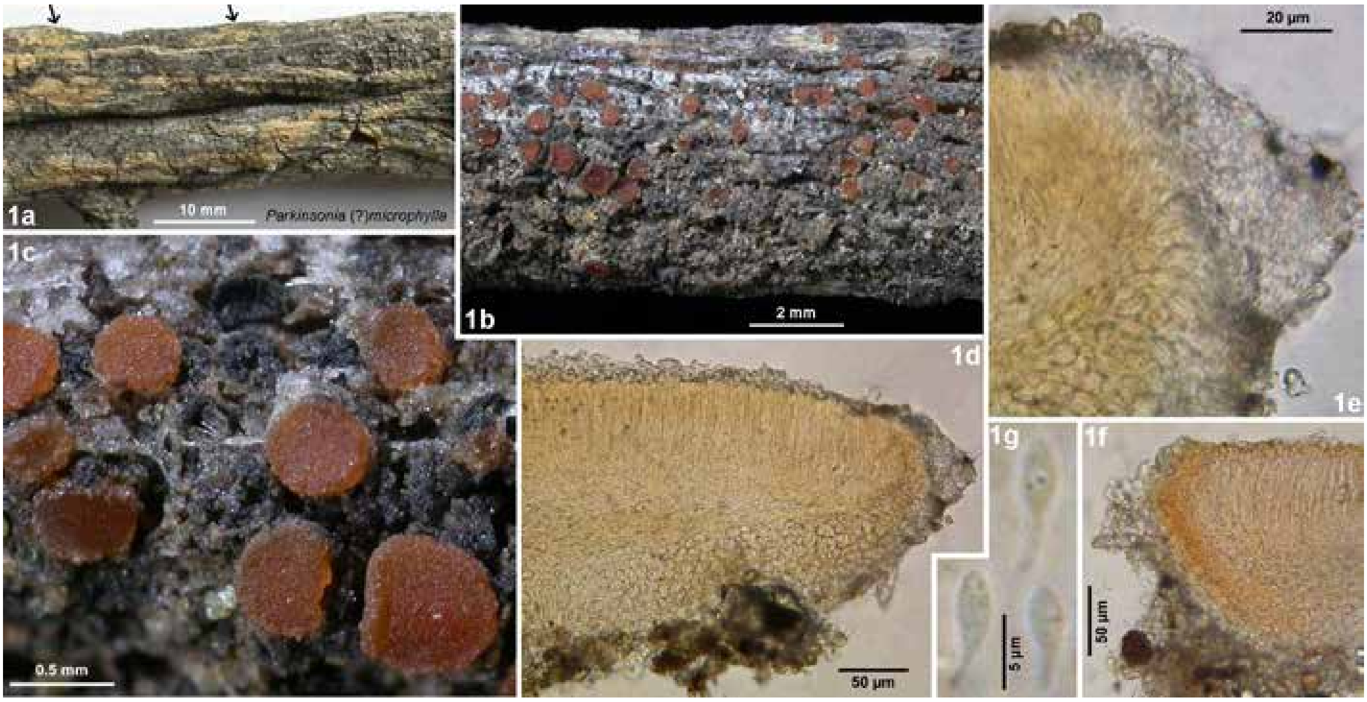


Plate 694. **1**: *Orbilia paloverdensis* (holotype). – **1a–b**. decorticated, rotten xeric branches; **1b–c**. rehydrated apothecia; **1d**, **f**. apothecia in median section; **1e**. id., marginal ectal excipulum with hyaline covering layer; **1g**. ascospores. – Dead state (**f** in H_2O; **d–e**, **g** in KOH). — **1a–g**. H.B. 5671e: USA, Arizona, on *Parkinsonia*.

flexuous stalk, L- to Y-shaped. **Ascospores** *6.5–9(–10.5) × 2.5–3 µm, †7–8 × 2–2.3 µm, with an ellipsoid-fusoid head and a distinct tail, apex obtuse to subacute, tail *~1.3–2.6 × 0.7–0.9 µm, †2–3.2 × 0.4–0.8 µm; straight or often slightly to medium curved at base (less so in dead state, here tail partly swollen at base); **SBs** *~4–5 × 0.3–0.5 µm in situ (~5–5.5 µm actual length), vermiform to subulate, not swollen at the base, slightly to strongly flexuous or helicoid, partly uncinate. **Paraphyses** apically (medium to) strongly or very strongly clavate-capitate (rarely lageniform), terminal cells *9.5–14 × 4.5–7.2 µm, †9–14 × 3.5–6 µm, lower cells *~10–14 × 1.7–2.3 µm (near apex up to 3.5 µm wide); unbranched at upper septum, hymenium light orange. **Medullary excipulum** pale orange, 30–70 µm thick, of dense textura intricata with many inflated cells, sharply delimited. **Ectal excipulum** pale orange (at margin partly bright orange), of (†) irregularly oriented textura (globulosa-)angularis from base to submargin, overall (thin-walled to) slightly gelatinized [common walls ~1(–1.5) µm thick], 35–50 µm thick near base, cells †(5–)7–13(–16) × (5–)6–9(–10) µm; 25–30 µm thick near margin, upper margin of t. prismatica oriented at a 30–60° angle to the surface, marginal cortical cells †~5–8 × 2.5–3 µm. **Anchoring hyphae** rather abundant, 1.8–3 µm wide, walls 0.2–0.4 µm thick, forming a dense, 10–30 µm thick hyaline layer at flanks and margin. **SCBs** in paraphyses absent. **Exudate** over paraphyses and margin 0.3–1 µm thick, granular-cloddy, firmly attached, hyaline. — **ANAMORPH**: unknown.

Habitat: attached, partially or mostly entirely decorticated, 6–16 mm thick branches of *Parkinsonia* (?)*microphylla*, on 0.5–1 mm deep strongly decayed wood, strongly greyed, no algae. **Associated**: *Orbilia calyptrata*, *O. maeandrina*, *O. multicercocarpi*, *O. pleioserpens*, *O. sedonensis*, *Patellaria* '*andina*'. **Desiccation tolerance**: fully viable for at least 1 year. **Altitude**: 810 m a.s.l. **Geology**: Permian-Triassic-Jurassic sandstone; volcanic rock. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia paloverdensis* differs from *O. vermiculati* in smaller ascospores with more distinct tails, also in the spore bodies being mostly longer than half the spore length, in much larger apothecia, and in unbranched paraphyses. *O. caudimaeandrina* differs from *O. paloverdensis* in a similar way, except for having also distinct spore tails and long SBs. With its spore characteristics *O. paloverdensis* further resembles *O. multiurosperma* which, however, differs in 32-spored asci, shorter SBs, partly branched paraphyses, and in having crystalloid SCBs.

Not included collection. A sample from Utah on *Fraxinus* (Pl. 693: 2) resembles *O. paloverdensis* in the spores, but differs in 32-spored asci. Only a few cells of paraphyses and ectal excipulum were alive when studied 32 months after collecting, and no SCBs have been seen in them. The sparse apothecia measured rehydrated 0.4–0.5 mm diam., and had a bright brick-orange disc and a slightly protruding, rough, whitish margin. Undoubtedly this represents a species of its own, but in the absence of vital characters we refrained from describing it as a new species.

Ecology. *O. paloverdensis* was found on rotten wood of xeric branches of *Parkinsonia* (?)*microphylla* (foothill paloverde) in a subtropical semiarid Sonoran paloverde-mixed cacti desert scrub in the southwest of Northern America. The not included collection was on xeric wood of *Fraxinus* in a warm-continental semiarid pinyon-juniper woodland of the Colorado Plateau.

Specimens included. **USA**: **Arizona**, Sonoran Desert, 19 km W of Tucson, W of Old Tucson Studios, 810 m, branches of *Parkinsonia* (?)*microphylla*, on wood, 6.V.1995, G. Marson (ex H.B. 5671e, M-0276549, **holotype**).

Not included. **USA**: **Utah**, Canyonlands, Arches, 25 km NNW of Moab, Devils Garden, Landscape Arch, 1590 m, branch of *Fraxinus anomala*, on wood, 8.VI.2003, G. Marson (H.B. 8051a).

Series *Ellipsospermae*

Orbilia subgenus ***Habrostictis*** section ***Habrostictis*** series ***Ellipsospermae*** Baral & E. Weber, **ser**. **nov**., MB 815020 – Type species: *Orbilia gambelii* Baral & G. Marson

Etymology: named after the usually ± ellipsoid ascospores with rounded to obtuse ends.

Latin diagnosis: *Ascosporae *3.3–11.8 × 1.3–3.5(–4.5) µm, obovoideae vel ellipsoideo-clavatae, apice hemisphaerico vel obtuso, intus corpusculo refringenti, longe filiformi, flexuoso, ad apicem affixo. Paraphyses ad apicem clavato-capitatae. Status anamorphicus typo* Trinacrium.

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.1–)0.2–0.8(–1) mm diam., pale to bright rose or (yellowish-)orange(-ochre), margin smooth to finely rough or crenulate, partly protruding, sessile or with an ill-defined stipe. **Asci** 8- up to 128-spored, *(29–)35–70(–78) × 4–6.5(–7) µm when 8-spored, (40–)45–85(–101) × (4.5–)5–8(–9) µm when 16-spored, (50–)60–90(–120) × (6.2–)7–10(–11.5) µm when 32–128-spored, lower (1–)2–5(–6) spores inverted when 8-spored, (5–)7–10(–11) when 16-spored; **base** never H-shaped. **Ascospores** *(3.3–)4–10(–11.8) × (1.3–)1.5–3.2(–3.5) (rarely 3.5–4.5) µm, ellipsoid-ovoid to fusoid-clavate, also subcylindrical, apex rounded to obtuse, sometimes subacute or even acute, base sometimes tail-like, straight to slightly or sometimes strongly curved near base. **SBs** apically affixed to spore wall, rarely subapically affixed (in *O. namibica* and *O. myrionamibica*, rarely *O. microserpens*), (1.5–)2–8(–12) × (0.2–)0.3–1(–1.3) µm (actual length), filiform to subulate, with or without a thickened lower part, apically narrowed to a small point, without or with a very short filum, straight or often slightly to strongly flexuous, partly helicoid or uncinate. **Paraphyses** slightly or often medium to strongly clavate-capitate at the apex, terminal cells (0.3–)0.5–1.5(–2.5)× longer than lower cells. **Ectal excipulum** of (†) thin-walled or slightly gelatinized (common walls 0.3–1.5 µm), vertically or indistinctly, rarely horizontally oriented textura (globulosa-)angularis(-prismatica), cells near base *(5–)8–20(–30)((–41)) × (4–)6–14(–19) µm; near margin exceptionally with 2–5 µm thick **glassy caps** (*O. jurana*), **hairs** absent. **SCBs** globose or mixed with crystalloid ones. **Exudate** 0.2–1(–3)((–6)) µm thick, granular or granular-cloddy to continuous, loosely to mostly firmly attached, hyaline or pale yellowish-reddish, rarely only 0.1 µm thick or absent. — **ANAMORPH**: trinacrium-like. **Conidiophores** up to 30 µm long. **Conidia** Y-shaped, rarely 3–4-armed by repeated dichotomous branching, *19–55 × 17–56 µm, with or without unbranched phragmoconidia *25–61 × 4.5–6.2 µm, 3–7-septate.

Habitat: on wood and bark of angiosperms, exceptionally gymnosperms, also herbaceous stems or petioles of palms, humid to arid, temperate to predominantly warm-temperate to subtropical.

Recognized species: 33, plus 1 with a provisional name and 7 unnamed species ('affinis').

Taxonomic remarks. Series *Ellipsospermae* is segregated here from series *Serpentinae* based on typically ellipsoid ascospores with rounded to obtuse apices and not or only slightly attenuated bases. Representative members are *O. vitalbae*, *O. microserpens*, *O. gambelii* and allied taxa, but undoubtedly closely related species deviate in basally tapered, also often in more or less curved spores. Our molecular analysis confirms subdivision of the bulk of section *Habrostictis* into two large groups (see Phyls 19–20). As a result, also species with medium to strongly tapered spore bases are included in series *Ellipsospermae*, for instance *O. calyptrata*, but also two with fusoid to fusiform spores with obtuse to acute apices (*O. trapeziformis*, *O. obtusispora*) which we have retained in series *Serpentinae* based on spore morphology and a close resemblance to species such as *O. cylindrosoma*, *O. filiformis*, and *O. subtrapeziformis*. Exceptions in spore shape are actually not rare in both series and make series recognition based on morphology quite problematic. For instance, three taxa with apically obtuse and basally attenuated spores similar to *O. calyptrata* (*O. quaestiformis*, *O. mesaverdiana*, *O. vermiculati*) cluster in series *Serpentinae*. Quite a few taxa, for which no sequence was available, are only tentatively assigned to a series.

For instance, species around *O. vitalbae*, including *O. ungulata* and *O. jurana*, are considered here as closely related to typical members of series *Ellipsospermae*, but they differ in narrower, often more fusoid spores with apices varying from rounded to obtuse, obtuse to subacute, or subacute to acute, respectively. However, morphologically *O. vitalbae* and *O. subvitalbae* strongly resemble three further species with obtuse spore apices (*O. dixiensis*, *O. acaciae*, *O. pleioobtusispora*) which are tentatively assigned to series *Serpentinae* because of similarities with *O. obtusispora* which clustered close to *O. serpentina*. Likewise, *O. trapeziformis* and *O. cisti* resemble *O. maeandrina* and *O. multimaeandrina* in their fusoid-clavate spores with partly subacute apices, but their sequence data refer them to series *Ellipsospermae*, whereas *O. multimaeandrina* clusters in series *Serpentinae*.

O. namibica and *O. myrionamibica* deviate from most other members of series *Ellipsospermae* in their SBs being often subapically affixed, but this feature is also sometimes seen in *O. microserpens*. *O. jurana* is extraordinary, even within the entire section *Habrostictis*, because of very short glassy processes at the margin.

Species delimitation. Similar as in series *Serpentinae*, difficulties in species delimitation were also frequently encountered in series *Ellipsospermae*. For instance, *O. vitalbae* comprises populations with a very different spore length and also shape, and probably includes two species. Variation in spore size and shape is also noted, e.g., in *O. commarosa*, *O. barrowensis*, *O. gambelii*, *O. microserpens* etc. This variation obscures the limits to other taxa, e.g. between *O. gambelii* and *O. cercocarpi*. Almost each taxon made problems as soon as a couple of collections became available for study.

Anamorph. The conidia of series *Ellipsospermae* closely concur with those observed in series *Serpentinae*, being more or less of the *Trinacrium robustum*-type and often very similar among each other. In *O. ungulata* the two arms form a narrower, V-like angle. In some species, repeated dichotomous branching of the arms was noted (e.g., in *O. pleioungulata*).

Phylogeny. Sequence data were available for 10 of the 33 species included in series *Ellipsospermae*. Two additional species, *O. trapeziformis* and *O. obtusispora*, are tentatively treated by us in series *Serpentinae* for morphological reasons, but possibly belong partly to series *Ellipsospermae* based on available molecular data, except for one of the *O. trapeziformis* samples which fell in series *Serpentinae*. However, in the absence of such data in 66% of the species of this series we feel unable at the moment to make proper affiliations for all members of section *Habrostictis* according to the molecular concept.

The *Ellipsospermae* clade received high (SSU+ITS+LSU, LSU) or medium (ITS) bootstrap support in our phylogenetic analyses (Phyls 19–20, S22). Indeed, the alignment of the ITS region looks more homogeneous here compared to the more variable *Serpentinae-Habrostictis* clade.

In analyses of different rDNA regions (Phyls 19, 20, S20), two subclades can be recognized within series *Ellipsospermae*, though only with limited support. The *gambelii-vitalbae* clade includes, besides *O. gambelii*, *O. vitalbae*/*O. subvitalbae* and *O. obtusispora*/*O. trapeziformis* each clustering with high or medium support when analysing SSU+ITS+LSU or ITS. The moderately supported *microserpens-ungulata* clade includes also *O. macroserpens*, *O. cisti*, *O. cercocarpi*, *O. myrionamibica*, and *O. calyptrata*, whereas *O. ungulata* clustered unresolved in the *Ellipsospermae* clade (Phyl. 20).

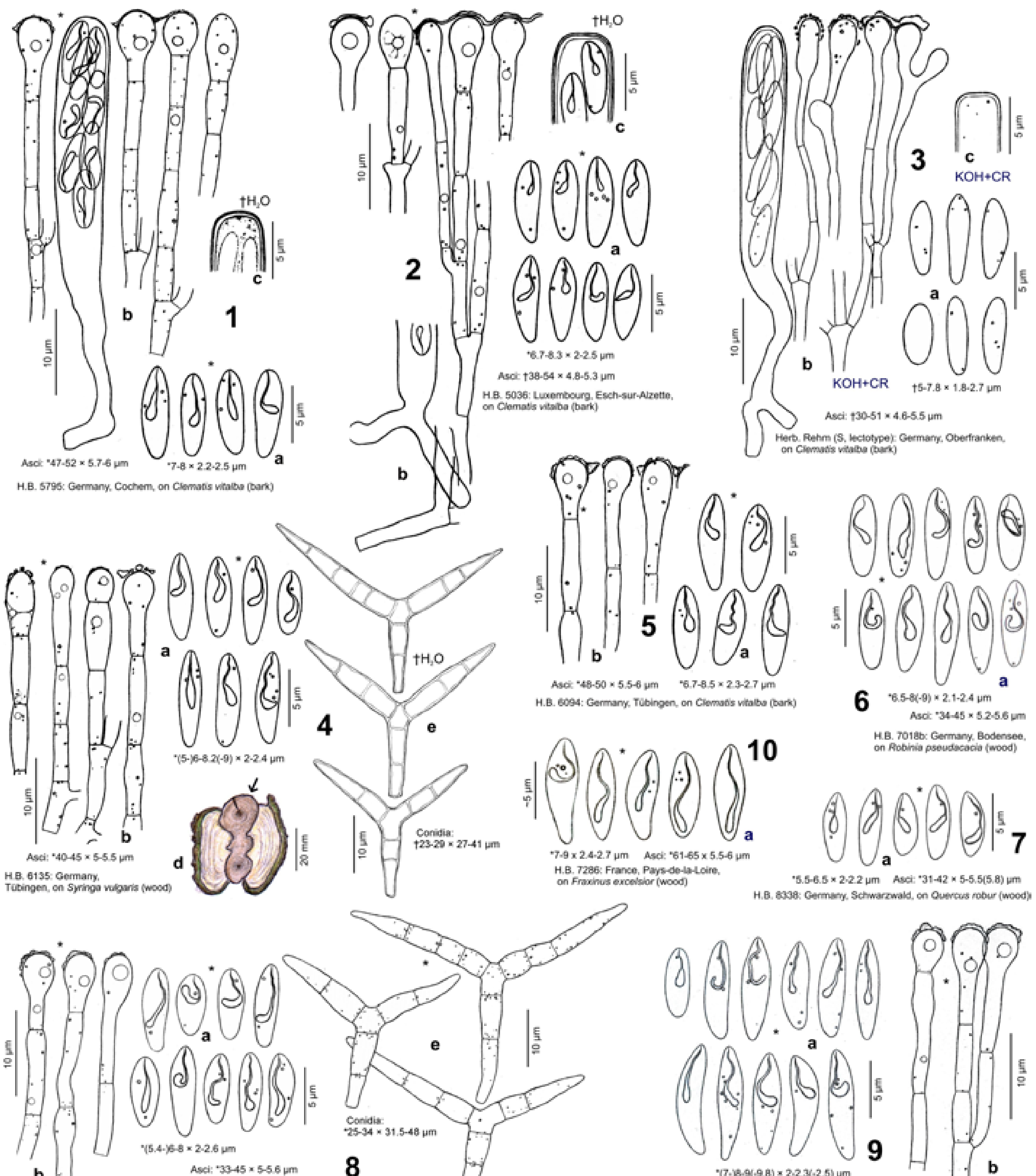


Plate 695. **1–9**: *Orbilia vitalbae*; **10**. *O.* cf. *vitalbae*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apex; **d**. living branch in cross section, with decorticated areas (same collection in Pl. 697: 3); **e**. conidia from substrate.

Specific nucleotide positions. Various nucleotide positions characterize the *Ellipsospermae* clade (see under section *Habrostictis*, p. 1014, and Tab. 72). These positions concur also with our phylogenetic result regarding two taxa (*O. obtusispora*, *O. trapeziformis* p.p.) which would from their fusoid spores with obtuse to subacute apices rather belong to series *Serpentinae*.

Orbilia vitalbae Rehm, in Ade, Hedwigia 64: 315 (1923) — Pls 695–698, Map 115

Etymology: named after the host in the holotype, *Clematis vitalba*.

Typification: Germany, Weismain, twig of *Clematis vitalba*, 30.III.1912, A. Ade (S-F9983, short-spored apothecia, lectotype, designated here, MBT202379); Switzerland, Seewis, twigs of *Clematis vitalba*, 20.VIII.2014, E. Weber & H.O. Baral (ex H.B. 9905a, M-0276607, epitype, designated here, MBT202380; sq.: KT380075).

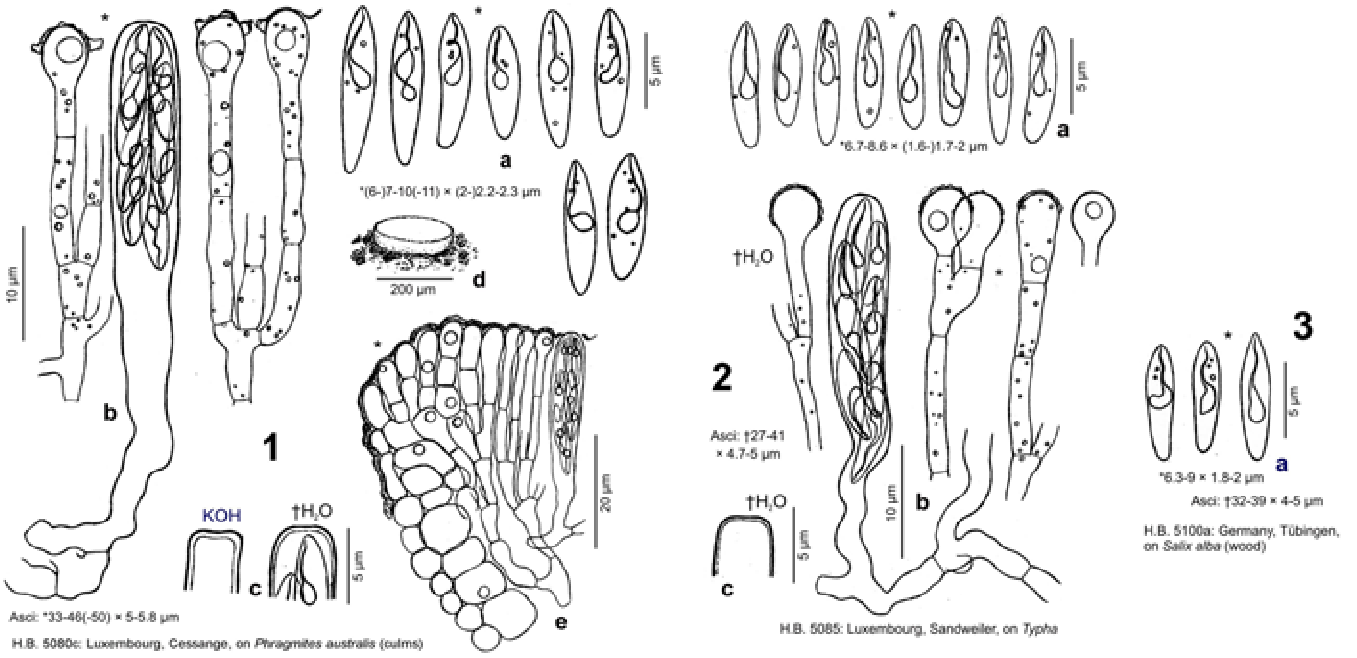


Plate 696. **1–3**: *Orbilia* cf. *vitalbae*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. rehydrated apothecium; **e**. apothecium in median section.

Misinterpretation of *O*. *vitalbae*: Baral in Krieglsteiner (1999: 271), = *Hyalorbilia subfusispora*; Quijada et al. (2016: 244f.), ?= *O. paravitalbae*.

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.15–0.4 mm diam., 0.09–0.15(–0.2) mm high, very pale to bright cream-amber, (yellowish-)orange(-rose) or pure isabelline to (vinaceous-) rose, ± translucent, round, very scattered to gregarious; disc flat, sometimes finally slightly convex, margin indistinct or distinct, thin, 0–5 µm protruding, smooth or sometimes finely crenulate; sessile on a broader or narrower base, superficial to slightly immersed in biofilm or erumpent from beneath epidermis; dry light to deep cream, orange, rose. **Asci** *(31–)35–55(–60) × 4.6–5.7(–6) µm {15}, †(27–)30–50(–54) × (3.5–)4–5.3(–5.5) µm {7}, 8-spored, spores *2–3-seriate, (2–)3–5 lower spores inverted {18} (sometimes mixed), pars sporifera *17–25 µm long; **apex** (†) (slightly to) strongly truncate (without or sometimes very slightly indented, laterally rarely slightly inflated); **base** with short to medium long, ± thin, flexuous stalk, T-, L-, Y- or h-shaped. **Ascospores** *(5–)5.5–9.5(–11) × (1.6–)1.8–2.5(–2.8) µm {27}, †5–8(–10) {4} × 1.4–1.6 {1} or 1.8–2.5(–2.7) µm {3}, (narrowly) ellipsoid to fusoid(-clavate), also subcylindric, apex rounded to obtuse, sometimes subacute, base not or slightly (to medium) attenuated, straight to slightly inequilateral; **SBs** *(2.5–)3–5.5 × (0.4–)0.5–1.1(–1.3) µm in situ {23} [~(3–)4–6(–7) µm actual length], divided into a ± abruptly swollen, subglobose, tear- or stomach-shaped or fusoid to fusiform lower part and a filiform or continuously thickened upper part of 0.5–1.5× the length of the inflated part, slightly to strongly flexuous, sometimes uncinate. **Paraphyses** apically slightly to (very) strongly capitate(-clavate), rarely spathulate, terminal cells *(4–)6–16 {10} or (11–)13–25 {3} × (2.8–)3.5–5 µm {13}, †2–5.7 µm wide {4}, lower cells *(5–)7–12(–15) × (1.3–)1.5–2.3(–2.7) µm {4}; very rarely branched at upper septum, hymenium pale rose. **Medullary excipulum** pale rose, 25–40 µm thick, of ± dense textura intricata with many inflated cells, medium sharply delimited. **Ectal excipulum** very pale to light rose or pink, of (†) thin-walled or slightly gelatinized t. globulosa-angularis from base to (sub)margin, 20–60(–105) µm thick near base, cells *6–15(–19.5) × 6–12(–16) µm {6}; 12–30 µm thick at mid flanks and margin, cells *5–9(–12) × 6–9(–11) µm, oriented at a 10–80° angle to the surface, marginal cortical cells */†6–10 × (3–)3.8–6 µm {4}. **Anchoring hyphae** sparse to ± abundant, *2–3.3(–4) µm wide, walls 0.2–0.3(–0.5) µm thick {6}, sometimes forming a thin covering layer up to the margin. **SCBs** in paraphyses and ectal excipulum (near margin) globose {11}, 1–1.8(–2.5) µm diam., also ± absent {3}. **Exudate** over paraphyses 0.2–1(–1.5) µm thick, granular-cloddy to continuous, mostly firmly attached, sometimes lacking; over margin and flanks 0.2–2 µm thick, cloddy to granular. **— ANAMORPH**: trinacrium-like (from ascospore isolate {1} and natural substrate {6}). **Conidiophores** not seen. **Conidia** on substrate Y-shaped, total size */†23–34 × 27–49 µm, stipe */†10–21 × 3–4 µm, 2(–3)-septate, arms tapering, */†15.5–27 × 3–4.3 µm, 2–4(–5)-septate {4}; in culture Y-shaped, total size *(23–)25–34 × (23–)25–47(–57) µm {1}, stipe *13–17 × 3.7–4.3 µm, 2-septate, arms tapering, *13–27(–32) × 3.5–4.5 µm, 2–4(–5)-septate {1}, sometimes unbranched, narrowly fusoid, *33–46 × 3.8–4.7 µm, 5–7-septate {1}.

Habitat: collected 0.1–6 m above the ground, corticated to decorticated, 5–40 mm thick, dead or sometimes still-living twigs and branches of *Acer pseudoplatanus* {1}, *Berberis vulgaris* {2}, *Buxus sempervirens* {1}, *Clematis vitalba* {9}, *Crataegus monogyna* {1}, *Ficus carica* {2}, *Hedera helix* {1}, *Juglans regia* {1}, *Lonicera etrusca* {1}, *Quercus* sp. {1}, *Q. robur* {1}, *Robinia pseudoacacia* {1}, *Rubus* (?)*bifrons* {1}, *R. fruticosus* {3}, *Salix alba* {1}, *S. caprea* {2/2}, *S.* ?*viminalis* {1}, *Sambucus nigra* {1}, *S. racemosa* {2}, *Syringa vulgaris* {1}, *Viburnum lantana* {1}, indet. angiosperm {1}, on 0.1–0.5 mm deep (or entirely) medium to strongly decayed wood {25} and bark (bast) {11}, also on textile (rope) {1}, ~1–2 year's old herbaceous stems and culms or leaves of ?*Cirsium* sp. {1}, *Pastinaca sativa* {1}, *Phragmites australis* {2}, *Sambucus ebulus* {1}, *Solidago canadensis* {1}, *Typha* sp. {2}, *T. latifolia* {1}, *Verbascum* sp. {1}, still standing or lying on dry ground, epidermis removed; partly eroded, slightly to strongly greyed, with a few to often many green algae. **Associated**: *Allophylaria sublicoides* {1}, *Bulbillomyces* sp. {1}, *Calloriopsis* sp. {1}, *Cryptodiscus foveolaris* {1}, '*Dasyscyphus*' *castaneus* {1}, *Durella connivens* {1}, *Eutypa acharii* {1}, *Eutypella* ?*scoparia* {1}, *Hohenbuehelia* sp. {1}, *Hyalorbilia juliae* {1}, *H. latispora* {3}, *H. subfusispora* {2}, *Hyaloscypha minuta* {1}, *Karstenia rhopaloides* {3}, *Lachnella* ?*villosa* {1}, *Lasiobelonium sublonicerae* {1}, *Lecophagus ellipsoideus* {1}, *Mollisia ligni* {1}, ?*Nectria* sp. {1}, *Neodasyscypha cerina* {1}, *Olla scrupulosa* {1}, *Orbilia albovinosa* {1}, *O. aristata* {2}, *O. breviaristata* {3}, *O. caulicola* {3}, *O. clavuliformis* {2}, *O. comma* {1}, *O. cylindrosoma* {2}, *O. eucalypti* {2}, *O. euonymi* {1}, *O. ficicola* {1}, *O. filiformis* {4}, *O. flavida* {4}, *O. flavidorosella* {1}, *O. gambelii* {1}, *O. obtusispora* {2}, *O. pleioeuonymi* {1}, *O. pleiolentiformis* {1}, *O. quaestiformis* {6}, *O. septispora* {2}, *O. subclavuliformis* {2}, *O. subtrapeziformis* {1/1}, *O. trapeziformis*

Plate 697. **1–7**: *Orbilia vitalbae*. – **3**. old *Syringa* shrub in a garden; **2a**. dead xeric herbaceous stem; **1a–c**, **2b–d**, **5a**, **6a–e**. rehydrated apothecia; **6f**. apothecium in median section; **5b**, **6g**. id., ectal excipulum near margin; **1d**, **4**. asci with mature spores; **1e–f**, **5c**, **6h**. ascospores; **7**. conidium from substrate. – Living state, except for **7**, asci in **1e** (in H_2O). — **1a–f**. H.B. 7736: Luxembourg, Oberkorn, on *Acer*; **2a–d**. H.B. 7168: Luxembourg, Ettelbruck, on *Pastinaca*; **3**. H.B. 6135: Germany, Tübingen, on *Syringa*; **4**. 14.V.2002: Luxembourg, Kockelscheier, on *Typha*; **5a–c**. H.B. 9457a: Germany, Egenhausen, on *Viburnum*; **6a–h**. H.B. 9165a: Switzerland, Wallis, on *Sambucus*; **7**. H.B. 7171b: Germany, Tübingen, on *Rubus*.

{1}, *O. ungulata* {2}, *Patellaria atrata* {3}, *Phyllactinia guttata* {1}, *Pirottaea ?imbricata* {1}, *Pseudolachnea hispidula* {1}, ?*Stictis* sp. {2}, *S. ?stellata* {1}, *Trichopeziza ?perrotioides* (immature) {1}, *Tryblidaria fenestrata* {1}, *Unguiculariopsis* sp. {1}, various lichens. **Desiccation tolerance**: fully viable for at least 2 months, conidia viable for 2 months, after 4 months only ascospores survived. **Altitude**: 125–1480 m a.s.l. (central Europe), 75–1070 m (southern Europe). **Geology**: Devonian sandstone, Buntsandstein, Muschelkalk, Keuper (marl & sandstone), Lower to Upper Jurassic & Cretaceous shale, sand- & limestone, Minette, dolomite, flysch, Miocene sand & molasse, Holocene sand & gravel; gneiss, mica schist, amphibolite, serpentinite, gabbro, basalt. **Phenology**: II–XI (throughout the year, long-lived).

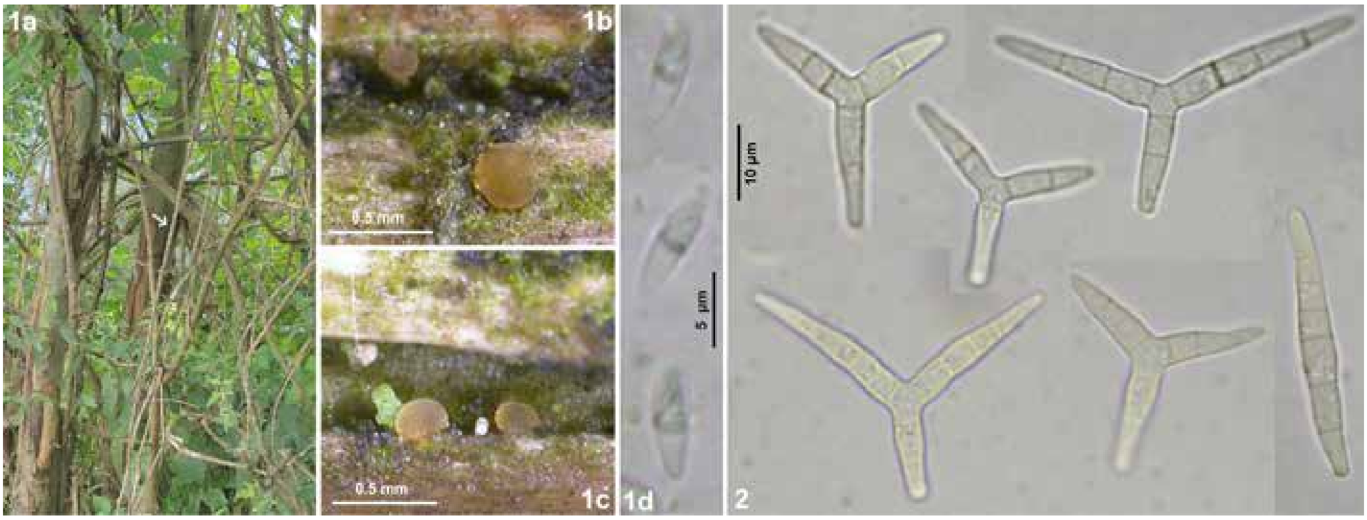


Plate 698. **1**: *Orbilia vitalbae*. – **1a**. South-exposed hedge along path with *Clematis vitalbae*; **1b–c**. rehydrated apothecia: **1d**. ascospores; **2**. conidia from pure culture. – Living state. **— 1a–d**. H.B. 9905a (epitype): Switzerland, Seewis, on *Clematis*; **2**. 16.XI.2013: Luxembourg, Dudelange, on *Clematis*.

Phenology of *O. vitalbae*											
Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
0	1	3	2	10	8	5	5	6	3	5	0

Taxonomic remarks. *Orbilia vitalbae* is characterized by predominantly homopolar, narrowly ellipsoid to fusoid-clavate or subcylindrical, ± straight ascospores with rounded to obtuse ends. The most distinctive character concerns the spore body which consists of a ± filiform upper part and a ± abruptly and strongly swollen, often strongly bent lower part (resembling a music note or a stomach with oesophagus). The length of the SBs (in situ) is mostly 1/2–3/4 of spore length. *O. vitalbae* has often very minute apothecia (0.15–0.3 mm) and is then very difficult to detect when sparsely occurring over the greyed host surface.

The mediterranean *O. subvitalbae* (on *Arundo*) differs from *O. vitalbae* in the presence of distinct crystalloid SCBs and in slightly wider spores. *O. trapeziformis* and *O. obtusispora* usually differ in more distinctly fusoid spores with more often subacute apices, and in narrower SBs without an abrupt swelling of its lower part. However, these taxa are not sharply delimited. *O. ungulata* differs from *O. vitalbae* in smaller spores and the presence of crystalloid SCBs.

O. paravitalbae (section *Aurantiorubrae*, Pl. 489–490) deviates from *O. vitalbae* in rather long and narrow, more subcylindrical spores with predominantly rounded apices, and apothecia with a distinctly crenulate margin. In this respect, *O. paravitalbae* shows some similarities to *O. rosella* and *O. ebuli* of section *Aurantiorubrae*. A somewhat intermediate Macaronesian collection on *Sideritis* is mentioned under *O. paravitalbae* (p. 911, IVV: TFC Mic. 23937) although it was identified in Quijada et al. (2016) as *O. vitalbae*.

The North American *O. dixiensis* is very similar to *O. vitalbae* (for the differences see p. 1177). A North American collection on *Larrea* (IVV: H.B. 5684g) with rose-violaceous apothecia mentioned under *O. obtusispora* resembles also *O. vitalbae* and *O. dixiensis*. Its rather long SBs are not very abruptly inflated at the base, but the material was too scanty to make a detailed study. Two North American collections on *Amelanchier* (Pl. 715: 5; IVV: H.B. 8056h) mentioned under *O. commarosa* resemble *O. vitalbae* and *O. dixiensis* in their SBs, but the former deviates from these two taxa in rather strongly tapered, somewhat curved spore bases, also in the presence of small crystalloid SCBs in the excipulum.

Identification of *O. vitalbae* from dead herbarium material is highly problematic because some other species, such as *O. rosella* and *O. obtusispora*, and partly *O. eucalypti*, have a very similar spore size and shape, though strongly differing in their spore bodies. *O. rosella* (section *Aurantiorubrae*) resembles the long-spored specimens of *O. vitalbae* in spore size and shape, but appears to differ in rather short SBs, judging from a restudy of the type. *O. rosella* further differs in producing short, septate marginal hairs which are occasionally tipped by small glassy processes. In spore shape and size, short-spored collections of *O. vitalbae* come close to long-spored collections of *O. eucalypti* (section *Orbilia*), and may with certainty be distinguished only in the living state by their very different SBs. Also the dubious taxon *O. inconspicua* (p.p., on leaves and stems of *Dryas*) resembles *O. vitalbae*, regrettably it was only studied in the dead state (see p. 1674).

Variation. *O. vitalbae* shows a very high variation in ascospore length and width, also in spore body shape and size, and in the length of the terminal cells of paraphyses. A majority of collections have rather short and wide, ± ellipsoid spores measuring *5–9 × 2–2.5(–2.8) µm, with a length/width ratio of mostly 2.5–3.5 (Pl. 695: 1–8), particularly those on the type substrate *Clematis*. Others have slightly longer and narrower, more subcylindric to fusoid-clavate spores measuring *6–10(–11) × 1.6–2.3 µm, with a length/width ratio of 3–5 (Pl. 696: 1–3). In quite a few of the long-spored populations, the spores are predominantly only *1.7–2 µm wide. Yet, intermediate populations sometimes occur (e.g., Pls 695: 4; 696: 1), and the host range encompasses woody and herbaceous substrates in both cases. The shape of the spore apex varies among the included collections from obtuse to subacute. Finally, variation in SB shape is rather high among the collections as can be seen on the drawings, but within a population SB length, curvature, shape, and width of the basal inflation also varies to some extent.

A somewhat marginal collection (Pls 695: 9; 697: 6) has partly fusoid spores with subacute apex and tapered base, resembling *O. trapeziformis* or *O. obtusispora*, but some other spores are ellipsoid-subcylindrical and the SBs partly stomach-shaped as is typical of *O. vitalbae*.

Type studies. The protologue of *O. vitalbae* is based on two collections, both 'in furrows of bark of *Clematis vitalba*': 30.III.1912, Oberfranken, Erlach near Weismain; 1.V.1913, Unterfranken, Homburg castle ruin near Gössenheim. A specimen of the first collection exists in S and was reexamined in the present study; the second collection could not be located in S and M.

On the label is a sketch of two oblong ascospores with rounded ends, one with a single large central drop and one with a small drop near each end. The spore size is given as 7 × 2 µm, the ascus size 35 × 5 µm, and the paraphyses with globose apices up to 4 µm wide. The protologue, however, gives the spores as narrowly fusiform, acute, straight, 5–6 × 2–2.5 µm, with minute oil drops, the ascus size as 20–33 × 4.5–5.5 µm, and the paraphyses apically 'elongate rounded' (?clavate), 3 µm wide. These differences indicate that the microscopic data of the protologue were not gained from this collection. However, in the absence of a voucher specimen of the second collection the specimen from Erlach must serve as lectotype of *Orbilia vitalbae*.

In this specimen eight apothecia were found, four of which were examined. As a result, this sample is a mixture of two or perhaps ?three macroscopically identical and even microscopically similar taxa growing in close vicinity on the same stem. They differ in spore size and shape: two apothecia (taxon 1) have spores 5–7.8 × 1.8–2.7 µm, with rounded to obtuse ends (Pl. 695: 3), whereas another apothecium (taxon 2, IVV: H.B. 6348b) has spores 8–10.7 × 2–2.3 µm, with ± distinctly acute upper ends. Also in the fourth apothecium the spores are apically ± acute, but measure only 7–8 × 2.2–2.5 µm. This apothecium appears to be intermediated between taxon 1 and 2.

Taxon 1 fits well the sketch on the label, whereas taxon 2 was probably overlooked by Rehm. Taxon 1 is obviously conspecific with our short-spored specimens in the present concept of *O. vitalbae*, particularly those on *Clematis*. Therefore, the name *O. vitalbae* is adopted here. Taxon 2 might be the species here reported as *O. obtusispora*. The apothecium with intermediate characters could also belong to taxon 1, but the acute spore apices would better fit *O. trapeziformis*. Due to the fact that shape and size of the SBs cannot be recognized in dead herbarium material, the identity of these taxa remains somewhat uncertain. In order to settle this confusing situation we here designate those apothecia with short spores and rounded to obtuse ends (Pl. 695: 3) in the collection from Erlach near Weismain (30.III.1912, S-F9983) as **lectotype** of *O. vitalbae*. Because of the paucity of the lectotype and the uncertainty of its identity, a specimen from Switzerland (Seewis, on *Clematis*, ex H.B. 9905a, Pl. 698), from which a sequence was gained, is designated here as **epitype** of *O. vitalbae*.

Before studying the type, the name *O. vitalbae* was erroneously applied by one of us (H.B., in Krieglsteiner, 1999: 271) to two collections now referred to *Hyalorbilia subfusispora*. In fact, the protologue data which report rather short asci without information on the ascus base, could as well refer to a species of *Hyalorbilia*.

Not included collections. Two specimens (France, on *Fraxinus*, Pl. 695: 10; Tübingen, on *Carpinus*, IVV: 4.VIII.2002) are not included in the description because the spore bodies show a more gradual than abrupt basal inflation, also the asci are extraordinarily long (*59–78 × 5.5–5.8 µm in the latter specimen). Both show a certain similarity in spore shape to *O. trapeziformis*, but appear to be better accomodated near *O. vitalbae* because of the shape of the spores that predominantly lack a strongly tapered base. However, J.P. Priou's drawing of H.B. 7286 shows spores typical of *O. trapeziformis*. Whether this refers to variation, interpretation, or to a mixture could not be clarified.

Map 115. Known distribution of *O. vitalbae* in Europe (yellow = not included collection).

Anamorph. Trinacrium robustum-like conidia were found on the natural substrate near apothecia of *O. vitalbae* (Pls 695: 4e, 8e; 697: 7), and quite the same conidia were obtained in pure culture (Pl. 698: 2). The rather large conidia with slender arms and stipe resemble those of *O. subvitalbae* or *O. pleiovitalbae*, but also those of *O. cylindrosoma*. Quite a few unbranched conidia occurred in pure culture, which were also obtained in culture of *O. pleiovitalbae* (Pl. 710: 1) but which were not seen on the natural substrate.

Phylogeny. Two sequences of *O. vitalbae* were available, both on *Clematis* (XI.2013, Luxembourg, LSU, from pure culture; H.B. 9905a, Switzerland, ITS+LSU, from apothecia, epitype). They fully concur in the LSU (D1–D2) and form with *O. subvitalbae* a strongly or medium (ITS) supported subclade (Phyls 19–20, S22), with a distance of 0.2% in the LSU and 2.7% in the ITS. The S1506 intron is absent in H.B. 9905a. The morphologically similar *O. paravitalbae* (p. 910, from Spain, on *Daphne*) strongly deviates and does not even cluster in section *Habrostictis* but in section *Aurantiorubrae*.

Ecology. *O. vitalbae* occurs on ± rotten wood (more rarely bark) of xeric twigs and branches of various angiosperm trees and shrubs (including *Rubus*), with a preference for *Clematis*, but also on herbaceous stems of both mono- and dicotyledonous plants. The species was mainly collected in subcontinental cold-temperate humid central Europe at colline to montane and even subalpine altitudes, often in thermophilous, sun-exposed vegetation such as heaths, hedges, old quarries, borders of forests, banks of rivers and lakes, and wetlands (*Salicetum*, *Phragmitetum*, *Typhetum*). However, it occurs also in orotemperate to orosubmediterranean humid and meso(sub) mediterranean semihumid areas of southern Europe, and in thermoboreal humid Scandinavia.

Specimens included. **FINLAND**: **North Karelia**, 42 km WNW of Joensuu, 1 km W of Outokumpu, Mökkivaara, 140 m, branch of *Sambucus racemosa*, on wood, 4.IV.2012, M. Pennanen (M.P., doc. vid.). — **GERMANY**: **Thüringen**, 2.5 km S of Sonneberg, WSW of Oberlind, An der Müß, 355 m, stem of *Solidago canadensis*, 22.XI.2015, I. Wagner (ø, doc. vid.). – **Rheinland-Pfalz**, 0.5 km SSE of Cochem, SE-slope of Cochem castle, 125 m, twig of *Clematis vitalba*, on bark, 12.V.1997, H.O. Baral (H.B. 5795 ø). – **Baden-Württemberg**, 3.2 km SE of Altensteig, 1.1 km EE of Egenhausen, Egenhäuser Kapf, 620 m, branch of *Viburnum lantana*, on wood, 22.XI.2010, H.O. Baral (H.B. 9457a ø). – ibid., branch of *Salix* ?*caprea*, on wood, 22.XI.2010, H.O. Baral (H.B. 9459b ø). – 9.3 km NW of Horb, NNE of Heiligenbronn, Spitalwald, 582 m, branch of *Quercus*, on wood, 4.X.2006, H.O. Baral (H.B. 8338). – 5 km WNW of Stuttgart, 1.2 km NE of Solitude, Sandkopf, Daimlerplatz, 426 m, leaves of *Typha latifolia*, 15.VII.1994, H.O. Baral (ø). – 2.5 km SW of Tübingen, Spitzberg, Sonnenhalde, 370 m, twig of *Clematis vitalba*, on wood, 28.VII.2002, H.O. Baral (ø). – 2 km SSE of Hagelloch, Schweigbrühl, 335 m, twig of *Salix alba*, on wood, 21.VI.1994, H.O. Baral (H.B. 5100a ø). – 5 km NE of Tübingen, 0.6 km S of Pfrondorf, Obere Mähder, 390 m, stem of *Rubus fruticosus*, on wood, 24.VII.2002, H.O. Baral (H.B. 7171b, in M-0276444 [*O. breviaristata*], anam. substr.). – Pfrondorf, Blaihofstraße, 430 m, branch of *Syringa vulgaris*, on wood, 26.V.1998, H.O. Baral (H.B. 6135, anam. substr.). – ibid., on rope, 24.XI.2009, H.O. Baral (H.B. 9226k ø). – 1 km SE of Pfrondorf, Rauhalde, 345 m, branch of *Clematis vitalba*, on bark, 1.V.1998, H.O. Baral (H.B. 6094 ø). – 8 km NE of Radolfzell, 1.5 km SE of Bodman, 400 m, branch of *Robinia pseudoacacia*, on wood, 29.VIII.2001, H.O. Baral (H.B. 7018b). – **Bayern**, **Oberfranken**, Nördliche Frankenalb, 14 km SE of Lichtenfels, ~2 km SW of Weismain, Erlach, ~350 m, twig of *Clematis vitalba*, on bark, 30.III.1912, A. Ade (S-F9983, **lectotype**, H.B. 6348a ø). — **SWITZERLAND**: **Graubünden**, 6.3 km ENE of Landquart, NW of Grüsch, SE of Seewis, 860 m, twigs of *C. vitalba*, on wood & bark, 20.VIII.2014, E. Weber & H.O. Baral (ex H.B. 9905a, M-0276607, **epitype**; sq.: KT380075). – **Wallis**, 14.5 km ENE of Brig, 2.7 km SSW of Binn, SW of Heiligkreuz, 1480 m, branch of *Sambucus racemosa*, on wood, 18.VIII.2009, H. Aeberhard (H.B. 9165a). — **LUXEMBOURG**: **Gutland**, **Diekirch**, 4.5 km SW of Diekirch, W of Ettelbruck, railway station, 197 m, stem of *Pastinaca sativa*, 6.VII.2002, G. Marson (H.B. 7168, anam. substr.). – **Grevenmacher**, 17 km NE of Luxembourg, 3 km NNE of Junglinster, Appelescht, 307 m, stem of *Sambucus ebulus*, 27.VIII.2004, G. Marson (H.B. 7564e ø). – **Luxembourg**, 7.5 km E of Luxembourg, 1.2 km ENE of Sandweiler, Neimillen, 305 m, leaf sheath of *Typha*, 20.V.1994, G. Marson (H.B. 5085, G.M. 5173). – 4.5 km SW of Luxembourg, 1.5 km SW of Cessange, Brichen, 295 m, culms & leaf sheaths of *Phragmites australis*, 10.V.1994, G. Marson (H.B. 5080c). – **Esch-sur-Alzette**, 7 km S of Luxembourg, 1.5 km SE of Kockelscheier, Laanguecht, 283 m, leaf sheath of *Typha*, 14.V.2002, G. Marson (ø). – 2 km NNE of Dudelange, 1.5 km S of Bettembourg, train station, 275 m, branch of *Salix* (?)*caprea*, on wood, 15.VI.1994, G. Marson (ø). – 4.2 km S of Bettembourg, 1.7 km E of Dudelange, 2.6 km NW of Zoufftgen, along railway, 290 m, twig of *Clematis vitalba*, on bark, 16.XI.2013, G. Marson (G.M. 2013-11-16.2 ø, anam. cult.; sq.: KT380065). – 6.7 km W of Esch-sur-Alzette, 1.5 km S of Obercorn, Ronnebierg, 410 m, branch of *Acer pseudoplatanus*, on bark, 3.IV.2005, G. Marson (H.B. 7736). – 5.2 km E of Pétange, 2.5 km SSW of Schouweiler, Héierchen, Neiwies, 310 m, stem of ?*Cirsium*, 6.V.1999, H.O. Baral (ø). – 4 km SE of Esch-sur-Alzette, 1.5 km W of Tétange, Holleschbierg, Minières, 355 m, branches of *Clematis vitalba*, on bark, 11.III.1994, G. Marson (H.B. 5036, anam. substr.). – 3 km E of Esch-sur-Alzette, 2 km NW of Kayl, Brucherbierg, 375 m, branch of *Salix caprea*, 5.VI.1999, G. Marson (ø). – 6 km SE of Esch-sur-Alzette, SSW of Rumelange, former train station, 305 m, branch of *S. caprea*, 23.X.1994, G. Marson (ø). – **Remich**, 8 km SSW of Remich, 1.5 km WNW of Schengen, Grouf, 220 m, stem of *Verbascum*, 16.VII.2001, G. Marson (ø). – 0.8 km SW of Schengen, N of Stroumberg, 225 m, stem of *Rubus* (?)*bifrons*, on bark, 11.II.2007, G. Marson (ø). — **FRANCE**: **Rhône-Alpes**, **Savoie**, 43.5 NNE of Besançon, SW of Termignon, 1343 m, twig of *Berberis vulgaris*, on wood, 2.IX.2017, J.P. Priou (J.P.P. 17199, doc. vid.). – **Drôme**, 1 km N of Nyons, W of Col du Pontias, 415 m, branch of *Ficus carica*, on bark & wood, 11.X.2002, G. Marson (H.B. 7231e). – 25 km WNW of Sisteron, 1 km SW of Ballons, 1,7 km SSE of Col de St.-Jean, 900 m, branch of indet. angiosperm, on wood, 23.VIII.1996, G. Marson (H.B. 5609). – **Isère**, 7 km NNW of Voiron, N of Chirens, 470 m, branch of *Salix* (?)*viminalis*, on wood, 29.IX.1999, H.O. Baral (H.B. 6534 ø). – ibid., branch of *Juglans regia*, on wood, 29.IX.1999, G. Marson (ø). – **Ardèche**, 1.5 km SSE of Vallon-Pont-d'Arc, S of La Combe St.-Pierre, 90 m, branches of *Ficus carica*, on wood, 12.IX.2016, G. Marson (H.B. 10138c). — **SPAIN**: **Asturias**, 2.4 km N of Pola de Somiedo, 2 km S of Castro, 703 m, branch of *Berberis vulgaris*, on wood, 7.VI.2013, H.O. Baral (ø). – 3.6 km ENE of Pola de Somiedo, Veigas, 815 m, stem of *Rubus fruticosus*, on wood, 6.VI.2013, H.O. Baral (ø, anam. substr.). – ibid., branch of *Clematis vitalba* (ø, anam. substr.). – ibid., 805 m, branch of *Sambucus nigra*, on wood (H.B. 9812 ø). – 7 km E of Pola de Somiedo, 0.7 km ESE of Arbeyales (Arbellales), 1070 m, branch of *Crataegus monogyna*, on wood, 7.V.2011, E. Rubio (E.R.D. 5306, doc. vid.). – **Castilla-La Mancha**, **Guadalajara**, 9 km S of Guadalajara, 2.5 km SSW of Chiloeches, 923 m, branch of *Lonicera etrusca*, on wood, 20.V.1996, R. Galán & H.O. Baral (ø). — **ITALY**: **Emilia-Romagna**, **Reggio Emilia**, 43 km SW of Reggio nell'Emilia, NW of Busana, Albergo Castagno hotel, 900 m, branch of *Buxus sempervirens*, on wood, 29.IX.2004, J.P. Priou (J.P.P. 24150, H.B. 7585). — **CROATIA**: **Dubrovnik-Neretva**, **Korčula**, 8 km W of Korčula, Pupnat, bus station, 320 m, branch of *Hedera helix*, on wood, 11.VI.2000, H.O. Baral (ø). — **SERBIA**: **Vojvodina**, Fruška Gora, 13 km S of Novi Sad, 5.7 km NNW of Irig, Iriški venac, SW of WWII memorial, 440 m, branch of *Clematis vitalba*, on bark, 15.I.2019, D. Savić (doc. vid.). – ibid., SSW of memorial, 450 m, branch of *Clematis vitalba*, on bark, 18.IX.2019, D. Savić (doc. vid.). – 10 km SW of Novi Sad, 1 km E of Beočin, 75 m, stems & leaves of *Phragmites australis*, 20.III.2019, D. Savić (FG-1021, doc. vid.).

Not included. **GERMANY**: **Baden-Württemberg**, 2.5 km NE of Tübingen, 1.5 km N of Lustnau, Hägnach, 380 m, branch of *Carpinus betulus*, on bark, 4.VIII.2002, H.O. Baral (ø). — **FRANCE**: **Pays-de-la-Loire**, **Maine-et-Loire**, 4 km SE of Ancenis, 1.8 km E of Liré, Chasserat, 42 m, branch of *Fraxinus excelsior*, on wood, 2.I.2003, J.P. Priou (J.P.P. 23001, H.B. 7286).

Orbilia dixiensis Baral & G. Marson, **sp. nov.**, MB 813706 — Pls 699–700

Etymology: named after the geographical origin, Dixie Forest (Utah, USA).
Typification: USA, Utah, Grover, branch of *Salix* ?*bebbiana*, 15.V.1995, G. Marson (ex H.B. 5410a, M-0276475, holotype).
Latin diagnosis: *Similis* Orbiliae vitalbae *sed ascosporae saepe leniter curvatae, corpusculum refringens saepe brevius quam longitudo dimidiata ascosporae. Habitat ad lignum vel corticem ramorum siccorum fruticum in zona temperata semiarida ad boreali humida Americae septentrionalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.18–0.4 mm diam., 0.11–0.17 mm high, light to bright orange, also or yellow-ochraceous, scarcely translucent, round, subgregarious; disc slightly concave to flat, margin distinct, 0–10 µm protruding, smooth to finely rough; broadly sessile, somewhat immersed. **Asci** *45–62 × 5.4–6.4 µm {2}, †42–63 × 5–5.5 µm {1}, 8-spored, spores *2–3-seriate, 1–5 lower spores inverted {2} (sometimes mixed), pars sporifera *25–35 → 18–22 µm long; **apex** (†) strongly truncate (not distinctly indented, laterally hardly inflated); **base** with very short, thick stalk, L-, Y- or h-shaped. **Ascospores** *(6–)7.5–10(–11.8) × (1.9–)2.1–2.4(–2.6) ((?–2.8)) µm {3}, subcylindric (to fusoid-clavate), apex rounded to obtuse, base not or slightly (to medium) attenuated, straight to slightly (or medium) curved; **SBs** (2.4–)2.8–4.3(–5) × (0.3–)0.4–0.7(–0.8) µm in situ {3}, vermiform to subulate, basally often slightly to strongly inflated, sometimes also subapically so (dumbbell-shaped), straight or ± flexuous. **Paraphyses** apically medium to very strongly clavate-capitate, terminal cells *6–15(–21) × (2.5–)3–4.5(–5.5) µm {2}, lower cells *8–16 × 1.4–2.6 µm {2}; unbranched at upper septum. **Medullary excipulum** very pale yellow-orange, 30–50 µm thick, of dense textura intricata with many inflated cells, medium sharply delimited. **Ectal excipulum** very pale rose, of (†) thin-walled, vertically oriented t. angularis-prismatica from base to mid flanks, 20–50 µm thick near base, cells *8–20 × 6–12 µm {1}; 20–25 µm thick at flanks, of t. globulosa, cells *6–12 × 5–7 µm, 20 µm thick near margin, of t. porrecta oriented at a 30–45° angle to the surface, marginal cortical cells *7–14 × 2–4 µm {1}, converging as small teeth. **Anchoring hyphae** medium abundant, *2–3.5 µm wide, walls 0.2–0.4 µm thick {1}. **SCBs** in paraphyses and ectal excipulum (near margin) globose, 0.8–2.2 µm diam. **Exudate** over paraphyses 0.2–1 µm thick, rough-cloddy to continuous, very pale yellowish-orange, firmly attached, over margin and flanks 1–2.5 µm thick. **— ANAMORPH**: unknown.

Habitat: collected 0.1–0.5 m above the ground, corticated or decorticated, 8–15 mm thick branches of *Artemisia tridentata* {1}, *Ericameria nauseosa* {1}, *Salix* ?*bebbiana* {1}, on 0.5–1 mm deep strongly decayed wood {1} and bark (bast) {2}, sometimes in clefts, bark partially detached, strongly greyed or not, with a few to many green algae. **Associated**: *Diplolaeviopsis* sp. {1}, *Hysterographium* sp. {1}, *Lophiostoma* sp. {1}, *Orbilia delphinus* {1}, *O. gambelii* {1}, *O. lentiformis* {1}, *O. mesaverdiana* {2}, *O. multimaeandrina* {1}, *O. multiphanosoma* {1}, *O. multitrapezoidea* {1}, *O. myriophanosoma*

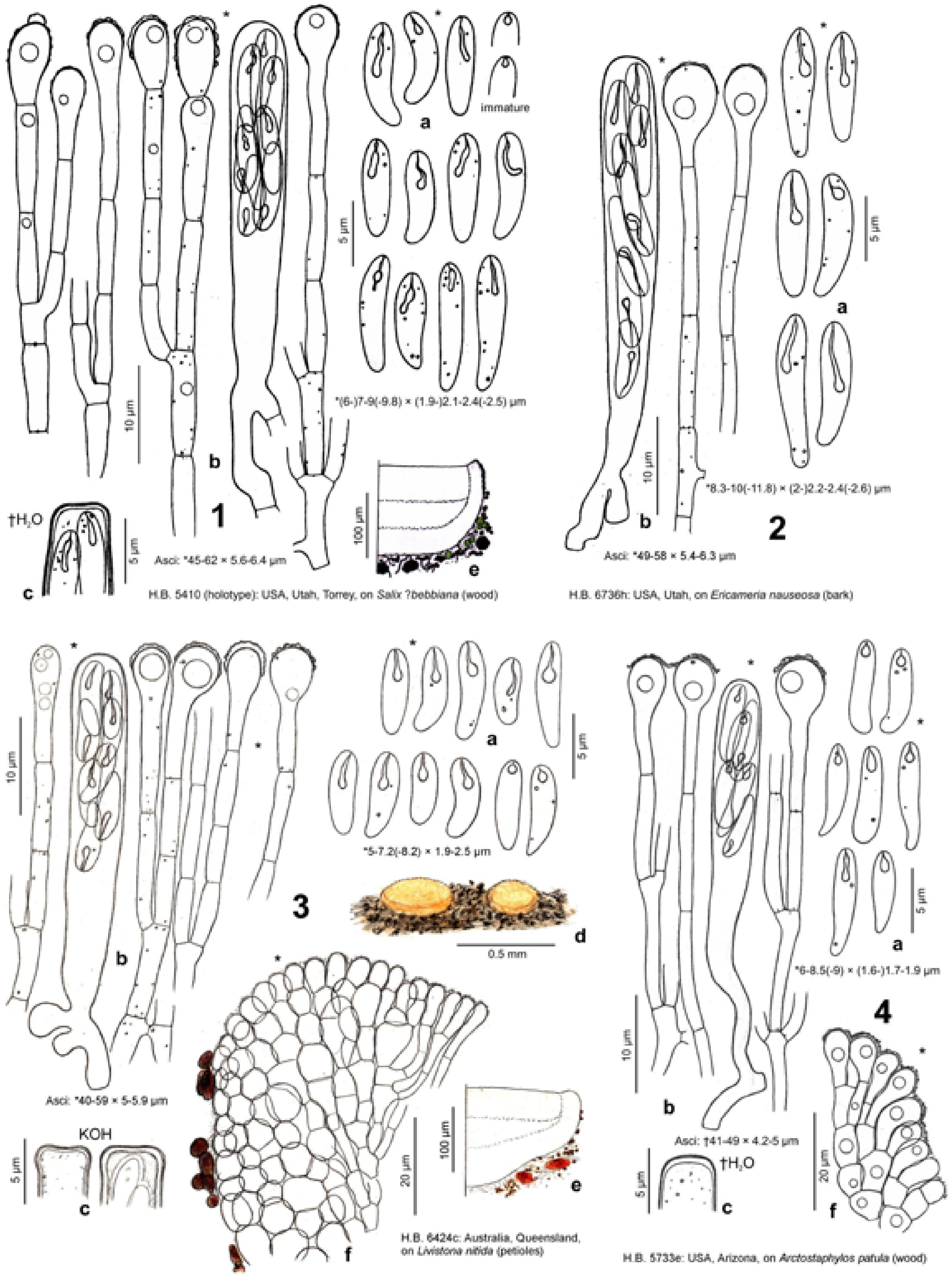


Plate 699. **1–2**: *Orbilia dixiensis*; **3**: *O.* cf. *dixiensis*; **4**: *O.* aff. *dixiensis*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. rehydrated apothecia; **e**. apothecia in median section; **f**. id., marginal ectal excipulum.

{1}, *O. navajoana* {1}, *O. ocellata* {1}, *O. plurilentiformis* {1}, *O. spathulata* {1}, *Perrotia flammea* {1}, *Schizoxylon argentinum* {1}, *Unguiculariopsis* sp. {1}, crustose lichens. **Desiccation tolerance**: fully viable for at least 9 months. **Altitude**: 1700–2825 m a.s.l. **Geology**: Triassic-Jurassic-Cretaceous sand & sandstone. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia dixiensis* is very similar to European *O. vitalbae*, from which it is tentatively separated by somewhat shorter spore bodies (usually shorter than half the spore length), and by often slightly curved ascospores. Two North American collections on *Amelanchier utahensis* mentioned under *O. commarosa* (Pl. 715: 5, IVV: H.B. 8056h) deviate from *O. dixiensis* especially in more strongly tapered spore bases, also in the presence of small crystalloid SCBs. The two European species *O. subvitalbae* and *O. ungulata* differ from *O. dixiensis* in the presence of crystalloid SCBs, the latter also in smaller spores.

Variation. The holotype slightly differs from the samples on *Artemisia* and *Ericameria* in less inflated paraphysis apices and shorter, partly dumbbell-shaped SBs.

Not included collections. An Australian sample on *Livistona* (Pl. 699: 3) deviates from *O. dixiensis* merely in slightly shorter spores and wider marginal cortical cells (*8–10 × 4–8 µm). This

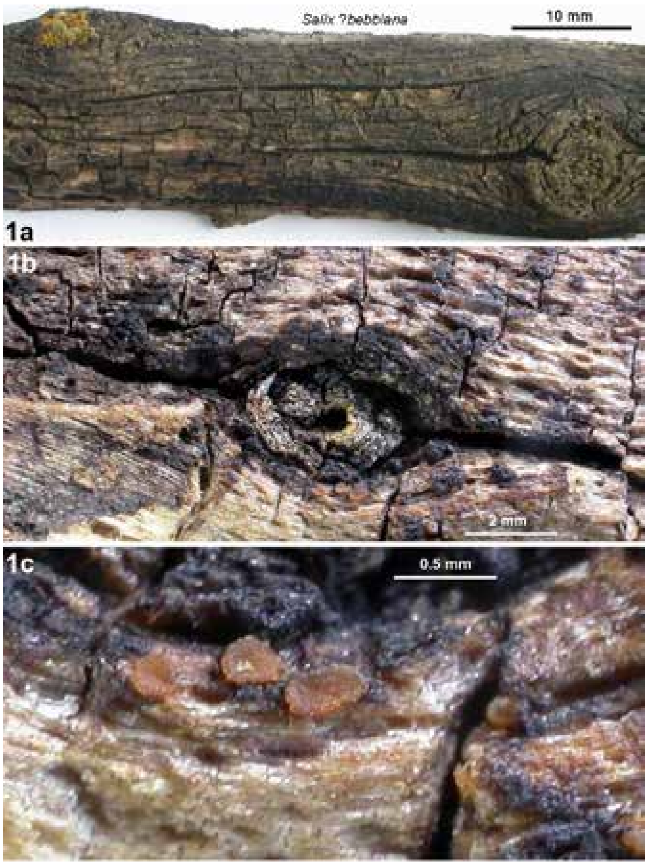


Plate 700. **1**: *Orbilia dixiensis*. – **1a**. decorticated xeric branch; **1b–c**. apothecia (rehydrated 9.5 years later). — **1a–c**. H.B. 5410a (holotype): USA, Utah, on *Salix*.

population grew associated with apothecia which gradually deviated by ± strongly curved spores (illustrated and mentioned under *O. commarosa*, Pl. 715: 6). A collection on *Arctostaphylos* (Pl. 699: 4) differs from *O. dixiensis* in smaller, especially narrower spores and mostly very short SBs, a feature for which this specimen is also mentioned under *O. pseudocylindrospora* (series *Regales*, section *Aurantiorubrae*). A sample on *Berberis* from Spain with spores of *(7.7–)8–10(–12.3) × 2–2.2(–2.4) µm (IVV: E.R.D. 7892) resembles long-spored *O. vitalbae*, but the often slightly curved spore bases better fit *O. dixiensis*.

Ecology. *O. dixiensis* grew on very rotten wood and bark of xeric branches of different angiosperm shrubs in western North America. The holotype on *Salix* wood was collected in the boreal humid Douglas fir mixed forest in the Dixie Forest of Utah Mts., the two paratypes on bark of *Artemisia* and *Ericameria* at lower altitude in cold-temperate to warm-continental semiarid sagebrush desert scrubs of the Colorado Plateau (Utah Mountains and Canyonlands). The not included North American collection was in a warm-continental subhumid manzanita chaparral scrubland (pinyon-juniper woodland) in the Mogollon Rim adjacent to Sonoran Desert, that from Australia in a subtropical semihumid eucalypt woodland on Jurassic sedimentary rock, and that from Europe in a suprasubmediterranean semihumid area of northern Spain.

Specimens included. **USA**: **Utah**, Utah Mts., Dixie Forest, 27 km SSE of Torrey, 18 km S of Grover, 3 km N of pass, 2825 m, branch of *Salix ?bebbiana*, on wood, 15.V.1995, G. Marson (M-0276475, **holotype**; **isotype** in H.B. 5410a). – Canyonlands, 60 km NW of Page, Cottonwood Canyon, ~1700 m, branches of *Artemisia tridentata*, on bark, 25.VIII.1994, G. Marson (H.B. 5197a ø). – 36 km S of Moab, Canyonlands, 5 km WNW of Hatch Rock, 1813 m, branch of *Ericameria nauseosa*, on bark, 16.VI.2000, G. Marson (H.B. 6736h).

Not included. **USA**: **Arizona**, Mogollon Rim, 37 km SSW of Flagstaff, ~1 km NE of Sedona, 1320 m, branch of *Arctostaphylos patula*, on wood, 8.V.1995, G. Marson (H.B. 5733e). — **AUSTRALIA**: **Queensland**, Brigalow Belt South, 69 km SSW of Theodore, 15 km N of Taroom, Palm-Tree Creek, Roy Staines Bridge, 200 m, leaves of *Livistona nitida*, on petioles, 22.X.1998, G. Marson (H.B. 6424m ø). — **SPAIN**: **Asturias**, 49 km NW of León, E of Rabanal de Luna, 1142 m, branch of *Berberis vulgaris*, on bark, 18.IV.2019, E. Rubio (E.R.D. 7892, doc. vid.).

Orbilia subvitalbae Baral & E. Weber, **sp. nov.**, MB 813707 — Pl. 701

Etymology: named after the resemblance to *O. vitalbae*.

Typification: France, Hérault, Sète, culms of *Arundo donax*, 20.IX.1999, G. Marson & H.O. Baral (ex H.B. 6504a, M-0276600, holotype; ex-type culture: CBS 116228; sq.: KT215250).

Latin diagnosis: *Similis* Orbiliae vitalbae *sed ascosporae latiores*, *cellulae vivae excipuli et paraphysium corpuscula crystalloidea pallide aurantiaca continentes. Habitat ad culmos putridos* Arundinis *et* Junci *in zona mesomediterranea Europae meridionalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.15–0.35(–0.45) mm diam., 0.08–0.1 mm high, pale to light (sometimes dirty) orange, medium translucent, round or sometimes elongate, scattered to subgregarious; disc flat, margin distinct or not, 0–10 µm protruding, smooth; broadly sessile, nearly superficial or slightly to entirely immersed (erumpent). **Asci** *50–64 × 5.5–6.6 µm, †42–50 × 5–5.4 µm, 8-spored, spores *2(–3)-seriate, 2–5 lower spores inverted (somewhat mixed), pars sporifera *28–33 µm long; **apex** (†) medium to strongly truncate (not distinctly indented, laterally inflated or not); **base** with very short to medium long, thin or thick, flexuous stalk, L- or Y-shaped. **Ascospores** *(5.5–)7.5–8.5(–9.5) × (2.2–)2.7–3(–3.3) µm, subcylindric to fusoid-clavate, apex rounded to obtuse, rarely subacute, base not or slightly to medium attenuated, straight to somewhat inequilateral, rarely slightly curved at base; **SBs** *3–5(–6) × (0.3–)0.5–1 µm in situ, divided into a narrowly to broadly tear-shaped lower part and a filiform to subulate upper part, slightly to medium flexuous or helicoid. **Paraphyses** apically medium to strongly (clavate-)capitate, terminal cells *(4.5–)6–16 × (2.5–)3–5.3 µm, lower cells *(4–)5.5–12.5(–14) × 1.4–2.2(–3.3) µm; sometimes branched at upper septum. **Medullary excipulum** 15 µm thick, of ± dense textura intricata with indistinctly inflated cells, sharply delimited. **Ectal excipulum** of (†) thin-walled, ± horizontally oriented t. globulosa-angularis from base to margin, 20–35 µm thick near base, cells *7–13 × 5–11 µm; 15–30 µm thick near margin, oriented at a 10° angle to the surface, uppermost margin of t. prismatica, marginal cortical cells *5–10 × 3–5 µm. **Anchoring hyphae** ± sparse, †2–3 µm wide, walls 0.2 µm thick. **SCBs** in apices of paraphyses and upper margin globose, 1–2.5 µm diam., lower part of paraphyses and ectal excipulum from base to margin with rod-, angular or ring-shaped crystalloid SCBs of 2–5.5 × 1–3.5 µm, very pale to light yellowish-orange. **Exudate** over paraphyses 0.3–0.7 µm thick, cloddy, ± firmly attached; over margin and flanks 0.5–1.3 µm thick, rough-cloddy. **— ANAMORPH**: trinacrium-like (from ascospore isolate and natural substrate). **Conidiophores** not seen. C**onidia** (from substrate) Y-shaped, total size *23.5–36 × 28.5–53 µm, stipe *12–19.5 × 4–4.5 µm, 1–3-septate, arms gradually tapering, *14–30.5 × 4.5–6 µm, 2–3-septate; a single 3-armed conidium was seen, with one arm again dichotomously branched.

Habitat: 13–17 mm thick culms of *Arundo donax* {1} lying on the dry ground, 2–3 mm thick standing culms of *Juncus acutus* {1}, medium to very decayed, partially greyed, with a few green algae. **Associated**: *Lophiostoma* sp. {1}, *Patellaria atrata* {1}. **Desiccation tolerance**: fully viable for at least 8 months. **Altitude**: 0–1 m a.s.l. **Geol**: calcareous marine sand dunes. **Phenology**: IX, but long-lived.

Taxonomic remarks. *Orbilia subvitalbae* resembles *O. vitalbae* and *O. dixiensis* in the ascospores, but differs in wider spores and mainly in the presence of distinct crystalloid SCBs.

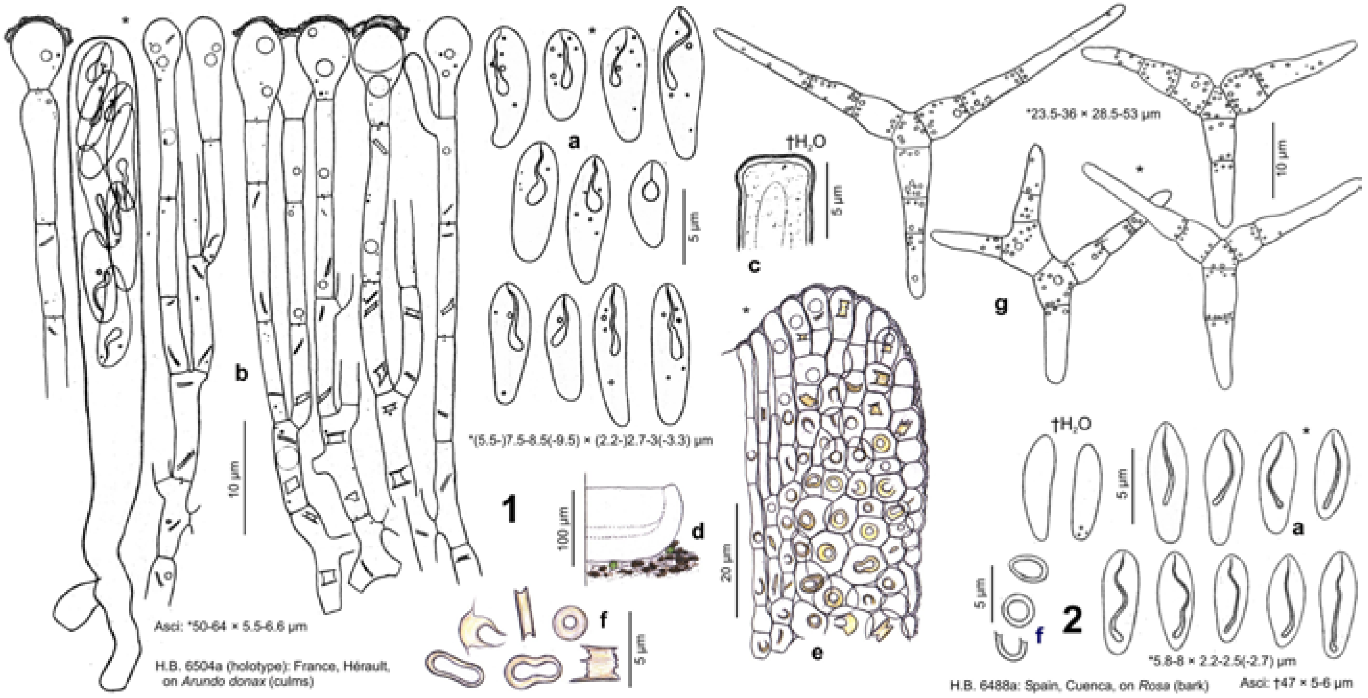


Plate 701. **1**: *Orbilia subvitalbae*; **2**: *O.* aff. *subvitalbae*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apex; **d**. apothecium in median section; **e**. id., marginal ectal excipulum; **f**. crystalloid SCBs in ectal excipular cells at lower flanks; **g**. conidia from substrate.

Long-spored collections of *O. gambelii* approach *O. subvitalbae* but differ in slightly wider spores and particularly in much longer spore bodies. *O. ungulata* differs from *O. subvitalbae* in distinctly smaller spores.

Not included collection. A Spanish collection on *Rosa* (Pl. 701: 2) differs from *O. subvitalbae* mainly in subulate, narrower and longer SBs.

Anamorph. A few trinacrium robustum-like conidia were obtained in pure culture of the holotype. They were not documented but concurred with those found on the natural substrate (Pl. 701: 1g). This anamorph is very similar to that obtained in *O. vitalbae*.

Phylogeny. Sequences were gained from pure culture of the holotype and from apothecia of the paratype. Both comprise SSU (without S1506 intron), ITS, and LSU. The two strains are fully identical in the SSU (V8–V9, except for 2 gaps), ITS, and LSU (D1–D2). In the ITS region, *O. subvitalbae* shows 2.7 % distance to *O. vitalbae* (0.2 % in LSU), 4 % to *O. gambelii* (0.8 % in LSU), and 4.5–5 % to *O. trapeziformis* (0.4 % in LSU).

Ecology. *O. subvitalbae* was collected on medium decayed, xeric culms of *Arundo* and *Juncus* on sand dunes of lagunas at the sea shore in mesomediterranean semihumid southern France. The not included collection on bark of *Rosa* was in an orosubmediterranean, south-exposed, (semi)humid pine-juniper woodland in eastern Spain.

Specimens included. **FRANCE**: **Languedoc-Roussillon**, **Hérault**, 7 km SW of Sète, 13 km NE of Cap d'Adge, 1 m, culms of *Arundo donax*, 20.IX.1999, G. Marson & H.O. Baral (M-0276600, **holotype**; **isotype** in H.B. 6504a; anam. substr., anam. cult., CBS 116228; sq.: KT215250). – **Provence-Alpes-Côte d'Azur**, **Bouches-du-Rhône**, 2 km ENE of St.-Maries-de-la-Mer, Réserves des Impériaux (lagune), 0 m, culms of *Juncus acutus*, 5.IX.2017, G. Marson (G.M. 2017-09-05.1; sq.: MH221051).

Not included. **SPAIN**: **Castilla-La Mancha**, **Cuenca**, Sierra de Albarracín, 43 km NE of Cuenca, 8 km SW of Guadalaviar, S of Mt. Mogorrit, 1600 m, twig of *Rosa*, on bark, 26.IX.1999, H.O. Baral (H.B. 6488a).

Orbilia ungulata Baral, G. Marson & Matočec, **sp. nov.**, MB 813708 — Pls 702–703, Map 116

Etymology: referring to the horseshoe-shaped SCBs in the ectal excipulum.

Typification: Luxembourg, Hesperange, stem of *Reynoutria sachalinensis*, 4.VII.1999, G. Marson (ex H.B. 6412a, M-0276604, holotype).

Latin diagnosis: *Similis* Orbiliae vitalbae *sed asci et ascosporae minores, cellulae vivae excipuli corpuscula crystalloidea hyalina continentes. Habitat ad lignum vel corticem siccum putridum ramorum fruticum vel ad caules siccos in zona temperata humida ad thermomediterranea semihumida Europae.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.1–0.35(–0.5) mm diam., 0.08–0.11 mm high, whitish-hyaline to pale or light cream-amber to orange-rose, translucent, round, scattered to subgregarious; disc slightly concave to flat, sometimes slightly convex, margin indistinct, thin, not protruding, ± smooth; broadly sessile or with a short obconical base, superficial; dry light orange. **Asci** *(29–)31–40(–45) × (4.2–)4.5–5(–5.5) µm {8}, †(23–)25–38(–45) × 4–4.3(–4.5) µm {3}, 8-spored, spores *2–3-seriate, (1–)3–4(–5) lower spores inverted {8} (rarely mixed), pars sporifera *(11.5–)14–18(–21) µm long; **apex** (†) strongly truncate (slightly indented, laterally sometimes inflated); **base** with short to medium long, ± thin, flexuous stalk, T-, L- or h-shaped. **Ascospores** *(4–)5–7.5(–8.5) ((–9.5)) × ((1.4–))(1.6–)1.7–2(–2.2) µm {13}, †5–7.5 × 1.5–1.8 µm {1}, narrowly ellipsoid to fusoid or often fusoid-clavate, apex obtuse to subacute, base mostly slightly to strongly attenuated, straight to slightly inequilateral, sometimes slightly curved near base; **SBs** *(1.7–)2–4(–4.5) × (0.2–)0.3–0.6(–0.8) µm in situ {9}, subulate, base not or slightly inflated, narrowly tear-shaped to fusoid, straight to ± flexuous, in more aged spores divided into an abruptly swollen, tear-shaped lower part and a fine filum of ± equal length. **Paraphyses** apically slightly to strongly capitate(-clavate), terminal cells *(6–)8–14(–15) × (2.5–)3–4.5(–5) µm {5}, †(2.2–)2.5–4(–5) µm wide {2}, lower cells *4–8(–12.5) × 1.5–2(–2.3) µm {4}; unbranched at upper septum. **Medullary excipulum** 15–50 µm thick, of ± dense textura intricata with many inflated cells, indistinctly to medium sharply delimited. **Ectal excipulum** of thin-walled, vertically oriented t. (globulosa-)angularis from base to margin, 25–40 µm thick near base, cells *(8–)10–15(–24) × 7–13(–18) µm {5}; 12–20 µm thick near margin, oriented at a 10–45° or higher angle to the surface, marginal

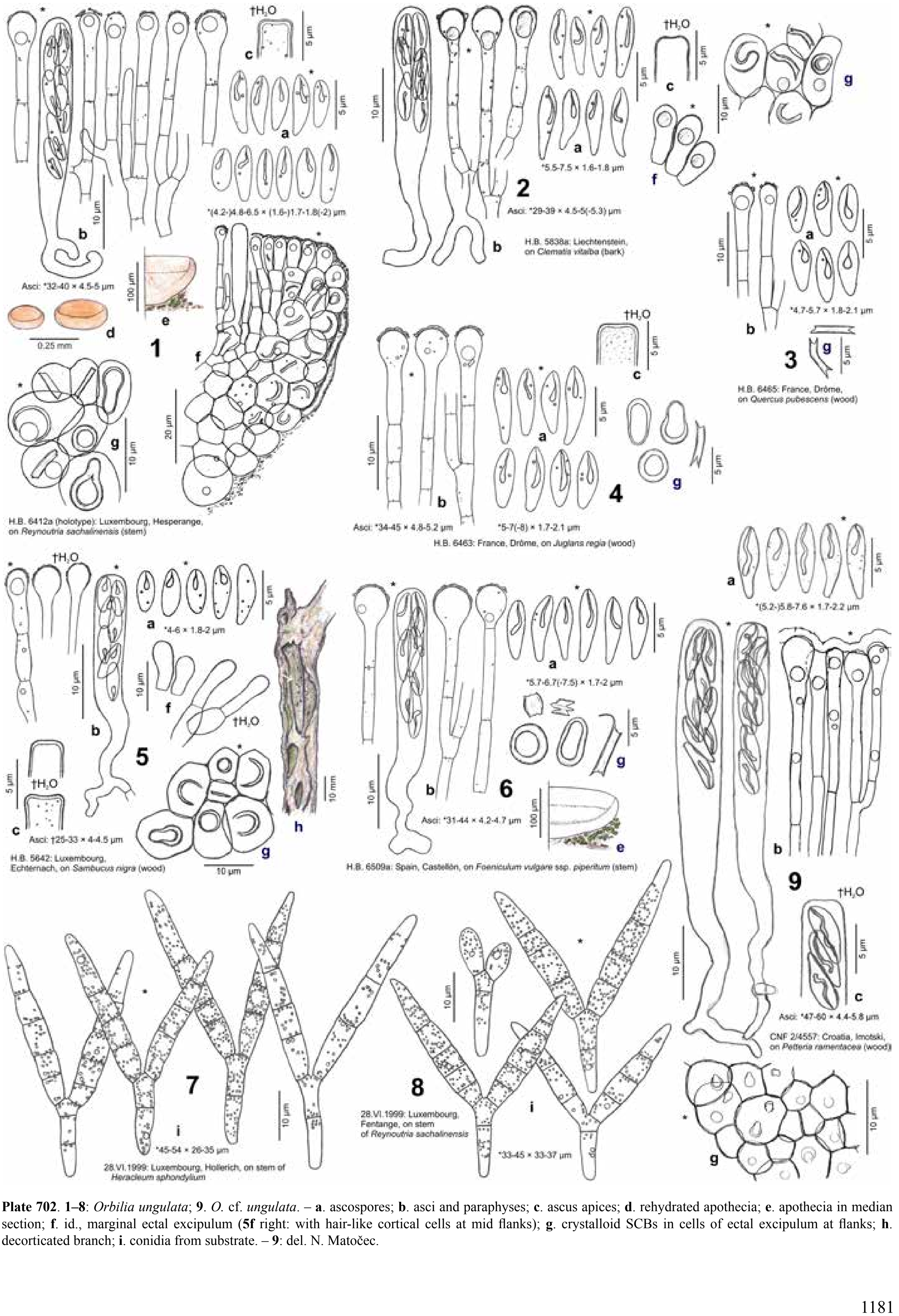


Plate 702. **1–8**: *Orbilia ungulata*; **9**. *O.* cf. *ungulata*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. rehydrated apothecia; **e**. apothecia in median section; **f**. id., marginal ectal excipulum (**5f** right: with hair-like cortical cells at mid flanks); **g**. crystalloid SCBs in cells of ectal excipulum at flanks; **h**. decorticated branch; **i**. conidia from substrate. – **9**: del. N. Matočec.

Plate 703. **1–3**: *Orbilia ungulata*. – **2a**. previous year's xeric herbaceous stem; **1a–d**, **f–g**, **2b–f**. rehydrated apothecia (**2**: with *Olla millepunctata*); **1e**. dry apothecia; **2g**. marginal ectal excipulum (external view); **2h–i**. crystalloid SCBs in excipular cells (external view); **2j**. asci; **2k**. conidia from substrate; **3a–c**. conidia from culture. – Living state. — **1a–g**. H.B. 7869b: Luxembourg, Bonnevoie, on *Heracleum*; **2a–k**. H.B. 7819a: Luxembourg, Fentange, on *Reynoutria*; **3a–c**. 17.VIII.2013: Luxembourg, Hesperange, on *Heracleum*.

cortical cells *(5–)8–13 × 4–5.5(–7.5) µm {3}, †8–13 × 3–4.5 µm, externally with some hyphoid to sublageniform, appressed cortical cells *10–15 × 3–4 µm. **Anchoring hyphae** ± sparse, *1.8–3 µm wide, walls 0.2–0.3(–0.4) µm thick {2}. **SCBs** in paraphyses and ectal excipulum globose, 1–3 µm diam.; in excipulum near margin also rod- or ring- to horseshoe-shaped {11}, ± hyaline, 3–7(–9) µm diam., rarely absent {2}. **Exudate** over paraphyses 0.2–0.5 µm thick, ± rough to granular, firmly attached; over margin and flanks 0.5–1(–2) µm thick, granular. — **ANAMORPH**: trinacrium/dicranidion-like (from ascospore isolate {1} and natural substrate {3} [1 × without teleomorph]). **Conidiophores** not seen. **Conidia** Y-shaped, total size *30–55 × 23–42 µm, stipe *11.5–18 × 3–4.2 µm, 1–2-septate, arms *(17–)24–41 × 3.7–5.5 µm, (2–)3–6-septate {4}, slightly converging, rarely one arm again dichotomously branched.

Habitat: collected 0–3 m above the ground, corticated to decorticated, 7–20 mm thick branches of *Acer campestre* {1}, *Clematis vitalba* {3}, *Euphorbia balsamifera* {1}, *Ficus carica* {1}, *Fraxinus ornus* {1}, *Juglans regia* {1}, *Juniperus phoenicea* var. *turbinata* {1}, *Quercus pubescens* {1}, *Sambucus nigra* {1}, on 0.2–1 mm deep medium to strongly decayed wood {6} or bark {4}, ~1–2 year's old herbaceous stems of *Foeniculum vulgare* {1}, *Heracleum sphondylium* {3}, *Reynoutria japonica* {2}, *R. sachalinensis* {2}, *Sambucus ebulus* {2}, epidermis partially removed, greyed, with a few or often many green algae, sometimes in old beetle galleries. **Associated**: *Calloriopsis* sp. {1}, *Cistella grevillei* {1}, *Cyathicula cacaliae* {1}, *C. cyathoidea* {1}, '*Dasyscyphus*' *castaneus* {2}, *Eutypella* ?*scoparia* {1}, *Hyalorbilia latispora* {1}, *Hydropisphaera arenula* {1}, *Karstenia idaei* {1}, *K. rhopaloides* {2}, *Lachnum* sp. {1}, *Lecophagus ellipsoideus* {1},

Map 116. Known distribution of *O. ungulata* in Europe (yellow = not included collection).

?*Nectria* sp. {1}, *Olla millepunctata* {4}, *Ophioceras leptosporum* {1}, *Orbilia albovinosa* {1}, *O. caulicola* {4}, *O. cylindrosoma* {2}, *O. filiformis* {1}, *O. flavida* {4}, *O.* ?*obtusispora* {1}, *O. pleiolentiformis* {1}, *O. pleistoeuonymi* {1}, *O. quaestiformis* {2}, *O. vitalbae* {2}, *Patellaria atrata* {4}, *Pirottaea imbricata* {1/1}, *Pyrenopeziza ebuli* {1}, *Ramichloridium* ?*schulzeri* {1}, *Trichopeziza lizonii* {1}, *T.* ?*perrotioides* (immature) {1}, *Trichopezizella rubroguttata* {1}, *Stictis stellata* {1/1}, *Urceolella* ?*pani* {1}. **Desiccation tolerance**: fully viable for at least 1–2 weeks, after 2 months a few mature asci still alive. **Altitude**: 4–475 m a.s.l. **Geology**: Buntsandstein, Lower Jurassic, Cretaceous & Tertiary marl- & sandstone, flysch, Pleistocene sand & loess; alluvial deposits from granite. **Phenology**: IV–XI (but probably throughout the year, long-lived).

Taxonomic remarks. *Orbilia ungulata* resembles *O. vitalbae* but differs in shorter and narrower, slightly more fusoid ascospores, shorter and narrower asci, and particularly in the consistent presence of crystalloid SCBs in the ectal excipulum, though virtually never in the paraphyses. Although it is unknown whether SCBs occurred in the lectotype of *O. vitalbae*, the dimensions of the dead asci and spores clearly exclude *O. ungulata.* As *O. ungulata*, the similar *O. subvitalbae* and the extra-European *O. acaciae* possess crystalloid SCBs but likewise differ in distinctly larger spores.

Variation. *O. ungulata* seems to be a fairly constant species. However, a few specimens deviated from the typical ones. The only sample from Germany (Thüringen), examined by I. Wagner (IVV: 24.VII.2017) on hygric *Reynoutria* stems, lacks crystalloid SCBs but otherwise seems to fit *O. ungulata* better than *O. vitalbae* because of narrow spores and not abruptly swollen SBs. It is included here because it concurs with a sample from Luxembourg on xeric *Reynoutria* stems (H.B. 7819) in its whitish apothecia growing associated with *Olla millepunctata*. The two Serbian samples deviate by comparatively long and narrow spores of *(5–)6–7.5(–8.5) × (1.4–)1.5–1.7(–1.8) µm and rather indistinct (*Fraxinus*) or seemingly absent (*Clematis*) crystalloid SCBs.

Not included collections. A Croatian sample on *Petteria* studied by N. Matočec (Pl. 702: 9) deviates by distinctly longer asci and slightly longer SBs (3–5.3 × 0.5–0.6 µm), although spore size and shape fit well. A specimen on *Krascheninnikovia lanata* from semiarid North America (IVV: H.B. 6085e) likewise differs in longer asci (*50–53 × 4.8–5.3 µm) and slightly longer spores (*8–9 × 1.6–2 µm).

Anamorph. The conidia of the anamorph of *O. ungulata* (Pls 702: 7i, 8i; 703: 2k, 3a–c) have somewhat converging arms reminiscent of *Trinacrium gracile* (with narrower stipe and arms) or some members of the genus *Dicranidion*, especially *D. gracile* (with somewhat shorter more converging arms).

Phylogeny. Sequences were gained from two samples of *O. ungulata* from Luxembourg, one from pure culture (17. VIII.2013, LSU) and one from apothecia (25.VII.2014, S1506 intron, ITS, LSU). In the LSU (D1–D2) the two are identical. When analysing ITS, LSU, or SSU+ITS+LSU, *O. ungulata* clustered unresolved in the highly or medium (ITS) supported *Ellipsospermae* clade (Phyls 19–20, S22). When analysing LSU a distance of only 0.5–1 % is noted to most other species of series *Ellipsospermae*, whereas in the ITS the minimum distance is 10–11 %. In the intron the distance is very high to any other species that has this intron.

An environmental strain from Australia (JQ026988, LSU) clustered with medium support and 1 % distance with *O. ungulata* in a clade (S22).

Ecology. *O. ungulata* was collected on rotten wood or bark of xeric branches of angiosperm trees and shrubs, but often also on xeric herbaceous stems of large dicotyledonous plants. Collections emanate from atlantic to subcontinental central warm- to cold-temperate humid Europe at planar to colline altitudes, but include also suprasub- to thermomediterranean semihumid areas of southern Europe. In central Europe the species appears to prefer thermophilous sites, e. g., sun-exposed ruderal places, e.g., along railways, but also forests with *Fraxinus*, *Salix*, *Alnus*, *Rhamnus*, and *Ilex*. In southern Europe the vegetation includes a *Quercus pubescens* forest with *Ruscus* and an old *Olea-Prunus persica* plantation. *O. ungulata* is so far absent in (hemi)boreal zones.

The not included collection on *Krascheninnikovia* (*Chenopodiaceae*) was in a warm-temperate semiarid Sonoran paloverde-mixed cacti desert scrub in a valley between Mogollon Rim and Sonoran Desert in the southwest of Northern America, that on *Petteria* (*Faboideae*) in a mesomediterranean semihumid shrubland in Dalmatia.

Specimens included. **FRANCE**: **Bretagne**, **Morbihan**, 5.3 km S of La Gacilly, 2 km N of St.-Vincent-sur-Oust, La Provostaie, 4 m, stem of *Reynoutria japonica*, 28.XI.2006, J.P. Priou (J.P.P. 26215, doc. vid.). – **Rhône-Alpes**, **Drôme**, 7.8 km NNE of Pierrelatte, 2.5 km E of Donzère, 120 m, branch of *Quercus pubescens*, on wood, 20.IX.1999, H.O. Baral (H.B. 6465 ø). – 7 km NNE of Pierrelatte, 2.3 km ESE of Donzère, 95 m, branch of *Juglans regia*, on wood, 20.IX.1999, H.O. Baral (H.B. 6463). – 1 km NNW of Nyons, W of Col du Pontias, 400 m, branch of *Ficus carica*, on wood, 11.X.2002, G. Marson (H.B. 7231g). — **LUXEMBOURG**: **Gutland**, **Echternach**, 7 km W of Echternach, 4 km SW of Berdorf, NE of Müllerthal, Schnellert, 230 m, branch of *Sambucus nigra*, on wood, 20.X.1996, G. Marson (H.B. 5642). – **Grevenmacher**, 17 km NE of Luxembourg, 3 km NNE of Junglinster, Appelescht, 307 m, stem of *S. ebulus*, 27.VIII.2004, G. Marson (ø). – **Mersch**, 4.5 km NW of Junglinster, W of Koedange, Schaedchen, 365 m, stems of *Reynoutria japonica*, 12.VI.2005, G. Marson (H.B. 7819a, anam. substr.). – **Luxembourg**, 2 km SSW of Luxembourg, 0.5 km S of Hollerich, railway station, 280 m, stem of *Heracleum sphondylium*, 28.VI.1999, G. Marson (ø, anam. only). – 2.5 km S of Luxembourg, 1 km SW of Bonnevoie, railway depot, 282 m, stem of *H. sphondylium*, 4.VIII.2005, G. Marson (H.B. 7869b). – 5 km S of Luxembourg, 1.5 km W of Hesperange, Biersak/Géisselbierg, 290 m, stem of *Reynoutria sachalinensis*, 4.VII.1999, G. Marson (ex H.B. 6412a, M-0276604, **holotype**, anam. substr.). – 2 km SSW of Hesperange, SW of Fentange, Bëlz, 270 m, stem of *R. sachalinensis*, 28.VI.1999, G. Marson (ø, anam. substr.). – 3 km ESE of Hesperange, 2 km W of Syren, Héid, 295 m, stem of *Heracleum sphondylium*, 17.VIII.2013, G. Marson (G.M. 2013-08-17, anam. cult.; sq.: KT380066). – **Esch-sur-Alzette**, 4.2 km S of Bettembourg,

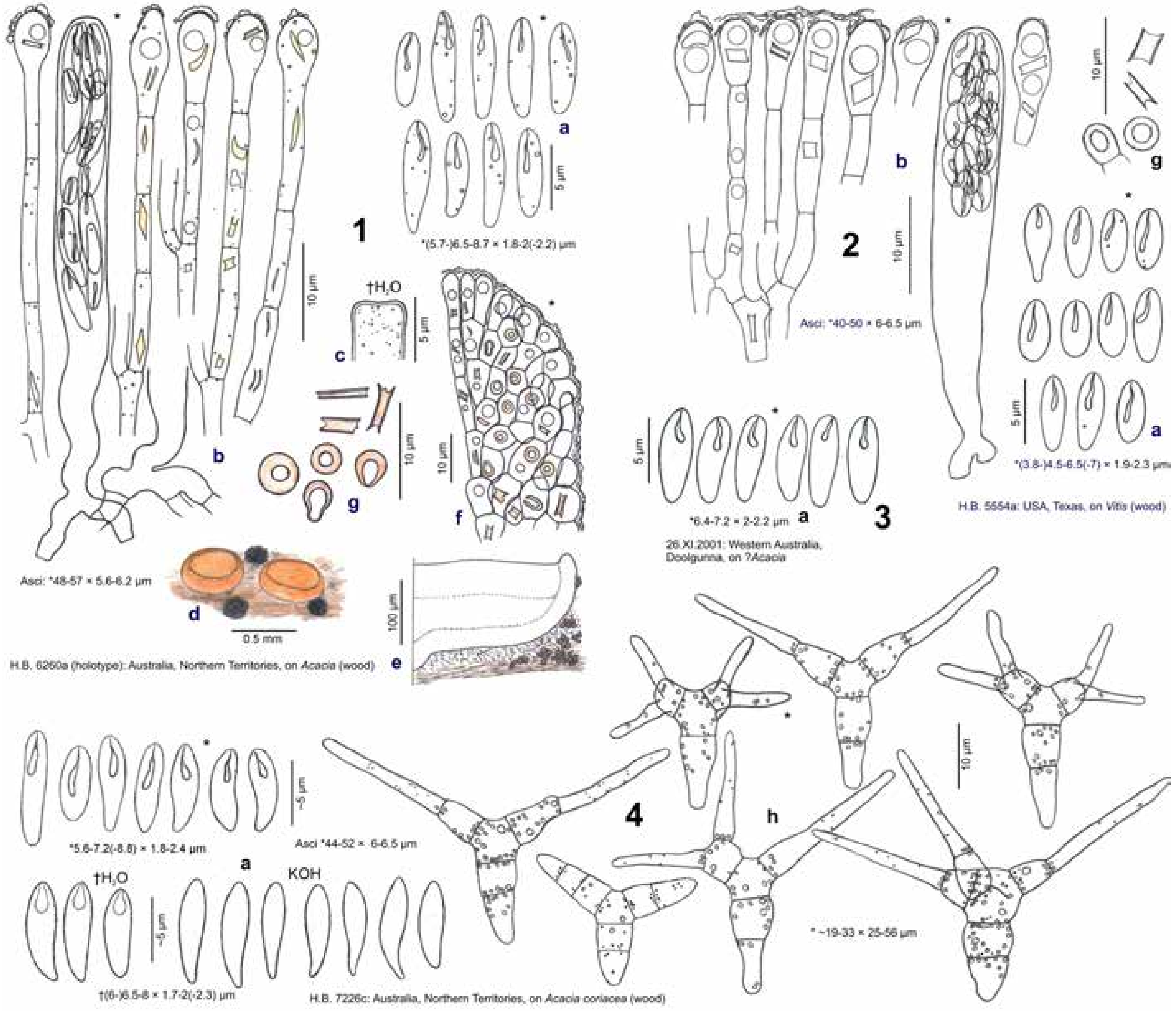


Plate 704. **1**, **3–4**: *Orbilia pleioungulata*; **2**: *O.* cf. *pleioungulata*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apex; **d**. rehydrated apothecia (with *Capronia* sp.); **e**. apothecium in median section; **f**. id., marginal ectal excipulum; **g**. crystalloid SCBs in ectal excipulum near margin; **h**. conidia from substrate.

bridge 2.7 km NW of Zoufftgen, along railway, 290 m, twigs of *Clematis vitalba*, on bark, 25.VII.2014, G. Marson (G.M. 2014-07-25.3, H.B. 9902d ø; sq.: KT380077). – **GERMANY**: **Nordrhein-Westfalen**, 7 km NW of Duisburg, 3 km NE of Moers, Uettelsheimer See, 38 m, stems of *Sambucus ebulus*, 18.IV.2018 (grown in moist box), K. Müller (doc. vid.). – **Thüringen**, 4.3 km SSW of Sonneberg, SSE of Eberdorf, 343 m, stem of *Reynoutria*, 24.VII.2017, I. Wagner (I.W., doc. vid.). — **SLOVAKIA**: **Bratislava**, 10 km SE of Bratislava, 4.8 km S of Podunajské Biskupice, Topol'ové hony, 130 m, trunk of *Acer campestre*, on wood, 1.VI.2019, A. Polhorský (A.P. 19/23, doc. vid.). — **LIECHTENSTEIN**: 6 km NNE of Vaduz, 0.5 km S of Nendeln, Schwabbrunnen, 475 m, branch of *Clematis vitalba*, on bark, 6.VII.1997, H.O. Baral (H.B. 5838a). — **SERBIA**: **Vojvodina**: Fruška Gora, 19.5 km SW of Novi Sad, 3.5 km SE of Grabovo, Andrevlje, 315 m, branch of *Clematis vitalba*, on bark, 31.X.2019, D. Savić (doc. vid.). – ibid., branch of *Fraxinus ornus*, on bark, 31.X.2019, D. Savić (doc. vid.). — **SPAIN**: **Com. Valenciana**, **Castellón**, 13.5 km NNW of Castellón, 3.2 km WSW of Vilafamés, Camí de Costur, 400 m, stem of *Foeniculum vulgare*, 27.IX.1999, H.O. Baral & G. Marson (H.B. 6509a).

Not included. **CROATIA**: **Split-Dalmatia**, 3.2 km ENE of Zagvozd, 11 km WSW of Imotski, podr. Brežine, 635 m, branch of *Petteria ramentacea*, on wood, 27.VII.2000, N. Matočec (CNF 2/4557, doc. vid.). — **USA**: **Arizona**, Sonoran Desert, 68 km SSW of Flagstaff, 5.5 km NNE of Camp Verde, Montezuma Castle, 975 m, branch of *Krascheninnikovia lanata*, on wood, 8.V.1995, G. Marson (H.B. 6085e ø).

Orbilia pleioungulata Baral, Quijada & R. Tena, **sp. nov.**, MB 813710 — Pls 704–705, Map 117

Etymology: named after the 16-spored asci and the resemblance to *O. ungulata*. **Typification**: Australia, Northern Territories, Wilora, branches of *Acacia*, 8.X.1998, G. Marson (ex H.B. 6260a, MEL 2389192, holotype).

Latin diagnosis: *Differt ab* Orbilia ungulata *ascis 16-sporis, ascosporis saepe subcylindricis, cellulae vivae non solum excipuli sed etiam paraphysium corpuscula crystalloidea pallide aurantiaca continentes. Habitat ad lignum vel corticem siccum putridum ramorum in zona (sub)tropica arida Australiae et thermomediterranea semiarida ad semihumida Macaronesiae et Europae.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.2–0.5(–0.7) mm diam., 0.1–0.2.5 mm high (receptacle 0.1–0.13 mm), pale to bright orange-ochraceous, ± round, scattered to subgregarious; disc slightly concave to flat, margin distinct, 0–20 µm protruding, smooth or sometimes crenulate; sessile or with a very small stipe-like base, superficial to slightly erumpent; dry deep apricot. **Asci** *(44–)48–60 × (5–)5.5–6.5 µm {6}, †42–53 × 5–5.5(–6) µm {1}, 16-spored, spores *4-seriate, lower spores inverted (strongly mixed), pars sporifera *23–35 µm long; **apex** (†) strongly truncate (sometimes slightly indented, laterally slightly widened); **base** with medium long, ± thick, flexuous stalk, Y- to h-shaped. **Ascospores** *(5.6–)6–8(–9) × (1.7–)1.8–2.3(–2.5) µm {6}, †(6–)6.5–8 × 1.7–2(–2.3) µm {1}, subcylindrical (to

Plate 705. **1–5**, **7–8**: *Orbilia pleioungulata*; **6**: *O.* cf. *pleioungulata*. – **1**. tropical arid acacia shrubland; **7a**. thermomediterranean semihumid forest with fallen *Pinus pinea*; **5a**, **8a**. decorticated xeric branches; **2a–c**, **5b–d**, **7b–c**, **8d**. rehydrated apothecia; **8b–c**. dry apothecia; **3a**. apothecium in median section; **3e**. id., basal excipulum; **7d–f**. crystalloid SCBs in basal excipular cells; **8g**. id., at flanks; **7g–h**. id., in lower parts of paraphyses; **7i–j**. id., in apices of paraphyses; **2d**, **3c–d**, **7h–l**. asci and paraphyses (**3c** showing cloddy exudate); **4a**. ascus apices; **3b**, **4b**, **7m**, **8e**. ascospores; **6**, **8f**. conidia from substrate. – Living state (**7k**, **8f** in CRB) except for **2d** (in KOH+IKI), **4a** (in CR), **6** (in H_2O). – **3a–e**, **4a–b**: phot. L. Quijada, **7a–m**, **8a–g**: phot. R. Tena. — **1**. 26.XI.2001: Western Australia, Gascoyne, on *Acacia*; **2a–d**. H.B. 8697b: ibid., Gascoyne, on *Acacia*; **3a–e**. TFC-Mic 22541: Tenerife, on *Euphorbia balsamifera*; **4a–b**. L.Q. F-23: Tenerife, on *Juniperus*; **5a–d**. H.B. 6260a (holotype): Australia, Northern Territories, on *Acacia*; **6**. H.B. 5554a: USA, Texas, on *Vitis*; **7a–l**. R.T.L. 12043003: Spain, Valencia, on *Pinus*; **8a–g**. R.T.L. 12092902: ibid.

Map 117. Known distribution of *Orbilia pleioungulata* in Australia and Tenerife (Macaronesia).

narrowly ellipsoid-fusoid), apex rounded to obtuse, base not or slightly (rarely medium to strongly) attenuated, straight to slightly inequilateral; **SBs** *2.5–3(–3.7) {3} or 4–6.5 {2} × 0.3–0.6 µm in situ {5} (~3–4 µm actual length), subulate, sometimes medium inflated in lower part, straight to slightly flexuous. **Paraphyses** apically slightly to medium (to strongly) clavate-capitate, rarely sublageniform, terminal cells *(6–)9–17(–21) × (2.5–)3.3–4.5(–5.2) µm {3}, lower cells *(5.5–)7–15 × 1.5–2.5(–3) µm {3}; unbranched at upper septum. **Medullary excipulum** 25–70 µm thick, of dense textura intricata-prismatica-angularis, sharply delimited. **Ectal excipulum** subhyaline, of (†) thin-walled, vertically oriented t. angularis(-prismatica) from base to margin, 20–35 µm thick near base, cells *(6–)8–15(–20) × (4–)6–10(–13) µm {3}, †5–10 × 4–7 µm {1}; 15–20 µm thick near margin, oriented at a 10–30 or 45–80° angle to the surface, marginal cortical cells */†5–7 × 2.5–5 µm {2}, sometimes projecting as short hyphoid elements. **Anchoring hyphae** abundant, *2–3(–5) µm wide, walls 0.2–0.4 µm thick {1}, forming a 5 µm thick covering layer up to mid flanks. **SCBs** in paraphyses, whole ectal excipulum and partly medullary excipulum globose, 1–2.5 µm diam., and rod- or ring- or spool-shaped {6}, (1–)2–5 µm diam., pale orange. **Exudate** over paraphyses 0.5–1.5 µm thick, granular-cloddy, hyaline, firmly attached; over margin and flanks ~1 µm thick, rough-cloddy. — **ANAMORPH**: trinacrium-like (presumed, from natural substrate {2}). **Conidiophores** not seen. **Conidia** in H.B. 7226c: Y-shaped or often (70%) 3–4-armed by repeated branching (3-dimensional), total size *~(19–)30–35 × (25–)28–56 µm, stipe *11–17 × 5.5–7.5 µm, 1–2-septate, arms (unbranched) *(11–)25–28 × 4.5–5.5 µm, often abruptly tapering into a long and narrow terminal part, (1–)2-septate; in R.T.L. 12092902: Y-shaped, *28 × 27 µm, stipe *16 × 5.7 µm, 2-septate, arms *12–14 × 5 µm, 2-septate, tapering but without narrow part (only 1 conidium).

Habitat: 0–0.1 {Australia} or 0.5–3 m {Spain} above the ground, decorticated, 6–70 mm thick branches of *Acacia* sp. {3}, *A. coriacea* {1}, *Aeonium lindleyi* {1}, *Asparagus* sp. {1}, *Euphorbia balsamifera* {2}, *Juniperus phoenicea* var. *turbinata* {1}, *Lavandula canariensis* {1}, *Lycium intricatum* {1}, *Periploca laevigata* {1}, *Pinus pinea* {1}, *Plocama pendula* {3}, *Rubia fruticosa* {1}, on 0.1–0.2 mm deep (medium to) strongly decayed wood {6}, also on inner surface of bark {1}, slightly to strongly greyed, green algae absent or rather abundant. **Associated**: *Acanthostigma ellisii* {1}, *Capronia* sp. {1}, *Melaspilea emergens* {1}, *Orbilia barrowensis* {1}, *O. corculispora* {1}, *O. ?livistonae* {1}, *O. macrocarpa* {1}, *O. maeandrina* {1}, *O. ?multivirgula* {1}, *O. myriella* {1}, *O. myriomuscula* {1}, *O. pleiostomachia* {1}, *O. pluristomachia* {1}, *O. ?pseudeuphorbiae* {1}, *O. subaristata* {1}, *Ostropales* {2}, *Peniophora* sp. {1}, *Rhizodiscina* sp. {1}, *Symbiotaphrina desertorum* {1}, *Tryblidaria* sp. {1}. **Desiccation tolerance**: fully viable for at least 2 weeks. **Altitude**: 6–711 m a.s.l. **Geology**: Australia: Paleo- & Mesoproterozoic sedimentary rock, Cenozoic regolith (sand), granulite with granitic gneiss; Tenerife: (trachy)basaltic and phonolitic flows and pyroclasts. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia pleioungulata* is characterized by 16-spored asci, ± homopolar, subcylindrical ascospores with typically rather short, subulate, only slightly flexuous SBs, and abundant crystalloid SCBs in the cells of paraphyses and ectal excipulum. The very similar *O. pleioobtusispora* is tentatively separated merely by the absence of crystalloid SCBs. *O. pleiovitalbae* differs in slightly broader spores with SBs divided into a filiform upper part and a strongly tear-shaped basal part, in more strongly swollen paraphysis apices, and in the absence of crystalloid SCBs. *O. acaciae* and the European *O. ungulata* appear to be closely related to *O. pleioungulata*, but differ in 8-spored asci, the former also in longer spores, the latter in more fusoid spores and in crystalloid SCBs being restricted to the ectal excipulum. *O. microserpens* differs in the consistent absence of crystalloid SCBs, and *O. pleiogambelii* in much wider (or shorter), ellipsoid spores; both differ from Australian samples of *O. pleioungulata* also in much longer SBs. The North American *O. calyptrata* differs in consistently spathulate to lageniform paraphyses, also in more fusoid-clavate, partly curved spores and in having very short marginal hairs.

Variation. In an Australian collection from Alice Springs the spores were partly strongly tapered at the base, particularly in the dead state (Pl. 704: 4). Collections from Tenerife (Macaronesia, on various substrates) and Valencia (Spain, on *Pinus*) fit quite well those from Australia, but tend to have longer SBs (3–4 or 4–6.5 µm, respectively, Pl. 705: 3–4, 7–8, L. Quijada & R. Tena pers. comm.), that from Valencia differs also in a tendency to rather large apothecia with a crenulate margin. Whether these differences are indicative for different taxa remains to be clarified, although a similar variation in SB length was noted in *O. ungulata*.

Not included collection. A North American sample on *Vitaceae* (Pls 704: 2; 705: 6) differs in comparatively short asci and spores.

Anamorph. Two types of conidia were observed on the natural substrate. In one type the conidia have 2 rather short arms and resembles *Trinacrium robustum* (Pl. 705: 6, 8f; 1 conidium of Pl. 704: 4h). In the other type the arms form long and narrow terminal cells, which are extraordinary in the *Orbiliomycetes*, also in having frequently 3 or 4 arms (Pl. 704: 4h). Both types occurred in abundance in H.B. 7226c, and it remains unclear which of them (or perhaps both?) belong to *O. pleioungulata*.

Also the not included collection from North America showed trinacrium robustum-like conidia, with a total size of †18–21 × 21–23 µm, 2-septate stipes of †11–12 × 5 µm, and 1–2-septate, gradually tapering arms of †10–12 × (3–)4–5 µm.

Ecology. *O. pleioungulata* was found on rotten wood (and bark) of xeric branches of *Acacia*, in subtropical to tropical arid acacia open woodlands and mainly shrublands (mulga) of western and central Australia. In Tenerife L. Quijada (pers. comm.) found it at a total of eight sites. Besides the records listed below, *O. pleioungulata* grew there in the inframediterranean arid *Ceropegio fuscae-Euphorbietum balsamiferae* and thermomediterranean semiarid juniper woodland with *Euphorbia* spp. (*Junipero canariensis-Oleetum cerasiformis*). The collection from Spain was in a thermomediterranean semihumid woodland with *Pinus pinea*, *Quercus coccifera* and *Myrtus communis*. *O.* cf. *pleioungulata* grew on rotten wood of a xeric branch of an unidentified *Vitaceae* in a warm-temperate subhumid woodland with *Quercus virginiana* in the Edwards Plateau (south of Northern America).

Specimens included. **AUSTRALIA**: **Northern Territories**, Burt Plain, 31 km SW of Barrow-Creek Hotel, 3.7 km WSW of Wilora, 480 m, branches of *Acacia*, on wood, 8.X.1998, G. Marson (ex H.B. 6260a, MEL 2389192, **holotype**). – 48 km NNW of Alice Springs, 15 km SW of Yambah, 711 m, branches of *Acacia coriacea*, on wood, 13.X.1998, G. Marson (H.B. 7226c, anam. substr.). – **Western Australia**, Gascoyne, southern border of Collier Range, 175 km NE of Meekatharra, 41 km SW of Kumarina Roadhouse, 560 m, branches of *Acacia*, on bark, 26.XI.2001, G. Marson (H.B. 8697b). – Murchison, southern border of Collier Range, 117 km NE of Meekatharra, 6.5 km WSW of Doolgunna, 573 m, branch of *Acacia*, on wood, 26.XI.2001, G. Marson (ø). — **MACARONESIA**: **Canary Islands**, **Tenerife**, Buenavista del Norte, 5 km WSW of Buenavista del Norte, 3 km NW of Teno Alto, Punta de Teno, Lomo las Toldas, 190 m, branches of *Plocama pendula*, 27.XII.2012, L. & C. Quijada (TFC Mic. 23832, 23833, non vid.). – ibid., branch of *Lycium intricatum* (TFC Mic. 23839, non vid.). – ibid., branch of *Periploca laevigata* (TFC Mic. 23840, 23841, non vid.). – St. Cristóbal de la Laguna, 5.7 km NNE of Tegueste, 1.5 km E of Punta de Hidalgo, Andén de la Cruz, 75 m, on *Plocama pendula*, 27.X.2012, L. Quijada, I. Pérez-Vargas & R. Hernández (TFC Mic. 22704, non vid.). – ibid., on *Asparagus*, 11.X.2009, L. Quijada & E.V. Rodríguez (TFC Mic. 22365, non vid.). – ibid., on *Aeonium lindleyi* (TFC Mic. 22366, non vid.). – Tacoronte, 2.7 km NNE of El Sauzal, SSW of Mesa del Mar, Hoya las Higueras, 90 m, branches of *Euphorbia balsamifera*, on wood, 26.XI.2009, L. Quijada & E.V. Rodríguez (TFC Mic. 22641, non vid.). – Candelaria, 5.5 km NE of Güímar, 1 km S of Candelaria, Barranco Samarines, 40 m, on *Rubia fruticosa*, 12.XI.2009, L. Quijada & E.V. Rodríguez (TFC Mic. 22504–06, non vid.). – Arico, 3 km NNE of Abades, 0.7 km NNE of Porís de Abona, Llanos de Porís, 40 m, branches of *Euphorbia balsamifera*, on wood, 13.XI.2009, L. Quijada & E.V. Rodríguez (TFC Mic. 22541, doc. vid.). – 2.2 km NW of Abades, Montaña Centinela, 160 m, on *Lavandula canariensis*, 23.I.2010, L. Quijada & E.V. Rodríguez (TFC Mic. 22766, non vid.). – Guía de Isora, 5 km NNW of Guía de Isora, 1.7 km NW of Chío, Los Corchos, 640 m, branch of *Juniperus phoenicea* var. *turbinata*, 24.X.2014, L. Quijada, C. Quijada & J. Kout (L.Q. F-9, F-23, doc. vid.). – San Miguel de Abona, 4 km SSW of Las Chafiras, 1.5 km NE of Costa del Silencio, Montaña Amarilla, 35 m, on *Plocama pendula* (TFC Mic. 23678, non vid.). — **SPAIN**: **Com**. **Valenciana**, **Valencia**, 14 km SSE of Valencia, 3.5 km S of El Saler, SSE of Les Gavines, Gola de Puçol, 6 m, branches of *Pinus pinea*, on wood, 30.IV.2012, R. Tena (R.T.L. 12043003, doc. vid.). – ibid., 29.IX.2012, R. Tena (R.T.L. 12092902, anam. substr., doc. vid.).

Not included. **USA**: **Texas**, Oaks and Prairies, Edwards Plateau, 65 km W of Austin, ~2 km WSW of Johnson City, 380 m, branch of *Vitis*, on wood, 18.VI.1996, G. Marson (H.B. 5554a).

Orbilia calyptrata Baral & G. Marson, **sp. nov**., MB 813711 — Pls 706–707, Map 118

Etymology: named according to the paraphyses being tipped by cap-like glassy exudate.

Typification: USA, Utah, Moab, branches of *Purshia stansburyana*, 10.VI.2003, G. Marson (ex H.B. 8079c, M-0276447, holotype; sq.: KT222420).

Latin diagnosis: *Apothecia rehydratata 0.2–1 mm diam., aurantiaca, margine pruinoso vel breviter fimbriato. Asci 16-spori. Ascosporae *4.7–11 × 1.7–2.5 µm, ellipsoideo- vel fusoideo-clavatae, apice obtusae. Paraphyses ad apicem spathulatae vel sublageniformes, exsudato calyptriforme tectae. Habitat ad lignum putridum siccum arborum, fruticum vel plantae succulentae in zona subtropica semiarida vel temperata subhumida Americae septentrionalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.2–)0.3–0.7(–1) mm diam., 0.12–0.21 mm high, light to bright (rose-)orange(-ochraceous), round, broadly elliptical when growing in a cleft, scattered or gregarious in small groups; disc slightly to strongly concave, sometimes flat, margin thin or thick, ± whitish pruinose-pubescent, protruding 10–70 µm (incl. hairs), sometimes torn into broad lobes; broadly sessile, erumpent (slightly to completely immersed, especially in biofilm); dry urceolate with small opening. **Asci** *(48–)55–71(–78) × (4.8–)5.2–6.4(–6.8) µm {6}, †(46–)50–65(–70) × 4–5.7 µm {7}, 16-spored, spores 2–3-seriate, (4–)8(–10) lower spores inverted (sometimes mixed), pars sporifera *(23–)30–36(–45) µm long; **apex** (†) medium to strongly truncate (without or distinctly indented, laterally never or partly inflated); **base** with short to medium long, ± thick, flexuous stalk, L-, T- or h-shaped. **Ascospores** *(4.7–)5.5–9(–11) × 1.7–2.3(–2.5) µm {12}, †4.7–8(–9) × 1.5–2(–2.2) µm {5}, ellipsoid- to fusoid-clavate, apex (rounded to) obtuse (rarely subacute), base mostly slightly to strongly attenuated, straight or often slightly to medium curved near base; **SBs** *(2.5–)3.5–5(–5.8) × 0.2–0.7 µm in situ {3} [(2.5–)4–6.5 µm actual length], filiform to vermiform, often subulate, sometimes inflated at base, straight or often flexuous, rarely uncinate; overmature divided into a tear-shaped basal part and a fine filum of ± equal length. **Paraphyses** apically spathulate to sublageniform, terminal cells */†(8.5–)11–23(–27?) × (2.5–)3–4.3(–5) µm {5}, exceeding the dead asci by 3–8 µm, lower cells *9–14(–16) × 1.4–2.4(–2.8) µm {2}; unbranched at upper septum. **Medullary excipulum** subhyaline, pale orange near margin, 20–70(–100) µm thick, of ± dense textura intricata with some or many inflated cells, sharply delimited. **Ectal excipulum** subhyaline to pale rose-orange, of thin-walled to distinctly gelatinized, vertically oriented t. angularis(-prismatica) from base to mid flanks, 20–90 µm thick near base, cells */†(8–)12–24(–30) × (5–)8–14(–17) µm {6}; 15–40 µm thick at mid flanks and margin, of t. angularis-prismatica oriented at a 20–40(–70)° angle to the surface, cells *6–9 × 5–7 µm, uppermost margin of t. prismatica(-porrecta) oriented at 0–10°, marginal cortical cells */†7–18 × 2.5–5 µm {4}, firm-walled, partly forming somewhat flexuous, ± free hairs up to 20–30(–40) µm long and 2–3-celled, walls 0.2–0.4(–1) µm thick. **Anchoring hyphae** abundant, */†2–3.3 µm wide, walls 0.2–0.3(–0.8) µm thick {4}, covering the excipulum up to mid flanks. **SCBs** in paraphyses globose (sparse), mainly crystalloid {8}, 2.5–7 × 0.1–0.7 µm; in excipulum from lower flanks up to margin rod-shaped to trapezoid or ring-shaped, refractive, hyaline to pale orange, 2–6(–8) × 1–4.5 µm. **Exudate** on apices of paraphyses cap-like, 0.5–1.5(–3) µm thick, glassy, firmly attached, rarely only 0.3 µm thick and granular; over margin and flanks absent or sparse, granular. — **ANAMORPH**: trinacrium-like (presumed, from natural substrate {1}). **Conidiophores** not observed. A single **conidium** seen, Y-shaped, †27 × 18 µm, stipe †17 × 5.8 µm, 3-septate, arms †8 × 5 µm, 2-septate.

Habitat: collected 0.2–2.5 m above the ground, decorticated, 4–20 mm thick twigs and branches of *Canotia holacantha* {2}, *Ephedra ?viridis* {1}, *Juniperus osteosperma* {2}, *Krascheninnikovia lanata* {1}, *Larrea tridentata* {3}, *Opuntia* sp. {1}, *Parkinsonia* (?)*microphylla* {1}, *Purshia stansburyana* {2}, on 0.2–1 mm deep strongly decayed, eroded wood {9}, often in longitudinal clefts, also on splitted wood, strongly greyed, green algae absent or few to many. **Associated**: *?Baggea* sp. {1}, *Candelariella* sp. {1}, *Hysterobrevium mori* {3}, *Hysteropatella* sp. {1}, *?Lecidea* sp. {1}, *Melaspilea emergens* {3},

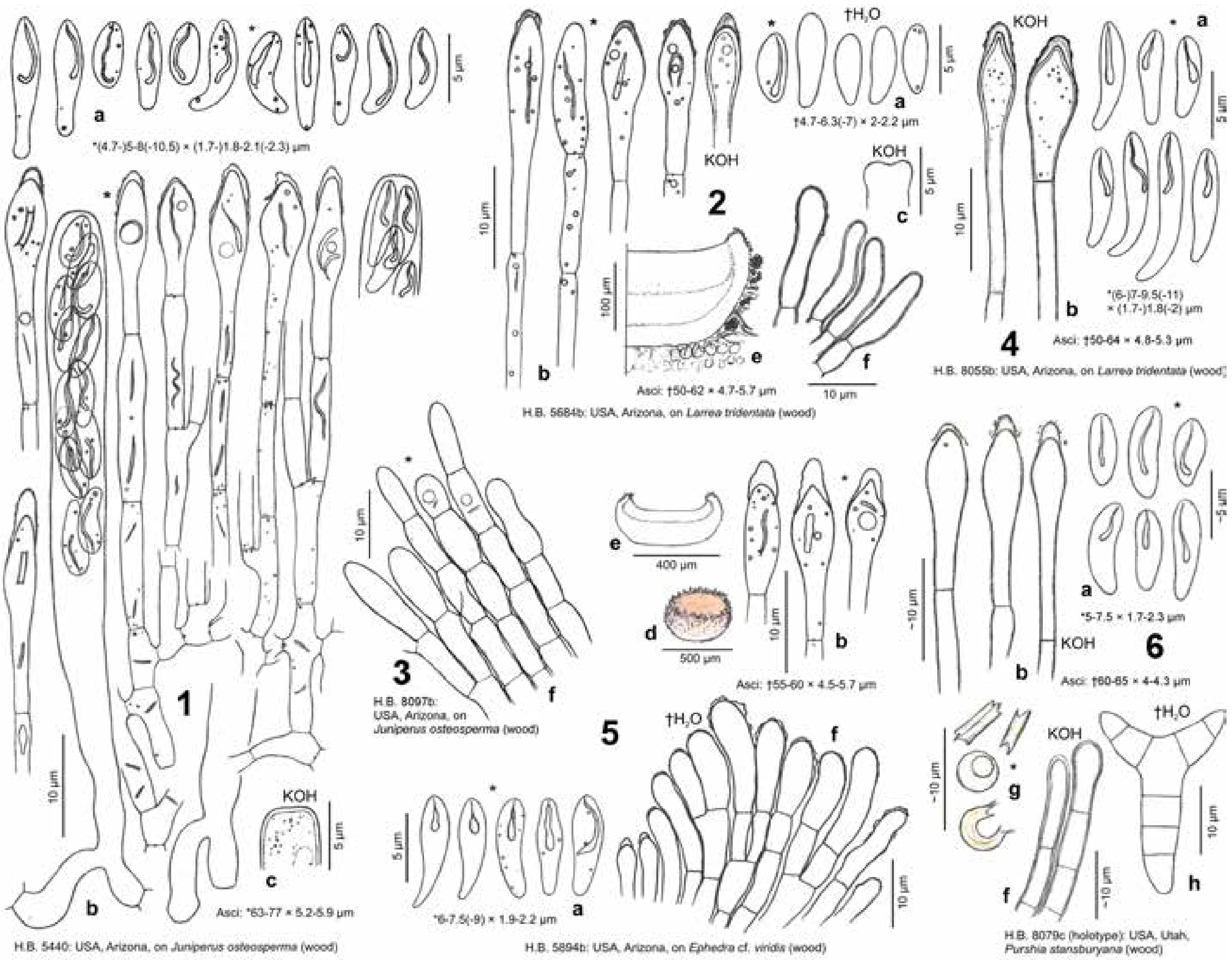


Plate 706. **1–5**: *Orbilia calyptrata*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. rehydrated apothecium with pubescent margin; **e**. apothecia in median section; **f**. id., marginal ectal excipulum with hair-like cortical cells; **g**. crystalloid SCBs in marginal ectal excipulum; **h**. conidium (from natural substrate).

?*Menispora* sp. {1}, *Odontotrema* sp. {1}, *Odontura rhaphidospora* {1}, *Orbilia arizonensis* {2}, *O. bicknellensis* {3}, *O. ?cactacearum* {1}, *O. cryptogena* {2}, *O. flexisoma* {1}, *O. lacrimispora* {3}, *O. lentiformis* {2/1}, *O. macrodelphinus* {3}, *O. macrohesperidea* {1}, *O. maeandrina* {2}, *O. multicercocarpi* {1}, *O. multigambelii* {3}, *O. multimaeandrina* {1}, *O. multiserpens* {1}, *O. navajoana* {1/1}, *O. ophiosoma* {1}, *O. paloverdensis* {1}, *O. ?pleionavajoana* {1}, *O. pleioserpens* {1}, *O. purshiae* {1}, *O. sedonensis* {1}, *O. sonorensis* {2}, *O. ?ungulata* {1}, *O. ?vitalbae* {1}, *Patellaria* '*andina*' {2}, *P. atrata* {2}, *Psiloglonium lineare* {1}, *Schizoxylon* sp. {1/1}, *Sclerococcum* sp. {1}, *Symbiotaphrina larreae* {2}. **Desiccation tolerance**: fully tolerant for 20 months; paraphyses, excipular cells and ascospores survive for up to 35 months. **Altitude**: 615–2075 m a.s.l. **Geology**: Pennsylvanian-Permian and Jurassic-Cretaceous-Tertiary sand-, lime- and mudstone; granite & diorite. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia calyptrata* somewhat resembles *O. flavidorosella* (series *Habrostictis*) in the ascospores and tapered paraphysis apices, but differs in 16-spored asci and obtuse spore apices. The predominant presence of cap-like (glassy) exudate on the paraphyses, which looks like a thickened apical cell wall, is rather untypical for section *Habrostictis*, being otherwise only observed in the similar *O. spathulata* (series *Serpentinae*). *O. delphinus* differs in larger spores with acute apices, paraphyses apically mainly globose and without glassy caps, and in lacking crystalloid SCBs. A European mediterranean collection on *Cupressus* mentioned under *O. subdelphinus* (Pl. 638: 3) seems to be somewhat intermediate due to slightly spathulate paraphyses. For the similar *O. pleioungulata* see p. 1184.

Variation. Rather high variation was noted in spore shape and size. In a part of the collections the spores are predominantly ellipsoid-clavate and rather short and broad, whereas in others they are more fusoid-clavate and tend to be longer and narrower. However, this variation was repeatedly also observed within a population (e.g., Pl. 706: 1a). Paraphysis shape varies from spathulate to less often sublageniform. Also the cap-like exudate strongly varies in thickness, being partly ± absent (2b).

Phylogeny. A sequence of *O. calyptrata* was gained from apothecia of the holotype (from Utah, on *Purshia*) which comprises SSU (with S1506 intron), ITS, and LSU. In spite of its spathulate paraphyses which resemble those of series *Habrostictis*, the species clustered with high or medium (ITS) support in the *Ellipsospermae* clade (Phyls 19–20, S22), with a minimum distance of 6.5% in the ITS (0.5–0.9% in LSU) to *O. cercocarpi*, *O. cisti*, and *O. microserpens*. In the SSU *O. calyptrata* concurs with 4 other species of the *microserpens-ungulata* clade but sharply deviates from members of the *gambelii-vitalbae* clade (S20).

Ecology. *O. calyptrata* was found on very rotten wood of xeric twigs and branches of various gymno- and angiosperm shrubs (and trees), but also on old branches of *Opuntia*, in warm-temperate to subtropical semiarid paloverde-mixed cacti desert

Plate 707. **1–2**: *Orbilia calyptrata*. – **1a–e**, **2a**. rehydrated apothecia; **1f–g**, **2b**. apothecia in median section; **1h**. id., marginal ectal excipulum; **2c**. id., basal excipular cells with anchoring hyphae; **1i–l**. crystalloid SCBs in ectal excipular cells at lower flanks. – Living state. — **1a–l**. H.B. 8079c (holotype): USA, Utah, on *Purshia*; **2a–c**. H.B. 8055b: USA, Arizona, on *Larrea*.

scrubs in the Sonoran Desert, and in warm-continental semiarid to cold-temperate subhumid pinyon-juniper woodlands of the Colorado Plateau in the southwest of Northern America.

Map 118. Known distribution of *O. calyptrata* in North America.

Specimens included. **USA**: **Utah**, Canyonlands, 20 km SW of Moab, Dead Horse Point, 1810 m, branches of *Purshia stansburyana*, on wood, 10.VI.2003, G. Marson (ex H.B. 8079c, M-0276447, **holotype**, anam. substr.; sq.: KT222420). – Utah Mts., 13 km ESE of Escalante, 16 km SSW of Boulder, Big Flat, Borrow Pit, 1917 m, branch of *P. stansburyana*, on wood, 11.VI.2003, G. Marson (H.B. 8059c ø). – **Arizona**, Grand Canyon, Coconino Plateau, 3.5 km N of Tusayan, 2075 m, branch of *Juniperus osteosperma*, on wood, 17.VI.2003, G. Marson (H.B. 8097b). – 3 km S of Tusayan, 2033 m, branch of *J. osteosperma*, on wood, 28.VIII.1994, G. Marson (H.B. 5440). – Sonoran Desert, 65 km SSE of Flagstaff, 9 km NNE of Camp Verde, 4 km NE of Montezuma Castle, 1073 m, branches of *Canotia holacantha*, on wood, 12.VI.2000, G. Marson (H.B. 7218b). – ibid., 5.5 km NNE of Camp Verde, Montezuma Castle, 975 m, branch of *C. holacantha*, 8.V.1995, G. Marson (ø). – ibid., branches of *Larrea tridentata*, on wood, 8.V.1995, G. Marson (H.B. 5684b). – ibid., branch of *Krascheninnikovia lanata*, 8.V.1995, G. Marson (H.B. 6085f ø). – 82 km NW of Phoenix, ~1.5 km SE of Wickenburg, 615 m, branches of *Ephedra ?viridis*, on wood, 4.V.1995, G. Marson (H.B. 5894b). – 40 km NNE of Tucson, 11 km NE of Catalina, Biosphere, 1165 m, branch of *Opuntia*, 7.V.1995, G. Marson (ø). – 17.5 km NNE of Lukeville, Organ Pipe, Ajo Mountain Trail, 710 m, branch of *L. tridentata*, 5.V.1995, G. Marson (H.B. 5687j ø). – 23 km WNW of Tucson, 6 km SE of Picture Rocks, Saguaro, 882 m, branches of *L. tridentata*, on wood, 30.V.2003, G. Marson (H.B. 8055b). – 19 km W of Tucson, 0.2 km W of Old Tucson Studios, 810 m, branch of *Parkinsonia* (?)*microphylla*, on wood, 6.V.1995, G. Marson (H.B. 5671c ø).

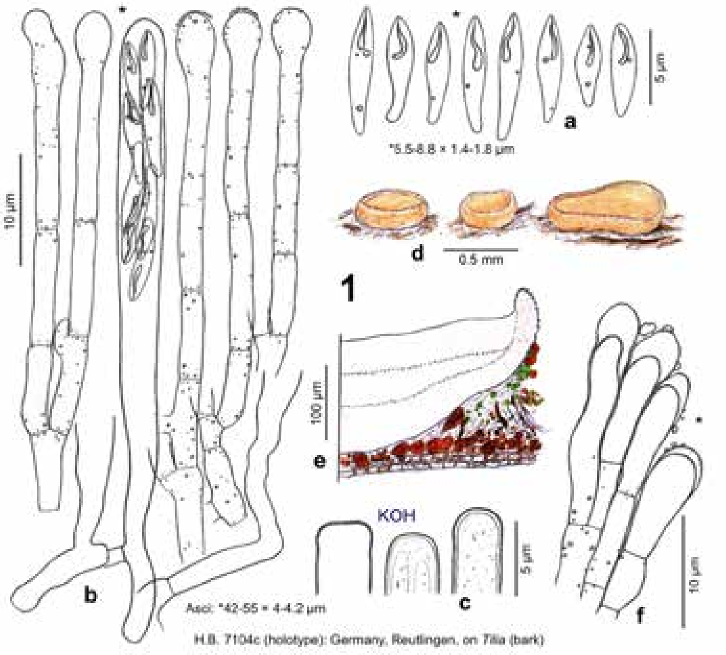


Plate 708. **1**: *Orbilia jurana*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apices; **d**. rehydrated apothecia; **e**. apothecium in median section; **f**. id., marginal ectal excipulum (cortical cells with glassy caps).

Orbilia jurana Baral, **sp. nov.**, MB 813712 — Pls 708–709

Etymology: named after the geology of the collection site in the Swabian Jura.
Typification: Germany, Eningen, branch of *Tilia*, 3.III.2002, H.O. Baral (ex H.B. 7104c, M-0276496, holotype).

Latin diagnosis: Similis Orbiliae ungulatae *sed cellulae vivae excipuli absque corpusculis crystalloideis*, *ascosporae apice magis acutae*, *apothecia majora*, *margine eminenti*, *subtiliter crenulato*, *cellulis plerumque processis vitreis brevibus praeditis. Habitat ad corticem putridum rami sicci* Tiliae *in zona temperata humida subcontinentali montana Europae centralis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.25–0.5(–0.8) mm diam., 0.14–0.15 mm high, light to bright orange(-rose), round, elliptical when large, subgregarious; disc slightly to medium concave, margin very distinct, 15–30 µm protruding, very finely crenulate; sessile on a broad stipe-like base, nearly superficial but ± immersed in crevices of bast; dry bright orange-apricot. **Asci** *42–55 × 4–4.2 µm, †35–44 × 3.3–3.6 µm, 8-spored, spores (*) biseriate, 4 lower spores inverted (sometimes strongly mixed, rarely upper spores inverted), pars sporifera *21–25 µm long; **apex** (†) slightly to medium, rarely strongly truncate (not indented, laterally rarely slightly inflated); **base** with short to medium long, thin, flexuous stalk, T- to L-shaped. **Ascospores** *5.5–8.8 × 1.4–1.8 µm, fusiform(-clavate), apex subacute to acute, base medium to strongly attenuated, sometimes tail-like, straight, sometimes slightly curved near base; **SBs** *2.5–3.5 × 0.3–0.5 µm in situ, mostly subulate, base sometimes slightly inflated, slightly to medium flexuous. **Paraphyses** apically slightly to medium capitate(-clavate), terminal cells *(14–)16–26(–32) × (2–)2.8–3.7 µm, lower cells *7–12 × 1.8–2.3 µm; unbranched at upper septum, hymenium subhyaline. **Medullary excipulum** subhyaline, 40 µm thick, of dense textura globulosa-angularis with a few hyphae, medium sharply delimited. **Ectal excipulum** very pale orange, of thin-walled, vertically oriented t. angularis(-prismatica) from base to mid flanks, 50–70 µm thick near base, cells *11–19 × 8–14 µm; 30–40 µm thick at flanks, 30 µm at margin, oriented at a 30–45° angle to the surface, marginal cortical cells *10–17 × 2.5–4 µm; mostly with **glassy caps** 2–5 × 3–4 µm, high-refractive, not stratified. **Anchoring hyphae** abundant, *2–4 µm wide, walls 0.2 µm thick. **SCBs** in paraphyses and ectal excipulum absent, with or without minute, scattered, very pale orange **LBs** (carotenoids). **Exudate** over paraphyses 0.2–0.3 µm thick, finely granular, firmly attached to each tip, partly absent; very sparse over margin and flanks. **— ANAMORPH**: unknown.

Habitat: collected 3 m above the ground, corticated, 30 mm thick, dead branch of *Tilia cordata*, on medium decayed bark (bast), with some algae and a few brown hyphae. **Associated**: *Cistella ?mali*, *Parmelia sulcata* (on periderm), *Patellaria atrata*. **Desiccation tolerance**: fully viable for at least 17 days. **Altitude**: 745 m a.s.l. **Geology**: Upper Jurassic limestone. **Phenology**: III (but rather long-lived).

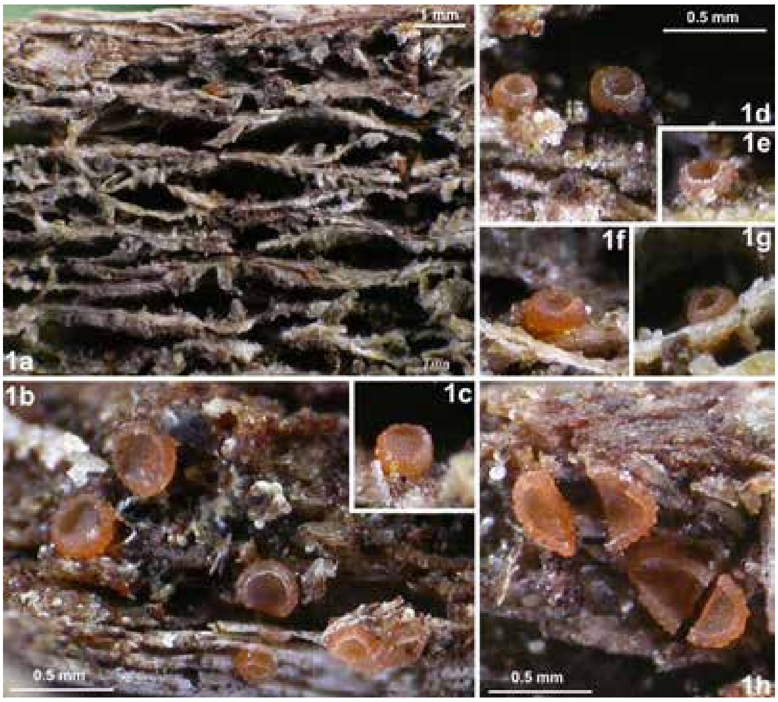


Plate 709. **1**: *Orbilia jurana* (holotype). – **1a**: exterior of bast of xeric branch (rehydrated); **1b–h**. rehydrated apothecia. — **1a–h**. H.B. 7104c: Germany, Reutlingen, on *Tilia*.

Taxonomic remarks. *Orbilia jurana* resembles *O. ungulata* in ascospore size and shape but differs in lacking any kind of SCBs, in more acute spore apices, in larger apothecia with protruding, finely crenulate margin, and in short glassy caps on the marginal cells. *O. vitalbae* differs in broader spore bodies and in often broader spores with obtuse apices. *O. obtusispora* and *O. subtrapeziformis* (series *Serpentinae*) have distinctly larger spores.

Ecology. *O. jurana* grew on medium decayed bark of a xeric branch of one of several free-standing, old, planted *Tilia cordata* trees (small-leaved lime) on a grassland close to a *Fagetum* on the very calcareous Upper Jurassic (malm α–β) at the edge of the high plateau of the Schwäbische Alb in cold-temperate humid montane central Europe.

Specimens included. **GERMANY**: **Baden-Württemberg**, Schwäbische Alb, 7 km ESE of Reutlingen, 3 km E of Eningen, Renkenberg, 745 m, branch of *Tilia cordata*, on bark, 3.III.2002, H.O. Baral (ex H.B. 7104c, M-0276496, **holotype**).

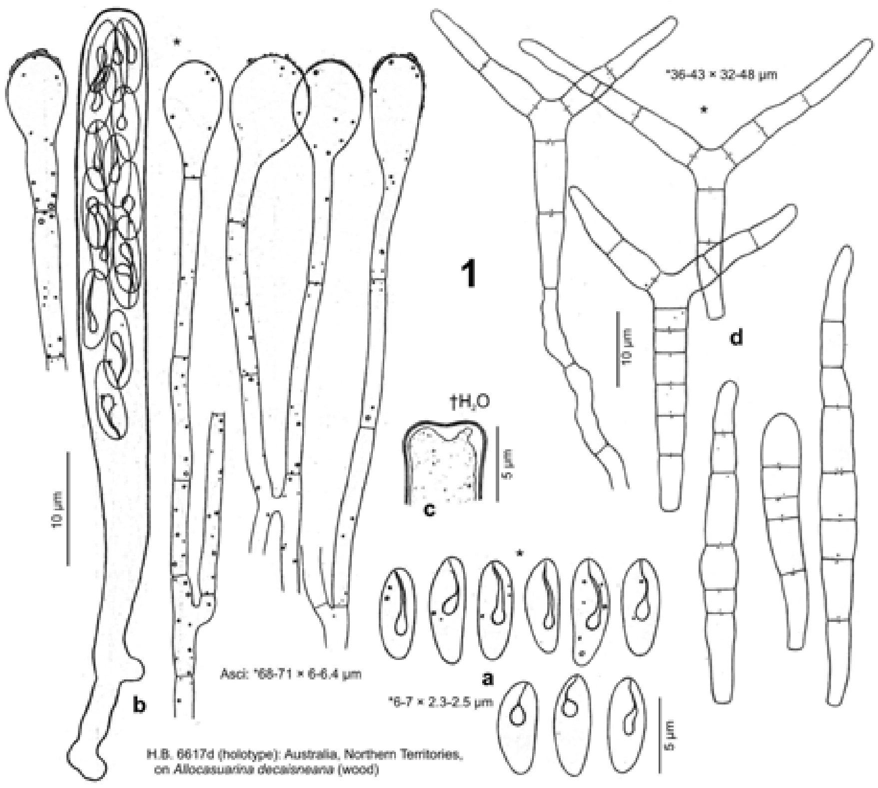


Plate 710. **1**: *Orbilia pleiovitalbae*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apex; **d**. conidiophore and conidia from culture.

Orbilia pleiovitalbae Baral, **sp. nov.**, MB 813713 — Pl. 710

Etymology: named after the 16-spored asci and the resemblance to *O. vitalbae*.

Typification: Australia, Northern Territories, Yulara, branch of *Allocasuarina decaisneana*, 12.X.1998, G. Marson (ex H.B. 6617d, MEL 2389213, holotype).

Latin diagnosis: *Similis* Orbiliae vitalbae *sed asci 16-spori, apices paraphysium latiores. Habitat ad lignum vel corticem putridum rami sicci* Allocasuarinae decaisneanae *in zona subtropica arida Australiae centralis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.2–0.4 mm diam., 0.13 mm high, light dirty orange, round, scattered to subgregarious; disc flat, margin thin, 10 µm protruding, smooth; broadly sessile, slightly erumpent. **Asci** *68–71 × 6–6.4 µm, †50 × 5–5.8 µm, 16-spored, spores *2–3-seriate, ~8 lower spores inverted (strongly mixed), pars sporifera *34–39 µm long; **apex** (†) medium to strongly truncate (partly distinctly indented, not so in KOH, laterally sometimes inflated); **base** with medium long and thick, somewhat flexuous stalk, L-shaped. **Ascospores** *6–7 × 2.3–2.5 µm, narrowly ellipsoid to fusoid-clavate, apex rounded to obtuse, base not or slightly attenuated, straight to slightly inequilateral; **SBs** *4–4.7 × 0.7–0.9(–1.1) µm in situ, divided into a ± abruptly swollen, tear-shaped lower part, and a subulate or filiform upper part, slightly to medium flexuous. **Paraphyses** apically medium to very strongly (clavate-)capitate, terminal cells *10–20 × (4–)5–6(–7) µm, lower cells *11–19 × 1.3–2.4 µm (basal cells 7–9 µm long); unbranched near apex. **Medullary excipulum** 30 µm thick, of dense textura intricata with inflated cells, rather sharply delimited. **Ectal excipulum** of (†) ± thin-walled, indistinctly vertically oriented t. angularis from base to mid flanks, 30 µm thick near base, cells †8–15 × 5–10 µm; 20 µm thick near margin, of t. prismatica oriented at a 10° angle to the surface, marginal cortical cells 8–11 × 3.5–6 µm. **Anchoring hyphae** rather sparse, †2–3.5 µm wide, walls 0.2(–0.4) µm thick. **SCBs** in paraphyses ?and ectal excipulum absent. **Exudate** over paraphyses 0.2–0.3 µm thick, granular, firmly attached, over margin and flanks 0.2 µm thick, granular, scattered. — **ANAMORPH**: trinacrium-like (from ascospore isolate). **Conidiophores** *~30 × 3 µm. **Conidia** Y-shaped, total size *36–43 × 32–48 µm, stipe *19–28 × 3.9–4.5 µm, 2(–3–6)-septate, arms slightly tapering, *17–21(–28) × 3.8–4.3 µm, 2–3-septate; phragmoconidia quite equally frequent, fusoid, rarely clavate, *31–61 × 4.5–5 µm 4–7-septate.

Habitat: collected 3–4 m above the ground, rather decorticated, 15 mm thick branch of *Allocasuarina decaisneana*, on 0.1 mm deep strongly decayed wood (and bast), strongly greyed, no algae. **Associated**: *Orbilia macrotrapeziformis*, *O. multivinosa*, *O. phanosoma*, *O. pleiolentiformis*, *O. pleioobtusispora*, *O. pluristomachia*, *O. serpentina*, *Teichosporella dura*, *Symbiotaphrina desertorum*. **Desiccation tolerance**: fully viable for at least 30 months. **Altitude**: 500 m a.s.l. **Geology**: Cenozoic regolith (red-brown sand). **Phenology**: long-lived.

Taxonomic remarks. *Orbilia pleiovitalbae* appears to be very closely related to European *O. vitalbae*, from which it mainly differs in 16-spored asci, also in wider paraphysis apices. The ascospores fit rather well those of *O. vitalbae*, especially in the basally ± abruptly inflated spore bodies, also regarding spore size which matches short-spored populations of *O. vitalbae*. The North American *O. macroserpens* differs

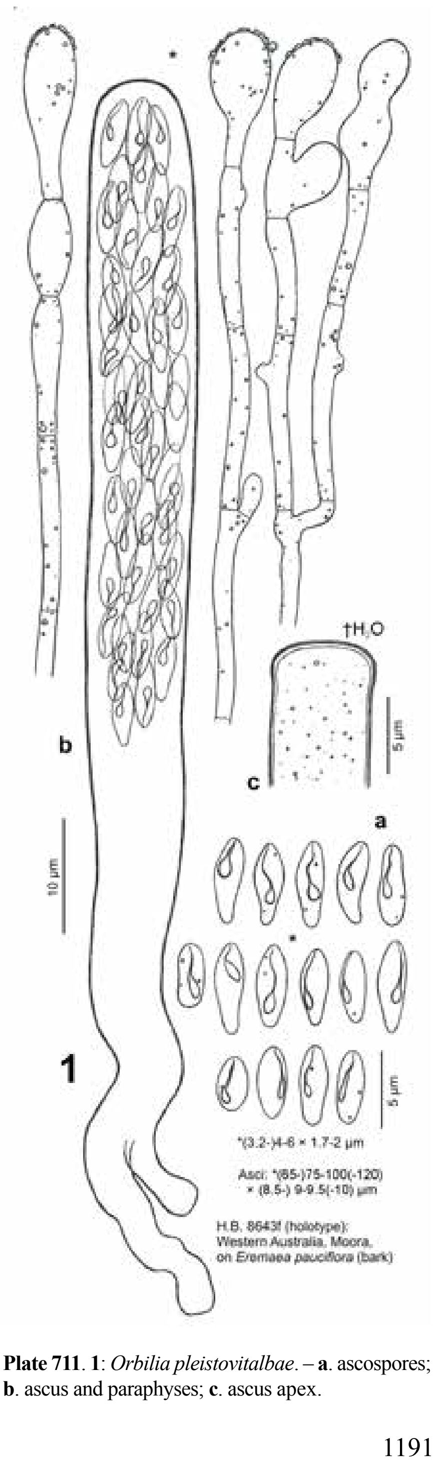


Plate 711. **1**: *Orbilia pleistovitalbae*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apex.

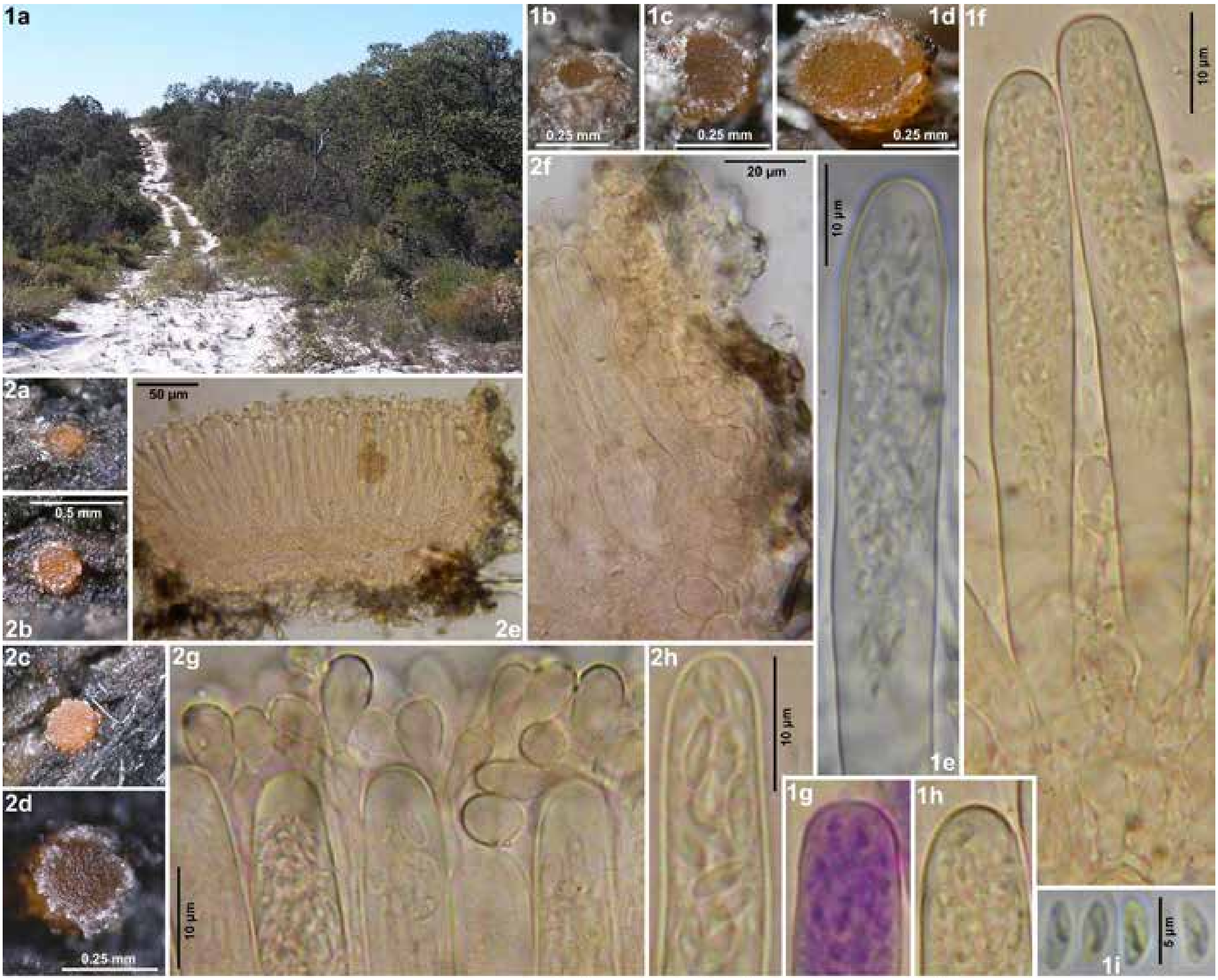


Plate 712. **1–2**: *Orbilia pleistovitalbae*. – **1a**. semihumid banksia-eucalypt-acacia open wood- and shrubland; **1b–d**, **2a–d**. rehydrated apothecia; **2e**. apothecium in median section; **2f**. id., marginal ectal excipulum; **1e–f**. mature asci; **1g–h**, **2g–h**, apices of asci and paraphyses; **1i**. ascospores. – Living state, except for asci in **1g**, **2g–h** (**1g** in CRB). — **1a–i**. H.B. 8643f (holotype): Western Australia, Moora, on *Eremaea*; **2a–h**. H.B. 8775h: ibid.

in distinctly larger spores and less inflated SBs. Australian collections of *O. microserpens* have a very similar spore size and shape, but differ in much longer, more flexuous, sometimes uncinate SBs with much less swollen bases. *O. pleioserpens* differs in wider spores with subulate to vermiform SBs and in less inflated paraphysis apices. The North American *O. cercocarpi* and an Australian collection of *O. pleioungulata* differ in the presence of crystalloid SCBs, the former also in basally uninflated SBs. Further collections of *O. pleiovitalbae* are required to find out whether the taxon is distinct from *O. microserpens*.

Anamorph. The branched, trinacrium-like, Y-shaped conidia resemble those of European *O. vitalbae* but also those of *O. microserpens*. The frequent occurrence of unbranched conidia in our culture seems remarkable, though very similar conidia occurred also in our culture of *O. vitalbae*. Similar multiseptate conidial stipes were seen in *O. microserpens* but not in *O. vitalbae*.

Ecology. The sparse apothecia in the only known collection of *O. pleiovitalbae* grew on rotten wood (rarely bark) of a xeric branch of *Allocasuarina decaisneana* in a subtropical arid acacia open shrubland northeast of Ayers Rock at the southeastern end of the Great Sandy Desert of central Australia.

Specimens included. **AUSTRALIA**: **Northern Territories**, Great Sandy Desert, 11.5 km ENE of Yulara, 14 km NNE of Ayers Rock, 500 m, branch of *Allocasuarina decaisneana*, on wood, 12.X.1998, G. Marson (ex H.B. 6617d, MEL 2389213, **holotype**, anam. cult.).

Orbilia pleistovitalbae Baral & G. Marson, **sp. nov.**, MB 813714 — Pls 711–712

Etymology: named after the 128-spored asci and the ascospores resembling those in *O. vitalbae*.

Typification: Western Australia, Cowalla, branches of *Eremaea pauciflora*, 5.IX.2006, G. Marson (ex H.B. 8643f, MEL 2389246, holotype).

Latin diagnosis: *Apothecia rehydratata 0.18–35 mm diam., aurantiaca, margine laevi vel albido-crenulato. Asci 128-spori. Ascosporae *4.5–6 × 1.7–2 µm, fusoideae, in statu vivo corpusculum lacrimiforme, ad apicem filo longo flexuoso affixum continentes. Paraphyses ad apicem modice vel valde capitato-clavatae. Cellulae vivae excipuli et paraphysium absque corpusculis crystalloideis et globosis. Habitat ad corticem putridum ramorum siccorum* Eremaeae pauciflorae *in zona subtropica semihumida Australiae meridio-occidentalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.18–)0.25–0.35 mm diam., (0.12–)0.15–0.19 mm high, light (brick-)orange, non-translucent, round, scattered; disc flat, margin distinct, (0–)20–30 µm protruding, almost smooth or mostly distinctly whitish-crenulate; broadly sessile, ± half immersed (erumpent) to almost superficial. **Asci** *(65–)70–90(–120) × 8.5–10 µm {2}, †65–73 × (6.3–)7–7.5(–8) or 75–92 × 8–9 µm {1}, 128-spored (evaluated from volume, ~80–100

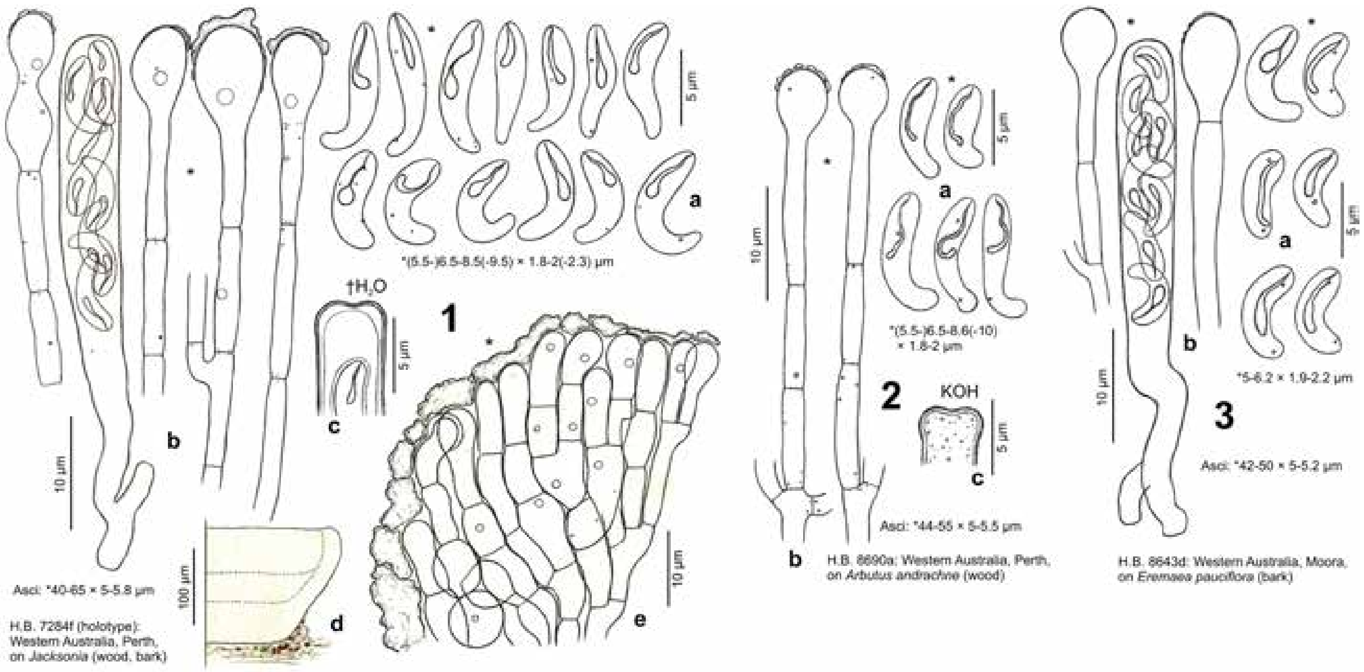


Plate 713. **1–3**: *Orbilia curvativitalbae*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apices; **d**. apothecium in median section; **e**. id., marginal ectal excipulum.

spores counted), spores multiseriate, lower spores inverted (strongly mixed), pars sporifera *40–50 {1} or 50–66(–70) {2} µm long; **apex** (†) medium to strongly truncate (not indented, laterally sometimes slightly inflated); **base** unstalked or with short to medium long, thick, flexuous stalk, L-, Y- or h-shaped. **Ascospores** *4.5–5.5(–6) × 1.7–2 µm {2}, †4–5.3 × 1.5–1.9(–2) µm {2}, (ellipsoid-)fusoid to fusoid(-clavate), apex obtuse, base slightly to medium attenuated, straight to slightly inequilateral; **SBs** *2.5–4.2 × 0.3–0.8 µm in situ {1} (~3–5 µm actual length), with a rod- to tear-shaped or subglobose lower part and a narrow filiform part of varying length, ± flexuous, never uncinate. **Paraphyses** apically medium to strongly clavate-capitate, sometimes mammiform, terminal cells *(5.5–)8–17(–19) × (3–)4–5(–5.5) µm {2}, lower cells *(7–)10–18 × 1.5–2 µm {1} (near apex 3–4 µm wide); sometimes branched at upper septum. **Medullary excipulum** 30–50 µm thick, of ± dense textura intricata with many inflated cells, sharply delimited. **Ectal excipulum** very pale orange-rose, of (†) thin-walled to slightly gelatinized, irregularly vertically or horizontally oriented t. angularis(-prismatica) from base to mid flanks, 30–50 µm thick near base, cells *8–16 × 6–11 µm {1}; 20–25 µm thick near margin, of t. prismatica-angularis oriented at a 0–10° angle to the surface, marginal cortical cells *7–10 × 3–5 µm {1}. **Anchoring hyphae** sparse, †2–3 µm wide, walls 0.2–0.3(–0.8) µm thick {1}, loosely covering the flanks, at margin forming a ~20–30 µm thick hyaline layer of ± thick-walled hyphae oriented at 10–70° and protruding as agglutinated small teeth. **SCBs** in paraphyses and ectal excipulum absent. **Exudate** over paraphyses absent or 0.2–0.3(–0.5) µm thick, firmly attached, over margin 0.2–1.5 µm thick, continuous, hyaline. — **ANAMORPH**: unknown.

Habitat: collected 0–0.5 m above the ground, corticated, 4.5–12 mm thick branches of *Eremaea pauciflora* {2}, on strongly decayed bark {2} (bast), strongly greyed, green algae sparse. **Associated**: *Capronia* sp. {1}, *Corticiaceae* {1}, *Durella* aff. *connivens* {1}, ?*Eutypa* sp. {1}, *Gloniopsis praelonga* {2}, *Hyalorbilia juliae* {1}, *Orbilia amberina* {1}, *O. austrocylindrica* {2}, *O. curvativitalbae* {1}, *O. eremaeae* {1}, *O. eucalypti* {1}, *O. microserpens* {1}, O. *multicurvula* {2}, *O. plurililacina* {1}, *Proliferodiscus olivaceoviridis* {2}, *Rhizodiscina lignyota* {1}. **Desiccation tolerance**: fully viable for at least 13 months. **Altitude**: 77 m a.s.l. **Geology**: Cretaceous sedimentary rock (white sandy soil). **Phenology**: long-lived.

Taxonomic remarks. *Orbilia pleistovitalbae* resembles *O. vitalbae* and *O. pleiovitalbae* in the shape of ascospores and spore bodies, but differs in much larger asci with a much higher spore number, also in smaller spores. *O. myriella* differs in 64-spored asci, more cylindrical spores with shorter and especially narrower, subulate SBs, and in having large globose SCBs. For the similar *O. pleistolilacina* (subgenus *Orbilia*) see p. 1271.

Variation. Ascus and pars sporifera length in the holotype varied remarkably between apothecia from different branches. Those illustrated in Pl. 711 and Pl. 712: 1e are at the upper end of the range (*80–120 µm, 50–70 µm, respectively). Thereby, spore size and number did not differ in apothecia with shorter asci (*65–83 µm, 40–48 µm, Pl. 712: 1f). The paratype was somewhat between these data (*65–90 µm, 55–66 µm).

Ecology. *O. pleistovitalbae* was found on decayed bark of xeric branches of *Eremaea pauciflora* in a subtropical semihumid banksia-eucalypt-acacia open wood- and shrubland in southwestern Australia.

Specimens included. **AUSTRALIA**: **Western Australia**, Swan Coastal Plain, 59 km SW of Moora, 8 km NE of Cowalla, Moore River, Orange Springs Rd, 77 m, branches of *Eremaea pauciflora*, on bark, 5.IX.2006, G. Marson (ex H.B. 8643f, MEL 2389246, **holotype**). – ibid., branch of *E. pauciflora*, on bark, 23.X.2007, G. Marson (H.B. 8775h).

Orbilia curvativitalbae Baral & G. Marson, **sp. nov.**,
MB 813715 — Pls 713–714

Etymology: named after the often strongly curved ascospores which otherwise resemble those of *O. vitalbae*.

Typification: Western Australia, Walyunga, branches of *Jacksonia*, 23.XI.2001, G. Marson (ex H.B. 7284f, MEL 2389233, holotype).

Latin diagnosis: *Similis* Orbiliae vitalbae *sed ascosporae valde curvatae. Habitat ad corticem vel lignum putridum ramorum siccorum angiospermarum in zona subtropica semihumida Australiae meridio-occidentalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.15–0.35 mm diam., 0.09–0.2 mm high, pale to light (rose-)orange(-cream), medium translucent, round or sometimes elliptical, scattered; disc flat (to slightly convex), margin indistinct or distinct, 0–10 µm protruding, smooth or finely rough; broadly sessile, superficial or erumpent from between fibres, rarely deeply immersed in bast; dry light orange. **Asci** *(40–)44–55(–65) × 5–5.5(–5.8) µm {4}, †36–60 × 4–5 µm {4}, 8-spored, spores *2–3-seriate, 3–5 lower spores inverted {5}

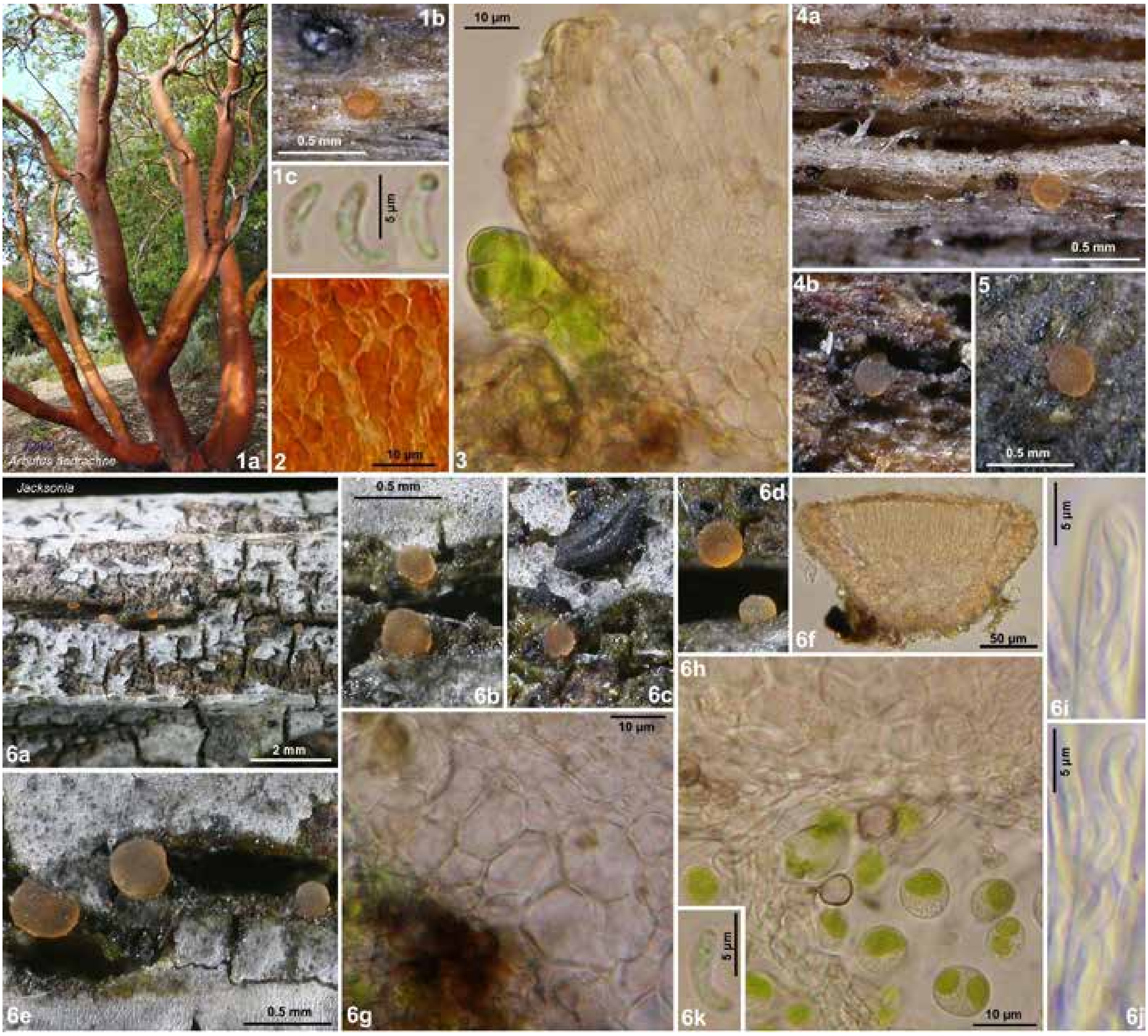


Plate 714. **1–6**: *Orbilia curvativitalbae*. – **1a**. *Arbutus andrachne* tree in a mediterranean park; **1b**, **4a–b**, **5**, **6a–e**. rehydrated apothecia (**6c** with *Gloniopsis praelonga*); **6f**. apothecium in median section; **3**. id., marginal ectal excipulum; **6g**. id., basal ectal excipulum; **6h**. id., anchoring hyphae and algae (?*Gloeocapsa*); **2**. exudate on margin (external view); **6i–j**. asci with spores; **1c**, **6k**. ascospore. – Living state, except for **1c**, **6k** (in KOH), **2** (in KOH+CR), asci in **6i–j**. — **1a–c**. H.B. 8649c: Western Australia, Perth, on *Arbutus*; **2**. H.B. 8643d: Moora, on *Eremaea*; **3**. H.B. 8690a: Perth, on *Arbutus*; **4a–b**. H.B. 7284f (holotype): ibid., on *Jacksonia*; **5**. H.B. 8748f: Moora, on *Verreauxia*; **6a–j**. H.B. 8611c: Perth, on *Jacksonia*.

(sometimes mixed), pars sporifera *(21–)23–26(–29) µm long; **apex** (†) medium to strongly truncate (not or ± distinctly indented, laterally not or sometimes slightly inflated); **base** with short to long, thin or thick, flexuous stalk, L-, T-, Y- or h-shaped. **Ascospores** *(5–)6–8.5(–10) × 1.8–2.1(–2.3) µm {5}, †5.5–7.5(–9) × 1.5–2 µm {2}, subcylindrical to narrowly (fusoid-)clavate, apex rounded to obtuse, base mostly slightly to medium attenuated, (slightly to) predominantly strongly to very strongly curved (cashew-shaped or often only near base); **SBs** *(3–)3.5–5(–5.3) × (0.3–)0.4–0.8(–1) µm in situ {5} (3.5–5.5 µm actual length), subulate to vermiform, often basally inflated, slightly to medium flexuous, in more aged spores with ellipsoid to globose lower part and long filum. **Paraphyses** apically (medium to) strongly to very strongly (clavate-)capitate, rarely sublageniform to moniliform, terminal cells *11–20(–24) × (2.5–)3.5–5.2 µm {3}, †3–4.5 µm wide {1}, lower cells *8–11.5(–12.5) × 1.8–2.5 µm {3}; unbranched at upper septum. **Medullary excipulum** 20–40 µm thick, of dense textura intricata with many inflated cells, sharply delimited from ectal excipulum except at the base. **Ectal excipulum** of thin-walled († slightly gelatinized), ± vertically oriented t. angularis(-globulosa) from base to submargin, 15–90 µm thick near base, cells 6–18(–24) × 6–15(–18) µm {2}, †5–9 × 3–5 µm {1}; 20–25 µm thick at flanks, 10–20 µm near margin, upper margin of t. prismatica-angularis oriented at a 40–70° angle to the surface, or of t. prismatica oriented at 10–20°, marginal cortical cells *6–10(–13) × 3–6 µm {3}. **Anchoring hyphae** sparse to abundant, †2–3(–4) µm wide, walls 0.2–0.4 µm thick {2}. **SCBs** in paraphyses and ectal excipulum (near margin) absent {2} or globose {1}, 0.8–1.5 µm diam. **Exudate** over paraphyses 0.2–1(–2.5) µm thick, firmly attached; over margin and flanks 0.3–2.5 or 2–6 µm thick, rough-cloddy, very pale chlorinaceous. — **ANAMORPH**: unknown.

Habitat: collected 0.2–3 m above the ground, corticated to partially decorticated, 5–10 mm thick twigs and branches of *Arbutus andrachne* {2}, *Eremaea pauciflora* {1}, *Jacksonia* sp. {2}, *Verreauxia reinwardtii* {1}, on 1 mm deep strongly decayed wood {4} and bark {4} (periderm and bast), at edges of clefts in bark or over splits in periderm, partly on inner surface of detached bark, greyed, algae sparse to often abundant (partly ?*Gloeocapsa*). **Associated**: *Caloplaca* sp. {1}, *Capronia* sp. {1}, *Claussenomyces* sp. {2}, *Durella* sp. {1}, *D*. aff. *connivens* {1}, *Gloniopsis* sp. {1}, *G. praelonga* {3}, *Hyalorbilia juliae* {1}, *Nectria* sp. {1}, *Orbilia albidorosea* {1}, *O. amberina* {2}, *O. australiensis* {2}, *O. austrocylindrica* {1}, *O. eucalypti* {3}, *O. kingsiana* {1}, *O. lilacina* {1}, *O. macrotrapeziformis* {1}, *O. microserpens* {2}, *O. multicurvula* {1}, *O. myrioeuonymi* {1}, *O. myriofusiclava* {2}, *O. myriooobliqua* {2}, *O. nothovinosa* {1}, *O. octoserpentina* {2}, *O. pleistovitalbae* {1}, *O. plurililacina* {2}, *O. serpentina* {2}, *O. triangulispora* {1}, *Ostropales* {1}, *Patellaria atrata* {3}, *Proliferodiscus olivaceoviridis* {2}, *Trichopeziza perrotioides* {2}. **Desiccation tolerance**: fully viable for at least 12–14 months. **Altitude**: 37–235 m a.s.l. **Geology**: Cretaceous sedimentary rock, Cenozoic regolith; granite. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia curvativitalbae* is easily recognizable by its quite consistently strongly curved, ± cashew-shaped, subcylindrical to fusoid-clavate, comparatively small ascospores. Except for spore curvature the species closely resembles *O. vitalbae*, especially in shape of spores and spore bodies. For the similar *O. commarosa* on *Acacia* and *O.* cf. *commarosa* on *Livistona* petioles (Pl. 715: 6) see below.

Variation. *O. curvativitalbae* varies mainly in spore length, and that within and between collections. In two samples only rather short, cashew-shaped spores were observed (H.B. 8748 and Pl. 713: 3).

Ecology. *O. curvativitalbae* was found on rotten wood and especially bark of xeric twigs and branches of different angiosperm trees and shrubs in subtropical semihumid banksia-eucalypt-acacia open wood- and shrublands in the Swan Coastal Plain of southwestern Australia.

Specimens included. **AUSTRALIA**: **Western Australia**, Swan Coastal Plain, 150 km N of Perth, 13 km WNW of Moora, 235 m, branch of *Verreauxia reinwardtii*, on bark, 24.X.2007, G. Marson (H.B. 8748f). – 59 km SW of Moora, 8 km NE of Cowalla, Moore River, Orange Springs Rd, 77 m, branch of *Eremaea pauciflora*, on bark, 5.IX.2006, G. Marson (H.B. 8643d). – 30 km NE of Perth, 4 km N of Upper Swan, Swan Valley, W of Walyunga, 37 m, branches of *Jacksonia*, on wood & bark, 23.XI.2001, G. Marson (ex H.B. 7284f, MEL 2389233, **holotype**). – ibid., 4 km NE of Upper Swan, 76 m, branches of *Jacksonia*, on bark & wood, 2.IX.2006, G. Marson (H.B. 8611c). – Perth, Kings Park, 45 m, twig of *Arbutus andrachne*, on wood, 18.XII.2001, G. Marson (H.B. 8649c). – ibid., branch of *A. andrachne*, on wood, 19.X.2007, G. Marson (H.B. 8690a).

Orbilia commarosa Baral & G. Marson, **sp. nov.**,
MB 813716 — Pls 715–716, Map 119

Etymology: named after the comma-shaped ascospores and the rose-coloured apothecia.

Typification: Western Australia, Kalbarri, branches of *Acacia*, 9.XII.2001, G. Marson (ex H.B. 7415a, MEL 2389236, holotype).

Latin diagnosis: *Apothecia rehydratata 0.2–0.8 mm diam., salmoneo-rosea, margine laevi. Asci 8-spori. Ascosporae *6.5–11.5 × 2.1–2.6 µm, ellipsoideo-vel fusoideo-clavatae, in statu vivo corpusculum lacrimiforme ad apicem filo longo flexuoso affixum continentes. Paraphyses ad apicem leniter vel valde capitato-clavatae. Cellulae vivae excipuli absque corpusculis crystalloideis. Habitat ad corticem putridum ramorum siccorum* Acaciae *in zona tropica vel subtropica arida ad semihumida Australiae (meridio-)occidentalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.2–)0.3–0.6(–0.8) mm diam., 0.11–0.14 {1} or 0.13–0.24 mm {3} high (receptacle 0.08–0.1 mm), light to bright salmon-rose(-lilaceous), rarely pale cream-orange, not or slightly translucent, round or somewhat irregular, (very) scattered to gregarious in small groups; disc flat, margin ± thick, 0–10 µm protruding, smooth; broadly sessile or with an abrupt hidden stipe 0.07–0.1 × 0.09–0.15 mm, erumpent through fissures of periderm or bast, also ± superficial; dry bright rose-red. **Asci** *54–67 × 4.4–4.8 µm {2}, †(42–)50–62 {5} × 3.5–4.3 {4} or 4.4–5 µm {1}, 8-spored, spores *(sub)biseriate, 3–5 lower spores inverted {5} (sometimes ± mixed), pars sporifera *33–37(–40) µm long; **apex** (†) (medium to) strongly truncate (sometimes slightly indented, laterally not or slightly to strongly inflated); **base** with medium long, thin, flexuous stalk, L- to Y-shaped. **Ascospores** *(6.5–)7–8.5(–9.5) {4} or 8.5–11.5 {2} × 2.1–2.5(–2.6) µm {6}, †(7–)7.5–8.3 {2} or 9–11 {1} × 2–2.3(–2.5) {3} µm, ellipsoid- to fusoid-clavate, apex obtuse (to rounded), sometimes predominantly subacute {1}, base strongly attenuated in a short tail-like end or tail, slightly to strongly curved at base; **SBs** *(3.5–)4–5.5(–6) × (0.5–)0.6–0.9(–1) µm in situ {5} (~4.5–6.5 µm actual length), divided into an abruptly swollen, tear- to rod-shaped or ellipsoid lower part and a long, fine, filiform, slightly to strongly flexuous upper part with (1–)2(–3)× the length of the lower part. **Paraphyses** apically uninflated or usually slightly to medium {4} but also strongly {1} clavate-capitate, terminal cells *(12–)15–23(–27.5) × (2.5–)3–4(–4.4) µm {2}, †15–22 × (2–)3–4.5 µm {1}, lower cells *8–15(–16) × 1.6–2.5(–2.8) µm {3} (near base *6–9 × 2.5–3.3 µm); never branched in upper part, hymenium usually pale rose. **Medullary excipulum** (very) pale rose, 30–40(–110) µm thick, of ± dense, in lower part sometimes more loose textura intricata with many inflated cells, indistinctly to usually sharply delimited from ectal excipulum (by a thin layer of t. porrecta). **Ectal excipulum** hyaline to pale rose, of thin-walled († slightly gelatinized), (indistinctly) vertically oriented t. angularis(-prismatica) from base to mid flanks, 25–90 µm thick near base, cells *(6–)8–20(–24) × (5–)7–12(–16) µm {4}, †7–12 × 5–8 µm {1}; 15–30 µm thick at mid flanks, 10–30 µm thick near margin, submargin of t. globulosa-prismatica oriented at a 45–80° angle to the surface, upper margin of t. prismatica-porrecta oriented at 10–30°, marginal cortical cells */†(5–)8–12(–16) × (2.5–)3–5(–6.5) µm {4}. **Anchoring hyphae** abundant, */†1.7–3(–5) µm wide, walls */†0.2–0.3(–0.5) µm thick {3}, forming a dense (basally loose), hyaline, partly gelatinized layer on base and lower flanks, 20–40 µm thick at base, rarely extending to the margin (5–10 µm thick). **SCBs** in paraphyses globose {4}, inconspicuous, (0.5–)1–1.8 µm diam., in excipulum 2–2.5 µm diam. **Exudate** over paraphyses (0.3–)1–3(–5) µm thick, cloddy, firmly or sometimes loosely attached, hyaline to pale yellowish-chlorinaceous, over margin and flanks (0.3–)1–4(–6) µm thick, subhyaline to light yellow-ochre. **— ANAMORPH**: unknown.

Habitat: collected 0.2–2 m above the ground, corticated, 6–50 mm thick branches of *Acacia* sp. {6}, *A. aneura* {1}, on slightly to medium decayed, partly ± detached bark {7}, on bast, often in fissures through periderm, also often on edges and especially on inner surface of bark, exceptionally on 0.2 mm deep very rotten wood {1}, slightly to strongly greyed, without or with a few green algae. **Associated**: *Baggea* sp. {1}, *Caloplaca* sp. {2}, *Gloniopsis* sp. {1}, *Hypoxylon* sp. {1}, *Hysterobrevium mori* {1}, ?*Hysteropatella* sp. {1}, *Muellerella lichenicola* {1}, *Orbilia australiensis* {1}, *O. eucalypti* {1/1}, *O. euphorbiae* {1}, *O. macrocarpa* {1}, *O. macrotrapeziformis* {1}, *O. microserpens* {2}, *O. multigambelii* {1}, *O. multimicrosoma* {2}, *O.* ?*multiserpens* {1}, *O. myrioauris* {1}, *O. myriofusiclava* {2}, *O.* ?*pleiohesperidea* {1}, *O. pleioquaestiformis* {1}, *O. pluristomachia* {1}, *O.* ?*serpentina* {1}, *O. wannerooensis* {1}, *Patellaria* ?*andina* {1}, *Schizoxylon* sp. {1}. **Desiccation tolerance**: a few mature asci and many cells of ectal excipulum still viable after 21 months. **Altitude**: 6–300 m a.s.l. **Geology**: Silurian & Jurassic sedimentary rock (sandstone), Cenozoic whitish to red-brown sand & gravel; granitic gneiss. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia commarosa* is characterized by ± comma-shaped ascospores with usually obtuse apices and short, curved, tail-like bases, and by rather long spore bodies divided into a strongly swollen basal part and a very narrow, flexuous, long-filiform upper part, also by the bright and pure salmon-rose colour of the medium-sized apothecia with a smooth, partly rather broad margin, finally by a thick exudate.

O. curvativitalbae differs from *O. commarosa* in narrower, partly cashew-shaped spores with a much less developed tail, spore bodies with a subulate upper part, and in smaller,

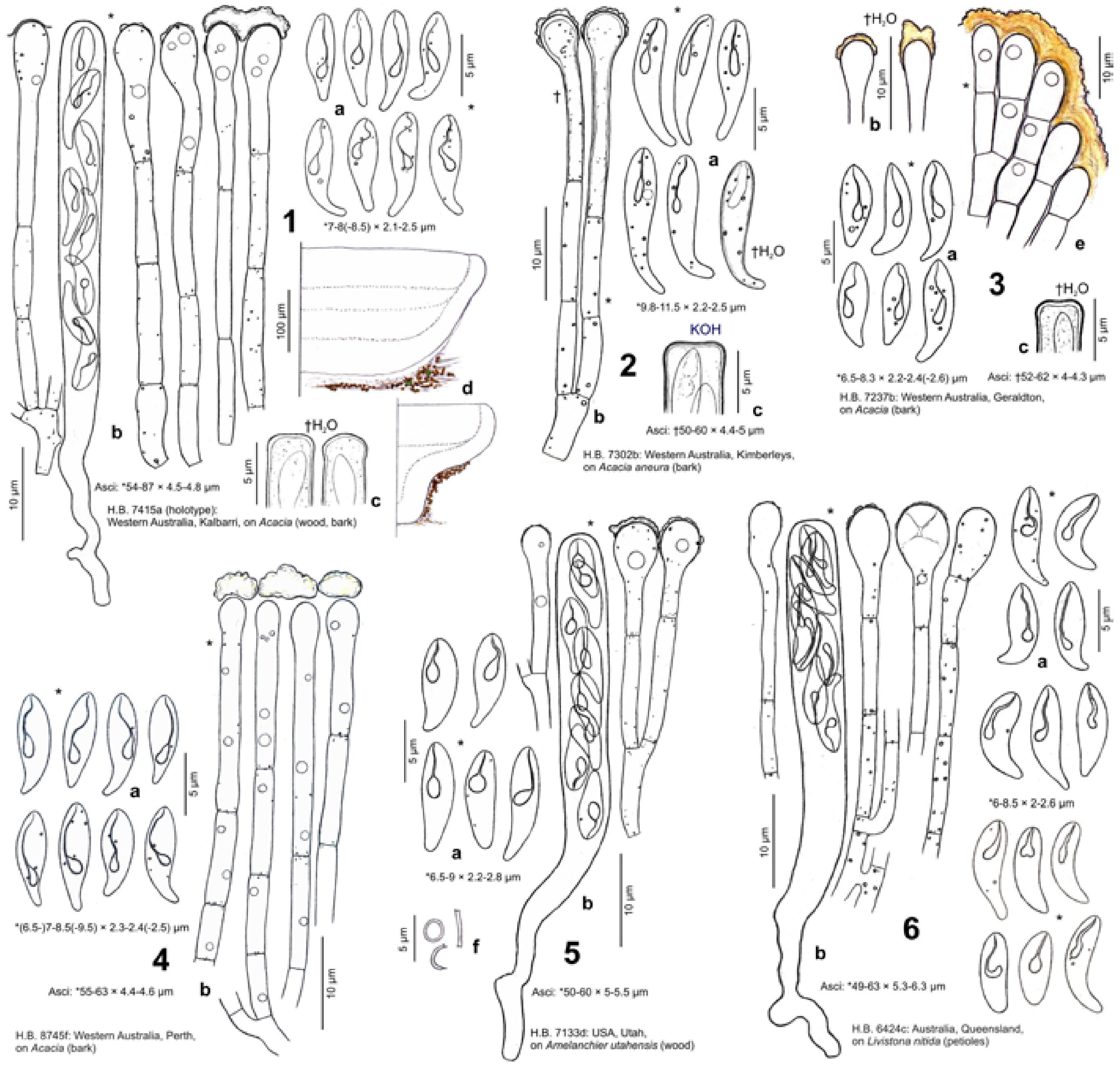


Plate 715. **1–4**: *Orbilia commarosa*; **5–6**: *O.* cf. *commarosa*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. apothecia in median section; **e**. id., marginal ectal excipulum covered by yellow-ochre exudate; **f**. crystalloid SCBs in ectal excipulum.

orange-coloured apothecia. *O. commarosa* (especially Pl. 713: 2) resembles European *O. quaestiformis* in spore shape, but the spore bodies of the latter are not swollen at the base, and the apothecia never pure rose or lilaceous.

Variation. Two of the seven included collections (Pls 715: 2; 716: 1, 4) markedly differ in longer spores, also wider asci and apically more strongly inflated paraphyses (in H.B. 7302b), therefore, the measurements of these samples are separately given in the description. We prefer to consider them as conspecific because of the similar shape of the spores and SBs, the remarkable macroscopy of the apothecia, and the uniform ecology in the seven included collections. Yet, in one specimen (Pls 715: 4; 716: 2) the apothecial colour varied from pale cream-orange to mostly bright pink-red.

Map 119. Known distribution of *O. commarosa* in Australia (yellow = not included collection).

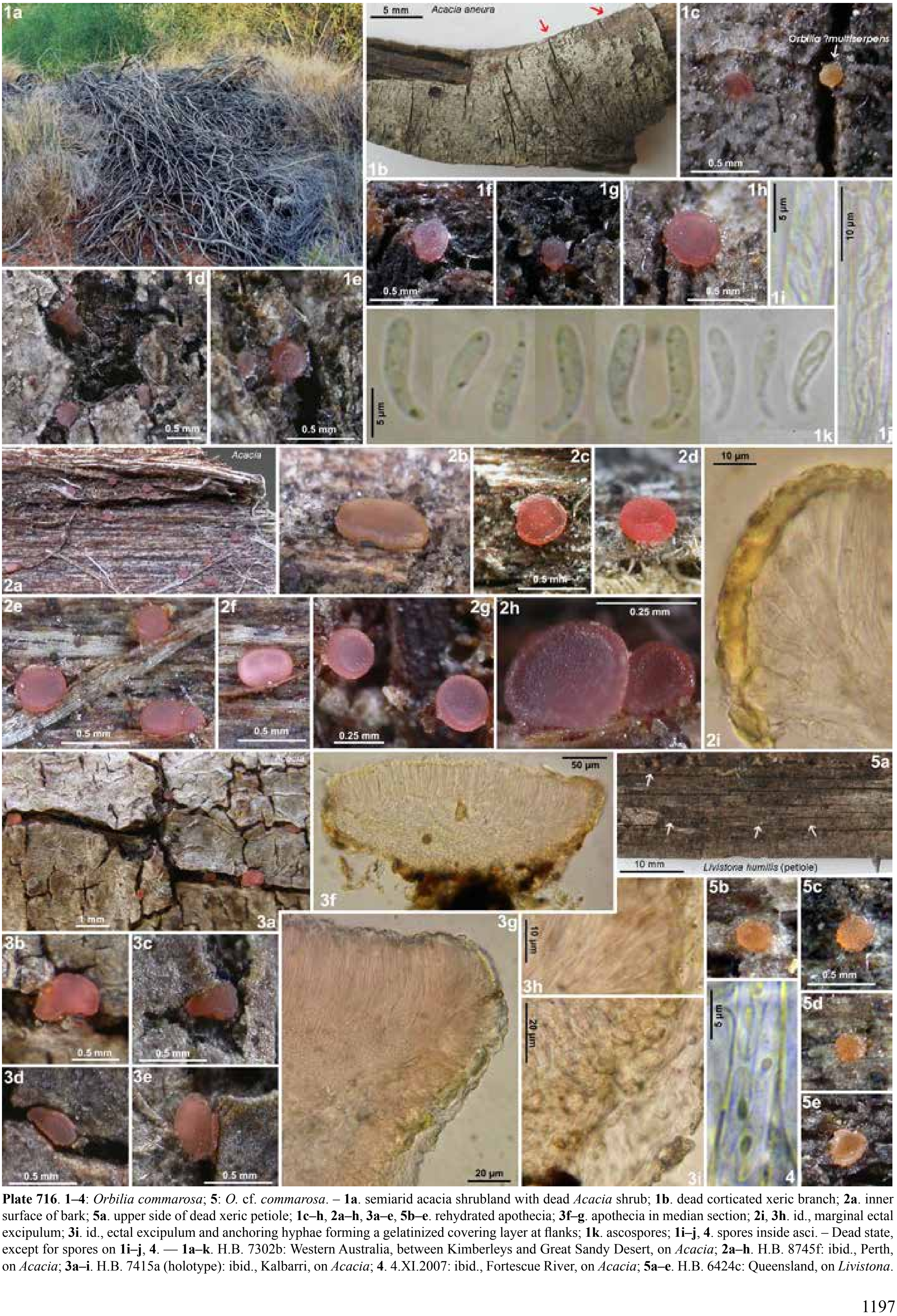


Plate 716. **1–4**: *Orbilia commarosa*; **5**: *O.* cf. *commarosa*. – **1a**. semiarid acacia shrubland with dead *Acacia* shrub; **1b**. dead corticated xeric branch; **2a**. inner surface of bark; **5a**. upper side of dead xeric petiole; **1c–h**, **2a–h**, **3a–e**, **5b–e**. rehydrated apothecia; **3f–g**. apothecia in median section; **2i**, **3h**. id., marginal ectal excipulum; **3i**. id., ectal excipulum and anchoring hyphae forming a gelatinized covering layer at flanks; **1k**. ascospores; **1i–j**, **4**. spores inside asci. – Dead state, except for spores on **1i–j**, **4**. — **1a–k**. H.B. 7302b: Western Australia, between Kimberleys and Great Sandy Desert, on *Acacia*; **2a–h**. H.B. 8745f: ibid., Perth, on *Acacia*; **3a–i**. H.B. 7415a (holotype): ibid., Kalbarri, on *Acacia*; **4**. 4.XI.2007: ibid., Fortescue River, on *Acacia*; **5a–e**. H.B. 6424c: Queensland, on *Livistona*.

Not included collections. In a sample on *Livistona* (Pls 715: 6; 716: 5) the spores and spore bodies are similar to *O. commarosa*, but the apothecia are smaller and light orange, lacking any rose component, also the exudate is very thin. The spores differ from typical *O. commarosa* in having more tapered apices, therefore, they resemble those of *O. trapeziformis* (but *O. commarosa* may also sometimes have spores with subacute apices, especially in Pl. 715: 3), and some spores resemble those of *O. curvativitalbae*. Some of the apothecia had spores with obtuse apices, but these were frequently more or less straight and closely resemble the North American *O. dixiensis* (see Pl. 699: 3). Likewise, two North American specimens on *Amelanchier* (Pl. 715: 5; IVV: H.B. 8056h) have spores and SBs very similar to *O. commarosa*, but differ in orange apothecia and less curved spores. Moreover, small crystalloid SCBs were seen in the former record, therefore, they are not included in the description. All these specimens resemble also *O. vitalbae* and *O. subvitalbae.*

Ecology. *O. commarosa* grows on medium rotten bark of xeric branches of *Acacia* in tropical arid acacia shrublands (mulga, partly in a tussock grassland with *Livistona alfredii*), subtropical semiarid acacia open shrublands and semihumid open wood- and rather dense shrublands (*Acacia*, *Nuytsia*, partly on sand dunes) of western and southwestern Australia. The not included collection from Queensland was on leaves of *Livistona* in a subtropical subhumid (winter-dry savannah) eucalypt woodland of eastern Australia (Great Dividing Range), those from western North America on *Amelanchier* in cold-temperate subhumid pinyon-juniper woodlands of the Colorado Plateau on Pennsylvanian-Permian sand- and limestone.

Specimens included. **AUSTRALIA**: **Western Australia**, Dampierland, 235 km SW of Broome, 6 km E of Sandfire Roadhouse, border of Great Sandy Desert, 12 m, branches of *Acacia aneura*, on bark, 3.XII.2001, G. Marson (H.B. 7302b). – Pilbara, 96 km S of Roebourne, 42 km SSW of Python Pool, Millstream-Chichester, road crossing the Fortescue River, 300 m, branch of *Acacia*, on bark, 4.XI.2007, G. Marson (ø). – Geraldton Sandplains, 80 km NNW of Northampton, 29 km ENE of Kalbarri, near meander of Murchison, 160 m, branches of *Acacia*, on bark & wood, 9.XII.2001, G. Marson (ex H.B. 7415a, MEL 2389236, **holotype**). – 60 km N of Geraldton, 12 km N of Northampton, 278 m, branch of *Acacia*, on bark, 9.XII.2001, G. Marson (H.B. 7237b ø). – 90 km SSE of Geraldton, 21 km N of Illawong, 6 m, branch of *Acacia*, on bark, 9.XI.2007, G. Marson (H.B. 8996b ø). – 96 km SSE of Geraldton, 15 km N of Illawong, S of Cliff Head lighthouse, 7 m, branch of *Acacia*, on bark, 10.XI.2007, G. Marson (H.B. 9582b). – Swan Coastal Plain, 30 km NNW of Perth, 1 km NW of Kinross, Tamala Park, 40 m, branch of *Acacia*, on bark, 23.X.2007, G. Marson (H.B. 8745f).

Not included. **AUSTRALIA**: **Queensland**, Brigalow Belt South, 69 km SSW of Theodore, 15 km N of Taroom, Palm-Tree Creek, Roy Staines Bridge, 200 m, leaves of *Livistona nitida*, on petioles, 22.X.1998, G. Marson (H.B. 6424c). — **USA**: **Utah**, Canyonlands, 41 km W of Blanding, Natural Bridges, 2090 m, branch of *Amelanchier utahensis*, on wood, 14.VI.2000, G. Marson (H.B. 7133d). – **Arizona**, Grand Canyon, Coconino Plateau, 15 km ESE of Grand Canyon Village, Grandview Point, 2260 m, branch of *A. utahensis*, on wood, 16.VI.2003, G. Marson (H.B. 8056h ø).

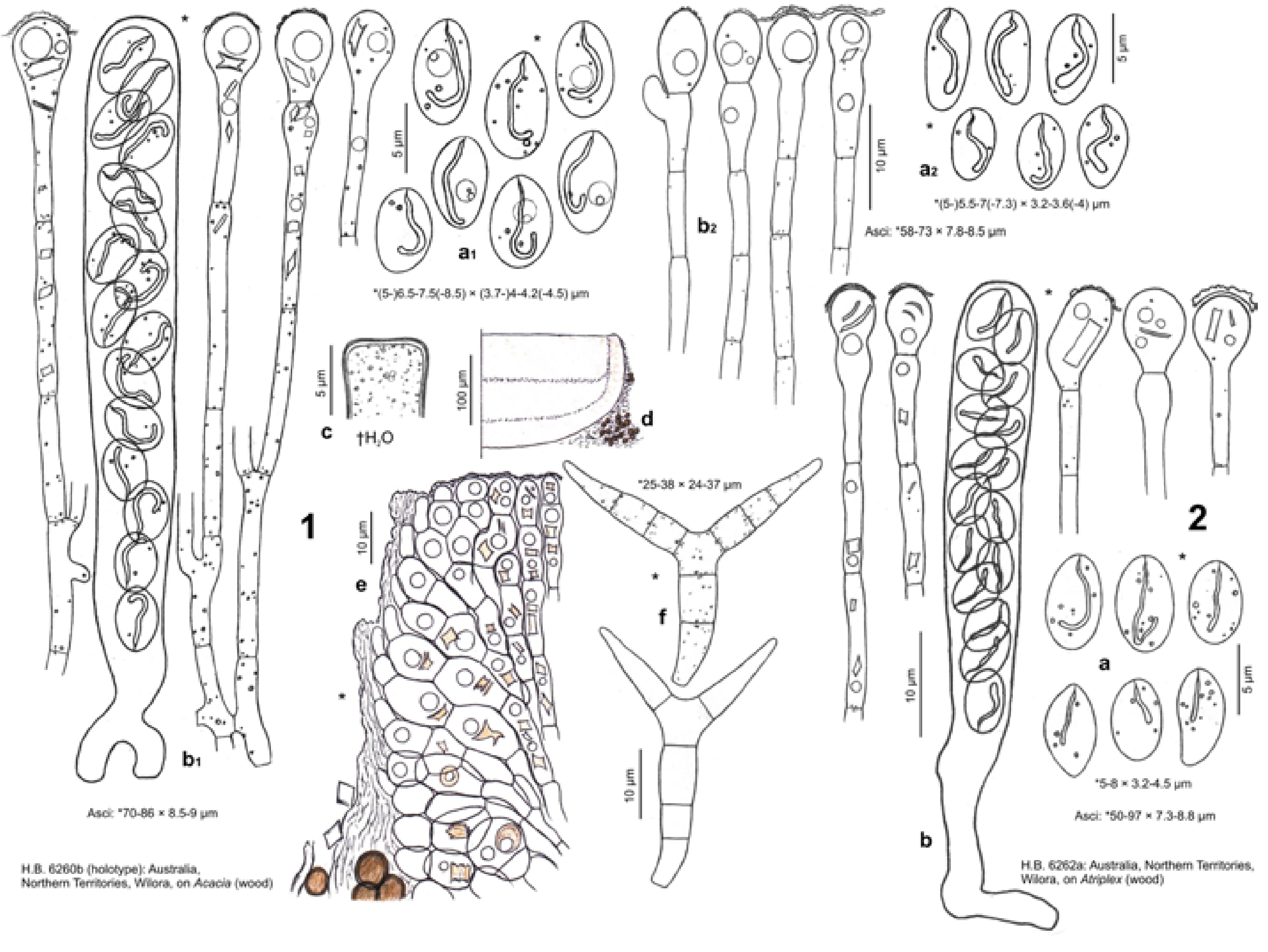


Plate 717. **1–2**: *Orbilia barrowensis* (**1a**$_2$, **b**$_2$: untypical population). – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apex; **d**. apothecium in median section; **e**. id., marginal ectal excipulum; **f**. conidia from culture.

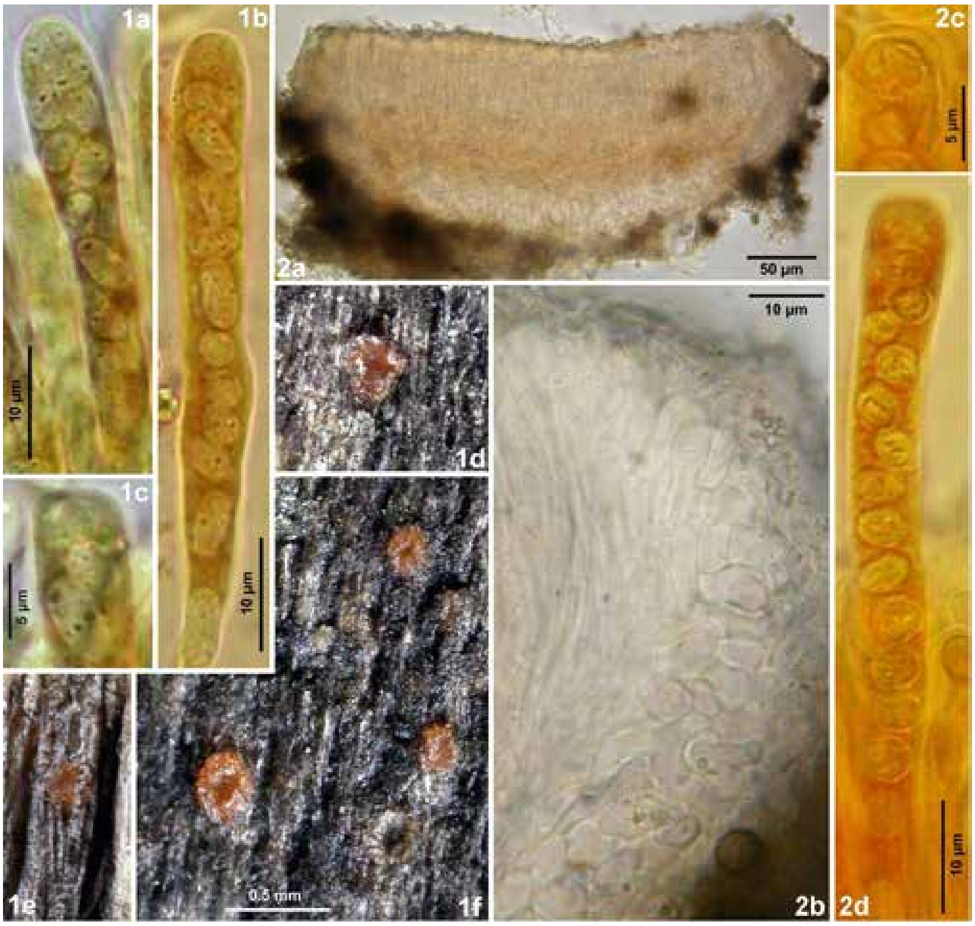


Plate 718. **1**: *Orbilia barrowensis*; **2**: *Orbilia* cf. *barrowensis*. – **1d–f**. rehydrated apothecia; **2a**. apothecium in median section; **2b**. id., marginal ectal excipulum; **1a–b**, **2d**. asci; **1c**, **2c**. ascus apices. – Dead state: **1a–c** in KOH+IKI, **2b** in KOH, **2c–d** in IKI. — **1a–f**. H.B. 6260b (holotype): Australia, Northern Territories, on *Acacia*; **2a–d**. H.B. 8085g: USA, Arizona, on *Olneya*.

Orbilia barrowensis Baral & G. Marson, **sp. nov.**, MB 813717 — Pls 717–718

Etymology: named after the origin of the two known collections (vicinity of the Barrow Creek in central Australia).

Typification: Australia, Northern Territories, Wilora, branches of *Acacia*, 8.X.1998, G. Marson (ex H.B. 6260b, MEL 2389193, holotype [large-spored population in Pl. 148 Fig. 1a$_1$, b$_1$, c–f]).

Latin diagnosis: *Apothecia rehydratata 0.2–0.4 mm diam., aurantiaca, margine subtiliter aspero. Asci 16-spori. Ascosporae *5–8.5 × 3.2–4.5 µm, ellipsoideae vel ovoideae, in statu vivo corpusculum vermiforme vel subulatum, flexuosum ad uncinatum continentes. Paraphyses ad apicem modice vel valde capitato-clavatae. Cellulae vivae excipuli corpuscula crystalloidea continentes. Habitat ad lignum putridum ramorum siccorum* Acaciae *et* Atriplicis *in zona tropica arida Australiae centralis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.2–0.4 mm diam., 0.14–0.16 mm high, pale to bright orange, round, (very) scattered; disc medium to slightly concave, margin thin, 0–10 µm protruding, finely rough; sessile, ± erumpent; dry sunken between wood fibres. **Asci** *(50–)70–86(–97) × (7.3–)7.8–9 µm {2}, 16-spored, spores (*) biseriate (uniseriate near base), majority of lower spores inverted, pars sporifera *40–61 µm long; **apex** (†) strongly truncate (slightly indented, laterally sometimes inflated); **base** without or with short, thick stalk, L- or h-shaped. **Ascospores** *(5–)6–7.5(–8.5) × (3.2–)3.5–4.2(–4.5) µm {2}, ellipsoid to ovoid (or fusoid), both ends rounded to obtuse (rarely subacute), straight or slightly inequilateral; **SBs** *(3.5–)4.7–6.5 × 0.3–0.5(–1) µm in situ {2} [~(3.5–)6–8.5 µm actual length], vermiform or subulate, base rarely slightly thickened, flexuous to helicoid, sometimes uncinate. **Paraphyses** apically medium to (very) strongly capitate(-clavate), rarely spathulate, terminal cells *(6.5–)12–17(–22) × (3.4–)4–5.8(–6.3) µm {2}, lower cells *7.5–16(–20) × 1.5–2.3(–3.3) µm {2}; rarely branched near apex. **Medullary excipulum** hyaline, 30–60 µm thick, of ± dense textura intricata with many inflated cells, sharply delimited. **Ectal excipulum** of thin-walled, vertical t. angularis from base to margin, 25–30 µm thick near base, cells *10–18 × 8–12 µm {1}; 20 µm thick at mid flanks and margin, oriented at a 50–70° angle to the surface, marginal cortical cells *5–11 × 4–7 µm {1}. **Anchoring hyphae** abundant, *2–2.5 µm wide, walls 0.2–0.8 µm thick {1}, forming a thin layer up to margin, terminated in dead hyphal projections. **SCBs** in paraphyses and marginal ectal excipulum globose, 1–3.7 µm diam., and rod- or ring-/spool-shaped {2}, pale orange, 3–6 µm diam., rarely absent. **Exudate** over paraphyses 0.2–1 µm thick, ± rough, finally firmly attached; over margin and flanks indistinct, 0.2 µm thick. — **ANAMORPH**: trinacrium-like (from ascospore isolate {1}). **Conidiophores** not seen. **Conidia** Y-shaped, total size *25–38 × 24–37 µm, stipe *18–23.5 × 5–5.5 µm, 2–3-septate, arms gradually tapering, *14–20 × 4–4.5 µm, 1–3-septate {1}, some conidia unbranched.

Habitat: collected 0–2 m above the ground, partially to entirely decorticated, 10–15 mm thick branches of *Acacia* sp. {1}, *Atriplex* sp. {1}, on 0.2–0.3 mm deep strongly decayed wood {2}, greyed, no algae. **Associated**: *Acanthostigma ellisii* {1}, *Capronia* sp. {1}, *Dothideales* {2}, *Orbilia lanternae* {1}, *O.* ?*livistonae* {1}, *O. maeandrina* {1}, *O. multiaustrocylindrica* {1}, *O.* ?*multigambelii* {1}, *O. octocercocarpi* {1}, *O. pleioaustraliensis* {1}, *O. pleiostomachia* {1}, *O. pleioungulata* {1}, *O. pluristomachia* {1}, *Peniophora* sp. {1}. **Desiccation tolerance**: fully viable for at least 2 weeks. **Altitude**: 480 m a.s.l. **Geology**: Cenozoic regolith. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia barrowensis* is characterized by 16-spored asci, broadly ellipsoid to ovoid, medium-sized ascospores with vermiform, partly uncinate spore bodies, and by the presence of crystalloid SCBs. European *O. pleiogambelii* differs in much narrower and partly shorter spores and in the geographical origin. In the paratype a single apothecium with consistently 32-spored asci and distinctly smaller spores was detected (see Pl. 724: 7). This appears to belong to *O. multigambelii*, a taxon which is so far mainly known from North America.

Variation. In the holotype of *O. barrowensis* one apothecium contained among the normal asci very few aberrant 8-spored asci with larger spores (*8–9 × 4.5–5.5 µm, not illustrated), which were not included in the description. On a separate branch occurred apothecia with distinctly smaller, especially narrower spores, smaller asci, and virtually absent crystalloid SCBs in paraphyses and excipular cells (Pl. 717: 1a$_1$, 1b$_2$). Because it otherwise did not deviate from typical *O. barrowensis*, this population was included in the description.

Not included collections. Two North American collections (Pl. 718: 2, on *Olneya*; H.B. 8096a, on *Coleogyne*) appear to be conspecific, but were studied almost 3 years after being collected, therefore, merely the excipular cells (containing crystalloid SCBs) and a single spore was found to be viable in one of them (*Olneya*). Although their features (asci †60–85 × 6–7.5 µm, spores †5–7 × 3–4.3 µm) fit *O. barrowensis* quite well, the two specimens are not included in the description because the vital characters are mainly unknown.

Anamorph. The trinacrium-like conidia obtained in pure culture are morphologically very similar to those reported for *O. gambelii* and *O. pleiogambelii.* They were obtained from the large-spored population (holotype).

Ecology. *O. barrowensis* was found on rotten wood of xeric branches of *Acacia* and *Atriplex* (climbing up the *Acacia*) in a tropical arid acacia open shrubland of central Australia. The not included collections on *Coleogyne* and *Olneya* are from warm-temperate to subtropical semiarid blackbrush and paloverde-mixed cacti desert scrub in the Colorado Plateau and Sonoran Desert of western North America.

Specimens included. **AUSTRALIA**: **Northern Territories**, Burt Plain, 31 km SW of Barrow-Creek Hotel, 3.7 km WSW of Wilora, 480 m, branches of *Acacia*, on wood, 8.X.1998, G. Marson (ex H.B. 6260b, MEL 2389193, **holotype**, anam. cult.; specimen contains also small-spored population). – ibid., branches of *Atriplex*, on wood, 8.X.1998, G. Marson (H.B. 6262a).

Not included. **USA**: **Arizona**, Canyonlands, 45 km SW of Page, 26 km SW of Marble Canyon, 1522 m, branch of *Coleogyne ramosissima*, on wood, 16.VI.2003, G. Marson (H.B. 8096a). – Sonoran Desert, 25 km WNW of Tucson, 5 km S of Picture Rocks, Saguaro, 745 m, branches of *Olneya tesota*, on wood, 30.V.2003, G. Marson (ex H.B. 8085g, in M-0276519 [H.B. 8085f, type of *O. multicreosoteris*]).

Orbilia gambelii Baral & G. Marson, in Karasch et al., Österr. Z. Pilzk. 14: 286 (2005) — Pls 719–721, Map 120

Etymology: referring to the host species *Quercus gambelii* in the first collection. **Typification**: Spain, Chiloeches, twig and branches of *Jasminum fruticans*, 2.V.1996, H.O. Baral (ex H.B. 5483a, M-0140894, holotype).

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.1–)0.15–0.6(–0.8) mm diam., 0.11–0.2 mm high, (pale to) light to bright orange(-rose) (to yellowish-ochraceous or brick-red), round, scattered to gregarious; disc (slightly concave to) flat, rarely slightly convex, margin distinct, 0–20 µm protruding, smooth to finely crenulate; ± sessile, ± immersed in biofilm. **Asci** *(42–)50–72(–78)((–86)) × (5–)5.3–6.5(–7) µm {25} → 6.5–7 µm, †(38–)42–65(–70) × (4–)4.3–5.5(–6.2) µm {9}, 8-spored, spores *1–2-seriate, (1–)3–5(–6) lower spores inverted {17} (rarely or often mixed), pars sporifera *25–38 → 16–23 µm long; **apex** (†) strongly truncate (without or distinctly indented, laterally inflated); **base** with short to medium long, flexuous stalk, T-, L-, Y- or h-shaped. **Ascospores** *(4.5–)5–8(–9)((–10)) × (2.2–)2.5–3.5(–3.8) ((–4)) µm {60}, †(4.3–)5–7.5 × (2–)2.5–3.5 µm {4}, ellipsoid to ovoid or obovoid, sometimes fusoid (partly amygdaliform), rarely subcylindrical, apex rounded, obtuse or subacute, base not or slightly to medium attenuated, straight to sometimes slightly inequilateral, exceptionally curved at base; **SBs** *(3–)4–7(–8) × (0.2–)0.3–1(–1.2) µm in situ {23} [~(5–)6–9(–12) µm actual length], subulate, also filiform to vermiform, base not or slightly, rarely medium inflated, flexuous to helicoid, sometimes or often uncinate, in overmature spores with ovoid to globose lower and filiform upper part. **Paraphyses** apically (slightly to) medium to very strongly capitate-clavate, sometimes spathulate to sublageniform, terminal cells *(4.5–)6–17(–22) {11} × (2.5–)3–5.5(–6) µm {14}, lower cells *8–15(–17) × (1–)1.3–2(–3) µm {6}; unbranched at upper septum. **Medullary excipulum** hyaline, 30–60 µm thick, of ± loose to dense textura intricata with many inflated cells, not or medium sharply delimited. **Ectal excipulum** pale to light orange-rose, of thin-walled, ± vertically oriented t. (globulosa-)angularis(-prismatica) from base to mid flanks, (20–)30–55(–80) µm thick near base, cells *(7–)9–19(–23) × (5–)7–13(–16) µm {9}; (10–)20–30(–35) µm thick at flanks and margin, at margin of t. globulosa to t. prismatica(-porrecta) oriented at a (10–)20–50(–90)° angle, marginal cortical cells *(5–)6–12(–14) × (2.5–)3–5(–6) µm {9}, †10–12 × 2.5–3.5 µm {1}, firm-walled, sometimes somewhat free (hair-like) or slightly converging to form minute indistinct teeth. **Anchoring hyphae** sparse to very abundant, *2–3.3 µm wide, walls 0.2–0.3(–0.5) µm thick {7}, forming a 5–10 µm thick covering layer at flanks. **SCBs** in apices of paraphyses globose, 1–2.5 µm diam., in ectal excipulum near margin 2–3.2 µm; rod- or spool- to ring-shaped crystalloid SCBs in ectal excipulum {56}, hyaline to light yellowish-orange, (1.5–)2.5–5.5(–7) µm diam., rarely (partly) absent {2}, infrequently present in paraphyses. **Exudate** over paraphyses 0.3–1.5(–2) µm thick, cloddy, continuous, later breaking into firmly attached caps; over margin and flanks 1.5–3 µm thick, cloddy to granular, hyaline to pale yellowish. **— ANAMORPH**: trinacrium-like (from ascospore isolate {1} and natural substrate {3}). **Conidiophores** not observed. **Conidia** Y-shaped, total size *23–28 × 25–39.5 µm, stipe *12–16 × 5.2–6 µm, 2-septate, arms gradually to abruptly tapering, *15–21 × 5.2–5.5 µm, 2–3-septate {2}.

Habitat: collected 0.2–3.5 m above the ground, ± corticated (periderm ± removed) to decorticated, 4–30(–40) mm thick, dead (rarely living) twigs and branches of *Acer glabrum* {1}, *Adenocarpus viscosus* {1}, *Anagyris foetida* {1}, *Carpinus betulus* {1}, *Calicotome villosa* {1}, *Carlina xeranthemoides* {1}, *Cercis siliquastrum* {1}, *Cercocarpus ledifolius* {1}, *Chamaecytisus proliferus* {1}, *Cistus* sp. {1}, *Clematis vitalba* {2}, *Cytisus scoparius* {1}, *Echium leucophaeum* {1}, *Eucalyptus camaldulensis* {4}, *Euonymus europaeus* {4}, *Ficus carica* {2}, *Fraxinus excelsior* {1}, *Genista scorpius* {2}, *Ilex aquifolium* {1}, *Jasminum fruticans* {1}, *Juglans regia* {2}, *Juniperus* sp. {1}, *J. thurifera* {1}, *Lonicera etrusca* {1}, *L. ?xylosteum* {1}, *Olea europaea* {4}, *Passiflora caerulea* {3}, *Petteria ramentacea* {1}, *Pinus sylvestris* {1}, *Populus × canadensis* {1}, *P. tremuloides* {2}, *Prunus domestica* {1}, *Punica granatum* {1}, *Quercus coccifera* {4}, *Q. gambelii* {3}, *Q. ilex* {2}, *Q. rotundifolia* {2}, *Rhamnus myrtifolia* {1}, *Rosa* sp. {5}, *Rosmarinus officinalis* {4}, *Rubia fruticosa* {1}, *Rubus fruticosus* {1}, *Salix* sp. {2}, *S. alba* {1}, *S. ?bebbiana* {1}, *Spartium junceum* {1}, *Syringa vulgaris* {1}, *Ulex europaeus* {1}, *U. parviflorus* {1}, *Ulmus minor* {1}, on 0.3–1 mm deep or much deeper medium to mostly strongly decayed wood {53} and bark {23} (bast), partly strongly eroded, also on inner surface of detaching bark, sometimes in beetle galleries or longitudinal clefts, exceptionally on boring dust of a bark beetle {1}; on 15–35 mm thick herbaceous stem of *Reynoutria japonica* {1}, *Opopanax* sp. {1}; strongly greyed, sparsely to densely covered by green algae. **Associated**: *Baggea* spp. {2}, *B. pachyascus* {1}, *?Calloria* sp. {1}, *Capronia* sp. {1}, *Carestiella ?schizoxyloides* {1}, *Catillaria nigroclavata* {1}, '*Chlorosplenium*' *viridulum* {1}, *Claussenomyces* spp. {2}, *Coniochaeta ?alkalivirens* {1}, *Cyathicula* sp. {1}, *Diplolaeviopsis* sp. {2}, *Dothideales* {1}, *Durella* sp. {1/3}, *D.* aff. *connivens* {1}, *D. connivens* {2}, *Eutypa crustata* {1}, *Gloniopsis praelonga* {1}, '*Helotium*' *uvidulum* {1}, *?Herpotrichia* sp. {1}, *Hyalorbilia erythrostigma* {1}, *H. orbiliicola* {1}, *Hysterium* sp. {2/1}, *Hysteropatella* spp. {2}, *Karstenia* sp. {1}, *K. idaei* {1}, *Lasiobelonium sublonicerae* {1}, *Lecidella elaeochroma* {1}, *Lophiostoma ?quadrinucleatum* {1}, *Melanohalea subolivacea* {1}, *Melanomma seminudum* {1}, *Melaspilea emergens* {1}, *Mellitiosporiella* sp. {1}, *M. pulchella* {5}, *Mollisia ligni* {1}, *M. rosae* {1}, *Nitschkia broomeana* {1}, *Odontotrema oregonensis* {1}, *Orbilia albidorosea* {1}, *aristata* {2}, *O. ?carpoboloides* {1}, *O. ?cejpii* {1}, *O. cercidicola* {1}, *O. clavuliformis* {1}, *O. corculispora* {3}, *O. curvatitrapeziformis* {1}, *O. delphinus* {5}, *O. dixiensis* {1}, *O. euonymi* {1}, *O. flagellispora* {1}, *O. flexisoma* {2}, *O. ?gregorii* {1}, *O. ?halimi* {1}, *O. hesperidea* {1}, *O. mali* {1}, *O. microserpens* {1}, *O. microsoma* {1}, *O. multiphanosoma* {1}, *O. myriolentiformis* {1}, *O. myriosphaera* {2}, *O. navajoana* {2}, *O. obtusispora* {1/1}, *O. ocellata* {1}, *O. ovalis* {2}, *O. ovoidea* {1}, *O. pilifera* {1}, *O. pleiogambelii* {5/1}, *O. polyspora* {3}, *O. ?pubescens* {1}, *O. quaestiformis* {1}, *O. rosicola* {1}, *O. sarothamni* {1}, *O. sedonensis* {1}, *O. sphaerospora* {1}, *O. subaristata* {7},

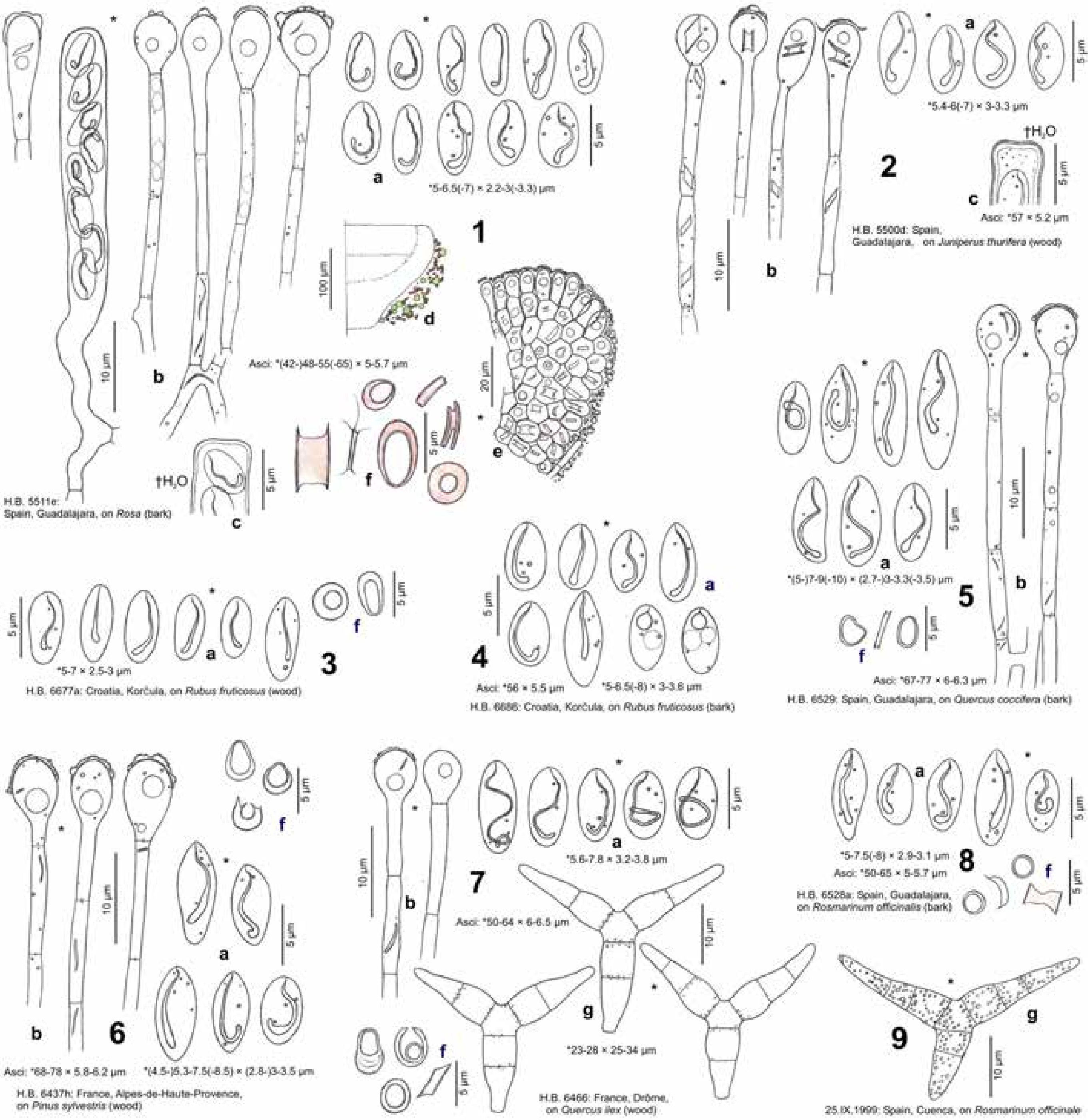


Plate 719. **1–9**: *Orbilia gambelii*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apices; **d**. apothecium in median section; **e**. id., marginal ectal excipulum; **f**. crystalloid SCBs in ectal excipulum; **g**. conidia (**7g** from culture, **9g** from substrate).

O. subclavuliformis {5}, *O. subocellata* {1}, *O. subovoidea* {5}, *O. subtrapeziformis* {1}, *O. subvinosa* {1}, *O. trapeziformis* {1}, *O. tremuloidis* {1}, *O. vinosa* {3}, *O. vitalbae* {1}, *Ostropa barbara* {2}, *Patellaria atrata* {5}, *Patellariopsis dennisii* {1}, *Peniophora quercina* {1}, *Perrotia flammea* {5}, *Phragmiticola* sp. {2}, *Physcia leptalea* {1}, *Pirottaea* ?*imbricata* {1}, ?*Pleospora* sp. {1}, *Propolis farinosa* {2/1}, *P. viridis* {1}, *Pseudolachnea hispidula* {1}, *Psiloglonium lineare* {1}, *Schizoxylon* sp. {1}, *Sclerococcum* sp. {1}, *Teichosporella dura* {1}, *Trichopeziza perrotioides* {1}, *Tryblidaria fenestrata* {3}, *Unguiculariopsis* sp. {2}, *U. ilicincola* {1}, *Xanthoria* ?*parietina* {3}, crustose lichens. **Desiccation tolerance**: within Europe fully viable for at least 3 months (excipular cells and ascospores for 6 months), in North America for up to 2–2.5 years. **Altitude**: 1–138 m a.s.l. (western Europe), 1–1600 m (southern Europe), 1885–2825 m (western North America). **Geology**: Cambrian siltstone & quartzitic wacke, Permian sand-, clay- & limestone, Rotliegend, Middle & Upper Jurassic, Cretaceous & Tertiary clay, lime- & sandstone, dolomite, Quaternary sand, silt & clay, peat; granite, migmatite, gneiss, schist, basaltic and phonolitic lava with andesite & rhyolite. **Phenology**: throughout the year (long-lived).

Phenology of *O. gambelii*											
Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
3	4	7	6	19	11	1	9	12	3	3	4

Taxonomic remarks. *Orbilia gambelii* is characterized by broadly ellipsoid to ovoid or obovoid, partly also fusoid ascospores, rather long, often strongly flexuous, helicoid or uncinate spore bodies, 8-spored asci, and the presence of crystalloid SCBs. *O. pleiogambelii* mainly differs in 16-spored

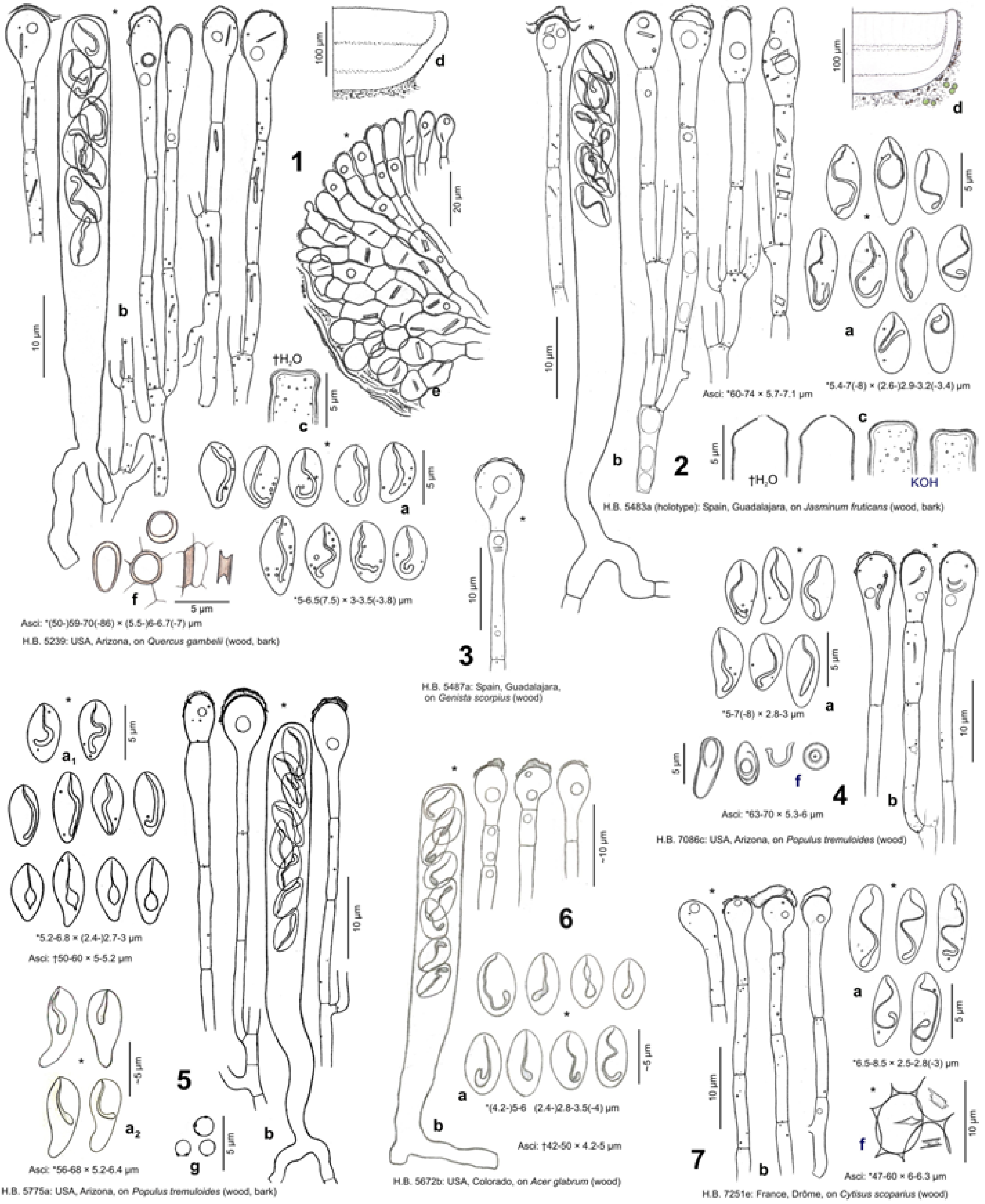


Plate 720. **1–7**: *Orbilia gambelii*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices (partly after discharge); **d**. apothecia in median section; **e**. id., marginal ectal excipulum; **f**. crystalloid SCBs in ectal excipulum; **g**. SCB-like cytoplasmic structure in ectal excipulum.

asci, *O. trapeziformis* in consistently lacking crystalloid SCBs, somewhat longer spores with more tapered apices, and a temperate distribution. *O. subvitalbae* differs in narrower, partly subcylindrical spores and much shorter SBs, *O. cactacearum* in longer, basally more attenuated spores and shorter SBs. For the similar Australian *O. octocercocarpi* see p. 1212.

Variation. In the present circumscription the species shows a remarkable variation in size, length/width ratio, and shape of ascospores and spore bodies, also in ascus size. The spores vary from ovoid-ellipsoid to fusoid, rarely fusoid-clavate, their

Plate 721. **1–7**: *Orbilia gambelii*. – **1a**. *Reynoutria japonica* in a garden in submediterranean western Europe, with dead standing stems (arrow); **3**. partly decorticated xeric branch with *Xanthoria*; **1b–d**, **2a–c**, **4**, **7**. rehydrated apothecia; **1f**, **5a**. ectal excipulum at margin and mid flanks, in median section; **5c**, **7b–c**. crystalloid SCBs in excipular cells at mid flanks; **7d**. asci and paraphyses; **5b**, **7e**. ascospores; **1e**, **6**. spores in asci. – Living state (**7d** middle ascus fully turgescent), except for asci in **1e**, **6**. – **7a–e**: phot. R. Tena. — **1a–f**. H.B. 8124: France, Poitou, on *Reynoutria*; **2a–c**. H.B. 8682a: USA, Arizona, on *Quercus gambelii*; **3**. H.B. 5483a (holotype): Spain, Guadalajara, on *Jasminum*; **4**. H.B. 7664b: La Palma, on *Chamaecytisus*; **5a–c**. H.B. 9094c: Greece, on *Quercus coccifera*; **6**. H.B. 7567b: France, Massif central, on *Ulmus*; **7**. R.T.L. 13083001: Spain, Aragón, on *Rhamnus*.

Map 120. Known distribution of *O. gambelii* in Europe (including Macaronesia and Turkey) and North America.

apices being either consistently rounded to obtuse, or showing a tendency to subacute, and their bases sometimes more tapered and slightly curved, leading to a heteropolar spore shape. The SBs vary in length, being often distinctly longer than the spores and then helicoid and/or basally uncinate. Frequently they are gradually thicker towards base (subulate) but also equally thick (filiform or vermiform), and only sometimes they show a ± abruptly inflated base.

All six collections from Arizona (3× *Quercus gambelii*: Pl. 720: 1, IVV: H.B. 8682a, 8.V.1995; 2× *Populus tremuloides*: Pl. 720: 4–5; 1× *Cercocarpus*, IVV: 17.V.1995) deviate from typical European *O. gambelii* in a strong tendency of the spores to be tapered at the base. In one of them (Pl. 720: 5) crystalloid SCBs could only sometimes be observed, and the spore bases are in some of the examined apothecia partly tail-like and often medium (to strongly) curved, reminiscent of the European *O. trapeziformis* (720: 5a$_2$). But also three collections from Spain (on *Rhamnus*, Pl. 721: 7e; on *Rosmarinus*, 25.IX.1999; on *Amelanchier*, IVV: H.B. 6487d) show rather often ± strongly tapered spore bases. In the specimen on *Rosmarinus* the SBs were only about half as long as the spores, but this might be due to not fully mature apothecia. Similarly short SBs were also illustrated in some other samples, e.g., in that on *Cercocarpus*.

Anamorph. The trinacrium-like conidia obtained in pure culture and from natural substrate (Pl. 719: 7g, 9g) are of the *Trinacrium robustum*-type and do not differ in morphology from those of many other species of section *Habrostictis*.

Phylogeny. Sequences of *O. gambelii* were gained from pure culture of H.B. 6466 (on *Quercus*) and from apothecia of a specimen from southern France (G.M. 2017-08-30.1, on *Clematis*). Both comprise SSU, ITS, and LSU. In the ITS 1 nt of the ITS1 differs between the two strains, while in the overlapping SSU (V7–V9) and LSU (D1–D2) they are identical. Surprisingly, the *Clematis* strain possesses the S1506 intron, whereas the *Quercus* strain lacks it.

When analysing the ITS region or SSU+ITS+LSU, the species clustered with *O. vitalbae*, *O. subvitalbae*, *O. trapeziformis* (H.B. 9139, 9151c) and *O. obtusispora* in the strongly (SSU+ITS+LSU) or medium (ITS) supported *gambelii-vitalbae* clade (Phyls 19–20), showing a 4% distance to *O. subvitalbae* and 6% to the other three species (0.5–1% in LSU). This relationship is also seen in analyses of SSU (S20), but less so in the LSU (S22). When analysing the intron *O. gambelii* surprisingly clustered with *O. cisti* in a strongly supported clade (S21).

Ecology. *O. gambelii* was found on rotten wood and bark of xeric twigs and branches of both gymno- and angiosperm trees and shrubs, sometimes also on standing herbaceous stems of large dicotyledonous plants. The species is widely distributed in warm-temperate humid (sub)atlantic western Europe and especially in orosub- to thermomediterranean, mainly semihumid to semiarid southern Europe. Here it belongs to the most frequently collected desiccation-tolerant species, occurring in the semihumid maquis (e.g., *Juniperetum thuriferae*) and old *Olea* plantations as well as in humid conifer or broad-leaved forests and shrublands. In Macaronesia it was found in inframediterranean semiarid zones (*Periploco laevigatae-Euphorbietum canariensis*) as well as in a thermomediterranean semihumid *Chamaecytisus* (tagasaste) plantation and in the upper meso- to supramediterranean semihumid summit broom scrub (*Spartocytisetum supranubii*). An isolated sample from the southeast of Slovakia was made in a thermophilous (xerophilous) pannonian oak grove in the Danubian lowlands. This and one from eastern France (Haut Jura) represent the only records from temperate humid central Europe.

Collections from western North America were made in cold-temperate (to boreal) humid ponderosa pine forests, also in Douglas fir mixed forests or once in the upper zone of the subhumid pinyon-juniper woodland, in Southern Rocky Mountains, Utah Mountains, Grand Canyon, and Mogollon Rim.

Specimens included. **FRANCE**: **Bretagne**, **Morbihan**, 3 km NW of La Gacilly, km S of La Villio, 32 m, twigs of *Euonymus europaeus*, on wood, 28.III.2013, J.P. Priou (J.P.P. 13051, doc. vid.). – 1.7 km NNE of La Gacilly, NE of Les Villes Geffs, Pont des Boussards, rivulet of Rahun, 11 m, twig of *E. europaeus*, on wood, 27.III.2013, J.P. Priou (J.P.P. 13047, doc. vid.). – 0.4 km NE of La Gacilly, E of Cimetière, 11 m, twig of *E. europaeus*, on wood, 8.III.2013, J.P. Priou (J.P.P. 13027, doc. vid.). – La Gacilly, Hotel de France, 22 m, branch of *Syringa vulgaris*, on wood, 11.I.2012, J.P. Priou (J.P.P. 12018, doc. vid.). – ibid., Rue Marcel Chesnais, 20 m, branch of *Passiflora caerulea*, on wood, 25.II.2011, J.P. Priou (J.P.P. 11026, non vid.). – 1 km WNW of La Gacilly, Gazeau, rue de Picardie, 24 m, twig & branch of *P. caerulea*, on wood, 17.II.2011, J.P. Priou (J.P.P. 11014, doc. vid.). – ibid., 20.X.2011, J.P. Priou (ø, non vid.). – 1.3 km W of La Gacilly, W of La Glouzie, Buhan, 57 m, branch of *Ilex aquifolium*, on wood, 16.II.2012, J.P. Priou (J.P.P. 12043, doc. vid.). – 7.5 km SSE of Vannes, 2.8 km SSE of Séné, W of Montsarac, 1 m, branch of *Ulex europaeus*, on wood, 13.VI.2009, J.P. Priou (J.P.P. 29120, doc. vid.). – **Poitou-Charentes**, **Deux-Sèvres**, Melle, lycée Joseph Desfontaines, 138 m, branch of *Juniperus*, on wood, 29.IV.2011, M. Pennanen (H.B. 9505 ø). – 7 km ESE of Beauvoir-sur-Niort, E of Villiers-en-Bois, W-end of Virollet, 89 m, stem of *Reynoutria japonica*, 23.IV.2006, H.O. Baral & S. Helleman (H.B. 8124). – 14 km WSW of Niort, 1.2 km NNE of Amuré, Marais Poitevin, Port Goron, 5 m, twig of *Euonymus europaeus*, 29.IV.2011, S. Helleman (S.H. 698). – branch of *Fraxinus excelsior*, on wood, 29.IV.2011, E. Weber (H.B. 9504 ø). – **Rhône-Alpes**, **Ain**, Haut Jura, 20 km NNE of Bourg-en-Bresse, 1.5 km SSW of Coligny, 265 m, branch of *Juglans regia*, on wood, 19.IX.1999, H.O. Baral (H.B. 6460 ø, anam. substr.). – **Drôme**, 1 km N of Nyons, Col du Pontias, 460 m, branch of *Cercis siliquastrum*, on boring dust, 13.VIII.2009, G. Marson (ø). – 16.3 km E of Nyons, 1.5 km NNW of Bellecombe, Col de Soubeyrand, 880 m, branch of *Cytisus scoparius*, on wood, 10.X.2002, G. Marson (H.B. 7251e ø). – **Provence-Alpes-Côte d'Azur**, **Hautes-Alpes**, 7 km NNE of Jausiers, 3.2 km WNW of Meyronnes, NNW of Les Gleizolles, 1347 m, branch of *Clematis vitalba*, on wood, 30. VIII.2017, G. Marson (G.M. 2017-08-30.1; sq.: MH221050). – **Alpes-de-Haute-Provence**, 24 km S of Digne, 3.3 km NNW of Moustiers-Ste.-Marie, N of Canyon du Verdon, 970 m, branch of *Pinus sylvestris*, on wood, 6.VIII.1999, G. Marson (H.B. 6437b). – Mercantour, 13.5 km SE of Seyne-les-Alpes, 5.5 km SW of Tête de l'Estrop, SE of Vière, 1350 m, branches of *Salix*, on wood, 16. IX.2011, G. Marson (ø). – 10 km ESE of Sederon, W of Curel, 765 m, twig of *Spartium junceum*, on wood, 17.VIII.2001, G. Marson (ø). – 2.5 km N of Colmars-les-Alpes, WSW of Chaumie-Haut, 1455 m, branch of *Juglans regia*, on wood, 11.VI.2010, J.P. Priou (J.P.P. 10131 ø, H.B. 9425). – **Vaucluse**, 14 km SE of Carpentras, 4 km SE of Venasque, 485 m, branch of *Lonicera* (?)*xylosteum*, on bark, 9.X.2002, G. Marson (ø). – **Languedoc-Roussillon**, **Gard**, 25 km NW of Nîmes, 7 km NNE of Remoulins, SSE of Valliguières, 135 m, branches of *Quercus ilex*, on wood, 20.IX.1999, H.O. Baral (H.B. 6466, anam. cult., CBS 140815; sq.: KT215249). – **Midi-Pyrénées**, **Aveyron**, 8 km ENE of Rodez, NE of Canabols, 560 m, branch of *Ulmus minor*, on wood, 25.VIII.2004, G. Marson (H.B. 7567b ø). — **SPAIN**: **Galicia**, **Lugo**, 30 km ESE of Monforte de Lemos, 1 km ESE of Montefurafo, 187 m, branch of *Ficus carica*, on wood, 27.XII.2006, J.P. Priou (J.P.P. 26228 ø, doc. vid.). – **Navarra**, 26 km SW of Carcastillo, 1 km NW of Valtierra, Bardenas Reales, 275 m, wood of *Olea europaea*, 22.XII.2007, J.P. Priou (J.P.P. 27144 ø, doc. vid.). – **Aragón**, **Teruel**, 21 km WSW of Montalbán, SW of Pancrudo, 1220 m, twig of *Rosa*, on wood, 31.III.2013, R. Tena (R.T.L. 13033101, doc. vid.). – W of Pancrudo, 1250 m, branch of *Rhamnus myrtifolia*, on wood, 30.VIII.2013, R. Tena (R.T.L. 13083001, doc. vid.). – Sierra de Albarracín, 25 km WNW of Teruel, 5 km ENE of Albarracín, 1090 m, branch of *Salix*, on wood, 16.V.2015, J.P. Priou (J.P.P. 15128, doc. vid.). – 50 km ESE of Teruel, 4.5 km SW of Cortes de Arenoso, Rio de Roche, 828 m, branches of *Ficus carica*, on wood, 26.IX.1999, H.O. Baral & G. Marson (H.B. 6492). – **Castilla-La Mancha**, **Cuenca**, 43 km NE of Cuenca, 8 km SW of Guadalaviar, S of Mt. Mogorrit, 1600 m, twig & branch of *Prunus domestica*, on wood, 26. IX.1999, H.O. Baral & G. Marson (H.B. 6487d). – 28 km NE of Cuenca, 1 km SW of Beamud, 1320 m, branch of *Rosa*, on wood, 25.IX.1999, G. Marson (ø). – Sierra de Cuenca, 6 km ENE of Cuenca, 4 km NW of Palomera, 1120 m, twigs of *Rosmarinus officinalis*, on wood, 25.IX.1999, G. Marson (ø, anam. substr.). – 9 km SSE of Priego, 0.9 km NW of Albalate de las Nogueras, 830 m, twigs of *Rosa*, on wood, 26.IV.2015, J.P. Priou (J.P.P. 15106, doc. vid.). – 18 km SSE of Cuenca, 2.3 km SE of Villar del Saz de Arcas, 1200 m, twig of *Rosa*, 27.IV.2015, J.P. Priou (J.P.P. 15111, doc. vid.). – **Guadalajara**, 9 km S of Guadalajara, 2.5 km SSW of Chiloeches, 923 m, branch of *Rosmarinus officinalis*, on bark, 20.V.1996, H.O. Baral (H.B. 5485a). – ibid., branch of *Quercus rotundifolia*, on wood, 20.V.1996, H.O. Baral (ø). – ibid., branches of *Genista scorpius*, on wood, 20.V.1996, H.O. Baral (H.B. 5487a). – ibid., branch of *Lonicera etrusca*, 20.V.1996, R. Galán & H.O. Baral (ø). – twig & branches of *Jasminum fruticans*, on wood & bark, 20.V.1996, H.O. Baral (ex H.B. 5483a, M-0140894, **holotype**; AH 7639, **isotype**). – 18 km SW of Sigüenza, 2.5 km NE of Almadrones, 1065 m, branch of *Cistus*, on wood, 24.IX.1999, H.O. Baral (ø). – 43 km NNW of Guadalajara, 2 km NNW of Tamajón, Ermita de los Enebrales, 1040 m, branch of *Juniperus thurifera*, on wood, 14.V.1996, H.O. Baral (H.B. 5500d). – ibid., branch of *Genista scorpius*, on wood, 14.V.1996, H.O. Baral (ø). – branches of *Rosa*, on bark, 14.V.1996, H.O. Baral (H.B. 5511e). – Meseta Central, 38 km ESE of Guadalajara, 8 km S of Alocén, 2.3 km NW of Sacedón, Pantano de Entrepeñas, 755 m, branch of *Quercus coccifera*, on bark, 25.IX.1999, H.O. Baral (H.B. 6529). – ibid., branch of *Rosmarinus officinalis*, on bark, 25.IX.1999, H.O. Baral (H.B. 6528a). – 0.8 km SSE of Alocén, Pantano de Entrepeñas, 930 m, branch of *Olea europaea*, on bark, 25.IX.1999, H.O. Baral (ø). – ibid., twigs of *Calicotome villosa*, on bark, 25.IX.1999, H.O. Baral (ø). – 9 km ENE of Alcalá de Henares, SSW of Los Santos de la Humosa, 875 m, branch of *Quercus rotundifolia*, on wood & bark, 23.V.1996, H.O. Baral (H.B. 5496a). – **Com. Valenciana**, **Castellón**, 51 km W of Castellón, 6 km SE of Barracas, 980 m, branch of *Ulex parviflorus*, on wood, 4.I.2008, J.P. Priou (J.P.P. 28007, doc. vid.). – **Andalucía**, **Granada**, 28 km NE of Guadix, 6 km E of Baúl, 1384 m, branch of *Rosmarinus officinalis*, on bark, 16.V.2015, J.P. Priou (J.P.P. 15126, doc. vid.). – **Extremadura**, **Cáceres**, 9.3 km SE of Jarandilla de la Vera, 8.5 km NNE of Talayuela, Cuestas de Torresca, 363 m, branch of *Eucalyptus camaldulensis*, on bark, 28.II.2016, E. Rubio (E.R.D. 6658, doc. vid.). — **PORTUGAL**: **Santarém**, Ribatejo, 10 km NNW of Santarém, 2.3 km NE of Romeira, Val de Flores, 60 m, branch of *Olea europaea*, on wood, 5.V.2009, J.P. Priou (J.P.P. 29081, doc. vid.). — **SLOVAKIA**: **Bratislava**, 10 km SE of Bratislava, 4.8 km S of Podunajské Biskupice, Topoľové hony, 130 m, branch of *Clematis vitalba*, on bark, 18.V.2019, A. Polhorský (A.P. 19/20, doc. vid.). — **SERBIA**: **Vojvodina**: 12 km WSW of Novi Sad, 2 km NW of Beočin, N of Brazilija, 74 m, branch of *Populus × canadensis*, on wood, 13.XII.2019, D. Savić (doc. vid.). – 7.5 km WSW of Sremska Mitrovica, 2.2 km E of Zasavica, 76 m, branch of *Salix alba*, on bark 21.XI.2019, D. Savić (doc. vid.). — **CROATIA**: **Dubrovnik-Neretva**, **Korčula**, 11.5 km W of Korčula, 2 km W of Račišće, below Samograd cave, 40 m, branch of *Olea europaea*, on bark, 4.VI.2000, H.O. Baral & N. Matočec (CNF 2/4465, 4480). - ibid., stem of *Opopanax*, 4.VI.2000, N. Matočec (CNF 2/4470, H.B. 6686 ø). – 1.5 km W of Račišće, S of Zaglavak peak, 50 m, branch of *Rubus fruticosus*, on bark, 4.VI.2000, H.O. Baral (H.B. 6677a ø). – 2.5 km W of Korčula, NW of Žrnovska Banja, Vrbovica bay, 1 m, branch of indet. angiosperm, on wood, 1.VI.2000, H.O. Baral (H.B. 6671b). – ibid., branch of *Quercus coccifera*, 24.VIII.2000, N. Matočec (H.B. 7012b ø, non vid.). – **Split-Dalmatia**, Dinaric Alps, 3.2 km ENE of Zagvozd, 11 km WSW of Imotski, podr. Brežine, 635 m, branch of *Petteria ramentacea*, on wood, 27.VII.2000, N. Matočec (CNF 2/ 4546, 4550, 4558 & 4560). — **MONTENEGRO**: 15 km NNW of Podgorica, 1.9 km NE of Donje Selo, Glizica, 210 m, twig of *Punica granatum*, on wood & bark, 1.V.2016, B. Perić (B.P. Dgf/C7D-01-05-16a, doc. vid.). — **GREECE**: **Central Macedonia**, 10 km NE of Kalamaria, 1.3 km E of Asvestochori, 550 m, branch of *Carpinus betulus*, on wood, 1.III.2015, T. Giannakis, vid. B. Wergen (ø, doc. vid.). – **Peloponnese**, 8 km SW of Epidauros, 4 km ESE of Asklipieio, S border of amphitheatre, 365 m, branch of *Quercus coccifera*, on wood & bark, 10.VI.2009, S. Helleman (H.B. 9098a). – ibid., NW of amphitheatre, 335 m, branch of *Q. coccifera*, on wood, 10.VI.2009, S. Helleman (H.B. 9094c). – **South Aegean**, **Rhodos**, 17 km WSW of Archangelos, 4.5 km NNW of Laerma, 185 m, twig of indet. angiosperm, on wood, 21. III.2010, V. Kummer (H.B. 9332a ø). – 17 km WNW of Archangelos, 1 km SSE of Salakos, NNE of Profitis Ilias, 495 m, branch of *Anagyris foetida*, on wood & bark, 20.III.2010, V. Kummer (H.B. 9353b ø). — **TURKEY**: **Marmara**, **Balıkesir**, 51 km WSW of Balıkesir, 2.7 km WNW of Korucu, NE of Büyükilica Bridge, 330 m, branch of *Quercus ilex*, 23.XI.2002, T. Askun (T.A. 41b, H.B. 7417b ø, doc. vid.). — **MACARONESIA**: **Canary Islands**, **La Palma**, 2.5 km E of El Paso, Centro Visitantes, 845 m, branch of *Chamaecytisus proliferus*, on wood, 15.I.2005, P. Karasch (H.B. 7664b). – **Tenerife**, La Laguna, Anaga, 6 km NE of Tegueste, 1.2 km NW of Chinamada, Andén de la Cruz, 337 m, on *Echium leucophaeum*, 29.XII.2013, L. Quijada & E.V. Rodríguez (TFC Mic. 24443). – ibid., on *Rubia fruticosa*, 29.XII.2013, L. Quijada & E.V. Rodríguez (TFC Mic. 24447). – La Orotava, 6 km SSE of Teide, Cañada de la Mareta, 2190 m, on *Carlina xeranthemoides*, 5.XI.2012, L. & C. Quijada (TFC Mic. 23751). – ibid., Cuesta la Burra, 2078 m, branch of *Adenocarpus viscosus*, on wood, 30. XII.2013, L. & C. Quijada (TFC Mic. 24371). — **USA**: **Colorado**, Southern Rocky Mountains, ~26 km NNW of Boulder, WNW of Lyons, ~1885 m, branch of *Acer glabrum*, on wood, 13.VI.1996, G. Marson (H.B. 5672b). – **Utah**, Utah Mts., Dixie Forest, 27 km SSE of Torrey, 18 km S of Grover, 2825 m, branch of *Salix ?bebbiana*, 15.V.1995, G. Marson (H.B. 5410b ø). – **Arizona**, Grand Canyon, Kaibab Plateau, 93 km SSE of Fredonia, S of North Rim, 2500 m, branch of *Cercocarpus ledifolius*, 17.V.1995, G. Marson (ø). – Coconino Plateau, 3 km N of Tusayan, 2068 m, branch of *Quercus gambelii*, on bark & wood, 28.VIII.1994, G. Marson (H.B. 5239). – Mogollon Rim, 28 km WNW of Flagstaff, 23 km E of Williams, SE of Parks, 2166 m, branches of *Q. gambelii*, on bark, 29.VIII.1994, G. Marson (H.B. 8682a). – 23 km NW of Flagstaff, San Francisco Peaks, 10.5 km WNW of Humphreys Peak, Rte. 180, 2450 m, branches of *Populus tremuloides*, on wood, 12.VI.2000, G. Marson (H.B. 7086c). – 9 km SSW of Humphreys Peak, Rte. 180, 2250 m, branches of *P. tremuloides*, on bark & wood, 9.V.1995, G. Marson (H.B. 5775a, anam. substr.). – 22 km SSW of Flagstaff, 17.5 km N of Sedona, Oak Creek Viewpoint, 1955 m, branch of *Quercus gambelii*, 8.V.1995, G. Marson (ø).

Orbilia pleiogambelii Baral, **sp. nov.**, MB 813718 — Pls 722–723, Map 121

Etymology: named after the resemblance to *O. gambelii* but differing in 16-spored asci.

Typification: Spain, Alocén, branch of *Calicotome villosa*, 25.IX.1999, G. Marson & H.O. Baral (ex H.B. 6482a, M-0276558, holotype).

Latin diagnosis: *Similis* Orbiliae gambelii *sed asci 16-spori.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.15–0.4 mm diam., 0.13–0.19 mm high, pale to bright (partly dirty) orange,

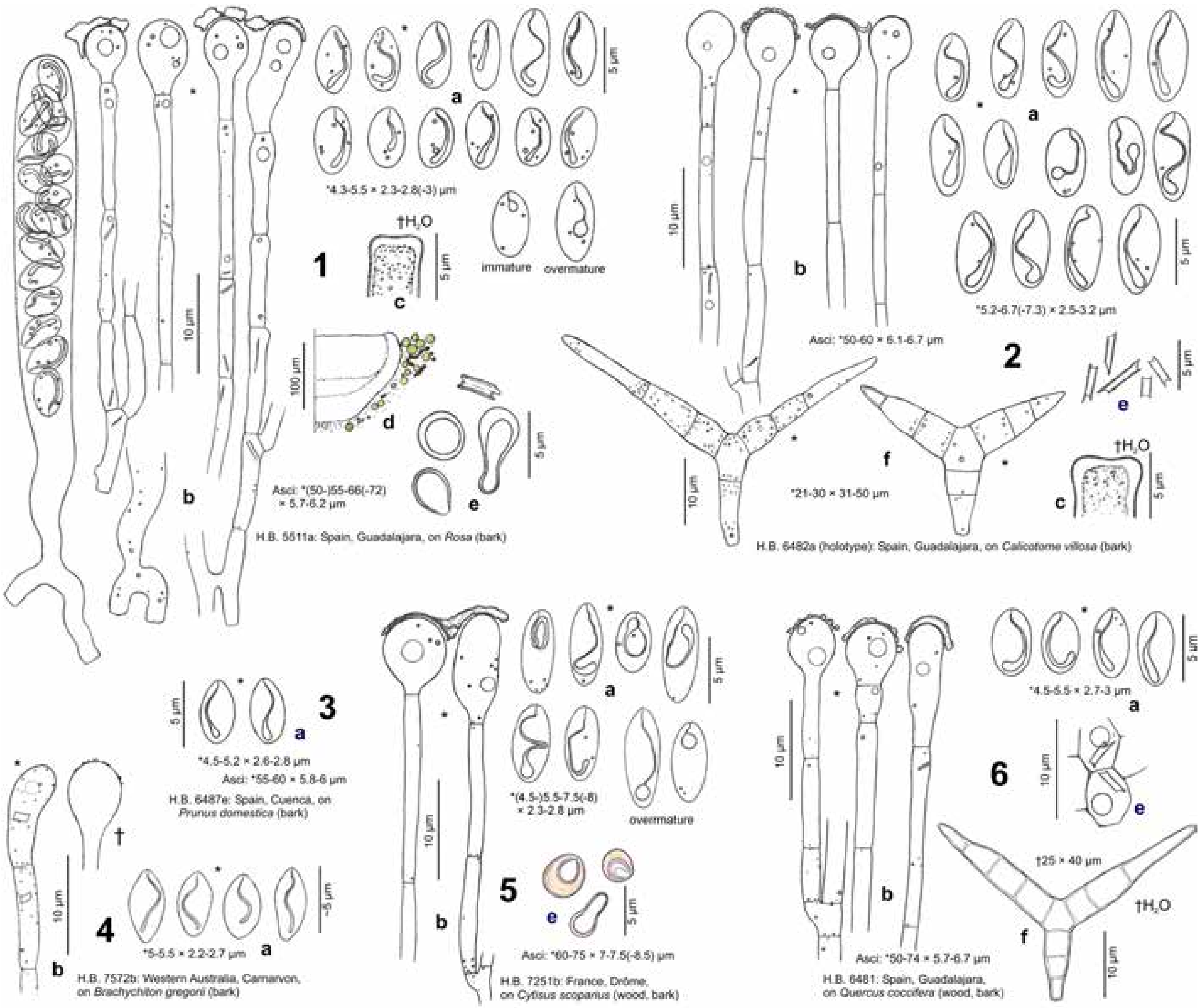


Plate 722. **1–3**, **5–6**: *Orbilia pleiogambelii*; **4**: *O.* cf. *pleiogambelii*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apices; **d**. apothecium in median section; **e**. crystalloid SCBs in ectal excipulum; **f**. conidia from substrate.

translucent, round, ± scattered to subgregarious; disc flat, margin distinct or not, 0–5 µm protruding, smooth; sessile, superficial or distinctly erumpent between fibres. **Asci** *(50–)55–71(–75) × (5.7–)6–7.5(–8.5) µm {6}, †50–60(–72) × (4.5–)5–6.3 µm {3}, 16-spored, spores 1–2-seriate, (5–)7–10 lower spores inverted {4} (often mixed), pars sporifera *29–48 µm long; **apex** (†) strongly truncate (distinctly indented, laterally inflated); **base** with short, ± thick, flexuous stalk, L- or h-shaped. **Ascospores** *(4.3–)5.2–7(–8) × (2.3–)2.5–3.3(–3.5) µm {11}, narrowly ellipsoid to ellipsoid(-ovoid), apex rounded to obtuse, straight, rarely slightly inequilateral; **SBs** *(3–)4–6.5(–7) × (0.2–)0.4–0.9(–1.2) µm in situ {9}, ~(4–)6–9(–10) µm actual length, subulate or filiform with slightly to strongly inflated, tear-shaped base, often strongly flexuous to helicoid, sometimes uncinate, in aged spores with globose lower and filiform upper part. **Paraphyses** apically slightly to very strongly clavate-capitate, terminal cells *6–15(–19) × 3.5–5.5(–6.3) µm {6}, lower cells *(4–)8–16(–19) × 1.2–2.2(–3) µm {4}; rarely branched at upper septum. **Medullary excipulum** hyaline, 25–90 µm thick, of ± dense textura intricata with many inflated cells, indistinctly or medium sharply delimited from ectal excipulum (partly by a t. porrecta). **Ectal excipulum** of thin-walled, ± vertically oriented t. angularis-prismatica from base to margin, 40–50 µm thick near base, cells *8–20 × 5–13 µm {3}; 15–20 µm thick near margin, oriented at a 30–45° angle to the surface, marginal cortical cells *5–12 × 2.5–5 µm {2}. **Anchoring hyphae** sparse, *2–3 µm wide, walls 0.2–0.3 µm thick {2}. **SCBs** in paraphyses globose (near apex) or rod-shaped (towards base, abundant, small); in ectal excipulum globose, or ring- (to horseshoe-) shaped {9}, 2.5–6.5 × 2.5–4 µm, hyaline to pale orange. **Exudate** over paraphyses 0.3–1(–2.5) µm thick, cloddy(-granular), ± loosely

Map 121. Known distribution of *O. pleiogambelii* in Europe and Macaronesia.

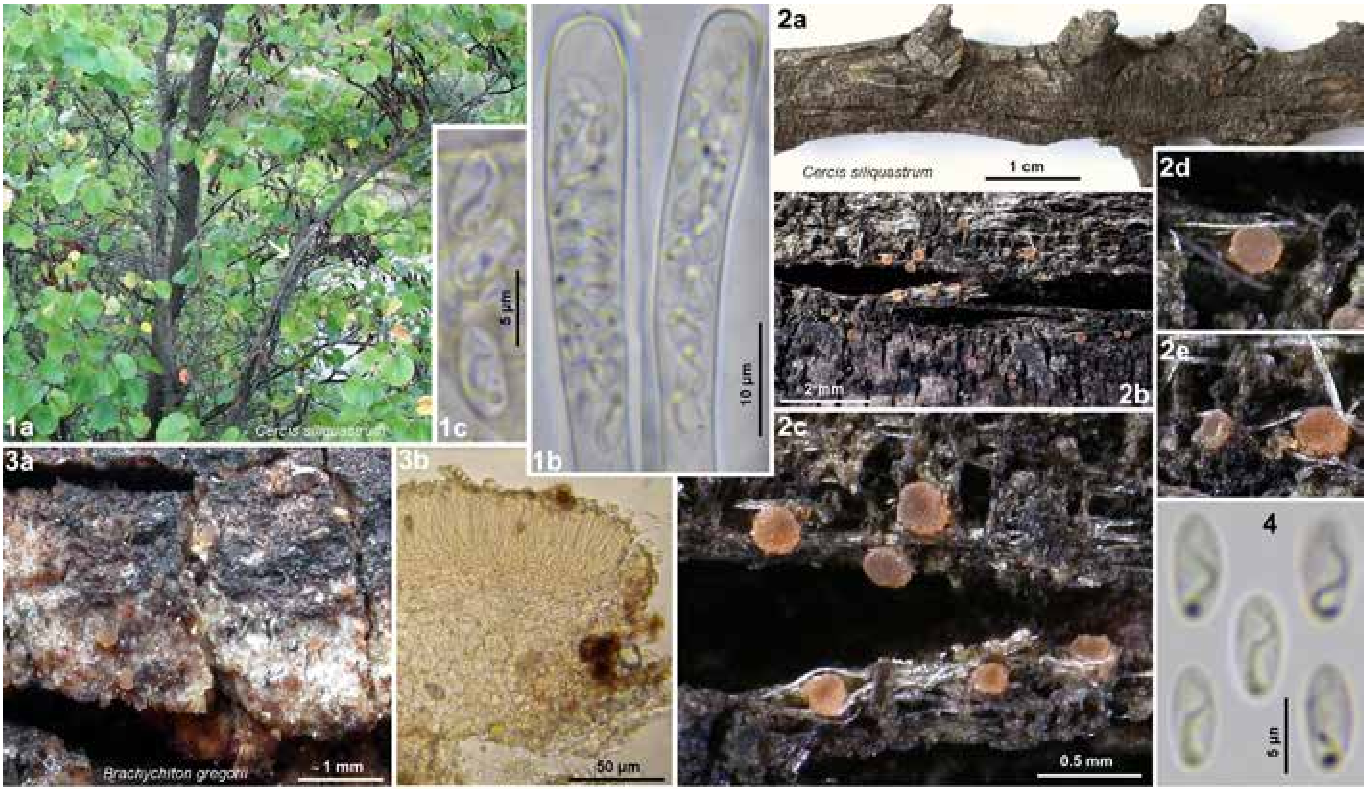


Plate 723. **1–2**, **4**: *Orbilia pleiogambelii*; **3**: *O.* cf. *pleiogambelii*. – **1a**. Mediterranean maquis with *Cercis* shrub at roadside with dead branches; **2a**. corticated xeric branch; **2b–e**, **3a**. rehydrated apothecia; **3b**. apothecium in median section; **1b**. asci; **1c**, **4**. ascospores. – Living state. — **1a–c**. H.B. 9182d: France, Nyons, on *Cercis*; **2a–e**. H.B. 7272d: ibid.; **3a–b**. H.B. 7572b: Western Australia, Carnarvon, on *Brachychiton*; **4**. S.T. 03051502: Spain, Andalucía, on *Berberis*.

attached; over margin and flanks 1–2.5 µm thick, pale chlorinaceous. — **ANAMORPH**: trinacrium-like (presumed, from natural substrate {2}). **Conidiophores** not seen. **Conidia** Y-shaped, total size */†21–30 × 31–50 µm, stipe */†10.5–13 × 4–5 µm, 1–3-septate, arms ± gradually tapering, */†15–28 × 4.5–5 µm, 2–3(–4)-septate {2}.

Habitat: collected 0.1–3 m above the ground, corticated or ± decorticated, 2–20 mm thick twigs and branches of *Adenocarpus viscosus* {1}, *Berberis hispanica* {1}, *Calicotome villosa* {1}, *Cercis siliquastrum* {2}, *Cistus* sp. {1}, *Cytisus scoparius* {1}, *Prunus domestica* {1}, *Quercus coccifera* {1}, *Rosa* sp. {1}, *Spartium junceum* {2}, on 0.1–0.2 mm deep medium to strongly decayed wood {6} and bark {7} (± detaching, often on bast, periderm partially removed), slightly to strongly greyed, with a few to many green algae, sometimes in beetle galleries. **Associated**: *Baggea* sp. {1}, *B. pachyascus* {1}, ?*Calloria* sp. {1}, *Caloplaca* sp. {1}, '*Chlorosplenium*' *viridulum* {1}, *Claussenomyces* sp. {1}, *Durella connivens* {2}, ?*Evernia* sp. {1}, *Hyalorbilia erythrostigma* {1}, *Ionomidotis fulvotingens* {1}, *Mellitiosporiella pulchella* {2}, *Mollisia rosae* {1}, *Nitschkia* ?*broomeana* {1}, *Orbilia adenocarpi* {1}, *O. carpoboloides* {1}, *O.* ?*cejpii* {1}, *O. cercidicola* {1}, *O. delphinus* {1}, *O. gambelii* {5}, *O. myriosphaera* {2}, *O. ovalis* {1}, *O. polyspora* {3}, *O. rosicola* {1}, *O. sarothamni* {1}, *O. subaristata* {3}, *O. subclavuliformis* {4}, *O. subovoidea* {1}, *O. subtrapeziformis* {1}, *O.* ?*tremulae* {1}, *O. vinosa* {2}, *O. xanthoguttulata* {1}, *Ostropa barbara* {1}, *Patellaria atrata* {1}, *Propolis farinosa* {1}, *Perrotia flammea* {1}, *Schizoxylon* {1}, *Trichosphaerella decipiens* {1}. **Desiccation tolerance**: fully viable for at least 3 months, conidia viable for 3 years. **Altitude**: 383–880 m a.s.l. (southern France), 930–1600 m (Spain), 2230 m (Tenerife). **Geology**: Cretaceous & Tertiary lime-, marl- & sandstone, dolomite; phonolitic flow. **Phenology**: V, VIII–X (certainly throughout the year, long-lived).

Taxonomic remarks. *O. pleiogambelii* closely resembles *O. gambelii*, from which it merely differs in the consistently 16-spored asci. The 16-spored *O. microserpens* has similar but distinctly smaller spores and lacks any crystalloid and globose SCBs. Also *O. cisti* and *O. pleioserpens* differ in the consistent absence crystalloid and partly also globose SCBs. The extra-European *O. barrowensis* differs in distinctly wider spores whereas the also extra-European *O. pleioungulata* has narrower spores and shorter asci. The North American *O. cercocarpi* (p. 1213) is only tentatively separated from *O. pleiogambelii*.

Variation. Like *O. gambelii*, *O. pleiogambelii* varies in ascospore and SB length, also in the strength of basal inflation of SBs.

Not included collection. In an Australian sample (Pls 722: 4; 723: 3) only a few paraphyses were viable, therefore, the presence of crystalloid SCBs is uncertain. The rather short spores are more fusoid, and the SBs are filiform down to the base similar as in *O. cercocarpi* and *O. cisti*, or in *O.* cf. *pleioserpens* (Pl. 736: 4–5).

Anamorph. The conidia observed near apothecia of *O. pleiogambelii* are similar to those of *O. gambelii*, but tend to have longer arms (Pl. 722: 2f, 6f).

Ecology. *O. pleiogambelii* inhabits ± rotten wood and bark of xeric twigs and branches of various angiosperm shrubs and also trees. It was collected in supra- to mesosubmediterranean and supra- or mesomediterranean semihumid, rarely orosubmediterranean humid, maquis and forests of southern Europe (*Quercetum ilicis*, *Juniperetum thuriferae*, pine forest with *Rhus coriaria*, mixed conifer forest with *Amelanchier ovalis*) also in the upper mesomediterranean semihumid summit broom scrub (retamar, *Spartocytisetum supranubii*) in the caldera of the volcano Teide (Tenerife, Macaronesia). The not included collection on *Brachychiton* was on Cenozoic regolith in a subtropical semiarid acacia open woodland in western Australia.

Specimens included. **FRANCE**: **Rhône-Alpes**, **Drôme**, 16.3 km E of Nyons, 2.5 km NNW of Bellecombe, Col de Soubeyrand, 880 m, twig of *Cytisus scoparius*, on wood & bark, 10.X.2002, G. Marson (H.B. 7251b). – 1 km N of Nyons, Col du Pontias, 460 m, branch of *Cercis siliquastrum*, on bark,

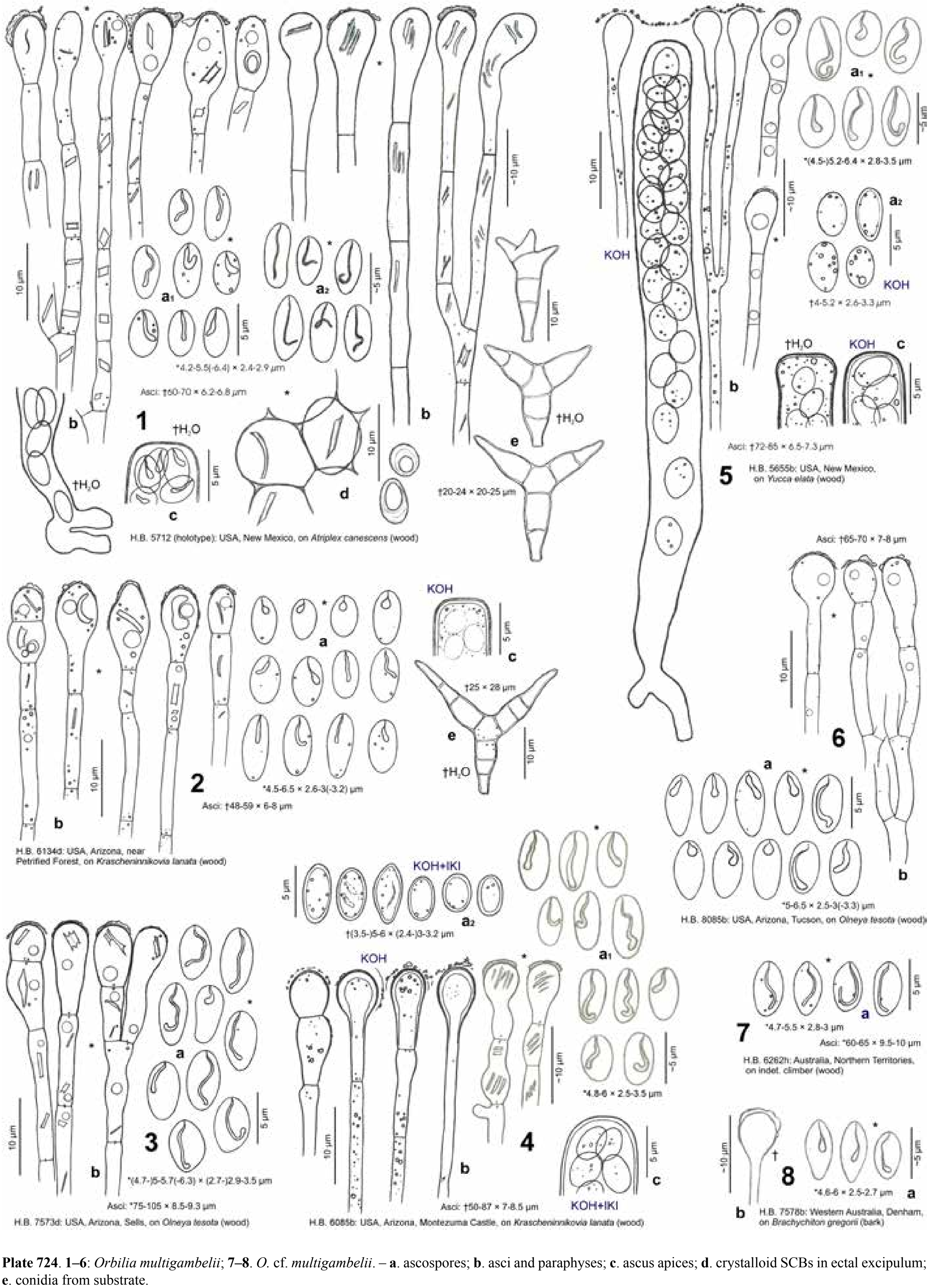


Plate 724. **1–6**: *Orbilia multigambelii*; **7–8**. *O.* cf. *multigambelii*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. crystalloid SCBs in ectal excipulum; **e**. conidia from substrate.

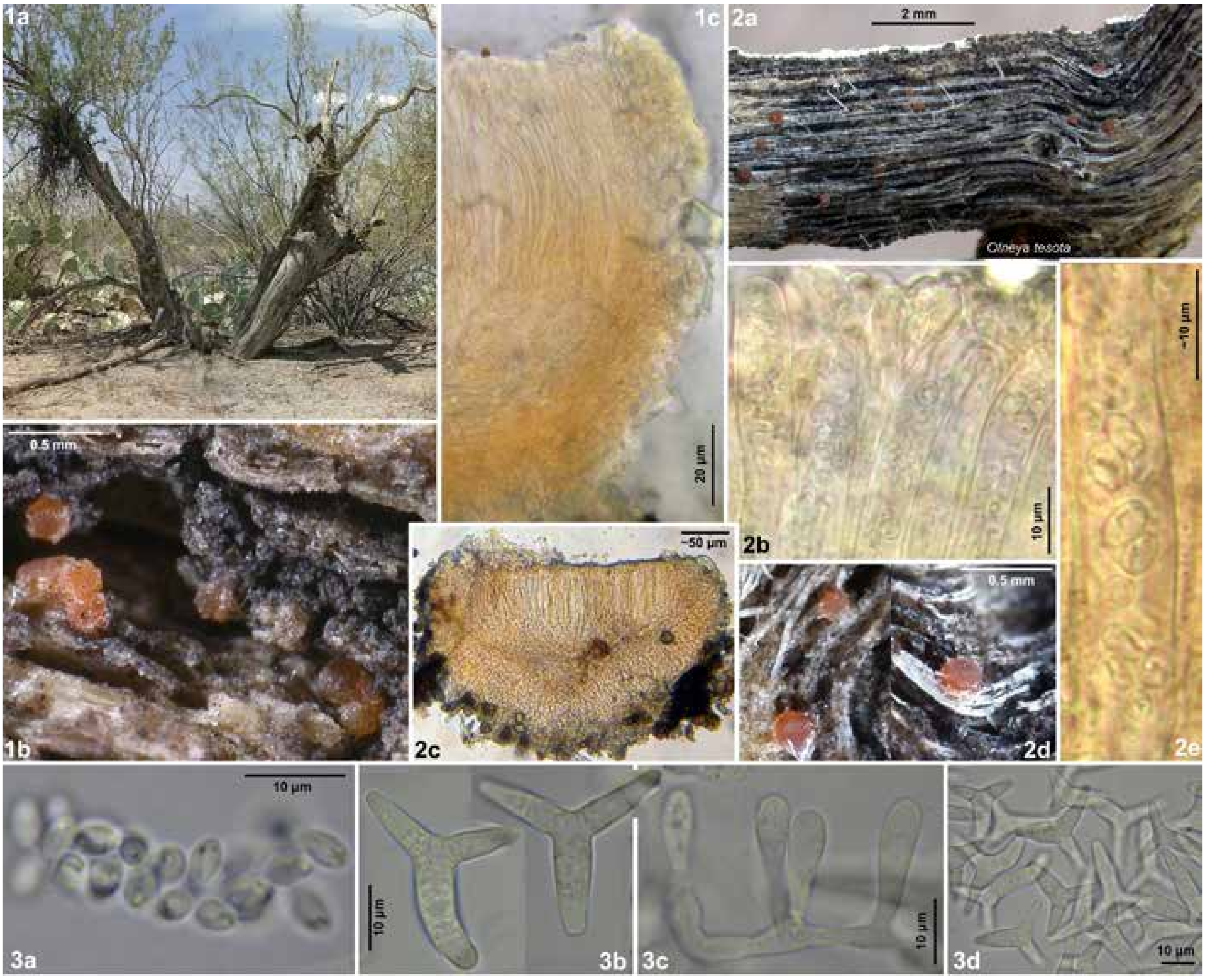


Plate 725. **1–3**: *Orbilia multigambelii*. – **1a**. semiarid paloverde-mixed cacti desert scrub with *Olneya tesota*, *Larrea tridentata* and *Opuntia engelmannii*; **1b**, **2a**, **d**. rehydrated apothecia; **2c**. apothecium in median section; **1c**. id., ectal excipulum at margin and flanks; **2b**, **e**. asci and paraphyses; **2e**, **3a**. ascospores (**3a** freshly ejected spore cluster); **3b**, **3d**. conidia from culture; **3c**. young conidia emerging from conidiophores. – Living state. — **1a–c**. H.B. 8085b: USA, Arizona, on *Olneya*; **2a–e**. H.B. 7573d: ibid.; **3a–d**. 4.XI.2007: Australia, Pilbara, on *Acacia*.

11.X.2002, G. Marson (H.B. 7272d). – 10 km ENE of Nyons, 1 km N of Curnier, Rte. D94, 383 m, branch of *C. siliquastrum*, 12.VIII.2009, G. Marson (H.B. 9182d ø). – **Provence-Alpes-Côte d'Azur**, **Alpes-de-Haute-Provence**, 10 km ESE of Sederon, 0.8 km W of Curel, 765 m, twig of *Spartium junceum*, on wood, 17.VIII.2001, G. Marson (ø). – **Vaucluse**, 18 km SE of Carpentras, 9 km NNW of Roussillon, ESE of Col de Murs, 552 m, branch of *S. junceum*, on wood, 9.X.2002, G. Marson (ø). — **SPAIN**: **Castilla-La Mancha**, **Cuenca**, Sierra de Albarracín, 43 km NE of Cuenca, 8 km SW of Guadalaviar, S of Mt. Mogorrit, 1600 m, branch of *Prunus domestica*, on bark, 26.IX.1999, H.O. Baral & G. Marson (H.B. 6487e). – **Guadalajara**, 36 km ESE of Guadalajara, SSE of Alocén, Pantano de Entrepeñas, 930 m, branch of *Calicotome villosa*, on bark, 25.IX.1999, G. Marson & H.O. Baral (ex H.B. 6482a, M-0276558, **holotype**, anam. substr.). – 18 km SW of Sigüenza, 2.5 km NE of Almadrones, 1065 m, branch of *Quercus coccifera*, on wood & bark, 24.IX.1999, H.O. Baral (H.B. 6481, anam. substr.). – ibid., branch of Cistus, on wood (ø). – Sierra de Guadarrama, 43 km NNW of Guadalajara, 2 km NNW of Tamajón, Ermita de los Enebrales, 1040 m, branch of *Rosa*, on bark, 14.V.1996, H.O. Baral (H.B. 5511a ø). – **Andalucía**, **Jaén**, 22 km S of Jaén, 1.7 km SE of Valdepeñas de Jaén, 1142 m, twig of *Berberis hispanica*, on bark, 3.V.2015, S. Tello (S.T. 03051502). — **MACARONESIA**: **Canary Islands**, **Tenerife**, La Orotava, Las Cañadas del Teide, 4.8 km SE of Teide, Tabonal Negro, 2230 m, on wood of *Adenocarpus viscosus*, 17.X.2008, E. Beltrán-Tejera, A. Losada & L. Quijada (TFC Mic. 18428, doc. vid.).

Not included. **AUSTRALIA**: **Western Australia**, Carnarvon, 160 km SSE of Carnarvon, Peron Peninsula, 18 km SE of Shell Beach, 48 m, branch of *Brachychiton gregorii*, on bark, 8.XII.2001, G. Marson (H.B. 7572b).

Orbilia multigambelii Baral & G. Marson, **sp. nov.**, MB 813719 — Pls 724–725, Map 122

Etymology: named after the 32-spored asci and the resemblance to *O. gambelii*. **Typification**: USA, New Mexico, Malaga, branch of *Atriplex canescens*, 17.VI.1996, G. Marson (ex H.B. 5712, M-0276521, holotype).

Latin diagnosis: *Similis* Orbiliae gambelii *sed asci 32-spori. Habitat in zona temperata ad tropica semiarida ad arida Americae septentrionalis et Australiae.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.18–0.4(–0.6) mm diam., 0.13–0.2 mm high, pale to bright (to deep) orange(-ochraceous), non-translucent, round, rarely slightly ellipsoid, scattered or gregarious in small groups; disc medium concave to flat, margin distinct, 0–30 µm protruding, smooth to finely rough; broadly sessile, erumpent, nearly superficial to entirely immersed. **Asci** *(60–)70–90(–105) × (7.5–)8–8.8(–9.3) µm {5}, †(48–)60–75(–87) × 6–8(–8.8) µm {7}, 32-spored (28–31 spores counted), spores *~4-seriate, lower spores inverted {4} (partly oriented in all directions), pars sporifera *43–48 µm long; **apex** (†) slightly to strongly truncate (not indented, laterally sometimes inflated); **base** without or with short to medium long, thick, ± flexuous stalk, L-, h- to Y-shaped. **Ascospores** *(4.2–)4.7–6.5 × (2.4–)2.6–3.2(–3.5) µm {7}, †(3.5–)4.2–6((–8)) × (2.4–)2.6–3.2(–3.5) µm {5}, ellipsoid, exceptionally fusoid or clavate, apex rounded (to obtuse), base not or sometimes slightly attenuated, straight, rarely slightly inequilateral; **SBs** *2.5–4.5(–6) × 0.3–0.5(–0.8) µm in

Map 122. Known distribution of *O. multigambelii* in North America and Australia (yellow = not included collections).

situ {5} (~3–6.5 µm actual length) → 1.5–3 × 0.5–0.8(–1) µm, rod-shaped to vermiform, sometimes subulate, base not or slightly inflated, straight to strongly flexuous, sometimes uncinate, in aged spores pear- to broadly tear-shaped. **Paraphyses** apically medium to (very) strongly clavate-capitate or spathulate, sometimes moniliform, terminal cells *(4.5–)7–14(–20) × (2.5–)4–5.7 µm {4}, †(2–)3–4.5(–5.3) µm wide {3}, lower cells *(3–)7–18(–20) × 1.7–2.2(–3) µm {4}, †1–1.7 µm wide, subapical cell partly *3–5 µm wide; sometimes branched near apex. **Medullary excipulum** 30–70 µm thick, of dense textura intricata with many inflated cells, very sharply delimited from ectal excipulum, partly by a layer of t. porrecta. **Ectal excipulum** very pale rose, of thin-walled († very slightly gelatinized), vertically oriented t. angularis(-prismatica) from base to submargin, 20–90 µm thick near base, cells */†7–20 × 5–13 µm {4}; 30–35 µm thick near margin, oriented at an 80–90° angle to the surface, upper margin of t. prismatica-porrecta oriented at 30–40°, marginal cortical cells †8–14 × 2–4 µm {2}. **Anchoring hyphae** sparse, †2–3.3 µm wide, walls 0.2–0.3 µm thick {1}, also forming a t. prismatica-globulosa, cells *3–5 µm wide. **SCBs** in paraphyses and ectal excipulum (near margin) globose, 1–2.2 µm diam.; crystalloid, rod-shaped to angular SCBs in paraphyses {8}, also in excipulum (here 3–5 µm diam.), subhyaline; sometimes ± completely absent {2}. **Exudate** over paraphyses 0.1–0.7 µm thick, granular(-cloddy), ± firmly attached over margin and flanks sparse, granular. — **ANAMORPH**: trinacrium-like (from ascospore isolate {1} and natural substrate {2}). **Conidiophores** reduced (*~5–10 × 3 µm) or integrated (*1–1.5 × 2–2.5 µm). **Conidia** Y-shaped, total size *22–30(–38) × 17–28 µm, †20–25 × 20–28 µm, stipe *12–18(–28) × 5–6.2 µm, †11–14 × 4–5.5 µm, 2–3-septate, arms ± abruptly tapering, *8–13 × 3.7–4.2 µm, †10–17 × 4–4.5 µm, 1–3-septate {3}; a single 3-armed conidium seen (one arm again dichotomously branched); phragmoconidia in culture narrowly fusoid, *28–32 × 5–6.2 µm, 3–4-septate {1}.

Habitat: collected 0.05–2 m above the ground, mostly decorticated, 4–19 mm thick twigs and branches of *Acacia* sp. {1}, *Atriplex canescens* {1}, *Cylindropuntia versicolor* {1}, *Krascheninnikovia lanata* {2}, *Larrea tridentata* {2}, *Olneya tesota* {2}, on 0.2–2 mm deep strongly decayed wood {7}, rarely bark (bast) {1}; inflorescence stem of *Yucca elata* {1}; partly in deep clefts, strongly greyed, no algae, often on or close to pycnidia of *Diplodia*. **Associated**: *Cyathicula ?nigrofusca* {1}, *Hysterobrevium mori* {1}, *Hysteropatella* sp. (on *Larrea*) {1}, *Melaspilea emergens* {1}, *Odontura rhaphidospora* {1}, *Orbilia arizonensis* {1}, *O. ?barrowensis* {1}, *O. bicknellensis* {3}, *O. ?cactacearum* {1}, *O. calyptrata* {3}, *O. commarosa* {1}, *O. cryptogena* {1}, *O. lacrimispora* {1}, *O. lentiformis* {1}, *O. macrodelphinus* {1}, *O. macrotrapeziformis* {1}, *O. maeandrina* {2}, *O. microserpens* {1}, *O. multicreosoteris* {1}, *O. myrioauris* {1}, *O. myrioolneyae* {2}, *O. myriourosperma* {2}, *O. ?navajoana* {1}, *O. ?pleionavajoana* {1}, *O. plurilentiformis* {1}, *O. serpentina* {1}, *O. sonorensis* {1}, *O. ?ungulata* {1}, *O. vitalbae* {1}, *O. yuccae* {1}, *Patellaria 'andina'* {2}, *P. atrata* {2}, *Schizoxylon* sp. {1/1}, *S. ?argentinum* {1}, *Teichosporella dura* {2}, *Symbiotaphrina desertorum* {1}, *S. larreae* {1}. **Desiccation tolerance**: almost fully viable for 34 months. **Altitude**: 600–1645 m a.s.l. (North America), 300 m (Australia). **Geology**: Neogene & Quaternary sand-, lime & mudstone, Cenozoic regolith (red-brown sand); felsic volcanic rock. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia multigambelii* is characterized by 32-spored asci with rather small ellipsoid ascospores with usually long and flexuous spore bodies. *O. multiserpens* differs in shorter and especially narrower spores and in the consistent absence of crystalloid and often also globose SCBs, and *O. multicercocarpi* in distinctly longer spores.

Variation. In the present circumscription of *O. multigambelii* the ascospores vary somewhat in size and the spore bodies in length. Also the crystalloid SCBs were not consistently present. In the collections on *Yucca* (Pl. 724: 5) and *Olneya* (6) only globose SCBs could be found, but in the latter a single crystalloid SCB was seen in the excipulum. Due to the predominant absence of crystalloid SCBs, these two collections strongly resemble *O. pleioserpens* which differs in 16-spored asci, whereas the 32-spored *O. multiserpens* differs in distinctly narrower spores.

Not included collections. In an Australian population of the 16-spored *O. barrowensis* (Pl. 717: 2) a single apothecium with 32-spored asci was detected (Pl. 724: 7) which might belong to *O. multigambelii*. Both globose and crystalloid SCBs were present in the paraphyses, but the asci were wider than observed in *O. multigambelii*. In another Australian collection which consisted of only two apothecia, no data on SCBs could be gained, and only a few living spores were seen which deviated in an ellipsoid-fusoid shape (Pl. 724: 8). Both specimens are not included in the description, as is a third (H.B. 10120) which was only studied in the dead state.

Anamorph. The trinacrium robustum-like conidia of *O. multigambelii* hardly differ in morphology from those of *O. gambelii*. Some unbranched conidia occurred in pure culture which were not seen on the natural substrate.

Ecology. *O. multigambelii* was collected on rotten wood (rarely bark) of xeric twigs and branches of various angiosperm shrubs, also *Cactaceae* and stems of *Yucca*, in warm-temperate to subtropical semiarid (to arid) paloverde-mixed cacti,

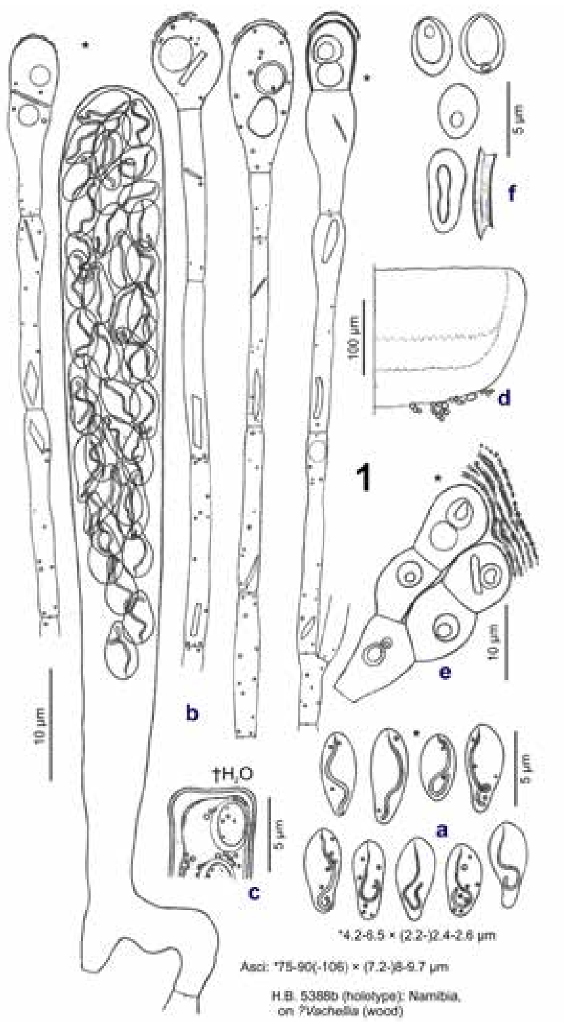


Plate 726. **1**: *Orbilia myrioflexa*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apex; **d**. apothecium in median section; **e**. id., marginal cells of ectal excipulum; **f**. crystalloid SCBs in excipular cells.

creosotebush, and winterfat desert scrubs or mixed grass-scrubland of the Colorado Plateau, Sonoran and Chihuahuan Desert in western North America. The collection from western Australia was in an almost tropical arid acacia shrubland/tussock grassland with *Livistona alfredii* in a dry riverbed, and the three not included samples from subtropical semiarid to arid acacia shrublands.

Specimens included. **USA**: **Arizona**, Navajo, Petrified Forest, 27 km ESE of Holbrook, 1645 m, branch of *Krascheninnikovia lanata*, on wood, 29.V.1996, G. Marson (H.B. 6134d, anam. substr.). – Sonoran Desert, 68 km SSW of Flagstaff, 5.5 km NNE of Camp Verde, Montezuma Castle, 975 m, branches of *K. lanata*, on wood, 8.V.1995, G. Marson (H.B. 6085b). – ibid., branch of *Larrea tridentata*, on wood, 8.V.1995, G. Marson (H.B. 5684e). –200 km NW of Phoenix, Wikieup, ~600 m, on *Cylindropuntia versicolor*, 3.V.1995, G. Marson (H.B. 8356). – 100 km WSW of Tucson, 10 km NW of Sells, 683 m, twig of *Olneya tesota*, on wood, 28.V.2003, G. Marson (H.B. 7573d). – 25 km WNW of Tucson, 5 km S of Picture Rocks, Saguaro, 745 m, branch of *O. tesota*, on wood & bark, 30.V.2003, G. Marson (H.B. 8085b). – 17.5 km NNE of Lukeville, Organ Pipe, Ajo Mountain Trail, 710 m, branch of *Larrea tridentata*, 5.V.1995, G. Marson (H.B. 5687e ø). – **New Mexico**, Chihuahuan Desert, ~13 km W of Artesia, 1120 m, inflorescence stem of *Yucca elata*, on wood, 25.V.1996, G. Marson (H.B. 5655b). – 25.5 km SE of Carlsbad, Malaga, 918 m, branch of *Atriplex canescens*, on wood, 17.VI.1996, G. Marson (ex H.B. 5712, M-0276521, **holotype**, anam. substr.). — **AUSTRALIA**: **Western Australia**, Pilbara, 96 km S of Roebourne, 42 km SSW of Python Pool, road crossing Fortescue River, 300 m, on *Acacia*, 4.XI.2007, G. Marson (ø, anam. cult.).

Not included. **AUSTRALIA**: **Western Australia**, Carnarvon, 165 km SSE of Carnarvon, Peron Peninsula, 24 km SE of Shell Beach, 41 m, branch of *Brachychiton gregorii*, on bark, 8.XII.2001, G. Marson (H.B. 7578b ø). – **Northern Territories**, Burt Plain, 31 km SW of Barrow-Creek Hotel, 3.7 km WSW of Wilora, 480 m, branch of *Atriplex*, on wood, 8.X.1998, G. Marson (H.B. 6262h ø). – MacDonnell Ranges, 11 km W of Alice Springs, 5 km N of White Gums, Larapinta Drive, 605 m, branch of *Atriplex*, on wood, 13.X.1998, G. Marson (H.B. 10120 ø).

Orbilia myrioflexa Baral, **sp. nov.**, MB 813720 — Pl. 726

Etymology: referring to the 64-spored asci and flexuous spore bodies.
Typification: Namibia, Rehoboth, branch of ?*Vachellia*, 25.VIII.1995, R. Reuter (ex H.B. 5388b, M-0276529, holotype).

Latin diagnosis: *Apothecia rehydratata 0.3–0.4 mm diam., aurantiaca, margine laevi. Asci 64-spori. Ascosporae *4.2–6.5 × 2.2–2.6 µm, ellipsoideo-clavatae, basi plerumque valde attenuatae, in statu vivo corpusculum refringens longum, filiforme, valde flexuosum vel uncinatum, ad apicem affixum continentes. Paraphyses ad apicem modice vel valde capitatae vel clavatae. Cellulae vivae excipuli et paraphysium corpuscula globosa et crystalloidea continentes. Habitat ad lignum putridum rami sicci* ?Vachelliae *in zona subtropica arida Africae austro-occidentalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.3–0.4 mm diam., 0.19–0.2 mm high, light orange, round; disc flat, margin 0–10 µm protruding, ± smooth; broadly sessile. **Asci** *75–90(–106) × (7.2–)8–9 µm, †72–88 × 6–7.2 µm, 64-spored (min. 50 spores counted), spores multiseriate, lower spores inverted (very strongly mixed), pars sporifera *(36–)43–60 → 29 µm long; **apex** (†) strongly truncate (slightly indented, laterally slightly inflated); **base** with short, thick, slightly flexuous stalk, h-shaped. **Ascospores** *4.2–6.5 × (2.2–)2.4–2.6 µm, †3.5–6 × 2–2.3 µm, ellipsoid or mostly ellipsoid- to ovoid-clavate, apex rounded to obtuse, base not or slightly to mostly strongly attenuated, straight or sometimes slightly inequilateral; **SBs** *3.5–5.5(–6) × 0.2–0.3 µm in situ (~5–7.5 µm actual length), filiform, not inflated at base, strongly flexuous and often uncinate. **Paraphyses** apically medium to very strongly capitate-clavate, sometimes moniliform, terminal cells *(6–)8–18 × 3.5–6.5 µm, distinctly protruding beyond living asci, subapical cell sometimes also strongly inflated, lower cells *(6–)13–20 × 1.4–2.4 µm; very rarely branched near apex. **Medullary excipulum** pale rose, 40 µm thick, of ± loose textura intricata with many inflated cells, sharply delimited. **Ectal excipulum** pale rose, light rose-orange towards margin, of vertically oriented t. angularis-prismatica from base to margin, 35–50 µm thick near base, cells *10–22 × 7–11 µm; 25 µm thick at mid flanks and margin, cells *9–15 × 6–8 µm, oriented at a 70–90° angle to the surface, marginal cortical cells *7–10 × 5.5–8 µm. **Anchoring hyphae** not seen. **SCBs** in paraphyses and ectal excipulum (near margin) globose, 1.5–3 µm diam., and crystalloid, in excipulum pale orange, ring-shaped, 2.5–6.5 × 2.5–3.5 µm. **Exudate** over paraphyses 0.2–1.5 µm thick, finely rough, ± firmly attached; over margin and flanks 3–6 µm thick, layered, granular, hyaline to pale reddish. **— ANAMORPH**: unknown.

Habitat: still-attached, decorticated, 30 mm thick branch of ?*Vachellia*, on 0.5–1 mm deep strongly decayed, eroded wood, greyed, no algae. **Associated**: *Hysterobrevium mori*, *Orbilia maeandrina*, *O. namibica*, *O. pluristomachia*, *Patellaria atrata*, ?*Peniophora* sp., *Teichospora* ?*obducens*, 3 different indet. coelomycetes. **Desiccation tolerance**: fully viable for at least 4 months. **Altitude**: 1560 m a.s.l. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia myrioflexa* is characterized by 64-spored asci and rather small, ellipsoid- to ovoid-clavate ascospores with very long, filiform, flexuous, often uncinate spore bodies. Besides spore number, *O. multigambelii* and its lower-spored relatives differ in more homopolar spores. For the similar *O. myrionamibica* see p. 1239. *O. myrioserpens*, *O. myrioolneyae,* and *O. myriella* differ in much shorter SBs, partly non-clavate spores, and in the consistent absence of crystalloid SCBs.

Ecology. Only two apothecia of *O. myrioflexa* were detected in the holotype among the associated, macroscopically indistinguishable species. They grew on rotten wood of a xeric branch of an unidentified angiosperm tree (?*Vachellia*) in the

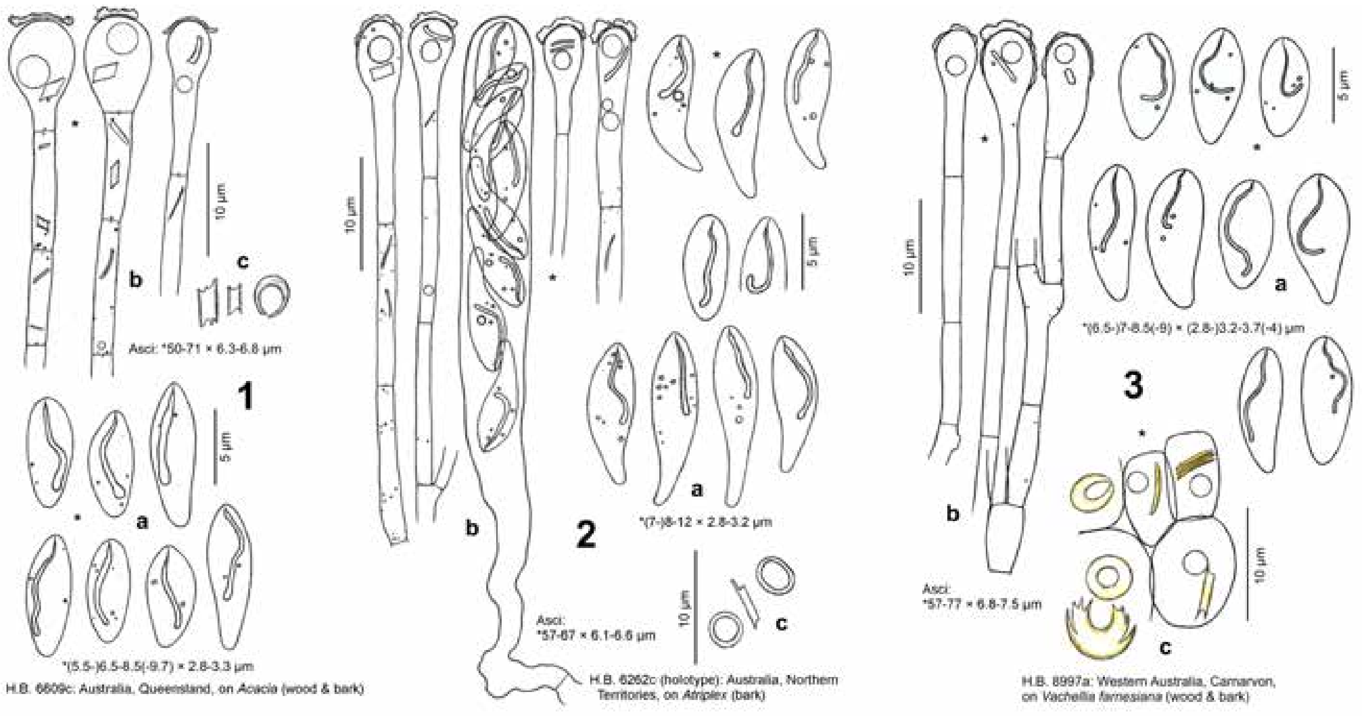


Plate 727. **1–3**: *Orbilia octocercocarpi*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. crystalloid SCBs in ectal excipulum.

hot, subtropical arid (winter-dry) Kalahari highland thornbush savannah about 150 km away from the Namib Desert in southwestern Africa.

Specimens included. **NAMIBIA**: **Khomas**, 60 km S of Windhoek, 25 km N of Rehoboth, Central Plateau, Auas Mts., 1560 m, branch of ?*Vachellia*, on wood, 25.VIII.1995, R. Reuter (ex H.B. 5388b, M-0276529, **holotype**).

Orbilia octocercocarpi Baral & E. Weber, **sp. nov.**, MB 813721 — Pls 727–728

Etymology: named after the similarity to *O. cercocarpi*, deviating in 8-spored asci.

Typification: Australia, Northern Territories, Wilora, branch of *Atriplex*, 8.X.1998, G. Marson (ex H.B. 6262c, MEL 2389196, holotype).

Latin diagnosis: *Similis* Orbiliae gambelii *sed ascosporae saepe longiores, basi valde attenuatae et leniter curvatae.*

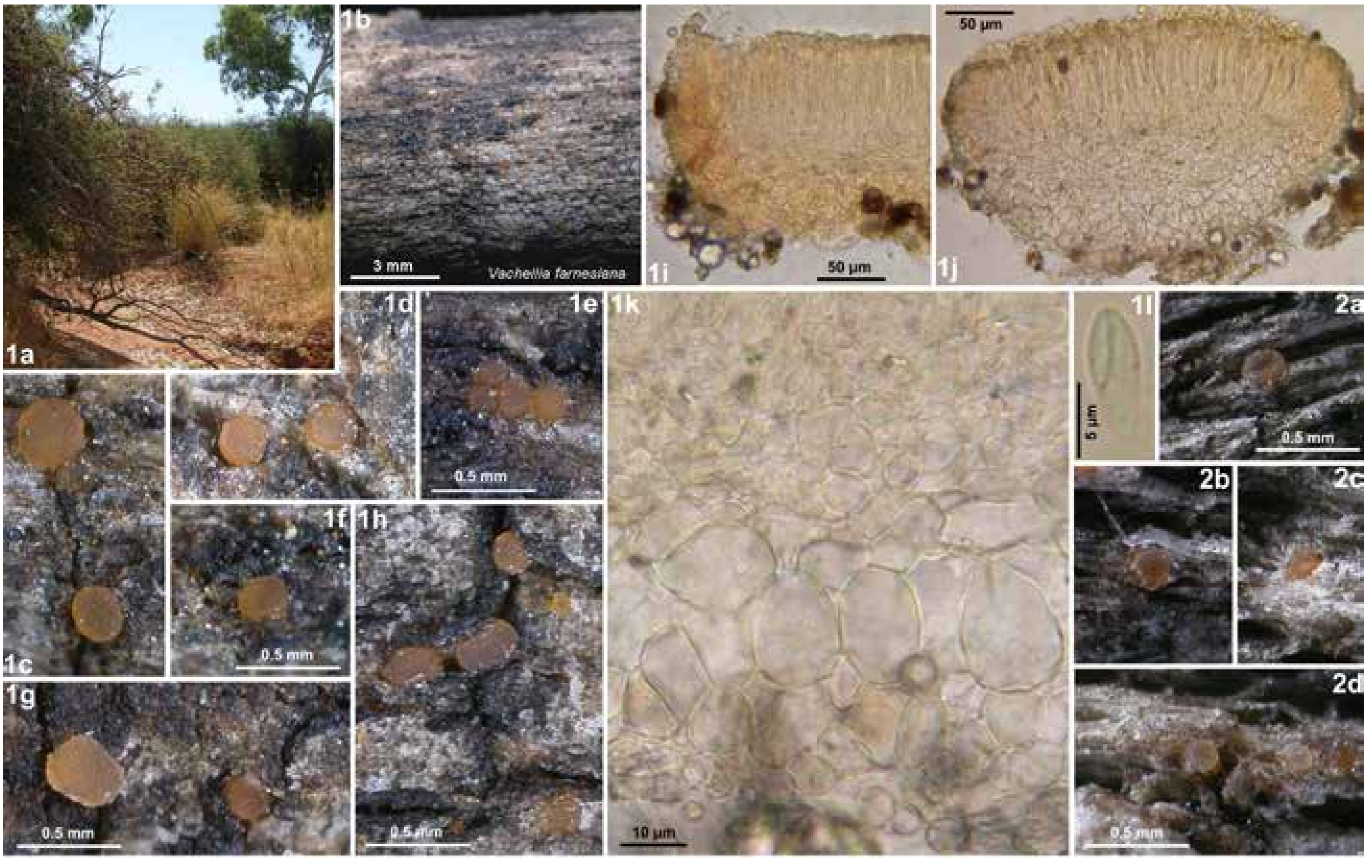


Plate 728. **1–2**: *Orbilia octocercocarpi*. – **1a**. arid *Acacia* woodland in dry riverbed; 1b. decorticated xeric branch; **1c–h**, **2a–d**. rehydrated apothecia (**2**: after 8 years); **1i–j**. apothecia in median section; **1k**. id., basal ectal excipulum; **1l**. ascospore. – Living state. — **1a–l**. H.B. 8997a: Western Australia, Carnarvon, on *Vachellia*; **2a–d**. H.B. 6609c: Australia, Queensland, on *Acacia*.

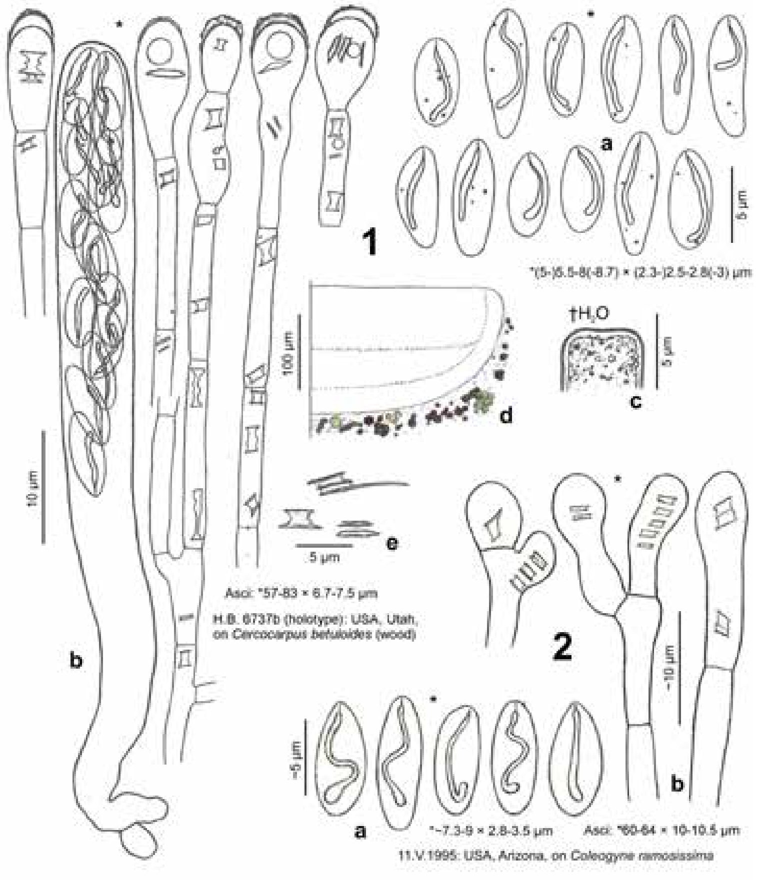


Plate 729. **1–2**: *Orbilia cercocarpi*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apex; **d**. apothecium in median section; **e**. crystalloid SCBs in ectal excipulum at mid flanks.

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.2–0.4 mm diam., 0.14–0.17(–0.19) mm high, pale to bright orange(-ochraceous), hardly translucent, round or sometimes irregularly compressed, ± scattered; disc flat, margin ± thin, 0–10 µm protruding, ± smooth; ± broadly sessile, superficial to partly entirely immersed in biofilm or in clefts. **Asci** *(50–)55–70(–77) {3} × (5.8–)6.3–6.8 {2} or 6.8–7.5 {1} µm, 8-spored, spores *2–3-seriate, (2–)3–4(–6) lower spores inverted {3} (not or sometimes mixed), pars sporifera *29–34 µm long; **apex** (†)strongly truncate (distinctly indented and laterally inflated), hemispherical in side view, thin-walled; **base** with medium long and thin, flexuous stalk, T- to L-shaped. **Ascospores** *(5.5–)6.5–8.5(–9.7) {2} or (7–)8–12 {T} × 2.8–3.5(–4) µm {3}, ellipsoid-fusoid or often ellipsoid- to fusoid-clavate, apex obtuse (to subacute), base not or slightly to strongly attenuated (tail-like), straight to slightly, sometimes medium curved; **SBs** *(4–)5–6.5(–7.5) × (0.2–)0.3–0.5(–1) µm in situ {3} [~(4.5–)5.5–7(–8) µm actual length], filiform to vermiform or subulate, slightly to strongly flexuous to helicoid, sometimes uncinate. **Paraphyses** apically slightly to strongly clavate-capitate, terminal cells *(6–)8–18(–22) × (2.5–)3–5(–6) µm {3}, lower cells *8–15 × 1.5–2(–2.7) µm {3}; rarely branched near apex. **Medullary excipulum** very pale orange, 30–50(–80) µm thick, of ± dense textura intricata with many ± inflated cells, sharply delimited. **Ectal excipulum** hyaline to pale orange (especially at margin), of (†) thin-walled, indistinctly oriented textura globulosa-angularis from base to mid flanks, 40–60 µm thick near base, cells *11–23((–38)) × 9–14(–18)((–30)) µm {1}; 15–20(–30) µm thick near margin, of t. globulosa-prismatica oriented at a 20–40° angle to the surface, marginal cortical cells *6–10 × 2.5–4.5 µm {1}. **Anchoring hyphae** rather sparse, *2–3(–4) µm wide, walls 0.2–0.3 µm thick {1}, covering flanks and margin as a 4–6 µm thick layer. **SCBs** in paraphyses and ectal excipulum (near margin) globose, 1–2.8 µm diam., associated with angular or rod- to ring- or spool-shaped SCBs {3}, hyaline to pale orange, exceptionally absent. **Exudate** over paraphyses and margin 0.3–1(–2.5) µm thick, rough, hyaline to very pale yellowish, firmly attached. **— ANAMORPH**: trinacrium-like (from ascospore isolate {1}). **Conidia**: not examined.

Habitat: collected 0.1–2 m above the ground, corticated to decorticated, 3–14 mm thick twigs and branches of *Acacia* sp. {1}, *Atriplex* sp. {1}, *Vachellia farnesiana* {1}, on 0.1–0.3 mm deep strongly decayed wood {2} and bark {3} (on bast or periderm), often in fine fissures or larger clefts, greyed or not, without algae. **Associated**: *Dothideales* {1}, *Hysterobrevium mori* {1}, *Orbilia barrowensis* {1}, *O. corculispora* {2}, *O. coronohesperidea* {1}, *O. farnesianae* {1}, *O. lanternae* {1}, *O. ?livistonae* {1}, *O. multiaustrocylindrica* {1}, *O. ?multigambelii* {1}, *O. ?myriella* {1}, *O. octoserpentina* {1}, *O. pleioaustraliensis* {2}, *O. serpentina* {1}, *Patellaria* '*andina*' {1}, ?*Stictis* sp. {2}. **Desiccation tolerance**: fully viable for at least 17 months. **Altitude**: 13–480 m a.s.l. **Geology**: Cretaceous sedimentary rock, Cenozoic regolith. **Phenology**: long-lived.

Taxonomic remarks. The type of *O. octocercocarpi* deviates from European and North American *O. gambelii* in longer ascospores with strongly attenuated, partly tail-like, slightly curved bases, coupled with the spore bodies being partly only half as long as the spores. The SBs further tend to be less flexuous and not or only slightly inflated at the base. The European *O. trapeziformis* and *O. quaestiformis* resemble *O. octocercocarpi* somewhat in the spores, but differ in lacking crystalloid SCBs. *O. cercocarpi* differs in 16-spored asci and *O. acaciae* in narrower spores.

Variation. The two collections additional to the holotype are included mainly because of their Australian origin. They deviate in their spores which are shorter than in the holotype and without curved tail-like bases or even not attenuated at all, and herein resemble American collections of *O. gambelii*. However, they also closely resemble the 16-spored *O. cercocarpi* in spore characters. The specimen on *Vachellia* differs from the two other samples in wider asci and spores and in narrower SBs. Regarding data on excipular tissues and anchoring hyphae the above description is solely based on the *Vachellia* specimen, due to lack of data in the two other samples.

Anamorph. In the sample on *Acacia* a few trinacrium robustum-like conidia developed on water agar which, however, could not be studied under oil immersion.

Ecology. *O. cercocarpi* was collected on rotten wood and bark of xeric twigs and branches of *Atriplex*, *Acacia* and *Vachellia* in subtropical to tropical semiarid to arid acacia (open) shrublands in dry, rarely flooded riverbeds in northwestern, central and northeastern Australia (west of Great Dividing Range).

Specimens included. **AUSTRALIA**: **Western Australia**, Carnarvon, 117 km NNE of Carnarvon, 7 km SSE of Minilya Roadhouse, Barrabiddy Creek, 13 m, branches of *Vachellia farnesiana*, on wood & bark, 6.XI.2007, G. Marson (H.B. 8997a). – **Northern Territories**, Burt Plain, 31 km SW of Barrow-Creek Hotel, 3.7 km WSW of Wilora, 480 m, branch of *Atriplex*, on bark, 8.X.1998, G. Marson (ex H.B. 6262c, MEL 2389196, **holotype**). – **Queensland**, Desert Uplands, 29 km E of Hughenden, 13 km W of Prairie, 390 m, branches of *Acacia*, on wood & bark, 16.X.1998, G. Marson (H.B. 6609c, anam. cult.).

Orbilia cercocarpi Baral & G. Marson, **sp. nov.**, MB 813722 — Pl. 729

Etymology: named after the substrate of the holotype, *Cercocarpus betuloides*. **Typification**: USA, Utah, Moab, branches of *Cercocarpus betuloides*, 16.VI.2000, G. Marson (ex H.B. 6737b, M-0276453, holotype; ex-type culture: CBS 140831; sq.: KT215253, MH878191).

Latin diagnosis: *Similis* Orbiliae pleiogambelii *sed ascosporae paulo longiores, partim heteropolares, corpuscula refringentia vermiformia; corpuscula crystalloidea in omnibus cellulis vivis paraphysium praesentia. Habitat ad lignum putridum ramorum siccorum* Cercocarpi betuloidis *in zona temperata subhumida ad semiarida Americae septentrionalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.3–0.5 mm diam., 0.17 mm high, light to bright orange(-rose), round, subgregarious; disc slightly concave to flat, margin not protruding, smooth or often finely pruinose or crenulate; broadly sessile, partially to entirely immersed. **Asci** *57–83 {2} × 6.7–7.5 {T} or 10–10.5 µm {1}, 16-spored, spores *(1–)2–3-seriate, 9–10 lower spores inverted {1} (± mixed), pars sporifera *36–43 µm long; **apex** (†) strongly truncate (very slightly indented, laterally not inflated); **base** with short to medium long, thick, slightly flexuous stalk, Y-shaped. **Ascospores** *(5–)5.5–8.5(–9) × (2.3–)2.5–3(–3.5) µm {2}, ellipsoid to fusoid-clavate, rarely subcylindrical, apex rounded to obtuse, base not or slightly (to medium) attenuated, straight to slightly inequilateral; **SBs** *(3.5–)4.5–6.5 × 0.3–0.5 µm in situ {T} (~4.5–8 µm actual length), vermiform (to subulate), not or sometimes slightly inflated at base, slightly to rather strongly flexuous. **Paraphyses** apically medium to strongly clavate(-capitate), sometimes spathulate, terminal cells *6–18 × 3.5–5.5 µm {T}, lower cells *8.5–17 × 1.6–2.2 µm {T}; unbranched at upper septum. **Medullary excipulum** 50 µm thick, of dense textura intricata with many indistinctly inflated cells, sharply delimited. **Ectal excipulum** of thin-walled, vertically oriented t. angularis from base to margin, 30 µm thick near base, cells *8–15 × 7–11 µm {T}; margin not examined. **Anchoring hyphae** not examined. **SCBs** in paraphyses globose, 1–2.3 µm diam., and crystalloid (also in ectal excipulum) {2}, hyaline. **Exudate** over paraphyses 0.2–1.5 µm thick, forming rough firmly attached caps. **— ANAMORPH**: unknown.

Habitat: collected 0–0.5 m above the ground (some immersed in sandy soil), on lower side of decorticated, 9–11 mm thick branches of *Cercocarpus betuloides* {1}, *Coleogyne ramosissima* {1}, on very decayed wood {1}, strongly greyed, no algae. **Associated**: *Orbilia bicknellensis* {1}, *O. multimaeandrina* {1}. **Desiccation tolerance**: fully viable for at least 2 months. **Altitude**: 1905–1975 m a.s.l. **Geology**: Triassic red calcareous sandstone; basaltic lava and cinders with andesite, dacite & rhyolite. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia cercocarpi* is only tentatively segregated from European *O. pleiogambelii* based on very slightly longer, partly somewhat heteropolar ascospores, more vermiform spore bodies being often not or hardly inflated at the base, also by the crystalloid SCBs which are present in the paraphyses from base to apex. Among the 16-spored species, *O. pleioserpens* and *O. macroserpens* mainly differ in the absence of crystalloid SCBs, the latter also in slightly shorter SBs. The spores of *O. pleioungulata* are narrower than in *O. cercocarpi*, and their SBs are much shorter, often almost straight and mostly distinctly thickened in their lower half. *O. cisti* has spores very similar to *O. cercocarpi* but differs in lacking any kind of SCBs, and *O. saguarina* differs in addition in narrower spores. The Australian *O. octocercocarpi*, particularly the collection in Pl. 727: 1, resembles *O. cercocarpi*, but differs in 8-spored asci. The North American *O. multicercocarpi* differs in 32-spored asci and slightly wider spores.

Variation. In the collection on *Coleogyne* the spores are slightly larger compared to the holotype, and the SBs are more helicoid and tend to be inflated at the base. Although here the SBs resemble those of *O. pleiogambelii* in their helicoid curvature, this collection fits better the holotype of *O. cercocarpi* because of more elongate spores and the presence of crystalloid SCBs in the paraphysis apices. However, from both it differs in much wider asci (*10–10.5 µm). A North American collection on wood of *Shepherdia* (Pl. 736: 4) mentioned under *O. pleioserpens* might belong to *O. cercocarpi*, but has slightly wider SBs and some of its paraphyses were without crystalloid SCBs.

Phylogeny. A sequence was gained from pure culture of the holotype which comprises SSU (with S1506 intron), ITS, and LSU. *O. cercocarpi* shows a minimum distance of 4% in the ITS region to *O. macroserpens* and *O. cisti* (0.5–0.6% in LSU), but lower distances are observed in the LSU, e.g., 0.2% to *O. myrionamibica*. In comparison, *O. gambelii* shows a much greater distance of 7% in the ITS (0.8% in LSU). When analysing different gene regions, *O. cercocarpi* clustered in the *microserpens-ungulata* clade (Phyls 19–20, S21–S22).

Ecology. *O. cercocarpi* was found on rotten wood of xeric branches of *Cercocarpus betuloides* (mountain mahogany) and *Coleogyne ramosissima* (blackbrush) in a warm-continental semiarid pinyon-juniper woodland adjacent to a chaparral scrubland in the Canyonlands section of the Colorado Plateau and in a cold-temperate subhumid blackbrush desert scrub in the Mogollon Rim in the southwest of Northern America.

Specimens included. **USA**: **Utah**, Canyonlands, 35 km SSW of Moab, E of Needles Overlook, Hatch Point, 1905 m, branches of *Cercocarpus betuloides*, on wood, 16.VI.2000, G. Marson (ex H.B. 6737b, M-0276453, **holotype**; **isotype** in M-0276523 [holotype of *O. multimaeandrina*]; CBS 140831; sq.: KT215253, MH878191). – **Arizona**, Mogollon Rim, 52 km WNW of Flagstaff, 16 km NNE of Williams, 1975 m, on *Coleogyne ramosissima*, 11.V.1995, G. Marson (ø).

Orbilia multicercocarpi Baral & G. Marson, sp. nov., MB 813723 — Pls 730–731

Etymology: similar to *O. cercocarpi* but with 32-spored asci.

Typification: USA, Arizona, New River, branches of *Larrea tridentata*, 19.VI.2003, G. Marson (ex H.B. 7397e, M-0276518, holotype).

Latin diagnosis: *Similis* Orbiliae cercocarpi *sed asci 32-spori. Habitat ad lignum putridum ramorum siccorum fruticum angiospermarum in zona subtropica semiarida Americae septentrionalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.2–0.3 mm diam., 0.12 mm high, light dirty orange, scarcely translucent, round,

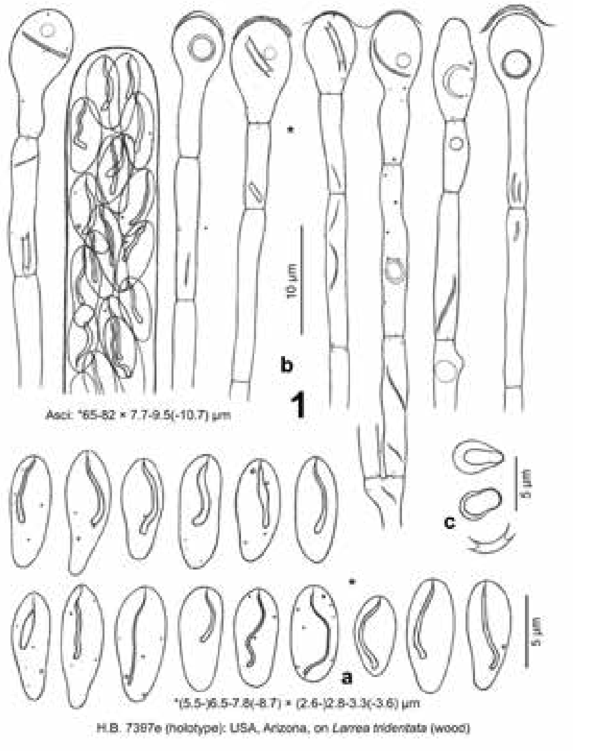


Plate 730. **1**: *Orbilia multicercocarpi*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. crystalloid SCBs in ectal excipulum.

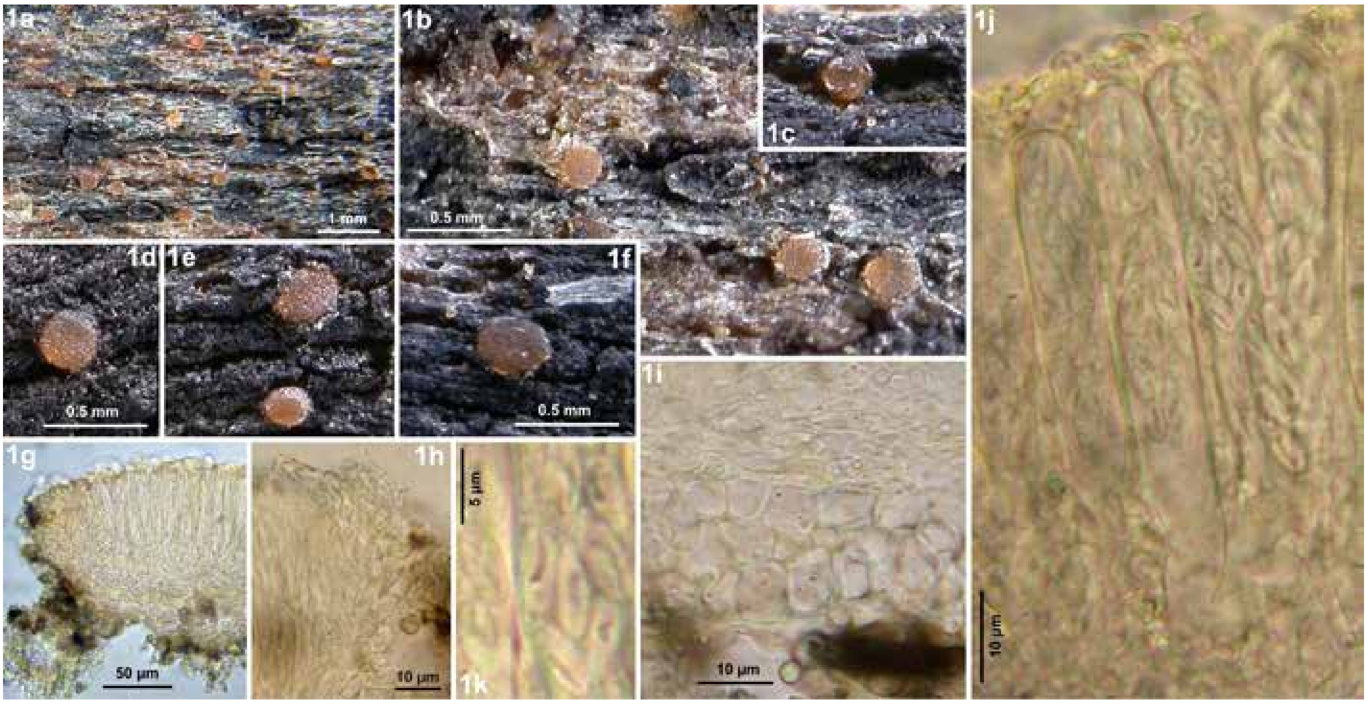


Plate 731. **1**: *Orbilia multicercocarpi*. – **1a–f**. rehydrated apothecia; **1g**. apothecium in median section; **1h**. id., marginal ectal excipulum; **1i**. id., near base; **1j**. asci (and paraphyses); **1k**. ascospores in ascus. – Living state, except for **1h–i** (in KOH), 2 right asci in **1j**. — **1a–j**. H.B. 7397e (holotype): USA, Arizona, on *Larrea*.

subgregarious; disc flat, margin ± indistinct, not protruding, smooth; broadly sessile, slightly to strongly immersed. **Asci** *65–82 × 7.7–9.5(–10.7) µm {1}, †60–80 × 7–9 µm {1}, 32-spored, spores *4-seriate, lower spores inverted {1} (± mixed), pars sporifera *43–65 µm long; **apex** (†) medium to strongly truncate (not distinctly indented, laterally sometimes distinctly inflated); **base** without or with thick, flexuous stalk, Y-, L- or h-shaped. **Ascospores** *(5.5–)6.5–7.5(–8.7) × (2.6–)2.8–3.2(–3.6) µm {2}, ellipsoid to ellipsoid-clavate, also subcylindrical, apex rounded to obtuse, base not or slightly, rarely medium attenuated (± tail-like), straight to slightly inequilateral; **SBs** *(3–)4–5.5(–6.5) × (0.2–)0.3–0.5(–0.7) µm in situ {1} (~4–7.5 µm actual length), filiform to vermiform or subulate, not or very indistinctly inflated at base, slightly to ± strongly flexuous, sometimes uncinate. **Paraphyses** apically medium to strongly clavate-capitate, sometimes spathulate to lageniform, terminal cells *7.5–19 × (3–)4–5.5 µm {1}, lower cells *9–17.5 × 1.6–2.5 µm {1}; rarely branched at upper septum. **Medullary excipulum** 20 µm thick, of dense textura intricata, horizontally oriented, with many inflated cells, medium to very sharply delimited. **Ectal excipulum** pale rose, of (†) slightly gelatinized, indistinctly or horizontally oriented t. angularis from base to mid flanks or margin, 20–30 µm thick near base, cells *6–13 × 5–10 µm {1}; 15 µm thick near margin, of t. prismatica-angularis oriented at a 10–40° angle to the surface, marginal cortical cells †5–6 × 3–5 µm {1}. **Anchoring hyphae** sparse, *2.2–3.7 µm wide, walls 0.3–0.4 µm thick {1}, covering also flanks and margin as a thin layer. **SCBs** in paraphyses and ectal excipulum globose, 1–1.2 µm diam., and crystalloid {2}. **Exudate** over paraphyses absent or 0.2–0.5 µm thick, rough, continuous, ± firmly attached; over margin and flanks 0.2 µm thick, granular, very sparse. — **ANAMORPH**: unknown.

Habitat: attached, partially to entirely decorticated, 9–16 mm thick branches of *Larrea tridentata* {1}, *Parkinsonia* (?)*microphylla* {1}, on 0.2–0.5 mm deep strongly decayed wood {2}, strongly greyed, no algae. **Associated**: *Carestiella* ?*schizoxyloides* {1}, *Coniochaeta* sp. {1}, ?*Muellerella* sp. {1}, *Orbilia calyptrata* {1}, *O. cryptogena* {1}, *O. maeandrina* {1}, *O. multiurosperma* {1}, *O. paloverdensis* {1}, *O. pleioserpens* {1}, *O. pluristomachia* {1}, *O. sedonensis* {1}, *Patellaria* ‘*andina*’ {1}, *Symbiotaphrina larreae* {1}. **Desiccation tolerance**: fully viable for at least 1.5 years. **Altitude**: 500–810 m a.s.l. **Geology**: Permian-Triassic sediment; granite, volcanic rock. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia multicercocarpi* appears to be very closely related to *O. cercocarpi*, from which it mainly differs in the 32-spored asci. *O. multigambelii* deviates in shorter ascospores, but its delimitation from *O. multicercocarpi* seems not very sharp.

Variation. The two included specimens closely concur in every respect.

Not included collection. A sample on *Fouquieria splendens* (IVV: H.B. 8650) differs in considerably larger (0.3–0.8 mm) and thicker (0.14–0.19 mm) apothecia with a thicker, 10–20 µm protruding margin, also in slightly smaller, especially narrower spores (*5–7 × ~2–2.5 µm).

Ecology. *O. multicercocarpi* was found on rotten wood of xeric branches of *Larrea* (creosotebush) and *Parkinsonia* (foothill paloverde) in subtropical semiarid paloverde-mixed cacti and arid creosotebush-bursage desert scrub in the Sonoran Desert in western North America.

Specimens included. **USA**: **Arizona**, Sonoran Desert, 32 km NNW of Phoenix, 13 km SW of New River, SE of Lake Pleasant, 500 m, branches of *Larrea tridentata*, on wood, 19.VI.2003, G. Marson (ex H.B. 7397e, M-0276518, **holotype**). – 19 km W of Tucson, W of Old Tucson Studios, 810 m, branch of *Parkinsonia* (?)*microphylla*, on wood, 6.V.1995, G. Marson (H.B. 5671d ø).

Not included. **USA**: **Arizona**, Sonoran Desert, 19 km W of Tucson, W of Old Tucson Studios, 810 m, branches of *Fouquieria splendens*, on wood, 6.V.1995, G. Marson (H.B. 8650).

Orbilia macroserpens Baral & G. Marson, **sp. nov.**, MB 813724 — Pls 732–733

Etymology: resembling *O. microserpens* but with larger asci and ascospores.
Typification: USA, California, branches of *Atriplex confertifolia*, 23.VI.2000, G. Marson (ex H.B. 6721c, M-0276505, holotype; ex-type culture: CBS 140812; sq.: KT215252, MH878184).
Latin diagnosis: *Similis* Orbiliae cercocarpi *sed ascosporae latiores*, *corpuscula refringentia breviora*, *cellulae vivae excipuli et paraphysium absque corpusculis crystalloideis. Habitat ad lignum putridum ramorum siccorum* Atriplicis *in zona temperata arida Americae septentrionalis.*

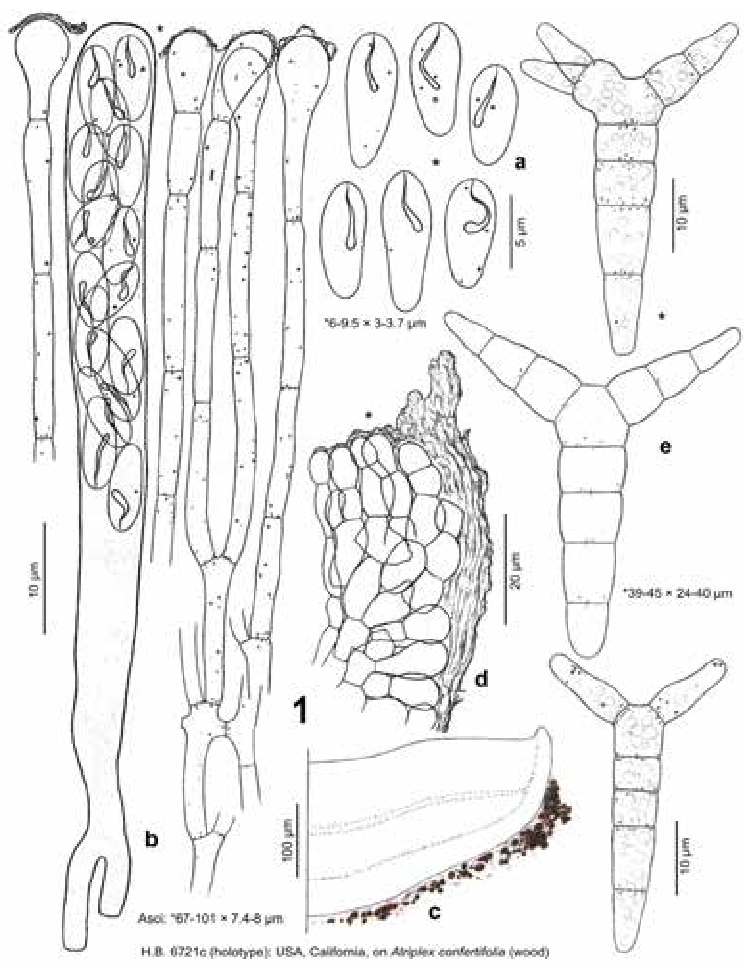


Plate 732. **1**: *Orbilia macroserpens*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. apothecium in median section; **d**. id., marginal ectal excipulum; **e**. conidia from culture.

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.2–)0.3–0.5(–0.7) mm diam., 0.21 mm high (receptacle 0.12–0.18 mm), pale to light greyish-orange, non-translucent, round or laterally compressed, ± gregarious in small groups; disc flat to slightly convex, margin distinct, thin, 10–20 µm protruding, smooth; sessile, superficial to immersed in clefts; dry strongly contracted. **Asci** *(67–)78–101 × (6.5–)7.5–8 µm {2}, †72–80 × 6.3–7 µm {1}, 16-spored, spores *2–3-seriate, ~8 lower spores inverted {T} (± strongly mixed), pars sporifera *40–50 µm long; **apex** (†) strongly truncate (slightly indented, laterally sometimes distinctly inflated); **base** with short to medium long, thin or thick, somewhat flexuous stalk, L-, Y- or h-shaped. **Ascospores** *6–9(–9.5) × (2.8–)3–3.7 µm {2}, †6.8–8.8 × 3–3.4 µm {1}, subcylindric-ellipsoid to clavate, apex rounded, base mostly slightly attenuated, straight, sometimes slightly inequilateral; **SBs** *3.5–4.8 × 0.25–0.7(–1) µm in situ {T} (~4–5.2 µm actual length), subulate, base not or slightly inflated, ± flexuous. **Paraphyses** apically slightly to strongly capitate(-clavate), terminal cells *7–17 × 3.3–5(–6.8) µm {T}, lower cells *7.5–18 × 1.6–2 µm {T}; sometimes branched near apex. **Medullary excipulum** 70 µm thick, of ± loose textura intricata with many inflated cells, sharply delimited. **Ectal excipulum** of (†) thin-walled to slightly gelatinized, vertically oriented t. angularis-prismatica from base to margin, 40–50 µm thick near base, cells *(9–)12–21 × (6.5–)8.5–11.5 µm {T}; 20 µm thick near margin, of t. angularis oriented at a 10–80° angle to the surface, marginal cortical cells *5.5–10(–13) × 4.5–7.5 µm {T}. **Anchoring hyphae** sparse, *2–4 µm wide, walls 0.2–0.5 µm thick {T}. **SCBs** in paraphyses and ectal excipulum absent. **Exudate** over paraphyses 0.3–1.5 µm thick, rough-granular to continuous, ± firmly attached; over margin and flanks 0.2–0.5 µm thick, rough-granular. **— ANAMORPH**: trinacrium-like (from ascospore isolate {T}). **Conidiophores** not observed. **Conidia** Y-shaped, total size *39–45 × 24–40 µm, stipe *30–33 × 6.4–9.5 µm, 3–4-septate, arms gradually tapering, *11.5–20 × 4–7.5 µm, 1–3-septate; rarely 3-armed conidia seen (one arm again dichotomously branched).

Habitat: collected ~0.2 m above the ground, decorticated, 14–17 mm thick branches of *Atriplex confertifolia* {1}, ?*A. polycarpa* {1}, on 0.3 mm deep strongly decayed wood {2}, on lower side, strongly greyed, no algae. **Associated**: *Carestiella schizoxyloides* {1}, *Hysteropatella* sp. {1}, *H. oregana* {1}, *Orbilia lentiformis* {1}, *O. multimaeandrina* {1}, *O. multiphanosoma* {1}, *O. multitrapezoidea* {1}, *O. sonorensis* {1}, *O. vermiculati* {1}, *Stictis* sp. {1}, *Teichospora* sp. {1/1}. **Desiccation tolerance**: fully viable for at least 1 month. **Altitude**: 830–1315 m a.s.l. **Geology**: Neoproterozoic-Cambrian sedimentary rock; alluvial sandy deposits from granite. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia macroserpens* is characterized by medium-sized, ellipsoid-clavate ascospores with rather short, subulate spore bodies, by the absence of any kind of SCBs, and by rather large 16-spored asci. The species resembles 8-spored *O. cactacearum* in spores and SBs, but differs in spore number and absence of crystalloid SCBs. *O. pleiovitalbae* deviates in much narrower spores and basally much more inflated SBs. *O. cercocarpi*, *O. cisti*, *O. pleioserpens*, and *O. microserpens* differ in their SBs being often almost as long as the spores, the former two also in narrower, more fusoid spores, *O. cercocarpi* also in the presence of crystalloid SCBs, and *O. microserpens* in much smaller spores.

Variation. The collection from Death Valley on an indet. angiosperm (IVV: H.B. 8528b) fully concurs with the holotype.

Anamorph. Very few trinacrium robustum-like conidia were obtained in pure culture, but only after flooding with water. In their thick arms and stipes they differ somewhat from trinacrium robustum-like anamorphs which are usually observed in section *Habrostictis*.

Phylogeny. A sequence was gained from pure culture of the holotype which comprises SSU (with S1506 intron), ITS, and LSU. In concordance with its morphology, the closest relatives

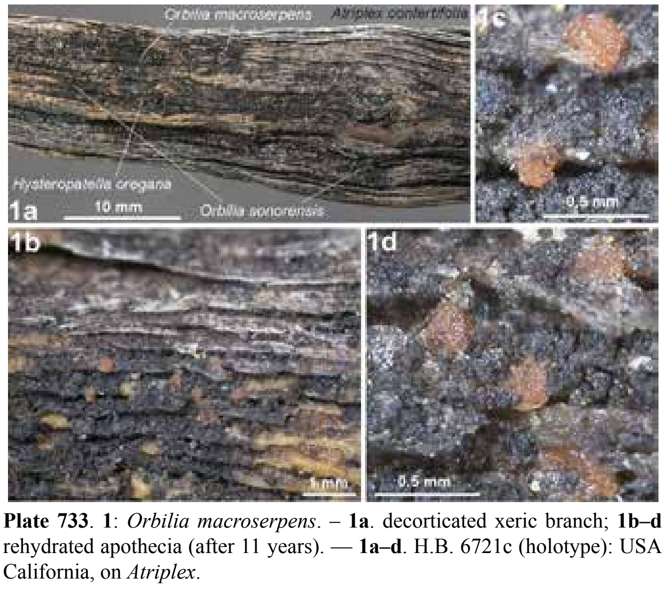


Plate 733. **1**: *Orbilia macroserpens*. – **1a**. decorticated xeric branch; **1b–d**. rehydrated apothecia (after 11 years). — **1a–d**. H.B. 6721c (holotype): USA, California, on *Atriplex*.

of *O. macroserpens*, when comparing in the ITS region, are *O. microserpens* with 3.3 % (0.6 % in LSU D1–D2), and *O. cercocarpi* or *O. cisti* with 3.5 % (0.5–0.8 % in LSU), which clustered in the *microserpens-ungulata* clade (Phyls 19–20, S21–S22).

Ecology. *O. macroserpens* grew on rotten wood of xeric branches of *Atriplex* and an indet. angiosperm in warm-temperate arid Mojave saltbush desert scrubs at the eastern border of Death Valley and southern end of Sierra Nevada in western North America.

Specimens included. **USA**: **California**, Mojave Desert, 130 km NNE of Los Angeles, 14 km NW of California City, 830 m, branches of *Atriplex confertifolia*, on wood, 23.VI.2000, G. Marson (ex H.B. 6721c, M-0276505, **holotype**, anam. cult., CBS 140812; sq.: KT215252, MH878184). – border to Nevada, Death Valley, 20 km SW of Beatty, 16 km SW of Rhyolite, Daylight Pass, 1315 m, branch of indet. angiosperm, on wood, 2.V.1995, G. Marson (H.B. 8528b ø).

Orbilia cisti Baral & E. Weber, **sp. nov.**, MB 813725 — Pls 734–735

Etymology: named after the substrate of the type, *Cistus albidus*.
Typification: France, Valliguières, branch of *Cistus albidus*, 20.IX.1999, H.O. Baral (ex H.B. 6500, M-0276454, holotype; ex-type culture: CBS 140810; sq.: KT215239, MH878182).

Latin diagnosis: *Differt ab* Orbiliae cercocarpi *cellulis vivis excipuli et paraphysium absque corpusculis crystalloideis. Habitat ad lignum vel corticem putridum ramorum siccorum* Cisti albidi *in zona arida mesomediterranea semihumida Europae meridio-occidentalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.2–0.4 mm diam., 0.13–0.15 mm high, bright orange, scarcely translucent, ± round, scattered; disc slightly concave to flat, margin distinct, thick, 10 µm protruding, smooth; broadly sessile, erumpent, slightly to entirely immersed. **Asci** *70–87 × 6.3–6.8 µm, †52–63 × 5.5–6.5 µm, 16-spored, spores †2–3-seriate, lower spores inverted (± mixed), pars sporifera *29–36 µm long; **apex** (†) medium to strongly truncate (not indented, laterally not inflated); **base** with short to medium long, ± thin, flexuous stalk. **Ascospores** *6–9 × 2.3–2.9 µm, (ellipsoid-)fusoid to fusoid-clavate, partly narrowly amygdaliform, apex obtuse to subacute, base not or mostly slightly attenuated, straight to slightly inequilateral; **SBs** *(4–)5–6.5(–7) × 0.25–0.3(–0.35) µm in situ (~4–7.5 µm actual length), filiform, base not inflated, straight or mostly ± flexuous. **Paraphyses** apically uninflated or slightly to strongly clavate-capitate, terminal cells *7–13 × 2.3–5.3 µm, lower cells *7.5–13 × 2.3–3.2 µm; unbranched at upper septum. **Medullary excipulum** pale orange, 30–40 µm thick, of ± dense textura intricata with many inflated cells. **Ectal excipulum** pale orange, of (†) ± thin-walled, indistinctly oriented t. angularis from base to submargin, 35–50 µm thick near base, cells *12–15 × 7–9 µm (†5–9 × 4–6.5 µm); 15 µm thick near margin, of t. prismatica oriented at a 40–50° angle to the surface, marginal cortical cells */†5–8 × 2.5–3 µm, embedded in exudate. **Anchoring hyphae** medium abundant, †2–3 µm wide, walls 0.2–0.3(–0.4) µm thick. **SCBs** in paraphyses and ectal excipulum absent. **Exudate** over paraphyses absent or 0.3–1(–2) µm thick, granular-cloddy, ± firmly attached; over margin and flanks 0.2–1(–2.5) µm thick, cloddy-granular. **— ANAMORPH**: trinacrium-like (from ascospore isolate). **Conidiophores** not seen. **Conidia** Y-shaped, total size *30–32 × 30–35 µm, stipe *15–16 × 5–6.5 µm, 2-septate, arms gradually tapering, *18–21 × 5–6 µm, 2–3(–4)-septate, stipe and arms hardly distinguishable.

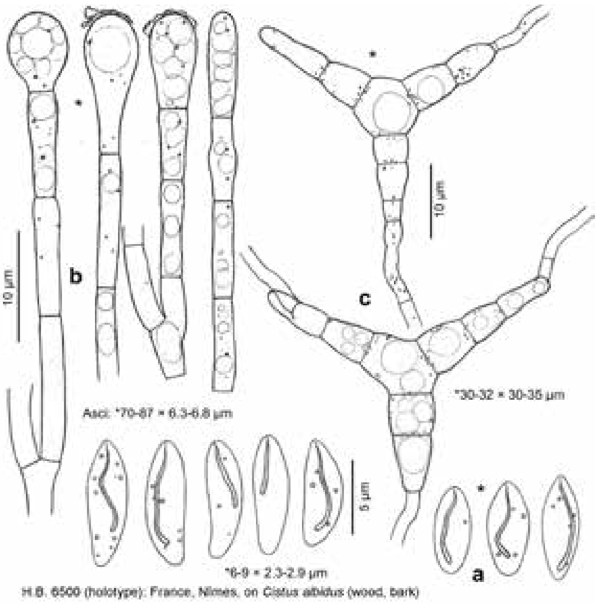


Plate 734. **1**: *Orbilia cisti*. – **a**. ascospores; **b**. paraphyses; **c**. conidia from culture.

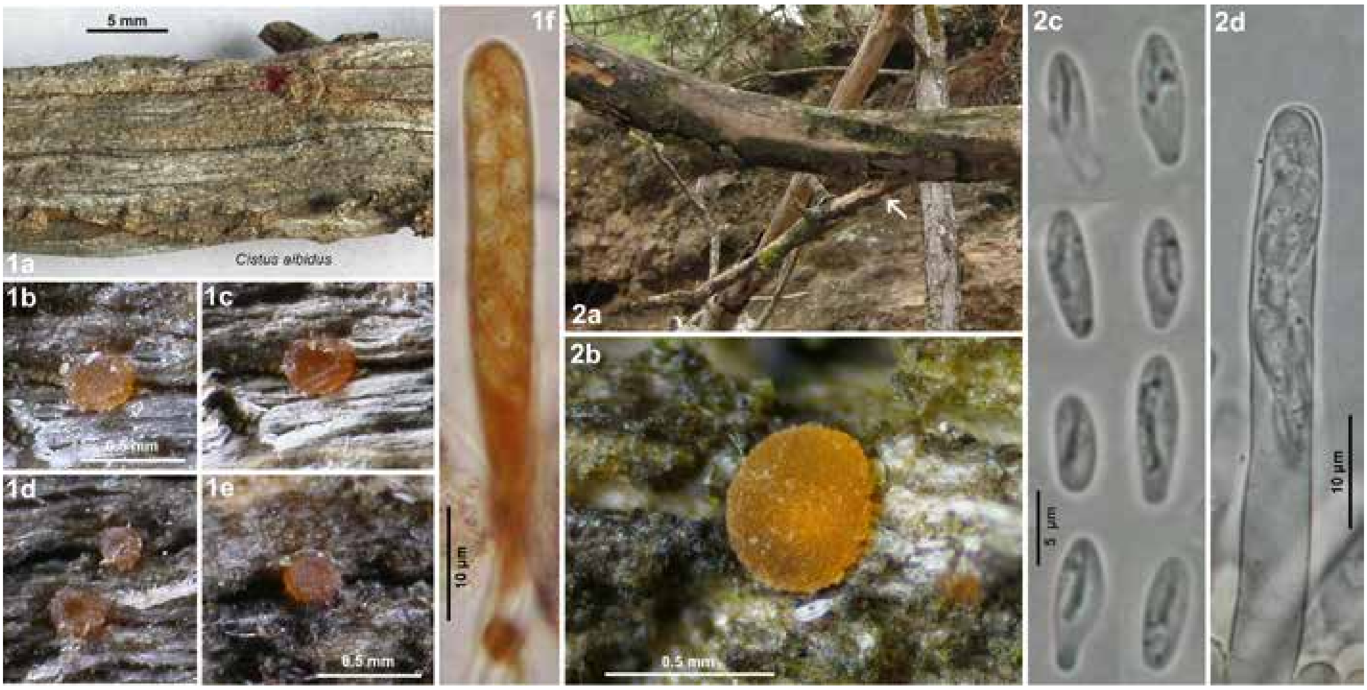


Plate 735. **1**. *Orbilia cisti*; **2**. *O.* cf. *cisti*. – **1a**, **2a**. decorticated xeric branches; **1b–e**, **2b**. rehydrated apothecia; **1f**, **2d**. mature ascus (**1f** in KOH+IKI); **2c**. ascospores. — **1a–f**. H.B. 6500 (holotype): France, Gard, Nîmes, on *Cistus*; **2a–d**: Spain, Teruel. on *Juglans*.

Habitat: collected ~0.2–0.5 m above the ground, ± decorticated, 11 mm thick branches of *Cistus albidus*, on 0.5 mm deep strongly decayed wood, also on remnants of bark (bast), eroded, partly in beetle galleries, greyed, no algae. **Associated**: sparse minute green lichen thalli. **Desiccation tolerance**: fully viable for at least ~2 weeks (certainly also much longer). **Altitude**: 135 m a.s.l. **Geology**: Lower Cretaceous (Urgonian) limestone. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia cisti* is characterized by 16-spored asci and ± fusoid(-clavate) ascospores with rather thin, long, flexuous spore bodies, also by the consistent absence of any kind of SCBs. For the similar *O. cercocarpi*, *O. pleioserpens*, *O. macroserpens*, *O. maeandrina*, and *O. saguarina* see there. The spores tend to be fusoid with subacute apices similar as in species of series *Serpentinae*, such as *O. maeandrina* and *O. trapeziformis*, but they also do not essentially differ from the ellipsoid spores of, e.g., *O. macroserpens*.

Not included collection. A sample on *Juglans* fits quite well in ascus and spore size [*88–92 × 5.5–6.3 µm, *(5.5–)6–9.1 × (2.1–)2.3–2.5(–3) µm] (Pl. 735: 2). It differs in slightly narrower spores and wider SBs (4.5–7 × 0.3–0.5 µm), and a different substrate, but is probably conspecific.

Anamorph. Very few trinacrium robustum-like conidia were obtained in pure culture, but only after flooding with water. When we detected them they had already germinated, therefore, only conidia with germ tubes have been documented.

Phylogeny. A sequence was gained from pure culture of the holotype which comprises SSU (with S1506 intron), ITS, and LSU. *O. cisti* clustered in the *microserpens-ungulata* clade (Phyls 19–20, S20, S22), with a distance of 3.8–4 % in the ITS and 0.6–0.8 % in the LSU D1–D2 to other members.

Ecology. *O. cisti* was collected on rotten wood and bark of xeric branches of *Cistus albidus* in a mesomediterranean semihumid, dense maquis in a quarry in the Languedoc in southwestern Europe. The not included sample from eastern Spain was from a supramediterranean semihumid forest strip of *Pinus* and *Juglans* along a river.

Specimens included. **FRANCE**: **Languedoc-Roussillon**, **Gard**, Languedoc, 25 km NW of Nîmes, 7 km NNE of Remoulins, SSE of Valliguières, 135 m, branch of *Cistus albidus*, on wood & bark, 20.IX.1999, H.O. Baral (ex H.B. 6500, M-0276454, **holotype**, anam. cult., CBS 140810; sq.: KT215239, MH878182).

Not included. **SPAIN**: **Aragón**, **Teruel**, 2 km NNW of Teruel, Atarazanas, Alfambra river, 910 m, branch of *Juglans regia*, on wood, 19.XI.2013, R. Tena Lahoz (R.T.L. 13111902, doc. vid.).

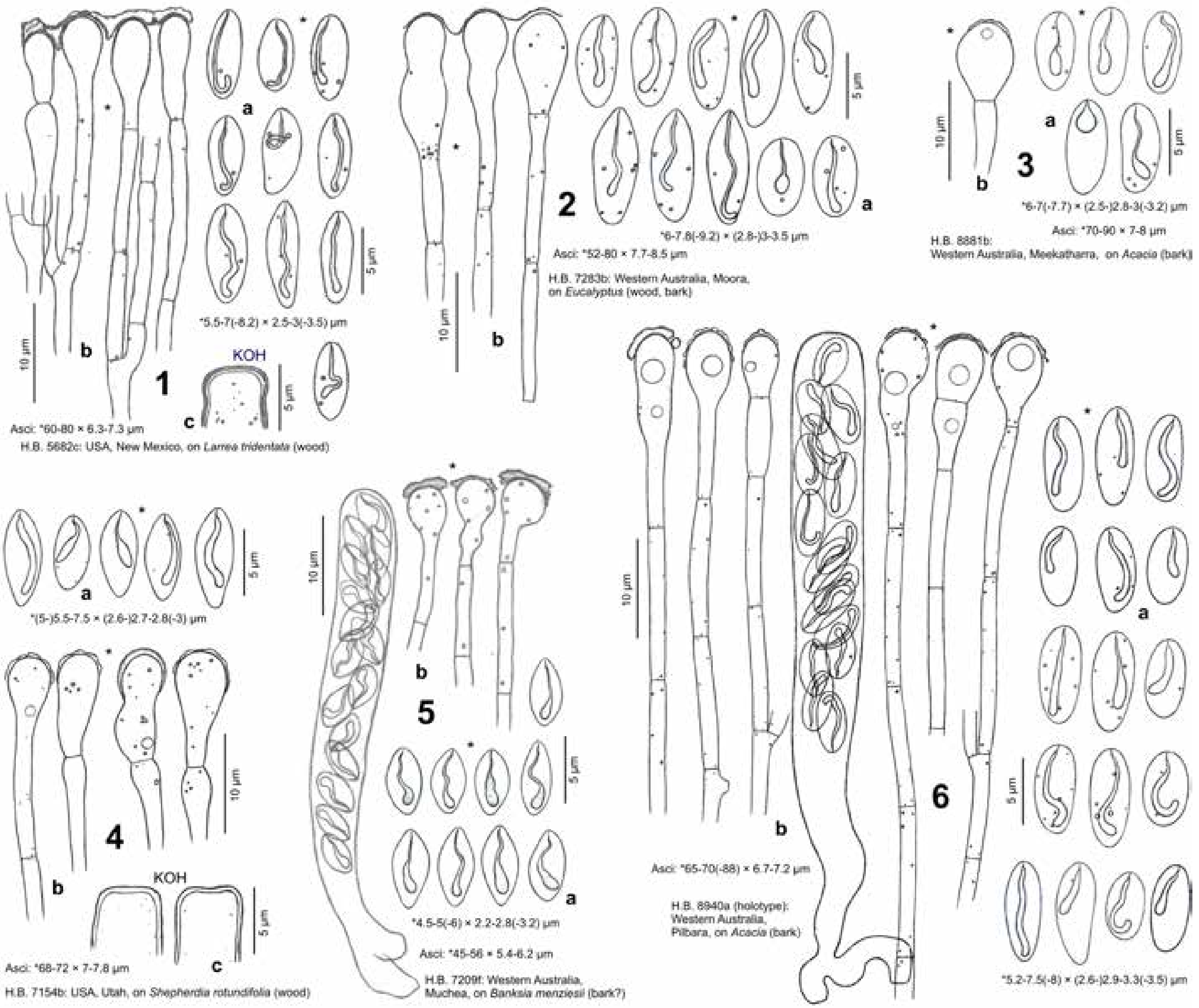


Plate 736. **1–3**, **6**: *Orbilia pleioserpens*; **4–5**: *O.* cf. *pleioserpens*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices.

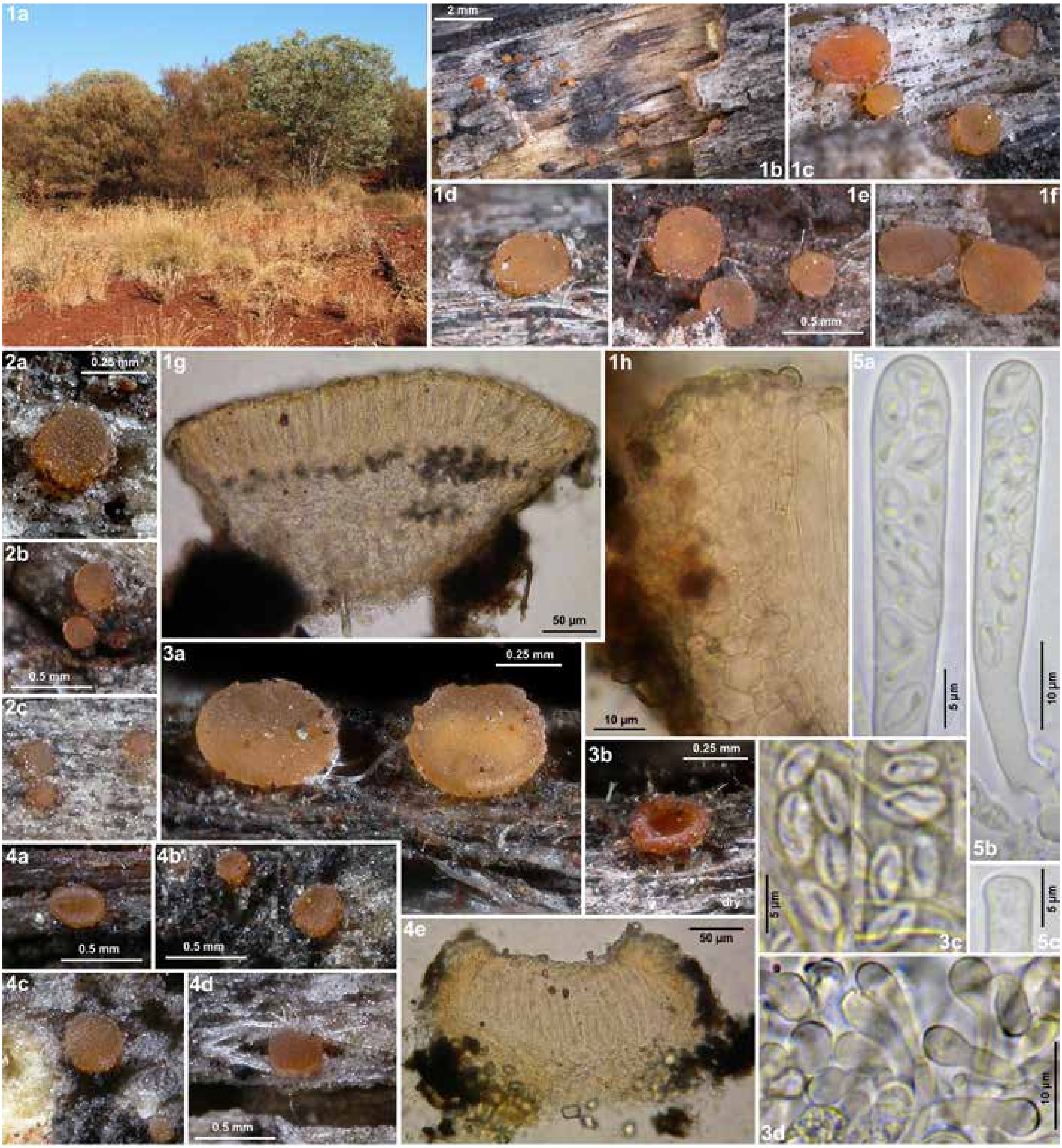


Plate 737. **1–3**, **5**. *Orbilia pleioserpens*; **4**. *O.* cf. *pleioserpens*. – **1a**. acacia shrubland hummock grassland in centre of Pilbara desert; **1b–f**, **2a–c**, **3a**, **4a–d**. rehydrated apothecia; **3b**. dry apothecium; **1g**, **4e**. apothecia in median section; **1h**. id., marginal ectal excipulum; **5a–b**. asci; **5c**. apex of immature ascus; **3c**. ascospores; **3d**. apices of paraphyses. – Living state, except for **5c** (in H_2O). — **1a–h**. H.B. 8940a (holotype): Western Australia, Pilbara, on *Acacia*; **2a–c**. H.B. 8976e: ibid., Wittenoom, on *Acacia*; **3a–d**. H.B. 8879b: ibid., Pilbara, on *Acacia*; **4a–e**. H.B. 8583b: ibid., Wittenoom, on *Acacia*; **5a–c**. H.B. 8937d: ibid., Moora, on *Allocasuarina*.

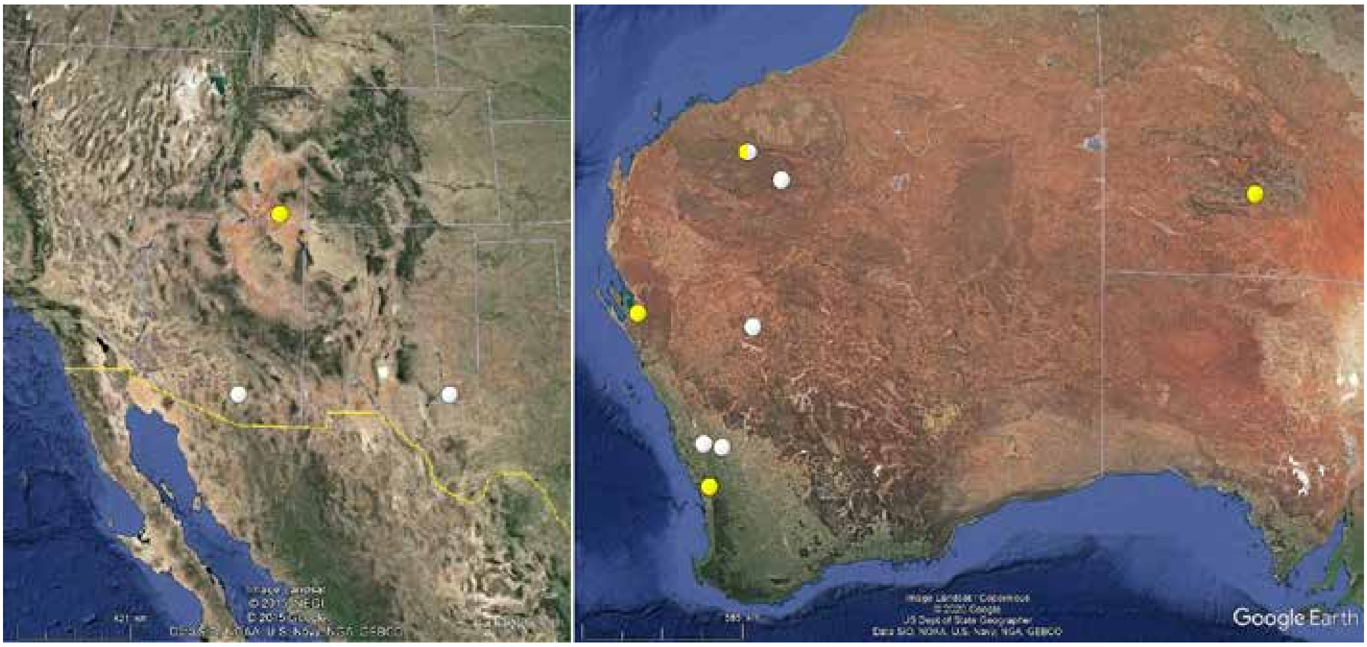
Orbilia pleioserpens Baral & G. Marson, **sp. nov.**, MB 813726 — Pls 736–737, Map 123

Etymology: named after the 16-spored asci and flexuous spore bodies.

Typification: Western Australia, Newman, branches of *Acacia*, 28.X.2007, G. Marson (ex H.B. 8940a, MEL 2389267, holotype).

Latin diagnosis: *Differt ab* Orbilia cisti *ascosporis paulo brevioribus, magis ellipsoideis, apice obtuso ad rotundato. Habitat ad lignum vel corticem putridum ramorum siccorum fruticum vel arborum angiospermarum in zona tropica vel subtropica semiarida ad arida Americae septentrionalis vel Australiae occidentalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.2–0.5(–0.6) mm diam., 0.13–0.23(–0.28) mm high (receptacle 0.12 mm), light to bright greyish or pure (brick-)orange(-ochraceous), slightly translucent, round, scattered to subgregarious; disc slightly concave to flat, margin distinct, 0–20 µm protruding, smooth or somewhat rough; broadly sessile or with a ± narrowed base, superficial to half immersed. **Asci** *(52–)60–80(–90) × (6.3–)6.5–8(–8.5) µm {6}, †(50–)55–70(–82) × (5.4–)5.7–6.5(–6.8) µm {3}, 16-spored, spores *2–4-seriate, 6–9(–11) lower spores inverted {3} (± mixed), pars sporifera *31–40 or 40–55 µm long; **apex** (†) (medium to) strongly truncate (not or very slightly indented, laterally distinctly inflated or not); **base** with short



Map 123. Known distribution of *O. pleioserpens* in North America and Australia (yellow = not included collections).

to long, thin or thick, flexuous stalk, L-, Y- to h-shaped. **Ascospores** *(4.6–)5–7.5(–8.2)((–9.2)) × (2.4–)2.6–3.2(–3.5) µm {8}, †(4–)5.3–7 × 2.4–2.9 µm {2}, ellipsoid, sometimes ellipsoid- to fusoid-clavate, subcylindrical, or fusoid, apex rounded to obtuse, exceptionally subacute, base not or sometimes slightly to medium attenuated, straight or very slightly inequilateral; **SBs** *(3.5–)5–6.5(–7.5) × (0.3–)0.4–1 µm in situ {4} [~(4–)6–8 µm actual length], vermiform to subulate, base not or slightly inflated, slightly to strongly flexuous or helicoid, sometimes uncinate, overmature with strongly inflated lower part, 2.5–3 × 1–1.5 µm. **Paraphyses** apically slightly to (very) strongly clavate(-capitate), sometimes moniliform, terminal cells *(6–)8–20(–24) × (2.5–)3–5(–5.7) µm {4}, lower cells *8–18 × 1.5–2.5(–2.8) µm {4}, near apex sometimes up to 3.3 µm wide; unbranched or sometimes branched at upper septum. **Medullary excipulum** pale orange, 30–60(–150) µm thick in centre, of dense (or loose) textura intricata with some or many inflated cells, medium to very sharply delimited from ectal excipulum at flanks. **Ectal excipulum** of pale to light orange, (†) ± thin-walled to slightly gelatinized, vertically oriented t. angularis-prismatica from base to mid flanks or margin, 20–70 µm thick near base, cells *9–20(–25) × (6–)7–12(–14) µm {4}, †5–17 × 4–9 µm {2}; (10–)15–25(–30) µm thick near margin, of t. prismatica or t. globulosa-angularis oriented at a 10–50° angle to the surface, marginal cortical cells *5–12 × 3–6 µm {2}, †~6–7 × 2.5–3.5 µm {1}. **Anchoring hyphae** sparse to medium abundant, */†1.5–3 µm wide, walls 0.2–03 µm thick {2}, extending as a thin layer up to the margin. **SCBs** partly to regularly present in paraphyses and ectal excipulum, globose, (1–)1.5–2.5(–3) µm diam. {2}, also consistently absent {2}. **Exudate** over paraphyses (0.1–)0.2–1(–1.3) µm thick, cloddy-continuous, firmly attached; over margin and flanks 0.4–2 µm thick, cloddy. **— ANAMORPH**: unknown.

Habitat: collected 0.2–2 m above the ground, decorticated, 6–12 mm thick branches of *Acacia* spp. {4}, *Allocasuarina campestris* {1}, *Eucalyptus* sp. {1}, *Larrea tridentata* {1}, *Parkinsonia* (?)*microphylla* {1}, on 0.3 mm deep strongly decayed wood {4} or bark {5} (bast), partly in clefts of periderm, medium to strongly greyed, without or with some green algae. **Associated**: ?*Baggea* sp. {1}, *Dinemasporium* sp. {1}, *Hyalorbilia* aff. *orbiliicola* (parasitic in *O. pleioserpens*) {1}, *Lophiostoma* sp. {1}, *Orbilia calyptrata* {1}, *O. coronohesperidea* {2}, *O. maeandrina* {1}, *O. microserpens* {2}, *O. multicercocarpi* {1}, *O.* ?*multidelphinus* {1}, *O. multiserpens* {1/2}, *O. multivirgula* {1}, *O. myrioaustraliensis* {3}, *O. myriofusiclava* {1}, *O. myriofusoidea* {1}, *O. myriomuscula* {2}, *O. myrionanosoma* {1}, *O. myriopseudoregalis* {1}, *O. paloverdensis* {1}, *O. phanosoma* {2}, *O. pleioaustraliensis* {1}, *O. pleiocoronohesperidea* {2}, *O. sedonensis* {1}, *Ostropales* {1}, *Patellaria* '*andina*' {3}, *P.* ?*atrata* {1}, *Proliferodiscus griseoviolaceus* {1}, ?*Teichospora* sp. {1}, ?*Trimmatostroma* sp. {1}. **Desiccation tolerance**: fully viable for at least 15 months. **Altitude**: 320–690 m a.s.l. (eastern Australia), 810–915 m (western North America). **Geology**: Archean to Proterozoic sedimentary rock (red-brown gravel), Pennsylvanian-Permian-Triassic carbonate red sandstone; granite, basalt. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia pleioserpens* is apparently very closely related to *O. microserpens*, from which it differs in distinctly wider ascospores and somewhat larger asci, also in the partial presence of globose SCBs. *O. pleiovitalbae* differs in slightly narrower spores and shorter and wider, basally abruptly swollen spore bodies. For the similar *O. macroserpens* see p. 1215. *O. cercocarpi* mainly differs in the presence of crystalloid SCBs. The European *O. cisti* is tentatively separated from *O. pleioserpens* based on slightly longer, more fusoid spores with more subacute apices. A collection mentioned under *O. multitrapezoidea* (on *Acacia*, Pl. 645: 4) resembles *O. pleioserpens* in the spores but has 32-spored asci.

Variation. The North American collection on *Larrea* (Pl. 736:Fig. 1) differs from the remaining in a tendency to narrower spores and SBs, but this hardly allows to separate different taxa. In spore width this collection seems to be safely distinct from *O. microserpens*. Globose SCBs were regularly present in four collections on *Acacia*, but they were consistently absent in the samples on *Eucalyptus* and *Banksia*, also in that on *Larrea*.

Not included collections. Three further samples on *Acacia* (H.B. 7215f, 8583b, 13.X.1998) were only studied in the dead state, therefore they are not included in the description. In two collections from southern Spain on *Ulex* studied by J.P. Priou (IVV: J.P.P. 27139, 28008) the rather short spores of *5–6(–6.5) × 2.5–3(–3.5) µm could instead belong to *O. pleiogambelii*, but SCBs were not observed.

An Australian sample on *Banksia* (Pl. 736: 5) tends to fusoid though shorter spores. Likewise, a North American sample on *Shepherdia* (Pl. 736: 4) differs from *O. pleioserpens* in more fusoid spores (both are not included in either description). In some examined apothecia of the *Shepherdia* sample the paraphyses contained crystalloid SCBs (IVV: H.B. 7154b), therefore, this might instead belong to *O. cercocarpi.*

Ecology. *O. pleioserpens* was found on rotten bark and wood of xeric branches of various angiosperm trees and shrubs. In western Australia it is known from tropical arid acacia open shrublands (mulga) in the Pilbara, and from subtropical semiarid acacia shrublands or eucalypt (open) woodlands, and in the southwest and south of Northern America from subtropical semiarid Sonoran paloverde-mixed cacti and warm-temperate semiarid Chihuahuan creosotebush-tarbush desert scrubs. The not included Australian collection on *Banksia* is from a subtropical semihumid banksia-eucalypt woodland, that from North America on *Shepherdia* from a cold-temperate subhumid pinyon-juniper woodland in the Colorado Plateau, and those from southwestern Europe from a mesomediterranean semihumid site with *Ulex*.

Specimens included. **AUSTRALIA**: **Western Australia**, Pilbara, 1.5 km SW of Wittenoom, N of Karijini, Wittenoom Gorge, 467 m, branches of *Acacia*, on wood & bark, 29.X.2007, G. Marson (H.B. 8976e). – 49 km NW of Newman, northern border of Ophthalmia Range, 690 m, branches of *Acacia*, on bark, 28.X.2007, G. Marson (ex H.B. 8940a, MEL 2389267, **holotype**). – ibid., branch of *Acacia*, on bark, 28.X.2007 (H.B. 8879b). – Murchison, 72 km SW of Meekatharra, 17 km W of Reedy, 1.5 km E of Tuckanarra, 493 m, branch of *Acacia*, on bark, 27.X.2007, G. Marson (H.B. 8881b). – Avon Wheatbelt, 40 km N of Moora, 4 km NNW of Watheroo, 320 m, branch of *Allocasuarina campestris*, 25.X.2007, G. Marson (H.B. 8937d ø). – 68 km NE of Moora, 14 km S of Dalwallinu, S of Pithara, 326 m, branches of *Eucalyptus*, on bark & wood, 24.XI.2001, G. Marson (H.B. 7283b). — **USA**: **Arizona**, Sonoran Desert, 19 km W of Tucson, W of Old Tucson Studios, 810 m, branch of *Parkinsonia* (?)*microphylla*, on wood, 6.V.1995, G. Marson (H.B. 5671g ø). – **New Mexico**, Chihuahuan Desert, 25.5 km SE of Carlsbad, Malaga, 915 m, branches of *Larrea tridentata*, on wood, 17.VI.1996, G. Marson (H.B. 5682c).

Not included. **AUSTRALIA**: **Western Australia**, Pilbara, 1.5 km SW of Wittenoom, N of Karijini, Wittenoom Gorge, 467 m, branches of *Acacia*, on bark & wood, 28.XI.2001, G. Marson (H.B. 8583b). – Carnarvon, 183 km SSE of Carnarvon, 10 km W of Overlander Roadhouse, 12 km NE of Hamelin Pool, 67 m, branch of *Acacia*, on bark, 7.XII.2001, G. Marson (H.B. 7215f). – Jarrah Forest, 54 km NNE of Perth, 11 km NE of Muchea, Darling Range, 187 m, trunk of *Banksia menziesii*, on bark?, 23.XI.2001, G. Marson (H.B. 7209f ø). – **Northern Territories**, MacDonnell Ranges, 11 km W of Alice Springs, 5 km N of White Gums, Larapinta Drive, 605 m, branch of *Acacia*, on wood, 13.X.1998, G. Marson (ø). — **USA**: **Utah**, Canyonlands, 16 km NNW of Mexican Hat, 1 km N of Mokee Dugway, Cedar Mesa, 1965 m, branch of *Shepherdia rotundifolia*, on wood, 14.VI.2000, G. Marson (H.B. 7154b). — **SPAIN**: **Com**. **Valenciana**, **Castellón**, 51 km W of Castellón, 6 km SE of Barracas, 980 m, branch of *Ulex parviflorus*, on wood, 27.XII.2007, J.P. Priou (J.P.P. 27139, doc. vid., H.B. 8738c ø). – ibid., 4.I.2008 (J.P.P. 28008, doc. vid.).

Orbilia saguarina Baral & G. Marson, **sp**. **nov**.,
MB 813727 — Pls 738–739

Etymology: from the host plant in the holotype, *Carnegiea gigantea* (saguaro cactus).

Typification: USA, Arizona, Lukeville, stems of *Carnegiea gigantea*, 28.V.2003, G. Marson (ex H.B. 7764b, M-0276581, holotype).

Latin diagnosis: *Similis* Orbiliae microserpenti *sed ascosporae longiores, paraphyses ad apicem leniter inflatae. Habitat ad caules putridos siccos* Cactacearum *in zona subtropica semiarida Americae septentrionalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.25–)0.35–0.8(–1) mm diam., 0.17–0.3 mm thick, light to bright orange to brick-red, non-translucent, round (to broadly elliptical), scattered to gregarious; disc slightly concave to flat, margin distinct, 5–20 µm protruding, ± rough, partly somewhat crenulate; broadly sessile or with an obconical base, slightly to entirely immersed among fibres of host; dry bright dirty brick-red, often sunken back and inconspicuous. **Asci** *(61–)70–80(–88) × 5.8–7.2 µm {1}, †64–74 × 4.8–5.2 µm {1}, 16-spored (10–16

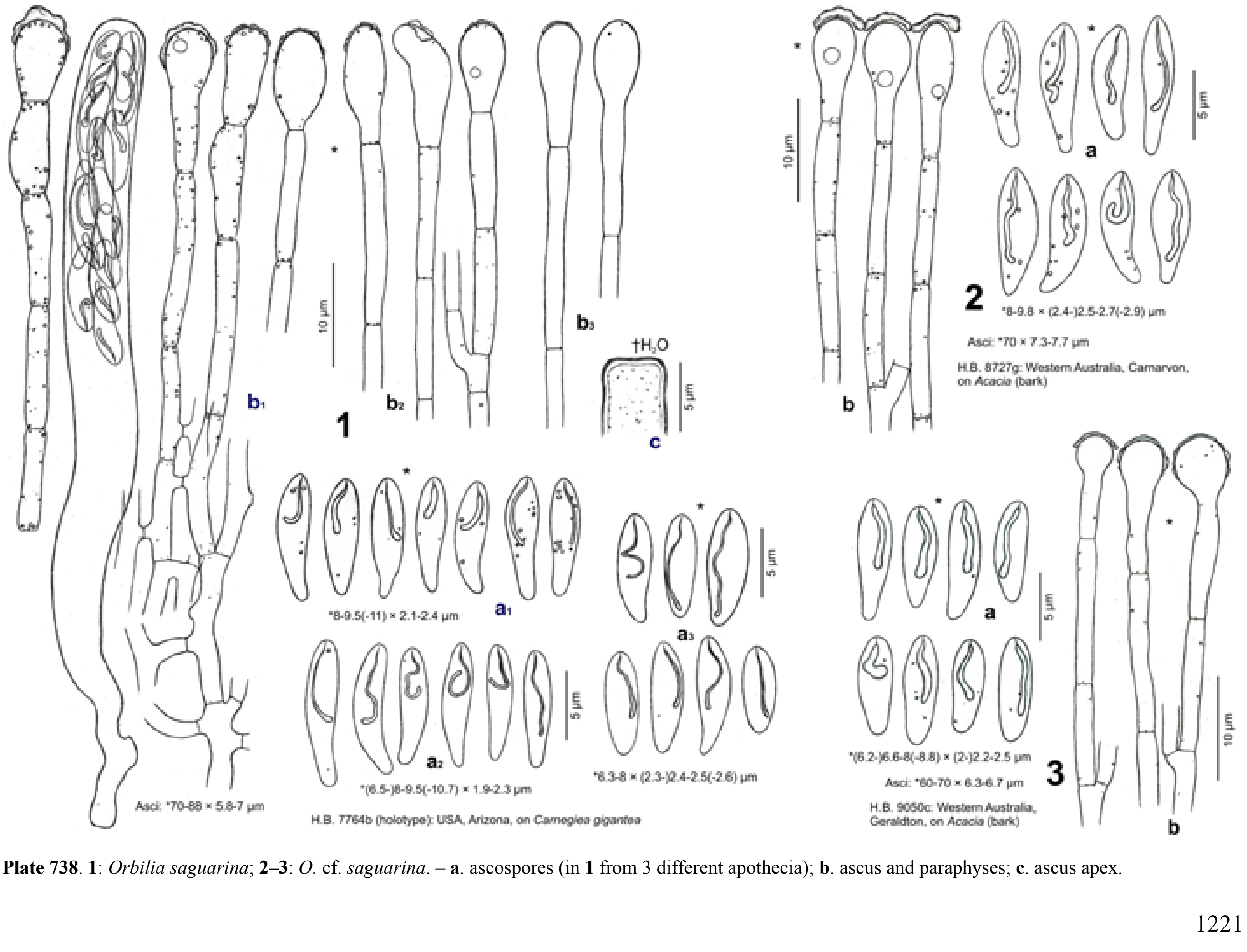


Plate 738. **1**: *Orbilia saguarina*; **2–3**: *O.* cf. *saguarina*. – **a**. ascospores (in **1** from 3 different apothecia); **b**. ascus and paraphyses; **c**. ascus apex.

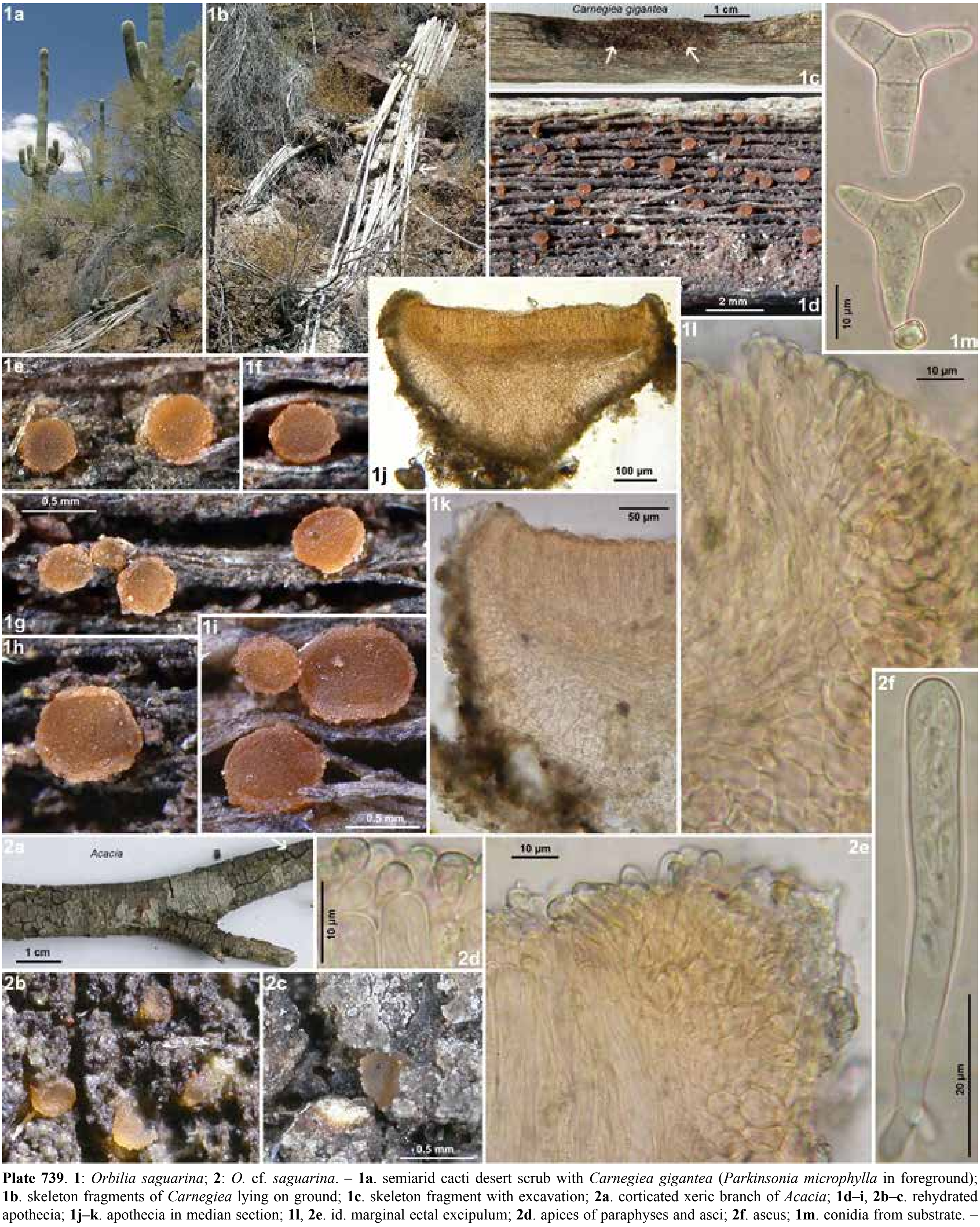


Plate 739. **1**: *Orbilia saguarina*; **2**: *O.* cf. *saguarina*. – **1a**. semiarid cacti desert scrub with *Carnegiea gigantea* (*Parkinsonia microphylla* in foreground); **1b**. skeleton fragments of *Carnegiea* lying on ground; **1c**. skeleton fragment with excavation; **2a**. corticated xeric branch of *Acacia*; **1d–i**, **2b–c**. rehydrated apothecia; **1j–k**. apothecia in median section; **1l**, **2e**. id. marginal ectal excipulum; **2d**. apices of paraphyses and asci; **2f**. ascus; **1m**. conidia from substrate. – Living state. — **1a–m**. H.B. 7764b (holotype): USA, Arizona, on *Carnegiea*; **2a–f**: H.B. 9050c, Western Australia, on *Acacia*.

spores developed), spores *3–4-seriate, 6–11 lower spores inverted {2} (sometimes strongly mixed), pars sporifera *31–34 µm long; **apex** (†) medium to strongly truncate (not distinctly indented, laterally not or slightly inflated); **base** with short to medium long, thick, flexuous stalk, T-, L- or h-shaped. **Ascospores** *(6.3–)7–9.5(–11) × (1.9–)2–2.4(–2.6) µm {2}, narrowly ellipsoid to often ellipsoid- to fusoid-clavate, apex obtuse, base usually more or less attenuated, straight to slightly curved near base; **SBs** *(3–)4–6(–7.8) × 0.2–0.4(–0.5) µm in situ {2} [(3–)4–8.5 µm actual length], filiform to subulate, base not or rarely slightly inflated, ± flexuous, partly helicoid or uncinate, in more aged spores rod-shaped. **Paraphyses** apically slightly to medium (to strongly) clavate(-capitate), sometimes spathulate, terminal cells *7.5–15(–24) × (3.3–)4–

5(–5.5) µm {1}, lower cells *7–17.5 × 1.6–2.8 µm {1}; rarely branched at upper septum, hymenium pale orange. **Medullary excipulum** pale orange, 50–130 µm thick, of ± dense textura intricata with some or many inflated cells, sharply delimited at flanks. **Ectal excipulum** very pale orange, of thin-walled († slightly to medium gelatinized), vertically oriented t. globulosa-angularis(-prismatica) from base to submargin, 40–100 µm thick near base, cells *9–25(–41) × 8–15(–17.5) µm {2}; 25–35 µm thick near margin, of t. prismatica(-porrecta) oriented at a 20–45° angle to the surface, marginal cortical cells *5–12 × 3–5 µm {1}. **Anchoring hyphae** medium abundant, */†2–4(–5) µm wide, walls 0.2–0.3(–0.7) µm thick {2}, sometimes moniliform. **SCBs** in paraphyses and ectal excipulum absent {2} though small globose SCBs exceptionally seen. **Exudate** over paraphyses 0.2–2 µm thick, granular-cloddy, hyaline, firmly attached; over margin and flanks 0.5–1.5 µm thick, rough-cloddy. — **ANAMORPH**: trinacrium-like (presumed, from natural substrate {1}). **Conidiophores** not seen. **Conidia** Y-shaped, *18–29 × 23.5–26 µm, main axis *(14–)23–25.5 × (4.3–)7.5–8 µm, 2–3-septate, arms *10–13 × (4.5–)6.5–7 µm, 2(–3)-septate, tapering only at terminal cell.

Habitat: lying on dry ground or up to 0.5 m above the ground, ~15–50 mm thick branches (outer layers removed) of *Carnegiea gigantea* {1}, *Stenocereus thurberi* {1}, on wood {2}, in broadly excavated areas (*Carnegiea*) or only on inner surface (*Stenocereus*), strongly decayed, greyed, no algae. **Associated**: *Orbilia cactacearum* {2}, *O. carnegieae* {1}, *Teichosporella dura* {1}, ?*Trichopeziza* sp. {1}. **Desiccation tolerance**: fully viable for at least 26 months. **Altitude**: 710–750 m a.s.l. **Geology**: Lava of basalt breccia, andesite and rhyolite. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia saguarina* is characterized by 16-spored asci, narrowly ellipsoid-clavate ascospores, and ± thin, flexuous spore bodies, also by rather large apothecia with partly crenulate margin.

The European *O. cisti* differs in slightly shorter and wider, more fusoid spores with more subacute apices, and a smooth apothecial margin. Similarly, the North American *O. cercocarpi* and an Australian collection (Pl. 704: 4, on *Acacia*) mentioned under *O. pleioungulata* differ in slightly wider SBs and especially in the presence of crystalloid SCBs, *O. cercocarpi* also in slightly shorter and wider spores. The European *O. microserpens* differs in distinctly shorter, ± homopolar spores and more strongly inflated paraphysis apices, but some Australian specimens referred to *O. microserpens* (Pl. 740: 3, 6) have longer, partly heteropolar spores reminiscent of but still smaller than in *O. saguarina*. *O. pleioserpens* differs in shorter and wider, predominantly homopolar spores.

Variation. Some variation in spore and SB size was noted between the examined apothecia of the holotype (Pl. 738: 1a). They derive from different branch areas, but undoubtedly belong to a single species. The collection on *Stenocereus* (organ pipe cactus, IVV: H.B. 7217b) fits well the holotype but was only sketchily documented.

Not included collections. Three sparse Australian samples (on *Acacia*, Pls 738: 2: 739: 2; on *Casuarina*, IVV: H.B. 6809d) appear to be conspecific but are not included in the description because of their geographical origin and a tendency to wider asci, wider SBs, and often also wider spores. Another collection on *Acacia* (Pl. 738: 3) deviates from the holotype mainly in wider SBs.

Anamorph. The conidia detected on the natural substrate in the holotype differ in their thick and rather short arms and stipes from those trinacrium-like anamorphs usually observed in section *Habrostictis*.

Ecology. *O. saguarina* was found on rotten skeleton fragments of xeric branches of two large *Cactaceae* in subtropical semiarid Sonoran paloverde-mixed cacti desert scrubs in the southwest of Northern America. The not included collections were on Cretaceous red-brown sand & gravel in subtropical semiarid to almost arid acacia open shrublands in the Yalgoo and Carnarvon ecoregion of western Australia, and in a subtropical subhumid savannah-like eucalypt open woodland in eastern Australia west of the Great Dividing Range.

Specimens included. **USA**: **Arizona**, Sonoran Desert, 17 km NNE of Lukeville, Ajo Mountain Trail, Organ Pipe, 750 m, branches of *Carnegiea gigantea*, 28.V.2003, G. Marson (M-0276581, **holotype**; **isotype** in H.B. 7764b, anam. substr.). – 17.5 km NE of Lukeville, 710 m, branch of *Stenocereus thurberi*, 11.VI.2000, G. Marson (H.B. 7217b).

Not included. **AUSTRALIA**: **Western Australia**, Carnarvon, 183 km SSE of Carnarvon, 10 km W of Overlander Roadhouse, 12 km NE of Hamelin Pool, 67 m, twig of *Acacia*, on bark, 6.XI.2007, G. Marson (ex H.B. 8727g, mixture in MEL 2389251 [type of *O. myrioauris*]). – Yalgoo, 187 km N of Geraldton, W of Toolonga, Nerren Nerren, 190 m, branch of *Acacia*, on bark, 8.XI.2007, G. Marson (H.B. 9050c). – **Queensland**, Brigalow Belt South, 100 km S of Miles, 22.5 km NW of Moonie, 305 m, branch of *Casuarina cunninghamiana*, 23.X.1998, G. Marson (H.B. 6809d ø).

Orbilia microserpens Baral, sp. nov.,
MB 813728 — Pls 740–741, Map 124

Etymology: referring to the filiform, flexuous spore bodies inside the comparatively small ascospores.

Typification: Spain, Cambrils, branch of *Ceratonia siliqua*, 27.IX.1999, G. Marson (ex H.B. 6519a, M-0276514, holotype; ex-type culture: CBS 140817; sq.: KT215251, MH878187).

Latin diagnosis: *Apothecia rehydratata 0.15–0.45 mm diam., aurantiaca, margine laevi. Asci 16-spori. Ascosporae *3.5–7.7 × 1.8–2.5 µm, ellipsoideae vel fusoideo-clavatae, rectae vel subrectae, in statu vivo corpusculum refringens longum, filiforme, flexuosum, basaliter interdum inflatum, ad apicem affixum continentes. Paraphyses ad apicem plerumque valde capitatae. Cellulae vivae excipuli et paraphysium absque corpusculis globosis et crystalloideis. Habitat ad lignum vel corticem putridum ramulorum vel ramorum siccorum fruticum vel arborum angiospermarum, raro gymnospermarum, in zona subtropica arida ad semihumida Australiae et Europae meridionalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.15–)0.2–0.35(–0.45) mm diam., 0.1–0.15 mm high, pale to light orange, round, scattered or ± gregarious; disc slightly concave to flat (to slightly convex), margin distinct, 0–20 µm protruding, ± smooth; sessile, superficial to completely immersed (erumpent). **Asci** *(40–)45–65(–70) {8} × 4.6–5.2 {1} or 5.3–6.4(–6.6) µm {9}, †40–55 {3} × 3.8–4.5 {1} or 4.8–5.5 µm {2}, 16-spored, spores 2–4-seriate, 7–8 lower spores inverted {5} (strongly mixed), pars sporifera *23–37(–42) µm long; **apex** (†) strongly truncate (slightly indented, laterally scarcely inflated); **base** with very short to medium long, thin or thick, flexuous stalk, T-, L-, Y- or h-shaped. **Ascospores** *(3.5–)4–5(–5.3) {4} or (4.5–)5–6.5(–7) {11} or 6.5–7.7 {1} × (1.7–)1.8–2 {5} or 2–2.3(–2.5) µm {12}, subcylindrical to often narrowly ellipsoid(-ovoid) to fusoid-clavate, apex (rounded to) obtuse, sometimes subacute, base not or sometimes slightly to medium attenuated, straight or somewhat inequilateral, sometimes slightly to medium curved; **SBs** apically (rarely subapically) attached to spore wall, *(3.5–)4–5.5(–6) × 0.2–0.4(–0.7) µm in situ {8} [~(4–)5–6(–6.5) µm actual length], filiform to subulate, sometimes slightly to medium swollen at base, straight to often flexuous, sometimes uncinate. **Paraphyses** apically medium to (very) strongly capitate, also clavate or spathulate, terminal cells *6–22 {8} or 17–28 {1} × (2–)2.5–5(–6) {9} µm, lower cells *(5–)6–13(–18) × 1.1–2 µm {4}, near base 2–2.5(–3) µm; sometimes branched near apex, hymenium very pale orange. **Medullary excipulum** hyaline, 20–35 µm thick, of ± loose or dense textura intricata with many inflated cells, indistinctly to sharply delimited. **Ectal excipulum** hyaline, near margin very pale rose, of thin-walled to slightly gelatinized, irregularly oriented t. angularis from base to submargin, 20–50 µm thick near base, cells *9–20 × 7–14(–15.5) µm

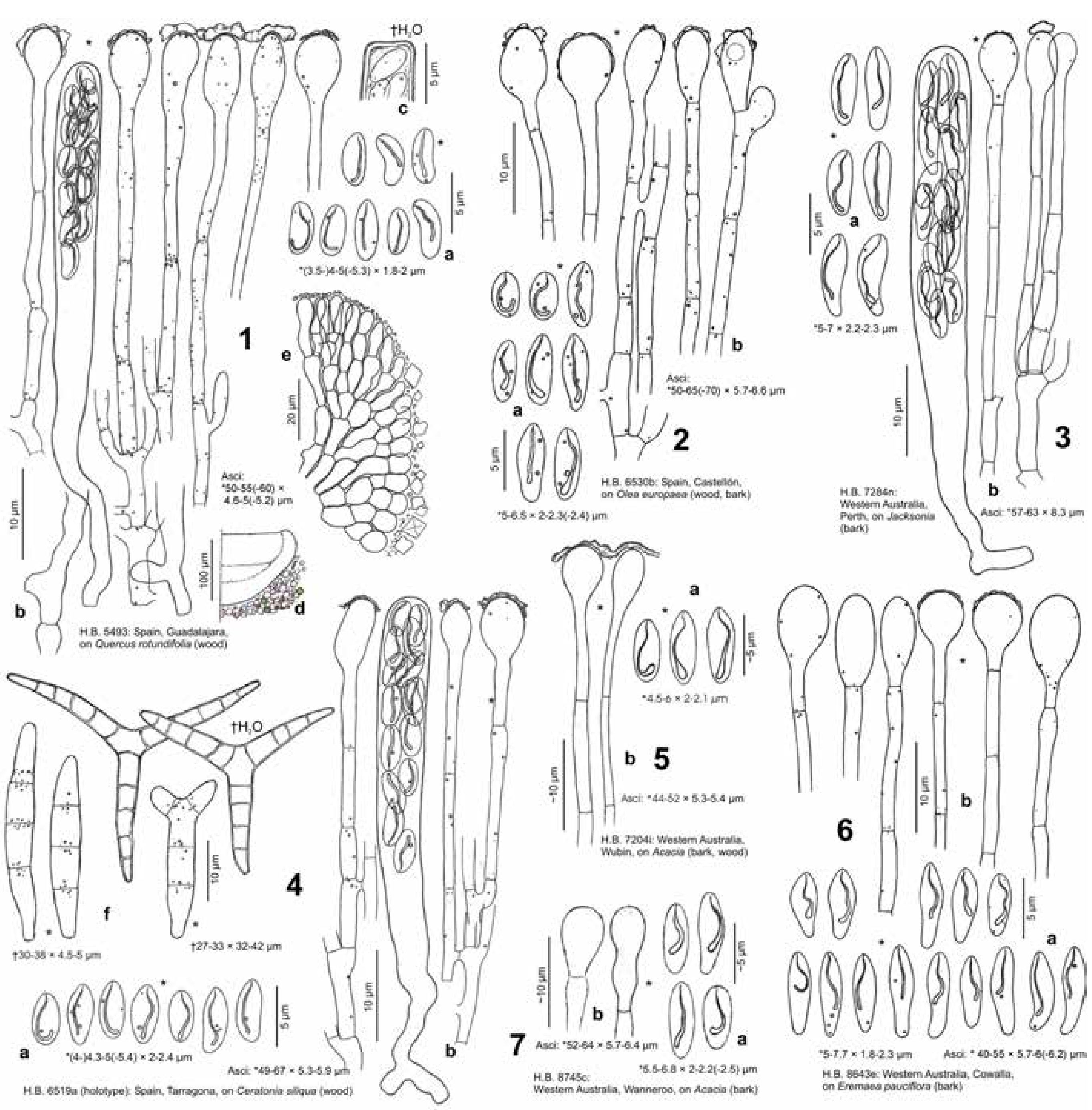


Plate 740. **1–7**: *Orbilia microserpens*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apex; **d**. apothecium in median section; **e**. id., marginal ectal excipulum; **f**. conidia (from culture, dead conidia from substrate).

{4}; 15–25 µm thick near margin, of t. prismatica-porrecta oriented at a 0–70° angle to the surface, marginal cortical cells *6–15 × 3–5(–8) µm {3}. **Anchoring hyphae** sparse to abundant, *1.8–3 µm wide, walls 0.2–0.4(–0.7) µm thick {3}. **SCBs** absent {10}. **Exudate** hyaline to pale or light yellowish-orange, over paraphyses 0.3–2(–3) µm thick, cloddy(-granular), loosely or firmly attached; over margin and flanks 0.8–5 µm thick, granular or cloddy, very rough. **— ANAMORPH**: trinacrium-like (from ascospore isolate {1} and natural substrate {2}). **Conidiophores** not seen. **Conidia** Y-shaped, total size †~27–33 × 32–42 µm, stipe †~17–20 × 3.5–4.5 µm, (1–)4–6-septate, arms gradually slightly to strongly tapering, †/*(6–)16–22 × 3–4.5 µm, (1–)4–5-septate {1}; phragmoconidia */†25–38 × 4.5–5 µm, 3(–4)-septate, fusoid {1}.

Habitat: collected 0–2 m above the ground, corticated to entirely decorticated, 3–25 mm thick twigs and branches of *Acacia* sp. {5}, *Allocasuarina campestris* {1}, *Banksia grandis* {1}, *Eremaea pauciflora* {1}, *Ceratonia siliqua* {1}, *Eucalyptus* sp. {1}, *Genista scorpius* {1}, *Jacksonia* sp. {1}, *Melaleuca* sp. {1}, *Olea europaea* {1}, *Pinus halepensis* {1}, *Quercus rotundifolia* {2}, *Rhamnus alaternus* {1}, *Ulex* sp. {1}, *U. parviflorus* {1}, on 0.2–0.5(–1.5) mm deep strongly decayed wood {13} and bark {10} (bast, rarely periderm), bark sometimes detached, wood partly strongly eroded; greyed, green algae absent to abundant. **Associated**: *Amandinea* sp. {1}, *Baggea* sp. {1}, *Caloplaca* sp. {2}, *Capronia* sp. {1}, *Claussenomyces* sp. {1}, *Coniochaeta sarothamni* {1}, *Cosmospora* sp. {1}, *Dacrymyces* sp. {1}, *Didymosphaeria futilis* {1}, *Durella* sp. {1}, *D.* aff. *connivens* {1}, *Gloniopsis praelonga* {3}, *Hyalorbilia juliae* {1}, *Hypoxylon* sp. {1}, *Hysterium angustatum* {1}, *Hysterographium fraxini* {1}, ?*Hysteropatella* sp. {1}, *Lecanora* sp. {1}, *Lophiostoma* sp. {1}, *L. caulium* {1}, *Mellitiosporiella* sp. {1}, *Muellerella lichenicola* {1}, *Nitschkia* ?*broomeana* {1}, *Orbilia acaciae* {1}, *O. albidorosea* {1}, *O. amberina* {2}, *O. anguliobliqua* {1}, *O. australiensis* {2/1}, *O. austrocylindrica* {1}, *O. austroobtusispora* {2}, *O. aviceps*

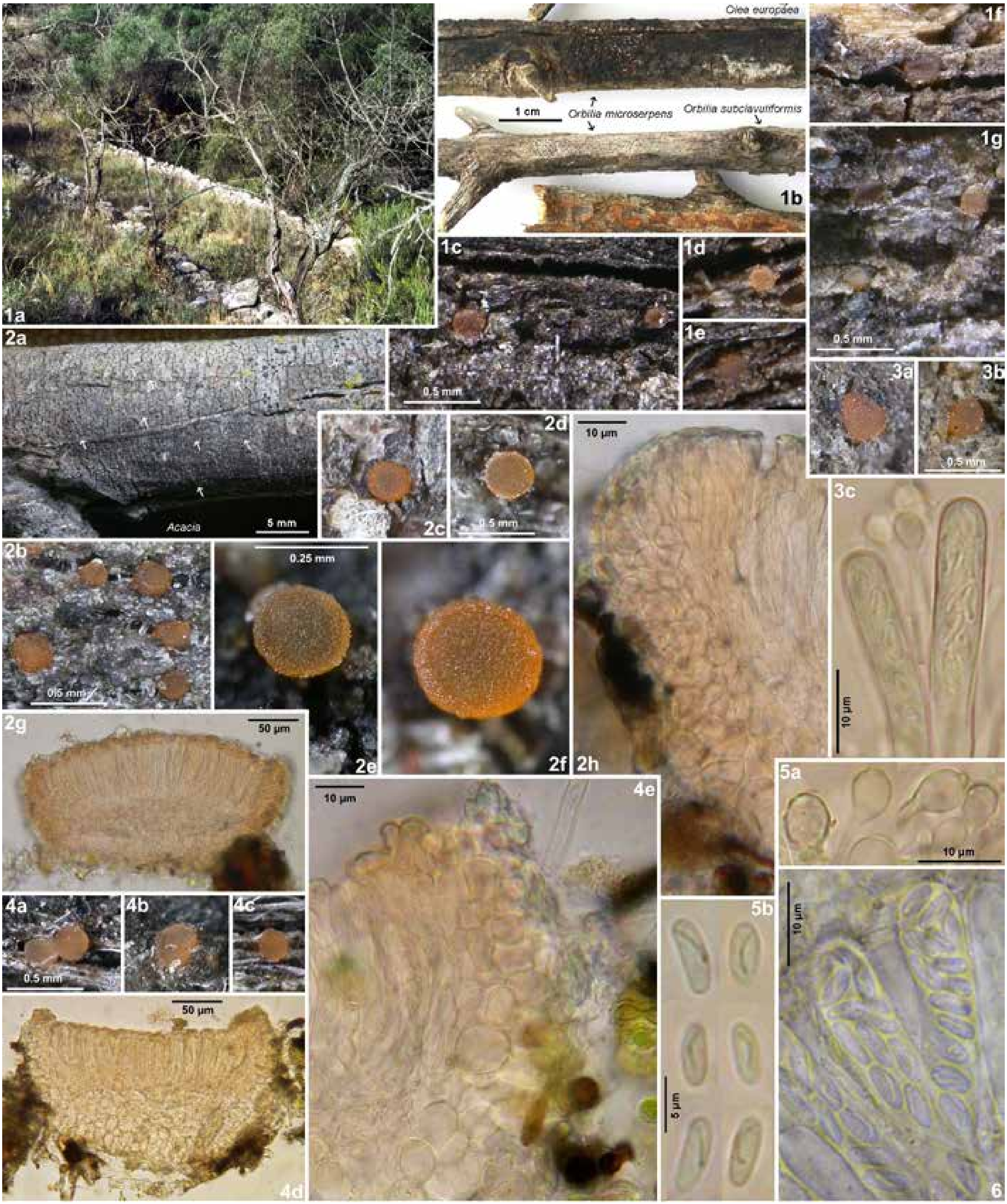


Plate 741. **1–6**: *Orbilia microserpens*. – **1a**. plantation with *Prunus dulcis* and *Olea*; **1b**. decorticated xeric branches; **2a**. corticated xeric branch with *Caloplaca* and *Amandinea* (arrows: *O. microserpens*); **1c–g**, **2b–f**, **3a–b**, **4a–c**. rehydrated apothecia; **2g**, **4d**. apothecia in median section; **2h**, **4e**. id., marginal ectal excipulum; **3c**, **6**. asci; **5a**. apices of paraphyses; **5b**. ascospores. – Living state, except for asci in **6**. — **1a–g**. H.B. 6530b: Spain, Castellón, on *Olea*; **2a–h**. H.B. 8745c: Western Australia, Perth, on *Acacia*; **3a–c**. H.B. 8937b: ibid., Moora, on *Allocasuarina*; **4a–e**. H.B. 8643e: ibid., Cowalla, on *Eremaea*; **5a–b**. H.B. 8976g: ibid., Wittenoom, on *Acacia*; **6**. 4.XI.2007: ibid., Fortescue River, on *Acacia*.

{1}, *O. aviflagellata* {1}, *O. ?cejpii* {1}, *O. commarosa* {2}, *O. coronohesperidea* {1}, *O. curvativitalbae* {2}, *O. eucalypti* {3}, *O. gambelii* {1}, *O. helicoobliqua* {1}, *O. hesperidea* {1}, *O. kingsiana* {1}, *O. macrocarpa* {1}, *O. macrotrapeziformis* {2}, *O. multicurvula* {1}, *O. multigambelii* {1}, *O. multiserpens* {2/1}, *O. ?multivirgula* {1}, *O. myrioauris* {1}, *O. myriofusiclava* {2}, *O. myriofusoidea* {1}, *O. myriolilacina* {1}, *O. myrioobliqua* {3}, *O. ?navajoana* {1}, *O. nothovinosa* {3}, *O. ocellata* {1}, *O. octocorculispora* {1}, *O. paraobliqua* {1}, *O. pleioaustraliensis* {1}, *O. pleioaustrocylindrica* {1}, *O. pleiocoronohesperidea* {1}, *O. pleioquaestiformis* {1}, *O. pleioserpens* {2}, *O. pleistovitalbae* {1}, *O. plurililacina* {1}, *O. pluristomachia* {1}, *O. polyspora* {1}, *O. serpentina* {2/1}, *O. subclavuliformis* {1}, *O. wannerooensis* {1}, *Ostropales* {2}, ?*Parmelia* sp. {1}, *Patellaria* '*andina*' {1/1}, *P. atrata* {1}, *Proliferodiscus griseoviolaceus* {1}, *P. olivaceoviridis* {1}, *Schizoxylon* sp. {1}, *Stilbella* sp. {1}, ?*Teichospora* sp. {1}, ?*Triblidium* sp. {1}, *Trichopeziza perrotioides* {1}, ?*Trimmatostroma* sp. {1}. **Desiccation tolerance**: fully viable for at least 14 months, after 25 months some submature asci still alive. **Altitude**: 15–1348 m a.s.l. **Geology**: Spain: Tertiary limestone, sand & clay; Australia: Precambrian and Cretaceous sedimentary rock, Cenozoic regolith; granite. **Phenology**: throughout the year (long-lived).

Taxonomic remarks. *Orbilia microserpens* is characterized by 16-spored asci and small, ± ellipsoid-fusoid-clavate ascospores with long, filiform or subulate spore bodies. It differs from *O. pleiogambelii* in the consistent absence of both globose and crystalloid SCBs, and in narrower spores. The North American and Australian *O. pleioserpens* and *O. macroserpens* and the European *O. cisti* mainly differ in larger spores, the predominantly Australian *O. multiserpens* in 32-spored asci. The Australian *O. pleiocrescens* is very similar to *O. microserpens*, and differs merely in distinctly curved spores.

Variation. *O. microserpens* varies among the collections mainly in size and shape of the spores, but this variation was sometimes also observed within a collection. In a sample on *Olea* some apothecia contained some asci with extraordinarily short spores (Pl. 740: 2a, upper 2 spores). A collection on *Quercus ilex* (Pl. 740: 1) differs from all others in rather short and particularly narrow, partly reniform spores (very similar to *O. pleiocrescens*), distinctly narrower asci, and comparatively long paraphysis cells, although in another, unpreserved collection on the same substrate (Castellón, 27.IX.1999) asci and spores were of the typical size. Similarly short spores were found in the holotype on *Ceratonia* (Pl. 740: 4), but here the asci and spores were distinctly wider. The Australian specimens often tend to have slightly longer, more heteropolar spores, nevertheless they fit quite well the European specimens. A collection from the arid Pilbara desert (Pl. 741: 5) deviates from all other samples in frequently subapically inserted SBs (similar as in *O. namibica*), also in rather wide spores of *5.5–7 × 2.2–2.5 µm.

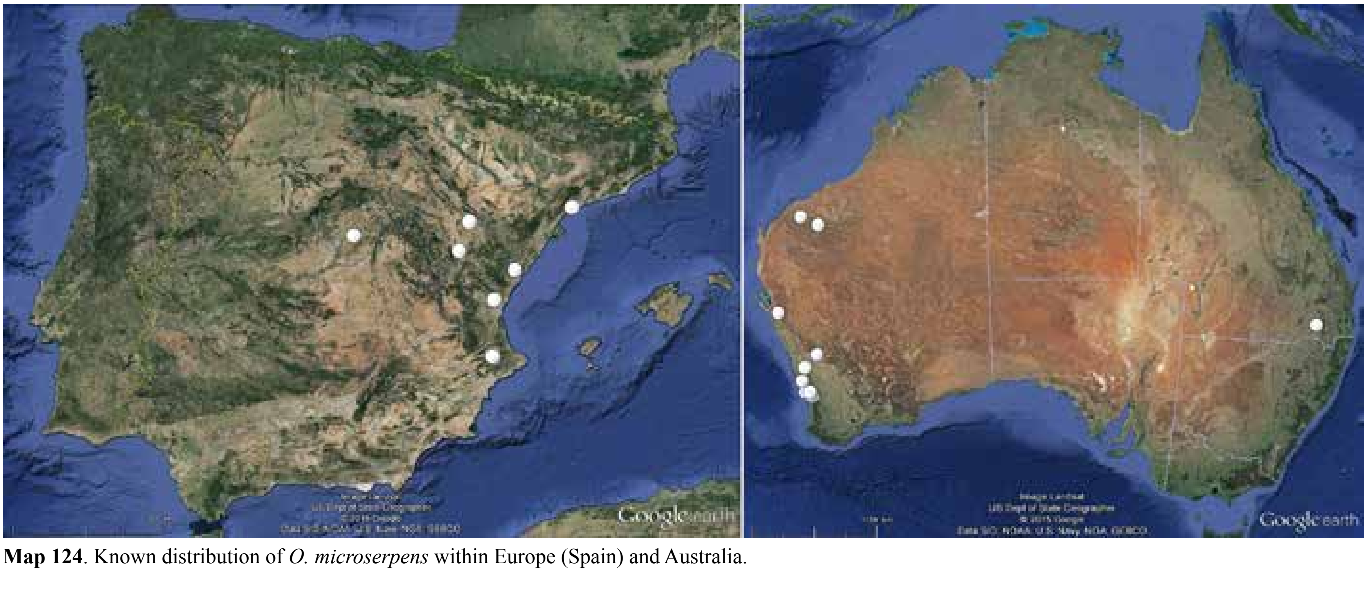
Anamorph. Mainly unbranched conidia developed near an apothecium which was placed on the lid of a Petri dish (Pl. 740: 4f). The single observed trinacrium-like conidium had rather short arms in comparison to the probably more typical conidia which we have found on the natural substrate in this collection. Also some unbranched conidia were seen on the natural substrate. This anamorph differs from *Trinacrium robustum* in narrower arms and stipes.

Phylogeny. A sequence was gained from pure culture of the holotype from Cataluña (on *Ceratonia*) which comprises SSU (without S1506 intron), ITS, and LSU. *O. microserpens* is close to *O. macroserpens* (3.3% in ITS, 0.6% in LSU D1–D2), *O. cisti* (3.6%, 0.8%), and *O. cercocarpi* (4.3%, 0.5%), and *O. myrionamibica* (4.7%, 0.6%), with which it clusters in the *microserpens-ungulata* clade (Phyls 19–20, S20, S22).

A sequence of unknown origin (MH221069) clustered with *O. microserpens* in a strongly supported subclade (ITS, SSU+ITS+LSU), with a distance of 1.8% in the ITS and 1% in the LSU (5 nt in the D2). It also differs in possessing the S1506 intron in which region it clustered unresolved in the *Ellipsospermae* clade (S21). Therefore, it is provisionally called *O.* aff. *microserpens*.

Ecology. *O. microserpens* was collected on wood and bark of xeric twigs and branches of various angiosperm trees and shrubs, rarely gymnosperms. Within Europe it was so far only found in Spain in thermo- to supramediterranean semiarid to semihumid maquis (*Quercus ilex* shrubs, old *Olea* plantations, often with *Ulex*), once also in a suprasubmediterranean semiarid shrubland with *Genista scorpius* and *Rhamnus myrtifolia* (Pancrudo). Within Australia the species occurred in subtropical semihumid acacia mixed shrublands and banksia-eucalypt woodlands (mallee) in the southwest or an eucalypt open woodland in the east, but also in (sub)tropical, semiarid to arid acacia open shrublands (mulga) in the west, one of them in an almost tropical tussock grassland with *Livistona alfredii*.

Specimens included. **SPAIN**: **Cataluña**, **Tarragona**, 20 km WSW of Tarragona, 3 km W of Cambrils, Carrer Gotic, La Dorada, 15 m, branch of *Ceratonia siliqua*, on wood, 27.IX.1999, G. Marson (ex H.B. 6519a, M-0276514, **holotype**, anam. substr., anam. cult., CBS 140817; sq.: KT215251, MH878187). – **Aragón**, **Teruel**, 18.5 km WSW of Montalbán, 4 km NE of Pancrudo, Loma de la Sima, 1348 m, branch of *Genista scorpius*, on wood, 11.VIII.2011, R. Tena (ø, doc. vid.). – 7.5 km WNW of Teruel, 1.5 km W of San Blas, Guadalaviar river, 965 m, branch of *Rhamnus alaternus*, on wood, 12.III.2012, R. Tena (R.T.L. 12031201, H.B. 9676a). – **Castilla-La Mancha**, **Guadalajara**, 9 km ENE of Alcalá de Henares, SSW of Los Santos de la Humosa, 875 m, branch of *Quercus rotundifolia*, on wood, 23.V.1996, H.O. Baral (H.B. 5493, anam. substr.). – **Com. Valenciana**, **Valencia**, 22 km NNW of Valencia, 5.2 km SW of Serra, Porta



Map 124. Known distribution of *O. microserpens* within Europe (Spain) and Australia.

Çoeli, 500 m SE of Hospital Doctor Moliner, 185 m, branch of *Pinus halepensis*, on wood, 26.I.2014, R. Tena (R.T.L. 14012601, doc. vid.). – **Castellón**, 50 km N of Alicante, 3.5 km NNW of Muro de Alcoy, Puerto de Benicadell, 563 m, branch of *Ulex parviflorus*, on wood, 4.I.2008, J.P. Priou (J.P.P. 28010, doc. vid.). – 13.5 km NNW of Castellón, 3.2 km WSW of Vilafamés, Camí de Costur, 400 m, branches of *Olea europaea*, on bark & wood, 27.IX.1999, H.O. Baral (ex H.B. 6530b). – ibid., branch of *Quercus rotundifolia*, on wood, 27.IX.1999, H.O. Baral (ø). – ibid., branch of *Ulex*, on wood, 27.IX.1999, H.O. Baral (H.B. 6531). — **AUSTRALIA**: **Western Australia**, Pilbara, 96 km S of Roebourne, 42 km SSW of Python Pool, road crossing the Fortescue River, 300 m, branch of *Acacia*, on bark, 4.XI.2007, G. Marson (ø). – 1.5 km SW of Wittenoom, N of Karijini, Wittenoom Gorge, 467 m, branch of *Acacia*, on bark, 29.X.2007, G. Marson (H.B. 8976g). – Yalgoo, 200 km N of Geraldton, 15 km SSE of Wannoo Billabong Roadhouse, W of Toolonga, 157 m, twig of *Acacia*, on bark, 8.XII.2001, G. Marson (H.B. 9033g ø). – Avon Wheatbelt, 40 km N of Moora, 4 km NNW of Watheroo, Midlands Road, 320 m, branch of *Allocasuarina campestris*, on bark, 25.X.2007, G. Marson (H.B. 8937b). – 78 km NE of Wubin, 18 km SW of Mt. Singleton, 380 m, branch of *Acacia*, on bark & wood, 24.XI.2001, G. Marson (H.B. 7204i ø). – Swan Coastal Plain, 59 km SW of Moora, 8 km NE of Cowalla, Moore River, Orange Springs Rd, 77 m, branch of *Eremaea pauciflora*, on bark, 5.IX.2006, G. Marson (H.B. 8643e). – 30 km NNW of Perth, 1 km NW of Kinross, Tamala Park, 38 m, branch of *Acacia*, on bark, 23.X.2007, G. Marson (H.B. 8745c). – 30 km NE of Perth, 4 km N of Upper Swan, W of Walyunga, 37 m, branch of *Jacksonia*, on bark, 23.XI.2001, G. Marson (H.B. 7284n ø). – 15 km ENE of Perth, 1.7 km S of Midland, 16 m, branch of *Eucalyptus*, on wood, 22.XI.2001, G. Marson (ø). – Jarrah Forest, 28 km E of Perth, 8 km ESE of Kalamunda, 4 km E of Bickley, Darling Range, Junction of Lockwood and Gunjin Road, 370 m, branch of *Banksia grandis*, on wood & bark, 7.IX.2006, G. Marson (ø). – **Queensland**, Brigalow Belt South, 80 km N of Goondiwindi, 10 km S of Moonie, 278 m, twig of *Melaleuca*, on wood, 23.X.1998, G. Marson (ø).

Not included. unlocalized (confusion of unclear origin, sequence taken in IV.2014; sq.: MH221069).

Orbilia pleiocrescens Baral & G. Marson, **sp. nov.**, MB 813729 — Pls 742–743

Etymology: named after the 16-spored asci and crescent-shaped ascospores.
Typification: Western Australia, Wannamal, branch of *Acacia*, 4.IX.2006, G. Marson (ex H.B. 8582b, MEL 2389242, holotype).

Latin diagnosis: *Similis* Orbiliae microserpenti *sed ascosporae semper leniter ad valde curvatae. Habitat ad corticem, raro lignum putridum ramorum siccorum* Acaciae *in zona subtropica semiarida Australiae meridio-occidentalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.2–0.35(–0.4) mm diam., 0.17–0.19 mm high, light to bright orange, hardly translucent, round, subgregarious in small groups; disc flat, margin distinct, thin, 5–15 µm protruding, smooth to somewhat crenulate (partly whitish); broadly sessile, nearly superficial to almost completely immersed. **Asci** *(40–)50–60(–65) × (4.5–)4.8–5.4(–5.7) µm, †40–54 × 4–4.5 µm, 16-spored, spores (*) biseriate, ~4–9 lower spores inverted (sometimes strongly mixed), pars sporifera *22–26 µm long; **apex** (†) strongly truncate (not or ± distinctly indented, laterally sometimes slightly inflated); **base** with short to long, ± thin and flexuous stalk, L-, T- or Y-shaped. **Ascospores** *(3.3–)3.5–4.3(–5) × (1.4–)1.5–1.8(–2) µm, cylindrical to cylindric-clavate, apex rounded to obtuse, base not or somewhat attenuated, slightly to mostly medium to (very) strongly curved (crescent-shaped), sometimes geniculate in lower half; **SBs** *2–3.8 × 0.2–0.5 µm in situ (~2–5 µm actual length), filiform to subulate, with or without a swollen, irregularly shaped lower part, ± flexuous, sometimes almost uncinate. **Paraphyses** apically medium to very strongly clavate-capitate, terminal cells *10–20 × (3–)3.4–4.5(–5) µm, lower cells *10–14 × 1–1.7 µm (near base *7–8 × 2–2.5 µm); unbranched at upper septum, hymenium very pale orange. **Medullary excipulum** 50–60 µm thick, of dense textura intricata-angularis, very indistinctly delimited. **Ectal excipulum** of thin-walled († slightly gelatinized), ± vertically oriented t. angularis(-prismatica) from base to margin, 50 µm thick near base, cells *10–22 × 7–15 µm; 20–30 µm thick near margin, upper margin of t. prismatica-porrecta oriented at a 10° angle to the surface, marginal cortical cells */†7–11 × 2.5–4 µm. **Anchoring hyphae** medium abundant, †1.7–2.5(–3) µm wide, walls 0.2(–0.4) µm thick. **SCBs** in paraphyses and ectal excipulum (near margin) absent. **Exudate** over paraphyses 0.2–0.3(–1) µm thick, finely rough, ± continuous, pale yellow-orange, also absent, ± firmly attached, over margin and flanks 0.2–1 µm thick, continuous. **— ANAMORPH**: unknown.

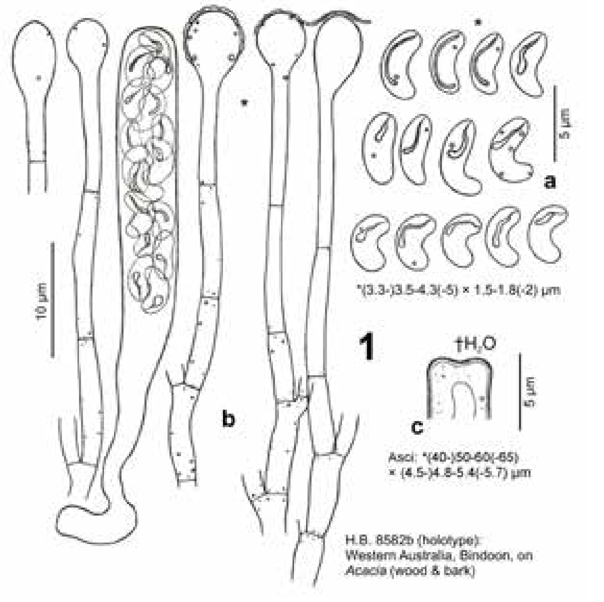


Plate 742. **1**: *Orbilia pleiocrescens*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apex.

Habitat: collected 0.5–1.5 m above the ground, ± corticated, 10–12 mm thick branches of *Acacia* sp., on bark (on bast, especially in small cracks in periderm), exceptionally on wood, 0.2–0.4 mm deep strongly decayed, ± greyed, green algae sparse. **Associated**: *Orbilia albidorosea*, *O. australiensis*, *O. austroocculta*, *O. austroregalis*, *O. myriooobliqua*, crustose lichens. **Desiccation tolerance**: fully viable for at least 1 year. **Altitude**: 272 m a.s.l. **Geology**: Archean granulite with granitic gneiss. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia pleiocrescens* is very closely related to *O. microserpens*, from which it mainly differs in predominantly strongly curved (cashew-shaped) ascospores. In a small-spored European and two large-spored Australian collections (Pl. 740: 1, 3, 6) here referred to *O. microserpens* a few spores were slightly curved by looking very similar as in *O. pleiocrescens*, whereas in the remaining collections usually no such distinct curvature could be noted. A species with similar crescent-shaped spores and subulate SBs, *O. graminis* differs in 8-spored asci with hemispherical apices and distinct apical domes and belongs to series *Vibrioides* of section *Hemiorbilia*. *O. curvativitalbae* differs in 8-spored asci and much larger spores which are often almost straight in their upper part.

Ecology. The single collection of *O. pleiocrescens* was made on rotten bark (rarely wood) of xeric branches of *Acacia* in a subtropical semihumid eucalypt woodland with *Macrozamia riedlei* in southwestern Australia.

Specimens included. **AUSTRALIA**: **Western Australia**, Jarrah Forest, 25 km NNE of Bindoon, 12 km ESE of Wannamal, 272 m, branch of *Acacia*, on wood, 4.IX.2006, G. Marson (ex H.B. 8582b, MEL 2389242, **holotype**).

Orbilia multiserpens Baral & G. Marson, **sp. nov.**, MB 813730 — Pls 744–745, Map 125

Etymology: named according to the 32-spored asci and close resemblance to *O. microserpens*.
Typification: Portugal, Achete, branch of *Rhamnus alaternus*, 3.I.2007, J.P. Priou (ex H.B. 8419, M-0276525, holotype).

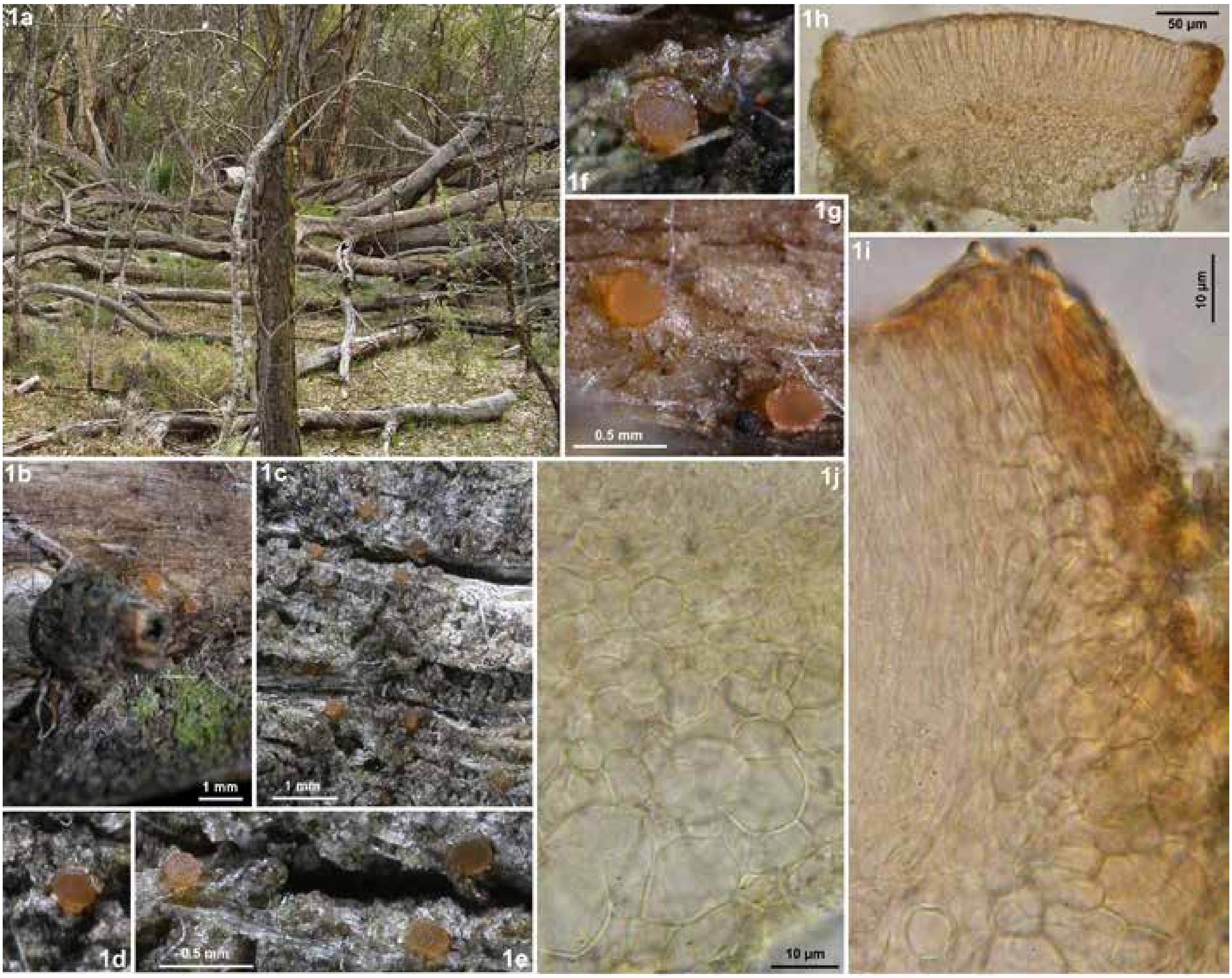


Plate 743. **1**: *Orbilia pleiocrescens*. – **1a**. semihumid eucalypt open woodland with *Acacia*; **1b–g**. rehydrated apothecia; **1h**. apothecium in median section; **1i**. id., marginal ectal excipulum; **1j**. id., basal ectal excipulum. – Living state. — **1a–j**. H.B. 8582b (holotype): Western Australia, Bindoon, on *Acacia*.

Latin diagnosis: *Similis* Orbiliae microserpenti *sed asci 32-spori. Habitat ad lignum vel corticem putridum ramulorum vel ramorum siccorum fruticum vel arborum angiospermarum, etiam ad petiolum* Livistonae, *in zona subtropica subhumida ad arida Australiae, Europae meridionalis et Americae septentrionalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.15–0.3 mm diam., 0.12–0.16 mm high, pale to light orange, round, scattered; disc flat, margin thin or thick, 10 µm protruding, smooth; sessile, slightly immersed. **Asci** *50–73(–80) × 6.2–7.5(–8.3) µm {8}, †46–60 × 5–6.2 µm {2}, 32-spored, spores multiseriate, lower spores inverted {5} (strongly mixed), pars sporifera *30–43 → 28 µm long; **apex** (†) strongly truncate (very slightly indented, laterally inflated or not); **base** with short, thick, flexuous stalk, L-, Y- to h-shaped. **Ascospores** *(3.3–)4–5.7(–6.7) × 1.8–2.4(–2.7) µm {10}, subcylindric to ellipsoid, sometimes ± fusoid(-clavate), apex rounded to obtuse, exceptionally subacute, base not or sometimes slightly attenuated, straight to slightly inequilateral; **SBs** *(2.5–)3–5.5(–6.2) × 0.2–0.5(–0.7) µm in situ {8} [~(2.5–)4–7(–8.5) µm actual length], filiform to subulate, base not or slightly, rarely strongly inflated (then probably overmature), slightly to strongly flexuous, often uncinate. **Paraphyses** apically medium to very strongly (clavate-)capitate, sometimes spathulate, terminal cells *7–18(–22) × (3–)3.5–5.8(–6.3) µm {9}, lower cells *(6–)8–15 × 1.2–2(–2.5) µm {4}; unbranched at upper septum, very pale orange-rose. **Medullary excipulum** very pale orange-rose, 30–40 µm thick, of ± dense textura intricata with inflated cells, sharply delimited. **Ectal excipulum** very pale orange-rose, of thin-walled, ± vertical t. (globulosa-)angularis(-prismatica) from base to mid flanks or margin, 30 µm thick near base, cells *8–15 × 5–12 µm {3}; 15–20 µm thick at mid flanks and margin, at margin sometimes a t. prismatica oriented at a 10–20° angle to the surface, marginal cortical cells *6–11 × 3–6 µm {3}, at submargin 3–6 × 3–5 µm. **Anchoring hyphae** not seen. **SCBs** absent {8}, rarely globose, in tips or lower cells of paraphyses. **Exudate** over paraphyses 0.2–1.5 µm thick, rough to cloddy, ± firmly attached, over margin and flanks 0.3–4 µm, granular to rough-cloddy. **— ANAMORPH**: unknown.

Habitat: collected 0–4 m above the ground, ± corticated to entirely decorticated, 2–14 mm thick twigs and branches of *Allocasuarina campestris* {1}, *Acacia* sp. {3}, *A. jennerae* {1}, *Casuarina cunninghamiana* {1}, *Ephedra ?viridis* {1}, *Pittosporum phillyreoides* {1}, *Psydrax latifolia* {1}, *Rhamnus alaternus* {1}, on 0.2–1 mm deep strongly decayed wood {5} and bark (bast) {4}; petioles of *Livistona nitida* {1}, ± greyed, green algae sparse or absent. **Associated**: *Baggea* sp. {1/1}, *Capronia* sp. {1}, *Claussenomyces* sp. {1}, *Coccomycetella* sp. {1}, *Gloniopsis* sp. {2}, *Hysterobrevium mori* {1}, *Hysterium angustatum* {1}, *Lecanora* sp. {1}, *Melaspilea emergens* {1}, *Mellitiosporiella* sp. {1}, *Orbilia acaciae* {1}, *O. amberina* {1}, *O. anguliobliqua* {1}, *O. angustoaristata* {2}, *O. australiensis* {1/2}, *O. austroobtusispora* {1}, *O. austropleiomicrosoma* {1}, *O. aviflagellata* {1}, *O. calyptrata* {1}, *O. ?commarosa* {1}, *O. coronohesperidea* {2}, *O. ?dixienis* {1}, *O. helicoobliqua* {1}, *O. hesperidea* {1}, *O. lacrimispora* {1/1}, *O. livistonae* {1/1}, *O. macrocarpa* {1}, *O. macrohesperidea* {1}, *O. maeandrina* {1}, *O. megahesperidea* {1}, *O. microserpens*

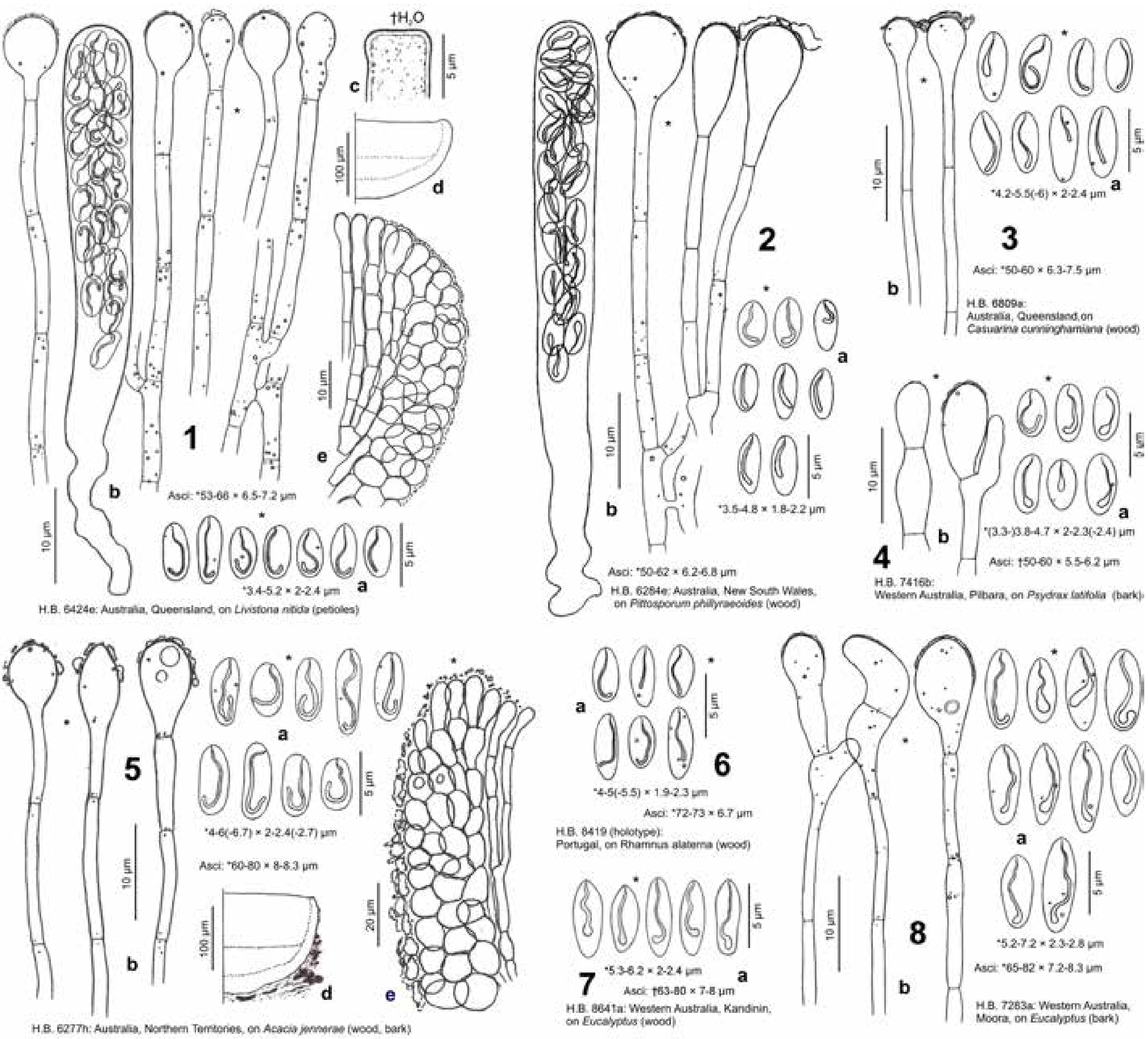


Plate 744. **1–6**: *Orbilia multiserpens*; **7–8**: *O.* cf. *multiserpens*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apex; **d**. apothecia in median section; **e**. id., marginal ectal excipulum.

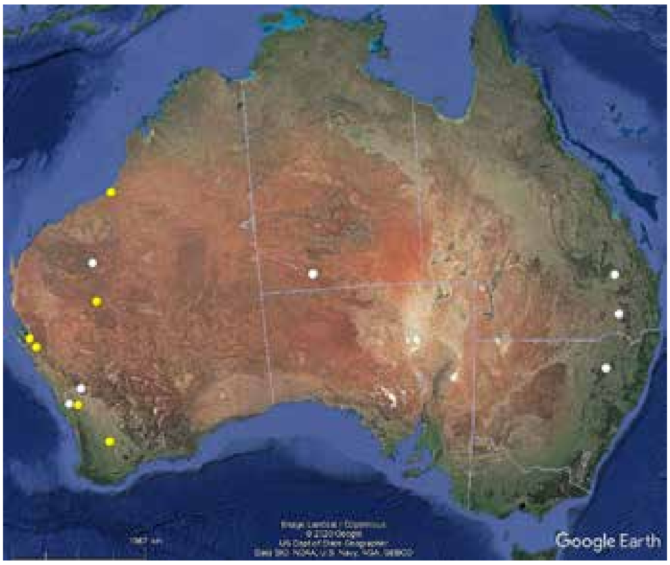
{3}, *O. multiaustraliensis* {1}, *O.* ?*multivirgula* {1}, *O. myriella* {1}, *O. myrioeuonymi* {1}, *O. myriofusiclava* {1}, *O. myriolilacina* {1}, *O. myrionamibica* {1}, *O. myrionanosoma* {1}, *O. myrioobliqua* {2}, *O.* ?*myrioolneyae* {1}, *O. myriopseudoregalis* {1}, *O.* ?*navajoana* {1}, *O. nothovinosa* {1}, *O. octoserpentina* {1}, *O. palmicola* {1}, *O. paraobliqua* {1}, *O. parviclava* {1}, *O. pleioaustraliensis* {4}, *O. pleioaustrocylindrica* {1}, *O. pleiocoronohesperidea* {1}, *O. pleiohesperidea* {1}, *O. pleioserpens* {1/1}, *O.* ?*saguarina* {1}, *O. sonorensis* {1}, *Ostropales* {1}, ?*Parmelia* sp. {1}, *Patellaria* ?*andina* {1}, *Proliferodiscus griseoviolaceus* {1}, ?*Triblidium* sp. {2}, *Symbiotaphrina desertorum* {2}. **Desiccation tolerance**: fully viable for 2 years, immature asci, spores and paraphyses still viable after 33 months. **Altitude**: 200–706 m a.s.l. (Australia), 50 m (Portugal), 615 m (North America). **Geology**: Archean, Proterozoic, Jurassic & Cretaceous sedimentary rock, Oligo- to Miocene schist, sand-, lime- & mudstone, Cenozoic regolith; granite, granitic gneiss, volcanic rock. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia multiserpens* closely resembles *O. pleioserpens* and *O. microserpens*, from which it mainly differs in 32-spored asci. The similar North American *O. multigambelii* differs in usually possessing abundant and conspicuous crystalloid SCBs, also in distinctly wider and slightly longer, more consistently broadly ellipsoid ascospores. The African *O. namibica* and the North American *O. multicercocarpi* differ in larger spores and the presence of crystalloid SCBs, the former also in more cylindrical spores.

Variation. The single collections of *O. multiserpens* from USA and Europe fit quite well the Australian ones. However, rather high variation in size and shape of spores and SBs is noted between but also within the populations, irrespective of their geographical origin. In a few asci of one sample (H.B. 6277h) all spores had an abnormal ovoid-subglobose shape (not figured).

Only 1–5 apothecia were detected in each of the seven Australian collections. Since the apothecia did not macroscopically differ from the many associated species of *Orbilia*, more of them might exist on the preserved branches.

Not included collections. Two partly rather abundant samples on *Eucalyptus* (Pls 744: 7–8; 745: 1, 3) differ in somewhat larger, more fusoid spores with partly subacute apices



Map 125. Known distribution of *O. multiserpens* in Australia (yellow = not included collections).

and are, therefore, not included in the description. They appear to represent a close relative of the 16-spored *O. pleioserpens*, with which one of them (Pl. 736: 2) grew together. Four further Australian collections (IVV: on *Acacia*, H.B. 7215g, 7302d, 9033c; on *Eucalyptus*, H.B. 9772d) were only studied in the dead state [spores †(3–)4–6 × 1.8–2.3 µm], therefore, spore and paraphysis contents are unknown here.

Ecology. *O. multiserpens* was found on rotten wood and bark of xeric twigs and branches of angiosperm trees and shrubs, also on palm petioles. The holotype and only European collection was on *Rhamnus* in a mesomediterranean semihumid valley 70 km northeast of Lisboa. The sample from western North America on *Ephedra* was from a subtropical semiarid Sonoran paloverde-mixed cacti desert scrub. Most collections were made in Australia, in subtropical (to tropical), subhumid to semihumid and semiarid acacia or eucalypt open wood- and shrublands in the southwest, west (Pilbara), and centre (south of MacDonnell Ranges), and the subtropical (to tropical) wet and dry (subhumid) savannah in the east (Great Dividing Range). The not included collections are from similar habitats in western Australia.

Specimens included. **AUSTRALIA**: **Western Australia**, Pilbara, 30 km NW of Newman, northern border of Ophthalmia Range, 706 m, branch of *Psydrax latifolia*, on bark, 27.XI.2001, G. Marson (H.B. 7416b). – Avon Wheatbelt, 40 km N of Moora, 4 km NNW of Watheroo, Midlands Road, 320 m, on *Allocasuarina campestris*, 25.X.2007, G. Marson (H.B. 8937c ø). – 78 km NE of Wubin, 18 km SW of Mt. Singleton, 380 m, on *Acacia*, 24.XI.2001, G. Marson (H.B. 7204j ø). – **Northern Territories**, Finke, 100 km E of Yulara, 24 km ENE of Curtin Springs Roadhouse, 480 m, twig of *Acacia jennerae*, on wood & bark, 10.X.1998, G. Marson (H.B. 6277h). – **Queensland**, Brigalow Belt South, 69 km SSW of Theodore, 15 km N of Taroom, Palm-Tree Creek, Roy Staines Bridge, 200 m, petioles of *Livistona nitida*, 22.X.1998, G. Marson (H.B. 6424e). – 100 km S of Miles, 22.5 km NW of Moonie, 305 m, branch of *Casuarina cunninghamiana*,

Plate 745. **2**: *Orbilia multiserpens*; **1**, **3**: *O.* cf. *multiserpens*. – **1a**. decorticated xeric branch; **1b–l**, **3a–d**. rehydrated apothecia; **2d**. apothecium in median section; **1m–n**, **2a–c**, **3e**. asci. – Dead state (**2c** in CB$_L$; **1n** in IKI; **1m**, **3e** in KOH+IKI), except for spores in **2a–b**. – **1a–n**. H.B. 7283a: Western Australia, Moora, on *Eucalyptus*; **2a–d**: H.B. 8419 (holotype): Portugal, Santarém, on *Rhamnus*; **3a–e**. H.B. 8641a: Western Australia, Kandinin, on *Eucalyptus*.

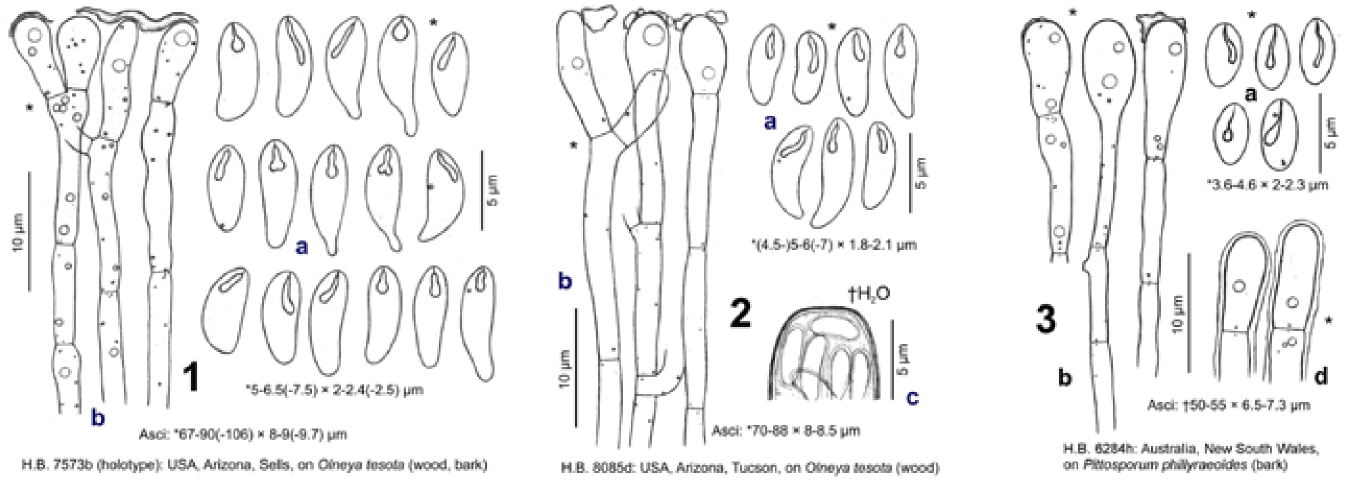


Plate 746. **1–2**: *Orbilia myrioolneyae*; **3**. *O.* aff. *myrioolneyae*. – **a**. ascospores; **b**. paraphyses; **c**. ascus apex; **d**. marginal cortical cells in surface view.

on wood, 23.X.1998, G. Marson (H.B. 6809a). – **New South Wales**, Brigalow Belt South, 20 km SW of Narrabri, 248 m, branch of *Pittosporum phillyreoides*, on wood, 24.X.1998, G. Marson (H.B. 6284e ø). — **USA**: **Arizona**, Sonoran Desert, 82 km NW of Phoenix, ~1.5 km SE of Wickenburg, 615 m, branches of *Ephedra ?viridis*, on wood, 4.V.1995, G. Marson (H.B. 5894h). — **PORTUGAL**: **Santarém**, Ribatejo, 10 km NNW of Santarém, 2.3 km NE of Romeira, Val de Flores, 50 m, branch of *Rhamnus alaternus*, on wood, 3.I.2007, J.P. Priou (ex J.P.P. 27001 & H.B. 8419, M-0276525, **holotype**).

Not included. **AUSTRALIA**: **Western Australia**, Dampierland, 235 km SW of Broome, 6 km E of Sandfire Roadhouse, 12 m, branch of *Acacia aneura*, on bark, 3.XII.2001, G. Marson (H.B. 7302d). – Carnarvon, 183 km SSE of Carnarvon, 10 km W of Overlander Roadhouse, 12 km NE of Hamelin Pool, 67 m, branch of *Acacia*, on bark, 7.XII.2001, G. Marson (H.B. 7215g). – Gascoyne, 171 km NE of Meekatharra, 62 km SSW of Kumarina Roadhouse, 16 km NW Plutonic Gold Mine, 540 m, branch of *Eucalyptus*, on wood, 28.X.2007, G. Marson (H.B. 9772d). – Yalgoo, 200 km N of Geraldton, 15 km SSE of Wannoo Billabong Roadhouse, W of Toolonga, 157 m, branches of *Acacia*, on bark, 8.XII.2001, G. Marson (H.B. 9033c). – Avon Wheatbelt, 68 km NE of Moora, 14 km S of Dalwallinu, 1.5 km S of Pithara, 326 m, branches of *Eucalyptus*, on bark, 24.XI.2001, G. Marson (H.B. 7283a). – Mallee, 14 km SSW of Kondinin, 9 km NE of Kulin, 286 m, branches of *Eucalyptus*, on wood, 14.XII.2001, G. Marson (H.B. 8641a).

Orbilia myrioolneyae Baral & G. Marson, **sp. nov.**, MB 813731 — Pls 746–747

Etymology: referring to the asci containing 64 small ascospores, and to the substrate, *Olneya tesota*.

Typification: USA, California, Sells, branches of *Olneya tesota*, 28.V.2003, G. Marson (ex H.B. 7573b, M-0276531, holotype; sq.: MT408188).

Latin diagnosis: *Similis* Orbiliae myriellae *sed ascosporae paulo latiores*, *basi partim valde attenuatae*, *apice obtusae*, *corpuscula refringentia magis latiora. Habitat ad lignum vel corticem putridum ramorum siccorum* Olneyae tesotae *et* Sarcobati vermiculati *in zona subtropica semiarida Americae septentrionalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.15–0.45 mm diam., 0.11–0.2 mm high, light to bright (yellowish-)orange(-rose), round, very scattered to subgregarious in small groups; disc flat, margin ± distinct, protruding 5–40 µm, finely rough or crenulate; broadly sessile, slightly erumpent. **Asci** *(62–)67–90(–106) {2} × 8–9(–9.7) {2} or 9.4–10.8 {1} µm, †64–83 × (6–)7–8(–9) µm {2}, 64-spored (45–50 spores counted), spores multiseriate, lower spores predominantly inverted {1} (very strongly mixed), pars sporifera *40–55 µm long (†35–50 µm); **apex** (†) (slightly to) medium to strongly truncate (sometimes very slightly indented and/or laterally distinctly inflated); **base** without or with short, flexuous stalk, h-shaped. **Ascospores** *(4.5–)5–6.5(–7.5) × 1.8–2.2(–2.5) µm {3}, †5–6(–7) × 1.7–2.2 µm {2}, subcylindric to ellipsoid- or (fusoid-)clavate, apex rounded to obtuse, base often slightly to strongly attenuated, sometimes tail-like, here often slightly to medium curved; **SBs** *(1.5–)2–2.5(–3.3) × 0.3–0.5 µm {3} (→ 1.5–2 × 0.9 µm), rod-shaped to (narrowly) pyriform, sometimes subulate, straight to slightly flexuous, broadly tear-shaped when overmature. **Paraphyses** apically slightly to medium clavate(-capitate), sometimes sublageniform or moniliform, terminal cells *6–18(–20) × 2.3–4.5(–5.5) µm {2}, †2–3.7 µm wide {1}, lower cells *8–21 × 1.6–2.3 µm {2}, near apex and base up to 3(–4) µm wide; frequently branched near apex. **Medullary excipulum** 15–30 µm thick, of dense textura intricata with many inflated cells, indistinctly to very sharply delimited. **Ectal excipulum** of thin-walled († distinctly gelatinized, common walls 0.5–1 µm), irregularly oriented t. globulosa-angularis from base to submargin, 20–90 µm thick near base, cells *7–12(–17) × 5–9(–13) µm {2}; mid flanks of t. angularis-prismatica oriented irregularly or at 10–20(–40)°, or of t. porrecta at 0°, 15–50 µm thick near margin, of t. prismatica-porrecta oriented at a 0–10° angle to the surface, marginal cortical cells *(5–)6–11(–13) × 2.5–5 µm {2}. **Anchoring hyphae** medium sparse, *2–3(–4) µm wide, walls 0.2(–0.3) µm thick {2}. **SCBs** in paraphyses and ectal excipulum (near margin) globose, 0.5–2.5 µm diam. {2}. **Exudate** over paraphyses 0.3–1.5(–2) µm thick, cloddy-continuous, loosely to firmly attached; over margin and flanks 1–3 µm thick. — **ANAMORPH**: unknown.

Habitat: collected 0.5–2.5 m above the ground, decorticated or partially corticated, 6–16 mm thick branches of *Olneya tesota* {2}, *Sarcobatus vermiculatus* {1}, on 0.3 mm deep strongly decayed wood {3} and bark {2}, strongly greyed, no or a few green algae. **Associated**: *Orbilia ?barrowensis* {1}, *O. maeandrina* {3}, *O. multicreosoteris* {2}, *O. multigambelii* {2}, *O. myriourosperma* {2}, *Patellaria* '*andina*' {2}, *Schizoxylon ?argentinum* {1}. **Desiccation tolerance**: fully viable for at least 16 months, after 34 months still many immature asci viable. **Altitude**: 683–745 m a.s.l. **Geology**: alluvial sand and gravel; felsic volcanic rock. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia myrioolneyae* is characterized by large, 64-spored asci and rather small, slightly curved ascospores with partly attenuated bases and short vermiform spore bodies. For the similar Australian *O. myriella* see p. 1233. The African *O. myrioflexa* differs in much longer SBs and the presence of crystalloid SCBs. In the two collections on *Olneya* the similar *O. myriourosperma* grew in association, and one of its populations (Pl. 665: 4) showed spores similar to *O. myrioolneyae* though much wider, and further differed in having crystalloid SCBs.

Variation. The three collections included in *O. myrioolneyae* hardly differ from each other. In the type collection, the rather few apothecia on bark differed in several points from the more abundant ones on wood: the apothecia were much thinner due to a much thinner basal ectal excipulum, also the marginal ectal excipulum was much thinner and formed a textura porrecta

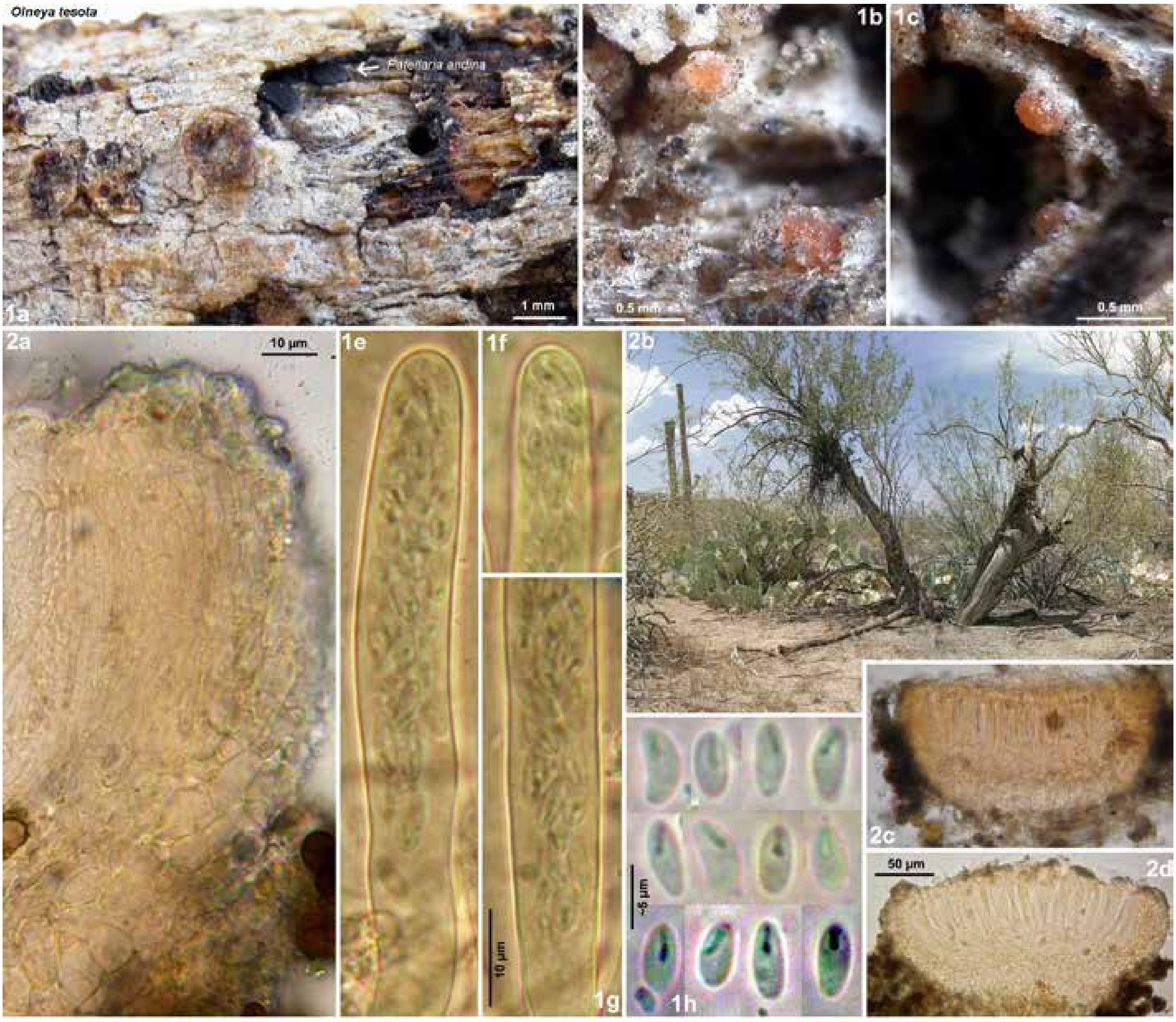


Plate 747. **1–2**: *Orbilia myrioolneyae*. – **2b**. semiarid paloverde-mixed cacti desert scrub with *Olneya tesota*, *Larrea tridentata* and *Opuntia engelmannii*; **1a**. dead corticated branch with rehydrated apothecia on bark; **1b–c**. rehydrated apothecia on wood; **2c–d**. apothecia in median section; **2a**. id., ectal excipulum at margin and mid flanks; **1e–g**. asci; **1h**. ascospores. – Living state. — **1a–h**. H.B. 7573b (holo-/isotype): USA, Arizona, Sells, on *Olneya*; **2a–d**. H.B. 8085d: ibid., Tucson, on *Olneya*.

running parallel to the outside (t. angularis-prismatica on wood), finally the asci were disctinctly wider.

Not included collection. An Australian sample on *Pittosporum phillyreoides* (Pl. 746: 3) differs in shorter, straight, ellipsoid, basally never attenuated spores. Only a single apothecium was detected, which grew in association with 32-spored *O. multiserpens*. From the latter it did not significantly differ, except for a higher spore number and apparently more thick-walled marginal cortical cells.

Phylogeny. A sequence of the holotype was taken in I.2020 from apothecia on remaining branches, comprising a short part of SSU (V9, S1506 intron absent), ITS, and LSU D1–D5. In the ITS region it differs from *O. multimaeandrina* by 11.5% and from *O. multiurosperma* by 12%. When analysing SSU+ITS+LSU it clustered in the strongly supported *Serpentinae*-*Habrostictis* clade, and here with medium support in a clade with *O. quaestiformis* and *O. septispora* (not shown in phylotree) with a 13–14% ITS distance. This result, which is in contradiction to the present placement of *O. myrioolneyae* in series *Ellipsospermae*, is supported by the morphological resemblance with broader-spored, somewhat untypical *O. myriourosperma* in the same collection (Pl. 665: 4).

Ecology. *O. myrioolneyae* was collected on rotten wood and bark of xeric branches of *Olneya tesota* (ironwood) and *Sarcobatus vermiculatus* (greasewood) in subtropical semiarid (almost arid) Sonoran paloverde-mixed cacti desert scrubs in the southwest of Northern America. The not included collection was on rotten bark of a xeric branch of *Pittosporum phillyreoides* on Cenozoic regolith in a subtropical subhumid eucalypt woodland in eastern Australia west of Great Dividing Range.

Specimens included. **USA**: **Arizona**, Sonoran Desert, 17.5 km NNE of Lukeville, Organ Pipe, Ajo Mountain Trail, 710 m, branches of *Sarcobatus vermiculatus*, on bark & wood, 5.V.1995, G. Marson (H.B. 5806a). – 25 km WNW of Tucson, 5 km S of Picture Rocks, Saguaro, 745 m, branch of *Olneya tesota*, on wood, 30.V.2003, G. Marson (H.B. 8085d ø). – Papago Indian Reservation, 100 km WSW of Tucson, 10 km NW of Sells, 683 m, branches of *O. tesota*, on wood & bark, 28.V.2003, G. Marson (M-0276531, **holotype**; **isotype** in H.B. 7573b; sq.: MT408188).

Not included. **AUSTRALIA**: **New South Wales**, Brigalow Belt South, 20 km SW of Narrabri, 248 m, branch of *Pittosporum phillyreoides*, on bark, 24.X.1998, G. Marson (H.B. 6284h ø).

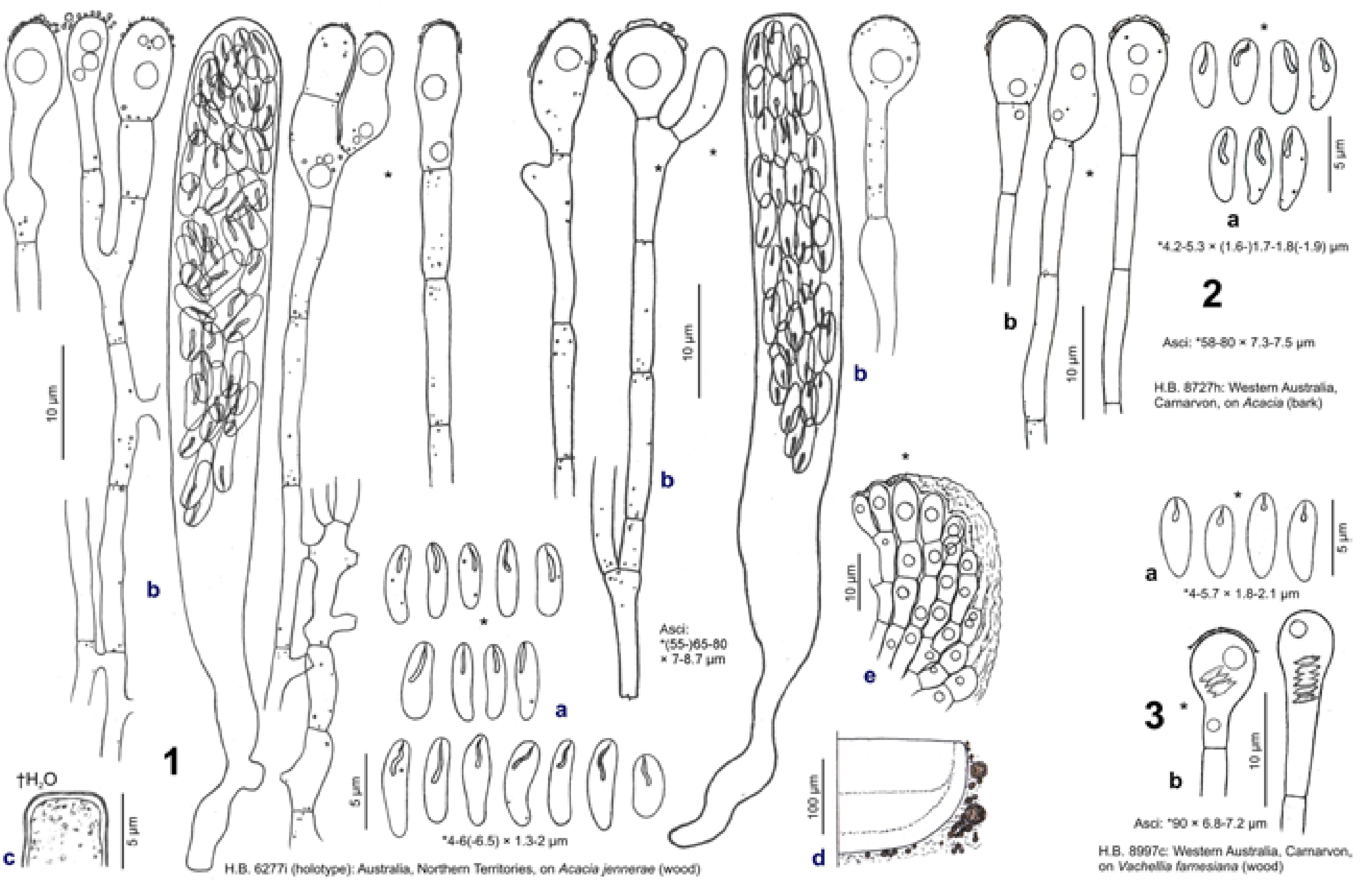


Plate 748. **1–2**: *Orbilia myriella*; **3**: *O.* aff. *myriella*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apex; **d**. apothecium in median section; **e**. id., marginal ectal excipulum.

Orbilia myriella Baral & G. Marson, **sp. nov.**, MB 813732 — Pls 748–749

Etymology: referring to the asci that contain 64 small ascospores.

Typification: Australia, Northern Territories, Yulara, twigs of *Acacia jennerae*, 10.X.1998, G. Marson (ex H.B. 6277i, MEL 2389202A, holotype).

Latin diagnosis: *Apothecia rehydratata 0.25–0.35 mm diam., aurantiaca, margine laevi vel subcrenulato. Asci 64-spori. Ascosporae *4–6.5 × 1.3–2 µm, subcylindricae, apice rotundatae, interdum obtusae, rectae vel leniter curvatae, in statu vivo corpusculum refringens breve, bacilliforme, leniter flexuosum, ad apicem affixum continentes. Paraphyses ad apicem partim valde capitatae. Cellulae vivae excipuli et paraphysium corpuscula globosa continentes. Habitat ad lignum vel corticem putridum ramulorum vel ramorum siccorum* Acaciae *in zona subtropica (semi)arida Australiae occidentalis et centralis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.25–0.35 mm diam., 0.12–0.15 mm high, pale to light (ochraceous-)orange(-isabelline), round (to broadly elliptical), scattered to subgregarious; disc slightly concave to flat, margin ± distinct, not or slightly protruding, smooth to somewhat crenulate; broadly sessile, ± superficial or immersed. **Asci** *(55–)60–80 × 7–8(–8.7) µm {2}, †50–71 × 6–7.3(–7.7) µm {3}, 64-spored (50–60 spores counted), spores multiseriate, lower spores predominantly inverted (strongly mixed), pars sporifera *34–54 µm long; **apex** (†) medium to strongly truncate (hardly indented, laterally sometimes slightly inflated); **base** without or with short to medium long, ± thick, flexuous stalk, L-, T-, Y- or h-shaped. **Ascospores** *(4–)4.3–6(–6.5) {4} × 1.3–1.5 {1} or (1.4–)1.6–1.9(–2) {3} µm, †5–6 × 1.4–1.8 µm {1}, (sub)cylindric or sometimes slightly (fusoid-)clavate, apex rounded (to obtuse), exceptionally subacute, base in some spores slightly (to medium) attenuated, straight to slightly curved; **SBs** *1.8–2.5(–3) × 0.2–0.3(–0.4) µm {2}, rod-shaped to subulate, base not inflated, straight to medium flexuous. **Paraphyses** apically slightly to (very) strongly clavate-capitate, also spathulate to sublageniform, sometimes moniliform, terminal cells *6–15(–20) × (3–)4–5(–6.5) µm {2}, lower cells *(5.5–)9–13(–15) × 1.5–2(–2.5) µm {2}, near apex and base up to 3–3.5 µm wide; not or frequently branched near apex. **Medullary excipulum** 20–50 µm thick, of ± dense textura intricata with many inflated cells, medium sharply delimited. **Ectal excipulum** of (†) thin-walled to slightly gelatinized, irregularly oriented t. globulosa from base to submargin, 20–25 µm thick near base, cells *5–14 × 5–9.5 µm {2}; 15–25 µm thick near margin, of t. prismatica oriented at a 0–20° angle to the surface, marginal cortical cells *7–12 × 3.5–5 µm {2}. **Anchoring hyphae** sparse, *2–3 µm wide, walls 0.2(–0.3) µm thick {2}, present as thin layer up to margin. **SCBs** in paraphyses and ectal excipulum (near margin) globose, 1–3 µm diam. {2}. **Exudate** over paraphyses and marginal excipulum 0.2–1 µm thick, granular(-cloddy), loosely or firmly attached. **— ANAMORPH**: unknown.

Habitat: on dry soil or in 1–3 m above the ground, decorticated or ± corticated, 1.5–15 mm thick twigs and branches of *Acacia* sp. {3}, *A. jennerae* {1}, on 0.3 mm deep strongly decayed wood {1} or bark {3}, on outer surface, partially detached, greyed, no algae. **Associated**: *Baggea* sp. {1}, *Coccomycetella* sp. {2}, *Hysterobrevium mori* {1}, *Orbilia anguliobliqua* {1}, *O. angustoaristata* {1}, *O. angustoobliqua* {1}, *O. ?atriplicis* {1}, *O. austropleiomicrosoma* {1}, *O. corculispora* {1}, *O. coronohesperidea* {1}, *O. curvatimyriella* {1}, *O. helicovinosa* {1}, *O. macrocarpa* {1}, *O. multiaustraliensis* {1}, *O. multiserpens* {1}, *O. ?multivirgula* {1}, *O. myrioauris* {1}, *O. myriomuscula* {1}, *O. myrionamibica* {1/1}, *O. pleioaustraliensis* {2}, *O. pleiocoronohesperidea* {1}, *O. pleioungulata* {1}, *O. pleistoobliqua* {1}, *O. ?pseudeuphorbiae* {1}, *O. saguarina* {2}, *Ostropales* {2}, *Rhizodiscina* sp. {1}, ?*Triblidium* sp. {1}, *Symbiotaphrina desertorum* {1}, *Tryblidaria* sp. {1}. **Desiccation tolerance**: fully viable for at least 2 months. **Altitude**: 67–560 m a.s.l. **Geology**: Mesoproterozoic and Cretaceous sedimentary rock (red-brown sand & gravel), Cenozoic regolith. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia myriella* is easily recognized by its 64-spored asci and small, subcylindrical ascospores that

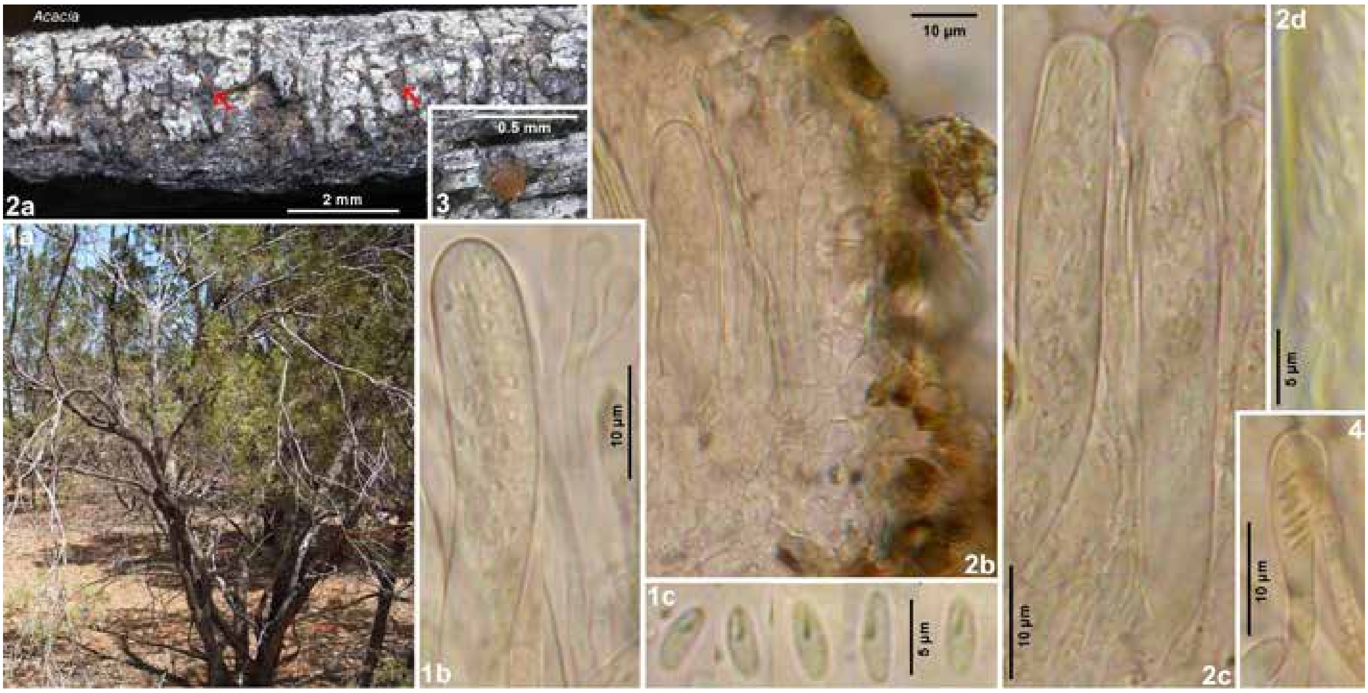


Plate 749. **1–3**: *Orbilia myriella*; **4**: *O.* aff. *myriella*. – **1a**. semiarid acacia shrubland with dead *Acacia* shrub in front; **2a**. corticated xeric branch; **3**. rehydrated apothecium; **2b**. marginal ectal excipulum in median section; **1b**, **2c**. asci and paraphyses; **1c**, **2d**. ascospores; **4**. paraphysis apex containing crystalloid SCBs. – Living state. — **1a–c**. H.B. 9050e: Western Australia, Geraldton, on *Acacia*; **2a–d**. H.B. 8727h: ibid., Carnarvon, on *Acacia*; **3**. H.B. 6277i (holotype): Northern Territories, on *Acacia*; **4**. H.B. 8997c: Carnarvon, on *Vachellia*.

contain narrowly rod-shaped spore bodies with, as a maximum, half the spore length. The North American *O. myrioolneyae* differs in slightly wider spores which usually show a stronger tendency to attenuated bases and obtuse apices (more ellipsoid-clavate, rarely with a short tail), also in wider SBs. For the similar *O. curvatimyriella* and *O. pleistovitalbae* see p. 1234 and p. 1192.

Not included collections. A sample on wood of *Vachellia* (Pls 748: 3: 749: 4) resembles *O. myriella* in the spores and SBs, but the paraphyses contained distinct crystalloid SCBs. A collection on *Eremaea* (IVV: H.B. 9132b) was only studied in the dead state.

Variation. A single ascus of *O. myriella* contained abnormal ovoid-subglobose spores *3–3.5 × 2.2–2.8 µm that resembled those of *O. myrioeuonymi*, even in SB shape, but that species has asci with hemispherical, thick-walled apices and belongs to section *Lentiformes*.

Ecology. *O. myriella* was found on rotten bark and wood of xeric twigs and branches of *Acacia* in subtropical arid (to semiarid) acacia open shrublands mainly in western but also central Australia (south of MacDonnell Ranges). The not included collection on *Vachellia* grew under similar conditions, that on *Eremaea* in a subtropical semihumid banksia-eucalypt woodland.

Specimens included. **AUSTRALIA**: **Western Australia**, Gascoyne, southern border of Collier Range, 175 km NE of Meekatharra, 41 km SW of Kumarina Roadhouse, 560 m, branch of *Acacia*, on bark, 26.XI.2001, G. Marson (H.B. 8697a ø). – Carnarvon, 183 km SSE of Carnarvon, 10 km W of Overlander Roadhouse, 12 km NE of Hamelin Pool, 67 m, twig of *Acacia*, on bark, 6.XI.2007, G. Marson (ex H.B. 8727h, mixture in MEL 2389251 [type of *O. myrioauris*]). – Yalgoo, 187 km N of Geraldton, W of Toolonga, Nerren Nerren, 190 m, branch of *Acacia*, on bark, 8.XI.2007, G. Marson (H.B. 9050e ø). — **Northern Territories**, Finke, 100 km E of Yulara, 24 km ENE of Curtin Springs Roadhouse, 480 m, twigs of *Acacia jennerae*, on wood, 10.X.1998, G. Marson (ex H.B. 6277i, MEL 2389202A, **holotype**).

Not included. **Western Australia**, Carnarvon, 117 km NNE of Carnarvon, 7 km SSE of Minilya Roadhouse, Barrabiddy Creek, 13 m, branch of *Vachellia farnesiana*, on wood, 6.XI.2007, G. Marson (H.B. 8997c ø). – Swan Coastal Plain, 20 km SW of Jurien Bay, 19.5 km NE of Cervantes, Cervantes Rd, 80 m, branch of *Eremaea*, on bark, 11.XI.2007, G. Marson (H.B. 9132b ø).

Orbilia curvatimyriella Baral & G. Marson, **sp. nov.**,
MB 813733 — Pls 750–751

Etymology: named after the curved ascospores and a resemblance to *O. myriella*.
Typification: Western Australia, Overlander Roadhouse, branch of *Acacia*, 6.XI.2007, G. Marson (ex H.B. 8727a, MEL 2389250, holotype).

Latin diagnosis: *Similis* Orbiliae myriellae *sed ascosporae valde curvatae, paulo majores, corpuscula refringentia longiora. Habitat ad corticem putridum ramorum siccorum* Acaciae *in zona subtropica semiarida Australiae occidentalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.13–0.25 mm diam., 0.1–0.14 mm high, light brick-orange, non-translucent, round, scattered; disc flat to slightly convex, margin indistinct, 0–5 µm protruding, finely rough; broadly sessile, ± immersed in biofilm or cracks of bark; dry almost invisible. **Asci** *58–73 × 8.8–10.2 µm, †54–68 × 7.8–8.3 µm, 64-spored (min. 40 spores counted), spores (*) multiseriate, basal spores inverted (strongly mixed), pars sporifera

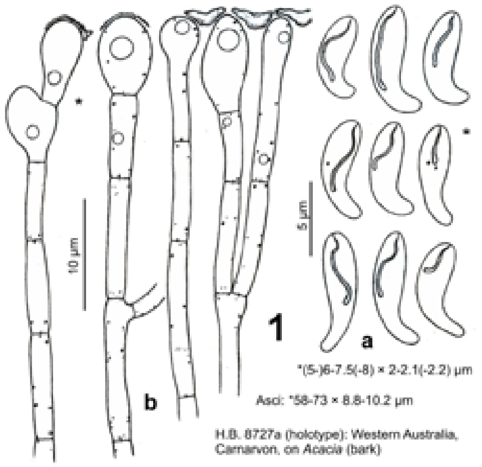


Plate 750. **1**: *Orbilia curvatimyriella*. – **a**. ascospores; **b**. paraphyses.

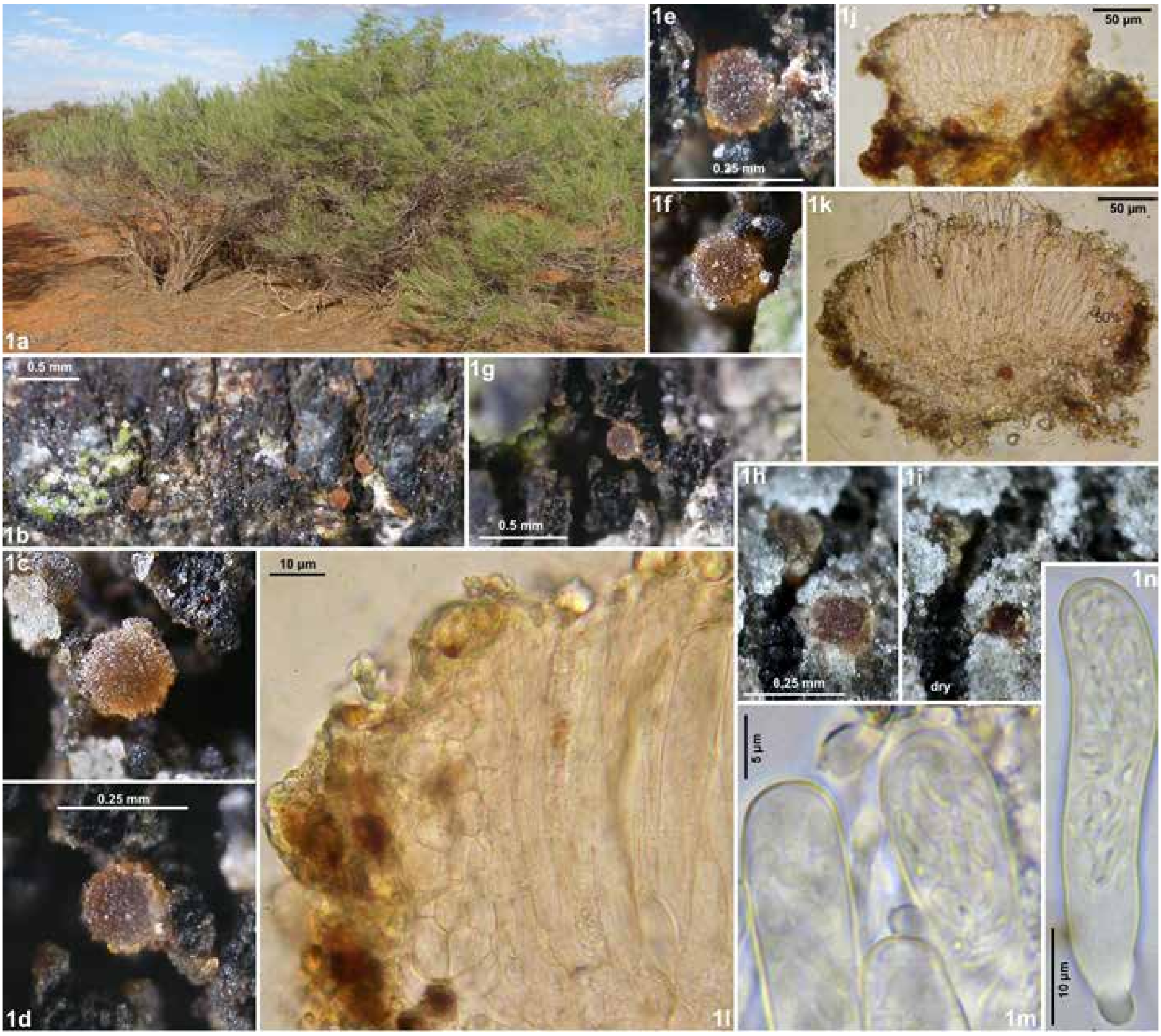


Plate 751. **1**: *Orbilia curvatimyriella*. – **1a**. arid acacia shrubland; **1b–h**. rehydrated apothecia; **1i**. dry apothecia; **1j–k**. apothecia in median section; **1l**. id., marginal ectal excipulum; **1m–n**. asci and paraphyses. – Living state. — **1a–n**. H.B. 8727a (holotype): Western Australia, Carnarvon, on *Acacia*.

*42–57 µm long; **apex** (†) (medium to) strongly truncate (not indented, laterally sometimes distinctly inflated); **base** unstalked or with short, thick stalk, Y- to h-shaped. **Ascospores** *(5–)6–7.5(–8) × 2–2.1(–2.2) µm, cylindric-ellipsoid to mostly ellipsoid-clavate, apex obtuse, base slightly to medium attenuated, here medium to often strongly curved; **SBs** *(2.7–)3.5–5.5 × 0.3–0.4(–0.5) µm in situ [~(3–)4–6 µm actual length], filiform to subulate, ± flexuous to helicoid. **Paraphyses** slightly to mostly medium to strongly clavate-capitate(-spathulate), terminal cells *(5–)7–17 × (1.8–)3–5 µm, lower cells *6–15 × 1.5–2(–2.7) µm; sometimes branched at upper septum. **Medullary excipulum** 15–40 µm thick, of dense textura intricata with many inflated cells, sharply delimited. **Ectal excipulum** pale rose, of thin-walled, irregularly (or horizontally) oriented t. (prismatica-)globulosa-angularis from base to mid flanks or margin, 15–25 µm thick near base, cells *8–11 × 6–9 µm; 10–20 µm thick near margin, oriented at a 0–20° angle to the surface, marginal cortical cells *6–12 × (3–)4–5(–6) µm. **Anchoring hyphae** sparse, †1.8–2 µm wide, walls 0.2 µm thick. **SCBs** in paraphyses globose, 1–2 µm diam., in ectal excipulum (near margin) 1.5–2.5 µm. **Exudate** over paraphyses 0.3–1.5 µm thick, cloddy, ± loosely attached, over margin and flanks 0.2–2 µm thick, cloddy. — **ANAMORPH**: unknown.

Habitat: collected 0.5–2 m above the ground, corticated, 6–8 mm thick branches of *Acacia* sp., on very decayed bark (bast), in cross-clefts of periderm, strongly greyed, with a few green algae. **Associated**: *Coccomycetella* sp., *Hysterobrevium mori*, *Orbilia myriella*, *O. myrioauris*, *O. ʔmyrionamibica*, *O. pleioaustraliensis*, *O. pleistoobliqua*, *O. ʔsaguarina*, *Ostropales*, *Tryblidaria* sp. **Desiccation tolerance**: fully viable for at least 7 weeks. **Altitude**: 67 m a.s.l. **Geology**: Cretaceous sedimentary rock (red-brown gravel). **Phenology**: long-lived.

Taxonomic remarks. *Orbilia curvatimyriella* is similar to *O. myriella*, from which it differs in slightly larger, consistently curved, basally always tapered ascospores, longer SBs, and apparently also wider asci. In spore characters *O. curvatimyriella* somewhat resembles taxa with different spore numbers, such as *O. quaestiformis* and *O. curvativitalbae* (8-spored), *O. saguarina* (16-spored), and *O. multivirgula* (32-spored). *O. myriofusoidea* differs in the presence of crystalloid SCBs, narrower SBs, and narrower asci.

Ecology. *O. curvatimyriella* was found on rotten bark of xeric branches of *Acacia* in an subtropical semiarid acacia open shrubland in western Australia.

Specimens included. **AUSTRALIA**: **Western Australia**, Carnarvon, 183 km SSE of Carnarvon, 10 km W of Overlander Roadhouse, 12 km NE of Hamelin Pool, 67 m, branch of *Acacia*, on bark, 6.XI.2007, G. Marson (ex H.B. 8727a, MEL 2389250, **holotype**).

Orbilia myriofusoidea Baral, **sp. nov.**, MB 813738 — Pls 752–753

Etymology: named after the 64-spored asci and fusoid ascospores.

Typification: Western Australia, Wittenoom, branch of *Acacia*, 29.X.2007, G. Marson (ex H.B. 8976b, MEL 2389269, holotype).

Latin diagnosis: *Similis* Orbiliae curvatimyriellae *sed ascosporae basi valde attenuatae, cellulae vivae excipuli et paraphysium corpuscula crystalloidea pallide aurantiaca continentes. Habitat ad lignum putridum ramorum siccorum* Acaciae *in zona tropica arida Australiae occidentalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.25–0.3 mm diam., 0.17–0.19 mm high, pale light dirty orange, indistinctly translucent, round, scattered; disc slightly concave to flat, margin thin, not protruding, smooth; broadly sessile, ± superficial but immersed in cracks. **Asci** †70–85 × 6.7–7.6 µm, 64-spored (~50 spores counted), spores (†) multiseriate; **apex** (†) strongly truncate (partly distinctly indented and/or laterally inflated); **base** with short to medium long, ± thick, flexuous stalk, L-shaped. **Ascospores** *7.2–8.5(–9.5) × 2.1–2.3 µm, ellipsoid-fusoid-clavate, apex obtuse, base medium to mostly strongly attenuated, slightly to medium curved near base; **SBs** *3.2–4.2 × 0.2(–0.3) µm in situ (~3.5–5 µm actual length), filiform, somewhat flexuous. **Paraphyses** apically medium to strongly clavate-capitate, terminal cells *9–15 × 4–5.7 µm, lower cells *12–26 × 1.5–2 µm (up to 4 µm wide above); unbranched near apex. **Medullary excipulum** 25–50 µm thick, of ± dense textura intricata with many inflated cells, medium to sharply delimited. **Ectal excipulum** of (†) thin-walled to slightly gelatinized, vertically or indistinctly oriented t. angularis(-prismatica) from base to (sub)margin, 40–60 µm thick near base, cells */†8–23 × 6–13 µm; 20–30 µm thick near margin, of t. angularis-prismatica, marginal cortical cells †7–12 × 3–5 µm, slightly gelatinized. **Anchoring hyphae** sparse to abundant, †2.5–3 µm wide, walls 0.2 µm thick, partly extending as a covering layer up to the margin. **SCBs** in paraphyses globose, 2–3 µm diam., in paraphyses and ectal excipulum (near margin) also crystalloid, pale orange. **Exudate** over paraphyses 0.2–0.4 µm thick, continuous, loosely attached, over margin and flanks indistinct. **— ANAMORPH**: unknown.

Habitat: decorticated, 11–12 mm thick branches of *Acacia* sp., on 0.5 mm deep very decayed wood, strongly greyed (blackened), without algae. **Associated**: *Lophiostoma* sp., *Orbilia coronohesperidea*, *O. microserpens*, *O. pleiocoronohesperidea*, *O. pleioserpens*, *Ostropales*, *Patellaria* '*andina*', ?*Teichospora* sp., ?*Trimmatostroma* sp. **Desiccation tolerance**: excipular cells, paraphyses and many spores still viable after 14 months. **Altitude**: 467 m a.s.l. **Geology**: Precambrian sedimentary rock. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia myriofusoidea* closely resembles *O. curvatimyriella*, from which it mainly differs in the presence of crystalloid SCBs, narrower SBs, and narrower asci. The ascospores also tend to be more tapered at their less curved bases. The North American *O. multivirgula* differs in 32-spored asci, narrower spores, and absence of any kind of SCBs. The central Australian *O. myrionamibica* deviates in straight, basally much less tapered, wider spores with longer and thicker SBs.

Ecology. The very sparse apothecia, which were almost used up during examination, were detected on rotten wood of xeric branches of *Acacia* in a tropical arid acacia open shrubland in the mostly dry delta of the Wittenoom Gorge in the Pilbara desert of western Australia.

Specimens included. **AUSTRALIA**: **Western Australia**, Pilbara, 1.5 km SW of Wittenoom, N of Karijini, Wittenoom Gorge, 467 m, branch of *Acacia*, on wood, 29.X.2007, G. Marson (ex H.B. 8976b, MEL 2389269, **holotype**).

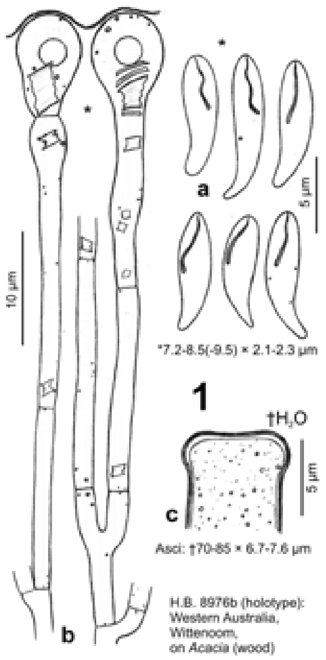


Plate 752. **1**: *Orbilia myriofusoidea*. – **a**. ascospores; **b**. paraphyses; **c**. ascus apex.

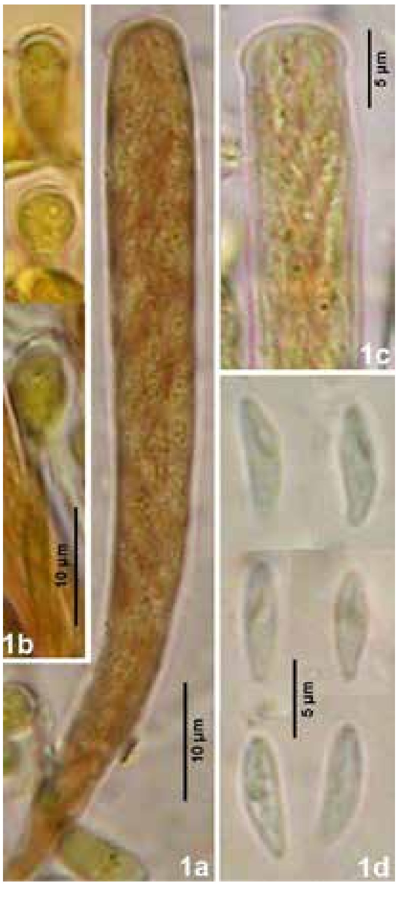


Plate 753. **1**: *Orbilia myriofusoidea*. – **1a**. ascus; **1b**. apices of paraphyses; **1c**. ascus apex; **1d**. ascospores. – Dead state (in KOH+IKI), except for **1d**. — **1a–d**. H.B. 8976b (holotype): Western Australia, Wittenoom, on *Acacia*.

Orbilia multivirgula Baral & G. Marson, **sp. nov.**, MB 813739 — Pls 754–755

Etymology: referring to the 32-spored asci and the comma-shaped ascospores (from French virgule = comma).

Typification: USA, New Mexico, Carlsbad, branches of *Larrea tridentata*, 17.VI.1996, G. Marson (ex H.B. 5682b, M-0276528, holotype).

Latin diagnosis: *Apothecia rehydratata 0.2–0.75 mm diam., aurantiaca, margine laevi. Asci 32-spori. Ascosporae *6–11.2 × 1.4–2 µm, angusto-clavatae, ad basim valde attenuatae, etiam subcylindricae, subrectae vel saepe valde curvatae, in statu vivo corpusculum refringens breve, filiforme, subrectum ad uncinatum, ad apicem affixum continentes. Paraphyses ad apicem valde clavato-capitatae. Cellulae vivae excipuli et paraphysium absque corpusculis globosis et crystalloideis. Habitat ad lignum putridum ramorum siccorum* Larreae tridentatae *in zona temperata semiarida Americae septentrionalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.2–0.75 mm diam., 0.14–0.2 mm high, light (pure or dirty) orange, round to ± elliptical, scattered to ± gregarious; disc slightly concave to flat, margin distinct, 5–15 µm protruding, smooth; sessile, with or without a ± obconical base, slightly to entirely immersed among fibres. **Asci** *60–75(–89) × 6.5–7.4 µm, †55–70(–75) × 5.3–6.5 µm, 32-spored (25–30 spores counted), spores ~4-seriate, lower spores inverted (strongly mixed), pars sporifera *35–43 µm long; **apex** (†) strongly truncate (sometimes slightly indented and laterally widened); **base** with short to medium long, thick stalk, T-, L- or Y-shaped. **Ascospores** *6–9.7(–11.2) × 1.4–1.8(–2) µm, †6–9 × 1.3–1.5 µm, subcylindrical to narrowly clavate, apex rounded to obtuse, base not or mostly slightly to strongly attenuated in a ± long tail-like end, straight or often slightly to strongly curved (comma-shaped); **SBs** *2.5–4.7 × 0.2–0.3 µm, filiform-subulate, base not inflated, mostly slightly to strongly flexuous, sometimes uncinate. **Paraphyses** apically medium to (very) strongly clavate-capitate, also spathulate, terminal cells *9.5–26 × (3–)4–5.5(–6.5) µm, lower cells *8–10 × 1.7–2.2(–3) µm; unbranched near apex, hymenium light rose. **Medullary excipulum** hyaline, 20–70 µm thick, of ± dense textura intricata with many inflated cells, medium to very sharply delimited. **Ectal excipulum** pale rose, of non- to medium gelatinized (common walls up to †1–1.5 µm thick), vertically oriented t. angularis from base to (sub)margin, 25–65 µm thick near base, cells *11–26 × 8–19 µm, †7–10 × 5–9 µm; 35–40 µm thick at flanks, 15–35 µm near margin, marginal cortical cells *7–12 × 4–7 µm, oriented at a low angle, terminated by dead hyphoid cells †5–11 × 2–3 µm. **Anchoring hyphae** sparse to abundant, 1.8–3 µm wide, walls 0.2–0.5 µm thick, forming a ± dense t. intricata up to 100 µm thick; margin and flanks covered by an 8–10 µm thick hyaline layer of gelatinized t. intricata-porrecta. **SCBs** in paraphyses and ectal excipulum absent. **Exudate** over paraphyses 0.2–1.5 µm thick, finely to roughly granular; over margin and flanks 0.2–2 µm thick, granular-cloddy. — **ANAMORPH**: unknown.

Habitat: collected 0.2–1 m above the ground, decorticated, 7–11 mm thick branches of *Larrea tridentata*, on 0.3 mm deep very decayed, eroded wood, medium to strongly greyed or blackened, with some or many green algae. **Associated**: *Orbilia* ?*multidelphinus*, *O. pleioserpens*, *Patellaria* '*andina*', *P. atrata*. **Desiccation tolerance**: fully viable for at least 6 months. **Altitude**: 915 m a.s.l. **Geology**: Quaternary deposits from Upper Permian sandstone. **Phenology**: long-lived.

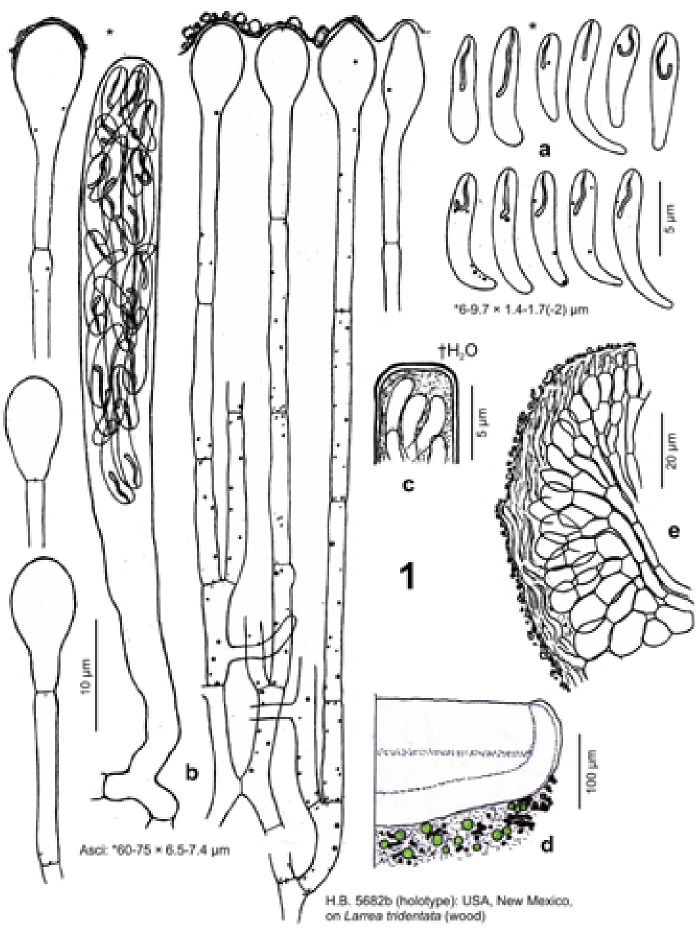


Plate 754. **1**: *Orbilia multivirgula*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apex; **d**. apothecium in median section; **e**. id., marginal ectal excipulum.

Taxonomic remarks. *Orbilia multivirgula* is characterized by narrowly cylindric-clavate, often basally ± strongly attenuated and curved (comma-shaped) ascospores that contain short, narrowly subulate SBs, and by 32-spored asci. *O. myriella*, *O. curvatimyriella* and *O. myriofusoidea* are similar but differ in 64-spored asci and large globose SCBs, the latter also in crystalloid SCBs, and the former in much shorter, basally scarcely attenuated, less curved spores. *O. namibica* differs from *O. multivirgula* in much wider and likewise less curved and tapered spores, also in the presence of crystalloid SCBs. The large heads of the paraphyses and the absence of any kind of

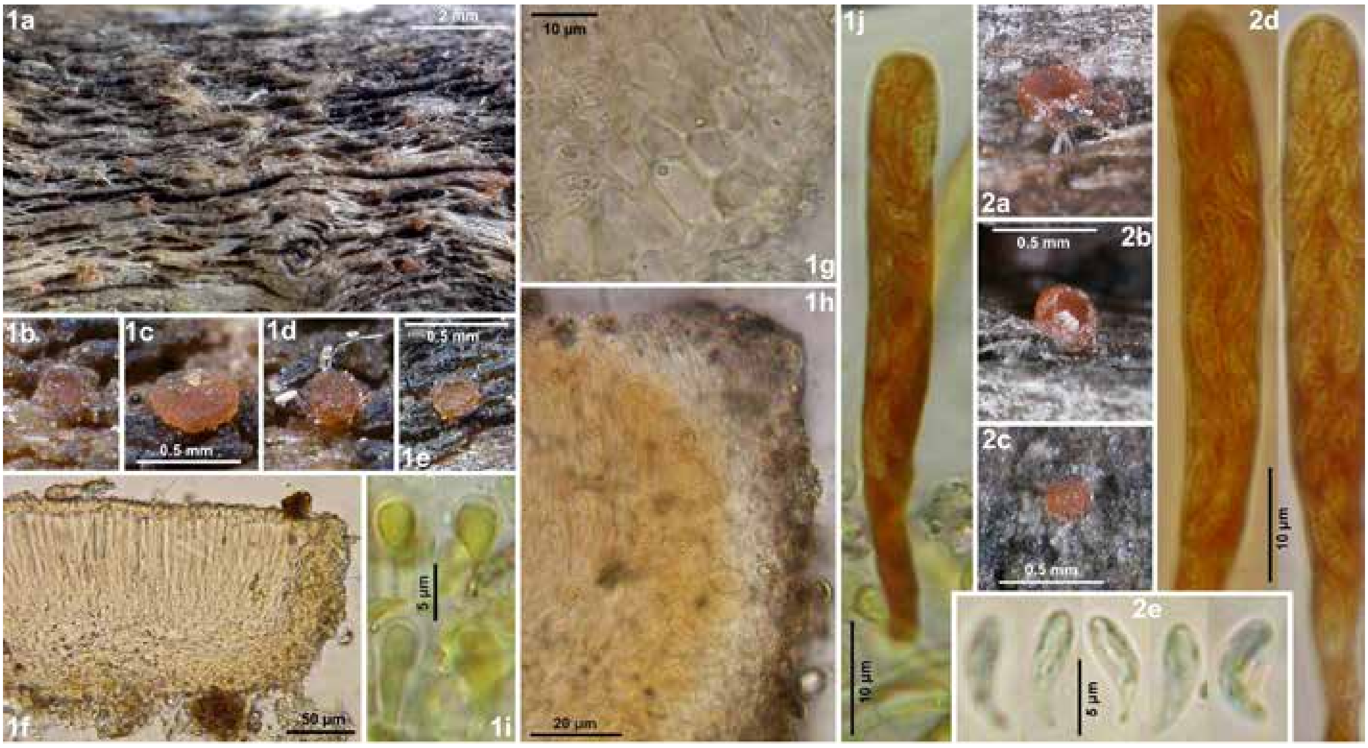


Plate 755. **1**: *Orbilia multivirgula*; **2**: *O.* aff. *multivirgula*. – **1a–e**, **2a–c**. rehydrated apothecia; **1f**. apothecium in median section; **1h**. id., marginal ectal excipulum; **1g**. id., basal excipular cells; **1i**. apices of paraphyses; **1j**, **2d**. asci; **2e**. ascospores. – Dead state (**2e** in H_2O, **1g–h** in KOH, **1i–j**, **2d** in KOH+IKI). — **1a–j**. H.B. 5682b (holotype): USA, New Mexico, on *Larrea*; **2a–e**. H.B. 9033b: Western Australia, Geraldton, on *Acacia*.

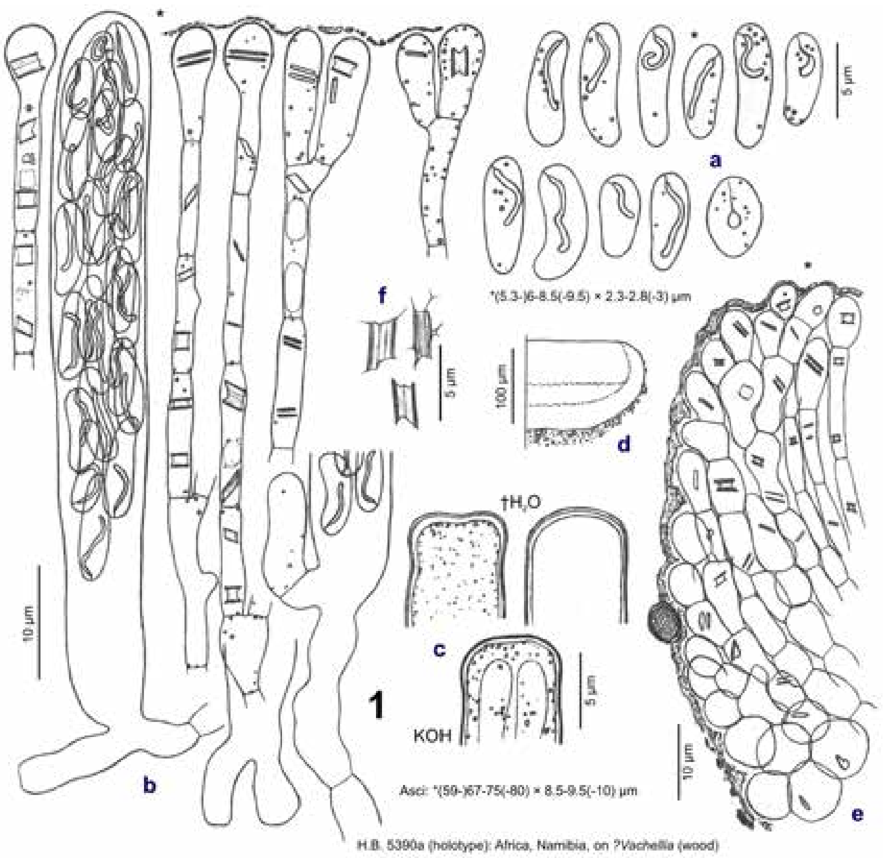


Plate 756. **1**: *Orbilia namibica*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apices; **d**. apothecium in median section; **e**. id., marginal ectal excipulum; **f**. crystalloid SCBs in ectal excipulum near margin.

SCBs in *O. multivirgula* suggest a relation to *O. microserpens* and *O. multiserpens*. In spore and SB shape it resembles the 8-spored *O. quaestiformis*.

Not included collections. Three Australian samples were only studied in the dead state. In one on *Acacia* the spores (†10.5–12.5 × 1.4–1.7 µm) are cylindrical and ± bent below (IVV: H.B. 8697i). Another on *Acacia* (Pl. 755: 2) has more ellipsoid, distinctly wider spores compared to *O. multivirgula*, but they are too narrow to be included in *O. multiurosperma*. One on *Dodonaea* (IVV: H.B. 8838f) mainly differs in 16-spored asci (spores †8–10 × 1.6–1.8 µm, as ***O. pleiovirgula*** Baral, nom. prov.).

Ecology. *O. multivirgula* was detected on rotten wood of xeric branches of *Larrea tridentata* (creosotebush) in a warm-temperate semiarid Chihuahuan creosotebush-tarbush desert scrub (at border to Mesa and Plains) in the south of Northern America. The not included collections are from subtropical semiarid to arid acacia shrublands or open woodlands on Mesoproterozoic and Cretaceous sedimentary rock in western Australia.

Specimens included. **USA**: **New Mexico**, Chihuahuan Desert, 25.5 km SE of Carlsbad, Malaga, 915 m, branches of *Larrea tridentata*, on wood, 17.VI.1996, G. Marson (M-0276528, **holotype**, **isotype** in H.B. 5682b).

Not included. **AUSTRALIA**: **Western Australia**, Gascoyne, southern border of Collier Range, 175 km NE of Meekatharra, 41 km SW of Kumarina Roadhouse, 560 m, branch of *Acacia*, on bark, 26.XI.2001, G. Marson (H.B. 8697i ø). – Yalgoo, 200 km N of Geraldton, 15 km SSE of Wannoo Billabong Roadhouse, W of Toolonga, 157 m, branch of *Acacia*, on wood & bark, 8.XII.2001, G. Marson (H.B. 9033b).

O. pleiovirgula: **AUSTRALIA**: **Western Australia**, Yalgoo, 187 km N of Geraldton, W of Toolonga, Nerren Nerren, 190 m, trunk of *Dodonaea viscosa* subsp. *angustissima*, on bark, 8.XI.2007, G. Marson (H.B. 8838f).

Orbilia namibica Baral & G. Marson, **sp. nov.**, MB 813740 — Pl. 756

Etymology: named after the geographical origin of the holotype, Namibia.

Typification: Namibia, Rehoboth, branch of ?*Vachellia*, 25.VIII.1995, R. Reuter (ex H.B. 5390a, M-0276535, holotype).

Latin diagnosis: *Apothecia rehydratata 0.2–0.3 mm diam., aurantiaca, margine laevi. Asci 32-spori. Ascosporae *5.3–9.5 × 2.3–2.9 µm, subcylindricae, rectae vel leniter curvatae, in statu vivo corpusculum refringens breve vel longum, vermiforme, subrectum ad uncinatum, ad apicem vel subapicem affixum continentes. Paraphyses ad apicem leniter vel valde clavato-capitatae. Cellulae vivae excipuli et paraphysium corpuscula crystalloidea sublutea continentes. Habitat ad lignum putridum rami sicci arboris angiospermae in zona subtropica arida Africae austro-occidentalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.2–0.3 mm diam., 0.12–0.17 mm high, light (dirty) orange, round, gregarious in small groups; disc slightly concave, margin 0–25 µm protruding, ± smooth; sessile; dry deep dirty orange-red. **Asci** *(59–)67–75(–80) × 8.5–9.5(–10) µm, †54–60 × 6.4–7.8(–8.5) µm, 32-spored, spores *4–6-seriate, lower spores inverted (strongly mixed), pars sporifera *38–50 µm long; **apex** (†) slightly to strongly truncate (distinctly indented, laterally sometimes inflated); **base** not or very short- and thick-stalked, T- to h-shaped. **Ascospores** *(5.3–)6–8.5(–9.5) × 2.3–2.9 µm, †6.5–8.2 × 2–2.4 µm, subcylindrical to sometimes clavate, both ends rounded, base often slightly attenuated, straight to slightly curved; **SBs** apically or mostly subapically attached to spore wall, *(3–)4–6.2 × 0.4–0.6(–0.8) µm in situ (~5–7 µm actual length), vermiform, base not inflated, slightly to strongly flexuous (sometimes uncinate), in more aged or aberrant spores with broadly tear- to stomach-shaped lower and filiform upper part. **Paraphyses** apically slightly to strongly clavate-capitate, terminal cells *7–16.5 × 2.5–4.3 µm, lower cells *10–15 × 1.7–2.4(–2.8) µm; sometimes branched near apex, upper part of hymenium pale orange. **Medullary excipulum** pale yellowish-reddish, 30–40 µm thick, of ± dense textura intricata with many inflated cells, rather sharply delimited. **Ectal excipulum** subhyaline, of thin-walled, vertically oriented t. globulosa-angularis from base to mid flanks, 30–50 µm thick near base, cells *(7–)10–16(–20) × 8–13 µm; 20 µm thick at mid flanks and margin, oriented at a 40 → 20° angle to the surface, marginal cortical cells *5–12 × 3.5–5.5 µm. **Anchoring hyphae** very sparse, *2–4 µm wide, walls 0.3 µm thick. **SCBs** in paraphyses and ectal excipulum (near margin) very pale yellowish, rod-, spool- or ring-shaped. **Exudate** over paraphyses 0.5–1 µm thick, finely granular, loosely attached; over margin and flanks 1–3 µm thick, cloddy-granular, hyaline. **— ANAMORPH**: unknown.

Habitat: collected 0.2–1.2 m above the ground, decorticated, 30 mm thick branches of ?*Vachellia*, on 0.2 mm deep medium decayed wood, greyed. **Associated**: *Hysterobrevium mori*, *Orbilia maeandrina*, *O. myrioflexa*, *O. pluristomachia*, *Patellaria atrata*, ?*Peniophora* sp., *Teichospora* ?*obducens*, 3 different indet. coelomycetes. **Desiccation tolerance**: fully viable for at least 3.5 months. **Altitude**: 1560 m a.s.l. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia namibica* is characterized by subcylindrical, slightly clavate ascospores and vermiform, mostly subapically inserted SBs, also by the presence of crystalloid SCBs. The North American *O. multicercocarpi* and *O. multigambelii* differ in always apically inserted SBs, also in usually shorter and wider, more ellipsoid spores. *O.*

multicercocarpi approaches *O. namibica* in the more elongate spores. The mainly Australian *O. multiserpens* (Pl. 744: 5) resembles *O. namibica* in the shape of spores and SBs, but has smaller spores and is consistently without crystalloid SCBs.

Variation. Very few asci contained only aberrant, broadly ellipsoid spores with tear-shaped SBs with a long filum (Pl. 756: 1a, lower right spore).

Ecology. *O. namibica* was found on medium decayed wood of a xeric branch of an unidentified angiosperm tree (?*Vachellia*) in the hot, subtropical arid (winter-dry) Kalahari highland thornbush savannah about 150 km away from the Namib Desert in southwestern Africa.

Specimens included. **NAMIBIA**: **Khomas**, 60 km S of Windhoek, 25 km N of Rehoboth, Central Plateau, Auas Mts., 1560 m, branch of *?Vachellia*, on wood, 25.VIII.1995, R. Reuter (ex H.B. 5390a, M-0276535, **holotype**).

Orbilia myrionamibica Baral, **sp**. **nov**., MB 813741 — Pls 757–758

Etymology: referring to the 64-spored asci and the resemblance to *O. namibica*. **Typification**: Australia, Northern Territories, Curtin Springs Roadhouse, twig of *Acacia jennerae*, 10.X.1998, G. Marson (ex H.B. 6277g, MEL 2389202B, holotype).

Latin diagnosis: *Similis* Orbiliae namibicae *sed asci 64-spori. Habitat ad lignum putridum ramulorum siccorum* Acaciae *in zona subtropica arida Australiae centralis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.25–0.4 mm diam., 0.12 mm thick, light (yellowish-)orange(-rose), round, scattered; disc concave to flat, margin smooth or finely rough, 0–20 µm protruding; sessile, erumpent to entirely immersed. **Asci** *80–90 × 10–11.5 µm {T}, †70–90 × 8–9.7 µm {1}, 64-spored (> 50 spores counted), spores multiseriate, lower spores inverted (very strongly mixed), pars sporifera *46–65 µm long; **apex** (†) strongly truncate (sometimes slightly indented and laterally inflated); **base** unstalked or with short thick stalk, Y- to h-shaped. **Ascospores** *6–8 × 2.2–3 µm {T}, †(4.2–)6–7(–7.7) × 2.4–2.9 µm {1}, subcylindrical to (fusoid-) clavate, apex rounded (to obtuse), base not or often slightly (to medium) attenuated, straight or sometimes slightly inequilateral; **SBs** apically or partly subapically attached to spore wall, *(3–)4.5–6(–7) × 0.3–0.6 µm in situ {T} [~(4–)5–7(–8) µm actual length], vermiform to subulate, base not or sometimes slightly inflated, medium to strongly flexuous, sometimes uncinate. **Paraphyses** apically medium to very strongly capitate(-clavate), sometimes moniliform, terminal cells *8–16 × 2.5–5.5(–6.5) µm {T}, subapical cell sometimes also strongly inflated (up to 5.5 µm), lower cells *6–17 × 1.7–3 µm {T}; very rarely branched near apex. **Medullary excipulum** very pale orange, 30 µm thick, of dense t. intricata with some inflated cells, sharply delimited. **Ectal excipulum** pale orange, from base to margin of 20 µm thick, indistinctly oriented, (†) thin-walled t. angularis, cells at base †5–10 × 4–7 µm {1}, upper margin of t. porrecta oriented at a low angle, marginal cortical cells †8–11 × 4–4.5 µm {1}. **Anchoring hyphae** abundant, †1–2.5 µm wide, wall 0.2 µm thick, covering exterior up to the margin as a thin layer. **SCBs** in paraphyses globose, 1.3–2 µm diam., in paraphyses and ectal excipulum (near margin) crystalloid, pale orange, spool-shaped {T}. **Exudate** over paraphyses and margin 0.1–0.5 µm thick, very finely rough, ± firmly attached. **— ANAMORPH**: unknown.

Habitat: lying on dry ground, decorticated, 2–9 mm thick twigs and branches of *Acacia* sp. {1}, *Acacia jennerae* {T}, on 0.3 mm deep strongly decayed wood {2}, greyed, no algae. **Associated**: *Baggea* sp. {1}, *Coccomycetella* sp. {1}, *Orbilia angustoaristata* {1}, *O. austropleiomicrosoma* {1}, *O. coronohesperidea* {1}, *O. multiaustraliensis* {1}, *O. multiserpens* {1}, *O. myriella* {1}, *O. pleioaustraliensis* {1}, *O. pleiocoronohesperidea* {1}, *O. ?pleioserpens* {1}, *Ostropales* {1}, *Symbiotaphrina desertorum* {2}. **Desiccation tolerance**: fully viable for at least 1 month. **Altitude**: 480–605 m a.s.l. **Geology**: Proterozoic and Cretaceous sedimentary rock (red-brown gravel), Cenozoic regolith (sand); granite. **Phenology**: long-lived.

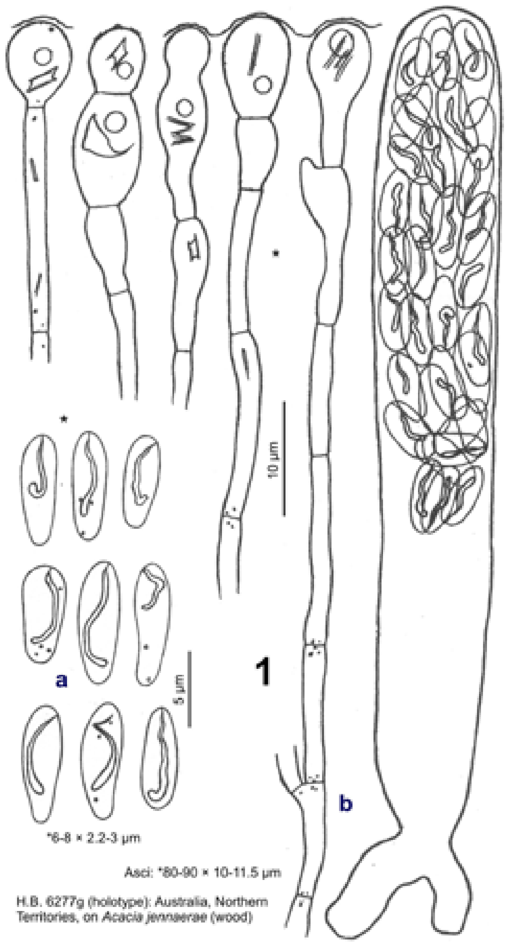


Plate 757. **1**: *Orbilia myrionamibica*. – **a**. ascospores; **b**. ascus and paraphyses.

Taxonomic remarks. *Orbilia myrionamibica* is characterized by 64-spored asci, otherwise it is similar to the African *O. namibica*. Although collected in different continents, the two species appear to be more closely related than is *O. namibica* to *O. myrioflexa* which both grew on the very same branch. The latter differs from *O. myrionamibica* in shorter, more clavate ascospores with thinner SBs which are always apically attached and always longer than the spores, also in narrower asci. In spore morphology *O. myrionamibica* resembles *O. microsoma* and *O. multimicrosoma*, from which it differs in the higher spore number and in showing crystalloid SCBs.

Only two apothecia were detected in the holotype of *O. myrionamibica* among the eight further, macroscopically almost indistinguishable species of *Orbilia*. One of them is assigned to *O. multiserpens*, which has spores and SBs very similar to *O. myrionamibica* but differs in 32-spored asci, somewhat shorter spores and in lacking crystalloid SCBs.

The paratype is tentatively placed here because it was only studied in the dead state. Its spores are partly shorter but vary strongly in length.

Not included collection. Another sample on *Acacia* (Pl. 758) differs in shorter, more homopolar spores (*4.4–5.6 × 2.2–2.4 µm) and narrower asci (*9–9.2 µm).

Phylogeny. A sequence was taken from apothecia of the paratype, comprising S1506 intron, ITS, and LSU D1–D2. However, the apothecia were only examined after the DNA was extracted, so there is some uncertainty because also *O.*

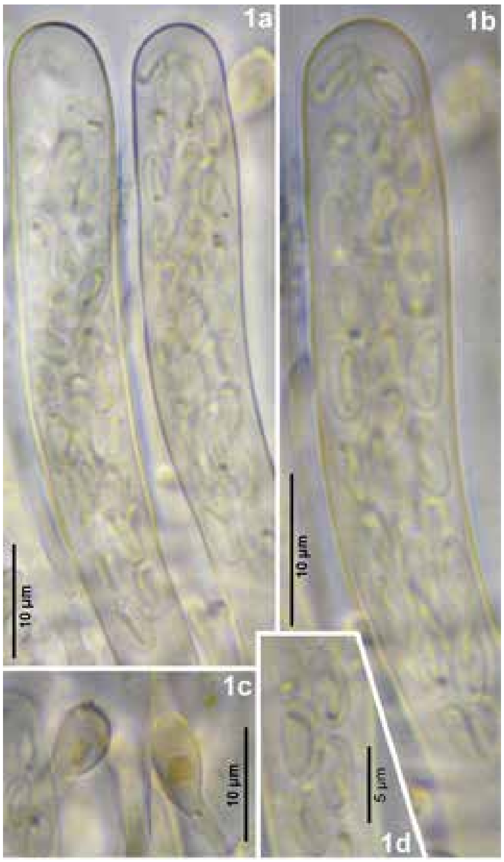


Plate 758. **1**: *Orbilia* cf. *myrionamibica*. – **1a–b**, **d**. asci and ascospores (**1a** & **b** at different scale); **1c**. apices of paraphyses. – Living state. — **1a–d**. H.B. 8727l: Western Australia, Carnarvon, on *Acacia*.

cf. *pleioserpens* was once observed on the branches (this was likewise only studied in the dead state and no documentation exists for it). *O. myrionamibica* clustered with medium support in the *microserpens*-*ungulata* clade when analysing SSU+ITS+LSU (Phyl. 20). The ITS distance lies in the range of 3.5–4.7% to *O. cisti*, *O. macroserpens*, *O.* cercocarpi, and *O. microserpens*. In the LSU (D1–D2) the closest taxon was *O. cercocarpi* (0.2%, 1 nt), but several other species differ by only 2–3 nt. In the intron region the closest species were *O. cisti* and *O. calyptrata* (~13%).

Ecology. *O. myrionamibica* is only known from two very sparse collections on rotten wood of xeric twigs and branches of *Acacia* in subtropical arid acacia open shrublands around the MacDonnell Ranges in central Australia. The not included collection was in a subtropical semiarid acacia shrubland in western Australia.

Specimens included. **AUSTRALIA**: **Northern Territories**, Finke, 100 km E of Yulara, 24 km ENE of Curtin Springs Roadhouse, 480 m, twig of *Acacia jennerae*, on wood, 10.X.1998, G. Marson (H.B. 6277g, MEL 2389202B, **holotype**). – MacDonnell Ranges, 11 km W of Alice Springs, 5 km N of White Gums, Larapinta Drive, 605 m, branch of *Acacia*, on wood, 13.X.1998, G. Marson (H.B. 10119a ø; sq.: MH221070).

Not included. **AUSTRALIA**: **Western Australia**, Carnarvon, 183 km SSE of Carnarvon, 10 km W of Overlander Roadhouse, 12 km NE of Hamelin Pool, 67 m, twig of *Acacia*, 6.XI.2007, G. Marson (H.B. 8727l ø).

Subgenus *Orbilia*

Orbilia Fr. subgenus ***Orbilia*** – Lectotype species: *Orbilia xanthostigma* (Fr.) Fr.

Description: — **TELEOMORPH**: **Apothecia** hydrated whitish, ochraceous, yellowish, rose, orange, lilaceous, rarely red, purplish-brownish or olivaceous-black, margin glabrous or crenulate, denticulate to dentate, or hairy, sessile or (short-)stipitate. **Ascus apex** (†) slightly to medium to strongly truncate, not or slightly to distinctly indented and laterally inflated, hemispherical in profile view, thin-walled, rarely with 1–1.4 µm thick dome, sometimes with apical chamber (section *Ovoideae* p.p.); **base** T-, L-, Y-, h- or H-shaped. **Ascospores** variously shaped; **SBs** apically, rarely laterally affixed to spore wall, globose to tear-shaped, subulate, rod-shaped, plug-shaped, dumbbell-shaped or ampulliform, rarely lens-shaped, attachment invisible or apically narrowed to a small or wide point, filum absent or very short. **Paraphyses** apically uninflated to strongly capitate-clavate, also spathulate to lanceolate. **— ANAMORPH**: arthrobotrys-like, dactylella-like, dactylellina-like, descalsia-like, dicranidion-like, drechslerella-like, gamsylella-like, trinacrium-like, vermispora-like. **Trapping organs**: unknown in sections *Ovoideae* and *Orbilia*, often present in section *Arthrobotrys*.

Habitat: on wood and bark of gymno- and angiosperms, also caulicolous, foliicolous, fungicolous, or coprophilous, from boreal to tropical climates, desiccation-tolerant or -sensitive.

Recognized sections: *Arthrobotrys*, *Orbilia*, and *Ovoideae*, with 150 recognized species (35 of them without known teleomorph, further 67 anamorphic species of section *Arthrobotrys* not treated here) plus 2 with a provisional name and 27 unnamed species ('affinis').

Taxonomic remarks. Subgenus *Orbilia* represents an assemblage of quite different morphological and ecological groups. It is circumscribed here more on the basis of morphological than phylogenetic data and includes three sections: *Ovoideae*, *Orbilia*, and *Arthrobotrys*. Characteristic are the truncate, thin-walled ascus apex and the frequent presence of an H-shaped ascus base, also the terminal cells of paraphyses being usually much longer than the lower cells. However, section *Ovoideae* deviates more or less hereof. Similar as in subgenus *Habrostictis*, desiccation-tolerant taxa occur along with desiccation-sensitive taxa, except that section *Ovoideae* and series *Microsomates* of section *Orbilia* comprise exclusively desiccation-tolerant taxa.

Section delimitation: Members of section *Ovoideae* approach subgenus *Hemiorbilia* in their ascus characters and short terminal cells of paraphyses. These two groups share also the desiccation tolerance of all their members, therefore, we believe that they have preserved some plesiomorphic characters of the genus *Orbilia*. Section *Ovoideae* is defined by a rather primitive ascospore and SB shape, but such spores and SBs also occur in section *Orbilia*.

Sections *Orbilia* and *Arthrobotrys* share paraphyses with more or less long terminal cells in comparison to the lower cells, the frequency of an H-shaped ascus base, and ascospores with comparatively small SBs. Their delimitation is problematic because they are linked to morphologically intermediate taxa which cluster in series *Neodactylella*. For a key to the sections of subgenus *Orbilia* see p. 452.

Anamorphs. In section *Ovoideae* curved phragmoconidia (vermispora-like) were observed as presumed anamorphs. Stauroconidia are frequent in section *Orbilia* (mainly dicranidion-like), but also curved (vermispora-like) and straight phragmoconidia occur. Stauroconidia of an extraordinary type characterize series *Microsomates*. Didymo- or phragmoconidia are typical of section *Arthrobotrys*, being straight or sometimes curved, with or without swollen central or terminal cell, exceptionally branched (trinacrium-like). Most members of section *Arthrobotrys* possess predatory capabilities, with the exception of series *Neodactylella*, but two predacious taxa with rather primitive trapping organs (*Tridentaria implicans*, *Dicranidion dactylopagum*) possibly belong to series *Orbilia*.

Phylogeny. Subgenus *Orbilia* clustered in the analysis of Baral et al. (2017b, SSU+ITS+LSU) as a paraphyletic group composed of three monophyletic clades which represent the three included sections. The subgenus formed a basal sister group to the subgenera *Hemiorbilia* and *Habrostictis*. However, its basal position lacks any support and also the phylogeny of the three included sections remained unresolved. The topology in the present analysis (Phyl. 7) is different but likewise unresolved. All the available analyses do not unravel the relationship between subgenera Orbilia and *Hemiorbilia* and leave our hypothesis unconfirmed that the hemispherical, thick-walled ascus apex is a plesiomorphic character, from which subgenus *Orbilia* developed by regression to a truncate, thin-walled apex.

Section *Arthrobotrys*, in which acicular-subulate, falcate ascospores are characteristic of many species and the ability to prey on nematodes unique within the genus, seems to have developed from a common ancestor with cylindric-ellipsoid spores which survived, e. g., in *O. orientalis* or *O. pilosa*, and are typical of section *Ovoideae* p.p. and section *Orbilia* p.p. From the distribution of the different traits of these three sections it can be speculated that the common ancestor of subgenus *Orbilia* was a desiccation-tolerant, non-nematophagous fungus with a hemispherical, thick-walled ascus apex and ellipsoid ascospores, represented by taxa of section *Ovoideae*, such as *O. clavipisca*, *O. eremaeae*, and *O. yuccae*, which form a morphological transition to members of subgenus *Hemiorbilia*, such as *O. arizonensis*.

Specific nucleotide positions. No molecular motifs being characteristic of subgenus *Orbilia* have been discovered in any of the frequently recorded regions of nuclear rDNA. Only for one of the three included sections (*Ovoideae*) and for all adhesive trap formers of section *Arthrobotrys* some consistent nucleotides occur by which they can be recognized (see there).

Section *Ovoideae*

Orbilia subgenus ***Orbilia*** section ***Ovoideae*** Baral & E. Weber, **sect**. **nov**., MB 815021 – Type species: *Orbilia ovoidea* Baral & G. Marson

Etymology: named after the type species, *Orbilia ovoidea*.

Latin diagnosis: *Apothecia ochracea, aurantiaca, rosea, lilacea, raro olivaceo-atra, margine ± laevi, raro fimbriato-dentato.] Asci 8- ad 128-spori, apice in statu emortuo haud vel valde truncati, non vel interdum modice crassitunicati. Ascosporae plerumque *3–12.3 × 1.3–4.3 µm, globosae ad ellipsoideae vel subcylindricae ad fusoideo-clavatae, apice rotundato ad obtuso, raro acuto, saepe ± rectae, interdum prope basin curvatae, in statu vivo corpusculum refringens globosum vel late lacrimiformem, raro obturamentiformem continentes. Excipulum ectale ad marginem partim crassitunicatum. Habitat ad lignum vel corticem putridum ramorum gymno- vel angiospermarum in aere prominentium, raro ad caules, in zona arctica ad tropica, humida ad arida.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.1–)0.2–1(–2.2) mm diam., pale to bright ochraceous, orange, rose, lilaceous, rarely olivaceous-black, margin smooth or sometimes finely rough, rarely with prominent hairy teeth (*O. octosporoides*), ± sessile (rarely with a distinct short stipe). **Asci** *(27–)33–75(–97) × (4–)4.5–7(–7.5) µm when 8-spored, *(40–)50–90(–102) × (5.5–)6–9(–10.5) µm when 16–128-spored, (1–)3–6(–8) lower (rarely upper) spores inverted (when 8-spored), but often strongly mixed (often also oriented in all directions); **apex** (†) very slightly to strongly truncate, rarely slightly indented or laterally inflated, thin-walled, rarely with 1–1.4 µm thick dome with or without apical chamber; **base** T-, L-, Y- or h-, exceptionally H-shaped. **Ascospores** *3–10(–12.3) × (1.3–)1.7–3.8(–4.3) µm, globose, ovoid, ellipsoid, (sub)cylindrical to fusoid-clavate, apex rounded to obtuse, rarely subacute or acute, base rarely with a thick tail, straight or sometimes ± strongly curved near base, **SBs** affixed to apical spore wall, exceptionally laterally attached, (0.7–)1–2.2(–2.8) × (0.6–)0.7–1.5(–1.9) µm, globose to broadly tear-shaped, also ampulliform or broadly plug-shaped, sometimes apically narrowed to a small, rarely wide point, often with a very short, sometimes invisible filum. **Paraphyses** uninflated or slightly to strongly clavate-capitate at the apex, rarely spathulate, terminal cells (0.5–)1–2(–3)× as long as lower cells, unbranched or sometimes branched near apex. **Ectal excipulum** of textura (globulosa-)angularis(-prismatica), indistinctly or ± vertically oriented, sometimes obliquely (~45°), rarely horizontally (*O. sarcobati*), cells near base *(5–)6–20(–27)((–36)) × (4–)5–15(–18)((–20)) µm, (†) thin-walled to slightly or medium gelatinized (common walls †0.2–2 µm), cells at mid flanks and margin thick-walled or not; **glassy processes** sometimes present, 1–13 µm or rarely 5–40 µm long, **hairs** rarely present, 50–110 µm long, thin- to firm-walled, forming teeth (*O. octosporoides*). **SCBs** globose, rarely mixed with crystalloid ones (*O. octosporoides*); **VBs** consistently absent; **carotenoids** in LBs rarely observed (*O. octosporoides*). **Exudate** (0.1–)0.3–3(–5) µm thick, continuous-cloddy, also granular, loosely or partly firmly attached, hyaline or pale (rarely light) yellow, rarely dark olive. **— ANAMORPH** (presumed): vermispora-like. **Conidiophores** not observed. **Conidia** fusoid, slightly to strongly curved, */† 31–97(–127) × 4.2–9.8 µm, 7–19-septate. **Trapping organs**: unknown.

Habitat: on wood and bark of both gymno- and angiosperms, exceptionally resinicolous or caulicolous, from arctic to tropical, humid to arid areas, all species desiccation-tolerant.

Recognized species: 27, plus 1 with a provisional name and 3 unnamed species (‘affinis’).

Taxonomic remarks. Members of section *Ovoideae* share ascospores and SBs of a more or less primitive shape (spores globose, ellipsoid, fusoid-clavate or cylindrical, straight or sometimes ± curved, apex mostly rounded to obtuse; SBs globose to broadly tear-shaped). They deviate from the other two sections of subgenus *Orbilia* in the occasional presence of hemispherical ascus apices with apical thickenings, reminiscent of subgenus *Hemiorbilia*, in the predominant absence of an H-shaped ascus base, and in the tendency to an equal distribution of paraphysis septa.

Characteristic of some species are the thick-walled, partly very long marginal cortical cells which form a conglutinate texture, particularly in *O. polyspora* and *O. ovoidea*. The walls of these cells are compressible, and that is why they are much thinner when the cells are turgescent. Glassy processes are predominantly absent, but present in *O. cupularis*, *O. subsphaerospora*, and *O. octosporoides*. The latter is extraordinary in its prominent teeth composed of very long, septate hairs tipped by glassy processes, also in the presence of crystalloid SCBs. An alternative solution would be to place this species in section *Hemiorbilia*, but the complete absence of apical domes tells against such a placement.

A major part of the collections of *O. clavipisca* and *O. lilacina*, and also *O. eremaeae* differ from the general situation of section *Ovoideae* in showing predominantly distinct apical domes with an apical chamber, suggesting a relation to section *Hemiorbilia*. However, the partial absence of apical domes and the strong similarity of *O. lilacina* to polysporous taxa with lilaceous apothecia (e. g., *O. plurililacina*) underline the limited value of ascus characters in section *Ovoideae*. Actually, in at least nine species of section *Ovoideae* ascus apices varied among different populations, or even among asci of a single apothecium, the apical domes being often only exceptionally present.

O. olivacea is extraordinary within section *Ovoideae* by its dark olivaceous exudate. This species and *O. yuccae* are somewhat marginal also in their partly distinctly stipitate apothecia and in only slightly truncate ascus apices, though such asci are also found in *O. amberina* and *O. eremaeae*. Ecologically, *O. olivacea* differs in growing near resinous wounds of gymnosperms. *O. pisciculus* is exceptional in having distinct spore tails, and *O. stansburyanae* in a tendency to acute spore apices. The terminal cells of paraphyses are usually about the same or max. 1.5 × the length of the lower cells, but in some species (*O. subsphaerospora*, *O. octosporoides*, *O. yuccae*) they are often 2 × or even over 3 × as long as the lower cells.

In its small cylindrical spores and globose SBs, the 8-spored *O. subcylindrospora* resemble *O. lilacina* and its multispored allies, and *O. atriplicis*. However, it resembles also members of section *Orbilia* like *O. cylindrospora*, *O. paracylindrospora*, *O. austrocylindrica* and its multispored allies, and *O. cupressi*, *O. pseudeuphorbiae* and others of series *Neodactylella* (section *Arthrobotrys*). Molecular data refer *O. cupressi* to series *Neodactylella* where it fits indeed better because of the large, dactylella-like conidia. The subcylindrical to narrowly ellipsoid spores of *O. paracylindrospora* resemble those of *O. frangulae* and *O. eucalypti* (series *Orbilia*), with which it clusters.

Species delimitation. The limits between *O. ovoidea* and *O. subovoidea* are indistinct, particularly because *O. subovoidea* shows high variation in spore size and shape. The genetic distance between the two available sequences suggests, however, that separation between the two taxa is justified. Similar problematic groups of taxa are, e. g., *O. polyspora* and *O. plurililacina*, or *O. multicreosoteris*, *O. atriplicis* and *O. multiaustrocylindrica* (section *Orbilia*).

Anamorph. Within section *Ovoideae* we never succeeded to obtain an anamorph in pure culture. The three species of which we got an isolate failed to produce conidia, even when flooding the culture with water. In six species large, narrowly fusiform, multiseptate, vermispora-like phragmoconidia were observed on the natural substrate. These are rather similar among each other, though showing some variation in length and curvature, sometimes within a collection (see Pl. 757: 4).

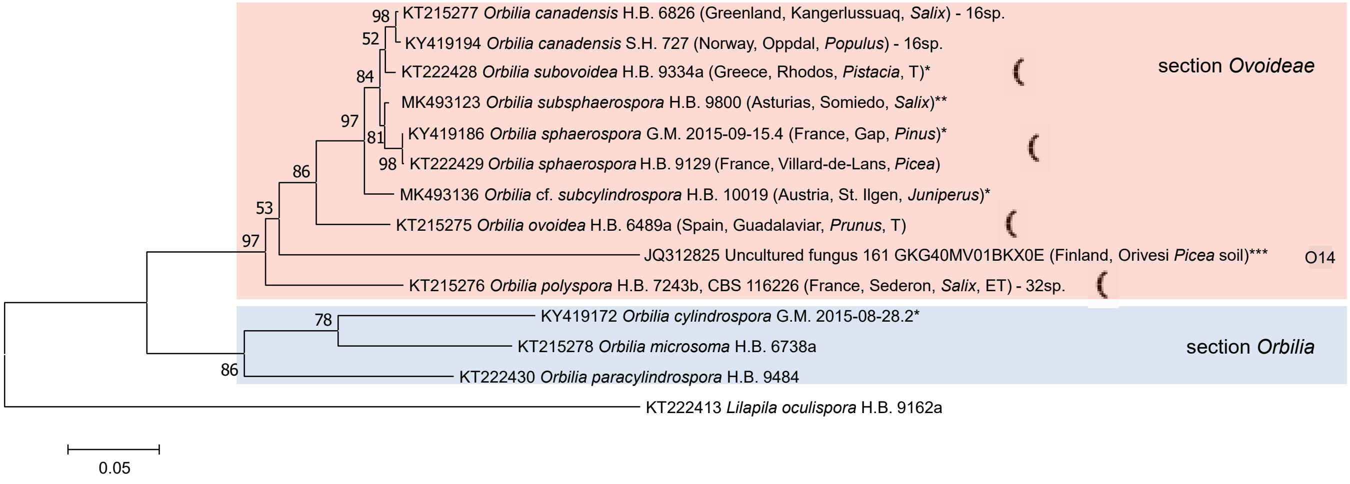
The conidia were found on very different substrates (*Pinus*, *Juniperus*, *Acer*, *Rosmarinus*, *Quercus*, etc.) in different countries (France, Spain, Turkey) or even different continents (Europe, North America). Therefore, it seems rather unlikely that these vermispora-like conidia occurred only in accidental association, and we presume that they represent the anamorph of these species.

In *O. olivacea*, a single flexuous vermispora-like conidium was seen in one collection, emerging from an anchoring hypha near an apothecium. However, the conidium looked somewhat thick-walled in the living state, whereas living orbiliaceous conidia generally have thin walls, and only in the dead state the detached cytoplasm simulates a thick wall as shown, e. g., in Pls 768: 1g; 769: 3d.

Phylogeny. Molecular data were obtained from seven species. The sequenced gene regions comprise SSU, ITS, and LSU (in *O. subovoidea* and *O.* cf. *subcylindrospora* SSU is lacking and in *O. subsphaerospora* also LSU). The S1506 intron (401 nt) was absent, except for *O. ovoidea* and *O. subovoidea*. In *O. ovoidea* a smaller intron of 70 nt (S1516) occurs at a very unusual, conservative position within the ITS1 primer at the 3'-end of SSU.

Section *Ovoideae* formed in analyses of ITS, LSU, or SSU+ITS+LSU always a highly supported monophyletic clade (Baral et al. 2017b, Phyls 7, 21, S23–S24). The two comprehensive former analyses support that section *Ovoideae* form a group different from other sections of *Orbilia*. However, molecular data were unavailable for 22 (76%) of the 29 species recognized at present. *O. polyspora* deviates rather strongly from the other species of section *Ovoideae* in both the ITS1 and ITS2 region but also in the LSU. The position of the *Ovoideae* clade is difficult to assess, as it clustered more or less unresolved in the tree, depending on, e. g., the selected gene regions and species.

Specific nucleotide positions. Several motifs are more or less unique to section *Ovoideae*, in comparison to other groups of *Orbiliomycetes*. At pos. 142–143 of the 5.8S region, which is within the primer Orb5.8s3F just upstream of GAGCGTC, section *Ovoideae* has G**CC**TGTTT or G**CT**TGTTT compared to G**TC**TGTTT (or G**TC**TGTCT) in any other *Orbilia* spp. (see Tab. 18). Within *Orbiliomycetes*, **CC** occurs only in *Hyalorbilia*



Phylogenetic analysis 21. Phylogram of section *Ovoideae* inferred from combined ML analysis of SSU (V8–V9)+ITS1-5.8S-ITS2+LSU (D1–D2) rDNA dataset (14 sequences, 1607 positions, aligned with MUSCLE) using the K2+G model in MEGA7 (500 replicates). An environmental strain from GenBank is included representing an unidentified species (O14). The tree is rooted with *Lilapila oculispora* and three members of section *Orbilia*. Asci 8-spored except when otherwise stated; T = type, ET = epitype, * = without SSU, ** = without SSU and LSU, *** = without SSU, ITS1, and LSU.

Key to species of section *Ovoideae*

1. Apothecia blackish-olivaceous; asci 8-spored; spores ellipsoid, *5–8.5 × 2.3–3.2 µm; SBs ellipsoid to ovoid; predominantly upper spores inverted within asci; resinous bark of *Pinus*, cold-temperate to orosubmediterranean humid southern Europe .... ***O. olivacea***, p. 1290
1. Apothecia pale to bright reddish, rarely ochraceous 2

2. Asci 8-spored .... SUBKEY A
2. Asci 16-spored .... SUBKEY B
2. Asci 32- up to 128-spored.. SUBKEY C

SUBKEY A (asci 8-spored)

1. Spores *1–2(–2.2) µm wide, cylindrical to fusoid 2
1. Spores min. *(2–)2.2–2.5 µm wide, variously shaped (if subglobose and 2–4 µm diam. compare also subglobose-spored *Hyalorbilia* spp.) 11

2. Spores (sub)cylindrical, *4.5–6.5 × 1.2–1.5 µm; SBs ± globose, laterally attached in centre of spore; apothecial margin distinctly dentate by glassy processes; bark of *Quercus*, suprasubmediterranean semihumid southern Europe......... ***O. beatricis*** (section *Orbilia*), p. 1322
2. Spores with apically attached SBs 3

3. Spores ± straight, never distinctly curved 4
3. Spores ± straight to distinctly curved 8

4. Spores *3–5 × 1–1.5 µm 5
4. Spores exceeding 5 µm in length or 1.5 µm in width 6

5. Spores subcylindric(-ellipsoid), *3–5 × 1.3–1.6 µm; SBs 0.3 µm wide; paraphyses apically curved or not; wood of *Euonymus*, warm-temperate humid atlantic Europe .... ***O. paracylindrospora*** (section *Orbilia*), p. 1343
5. Spores (sub)cylindrical, *1–1.5 µm wide; SBs 0.4–0.8 µm wide; paraphyses apically straight..7

6. SBs globose, in most cases a short distance from the spore apex, attachment often invisible; apothecia desiccation-sensitive, whitish, 0.3–2.3 mm diam., margin often with short glassy processes .... series ***Neodactylella*** p.p. (section *Arthrobotrys*, species with ± straight spores)
6. SBs globose, rarely tear-shaped, close to apex or with a visible connecting part; apothecia usually desiccation-tolerant, whitish to rose-orange, 0.15–0.7 mm diam. 7

7. Spores *(4–)5–6.5(–8) × (1.1–)1.3–1.7(–1.9) µm; glassy processes rarely present; bark of *Myrtaceae* and *Proteaceae*, subtropical semihumid to arid Australia.. ***O. austrocylindrica*** (section *Orbilia*), p. 1317
7. Spores *(3.7–)4–7(–8.2) × (1–)1.1–1.3(–1.5) µm; glassy processes absent; wood (& bark) of gymno- & angiosperms, orotemperate to suprasubmediterranean humid Europe .... ***O. cylindrospora*** (section *Orbilia*), p. 1314

8. Spores *7.3–9.5 × 2–2.3 µm, medium to strongly tapered and curved at base; bark of *Lonicera*, orotemperate subhumid, cold-continental central Asia .... ***O. basiflexa***, p. 1279
8. Spores *4.5–8.5 × 1.4–2 µm, not or max. medium tapered at base 9

9. Total length of SBs 1.3–2 µm; wood of *Arctostaphylos*, orotemperate subhumid western North America.. ....***O.* aff. *dixiensis*** (section *Habrostictis*) Pl. 699: 4, p. 1179
If paraphyses with glassy caps or marginal cells with glassy processes, see series *Regales* of section *Aurantiorubrae.*
9. Total length of SBs 0.6–1.4 µm..10

10. Spores *(4–)5–7.2 × (1.3–)1.6–1.8(–2.2) µm; SBs 0.6–1.2 µm long (including very short filum, or closely attached without filum); paraphyses medium to strongly capitate; wood of gymno- and angiosperms, orosub- to mesosubmediterranean humid to semihumid southern Europe.. ***O. subcylindrospora***, p. 1277
A collection from orotemperate humid central Europe has slightly larger spores and approaches *O. subovoidea* (p. 1257).
10. Spores *(3.7–)5–8.5(–9.3) × (1.5–)1.8–2(–2.3) µm; SBs 1–1.4 µm long (including very short filum); paraphyses mostly only slightly clavate-capitate to ellipsoid; wood of *Cupressus*, mesosubmediterranean western Europe.... ***O. cupressi*** (series *Neodactylella*), p. 1479

11. Spores globose or broadly ellipsoid-ovoid, *3.2–4.3 µm long.. 12
11. Spores broadly ellipsoid-ovoid to oblong or clavate, *4–10 µm long 15

12. Marginal excipulum without glassy processes, margin smooth, inner wall layers of cortical cells swellable or not; spores *(2.6–)3–3.8(–4.2) µm wide, globose to ellipsoid 13
12. Marginal excipulum with short but distinct glassy processes, margin usually finely crenulate, cortical cells thin-walled, unable to swell; spores *(2.7–)2.9–3.5(–3.8) µm wide, globose to subglobose.. 14

13. Spores *3.2–4.3 × (2.8–)3–3.8(–4.2) µm, always ± globose; inner wall layers of cortical cells swellable; apothecia 0.2–1 mm diam., rose-orange; wood (& bark) of *Picea* and *Pinus*, orotemperate to orosubmediterranean humid southern Europe .... ***O. sphaerospora***, p. 1246
13. Spores *3.7–4 × 2.6–2.8 µm, ovoid to broadly ellipsoid; cortical cells thin-walled when dead; apothecia 0.13–0.15 mm diam., orange(-brownish); bark of *Eremaea*, subtropical semihumid western Australia....***O. amberina*** p.p. (small-spored collection) Pl. 770: 3, p. 1260

14. Ectal excipulum at mid flanks abruptly changing to a horizontal textura porrecta; apothecia 0.4–2 mm diam., disc concave; wood of *Acer*, orotemperate subhumid western North America .... ***O. cupularis***, p. 1253
14. Ectal excipulum at mid flanks of vertically oriented t. angularis(-prismatica); apothecia 0.2–0.7 mm diam., disc ± flat; wood & bark of angiosperms (rarely gymnosperms), hemiboreal, orotemperate, and sub- to eumediterranean Europe.........***O. subsphaerospora***, p. 1249

15. Apothecial margin strongly dentate, teeth of agglutinated septate hairs, some of the latter tipped by glassy processes; spores *(5–)5.7–7.5(–9) × (3.7–)4–4.8 µm, broadly ellipsoid-ovoid; SBs 1.2–1.8 µm wide, globose, mostly with triangular connecting part; paraphyses with crystalloid SCBs; bark of *Juniperus*, orotemperate subhumid western North America .... ***O. octosporoides***, p. 1280
15. Apothecial margin smooth; spores *< 4 µm wide 16

16. Spores *(5–)8–11 × (2.8–)3–3.3(–4) µm, mostly with a distinct, thick, basally partly swollen tail; SBs closely attached to spore apex; terminal cells of paraphyses mostly longer than lower cells; ascus apices thin-walled; bark of *Juniperus*, orotemperate subhumid western North America .... ***O. pisciculus***, p. 1282
16. Spores with or without very short tail 17

17. Ascus apices (†) mostly with distinct apical thickening with apical chamber; SBs globose, with thin filum or triangular connecting part (half as long as globose part); cortical excipular cells (†) ± thin-walled 18
17. Ascus apices (†) without distinct apical thickening (in water), or some asci with slight wall thickening without apical chamber; SBs with or without very short filum; cortical excipular cells (†) often thick-walled 21

18. Spores *6–11 × (2.9–)3.2–4(–4.3) µm; SBs 1.6–2.5 × 0.8–1.6 µm 19
18. Spores *2.5–3(–3.3) µm wide, ellipsoid to slightly attenuated at base; SBs 1–1.8 × 0.7–1.4 µm 20

19. Spores elongate-obovoid, medium to strongly attenuated at base; SBs attached by a fine filum; apothecia (0.2–)0.4–1.2 mm diam.; wood of gymnosperms, temperate (sub)humid western North America .... ***O. clavipisca***, p. 1283
19. Spores cylindric-ellipsoid, not or slightly attenuated at base; SBs partly attached by a triangular connecting part; apothecia 0.18–0.27 mm diam.; bark of *Eremaea*, subtropical semihumid western Australia .... ***O. eremaeae***, p. 1285
Comparable collections were made on *Carya* and *Arbutus* in temperate humid eastern and western North America.

20. Apothecia rose-orange; spores *7–8 µm long; wood of ?*Abies*, boreal humid eastern North America .... ***O.* aff. *clavipisca***, p. 1284
20. Apothecia rose-lilaceous; spores *(4.5–)5–7(–8) µm long; bark of *Eucalyptus* & *Verreauxia*, subtropical semihumid western Australia .... ***O. lilacina***, p. 1265
21. Marginal cortical cells and paraphyses distinctly clavate-capitate, (†) thin-walled; asci *27–33.5 × 5.5–6 µm, apex not or only slightly truncate, slightly thick-walled; spores *4–5(–5.6) × 2.5–3 µm; SBs closely and broadly attached to apex; apothecia 0.1–0.22 mm diam., whitish-yellowish; inflorescence stem of *Yucca*, temperate semiarid western North America .... ***O. yuccae***, p. 1291
21. Marginal cortical cells only slightly inflated, (†) thin- or thick-walled; asci min. *33 µm long; SBs narrowly attached at spore apex; apothecia 0.15–0.8 mm diam., light rose-lilaceous, orange to amber-brown 22

22. Spores with very short tails, *8.3–11.5 µm long; SBs broadly tear-shaped, attached to apex by a distinct triangular upper part 23
22. Spores without tails, *4–7(–11) µm long; SBs globose, either very close to apex or attached by a fine and short filum 24

23. Spores *8.3–10 × 2.3–2.5(–2.7) µm; bark of *Brachychiton*, subtropical semiarid western Australia .... ***O. gregorii***, p. 1289
If spores *2–2.3 µm wide and tail-like base bent see ***O. basiflexa*** (p. 1279).
23. Spores *8.8–11.5 × 2.8–3.5 µm; *Sarcobatus*, temperate semiarid western North America .... ***O.*** aff. ***gregorii***, p. 1290
A similar collection was on *Juniperus* from the south of Northern America (spores *6–8 × 2–2.4 µm, Pl. 804: 2).

24. SBs rod-shaped to ampulliform or tear-shaped, mostly with a wide, broadly attached upper part; mountainous Europe, North America .... see ***O. ovalis*** (series *Ovales*, section *Lentiformes*), p. 498
24. SBs ± globose, often with a short, filiform upper part, always very narrowly attached 25

25. Asci *33–55 µm long, apex slightly to medium truncate 26
25. Asci *48–75 µm long, apex medium to strongly truncate 27

26. Apothecia rose-lilaceous; spores l:w-ratio 1.5–2.5; SBs 0.7–1.3 µm wide .... see under 20 (*O. lilacina*)
26. Apothecia orange- to amber-brown; spores l:w-ratio 1.3–1.6; SBs 1–1.5 µm wide; bark & wood of *Verreauxia* & *Acacia*, subtropical semihumid to semiarid western Australia .... ***O. amberina*** p.p. (large-spored collections, Pl. 770: 1–2), p. 1260

27. Spores *4–9 × (2–)2.2–3(–3.3) µm, rarely tapered at base; asci *50–65(–70) × 5–6(–6.3) µm; marginal cortical cells 7–15 µm long, mainly terminally thick-walled; wood and bark of angiosperms, orosub- to thermomediterranean semihumid Europe, rarely emsotemperate humid atlantic Europe or cold-temperate humid mountainous western North America .... ***O. subovoidea***, p. 1257
27. Spores *3–4 µm wide, at least partly tapered at base; asci *(55–)65–75 × (5.5–)6–7 µm 28

28. Spores *5–7(–8) µm long, partly tapered at base; marginal cortical cells 9–20 µm long, (†) overall thick-walled; wood of angio-, rarely gymnosperms, orotemperate to suprasubmediterranean humid Europe .... ***O. ovoidea***, p. 1254
28. Spores *(6–)7–10(–11) µm long, always tapered at base; marginal cortical cells 6–15 µm long, (†) ± thin-walled; wood of gymnosperms, cold-temperate to boreal (sub)humid western America .... ***O. clavipisca***, p. 1283

SUBKEY B (asci 16-spored)

1. Spores subglobose to broadly ellipsoid, *3.4–5.3 × 2.3–3.4 µm; wood (& bark) of *Betulaceae*, *Salicaceae*, orotemperate to subarctic humid northern North America and northern Europe .... ***O. canadensis***, p. 1251
1. Spores cylindrical, ellipsoid or fusoid, min. *6.5 µm long 2

2. Spores *11–17.5 × 2–3.2 µm; asci (†) with rounded to slightly truncate, slightly thick-walled apex with apical chamber .... see ***O. pleionavajoana*** (p. 573) & ***O. pleiohesperidea*** (p. 582, series *Hesperideae*, section *Hemiorbilia*)
2. Spores *6.5–12.5 µm long; asci (†) with medium to strongly truncate, thin-walled apex (though rarely immature with slight apical wall thickening in some asci) 3

3. Spores *1.5–2.5(–2.8) µm wide; Australia 4

3. Spores *3–4 µm wide; western North America 5

4. Spores *5.5–8.8 × 1.4–1.6(–1.7) µm; SBs narrowly attached; paraphysis apices *3–5 µm wide; ectal excipulum (†) distinctly thick-walled; wood of *Acacia*, *Eucalyptus*, subtropical semihumid to semiarid western Australia.......... ***O***. ***pleioaustrocylindrica*** (section *Orbilia*), p. 1319

4. Spores *(7.5–)8.5–10(–11) × 2–2.5(–2.8) µm; SBs more broadly attached; paraphysis apices *2.3–3 µm wide; ectal excipulum (†) thin-walled; bark of *Geijera*, tropical subhumid eastern Australia .... ***O***. ***geijerae***, p. 1274

5. Spores ellipsoid-fusoid, with obtuse to subacute apex, *8–12.3 × 3.2–3.5(–3.7) µm; SBs globose to broadly tear-shaped, ± closely attached; wood of *Purshia*, orotemperate subhumid .... ***O***. ***stansburyanae***, p. 1272

5. Spores cylindrical to ellipsoid, with rounded apex, SBs with distinct filum or ± thick triangular connecting part........ 6

6. Spores (9–)11–12.5 × 2.8–3.5 µm, cylindric(-ellipsoid); wood of *Larrea*, warm-temperate arid........ ***O***. ***pleiocreosoteris***, p. 1274

6. Spores *(5–)6.5–9(–11) × (2.8–)3–3.8(–4.3) µm, ellipsoid 7

7. Marginal ectal excipulum of t. porrecta; SBs globose; paraphyses rarely capitate, terminal cells *(10–)13–19(–22) µm long; apices of dead asci not indented; bark of *Pinus*, orotemperate humid........ ***O***. ***ponderosae***, p. 1286

7. Marginal ectal excipulum of t. globulosa-angularis; SBs globose to ellipsoid or tear-shaped; paraphyses always capitate, terminal cells *(3–)5–14(–17) µm long; apices of dead asci slightly to distinctly indented; bark of *Sarcobatus*, temperate semiarid . ***O***. ***sarcobati***, p. 1287

SUBKEY C (asci 32–128-spored)

1. Spores ellipsoid-obovoid to tear-shaped or fusiform, *3.8–7 × 2.7–3.3(–3.8) µm; ascus apex (†) with slight apical thickening; (sub) mediterranean southern Europe 2

1. Spores cylindrical to ellipsoid, *1.5–3 µm wide; SBs globose, close to spore apex, invisibly or narrowly attached, never with a filum; ascus apex (†) without apical thickening 3

2. Asci 64-spored; spore apex rounded to obtuse; SBs globose, with long, fine filum; wood & bark of angiosperms .... see ***O***. ***myriosphaera*** (series *Phanosomates* of section *Lentiformes*), p. 523

2. Asci 32-spored; spore apex obtuse to acute; SBs tear-shaped, with very short filum; bark (& wood) of *Cytisus* .... see ***O***. ***sarothamni*** (series *Hesperideae* of section *Hemiorbilia*), p. 668

3. Asci 128-spored; spores *3.7–6 × 1.7–2.2 µm; apothecia rose-lilaceous; wood of *Eucalyptus*, subtropical semihumid to semiarid western Australia........ ***O***. ***pleistolilacina***, p. 1271

3. Asci 32–64-spored........ 4

4. Asci 64-spored; spores *3–6.5 × 1.3–2.1 µm; apothecia rose-lilaceous or orange; bark (& wood) of *Acacia* & *Lamarchea*, subtropical semiarid western Australia........ ***O***. ***myriolilacina***, p. 1269

4. Asci 32-spored........ 5

5. Marginal cortical cells 15–50 µm long, (†) overall thick-walled; terminal cells of paraphyses *(12–)16–30(–42) µm long; spores *3.5–6 × 1.9–2.8 µm; apothecia orange; wood and bark of angiosperms, cold-temperate humid to to mesomediterranean semihumid southern Europe .... ***O***. ***polyspora***, p. 1262

5. Marginal cortical cells 5–12 µm long, (†) thin- or thick-walled; terminal cells of paraphyses *6–16(–18) µm long; North America and Australia........ 6

6. Marginal cortical cells (†) partly strongly thick-walled; spores *3.2–6 × 1.8–2.5 µm; apothecia rose-lilaceous; bark of different angiosperms, warm-temperate humid eastern and subtropical semihumid western Australia .... ***O***. ***plurililacina***, p. 1267

6. Marginal cortical cells (†) ± thin-walled; (semi)arid regions 7

7. Spores *(5–)6–8.5(–9.5) × 2–3 µm, straight or only slightly curved; SBs 1.1–1.3 µm wide, narrowly to broadly attached; bark of *Olneya* & *Sarcobatus*, subtropical semiarid western North America .... ***O***. ***multicreosoteris***, p. 1275
The likewise western North American *O*. aff. *multiaustrocylindrica* (section *Orbilia*, Pl. 831: 2) on bark of indet. angiosperm differs in somewhat narrower asci and spores (p. 1322).

7. Spores *4–7.8 × 1.5–2.3 µm; SBs 0.6–1 µm wide, narrowly attached; subtropical arid central Australia 8

8. Spores straight or slightly curved, *4–7.7 × 1.5–1.7(–2) µm; SBs 0.6–0.9 µm wide; wood of *Atriplex* .... ***O***. ***multiaustrocylindrica*** (section *Orbilia*), p. 1321

8. Spores straight to strongly curved, *5–7.8 × (1.7–)1.8–2.3(–3) µm; SBs 0.8–1 µm wide; bark of *Atriplex* .... ***O***. ***atriplicis***, p. 1276

p.p.maj. (G**CC**CGTTT), *Vermispora* (G**CC**TGTTT), and *Lecophagus vermicola* (G**CC**TGTCT). The deviation **T** at pos. 143 is unknown in any other member of *Orbiliomycetes*. Also at pos. 30 of 5.8S section *Ovoideae* differs from remaining *Orbilia* spp. by GGTTC**C**CGCAT compared to GGTTC**T**CGCAT. However, the motif GGTTC**C**CGCAT occurs also in some taxa of series *Abutilones* (*O. milinana*, *O. siculispora*, *O. ficicola*, *O. carminorosea*, *O. aethiopica*, *O. ebuli*), a few of series *Orbilia* (*O. dryadum*, and *O. cunninghamii*), and almost all *Hyalorbilia* spp., *Mycoceros*, and most predacious members of section *Arthrobotrys* (see Tab. 76), whereas other genera of *Orbiliomycetes* and other classes have GGTTC**T**CGCAT.

In the LSU D1–D2 domain, section *Ovoideae* is characterized within *Orbiliomycetes* by 3 motifs: pos. 14–16: CA**AGT**AA, rarely CA**GGC**AA (*O. polyspora*) or CA**GGT**AA (*O. ovoidea*), remaining *Orbiliomycetes* CA**GAC**AA or CA**GAC**GA, sometimes CA**GAT**GA; pos. 167–170: CG**AGGT** (*O. polyspora* CGG**AGGT)**, remaining *Orbiliomycetes* CG**GTTG**, rarely

CG**GCTG** or CG**GTCG** etc.; pos. 437–438: AGA**TC**TGC, remaining *Orbiliomycetes* AGA**CT**CGC or AGA**CT**CAC or AGA**CT**TGC, in *O. subocellata* AGA**TT**TGC. Some other, less consistent motifs of section *Ovoideae* are: pos. 201 is GA**T**GTCA but in other *Orbilia* spp. GA**C**GTCG or GA**C**GTCA, rarely GA**T**GTCA (in *O. pleistoeuonymi*, *O. gemma*, and a few of section *Arthrobotrys*) or GA**T**GTCG; pos. 218 is mostly AGA**G**TCC (AGA**A**TCC in *O. polyspora*) but in other *Orbilia* spp. mostly AGA**A**TCC (but AGA**G**TCC in *O. albovinosa*, *O. gemma*, and *Orbilia* sp. MH520123); pos. 241–245 is TTCTT (in *O. polyspora* TTCCT) but in other *Orbilia* spp. often ACTTC, also GCTTC or ATTTC or TCAAT etc.; pos. 332 is GGCG**G**GAGACC as in series *Abutilones*, *O. dryadum*, and section *Arthrobotrys* p.p.maj., but GGCG**A**GAGACC in most other *Orbilia* spp.

Ecology. All species of section *Ovoideae* are desiccation-tolerant and generally grow on exposed (xeric), woody substrates. Only one species grew on herbaceous substrate (*O. yuccae*) and one on resinous wounds (*O. olivacea*). Most species were observed in semihumid to arid regions, but one species was partly recorded in humid, montane or hemiboreal areas (*O. subsphaerospora*) and another only in boreal areas (*O. canadensis*). Records are known from North America, Europe, and Australia.

Orbilia sphaerospora Baral & G. Marson, **sp. nov.**, MB 813906 — Pls 759–760, Map 126

Etymology: referring to the globose ascospores.

Typification: France, Tête de l'Estrop, branches of *Pinus sylvestris*, 24.VIII.1996, G. Marson (ex H.B. 5608a, M-0276589, holotype).

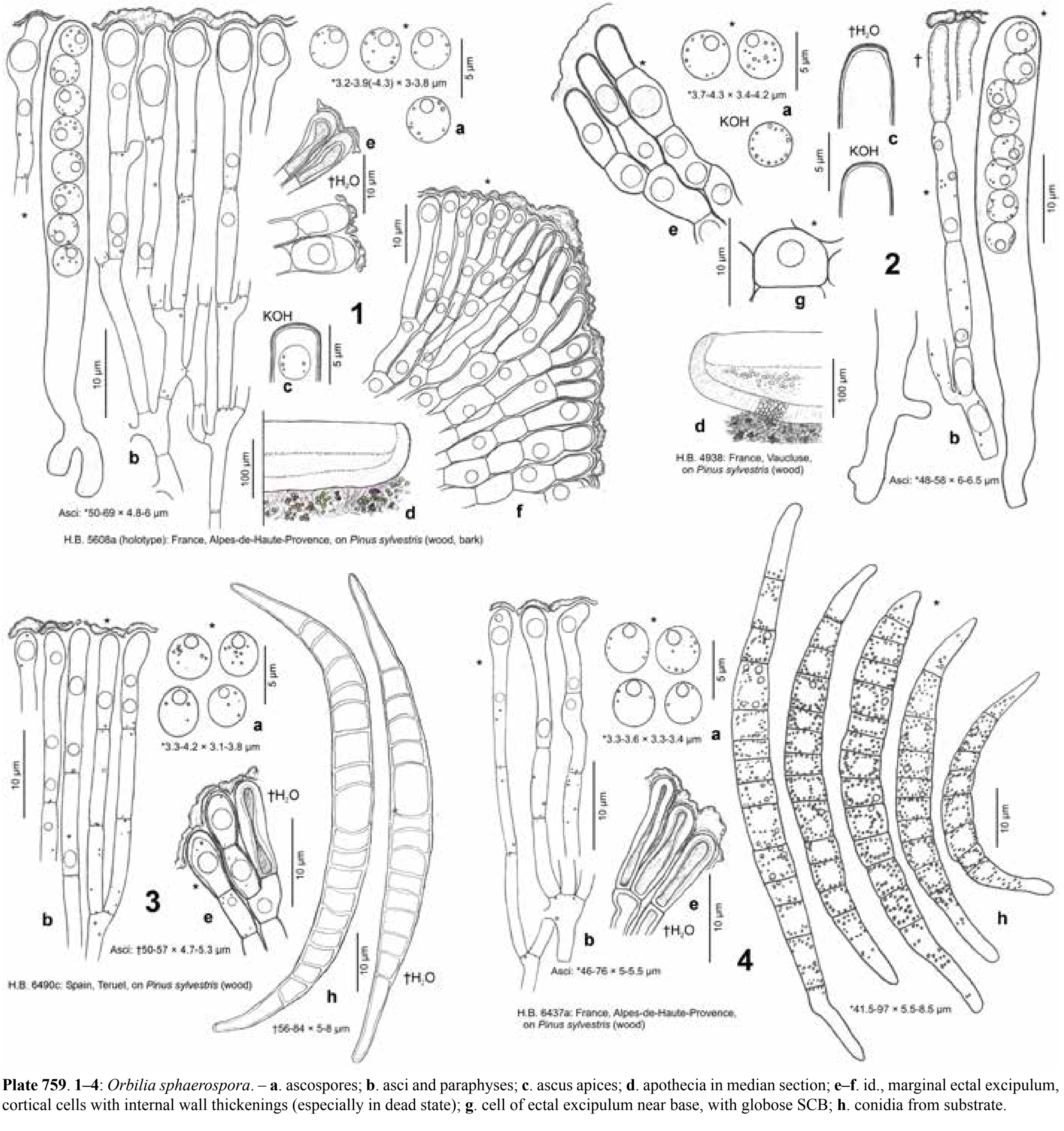


Plate 759. **1–4**: *Orbilia sphaerospora*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. apothecia in median section; **e–f**. id., marginal ectal excipulum, cortical cells with internal wall thickenings (especially in dead state); **g**. cell of ectal excipulum near base, with globose SCB; **h**. conidia from substrate.

Plate 760. **1–3**: *Orbilia sphaerospora*. – **1a**. orotemperate *Picea* forest; **1b**. decorticated xeric branches of *Picea abies*; **1e**, **2a–b**, **3a–d**. rehydrated apothecia; **1c**, **3e–f**. apothecia in median section; **1d**, **3g**. id., marginal ectal excipulum; **1f–g**, **3h**. asci with ascospores. – Dead state, except for ascospores in **1f–g**, ascus in **1f** (**1c–d** in H_2O, **3e–g** in KOH, **3h** in KOH+IKI). — **1a–h**. H.B. 9129: France, Grenoble, on *Picea*; **2**. H.B. 9173e: France, Mont Ventoux, on *Pinus*; **3a–h**. H.B. 5608a (holotype): France, Seyne-les-Alpes, on *Pinus*.

Latin diagnosis: *Apothecia rehydratata 0.2–1 mm diam., aurantiaca vel rosea, sessilia, margine laevi. Asci 8-spori. Ascosporae *3.2–4.3 × 2.8–4.2 µm, globosae vel leniter subglobosae, corpusculum refringens globosum excentricum, cuspide minuta affixum continentes. Excipulum marginale cellulis elongatis crassitunicatis, absque processis vitreis. Habitat ad lignum leniter vel valde putridum, raro corticem, ramulorum et ramorum siccorum coniferarum, plerumque* Pini*, in zona orosubmediterranea vel orotemperata humida Europae meridionalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.2–0.8(–1) mm diam., 0.12–0.16 mm high, pale to bright orange to brick-red or pink, medium translucent, round to somewhat irregular, ± scattered to subgregarious; disc flat, margin thin or thick, 0–5 µm protruding, smooth; broadly sessile, ± superficial; dry bright to deep rose- or brick-red to apricot. **Asci** *(40–)48–65(–76) × 4.8–6.5 µm {5}, †39–

64 × 4.4–6 µm {4}, 8-spored (rarely only 6–7 spores developed), spores (*) uni-, sometimes subbiseriate, oriention irregular, pars sporifera *25–29 µm long, †30–34 µm; **apex** (†) slightly (rarely medium) truncate, sometimes slightly laterally inflated, thin-walled; **base** with ± short to long, flexuous, ± thick stalk, T-, L- or h-shaped. **Ascospores** *3.2–4.3 × (2.8–)3–3.8(–4.2) µm {7}, †2.8–4 µm diam. {2}, globose to sometimes slightly subglobose; **SBs** *(1–)1.2–1.6 × (0.9–)1–1.2(–1.4) µm diam. {6}, globose (to subglobose), attachment often invisible, also closely attached, rarely with a very short filum. **Paraphyses** apically uninflated to slightly or medium clavate to irregularly lageniform, sometimes ± flexuous, terminal cells *(5–)9–20(–23) {5} × 1.7–3.3 {6} or (2.5–)3.5–4.3(–4.8) {T} µm, lower cells *7–17 × 1.5–2.5 µm {4}, rarely branched near apex. **Medullary excipulum** pale rose, 20–60 µm thick, of medium dense textura intricata(-angularis) with many inflated cells, sharply delimited from ectal excipulum by a distinct, parallel, ~10 µm thick layer of t. porrecta. **Ectal excipulum** pale rose, of vertically oriented t. globulosa-angularis(-prismatica) from base to lower flanks, 20–50 µm thick near base, cells *6–13 × 5–9.5 µm {2}, outer layers medium gelatinized; 30 µm thick at mid flanks, of t. prismatica oriented at a 70–80° angle to the surface, 15–20 µm thick at margin, of t. prismatica-porrecta oriented at 35–80°, cortical cells especially at mid flanks and margin thick-walled, */†5–16 × 2.2–4 µm {4}, walls (*) firm, refractive, (†) 0.6–1.2 µm thick, apically rarely 1.5–4 µm, low-refractive {4}, **glassy processes** absent {6}. **Anchoring hyphae** ± abundant, *2.2–4 µm wide, walls smooth, *(0.2–)0.3–0.5(–0.8) µm thick, †0.3–0.8 µm {4}. **SCBs** in paraphyses globose (to ellipsoid), 1–2.5(–5) µm diam. {6}; in excipular cells globose, (1–)2–3.5 µm diam. **Exudate** over paraphyses cloddy, subhyaline, 0.3–2 µm thick, loosely attached; over margin and flanks rough-cloddy, 1–4 µm. — **ANAMORPH**: vermispora-like (presumed, from natural substrate {2}). **Conidiophores** not seen. **Conidia** unbranched, slightly to strongly curved, tapered towards the ends, */†41.5–97 × (5–)5.5–8.5 µm, 7–19-septate {2}, terminal cells distinctly longer than remaining cells.

Habitat: collected ~1–2 m above the ground, mostly decorticated, 4–28 mm thick twigs and branches of *Juniperus communis* {1}, *Picea abies* {1/1}, *Pinus sylvestris* {7/1}, on wood {10}, rarely on ± loose bark {1}, sometimes on corticated branches with fresh or old resinous wounds {2} (in wound on bare wood), outer 0.1–2 mm slightly to strongly decayed, often eroded and strongly greyed, often in old beetle galleries, often with many green algae. **Associated**: *Amphosoma atroolivaceum* {3}, *Caloplaca* sp. {2}, *Ciliolarina pinicola* {1}, *Cladonia* sp. {1}, *Coniochaeta malacotricha* {1}, *Dacrymyces* sp. {3}, *Lecophagus pini* {1}, *Lilapila oculisporella* {2}, *Lophium mytilinum* {1}, *Melaspilea emergens* {1}, *Monodictys* sp. {1}, *Orbilia aristata* {1}, *O. gambelii* {1}, *O. ?graminis* {1}, *O. ?ocellata* {1}, *O. patellarioides* {3}, *O. subcylindrospora* {2}, *O. subvinosa* {4}, *O. trapeziformis* {1}, *Propolis betulae* {1}, *Resinomyces griseus* {2}, *R. kirschsteinianus* {2}, *Sarea difformis* {2}, *S. resinae* {1}. **Desiccation tolerance**: fully viable for up to 7 months. **Altitude**: 890–1385 m a.s.l. (Austria & France), 1615 m (Spain), 1200-1750 m (Montenegro). **Geology**: Middle Jurassic and Lower to Upper Cretaceous marl-, sand- & limestone, dolomite, siliceous shale, Neogene clay; migmatite, gneiss. **Phenology**: VIII–X (but certainly throughout the year, long-lived).

Taxonomic remarks. *Orbilia sphaerospora* is well characterized by its globose ascospores containing a globose, strongly eccentric spore body, and by occurring on coniferous substrate. In contrast to the otherwise very similar angiosperm-inhabiting *O. subsphaerospora*, the cortical excipular cells of *O. sphaerospora* are consistently without glassy processes but, instead, have internal wall thickenings that are able to swell. The also similar North American *O. canadensis* differs in 16-spored asci, subglobose to broadly ellipsoid spores, and occurrence on angiosperm substrate. Populations of *O. eucalypti* (section *Orbilia*) with subglobose spores may easily be confused with *O. sphaerospora* or *O. subsphaerospora*, but are sharply separated by a different, lipidic nature of the large drop in the spores which is KOH-resistant, while SBs are inconspicuous or absent, also in the absence of thick-walled marginal cortical cells or glassy processes.

Map 126. Known distribution of *O. sphaerospora*.

Variation was observed in the paraphyses which showed a much stronger apical or subapical inflation in the holotype compared to the other samples. Only slight variation occurred in spore shape. Two oversized spores in a 5-spored ascus measured 5 × 4.8 µm, with SBs 1.7 × 1.6 µm.

Anamorph. We observed two times large phragmosporous conidia on the substrate near the apothecia (Pl. 759: 3h, 4h) which are typical of section *Ovoideae*.

Phylogeny. Sequences were taken from apothecia of two collections from Southern French Alps (H.B. 9129, G.M. 2015-09-15.4), comprising ITS and LSU, the former also SSU. The S1506 intron is absent in both. The two sequences coincide in the entire ITS and overlapping LSU, except for 2 missing adjacent nt in the ITS1 in H.B. 9129 (downstream of TGCCGGCAG, confirmed from chromatogram) which are present in G.M. 2015-09-15.4 and all other available sequences of section *Ovoideae* (TGCCGGCAG**CA**). A DNA isolate from *Pinus heldreichii* needles in Montenegro (partial 5.8S and entire ITS2, Lazarević & Menkis 2020) fully coincides with them in the ITS2. *O. sphaerospora* shows in the ITS region a distance of 2% to *O. subsphaerospora*, 4.2% to *O. subovoidea*, and 4.5% to *O. canadensis*. In the SSU (V7–V9) and LSU (D1–D2) the lowest distance is 0% and 0.8% to *O. canadensis*, respectively.

Ecology. The partly rather abundant populations of *O. sphaerospora* were found on slightly to strongly decayed wood (rarely bark) of xeric twigs and branches of coniferous trees (mainly *Pinus*) in north- to south-exposed, ± open conifer forests with *Pinus*, *Picea*, *Larix*, and *Juniperus* at altimontane to subalpine altitudes. Known collections are from south Europe mountain ranges in orotemperate to orosubmediterranean humid Austrian eastern and Southern French Alps, and Spanish Sistema Iberico.

Specimens included. **AUSTRIA**: **Steiermark**, 20 km NNW of Bruck an der Mur, 3 km NNW of St. Ilgen, Karlschütt, 890 m, twig of *Juniperus communis*, on wood, 6.VIII.2016, G. Friebes (G.F. 20160172). — **FRANCE**: **Rhône-Alpes**, **Savoie**, 19 km ENE of Albertville, 4.5 km ESE of Beaufort, N of Lac de Roseland, ~1320 m, on (?)*Picea abies*, 4.VIII.1995, G. Marson (ø). – **Isère**, Vercors, 20 km SW of Grenoble, 2 km SSE of Villard-de-Lans, W of Les Glovettes, 1200 m, branches of *P. abies*, on wood, 11.VIII.2009, G. Marson, B. Liu & H.O. Baral (H.B. 9129; sq.: KT222429). – **Provence-Alpes-Côte d'Azur**, **Hautes-Alpes**, 18.3 km WNW of Gap, 1 km NW of La Montagne, SW of Pic de Bure, 1043 m, branch of *Pinus sylvestris*, on wood, 15.IX.2015, G. Marson (G.M. 2015-09-

15.4; sq.: KY419186). – **Alpes-de-Haute-Provence**, Mercantour, 13.5 km SE of Seyne-les-Alpes, 5.5 km SW of Tête de l'Estrop, SE of Vière, 1350 m, branches of *P. sylvestris*, on wood & bark, 24.VIII.1996, G. Marson (M-0276589, **holotype**; **isotype** in H.B. 5608a). – 17 km NE of Digne-les-Bains, 5 km SSW of Prads-Haute-Bléone, 0.3 km WSW of Blégier, 970 m, branch of *P. sylvestris*, on wood, 24.VIII.1996, G. Marson (H.B. 5628c). – 24 km S of Digne, 3.3 km NNW of Moustiers-Ste.-Marie, N of Canyon du Verdon, 970 m, branches of *P. sylvestris*, on wood, 6.VIII.1999, G. Marson (H.B. 6437a, anam. substr.). – 6.5 km SE of Castellane, 0.8 km NW of La Bâtie, Col de Luens, 1080 m, branch of *P.* (?)*sylvestris*, on wood, 5.X.1993, G. Marson (H.B. 5015b). – **Vaucluse**, 9.5 km NE of Bedoin, 1.5 km NW of Mt. Ventoux summit, Mt. Serein, 1385 m, branch of *P. sylvestris*, on wood, 13.VIII.2009, G. Marson (H.B. 9173e ø). – 17 km NE of Carpentras, 5.5 km E of Malaucêne, 6 km W of Mt. Ventoux summit, Les Ramayettes, 980 m, branch of *P. sylvestris*, on wood, 13.VIII.1993, G. Marson (H.B. 4938). — **SPAIN**: **Aragón**, **Teruel**, Sierra de Albarracín, 49 km W of Teruel, 5.8 km WSW of Frias de Albarracín, 1615 m, branches of *P. sylvestris*, on wood, 26.IX.1999, G. Marson & H.O. Baral (H.B. 6490c, anam. substr.). — **MONTENEGRO**: WNW & NNW of Podgorica, Orjen and Prekornica, 1200–1750 m, needles of *Pinus heldreichii*, V.2015 (2814_464, Lazarević & Menkis 2020, mol. extr., sq.: MT242183).

Orbilia subsphaerospora Baral, **sp. nov.**, MB 813907 — Pls 761–762, Map 127

Etymology: named after the similarity to *O. sphaerospora*.

Typification: Switzerland, Hergiswil, branch of *Acer pseudoplatanus*, 15.VIII.2006, H.O. Baral (ex H.B. 8236, M-0276598, holotype).

Latin diagnosis: *Similis* Orbiliae sphaerosporae *sed excipulum marginale cellulis tenuitunicatis, processis vitreis brevibus praeditis. Habitat ad lignum vel corticem putridum ramorum et truncorum siccorum fruticum vel arborum angiospermarum, raro* Juniperi, *in zona boreali, orotemperata et mediterranea Europae.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.2–)0.3–0.5(–0.75) mm diam., 0.09–0.17 mm high (receptacle 0.06–0.12 mm), pale orange-rose(-pinkish) or carneous-cream, ± translucent, round, very scattered or in small groups; disc slightly concave to flat, margin distinct, thin or thick, 0–8 µm protruding, smooth to finely crenulate; sessile on a small, ill-defined stalk; dry bright (orange-)rose or cream. **Asci** *34–55 {3} × 4.2–4.7 {2} or 5.5–6 µm {2}, †32–47(–53) × (3.2–)3.5–4.2 µm {6}, 8-spored, spores (*) uniseriate, orientation irregular, pars sporifera *19–23 µm; **apex** (†) medium (to strongly) truncate (not indented, laterally not or sometimes very slightly inflated), thin-walled; **base** with short to medium long, thin or thick, flexuous stalk, T-, L-, Y- or h-, exceptionally H-shaped. **Ascospores** *(2.9–)3.2–3.7(–4) × ((2.4–))(2.7–)2.9–3.5(–3.8) µm {13}, †2.7–3.4 × 2.6–3.2 µm {2}, globose to subglobose, rarely somewhat subcylindrical; **SBs** *(1–)1.2–1.5(–1.7) × (0.8–)1–1.3(–1.4) µm {8}, globose to subglobose, sometimes with a very short filum, or attachment invisible, also closely attached. **Paraphyses** apically (uninflated to) slightly to medium (rarely strongly) clavate-capitate, terminal cells *(12–)15–23(–25) {4} × (2.3–)3–4(–5) µm {5}, †2.5–4.5 µm wide {3}, lower cells *(4.5–)6–11 × 1.5–2.5 µm {3}; sometimes branched at upper septum. **Medullary excipulum** hyaline, 20–60 µm thick, of medium dense textura intricata-angularis, not sharply delimited. **Ectal excipulum** hyaline to pale rose, of thin-walled, irregularly vertically oriented t. angularis(-prismatica) from base to mid flanks, 20–90 µm thick near base, cells *7–14 × 5–8.5 µm {2}, †7–13 × 5–6 µm {1}; 10–30 µm thick near margin, of t. prismatica-porrecta oriented at a 10–40° angle to the surface (internal part oriented at 45–60°), marginal cortical cells *(4.5–)7–14(–16) × (2–)3–4.2 µm {5}, †5–10 × 2.5–3.5 µm {1}, **glassy processes** 0–2 {3} or 1–9(–13) {12} × (2–)2.5–4(–5) {10} µm, strongly refractive, stratified, curved outwards {4}, sometimes arranged in distinct radial rows at the margin. **SCBs** globose, indistinct, in paraphyses 1–3.3 µm diam. {1}, in ectal excipulum 1–1.3 µm (only seen in some cells). **Exudate** over paraphyses 0.1–1(–3) µm thick, ± continuous, rough, hyaline, firmly (also loosely) attached; on margin and flanks pale to light yellowish, 0.2–0.5 µm thick. **Anchoring hyphae** sparse to abundant at base, †1.5–2.5 µm wide, walls 0.15–0.3 µm thick {4}. — **ANAMORPH**: unknown.

Habitat: lying on moist ground or often hanging or standing in 1–2.3 m above the ground, corticated or decorticated, 11–40 mm thick branches or ~25–100 cm thick trunks of *Acer pseudoplatanus* {1}, *Corylus avellana* {1}, *Fagus sylvatica* {3}, *Juniperus sabina* {1}, *Lonicera* (?)*implexa* {1}, *Olea europaea* {1}, *Populus tremula* {1}, *Quercus ilex* {1}, *Q. pubescens* {1}, *Q. robur* {1}, *Q. rotundifolia* {1}, *Salix* sp. {2}, indet. tree {1}, on medium to strongly decayed wood {10} or bark (periderm or bast) {7}, 0.5 mm or very deep medium to strongly brown- or white-rotten, slightly to strongly greyed, with some or many green algae. **Associated**: *Aleurodiscus disciformis* {1}, *Amandinea punctata* {1}, *Calycina citrina* {1}, *Dacrymyces* sp. {1}, *Frullania dilatata* {4}, *Hyalorbilia inflatula* {1}, *Hypnum cupressiforme* {1}, *Hysterographium fraxini* {1}, *Metzgeria* sp. {1}, ?*Monodictys* sp. {1}, *Navicella pileata* {1}, *Orbilia arachnovinosa* {1}, *O. vinosa* {2}, ?*Parmelia* sp. {2}, *Phaeomarasmius rimulincola* {1}, *Pithyella*

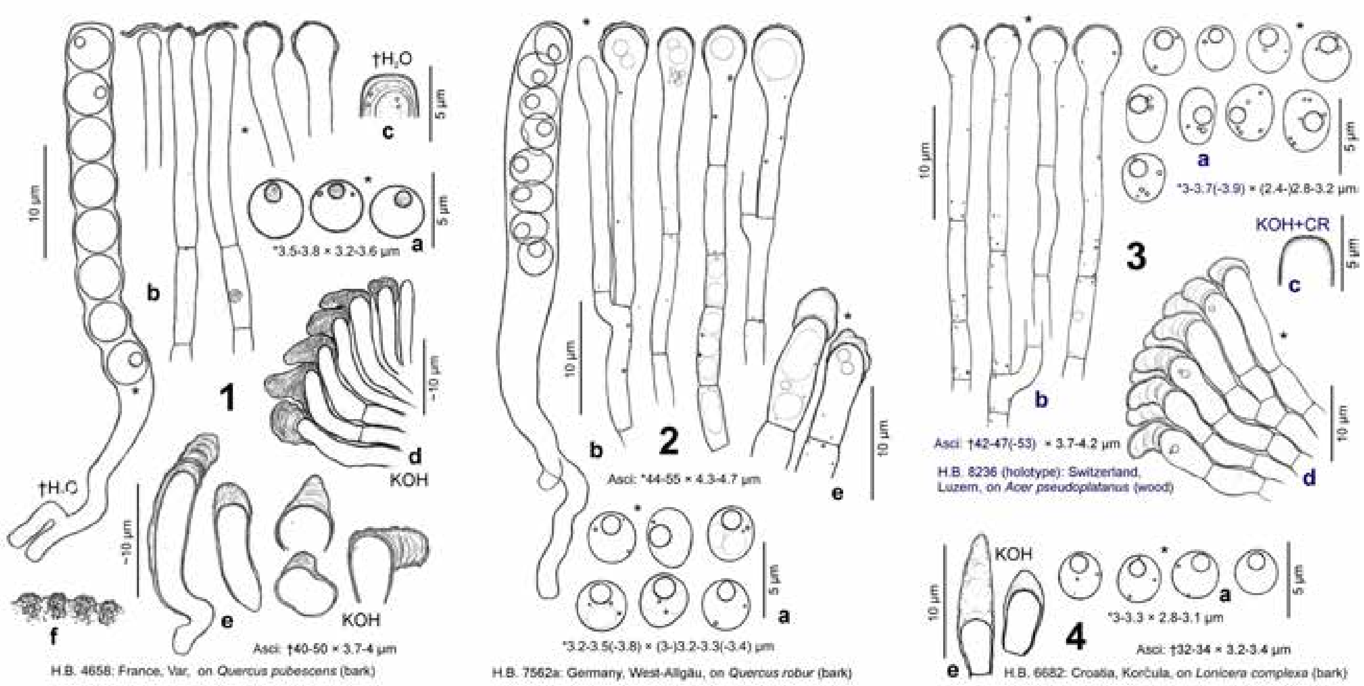


Plate 761. **1–4**: *Orbilia subsphaerospora*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. marginal ectal excipulum in median section; **e**. marginal cortical cells with glassy processes; **f**. margin of apothecium in external view, glassy processes forming teeth-like ribs.

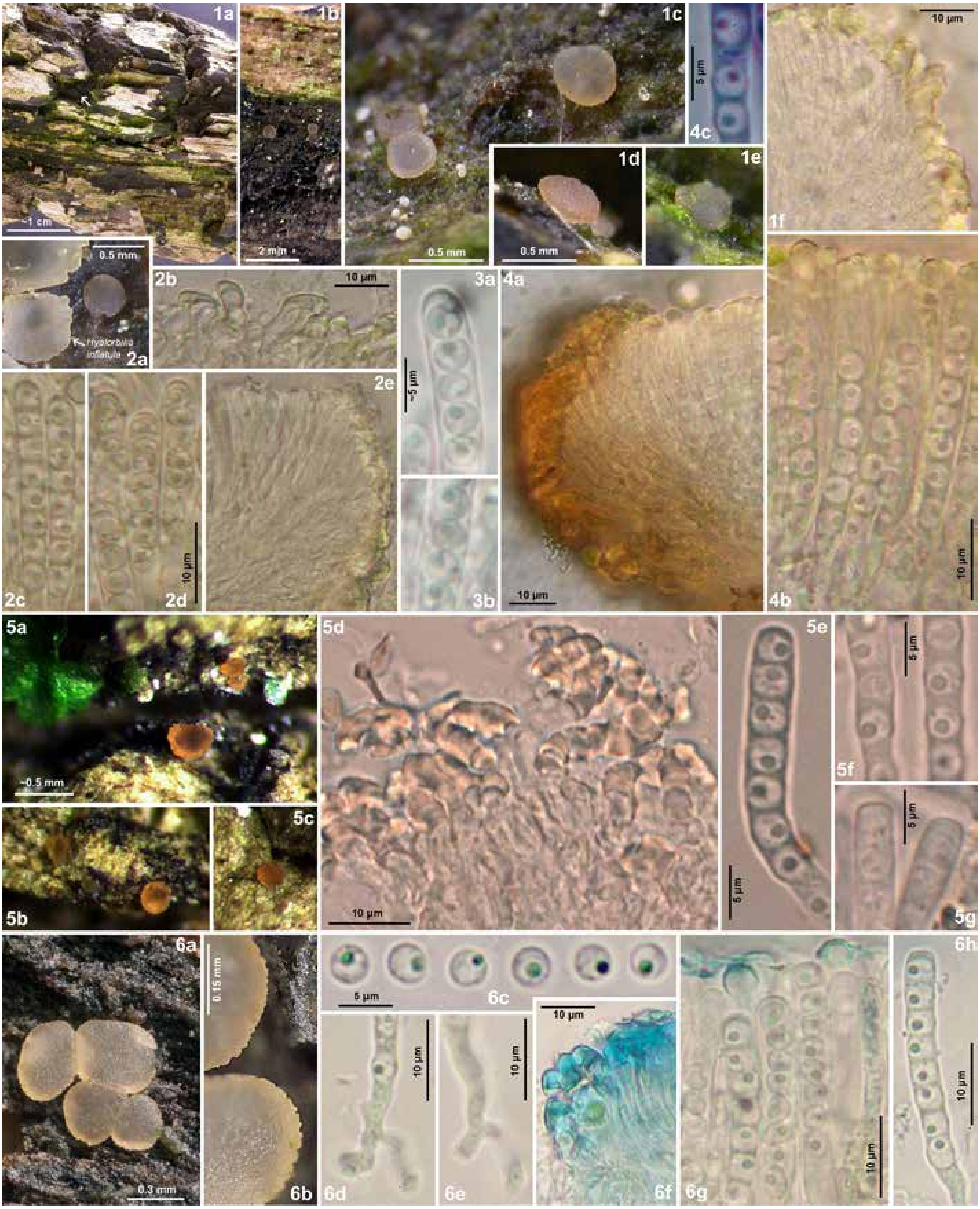


Plate 762. **1–6**: *Orbilia subsphaerospora*. – **1a**. decorticated rotten, blackened, mesic branch of *Acer pseudoplatanus*; **1b–e**, **2a**, **6a–b**. rehydrated/fresh apothecia (**2a** with *Hyalorbilia inflatula*); **5a–c**. dry apothecia; **1f**, **2e**, **4a**, **6f**. marginal ectal excipulum in median section, with glassy processes; **2b**, **5d**. id., in external view; **2c–d**, **3a–b**, **4b–c**, **5e–f**, **6g–h**. asci with ascospores; **5g**. ascus apices, **6d–e**. ascus bases; **6c**. ascospores. – Living state, except for **1f**, **5d**, **6d–e** (partly also **2e**, **4a**; in H_2O), **6f** (in CRB); asci in **2c**, **4b–c**, **5e–g**, **6g–h** p.p. (**4c** in CRB). — **1a–f**. H.B. 8236 (holotype): Switzerland, Luzern, on *Acer*; **2a–d**. H.B. 8241b: ibid., on *Fagus*; **3a–b**. H.B. 7562a: Germany, West-Allgäu, on *Quercus*; **4a–c**. H.B. 7656: Portugal, Santarém, on *Olea*; **5a–g**. UPS F-639447: Sweden, Stockholm, on *Populus*; **6a–h**. E.R.D. 6241: Spain, Asturias, on *Juniperus*.

frullaniae {1}, *Proliferodiscus pulveraceus* {1}, *P. tricolor* {1}, *Radula complanata* {1}, *Sclerococcum* sp. {1}, indet. lichens {1}. **Desiccation tolerance**: immature asci still viable after 2 weeks, paraphyses and spores sometimes after 10 months. **Altitude**: 45 m a.s.l. (hemiboreal Sweden), 730–1010 m (northern Alps), 50–1800 m (southern Europe). **Geology**: Permian (Rotliegend), Cretaceous & Miocene limestone, slate & quartz or clay, flysch; granite, amphibolite, mica schist & gneiss. **Phenology**: IV, VI–VIII, X, XII–I (throughout the year, long-lived).

Taxonomic remarks. *Orbilia subsphaerospora* is very close to the conifericolous *O. sphaerospora*, from which it differs in the cortical excipular cells, which are terminated by very short to medium long glassy processes whereas the cell walls are apparently unable to swell, also in a tendency to subglobose ascospores and to shorter lower cells of paraphyses, finally in the occurrence on angiosperm hosts. In spore features and glassy processes the North American *O. cupularis* is very similar to *O. subsphaerospora*, but differs in an ectal excipulum of textura porrecta, apically uninflated, sometimes sublanceolate paraphyses, and larger, cupulate apothecia.

Variation. No differences in micromorphology between collections from (oro-)mediterranean southern Europe and montane central Europe could be observed. A tendency to subglobose or even subcylindrical or subangular spores was noted in collections from the Alps but also in some (oro-) mediterranean ones. In all collections examined the presence of short glassy processes is strictly correlated with the substrate, except for an orotemperate collection on *Juniperus* which is assigned to *O. subsphaerospora* as it possesses glassy processes (Pl. 762: 6). This also fits well those on angiosperms because its spores were partly subglobose.

Phylogeny. An ITS sequence was taken from apothecia collected on *Salix* in Asturias. As in *O. sphaerospora*, the S1506 intron is absent. *O. subsphaerospora* shows a distance of 2% to *O. sphaerospora* and 2.7% to *O. canadensis*, but also to *O. subovoidea* the distance is only 2.6%.

Ecology. *O. subsphaerospora* was found on ± rotten bark and wood of xeric but also hygric branches and trunks of different broad-leaved trees and shrubs (mainly *Fagales*), rarely conifers (*Juniperus*). Repeatedly the species was found on bark of standing trees in close association with *Frullania* (P. Döbbeler, C. Roux, I. Olariaga pers. comm.). Collections are from mesosubmediterranean to mesomediterranean semihumid southern Europe, more or less orotemperate northern Alps and Pyrenees, and hemiboreal humid southern Scandinavia. The vegetation includes mediterranean *Quercetum ilicis* and *Junipero oxycedri-Quercetum rotundifoliae*, montane *Fagus* forests like *Abieti-Fagetum*, subalpine shrubs with *Juniperus oxycedrus*, and hemiboreal forests with *Populus tremula*.

Map 127. Known distribution of *O. subsphaerospora* in Europe.

Specimens included. **SWEDEN**: **Södermanland**, 32 km S of Stockholm, 9.7 km NE of Ösmo, Häringe, 45 m, trunk of *Populus tremula*, on bark, 6.X.2013, H.G. Thoresson & I. Olariaga (UPS F-639447, doc. vid.). — **GERMANY**: **Baden-Württemberg**, Westallgäuer Hügelland, 13 km E of Lindau, 1.8 km SSE of Scheidegg, 730 m, trunk of *Quercus robur*, on bark,15.VIII.2004, P. Karasch (H.B. 7562a ø). — **SWITZERLAND**: **Nidwalden**, 8.5 km SSW of Luzern, 2.2 km SW of Hergiswil, Renggdössen, 1010 m, branch of *Acer pseudoplatanus*, on wood, 15.VIII.2006, H.O. Baral (ex H.B. 8236, M-0276598, **holotype**). – 8 km SSW of Luzern, 2.5 km WSW of Hergiswil, W of Brunni, Mülibach, 960 m, branch of *Fagus sylvatica*, on wood, 16.VIII.2006, H.O. Baral (H.B. 8241b ø). — **SPAIN**: **Asturias**, 2.2 km SE of Pola de Somiedo, SW of Coto de Buenamadre, Hayedo de Mumián, 1350 m, branch of *F. sylvatica*, on wood, 3.VI.2013, J.P. Priou (H.B. 9796a). – 7.5 km ESE of Pola de Somiedo, 2 km ESE of Valle de Lago, 1300 m, branch of *Corylus avellana*, on wood, 4.VI.2013, H.O. Baral (H.B. 9801a ø). – ibid., branch of *Salix*, on wood, 4.VI.2013, R. Tena & H.O. Baral (H.B. 9800; sq.: MK493123). – 7 km S of Pola de Somiedo, 1.7 km W of Santa María del Puerto, 1527 m, branch of *Salix*, on wood, 5.VI.2013, J.P. Priou (J.P.P. 13125). – 12 km ESE of Pola de Somiedo, 4.5 km SSE of Saliencia, W of Lago Cerveiriz, 1800 m, branch of *Juniperus sabina*, on wood, 26.VII.2014, E. Rubio (E.R.D. 6241, doc. vid.). – **Madrid**, 30 km NW of Madrid, 1.6 km N of Hoyo de Manzanares, branch of *Quercus rotundifolia*, on bark, 11.I.2018, I. Olariaga (ARAN-F 8186, doc. vid.). – **Navarra**, 26 km NNE of Pamplona, 3.8 km NNE of Zilbeti, Ruinas de la Real Fábrica de Municiones, 790 m, branch of *Fagus sylvatica*, on wood, 3.IV.2017, S. García (S.G. 617-ASC, doc. vid.). — **PORTUGAL**: **Santarém**, Ribatejo, 10 km NNW of Santarém, 2.3 km NE of Romeira, Val de Flores, 50 m, branch of *Olea europaea*, on wood, 29.XII.2004, J.P. Priou (J.P.P. 24284 ø, H.B. 7656 ø). — **FRANCE**: **Provence-Alpes-Côte d'Azur**, **Var**, 13 km NNE of Hyères, 1.8 km NE of Pierrefeu-du-Var, le Défens de Bécasson, 78 m, trunk of *Quercus pubescens*, on bark, 13.VI.1991, C. Roux (C.R. 20815 ø, H.B. 4658a). — **ITALY**: **Toscana**, **Arezzo**, 24 km W of Arezzo, 7.5 km S of Montevarchi, S of San Leolino, 350 m, trunk of indet. woody tree, on bark, 30.VIII.2000, P. Döbbeler (P.D. 7447, H.B. 7271b). — **CROATIA**: **Dubrovnik-Neretva**, **Korčula**, 3.5 km WSW of Korčula, 1.8 km NW of Žrnovo, Kočje, 190 m, branch of *Quercus ilex*, on wood & bark, 3.VI.2000, N. Matočec (CNF 2/4471, 4472, H.B. 6700 ø, doc. vid.). – 11.5 km W of Korčula, 2 km W of Račišće, Samograd cave, 120 m, branch of *Lonicera* (?)*implexa*, on bark, 4.VI.2000, H.O. Baral (H.B. 6682 ø).

Orbilia canadensis Baral & G. Marson, **sp. nov.**, MB 813908 — Pls 763–764

Etymology: from the geographical origin of the holotype, Canada.
Typification: Canada, Alberta, Jasper, twigs of *Betula*, 17.VIII.1997, G. Marson (ex H.B. 5933a, M-0276448, holotype).

Latin diagnosis: *Similis* Orbiliae sphaerosporae *sed asci 16-spori, ascosporae subglobosae ad late ellipsoideae. Habitat ad lignum vel corticem putridum ramulorum et ramorum siccorum fruticum* Betulacearum *et* Salicacearum *in zona subarctica ad orotemperata humida Americae et Europae septentrionalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.3–0.8 mm diam., 0.13–0.16 mm high, light to bright pure orange-rose, round, scattered to ± gregarious in small groups; disc slightly concave to flat, margin thin or thick, 0–20 µm protruding, smooth; broadly sessile, superficial or ± erumpent between wood fibres. **Asci** *(51–)55–69 × 5.4–6.4 µm {2}, †50–68 × 4.5–5.7 µm {3}, 16-spored, spores (*) (sub)biseriate, towards base uniseriate († also apically partly uniseriate), lower spores inversely oriented (strongly mixed, some laterally oriented), pars sporifera *35–50 µm long; **apex** (†) slightly to strongly truncate (not indented, laterally not widened), thin-walled, sometimes with apical thickening up to 0.5 µm (with very slight apical chamber); **base** with short to medium long, thick, ± flexuous stalk, T-, L- or h-shaped. **Ascospores** *(3.4–)3.6–4.5(–5.3) × (2.3–)2.5–3.2(–3.4) µm {4}, †3.6–4.2 × 2.4–2.7 µm {1}, subglobose to ovoid or (broadly) ellipsoid, both ends rounded to obtuse; **SBs** *1.1–1.3(–1.5) × 0.8–1.3 µm {3}, globose, sometimes with a very short filum or attachment invisible, also closely attached. **Paraphyses** apically (uninflated to) slightly to medium (rarely strongly) clavate-capitate to spathulate, rarely lageniform or moniliform, terminal cells *5.5–19.5 × (2.5–)3–5(–5.7) µm {3}, lower cells *7–16 × 1.6–2.7(–4) µm {3}; sometimes branched near apex. **Medullary excipulum** hyaline to pale rose-orange, 40–50

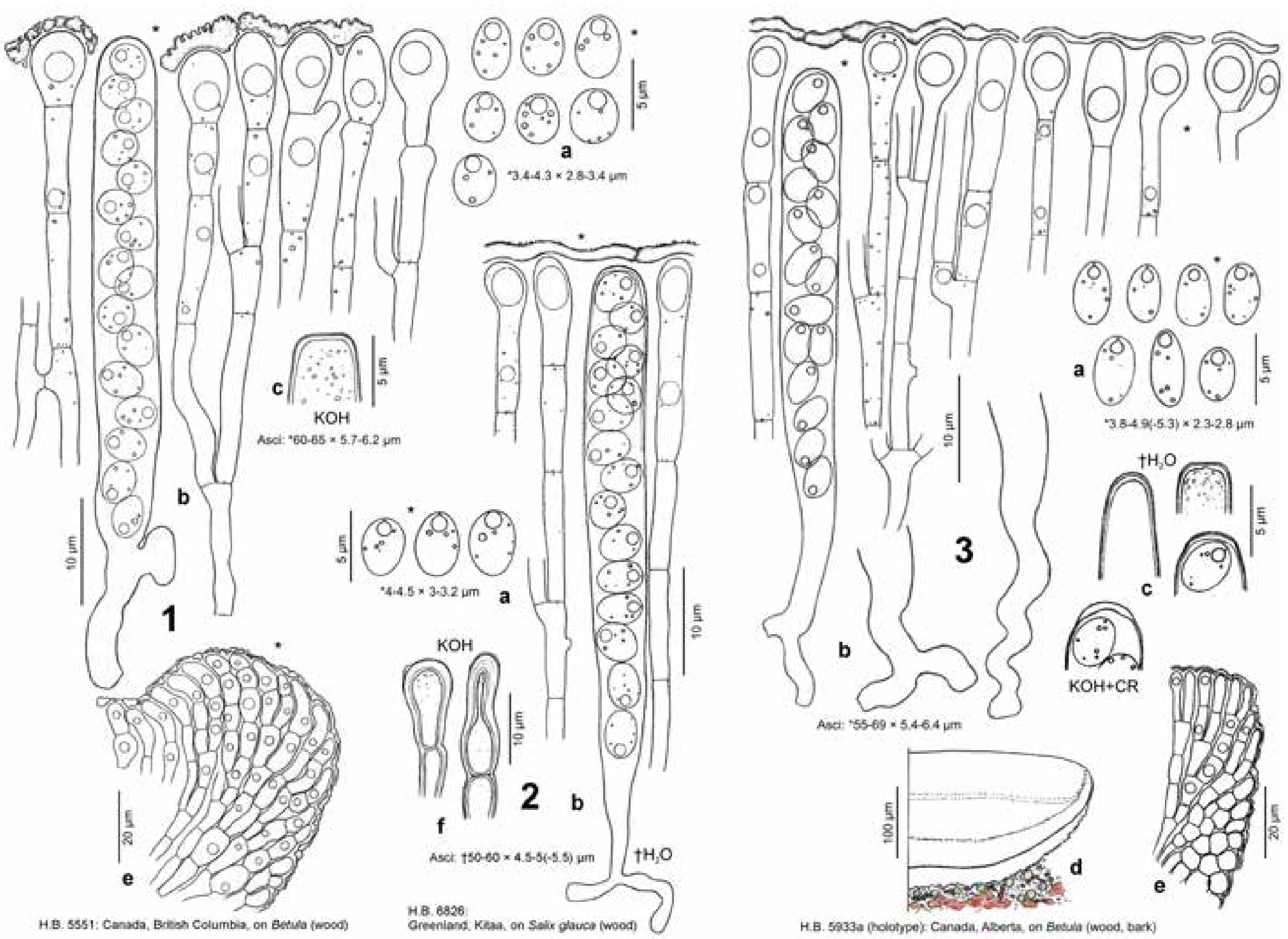


Plate 763. **1–3**: *Orbilia canadensis*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. apothecium in median section; **e**. id., marginal ectal excipulum; **f**. cortical cells with thickened wall (but more thin-walled in living state).

µm thick, of medium dense textura intricata with many inflated cells, sharply delimited. **Ectal excipulum** (very) pale rose-orange, of (†) slightly to medium gelatinized {3} (common walls 0.5–2 µm thick), vertically oriented t. angularis(-prismatica) from base to mid flanks, 25–50 µm thick near base, cells *8–22 × 6–14.5 µm {3}; 15–35 µm thick near margin, of t. prismatica oriented at a 20–45° angle to the surface, marginal cortical cells *8–18 × 2.8–3 or 4–6.5 µm {2}, (*) slightly or (†) strongly thick-walled (inner wall low-refractive), **glassy processes** absent. **Anchoring hyphae** sparse or often abundant, */†2.5–3.5(–4) µm wide, walls *0.2–0.7 µm [†0.3–0.8(–1) µm] thick {3}, forming a dense, medium gelatinized t. intricata up to 20–30 µm thick. **SCBs** globose, in paraphyses (1–)1.8–3.5 µm diam., in excipular cells 1.5–3.5 µm. **Exudate** over paraphyses 0.5–3 µm thick, continuous to cloddy, smooth to rough, very pale yellowish, ± loosely attached; over margin and flanks rough-cloddy. **— ANAMORPH**: unknown (a culture did not form conidia).

Habitat: collected 0–2.5 m above the ground, partially to sometimes entirely decorticated, 3–10 mm thick twigs and branches of (?)*Alnus* sp. {1}, *Betula* sp. {1}, *Populus alba* {1}, *Salix glauca* {1}, on 0.2–0.3 mm deep medium to strongly decayed wood {4}, also on bark (bast) {1}, ± greyed, with some green algae. **Associated**: *Lasionectria* sp. {1}, *Sclerococcum* sp. {1}, *Stictis* sp. {1}, ?*Trimmatostroma* sp. {1}, *Usnea* sp. {2}, small lichens. **Desiccation tolerance**: fully viable for at least 3 months. **Altitude**: 200 m a.s.l. (subpolar tundra), 500–1165 m (boreal forests). **Geology**: Canada & Greenland: Neoproterozoic & Devonian-Mississippian sedimentary rock; Norway: Pleistocene sand & gravel deposited from granite. **Phenology**: VI–VIII (but probably throughout the year, long-lived).

Taxonomic remarks. *Orbilia canadensis* is easily recognized by its subglobose to broadly ellipsoid ascospores and 16-spored asci. It appears to be closely related to the 8-spored *O. sphaerospora*, which differs in ± globose spores and in growing on coniferous substrate, but also to the 8-spored *O. subovoidea* and 32-spored *O. polyspora*, the latter differing in much longer cortical cells of the marginal excipulum.

Variation. In the holotype the spores were ellipsoid (to ovoid), whereas those of the other two specimens were more ovoid to subglobose.

Phylogeny. Sequences were taken from pure culture of a sample from Greenland and from apothecia of a Norwegian collection. Both comprise SSU (without S1506 intron), ITS, and LSU. In the overlapping parts of SSU and LSU they are identical, but they deviate in the ITS by 6 nt and 1 gap (1.1%). In the ITS region a distance of 2.3–2.7% to *O. subovoidea* and *O. subsphaerospora* is observed, and 4.5% to *O. sphaerospora*. In the LSU (D1–D2) the distances are 0.5%, 0.8%, 3.3%, and 6%, respectively.

Ecology. *O. canadensis* was found on ± rotten wood and bark of xeric twigs and branches of angiosperm shrubs and trees of the families *Betulaceae* and *Salicaceae* in the subarctic humid tundra of western Greenland, in orotemperate to boreal humid mixed conifer forests such as Douglas fir in northwestern North America (Canadian Rocky Mountains), and in oroboreal western Scandinavia.

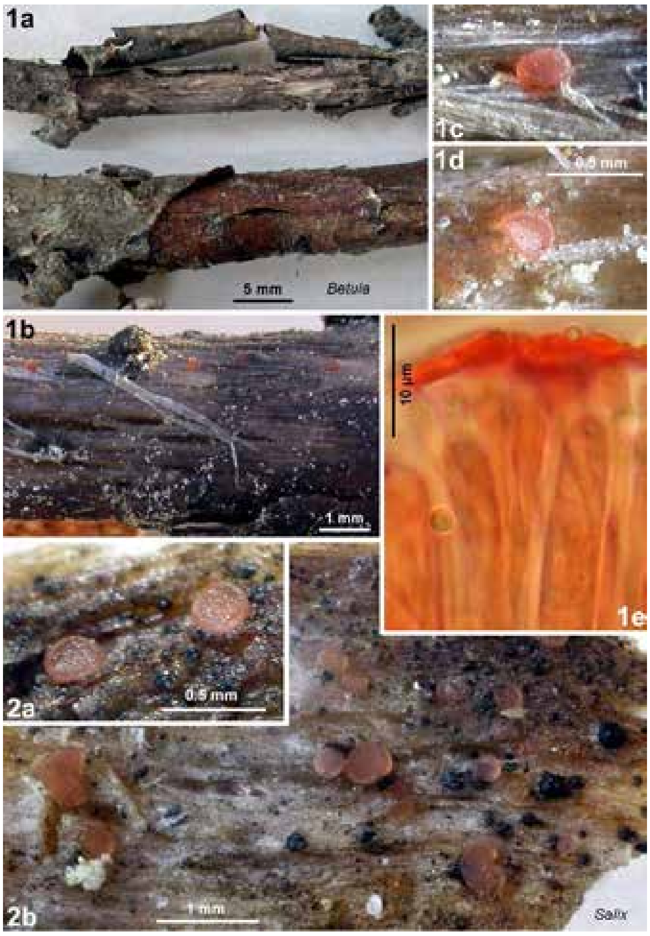


Plate 764. **1–2**: *Orbilia canadensis*. – **1a–b**. decayed semidecorticated xeric branches of *Betula*; **1b–d**, **2a–b**. rehydrated apothecia; **2e**. asci and paraphyses (in KOH+CR). — **1a–e**. H.B. 5933a (holotype): Canada, on *Betula*; **2a–b**. H.B. 6826: Greenland, on *Salix*.

Specimens included. **GREENLAND**: **Qeqqata**, 13 km WSW of Kangerlussuaq, close to Lake Helen, ~200 m, branch of *Salix glauca*, on wood, 14.VIII.2000, A. Raitviir (TAAM 137784, H.B. 6826, BBA 69366; sq.: KT215277). — **CANADA**: **British Columbia**, Canadian Rocky Mountains, ~400 km NE of Vancouver, North Thompson River, SE of Wells Gray, ?S of Blue River, 700 m, branches of (?)*Alnus*, on wood, 20.VI.1996, C. Peller (H.B. 5551). – **Alberta**, 310 km WSW of Edmonton, 7 km NE of Jasper, Maligne Canyon, 1165 m, twigs of *Betula*, on bark & wood, 17.VIII.1997, G. Marson (ex H.B. 5933a, M-0276448, **holotype**). — **NORWAY**: **Sør-Trøndelag**, 2.5 km W of Oppdal, 2 km NNE of Båggåstranda, Vang, 502 m, twig of *Populus canadensis*, on wood, 17.VII.2012, S. Helleman (S.H. 727, doc. vid.; sq.: KY419194).

Orbilia cupularis Baral & G. Marson, **sp. nov.**, MB 813909 — Pl. 765

Etymology: referring to the apothecia having a concave hymenium.

Typification: USA, Utah, Bryce Canyon, branch of *Acer*, on wood, 25.VIII.1994, G. Marson (ex H.B. 5164a, M-0276467, holotype).

Latin diagnosis: *Similis* Orbiliae subsphaerosporae *sed paraphyses leniter spathulatae ad lanceolatae, excipulum ectale ad marginem versus textura porrecta sub angulo acuto orientata, apothecia majora concava, margine magis distincte crenulata. Habitat ad lignum putridum rami sicci* Aceris *in zona orotemperata subhumida Americae septentrionalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.4–1.3(–2) mm diam., 0.2 mm high (receptacle 0.12 mm), pale to light orange-ochre-yellowish, round to irregularly elliptical, ± gregarious; disc strongly concave, margin 10–20 µm protruding, distinctly rough-crenulate, with or without ± prominent teeth; base whitish-cream, with or without obconical stipe up to 0.1–0.2 × 0.2–0.25 mm, superficial; dry bright orange. **Asci** *40–56 × (4–)4.3–4.8 µm, †33–47 × 3.2–4 µm, 8-spored, spores (*) ± uniseriate, finally subbiseriate, irregularly oriented, pars sporifera *19–24 → 14.5–16 µm long; **apex** (†) medium to strongly truncate (not indented, laterally rarely slightly inflated), thin-walled; **base** with short to medium long, thick, slightly flexuous stalk, T-, L- or Y-shaped. **Ascospores** *(3–)3.2–4.3(–4.7) × 2.7–3.3 µm, †2.8–3.2 × 2.5–2.8 µm, broadly ovoid to nearly globose; **SBs** *0.9–1.2(–1.3) × 0.9–1.1 µm, ± globose, eccentrical, placement in subglobose spores often close to lateral wall, attachment not seen. **Paraphyses** apically uninflated to slightly spathulate or lanceolate, partly flexuous, terminal cells *11–21 × 2–3 µm, exceeding the dead asci by 2–4 µm, lower cells *7–13.5 × 1.5–2.3 µm; branched only near base, apices covered by gel. **Medullary excipulum** hyaline, 40–100 µm thick, of medium loose textura intricata with many inflated cells, medium sharply delimited. **Ectal excipulum** hyaline to pale rose, of (*) thin-walled, vertically oriented t. angularis(-prismatica) at base and lower flanks, 50–60 µm thick near base, cells *8–14 × 6–9.5 µm; 30–40 µm thick at lower flanks, about 200 µm below margin ± abruptly replaced by a strictly parallel, 15–20 µm thick t. porrecta oriented at a 0–20° angle to the surface, cells *10–16 × 2–3 µm, at margin 10–15 µm thick, marginal cortical cells *8–15 × 2–3 µm; **glassy processes** 3–12 × 2–3.7 µm at margin and flanks, medium refractive, yellowish-amber, stratified, scarcely coherent. **Anchoring hyphae** very abundant, forming a dense t. intricata-porrecta 100–120 µm thick, hyphae *1.8–2.5(–3.5) µm wide, walls 0.2 µm thick. **SCBs** in paraphyses globose, 0.8–1 µm diam., partly also in ectal excipulum. **Exudate** over paraphyses 0.1–0.2 µm thick, partly rough, firmly attached to apex and subapex, tips ?embedded in gel; on margin and flanks thin, rough; exterior of subiculum with scattered yellow-amber exudate. — **ANAMORPH**: unknown.

Habitat: on a decorticated branch (or root?) of *Acer* sp. lying in dry riverbed, 20 mm thick, surface eroded, mainly in large old beetle galleries which penetrate the wood core, on 0.5–1 mm deep strongly decayed wood, greyed, no algae. **Associated**: *Mellitiosporiella macrospora*, *Orbilia microsoma*, *O. multimaeandrina*, *O. navajoana*, indet. pyrenomycete. **Desiccation tolerance**: fully viable for at least 2 months. **Altitude**: 2300 m a.s.l. **Geology**: Upper Cretaceous calcareous sandstone. **Phenology**: long-lived.

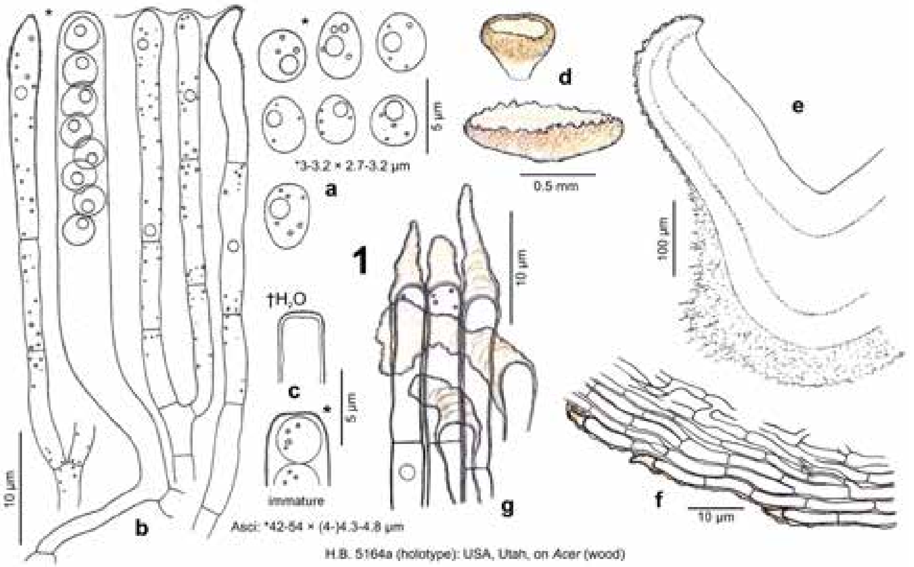


Plate 765. **1**: *Orbilia cupularis*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apices; **d**. apothecia with crenulate margin (rehydrated); **e**. apothecium in median section; **f**. id., ectal excipulum at flanks; **g**. cortical cells with glassy processes in external view.

Taxonomic remarks. *Orbilia cupularis* is easily recognized by ± subglobose ascospores, the paraphysis apices showing a tendency to spathulate-lanceolate, a textura porrecta oriented almost parallel to the surface from lower flanks to margin, with the cortical cells overall terminated by glassy processes, comparatively large apothecia with concave disc and crenulate margin, and a stipe-like base covered by a thick layer of anchoring hyphae. The European *O. sphaerospora* and *O. subsphaerospora* resemble *O. cupularis* in spore characters, but differ in most of the other mentioned features. The textura porrecta extending down to the flanks is extraordinary within the whole genus *Orbilia.*

Ecology. *O. cupularis* was found on rotten wood of a xeric branch of *Acer* lying in a dry riverbed in an open forest with *Quercus*, *Acer*, *Populus tremuloides* and *Cercocarpus ledifolius* in the cold-temperate subhumid ponderosa pine forest of the Utah Mountains in the southwest of Northern America. The holotype consists of ~25 apothecia and represents the only known collection of this species.

Specimens included. **USA**: **Utah**, Utah Mts., Bryce Canyon, 33 km SE of Panguitch, 8 km WSW of Tropic, Navajo Trail SE of Sunset Point, 2300 m, branch of *Acer*, on wood, 25.VIII.1994, G. Marson (ex H.B. 5164a, M-0276467, **holotype**).

Orbilia ovoidea Baral & G. Marson, **sp**. **nov**., MB 813910 — Pls 766–767, Map 128

Etymology: named after the ovoid ascospores.

Typification: Spain, Teruel, Guadalaviar, branch of *Prunus domestica*, 26.IX.1999, G. Marson (ex H.B. 6489a, M-0276547, holotype; sq.: KT215275).

Latin diagnosis: *Apothecia rehydratata 0.25–1.3 mm diam.*, *vivide aurantiaca vel roseo-rubra*, *sessilia*, *margine laevi. Asci 8-spori. Ascosporae *5–7.7 × 3–4 µm*, *ellipsoideae ad ovoideae vel late fusoideo-clavatae*, *basi partim curvatae*, *corpusculum refringens globosum*, *ad apicem cuspide brevi affixum continentes. Excipulum marginale textura porrecta valde crassitunicata*, *absque processis vitreis. Habitat ad lignum putridum ramorum siccorum arborum angio- et gymnospermarum in zona orotemperata vel orosub- ad suprasubmediterranea humida Europae meridionalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.25–0.8(–1.3) mm diam., 0.11–0.18 mm high, (light to) bright apricot-orange

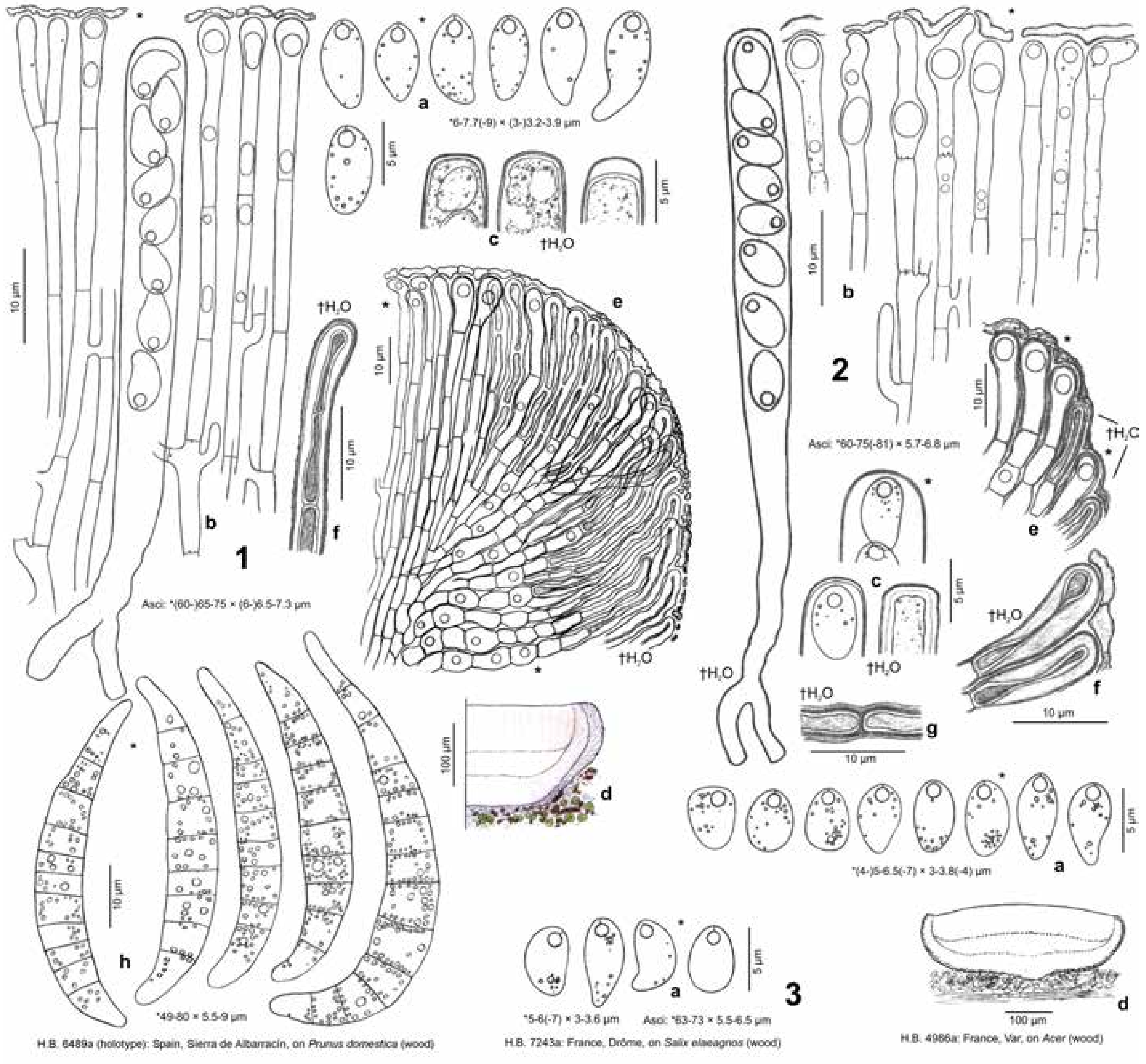


Plate 766. **1–3**: *Orbilia ovoidea*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. apothecia in median section; **e**. id., marginal ectal excipulum; **f**. id., cortical cells with internal wall thickening (but more thin-walled in living state); **g**. anchoring hypha; **h**. conidia from substrate.

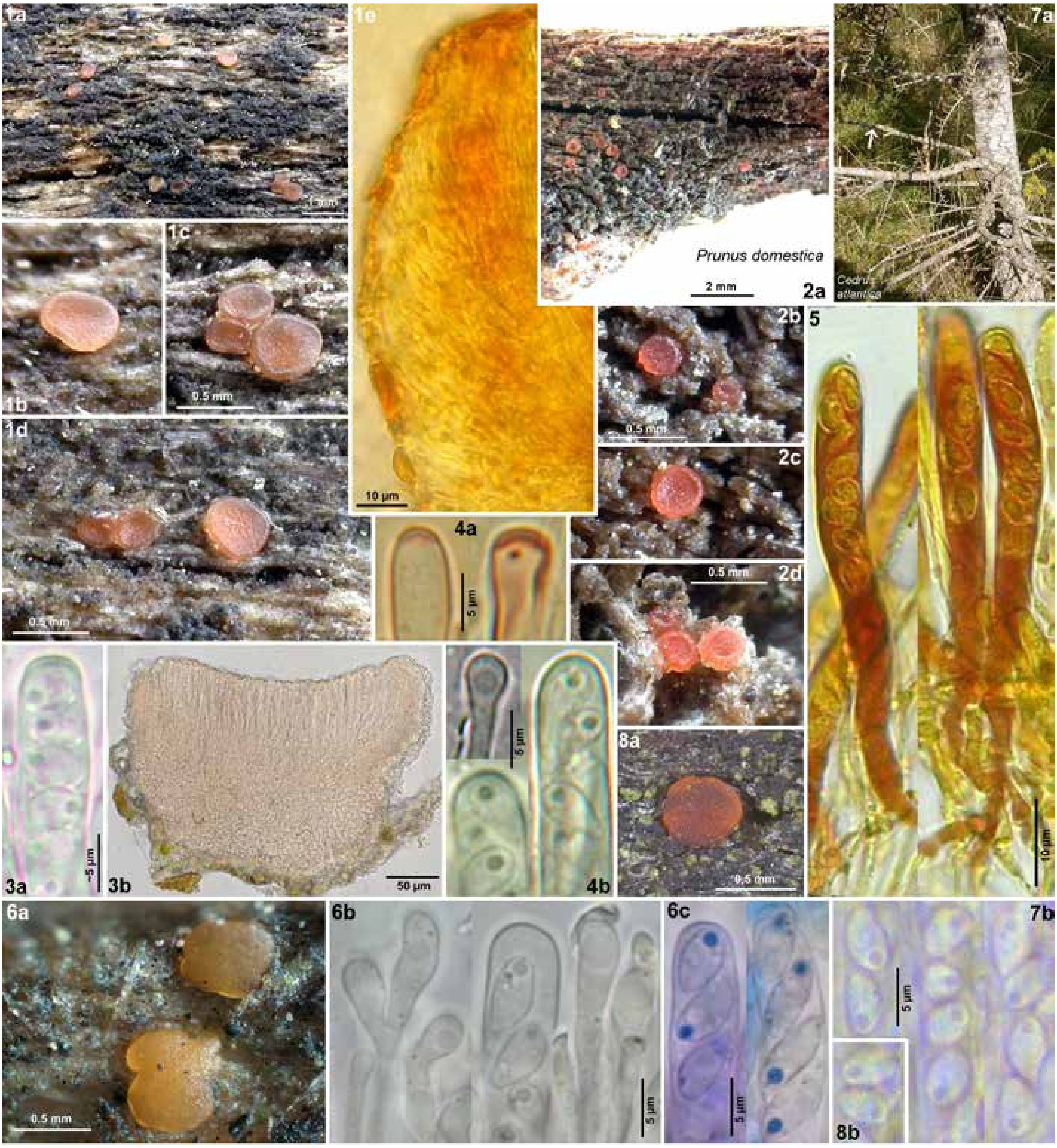


Plate 767. **1–8**: *Orbilia ovoidea*. – **1a–d**, **2a–d**, **6a**, **8a**. rehydrated apothecia (**1** after 11 years); **3b**. apothecium in median section; **1e**. id., marginal ectal excipulum; **3a**, **4b**, **5**, **6b–c**. mature asci, paraphyses; **4a**. ascus apices with apical thickening; **3a**, **4b**, **6c**, **7b**, **8b**. ascospores. – Living state (**6c** in CRB), except for **1e**, **5** (in IKI); **4a** (in CR$_{SDS}$); asci in **3a**, **6c**. – **3a–b**: phot. J.P. Priou; **4a–b**: M. Bemmann; **6a–c**: R. Tena. — **1a–e**. H.B. 4986a: France, Var, on *Acer*; **2a–d**. H.B. 6489a (holotype): Spain, Sierra de Albarracín, on *Prunus*; **3a–b**. J.P.P. 10133: France, Alpes Maritimes, on *Ulmus*; **4a–b**. 16.VI.2011: Austria, Tirol, on *Pinus*; **5**. H.B. 7243a: France, Drôme, on *Salix*; **6a–c**. R.T.L. 11071002: Spain, Sierra de Cuenca, on *Lonicera*; **7a–b**. H.B. 9130: France, Drôme, on *Cedrus*; **8a–b**. H.B. 9131: ibid., on *Pyrus*.

or rose-red, slightly translucent, round to somewhat undulating, scattered to gregarious in small groups; disc slightly concave to flat, margin thick, 0–20 µm protruding, smooth; broadly sessile, mostly erumpent (immersed in cracks); dry bright to deep (rose-)orange-red. **Asci** *(60–)65–75(–81) × (5.5–)6–6.8(–7.3) µm {3}, †(51–)55–75(–80) × (4.2–)5–6(–6.5) µm {3}, 8-spored, spores (*) subbiseriate above, uniseriate below († uniseriate), (2–)3–6(–8) lower (or sometimes upper) spores inverted {3} (mostly mixed), pars sporifera *28–39 µm long; **apex** (†) (slightly to) medium truncate (not indented), thin-walled {2}, sometimes with a 0.8–1.3 µm thick dome {2}, with indistinct apical chamber; **base** with short to medium long, thick, flexuous stalk, Y- to h-shaped. **Ascospores** *5–7(–8)((–9)) × 3–3.7(–4) µm {5}, ellipsoid-(ob)ovoid or ellipsoid- to broadly fusoid-clavate, rarely subcylindric-triangular, apex rounded to often obtuse, base very variable, strongly attenuated or not, straight or slightly to medium curved at base; **SBs** *1.3–1.6(–1.8) × (1–)1.1–1.3(–1.4) µm {3}, globose, with a very short filum, attachment mostly visible. **Paraphyses** apically (uninflated to) slightly or medium clavate-capitate, also spathulate to lageniform, terminal cells *(6–)9–25 × (2–)2.5–4.3(–4.7) µm {3}, lower cells *11–19 × 1.5–2.5 µm {2}; rarely branched at upper septum, hymenium pale to light orange-rose. **Medullary excipulum** subhyaline to pale rose, 40–50 µm thick, of dense, horizontally oriented textura intricata with many inflated cells, medium sharply delimited from ectal excipulum at flanks by a 10 µm thick layer of t. porrecta. **Ectal excipulum** of (*/†) slightly gelatinized, ± vertically oriented t. angularis-prismatica from base to submargin, 35–60 µm thick near base, cells *7–20 × 6–11 {2} or 9–29 × 7–20 {T} µm; 20–50 µm thick at flanks and margin, 2-layered: inner layer of pale rose-orange t. angularis-prismatica oriented at a ~60–80° angle to the surface, cells *5–10 × 5–7 µm, outer layer of hyaline t. porrecta oriented at 30–50°, hyphae ± flexuous, conglutinate, 15–40 µm long, septate when long, walls overall strongly thickened (much thinner when viable) {4}, terminal cells */†9–20 × (2.5–)3–4.5(–5) µm {2}; **glassy processes** absent. **Anchoring hyphae** (very) abundant, *2–4 µm wide, walls (0.2–)0.3–0.7(–1) µm thick {2}. **SCBs** globose, in paraphyses 1–2(–3) µm diam.; in ectal excipulum (near margin) 1.7–2 µm diam. **Exudate** over paraphyses and excipulum (0.5–)1–2(–3.5) µm thick, cloddy, loosely attached. — **ANAMORPH**: vermispora-like (presumed, from natural substrate {1}). **Conidiophores** unknown. **Conidia** unbranched, medium to strongly curved, strongly tapered towards both ends, *49–80 × 5.5–9 µm, 8–13-septate {1}, terminal cells longer than remaining cells.

Habitat: collected 0.4–3 m above the ground, partially to entirely decorticated, 6–25 mm thick branches of *Acer* sp. {1}, *Cedrus atlantica* {1}, *Juglans regia* {2}, *Lonicera xylosteum* {1}, *Pinus sylvestris* {1}, *Prunus domestica* {1}, *Pyrus communis* {1}, *Rosa* sp. {1}, *Salix eleagnos* var. *angustifolia* {1}, *Ulmus* sp. {1}, on 0.2–0.5 mm deep strongly decayed wood {10}, strongly greyed, green algae medium abundant. **Associated**: *Mellitiosporiella pulchella* {1}, *Orbilia gambelii* {1}, *O. polyspora* {1}, *O. vinosa* {1}, *Perrotia flammea* {1}, *Propolis farinosa* {1}, *Sclerococcum* sp. {1}. **Desiccation tolerance**: fully viable for at least 2 months. **Altitude**: 627–1600 m a.s.l. **Geology**: Jurassic & Cretaceous limestone, dolomite breccia. **Phenology**: VI–X (but long-lived).

Taxonomic remarks. *Orbilia ovoidea* is characterized by broadly ellipsoid-ovoid, basally often attenuated and somewhat curved ascospores with a large globose spore body which is apically attached by a very short filum. Very similar as in *O. polyspora*, there is a hyaline outer layer of the ectal excipulum composed of thick-walled hyphae, which resemble a textura oblita and emerge from the excipular cells at flanks and margin. The very similar but variable *O. subovoidea* differs in narrower spores, with the globose SBs mostly more close to the spore apex and often attached without a very short filum, also in shorter marginal excipular hyphae which are partially thick-walled at their ends, and in smaller asci. At one of the collection sites of *O. ovoidea*, *O. subovoidea* grew in association on the same substrate but on a different branch.

O. clavipisca differs from *O. ovoidea* in the predominant presence of an apical ascus wall thickening, longer spores with a more regularly tapered base, and in growing on coniferous hosts in North America. The Australian *O. amberina* differs in much shorter asci and slightly shorter spores, also in rather thin-walled marginal cortical cells in the dead state, and in more amber-brown apothecia.

Variation. Especially the base of the spores varies rather strongly in shape within most of the collections examined, with a tendency to be attenuated only in some of the spores. Spore size was rather consistent in a majority of collections, with the width distinctly over 3 µm in a majority of spores. In some collections spore width was sometimes only around 3 µm (e.g., J.P.P. 10130, 10133), hence delimitation from *O. subovoidea* was problematic. The length of the thick-walled marginal hyphae also differed between the collections, as did the size of the basal excipular cells.

Map 128. Known distribution of *O. ovoidea* in Europe.

Anamorph. Only once we found in *O. ovoidea*, as in the very similar *O. subovoidea*, large, slightly to strongly curved phragmoconidia on the natural substrate (Pl. 766: 1h).

Phylogeny. A sequence taken from pure culture of the holotype from Cuenca (H.B. 6489a) comprises SSU (with two introns: S1506 and S1516), ITS, and LSU. It shows in the ITS region a distance of 12–12.5% to *O. subovoidea*, *O. canadensis*, and *O.* (*sub*)*sphaerospora*, and 17% to *O. polyspora*. In the LSU (D1–D2) the distance lies in the range of 2.6–3.3%, but to *O. polyspora* 6%. The rather high distance to the similar *O. subovoidea* is astonishing, as also mentioned under that species. In the S1506 intron a 10% distance is observed to *O. subovoidea* in the overlapping 343 nt. The small intron S1516 in the region of the ITS1 primer has a length of 70 nt and was not observed in any other member of *Orbiliomycetes*.

Ecology. *O. ovoidea* was found on rotten wood of xeric branches of different angio-, rarely gymnosperm trees and shrubs in orotemperate and orosub- to suprasubmediterranean humid regions of central Europe (Austrian northern Alps) and southern Europe (Southern French Alps, Sierra de Albarracín).

Specimens included. **AUSTRIA**: **Tirol**, 2.5 km NNE of Landeck, 1 km NW of Zams, Zammer Lochoutz waterfall, 800 m, branch of *Pinus sylvestris*, on wood, 16.VI.2011, M. Bemmann (ø, doc. vid.). — **FRANCE**: **Rhône-Alpes**, **Drôme**, 9.7 km W of Séderon, 3.3 km NW of Montbrun-les-Bains, 640 m, branch of *Salix eleagnos* var. *angustifolia*, on wood, 10.X.2002, G. Marson (H.B. 7243a). – 19 km S of Die, 2.7 km SW of Poyols, 862 m, branch of *Cedrus atlantica*, on wood, 12.VIII.2009, H.O. Baral (H.B. 9130). – ibid., branch of *Pyrus communis*, on wood, 12.VIII.2009, H.O. Baral (H.B. 9131a). – **Provence-Alpes-Côte d'Azur**, **Hautes-Alpes**, 11.5 km WSW of Briançon, 2.5 km NNE of Vallouise, E of Pelvoux, l'Adret, 1567 m, branch of *Rosa*, 10.IX.2008, J.P. Priou (J.P.P. 28200). – ibid., branch of *Juglans regia*, on wood, 10.IX.2008, J.P. Priou (J.P.P. 28201, doc. vid.). – **Alpes Maritimes**, Mercantour, 2.5 km N of Colmars-les-Alpes, WSW of Chaumie-Haut, 1455 m, branch of *J. regia*, on wood, 11.VI.2010, J.P. Priou (J.P.P. 10130, doc. vid.). – ibid., branch of *Ulmus*, on wood, 8.VI.2010, J.P. Priou (J.P.P. 10133, doc. vid.). – **Var**, 26 km NW of Grasse, 12.5 km SE of Castellane, NNW Le Logis-du-Pin, 1035 m, branches of *Acer*, on wood, 5.X.1993, G. Marson (H.B. 4986a). — **SPAIN**: **Castilla-La Mancha**, **Cuenca**, Sierra de Albarracín, 43 km NE of Cuenca, 8 km SW of Guadalaviar, S of Mt. Mogorrit, E of Peñu la Varga, 1600 m, branch of *Prunus domestica*, on wood, 26.IX.1999, G. Marson (ex H.B. 6489a, M-0276547, **holotype**, BBA 69354, anam. substr.; sq.: KT215275). – **Castilla-La Mancha**, **Guadalajara**, Sierra de Cuenca, 37 km ENE of Priego, 7 km SSE of Peralejos de las Truchas, Las Juntas, 1258 m, branch of *Lonicera xylosteum*, on wood, 10.VII.2011, R. Tena (R.T.L. 11071002, doc. vid.).

Orbilia subovoidea Baral, Matočec & E. Weber, **sp. nov**., MB 813911 — Pls 768–769, Map 129

Etymology: named after the similarity to *O. ovoidea*.

Typification: Greece, Laerma, twig of *Pistacia lentiscus*, 21.III.2010, V. Kummer (ex H.B. 9334a, M-0276597, holotype; sq.: KT222428).

Latin diagnosis: *Similis* Orbiliae ovoideae *sed ascosporae angustiores, corpuscula refringentia cuspide brevissime vel confertim affixa, cellulae crassitunicatae exipuli marginalis breviores. Habitat ad lignum putridum ramorum siccorum fruticorum vel arborum angiospermarum in zona thermomediterranea ad mesotemperata (semi)humida Europae meridionalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.15–)0.2–0.5(–0.7) mm diam., 0.1–0.22 mm high, pale to bright reddish-orange to rose, medium translucent, round to slightly irregular, scattered to gregarious; disc slightly concave to slightly convex, margin thin or thick, 0–5 µm protruding, smooth; sessile on a narrow base, superficial to erumpent (slightly to medium immersed); dry light to bright (carmine-) red. **Asci** *(36–)50–65(–70) × (4.5–)5–6(–6.3) µm {10}, †(40–)45–60(–75) × 4.5–5(–5.5) µm {5}, 8-spored, spores *1–2-seriate, (2–)3–6(–7) lower spores inverted {10} (often mixed), pars sporifera *25–36(–43) µm long; **apex** (†) slightly to strongly truncate (not indented, laterally not or very slightly inflated), thin-walled {9}, exceptionally with up to 1 µm thick dome {3}; **base** with short to long, thick, flexuous stalk, L-, Y- or h-shaped. **Ascospores** *(4–)4.5–8(–9) × (2–)2.2–3(–3.3) µm {18}, †5–7 × 2–2.3 µm {1}, subcylindric to ellipsoid(-clavate) or ovoid, more rarely fusoid-clavate, apex rounded to obtuse (exceptionally subacute), towards base not or slightly, sometimes strongly attenuated, straight or slightly to medium curved near base; **SBs** *(0.8–)1–1.3(–1.5) × (0.6–)0.8–1.1(–1.2) µm {12}, globose to very broadly tear-shaped, apically closely attached to spore wall or narrowed to a ± small point, rarely with a very short filum. **Paraphyses** apically uninflated or slightly to medium clavate-capitate, sometimes spathulate or lageniform, sometimes ± flexuous, terminal cells */†(5.5–)9–18(–25) × (1.8–)2.3–3.5(–4.2) µm {5}, lower cells *6–15 × 1.7–2.8 µm {4}; sometimes branched at upper septum, hymenium pale rose. **Medullary excipulum** pale rose, 40–70 µm thick, of medium dense textura intricata with many inflated cells, medium sharply delimited from ectal excipulum only at flanks by an indistinct 10 µm thick t. porrecta. **Ectal excipulum** pale rose, of (*/†) distinctly gelatinized, indistinctly oriented t. globulosa-angularis from base to mid flanks, 30–70 µm thick near base, cells *8–17(–21) × 6–12(–15) µm {4}; 20–25 µm thick at flanks, cells *5–10 × 3–9 µm; 15–25(–30) µm near margin, of medium gelatinized t. prismatica-porrecta oriented at a 20–80° angle to the surface, marginal cortical cells */†7–13(–15) × (2–)2.5–4(–5) µm {4}; **glassy processes** absent, but terminal cells at flanks and margin often with strongly thickened walls, especially at their apex, wall here †(1–)2–5(–6) µm thick, about half as thick when in the living state. **Anchoring hyphae** medium (to very) abundant, */†(1.7–)2–3(–3.5) µm wide, walls (0.2–)0.3–0.5(–1) µm thick {5}. **SCBs** in paraphyses and in ectal excipulum (near margin) globose, 1–2.8 µm diam. {11}. **Exudate** over paraphyses, margin and flanks (0.5–)1–2(–3) µm thick, granular-cloddy to continuous, hyaline, ± loosely attached. **— ANAMORPH**: vermispora-like (presumed, from natural substrate {3}). **Conidiophores** not seen. C**onidia** unbranched, almost straight to strongly curved, strongly tapered towards ends, *67–82 × 5.5 µm {1}, †31–74 × 4.2–5 {1}, (8–)11–13-septate; or †37–53 × 6.5–8 µm {1}, 9–12-septate; terminal cells often longer than remaining cells.

Habitat: collected 0.1–4 m above the ground, corticated to partially or often entirely decorticated, 3.5–40 mm thick twigs and branches of *Acer* sp. {1}, *Arbutus unedo* {1}, *Cercocarpus ledifolius* {1}, *Cistus* sp. {1}, *Cytisus scoparius* {1}, *Genista scorpius* {1}, *Lonicera* (?) *xylosteum* {1}, *Petteria ramentacea* {1}, *Pistacia lentiscus* {1}, *Quercus ilex* {2}, *Q. rotundifolia* {1}, *Rhamnus alaternus* {1}, *Rosa* sp. {4}, *Rosmarinus officinalis* {2}, *Salix* sp. {1}, on 0.1–1 mm deep or more (slightly to) strongly decayed wood {13} or bark {4}, slightly to strongly greyed, with a few to many green algae. **Associated**: *Baggea* sp. {1}, *B. pachyascus* {1}, ?*Calloria* sp. {2}, *Candelariella lutella* {1}, '*Chlorosplenium*' *viridulum* {1}, *Cryptodiscus* sp. {1}, *C. foveolaris* {1}, *Durella* ?*atrocyanea* {1}, *D. connivens* {1}, *Evernia furfuracea* {1}, '*Helotium*' *uvidulum* {1}, *Hysterographium fraxini* {1}, *Lecidella elaeochroma* {1}, *Mellitiosporiella pulchella* {4}, *Mollisia rosae* {1}, *Orbilia angiosubvinosa* {1}, *O. arizonensis* {1}, *O. delphinus* {1}, *O. euonymi* {3}, *O. flexisoma* {1}, *O. gambelii* {5/1}, *O. maeandrina* {1}, *O. ocellata* {1}, *O. pleiogambelii* {1}, *O. polyspora* {1}, *O. purshiae* {1}, *O. rosicola* {1}, *O. subaristata* {3}, *O. subclavuliformis* {3}, *O. vinosa* {6}, *Parmelia sulcata* {1}, *Perrotia flammea* {1}, *Physcia leptalea* {1}, *Propolis farinosa* {2}, *P. viridis* {2}, *Schizoxylon* sp. {1}, *Unguiculariopsis* sp. {1}. **Desiccation tolerance**: fully viable for at least 3 months. **Altitude**: 8–1630 m a.s.l. (Europe), 2500 m (North America). **Geology**: USA: Pennsylvanian-Permian sand- & limestone; Europe: alluvial deposits from Cambrian-Ordovician silt- & sandstone and granite, Cretaceous limestone, dolomite, marl, sand & slate. **Phenology**: III–VII, IX–XI (throughout the year, long-lived).

Taxonomic remarks. *Orbilia subovoidea* is characterized by subcylindrical to ellipsoid-ovoid, basally sometimes narrowed and slightly curved spores which contain ± globose SBs closely attached to the spore apex. From the similar *O. ovoidea* the species is not sharply separated morphologically (for the differences see p. 1256.). *O. subcylindrospora* closely resembles those specimens of *O. subovoidea* with cylindrical spores, but differs in smaller spores and SBs and a stronger tendency to curved spores; yet, transitional collections exist which suggest a continuum between the two species. Large-spored populations of *O. eucalypti* (section *Orbilia*) resemble *O. subovoidea* in many respects, but sharply differ in much smaller SBs, also in the frequent presence of medium-sized, KOH-resistant LBs in the spores, in the absence of thick-walled marginal cortical cells, and in a different anamorph.

Variation. *O. subovoidea* is very variable in spore size and shape (broadly ellipsoid or ovoid to subcylindrical or fusoid-clavate). This variation was even observed within a collection, or a single apothecium. Length varied from 4–6 µm up to 6–9 µm, and width from 2–2.3 µm up to 2.7–3.3 µm. Wider spores were usually shorter, hence the spore volume showed much less variation. In some collections broad ellipsoid spores occurred together with narrow subcylindrical spores in a similar abundance (see Pls 768: 2a, 3a; 769: 5h–j, 6c), sometimes even within a single apothecium (Pl. 769: 7), but intermediate spore shapes were also frequent. Those specimens with predominantly rather wide, ellipsoid spores are sometimes difficult to distinguish from *O. ovoidea*.

Basally curved spores were only noted in some spores of some collections. In the first studied collection (on *Acer*, Pl. 768: 1a) a few spores deviated in subacute apices and a fusoid-clavate shape. In three collections (H.B. 5511a, 7002, 7417a) a few asci had a distinct apical thickening up to †1 µm (Pl. 769: 1e). Also in the North American sample on *Cercocarpus*

Map 129. Known distribution of *O. subovoidea* in Europe.

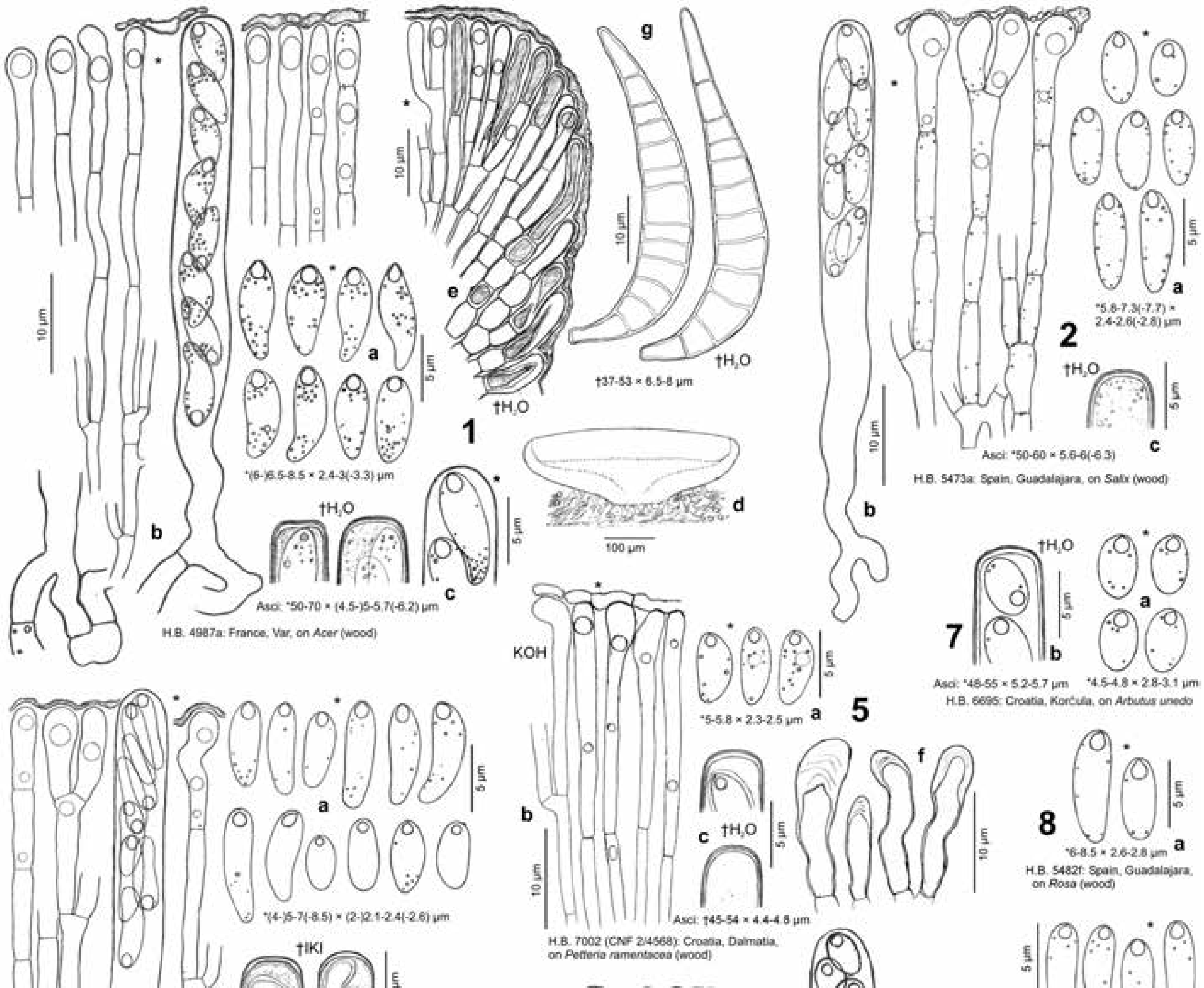


Plate 768. **1–11**: *Orbilia subovoidea*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. apothecium in median section; **e**. id., marginal ectal excipulum; **e–f**. marginal cortical cells with internal wall thickening when dead; **g**. conidia from substrate. – **5b** p.p. (living paraphyses), **5f**, **6a** upper 5 spores, right ascus: del. N. Matočec.

Plate 769. **1–7**: *Orbilia subovoidea*. – **1a**, **5a**. decorticated decayed xeric branches (**5a** with *Lecidella elaeochroma* & *Candelariella lutella*); **1a–c**, **3a–b**, **5b–f**, **6a–b**. rehydrated apothecia (**1** after 11 years, **3** after 13 years, **5** after 2 months, **6** after 5 days), **7a**. dry apothecia; **2c**, **5g**. apothecia in median section; **3e**, **5k**. id., marginal ectal excipulum; **1d**. exudate on margin (external view); **1e**, **3c**. ascus apices; **5l**, **7c**. apices of paraphyses; **5h**, **m–n**, **7b**. upper part of mature asci; **2a–b**, **4a–c**, **5h–j**, **6c**, **7d–e**. ascospores; **3d**. conidia from substrate. – Living state (**7d** in CRB), except for **2c**, **3d** (in H_2O); **1e**, **3c**, **e** (in KOH+IKI); asci in **2a–b**, **4a–c**, **5h–j**, **7b** left. – **6a–c**: phot. E. Rubio; **7a–e**: phot. R. Tena. — **1a–e**. H.B. 5511a: Spain, Guadalajara, on *Rosa*; **2a–c**. H.B. 7238e: France, Vaucluse, on *Lonicera*; **3a–e**. H.B. 4987a: France, Var, on *Acer*; **4a–e**. H.B. 7417a: Turkey, Balıkesir, on *Quercus*; **5a–n**. H.B. 9334a (holotype): Greece, Rhodos, on *Pistacia*; **6a–c**. E.R.D. 5265: Spain, Asturias, on *Rhamnus*; **7a–e**. 25.IV.2012: Spain, Teruel, on *Rosa*.

ledifolius (Pl. 768: 11) a slight ascus apical thickening (< 1 µm) was noted in the dead state.

Anamorph. The conidia observed on the natural substrate strongly varied in size. Those in Pls 768: 1; 769: 3d are much wider and never as long as those seen in two other specimens (Pl. 768: 10; IVV: H.B. 7417a); the conidia in the former collection strongly resemble in size and shape those of *O. ovoidea*, though being slightly shorter. *O. ovoidea* grew in association in this collection, though on a separate branch, so it could be that these shorter and wider conidia belong to *O. ovoidea*.

Phylogeny. A sequence taken from apothecia of the holotype from Rhodos comprises S1506 intron, ITS, and LSU. It shows in the ITS region a distance of 2.3–2.7% to *O. canadensis* and *O. subsphaerospora*, and 4.2% to *O. sphaerospora*. In the LSU (D1–D2) the distances are 0.5%, 0.6%, 2.8%, and 5.6%, respectively. The high distance to *O. ovoidea* is surprising, considering the difficulty to distinguish the two species morphologically.

At pos. 121 and 134 of the 5.8S region, which is part of stem-loop B8, *O. subovoidea* differs by G+C from members of section *Ovoideae* which have A+T like most *Orbilia* spp. G+C is otherwise only seen in section *Orbilia* p.p. and a few of section *Arthrobotrys* (Tab. 18).

Ecology. *O. subovoidea* was collected on ± rotten wood and bark of xeric twigs and branches of various broad-leaved trees and shrubs in thermo- to supramediterranean and supra-submediterranean semihumid, rarely orosubmediterranean or mesotemperate humid regions of southern and atlantic western Europe, moreover in a cold-temperate humid ponderosa pine forest of the Colorado Plateau in the southwest of Northern America.

Specimens included. **FRANCE**: **Bretagne**, **Morbihan**, 9.5 km SE of Malestroit, 2.7 km WNW of St.-Martin-sur-Oust, Beauvais, 8 m, branch of *Cytisus scoparius*, on wood, 1.III.2009, J.P. Priou (J.P.P. 29033, doc. vid.). – **Provence-Alpes-Côte d'Azur**, **Vaucluse**, 14 km SE of Carpentras, 4 km SE of Venasque, Aire de Pic-Nique de Venasque, 485 m, twig of *Lonicera* (?) *xylosteum*, on wood, 9.X.2002, G. Marson (H.B. 7238e). – **Var**, 26 km NW of Grasse, 12.5 km SE of Castellane, NNW Le Logis-du-Pin, 1035 m, branch of *Acer*, on wood, 5.X.1993, G. Marson (H.B. 4987a, anam. substr.). — **SPAIN**: **Asturias**, Somiedo, 25 km NNE of Villablino, 0.6 km NE of Las Viñas, La Riera de Somiedo, 520 m, branch of *Rhamnus alaternus*, on wood, 12.III.2011, E. Rubio (E.R.D. 5265, doc. vid.). – **Aragón**, **Teruel**, Sierra de Javalambre, 24 km SSE of Teruel, 4 km E of Camarena de la Sierra, 1630 m, branch of *Rosa*, 1.IV.2012, R. Tena (R.T.L. 12040103). – **Castilla-La Mancha**, **Guadalajara**, Sierra de Guadarrama, 43 km NNW of Guadalajara, 2 km NNW of Tamajón, Ermita de los Enebrales, 1040 m, branches of *Rosa*, on wood, 14.V.1996, H.O. Baral (H.B. 5482f, 5511h). – ibid., branch of *Genista scorpius*, on bark, 14.V.1996, H.O. Baral (H.B. 5517a). – 55 km NNW of Guadalajara, 0.7 km NW of Majaelrayo, Arroyo La Matilla, 1180 m, branch of *Salix*, on wood, 14.V.1996, H.O. Baral (H.B. 5473a). – 18 km SW of Sigüenza, 2.5 km NE of Almadrones, 1065 m, branch of *Quercus rotundifolia*, on wood, 24.IX.1999, H.O. Baral (H.B. 6476a). – ibid., branch of *Cistus*, on wood, 24.IX.1999, H.O. Baral & G. Marson (H.B. 6475c). – Meseta Central, 38 km ESE of Guadalajara, 8 km S of Alocén, 2.3 km NW of Sacedón, Pantano de Entrepeñas, 755 m, branch of *Rosmarinus officinalis*, on bark, 25.IX.1999, H.O. Baral (H.B. 6528c ø, anam. substr.). – **Cuenca**, 16 km ENE of Cuenca, 3 km E of Buenache de la Sierra, Vía del Saca, 1370 m, branch of *Rosa*, on wood, 25.IX.1999, H.O. Baral (ø). – 6 km ENE of Cuenca, 4 km NW of Palomera, 1120 m, twigs of *Rosmarinus officinalis*, on bark, 25.IX.1999, G. Marson (ø). — **CROATIA**: **Split-Dalmatia**, Dinaric Alps, 3.2 km ENE of Zagvozd, 11 km WSW of Imotski, podr. Brežine, 635 m, twig of *Petteria ramentacea*, on wood, 27.VII.2000, N. Matočec (CNF 2/4548, 4568, H.B. 7002). – **Dubrovnik-Neretva**, **Korčula**, 2.5 km ESE of Korčula, Badija island, NE of Turističkosportski centar, way to ruin, 40 m, branch of *Arbutus unedo*, 8.VI.2000, H.O. Baral (H.B. 6695). — **GREECE**: **South Aegean**, **Rhodos**, 17 km WSW of Archangelos, 4.5 km NNW of Laerma, 185 m, twig of *Pistacia lentiscus*, on bark, 21.III.2010, V. Kummer (ex H.B. 9334a, M-0276597, **holotype**; sq.: KT222428). — **TURKEY**: **Marmara**, **Balıkesir**, 51 km WSW of Balıkesir, 2.7 km WNW of Korucu, NE of Büyükilica Bridge, 330 m, branch of *Quercus ilex*, on wood, 23.XI.2002, T. Askun (T.A. 41a, H.B. 7417a, anam. substr.). – 33.5 km N of Balıkesir, 8.8 km NNE of Ilıca, Beypınar Mevkii, 490 m, branch of *Q. ilex*, on wood, 15.XI.2003, T. Askun (T.A. 68b). — **USA**: **Arizona**, Grand Canyon, Kaibab Plateau, 93 km SSE of Fredonia, S of North Rim, 2500 m, branch of *Cercocarpus ledifolius*, 17.V.1995, G. Marson (ø).

Orbilia amberina Baral & G. Marson, **sp. nov.**, MB 813912 — Pls 770–771

Etymology: named after the amber-coloured apothecia.

Typification: Western Australia, Moora, branch of *Verreauxia reinwardtii*, 24.X.2007, G. Marson (ex H.B. 8748c; MEL 2389257A, holotype).

Latin diagnosis: *Similis* Orbiliae ovoideae *sed asci multi breviores, ascosporae leniter breviores, cellulae excipuli marginalis tenuitunicatae. Habitat ad corticem putridum ramorum siccorum fruticorum vel arborum angiospermarum in zona subtropica semihumida ad semiarida Australiae meridio-occidentalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.13–0.35 mm diam., 0.09–0.12 mm high, light to bright orange- to amber-brown, slightly translucent, ± round, scattered; disc flat, margin distinct, thick, 5–12 µm protruding, smooth; sessile, ± deeply immersed in cracks or holes of bark. **Asci** *48–52 × 5.5–6.5 µm {1}, †(30–)34–42 × 4.2–5.2(–5.5) µm {2}, 8-spored, spores (*) uniseriate, lower spores ± inverted but often oriented in all directions (especially the middle spores), pars sporifera *33 µm long; **apex** (†) slightly to medium truncate (not indented, laterally not inflated), thin-walled or sometimes with dome †0.3–0.8 µm thick {1}, without apical chamber; **base** with short to long, thick or thin, flexuous stalk, L-, T- or h-shaped. **Ascospores** *(3.7–)4.2–

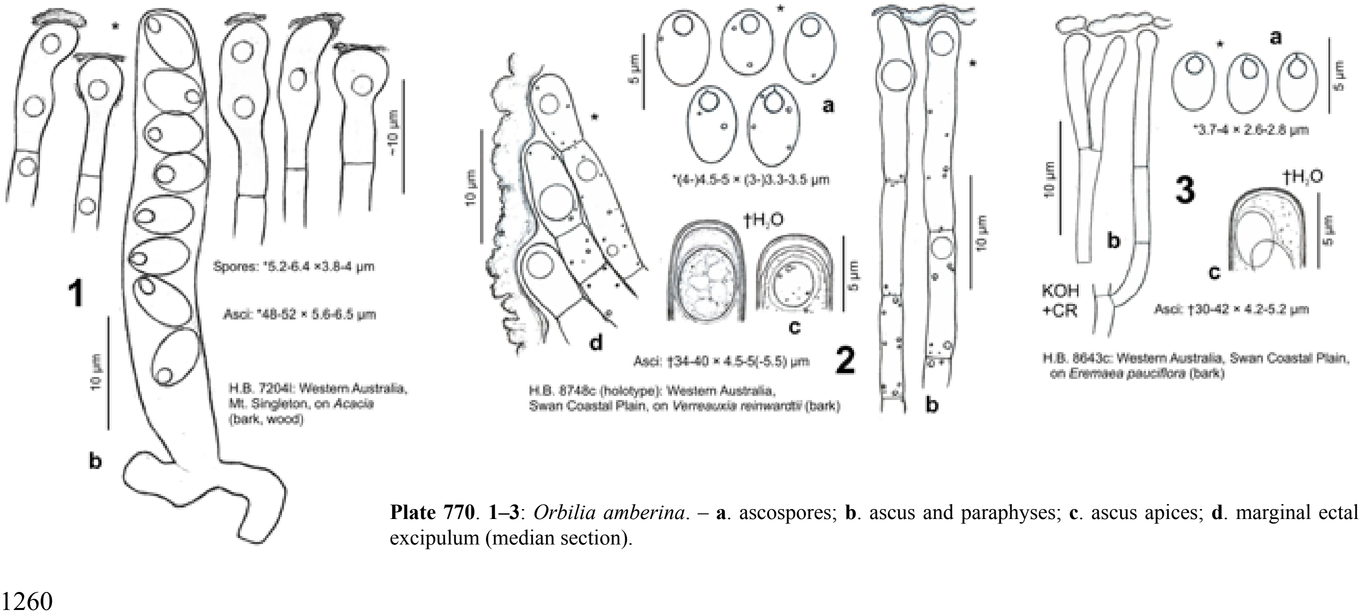


Plate 770. **1–3**: *Orbilia amberina*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apices; **d**. marginal ectal excipulum (median section).

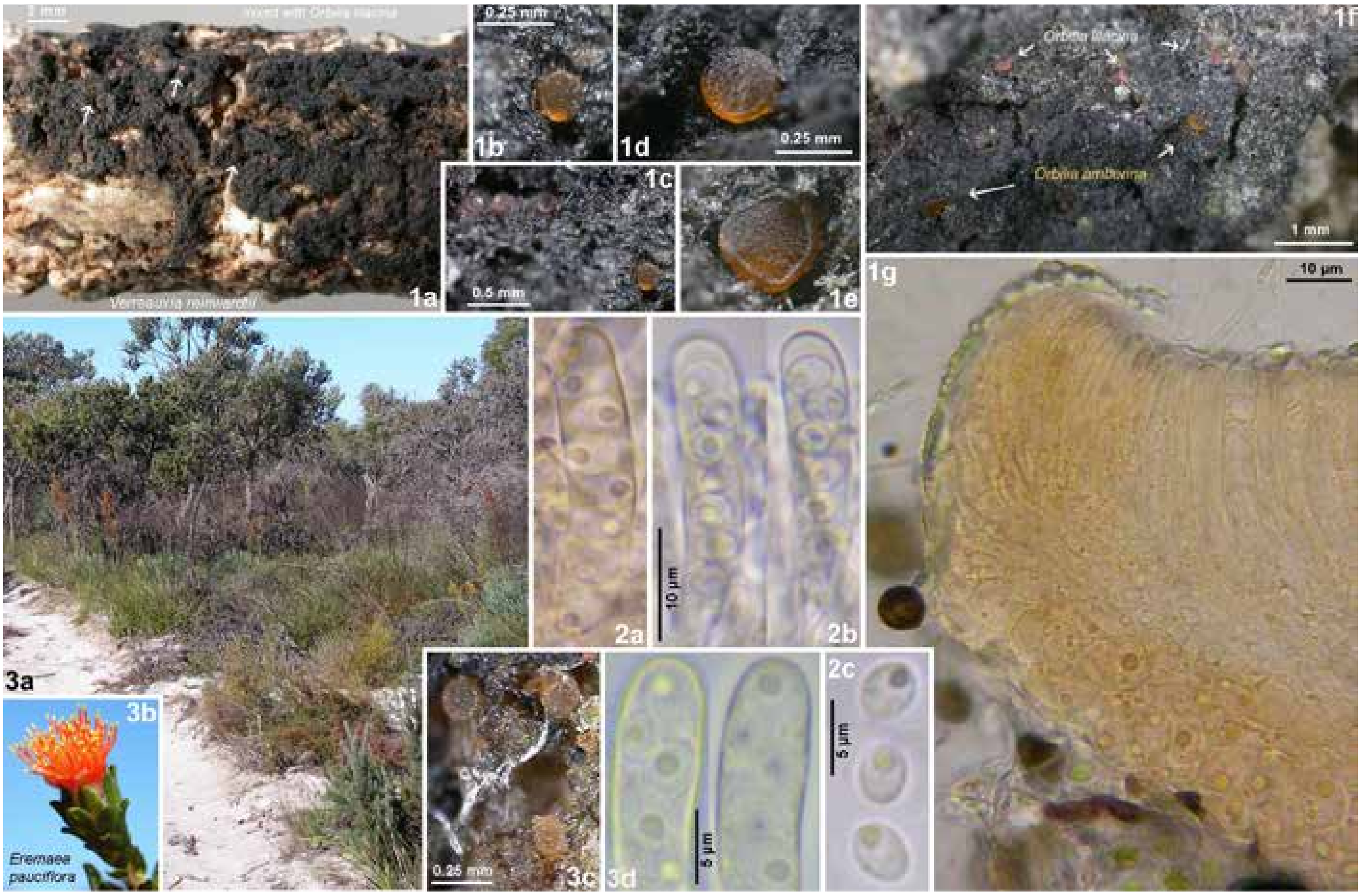


Plate 771. **1–3**: *Orbilia amberina*. – **3a**. banksia-eucalypt woodland with *Eremaea*; **3b**. flowering *Eremaea pauciflora*; **1a**, **f**. dead corticated xeric branch of *Verreauxia reinwardtii*, mixture with *Orbilia lilacina*; **1b–f**, **3c**. rehydrated apothecia; **1g**. apothecium in median section (marginal region); **2a–c**, **3d**. asci and ascospores. – Living state, except for asci in **2a**, **3d**. — **1a–f**. H.B. 8748c (holotype): Western Australia, Swan Coastal Plain, on *Verreauxia*; **2a–d**. G.M. 2006-09-03.3: ibid., on *Banksia*; **3a–d**. H.B. 8643c: ibid., on *Eremaea*.

5.5(–6.5) × (2.6–)3–3.7(–4.2) µm {4}, subglobose to broadly ellipsoid, ends rounded to obtuse, straight; **SBs** *1.5–1.9 × 1–1.5 µm {2}, globose, with a very short, sometimes invisible filum. **Paraphyses** apically uninflated or slightly to sometimes strongly clavate-capitate, sometimes lageniform, terminal cells *10–19 × 2.5–4.5 µm {2}, †8–13 × 1.5–2 µm {1}, lower cells *10–11 × 2–2.5 µm {1}, †6–10 × 1.2–1.5 µm {1}; rarely branched at upper septum, hymenium pale orange. **Medullary excipulum** hyaline to pale orange, 25–30 µm thick, of dense textura intricata with many inflated cells, indistinctly delimited. **Ectal excipulum** light orange, of (†) thin-walled to medium gelatinized (common walls 0.3–2 µm thick), indistinctly oriented t. globulosa-angularis from base to mid flanks, 25–30 µm thick near base, cells *8–11(–15) × 6–10(–11) µm {1}; 10–25 µm thick near margin, of t. prismatica oriented at a 10–30° angle to the surface, marginal cortical cells *7–10 × 3.5–4 µm {1}, †7–10 × 3–3.8 µm {1}, with thin to slightly gelatinized but unswellable walls; **glassy processes** absent. **Anchoring hyphae** sparse to ± abundant, †2–3.3(–4) µm wide, walls 0.2–0.4(–1.2) µm thick {2}. **SCBs** in paraphyses and ectal excipulum (near margin) globose, 1.5–3 µm diam.; **LBs** in ectal excipulum 1–3(–4) µm diam., light yellow-orange (but absent in another apothecium examined), at margin and in paraphyses much smaller. **Exudate** over paraphyses 0.3–2.5 µm thick, cloddy, hyaline to very pale yellowish, ± loosely attached, over margin and flanks 1–4 µm thick, forming large, very rough clods. — **ANAMORPH**: unknown.

Habitat: collected (0–)0.2–1 m above the ground, corticated, 8–11 mm thick branches of *Acacia* sp. {1}, *Banksia menziesii* {1}, *Eremaea pauciflora* {1}, *Verreauxia reinwardtii* {1}, on 0.3 mm deep strongly decayed bark {2} (bast), strongly greyed, without or with some or many green algae. **Associated**: *Capronia* sp. {1}, *Gloniopsis praelonga* {1}, *Hyalorbilia juliae* {1}, *Orbilia australiensis* {1}, *O. austrocylindrica* {2}, *O. austroobtusispora* {1}, *O. aviceps* {1}, *O. aviflagellata* {1}, *O. curvativitalbae* {2}, *O. eucalypti* {2}, *O. helicoobliqua* {1}, *O. hesperidea* {1}, *O. lilacina* {1}, *O. microserpens* {2}, *O. multicurvula* {1}, *O. multiserpens* {1}, *O. myriolilacina* {1}, *O. myrioobliqua* {1}, *O. nothovinosa* {1}, *O. paraobliqua* {1}, *O. pleioaustraliensis* {1}, *O. pleioaustrocylindrica* {1}, *O. pleistovitalbae* {1}, *O. plurililacina* {2}, *O. triangulispora* {1}, *Ostropales* {1/1}, ?*Parmelia* sp. {1}, *Patellaria* ?*andina* {1}, *Proliferodiscus olivaceoviridis* {2}, ?*Triblidium* sp. {1}. **Desiccation tolerance**: paraphyses and spores still viable for at least 4 months, after 13 months only spores alive. **Altitude**: 77–380 m a.s.l. **Geology**: Archean & Cretaceous sedimentary rock (whitish to ochre sandy soil). **Phenology**: long-lived.

Taxonomic remarks. *Orbilia amberina* is characterized by a remarkable amber-orange colour of the apothecia, partly due to orange LBs in the excipulum, and broadly ellipsoid ascospores with comparatively large globose SBs attached by a very short filum. The North American *O. yuccae* differs in pale yellowish apothecia and distinctly inflated apical ends of the marginal cortical cells, also in narrower spores with the SBs being closely attached to the spore apex without a filum, and in smaller asci. *O. amberina* is also similar to *O. lilacina* with which it grew in close association; the latter deviates in pure rose-lilaceous apothecia and somewhat narrower spores with distinctly smaller SBs. For the similar *O. ovoidea* see p. 1254. *O. eremaeae* (Pls 798–799) resembles *O. amberina* in apothecial colour and in the spores, but the spores are much longer, and the asci consistently possess distinct apical thickenings.

Variation. The collection on *Eremaea* deviates from the others in somewhat smaller spores (*3.7–4 × 2.6–2.8 µm, though on the photo from a different apothecium they measured

*4.2–4.6 × 3.2–3.5 µm, Pl. 771: 3d), and in smaller terminal cells of paraphyses (†8–13 × 1.5–2 µm). Also the apothecia were smaller than in the holotype. The sample on *Acacia* deviates in a tendency to strongly inflated paraphysis apices. However, for the samples on *Acacia* and *Banksia* some of these data were not available.

Ecology. *O. amberina* was found on decayed bark of xeric branches of different angiosperm trees and shrubs in the Darling Plateau of southwestern Australia, in subtropical semihumid eucalypt woodlands or banksia-eucalypt-acacia open wood- and shrublands (Swan Coastal Plain), also in a subtropical semiarid acacia shrubland (Avon Wheatbelt).

Specimens included. **AUSTRALIA**: **Western Australia**, Avon Wheatbelt, 78 km NE of Wubin, 18 km SW of Mt. Singleton, 380 m, twig of *Acacia*, 24.XI.2001, G. Marson (H.B. 7204l ø). – Swan Coastal Plain, 150 km N of Perth, 13 km WNW of Moora, Dandaragan Road, 235 m, branch of *Verreauxia reinwardtii*, on bark, 24.X.2007, G. Marson (ex H.B. 8748c; MEL 2389257A, **holotype**; **isotype** in MEL 2389257B). – 59 km SW of Moora, 8 km NE of Cowalla, Moore River, Orange Springs Rd, 77 m, branch of *Eremaea pauciflora*, on bark, 5.IX.2006, G. Marson (H.B. 8643c). – 48 km NNE of Perth, 4.5 km NE of Muchea, Reserve Road, 97 m, branch of *Banksia menziesii*, 3.IX.2006, G. Marson (G.M. 2006-09-03.3 ø).

Orbilia polyspora Grelet, Bull. Trimest. Soc. Mycol. Fr. 42: 205 (1926) — Pls 772–773, Map 130

Etymology: referring to the 32-spored asci.

Typification: France, Toulon, unlocalized, branch of ?*Rosmarinus officinalis*, VI.1926, A.É. de Crozals (PC, herb. Grelet, holotype); France, Séderon, branches of *Salix eleagnos* var. *angustifolia*, 10.X.2002, G. Marson (ex H.B. 7243b, M-0291765, epitype, designated here, MBT385129, ex-epitype culture: CBS 116226; sq.: KT215276).

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.2–0.8(–1) ((–1.2)) mm diam., (0.12–)0.14–0.21(–0.27) mm high, pale to bright orange(-rose) to brick-red(-vermilion), sometimes ochraceous, ± translucent or not, round to sometimes broadly elliptical, scattered to subgregarious; disc flat to slightly convex, margin thick, 0–25 µm protruding, concolorous or often paler to whitish, smooth or very finely pruinose to crenulate; broadly sessile, sometimes with ill-defined hidden stipe, superficial to distinctly erumpent between fibres, partly ± deeply immersed in biofilm or small clefts; dry bright to deep apricot-orange. **Asci** *(60–)65–95(–102) × (5.5–)6–6.8(–7) µm {13}, †(43–)55–85(–112) × (4.5–)5–6.2(–6.8) µm {6}, 32-spored (28–32 spores counted), spores (2–)4-seriate, about half of spores inversely oriented (strongly mixed), pars sporifera *(30–)40–50(–58) µm long; **apex** (†) (slightly to) medium (rarely strongly) truncate (always not indented, laterally not or hardly inflated), thin-walled (0.2–0.4 µm); **base** with short to medium long, ± thick, flexuous stalk, irregularly L- or h-shaped. **Ascospores** *(3.5–)4–5(–6) × (1.9–)2.1–2.5(–2.8) µm {16}, †3.5–4.7 × 2–2.3 µm {2}, (subcylindric-)ellipsoid(-fusoid), apex rounded to obtuse, straight to very slightly inequilateral; **SBs** *(0.8–)1.1–1.5(–1.6) × (0.5–)0.7–0.9(–1) µm {10}, subglobose to mostly broadly tear-shaped, apically narrowed to a small to wide point, rarely with a very short filum. **Paraphyses** apically (slightly to) medium to strongly clavate-capitate, terminal cells *(12–)16–30(–42) × (2–)3–5.5(–6.5) µm {7}, †11–32 × 2.5–4.5 µm {2}, lower cells *8–26 × 1.7–2.7 µm {3}, †11–20(–31) × 1.5–2 µm {1}; sometimes branched at upper septum, hymenium very pale to light rose(-orange). **Medullary excipulum** very pale to light rose, 30–70 µm thick, of dense textura intricata with many inflated cells, lower part of t. intricata or ± distinct horizontal t. porrecta, sharply delimited. **Ectal excipulum** (hyaline to) pale or light rose, of (*) thin-walled, (†) medium to strongly thick-walled (gelatinized), vertically oriented t. (globulosa-) angularis(-prismatica) from base to mid flanks or submargin, 20–60 µm thick at base and lower flanks, cells *(7–)10–20(–25) × (6–)8–15(–17) µm {11}; ~20–50 µm thick near margin, of t. globulosa-angularis to t. prismatica-porrecta oriented at a ~40–80° angle to the surface, cells *7–12(–17) × 5–7(–12) µm {2}, outer part of margin and mid or even lower flanks composed of abruptly hyaline, upwards curved, dense, somewhat flexuous, usually dead and then very thick-walled hair-like hyphae {22} forming a 15–45 µm thick compact layer that resembles a t. oblita, terminal cells †15–50(–94) × 2.8–4.5(–5.5) µm {8}, with 0–2 septa near base, wall †1–2 µm thick (2-layered: thin outer layer high-refractive, thick inner layer low-refractive), **glassy processes** and true **hairs** absent. **Anchoring hyphae** abundant, */†(2–)2.5–4(–5) µm wide, walls */†(0.2–)0.3–1(–1.5) µm thick {7}, sometimes forming a loose or dense, 50–100 µm thick t. intricata, also with projecting hyphal strands, at flanks gradually intergrading with the hair-like hyphae. **SCBs** globose {15}, in paraphyses 1–3 µm diam.; in inner part of marginal ectal excipulum 0.6–2 µm. **Exudate** over paraphyses 1–5 µm thick, hyaline, breaking into large clods, loosely attached but firmly so in older apothecia, over margin and flanks granular to cloddy or continuous, 0.3–3 µm thick. — **ANAMORPH**: vermispora-like (presumed, from natural substrate {4}, culture did not produce conidia). **Conidiophores** not seen. **Conidia** unbranched, strongly attenuated at the ends, medium to strongly curved, *36–55 × 7–8.3 µm (in situ, 42–70 µm actual length), 7–10-septate {2}.

Habitat: collected 0.1–3 m above the ground, ± corticated to decorticated, 2–21 mm thick twigs and branches of *Cercis siliquastrum* {4}, *Cytisus scoparius* {3}, indet. *Fabales* {1}, *Genista scorpius* {1}, *Petteria ramentacea* {1}, *Pinus* sp. {1}, *Quercus ilex* {1/1}, *Q. rotundifolia* {2}, *Rosa* sp. {1}, *Rubus fruticosus* agg. {1}, *Salix eleagnos* var. *angustifolia* {1}, *S.* ?*viminalis* {1}, *Sorbus aria* {1}, *Spartium junceum* {5}, *Ulex parviflorus* {1}, on 0.1–1 mm deep or in total medium to strongly decayed wood {24} and bark {10} (bast and periderm), periderm often detached or removed, sometimes below detaching bark, wood partly eroded or bleached, sometimes in beetle galleries (partly on boring dust), slightly to strongly greyed, with some or often many green algae. **Associated**: *Baggea* sp. {1}, *Caloplaca* sp. {2}, *Capronia* sp. {1}, *Claussenomyces* sp. {4}, *Cyathicula* ?*cacaliae* {1}, *Dacrymyces* sp. {4}, *Durella atrocyanea* {1}, *D.* ?*compressa* {1}, *D. connivens* {1}, *D.* aff. *connivens* {1/1}, *Ionomidotis fulvotingens* {1}, *Lecanora* sp. {1}, *Mellitiosporiella pulchella* {2}, *Nitschkia broomeana* {1/1}, *Orbilia aprilis* {1}, *O. carpoboloides* {1}, *O. cercidicola* {2}, *O. corculispora* {1}, *O. eucalypti* {1}, *O. gambelii* {3}, *O. hesperidea* {1}, *O. microserpens* {1}, *O. montigena* {1}, *O. myriosphaera* {4}, *O. ovoidea* {1}, *O. pleiogambelii* {3/1}, *O. pleiomicrosoma* {1}, *O. sarothamni* {1}, *O. subaristata* {3}, *O. subclavuliformis* {3}, *O. subovoidea* {1}, *O. trapeziformis* {1}, *O.* ?*tremulae* {1}, *O. vinosa* {4}, *Patellaria atrata* {3}, *Peniophora* sp. {2}, *Phragmiticola* sp. {1}, *Trichopeziza perrotioides* {1}, *Trichosphaerella decipiens* {1}. **Desiccation tolerance**: fully viable for at least 4 months, some mature asci still alive after 7 months, paraphyses and excipular cells after 1 year. **Altitude**: 9–1202 m a.s.l. **Geology**: Middle-Upper Jurassic & Cretaceous and Miocene lime- & sandstone, dolomite, calcareous marl, clay & sand. **Phenology**: II–X, XII (throughout the year, long-lived).

Taxonomic remarks. *Orbilia polyspora* is well characterized by 32-spored asci and ± ellipsoid spores with a broadly tear-shaped to almost globose spore body, also by rather long, thick-walled, hair-like cortical excipular cells at flanks and margin, which are agglutinated to form a compact hyaline layer. Due to this layer the apothecia have a rather thick, more whitish margin and can also macroscopically be recognized. The Australian *O. plurililacina* differs mainly in shorter asci and shorter terminal cells of the paraphyses and marginal ectal excipulum. *O. canadensis* and *O. subovoidea* mainly deviate in spore number (see there). *O. sarothamni* (section *Hemiorbilia*) resembles *O. polyspora* in the 32-spored asci and somewhat similar spores, but clearly differs in acute spore apices and larger SBs, also in slightly thick-walled ascus apices and thin-walled, much shorter marginal cortical cells.

Variation. Although *O. polyspora* is quite a constant species, some variation is noted in spore and SB shape. The

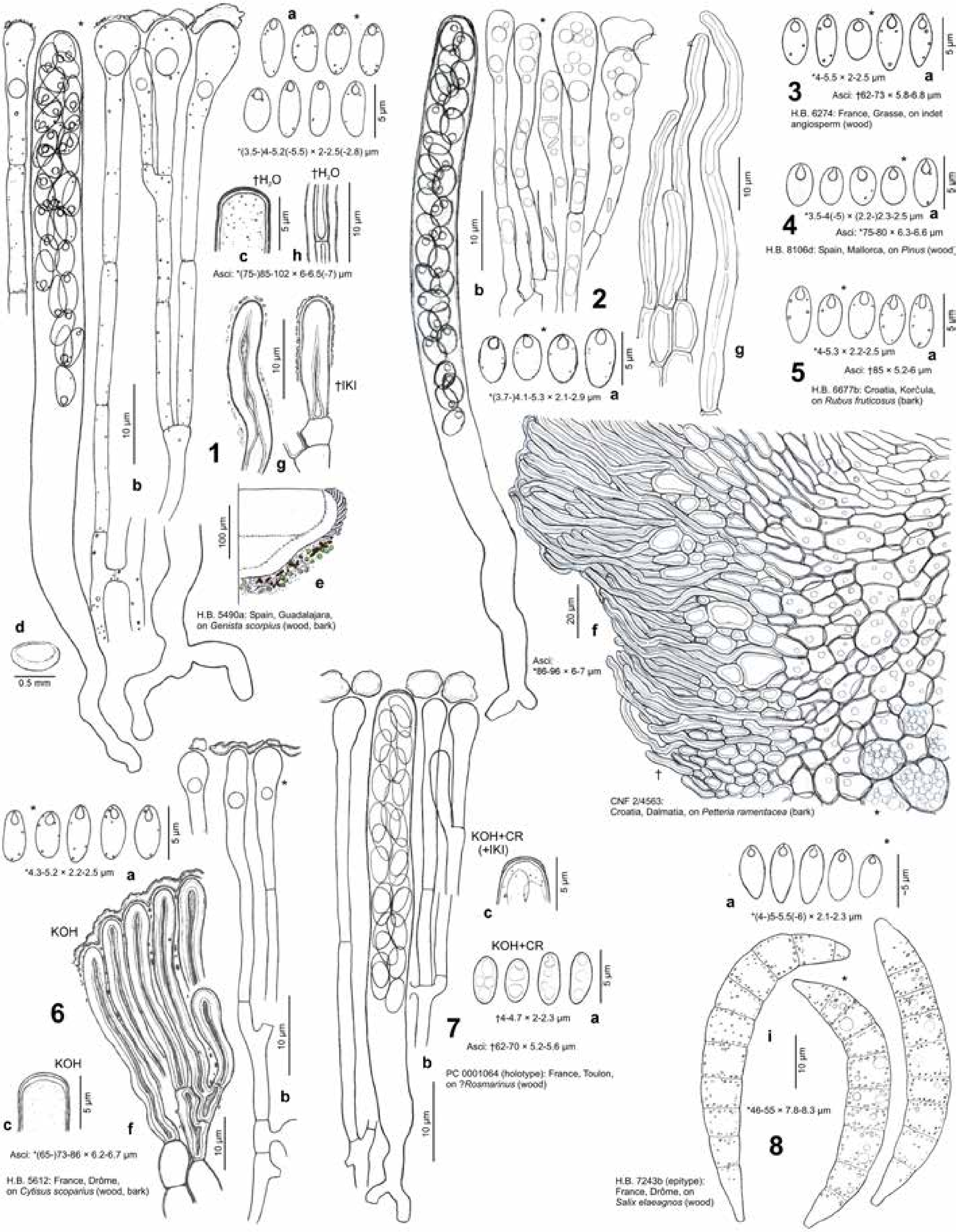


Plate 772. **1–8**: *Orbilia polyspora*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. rehydrated apothecium; **e**. apothecium in median section; **f**. id., marginal ectal excipulum with hair-like cortical cells (with internal wall thickenings when in the dead state); **g**. hair-like cortical cells (separated by pressure); **h**. anchoring hypha; **i**. conidia from substrate. – **2a–g**: del. N. Matočec.

SBs are attached by a smaller or larger point by a very short filum or triangular connecting part. In some collections some asci showed a spore number much less than 32, with extremely oversized spores. These large spores closely resemble those of

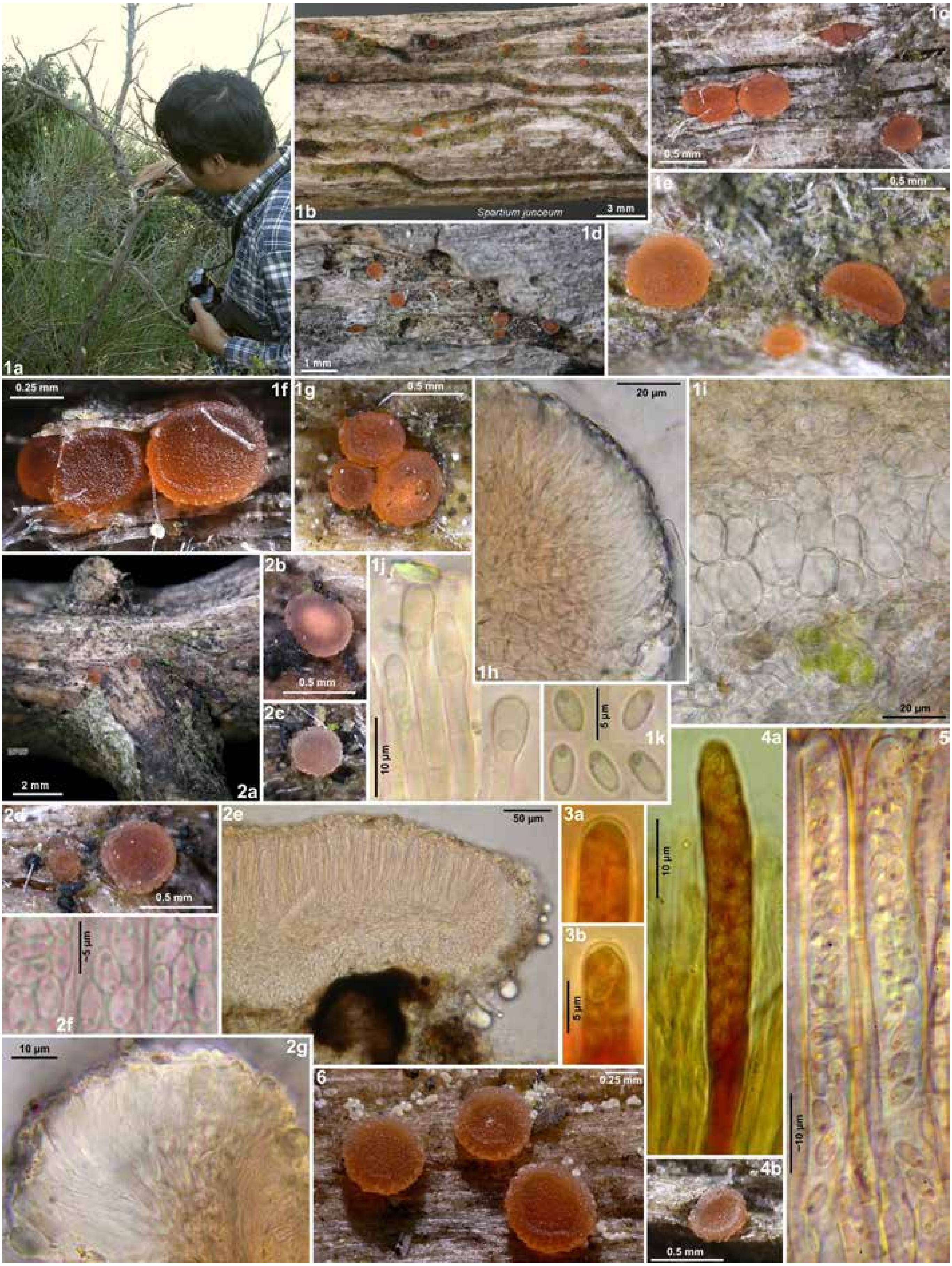


Plate 773. **1–6**: *Orbilia polyspora*. – **1a**. mediterranean macchia with *Spartium junceum*; **1b**, **2a**. decorticated xeric branches (rehydrated); **1b–g**, **2a–d**, **4b**, **6**. rehydrated apothecia; **2e**. apothecium in median section; **1h**, **2g**. id., marginal ectal excipulum with hyphoid, thick-walled cortical elements; **1i**. id., basal ectal excipulum; **3a–b**. ascus apices; **4a**, **5**. asci; **1j**. paraphyses; **1k**, **2f**. ascospores. – Living state, except for **3a–b** (in KOH+CR+IKI), **4a** (in KOH+IKI), **2g** (in H_2O), asci in **2f**. — **1a–k**. H.B. 9158b: France, Nyons, on *Spartium*; **2a–g**. H.B. 8738a: Spain, Castellón, on *Ulex*; **3a–b**. PC 0001064 (holotype): France, Toulon, on ?*Rosmarinus*; **4a–b**. H.B. 6468b: France, Narbonne, on *Spartium*; **5**. H.B. 7270a: France, Roussillon, on *Spartium*; **6**. 14.VIII.2009: France, Digne, on *Cytisus*.

the 8-spored *O. ovoidea*, which once even grew in association. Obviously, *O. ovoidea* is closely related to *O. polyspora*, but differs in the consistent absence of polysporous asci.

Type studies. Grelet (1926, 1948a: 53) considered *O. polyspora*, which he reported to grow on ‘probably *Rosmarinus officinalis*’, to be a polysporous form of *O. coccinella* (s.auct., = *O. eucalypti* or *O. tremulae*). He described the asci as ‘? ~24-spored’ or ‘usually 24-spored’, and the spores with ‘a minute guttule at each end’. Judging from his drawing (1926: pl. VIII fig. 29, 1948a: fig. 24) these guttules probably represent spore bodies. In the present reexamination of the holotype, which matches very well the protologue and the living specimens examined here, 28–32 spores were counted. Although remnants of SBs could not clearly be seen, we can assume that Grelet was in error when reporting the spores as biguttulate.

A specimen from France (Séderon, on *Salix*, Pl. 772: 8, IVV: H.B. 7243b), from which a sequence was gained, is designated here as **epitype** of *O. polyspora*.

Clements (1909:174) used the name *Orbilia polyspora* as a Latin circumscription of the genus *Myridium* (‘an *Orbilia* with polysporous asci’, see under *Orbilia myriospora*, p. 1679), not as a valid binomial.

Anamorph. In four collections we have seen large phragmoconidia near apothecia of *O. polyspora* (Pl. 772: 8). Similar conidia are presumed as anamorph of some other species of section *Ovoideae*. Since the apical conidial end looks similar as the basal end, the place of attachment cannot unequivocally be recognized, and some conidia might be wrongly oriented on the plates.

Phylogeny. A sample on *Salix* from dépt. Drôme, France (H.B. 7243b) was twice sequenced from pure culture, comprising SSU (without S1506 intron), ITS, and LSU, resulting in fully identical sequences. Another sample from the same department (on *Cercis*, not shown in phylograms) differs in 1 nt and 1 insert in the ITS1 and 1 nt in the LSU D1.

O. polyspora shows a distance of 17–19.5 % (ITS) and 5–6 % (LSU D1–D2) to the other members of section *Ovoideae*, to which it stands in sister position.

Ecology. *O. polyspora* was collected on ± rotten wood, more rarely bark of xeric twigs and branches of various angiosperm (exceptionally gymnosperm) trees and shrubs, preferably *Fabaceae*. The known distribution is ± restricted to the southern European mediterranean belt, where it occurs in suprasub- to mesomediterranean semihumid zones (see also Tkalčec et al. 2008). The vegetation includes maquis (*Quercetum ilicis*, *Juniperetum thuriferae*), and old *Olea* plantations. However, one collection (on *Sorbus aria*) was from cold-temperate humid eastern France (dépt. Doubs) in a thermophilous calcareous lawn with *Anthyllis montana* and scattered shrubs of *Juniperus communis* etc., and also a sample from Southern French Alps (on *Salix* ?*viminalis*) falls in the cold-temperate zone (border to suprasubmediterranean).

Specimens included. **FRANCE**: **Franche-Comté**, **Doubs**, 4 km SW of Ornans, 1 km W of Chassagne-St.-Denis, Rocher du Cul Blanc, 525 m, branch of *Sorbus aria*, on wood, 21.X.2017, G. Moyne (J.P.P. 17237, doc. vid.). – **Rhône-Alpes**, **Drôme**, 3.5 km N of Die, 1.8 km SW of Chamaloc, 552 m, twigs & branches of *Salix* ?*viminalis*, on wood & bark, 12.VIII.2001, G. Marson (H.B. 7062). – 1 km N of Nyons, Col du Pontias, 460 m, branches of *Cercis siliquastrum*, on wood, 22.VIII.1996, G. Marson (ø). – ibid., 18.VIII.2001, G. Marson (H.B. 7077b). – ibid., 11.X.2002, G. Marson (ø). – ibid., 12.IX.2018 (G.M. 2018-09-12.11; sq.: MK473391). – ibid., branches of *Spartium junceum*, on wood, 11.X.2002, G. Marson (H.B. 7293c). – ibid., twig of *Quercus ilex*, on wood, 13.VIII.2009, B. Liu & H.O. Baral (H.B. 9149a). – ibid., branches of *S. junceum*, on wood, 13.VIII.2009, G. Marson, H.O. Baral & B. Liu (H.B. 9158b). – 16.3 km E of Nyons, 1.5 km NNW of Bellecombe, SW of Col de Soubeyrand, 880 m, twigs of *Cytisus scoparius*, on wood & bark, 10.X.2002, G. Marson (H.B. 7251a, anam. substr.). – 9.7 km W of Séderon, 3.3 km NW of Montbrun-les-Bains, 627 m, branches of *Salix eleagnos* var. *angustifolia*, on wood & bark, 10.X.2002, G. Marson (ex H.B. 7243b, M-0291765, **epitype**, anam. substr., CBS 116226; sq.: KT215276). – 25 km WNW of Sisteron, 1 km SW of Ballons, SSE of Col de St.-Jean, 900 m, twigs of *C. scoparius*, on wood & bark, 23.VIII.1996, G. Marson (H.B. 5612). – **Provence-Alpes-Côte d’Azur**, **Alpes-de-Haute-Provence**, 15 km N of Digne-les-Bains, 3.7 km SSW of Barles, Clues de Barles, 910 m, branch of *C. scoparius*, on wood & bark, 14.VIII.2009, G. Marson (ø). – 12 km NE of Grasse, 4 km NE of Gourdon, 600 m, branch of indet. *Fabales*, on wood, 19.IX.1998, D. Triebel & G. Rambold (G.R. 6256/7, M-0229705/6, H.B. 6274 ø, anam. substr.). – **Vaucluse**, 18 km SE of Carpentras, 9 km NNW of Roussillon, ESE of Col de Murs, 552 m, branch of *Spartium junceum*, on wood, 9.X.2002, G. Marson (H.B. 7270a). – **Var**, around Toulon, unlocalized, branch of ?*Rosmarinus officinalis*, on wood, VI.1926, A.É. de Crozals (PC 0001064, herb. Grelet, **holotype**, H.B. 7734a ø). – **Languedoc-Roussillon**, **Aude**, 15 km SSW of Narbonne, 3.7 km NNW of Sigean, Reserve africaine, 9 m, branch of *Spartium junceum*, on wood, 21.IX.1999, H.O. Baral (H.B. 6468b). — **SPAIN**: **Navarra**, 10 km NNW of Tafalla, 3.3 km NE of Artajona, 480 m, twig of ?*Quercus ilex*, on wood, 8.II.2014, M. Tapia, vid. E. Rubio (E.R.D. 6125). – **Asturias**, 2.4 km N of Pola de Somiedo, 2 km S of Castro, 703 m, twig of *Rosa*, on wood, 7.VI.2013, H.O. Baral (H.B. 9824). – **Castilla-La Mancha**, **Guadalajara**, 18 km SW of Sigüenza, 2.5 km NE of Almadrones, 1065 m, branch of *Quercus rotundifolia*, on wood, 24.IX.1999, H.O. Baral (ø). – 43 km NNW of Guadalajara, 2 km NNW of Tamajón, Ermita de los Enebrales, 1040 m, twig & branch of *Genista scorpius*, on wood & bark, 14.V.1996, H.O. Baral (H.B. 5490a). – 9 km ENE of Alcalá de Henares, SSW of Los Santos de la Humosa, 875 m, branch of *Q. rotundifolia*, on bark, 23.V.1996, H.O. Baral (H.B. 5497). – **Cuenca**, 18 km SSE of Cuenca, 5 km SW of Fuentes, 1202 m, *Spartium junceum*, on wood, 27.IV.2015, J.P. Priou (J.P.P. 15113, doc. vid.). – **Com**. **Valenciana**, **Castellón**, 51 km W of Castellón, 6 km SE of Barracas, 980 m, twig of *Ulex parviflorus*, on bark & wood, 27.XII.2007, J.P. Priou (H.B. 8738a). – **Islas Baleares**, **Mallorca**, 15 km NNW of Palma, 4.3 km WSW of Valldemossa, NE of Coll de Claret, 480 m, branch of *Pinus*, on wood, 26.III.2006, R. Reuter, vid. G. Marson (H.B. 8106d ø, anam. substr.). — **CROATIA**: **Split-Dalmatia**, 3.2 km ENE of Zagvozd, 11 km WSW of Imotski, podr. Brežine, 635 m, twig of *Petteria ramentacea*, on bark, 27.VII.2000, N. Matočec (CNF 2/4563, doc. vid.). – **Dubrovnik-Neretva**, **Korčula**, 11 km W of Korčula, 1.5 km W of Račišće, S of Zaglavak peak, 50 m, branch of *Rubus fruticosus*, on bark, 4.VI.2000, H.O. Baral (H.B. 6677b ø).

Map 130. Known distribution of *O. polyspora* in Europe.

Orbilia lilacina Baral & G. Marson, **sp. nov.**, MB 813913 — Pls 774–775

Etymology: named after the rose-lilaceous apothecial colour.

Typification: Western Australia, Moora, branches of *Verreauxia reinwardtii*, 24.X.2007, G. Marson (ex H.B. 8748b, MEL 2389256, holotype).

Latin diagnosis: *Apothecia rehydratata 0.2–0.4 mm diam., vivide roseo-lilacina, sessilia, margine laevi. Asci 8-spori. Ascosporae *4.5–8 × 2.4–3.3 µm, subcylindricae ad ellipsoideae vel fusoideae, corpusculum refringens globosum, ad apicem cuspide brevi affixum continentes. Excipulum marginale textura prismatica crassitunicata, absque processis vitreis. Habitat ad corticem putridum ramorum siccorum* Eucalypti *et* Verreauxiae *in zona subtropica semihumida Australiae meridio-occidentalis.*

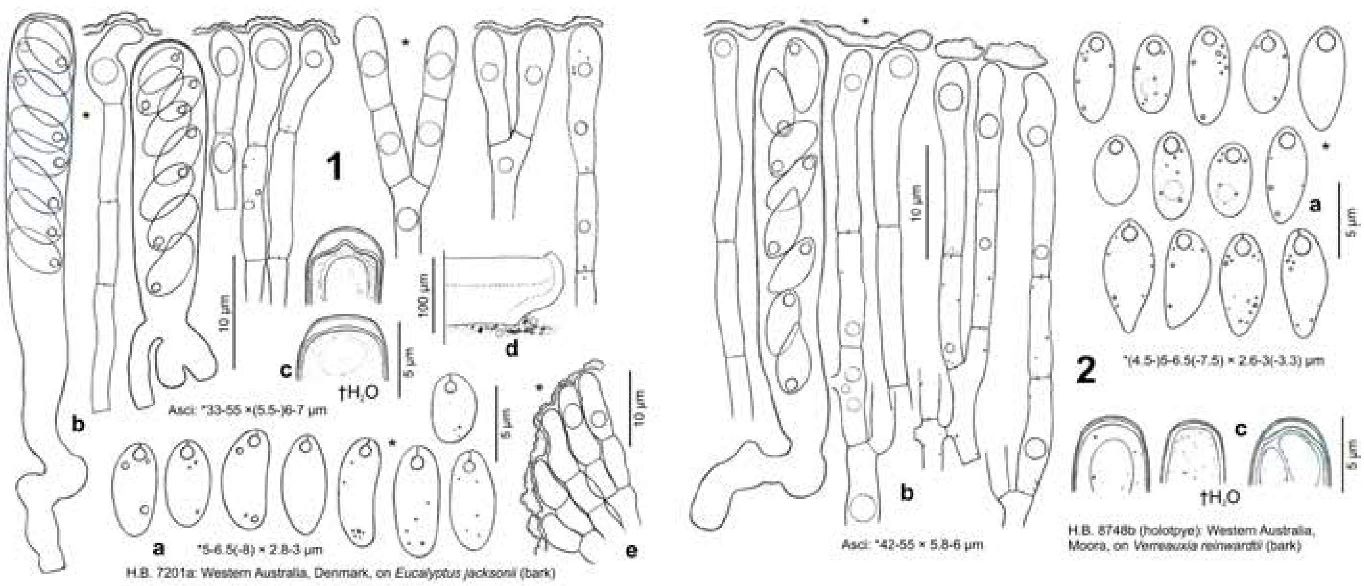


Plate 774. **1–2**: *Orbilia lilacina*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. apothecium in median section; **e**. id., marginal ectal excipulum.

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.15–0.4 mm diam., 0.09–0.15 mm high (receptacle 0.07 mm), (pale to) light to bright rose-lilaceous, semitranslucent, round, scattered; disc flat, margin distinct, thin, 5–10 µm protruding, ± smooth; sessile on a ± broad base, superficial; dry bright rose-pink(-orange). **Asci** *33–55 × 5.5–7 µm {2}, †29–46(–52) × 4.5–5 or 5.7–6.2 µm {2}, 8-spored, spores (*) obliquely subbiseriate, (2–)3–6 lower spores inverted {2} (often mixed), pars sporifera *23–32 µm long; **apex** (†) slightly to medium truncate, dome absent {1} or present, †1–1.2 → 0.8–1.2 µm thick {2}, often with distinct apical chamber; **base** without or with short to medium long, thick, flexuous stalk, L- to Y-shaped. **Ascospores** *(4.5–)5–7(–8) × (2.4–)2.6–3(–3.3) µm {2}, subcylindrical to ellipsoid, also fusoid, both ends rounded to obtuse (exceptionally subacute), straight to slightly inequilateral; **SBs** *(1–)1.2–1.6(–1.8) × (0.7–)0.9–1.1(–1.3) µm {2}, ± globose, apically abruptly narrowed to a very short, thin filum (attachment sometimes invisible). **Paraphyses** apically uninflated or slightly (rarely medium) clavate or lageniform, sometimes flexuous, terminal cells *7–18 × 2–3.7 µm {2}, lower cells *7–15 × 1.6–2.5 µm {2}, near base partly *2.5–3(–3.5) µm wide; rarely branched

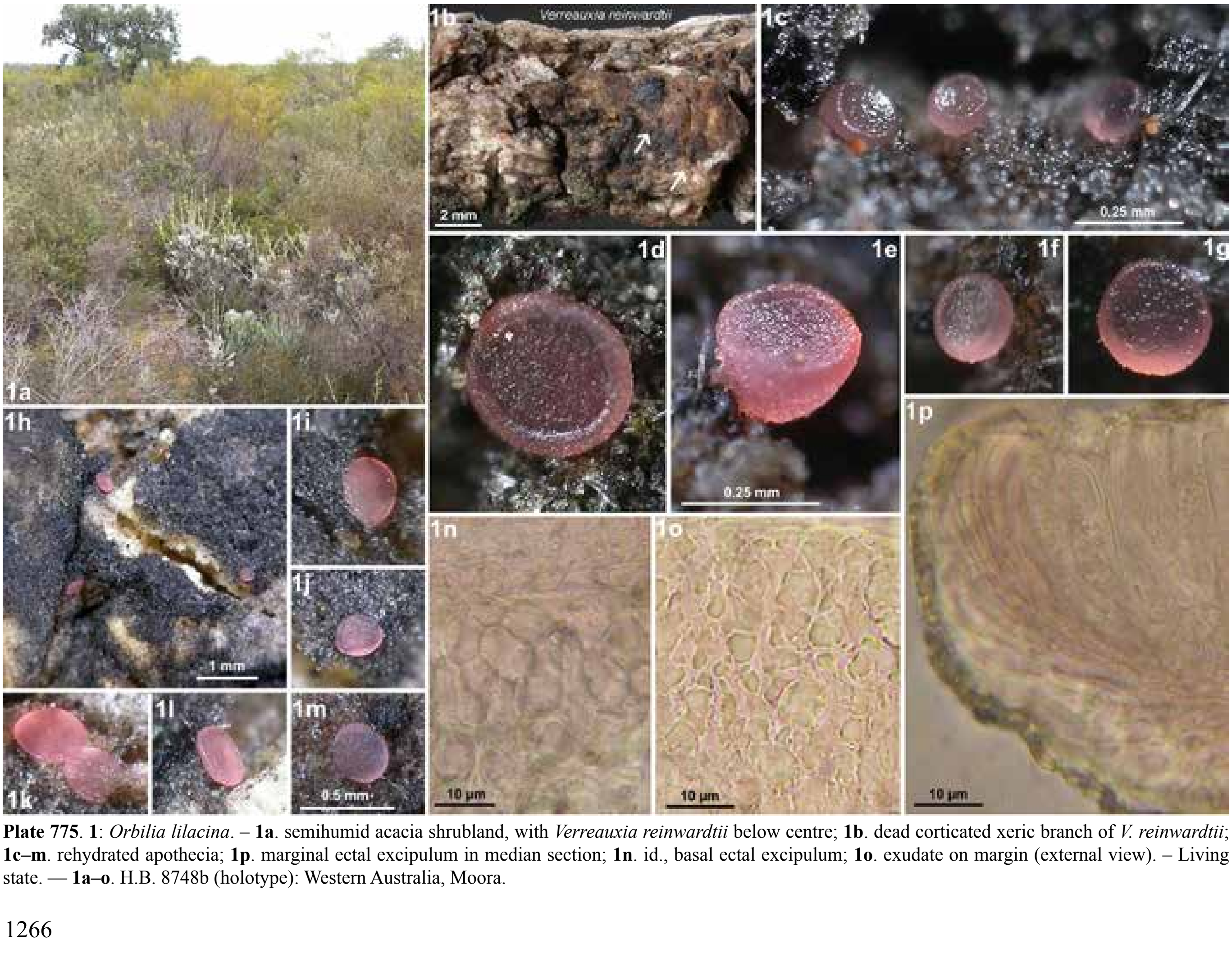


Plate 775. **1**: *Orbilia lilacina*. – **1a**. semihumid acacia shrubland, with *Verreauxia reinwardtii* below centre; **1b**. dead corticated xeric branch of *V. reinwardtii*; **1c–m**. rehydrated apothecia; **1p**. marginal ectal excipulum in median section; **1n**. id., basal ectal excipulum; **1o**. exudate on margin (external view). – Living state. — **1a–o**. H.B. 8748b (holotype): Western Australia, Moora.

at upper septum. **Medullary excipulum** pale rose or cream, 15–40 µm thick, of dense textura globulosa-intricata of partly rather large cells, non-gelatinized, indistinctly or sharply delimited at flanks by a 6–8 µm thick t. porrecta. **Ectal excipulum** hyaline to pale rose, of (†) medium gelatinized (common walls 1–2 µm thick {2}) t. globulosa-angularis(-prismatica) from base to mid flanks, 15–90 µm thick near base, cells †7–15 × 4.5–10 µm {2}; at mid flanks of t. prismatica oriented at a 30–70° angle to the surface, 10–15 µm thick near margin, of t. (angularis-)prismatica(-porrecta) oriented at 10–30°, marginal cortical cells *7–10.5 × 2.7–4 µm {2}, living cells at flanks and margin appearing thick-walled; **glassy processes** absent. **Anchoring hyphae** medium abundant, †2–3.7 µm wide, walls (0.2–)0.5–0.8 µm thick {1}. **SCBs** in paraphyses and ectal excipulum (near margin) globose, 1.5–2.5 µm diam. **Exudate** over paraphyses 0.3–0.8 or 1–2(–3) µm thick, cloddy-continuous, rough, hyaline, loosely attached; over margin and flanks 1–3 µm thick, forming very rough clods. — **ANAMORPH**: unknown.

Habitat: collected 0.2–4 m above the ground, large pieces of bark of *Eucalyptus jacksonii* {1}, entirely detached from trunk and fallen from above, now hanging in understory, 7–11 mm thick corticated branches of *Verreauxia reinwardtii* {1}, on medium to very decayed bark {2} (periderm {1} or bast {1}), strongly greyed or blackened, no or a few green algae. **Associated**: *Lachnum eucalypticola* {1}, *Orbilia amberina* {1}, *O. aviaristata* {1}, *O. curvativitalbae* {1}, *O. nanosperma* {1}, *O. plurililacina* {1}, *O. ?pseudoflagellispora* {1}, *O. triangulispora* {1}, *Ostropales* {1}, *Proliferodiscus olivaceoviridis* {1}. **Desiccation tolerance**: fully viable for at least 9 months. **Altitude**: 195–235 m a.s.l. **Geology**: Cretaceous sedimentary rock; granite with alkali feldspar. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia lilacina* resembles the European *O. subovoidea* in shape of ascospores and SBs, also in the paraphyses and their globose SCBs. *O. subovoidea* differs in more orange-rose apothecia and longer asci. *O. lilacina* is also similar to the North American conifer-inhabiting *O. clavipisca*, especially concerning the apical dome, but differs in much smaller asci and shorter, basally often not attenuated spores with smaller SBs, also in large SCBs in the paraphysis apices. Especially a Canadian collection on coniferous substrate mentioned under *O. clavipisca* (Pl. 796: 4) is similar to *O. lilacina* but deviates in light orange apothecia. *O. plurililacina*, *O. myriolilacina* and *O. pleistolilacina* differ from *O. lilacina* in polysporous asci and the consistent absence of apical domes. For the similar *O. amberina* which grew in association with *O. lilacina* see p. 1260.

Variation. The holotype collection (Pls 774: 2; 775), on corticated branches of *Verreauxia*) differs from that on detached bark of *Eucalyptus* in more lilaceous apothecia, narrower asci, the predominant absence of an apical dome, larger SBs, and longer and narrower terminal cells of paraphyses, but these differences appear to represent variation of a single species. In the holotype the spores vary between ellipsoid and fusoid, depending on the apothecium, also in the size of spores and SBs. In the four examined apothecia of the paratype the asci were consistently provided with an apical dome.

Ecology. *O. lilacina* was found on ± rotten bark of xeric branches of *Eucalyptus* (*Myrtaceae*) and *Verreauxia* (*Goodeniaceae*) at two subtropical semihumid localities in southwestern Australia: the holotype in a eucalypt open woodland at the northern end of Darling Range, and the paratype in a eucalypt open forest (karri-tingle) at the southern end of Darling Range.

Specimens included. **AUSTRALIA**: **Western Australia**, Swan Coastal Plain, 150 km N of Perth, 13 km WNW of Moora, Dandaragan Road, 235 m, branches of *Verreauxia reinwardtii*, on bark, 24.X.2007, G. Marson (ex H.B. 8748b, MEL 2389256, **holotype**, **isotype** in holotype of *O. amberina*). – Warren, 30 km SE of Pemberton, 14 km ENE of Northcliffe, W of Shannon, Middleton Road, 195 m, branch of *Eucalyptus jacksonii*, on bark, 16.XII.2001, G. Marson (H.B. 7201a).

Orbilia plurililacina Baral, G. Marson & E. Weber, **sp. nov.**, MB 813914 — Pls 776–777

Etymology: named after the 32-spored asci and the similarity with *O. lilacina*. **Typification**: Australia, New South Wales, Lithgow, branch of *Eucalyptus*, 26.X.1998, G. Marson (ex H.B. 6764a, MEL 2389215, holotype).

Latin diagnosis: Orbiliae lilacinae *similis sed asci 32-spori, apice in statu emortuo tenuitunicati, ascosporae minores. Habitat ad corticem putridum ramulorum et ramorum siccorum fruticorum vel arborum angiospermarum in zona temperata humida vel subtropica semihumida Australiae meridio-orientalis et -occidentalis.*

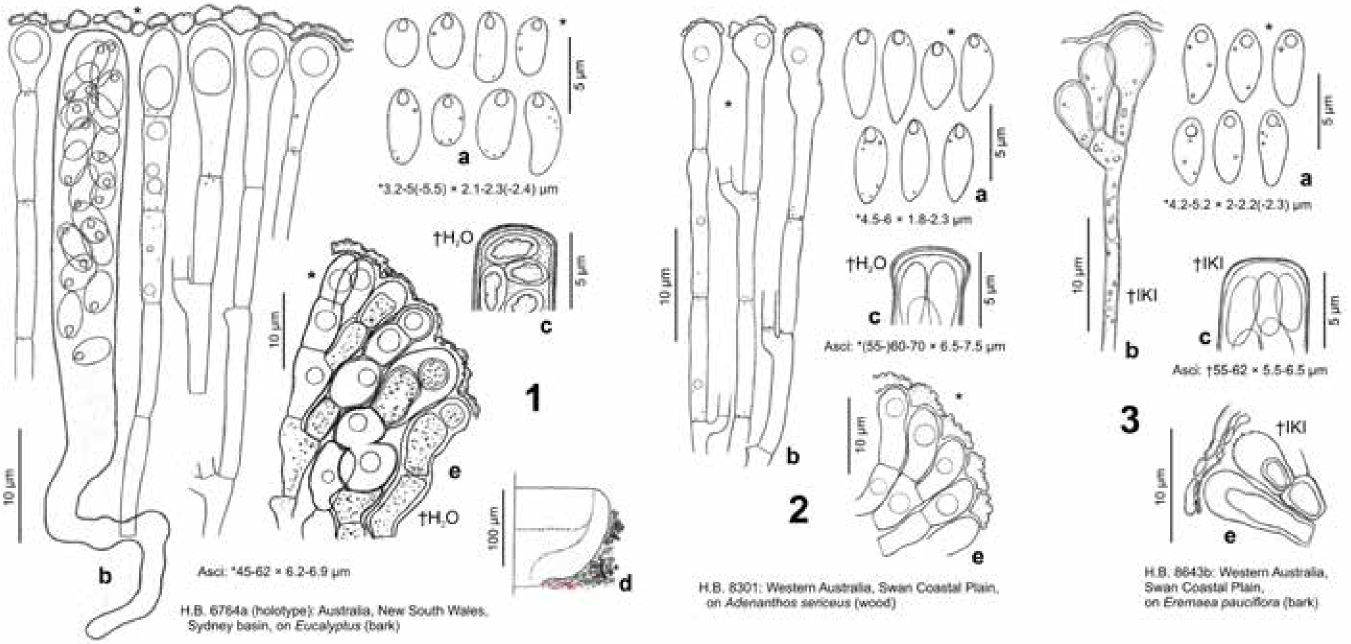


Plate 776. **1–3**: *Orbilia plurililacina*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apices; **d**. apothecium in median section; **e**. id., marginal ectal excipulum, cortical cells with internal wall thickenings in dead state.

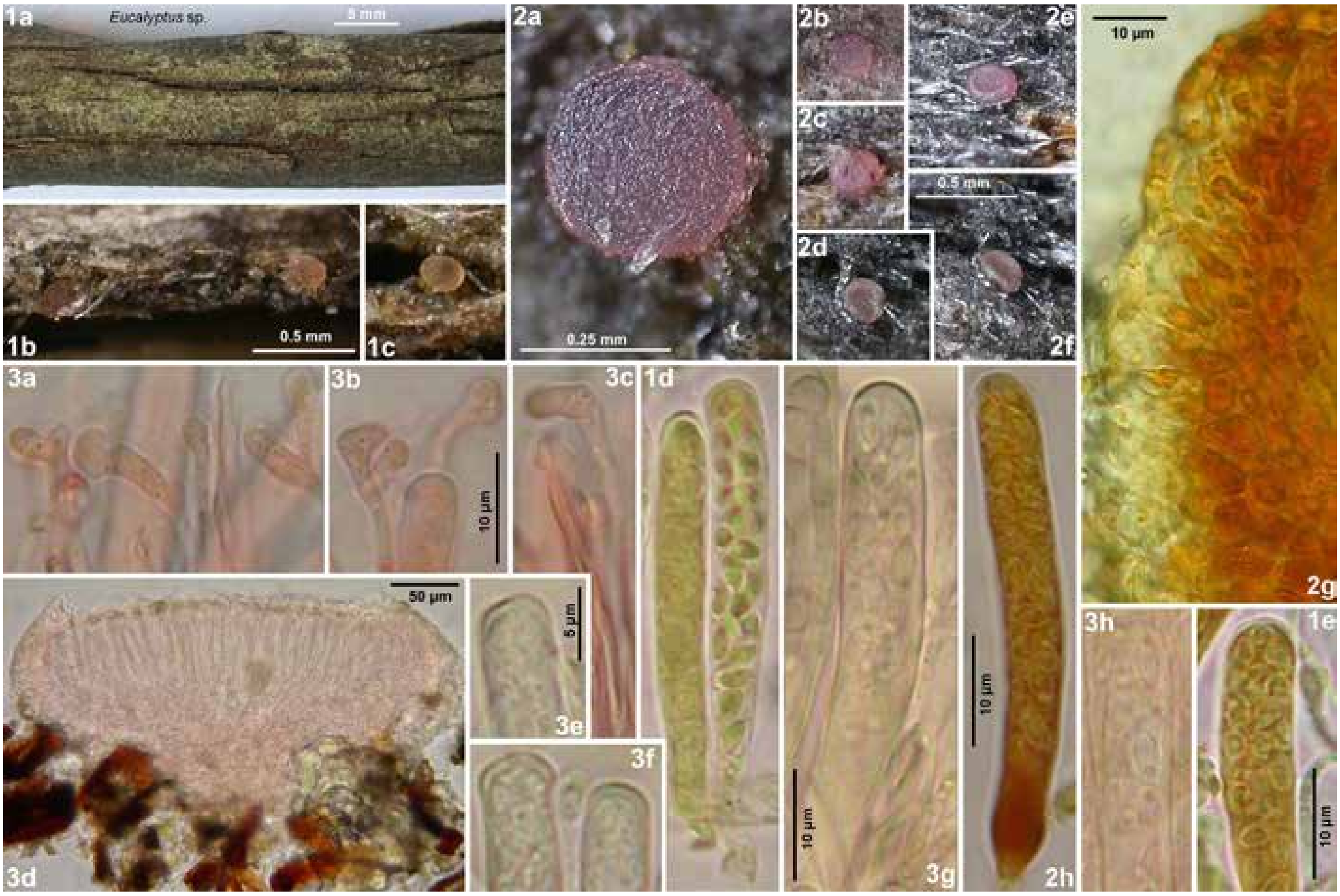


Plate 777. **1–3**: *Orbilia plurililacina*. – **1a**. dead corticated xeric branch of *Eucalyptus*; **1b–c**, **2a–f**. rehydrated apothecia (**1**: after 8 years, **2**: after 1 year); **3d**. apothecium in median section; **2g**. id., marginal ectal excipulum; **1d–e**, **2h**, **3a–c**, **g–h**. asci and paraphyses; **3e–f**. ascus apices. – Living state, except for **1d**, **2g–h** (in KOH+IKI); **3a–c** (in KOH+CR); **3e–f** (in H_2O). — **1a–d**. H.B. 6764a (holotype): Australia, New South Wales, Sydney Basin, on *Eucalyptus*; **2a–f**. H.B. 8643b: Western Australia, Swan Coastal Plain, on *Eremaea*; **3a–h**. H.B. 8301: ibid., on *Adenanthos*.

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.1–)0.2–0.35(–0.4) mm diam., 0.08–0.15 mm high (receptacle 0.08–0.11 mm), light rose or rose-lilaceous (pink), semitranslucent, round, very scattered; disc flat, margin distinct, ± thick, 0–10 µm protruding, smooth; sessile or with ill-defined stipe up to 0.04 × 0.09 mm, superficial or slightly erumpent, ± immersed in biofilm, dry bright rose-pink. **Asci** *(40–)45–62(–70) × 6–7.5 µm {3}, †40–62(–72) × 5.5–6.5(–7) µm {3}, 32-spored, spores (2–)4-seriate, some of the spores inversely oriented (strongly mixed), pars sporifera *29–37 µm long; **apex** (†) slightly to strongly truncate (never indented, laterally rarely inflated), thin-walled; **base** with short to medium long, ± thick, flexuous stalk, L- or h-shaped. **Ascospores** *(3.2–)4–5.5(–6) × (1.8–)2–2.3(–2.5) µm {3}, †3.5–4.8 × 1.8–2.1 µm {1}, cylindric-ellipsoidal to ellipsoid-fusoid(-clavate), apex rounded or obtuse, rarely subacute, base rarely or often somewhat tapered, straight to slightly inequilateral, exceptionally slightly curved; **SBs** *(0.8–)0.9–1(–1.2) × 0.7–0.8(–0.9) µm {3}, broadly tear-shaped to subglobose or globose, apically closely attached or narrowed to a small to wide point, rarely with a very short filum. **Paraphyses** apically slightly to strongly clavate-capitate, rarely spathulate, sometimes irregularly bent, terminal cells *(6–)8–16(–18) × 3–4.3 µm {2}, †5–14 {1} × 2.7–4.5 µm {2}, lower cells *8–13 × 1.5–1.8(–2) µm {2}; rarely or often branched at upper septum. **Medullary excipulum** pale rose, 10–50 µm thick, of medium dense textura intricata with many inflated cells, medium sharply delimited from ectal excipulum by a distinct thin t. porrecta. **Ectal excipulum** of hyaline, slightly to medium gelatinized t. globulosa-angularis(-prismatica) from base to margin or mid flanks, 20–50 µm thick near base, irregularly oriented at a 45–90° angle to the surface, cells *8–15 × 5–10 µm {3}; 25–30 µm thick at flanks, 15–20 µm near margin, of t. prismatica-angularis oriented at 30–70° or of t. prismatica-porrecta at 10–30°, marginal cortical cells */†5–10 × 4–6 µm, at upper margin 5.5–12 × 3–4 µm {3}, (*) firm-walled and refractive, (†) partly strongly thick-walled: inner layer low-refractive, total wall near apex up to 1–3 µm thick, **glassy processes** absent. **Anchoring hyphae** sparse to medium abundant, *†(2–)2.5–3.5(–4.5) µm wide, walls 0.2–1.2 µm thick {3}. **SCBs** globose, in paraphyses 1.2–3.5 µm diam., in ectal excipulum 1.5–3 µm. **Exudate** over paraphyses (0.3–)1–2(–3) µm thick, over margin and flanks 1–3 µm, rough-cloddy, hyaline. — **ANAMORPH**: unknown.

Habitat: lying on dry ground or hanging in 0.2–2 m above the ground, partially or entirely corticated, 5–12 mm thick twigs and branches of *Adenanthos sericeus* {1}, *Eremaea pauciflora* {1}, *Eucalyptus* sp. {1}, *Verreauxia reinwardtii* {1}, on 0.3 mm deep medium to strongly decayed bark {4} (periderm {1} and bast {2}), bark partly loosely attached, medium to strongly greyed, no or a few to many green algae. **Associated**: *Capronia* sp. {1}, *Gloniopsis praelonga* {1}, *Hyalorbilia juliae* {1}, *Orbilia amberina* {2}, *O. austrocylindrica* {1}, *O. curvativitalbae* {2}, *O. eucalypti* {1}, *O. lilacina* {1}, *O. microserpens* {1}, *O. multicurvula* {1}, *O. ?parviclava* {1}, *O. pleistovitalbae* {1}, *O. triangulispora* {1}, indet. *Ostropales* {1}, *Proliferodiscus olivaceoviridis* {2}. **Desiccation tolerance**: ± fully viable for at least 2 years. **Altitude**: 77–1073 m a.s.l. **Geology**: Permian-Triassic and Cretaceous sedimentary rock (ochraceous to whitish sand). **Phenology**: long-lived.

Taxonomic remarks. *Orbilia plurililacina* is very similar to European *O. polyspora* but differs in several respects: the asci and their pars sporifera, also the cells of the paraphyses are shorter. The ascospores closely correspond to *O. polyspora* though they are slightly narrower and the SBs somewhat shorter. The apothecia are smaller and not easy to discern, and have a pure rose(-lilaceous) colour in contrast to the usually orange apothecia of *O. polyspora*. A further difference lies in the thick-walled marginal cells of the ectal excipulum which form a thinner and much shorter-celled layer than in *O. polyspora*. *O. lilacina*, *O. myriolilacina* and *O. pleistolilacina* differ from *O. plurililacina* mainly a deviating spore number of their asci, but also somewhat in spore dimensions. *O. multiaustrocylindrica* (section *Orbilia*) differs in longer and narrower spores, more thin-walled marginal cortical cells, and orange apothecia.

Variation. The southwestern Australian collections of *O. plurililacina* on *Adenanthos*, *Eremaea* and *Verreauxia* each consisted of only 1–5 apothecia, which were larger (0.25–0.4 mm) than in the ca. 8 apothecia in the holotype on *Eucalyptus* from southeastern Australia which measured only 0.2–0.25 mm diam. In the southwestern Australian collections the spores were more fusoid with partly shortly tapered base. In the sample on *Adenanthos* the SBs differed in being more broadly attached whereas in those on *Eremaea* and *Verreauxia* the SBs were ± globose and attached by a short, hardly visible filum. Otherwise these collections match the holotype rather well.

Apothecial colour in the samples on *Eremaea*, *Eucalyptus*, *Verreauxia* was noted as light to bright rose when examined 1–2 years after collection when they were still alive, but this colour faded to brownish-cream after further 6 years (Pl. 777: 1b–c). In the collection on *Adenanthos* the apothecia were noted as rose-lilaceous when alive, but on the macrophoto of the *Eremaea* sample they look bright lilaceous (Pl. 777: 2a–f).

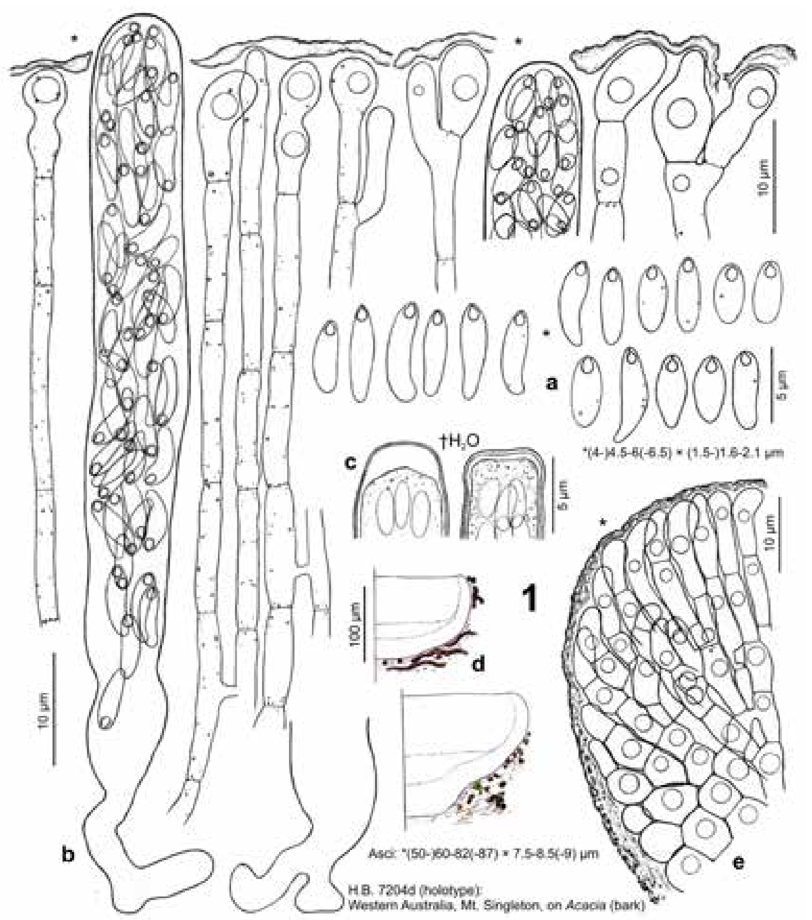


Plate 778. **1**: *Orbilia myriolilacina*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. apothecia in median section; **e**. id., marginal ectal excipulum.

Ecology. *O. plurililacina* was found on ± rotten bark of xeric twigs and branches of *Goodeniaceae*, *Myrtaceae* and *Proteaceae* in subtropical semihumid banksia-eucalypt-acacia open wood- and shrublands in the Darling Plateau of southwestern Australia and in a cold-temperate humid eucalypt open forest in the Great Dividing Range of southeastern Australia.

Specimens included. **AUSTRALIA**: **Western Australia**, Swan Coastal Plain, 57 km SW of Moora, 10 km NE of Cowalla, Moore River, Orange Springs Rd, 83 m, branch of *Adenanthos sericeus*, on bark, 5.IX.2006, G. Marson (H.B. 8301 ø). – 59 km SW of Moora, 8 km NE of Cowalla, Moore River, Orange Springs Rd, 77 m, twig of *Eremaea pauciflora*, on bark, 5.IX.2006, G. Marson (H.B. 8643b ø). – 150 km N of Perth, 13 km WNW of Moora, Dandaragan Road, 235 m, branch of *Verreauxia reinwardtii*, on bark, 24.X.2007, G. Marson (ø). – **New South Wales**, Sydney Basin, 95 km WNW of Sydney, 11.5 km SE of Lithgow, 1.6 km SE of Mt. York, 1073 m, branch of *Eucalyptus*, on bark, 26.X.1998, G. Marson (ex H.B. 6764a, MEL 2389215, **holotype**).

Orbilia myriolilacina Baral & G. Marson, **sp. nov.**, MB 813915 — Pls 778–779

Etymology: referring to the 64-spored asci and the resemblance to *O. lilacina*.

Typification: Western Australia, Wubin, twigs & branches of *Acacia*, 24.XI.2001, G. Marson (ex H.B. 7204d, MEL 2389224, holotype).

Latin diagnosis: Orbiliae plurililacinae *similis sed asci 64-spori*, *ascosporae angustiores. Habitat ad corticem putridum*, *raro lignum*, *ramulorum et ramorum siccorum* Acaciae *et* Lamarcheae *in zona subtropica semiarida Australiae meridio-occidentalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.2–0.35 mm diam., 0.11–0.16 mm high (receptacle 0.1–0.12 mm), light brick-red(-orange) or typically rose-lilaceous (pink), scarcely translucent, round, very scattered; disc flat, margin distinct, 0–5 µm protruding, smooth; sessile or with an indistinct stipe, nearly superficial but immersed in biofilm. **Asci** *(50–)60–80(–88) × (7.3–)8–8.5(–9) µm {3}, †(45–)55–75(–82) × 6.2–7.5 µm {T} (up to 9.5 µm when flattened), 64-spored (~50–55 spores counted), spores (*) multiseriate, lower spores inverted (very strongly mixed), pars sporifera *39–65 µm long {T}; **apex** (†) medium to strongly truncate (very slightly indented, laterally slightly inflated), thin-walled; **base** with (very) short, thick, flexuous stalk, T-, L- or h-shaped. **Ascospores** *(3–)3.8–5.5(–6.5) × (1.3–)1.5–1.9(–2.1) µm {3}, †4–5 × 1.4–1.6 µm {1}, subcylindrical, also fusoid to fusoid-clavate, more rarely ellipsoid, apex rounded to obtuse, rarely subacute, base not or slightly (rarely medium) attenuated, straight or slightly to medium curved in middle or lower part; **SBs** *0.8–1.1 × (0.6–)0.7–0.8(–0.9) µm {3}, (sub)globose to broadly tear-shaped, apically closely attached to spore wall, with or without a very short filum. **Paraphyses** apically slightly to strongly clavate-capitate, often moniliform or irregularly curved, rarely lageniform, terminal cells *(5–)7–15(–21) × (2.5–)3.5–5(–5.5) µm {2}, lower cells *(7.5–)9–16.5 × 1.5–2.8(–3.7) µm {1}; rarely to frequently branched at upper septum, hymenium pale rose. **Medullary excipulum** hyaline to pale rose, 10–40 µm thick, of medium dense textura intricata with many inflated cells, sharply delimited. **Ectal excipulum** hyaline to pale rose, of thin-walled († slightly gelatinized), vertically oriented t. globulosa-angularis from base to submargin, 20–40 µm thick near base, cells *11–17(–23) × 10–14 µm {1}; 20–25 µm thick near margin, upper margin of t. prismatica oriented at a 20–45° angle to the surface, marginal cortical cells *7–17 × 3–4.3 µm {1} (appearing thin-walled); **glassy processes** absent. **Anchoring hyphae** sparse, *2–3 µm wide, walls 0.2–0.3 µm thick {1}. **SCBs** absent or globose, in paraphyses 1.5–2.7 µm diam., in ectal excipulum (near margin) 1.5–4.5 µm. **Exudate** over paraphyses 0.5–2 µm thick, cloddy-continuous, hyaline to very pale yellowish, loosely attached; over margin and flanks 1–2(–3) µm thick, cloddy to granular. **— ANAMORPH**: unknown.

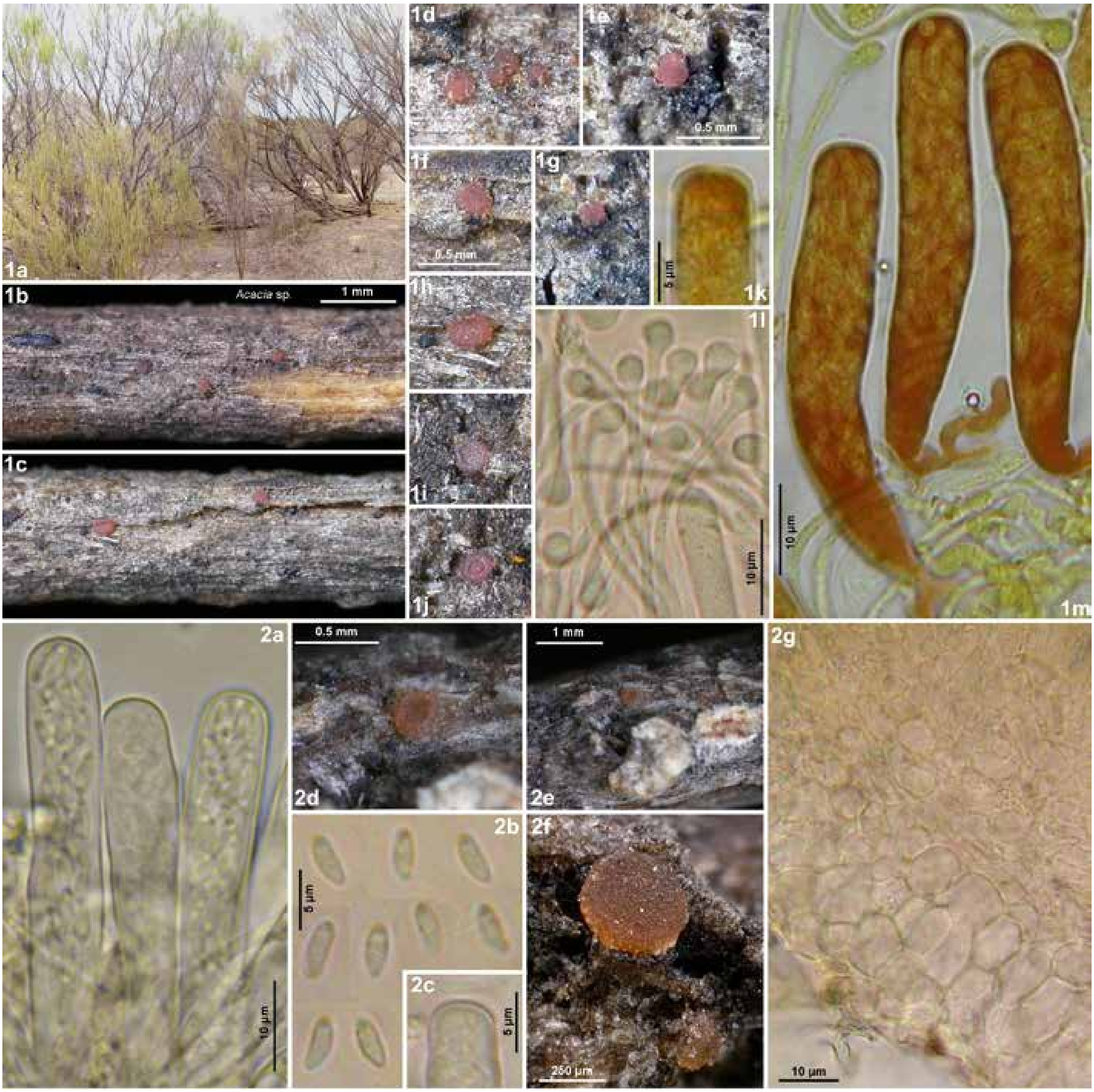


Plate 779. **1–2**: *Orbilia myriolilacina*. – **1a**. semiarid eucalypt woodland with *Acacia*; **1b–c**. decorticated xeric twigs of *Acacia*; **1b–j**, **2d–f**. rehydrated apothecia (**1b–j** after 6 years); **2g**. ectal excipulum in median section (lower flanks); **1m**, **2a**. mature asci; **1l**. paraphyses; **1k**, **2c**. ascus apices; **2b**. ascospores. – Living state, except for **2c** (in H_2O); **1l** (in KOH); **1k**, **m** (in KOH+ IKI). — **1a–m**. H.B. 7204d (holotype): Western Australia, Mt. Singleton, on *Acacia*; **2a–g**. H.B. 9020j: Western Australia, Yalgoo, on *Lamarchea*.

Habitat: collected 0.5–2 m above the ground, partially to almost entirely decorticated, 1.5–8 mm thick twigs and branches of *Acacia* sp. {2}, *Lamarchea hakeifolia* {1}, on medium to strongly decayed bark (periderm and bast) {2}, rarely on wood {1}, greyed, algae absent or sparse. **Associated**: *Amandinea* sp. {2}, *Caloplaca* sp. {1}, *Capronia* sp. {2}, *Claussenomyces* sp. {1}, *Hyalorbilia pleioerythrostigma* {1}, *Orbilia amberina* {1}, *O. anguliobliqua* {1}, *O. australiensis* {2}, *O. austroobtusispora* {2}, *O. aviflagellata* {1}, *O. curvatiobliqua* {1}, *O. gemma* {1}, *O. helicoobliqua* {2}, *O. hesperidea* {2}, *O. kingsiana* {1}, *O. lamarcheae* {1}, *O. microserpens* {1}, *O. multiserpens* {1}, *O. myriofusiclava* {1}, *O. myriomuscula* {1}, *O. myrioobliqua* {2}, *O. nothovinosa* {1}, *O. paraobliqua* {2}, *O. pleioaustraliensis* {2}, *O. pleioaustrocylindrica* {1}, *O. pseudoflagellispora* {1}, *O. ?pubescens* {1}, *Ostropales* {2}, ?*Parmelia* sp. {1}, *Patellaria ?andina* {1}, ?*Triblidium* spp. {2}, *Symbiotaphrina desertorum* {2}, ?*Xerotrema* sp. {1}. **Desiccation tolerance**: fully viable after 20 months. **Altitude**: 190–379 m a.s.l. **Geology**: Archean and Cretaceous sedimentary rock (light ochre soil, red-brown sand). **Phenology**: long-lived.

Taxonomic remarks. *Orbilia myriolilacina* is very similar to *O. pleioaustrocylindrica* and *O. multiaustrocylindrica* (both in section *Orbilia*), from which it mainly differs in 64-spored asci and rose-red to pink apothecia. *O. pleistolilacina* with similarly pinkish apothecia differs in longer, 128-spored asci, also in thick-walled marginal excipular cells and thicker apothecia due to the longer asci. *O. plurililacina* differs in 32-spored asci and wider spores.

Variation. In a majority of examined apothecia ± subcylindrical ascospores were observed. Yet, in a few apothecia the living asci contained slightly broader and shorter, more ellipsoid spores. However, in at least one of these apothecia also more cylindrical spores occurred. The sparse collection on *Lamarchea* (Pl. 779: 2) differs in orange apothecia, but seems otherwise congruent with the typical lilaceous populations.

Ecology. *O. myriolilacina* was found on very rotten bark of xeric twigs and branches of *Acacia* (*Mimosoideae*) and *Lamarchea* (*Myrtaceae*). Most of the apothecia grew on bark and only one was found on wood but very close to small remnants of bast. The three collections are from two subtropical semiarid sites in the Darling Plateau of southwestern Australia, in a eucalypt open woodland (on *Acacia*) and an acacia shrubland (on *Lamarchea*).

Specimens included. **AUSTRALIA**: **Western Australia**, Yalgoo, 187 km N of Geraldton, W of Toolonga, Nerren Nerren, 190 m, twig of *Lamarchea hakeifolia*, on bark, 8.XI.2007, G. Marson (H.B. 9020j ø). – Avon Wheatbelt, 78 km NE of Wubin, 18 km SW of Mt. Singleton, 380 m, twig & branch of *Acacia*, on bark, 24.XI.2001, G. Marson (ex H.B. 7204d, MEL 2389224, **holotype**); – ibid., on *Acacia*, 26.X.2010, G. Marson (H.B. 8883k ø).

Orbilia pleistolilacina Baral, G. Marson & E. Weber, **sp. nov.**, MB 813916 — Pls 780–781

Etymology: referring to the 128-spored asci and the resemblance to *O. lilacina*. **Typification**: Western Australia, Pithara, branch of *Eucalyptus*, 25.X.2007, G. Marson (ex H.B. 8746b, MEL 2389255, holotype).

Latin diagnosis: Orbiliae myriolilacinae *similis sed asci 128-spori. Habitat ad corticem putridum ramulorum et ramorum siccorum* Eucalypti *in zona subtropica semiarida et semihumida Australiae meridio-occidentalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.15–)0.22–0.45 mm diam., 0.18–0.27 mm high, light to bright (purplish-)rose-lilaceous, non- or slightly translucent, round, scattered to subgregarious; disc flat, margin ± thick, 0–10 µm protruding, smooth; broadly sessile or with an obconical base, nearly superficial to ± immersed in biofilm; dry bright (dirty) lilaceous to purplish carmine-rose. **Asci** *80–98 × (8–)9–9.5(–10) µm {2}, †(70–)80–93(–110) × (7–)7.5–8(–9) µm {2}, 128-spored (~90–100 spores counted), spores multiseriate, pars sporifera *55–65 µm long (†48–65 µm); **apex** (†) (slightly to) medium to strongly truncate (not or very slightly indented, laterally not or very slightly inflated), thin-walled; **base** with ± short, thick, ± flexuous stalk, T-, L-, Y- to h-shaped. **Ascospores** *(3.7–)4–5(–6) × (1.7–)1.8–2(–2.2) µm {2}, †3.5–4.7 × 1.6–1.8(–2) µm {1}, subcylindrical to cylindric-ellipsoid, sometimes fusoid, apex rounded to obtuse, base not or very slightly, rarely medium attenuated, straight or slightly inequilateral; **SBs** *~0.7–1.1(–1.2) × 0.6–0.8 µm {2}, broadly tear-shaped to subglobose, apically narrowed to a small to wide point, with or without a very short filum. **Paraphyses** apically slightly to strongly clavate-capitate, sometimes spathulate to lageniform or moniliform, terminal cells *7–17 × (2.8–)3.5–5 µm {1}, †(6–)8–20 × 2.5–4 µm {1}, lower cells *12–22 × 1.6–2.2(–2.8) µm {1}, †10–20 × 1.3–1.7 µm {1}; rather frequently branched at upper septum, hymenium pale rose. **Medullary excipulum** pale (lilaceous-) rose(-orange), 30–80 µm thick, of medium dense textura intricata with many inflated cells, medium sharply delimited from ectal excipulum (at flanks by a 10 µm thick t. porrecta). **Ectal excipulum** subhyaline to light rose-lilaceous (especially towards margin, more pale in KOH), of (†) thin-walled to medium gelatinized [common walls (0.2–)0.5–1(–2) µm], indistinctly to ± vertically oriented t. globulosa-angularis from base to mid flanks or submargin, 25–70 µm thick near base, cells */†7–13(–17) × 6–11(–13) µm {2}; 20–30 µm thick near margin, submarginal cells *8–12 µm diam., inner part of upper margin of t. prismatica-angularis, cubical cells oriented at a 30–50° angle to the surface, outer part of hyaline t. prismatica-porrecta oriented at 30–40°, marginal cortical cells */†7–13(–15) × (2.5–)3–4(–5) µm {2}, apically very thick-walled (†1.5–2.5 µm at submargin, †2–4 µm at margin) {T} or apparently thin-walled; **glassy processes** absent. **Anchoring hyphae** sparse to abundant, †(2–)2.5–4(–5) µm wide, walls †0.2–1.2 µm thick {2}. **SCBs** in paraphyses and marginal excipulum globose {2}, (1–)2–3 µm diam. **Exudate** over paraphyses (0.5–)1–2.5(–4) µm thick, cloddy-continuous, hyaline, loosely attached; over margin and flanks 0.2–1(–2) µm thick. **— ANAMORPH**: unknown.

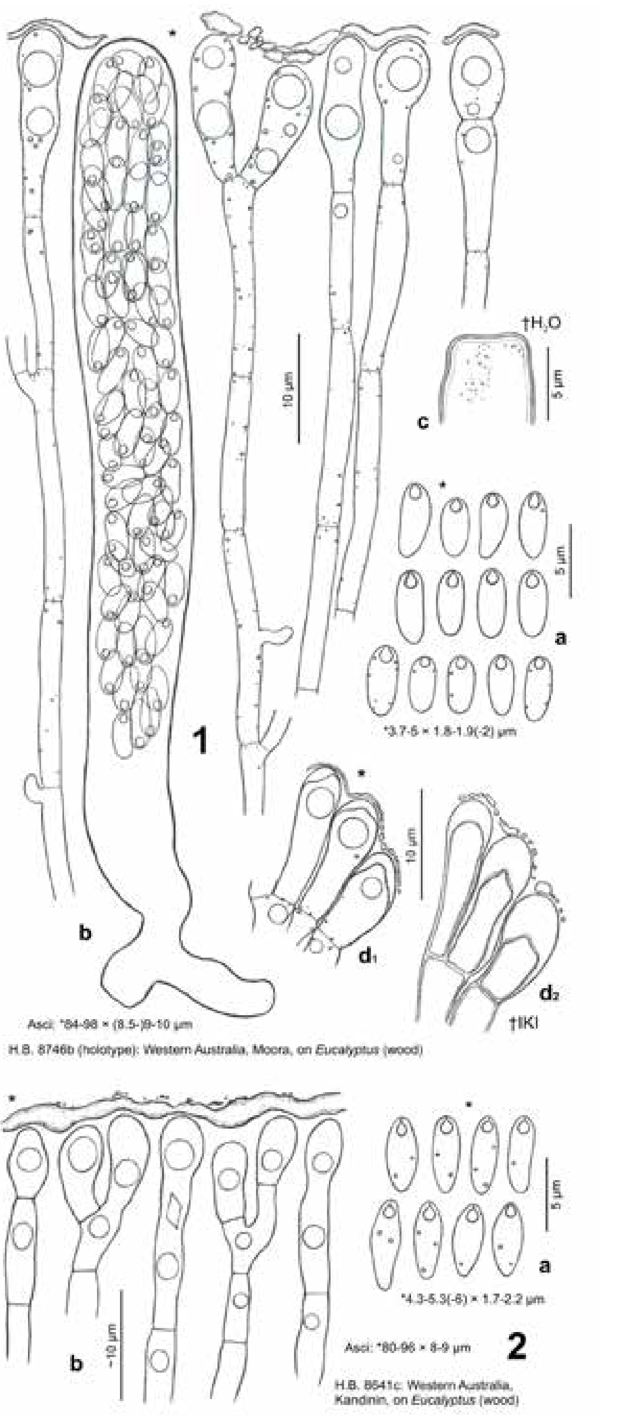


Plate 780. **1–2**: *Orbilia pleistolilacina*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apex; **d**. marginal ectal excipulum in median section, marginal cortical cells with internal wall thickenings that swell in the dead state (**d$_2$**).

Habitat: collected 1–2 m above the ground, decorticated to partially corticated, 5–14 mm thick branches of *Eucalyptus* sp. {2}, on 0.5 mm deep very decayed wood {2}, strongly greyed, green algae very sparse to abundant. **Associated**: ?*Amandinea* sp. {1}, *Dacrymyces* sp. {1}, *Gloniopsis praelonga* {1}, *G. subrugosa* {1}, *Orbilia* ?*multiserpens* {1}, *O. pleioaustrocylindrica* {1}, *Psiloglonium* ?*lineare* {1}, ?*Triblidium* sp. {1}. **Desiccation tolerance**: fully viable for at least 2 months. **Altitude**: 286–326 m a.s.l. **Geology**: granite, granulite with granitic gneiss. **Phenology**: long-lived.

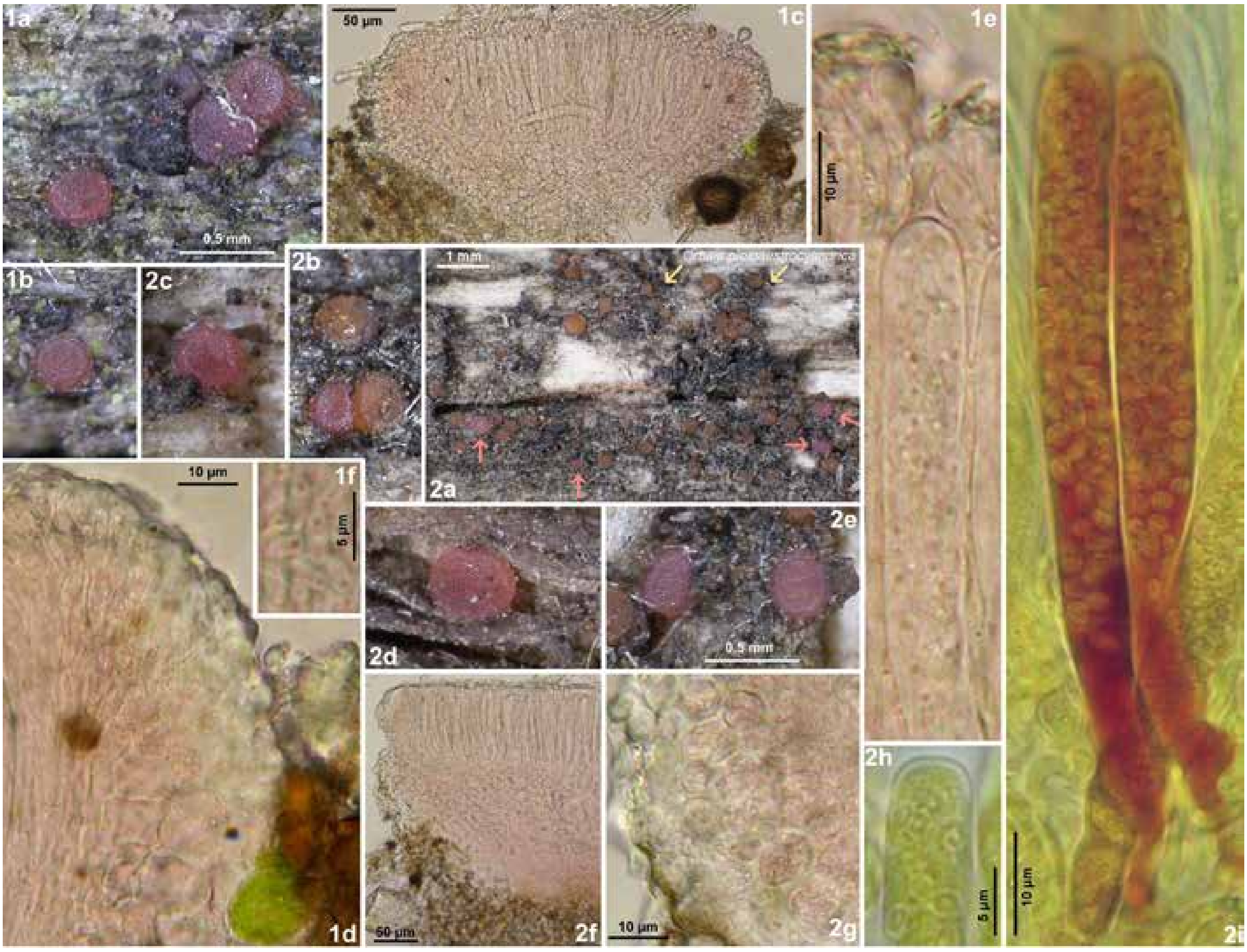


Plate 781. **1–2**: *Orbilia pleistolilacina*. – **1a–b**, **2a–e**. rehydrated apothecia (**2**: mixture with many orange apothecia of *O. pleioaustrocylindrica*); **1c**, **2f**. apothecia in median section; **1d**. id., marginal ectal excipulum; **2g**. id., ectal excipulum at flanks; **1e**, **2i**. asci and paraphyses, **2h**. ascus apex; **1f**. ascospores. – Living state, except for **2g** (in H_2O), **2h–i** (in KOH+IKI). — **1a–e**. H.B. 8746b (holotype): Western Australia, Moora, on *Eucalyptus*; **2a–h**. H.B. 8641c: ibid., Kandinin, on *Eucalyptus*.

Taxonomic remarks. *Orbilia pleistolilacina* is characterized by 128-spored asci and rose-lilaceous apothecia. The species is very closely related to *O. myriolilacina* (see p. 1269). *O. pleistovitalbae* (section *Habrostictis*) differs from *O. pleistolilacina* in elongate tear-shaped SBs, a less thick-walled ectal excipulum, a rough margin due to projecting covering hyphae, and orange apothecia. In the dead state, however, the two species are microscopically hardly distinguishable.

Variation. The paratype deviates from the holotype in narrower asci, in slightly longer spores in which the SBs are consistently narrowed to a small point, and in marginal cortical cells apparently without distinct terminal wall thickenings.

Ecology. *O. pleistolilacina* was found on very rotten wood of xeric branches of *Eucalyptus* in southwestern Australia in a subtropical semiarid eucalypt woodland in a dry floodplain (holotype) and in a semihumid small eucalypt forest in a cornfield. In the paratype (Pl. 779: 2a) the rather scattered apothecia occurred strongly intermingled among the very abundant *O. pleioaustrocylindrica* (section *Orbilia*), often in very close association, but they could easily be recognized by their striking rose-lilaceous colour. This association was very obvious on four of the five collected branch pieces, whereas the also associated *O. multiserpens* occurred more remotely. Six years after the collection was made, the difference in apothecial colour was still clearly visible, but after further 3 years the colour disappeared and the macroscopical distinction from *O. pleioaustrocylindrica* became impossible.

Specimens included. **AUSTRALIA**: **Western Australia**, Avon Wheatbelt, 68 km NE of Moora, 14 km S of Dalwallinu, 1.5 km S of Pithara, 326 m, branch of *Eucalyptus*, on wood, 25.X.2007, G. Marson (ex H.B. 8746b, MEL 2389255, **holotype**). – Mallee, 14 km SSW of Kondinin, 9 km NE of Kulin, Fence Road, 286 m, branches of *Eucalyptus*, on wood, 14.XII.2001, G. Marson (H.B. 8641c).

Orbilia stansburyanae Baral, **sp. nov.**, MB 813917 — Pls 782–783

Etymology: named after the substrate of the type, *Purshia stansburyana*.

Typification: USA, Utah, Dixie Forest, branch of *Purshia stansburyana*, 11.VI.2003, G. Marson (ex H.B. 7918a, M-0276512, holotype).

Latin diagnosis: *Apothecia rehydratata 0.17–0.22 mm diam., aurantiaca, sessilia, margine laevi. Asci 16-spori. Ascosporae *8–12.3 × 3.2–3.7 µm, ellipsoideo-fusoideae vel fusoideo-clavatae, rectae, apice obtusae ad acutae, corpusculum refringens magnum, globosum ad late lacrimiformem, ad apicem confertim affixum continentes. Excipulum marginale absque processis vitreis. Habitat ad lignum putridum rami sicci* Purshiae stansburyanae *in zona orotemperata subhumida Americae septentrionalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.15–0.22 mm diam., 0.12–0.14 mm high (receptacle 0.1–0.11 mm), light orange, slightly translucent, round, gregarious in a small group; disc flat, margin thin, not protruding, smooth; sessile on a narrowed base, slightly erumpent from wood fibres or immersed in biofilm; dry light orange.

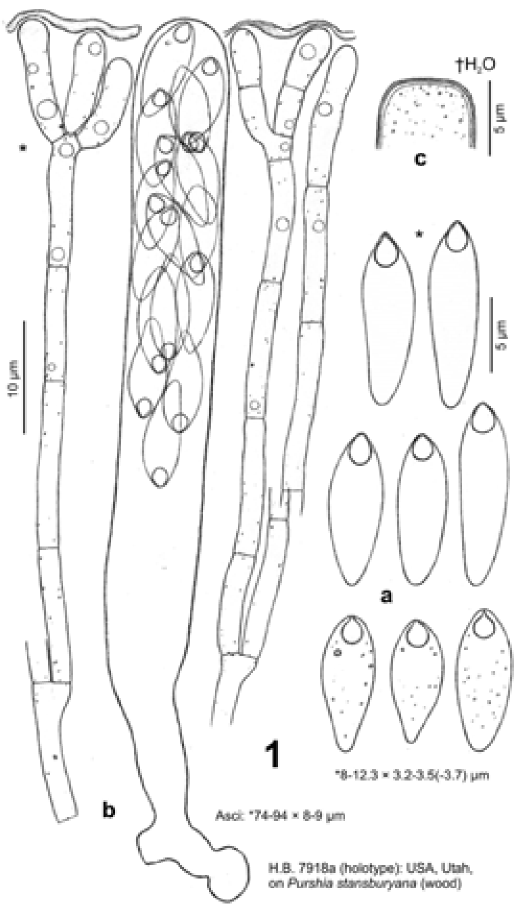


Plate 782. **1**: *Orbilia stansburyanae*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apex.

Asci *74–94 × 8–9 µm, †65–80(–90) × 7–8(–9.5) µm, 16-spored, spores *3–4-seriate, 6–9 lower spores inverted (mostly ± mixed), pars sporifera *41–46 µm long; **apex** (†) medium to strongly truncate (not indented, laterally not inflated), thin-walled; **base** with short to medium long, thick, ± flexuous stalk, L- to Y-shaped. **Ascospores** *8–12.3 × 3.2–3.5(–3.7) µm, ellipsoid-fusoid to fusoid-clavate, apex obtuse to acute, base slightly to strongly attenuated, straight to very slightly inequilateral; **SBs** *(1.7–)2–2.2 × (1.4–)1.5–1.8(–1.9) µm, globose to broadly tear-shaped, apically attached either very closely or narrowed to a small point. **Paraphyses** apically uninflated (to very slightly clavate), terminal cells *5–12 × 2.2–2.8(–3) µm, lower cells *9–15 × 1.6–2.3(–2.7) µm; frequently branched near apex. **Medullary excipulum** subhyaline, 30 µm thick, of dense textura intricata with many inflated cells, sharply delimited only at flanks. **Ectal excipulum** hyaline, of thin-walled († slightly gelatinized), ± vertically oriented t. angularis from base to margin, 30 µm thick near base, cells *7–11 × 5–8(–10) µm; 20 µm thick at flanks and margin, at upper margin of t. prismatica-angularis oriented at a 40–70° angle to the surface, marginal cortical cells *5–7 × 3–4 µm, (†) thin-walled; **glassy processes** absent. **Anchoring hyphae** sparse, †2–3 µm wide, walls †0.2–0.4 µm thick. **SCBs** globose, in paraphyses 0.8–1.7 µm diam., in ectal excipulum (near margin) 1.7–2.7 µm. **Exudate** over paraphyses 0.5–2(–3) µm thick, continuous, hyaline, loosely attached; over margin and flanks granular to cloddy, rather thin, ± scattered. — **ANAMORPH**: unknown.

Habitat: collected 0.5–1 m above the ground, ± decorticated, 15 mm thick branch of *Purshia stansburyana*, on 0.1 mm deep strongly decayed wood, in a broad and shallow beetle gallery close to a deep longitudinal cleft and remnants of bark, greyed, algae very sparse. **Associated**: *Durella* sp., *Mellitiosporiella pulchella*, *Orbilia macrodelphinus*, *O. maeandrina*, *O. microsoma*, *Propolis farinosa*, *Teichosporella dura*, indet. black pycnidia. **Desiccation tolerance**: fully viable for at least 28 months. **Altitude**: 2433 m a.s.l. **Geology**: Quaternary alluvial sandy deposits from granite. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia stansburyanae* is characterized by ± fusoid(-clavate), rather large ascospores with obtuse to acute apices, large, ± globose spore bodies closely attached to the apex, and 16-spored asci. The species might be related to *O. geijerae* which differs in narrower spores with a less tapered apex, and smaller SBs. It also resembles *O. ponderosae*, which differs in shorter spores with a rounded apex, SBs with a more distinct short filum, and in a textura porrecta at the margin.

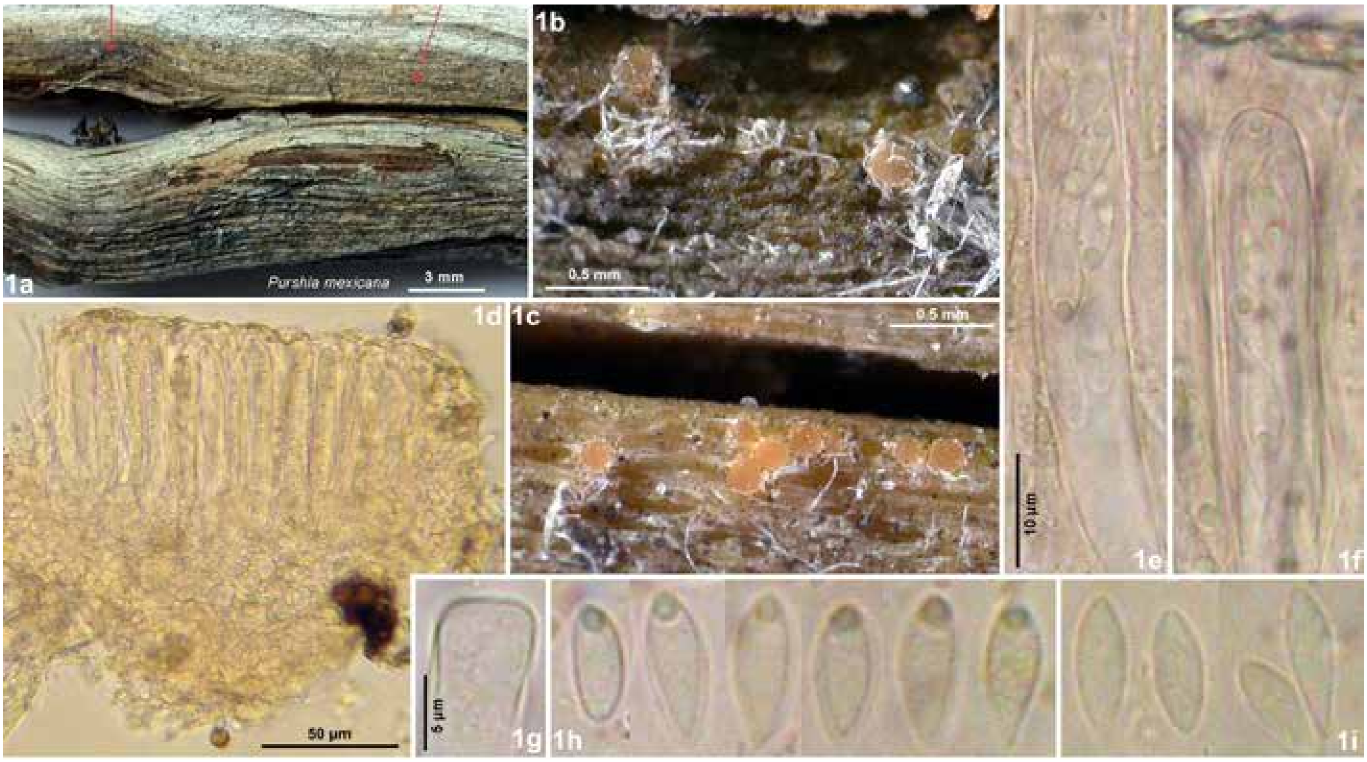


Plate 783. **1**: *Orbilia stansburyanae*. – **1a**. decorticated xeric branch of *Purshia stansburyana*; **1b–c**. rehydrated apothecia; **1d**. apothecium in median section; **1e–f**. mature asci and paraphyses; **1g**. ascus apex; **1h–i**. ascospores. – Living state, except for **1g**, **i** (in KOH). — **1a–h**. H.B. 7918a (holotype): USA, Utah.

The more cylindrical spores of *O. pleiocreosoteris* (Pl. 785) likewise differ from *O. stansburyanae* in rounded apices, and the SBs have a more distinct, ± broad triangular connecting part, also the paraphyses tend to a strongly capitate apex. In the marginal excipulum *O. ponderosae* sharply differs from *O. stansburyanae*, but this feature was not studied in *O. pleiocreosoteris*.

Ecology. *O. stansburyanae* was collected on rotten wood of a xeric branch of *Purshia stansburyana* in a scrub with *Purshia stansburyana* and *Amelanchier utahensis* on a south-exposed mountain slope in a cold-temperate subhumid pinyon-juniper woodland in the Dixie Forest of Utah Mountains in western North America.

Specimens included. **USA**: **Utah**, Utah Mts., Dixie Forest, 29 km NNE of Escalante, 10 km N of Boulder, 3.5 km W of Deer Mt., 2433 m, branch of *Purshia stansburyana*, on wood, 11.VI.2003, G. Marson (ex H.B. 7918a, M-0276512, **holotype**).

Orbilia geijerae Baral, **sp. nov.**, MB 813918 — Pl. 784

Etymology: named after the substrate, *Geijera parviflora*.

Typification: Australia, Queensland, Banana, branches of *Geijera parviflora*, 22.X.1998, G. Marson (ex H.B. 6279c, BRI AQ799179, holotype).

Latin diagnosis: *Similis* Orbiliae atriplicis *et* O. multicreosoteris *sed asci 16-spori, ascosporae leniter longiores. Habitat ad corticem putridum ramorum siccorum* Geijerae parviflorae *in zona tropica subhumida Australiae orientalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.15–0.3 mm diam., 0.08–0.1 mm high, pale rose-cream(-orange), round, ± scattered; disc slightly concave to flat, margin distinct, not protruding, smooth; broadly sessile, superficial or immersed in small cracks, dry light orange-cream. **Asci** *(45–)50–63 × 7.3–8.2 µm, †30–40(–55?) × 6.2–7.3 µm, 16-spored, spores *4–5-seriate, 8 lower spores inverted (scarcely mixed), pars sporifera *27–32 → 21–28 µm long; **apex** (†) medium (to strongly) truncate (not indented, laterally not inflated), thin-walled; **base** with short, thick, slightly flexuous stalk, L- to Y-shaped. **Ascospores** *(7.5–)8.5–10(–11) × 2–2.5(–2.8) µm, †6–8 × 2–2.3(–2.5) µm, subcylindric-clavate (to fusoid-clavate), apex rounded to sometimes obtuse, base slightly to medium attenuated, straight to slightly inequilateral, rarely slightly curved near base; **SBs** *1.1–1.5 × 1–1.3 µm, broadly tear- to almost plug-shaped, apically narrowed to a ± wide point or not narrowed. **Paraphyses** apically slightly clavate-capitate, terminal cells *6–15 × 2.3–3 µm, lower cells *8–11 × 1.7–2.4 µm; unbranched at upper septum. **Medullary excipulum** 20 µm thick, of dense textura intricata with inflated cells, medium sharply delimited. **Ectal excipulum** of (†) thin-walled, indistinctly oriented t. angularis from base to mid flanks, 15 µm thick near base, cells †~5–8 × 4–5 µm; 15 µm thick near margin, of t. porrecta oriented at a 10–30° angle to the surface, marginal cortical cells *6–9 × 2.1–2.8 µm, ± undulating, (†) thin-walled; **glassy processes** absent. **Anchoring hyphae** sparse, †1.5–2 µm wide, walls 0.2 µm thick. **SCBs** in paraphyses and marginal excipulum globose, in paraphyses 0.8–1.6 µm diam. **Exudate** over paraphyses 0.3–1(–2) µm thick, granular-cloddy, hyaline, loosely attached; over margin and flanks 0.5–1.5 µm thick, rough-cloddy, firmly attached. — **ANAMORPH**: unknown.

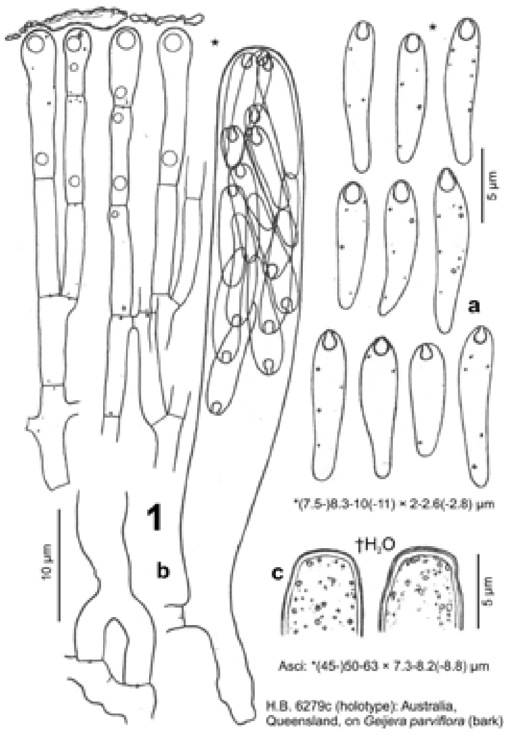


Plate 784. **1**: *Orbilia geijerae*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apices.

Habitat: collected 0.5–2 m above the ground, corticated, 6–9 mm thick branches of *Geijera parviflora*, on strongly decayed, eroded outer surface of detached bark (bast), greyed, green algae very sparse. **Associated**: *Orbilia acaciae*, *O. corculispora*, *Rhytidhysteron* sp., *Schizoxylon* sp., *Thyronectria* sp. **Desiccation tolerance**: fully viable for at least 2 months. **Altitude**: 136 m a.s.l. **Geology**: Permian sedimentary rock. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia geijerae* is characterized by subcylindric- to fusoid-clavate, medium-sized ascospores with large, closely attached SBs, and by 16-spored asci. Rarely 8-spored asci with up to 15 µm long spores were seen among the 16-spored ones. The North American *O. multicreosoteris* and Australian *O. atriplicis* differ mainly in 32-spored asci. The Australian *O. pleioaustrocylindrica* (section *Orbilia*) differs in smaller spores, SBs with a distinct but short filum, and more inflated paraphysis apices.

Ecology. *O. geijerae* was found on rotten bark of xeric branches of *Geijera parviflora* in a narrow strip of eucalypt open woodland between road and pasture in tropical subhumid eastern Australia (west of the Great Dividing Range).

Specimens included. **AUSTRALIA**: **Queensland**, Brigalow Belt South, 138 km SSW of Rockhampton, 11 km SW of Banana, 136 m, branches of *Geijera parviflora*, on bark, 22.X.1998, G. Marson (ex H.B. 6279c, BRI AQ799179, **holotype**).

Orbilia pleiocreosoteris G. Marson, **nom. prov.** — Pl. 785

Etymology: named after the host, *Larrea tridentata* (creosote bush).

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.3–0.45 mm diam., light orange. **Asci** *85–122 × 8–8.8 µm, 16-spored, spores *3–4-seriate, lower spores inverted; **base** with short, thick, slightly

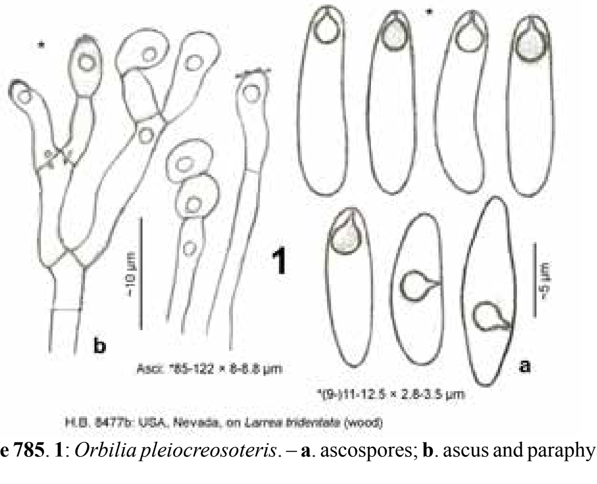


Plate 785. **1**: *Orbilia pleiocreosoteris*. – **a**. ascospores; **b**. ascus and paraphyses.

flexuous stalk, L- to Y-shaped. **Ascospores** *(8.8–)11.2–12.5 × 2.8–3.6 µm, ± subcylindric, apex rounded to sometimes obtuse, base not or rarely slightly attenuated, straight to rarely slightly curved; **SBs** apically or rarely laterally attached to spore wall, *2–2.5 × 1.7–2 µm, broadly tear-shaped, apically narrowed to small point. **Paraphyses** apically slightly to strongly clavate-capitate, terminal cells short, often branched at upper septum. **SCBs** in paraphyses globose. **Exudate** over paraphyses thin, granular-cloddy. **— ANAMORPH**: unknown.

Habitat: decorticated, 10–11 mm thick branches of *Larrea tridentata*, on strongly rotten and greyed wood. **Associated**: *Carestiella schizoxyloides*, *Orbilia ?flexisoma*, *O. lentiformis*, *O. sonorensis*, *Symbiotaphrina desertorum*, indet. hyphomycete. **Desiccation tolerance**: Probably highly tolerating drought. **Altitude**: 960 m a.s.l. **Geology**: Mississippian & Permian carbonate and clastic sedimentary rock. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia pleiocreosoteris* resembles *O. multicreosoteris*, especially the collection illustrated in Pl. 786: 2, but differs in 16-spored asci and distinctly larger ascospores. *O. geijerae* differs in narrower, basally tapered spores with much smaller and more broadly attached SBs, much shorter asci, and apically less inflated paraphyses. From *O. ponderosae* this species differs in longer spores. For the differences to *O. stansburyanae* see p. 1274. The occasional lateral SB attachment is reminiscent of *O. myrioauris* (section *Hemiorbilia*).

When still alive, the sparse material was sketchily studied by one of us (G.M.), but later no apothecia could be discovered on the branch fragments. We therefore refrained from validly publishing this species.

Ecology. *O. pleiocreosoteris* was found on decayed wood of a xeric branch of *Larrea tridentata* in a warm-temperate arid Mojave creosotebush desert scrub in western North America.

Specimens included. **USA**: **Nevada**, Mojave Desert, 18.5 km WSW of Las Vegas, 4.5 km ESE of Blue Diamond, 960 m, branch of *Larrea tridentata*, on wood, 1.V.1995, G. Marson (H.B. 8477b ø).

Orbilia multicreosoteris Baral & G. Marson, **sp. nov.**, MB 813919 — Pl. 786

Etymology: according to the similarity to *O. pleiocreosoteris* which grew on *Larrea tridentata* (creosote bush).

Typification: USA, Arizona, Tucson, branch of *Olneya tesota*, 30.V.2003, G. Marson (ex H.B. 8085f, M-0276519, holotype).

Latin diagnosis: *Similis* Orbiliae atriplicis *sed ascosporae latiores, rectae, corpuscula refringentia latiora, partim perlate ad apicem affixa. Habitat ad corticem putridum ramorum siccorum* Olneyae tesotae *et* Sarcobati *in zona subtropica semiarida Americae septentrionalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.18–0.34 mm diam., 0.1–0.11 mm high, pale to light (dirty) orange(-ochraceous), round, scattered; disc slightly concave to flat, margin distinct, not protruding, smooth; broadly sessile, slightly immersed. **Asci** *75–77 × 8.8–9.2 µm {1}, †45–60 × (6–)7–9(–9.5) µm {2}, 32-spored (26–30 spores counted), spores *4-seriate, lower spores inverted (strongly mixed); **apex** (†) slightly to strongly truncate (not distinctly indented, laterally not inflated), thin-walled (rarely immature slightly thick-walled); **base** without or with short, thick stalk, Y- to h-shaped. **Ascospores** *(5–)6–8.5(–9.5) × (2–)2.5–3 µm {2}, †5.5–8.5 × (2.3–)2.5–3(–3.2) µm {2}, subcylindrical to ellipsoid- (rarely fusoid-)clavate, apex rounded to obtuse, base not or often slightly to medium attenuated, straight to sometimes slightly curved at base; **SBs** *(0.8–)1.2–1.5 × 1.1–1.3 µm {2}, globose to broadly tear-shaped, also broadly plug-, rarely lens-shaped, apically closely attached or narrowed to a small point, with or without a very short filum, also broadly attached. **Paraphyses** apically uninflated to slightly clavate-capitate, rarely moniliform, terminal cells *6–9 × 2.3–2.6 µm {1}, †3.5–11 × 2–2.7 µm {T}, lower cells †(4–)6–9 × 1.3–1.8 µm {T}; frequently branched at upper septum. **Medullary excipulum** 15 µm thick, of dense textura intricata with many inflated cells, indistinctly delimited. **Ectal excipulum** of (†) thin-walled, indistinctly oriented t. angularis from base to mid flanks, 15–20 µm thick near base, cells †8–10 × 5–8 µm {T}; 10–15 µm thick near margin, oriented at a 10° angle to the surface, marginal cortical cells †~7–8 × 2–3 µm {T}, ± thin-walled; **glassy processes** absent. **Anchoring hyphae** sparse, †2–3 µm wide, walls 0.2 µm thick {T}. **SCBs** in paraphyses globose (rarely crystalloid?) {1}. **Exudate** over paraphyses 0.2 µm thick, continuous, also 2–3 µm thick, hyaline, loosely attached; over margin and flanks 0.2–0.7 µm, granular-cloddy. **— ANAMORPH**: unknown.

Habitat: collected 1–2 m above the ground, partially to almost entirely decorticated, 8–13 mm thick branches of *Olneya tesota* {1}, *Sarcobatus vermiculatus* {1}, on strongly decayed bark (bast) {2}, eroded, strongly greyed, no algae. **Associated**: *Orbilia ?barrowensis* {1}, *O. maeandrina* {2}, *O. multigambelii* {1}, *O. myrioolneyae* {2}, *O. myriourosperma* {1}, *Patellaria 'andina'* {1}. **Desiccation tolerance**: some paraphyses still viable after 2 years, spores still alive after 34 months. **Altitude**: 710–745 m a.s.l. **Geology**: Holocene alluvial sand, silt & clay; felsic volcanic rock. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia multicreosoteris* is characterized by 32-spored asci and cylindric-ellipsoid spores with rather large, ± isodiametric SBs of quite a variable shape. The species is similar to the Australian *O. atriplicis*, from which it differs in straight and wider, more ellipsoid spores with more attenuated bases, and in larger, broadly attached SBs. However, when the paratype was first examined by one of us (GM), the spores were found to be narrower, more cylindrical and with often untapered bases, with globose SBs being apically narrowed to a small point (Pl. 786: 2a$_2$). Therefore, the species is not sharply separated from *O. atriplicis*. *O. multicreosoteris* closely resembles *O. pleiocreosoteris*, which deviates in 16-spored asci

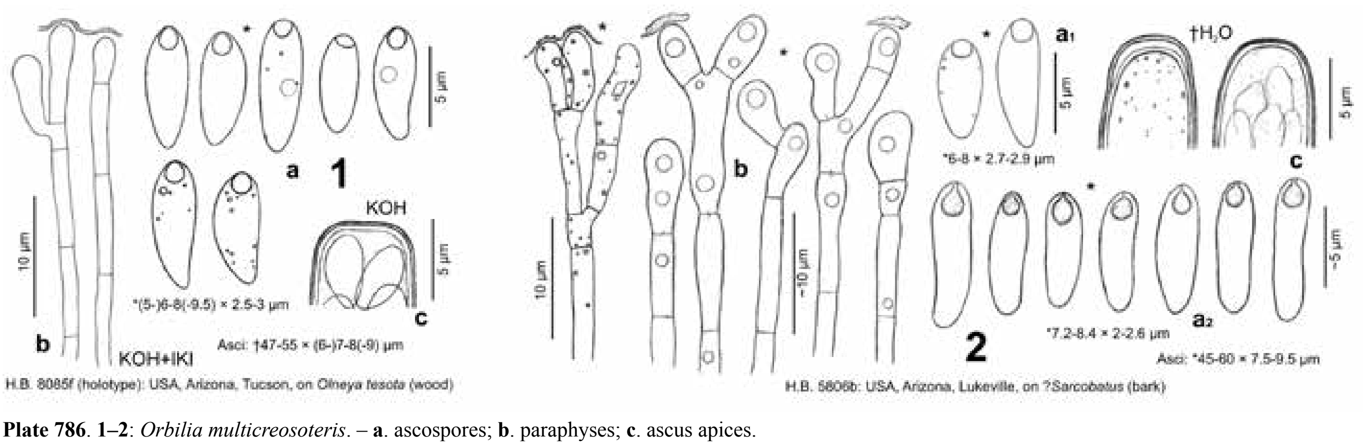


Plate 786. **1–2**: *Orbilia multicreosoteris*. – **a**. ascospores; **b**. paraphyses; **c**. ascus apices.

and larger spores. *O. flavida* (section *Lentiformes*) resembles *O. multicreosoteris* in spore size and shape but differs in consistently lens-shaped SBs being always wider than high.

Ecology. *O. multicreosoteris* was detected on rotten bark of xeric branches of two different angiosperm shrubs in subtropical semiarid (almost arid) Sonoran paloverde-mixed cacti desert scrubs in the southwest of Northern America.

Specimens included. **USA**: **Arizona**, Sonoran Desert, 25 km WNW of Tucson, 5 km S of Picture Rocks, Saguaro, 745 m, branch of *Olneya tesota*, on bark, 30.V.2003, G. Marson (ex H.B. 8085f, M-0276519, **holotype**). – 17.5 km NNE of Lukeville, Organ Pipe, Ajo Mountain Trail, 710 m, branch of *Sarcobatus vermiculatus*, on bark, 5.V.1995, G. Marson (H.B. 5806b).

Orbilia atriplicis Baral, **sp. nov.**, MB 813920 — Pls 787–788

Etymology: named after the substrate, *Atriplex nummularia*.

Typification: Australia, Northern Territories, Alice Springs, branches of *Atriplex nummularia*, 9.X.1998, G. Marson (ex H.B. 6569a, MEL 2389209, holotype).

Latin diagnosis: *Apothecia rehydratata 0.12–0.22 mm diam., pallide aurantiaca, sessilia, margine laevi. Asci 32-spori. Ascosporae *5–7.8 × 1.7–2.3 µm, plus minusve cylindricae, apice rotundatae, partim leniter vel valde curvatae, corpusculum refringens globosum ad late lacrimiformem, ad apicem confertim affixum continentes. Excipulum marginale absque processis vitreis. Habitat ad corticem putridum ramulorum vel ramorum siccorum* Atriplicis nummulariae *in zona subtropica arida Australiae centralis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.12–0.22 mm diam., 0.1 mm high (receptacle 0.07–0.09 mm), pale to light (rose-)orange, round, very scattered to subgregarious; disc flat, margin not protruding, smooth; sessile, superficial. **Asci** *48–68 × 7.5–8(–8.5) µm, †42–58 × 6–7.5 µm, 32-spored, spores *4–5-seriate, lower spores inverted (strongly mixed), pars sporifera *33–42 µm long; **apex** (†) slightly to medium truncate (not indented, laterally not inflated), thin-walled; **base** with very short to medium long, ± thick, flexuous stalk, L- to Y-shaped. **Ascospores** *5–7.8 × (1.7–)1.8–2.3(–3) µm, (sub) cylindrical (rarely slightly clavate), sometimes slightly dumbbell-shaped, rarely ± ellipsoid-(ob)ovoid (then 2.7–3 µm wide), apex rounded (to obtuse), base sometimes slightly attenuated, straight to slightly, sometimes strongly curved (geniculate) in middle or lower part; **SBs** *1–1.2 × 0.8–1 µm, globose to very broadly tear-shaped, closely attached to spore wall. **Paraphyses** apically slightly to strongly clavate-capitate, terminal cells *7–13(–16) × 2–3.5(–4.2) µm, lower cells *10–13 × 1.5–2(–3) µm [near base *5–10 × 2–2.7(–3) µm]; sometimes or frequently branched at upper septum. **Medullary excipulum** 25 µm thick, of medium dense textura intricata-angularis, indistinctly delimited. **Ectal excipulum** of (†) thin-walled, ± vertically oriented t. angularis from base to mid flanks, 20–30 µm thick near base, cells †5–9 × 4–7 µm; 15 µm thick near margin, of t. prismatica oriented at a 50–80° angle to the surface (t. porrecta at upper margin), marginal cortical cells †6–9 × 2.5–3.5 µm, thin-walled; **glassy processes** absent. **Anchoring hyphae** medium abundant, */†2–3 µm wide, walls 0.2(–0.3) µm thick. **SCBs** in paraphyses globose, 1–2.7 µm diam. **Exudate** over paraphyses 0.5–2 µm thick, cloddy, hyaline, ± firmly attached; over margin and flanks 0.5–1 µm thick, smooth, firmly attached, pale yellowish. **— ANAMORPH**: unknown.

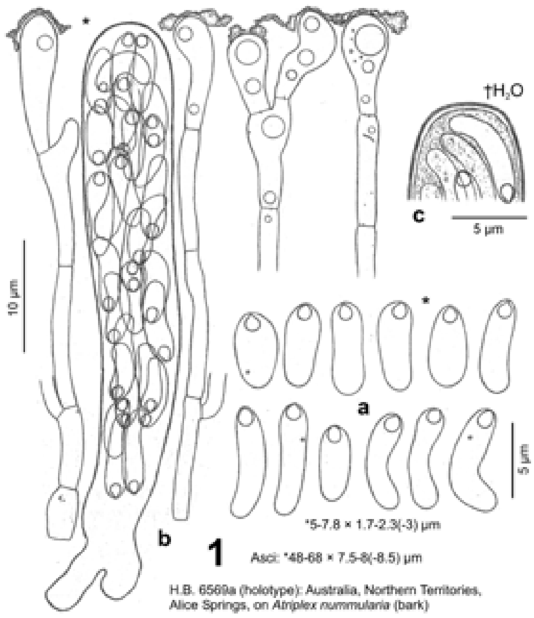


Plate 787. **1**: *Orbilia atriplicis*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apex.

Habitat: collected 0.5–1 m above the ground, decorticated on 1 side, 4–18 mm thick twigs and branches of *Atriplex nummularia*, on medium to strongly decayed bark, slightly to strongly greyed, without algae. **Associated**: *Dothideales*, *Orbilia bicknellensis*, *O. lentiformis*, *O. ?multitrapezoidea*, *O. myriostomachia*, *O. pluristomachia*. **Desiccation tolerance**: fully viable for at least 16.5 months. **Altitude**: 586 m a.s.l. **Geology**: Neoproterozoic sedimentary rock. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia atriplicis* is characterized by 32-spored asci and cylindrical, partly curved ascospores with ±

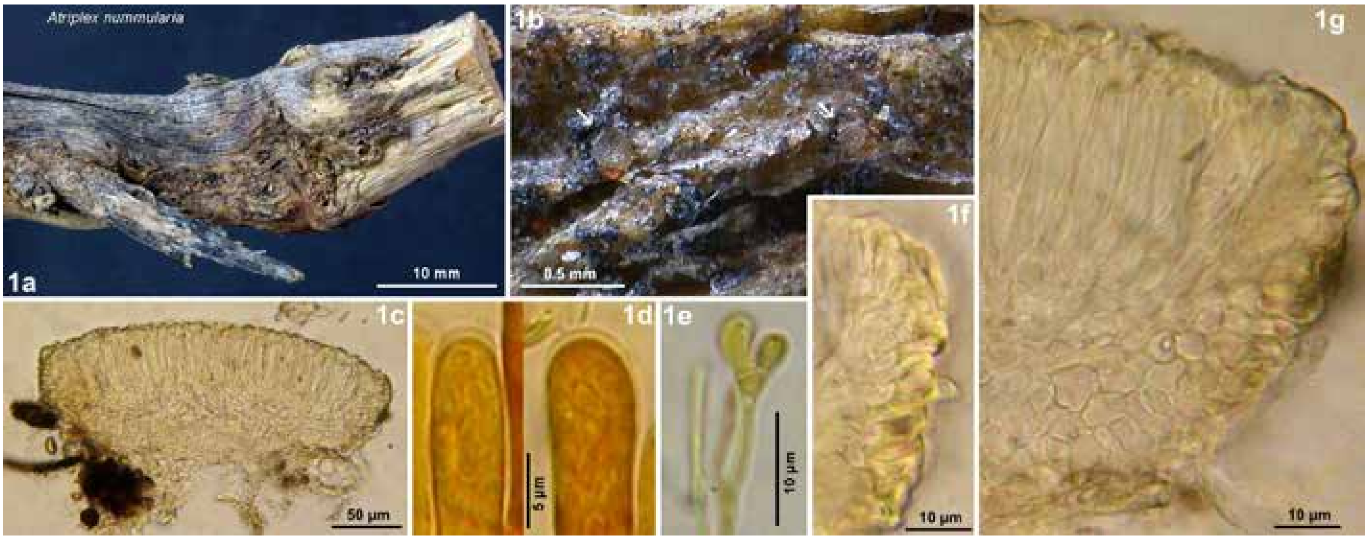


Plate 788. **1**: *Orbilia atriplicis*. – **1a**. partly decorticated xeric branch of *Atriplex nummularia*; **1b**. rehydrated apothecia (after 8 years); **1c**. apothecium in median section; **1f–g**. id., marginal ectal excipulum; **1d**. ascus apices; **1e**. upper part of paraphysis. – Dead state: **1c**, **f–g** in KOH; **1d–e** in KOH+IKI. — **1a–g**. H.B. 6569a (holotype): Australia, Northern Territories, Alice Springs, on *Atriplex*.

globose SBs. *O. multiaustrocylindrica* (section *Orbilia*) differs merely in narrower spores and SBs but these values overlap and the species is doubtfully distinct, as it grew on the same host genus in a similar ecological region though in 200 km distance. For the similar North American *O. multicreosoteris* see above. The 16-spored *O. geijerae* differs in longer spores with more attenuated bases.

Ecology. *O. atriplicis* was detected on ± rotten bark of xeric twigs and branches of *Atriplex nummularia* in a subtropical arid acacia open shrubland in a flat depression northeast of Macdonnell Ranges in central Australia.

Specimens included. **AUSTRALIA**: **Northern Territories**, MacDonnell Ranges, 15 km WNW of Alice Springs, N of Honey Moon Gap, S of Simpson Gap, 586 m, branches of *Atriplex nummularia*, on bark, 9.X.1998, G. Marson (ex H.B. 6569a, MEL 2389209, **holotype**).

Orbilia subcylindrospora Baral & E. Weber, **sp. nov.**, MB 813935 — Pls 789–790

Etymology: referring to the similarity with *O. cylindrospora*.

Typification: France, Neffiès, branches of *Erica arborea*, 6.V.2005, G. Garcia (ex H.B. 7843, M-0276594, holotype).

Latin diagnosis: *Similis* Orbiliae cylindrosporae *sed ascosporae leniter majores, saepe leniter vel valde curvatae, paraphyses ad apicem magis capitatae, apothecia magis intense rosea. Habitat ad lignum putridum ramorum siccorum arborum coniferarum et angiospermarum in zona orosub- ad mesosubmediterranea humida ad semihumida Europae meridionalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.2–0.5 mm diam., 0.1–0.2 mm high (receptacle 0.07–0.11 mm), pale to light rose to pink, slightly to rather strongly translucent, round (to elliptical) or slightly undulating, scattered to gregarious in smaller or larger groups; disc flat, margin distinct, thin, not protruding, smooth to finely rough; on a narrowed base or an indistinct stipe, superficial to slightly erumpent, partly deeply immersed in biofilm; dry light to bright rose- or orange-red. **Asci** *36–53 × 4.3–5.3 µm {2}, †(28–)33–45(–48) × (3.3–)3.7–4.3(–4.6) µm {3}, 8-spored, spores *2-seriate, (2–)3–5 lower spores inverted {3} (often mixed), pars sporifera *24–30 → 16.5 µm long; **apex** (†) slightly to medium (rarely strongly) truncate (not indented, laterally not inflated), thin-walled; **base** with short to long, ± thick and flexuous stalk, T-, L-, Y- or h-shaped. **Ascospores** *(4–)5–7.2 {3} × 1.3–1.6 {1} or 1.6–1.8(–2.2) {2} µm, †(4.5–)5–6 {2} × 1.2–1.4 {1} or 1.6–1.8 µm {1}, subcylindrical to slightly or sometimes strongly (fusoid-)clavate, apex rounded to obtuse, base not or slightly, sometimes strongly attenuated, slightly to strongly curved (often geniculate in middle or lower part), exceptionally straight; **SBs** *0.6–1.2 × 0.5–0.8 µm {3}, globose to broadly tear-shaped, apically closely attached, partly narrowed to a small point, sometimes with a very short, sometimes invisible filum. **Paraphyses** apically (slightly) medium to strongly capitate, terminal cells *(9–)12–19(–23.5) × (2.3–)2.8–4 µm {3}, †2.3–4 µm wide, lower cells *8–12 × 1.8–2 µm {T}, †1.2–1.8 µm wide; sometimes branched at upper septum. **Medullary excipulum** pale rose or yellow, 25–70 µm thick, of dense textura intricata with many inflated cells, medium to sharply delimited from ectal excipulum mainly at flanks by a 12–15 µm thick layer of t. porrecta. **Ectal excipulum** of hyaline, (†) slightly gelatinized, vertically oriented t. (globulosa-)angularis(-prismatica) from base to mid flanks, 20–60 µm thick near base, cells *10–18(–25) × 6–14(–18) µm {3}, †6–14 × 5–7 µm {1}; 20–40 µm thick at lower flanks, 15–25 µm at mid flanks, 10–30 µm near margin, at submargin of t. globulosa-prismatica oriented at a 50–90° angle to the surface, at upper margin of t. (angularis-)prismatica(-porrecta) oriented at 10–50°, marginal cortical cells *9–12 × 3–5 µm {1}, †6–12 × 3–4.2 µm {2}, (†) slightly thick-walled {3}; **glassy processes** absent. **Anchoring hyphae** sparse to abundant, */†2.3–3.7(–4.3) µm wide, walls (0.2–)0.3–0.5(–1) µm thick {3}. **SCBs** globose {2}, in paraphyses 1.3–2.2 µm diam., in ectal excipulum near margin 2–2.5(–3.5) µm. **Exudate** over paraphyses 0.3–1.5(–2) µm

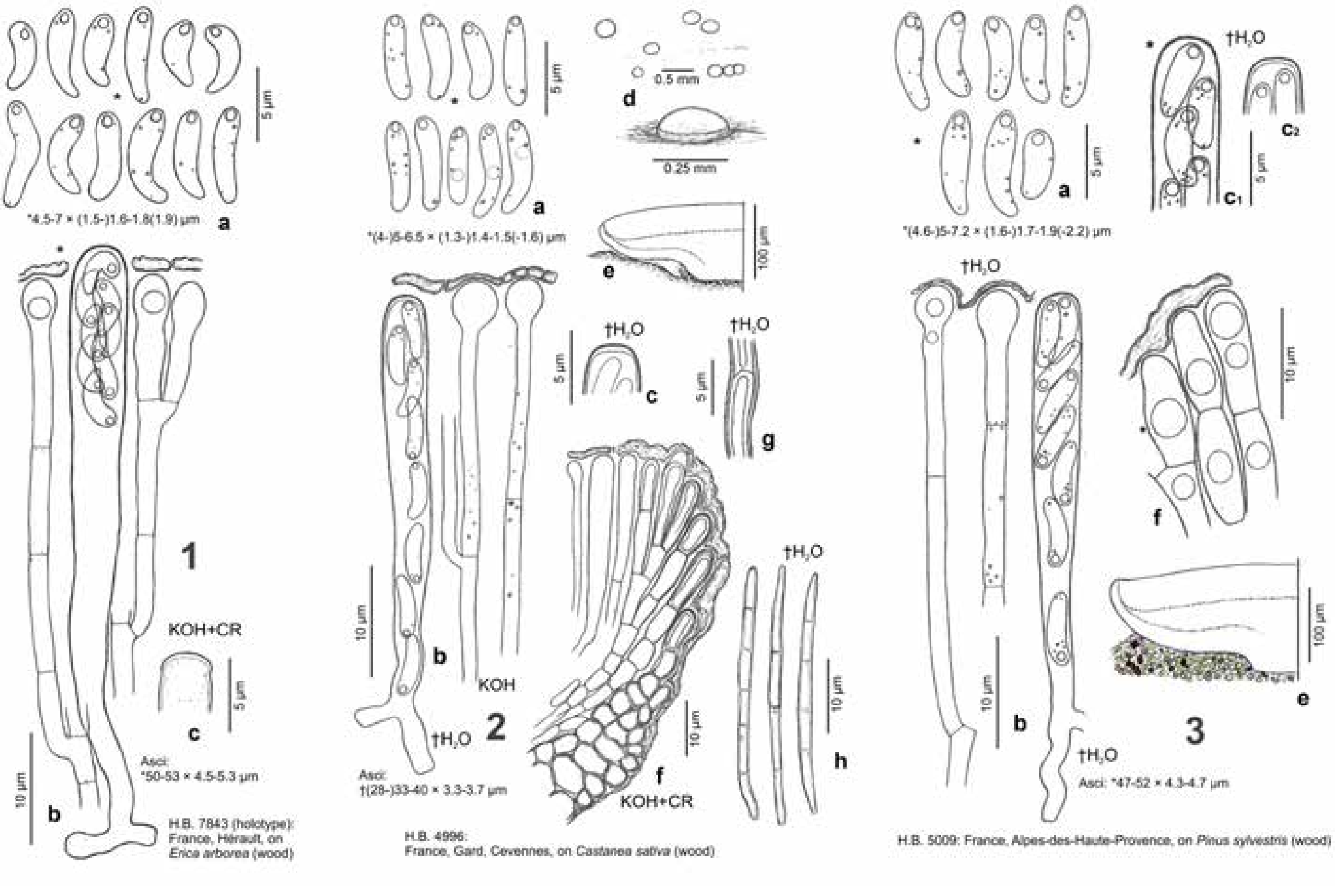


Plate 789. **1–3**: *Orbilia subcylindrospora*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. rehydrated apothecia; **e**. apothecia in median section; **f**. id., ectal excipulum at margin and mid flanks; **g**. anchoring hypha; **h**. conidia from substrate.

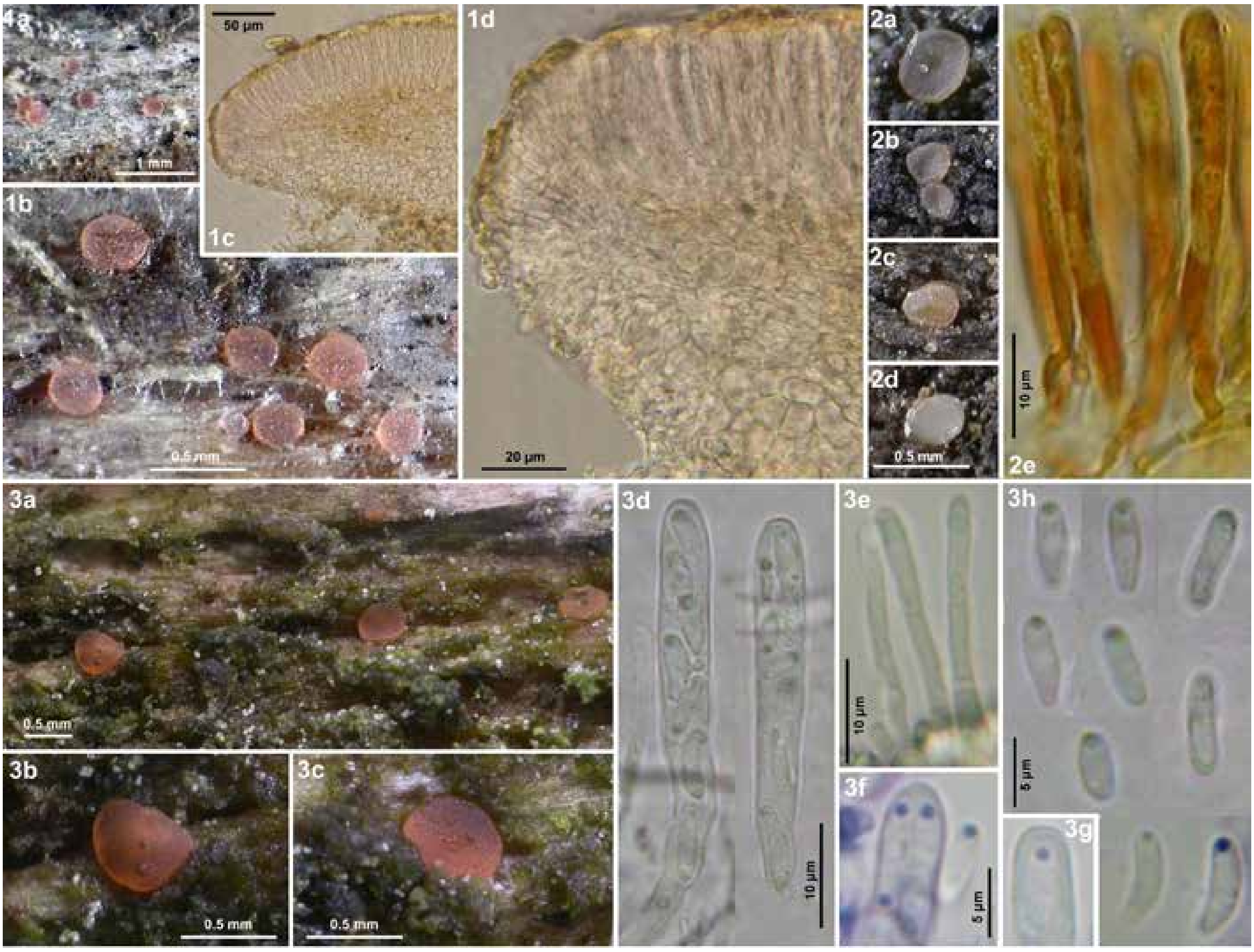


Plate 790. **1–2**: *Orbilia subcylindrospora*; **3**: *O.* cf. *subcylindrospora*. – **1a–b**, **2a–d**, **3a–c**. rehydrated apothecia (**1**: after 2 months, **2**: after 13 years); **1c–d**. apothecia in median section; **2e**, **3d–e**. asci and paraphyses; **3f–g**. ascus apices (in CBR); **3h**. ascospores (1 in CRB). – Living state, except for **2e** (in KOH+IKI), asci in **3d**. – **3e–g**, **3h** 2 spores below: phot. G. Friebes. — **1a–d**. H.B. 7843 (holotype): France, Hérault, on *Erica*; **2a–e**. H.B. 5009: France, Alpes-de-Haute-Provence, on *Pinus*; **3a–h**. H.B. 10019: Austria, Steiermark, on *Juniperus*.

thick, cloddy-continuous, ± loosely attached, ± hyaline; over margin and flanks (1–)1.5–3(–5) µm thick, rough-cloddy(-granular), hyaline to pale yellow-orange. — **ANAMORPH**: unknown (but see below).

Habitat: collected ~1.5 m above the ground, entirely decorticated, 15–25 mm thick branches of *Castanea sativa* {1}, *Erica arborea* {1}, *Pinus* (?)*sylvestris* {1}, on 0.2–0.4 mm up to 2–5 mm deep strongly decayed wood {3}, slightly to strongly greyed, green algae sparse to abundant. **Associated**: *Dacrymyces* sp. {1}, *Gloniopsis smilacis* {1}, *Orbilia patellarioides* {1}, *O. sphaerospora* {2}, *O. subvinosa* {1}, *Phragmiticola* sp. {1}, crustose and foliose lichens. **Desiccation tolerance**: fully viable for at least 2 months, some excipular cells still viable after 5 months. **Altitude**: 235–1080 m a.s.l. **Geology**: Austria: Mesozoic dolomite; Provence: Upper Cretaceous marl; Languedoc: mica schist, basalt. **Phenology**: V, IX–X (but long-lived).

Taxonomic remarks. *Orbilia subcylindrospora* is characterized by subcylindrical (sometimes clavate), medium-sized, generally more or less curved to geniculate ascospores and globose to broadly tear-shaped spore bodies, also by medium to strongly capitate paraphyses and rose-coloured apothecia. The taxonomic position of *O. subcylindrospora* is not clear. The closest relatives appear to be *O. cylindrospora* and *O. austrocylindrica*, which differ in smaller, ± straight spores, the former also in less inflated paraphyses, the latter in shorter asci. However, the spores of *O. subcylindrospora*, especially in the specimen on *Erica*, also resemble *O. basiflexa* and members of sections *Arthrobotrys* (*O. cupressi*) and *Aurantiorubrae* (some species of series *Regales*). Some of these differ in possessing glassy processes, others in having ± spathulate paraphyses, e.g., *O. pseudocylindrospora* (series *Regales*) which further differs in a thin exudate individually attached to each paraphysis, slightly longer spores, and SBs with a more distinct, partly apically widened filum. Also *O. cupressi* differs from *O. subcylindrospora* in slightly longer spores and in SBs with a short filum. Narrow-spored collections of *O. subovoidea* differ from *O. subcylindrospora* only gradually in their wider spores. *O.* aff. *dixiensis* (on *Arctostaphylos*, Pl. 699: 4) differs in a tendency to elongate SBs, for which reason we assume its relationship to section *Habrostictis*.

Variation. The three included collections show a rather high variation in several features, especially in the spores. The one on *Castanea* has distinctly narrower spores than the other two, and in that on *Erica* the spores are partly more curved and tapered at the base. The size of the SBs varies remarkably between the three collections, ranging from 0.6–0.8 × 0.5–0.6 µm (*Castanea*) over 0.8–1 × 0.6–0.8 µm (*Pinus*) to 0.8–1.2 × 0.6–0.8 µm (*Erica*). The paraphyses show a stronger apical inflation in the collection on *Castanea*.

Not included collection. The sample on *Juniperus* (Pl. 790: 3) is not included because of its larger spores which approach narrow-spored populations of *O. subovoidea*. It closely resembles the sample on *Pinus* except for having uninflated paraphyses, spores of *5–7.5(–8.5) × 1.8–2.3(–2.5) µm with wider SBs (1–1.2 × 1–1.2 µm), and longer asci (*50–60 × 5.3 µm). The ascus base was partly H-shaped.

Anamorph. In one collection we observed narrow phragmoconidia (†31–35 × 1–1.2 µm, Pl. 789: 2h) similar as in *O. cylindrospora*. At present we consider these conidia as doubtful. The presumed anamorph of the possibly distantly related *O. cupressi* (section *Arthrobotrys*) has very long, fusoid, multiseptate conidia similar as in *Dactylella oxyspora*.

Phylogeny. A sequence was taken from apothecia of the not included specimen from Steiermark (H.B. 10019), comprising ITS and LSU (D1–D2); the S1506 intron is absent. This strain deviates in the ITS and available LSU from *O. sphaerospora* by 5.2/1.8% and from *O. subovoidea* by 5.5/~1.8%, respectively. These distances and the presence of the S1506 intron in *O. subovoidea* suggest that H.B. 10019 is specifically distinct hereof.

Ecology. *O. subcylindrospora* was found on rotten wood of xeric branches of both gymno- and angiosperms. The species is so far only known from southern France and eastern Austria. The holotype on *Erica* is from a mesosubmediterranean semihumid shrubland with *Cheilanthes tinaei*, those on *Castanea* and *Pinus* from a suprasubmediterranean semihumid open chestnut forest and an orosubmediterranean humid pine forests. The not included collection on *Juniperus* was in an orotemperate humid pine forest with *Picea* and *Fagus* etc. and abundant *Cypripedium* in the eastern Alps.

Specimens included. **FRANCE**: **Provence-Alpes-Côte d'Azur**, **Alpes-de-Haute-Provence**, 6.5 km SE of Castellane, 0.8 km NW of La Bâtie, Col de Luens, 1080 m, branch of *Pinus* (?)*sylvestris*, on wood, 5.X.1993, G. Marson (H.B. 5009). – **Languedoc-Roussillon**, **Gard** (border to Lozère), Massif central, 10 km WNW of St.-Jean-du-Gard, 2.3 km N of Saumane, SW of St.-Roman-de-la-Tousque, 500 m, branch of *Castanea sativa*, on wood, 25.IX.1993, G. Marson (H.B. 4996). – **Hérault**, 18 km SE of Bédarieux, 2 km ENE of Neffiès, Les Baumes, 235 m, branches of *Erica arborea*, on wood, 6.V.2005, G. Garcia (ex G.G. 05050605/H.B. 7843, M-0276594, **holotype**).

Not included. **AUSTRIA**: **Steiermark**, 20 km NNW of Bruck an der Mur, 3 km NNW of St. Ilgen, Karlschütt, 890 m, branch of *Juniperus communis*, on wood, 6.VIII.2016, G. Friebes (ex G.F. 20160171, H.B. 10019; sq.: MK493136).

Orbilia basiflexa Baral, **sp. nov.**, MB 813746
— Pls 791–792

Etymology: named after the spores having a tapered, geniculate base.
Typification: Mongolia, Dayan lake, branch of *Lonicera microphylla*, 16.VIII.2005, P. Karasch (ex H.B. 7897c, M-0276439, holotype).

Latin diagnosis: *Apothecia rehydratata 0.2–0.35 mm diam.*, *aurantiaca*, *sessilia*, *margine laevi vel subcrenulato. Ascosporae *7.3–9.5 × 2–2.4 µm*, *fusoideo-clavatae*, *apice obtusae*, *basaliter valde curvatae*, *in statu vivo corpusculum refringens globosum*, *ad apicem filo brevissime affixum continentes. Paraphyses ad apicem leniter vel modice capitato-clavatae. Habitat ad corticem putridum rami sicci* Lonicerae microphyllae *in zona subhumida continentali subalpina Asiae centralis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.2–0.35 mm diam., 0.12–0.22 mm high (receptacle 0.08 mm), pale to light orange, translucent, round, subgregarious; disc slightly concave to flat, margin thin, not protruding, smooth or very indistinctly crenulate; with a broad, 20 µm high stipe, superficial. **Asci** *44–56 × 6–6.4(–6.7) µm, †35–51 × 5.2–5.7 µm, 8-spored, spores (*) obliquely biseriate, 2–6 lower spores inverted (scarcely mixed), pars sporifera *20–27 µm long; **apex** (†) slightly to medium truncate (not indented, laterally not inflated), thin-walled; **base** unstalked or with a short to medium long, thick stalk, T-, L- or Y-shaped. **Ascospores** *7.3–9.5 × 2–2.3(–2.4) µm, †8–9 × 2–2.2 µm, fusoid-clavate, apex rounded to obtuse, base medium to strongly attenuated in a tail-like end, here always medium to strongly curved (geniculate); **SBs** *1.2–1.4 × 0.9–1.2 µm, globose (to broadly tear-shaped). **Paraphyses** apically (uninflated to) slightly or medium clavate-capitate, sometimes moniliform, terminal cells *(5–)8–15(–20) × (2–)2.5–4(–4.5) µm, lower cells *7–11.5 × 1.6–2.5(–3.5) µm; sometimes branched at upper septum. **Medullary excipulum** subhyaline, 70–80 µm thick, of medium loose textura intricata with many inflated cells, rather sharply delimited. **Ectal excipulum** pale rose, of (†) distinctly gelatinized, indistinctly vertically oriented t. globulosa-angularis(-prismatica) from base to margin, 50–100 µm thick near base, cells *10–36 × 8–18 µm; 18 µm thick near margin, oriented at a high angle to the surface, marginal cortical cells *6–12 × 3–4.5 µm, thin-walled, somewhat free, converging to form minute teeth; **glassy processes** absent. **Anchoring hyphae** rather abundant, †2–3.3 µm wide, walls 0.2–0.3 µm thick. **SCBs** globose, in paraphyses (0.7–)1.5–2.3(–2.6) µm diam., in ectal excipulum (near margin) 1.5–3.7 µm. **Exudate** over paraphyses and excipulum 0.5–1.5 µm thick, cloddy(-continuous), loosely, later firmly attached, partly rough, hyaline. — **ANAMORPH**: unknown.

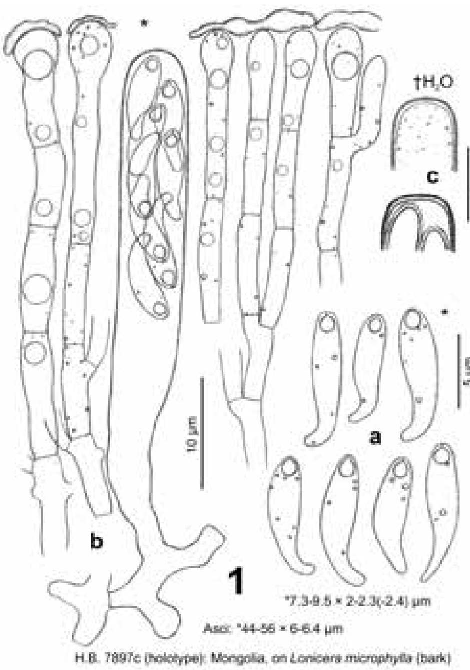


Plate 791. **1**: *Orbilia basiflexa*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apex.

Habitat: collected 0.5–1.5 m above the ground, corticated, 9–10 mm thick branch of *Lonicera microphylla*, on medium decayed bark detaching in thin layers, strongly greyed, green algae medium abundant. **Associated**: *Caloplaca* sp., *Durella* ?*atrocyanea*, *Lecanora* sp., *Orbilia concoloris*, *O. delphinus*, *O. maeandrina*, *Parmelia* sp., *Stenocybe* sp., ?*Teichospora* sp. **Desiccation tolerance**: fully viable for at least 1 month. **Altitude**: 2095 m a.s.l. **Geology**: Paleozoic sediment. **Phenology**: VIII (but rather long-lived).

Taxonomic remarks. *Orbilia basiflexa* is characterized by medium-sized, fusoid-clavate ascospores with rather strongly tapered and geniculate bases, and large, ± globose spore bodies in the apex. Its taxonomic position is difficult to determine. The large SBs appear to indicate a relation to section *Ovoideae*, especially to *O. subovoidea* or to *O. subcylindrospora*, whereas the basally curved spores recall members of section *Aurantiorubrae* (especially *O. comma* and *O. mali*). *O. comma* differs in smaller, helicoid, more fusiform spores and in the presence of crystalloid SCBs, *O. mali* in smaller, especially narrower spores and more elongate, tear-shaped to pyriform SBs. *O. subcylindrospora* differs in smaller spores and SBs, and less tapered, usually less curved spore bases.

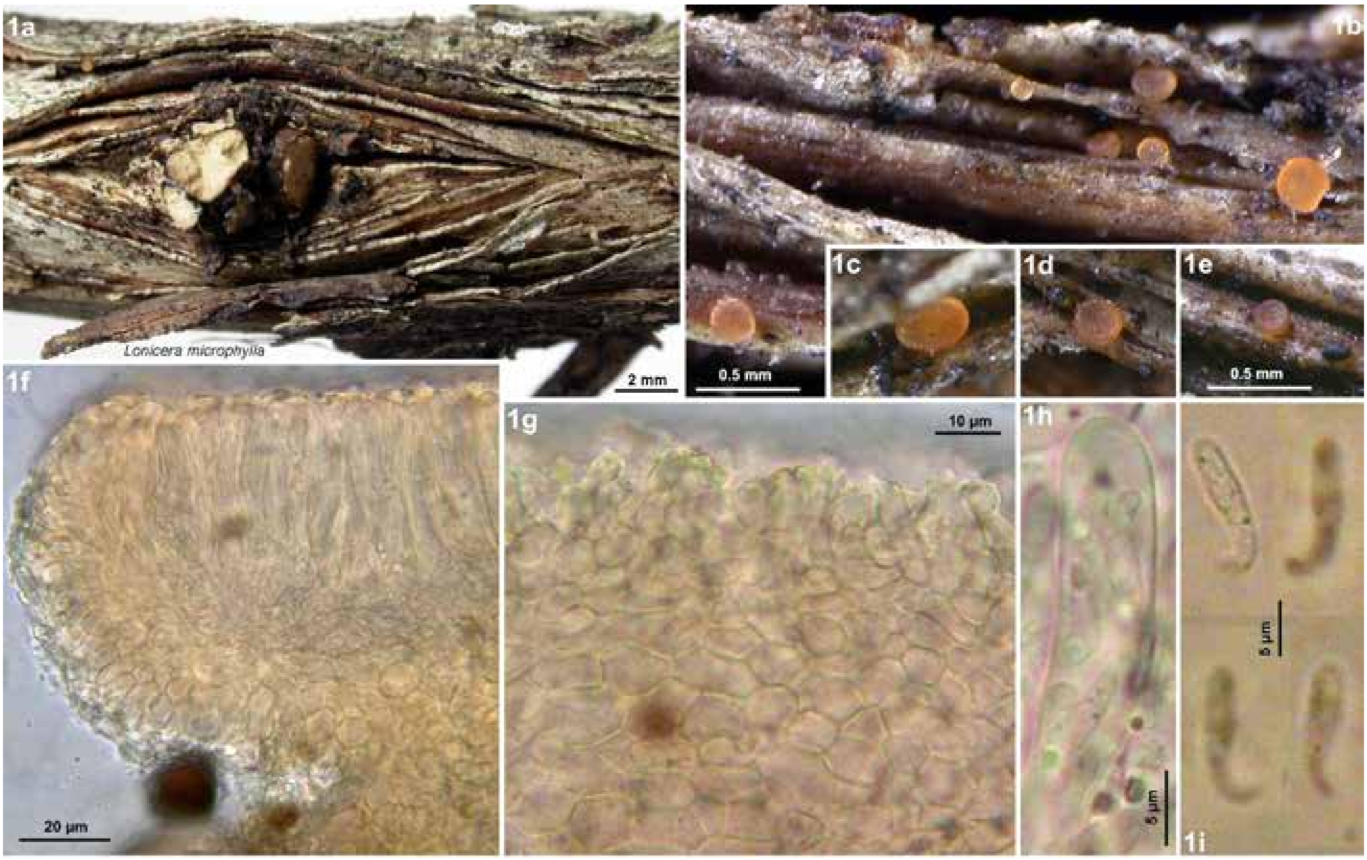


Plate 792. **1**: *Orbilia basiflexa*. – **1a**. corticated xeric branch of *Lonicera microphylla*; **1b–e**. rehydrated apothecia; **1f**. apothecium in median section; **1g**. marginal ectal excipulum in external view; **1h**. mature ascus; **1i**. ascospores. – Living state, except for **1i** (in H_2O). — **1a–i**. H.B. 7897c (holotype): Mongolia, Altay, on *Lonicera*.

Ecology. *O. basiflexa* was found on medium rotten bark of a xeric branch of *Lonicera microphylla* in a continental, orotemperate subhumid (winter-dry), subalpine shrub vegetation (*Spiraea alpina*, *Ribes nigrum*, *Juniperus sabina*) on a south-exposed slope in central Asia.

Specimens included. **MONGOLIA**: **Bayan Ölgii**, Sagsai, Altay Mts., S-part of Tavan Bogd, 20 km SE of Dayan lake, 8 km NE of Chinese border, Songino Gol river valley, 2095 m, branch of *Lonicera microphylla*, on bark, 16.VIII.2005, P. Karasch (ex H.B. 7897c, M-0276439, **holotype**).

Orbilia octosporoides Baral & G. Marson, **sp. nov.**,

MB 813937 — Pls 793–794

Etymology: referring to the genus *Octospora* Hedw. to which the *Orbilia* has several striking similarities.

Typification: USA, Utah, Cedar City, branch of *Juniperus osteosperma*, 24.VIII.1994, G. Marson (ex H.B. 5175b, M-0276542, holotype).

Latin diagnosis: *Apothecia rehydratata 0.3–2 mm diam., aurantio-rosea, substipitata, margine exigue albo-fimbriata vel dentata. Asci 8-spori, in statu emortuo modice truncati, tenuitunicati. Ascosporae *5–9 × 3.7–4.8 µm, ellipsoideo-ovoideae, corpusculum refringens magnum, late lacrimiformem, ad apicem cuspide brevi affixum continentes. Paraphyses saepe moniliformes, ad apicem non vel leniter capitatae, cellulis vivis corpuscula crystalloidea continentibus. Excipulum marginale pilis longis praeditum, partim processis vitreis brevibus terminatis. Habitat ad corticem putridum rami sicci* Juniperi osteospermae *in zona orotemperata subhumida Americae septentrionalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.3–)0.5–0.8(–2) mm diam. (including hairs), in total 0.3(–0.4) mm high [receptacle 0.19(–0.28) mm], light to bright orange-rose, round or laterally compressed, subgregarious in small groups; disc concave, finally flat, margin and flanks with white, prominent hairy teeth, strongly protruding at margin (~100–150 µm incl. hairs); with a distinct stipe 0.1–0.14 × 0.18–0.25 mm, stipe base very slightly immersed, apothecia sometimes entirely hidden beneath detaching thin periderm. **Asci** *65–88 × 6–7.2 µm, †60–75 × 5–6 µm, 8-spored, spores uniseriate, 1–6 lower spores inversely oriented (often mixed), pars sporifera *36–43 µm long; **apex** (†) slightly to medium truncate or hemispherical depending on the viewing direction (not indented, laterally not inflated), thin-walled; **base** with short to long, thick, flexuous stalk, L- or Y-shaped. **Ascospores** *(5–)5.7–7.6(–9) × (3.7–)4–4.8 µm, †5–7 × 3.8–4.6 µm, broadly ellipsoid-obovoid, apex rounded to obtuse, base exceptionally with a short tail-like end; **SBs** *(1.8–)2–2.8 × (1.2–)1.4–1.8 µm, broadly tear-shaped (globose with triangular upper part), apically narrowed to a very short filum. **Paraphyses** apically uninflated or only slightly clavate-capitate, often somewhat moniliform or sublageniform, terminal cells *13–40 × 3–4(–5.2) µm, scarcely exceeding the dead asci, lower cells *7.5–20 × 1.7–3(–3.4) µm, branched only near base. **Medullary excipulum** 30–100 µm thick in receptacle, of medium dense textura intricata with many inflated cells, sharply delimited from ectal excipulum by a distinct, 10–35 µm thick layer of t. porrecta. **Ectal excipulum** pale rose, of (*) thin-walled († slightly gelatinized, common walls 0.5–1.2 µm), vertically oriented t. angularis from base to lower flanks, 30–80 µm thick, cells *10–24 × 8–16 µm, †9–16 × 6–10 µm, 25–30 µm thick at mid flanks, of t. prismatica-angularis oriented at a 50–80° angle to the surface, 15 µm thick at margin, of t. porrecta oriented at ~0–20°, marginal cortical cells †10–15 × 3–4.5 µm, **hairs** at margin ± agglutinate, *50–110 × 4–6.5(–8) µm, 3–5-celled, cylindrical, slightly moniliform, terminal cells *8.5–22(–45) µm long, apex obtuse, partly covered by low warts, without glassy caps, basal cells 12–18 µm long, gradually emerging from ectal excipulum, wall *0.3–0.5(–0.8) µm thick, hairs at flanks always dead and ± collapsed, †2–4 µm wide, mostly tipped by high-refractive, hyaline, partly stratified **glassy processes** (2–)6–20 × 3.5–5.5 µm, sometimes instead with glassy lateral walls up to †1.8 µm thick. **Anchoring hyphae** forming an up to 80–100 µm thick, ± gelatinized layer of t. intricata, gradually passing over into hairs at flanks, hyphae *(2–)3–4.5 µm wide, walls *0.2–0.3(–0.5) µm thick (†0.3–0.7 µm), interspersed from base to margin with many small extracellular crystals. **SCBs** in paraphyses globose, 1–1.5 µm diam.,

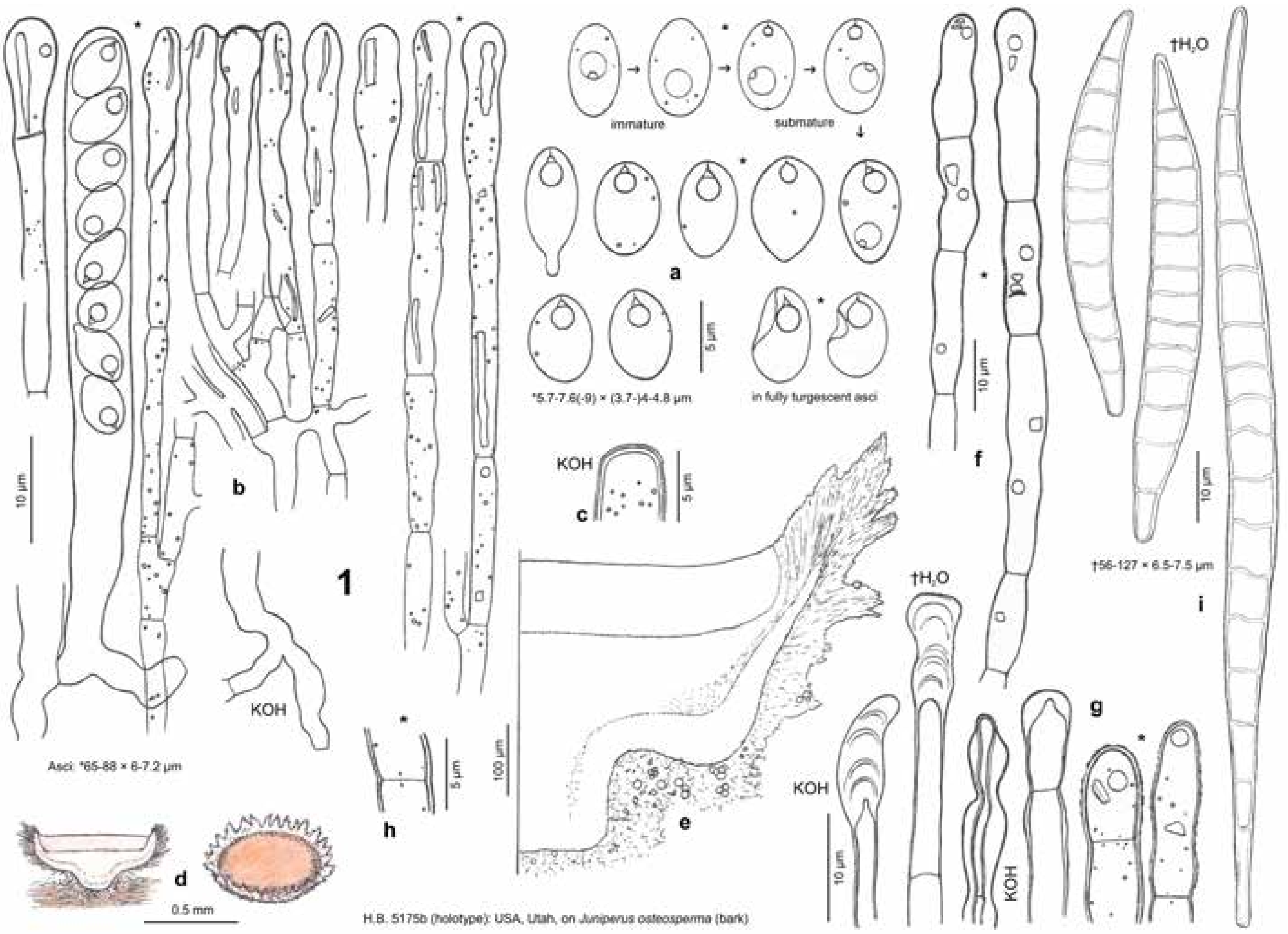


Plate 793. **1**: *Orbilia octosporoides*. – **a**. ascospores (nucleus figured in 5 immature and submature spores); **b**. ascus and paraphyses; **c**. ascus apex; d. rehydrated apothecium with dentate-hairy margin, left in median section; **e**. apothecium in median section; **f**. marginal hairs; **g**. tips of hairs, those at flanks with apical glassy processes or with lateral wall thickenings; **h**. detail of anchoring hypha; i. conidia from substrate.

mixed with 1–3 filiform or rectangular, crystalloid ones of (1.5–)2–7.5(–11) × 0.3–1.2 µm; in ectal excipulum globose (1 per cell, 1.3–2.2 µm diam.) and filiform to angular (1–2 per cell); **LBs** in paraphyses towards base abundant, small, orange, (carotenoids). **Exudate** over paraphyses absent, apices covered by inconspicuous gel; exudate only present near base of apothecia, light yellow-ochraceous, continuous. — **ANAMORPH**: vermispora-(to dactylella-) like (presumed, from natural substrate). **Conidiophores** not seen. **Conidia** unbranched, gradually strongly attenuated towards both ends, almost straight to slightly curved, †56–127 × 6–7 µm, 10–17-septate.

Habitat: lying in a dry riverbed, on corticated, 9–17 mm thick branch of *Juniperus osteosperma*, on medium decayed, detaching bark (periderm and bast), somewhat greyed, with some green algae. **Associated**: *Carestiella schizoxyloides*, *Orbilia cucumispora*, *O.* ?*maeandrina*, *O. multidelphinus*, *O. multihamulata*, *O. ophiosoma*, *O. osteospermae*, *O. pisciculus*. **Desiccation tolerance**: fully viable for at least 2 months, but completely dead (including the spores) after 1½ years. **Altitude**: 1815 m a.s.l. **Geology**: Upper Cretaceous sedimentary rock. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia octosporoides* is quite outstanding within section *Ovoideae* due to a series of characteristics. The apothecia have long, septate hairs forming large broad teeth at margin and flanks. Short glassy processes occurred only at the tips

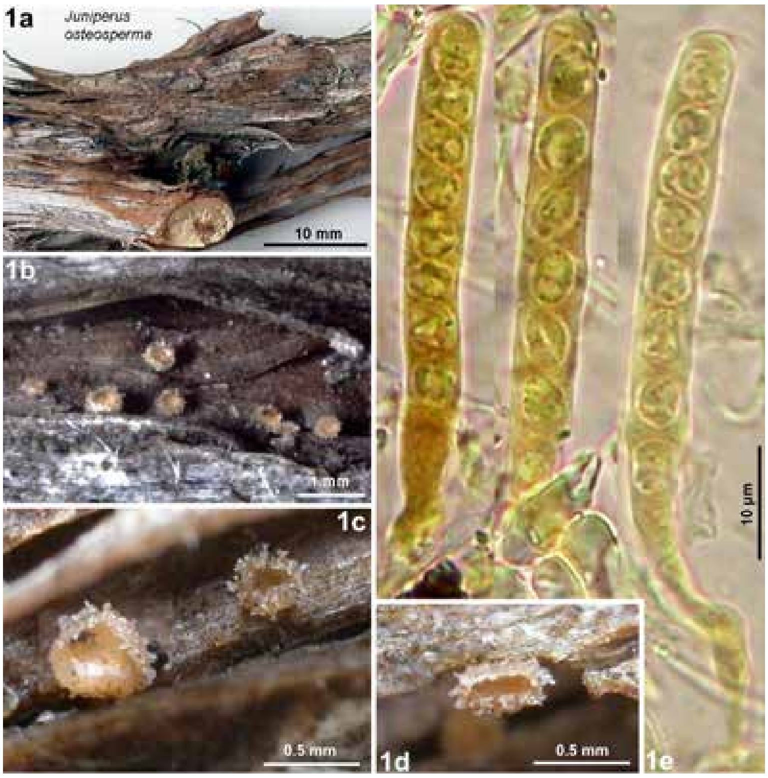


Plate 794. **1**: *Orbilia octosporoides*. – **1a**. dead corticated xeric branch of *Juniperus osteosperma*; **1b–d**. rehydrated apothecia (1b: after a few months, **1c–d**: after 10 years); **1e**. mature asci (in KOH+IKI). — **1a–e**. H.B. 5175b (holotype): USA, Utah, on *Juniperus*.

of the flank hairs. Also the presence of crystalloid SCBs is unique within this section. The large, ellipsoid-obovoid ascospores with large, globose to broadly tear-shaped spore bodies are typical of the group but resemble also spores of pezizalean taxa such as *Octospora*, with the difference that spore guttules in *Pezizales* are composed of lipid and are, therefore, KOH-resistant. We assume that *O. octosporoides* occupies a marginal position within section *Ovoideae*. A possible relationship to *O. arizonensis* (series *Hesperideae*) which has very similar spores and SBs cannot be excluded, although in that series the asci consistently have distinct apical domes.

Anamorph. Large multiseptate conidia similar to those of *O. ovoidea* and similar species were observed on the substrate near the apothecia of *O. octosporoides*.

Ecology. *O. octosporoides* was found on medium rotten bark of a xeric branch of *Juniperus osteosperma* in a cold-temperate subhumid pinyon-juniper woodland of Dixie Forest, a part of the Utah Mountains in western North America. The species is only known from the holotype which contained about 20 apothecia.

Specimens included. **USA**: **Utah**, Utah Mts., Dixie Forest, 1.5 km ESE of Cedar City, 1815 m, branch of *Juniperus osteosperma*, on bark, 24.VIII.1994, G. Marson (ex H.B. 5175b, M-0276542, **holotype**, anam. substr.).

Orbilia pisciculus Baral & G. Marson, **sp. nov.**,
MB 813938 — Pl. 795

Etymology: named after the spores resembling young fishes.

Typification: USA, Utah, Cedar City, branch of *Juniperus osteosperma*, 24.VIII.1994, G. Marson (ex H.B. 5175e, M-0276555, holotype).

Latin diagnosis: *Apothecia rehydratata 0.15–0.28 mm diam., aurantiaca, sessilia, margine laevi. Asci 8-spori, in statu emortuo modice truncati, plerumque tenuitunicati. Ascosporae *5.2–10.8 × 2.8–4 µm, fusoideo-ellipsoideae, basi cauda 2–5 × 0.9–1.7 µm partim basaliter inflata, corpusculum refringens magnum, globosum vel late lacrimiformem, ad apicem cuspide brevi affixum continentes. Paraphyses ad apicem leniter vel modice capitato-clavatae. Excipulum marginale absque processis vitreis. Habitat ad corticem putridum rami sicci* Juniperi osteospermae *in zona orotemperata subhumida Americae septentrionalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.15–0.28 mm diam., 0.1–0.11 mm high, light orange(-ochraceous), round, scattered; disc flat, margin distinct, 10–15 µm protruding, smooth; broadly sessile, slightly erumpent. **Asci** *48–64 × 5.5–6.5 µm, †44–55 × 4.3–5.5(–6) µm, 8-spored, spores *2–3-seriate, (1–)2–3(–4) lower spores inverted (not mixed), pars sporifera *26 µm long; **apex** (†) slightly to medium truncate (not indented, laterally not inflated), thin-walled, rarely with a 0.8 µm thick dome; **base** with short to long, thick, flexuous stalk, L- to Y-shaped. **Ascospores** *(5.2–)8–10.8 × (2.8–)3–3.3(–4) µm, †6–10.8 × 2.5–3 µm, divided into a broadly ellipsoid-fusoid head and a thick, basally partly swollen tail */†2–5 × 0.9–1.2(–1.7) µm, apex rounded to obtuse, tail straight to slightly, rarely strongly curved or flexuous, exceptionally absent; **SBs** *1.3–1.6 × 1–1.5 µm, globose to broadly tear-shaped, apically narrowed to a small point, mostly with a very short filum. **Paraphyses** apically slightly to medium clavate-capitate, terminal cells †13–19 × 2–3.3 µm, lower cells †5.5–15 × 1.1–1.4 µm; unbranched at upper septum. **Medullary excipulum** hyaline, 30 µm thick, of medium dense textura intricata with many inflated cells. **Ectal excipulum** pale orange, of (†) slightly gelatinized, 25 µm thick t. angularis-prismatica from base to mid flanks, cell size not measured (but in inflated cells in medulla *5–13 × 6–8.5 µm); at flanks oriented at a 45° angle to the surface, 20 µm thick near margin, of t. prismatica-porrecta oriented at 10–40°, marginal cortical cells †10–15 × 2–3 µm, thin-walled; **glassy processes** absent. **Anchoring hyphae** sparse, †2–3 µm wide, walls 0.2–0.5 µm thick. **SCBs** in paraphyses globose, (0.5–)1–1.8 µm diam. **Exudate** over paraphyses 0.1–0.3 µm thick, continuous, very finely rough, loosely attached, also 2–3 µm thick, cloddy; over margin and flanks 0.5–1.5 µm thick, continuous to cloddy. **— ANAMORPH**: unknown.

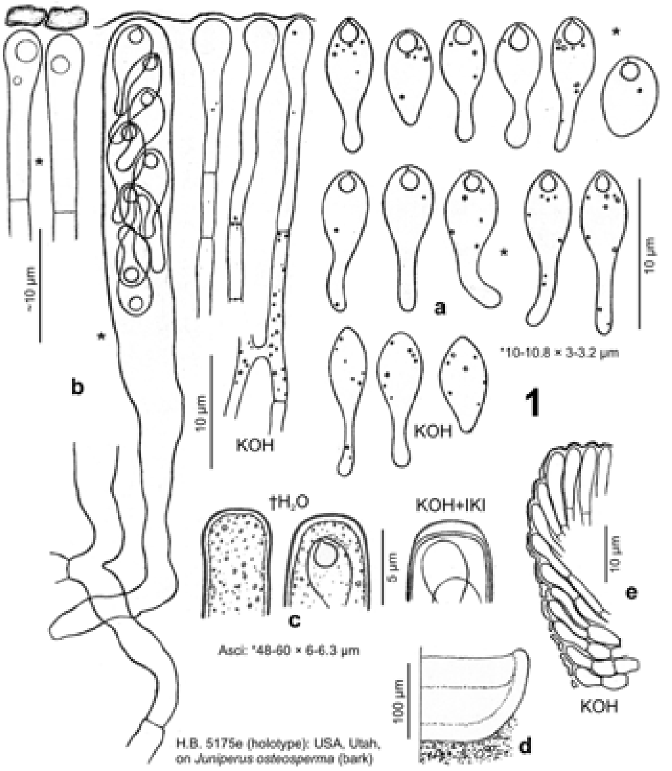


Plate 795. **1**: *Orbilia pisciculus*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apices; **d**. apothecium in median section; **e**. id., marginal ectal excipulum.

Habitat: ± corticated, 10–15 mm thick branch of *Juniperus osteosperma*, on medium decayed outer surface of bark, strongly greyed, without or with a few green algae. **Associated**: *Carestiella ?schizoxyloides*, *Orbilia cucumispora*, *O. ?maeandrina*, *O. multidelphinus*, *O. multihamulata*, *O. octosporoides*, *O. ophiosoma*, *O. osteospermae*. **Desiccation tolerance**: mature asci remain viable over at least 2 months. **Altitude**: 1815 m a.s.l. **Geology**: Upper Cretaceous sedimentary rock. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia pisciculus* is easily recognized by its ascospores having a thick, partly basally swollen tail and ± globose spore bodies in their ellipsoid head. The tail was present in almost all of the spores, whereas especially inside the asci a few spores were without a tail.

The species is obviously very closely related to *O. clavipisca*, which differs in spores almost always without a tail, the spore body with a distinctly longer filum, asci mostly with an apical thickening, finally in much larger and thicker apothecia. *O. gregorii* differs from *O. pisciculus* in narrower, more fusoid spores with longer SBs and only ± tail-like bases. Likewise, the Macaronesian *O. pisciformis* (section *Aurantiorubrae*) differs in much narrower, more fusiform spores with longer, tear-shaped SBs, while the spores have similar though shorter tails.

Further sections of the genus *Orbilia* include species with a similar spore shape. *O. clavuliformis* and allied taxa (section *Hemiorbilia*) differ from *O. pisciculus* in strongly elongated SBs and thick-walled ascus apices. Species of section *Habrostictis* with tailed spores (e. g., *O. quercus-ilicis*, *O. caudimaeandrina*) have vermiform to filiform SBs. In the type of *O. caudata* (section *Aurantiorubrae*) spore shape is very similar to *O. pisciculus* but spore size much smaller, the SBs more tear-shaped, and the apothecia possibly desiccation-sensitive.

Ecology. The sparse collection of *O. pisciculus* (~6–10 apothecia) was detected on medium rotten bark of a xeric branch of *Juniperus osteosperma* lying in a dry riverbed in the

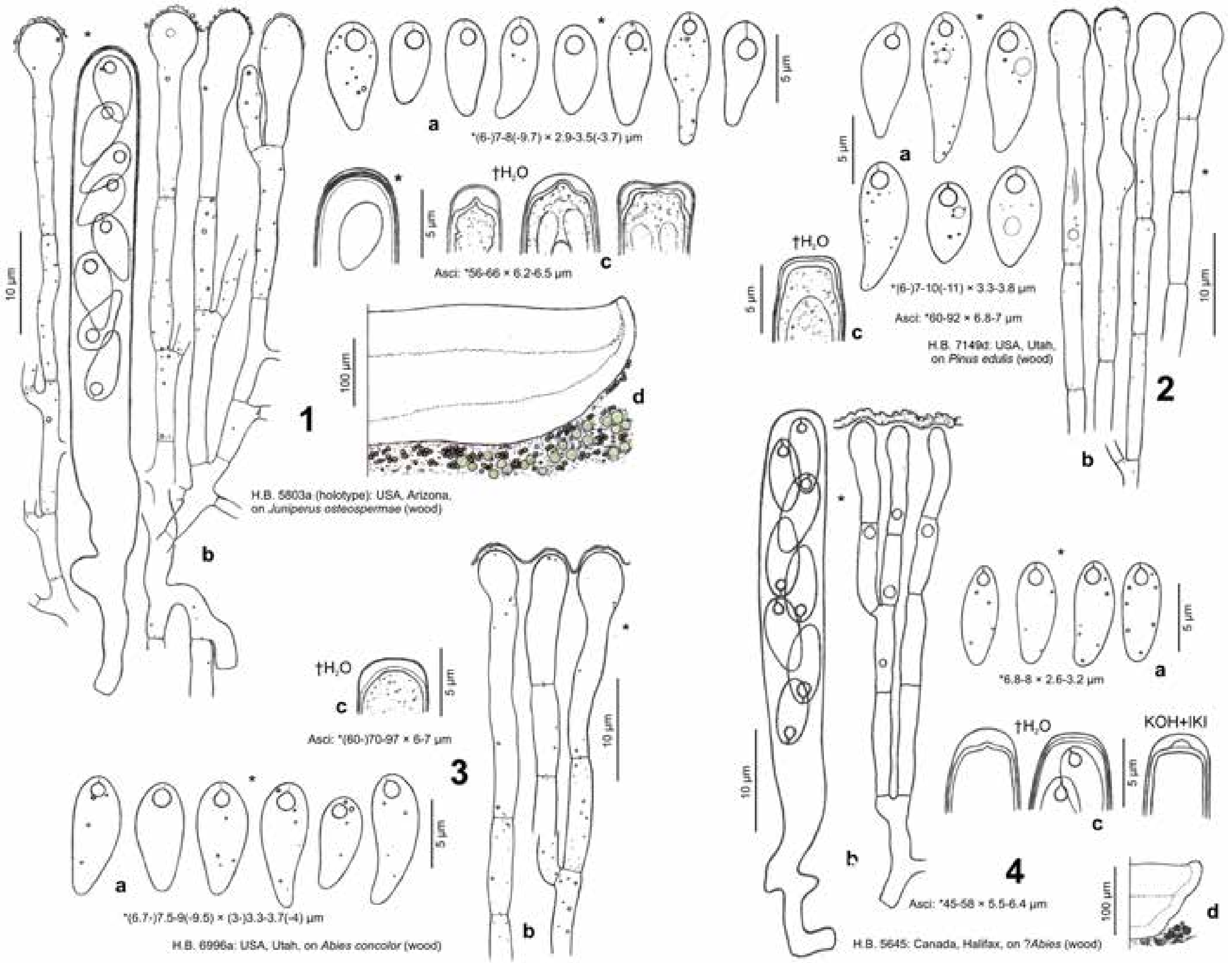


Plate 796. **1–3**: *Orbilia clavipisca*; **4**: *O.* aff. *clavipisca*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. apothecia in median section.

cold-temperate subhumid pinyon-juniper woodland of Dixie Forest, part of the Utah Mountains in western North America. The holotype appears to be empty after the seemingly last apothecium was used up during a later reexamination.

Specimens included. **USA**: **Utah**, Utah Mts., Dixie Forest, 1.5 km ESE of Cedar City, 1815 m, branch of *Juniperus osteosperma*, on bark, 24.VIII.1994, G. Marson (ex H.B. 5175e, M-0276555, **holotype**).

Orbilia clavipisca Baral & G. Marson, **sp. nov.**, MB 813939 — Pls 796–797

Etymology: referring to the clavate, somewhat fish-like ascospores and the resemblance to *O. pisciculus*.

Typification: USA, Arizona, Flagstaff, branch of *Juniperus osteosperma*, 9.V.1995, G. Marson (ex H.B. 5803a, M-0276455, holotype).

Latin diagnosis: *Similis* Orbiliae ovoideae *sed excipulum marginale cellulis tenuitunicatis*, *multo brevioribus compositum*, *in statu vivo absque corpusculis globosis magnis*, *asci apice in statu emortuo plerumque crassitunicati, etiam tenuitunicati. Habitat ad lignum putridum ramorum siccorum arborum coniferarum in zona boreale ad temperata (sub)humida Americae septentrionalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.4–1(–1.2) mm diam., 0.15–0.3 mm high, (light to) bright orange(-ochraceous), ± translucent or not, round to elliptical, slightly lobate when large, scattered or in small groups; disc slightly concave to flat, margin distinct, thick when young, (0–)5–20 µm protruding, smooth; broadly sessile or with a hidden stipe-like base, nearly superficial. **Asci** *55–66 {1} or 60–97 {2} × 6–7.5(–8) µm {3}, †(55–)60–80(–90) × 5–6.2(–6.5) µm {3}, 8-spored, spores subbiseriate, (1–)2–3(–5) lower spores inversely oriented {4} (never or very rarely mixed), pars sporifera *(25–)30–39(–42) µm long; **apex** (†) slightly to strongly truncate (rarely slightly indented and laterally inflated), thin-walled {1} or with †0.8–1.4 → 0.5–1 µm thick dome {3}, with or without apical chamber; **base** with short to long, thin or thick, flexuous stalk, T-, L- or h-shaped. **Ascospores** *(6–)7–10(–11) × (2.9–)3.2–3.8(–4) µm {4}, ellipsoid-obovoid(-fusoid) to often ellipsoid- to obovoid-clavate, apex rounded to obtuse, base mostly medium to strongly attenuated, exceptionally tail-like, straight to slightly curved near base; **SBs** *(1.6–)1.8–2.2(–2.8) × (1–)1.2–1.4(–1.6) µm {3}, globose, apically abruptly narrowed to a fine, ± short filum. **Paraphyses** apically cylindrical or mostly slightly to medium (rarely strongly) clavate-capitate, sometimes moniliform, rarely spathulate, terminal cells *(8–)11–26(–34.5) × (2.3–)3–4.5(–5.2) µm {3}, lower cells *(6–)8–15(–18) × 1.4–2.5(–3.3) µm {3}; rarely branched near apex; hymenium subhyaline to pale rose-orange. **Medullary excipulum** subhyaline to pale rose-orange, 50–130 µm thick, of medium dense textura intricata with many inflated cells, medium sharply delimited. **Ectal excipulum** pale rose-orange, of thin-walled († slightly gelatinized), vertically oriented t. angularis(-prismatica) from base to mid flanks or submargin, 30–70 µm thick near base, cells *(7–)10–22(–27) × (5–)6–15(–19) µm {4}; 30–70 µm thick at lower flanks, 15–30 µm at mid flanks, 15–20 µm near margin, of t. porrecta-prismatica or t. prismatica-angularis oriented at a 10–45° angle to the surface, slightly gelatinized at submargin, marginal cortical cells */†6–15 × 2–4 µm {4}, (†) ± thin-walled, **glassy processes** absent. **Anchoring hyphae** very abundant, †2–3(–3.7) µm wide, walls (0.1–)0.2–0.4(–0.6) µm thick {3}, sometimes forming a compact 10–20

Plate 797. **1**: *Orbilia clavipisca*. – **1a**. conifer forest in the Douglas fir mixed forest, young and old *Abies concolor* (also *Pinus ponderosa*, *Pseudotsuga menziesii* and *Quercus gambelii*); **1b–f**. rehydrated apothecia; **1i–j**. apothecia in median section; **1g**. id., marginal ectal excipulum; **1h**. id., basal ectal excipulum. – Living state, except for **1g** (in H_2O). — **1a–j**. H.B. 8095c: USA, Utah, on *Abies*.

µm thick gelatinized layer near base. **SCBs** in paraphyses absent, rarely a few globose, up to 1 µm diam.; in excipular cells absent. **Exudate** over paraphyses 0.2–0.8 µm thick, continuous to granular, ± firmly attached; over margin and flanks 0.2–1 µm thick, granular or cloddy. — **ANAMORPH**: unknown.

Habitat: collected 0.5–2 m above the ground, decorticated, 10–30 mm thick branches of *Abies concolor* {2}, *Juniperus osteosperma* {1}, *Pinus edulis* {1}, on 0.2–0.5 mm deep strongly decayed, eroded wood {4}, strongly greyed, with sparse to abundant green algae. **Associated**: ?*Amandinea* sp. {1}, *Caloplaca* sp. {2}, *Hypogymnia* sp. {1}, *Lecanorales* {2}, ?*Melanelia* sp. {1}, *Melaspilea emergens* {1}, *Mellitiosporiella pulchella* {1}, *Orbilia coniferarum* {1}, *O. delphinus* {1}, *O. edulis* {1}, *O. maeandrina* {1}, *O. multitrapezoidea* {1}, *O. ophiosoma* {1}, *Ostropales* {1}, *Parmelia* sp. {1}, *Tryblidaria* ?*fenestrata* {1}. **Desiccation tolerance**: fully viable for at least 2 years, after 33 months still many excipular cells and some spores alive. **Altitude**: 1965–2778 m a.s.l. **Geology**: Cambrian-Ordovician, Permian and Cretaceous to Miocene carbonate sandstone; lava flow of rhyolite and andesite. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia clavipisca* is very similar to the European *O. ovoidea*, from which it differs in thin-walled, much shorter marginal cortical cells, the absence of large globose SCBs, and (regarding three of the four included specimens) in consistently thick-walled ascus apices. The Australian *O. gregorii* differs in narrower spores, shorter terminal cells of paraphyses which regularly contain globose SCBs, and in the absence of apical domes. For the similar North American *O. pisciculus* and Australian *O. eremaeae* see above and below.

O. ponderosae differs in 16-spored asci and rarely tapered spore bases. In the shape of its spores and SBs *O. clavipisca* shows also similarities to the 64-spored *O. myriosphaera* of section *Lentiformes*. Even the hyphoid marginal cortical cells of *O. myriosphaera* which are thick-walled in the dead state resemble those of typical representatives of section *Ovoideae*.

Variation. *O. clavipisca* varies among the collections in the thickness of the apical dome. In the collection on *Pinus* (Pl. 796: 2) the asci were without a distinctly thickened apical wall, whereas in the holotype the apical domes were thickest.

Not included collection. A sample from Canada (Pl. 796: 4) deviates in narrower spores with smaller SBs, smaller asci, and much smaller apothecia (0.15–0.22 mm), besides apically hardly inflated paraphyses that contain globose SCBs.

Ecology. *O. clavipisca* was found on rotten wood of xeric branches of different gymnosperm trees and shrubs in cold-temperate to boreal humid ponderosa pine and Douglas fir mixed forests or once subhumid pinyon-juniper woodland in the Colorado Plateau (Utah Mountains, Canyonlands section, Mogollon Rim) in the southwest of Northern America. The not included Canadian collection was from the cold-temperate humid Atlantic Coast of northeastern North America.

Specimens included. **USA**: **Utah**, Utah Mts., Bryce Canyon, 32 km SE of Panguitch, 13 km WSW of Tropic, near Trough Spring, 2500 m, branch of *Abies concolor*, on wood, 13.VI.2003, G. Marson (H.B. 8095c). – 42 km SSE of Panguitch, Rainbow Point, 2778 m, branch of *A. concolor*, on wood, 20.VI.2000, G. Marson (H.B. 6996a). – Canyonlands, 16 km NNW of Mexican Hat, 1 km N of Mokee Dugway, Cedar Mesa, 1965 m, branch of *Pinus edulis*, on wood, 14.VI.2000, G. Marson (H.B. 7149d). – **Arizona**, Mogollon Rim, 9 km NW of Flagstaff, 9 km SSW of Humphreys Peak, Rte. 180, 2250 m, branch of *Juniperus osteosperma*, on wood, 9.V.1995, G. Marson (ex H.B. 5803a, M-0276455, **holotype**).

Not included. **CANADA**: **Nova Scotia**, 81 km ENE of Halifax, Taylor Head, Provincial Park, ~20 m, twig of ?*Abies*, on wood, X.1996, C. Peller (H.B. 5645).

Orbilia eremaeae Baral, **sp. nov.**, MB 813940
— Pls 798–799

Etymology: named after the host genus, *Eremaea* (*Myrtaceae*).
Typification: Western Australia, Cowalla, branch of *Eremaea pauciflora*, 23.X.2007, G. Marson (ex H.B. 8775b, MEL 2389259B, holotype).

Latin diagnosis: *Similis* Orbiliae clavipiscae *sed apothecia minora, ascosporae cylindricae ad ellipsoideae, basi non vel leniter attenuatae, paraphyses apice haud inflatae. Habitat ad corticem putridum ramuli sicci* Eremaeae pauciflorae *in zona subtropica semihumida Australiae meridio-occidentalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.18–0.27 mm diam., 0.1–0.17 mm high, light orange, slightly translucent, round, scattered; disc flat, margin distinct, 5–10 µm protruding, smooth; sessile on a narrowed base, ± immersed in biofilm. **Asci** *48–60 × 7–7.3 µm, †43–52 × 6–6.3 µm, 8-spored, spores */†1–2-seriate, 3–5 lower spores inverted (often mixed, laterally sometimes oriented); **apex** (†) (very) slightly truncate, dome †1–1.2 → 0.8–1 µm thick, without or with shallow apical chamber; **base** with short to long, ± thick, flexuous stalk, L- to Y-shaped. **Ascospores** *(6–)6.5–8.5(–10.5) × 3.2–4(–4.3) µm, cylindric-ellipsoid to broadly-ellipsoid, apex rounded, base sometimes slightly attenuated, straight to distinctly inequilateral; **SBs** *1.8–2.2(–2.5) × 1.2–1.6 µm, ± globose to broadly tear-shaped, apically partly narrowed to a short filum. **Paraphyses** apically uninflated to sometimes slightly clavate, terminal cells *7–20 × 2.3–3 µm, lower cells *(6.5–)8–11.5 × 1.7–2.6 µm; never branched at upper septum. **Medullary excipulum** pale orange, 30–80 µm thick, of dense textura intricata with many inflated cells, not sharply delimited. **Ectal excipulum** very pale orange, of (†) ± thin-walled, indistinctly oriented t. angularis from base to mid flanks, 20 µm thick near base, cells *8–13 × 6–10 µm; 15–20 µm thick near margin, of t. prismatica-porrecta oriented at a 0–20(–50)° angle to the surface, marginal cortical cells *6–13 × 2.5–3.5 µm, (†) thin-walled; **glassy processes** absent. **Anchoring hyphae** sparse to medium abundant, */†2–2.8 µm wide, walls 0.2–0.4(–0.6) µm thick. **SCBs** in paraphyses and ectal excipulum (near margin) globose, 1–2 µm diam. **Exudate** over paraphyses 0.3–1.5 µm thick, cloddy-continuous, hyaline, ± loosely attached, over margin and flanks 1.5–3 µm thick, rough-cloddy. **— ANAMORPH**: unknown.

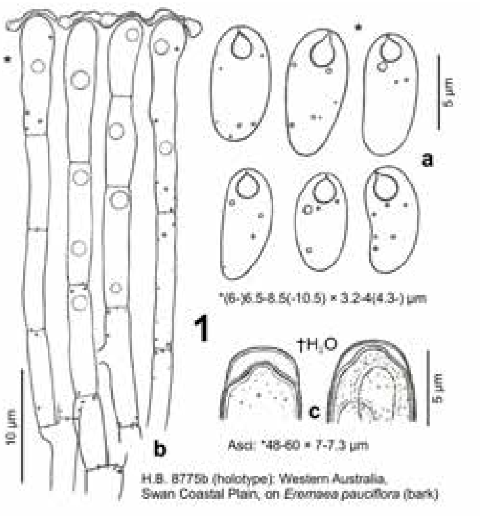


Plate 798. **1**: *Orbilia eremaeae*. – **a**. ascospores; **b**. paraphyses; **c**. ascus apices.

Habitat: collected 0–50 cm above the ground, corticated, 8 mm thick branch of *Eremaea pauciflora*, on strongly decayed bark (periderm), strongly greyed, green algae sparse. **Associated**: *Durella* aff. *connivens*, ?*Eutypa* sp., *Gloniopsis praelonga*, *Orbilia austrocylindrica*, *O. multicurvula*, *O. pleistovitalbae*, *Proliferodiscus olivaceoviridis*, *Rhizodiscina lignyota*. **Desiccation tolerance**: fully viable for at least 4 months. **Altitude**: 77 m a.s.l. **Geology**: Cretaceous sedimentary rock. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia eremaeae* resembles the conifericolous North American *O. clavipisca* in many respects, but differs in smaller apothecia, cylindric-ellipsoid ascospores with not or only slightly attenuated bases, spore bodies with a very short filum or a small triangular connecting part, apically

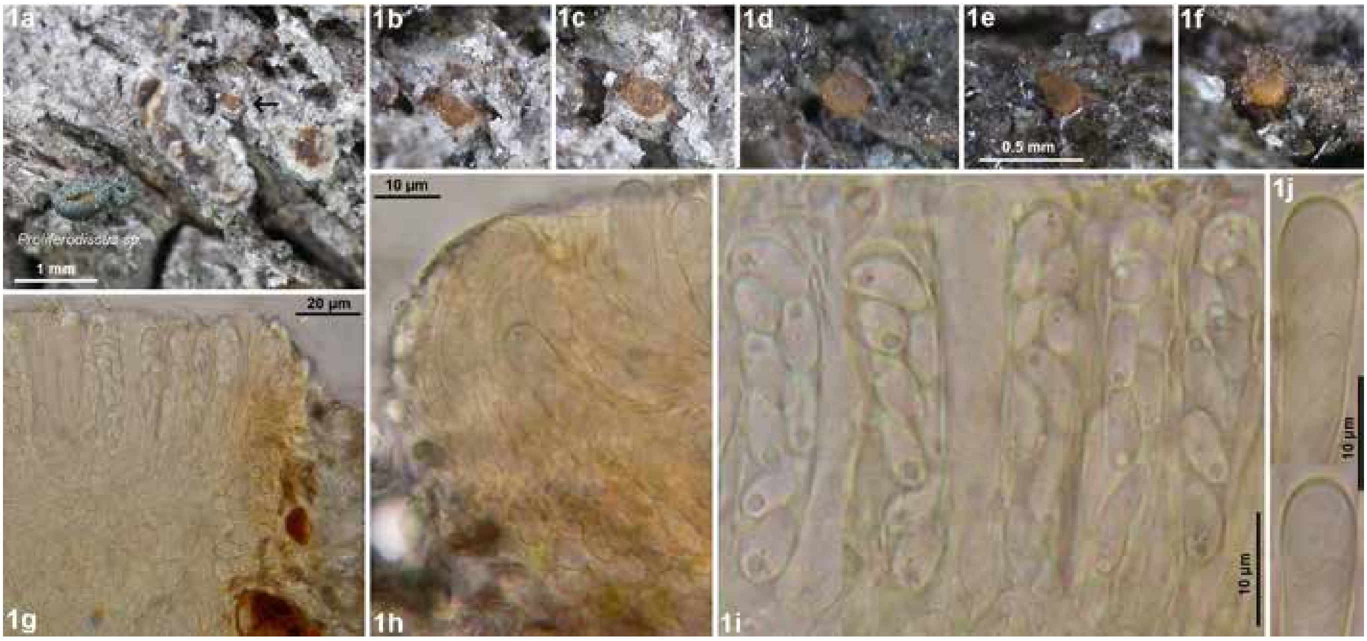


Plate 799. **1**: *Orbilia eremaeae*. – **1a–f**. rehydrated apothecia (**1a** with *Proliferodiscus olivaceoviridis*); **1g**. apothecium in median section; **1h**. id., marginal ectal excipulum; **1i**. mature asci with ascospores; **1j**. apices of submature asci. – Living state, except for marginal cells in **1g** and asci in **1i**. — **1a–j**. H.B. 8775b (holotype): Western Australia, Moora, on *Eremaea*.

not or only slightly inflated paraphyses, the abundant presence of medium-sized globose SCBs, and the occurrence on angiosperm bark in Australia.

Not included collections. A specimen with very similar spores grew on a branch of *Carya* in Massachusetts (USA) and was only seen from a microphoto made by B. Liu (IVV: ~VIII.2011). With its small, presumably orange apothecia (0.1–0.3 mm diam) it would fit *O. eremaeae*, but the spores are broader and more ellipsoid-ovoid (*~7–8.5 × 4–4.5 µm), also the SBs are broader (~2.3–2.6 × 1.6–1.8 µm). In a similar sample on bark of *Arbutus* in British Columbia (O. & A. Ceska, IVV: 30.IV.2017) the orange apothecia measure up to 0.53 mm diam. and have whitish marginal teeth composed of glassy processes. In the spores (*7–8 × 4–5 µm) and SBs (~2.5 × 1.5 µm) this would quite perfectly fit the sample on *Carya*.

Ecology. *O. eremaeae* was found on decayed bark of a xeric branch of *Eremaea pauciflora* in a subtropical semihumid banksia-eucalypt-acacia open wood- and shrubland in southwestern Australia. The not included North American collections were on *Carya* in a cold-temperate humid deciduous forest on granite in the Northeastern Coastal Forests, and on *Arbutus* in a mild-maritime humid mixed evergreen forest in the Pacific west (southern end of Coast Mountains).

Specimens included. **AUSTRALIA**: **Western Australia**, Swan Coastal Plain, 59 km SW of Moora, 8 km NE of Cowalla, Moore River, Orange Springs Rd, 77 m, branch of *Eremaea pauciflora*, on bark, 23.X.2007, G. Marson (ex H.B. 8775b, MEL 2389259B, **holotype**).

Not included. **CANADA**: **British Columbia**, 11 km NNW of Victoria, Observatory Hill, 140 m SE of planetarium, 195 m, branch of *Arbutus menziesii*, on bark 30.IV.2017, O. & A. Ceska (O.C. 2170430, doc. vid.). — **USA**: **Massachusetts**, ~4 km S of Concord, ~4 km W of Lincoln, Mt. Misery, ~40 m, branch of *Carya*, on ?wood, ?VIII.2011, B. Liu (B.L., doc. vid.).

Orbilia ponderosae Baral & G. Marson, **sp. nov.**, MB 813941 — Pls 800–801

Etymology: named after the substrate of the type, *Pinus ponderosa*.

Typification: USA, Arizona, Flagstaff, branches of *Pinus ponderosa*, 12.VI.2000, G. Marson (ex H.B. 6997a, M-0276568, holotype).

Latin diagnosis: *Apothecia rehydratata 0.2–0.33 mm diam., aurantiaca, subsessilia, margine laevi. Asci 16-spori, in statu emortuo modice truncati, tenuitunicati. Ascosporae *5–8.7 × 2.8–3.6 µm, subcylindrico-ellipsoideae, corpusculum refringens magnum, globosum, ad apicem cuspide interdum incrassata affixum continentes. Paraphyses ad apicem non vel modice capitato-clavatae, exsudato valido tectae. Excipulum marginale textura porrecta sub angulo acuto orientata, absque processis vitreis. Habitat ad corticem putridum ramorum siccorum* Pini ponderosae *in zona orotemperata humida Americae septentrionalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.15–0.33 mm diam., 0.16 mm high, light orange, round, (very) scattered; disc slightly to medium concave, margin thin, scarcely protruding, smooth; subsessile, superficial; dry deep orange(-apricot). **Asci** *60–89 × (6.7–)7.3–8(–9) µm, †56–85 × 6.4–7.7 µm, 16-spored, spores 2–4-seriate, lower 7–13 spores inversely oriented (strongly mixed), pars sporifera *45–58 µm long; **apex** (†) medium truncate (laterally not or slightly inflated), thin-walled, rarely young with 1.2 µm thick apical dome; **base** with short to medium long, thick, flexuous stalk, T-, L-, Y- or h-shaped. **Ascospores** *(5–)6.5–8(–8.7) × (2.8–)3–3.4(–3.6) µm, subcylindric-ellipsoid(-clavate), ends rounded, base rarely slightly to medium attenuated, straight to slightly inequilateral; **SBs** *(1.5–)1.8–2 × (1–)1.2–1.4 µm, globose to broadly tear-shaped (to ampulliform), apically narrowed to a ± small point, with a very short

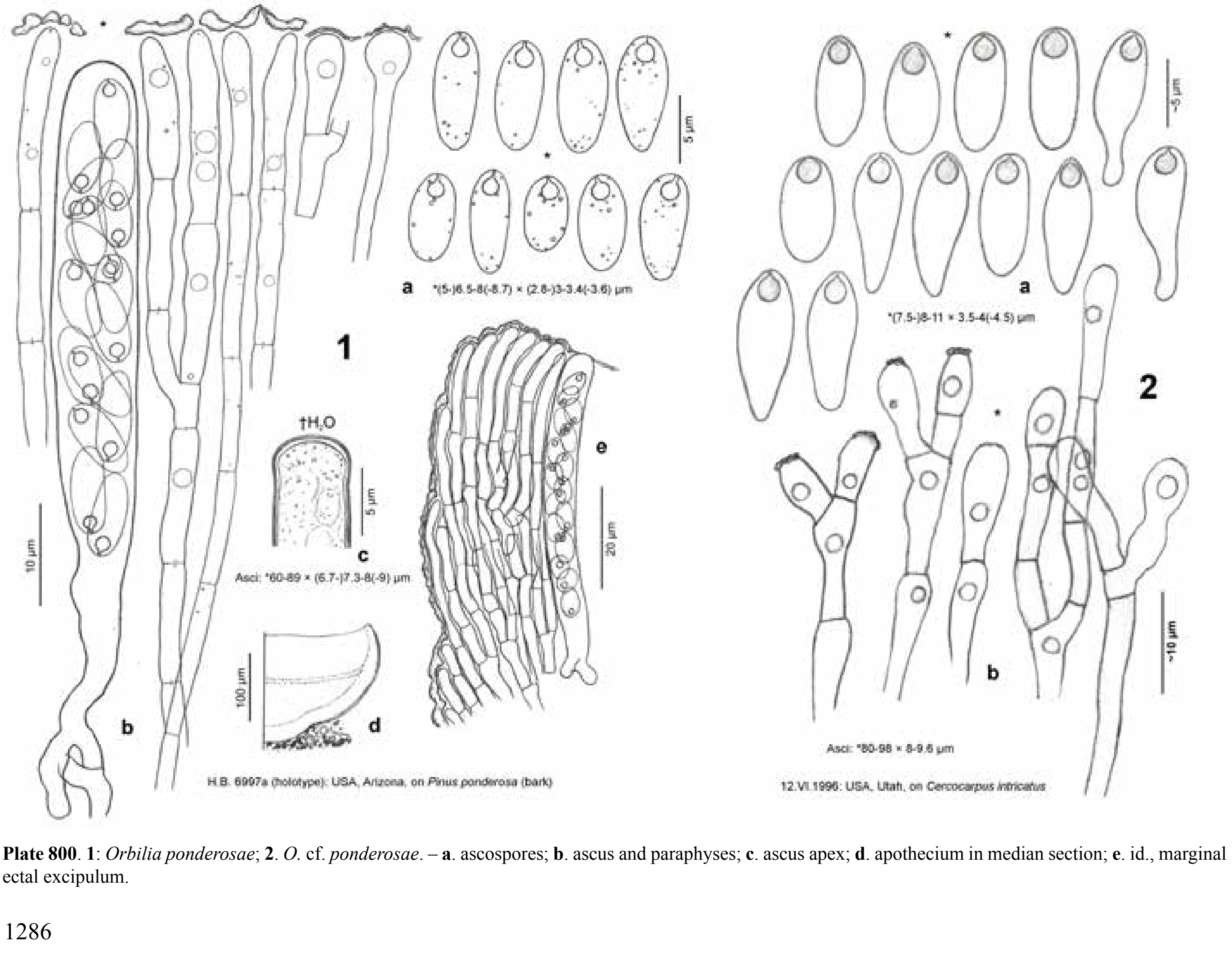


Plate 800. **1**: *Orbilia ponderosae*; **2**. *O.* cf. *ponderosae*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apex; **d**. apothecium in median section; **e**. id., marginal ectal excipulum.

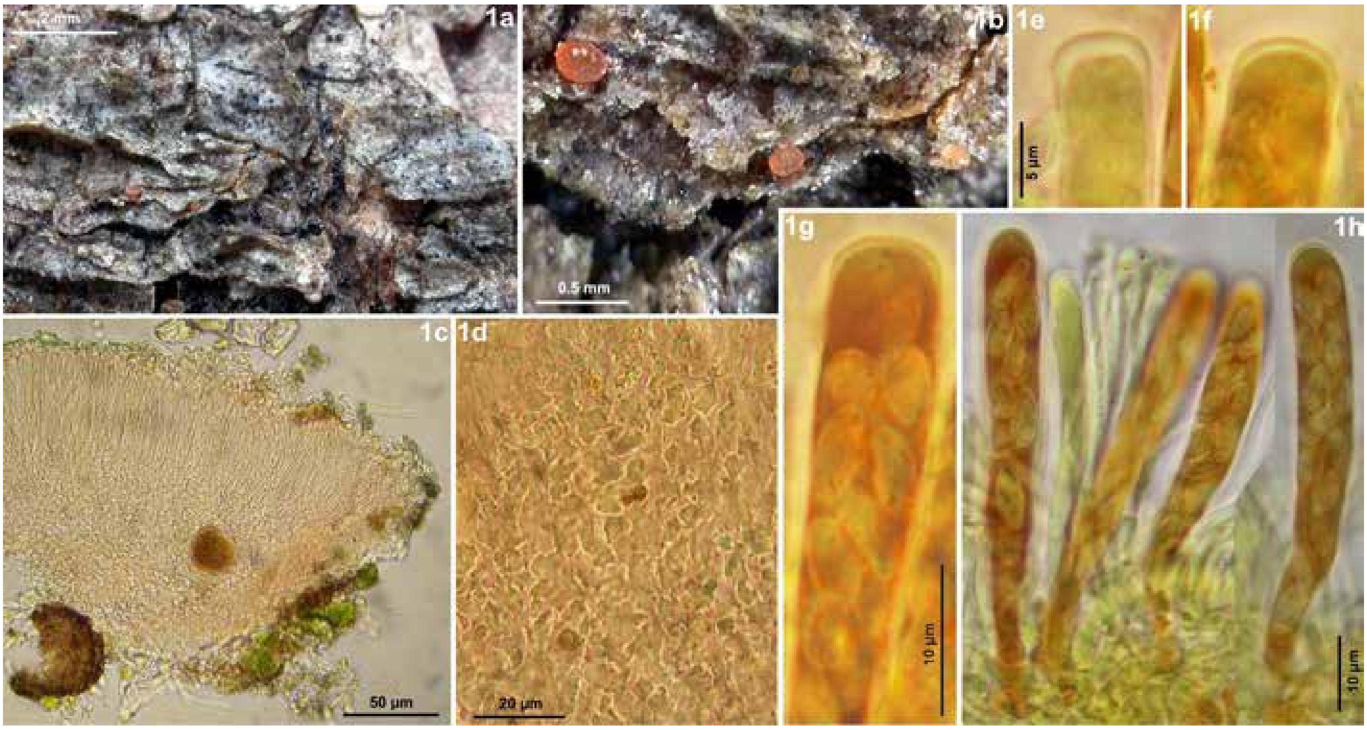


Plate 801. **1**: *Orbilia ponderosae*. – **1a**. bark surface of a xeric *Pinus ponderosa* branch, with apothecia (rehydrated); **1b**. rehydrated apothecia; **1c**. apothecium in median section; **1d**. exudate at margin in external view; **1e–g**. ascus apices; **1h**. mature asci. – Dead state (**1c–d** in KOH, **1e–h** in KOH+IKI). — **1a–h**. H.B. 6997a (holotype): USA, Arizona, on *Pinus*.

thick or sometimes thin, cylindrical or tapering connecting part. **Paraphyses** apically uninflated or slightly to medium (rarely strongly) clavate-capitate, sometimes slightly (obtusely) lanceolate, terminal cells *(10–)13–19(–22) × (1.6–)2–3.7(–4.3) µm, lower cells *8–16 × 1.5–2.5(–3.5) µm, finally sometimes branched near apex; hymenium very pale rose. **Medullary excipulum** 60 µm thick, of medium loose textura intricata with a few inflated cells, medium sharply delimited from ectal excipulum, at flanks forming a t. porrecta. **Ectal excipulum** pale rose, of thin-walled, irregularly oriented t. angularis from base to lower flanks, 20–25 µm thick near base, cells *6–13 × 4–10 µm; 15–20 µm thick from lower flanks up to margin, at mid flanks and margin (upper 100 µm) of t. porrecta, oriented at a 10–30° angle to the surface, cells *(2–)7–13 × 2–3(–4) µm, (*) thin-walled, marginal cortical cells *10–23 × 2.5–3 µm, **glassy processes** absent. **Anchoring hyphae** abundant, †2–3(–4) µm wide, walls 0.2–1.2 µm thick. **SCBs** in paraphyses globose, 1–2.7 µm diam.; in excipular cells absent. **Exudate** over paraphyses 0.3–2 µm thick, continuous to cloddy, hyaline, loosely attached; over margin and mid flanks continuous, ± rough, 0.5–2 µm thick, at lower flanks forming ~5 µm thick large clods. **— ANAMORPH**: unknown.

Habitat: collected 1.5–3 m above the ground, partially decorticated, 14–19 mm thick branches of *Pinus ponderosa*, on medium decayed, small, ± detaching squamules of the outer bark (periderm and bast, on surface, edges and lower side), greyed, many green algae. **Associated**: ?*Stictis* sp., crustose and foliose lichens. **Desiccation tolerance**: fully viable for at least 13 months. **Altitude**: 2250 m a.s.l. **Geology**: Triassic-Jurassic sedimentary rock; lava flows of rhyolite and andesite. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia ponderosae* appears to be closely related to *O. eremaeae*, from which it differs in 16-spored asci, and predominantly absent ascus apical thickenings. For the similar *O. stansburyanae* and *O. sarcobati* see p. 1272 and p. 1287. *O. ponderosae* also resembles *O. canadensis*, from which it differs in larger, more elongate spores and a thin-walled textura porrecta at margin and mid flanks.

Not included collection. A collection on *Cercocarpus* (Pl. 800: 2) differs in larger apothecia, longer, perhaps also wider spores with partly obtuse apices and apparently larger SBs, and paraphyses with somewhat shorter and thicker terminal cells. Regrettably, the marginal excipulum was not studied, therefore, a possibly close relationship to *O. stansburyanae* cannot be excluded.

Ecology. *O. ponderosae* was found on medium rotten bark of xeric branches of *Pinus ponderosa* in a cold-temperate humid ponderosa pine forest of the Mogollon Rim in the southwest of Northern America. The not included collection on *Cercocarpus* was in a cold-temperate subhumid pinyon-juniper woodland at the eastern end of the Uinta Basin.

Specimens included. **USA**: **Arizona**, Mogollon Rim, 9 km NW of Flagstaff, San Francisco Peaks, 9 km SSW of Humphreys Peak, Rte. 180, 2250 m, branches of *Pinus ponderosa*, on bark, 12.VI.2000, G. Marson (M-0276568, **holotype**; **isotype** in H.B. 6997a).

Not included. **USA**: **Colorado**, Uinta Basin, 50 km ESE of Vernal, 6 km NE of Dinosaur, 2100 m, on *Cercocarpus intricatus*, 12.VI.1996, G. Marson (ø).

Orbilia sarcobati Baral & G. Marson, **sp. nov.**, MB 813942 — Pls 802–803

Etymology: referring to the substrate, *Sarcobatus vermiculatus*.

Typification: USA, Utah, Blanding, branches of *Sarcobatus vermiculatus*, 14.V.1995, G. Marson (ex H.B. 5400a, M-0276582, holotype).

Latin diagnosis: *Similis* Orbiliae ponderosae *sed excipulum marginale textura globulosa-prismatica, cellulis multo brevioribus compositum, cellulae terminales paraphysium breviores et magis inflatae, corpuscula refringentia ascosporarum leniter angustiora, partim ampulliformia. Habitat ad corticem vel lignum leniter putridum ramorum siccorum* Sarcobati vermiculati *in zona temperata semiarida Americae septentrionalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.1–0.25(–0.3) mm diam., 0.09–0.125 mm high, pale to light (yellowish-) orange(-rose), round, very scattered to medium gregarious; disc flat to slightly convex, margin thin, 0–5 µm protruding, smooth; sessile or with ill-defined hidden stipe 0.02 × 0.03 mm, superficial or somewhat erumpent between fibres. **Asci** *50–65 × (8–)8.5–9.5(–10.5) µm {3}, †39–58 × 6.7–8.5 µm {2}, 16-spored, spores ± biseriate, ~7–10 lower spores inversely oriented {2} (rather mixed, especially in upper part,

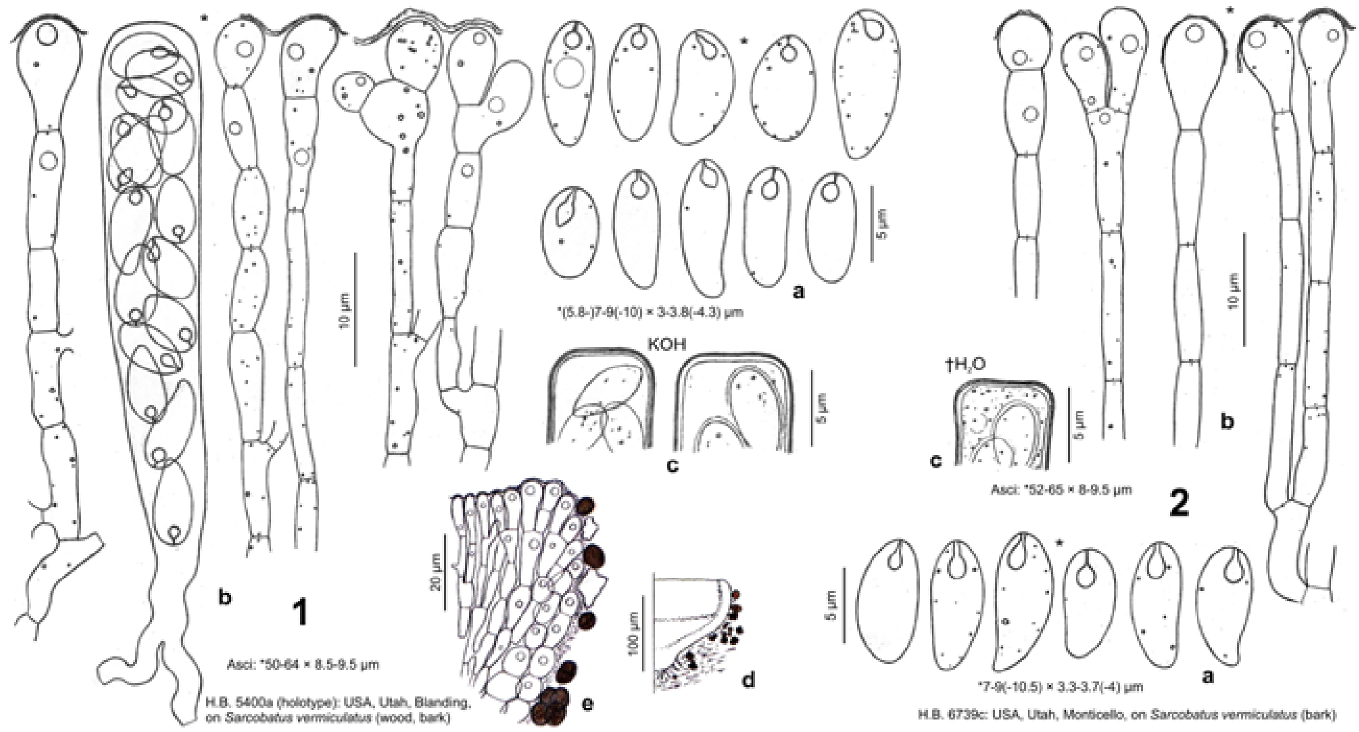


Plate 802. **1–2**: *Orbilia sarcobati*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apices; **d**. apothecium in median section; **e**. id., marginal ectal excipulum (with dark brown cells of black yeasts).

here partly laterally oriented), pars sporifera *33–47 µm long, †45–50 µm; **apex** (†) medium to strongly truncate (scarcely indented, laterally sometimes inflated), thin-walled; **base** with short, thick, flexuous stalk, L-, T-, h-, sometimes H-shaped. **Ascospores** *(5.8–)7–10(–11) × (2.8–)3–3.8(–4.3) µm {3}, †6.2–9 × 3.3–3.8 µm {1}, subcylindric-ellipsoid, sometimes obovoid-clavate, apex rounded, base often slightly (rarely strongly) tapered, straight to slightly curved near base; **SBs** *(1.3–)1.7–2.5 × (0.7–)0.9–1.2(–1.4) µm {3}, (sub)globose to tear- or pear-shaped, more rarely ampulliform, apically narrowed to a small, more rarely wide point, often with a short filum. **Paraphyses** apically slightly or mostly medium to strongly capitate-clavate, sometimes moniliform, terminal cells *(3–)5–14(–17) × 3–5.7 µm {3}, †3–5 µm wide, lower cells *(4.5–)7–14 × 1.8–3(–3.7) µm {2}; sometimes branched near apex. **Medullary excipulum** hyaline, 15–25 µm thick, of medium dense textura intricata with a few inflated cells, indistinctly or sharply delimited. **Ectal excipulum** very pale reddish, of thin-walled, ± horizontally oriented t. globulosa-angularis from base to mid flanks, 12–20 µm thick near base, cells *5–11 × 5–10 µm {2}; 12–15 µm thick at mid flanks and margin, of t. globulosa-prismatica oriented at a 10–40° angle, marginal cortical cells *5–14 × 3.7–6 µm {2}, **glassy processes** absent. **Anchoring hyphae** very sparse, 3–4 µm wide, walls 0.3–0.4 µm thick {1}. **SCBs** globose {3}, in paraphyses 0.8–2 µm diam., in ectal excipulum 1.4–2.2 µm. **Exudate** over paraphyses 0.2–0.5(–1) µm thick, continuous, loosely attached; over margin and flanks granular. **— ANAMORPH**: unknown.

Habitat: collected 0.05–0.1 m above the ground, ± corticated, 6–18 mm thick branches of *Sarcobatus vermiculatus* {3}, on slightly to medium decayed wood {1} or bark (periderm) {3}, slightly to medium greyed, sometimes in old wound, green algae present or absent. **Associated**: *Orbilia bicknellensis* {1}, *O. vermiculati* {2}, *Schizoxylon* ?*argentinum* {1}, *Teichospora* sp. {1}, *T. obducens* {1}, *Xanthoria* sp. {2}, various crustose lichens. **Desiccation tolerance**: fully viable for at least 8 months, some mature asci still alive after 26 months. **Altitude**: 1602–1905 m a.s.l. **Geology**: Triassic to Cretaceous red sand- & mudstone. **Phenology**: long-lived.

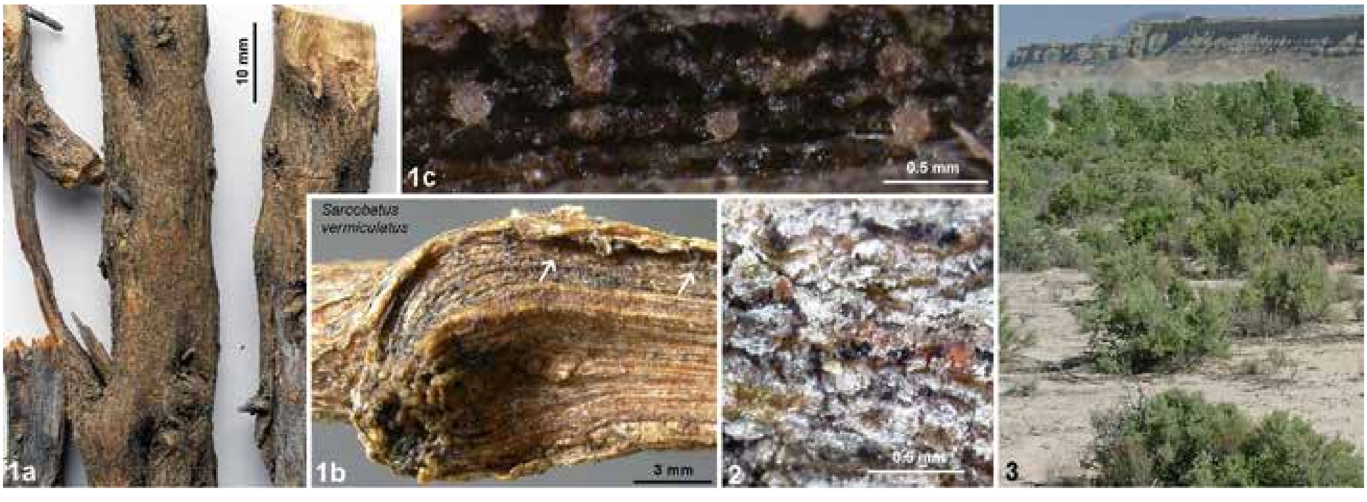


Plate 803. **1–3**: *Orbilia sarcobati*. – **3**. River plain with semiarid shrubland of *Sarcobatus vermiculatus*; **1a–b**. dead, undecayed, corticated xeric branches of *S. vermiculatus*; **1c**, **2**. rehydrated apothecia (**1c**: after 11 years, **2**: after 4.5 years). — **1a–c**. H.B. 5400a (holotype): USA, Utah, Blanding, on *Sarcobatus*; **2**. H.B. 6739c: ibid., Monticello, on *Sarcobatus*; **3**. 7 km W of Hanksville (phot. 10.VI.2003), showing a habitat similar as around Blanding.

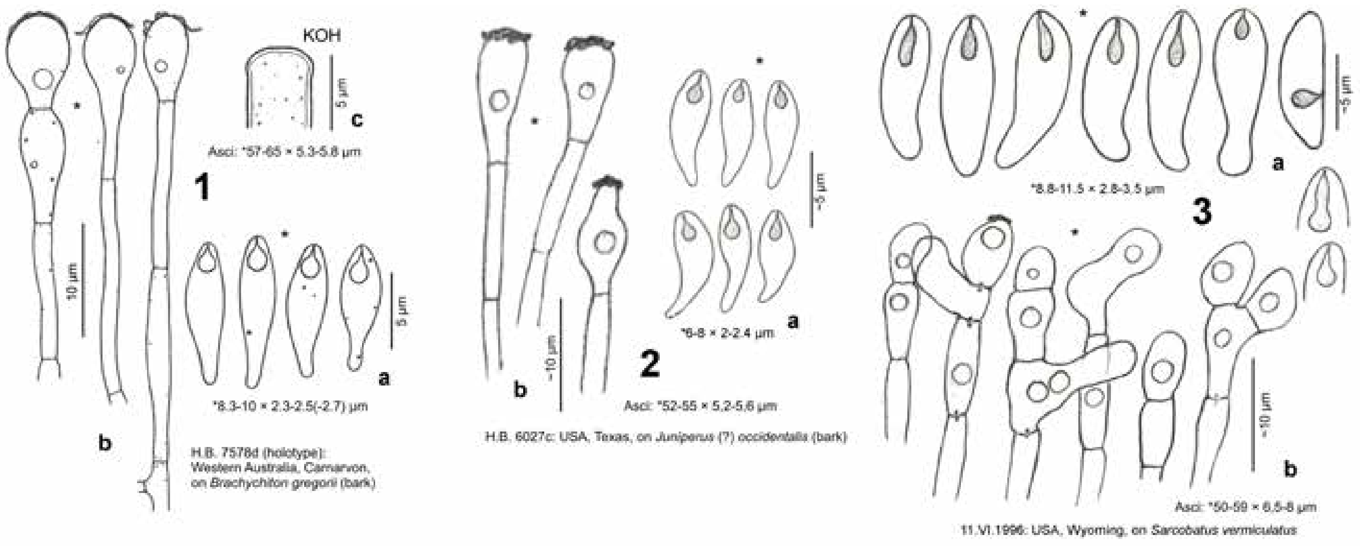


Plate 804. **1**: *Orbilia gregorii*; **2–3**: *O.* aff. *gregorii*. – **a**. ascospores; **b**. paraphyses; **c**. ascus apex.

Taxonomic remarks. *Orbilia sarcobati* is characterized by 16-spored asci with ± ellipsoid ascospores containing rather large, globose to tear-shaped SBs, paraphyses with short, distinctly capitate-clavate terminal cells, minute apothecia, and in a seeming restriction to *Sarcobatus*. A collection on the same host mentioned under *O. gregorii* (Pl. 804: 3) differs in 8-spored, narrower asci and slightly longer spores with more elongate SBs. Also *O. vermiculati* (section *Habrostictis*) appears to prefer the same host and has partly similar ascospores (particularly H.B. 7163a), but differs in much longer SBs and longer, basally more attenuated spores. In overmature spores, however, the SBs get tear-shaped, very similar as in *O. sarcobati*. *O. ponderosae* (on bark of *Pinus*) differs in a marginal ectal excipulum of t. porrecta, longer terminal cells of paraphyses being rarely inflated at the apex, and somewhat narrower, partly ampulliform SBs.

Ecology. *O. sarcobati* grows on ± undecayed bark (rarely wood) of xeric branches of *Sarcobatus vermiculatus* (greasewood), to which it might be restricted. It is so far only known from cold-temperate to warm-continental semiarid saltbush desert scrubs at the base of the Abajo Mountains in the Canyonlands section of the Colorado Plateau in the southwest of Northern America.

Specimens included. **USA**: **Utah**, Canyonlands, 45 km NNE of Blanding, 16 km N of Monticello, Peters Canyon, 1905 m, branch of *Sarcobatus vermiculatus*, on bark, 15.VI.2000, G. Marson (H.B. 6739c). – ~16 km WNW of Blanding, ~1795 m, branches of *S. vermiculatus*, on wood & bark, 14.V.1995, G. Marson (M-0276582, **holotype**; **isotype** in H.B. 5400a). – 15 km WSW of Blanding, Cottonwood Road, Brushy Basin Wash, 1602 m, branch of *S. vermiculatus*, on bark, 15.VI.2000, G. Marson (ø).

Orbilia gregorii Baral, **sp**. **nov**.,
MB 813943 — Pls 804–805

Etymology: after the substrate, *Brachychiton gregorii*.

Typification: Western Australia, Peron Peninsula, branch of *Brachychiton gregorii*, 8.XII.2001, G. Marson (ex H.B. 7578d, MEL 2389238, holotype).

Latin diagnosis: *Similis* Orbiliae sarcobati *sed ascosporae angustiores, fusiformes, asci octospori, excipulum ectale multo crassius. Habitat ad corticem rami sicci* Brachychitonis gregorii *in zona subtropica semiarida Australiae occidentalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.4 mm diam., 0.2 mm high, light orange; margin finely rough; superficial. **Asci** *57–65 × 5.3–5.8 µm, 8-spored, spores *biseriate, 2–6 lower spores inverted (not mixed), pars sporifera *27–34 µm long; **apex** (†) slightly to medium truncate (laterally not or only very slightly inflated), hemispherical in side view, thin-walled; **base** with short to medium long, thin or thick, slightly flexuous stalk. **Ascospores** *8.3–10 × 2.3–2.5(–2.7) µm, fusiform to fusiform-clavate, apex rounded to obtuse, base tail-like or with a short tail 1.3–1.7 × 0.8–1 µm, straight to slightly inequilateral; **SBs** *2–2.5 × 1–1.3 µm, tear-shaped, apically narrowed, ending in a very short filum. **Paraphyses** apically medium to (very) strongly capitate to broadly ellipsoid, terminal cells *6–16.5 × 3.5–5.5 µm, lower cells *10–19 × 1.5–2 µm (below terminal cells also up tp 4 µm wide); unbranched at upper septum. **Medullary excipulum** 20–30 µm thick, of ± dense textura globulosa-intricata, sharply delimited only towards margin. **Ectal excipulum** of (*) ± firm-walled t. globulosa from base to margin, 100 µm thick near base, cells *9–14 × 6.5–10 µm; 25 µm thick near margin, of t. angularis oriented at a 45° angle to the surface, marginal cortical cells elongate, †7–10 × 3–4 µm; **glassy processes** absent. **Anchoring hyphae** medium abundant, †2–3 µm wide, walls 0.2–0.3(–0.4) µm thick. **SCBs** in paraphyses and ectal excipulum (near margin) globose, (0.6–)1–1.8 µm diam. **Exudate** over

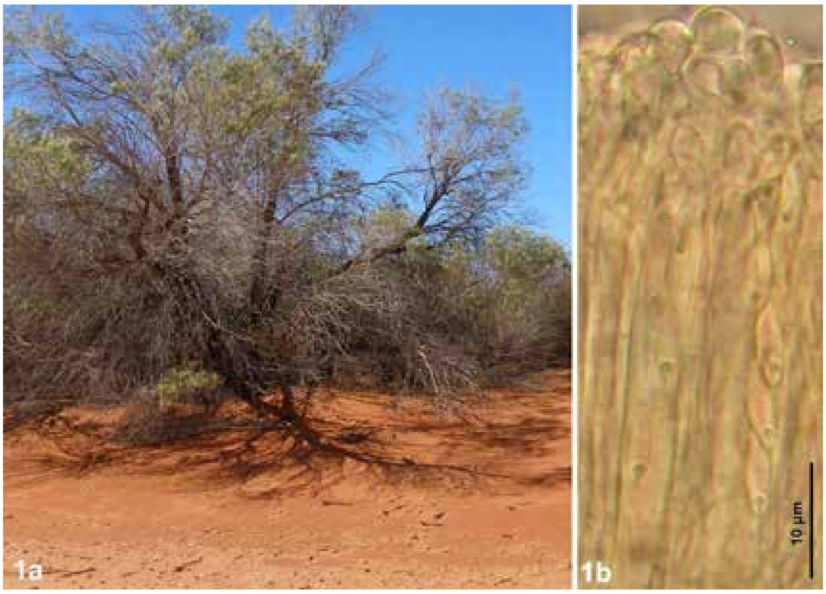


Plate 805. **1**: *Orbilia gregorii*. – **1a**. arid acacia shrubland with *Pittosporum phillyreoides* (*Brachychiton* also occurs here); **1b**. asci with spores, paraphyses. – Living state, except for ascus on the right. — **1**. H.B. 7578d (holotype): Western Australia, Carnarvon, on *Brachychiton*.

paraphyses and margin 0.3–1 µm thick, granular, firmly attached. — **ANAMORPH**: unknown.

Habitat: collected 2.5 m above the ground, corticated, 10–12 mm thick branch of *Brachychiton gregorii*, on medium decayed bark (periderm and bast). **Associated**: *Hysterographium fraxini*, *Orbilia brachychitonis*, *O.* ?*multigambelii*, *Patellaria* ?*andina*. **Desiccation tolerance**: fully viable after 33 months. **Altitude**: 41 m a.s.l. **Geology**: Cenozoic regolith. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia gregorii* resembles *O. sarcobati* in the short terminal cells of paraphyses, but differs in narrower, fusiform ascospores with short and thick tails, and in 8-spored asci, also in larger apothecia with a much thicker ectal excipulum. *O. pilifera* (section *Aurantiorubrae*) resembles *O. gregorii* in the spores, but differs in much larger, ochraceous, hairy apothecia and lageniform to mammiform paraphyses.

Not included collections. Two North American samples (Pl. 804: 2–3) differ from *O. gregorii* in the spores: the one on *Juniperus* has shorter spores and that on *Sarcobatus* wider spores with much wider tail-like bases. In both samples the asci are thin-walled and truncate at the apex. The sample on *Sarcobatus* could be closely related to 16-spored *O. sarcobati*.

Ecology. *O. gregorii* was collected on medium rotten bark of a xeric branch of *Brachychiton* in a subtropical semiarid acacia shrubland in western Australia. The sparse holotype originally consisted of only two apothecia which were used up during examination. The two not included North American collections were from a cold-temperate subhumid saltbush desert scrub adjacent to a ponderosa pine forest in the Wyoming Basin (*Sarcobatus*), and a warm-temperate subhumid *Quercus virginia* forest on Cretaceous limestone in the Edwards Plateau in southern USA (*Juniperus*).

Specimens included. **AUSTRALIA**: **Western Australia**, Carnarvon, 165 km SSE of Carnarvon, Peron Peninsula, 24 km SE of Shell Beach, Denham-Hamelin Rd, 41 m, branch of *Brachychiton gregorii*, on bark, 8.XII.2001, G. Marson (ex H.B. 7578d, MEL 2389238, **holotype**).

Not included. **USA**: **Texas**, Oaks and Prairies, Edwards Plateau, 65 km W of Austin, ~2 km WSW of Johnson City, 380 m, branch of *Juniperus* (?) *occidentalis*, on bark, 18.VI.1996, G. Marson (H.B. 6027c ø). – **Utah**, Wyoming Basin (adjacent to Uinta Mts.), ~2.5 km SW of Dutch John, Rte. 191 S, ~1900 m, on *Sarcobatus vermiculatus*, 11.VI.1996, G. Marson (ø).

Orbilia olivacea Baral & G. Marson, **sp. nov.**, MB 813944 — Pls 806–807

Etymology: named according to the dark olivaceous colour of the apothecial exudate.

Typification: France, Firminy, branch of *Pinus*, 21.IX.1990, G. Marson (ex H.B. 4232, M-0276543, holotype).

Latin diagnosis: *Apothecia rehydratata 0.15–0.35 mm diam., atro-olivacea, substipitata, margine laevi. Asci 8-spori, apice in statu emortuo hemisphaerici, tenuitunicati. Ascosporae *5–8.5 × 2.3–3.2 µm, subcylindrico-ellipsoideae, corpusculum refringens ellipsoideo-ovoideum, ad apicem indistincte affixum continentes. Paraphyses ad apicem non vel leniter inflatae. Excipulum marginale textura prismatica-angulari, absque processis vitreis, exsudato valido atroolivaceo tectum. Habitat ad corticem leniter putridum ramorum siccorum* Pini *in zona temperata ad orosubmediterranea humida Europae meridionalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.15–0.35 mm diam., 0.13–0.2 mm high (receptacle 0.07 mm), blackish-blue-green to blackish-olivaceous, round, scattered; disc flat, margin thin, not protruding, smooth; often distinctly stipitate, with a cylindrical to obconical stipe up to 0.1 × 0.1–0.14 mm, superficial; dry black. **Asci** *43–62 × 5.8–7 µm {3}, †41–55(–65) × 5.2–6 µm {2}, (6–)8-spored, spores 2–3-seriate, upper (2–)3–5 spores inversely oriented {3} (sometimes mixed, rarely some asci with inverted lower spores and upper spores not inverted {1}), pars sporifera *20–29 µm long; **apex** (†) hemispherical to very slightly truncate, thin-walled (†0.2–0.25 µm); **base** with short, thick, flexuous stalk, h-shaped. **Ascospores** *(5–)5.5–7.5(–8.5) × 2.3–2.8(–3.2) µm {3}, †5–7 × 2.2–2.6 µm {2}, subcylindric to ellipsoid, also fusoid or obovoid-clavate, apex rounded to obtuse, base sometimes ± attenuated, straight or slightly inequilateral; **SBs** *1.1–1.8 × 0.8–1.2 µm {3}, (subcylindric-)ellipsoid-ovoid(-subglobose), either closely attached or a short distance below apex (invisibly connected). **Paraphyses** apically uninflated to very slightly clavate or sublageniform, sometimes flexuous, terminal cells *8–19(–28) × 2–2.5(–3) µm {3}, †1.8–2.3(–3) µm wide, lower cells

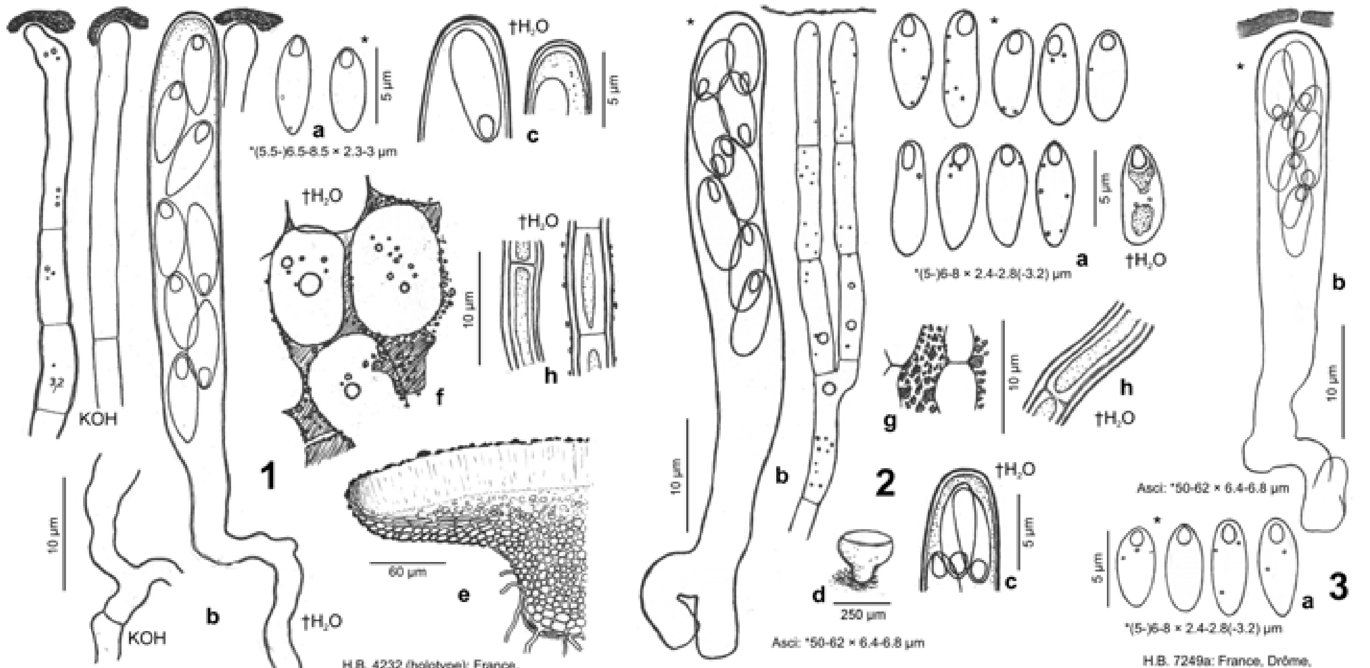


Plate 806. **1–3**: *Orbilia olivacea*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. rehydrated apothecium; **e**. apothecium in median section; **f**. ectal excipulum in surface view at lower flanks, with granular exudate and LBs in the cells; **g**. id., near margin; h. anchoring hyphae.

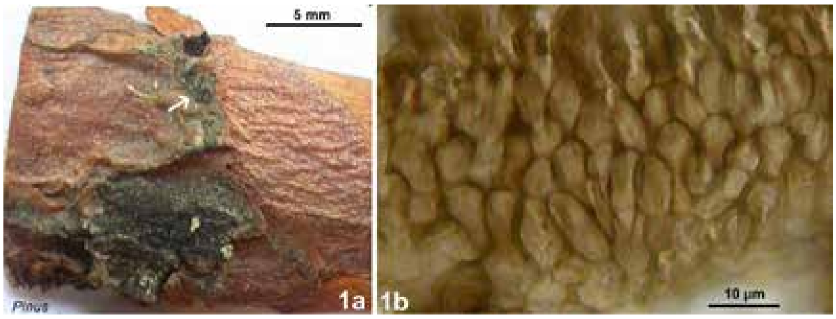


Plate 807. **1**: *Orbilia olivacea*. – **1a**. dead xeric corticated branch of *Pinus*, undecayed, with blackened resinous areas; **1b**. marginal ectal excipulum in external view (dead state, in H_2O). — **1a–b**. H.B. 4232 (holotype): France, Haute-Loire, Massif central, on *Pinus*.

*7–14 × 1.6–2.3(–3.2) µm {3}; unbranched near apex, lateral wall hyaline to pale olivaceous. **Medullary excipulum** hyaline with very few pale olivaceous patches, ~60–120 µm thick in centre, of dense t. globulosa-angularis, upwards of t. intricata, sharply delimited from ectal excipulum at flanks by a ~10 µm thick layer of pale olivaceous-brown t. porrecta. **Ectal excipulum** 30–40 µm thick at base, of (†) slightly gelatinized, indistinctly or vertically oriented t. globulosa-angularis-prismatica, cells †6–17 × 6–10 µm {2}; 15–20 µm thick at lower flanks, of t. prismatica-angularis oriented at a 20–30° angle to the surface, 10–15 µm thick near margin, of t. prismatica-porrecta oriented at 10°, marginal cortical cells †7–10 × 3–4.5 µm {1}, **glassy processes** absent. **Anchoring hyphae** sparse to abundant, projecting, hyaline, †3.5–4.5(–5.5) µm wide, walls 0.4–1.5 µm thick {3}, distinctly 3-layered (mid layer non-refractive). **SCBs** in paraphyses sparse, small, globose. **VBs** absent {3}; **LBs** in excipular cells distinct, ~0.3–2 µm diam. {1}. **Exudate** over paraphyses 0.3–2 µm thick, continuous to cloddy, dark olive(-brown), reddish-brown in KOH, loosely attached; over margin and flanks granular to cloddy or continuous, dark olive-brown, 2–3 µm thick, in KOH (brass-)ochre-brown, near base light olive(-ochre). — **ANAMORPH**: vermispora-like (presumed, from natural substrate {1}). A single **conidium** seen to emerge from anchoring hypha: *85 × 9.8 µm, 14-septate, thick-walled (*~0.5 µm), with gradually tapered ends, slightly flexuous.

Habitat: collected 1.5–3.5 m above the ground, corticated, recently dead, 20–55 mm thick branches of *Pinus* sp. {1}, *P. sylvestris* {2}, directly at the border of small to very large open resinous wounds, or somewhat remote from them, on little decayed bark {3} (thin detaching squamules of periderm), partly on old, dark brown resin {1}, strongly greyed or blackened, green algae partly abundant. **Associated**: *Amphosoma atroolivaceum* {2}, *Ciliolarina pinicola* {1}, *Claussenomyces olivaceus* {1}, *Hypogymnia physodes* {1}, *Orbilia cylindrospora* {1}, *O. vinosa* {1}, *Pseudohelotium sordidulum* {1}, *Resinomyces kirschsteinianus* {2}, *Sarea difformis* {2}, *S. resinae* {1}. **Desiccation tolerance**: fully viable for at least 2 months, ascospores still alive after 22 months. **Altitude**: 700–1405 m a.s.l. **Geology**: Southern French Alps: Upper Jurassic & lower Cretaceous marl- & limestone; Auvergne: granite. **Phenology**: IX–X (but long-lived).

Taxonomic remarks. *Orbilia olivacea* resembles *O. clavipisca* or *O. subovoidea* in the ascospores and is, therefore, tentatively placed in section *Ovoideae*, despite the asci being only slightly truncate at their apices. *O. olivacea* is very exceptional in this section on account of its deep black apothecia, particularly in the dry state, due to a dark olivaceous exudate. Other species with black apothecia (mainly in section *Lentiformes* but also in the genus *Amphosoma*) differ in the SBs being broadly attached to the spore apex, and in a ± thick-walled ascus apex. *Amphosoma atroolivaceum* resembles *O. olivacea* in spore shape but differs in having 2 SBs, one at each end, also in showing strongly refractive globose VBs in the living paraphyses.

Anamorph. On the substrate a single unbranched, multiseptate conidium was seen to emerge from an anchoring hypha of *O. olivacea* (IVV: H.B. 7249a). This was similar in size and shape to conidia observed in some other species of section *Ovoideae*.

Ecology. *O. olivacea* was found on rather undecayed bark more or less close to wounds of xeric, recently dead branches of *Pinus* in cold-temperate (holotype) to orosubmediterranean humid pine forests of very different age in the Massif central and Southern French Alps in southern Europe. The vegetation was either an open woodland of rather young pine trees on ± south-exposed slopes, or the west-exposed border of a pine forest (Col de Soubeyrand).

Specimens included. **FRANCE**: **Auvergne**, **Haute-Loire**, Massif central, 50 km SW of Lyon, ~9 km SW of Firminy, La Chapelle-d'Aurec, 700 m, branch of *Pinus*, on bark, 21.IX.1990, G. Marson (ex H.B. 4232, M-0276543, **holotype**). – **Rhône-Alpes**, **Drôme**, 17 km E of Nyons, 4.5 km S of Rémuzat, Col de Soubeyrand, 1005 m, branch of *P. sylvestris*, on bark & resin, 10.X.2002, G. Marson (H.B. 7249a ø, anam. substr.). – **Provence-Alpes-Côte d'Azur**, **Alpes Maritimes**, 19 km NNE of Grasse, 4 km NNE of Gréolières, Gréolières les Neiges, 1405 m, branch of *P. sylvestris*, on bark, 1.X.1993, G. Marson (H.B. 4999 ø).

Orbilia yuccae Baral & G. Marson, **sp. nov.**, MB 813945 — Pls 808–809

Etymology: referring to the host plant, *Yucca elata*.

Typification: USA, New Mexico, Artesia, inflorescence stem of *Yucca elata*, 25.V.1996, G. Marson (ex H.B. 5655a, M-0276609, holotype).

Latin diagnosis: *Apothecia rehydratata 0.1–0.22 mm diam., subhyalina vel dilute luteo-ochracea, sessilia vel substipitata, margine laevi. Asci 8-spori, apice in statu emortuo hemisphaerici vel conici, leniter crassitunicati. Ascosporae *4–5.6 × 2.5–3 µm, ellipsoideae(-ovoideae), corpusculum refringens (sub)globosum vel crasse lentiformem, ad apicem confertim vel perlate affixum continentes. Paraphyses ad apicem plerumque valde clavato-capitatae. Excipulum marginale textura prismatica sub angulo acuto orientata, cellulae terminales vesiculosae, absque processis vitreis. Habitat ad caulem putridum siccum inflorescentiae* Yuccae elatae *in zona temperata semiarida Americae septentrionalis.*

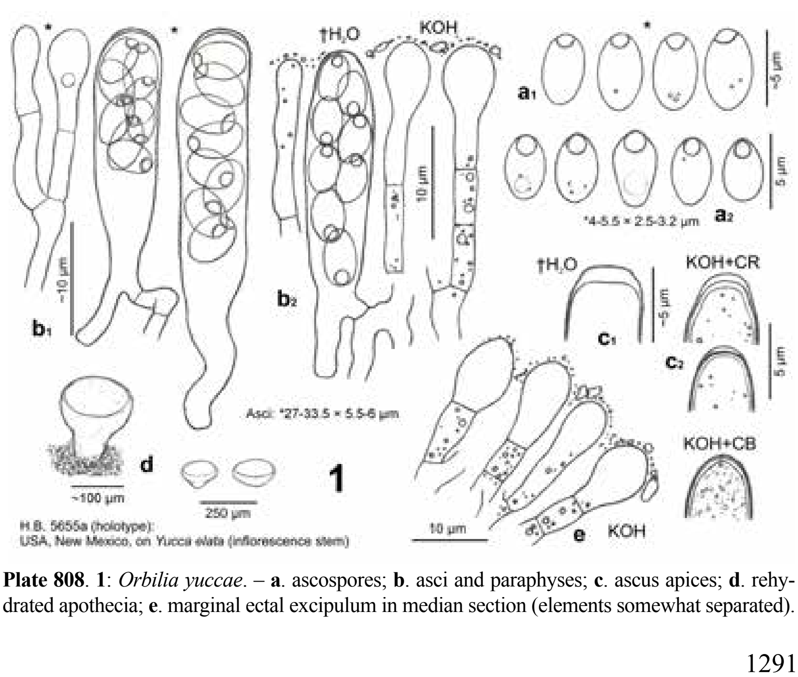


Plate 808. **1**: *Orbilia yuccae*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. rehydrated apothecia; **e**. marginal ectal excipulum in median section (elements somewhat separated).

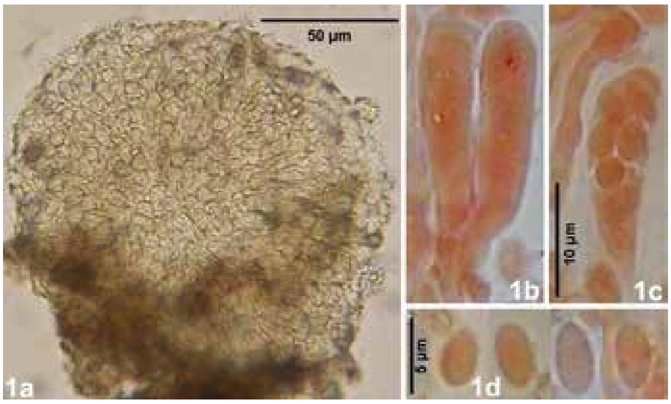


Plate 809. **1**: *Orbilia yuccae*. – **1a**. apothecium from below; **1b–c**. asci and paraphysis; **1d**. ascospores. – Dead state (**1a** in KOH, **1b–d** in KOH+CR). — **1a–d**. H.B. 5655a (holotype): USA, New Mexico, on *Yucca*.

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.1–0.22 mm diam., subhyaline to pale yellowish-ochraceous-amber, translucent, round, ± scattered; disc flat to slightly convex, margin thin, indistinct, not protruding, smooth; sessile or with a distinct short stipe ~0.03 × 0.06 mm, superficial. **Asci** *27–33.5 × 5.5–6 µm, †24–30 × (4–)4.7–5.6 µm, 8-spored, spores (*) biseriate († uni- or biseriate), ~4 lower spores inversely oriented (often mixed, laterally sometimes oriented); **apex** (†) hemispherical to slightly (truncate-) conical, apically very slightly thickened to †0.3–0.4 → 0.2 µm; **base** without or with short to medium long, ± thick, flexuous stalk, Y- to h-shaped. **Ascospores** *4–5(–5.6) × 2.5–3 µm, †3.5–4.8 × (2–)2.3–2.8 µm, broadly ellipsoid(-ovoid), rarely fusoid-clavate, apex rounded to obtuse; **SBs** *1.2–1.5 × (1–)1.2–1.4 µm, (sub)globose, closely but narrowly attached at apex (Pl. 808: 1a$_2$); in other apothecium lens-shaped and broadly attached (1a$_1$). **Paraphyses** apically uninflated to mostly medium to strongly clavate-capitate, terminal cells †(?9–)11–14 × (2–)3–5 µm, lower cells †6–8 × 1.5–2.2 µm; unbranched at upper septum. **Medullary excipulum** not examined. **Ectal excipulum** of (†) thin-walled to slightly gelatinized textura angularis from base to mid flanks, cells *13–20 × 10–15 µm; 5–10 µm thick near margin, of t. prismatica oriented at a ~10–30° angle, marginal cortical cells capitate-vesiculous, †10–19 × 5–7 µm, thin-walled, **glassy processes** absent. **Anchoring hyphae** very sparse, †3–3.5 µm wide, walls 0.2–0.5 µm thick. **SCBs** in paraphyses globose, sparse. **Exudate** over paraphyses and marginal excipulum granular to cloddy, 0.2–2 µm thick, hyaline, loosely attached. **— ANAMORPH**: unknown.

Habitat: 28 mm thick, decorticated inflorescence stem of *Yucca elata*, in a small old wound (depression), slightly to strongly decayed, very greyed (blackish), no algae. **Associated**: *Cyathicula ?nigrofusca*, *Orbilia bicknellensis*, *O. macrotrapeziformis*, *O. multigambelii*, *O. serpentina*, *Patellaria atrata*, *Teichosporella dura*. **Desiccation tolerance**: fully viable for at least 1.5 month, some ascospores and excipular cells alive after 5 months. **Altitude**: 1120 m a.s.l. **Geology**: Quaternary sediment. **Phenology**: probably long-lived.

Taxonomic remarks. *Orbilia yuccae* is characterized by ellipsoid-ovoid ascospores with large, closely or broadly attached, globose to lens-shaped SBs, small asci with indistinctly truncate apices, paraphyses with strongly capitate-clavate apices, thin-walled marginal cortical cells, and small subhyaline apothecia. The species appears to occupy a somewhat isolated position within *Orbilia* and is only tentatively placed in section *Ovoideae*. The spores resemble a bit those of *O. subovoidea* and particularly *O. amberina*, but the strongly inflated marginal cortical cells, the much smaller asci, and the unpigmented apothecia sharply distinguish *O. yuccae* from these species.

Another possible relationship might be with *Hyalorbilia*, particularly *H. erythrostigma*, because of the small asci and the structure of the ascus apex. However, the asci of *Hyalorbilia* always arise from croziers though these are often provided with a small or large perforation, whereas in *O. yuccae* the branches do not form a crozier and the ascus stalk, if present, is more flexuous than in *Hyalorbilia*. Also the genus *Lecophagus* resembles *O. yuccae* but has never a bifurcate ascus base and differs also in much wider anchoring hyphae.

Variation. When one of us (G.M.) examined the species about 1.5 months after collecting, he observed the SBs as a lens-shaped organelle that was broadly attached to the spore apex (Pl. 808: 1a$_1$). When the sample was reexamined 3.5 months later, the first author found subglobose narrowly attached SBs (1a$_2$). Such variation in SB morphology was also observed, e. g., in *O. multicreosoteris*.

Ecology. *O. yuccae* is only known from the sparse holotype collection. The species was found on a rotten, decorticated, xeric inflorescence stem of *Yucca elata* in a warm-temperate semiarid saltbush desert scrub at the northeastern end of Chihuahuan Desert (western North America).

Specimens included. **USA**: **New Mexico**, Chihuahuan Desert, ~13 km W of Artesia, 1120 m, inflorescence stem of *Yucca elata*, on wood, 25.V.1996, G. Marson (ex H.B. 5655a, M-0276609, **holotype**).

Section *Orbilia*

Orbilia Fr. subgenus ***Orbilia*** section ***Orbilia*** – Lectotype species: *Orbilia xanthostigma* (Fr.) Fr.

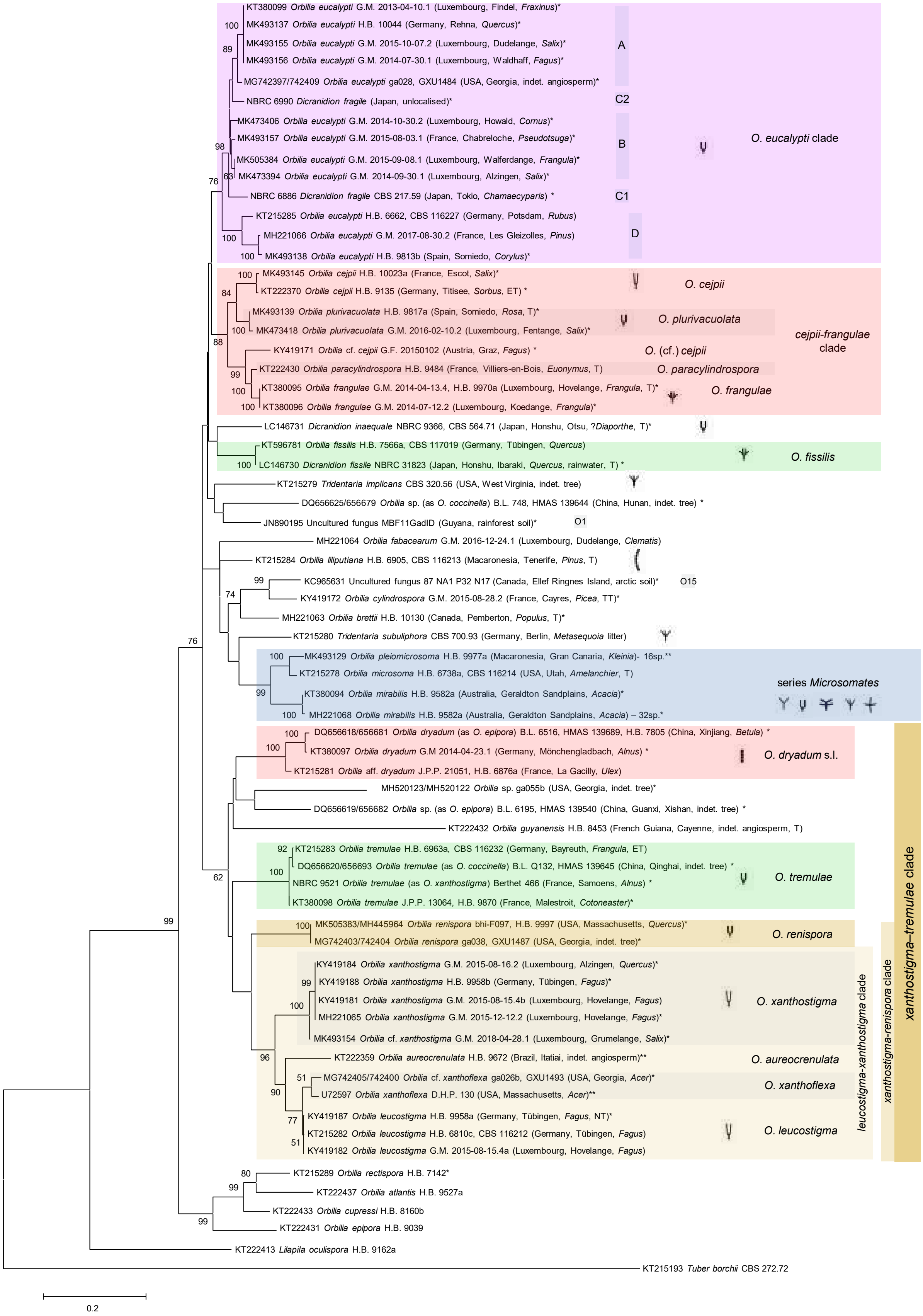
Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.15–)0.2–2(–4.5) mm diam., white or pale to bright yellow, orange, or rose(-lilaceous), margin smooth or finely rough to crenulate, also with prominent teeth or notched by small lobes, sessile or with a ± distinct stipe. **Asci** *(22–)27–70(–78) × (2.8–)3–7.7 µm, 8- up to 64-spored, (2–)3–5(–6) lower spores inverted (but often oriented in all directions); **apex** (†) slightly to often medium to strongly truncate, not to distinctly indented and/or laterally inflated, hemispherical in profile view, thin-walled; **base** T-, L-, Y-, h-, or H-shaped. **Ascospores** *(1.8–)2.2–11.5(–14) × (0.8–)1–2.5(–3) µm, subglobose, ovoid, ellipsoid(-clavate), cylindric(-fusoid) or fusoid-clavate, apex rounded to obtuse (exceptionally subacute), straight to very strongly curved (cashew-shaped, rarely helicoid); **SBs** apically (rarely laterally) affixed to spore wall, 0.3–1.2(–1.4) × (0.2–)0.3–0.8(–1.2) µm, globose to tear-shaped, also plug-shaped, dumbbell-shaped or ampulliform, rarely lens-shaped, ± broadly affixed or narrowed to a small point, with or without a short filum, attachment visible or not. **Paraphyses** uninflated or slightly to strongly capitate-clavate, ± spathulate(-mammiform), lageniform or lanceolate at the apex, terminal cells (1–)2–4(–6)× longer than lower cells, unbranched or very rarely branched near apex. **Ectal excipulum** of vertically or indistinctly oriented textura globulosa-angularis-prismatica, **glassy processes** near margin absent or 1–15 µm up to sometimes 10–120 µm long, **hairs** absent. **SCBs** globose or mixed with crystalloid ones, also absent; **VBs** absent or low- to high-refractive, hyaline to yellowish; **carotenoids** in **LBs** observed in some species. **— ANAMORPH**: dactylella-like, descalsia-like, dicranidion-like, dwayaangam-like, trinacrium-like, vermispora-like, also arthropod-like. **Conidiophores** reduced to rather long (1.5–105 µm), unbranched or branched. **Conidiogenous cells** monoblastic or sympodial. **Conidia** either unbranched, phragmosporous, straight or ± curved; or often branched, with or without a stipe and with 2–9 arms). **Trapping organs**: only known in *Tridentaria implicans* and *Dicranidion dactylopagum* (taxa of uncertain relationship).

Habitat: on wood and bark, rarely herbaceous stems or leaves, of gymno- and angiosperms, rarely on polypores, semiarid to humid, boreal to tropical, desiccation-tolerant or -sensitive.

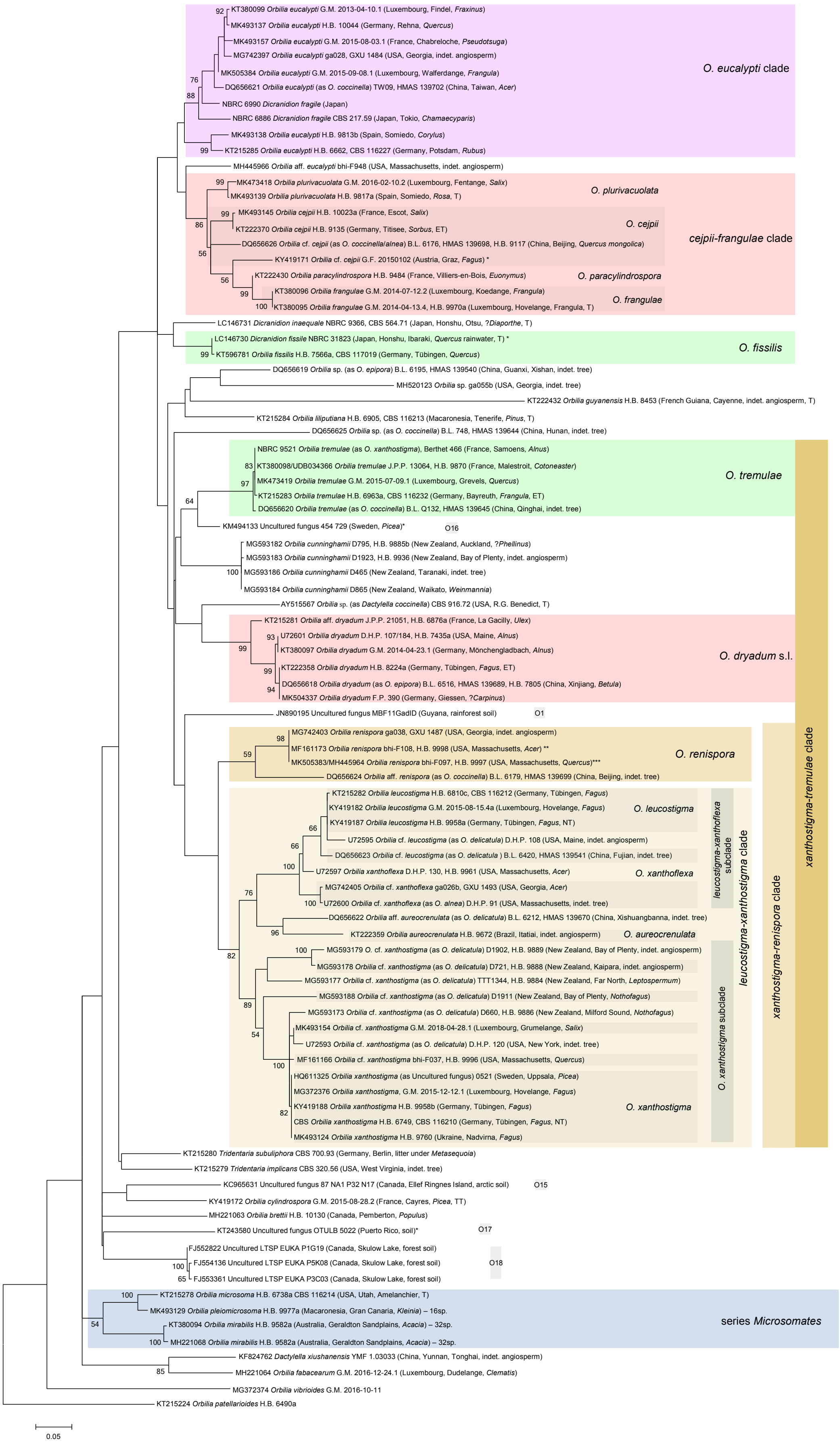
Recognized series: *Microsomates* and *Orbilia*, with 35 recognized species plus 6 unnamed ('affinis') and 7 species with uncertain affinity.

Taxonomic remarks. Members of section *Orbilia* are placed in two series, *Microsomates* and *Orbilia*, and the intermediate *O. cylindrospora* group. They have rather small ascospores of various shape and curvature, but mostly with a rounded to obtuse apex. Spore bodies are small and never strongly elongated.

Section *Orbilia* is morphologically difficult to separate



Phylogenetic analysis 22. Phylogram of section *Orbilia* inferred from combined ML analysis of SSU (V8–V9)+ITS+LSU (D1–D2) rDNA dataset (67 sequences, 1830 positions, aligned with MUSCLE) using the GTR+G+I model in MEGA6 (500 replicates). 2 environmental strains from GenBank are included representing unidentified species (O1, O15). The tree is rooted with *Tuber borchii*, *Lilapila oculispora*, and 4 species of section *Arthrobotrys*. Asci 8-spored if not otherwise stated; T = type, ET = epitype, NT = neotype, TT = topotype, * = SSU incomplete or absent, ** = without SSU and LSU.



Phylogenetic analysis 23. Phylogram of section *Orbilia* inferred from ML analysis of ITS1-5.8S-ITS2 rDNA dataset (90 sequences, 872 positions, aligned with MAFFT) using the GTR+G+I model in MEGA6 (500 replicates). 8 environmental strains from GenBank are included, 1 belonging to *O. xanthostigma* and 7 representing 5 unidentified species (O1, O15–O18). O18 includes 6 Canadian environmental strains (only 3 are included in phylogram) showing affinities with section *Orbilia* according to ITS BLAST results. All of them possess also SSU (V8–V9) and lack the S1506 intron, but only 3 (P5K08, P3C03, P1P24) appear to be correct in the SSU whereas the other 3 (P1G19, P5K09, P2K09) yield *Lecanorales* in SSU BLAST searches, suggesting a chimere. The tree is rooted with *O. patellarioides* and *O. vibrioides*. Asci 8-spored if not otherwise stated; T = type, ET = epitype, NT = neotype, TT = topotype. * = without ITS1 and partial 5.8S, ** = without partial 5.8S and ITS2, *** = without ITS2.

Key to series of section *Orbilia*

1. SBs plug- to tear-shaped, broadly or narrowly attached to apex, 0.3–1.2 µm long; spores narrowly cylindrical to fusoid-clavate, *(4–)5–11.5(–13) × (1–)1.2–2.5(–2.7) µm, ± straight in upper part, partly slightly or sometimes strongly curved near base; paraphyses with thin to thick refractive caps of exudate, often ± spathulate (to lageniform); SCBs globose, sometimes crystalloid; upper margin of. textura prismatica or t. porrecta, oriented at a ± low angle (0–45°), usually terminated by short to very long glassy processes; asci 8–64-spored; apothecia reddish, always desiccation-tolerant .... **series *Microsomates***, p. 1295

1. SBs globose to broadly tear-shaped, narrowly attached by a fine filum which is mostly invisible, rarely more broadly attached (*O. guyanensis*), 0.2–0.9 µm long (including invisible filum); spores cylindrical to ellipsoid or globose, straight to strongly curved, *(1.8–)2.2–6(–7) × 0.8–2.5(–2.8) µm; paraphyses rarely with refractive caps of exudate; SCBs globose or absent, never crystalloid; upper margin of t. globulosa-angularis or t. prismatica, oriented at a medium to high angle (40–80°), rarely at 10–30°, usually without glassy processes (rarely up to 7 µm long); asci 8(–16)-spored; apothecia variously coloured, desiccation-tolerant or -sensitive.....................**series *Orbilia***, p. 1325

from other groups, especially from sections *Ovoideae* and *Arthrobotrys*, based on the teleomorph. This difficulty mainly relates to species with straight, rod-shaped spores (*O. dryadum*, *O. paracylindrospora*, *O. umbilicata*, *O. cylindrospora* group), which resemble those here assigned to section *Ovoideae* (*O. subcylindrospora* and related species) or series *Neodactylella* (*O. atlantis*, *O. cardui*, *O. cupressi*, *O. epipora*, *O. fraxini*, *O. lamarcheae*, *O. rhamni*, *O. rectispora*). Species of section *Ovoideae* with ± cylindrical spores have always desiccation-tolerant, orange to reddish apothecia with abundant exudate and often rather short terminal cells of the paraphyses. Some of those species included in *Neodactylella* deviate by SBs situated more distant from the spore apex, unlike members of series *Orbilia* and section *Ovoideae*.

Members of the rather distant series *Regales* (section *Aurantiorubrae*) may easily be confused with those of series *Microsomates*. They differ from typical representatives of that series in tear-shaped to globose SBs which are mostly narrowly attached, often with a very short filum, and in vermispora-like anamorphs. Another species included in section *Aurantiorubrae* (*O. gemma*) resembles series *Microsomates* in spore shape, but seems better included in series *Albovinosae* based on molecular data.

Series delimitation. The morphological limits between series *Orbilia* and *Microsomates* are not very sharp. Especially series *Orbilia* in the present circumscription is morphologically very diverse and cannot be clearly circumscribed by available molecular data. Some species are only tentatively assigned here. Species of the *O. cylindrospora* group appear to be somewhat intermediate between series *Orbilia* and *Microsomates*. *O. flexispora* is only tentatively included in series *Orbilia* because of the absence of molecular data and the lack of characters in the living state. Also the relationship of three species with lanceolate paraphyses (*O. umbilicata*, *O. spirospora*, and *O. minutispora*) which lack molecular data remains unclear.

Anamorph. The conidiophores within section *Orbilia* vary from very short to rather long, with conidiogenous cells often monoblastic but also sympodial. The conidia are septate, unbranched (dactylella-like) or branched but never with one cell distinctly inflated. Trapping capabilities are not known with certainty (the two taxa for which they have been reported need confirmation regarding their phylogenetic relationship).

Phylogeny. Section *Orbilia* formed a strongly supported monophyletic group in the SSU+ITS+LSU analysis of *Orbiliomycetes* in Baral et al. (2017b). However, its affiliation in the genus *Orbilia* remained unresolved. Contrary to this, in the present analysis of the genus *Orbilia* regarding the same gene region, the section is paraphyletic by falling into two groups, the group with *O. xanthostigma* forming a medium supported clade with series *Hyalinia* of section *Aurantiorubrae* (Phyl. 7). Within section *Orbilia*, series *Orbilia* is also paraphyletic, as the other of the two groups includes the strongly supported monophyletic clade of series *Microsomates*, besides some taxa of unclear relationship.

Specific nucleotide positions. Characteristic motifs are observed in the 5.8S region: all members of section *Orbilia* (but also section *Ovoideae*, section *Hemiorbilia* p.p.maj., and some series of section *Aurantiorubrae*) have at pos. 132–133 CC**GA**C or CC**GA**T, whereas different groups of *Orbiliaceae* and many species of series *Neodactylella* and *Arthrobotrys* have CC**TT**T, CC**AT**T, or CC**GG**T (see Tab. 18); at pos. 140 members of section *Orbilia* (but also series *Abutilones*, *Poitevinicae*, series *Hemiorbilia* p.p.maj., the *aprilis-crenatovinosa* clade, and *Hyalorbilia*) have GCA**C**G, whereas all members of section *Arthrobotrys* and many of other groups have GCA**T**G. Also in the LSU D1 domain, section *Orbilia* shows some characteristic motifs: pos. 13–17 is consistently C**AGACG**A, but this occurs within the genus *Orbilia* also in series *Hemiorbilia* s.str., *O. poitevinica*, and the *aprilis-crenatovinosa* clade; at pos. 162–163 section *Orbilia* has TG**CC**T, rarely TG**CT**T (*O. brettii*, *Tridentaria implicans*) as in section *Ovoideae*, or TG**TC**A (*O. dryadum*), whereas section *Arthrobotrys* has TG**TT**T (rarely TG**CT**T), and also most members of subgenus *Habrostictis* and *Hemiorbilia* have TG**TT**T or TG**CT**T, but TG**CC**T occurs in some members of section *Hemiorbilia*; at pos. 252–254 a strong predominance is seen for TG**TGG**CT, rarely TG**TGA**CT or TG**AGG**CT, but in other groups of *Orbilia* TG**AAA**CT, TG**TAA**CT, TG**TAG**CT, or TG**AAG**CT.

Ecology. Section *Orbilia* occurs worldwide and includes desiccation-tolerant and -sensitive taxa at about equal proportion. Most of the taxa occur on wood and bark, whereas herbaceous stems, leaves, and perennial basidiomycetes were rarely recorded as substrate.

Series *Microsomates*

Orbilia subgenus ***Orbilia*** section ***Orbilia*** series ***Microsomates*** Baral & E. Weber, **ser**. **nov**., MB 815022

– Type species: *Orbilia microsoma* Baral & G. Marson

Etymology: named after the small spore bodies.

Latin diagnosis: *Apothecia aurantiaca* ad *rosea, margine laevi vel dentata. Asci 8- ad 64-spori, apice in statu emortuo plerumque modice vel valde truncati, tenuitunicati. Ascosporae plerumque *(4–)5–11.5(–14) × (1–)1.2–2.5(–2.7) µm, anguste ellipsoideae ad subcylindricae vel fusoideo-clavatae, apice rotundato ad obtuso, raro subacuto, rectae vel prope basin leniter ad valde curvatae, in statu*

Key to species of series *Microsomates*

1. Asci 32–64-spored; paraphyses tipped by thin refractive caps or continuous exudate 2
1. Asci 8–16-spored; paraphyses often tipped by thick refractive caps 7

2. Without glassy processes; asci 32-spored; spores *4–7.7 × 1.5–1.7(–2) µm, ± subcylindrical; SBs ± broadly tear-shaped; branch of *Atriplex*, subtropical arid central Australia ..... ***O. multiaustrocylindrica*** (inc. sed.), p. 1321
2. With 2–120 µm long glassy processes 3

3. Glassy processes 2–15 µm long, not forming teeth; spores straight to slightly curved; SBs 0.3–0.8 µm long 4
3. Glassy processes 10–120 µm long, forming discrete teeth; spores straight to strongly curved; SBs 0.8–1.2 µm long 5

4. Asci 64-spored; spores *(4.3–)5–7.5(–8.4) × (1.4–)1.5–1.6(–1.8) µm; paraphyses with globose and crystalloid SCBs; bark of *Acacia*, subtropical semiarid western Australia ..... ***O. myrionanosoma***, p. 1309
4. Asci 32-spored; spores *4.5–5.7 × 1.3–1.5 µm; paraphyses with globose SCBs; bark of *Eucalyptus*, subtropical subhumid eastern Australia ..... ***O. multinanosoma***, p. 1308

5. Spores *(8–)9.5–11(–14) × (1.5–)1.6–1.7 µm, predominantly medium to strongly curved or geniculate; asci 32-spored; bark of *Acacia*, subtropical semihumid western Australia ..... ***O. mirabilis***, p. 1311
5. Spores *(4–)5–6.5(–8) × (1–)1.1–1.4(–1.7) µm, ± straight 6

6. Apothecia with rose-pink disc, teeth ± straight; asci 32-spored; SBs close to apex, globose; bark of *Lamarchea*; subtropical semiarid western Australia ..... ***O. gemma*** (series *Albovinosae*, section *Aurantiorubrae*), p. 934
6. Apothecia with orange disc, teeth curved downwards; asci 64-spored; SBs with a distinct short filum; bark of *Acacia*, subtropical arid western Australia ..... ***O. myriopseudoregalis***, p. 1313

7. Asci 16-spored 8
7. Asci 8-spored 10

8. Without glassy processes, spores *6.5–8.8 × (1.4–)1.5–1.6(–1.7) µm, subcylindrical to (fusoid-)clavate, straight to often slightly to strongly curved below; SBs broadly tear-shaped; wood of *Acacia* and *Eucalyptus*; subtropical semiarid to semihumid western Australia ..... ***O. pleioaustrocylindrica*** (inc. sed.), p. 1319
8. With (0–)1–9(–16) µm long glassy processes 9

9. Spores *(4–)5–9(–10) × (1.3–)1.6–2.1(–2.4) µm, cylindrical to ellipsoid-fusoid-clavate; SBs plug- or tear-shaped; paraphyses rarely with crystalloid SCBs in apex; wood of various angiosperms, warm-temperate humid to inframediterranean arid southern Europe, Macaronesia, western North America ..... ***O. pleiomicrosoma***, p. 1301
9. Spores *(6–)7–12(–13) × (1.8–)2–2.4(–2.7) µm, cylindric(-clavate); SBs always plug-shaped; paraphyses often with crystalloid SCBs in apex; wood of *Acacia* & *Eucalyptus*, subtropical subhumid to arid Australia ..... ***O. austropleiomicrosoma***, p. 1304

10. SB laterally attached to spore wall, ± globose; spores *(4.5–)5–6(–6.5) × 1.2–1.4(–1.5) µm, (sub)cylindrical, straight; bark of *Quercus*, suprasubmediterranean semihumid southern Europe ..... ***O. beatricis*** (inc. sed.), p. 1322
10. Attachment of SBs terminally 11

11. Without glassy processes 12
11. With (0–)1–9(–16) up to 20–35 µm long glassy processes 13

12. Spores 4–7(–8) × (1–)1.1–1.3(–1.5) µm, ± subcylindrical, straight; SBs globose to broadly tear-shaped, rarely ampulliform; mainly on wood of conifers; boreal to suprasubmediterranean humid Europe ..... ***O. cylindrospora*** (inc. sed.), p. 1314
12. Spores *(4–)4.5–7.5(–8) × (1.1–)1.3–1.7(–1.9) µm, cylindrical to narrowly fusoid, ± straight; SBs globose to broadly tear-shaped;bark of angiosperm trees and shrubs; subtropical humid to semiarid western & eastern Australia ..... ***O. austrocylindrica*** (inc. sed.), p. 1317

13. Glassy processes 20–35 µm long; spores *(5–)6–7.3(–8) × (2.5–)2.8–3.5(–4) µm, ellipsoid; SBs *1–1.3 × 0.5–0.8 µm, indistinctly ampulliform (keyhole-shaped); wood of *Populus*, cold-temperate humid western North America ..... ***O. brettii*** (inc. sed.), p. 1323
13. Glassy processes (0–)1–9(–16) µm long; spores *1.4–2.7 µm wide, elongate ellipsoid to cylindrical 14

14. SBs *0.3–0.8 × 0.7–1.2 µm, subglobose to lens-shaped, (very) broadly attached; spores *5.7–12.3 × (1.7–)1.9–2.2(–2.4) µm; cone of *Pinus halepensis*, mesomediterranean semihumid southern Europe ..... ***O. microlentiformis***, p. 1300
14. SBs *0.3–1.1 × 0.3–0.8 µm, plug- (to tear-)shaped, broadly to narrowly attached 15
If SBs globose see under *O. austrocylindrica*.

15. Spores *8–11.5 × 1.4–1.8 µm; SBs 0.5–0.8 × 0.3–0.6 µm; asci *(30–)36–44 µm long; conidia (presumed) arthropod-like, with 4–8 arms; wood & bark of *Acacia* & *Eucalyptus*, (sub)tropical subhumid northern and eastern Australia ..... ***O. arachnopus***, p. 1305
15. Spores *(4–)6–10(–12) × (1.7–)1.8–2.4(–2.7) µm; conidia Y-, ┼- or ¥-shaped, with 2–4 arms 16

16. SBs 0.7–1.1 × 0.5–0.8 µm; asci *40–64 µm long; margin with 1–9 µm long glassy processes; wood of angiosperm trees & shrubs, orotemperate to mesomediterranean, humid to semiarid western North America, Macaronesia & southern Europe ..... ***O. microsoma***, p. 1298
16. SBs 0.3–0.7(–1) × 0.3–0.4 µm; asci *38–40 µm long; margin without glassy processes; wood of *Pinus ponderosa*; orotemperate humid western North America ..... ***O.* cf. *microsoma***, p. 1300

vivo corpusculum refringens minutum, plerumque obturamentiformem, sed etiam lacrimi- vel ampulliformem continentes. Paraphyses non vel leniter ad modice, raro valde inflatae, clavato-capitatae vel saepe spathulatae ad lageniformes vel mammiformes. Excipulum marginale processis vitreis brevibus vel longis praeditum. Habitat ad lignum vel corticem putridum ramorum gymno- vel angiospermarum, in aere prominentium, in zona subtropica, arida ad humida.

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.2–0.6(–1.2) mm diam., light to bright orange to rose, margin smooth or finely crenulate, also with prominent teeth; sessile or sometimes with a distinct short stipe. **Asci** *(30–)40–70(–78) × 4.6–7.7 µm, 8- up to 64-spored, lower spores inverted (~1/4–2/3 of total number), **apex** (†) slightly to mostly medium to strongly truncate, not or rarely slightly indented and laterally inflated; **base** T-, L-, Y- or h-, sometimes H-shaped. **Ascospores** *(4–)5–11.5(–14) × (1–)1.2–2.5(–2.7) µm, narrowly ellipsoid to subcylindrical or fusoid-clavate, apex rounded to obtuse (exceptionally subacute), straight to slightly, sometimes strongly curved, particularly near base; **SBs** 0.3–1.2(–1.4) × 0.25–0.8(–1.2) µm, plug-shaped, also tear- to dumbbell-shaped or ampulliform, rarely subglobose with a filum, or lens-shaped, ± broadly affixed to apical wall but sometimes narrowed to a small point. **Paraphyses** uninflated or slightly to medium, rarely strongly clavate-capitate or often ± spathulate(-mammiform) or lageniform at the apex, cells of ± equal length but terminal cells also often ~1.5–2 × longer than lower cells, near apex unbranched or rarely branched. **Ectal excipulum** of (†) thin-walled or sometimes slightly to medium gelatinized (common walls †0.3–1.5 µm), vertically or indistinctly oriented textura (globulosa -)angularis(-prismatica), cells near base *(6–)8–20(–24) × (5–)7–13(–15) µm, (upper) margin of t. prismatica-porrecta oriented at a 0–50° angle, with 1–15 or sometimes 10–120 µm long **glassy processes** (absent in *O.* cf. *microsoma*, H.B. 7518). **SCBs** globose, sometimes mixed with crystalloid ones; **VBs** consistently absent. **Exudate** 0.1–0.3 µm up to 0.5–3(–5) µm thick, granular to cloddy, often forming firmly attached caps on tips of paraphyses, hyaline or light yellow to ochraceous. **— ANAMORPH**: trinacrium-like, descalsia-like, arthropod-like. **Conidiophores** reduced. **Stauroconidia** *6.5–32 × 17.5–56 µm, 2–9-armed, partly associated with phragmoconidia. **Trapping organs**: unknown.

Habitat: on wood and bark of both gymno- and angiosperms, subtropical to orotemperate including (sub)mediterranean, arid to humid climates, all species desiccation-tolerant.

Recognized species: 9, plus 1 unnamed species ('affinis'), and 6 species with uncertain affinity.

Taxonomic remarks. Series *Microsomates* is characterized by very small, plug- to tear-shaped, usually broadly but also narrowly attached SBs, and more or less cylindric-ellipsoid, partly basally curved ascospores. The paraphyses tend to be spathulate and tipped by firmly attached glassy caps of exudate. Glassy processes are quite consistently present at the margin but are usually comparatively short. The apothecia are consistently reddish and desiccation-tolerant.

O. myrionanosoma, *O. mirabilis*, and *O. myriopseudoregalis* differ from typical members of series *Microsomates* in a rather thin exudate, the latter two species also in very long glassy processes forming discrete teeth, and *O. myriopseudoregalis* in tear-shaped SBs with a very short filum. *O. microlentiformis* is extraordinary because of its ± lens-shaped SBs. It might belong to series *Lentiformes*, but we prefer to place it here because of short glassy processes at the margin and exudate caps on the partly lageniform paraphyses. Also the strongly truncate, thin-walled ascus apex fits series *Microsomates* much better. The rather small SBs partly tend to be plug-shaped, and the taxon otherwise hardly differs from *O. microsoma*.

Similar as in series *Regales*, the glassy caps of exudate on the paraphyses in the present series closely resemble the glassy processes on the marginal cortical cells, which suggest that both are composed of cell wall material which is covered by yellowish exudate. Although exudate and cell walls behave very different in their staining properties, the question whether true glassy processes occur on the paraphyses could not be clarified (see also p. 99).

Species delimitation. Rather high variability in spore and SB shape and size is observed within *O. microsoma*, even within a population, and *O. microlentiformis* is only tentatively separated from it. Similarly, the Australian *O. austropleiomicrosoma* is proposed with hesitation as distinct from European *O. pleiomicrosoma*, based mainly on its larger spores. The remaining species are all Australian and appear to be well-defined, but are only known from one or a few records.

Anamorph. Different types of variously branched multiseptate conidia are known in some species of series *Microsomates*. They represent mere variations in the type of branching, therefore, they certainly do not indicate heterogeneity of the group, all the more as three of them occur even within a single isolate (*O. microsoma*). The observed spectrum comprises dichotomously branched, Y-shaped or multiarmed conidia with a single central cell (trinacrium-like), ┼-shaped conidia with either 1 central cell or 2 such cells with an oblique septum (descalsia-like), and characteristic ¥-shaped, arthropod-like conidia with a monopodial branching type with a septate main axis of 2 or more cells, from which lateral arms emerge on each side, besides unbranched phragomoconidia. The conidial arms are straight or slightly curved, septate, and usually ± attenuated at their apex.

Phylogeny. Sequences of three species were available, one comprising SSU+ITS+LSU (*O. microsoma*), one ITS+LSU (*O. mirabilis*), and one ITS (*O. pleiomicrosoma*). In all of them the S1506 intron at the 3'-end of SSU is absent. In phylogenetic analyses of SSU+ITS+LSU (Baral et al. 2017b, Phyls 7, 22) or LSU (S27), series *Microsomates* formed a strongly supported group. In Phyls 7 and 22 it clustered in an unsupported clade with *O. cylindrospora*, *O. brettii*, and *Tridentaria subuliphora*. The three species of series *Microsomates* show a high ITS distance to members of series *Orbilia*, the lowest percentage to *O. brettii*, *O. cylindrospora*, *O. liliputiana* and *O. eucalypti* (~16–20%). In the LSU (D1–D2, 613 nt) the lowest distance was 4.2–6% to *O. fissilis* and 5–7% to *O. liliputiana*, *O. brettii* and allied taxa. In comparison, the distance between the three available sequences of series *Microsomates* is 6–12.5% in the ITS region and 3.5% in the LSU.

Specific nucleotide positions. At pos. 175 in the LSU D1 domain, *O. microsoma* and *O. mirabilis* deviate by T (GT**T**C) from all members of series *Orbilia*, including *Tridentaria implicans* and *T. subuliphora*, which have GT**C**A, GT**C**C, GC**C**C, GC**C**A, GC**C**T, AC**C**C etc. Yet, various other sections (particularly *Lentiformes*, *Aurantiorubrae*, and *Arthrobotrys*) have also members with **T**. At pos. 181 *O. microsoma* and *O. mirabilis* deviate by GC**A**TA or GC**G**TA from other members of *Orbiliomycetes* having **C** or rarely **T**, exceptionally **A** (*O. atlantis*).

Ecology. Species of series *Microsomates* grow on exposed, xeric branches, rarely conifer cones, but were so far not observed on herbaceous substrate. Species derive from humid to arid regions but are absent in temperate humid central Europe. Records are known from North America, Europe, Macaronesia, and Australia.

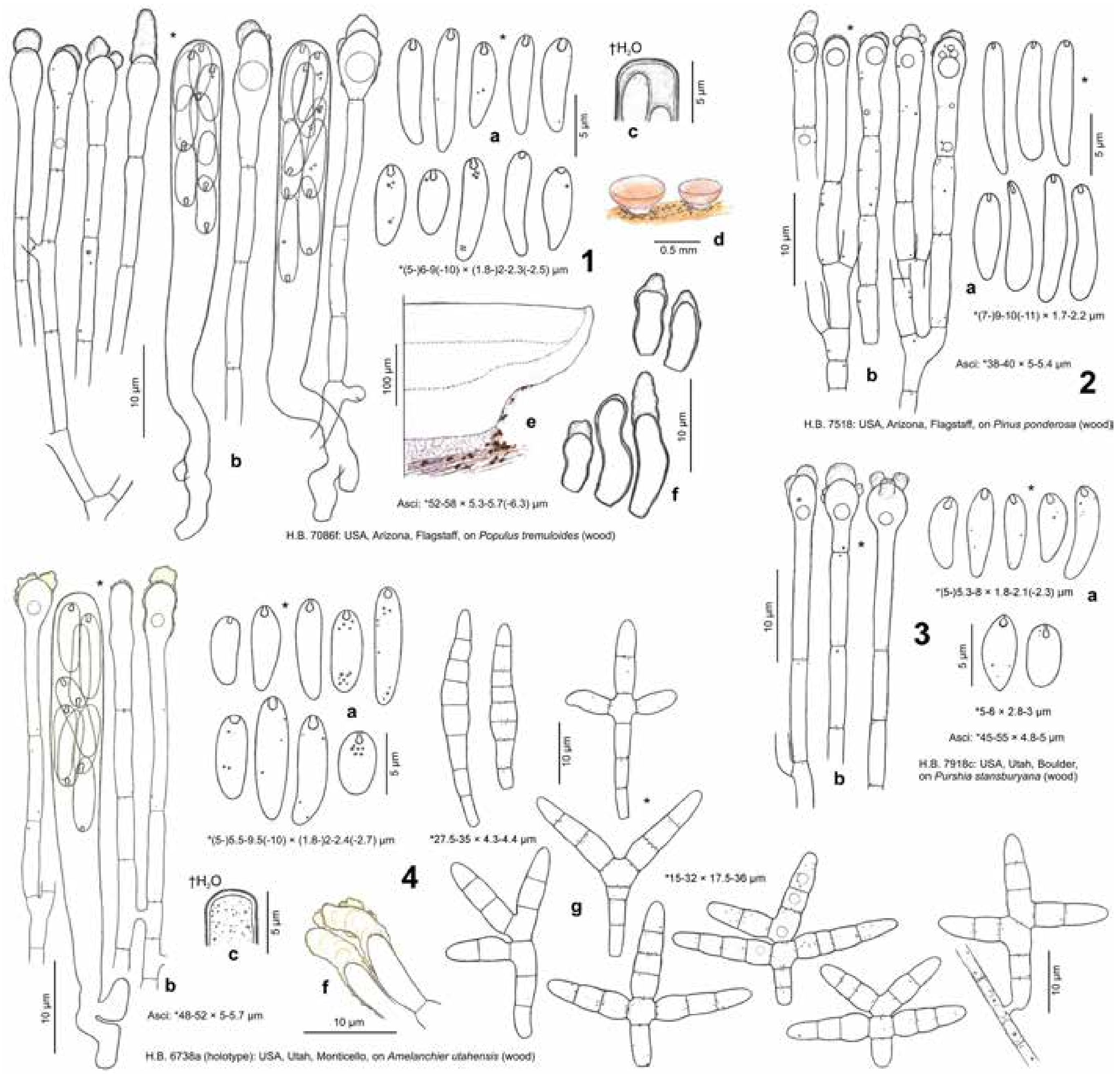


Plate 810. **1**, **3–4**: *Orbilia microsoma*; **2**: *O.* cf. *microsoma*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. rehydrated apothecia; **e**. apothecium in median section; **f**. marginal cortical cells with glassy processes; **g**. conidia from culture.

Orbilia microsoma Baral, G. Marson & E. Weber, **sp. nov.**, MB 814373 — Pls 810–811, Map 131

Etymology: named after the small plug-shaped spore body.

Typification: USA, Utah, Monticello, branch of *Amelanchier utahensis*, 15.VI.2000, G. Marson (ex H.B. 6738a, M-0276515, holotype; ex-type culture: CBS 116214; sq.: KT215278).

Latin diagnosis: *Apothecia rehydratata 0.2–0.7 mm diam., salmonea vel aurantiaca, sessilia vel substipitata, margine laevi ad minute crenulato. Asci 8-spori. Ascosporae *4–12 × 1.8–2.7 µm, cylindricae vel cylindrico-clavatae, rectae vel leniter curvatae corpusculum refringens minutum, obturamenti- vel ampulliformem, ad apicem plus minusve late affixum continentes. Paraphyses ad apicem leniter vel valde capitatae ad spathulatae, pileis vitreis tectae. Excipulum marginale processis vitreis brevibus, pallide luteis praeditum. Habitat ad lignum leniter vel valde putridum ramorum siccorum fruticorum vel arborum angiospermarum in zona orotemperata ad mesomediterranea humida ad semiarida Americae septentrionalis, Macaronesiae et Europae meridionalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.2–)0.3–0.6(–0.8) mm diam., 0.12–0.22 mm high (receptacle 0.1–0.14 mm), light to bright salmon-rose (or orange), slightly to strongly translucent, round, subgregarious to gregarious in ± small groups; disc slightly concave to flat, margin indistinct or distinct, smooth or finely crenulate, 5–10 µm protruding; broadly sessile or with a distinct stipe 0.05–0.1 × 0.2–0.3 mm, superficial, sometimes half immersed in biofilm, dry deep orange-red. **Asci** *(40–)43–58(–64) × 4.8–6(–6.3) µm {5}, †40–50(–55) × (4–)4.3–5(–5.2) µm {3}, 8-spored, spores 2–4-seriate, 2–5 lower spores inverted {5} (not or ± mixed), pars sporifera *20–27(–29) µm long; **apex** (†) medium to strongly truncate (never indented, laterally scarcely inflated); **base** with short to medium long, medium thick, flexuous stalk, L-, Y- or h-shaped. **Ascospores** *(4–)5.5–10(–12) × (1.7–)1.9–2.4(–2.7)((–3)) µm {6}, (sub)cylindrical, also cylindric-clavate (to clavate) or sometimes ellipsoid- to fusoid-clavate, apex rounded, rarely obtuse, base not or slightly (rarely medium) attenuated, straight or slightly inequilateral, some slightly (rarely medium) curved in middle or lower part; **SBs** *0.7–1.1 × 0.5–0.8(–0.9) µm {5}, plug-shaped or ampulliform,

Plate 811. **1–3**: *Orbilia microsoma*; **4**: *O.* cf. *microsoma*. – **3a**. mesomediterranean semihumid summit broom scrub (*Spartocytisetum supranubii*) with dead *Adenocarpus viscosus* in front of Teide; **1a–e**, **2a–c**, **3b**, **4a–d**. rehydrated apothecia; **3c**. dry apothecia; **3d**. ascus apex; **1f–g**, **3e**. apices of paraphyses covered by exudate; **3f**. ascospores. – Living state, except for **3e** above (in CR), ascus in **3d**. – **3a–f**: phot. L. Quijada. — **1a–g**. H.B. 7918c: USA, Utah, on *Purshia*; **2a–c**. H.B. 7086f: USA, Arizona, on *Populus*; **3a–f**. TFC-Mic 21528: Tenerife, on *Adenocarpus*; **4a–d**. H.B. 7518: USA, Arizona, on *Pinus*.

rarely tear- or ± lens-shaped, apically broadly attached or narrowed to a ± wide point. **Paraphyses** apically slightly to strongly capitate(-clavate) to spathulate, rarely moniliform or sublageniform, terminal cells *7.5–20(–25) × (2–)3–4(–4.7) µm {5}, lower cells *7–11(–14) × 1.5–2(–2.5) µm {4} (4–9 µm long near base); branched only near base. **Medullary excipulum** subhyaline, 20–80 µm thick, of medium dense textura intricata with many inflated cells, sharply delimited. **Ectal excipulum** very pale rose, of thin-walled, vertically oriented t. angularis(-prismatica) from base to mid flanks, 30–80 µm thick at base, cells *9–21 × (5.5–)8–13 µm {2}, †7–15 × 6–9 µm {1}; 30–40 µm thick at lower flanks, 15–20 µm near margin, of t. porrecta oriented at a 30–45° angle to the surface, marginal cortical cells *5–12 × 3–3.5(–4) µm {2}, †9–12 × 3–5 µm {1}; **glassy processes** present, 1–9 × (2–)2.5–3.5 µm {5}, strongly refractive, partly stratified, pale yellowish-chlorinaceous. **Anchoring hyphae** ± abundant, *2–3.5 µm wide (~1.5–2.5 µm), walls */†0.2–0.3(–0.7) µm thick {2}, forming a dense t. intricata up to 30–40 µm thick, covering the flanks as a thin network in surface view. **SCBs** in tips of paraphyses globose, 1–3 µm diam. {5}, also in ectal excipulum present {1}. **Exudate** forming firmly attached glassy caps (0.5–)1–3(–5) µm thick on tips of paraphyses, conical or tuberculate, pale yellowish-chlorinaceous; on marginal glassy processes thin, rarely with some clods. — **ANAMORPH**: conidia Y-shaped (trinarium-like), ┼-shaped (descalsia-like) and ¥-shaped (arthropod-like) (from ascospore isolate {1}). **Conidiophores** reduced. **Conidiogenous cells** integrated. **Conidia** of very diverse shape, 2–4-armed, total size *15–32 × 17.5–36 µm, stipe *5–16 × 2.6–3.3 µm, (1–)2–3-septate, arms *7–16 × 3.7–4.5 µm, (1–)2–4-septate; Y-, ┼- and ¥-shaped conidia in more or less equal frequency, also unbranched conidia present but less frequent, *27.5–35 × 4.3–4.4 µm, 7-septate, ± straight.

Habitat: collected 0–3 m above the ground, decorticated, 15–35 mm thick branches of (?)*Acer* sp. {1}, *Adenocarpus viscosus* {1}, *Amelanchier utahensis* {1}, *Laburnum anagyroides* {1}, *Populus tremuloides* {1}, *Purshia stansburyana* {1}, on ~0.5 mm deep slightly to strongly decayed wood {6}, ± strongly eroded, with or without internal beetle galleries, also on boring dust of bark beetles, strongly greyed, green algae present or not. **Associated**: *Durella* sp. {1}, *Hysterium* sp. {1/1}, *Hysteropatella* sp. {1}, *Mellitiosporiella macrospora* {2}, *M. pulchella* {3}, *Odontotrema oregonensis* {1}, *Orbilia aprilis* {1}, *O. cupularis* {1}, *O. delphinus* {1}, *O. gambelii* {1}, *O. macrodelphinus* {1}, *O. maeandrina* {1}, *O. montigena* {1}, *O. multimaeandrina* {1}, *O. navajoana* {2}, *O. pleiomicrosoma* {1}, *O. stansburyanae* {1}, *O. tremuloidis* {1}, *Phragmiticola* sp. {1}, *Propolis farinosa* {1}, *Teichosporella dura* {1}. **Desiccation tolerance**: fully viable for at least 18 months. **Altitude**: 1250 m a.s.l. (southern Europe), 2055–2450 m (North America, Macaronesia). **Geology**: Cretaceous limestone; basaltic lava & cinders, andesite & rhyolite, phonolitic flow. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia microsoma* is characterized by subcylindrical to slightly clavate, medium-sized ascospores with a small, ± plug-shaped spore body, paraphyses tipped by glassy caps of exudate, and marginal cells tipped by glassy processes. The Australian *O. arachnopus* differs in longer and narrower spores and in conidial shape. *O. pleiomicrosoma* differs in 16-spored asci and a slight tendency to narrower spores. The only European sample of *O. microsoma* was mixed with *O. pleiomicrosoma*, which here differed from *O. microsoma* in shorter and wider asci and shorter spores. The European *O. microlentiformis* differs in slightly longer spores with much wider, broadly plug- to mostly lens-shaped SBs.

Variation. Rather great variation is noted within *O. microsoma* concerning length and shape of the spores and spore bodies, even within an apothecium. Ellipsoid, apparently atypical spores were observed in several collections (especially inside dead asci), which resemble those of *O. ovalis* (section *Lentiformes*). In the sample from Macaronesia the glassy processes were very short (1–2 µm), while the unpreserved and sparse European record was not examined in this respect.

Not included collection. A North American sample on *Pinus ponderosa* (Pls 810: 2; 811: 4) deviates by rather long and narrow spores with distinctly narrower SBs (similar to *O. arachnopus*), absence of glassy processes at the margin, rather short asci, and the coniferous host.

Anamorph. The conidia of *O. microsoma* show a remarkably high diversity in shape due to different branching types: unbranched (multiseptate), 2-armed (Y-shaped), 3-armed (┼-shaped), and 4-armed (¥-shaped). In this respect the anamorph resembles, e. g., that of *O. aristata*, in which triradiate and higher-branched conidia simultaneously occur (see also p. 113: Drechsler 1938 und Ando 1992).

Phylogeny. A sequence from an ascospore isolate of the holotype from Utah (H.B. 6738a) comprises SSU, ITS, and LSU. In the ITS region, *O. microsoma* differs from *O. pleiomicrosoma* by 6% and from *O. mirabilis* by 12.5% (3% in the LSU D1–D2).

Ecology. *O. microsoma* was found on ± rotten wood of xeric branches of different angiosperm trees and shrubs. Most collections derive from cold-temperate semiarid to subhumid pinyon-juniper woodlands and subhumid to humid ponderosa pine forests of the Colorado Plateau (Utah Mountains, Canyonlands section, Mogollon Rim) in the southwest of Northern America. The site in the French southern Prealps is a south-exposed mountain flank with an orotemperate humid deciduous woodland with *Corylus avellana* and *Laburnum anagyroides*, and that in Macaronesia a *Spartocytisetum supranubii* in the mesomediterranean semihumid caldera of the volcano Teide in Tenerife.

Map 131. Known distribution of *O. microsoma* in North America (yellow = not included collection).

Specimens included. **USA**: **Utah**, Utah Mts., Dixie Forest, 29 km NNE of Escalante, 10 km N of Boulder, 3.5 km W of Deer Mt., 2433 m, branch of *Purshia stansburyana*, on wood, 11.VI.2003, G. Marson (H.B. 7918c). – Bryce Canyon, 33 km SE of Panguitch, 8 km WSW of Tropic, Navajo Trail SE of Sunset Point, 2300 m, branch of (?)*Acer*, on wood, 25.VIII.1994, G. Marson (H.B. 5164d ø). – Canyonlands, 42 km NNE of Blanding, 13 km N of Monticello, Peters Canyon, 2055 m, branch of *Amelanchier utahensis*, on wood, 15.VI.2000, G. Marson (ex H.B. 6738a, M-0276515, **holotype**, CBS 116214, anam. cult.; sq.: KT215278). – **Arizona**, Mogollon Rim, 23 km NW of Flagstaff, San Francisco Peaks, 10.5 km WNW of Humphreys Peak, Rte. 180, 2450 m, branches of *Populus tremuloides*, on wood, 12.VI.2000, G. Marson (H.B. 7086f). — **FRANCE**: **Rhône-Alpes**, **Drôme**, Vercors, 45 km SW of Grenoble, 8.3 km N of Die, 2.5 km SW of Col de Rousset, 1250 m, branch of *Laburnum anagyroides*, on wood, 22.VIII.2000, G. Marson (H.B. 7158d ø). — **MACARONESIA**: **Canary Islands**, **Tenerife**, La Orotava, Las Cañadas del Teide, 3.5 km SSE of Teide, Callao, Tabonal Negro, 2230 m, branches of *Adenocarpus viscosus*, on wood, 20.II.2009, E. Beltrán-Tejera, L. Quijada & J. Díaz Armas (TFC Mic. 21528, doc. vid.).

Not included. **USA**: **Arizona**, Mogollon Rim, 16 km NW of Flagstaff, San Francisco Peaks, 6 km WSW of Humphreys Peak, 2550 m, branches of *Pinus ponderosa*, on wood, 17.VI.2003, G. Marson (H.B. 7518).

Orbilia microlentiformis Baral, **sp. nov.**, MB 813946 — Pl. 812

Etymology: named after the small lens-shaped spore body.

Typification: France, Narbonne, cones of *Pinus halepensis*, 1.IX.1999, H.O. Baral (ex H.B. 6523c, M-0276513, holotype).

Latin diagnosis: *Similis* Orbiliae microsomati *sed corpuscula refringentia ascosporarum breviora et latiora, crasse lentiformia. Habitat ad strobilum putridum siccum* Pini halepensis *in zona mesomediterranea semihumida Europae meridionalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.19–0.2 mm diam., 0.11 mm high, light amber-reddish, round, scattered; disc flat, margin indistinct, ± smooth, not protruding; broadly sessile, superficial. **Asci** *55–60 × 4.6–5 µm, †45 × 5.3 µm, 8-spored, spores (*) obliquely biseriate, 5–8 lower spores inverted but sometimes also only 4 upper spores inverted, pars sporifera up to *29 µm long; **apex** (†) strongly truncate (very slightly indented, laterally hardly inflated); **base** with medium long, thick, flexuous stalk, L- to h-shaped. **Ascospores** *5.7–12.3 × (1.7–)1.9–2.2(–2.4) µm, †5–7 × 2–2.2 µm, narrowly ellipsoid to subcylindric(-clavate), apex obtuse, base hardly or sometimes rather strongly attenuated, straight to medium curved, especially near base (somewhat helicoid?); **SBs** *0.3–0.8 × 0.7–1.2 µm, lens- to broadly plug-shaped, apically broadly attached. **Paraphyses** apically uninflated to slightly clavate-capitate, also sublageniform (to moniliform), terminal cells *8–15 × 2.5–3.4 µm, lower cells *5–

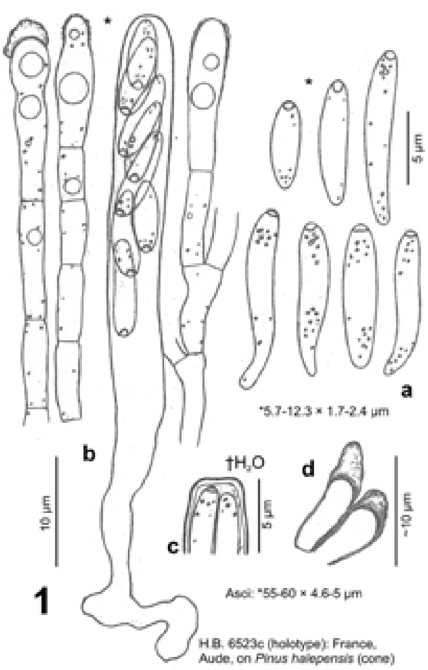


Plate 812. **1**: *Orbilia microlentiformis*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apex; **d**. marginal cortical cells with short glassy processes.

11 × 1.8–2.7 µm; unbranched at upper septum. **Medullary excipulum** not clearly seen, ~30 µm thick. **Ectal excipulum** of (†) thin-walled, indistinctly oriented textura angularis(-prismatica) from base to mid flanks, ~20 µm thick near base, cells †5–10 × 4–5 µm; 15 µm thick near margin, of t. prismatica-porrecta oriented at a 20–30° angle to the surface, marginal cortical cells †6–10 × 3–4 µm; tipped by **glassy processes** 1–5 × 2.5–4 µm, high-refractive, not stratified, pale chlorinaceous-yellow. **Anchoring hyphae** sparse, †1.5–2 µm wide, walls 0.2 µm thick. **SCBs** in paraphyses globose, 0.8–2.6 µm diam. **Exudate** over paraphyses 0.1–2 µm thick, finely granular or as cloddy caps, firmly attached. **— ANAMORPH**: unknown.

Habitat: collected ~1.5–2 m above the ground, still-attached cone of *Pinus halepensis*, on medium decayed scales, greyed, green algae absent to medium abundant. **Associated**: *Naemacyclus fimbriatus*, *Orbilia hesperidea*, *Propolis viridis*. **Desiccation tolerance**: fully viable for at least 1 week. **Altitude**: 9 m a.s.l. **Geology**: Lower Miocene marine limestone. **Phenology**: probably long-lived.

Taxonomic remarks. *Orbilia microlentiformis* closely resembles the mainly North American *O. microsoma* in size and shape of the ascospores, in shape and contents of paraphyses, in the glassy caps on them, and in the presence of short yellowish glassy processes on the margin. Yet, the spore bodies are distinctly wider and predominantly lens-shaped, and the paraphyses are apically less inflated. Size and shape of the spores showed a high variability within this sparse collection.

O. microlentiformis resembles members of series *Lentiformes* in the lens-shaped SBs. However, glassy processes are so far unknown in that series. Moreover, remnants of SBs in the dead spores are easily seen in series *Lentiformes*, but could not be discerned in *O. microlentiformis*. Due to these findings and the similarity with *O. microsoma* we place the species in series *Microsomates*.

Ecology. Only four apothecia could be discovered in the holotype collection. They grew in association with two apothecia of *O. hesperidea* and abundant *Naemacyclus fimbriatus* and *Propolis viridis* on dead cones still-attached to a living tree of *Pinus halepensis* in a sun-exposed open woodland strip with *Pinus halepensis* in mesomediterranean semihumid coastal lowland of southern Europe.

Specimens included. **FRANCE**: **Languedoc-Roussillon**, **Aude**, Languedoc, 15 km SSW of Narbonne, 3.7 km WNW of Sigean, Reserve africaine, 9 m, cones of *Pinus halepensis*, 1.IX.1999, H.O. Baral (ex H.B. 6523c, M-0276513, **holotype**).

Orbilia pleiomicrosoma Baral & G. Marson, **sp. nov.**, MB 814433 — Pls 813–814, Map 132

Etymology: named after the 16-spored asci and the spores similar as in *O. microsoma*.

Typification: Spain, Tarragona, branch of *Robinia pseudoacacia*, 27.IX.1999, H.O. Baral & G. Marson (ex H.B. 6494b, M-0276561, holotype).

Latin diagnosis: *Similis* Orbiliae microsomati *sed asci 16-spori. Habitat ad lignum putridum ramorum siccorum fruticum vel arborum coniferarum vel angiospermarum in zona temperata ad subtropica humida ad arida Europae meridionalis, Macaronesiae et Americae septentrionalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.15–)0.3–0.5(–1) mm diam., 0.11–0.23 mm high (receptacle 0.11–0.14 mm), pale to light rose to mostly (rose-)orange(-ochraceous), semitranslucent, ± round (to elliptical), scattered to sub- or densely gregarious; disc slightly concave to flat, margin distinct, thin or ± thick, 0–10 µm protruding, smooth to finely crenulate; broadly sessile or with an obconical base, superficial or erumpent between fibres, often immersed in biofilm; dry light orange. **Asci** *(40–)50–70(–74) × (4.7–)5.5–7(–7.5) µm {6}, †(33–)40–55(–60) × 4.7–5.5(–6.2) µm {3}, 16-spored, spores *3–4-seriate, 8–10 lower spores inverted {2} (± mixed), pars sporifera *19–32 µm long; **apex** (†) medium to strongly truncate (sometimes slightly indented, laterally rarely slightly inflated); **base** with short to long, thick, flexuous stalk, T-, L-, Y- or h-shaped. **Ascospores** *(4–)5–9(–10) {10} × 1.3–1.6 {1} or (1.6–)1.7–2.1(–2.4) {9}, †(5–)6–8(–9) × 1.7–2(–2.2) µm {2}, subcylindrical to narrowly ellipsoid-clavate, also cylindric-, fusoid- or ovoid-clavate, or fusoid to fusiform, apex rounded, sometimes obtuse, rarely subacute, base not or often slightly to strongly attenuated, straight to slightly, also medium, rarely strongly curved (± geniculate) near base; **SBs** *(0.5–)0.7–1(–1.2) × (0.4–)0.5–0.8 µm {7}, plug- to tear-shaped, apically broadly attached, or narrowed to a wide to small point. **Paraphyses** apically uninflated to slightly (rarely medium) clavate-capitate to spathulate, rarely lageniform, terminal cells *(8–)10–20(–22) × (2–)2.5–3.7(–4.2) µm {7}, lower cells *(4.5–)6–12(–13.5) × 1.5–2.5(–3) {6} µm; not or rarely branched at upper septum. **Medullary excipulum** 40–50 µm thick, of medium dense textura intricata with many inflated cells, sharply delimited from ectal excipulum by a layer of t. porrecta at flanks. **Ectal excipulum** of thin-walled, indistinctly vertically oriented t. angularis(-globulosa) from base to mid flanks, 35–80 µm thick near base, cells *9–19 × 6–11.5 µm {2}; 20–30 µm thick near margin, of t. prismatica-angularis oriented at an 80° angle to the surface, upper margin of t. prismatica-porrecta orieneted at 30°, marginal cortical cells *(7–)10–15(–19) × 2.5–4.5(–5.5) µm {3}; **glassy processes** on margin and flanks 1–9(–16) {7} × 2.5–3.5 {4} or 3–6 {2} µm, ± high-refractive, stratified, pale to light yellowish-chlorinaceous. **Anchoring hyphae** medium abundant, */†1.5–2.5(–3) µm wide, walls 0.2 µm thick {2}. **SCBs** in paraphyses and marginal cortical cells globose, 1–3 µm diam. {7}, exceptionally with a rod-shaped SCB in paraphysis tip {2}. **Exudate** over paraphyses 0.2–3(–4.5) µm thick, forming 1 or more variously shaped caps on a single tip, firmly attached, hyaline to pale or light yellowish-chlorinaceous. **— ANAMORPH**: unknown, but see below.

Habitat: collected 0–4 m above the ground, (±) decorticated, 10–150 mm thick branches of *Aeonium lindleyi* {1}, *Baccharis sarothroides* {1}, *Euphorbia atropurpurea* {1}, *E. lamarckii* {1}, *Kleinia neriifolia* {1}, *Laburnum anagyroides* {1}, *Periploca laevigata* {1}, *Quercus rotundifolia* {1}, *Robinia pseudoacacia* {1}, *Rumex lunaria* {1}, *Pinus brutia* {1}, *P. halepensis* {2}, *Spartium junceum* {1}, on 0.1–1 mm deep slightly to often strongly decayed wood {11}, partly in beetle galleries, also on splitted wood, ± greyed, without or with many green algae. **Associated**: *Claussenomyces* sp. {1}, *Dacrymyces* sp. {2},

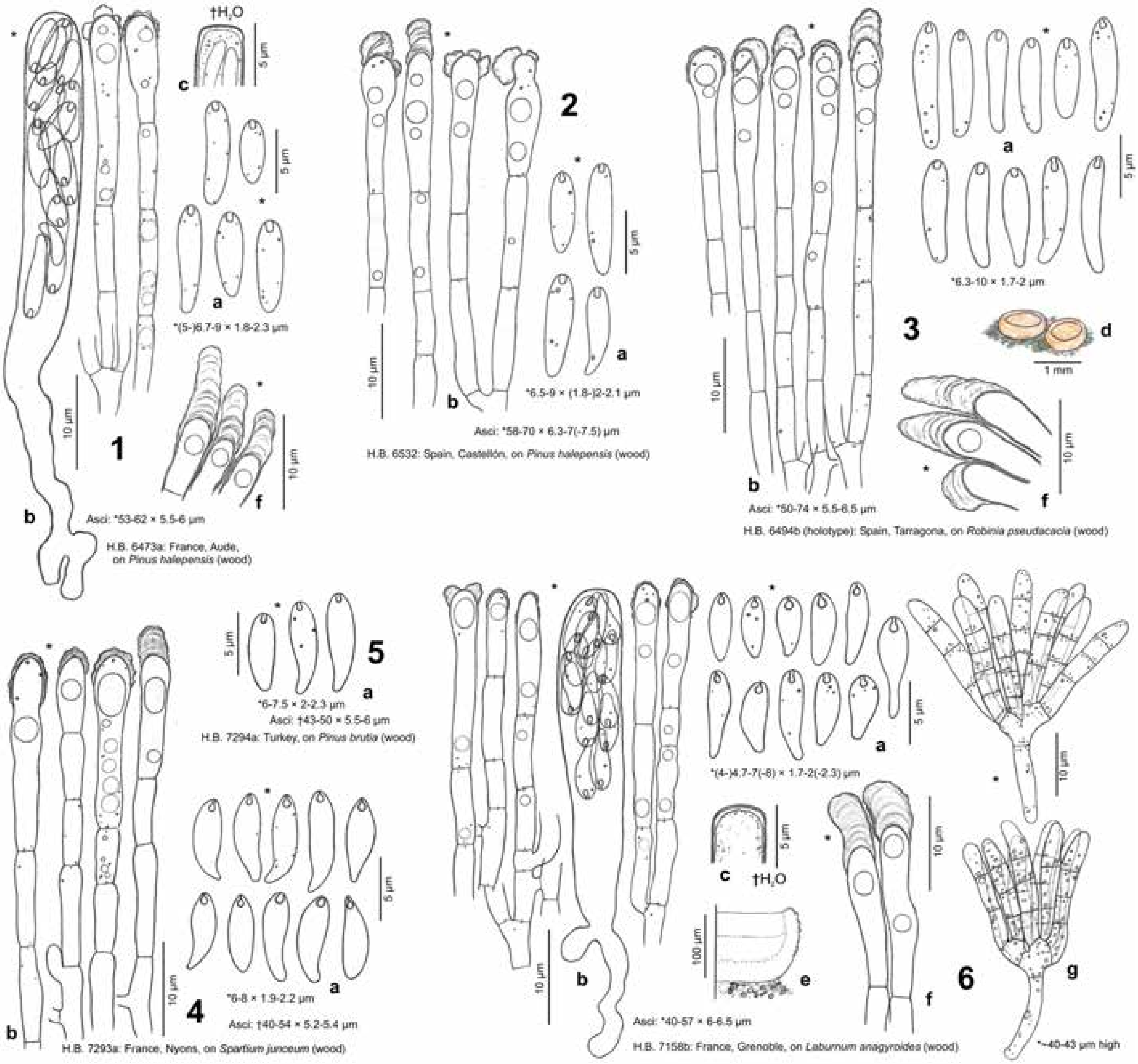


Plate 813. **1–6**: *Orbilia pleiomicrosoma*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. rehydrated apothecia; **e**. apothecium in median section; **f**. id., marginal cortical cells with glassy processes; **g**. conidia from substrate.

Durella ?*atrocyanea* {1}, *Orbilia aprilis* {1}, *O. bicknellensis* {2}, *O. corculispora* {1}, *O. eucalypti* {2}, *O. euonymi* {1}, *O. microsoma* {1}, *O. montigena* {1}, *O. pleistoeuonymi* {1}, *O. polyspora* {1}, *O. serpentina* {1}, *O. subaristata* {1}, *O. subvinosa* {1}, *O. vinosa* {3}, *Propolis viridis* {1}. **Desiccation tolerance**: fully viable after 3 (Gran Canaria) but also 23 months. **Altitude**: 9–1250 m a.s.l. **Geology**: Cretaceous & Miocene clay, lime- & sandstone; basaltic and trachybasaltic flows, mafic volcanic rock. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia pleiomicrosoma* is very similar to *O. microsoma*, from which it is easily distinguished by its 16-spored asci. Due to infraspecific variation, differences in ascus and ascospore size between the two species were only noted when selected populations were compared.

Variation. *O. pleiomicrosoma* is rather variable in size and shape of ascospores and spore bodies. In typical collections the spores are cylindric-ellipsoid to sometimes clavate and contain plug-shaped SBs (Pl. 813: 1–3). The collections on *Laburnum* and *Spartium* from France and those on *Quercus* from Spain and *Pinus* from Turkey differ in rather short spores which tend to be more fusoid-clavate with a more strongly attenuated base (Pl. 813: 4–6). The SBs are here often tear- instead of plug-shaped. In the *Pinus* collection from Turkey the smallest SBs were observed (Pl. 813: 5).

The only North American collection of *O. pleiomicrosoma* (IVV: 27.V.1996) showed rather short and wide, cylindric-ellipsoid spores of *6–6.8 × 2–2.4 µm. A 16-spored Australian collection on *Banksia* is mentioned under the 8-spored *O. arachnopus* because of its narrow spores. In other Australian collections the spores distinctly exceed those of *O. pleiomicrosoma* in length, therefore, they are treated below as a separate species.

Anamorph. Multi-armed dicranidion-like conidia were observed in association with *O. pleiomicrosoma* in four collections (Pls 813: 6; 814: 1, 6, 8). At least in the three latter samples the conidia emerged from the hymenium or margin of the apothecia. Additionally, such conidia were once found in association with *O.*

Plate 814. **1–8**: *Orbilia pleiomicrosoma* (with doubtful anamorph). – **1a**. decorticated xeric branch of *Spartium junceum*, with beetle galleries; **1b–c**, **2a**, **3a–c**, **6a**, **8a**. rehydrated apothecia; **5d**. marginal ectal excipulum in median section; **3d**. glassy processes at margin (squash mount); **4**. mature asci; 5c. ascus apex; **1d**, **5a–b**, **8c**. apices of paraphyses; **2b**, **5e**, **8b**. ascospores; **1e–f**, **6b**, **7**, **8d**. conidia formed on hymenium or margin of *O. pleiomicrosoma* (except for **7**). – Living state (**8b**: 4 spores in CRB), except for **1d** (in KOH+IKI), **1e** (in KOH), **8d** (in H_2O). – **4**, **5a–e**: phot. L. Quijada, **6a**, **7**: phot. T. Askun, **8a**: phot. J. Ormad, **8b–d**: phot. R. Tena. — **1a–f**. H.B. 7293a: France, Nyons, on *Spartium*; **2a–b**. H.B. 9977a: Gran Canaria, on *Kleinia*; **3a–d**. H.B. 7158b: France, Grenoble, on *Laburnum*; **4**. 5.II.2010: Tenerife, Güimar, on *Euphorbia*; **5a–e**. 6.XII.2009: Tenerife, Vera de Erques, on *Euphorbia*; **6a–b**. H.B. 7294a: Turkey, Ivrindi, on *Pinus brutia*; **7**. T.A. 38b, ibid., on *Quercus* (conidium near *O. subaristata*); **8a–d**. 2.XI.2011: Spain, Utiel, on *Quercus*.

subaristata (Pl. 814: 7). They resemble *Dicranidion incarnatum* or *Tridentaria fertilis* but differ in a longer stipe and, in the case of *D. incarnatum*, shorter arms. The charcters are as follows: conidia repeatedly dichotomously branched, with (4–)6–8(–12?)

fasciculate arms, total size */†(25–)35–43.5 × ~(7–)20–45 µm {5}, stipe */†(5–)7–15 × 1.5–3 µm, 1-septate, arms */†13–29 × 2.5–3.5 µm, 2–5-septate, conidiophores short, not clearly seen.

A parasitic infestation rather than a true anamorph cannot be excluded. Similar though less branched conidia found on apothecia of *O. vinosa* (section *Hemiorbilia*) are assumed here to be the anamorph of *Hyalorbilia hergiswiliana* (Pls 137–138). Also on apothecia of *O. cylindrospora* (incertae sedis) and *O. vibrioides* (section *Hemiorbilia*, Pls 370–371) we found similar conidia, which could likewise represent a parasite. However, similar conidia but with more diverging arms, observed on the substrate in association with *O. frangulae*, are presumed here to represent the anamorph of *O. frangulae* (series *Orbilia*, Pl. 850).

Phylogeny. An ITS sequence of *O. pleiomicrosoma* was taken from apothecia of a sample from Gran Canaria (H.B. 9977a), differing from *O. microsoma* by 6% and from *O. mirabilis* by 12.5%.

Ecology. *O. pleiomicrosoma* was collected on ± rotten wood of xeric branches of angiosperm trees, shrubs, and succulents, also of gymnosperms, in thermo- to supramediterranean or mesosub- and orosubmediterranean semihumid to humid scrubs and woodlands in southern Europe, subtropical (infra- to thermo-mediterranean) semihumid to arid desert scrubs in Macaronesia, and a warm-temperate semiarid Sonoran riparian mixed desert scrub near to the Mogollon Rim in western North America.

Specimens included. **FRANCE**: **Rhône-Alpes**, **Drôme**, Vercors, 45 km SW of Grenoble, 8.3 km N of Die, 2.5 km SW of Col de Rousset, 1250 m, branch of *Laburnum anagyroides*, on wood, 22.VIII.2000, G. Marson (H.B. 7158b, anam. substr.). – Préalpes du Dauphiné, 1 km N of Nyons, Col du Pontias, 460 m, branch of *Spartium junceum*, on wood, 11.X.2002, G. Marson (H.B. 7293a, anam. substr.). – **Languedoc-Roussillon**, **Aude**, 15 km SSW of Narbonne, 3.7 km WNW of Sigean, Reserve africaine, 9 m, branch of *Pinus halepensis*, on wood, 21.IX.1999, H.O. Baral (H.B. 6473a). — **SPAIN**: **Cataluña**, **Tarragona**, 20 km WSW of Tarragona, 3 km W of Cambrils, Carrer Gotic, La Dorada, 15 m, branch of *Robinia pseudoacacia*, on wood, 27.IX.1999, H.O. Baral & G. Marson (ex H.B. 6494b, M-0276561, **holotype**). – **Com. Valenciana**, **Castellón**, 13.5 km NNW of Castellón, 3.2 km WSW of Vilafamés, road Camí de Costur, 400 m, branch of *Pinus halepensis*, on wood, 27.IX.1999, H.O. Baral (H.B. 6532 ø). – **Valencia**, 14 km NNW of Utiel, 1.4 km NW of La Torre, Los Reguerillos, 840 m, trunk of *Quercus rotundifolia*, on wood, 2.XI.2011, J. Ormad, vid. R. Tena (J.O., doc. vid., anam. substr.). — **TURKEY**: **Marmara**, **Balıkesir**, 50 km WSW of Balıkesir, 16.5 km SW of Ivrindi, 2 km NW of Korucu, Sarıpınar Mevkii, 425 m, branch of *Pinus brutia*, on wood, 1.XI.2002, T. Askun (T.A. 35a, H.B. 7294a, anam. substr.). — **MACARONESIA**: **Canary Islands**, **Tenerife**, La Matanza de Acentejo, 8.5 km NE of Puerto de la Cruz, 1.5 km WNW of La Matanza de Acentejo, NW of Jagre, Puntillo del Sol, 43 m, branch of *Periploca laevigata*, on wood, 21.XI.2009, L. Quijada, E.V. Rodríguez & R. Castro (TFC Mic. 22553, non vid.). – Guía de Isora, 2.8 km NE of Guía de Isora, NNE of Chirche, 1060 m, stem of *Rumex lunaria*, 16.V.2016, J.P. Priou (J.P.P. 16163, doc. vid.). – 4 km WSW of Vera de Erques, 3 km SW of Tejina, NW of Tijoco Bajo, 225 m, branch of *Euphorbia lamarckii*, on wood, 6.XII.2009, L. Quijada, E.V. Rodríguez & R. Castro (TFC Mic. 22649, 22651, doc. vid.). – Fasnia, 7.5 km SSW of Güímar, 1.5 km NE of Fasnia, Barranco de Herques, 345 m, branch of *E. atropurpurea*, on wood, 5.II.2010, L. Quijada, E.V. Rodríguez & R. Castro (TFC Mic. 22829, 22832, doc. vid.). – **Gran Canaria**, 6.3 km NNE of La Aldea de San Nicolás, 3 km WSW of El Risco, Anden Verde, 600 m, branch of *Kleinia neriifolia*, on wood, 26.XI.2015, S. Feusi (H.B. 9977a; sq.: MK493129). — **USA**: **Arizona**, Sonoran Desert, 84 km N of Phoenix, 15 km NNE of Black Canyon City, Sunset Point, 1060 m, on *Baccharis sarothroides*, 27.V.1996, G. Marson (ø).

Map 132. Known distribution of *O. pleiomicrosoma* in Europe, Macaronesia, and Turkey.

Not included. **Turkey**: **Marmara**, **Balıkesir**, 50 km WSW of Balıkesir, 17 km SW of Ivrindi, 1km SW of Korucu, 410 m, branch of *Quercus ilex*, in vicinity of *O. subaristata*, 1.XI.2002, T. Askun (T.A. 38b, anam. only).

Orbilia austropleiomicrosoma Baral & G. Marson, **sp. nov.**, MB 813947 — Pls 815–816

Etymology: named after the close resemblance to *O. pleiomicrosoma* and the Australian origin.

Typification: Australia, Northern Territories, Curtin Springs Roadhouse, twigs and branches of *Acacia jennerae*, 10.X.1998, G. Marson (ex H.B. 6277a, MEL 2389198, holotype).

Latin diagnosis: Orbiliae pleiomicrosomati *similis sed ascosporae longiores et latiores, paraphyses apice saepe corpusculis crystalloideis continentes. Habitat ad lignum putridum siccum* Acaciae *et* Eucalypti *in zona subtropica arida ad subhumida Australiae occidentalis, centralis et meridio-orientalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.2–)0.25–0.5(–0.8) mm diam., 0.13–0.19 mm high, (pale to) light to bright pink-rose to orange or brick-red, rarely subhyaline, round (sometimes elliptical), (very) scattered or in small groups; disc slightly concave to flat, margin distinct, thin or thick, 0–15 µm protruding, nearly smooth; broadly sessile, superficial to entirely immersed; dry pale to deep orange or (rose-)red. **Asci** *60–78 × 6–7.2 {3} → 7.7 µm, †50–60 × 5–6 µm {T}, 16-spored, spores 3–5-seriate, ± half of spores inverted (strongly mixed), pars sporifera *35–45 → 34 µm long; **apex** (†) strongly truncate (partly very slightly indented, laterally not or slightly widened); **base** with short, thick stalk, L- to h-, sometimes H-shaped. **Ascospores** *(6–)7–12(–13) × (1.8–)2–2.4(–2.7) µm {3}, †(6.5–)8–12(–13) × 1.8–2.4 µm {T}, (sub)cylindrical to cylindric-clavate, apex rounded, base not or slightly to medium attenuated (sometimes tail-like), straight to often slightly to medium, rarely strongly curved near base (± geniculate); **SBs** *0.5–0.9 × 0.4–0.8(–1) µm {3}, plug-shaped, apically broadly attached; overmature generally getting 1-septate (SB thereby unchanged). **Paraphyses** apically slightly or mostly medium (rarely strongly) clavate-capitate to often spathulate (to mammiform) or obtusely lanceolate, terminal cells *(3–)7–18(–25) × (2–)3–4.5(–5.7) µm {3}, lower cells *7.5–14(–16) × 1.5–2.7(–3.5) µm {3}; branched only near base. **Medullary excipulum** 40–80 µm thick, of (medium) dense textura intricata with some or many inflated cells, sharply delimited. **Ectal excipulum** of thin-walled, vertically oriented t. angularis-globulosa from base to mid flanks, 30–50 µm thick near base, cells *9–20(–24) × 6–14.5 µm {3}; 20–30 µm thick near margin, of t. prismatica-porrecta oriented at a 10–40° angle to the surface, marginal cortical cells *(6–)7–12 × 2.7–4 µm {3}; **glassy processes** 1–8 × 2.8–4 µm {3}, refractive, stratified or not, hyaline to pale golden yellowish-chlorinaceous, ± coherent to form small indistinct teeth. **Anchoring hyphae** (medium) abundant, *2.5–3.5 µm wide, walls 0.2–0.3 µm thick {2}. **SCBs** in paraphyses and ectal excipulum globose {3}, 1.3–2.8 µm diam., in paraphysis apices also rod-shaped {2}. **Exudate** over paraphyses 0.1–3 µm thick, cloddy, hyaline to light yellow, partly absent, firmly individually attached, also on lateral parts of terminal cells, over margin 0.2–0.5 µm thick. — **ANAMORPH**: unknown.

Habitat: lying on dry ground or 3 m above ground, decorticated, (3–)6–17 mm thick (twigs and) branches of *Acacia cheelii* {1}, *A. jennerae* {1}, *Eucalyptus* sp. {1}, on 0.5 mm deep strongly decayed wood {3}, strongly greyed, without green algae, mostly on the ungreyed underside among adhering red sand grains. **Associated**: *Baggea* sp. {1}, *Coccomycetella* sp. {1}, *Hysteropatella* sp. {1}, ?*Monodictys* sp. {1}, *Orbilia angustoaristata* {1}, *O. coronohesperidea* {1}, *O. multiaustraliensis* {1}, *O. multiserpens* {1/1}, *O. myriella* {1}, *O. myrionamibica* {1}, *O. pleioaustraliensis* {1/1}, *O. pleiocoronohesperidea* {1}, *O. velutina* {1}, *Ostropales* {1}, ?*Peniophora* sp. {1}, *Symbiotaphrina desertorum*

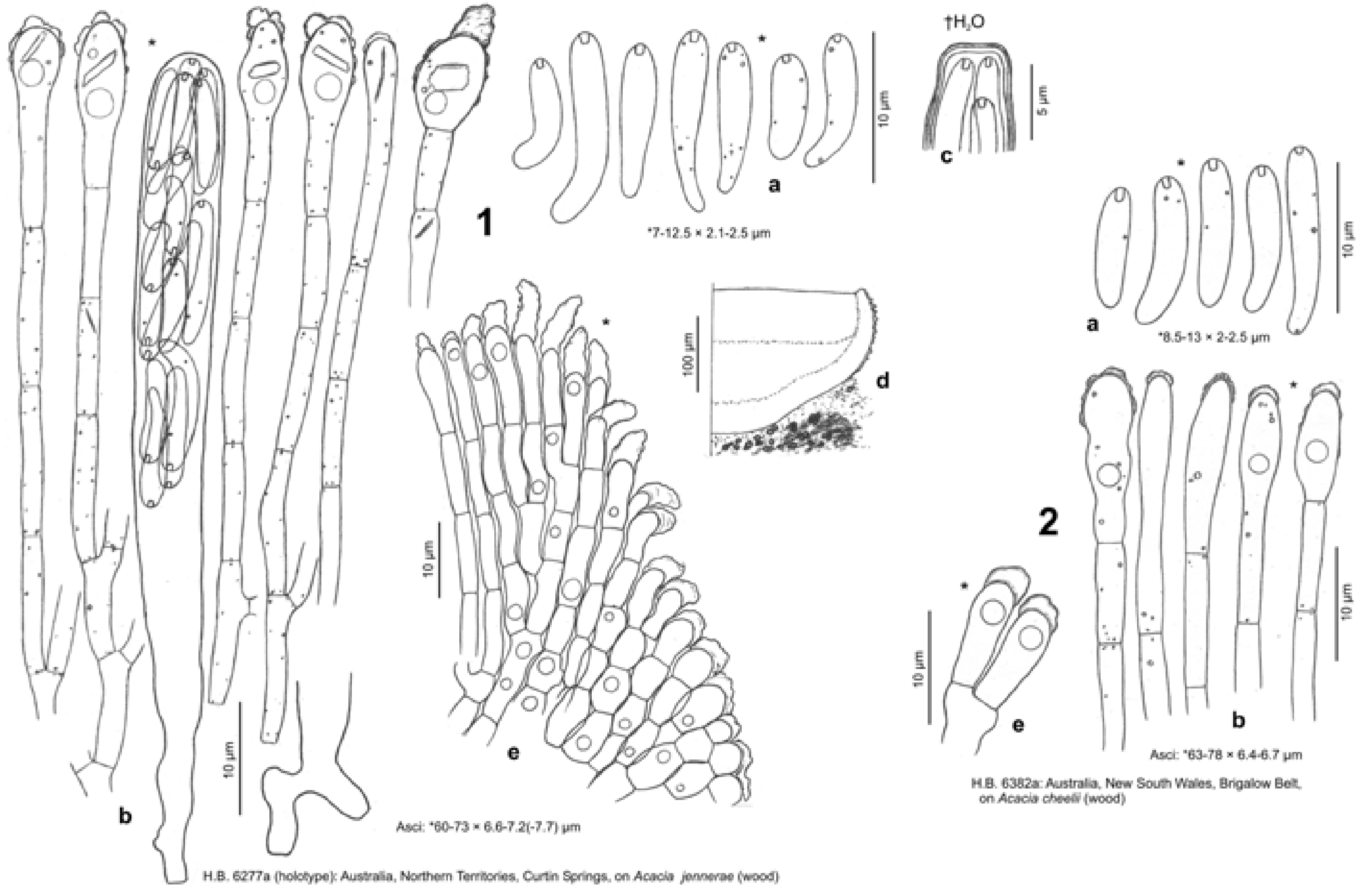


Plate 815. **1–2**: *Orbilia austropleiomicrosoma*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apex; **d**. apothecium in median section; **e**. id., marginal ectal excipulum, cortical cells with glassy processes.

{1}. **Desiccation tolerance**: fully viable for at least 7.5 months, a few paraphysis cells still alive after 45 months. **Altitude**: 480–540 m a.s.l. **Geology**: Mesoproterozoic and Jurassic sedimentary rock, Cenozoic regolith. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia austropleiomicrosoma* is tentatively segregated from European *O. pleiomicrosoma* because of slightly longer and wider ascospores and slightly wider paraphysis apices which more frequently contain rod- to plate-shaped SCBs.

Variation. Within each collection spore shape varied rather strongly between ellipsoid or cylindrical, basally tapered or not, straight or curved, also spore length and width show great variation. Paraphysis shape was often clavate but a tendency to spathulate and rarely mammiform was noted. The exudate formed thick caps on the paraphysis tips only in the holotype, and here only on some of the paraphyses. Crystalloid SCBs were seen in two of the three samples but are partly very inconspicuous. In one sample (Pl. 815: 2) no crystalloid SCBs could be observed.

Ecology. *O. austropleiomicrosoma* was found on rotten wood of xeric branches of *Acacia* and *Eucalyptus* in a subtropical arid acacia open shrubland in central Australia (northern border of Musgrave Range, holotype), in a subtropical arid acacia open woodland with *Eucalyptus* in western Australia, and in a subtropical subhumid eucalypt woodland with *Acacia* and *Callitris glaucophylla* in sand dunes of southeastern Australia (west of Great Dividing Range). In two of the three samples, the inhabited branches were lying on the dry sandy ground, with plenty of attached red sand grains which complicated detection of the small, similar coloured apothecia.

Specimens included. **AUSTRALIA**: **Western Australia**, Gascoyne, 171 km NE of Meekatharra, 62 km SSW of Kumarina Roadhouse, 16 km NW Plutonic Gold Mine, 540 m, branch of *Eucalyptus*, on wood, 28.X.2007, G. Marson (ex H.B. 9772c, mixture in MEL 2389281 [type of *O. velutina*]). – **Northern Territories**, Finke, 100 km E of Yulara, 24 km ENE of Curtin Springs Roadhouse, 480 m, twigs & branches of *Acacia jennerae*, on wood, 10.X.1998, G. Marson (MEL 2389198, **holotype**; **isotype** in H.B. 6277a). – **New South Wales**, Brigalow Belt South, 16 km S of Coonabarabran, Mendooran Road, 514 m, branch of *Acacia cheelii*, on wood, 25.X.1998, G. Marson (H.B. 6382a).

Orbilia arachnopus Baral & G. Marson, **sp. nov.**, MB 813948 — Pls 817–818

Etymology: referring to the presumed anamorph with conidia having 4–9 arms resembling a spider.

Typification: Australia, New South Wales, Coonabarabran, branch of *Eucalyptus*, 25.X.1998, G. Marson (ex H.B. 6387b, MEL 2389206A, holotype).

Latin diagnosis: *Similis* Orbiliae microsomati *sed ascosporae angustiores*, *corpuscula refringentia minores*, *asci breviores*, *conidia corpori* Arthropodae *similes. Habitat ad lignum vel corticem putridum siccum* Eucalypti *in zona tropica vel subtropica subhumida Australiae septentrionalis et meridio-orientalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.2–0.6 mm diam., 0.11 mm thick, pale to light (yellowish-)orange-apricot, round, sometimes compressed, scattered; disc slightly concave, margin ± thick, 10 µm protruding, very finely rough; sessile, superficial to slightly erumpent. **Asci** *(30–)36–44 × 5–5.5(–6.4) µm {T}, †30–35 × 4.5 µm {1}, 8-spored, spores 4-seriate, 3–4 lower spores inverted {2}, pars sporifera *17–19 µm long; **apex** (†) slightly to medium truncate (not indented, laterally not widened); **base** with short to medium long, flexuous stalk, T-, Y- or H-shaped. **Ascospores** *8–11.5 × 1.4–1.8 µm {2}, narrowly (fusoid-)subcylindric-clavate, apex rounded (to obtuse), base often slightly, also medium attenuated, ± slightly curved; **SBs** *0.5–0.8 × 0.3–0.6 µm {2}, plug- (to tear-)shaped, apically ± broadly attached, also narrowed to a wide point. **Paraphyses** apically uninflated or slightly (rarely medium) clavate to spathulate(-lageniform), terminal

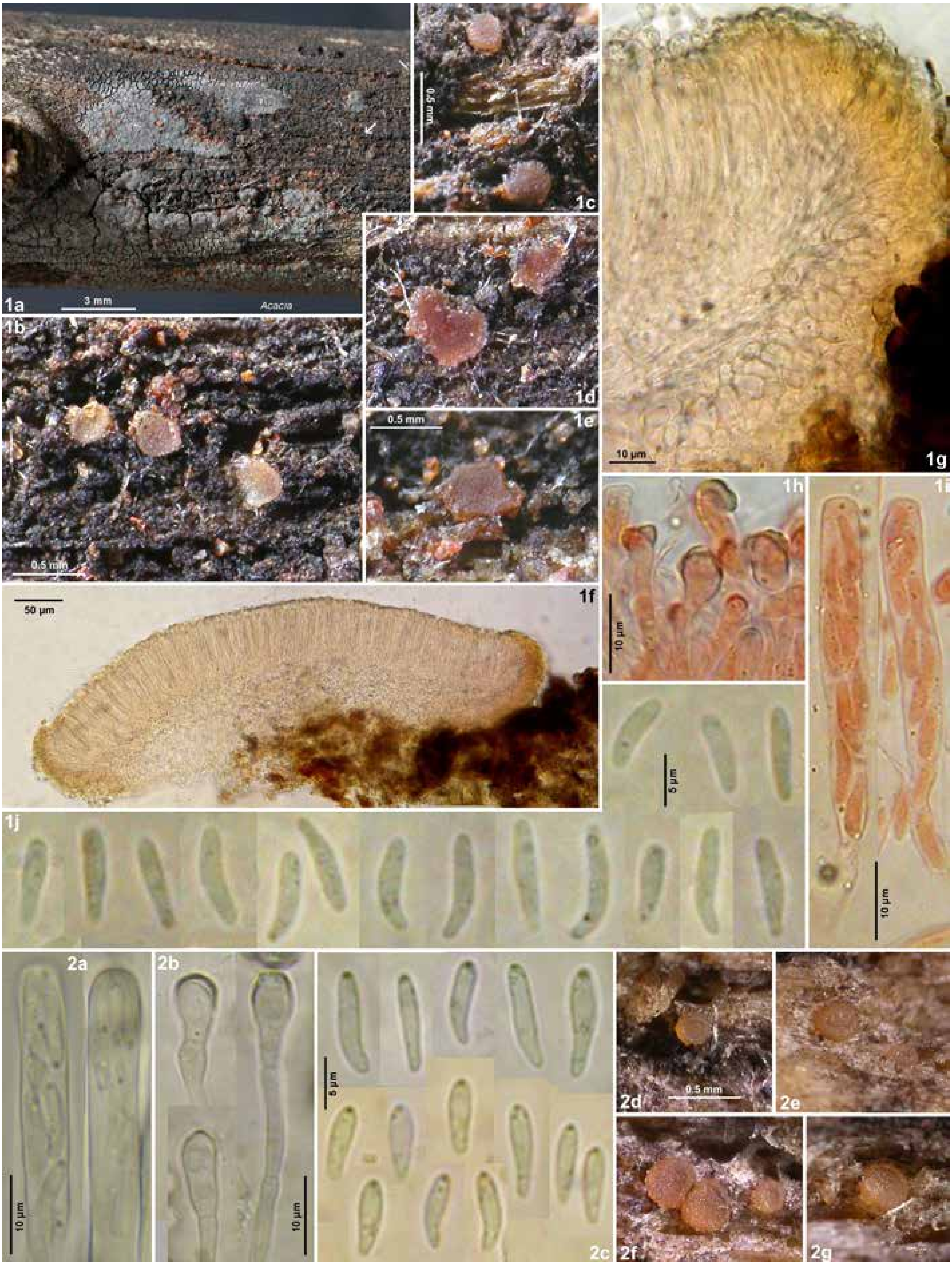


Plate 816. **1–2**: *Orbilia austropleiomicrosoma*. – **1a**. underside of xeric branch of *Acacia* lying on sandy ground; **1b–e**, **2d–g**. rehydrated apothecia (**1b–e**: after 8 years); **1f**. apothecium in median section; **1g**. id., marginal ectal excipulum; **1h**, **2b**. paraphyses; **1i**, **2a**. asci; **1j**, **2c**. ascospores. – Living state, except for **1h–i** (in KOH + CR), **1j** (KOH), **2a** (left ascus). — **1a–j**. H.B. 6277a (holotype): Australia, Northern Territories, Finke, on *Acacia*; **2a–g**. H.B. 9772c: Western Australia, Gascoyne, on *Eucalyptus*.

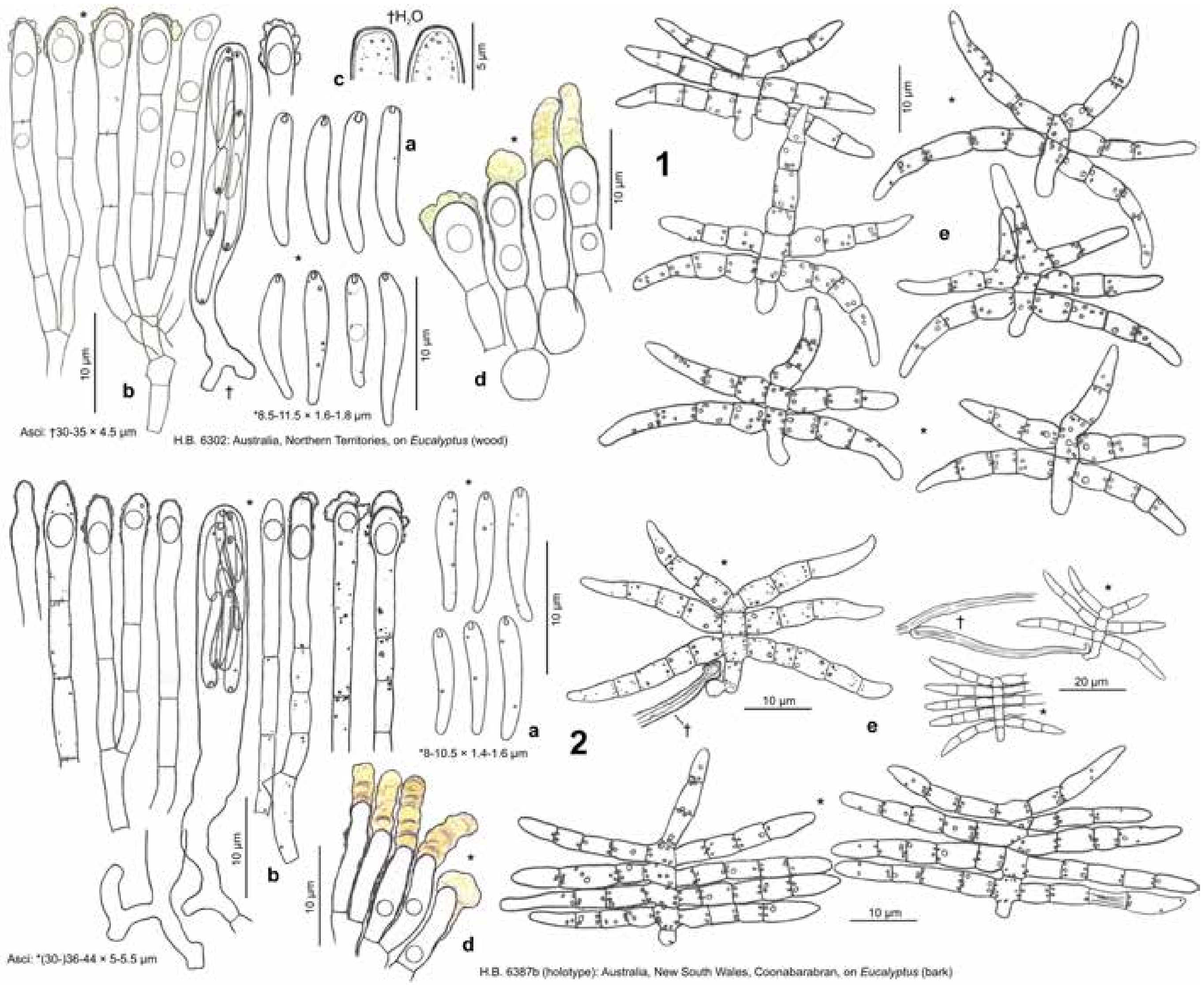


Plate 817. **1–2**: *Orbilia arachnopus*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. marginal ectal excipulum (median section), with glassy processes; **e**. conidia (from substrate).

cells *8–21 × 2.4–3.6 µm {2}, lower cells *4–10 × 1.7–2.5(–2.9) µm {2}; branched only near base. **Medullary excipulum** 40 µm thick, of dense textura intricata with some inflated cells, medium sharply delimited. **Ectal excipulum** of (†) thin-walled, indistinctly oriented t. angularis at base and flanks, 20 µm thick near base, cells †6–10 × 5–8 µm {1}; 10–15 µm thick near margin, of t. porrecta oriented at a 0–20° angle to the surface, marginal cortical cells *8–13 × 3–5 µm {2}; **glassy processes** (1–)4–9 × 2–3(–4) µm {2}, refractive, stratified, light golden yellow-chlorinaceous {2}, coherent to form small teeth. **Anchoring hyphae** abundant, *2–3.5 µm wide, walls 0.2–0.3 µm thick {2}. **SCBs** in paraphyses and ectal excipulum globose (or ellipsoid), 1.3–2.5 µm diam. {2}. **Exudate** over paraphyses 0.2–2 µm thick, rough to cloddy or cap-like, firmly attached, over glassy processes 0.2–1 µm thick, light yellow, cloddy-granular. **— ANAMORPH**: multiarmed conidia (arthropod-like, presumed, from natural substrate {2}). **Conidiophores** not seen. **Conidia** with a short stipe and 4–9 arms, emerging laterally from the main axis like the legs of a spider or crab, mostly with 5–6 arms, at distal end often only one arm, sometimes 1–2 arms dichotomously branched, total size: *21–32 × 38–56 µm, stipe *3–6 × (2–)2.5–3 µm, 0–1-septate, arms *(8–)14–27 × 3–4.5 µm, (1–)3–5-septate, straight to medium curved {2}.

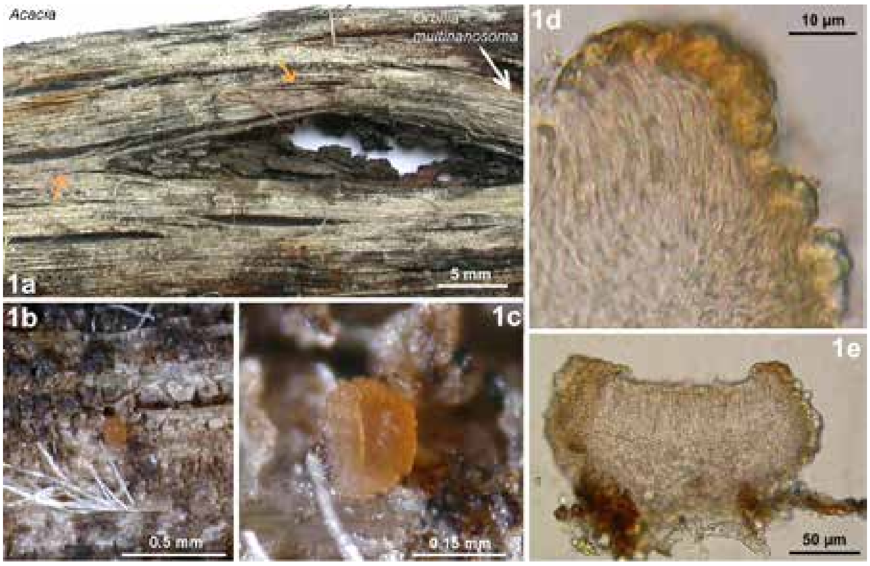


Plate 818. **1**: *Orbilia arachnopus*. – **1a**. outer surface of detached bark; **1b–c**. rehydrated apothecium; **1e**. apothecium in median section; **1d**. id., marginal ectal excipulum. – Dead state (in KOH). — **1a–e**. H.B. 6387b (holotype): Australia, New South Wales, on *Eucalyptus*.

Habitat: collected 2.5–3 m above the ground, corticated or partially decorticated, 15–17 mm thick branches of *Eucalyptus* {2}, on strongly decayed wood {1} or bark {1}, greyed, no algae. **Associated**: *Orbilia albidorosea* {1}, *O. multinanosoma* {1}, *Psiloglonium ?lineare* {1}. **Desiccation tolerance**: fully viable for at least 9.5 months, conidia viable for at least 6 months. **Altitude**: 193–540 m a.s.l. **Geology**: Jurassic sedimentary rock, Cenozoic regolith. **Phenology**: long-lived.

Taxonomic remarks. Within series *Microsomates*, *Orbilia arachnopus* is characterized by 8-spored asci with comparatively narrow ascospores. The similar *O. microsoma* differs in distinctly wider spores with larger SBs, longer asci, and particularly in differently shaped conidia. However, a deviating North American collection on *Pinus* mentioned under *O. microsoma* resembles *O. arachnopus* in the spores and asci, but lacks glassy processes.

O. euphorbiae (section *Aurantiorubrae*) shows some similarities to *O. arachnopus*, but differs in the always tear-shaped spore bodies (faintly visible also in the type material), a tendency to much larger apothecia, and in conidia of the *Vermispora*-type.

Not included collection. A sample on bark of *Banksia* (IVV: 18.XII.2001) fits *O. arachnopus* in the spores (*9–11 × 1.5–1.7 µm) and SBs but deviates in 16-spored asci. The specimen was only very briefly studied and not preserved and possibly it was only a narrow-spored variant of *O. austropleiomicrosoma*.

Anamorph. The staurosporous, multiarmed, arthropod-like conidia of the presumed anamorph of *O. arachnopus* somewhat resemble the 4-armed conidia of *O. microsoma* and *O. mirabilis*, but often develop more than 4 arms (up to 6–9) that emerge from a longer main axis with more septa.

Ecology. *O. arachnopus* was found on rotten wood and bark of xeric branches of *Eucalyptus* in a tropical subhumid (savannah) eucalypt open woodland in northern Australia (paratype) and a subtropical subhumid eucalypt woodland with *Acacia* and *Callitris glaucophylla* in sand dunes of southeastern Australia (west of Great Dividing Range, holotype). The not included 16-spored collection was from subtropical semihumid southwestern Australia.

Specimens included. **AUSTRALIA**: **Northern Territories**, Stuart Plateau, 72 km N of Dunmarra Roadhouse, 26 km N of Daly Waters, 193 m, branch of *Eucalyptus*, on wood, 6.X.1998, G. Marson (H.B. 6302, anam. substr.). – **New South Wales**, Brigalow Belt South, 16 km S of Coonabarabran, Mendooran Road, 514 m, branch of *Eucalyptus*, on bark, 25.X.1998, G. Marson (ex H.B. 6387b, MEL 2389206A, **holotype**, anam. substr.).

Not included. **Western Australia**, Swan Coastal Plain, Perth, Kings Park, 45 m, on bark of *Banksia sessilis*, 18.XII.2001, G. Marson (ø).

Orbilia multinanosoma Baral, **sp. nov.**,

MB 813949 — Pl. 819

Etymology: named after the 32-spored asci and the ascospores containing very minute SBs.

Typification: Australia, New South Wales, Coonabarabran, branch of *Eucalyptus*, 25.X.1998, G. Marson (ex H.B. 6387a, MEL 2389206B, holotype).

Latin diagnosis: *Similis* Orbiliae myrionanosomati *sed asci 32-spori, cellulae vivae paraphysium absque corpusculis crystalloideis. Habitat ad corticem putridum rami sicci* Eucalypti *in zona subtropica subhumida Australiae meridio-orientalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.25 mm diam., light orange-apricot, round; margin smooth; sessile. **Asci** *38–46 × 5.3–5.8 µm, 32-spored (28 counted), spores ~5–6-seriate, lower spores inverted (strongly mixed), pars sporifera *21–26 µm long; **apex** (†) strongly truncate (not indented, laterally not widened); **base** unstalked, h- (to H-)shaped. **Ascospores** *4.5–5.7 × 1.3–1.5 µm, subcylindric(-clavate) to fusoid, apex rounded to obtuse, base often slightly to medium attenuated, straight to slightly curved; **SBs** *0.4–0.5 × 0.25–0.3 µm, plug-shaped, apically broadly attached. **Paraphyses** apically medium (rarely strongly) clavate-capitate or often slightly spathulate (to sublageniform), terminal cells *(8–)10–18 × 3.3–4.8(–5.5) µm, lower cells *7–12 × 1.6–2.3(–2.6) µm; branched only near base. **Medullary excipulum** not examined. **Ectal excipulum** of thin-walled textura globulosa-angularis from base to mid flanks, at margin (upper 50 µm) of t. porrecta oriented at a low angle, marginal cortical cells †12–19 × 2.8–3.3 µm, slightly thick-walled; tipped by refractive stratified **glassy processes** 2–4 × 2–3.5 µm. **Anchoring hyphae** abundant, 2–4 µm wide, walls 0.3–1 µm thick, often slightly rough. **SCBs** in paraphyses globose, 1.2–2.3 µm wide. **Exudate** pale yellowish(-orange), over paraphyses 0.5–1.6 µm thick, cloddy, firmly attached; marginal cortical cells heavily encrusted by 0.3–1.3 µm thick yellow exudate. — **ANAMORPH**: unknown.

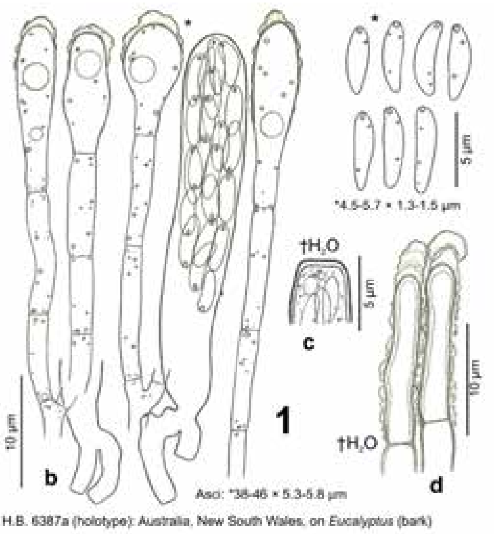


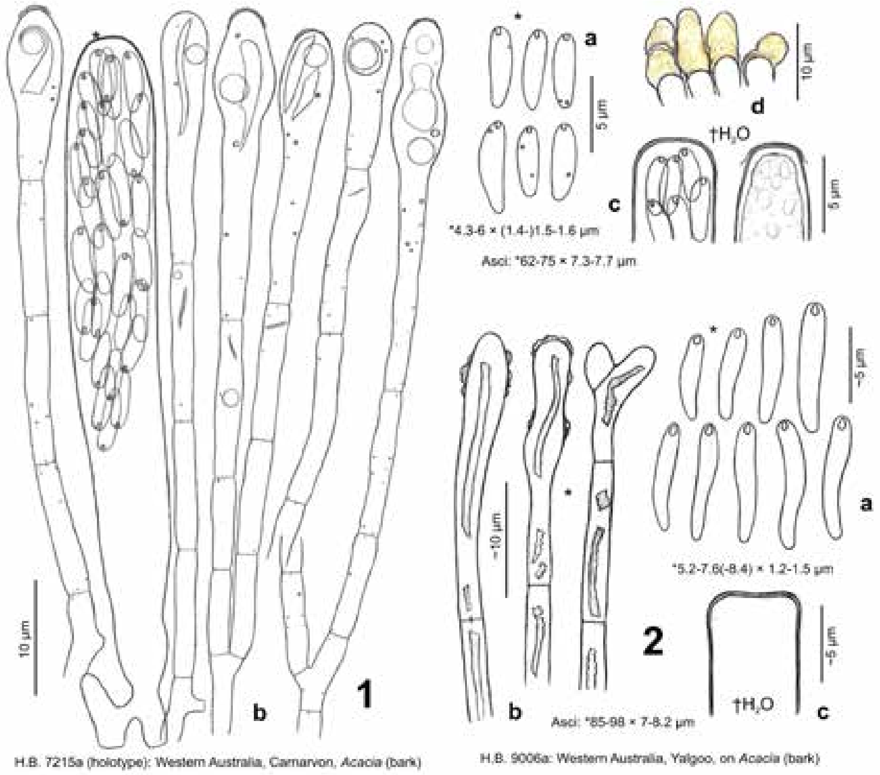
Plate 819. **1**: *Orbilia multinanosoma*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apex; **d**. marginal cortical cells in surface view, with small glassy processes covered by exudate.

Habitat: on hanging, corticated, 17 mm thick branch of *Eucalyptus*, on outer surface of detached bark (bast), very decayed, on blackened parts around scar of broken side twig, no algae. **Associated**: *Orbilia albidorosea*, *O. arachnopus*, *Psiloglonium lineare*. **Desiccation tolerance**: fully viable for at least 7 months. **Altitude**: 514 m a.s.l. **Geology**: Jurassic sedimentary rock. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia multinanosoma* and the similar *O. myrionanosoma* are well characterized within series *Microsomates* by comparatively small ascospores and SBs, and by multispored asci. *O. myrionanosoma* differs in much larger, 64-spored asci, slightly wider spores, and crystalloid SCBs in the paraphyses.

Ecology. The only known, very sparse collection of *O. multinanosoma* was made on rotten bark of a xeric branch of *Eucalyptus* in a subtropical subhumid eucalypt woodland with *Acacia* and *Callitris glaucophylla* in sand dunes of southeastern Australia west of Great Dividing Range.

Specimens included. **AUSTRALIA**: **New South Wales**, Brigalow Belt South, 16 km S of Coonabarabran, Mendooran Road, 514 m, branch of *Eucalyptus*, on bark, 25.X.1998, G. Marson (ex H.B. 6387a, MEL 2389206B, **holotype**).



H.B. 7215a (holotype): Western Australia, Carnarvon, *Acacia* (bark)

H.B. 9006a: Western Australia, Yalgoo, on *Acacia* (bark)

Plate 820. **1–2**: *Orbilia myrionanosoma*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apices; **d**. marginal cortical cells in surface view, with glassy processes.

Orbilia myrionanosoma Baral & G. Marson, **sp. nov.**, MB 813950 — Pls 820–821

Etymology: named after the 64-spored asci and the ascospores containing very minute SBs.

Typification: Western Australia, Hamelin Pool, branch of *Acacia*, 7.XII.2001, G. Marson (ex H.B. 7215a, MEL 2389230A, holotype).

Latin diagnosis: *Apothecia rehydratata 0.2–0.65 mm diam., aurantiaca, sessilia, margine laevi vel minute aspero. Asci 64-spori. Ascosporae *4.3–8.4 × 1.2–1.6 µm, subcylindricae vel anguste ellipsoideae, basi interdum attenuatae, rectae vel leniter curvatae, corpusculum refringens minutissimum, obturamenti- vel lacrimiformem, ad apicem late vel anguste affixum continentes. Paraphyses ad apicem leniter vel modice capitato-clavatae ad spathulatae, exsudato tenui tectae. Excipulum marginale processis vitreis brevibus, hyalinis vel pallide luteis praeditum. Cellulae vivae paraphysium corpuscula globosa et crystalloidea continentes. Habitat ad corticem putridum ramorum siccorum* Acaciae *in zona subtropica semiarida Australiae occidentalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.2–0.65 mm diam., 0.25 mm thick (receptacle 0.14–0.17 mm), light (ochraceous-) orange(-rose), round to strongly compressed, scattered to subgregarious in small groups; disc slightly concave to flat, margin ± thick, 30–40 µm protruding, smooth to usually yellowish powdery rough or with minute dents; sessile, ± deeply immersed in clefts. **Asci** *62–75 {T} or 85–98 {1} × (7–)7.3–7.7(–8.2) µm {2}, †56–74 × 5.5–7.2 µm {2}, 64-spored (~40–58 spores counted), spores */†multiseriate, lower spores inverted (strongly mixed), pars sporifera *36–40 → 35 µm long; **apex** (†) medium to strongly truncate (not indented, laterally not or distinctly widened); **base** without or with short to medium long, ± thick and flexuous stalk, h- or H-shaped. **Ascospores** *4.3–6 × (1.4–)1.5–1.6 {T} or *(4.7–)5.2–7.5(–8.4) × (1.2–)1.3–1.5 µm {2}, †4–6 × (1.1–)1.2–1.4 {T} or †(5–)6–7(–8.3) × 1.4–1.5(–1.8) µm {1}, ± subcylindrical to narrowly ellipsoid, also narrowly subcylindric-clavate, apex rounded to obtuse, base not or sometimes slightly to medium attenuated, straight to slightly curved; **SBs** *0.3–0.6 × 0.3 {T} or *0.5–0.8 × 0.3–0.4(–0.5) µm {2}, plug- {T} to tear-shaped, apically ± broadly {T} or narrowly attached. **Paraphyses** apically mostly slightly to medium clavate-capitate to often spathulate, sometimes lageniform to moniliform, terminal cells *(12.5–)14–27(–32) × (2.5–)3.5–5(–5.4) µm {T}, †14–30(–37) × (2–)2.5–4.5(–5) µm {2}, lower cells *7–15 × 1.8–2.5 µm {T}, †7–12 × 1.6–2 µm {1}; unbranched at upper septa, exceptionally branched at the very apex. **Medullary excipulum** 130 µm thick, of medium dense textura intricata with many ± distinctly inflated cells, sharply delimited at flanks. **Ectal excipulum** of (†) non- to medium gelatinized [common walls †0.5–1(–1.5) µm], vertically oriented t. angularis(-globulosa) from base to mid flanks, 30 µm thick near base, cells †6–14 × 4–10 µm {2}, hyaline, from flanks to margin light yellowish-ochraceous; 15–20 µm thick at lower flanks, of t. angularis(-prismatica) oriented at a 60–80° angle, 15 µm thick at mid flanks, of t. prismatica oriented at 30–50°, 25 µm thick at margin, of t. porrecta oriented at 0–20°, marginal cortical cells †8–15 × 2.2–4.3 µm {2}; **glassy processes** 2–15 × (2.3–)2.7–4(–5) µm {3}, low- to medium refractive in KOH, hyaline to pale or light amber-yellow, stratified, straight or often outwards curved, not forming discrete teeth. **Anchoring hyphae** (very) abundant, †(2–)2.5–2.8(–3) µm wide, walls 0.2–0.4 {T} or 0.3–0.8 µm thick {1}. **SCBs** in paraphyses globose, 1.5–2.5 µm diam., associated with low-refractive, large, hyaline crystalloid SCBs (rod- or ring-shaped) {3}. **Exudate** over paraphyses, margin and flanks 0.1–1 µm thick, finely rough, hyaline to pale yellowish, firmly attached, in ectal excipulum towards margin with yellowish-ochraceous intercellular exudate {2}. — **ANAMORPH**: unknown.

Habitat: collected 1–1.2 m above the ground, corticated, ~1–4 cm thick branches of *Acacia* sp. {3}, on outer or inner surface of attached or detached bark, sometimes immersed in clefts, on medium to strongly decayed bark {3} (bast), greyed, no algae. **Associated**: *Orbilia ?mirabilis* {1}, *O. ?multiserpens* {1}, *O. myriofusiclava* {1}, *O. myriohesperidea* {1}, *O. myriomuscula* {1}, *O. myriopseudoregalis* {1}, *O. pleioaustraliensis* {1}, *O. ?pleioserpens* {1}. **Desiccation tolerance**: fully viable after 33 months. **Altitude**: 67–540 m a.s.l. **Geology**: Mesoproterozoic and Cretaceous sedimentary rock (red-brown sand & gravel). **Phenology**: long-lived.

Taxonomic remarks. *Orbilia myrionanosoma* resembles *O. myriopseudoregalis*, with which it grew in association, and even more closely the 32-spored *O. multinanosoma* (for the differences see under these species). The 64-spored *O. myriella* (section *Habrostictis*) has a spore size and shape similar to *O. myrionanosoma* but differs in filiform SBs which attain a length of ⅓ to ½ of the spore length, and in the absence of both glassy processes and crystalloid SCBs.

Variation. In the two paratype collections (Pls 820: 2; 821: 2–3) which are tentatively included in *O. myrionanosoma*, the SBs are slightly larger and a little tear-shaped, though closely connected to the spore apex and not by a short filum as in *O. myriopseudoregalis*. Further features by which these collections deviate from the holotype involve longer asci and spores, and a tendency to less inflated paraphyses. Spore size in one of them (Pl. 821: 3) is somewhat intermediate, however [*(4.7–)5.3–7.1 × 1.3–1.5 µm].

Ecology. The three known very sparse collections of *O. myrionanosoma* were made on medium decayed bark of xeric branches of *Acacia* in subtropical semiarid acacia (open) shrublands (mulga) and a subtropical semiarid acacia open woodland with *Eucalyptus* in a dry riverbed in the Gascoyne ecoregion of western Australia.

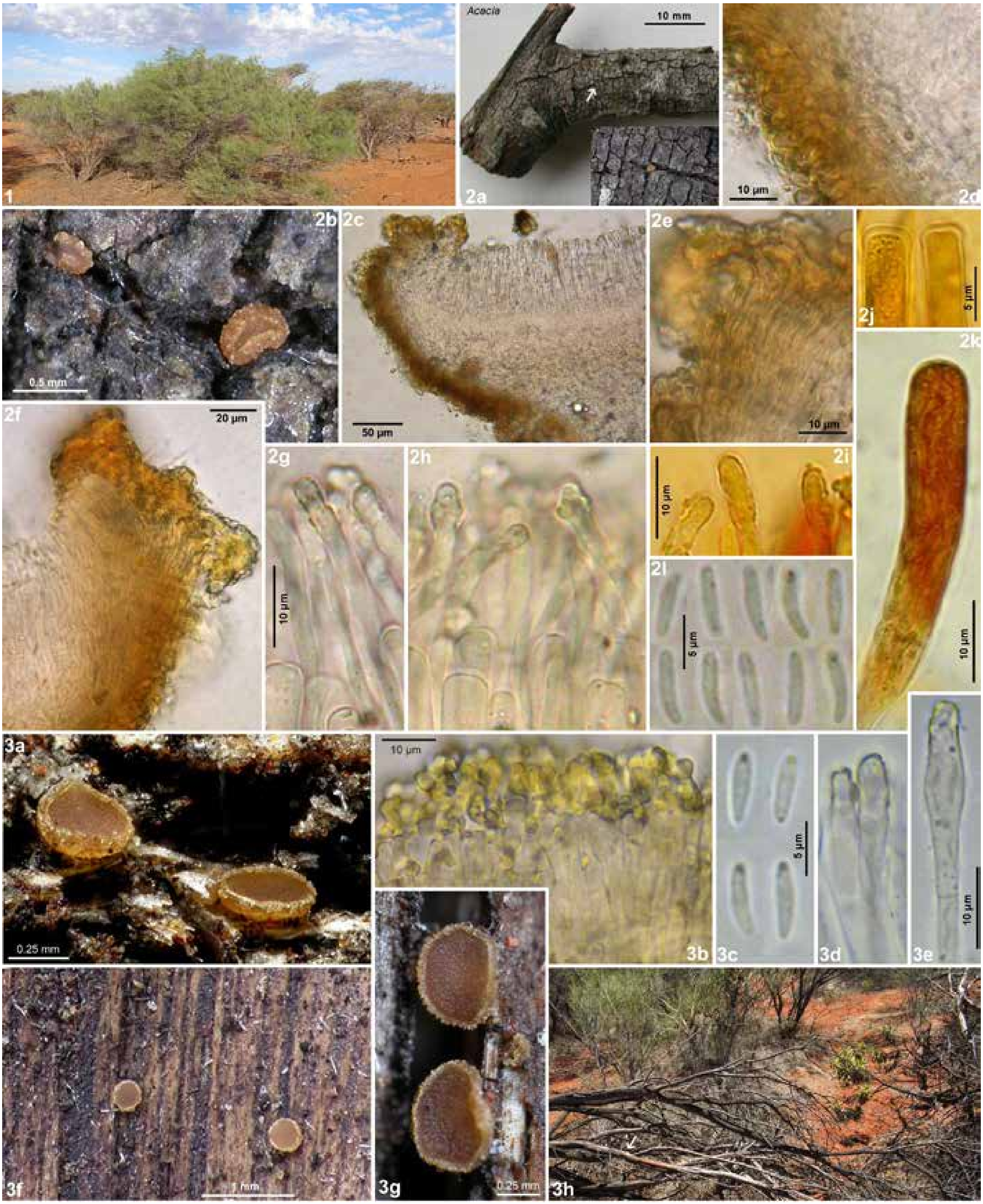


Plate 821. **1–3**: *Orbilia myrionanosoma*. – **1**. semiarid acacia shrubland (mulga); **3h**. arid acacia open woodland with dead parts of *Acacia* in a dry riverbed; **2a**. dead corticated xeric branch of *Acacia*; **2b**, **3a**, **f–g**. rehydrated apothecia (**2**: after > 7 years, **3**: after < 3 months); **2c**. apothecium in median section; **2e**, g. id., marginal ectal excipulum; **2d**. id., at flanks; **3b**. margin with glassy processes; **2k**. mature ascus; **2j**. apices of immature asci; **2g–i**, **3d–e**. apices of paraphyses (and asci); **2l**, **3c**. ascospores. – Living state, except for **2c–h**, **l** (in KOH), **2i–k** (in KOH+IKI). — **1**. H.B. 7215a (holotype): Western Australia, Carnarvon, *Acacia*; **2a–l**. H.B. 9006a: ibid., Yalgoo, on *Acacia*; **3a–h**. H.B. 9695k: ibid., Gascoyne, on *Acacia*.

Specimens included. **AUSTRALIA**: **Western Australia**, Carnarvon, 183 km SSE of Carnarvon, 10 km W of Overlander Roadhouse, 12 km NE of Hamelin Pool, 67 m, branch of *Acacia*, on bark, 7.XII.2001, G. Marson (ex H.B. 7215a, MEL 2389230A, **holotype**). – Yalgoo, 200 km N of Geraldton, 15 km SSE of Wannoo Billabong Roadhouse, W of Toolonga, 157 m, branch of *Acacia*, on bark, 8.XII.2001, G. Marson (H.B. 9006a). – Gascoyne, 171 km NE of Meekatharra, 62 km SSW of Kumarina Roadhouse, 16 km NW Plutonic Gold Mine, 540 m, branch of *Acacia*, on bark, 28.X.2007, G. Marson (H.B. 9695k ø).

Orbilia mirabilis Baral, G. Marson & E. Weber, **sp. nov.**, MB 813951 — Pls 822–823

Etymology: referring to the appealing apothecia with prominent marginal teeth. **Typification**: Western Australia, Illawong, branches of *Acacia*, 9.XI.2007, G. Marson (ex H.B. 8996a, MEL 2389270, holotype).

Latin diagnosis: *Apothecia rehydratata 0.2–1.2 mm diam., lateritio-aurantia, (sub)sessilia, margine exigue albido-dentata. Asci 32-spori. Ascosporae *8–14 × 1.5–1.7 µm, (sub)cylindricae, ad basim vix attenuatae, leniter ad valde curvatae, corpusculum refringens minutum, obturamenti- vel ampulliformem, ad apicem subanguste affixum continentes. Paraphyses ad apicem lageniformes, exsudato tenui tectae. Excipulum marginale processis vitreis longis hyalinis agglutinatis, deorsum curvatis praeditum. Cellulae paraphysium in statu vivo corpuscula globosa et crystalloidea continentes. Habitat ad corticem separatum putridum ramorum siccorum* Acaciae *in zona subtropica semihumida Australiae meridio-occidentalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.2–)0.3–0.65(–1.2) × 0.2–0.4(–0.75) mm (incl. teeth), (0.12–)0.15–0.2 mm high (receptacle 0.11–0.16 mm), pale to mostly light to bright brick-red-orange, non-translucent, round to often elliptical, scattered or often subgregarious; disc slightly concave to flat, margin with prominent whitish teeth ~50–150 × 27–50 µm, always strongly outwards curved, protruding (30–)40–60 µm beyond disc; broadly sessile or with a short obconical stipe 0.07–0.15 × 0.16–0.2 mm, superficial or somewhat erumpent from cracks in bast; dry ± completely closed by the incurved margin and teeth (hysterioid). **Asci** *~65–80 × 6.3–6.7 µm {1}, †55–76 × (5.2–)5.5–6 µm {2}, 32-spored (25–28 spores counted), spores *~4–5-seriate, especially the lower spores inverted {very strongly mixed}, pars sporifera *43–45 µm long; **apex** (†) slightly to strongly (subconico-)truncate (never indented nor inflated), (subconico-) hemispherical in profile view; **base** with rather short and thick, flexuous stalk, L- to h-shaped. **Ascospores** *(8–)9.5–11(–14) × (1.5–)1.6–1.7(–1.8) µm {T}, †8–11(–12) × 1.4–1.6 µm {2}, (sub)cylindrical, apex rounded to obtuse, base not or only slightly attenuated, slightly to strongly curved (predominantly near base, partly geniculate); **SBs** *0.8–1.2(–1.4) × 0.4–0.5 µm {T}, rod- to dumbbell-shaped or ampulliform, apically attached by a ± wide point, straight. **Paraphyses** apically not or usually slightly to medium inflated (lageniform), with thick, short (sometimes long), often ± flexuous or slightly nodding beak, terminal cells *20–30(–36) × 3–4.7 µm {T}, †2.5–3.5(–4.7) µm wide {T}, exceeding the dead asci by 3–13 µm, lower cells *10–16 × 2–2.6 µm {T}; never branched at upper septum. **Medullary excipulum** hyaline, 40–80 µm thick, of medium loose textura intricata with many inflated cells, sharply delimited. **Ectal excipulum** hyaline near base, of (†) ± thin-walled, ± vertically oriented t. globulosa(-prismatica), 30–60 µm thick, cells *10–19(–23) × 7–12 µm {T}; at lower and mid flanks of 15–20 µm thick vertically oriented t. angularis(-prismatica), bright yellow-ochre in outer part, cells *5–8(–13) × 3–5 µm, at submargin of t. prismatica oriented at a 30–40° angle, at upper margin of 20–30 µm thick t. porrecta oriented at 10–30°, marginal cortical cells *12–15 × 3–4 µm {T}; **glassy processes** (4–)10–65(–100) × 2.5–3.5(–5) µm {2}, high-refractive, stratified in KOH, strongly curved outwards under a rather wide arch, strongly coherent to form distinct teeth. **Anchoring hyphae** ± abundant, †2–3(–3.5) µm wide, walls 0.2–0.4 µm thick {T}. **SCBs** in paraphyses globose and often also rod-shaped to plate-like or angular {T}, low-refractive, hyaline, in ectal excipulum not observed; **LBs** in paraphyses sparse, pale yellow (carotenoids), 0.5–1 µm diam., especially near septa. **Exudate** over paraphyses 0.2–0.3 µm thick, finely rough, firmly attached, over glassy processes 0.2–2 µm thick, pale yellowish, at lower and mid flanks 1–2 µm thick, gel-like, bright yellow-ochre. — **ANAMORPH**: arthropod-like (presumed, from natural substrate {2}). **Conidiophores** not observed. **Conidia** ¥-shaped (like a 'K'), of the monopodial type, with 4 arms emerging from a central main axis with a very reduced central stipe, branching type monopodial, sometimes with a small nipple-like protrusion opposite to the stipe, total size *10–14(–17) × (24–)29–36 µm, stipe *1–2.2 × 2–3 µm (main axis 6.5–9 µm long), arms *(12–)14–17 × 3–3.5(–4) µm, straight, 2–4-septate, containing large LBs 1–1.5(–2) µm diam. {2}.

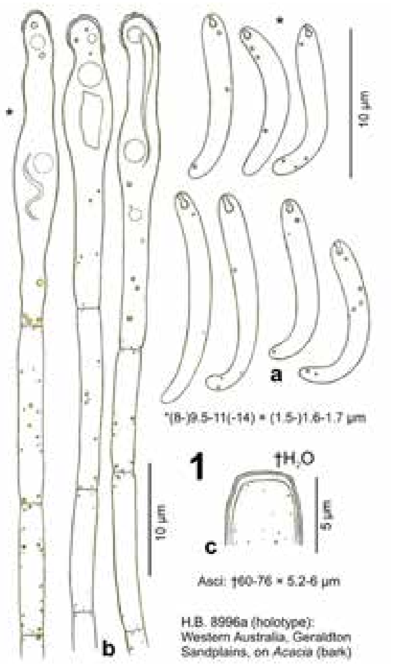


Plate 822. **1**: *Orbilia mirabilis*. – **a**. ascospores; **b**. paraphyses; **c**. ascus apex.

Habitat: collected 0.8–2 m above the ground, ~30–45 mm thick branches of *Acacia* sp. {2}, on inner surface (rarely on edges or outer surface) of detached bark {2}, medium decayed, ± greyed, no algae. **Associated**: *Orbilia commarosa* {2}, *O. eucalypti* {1}. **Desiccation tolerance**: excipular cells, paraphyses, immature asci, ascospores and conidia still viable after 15 months. **Altitude**: 6–7 m a.s.l. **Geology**: Cenozoic regolith. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia mirabilis* is easily recognized by its prominent, outwards curved, whitish teeth, 32-spored asci, and consistently curved ascospores. It differs from the 16-spored *O. austropleiomicrosoma* also in narrower spores and much longer glassy processes. In its spores, paraphyses and marginal glassy processes *Orbilia mirabilis* closely resembles species of series *Regales* (section *Aurantiorubrae*), e.g. *O. euphorbiae* or *O. carnegieae*. However, we have never seen members of that series with asci other than 8-spored. With its large outwards curved teeth *O. mirabilis* resembles the 64-spored *O. myriopseudoregalis* of the present series, whereas the marginal teeth within series *Regales* are more irregularly or indistinctly curved and usually also shorter.

Variation. The two included, geographically very close collections concurred quite well in their morphology.

Not included collection. A sample of the Australian midwest (Gascoyne) was only briefly examined in the dead state (IVV: 28.X.2007): apart from slightly shorter spores seen only inside the asci, its features are those of *O. mirabilis*, yet the shape of SBs and SCBs is unknown. It might instead be a 32-spored variant of *O. myriopseudoregalis*, but its paraphyses are predominantly lageniform.

Anamorph. The conidia associated with *O. mirabilis* resemble those 4-armed, ¥- or K-shaped conidia of *O. microsoma* but differ in much shorter, nearly reduced, aseptate stipes. With this presumed anamorph *O. mirabilis* fits very well series *Microsomates* but not series *Regales*.

Phylogeny. Sequences were gained from two different apothecia on the same piece of bark in the paratype, comprising ITS and LSU D1–D3 (the S1506 intron is absent). A few

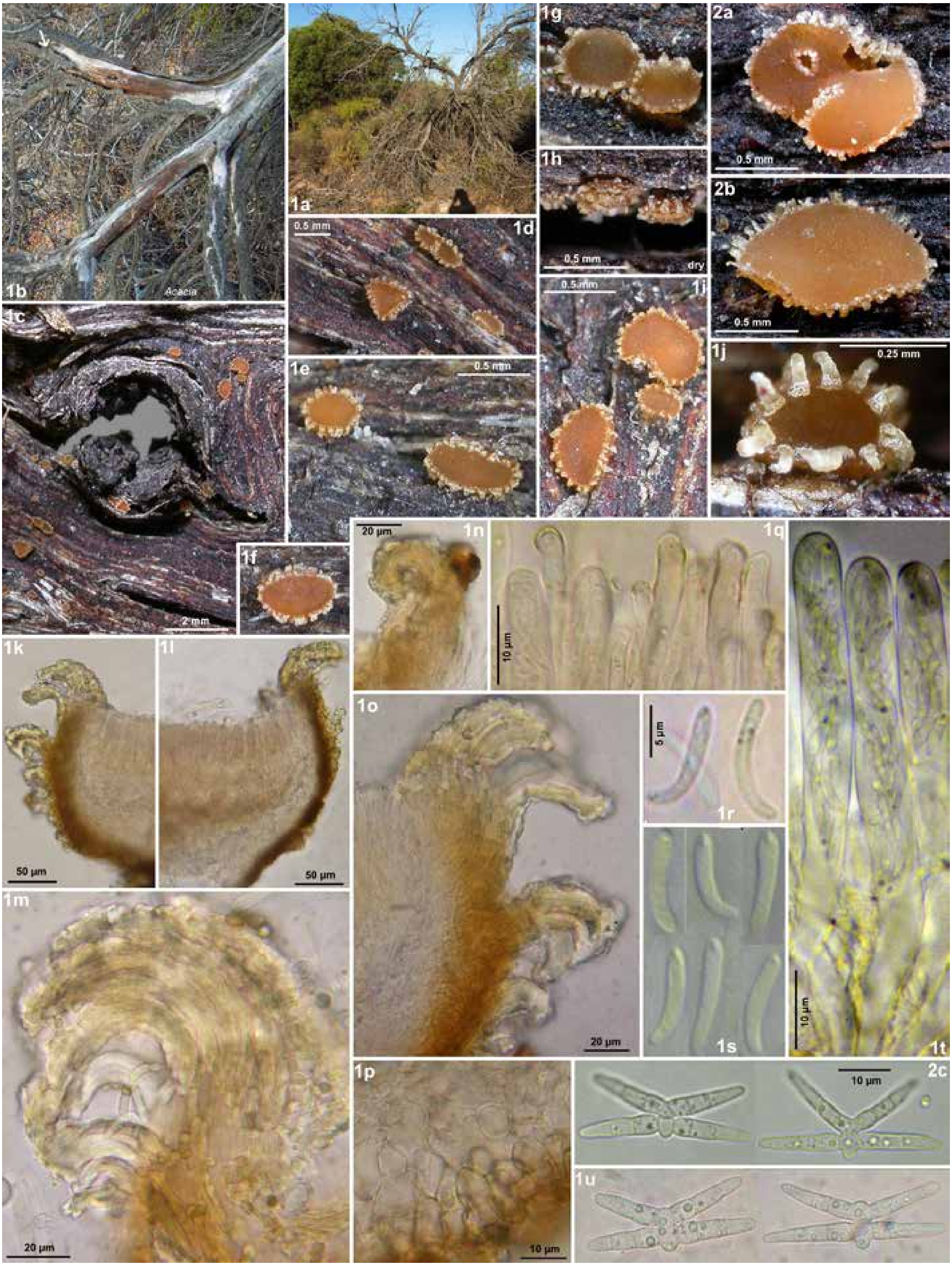


Plate 823. **1–2**: *Orbilia mirabilis*. – **1a**. semihumid acacia shrubland with dead *Acacia* shrub; **1b**. dead xeric branches of *Acacia* with loosely adhering bark; **1c–g**, **i–j**, **2a–b**. rehydrated apothecia on inner surface of bark; **1h**. dry apothecia; **1k–l**. apothecia in median section; **1m–o**. id., marginal ectal excipulum with outwards curved glassy processes; **1p**. id., lower flanks of ectal excipulum; **1q**. apices of paraphyses and asci; **1t**. mature asci; **1r–s**. ascospores; **1u**, **2c**. conidia from substrate. – Living state, except for **1q**, **r** (in H_2O). — **1a–u**. H.B. 8996a (holotype): Western Australia, Geraldton Sandplains, on *Acacia*; **2a–c**. H.B. 9582a: ibid., on *Acacia*.

deviating nucleotides were observed between the two sequences: in the ITS1 4 nt and 3 inserts, and in the LSU D1 domain 2 nt. Therefore, both sequences were uploaded. *O. mirabilis* differs in the ITS by 12–13 % from *O. microsoma* as well as *O. pleiomicrosoma*, and in the LSU D1–D2 by 3.3–3.6 % from *O. microsoma*.

Ecology. *Orbilia mirabilis* was detected on the medium rotten inner surface of xeric bark more or less detached from branches of dead, partly broken, large shrubs of *Acacia*. The two very close sites are located in the coastal subtropical semihumid acacia shrubland of Geraldton Sandplains in southwestern Australia, 330–340 m from the sea shore. The not included collection was in a subtropical semiarid acacia open woodland with *Eucalyptus* in a dry riverbed in the Gascoyne ecoregion in western Australia.

Specimens included. **AUSTRALIA**: **Western Australia**, Geraldton Sandplains, 90 km SSE of Geraldton, 21 km N of Illawong, 6 m, branches of *Acacia*, on bark, 9.XI.2007, G. Marson (ex H.B. 8996a, MEL 2389270, **holotype**, anam. substr.). – 96 km SSE of Geraldton, 15 km N of Illawong, 7 m, branch of *Acacia*, on bark, 10.XI.2007, G. Marson (H.B. 9582a, anam. substr., sq.: KT380094, MH221068).

Not included. **Western Australia**, Gascoyne, 171 km NE of Meekatharra, 62 km SSW of Kumarina Roadhouse, 16 km NW Plutonic Gold Mine, 540 m, branch of *Acacia*, on bark, 28.X.2007, G. Marson (ø).

Orbilia myriopseudoregalis Baral & G. Marson, **sp. nov.**, MB 813952 — Pl. 824

Etymology: named after the crown-like marginal teeth and the spore body shape that are both reminiscent of a member of series *Regales*.
Typification: Western Australia, Hamelin Pool, branch of *Acacia*, 7.XII.2001, G. Marson (ex H.B. 7215b, MEL 2389230B, holotype).

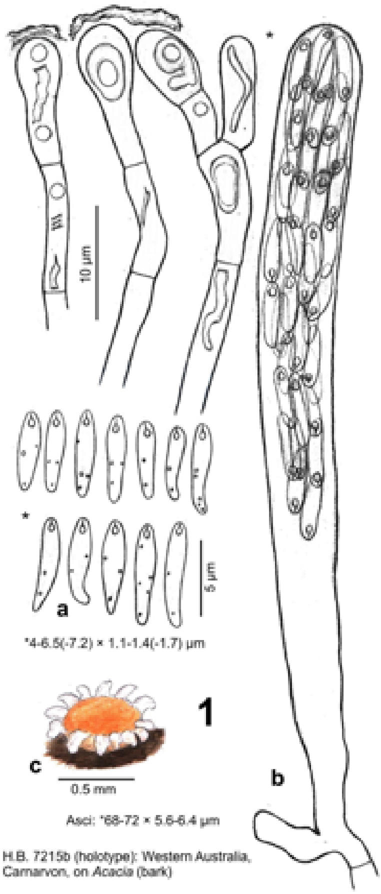


Plate 824. **1**: *Orbilia myriopseudoregalis*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. apothecium (rehydrated).

Latin diagnosis: *Similis* Orbiliae myrionanosomati *sed corpuscula refringentia ascosporarum longiora, subglobosa ad lacrimiforme, filo brevi affixa, excipulum marginale processis vitreis perlongis, agglutinatis praeditum. Habitat ad corticem putridum rami sicci* Acaciae *in zona subtropica arida Australiae occidentalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.5–0.6 mm diam. (0.6–0.7 mm incl. teeth), hardly translucent, round, scattered; disc light orange, slightly concave to flat, margin with prominent white teeth 100–150 × 40–80 µm, strongly protruding beyond hymenial surface; broadly sessile, superficial. **Asci** *68–72 × 5.5–6.5 µm, †4.3–4.8 µm wide, 64-spored (52–64 spores counted), spores (*) multiseriate, lower spores inverted (strongly mixed), pars sporifera *41 µm long; **apex** (†) strongly truncate (not distinctly indented, immature laterally distinctly inflated); **base** attenuated in a short stalk, T- or L-shaped. **Ascospores** *(4–)5–6.5(–7.2) × (1–)1.1–1.4(–1.7) µm, subcylindrical to often fusoid or fusoid-clavate, apex obtuse, base slightly to medium attenuated, straight to slightly or medium curved near base; **SBs** *0.8–1.2 × 0.3–0.5 µm, subglobose to tear-shaped, apically narrowed in a very short filum. **Paraphyses** apically uninflated or mostly slightly to medium clavate, also sublageniform, terminal cells *6.5–13 or 14–26 × 3–4.7 µm, †2–3 µm wide, lower cells *~(6–)8–15 × 1.8–3.3 µm; sometimes branched at upper septum. **Medullary excipulum** not studied. **Ectal excipulum** of textura angularis from base to mid flanks, (*) thin-walled, (†) slightly to medium gelatinized (common walls 0.5–1.5 µm thick), cells at flanks *5–9.5 × 5–8 µm, †5–8 × 4–6 µm, walls light ochre-yellow, near margin of t. porrecta oriented at a low angle to the surface, marginal cortical cells †7–15 × 2–3 µm; **glassy processes** 10–120 × 2.5–3.5(–4) µm, high-refractive, stratified in KOH, predominantly curved downwards (partly uncinate), coherent to form distinct teeth. **Anchoring hyphae** very abundant, †2–3.5 µm wide, walls 0.2–0.4(–0.8) µm thick, hyphae at flanks hair-like. **SCBs** in paraphyses and ectal excipulum (on margin an flanks) globose, 0.8–1 µm diam., and rod- or ring-shaped; in paraphyses with scattered pale yellowish **LBs** up to 1.5 µm diam. (carotenoids). **Exudate** over paraphyses ~0.5–1.3 µm thick, rough, loosely attached, on glassy processes absent but on hyphae at flanks rough cloddy, 0.5–1.5 µm thick, firmly attached. — **ANAMORPH**: unknown.

Habitat: corticated, ~4 cm thick xeric branch of *Acacia*, on inner surface of detached bark, on medium decayed bast, greyed, no algae. **Associated**: *Orbilia ?multiserpens*, *O. myriofusiclava*, *O. myrionanosoma*, *O. pleioaustraliensis*, *O. ?pleioserpens*. **Desiccation tolerance**: paraphyses still alive after 10 months. **Altitude**: 67 m a.s.l. **Geology**: Cretaceous sedimentary rock (red-brown gravel). **Phenology**: long-lived.

Taxonomic remarks. *Orbilia myriopseudoregalis* differs from *O. myrionanosoma*, which grew on the outer surface of the same piece of bark, in prominent marginal teeth made up of long glassy processes, and in slightly narrower ascospores containing longer tear-shaped SBs with a distinct short filum. The SBs resemble those in series *Regales*, but that group so far contains only members with 8-spored asci and shows never crystalloid SCBs. Since *O. myriopseudoregalis* otherwise closely matches *O. myrionanosoma*, we believe that it belongs to series *Microsomates*. In the marginal teeth and SB-shape *O. myriopseudoregalis* resembles *O. mirabilis.*

The very sparse apothecia in the holotype are predominantly strongly overmature, without hymenial elements. Apparently only the one apothecium studied in the living state was in good condition.

Ecology. *O. myriopseudoregalis* was only found a single time, on medium decayed bark of a xeric branch of *Acacia* in a subtropical arid acacia open shrubland of western Australia.

Specimens included. **AUSTRALIA**: **Western Australia**, Carnarvon, 183 km SSE of Carnarvon, 10 km W of Overlander Roadhouse, 12 km NE of Hamelin Pool, Denham-Hamelin Rd, 67 m, branch of *Acacia*, on bark, 7.XII.2001, G. Marson (ex H.B. 7215b, MEL 2389230B, **holotype**).

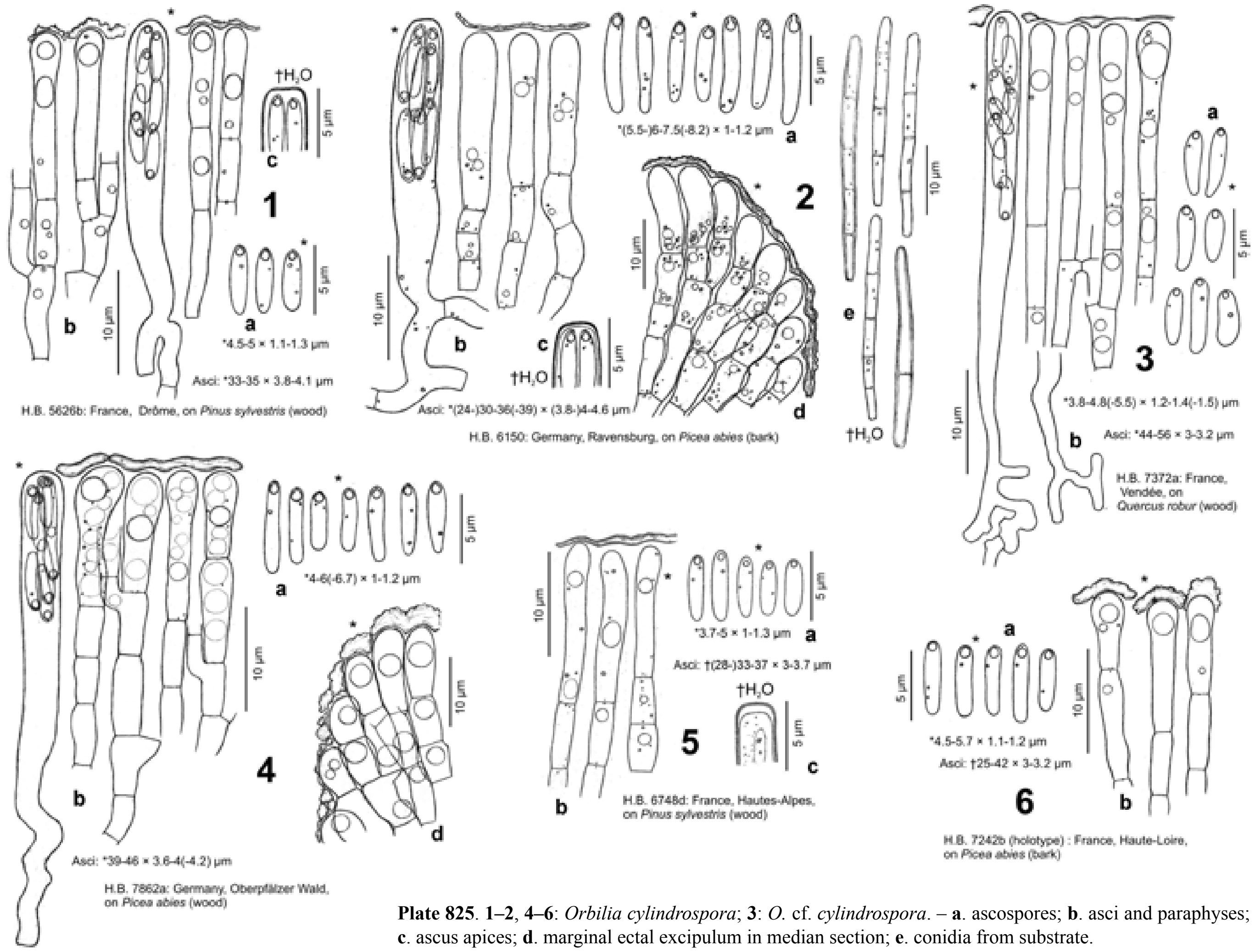


Plate 825. **1–2**, **4–6**: *Orbilia cylindrospora*; **3**: *O.* cf. *cylindrospora*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. marginal ectal excipulum in median section; **e**. conidia from substrate.

Incertae sedis (*O. cylindrospora* group)

Orbilia cylindrospora Baral, E. Weber & G. Marson, **sp. nov.**, MB 813921 — Pls 825–826, Map 133

Etymology: named after the cylindrical ascospores.

Typification: France, Le-Puy-en-Velay, Cayres, branches of *Picea abies*, 4.X.2002, G. Marson (ex H.B. 7242b, M-0276470, holotype).

Latin diagnosis: *Apothecia rehydratata 0.15–0.7 mm diam., pallide roseo-ad albido-cremea, sessilia, margine laevi vel leniter aspero. Asci 8-spori. Ascosporae *3.7–8.2 × 1–1.5 µm, plus minusve cylindricae, apice rotundatae ad obtusae, subrectae, corpusculum refringens globosum vel late lacrimiformem, ad apicem confertim affixum continentes. Paraphyses ad apicem non vel leniter clavato-capitatae. Excipulum marginale absque processis vitreis, exsudato valido tectum. Habitat ad lignum putridum, raro corticem, ramorum vel truncorum siccorum coniferarum, raro angiospermarum, in zona boreale ad orotemperata et orosub- vel suprasubmediterranea humida Europae.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.12–)0.15–0.5(–0.65) mm diam., 0.09–0.14 mm high, pale to light rose, rose-cream, also whitish to cream-isabelline, ± translucent, round to slightly undulating, scattered to (sub)gregarious; disc flat, rarely up to medium convex, margin indistinct or thin, 0–5 µm protruding, smooth or finely rough; broadly sessile or sometimes with an obconical base, superficial; dry light orange(-rose) to pink. **Asci** *(24–)33–46 {5} × 3.4–4(–4.2) {3} or 4–4.6 {2} µm, †(24–)28–37(–42) × (2.8–)3–3.7(–4.2) µm {6}, 8-spored, spores *2–4-seriate, (1–)3–5(–6) lower spores inverted {4} (± mixed), pars sporifera *13–18 µm long; **apex** (†) (slightly to) medium to strongly truncate (never or sometimes very slightly indented, laterally not inflated); **base** with short to long, gradually tapered, flexuous stalk, L- to often h-shaped. **Ascospores** *3.7–5(–5.7) {5} or (4–)5–7(–8.2) {4} × (1–)1.1–1.3(–1.5) µm {9}, †(3–)4–5 {2} or 6–7.8 {1} × 0.8–1.2 µm {3}, (sub)cylindrical, rarely slightly (ob)clavate with slightly to medium attenuated base, apex rounded to obtuse, straight, sometimes (very) slightly curved; **SBs** *0.4–0.6 {1} or 0.6–0.8 {5} µm diam., total length ~0.5–0.7 {1} or 0.7–1(–1.3) {4} µm, globose to broadly tear-shaped, rarely ampulliform, closely attached to spore apex, partly apically narrowed to a small (exceptionally wide) point, or attachment invisible. **Paraphyses** apically uninflated or slightly (exceptionally medium) clavate-capitate, terminal cells *(7.5–)9–17 × 1.9–3.2(–4) µm {6}, lower cells *((2–))(3–)5–8(–11) × (1.8–)2–2.5(–3.2) µm {6}; rarely branched at upper septum. **Medullary excipulum** 35–50 µm thick, of medium dense textura intricata with many inflated cells, indistinctly delimited. **Ectal excipulum** of thin-walled, indistinctly, rarely vertically oriented t. globulosa-angularis from base to mid flanks, 20–35 µm up to 40–60 µm thick near base, cells *(6–)8–13(–16) × (4–)6–10(–14) µm {6}; 15–20 µm thick near margin, of t. prismatica(-porrecta), rarely t. prismatica-angularis, oriented at a 30–45° angle to the surface, marginal cortical cells */†6–10(–12) × (2–)2.5–4.5(–6) µm {4}; **glassy processes** absent. **Anchoring hyphae** mostly abundant, */†(1.7–)2–2.5(–3) µm wide, walls 0.2(–0.3) µm thick {2}. **SCBs** globose, in paraphyses (0.5–)1.3–2(–3) µm diam., in marginal excipulum 1.5–3.5 µm {7}; lower excipular cells sometimes with thin ring-shaped SCBs {1}. **Exudate** over paraphyses 0.5–1.5(–2) µm thick, hyaline, continuous-cloddy, loosely but finally firmly attached; over margin and flanks 0.5–4 µm thick, continuous-cloddy, usually rough. **— ANAMORPH**: unknown (but see below).

Habitat: collected 0.2–4 m above the ground, ± corticated or partially to often entirely decorticated, 7–20(–55) mm thick branches, also 35 cm thick log, of *Juniperus communis* {1}, *Larix* sp. {1}, *L.* ?*decidua* {1},

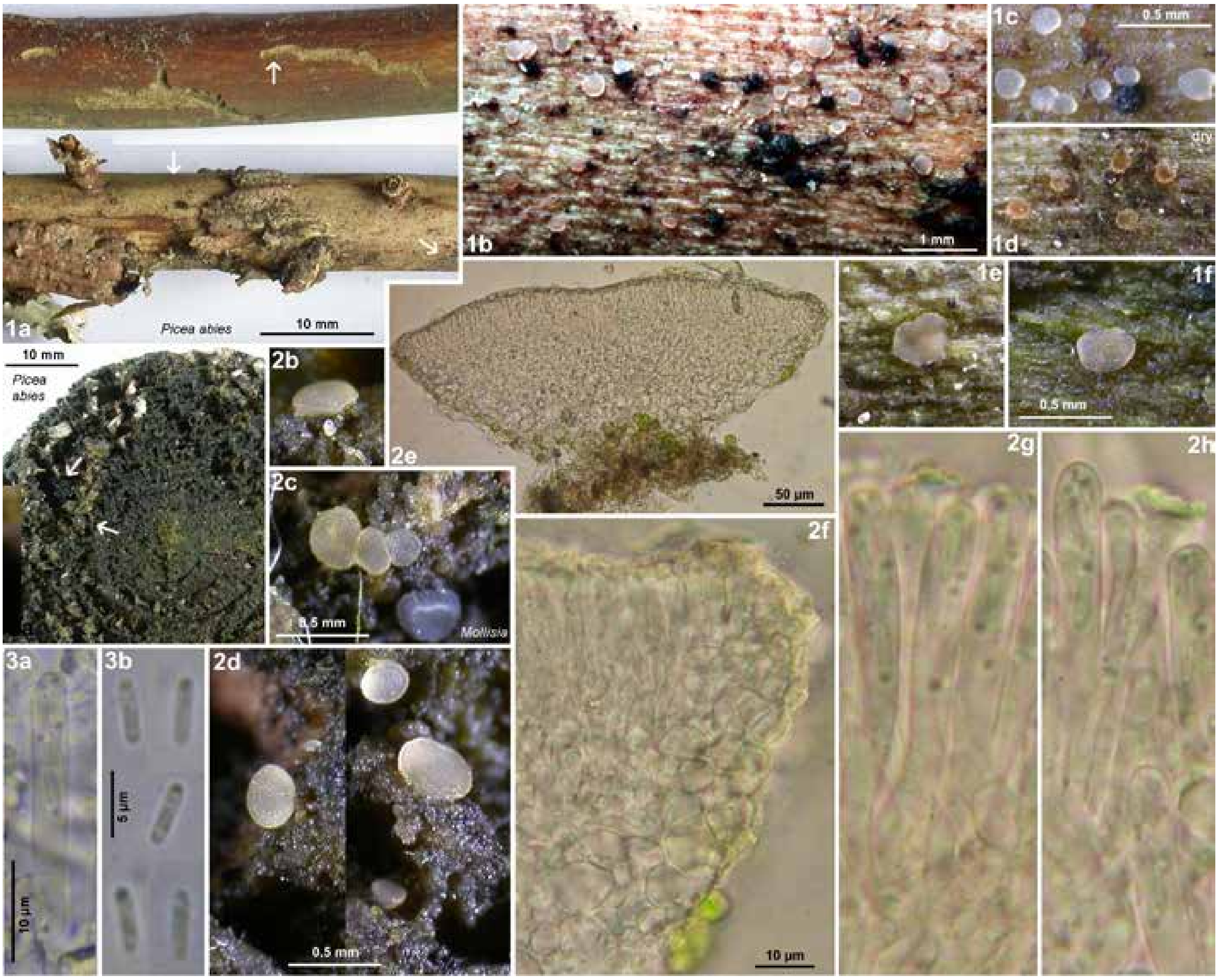


Plate 826. **1–3**: *Orbilia cylindrospora*. – **1a**. decorticated xeric branches of *Picea abies*; **2a**. cross-cut of *Picea abies* pole; **1b–c**, **e–f**, **2b–d**. rehydrated apothecia (**2c**: with *Mollisia* sp.); **1d**. dry apothecia; **2e**. apothecia in median section; **2f**. id., marginal ectal excipulum; **2g–h**, **3a**. asci and paraphyses; **3b**. ascospores. – Living state, except for 1 spore in **3b** right below. — **1a–f**. H.B. 7242b (holotype): France, Haute-Loire, on *Picea*; **2a–h**. H.B. 7862a: Germany, Oberpfälzer Wald, on *Picea*; **3a–b**. G.M. 2015-08-28: France, Haute-Loire, on *Picea*.

Picea abies {8}, *Pinus* sp. {1}, *P. sylvestris* {4}, on 0.05–0.3 or 0.5–1 mm deep medium to strongly decayed wood {14}, rarely bark (periderm) {1}, sometimes in beetle galleries or on resinous wounds {2}, slightly to strongly greyed, partly densely covered by green algae. **Associated**: *Amphosoma atroolivaceum* {1}, *Capronia* sp. {1}, *Chrysodisca peziculoides* {1}, *Ciliolarina* sp. {1}, *C. pinicola* {1}, ?*Cistella* sp. {1}, *Colpoma crispum* {1}, *Cryptodiscus pini* {2}, *Dacrymyces* sp. {1}, '*Helotium*' *uvidulum* {1}, *Hyaloscypha bulbopilosa* {1}, *Mellitiosporium propolidoides* {1}, *Mollisia* sp. {1}, *Mytilidion* sp. {1}, *Orbilia alpigena* {1}, *O. aprilis* {1}, *O. eucalypti* {2}, *O. euonymi* {3}, *O. olivacea* {1}, *O. patellarioides* {2}, *O. subvinosa* {2}, *O. vibrioides* {4}, *O. vinosa* {5}, *Propolis betulae* {1}, *P. rhodoleuca* {1}, *Pseudographis pinicola* {1}, *Resinomyces kirschsteinianus* {1}, *Sarea difformis* {1}, *S. resinae* {1}, *Stictis friabilis* {1}, *Unguiculariopsis* sp. {1}, crustose lichens {1}, pleurocarpous moss {1}. **Desiccation tolerance**: mature asci survive at least a few days, many paraphyses and excipular cells but scarcely any mature asci still viable after 1.5 months. **Altitude**: 510–1408 m a.s.l. (central and northern Europe), 812–1595 m (southern Europe). **Geology**: Muschelkalk, Middle & Upper Jurassic and Cretaceous marl- & limestone, Pleistocene moraine; granite, gneiss, mica schist, amphibolite, dolerite, basalt. **Phenology**: V–X (but probably throughout the year, long-lived).

Taxonomic remarks. The characters of *Orbilia cylindrospora* include small, straight, cylindrical ascospores with ± globose spore bodies close to the apex, 8-spored asci, and apically not or only slightly inflated paraphyses covered by a distinct layer of ± continuous exudate. *O. subcylindrospora* (section *Ovoideae*) is mainly separated by distinctly larger, often curved spores and often strongly capitate paraphyses. For the very similar *O. austrocylindrica* (p. 1317) and the distantly related *O. paracylindrospora* of series *Orbilia* (p. 1343) see there.

The more or less desiccation-sensitive *O. epipora* and *O. cardui* (series *Neodactylella*) differ in larger, whitish apothecia, the former also in smaller asci and spores and sparse to absent exudate, the latter in slightly larger spores with SBs distant from the spore apex. The type of *O. acuum* (section *Arthrobotrys*) appears to differ in a thin granular exudate and more tear-shaped SBs which were seen only in a few dead spores; the marginal excipulum is of t. globulosa oriented at a high angle, quite untypical for *O. cylindrospora*.

O. picea Velen., a dubious taxon found on a xeric *Picea* branch in Czechia, might be similar to *O. cylindrospora* but no type material exists (see p. 1682). The spores were described as '8–10 µm, very narrowly linear and acute', and the apothecia 1 mm diam., flesh-coloured.

Variation. The apothecial colour of *O. cylindrospora* varies from almost hyaline to light rose-orange depending on the

Map 133. Known distribution of *O. cylindrospora* in Europe (yellow = not included collection).

populations, the reddish colour occurring on the more xeric substrates. The oro- and (sub)mediterranean collections differ in having shorter spores and often distinctly smaller SBs, also smaller basal excipular cells, in comparison to the (sub)montane collections from central Europe. The sample on *Picea* log (Pl. 825: 2) deviates from the others in that the apothecia grew on bark; moreover, it shows the widest asci and longest spores. The terminal cells of paraphyses are usually distinctly longer than the lower cells, but in some collections terminal cells occur which are shorter than the penultimate cell (see 4 & 6).

Not included collection. The only sample on angiosperm substrate (Pl. 825: 3, attached branch of *Quercus*) differs from those on gymnosperms in extraordinarily long and narrow asci with a partly H-shaped base, a thicker marginal excipulum of t. prismatica-angularis oriented at a high angle, a sharply delimited medullary excipulum, slightly narrower paraphysis cells, and smaller SBs, though in the sample in Pl. 825: 5 the SBs were similarly small. Contrary to typical *O. cylindrospora*, it originates from an atlantic region at planar altitude. Therefore, it might well represent a different species.

Anamorph. Narrow phragmoconidia were seen in one collection (†27–35 × 1.2–2 µm, Pl. 825: 2e) similar to those observed in a sample of *O. subcylindrospora*. In both species we consider these conidia as possibly alien. In two further collections of *O. cylindrospora* we found tridentaria-like conidia emerging from the apothecia. In both samples *O. vibrioides* (section *Hemiorbilia*) grew in association, and it remained unclear whether the tridentaria-like conidia belong to one of the two or another species (see p. 749, Pls 370: 4g; 371: 5b).

Phylogeny. A sequence taken from apothecia of a topotype of *O. cylindrospora* (Pl. 826: 3) comprises S1506 intron, ITS, and LSU. In our combined analysis (Phyl. 7), the species clustered with low support within one of the two groups of section *Orbilia*. Within this section it formed with *O. brettii* a strongly (Phyls 7) or medium (22, S27) supported clade, and in the combined analyses also an unsupported clade with *Tridentaria subuliphora* and series *Microsomates*, whereas in analyses of ITS or the S1506 intron it clustered unresolved.

O. cylindrospora clustered strongly supported (Phyl. 22) with a 14% ITS distance with an environmental strain from Canadian arctic (Ellef Ringners Island, KC965631), while the distance to *O. brettii* is 19%. When analysing the S1506 intron, *O. cylindrospora* clustered in an unsupported clade which includes part of series *Orbilia* (*O. eucalypti*, *O. tremulae*, *O. renispora*) but also section *Ovoideae* (Phyl. S26). In the 5.8S region *O. cylindrospora* is identical with various members of sections *Hemiorbilia* and *Orbilia*, including *O. brettii* and *O. paracylindrospora*, but deviates by 3 nt from section *Ovoideae* (pos. 30 T vs. C, pos. 140 C vs. T, pos. 142 T vs. C). Also at the 3 LSU positions, which are characteristic of section *Ovoideae* (see p. 1245), *O. cylindrospora* deviates by showing the character typical of the remaining *Orbilia* species.

All these results suggest that *O. cylindrospora* belongs to section *Orbilia* and particularly to series *Orbilia*. However, DNA data are lacking for a large number of taxa here assigned to section *Ovoideae*, and also within the here tentatively established *O. cylindrospora* group, which comprises species with very similar ascospores, *O. cylindrospora* is the only for which a sequence was available, with the exception of *O. brettii* with ellipsoid spores.

Ecology. *O. cylindrospora* was collected on ± rotten wood (rarely bark) of xeric or mesic branches (rarely logs) of coniferous trees and shrubs. A single but doubtful collection was on wood of a xeric *Quercus* branch. Records are from oroboreal Scandinavia (Lapland), subcontinental, cold-temperate humid, montane central Europe (Hunsrück, Thüringer Schiefergebirge, Oberpfälzer Wald, Oberschwaben, High Tatras), and from orotemperate to orosub- or suprasubmediterranean humid southern Europe (Massif central, Southern French Alps). Mostly the apothecia grew on ± exposed xeric branches, but in some from central Europe they were on more mesic branches and logs in shady or open conifer forests, partly lying ± close to the ground. The not included collection is from an atlantic humid *Quercus robur*-*Castanea sativa* forest with *Ilex aquifolium* in the coastal lowland of western Europe.

Specimens included. **SWEDEN**: **Västerbotten**, Vilhelmina, 4.5 km SW of Saxnäs, Satsfjället, Pojken, 715 m, branch of *Juniperus communis*, on wood, 24.VII.2010, P. Perz (H.B. 9398 ø). — **SLOVAKIA**: **Prešov**, Carpathian Mts., Vysoké Tatry, 8.7 km SSW of Tatranská Javorina, Bielovodská valley, 1313 m, branch of *Picea abies*, on wood, 12.VII.2018, A. Polhorský (A.P. 18/69, doc. vid.). – ibid., 9.5 km SSW of Tatranská Javorina, 1408 m, branch of *P. abies*, on wood, 30.VII.2018, A. Polhorský (non vid.). — **GERMANY**: **Rheinland-Pfalz**, Hunsrück, 14 km W of Idar-Oberstein, ~4 km WNW of Waldfriede, SE of Erbeskopf, ~650 m, branch of *Larix*, on resin, 15.V.1994, G. Marson (ø). – **Thüringen**, Thüringer Schiefergebirge, 8 km NW of Sonneberg, 1.2 km SW of Rabenäußig, Langeberg, 510 m, branch of *Picea abies*, on wood, 20.IX.2010, S. Helleman (S.H. 668, doc. vid.). – **Bayern**, **Oberpfalz**, Hinterer Oberpfälzer Wald, 16 km NNE of Cham, 5.5 km NW of Furth im Wald, NW, Drei Wappen, 915 m, branch of *P. abies*, on wood, 5.VIII.2005, E. Weber (H.B. 7862a). – **Baden-Württemberg**, Oberschwäbisches Hügelland, 9 km WSW of Bad Waldsee, 6 km S of Aulendorf, Röschenwald, 530 m, log of *P. abies*, on bark, 3.VI.1998, E. Weber (H.B. 6150, anam. substr.). — **FRANCE**: **Auvergne**, **Haute-Loire**, Massif central, 15 km SSW of Le-Puy-en-Velay, 2.7 km WNW of Cayres, 1275 m, branches of *P. abies*, on wood, 4.X.2002, G. Marson (ex H.B. 7242b, M-0276470, **holotype**). – ibid., twigs and branches of *P. abies*, on wood, 28.VIII.2015, G. Marson (G.M. 2015-08-28.2, **topotype**; sq.: KY419172). – **Rhône-Alpes**, **Ardèche**, 8 km ENE of Le Cheylard, 1.5 km NE of St.-Julien-Labrousse, 812 m, twigs and branches of *P. abies*, on wood, 11.X.2016, G. Marson (G.M. 2016-10-11.2). – **Drôme**, 20 km SW of Serres, 8 km WNW of Ballons, Col de Perty, 1300 m, branch of *Pinus sylvestris*, on wood, 23.VIII.1996, G. Marson (H.B. 5626b). – 17 km E of Nyons, 4.5 km S of Rémuzat, Col de

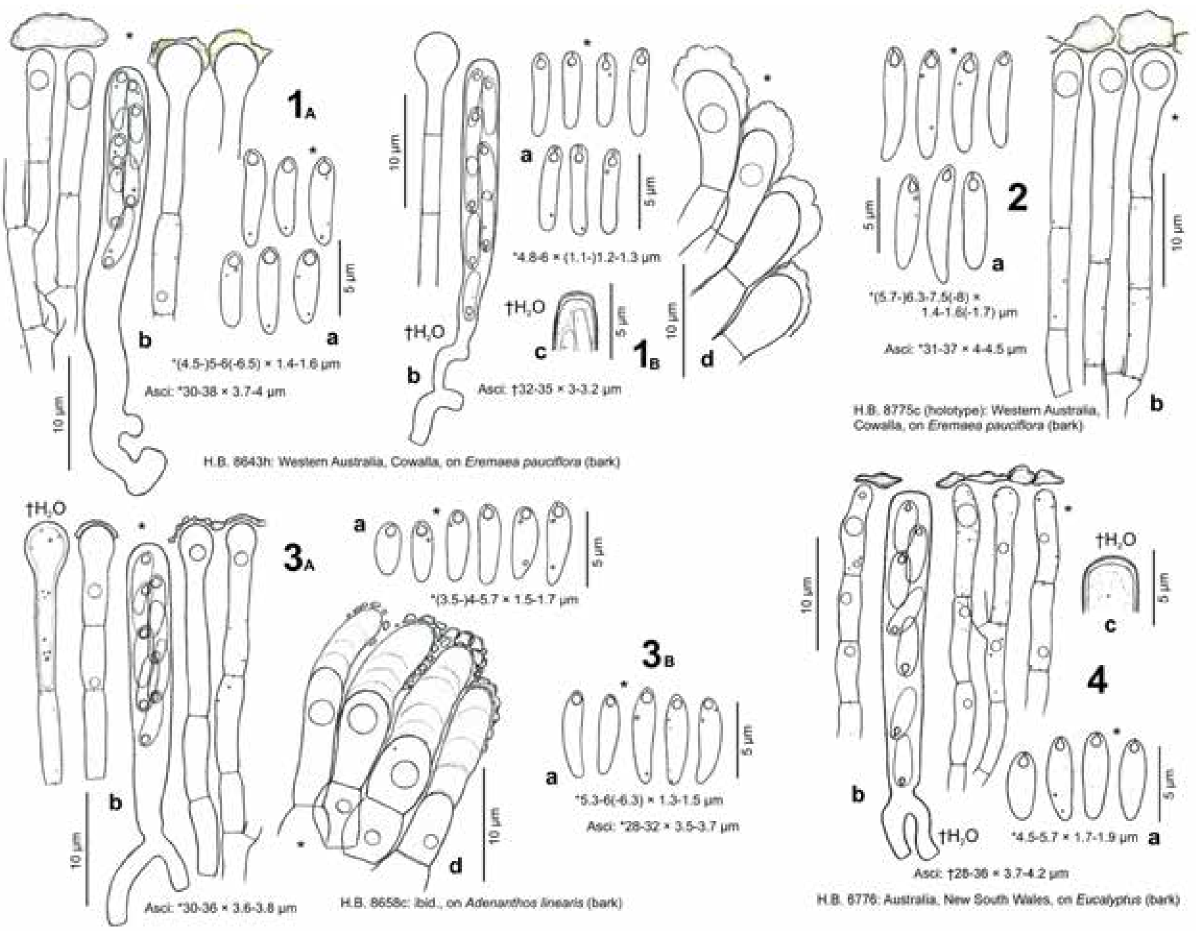


Plate 827. **1–4**: *Orbilia austrocylindrica*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. marginal ectal excipulum in median section. **1B**/**3B** from different branches than **1A**/**3A**; glassy processes only present on apothecia from **3A**.

Soubeyrand, 1005 m, branch of *P. sylvestris*, on wood & resin, 10.X.2002, G. Marson (ø). – 20 km W of Serres, 4.3 km NNW of Rosans, Col de Pommerol, 1045 m, branch of *P. sylvestris*, on wood, 22.VIII.2000, G. Marson (H.B. 6748d). – **Isère**, Vercors, 20 km SW of Grenoble, 2 km SSE of Villard-de-Lans, W of Les Glovettes, 1200 m, branch of *P. sylvestris*, on wood, 11.VIII.2009, H.O. Baral (H.B. 9180b). – **Provence-Alpes-Côte d'Azur**, **Hautes-Alpes**, – 21 km NW of Gap, 0.6 km E of Les Coutières, Col du Festre, 1390 m, branch of *Larix ?decidua*, on wood, 23.VIII.2000, G. Marson (ø). – **Alpes-de-Haute-Provence**, 8 km SE of St.-Julien-du-Verdon, 3 km NW of Soleilhas, Vauplane, 1595 m, branch of *Pinus*, on wood, 16.VII.1994, G. Marson (ø).

Not included. **FRANCE**: **Pays-de-la-Loire**, **Vendée**, 21 km SSW of La Roche-sur-Yon, 2.3 km NNW of Avrillé, Bois de la Garde, 35 m, branch of *Quercus robur*, on wood, 5.VI.2003, H.O. Baral (H.B. 7372a).

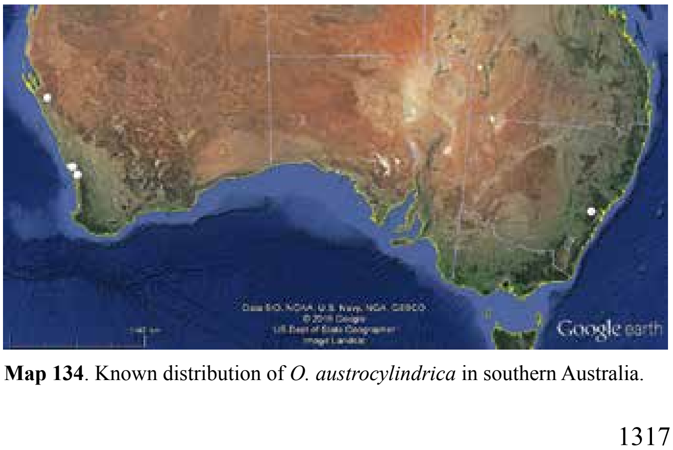
Orbilia austrocylindrica Baral & E. Weber, **sp. nov.**, MB 813931 — Pls 827–828, Map 134

Etymology: named after the occurrence in Australia and the subcylindrical spores.

Typification: Western Australia, Cowalla, branches of *Eremaea pauciflora*, 23.X.2007, G. Marson (ex H.B. 8775c, MEL 2389259A, holotype).

Latin diagnosis: *Similis* Orbiliae cylindrosporae *sed ascosporae leniter latiores, corpuscula refringentia partim cuspide brevi ad apicem affixa, paraphyses ad apicem partim magis capitatae. Habitat ad corticem putridum ramorum siccorum fruticum vel arborum angiospermarum in zona temperata humida ad subtropica semiarida Australiae meridio-occidentalis et -orientalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.15–0.33(–0.44)((–0.55)) mm diam., 0.075–0.14(–0.18) mm high (receptacle 0.05–0.07 → 0.04–0.06 mm), pale to bright rose, rose-orange or orange, ± translucent, ± round, scattered; disc flat, margin thin, 0–5(–10) µm protruding, smooth or sometimes with distinct small teeth, rarely indistinctly crenulate; broadly sessile or with obconical stipe 0.03–0.12 × 0.14–0.15 mm, ± superficial. **Asci** *26–38 × 3.3–4(–4.5) µm {5}, †(24–)26–34(–36) {7} × 2.8–3.6 {4} or 3.7–4.2 {3} µm, 8-spored, spores (*) biseriate, 3–5(–6) lower spores inverted {6} (not or often strongly mixed); **apex** (†) slightly to strongly truncate (not indented, laterally not or rarely very slightly inflated); **base** with very short to medium long, thin or ± thick, flexuous stalk, T-, Y- or h-, rarely H-shaped. **Ascospores** *((3.5–))(4–)4.5–6(–6.5) {6} or (5.7–)6.3–7.5(–8) {1} × (1.1–)1.3–1.7(–1.9) µm {7}, †4–5.5 × 1.3–1.5 µm {1}, cylindrical to narrowly (ellipsoid-)fusoid, rarely subclavate, apex rounded to obtuse, base not or slightly, rarely medium attenuated, straight to ± inequilateral or very slightly curved; **SBs** *(0.7–)0.8–1(–1.2) {5} or 1.1–1.4 {1} × 0.5–0.8(–1) µm {6}, globose to broadly tear-shaped, apically closely attached or by a very short filum, rarely by an inflated connecting part. **Paraphyses** apically uninflated or usually slightly to strongly capitate(-clavate), terminal cells *(6–)8–15(–19) {4} × (2–)2.5–3.5(–4) {5} µm, lower cells *(5–)6–9(–10) × 1.7–2.3 µm {4}; rarely branched at upper septum. **Medullary excipulum** pale rose, 15–60 µm thick, of loose or dense textura intricata with many inflated cells, sharply delimited from ectal excipulum mainly



Map 134. Known distribution of *O. austrocylindrica* in southern Australia.

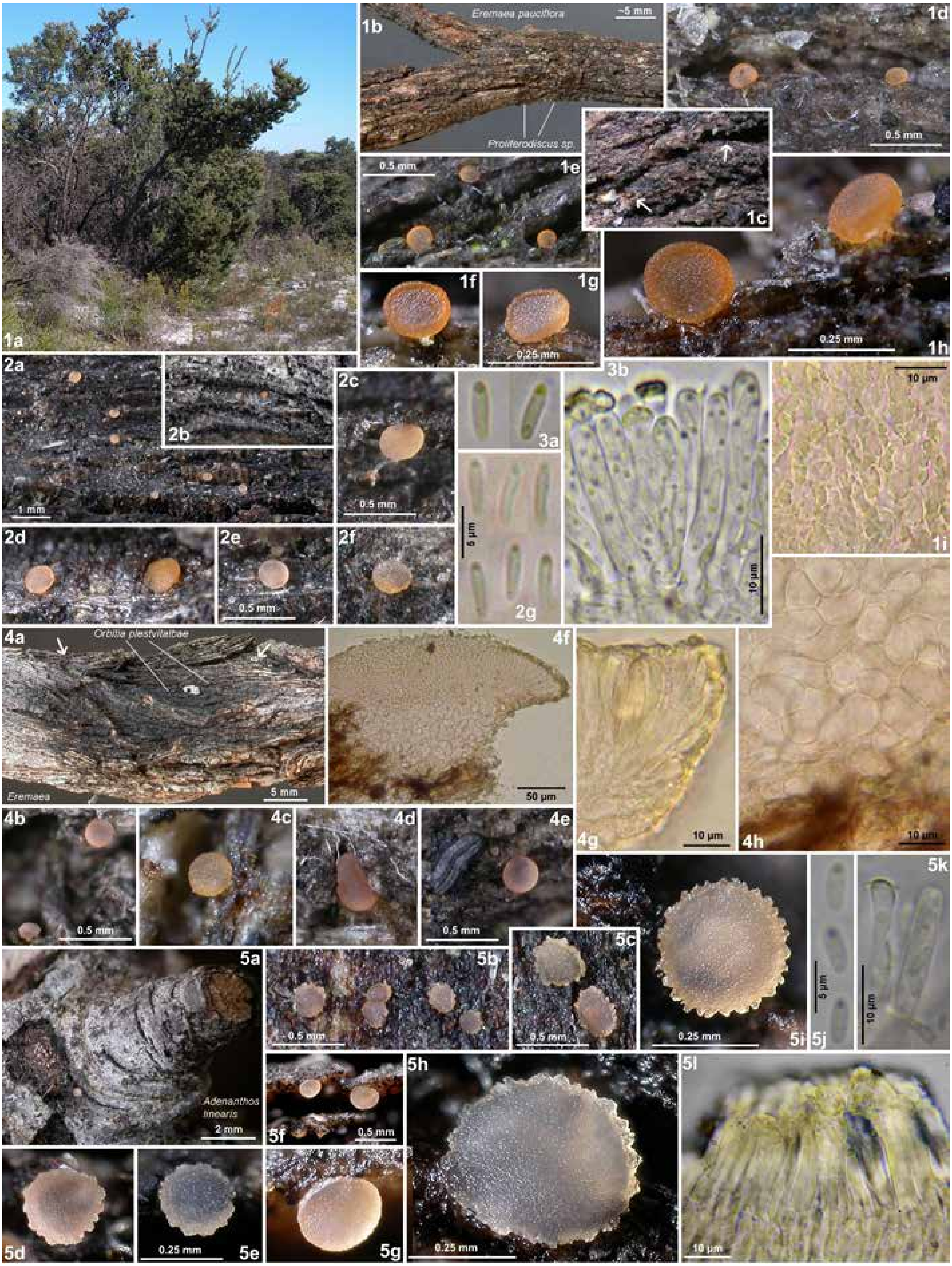


Plate 828. **1–5**: *Orbilia austrocylindrica*. – **1a**. banksia-eucalypt woodland on sand dunes, with *Banksia* and *Adenanthos sericeus* (large shrubs), and *Eremaea pauciflora*; **1b**, **4a**, **5a**. dead corticated xeric branches; **1c–h**, **2a–f**, **4b–e**, **5b–i**. rehydrated apothecia (**4e** with *Gloniopsis praelonga*, **5** often with dentate margin); **4f**. apothecium in median section; **4g**. id., marginal ectal excipulum; **4h**. id., basal ectal excipulum; **1i**. external view on exudate at margin; **5l**. id., glassy processes at margin; **3b**, **5k**. asci and paraphyses; **2g**, **3a**, **5j**. ascospores. – Living state, except for middle ascus in **3b**. — **1a–i**. H.B. 8775c (holotype): Western Australia, Cowalla, on *Eremaea*; **2a–g**. H.B. 8658c: ibid., on *Adenanthos*; **3a–b**. G.M. 2007-11-11.2: Western Australia, Gin Gin, on ?*Myrtaceae*; **4a–h**. H.B. 8643h: Cowalla, on *Eremaea*; **5a–l**. H.B. 8658c: ibid., on *Adenanthos*.

at flanks. **Ectal excipulum** hyaline to pale orange, of (†) thin-walled to slightly gelatinized, irregularly oriented t. globulosa-angularis from base to mid flanks or margin, 20–50 µm thick near base, cells *(6–)9–17(–22) × (5–)8–13(–17) µm {5}; 10–15 µm thick near margin, of t. prismatica to t. angularis oriented at a 10–30° angle to the surface, marginal cortical cells *7–10(–12) × 3–5 µm {3}, †4–6 or 7–10 × 2.5–4 µm {2}, thin-walled; **glassy processes** absent {5}, rarely present {1}, 5–30 × 2.5–3.5(–4.5) µm, medium refractive, stratified, straight or slightly upwards curved, coherent to form teeth. **Anchoring hyphae** sparse to medium abundant, †2–3(–4) µm wide, walls 0.2((–0.8)) µm thick {5}. **SCBs** globose, in paraphyses 0.8–1.7 or 2–2.5 µm diam., in ectal excipulum (near margin) 1.5–2.2(–2.7) µm. **Exudate** over paraphyses (0.2–)0.7–2.5(–4) µm thick, cloddy to granular, loosely to firmly attached, pale to light (chlorinaceous-)yellow, over margin and flanks 1–2.5 or 3–5 µm thick, rough-cloddy. — **ANAMORPH**: unknown.

Habitat: collected 0–2 m above the ground, corticated, 7–20 mm thick branches of *Adenanthos sericeus* {1}, *Banksia menziesii* {1}, *Dodonaea viscosa* subsp. *angustissima* {1}, *Eremaea pauciflora* {2}, *Eucalyptus* sp. {1}, ?*Myrtaceae* {1}, on strongly decayed bark {6} (bast {3} or periderm {1}), partly around small wounds or on inner surface of detached bark, strongly greyed, green algae sparse (rarely abundant). **Associated**: *Acanthostigma* ?*minutum* {1}, *Capronia* sp. {1}, *Durella* aff. *connivens* {1}, ?*Eutypa* sp. {1}, *Gloniopsis praelonga* {3}, *Hyalorbilia juliae* {1}, *Mellitiosporiella* sp. (spores 1-septate) {1}, *Mycocalicium* sp. {1}, *Orbilia amberina* {2}, *O.* ?*angustoaristata* {1}, *O. astrovinosa* {1}, *O. australiensis* {1}, *O. austroobtusispora* {1}, *O. aviceps* {1}, *O. curvativitalbae* {1}, *O. eremaeae* {1}, *O. eucalypti* {3}, *O. fimbriata* {1}, *O. microserpens* {1}, *O. multicurvula* {3}, *O. pleiovirgula* {1}, *O. pleistovitalbae* {2}, *O. plurililacina* {1}, *O.* ?*pubescens* {1}, *Proliferodiscus olivaceoviridis* {2}, *Rhizodiscina lignyota* {1}, ?*Usnea* sp. {1}, foliose lichen {1}, crustose lichen {1}. **Desiccation tolerance**: fully viable for at least 11 months, paraphyses and spores still alive after 2 years. **Altitude**: 77–1073 m a.s.l. **Geology**: Permian-Triassic and mainly Cretaceous sedimentary rock (in the latter case a whitish or red-brown sandy soil). **Phenology**: long-lived.

Taxonomic remarks. *Orbilia austrocylindrica* is characterized by small, subcylindrical, straight ascospores with comparatively large, globose to broadly tear-shaped SBs. The European *O. cylindrospora* is tentatively separated by a tendency to narrower spores, apically less inflated paraphyses, and longer asci. For the similar *O. subcylindrospora* (section *Ovoideae*) see p. 1277. *O. pleioaustrocylindrica* and *O. multiaustrocylindrica* mainly differ in their polysporous asci and in shorter terminal cells of paraphyses, the former also in a more gelatinized ectal excipulum.

Variation. The collections varied in shape and size of spores and SBs, and in the apical inflation of paraphyses, often within a given sample. The holotype (Pls 827: 2; 828: 1) differs from the other samples in often bright orange apothecia, distinctly longer spores, and slightly longer SBs. Yet, it originates from the same site and substrate (*Eremaea*) as a collection from the year before, which showed shorter spores and paler apothecia (Pls 827: 1; 828: 4). A small group of apothecia that grew on a separate branch of *Eremaea* (Pl. 827: 1B) deviates in narrower, cylindrical to almost dumbbell-shaped spores with narrower SBs with a distinct, often thickened filum; in spore shape this population approaches European *O. cylindrospora*. In a sample on *Adenanthos*, some of the apothecia (Pls 827: 3A; 828: 5) differ from those on a thicker branch (Pls 827: 3B; 828: 2) in having prominent marginal teeth composed of glassy processes, also in shorter and wider spores. This is possibly only a variant of the same species, the more so as these processes vary among the apothecia in length (see Pl. 828: 5f–g). Similar spores were observed in a sparse sample on *Eucalyptus* with smooth apothecia (Pl. 827: 4) which deviates in apically ± uninflated paraphyses.

Ecology. *O. austrocylindrica* grew on rotten bark of xeric branches of different trees and shrubs belonging to *Myrtaceae*, *Proteaceae* and *Sapindaceae* in subtropical semihumid (banksia-)eucalypt woodlands (northeast of Muchea) or semiarid acacia shrublands (Yalgoo) in southwestern Australia, and in a cold-temperate humid eucalypt open forest of southeastern Australia (Great Dividing Range).

Specimens included. **AUSTRALIA**: **Western Australia**, Yalgoo, 187 km N of Geraldton, W of Toolonga, Nerren Nerren, 190 m, trunk of *Dodonaea viscosa* subsp. *angustissima*, on bark, 8.XI.2007, G. Marson (H.B. 8838h ø). – Swan Coastal Plain, 48 km NNE of Perth, 4.5 km NE of Muchea, Reserve Road, 97 m, branch of *Banksia menziesii*, 3.IX.2006, G. Marson (G.M. 2006-09-03.4 ø). – 59 km SW of Moora, 8 km NE of Cowalla, Moore River, Orange Springs Rd, 77 m, branch of *Adenanthos sericeus*, on bark, 5.IX.2006, G. Marson (H.B. 8658c). – ibid., branches of *Eremaea pauciflora*, on bark, 5.IX.2006, G. Marson (H.B. 8643h). – ibid., branches of *E. pauciflora*, on bark, 23.X.2007, G. Marson (MEL 2389259A, **holotype**, **isotype** in H.B. 8775c). – 55 km SSW of Moora, 30 km NNE of Gin Gin, Moore River, 83 m, branch of ?*Myrtaceae*, on bark, 11.XI.2007, G. Marson (G.M. 2007-11-11.2 ø, doc. vid.). – **New South Wales**, Sydney Basin, 95 km WNW of Sydney, 11.5 km SE of Lithgow, Mt. York, 1073 m, branch of *Eucalyptus*, on bark, 26.X.1998, G. Marson (H.B. 6776 ø).

Orbilia pleioaustrocylindrica Baral, G. Marson & E. Weber, **sp. nov.**, MB 813933 — Pls 829–830

Etymology: named after the 16-spored asci and the resemblance to *O. austrocylindrica*.

Typification: Western Australia, Wubin, twig of *Acacia*, 24.XI.2001, G. Marson (ex H.B. 7204e, MEL 2389225, holotype).

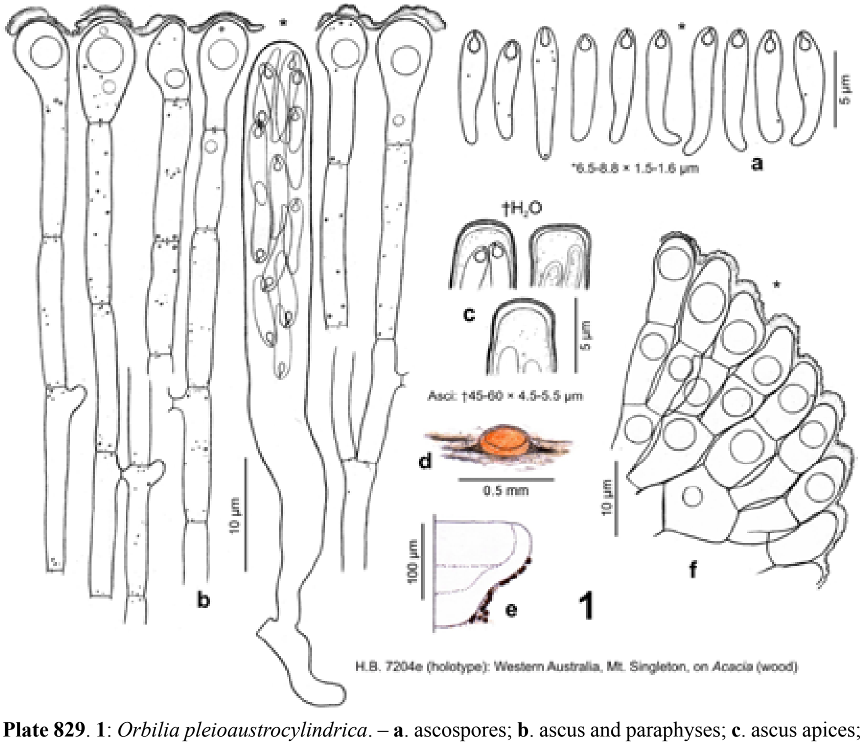


Plate 829. **1**: *Orbilia pleioaustrocylindrica*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apices; **d**. rehydrated apothecium; **e**. apothecium in median section; **f**. id., marginal ectal excipulum.

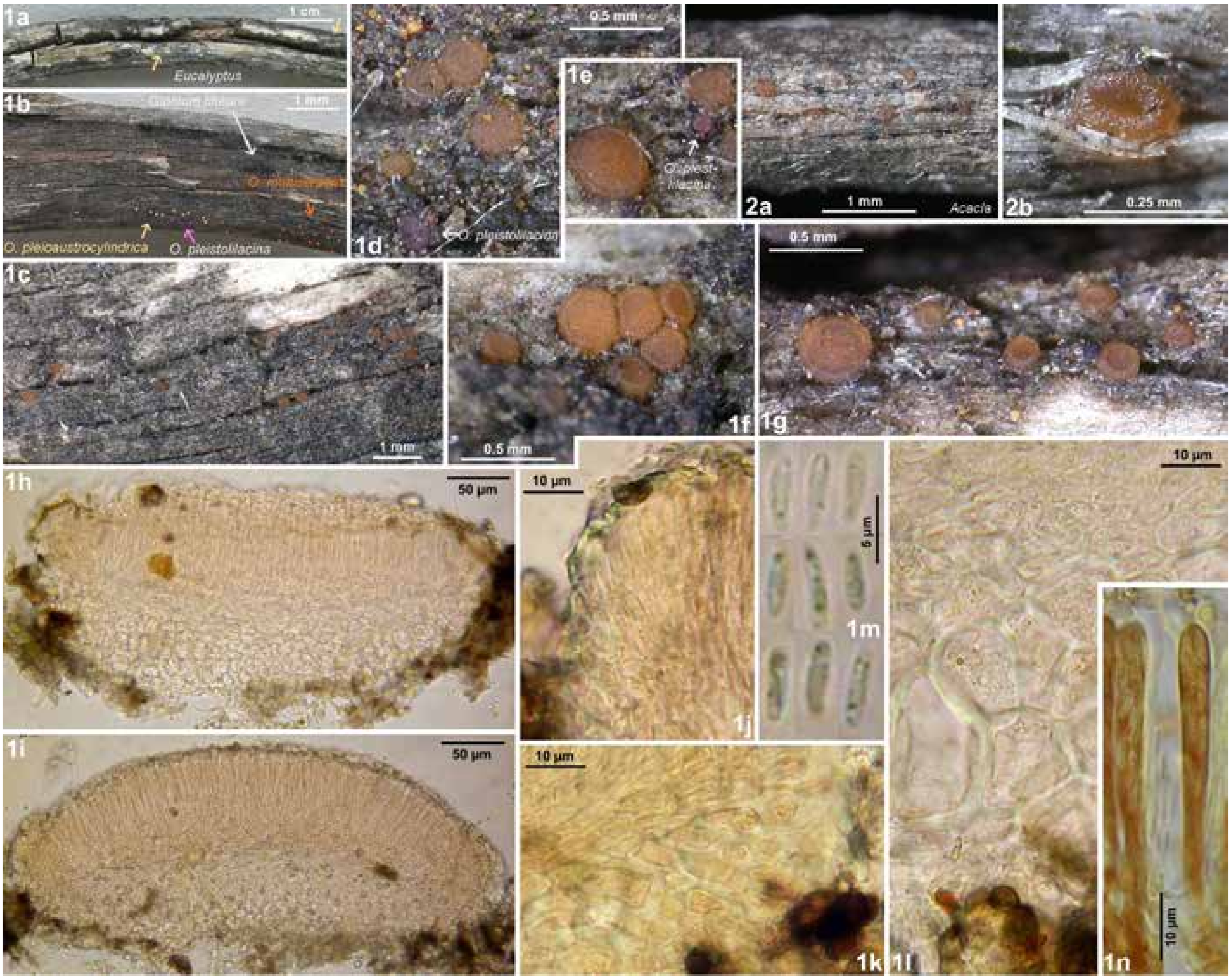


Plate 830. **1–2**: *Orbilia pleioaustrocylindrica*. – **1a–b**, **2a**. decorticated xeric twigs and branch; **1c–g**, **2a–b**. rehydrated apothecia; **1h–i**. apothecia in median section; **1j**. id., marginal ectal excipulum; **1k**. id., mid flanks; **1l**. id., lower flanks; **1m**. ascospores; **1n**. mature asci. – Dead state (**1h** in H_2O, **1i–m** in KOH, **1n** in KOH+IKI). — **1a–n**. H.B. 8641b: Western Australia, Kulin, on *Eucalyptus*; **2a–b**. H.B. 7204e (holotype): ibid., Mt. Singleton, on *Acacia*.

Latin diagnosis: *Similis* Orbiliae austrocylindricae *sed asci 16-spori*, *excipulum ectale basi crassitunicatum. Habitat ad lignum putridum ramulorum vel ramorum siccorum* Acaciae *et* Eucalypti *in zona subtropica semiarida et semihumida Australiae meridio-occidentalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.2–0.4(–0.6) mm diam., 0.14–0.2 mm high (receptacle 0.08–0.14 mm), light to bright orange, non-translucent, round, rarely broadly elliptical, scattered or ± densely gregarious in smaller or larger groups; disc flat, margin distinct, rather thick, not protruding, smooth; broadly sessile (sometimes with obconical base or with a hidden stipe), nearly superficial to entirely immersed, erumpent between fibres; dry bright orange to brick-red. **Asci** *55–67 × 5.8–6.8 µm {1}, †(38–)45–65(–70) × (4–)4.5–5(–5.5) µm {2}, 16-spored, spores *3–4-seriate, lower spores inverted (± mixed), pars sporifera *29–30 µm long; **apex** (†) medium to strongly truncate (not or slightly indented and laterally inflated); **base** with short to medium long, thin or thick, ± flexuous stalk, L- to h-shaped. **Ascospores** *6.5–8.8 × (1.4–)1.5–1.6(–1.7) µm {T}, †4.8–6.5(–7) × 1.2–1.5 µm {1}, subcylindrical to (fusoid-)clavate, apex rounded to obtuse, base mostly slightly to medium attenuated, straight to often slightly to strongly curved below; **SBs** *1–1.3 × 0.6–0.8 µm {1}, ± broadly tear-shaped, apically narrowed to a ± small point, mostly with a very short filum. **Paraphyses** apically (slightly to) medium to (very) strongly clavate-capitate, terminal cells */†8–19(–22) × 3–5 µm {2}, lower cells *9–17 × 1.8–2.5 µm {1}; never branched near apex. **Medullary excipulum** 20–40 µm thick, of dense textura intricata with many inflated cells, medium sharply delimited. **Ectal excipulum** (*) slightly gelatinized [† medium to strongly so, common walls 1–2(–3) µm thick], indistinctly to vertically oriented t. globulosa-angularis(-prismatica) from base to mid flanks, 40–70 µm thick near base, cells */†10–20(–33) × 7–15(–18) µm {2}; 20–30 µm thick near margin, of t. prismatica-angularis oriented at a 60–80° angle to the surface, marginal cortical cells *8–11 × 4–5.5 µm {T}, or t. prismatica(-porrecta) oriented at 40–50° {1}, cortical cells †8–17 × 3.5–6 µm {1}, slightly gelatinized; **glassy processes** absent. **Anchoring hyphae** sparse to medium abundant, */†2–3.5 µm wide, walls 0.2–0.3(–0.6) µm thick {2}. **SCBs** globose, in paraphyses 1.5–3 µm diam.; in ectal excipulum (near margin) 3–5 µm. **Exudate** over paraphyses and marginal excipulum 0.2–1.5(–2) µm thick, granular to cloddy-continuous, hyaline, ± firmly attached. **— ANAMORPH**: unknown.

Habitat: collected 0.5–2 m above the ground, decorticated, 1.5–27 mm thick twigs and branches of *Eucalyptus* sp. {1}, *Acacia* sp.{1}, on 0.5 mm deep very decayed wood {2}, strongly greyed, green algae sparse or absent. **Associated**: *Capronia* sp. {1}, *Gloniopsis subrugosa* {1}, *Orbilia amberina* {2}, *O. australiensis* {2}, *O. austroobtusispora* {2}, *O. aviflagellata* {1}, *O. helicoobliqua* {2}, *O. hesperidea* {2}, *O. microserpens* {2}, *O. multiserpens* {2/1}, *O. myriolilacina* {2}, *O. myrioobliqua* {2}, *O. nothovinosa* {2}, *O. paraobliqua* {2}, *O. pleioaustraliensis* {2}, *O. pleioaustrocylindrica* {1}, *O. pleistolilacina* {1}, *Ostropales* {2}, *Patellaria* ?*andina* {2}, *Psiloglonium* ?*lineare* {1}, *Triblidium* spp. {3}, *Symbiotaphrina desertorum* {1}. **Desiccation**

tolerance: after 16 months paraphyses and excipulum, also some submature asci still viable. **Altitude**: 286–379 m a.s.l. **Geology**: Archean sedimentary rock, granite. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia pleioaustrocylindrica* resembles the European *O. subcylindrospora* (section *Ovoideae*) in having often curved ascospores, but differs in 16-spored asci and in a rather strongly gelatinized ectal excipulum. *O. multiaustrocylindrica*, *O. myriolilacina*, and *O. pleistolilacina* (both section *Ovoideae*) differ in higher-spored asci, in a more thin-walled ectal excipulum, and in slightly shorter and wider spores. The latter two species differ also in distinctly rose-lilaceous apothecia; both grew in close association with *O. pleioaustrocylindrica*, partly even strongly intermingled. *O. austrocylindrica* differs from the present species in 8-spored asci, shorter, less curved spores, and a more thin-walled ectal excipulum.

Variation. The very rich paratype collection on branches of *Eucalyptus* was studied in the dead state only, except that a living spore was sketchily documented earlier by the third author (IVV: H.B. 8641b). It deviates from the rather sparse holotype in larger and thicker apothecia, slightly smaller spores, a thinner exudate, and more elongate marginal cortical cells. Only in the holotype a short apothecial stipe was observed.

Ecology. *O. pleioaustrocylindrica* was found on very rotten wood of xeric twigs and branches of *Acacia* and *Eucalyptus* in a subtropical semiarid acacia shrubland and a semihumid small eucalypt forest in a cornfield in southwestern Australia.

Specimens included. **AUSTRALIA**: **Western Australia**, Avon Wheatbelt, 78 km NE of Wubin, 18 km SW of Mt. Singleton, 380 m, twig of *Acacia*, on wood, 24.XI.2001, G. Marson (ex H.B. 7204e, MEL 2389225, **holotype**). – Mallee, 14 km SSW of Kondinin, 9 km NE of Kulin, Fence Road, 286 m, branches of *Eucalyptus*, on wood, 14.XII.2001, G. Marson (H.B. 8641b).

Orbilia multiaustrocylindrica Baral, sp. nov.,

MB 813934 — Pl. 831

Etymology: named after the 32-spored asci and the resemblance to *O. austrocylindrica*.

Typification: Australia, Northern Territories, Wilora, branch of *Atriplex*, 8.X.1998, G. Marson (ex H.B. 6262b, MEL 2389195, holotype).

Latin diagnosis: *Similis* Orbiliae pleioaustrocylindricae *sed asci 32-spori, excipulum ectale tenuitunicatum. Habitat ad lignum putridum ramorum siccorum* Atriplicis *in zona subtropica arida Australiae centralis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.2–0.4 mm diam., 0.12 mm high, pale to light (dirty) orange, round, scattered; disc flat, margin not protruding, smooth; broadly sessile, somewhat immersed. **Asci** *50–60 × 7–7.5 µm, †45–50 × 6–7 µm, 32-spored (28–29 spores counted), spores (*) multiseriate, part of spores inverted (mostly the lower spores, strongly mixed), pars sporifera *25–35 µm long; **apex** (†) medium to strongly truncate (not indented, laterally never inflated); **base** with short, thick stalk, Y-shaped. **Ascospores** *4–7.7 × 1.5–1.7(–2) µm, subcylindrical, rarely fusoid-clavate, apex rounded to obtuse, rarely subacute, base not or sometimes slightly attenuated, straight or slightly curved near base; **SBs** *0.9–1.3 × 0.6–0.9 µm, globose to mostly broadly tear-shaped, apically closely attached, with or without a very short filum. **Paraphyses** apically slightly to strongly capitate(-clavate), terminal cells *6.5–13 × 3–5 µm, lower cells *8–14 × 1.7–2.3 µm; sometimes branched at upper septum. **Medullary excipulum** hyaline, 25 µm thick, of dense textura angularis-intricata, indistinctly delimited. **Ectal excipulum** hyaline, of (*) thin-walled, indistinctly oriented t. angularis from base to mid flanks, 40 µm thick near base, cells *6–11 × 5–9 µm; 20 µm thick near margin, of t. prismatica oriented at a 30–45° angle to the surface, marginal cortical cells *6–12 × 3–4.5 µm; **glassy processes** absent. **Anchoring hyphae** sparse, 2–2.5 µm wide, walls 0.2 µm thick. **SCBs** globose, in paraphyses 1.5–2.7 µm diam., partly laterally more refractive (half-moon-like); in ectal excipulum (near margin) 2–3 µm. **Exudate** over paraphyses and marginal excipulum 0.5–2.5 µm thick, rough-cloddy, medium firmly attached. **— ANAMORPH**: unknown.

Habitat: collected 1–2 m above the ground, ± decorticated, 15–18 mm thick branches of *Atriplex* sp., on 0.3 mm deep strongly decayed wood, very greyed, no algae. **Associated**: *Orbilia barrowensis*, *O. lanternae*, *O. ?livistonae*, *O. ?multigambelii*, *O. octocercocarpi*, *O. pleioaustraliensis*, *?Pleospora* sp. **Desiccation tolerance**: fully viable for at least 3 weeks. **Altitude**: 480 m a.s.l. **Geology**: Cenozoic regolith. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia multiaustrocylindrica* is characterized by rather small, subcylindrical, predominantly straight ascospores with broadly tear-shaped SBs, and by 32-spored asci. It is obviously closely related to the 64-spored

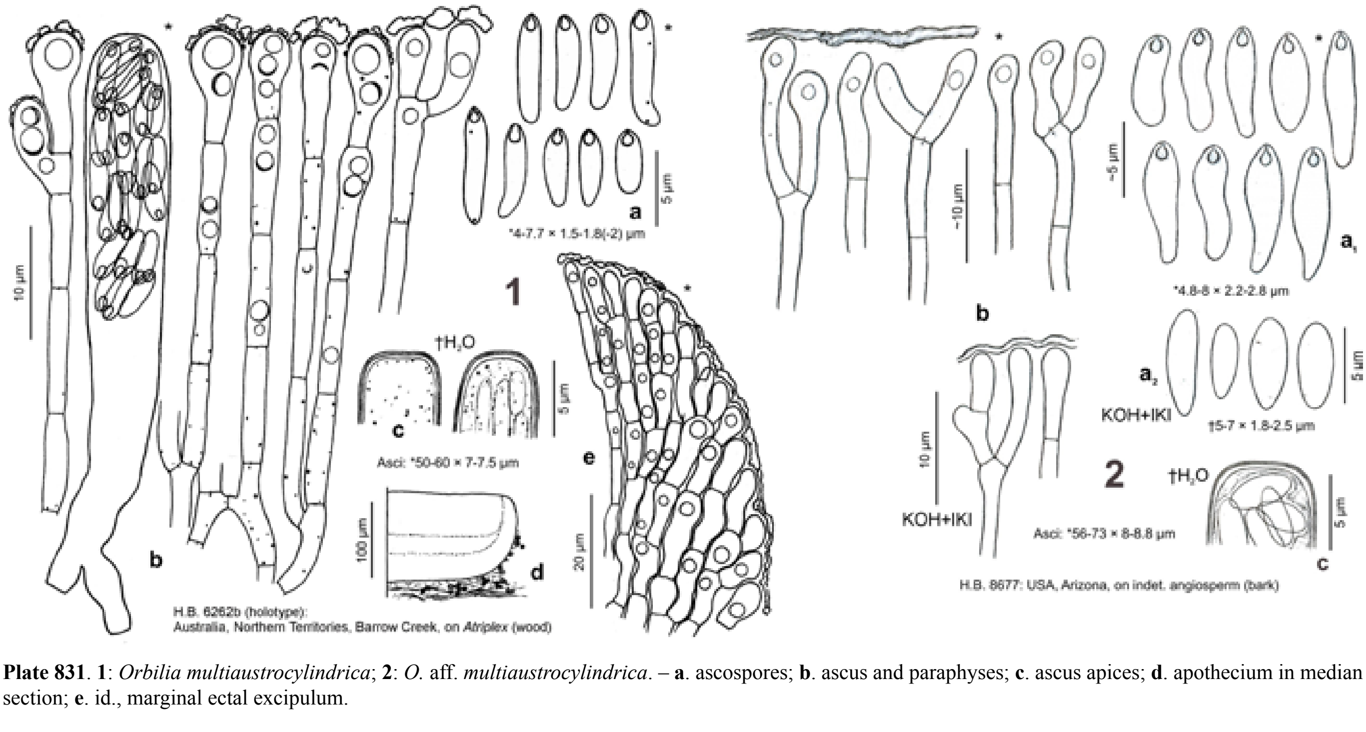


Plate 831. **1**: *Orbilia multiaustrocylindrica*; **2**: *O.* aff. *multiaustrocylindrica*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apices; **d**. apothecium in median section; **e**. id., marginal ectal excipulum.

O. myriolilacina (section *Ovoideae*) but also to the 16-spored *O. pleioaustrocylindrica*, the former differing further in rose-lilaceous apothecia, the latter in a gelatinized excipulum.

Not included collection. A very sparse North American sample on bark of unidentified angiosperm shrub (Pl. 831: 2) closely resembles *O. multiaustrocylindrica* except for somewhat larger asci and wider spores which are more often fusoid-clavate. Therefore, we have not included this specimen in the description. In its wider spores this closely resembles *O. atriplicis* (section *Ovoideae*), a taxon which we have only tentatively separated from *O. multiaustrocylindrica* because of wider spores and wider SBs, and which grew on the same host genus as the type, though on bark.

Two not included Australian collections each consisted of one apothecium only and were only briefly documented (IVV: H.B. 7213d, 9050d). Both might belong to *O. multiaustrocylindrica* though spore length was very different between them (*Acacia*: *7.5–8 × 1.5–2 µm; *Chamelaucium*: *4.7–5.5 × 1.8–1.9 µm). In the former the SBs were rather small, and the latter differed in bright rose-red apothecia.

Ecology. The type of *O. multiaustrocylindrica* represents a sparse collection on rotten wood of dead xeric branches of an unidentified species of *Atriplex* climbing up trees of *Acacia* in a subtropical arid acacia open shrubland north of Macdonnell Ranges in central Australia. The not included collections are from a subtropical semiarid Sonoran paloverde-mixed cacti desert scrub in the southwest of Northern America, and from a subtropical semiarid acacia shrubland and semihumid eucalypt low open forest in southwestern Australia.

Specimens included. **AUSTRALIA**: **Northern Territories**, Burt Plain, 31 km SW of Barrow-Creek Hotel, 3.7 km WSW of Wilora, 480 m, branch of *Atriplex*, on wood, 8.X.1998, G. Marson (ex H.B. 6262b, MEL 2389195, **holotype**).

Not included. **USA**: **Arizona**, Sonoran Desert, 82 km NW of Phoenix, ~1.5 km SE of Wickenburg, 620 m, branch of indet. angiosperm, on bark, 4.V.1995, G. Marson (H.B. 8677). — **AUSTRALIA**: **Western Australia**, Yalgoo, 187 km N of Geraldton, W of Toolonga, Nerren Nerren, 190 m, twig of *Acacia*, on bark, 8.XI.2007, G. Marson (H.B. 9050d ø). – Jarrah Forest, 47 km WNW of Albany, 13 km NNE of Denmark, Mount Lindesay, 75 m, branch of *Chamelaucium ciliatum*, on wood, 15.XII.2001, G. Marson (H.B. 7213d ø).

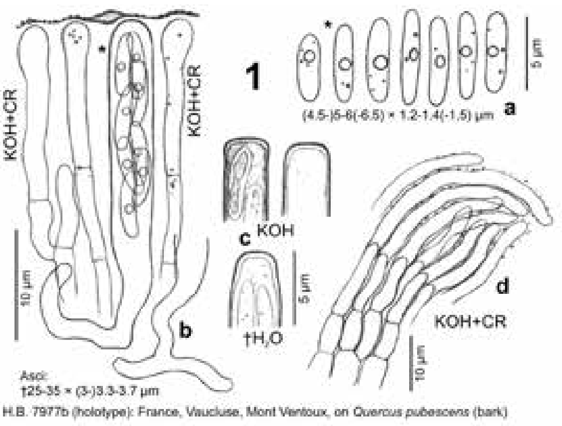


Plate 832. **1**: *Orbilia beatricis*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apices; **d**. marginal ectal excipulum with glassy processes (median section).

Orbilia beatricis Baral, **sp**. **nov**., MB 813936 — Pls 832–833

Etymology: named after the collector, Beatrice Senn-Irlet.

Typification: France, Bédouin, trunk of *Quercus* ?*pubescens*, 19.X.2005, B. Senn-Irlet (ex H.B. 7977b, M-0276441, holotype).

Latin diagnosis: *Apothecia rehydratata 0.3–0.4 mm diam., dilute roseo-aurantiaca, sessilia, margine exigue albido-dentata. Ascosporae *4.5–6.5 × 1.2–1.5 µm, (sub)cylindricae, subrectae, corpusculum refringens globosum, ad tunicam mediam lateralem indistincte affixum continentes. Paraphyses ad apicem leniter clavato-capitatae, exsudato tenui tectae. Excipulum marginale processis vitreis longis agglutinatis praeditum. Habitat ad corticem putridum trunci sicci* Quercus ?pubescentis *in zona suprasubmediterranea semihumida Europae meridionalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.3–0.4 mm diam., 140 mm high, light rose-orange, translucent, round, scattered; disc flat, margin with prominent, 20 µm protruding whitish teeth ~40 × 40 µm; broadly sessile but with a very indistinct, narrowed base, superficial. **Asci** *26–30 × 4 µm, †25–35 × (3–)3.3–3.7 µm, 8-spored, spores (*) obliquely biseriate, pars sporifera †19 µm long; **apex** (†) strongly truncate (not indented, laterally sometimes slightly inflated); **base** with short to medium long, ± thin, flexuous stalk, T- to L-shaped. **Ascospores** *(4.5–)5–6(–6.5) × 1.2–1.4(–1.5) µm, (sub) cylindrical, both ends rounded, straight to very slightly curved; **SBs**

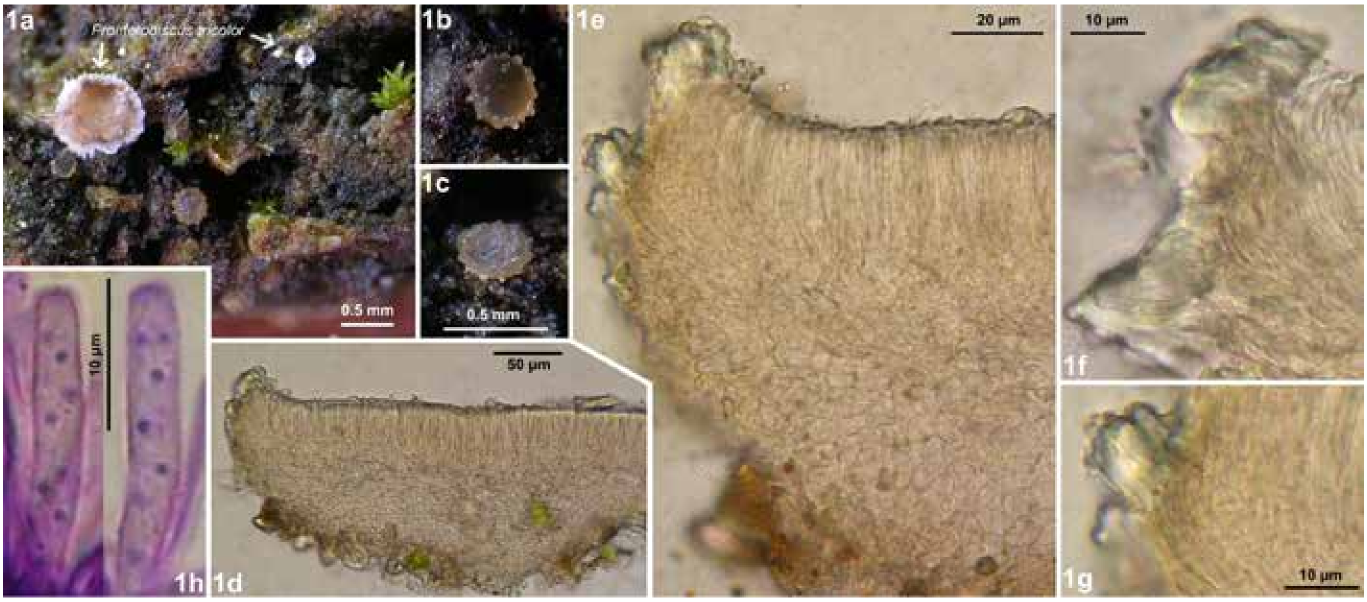
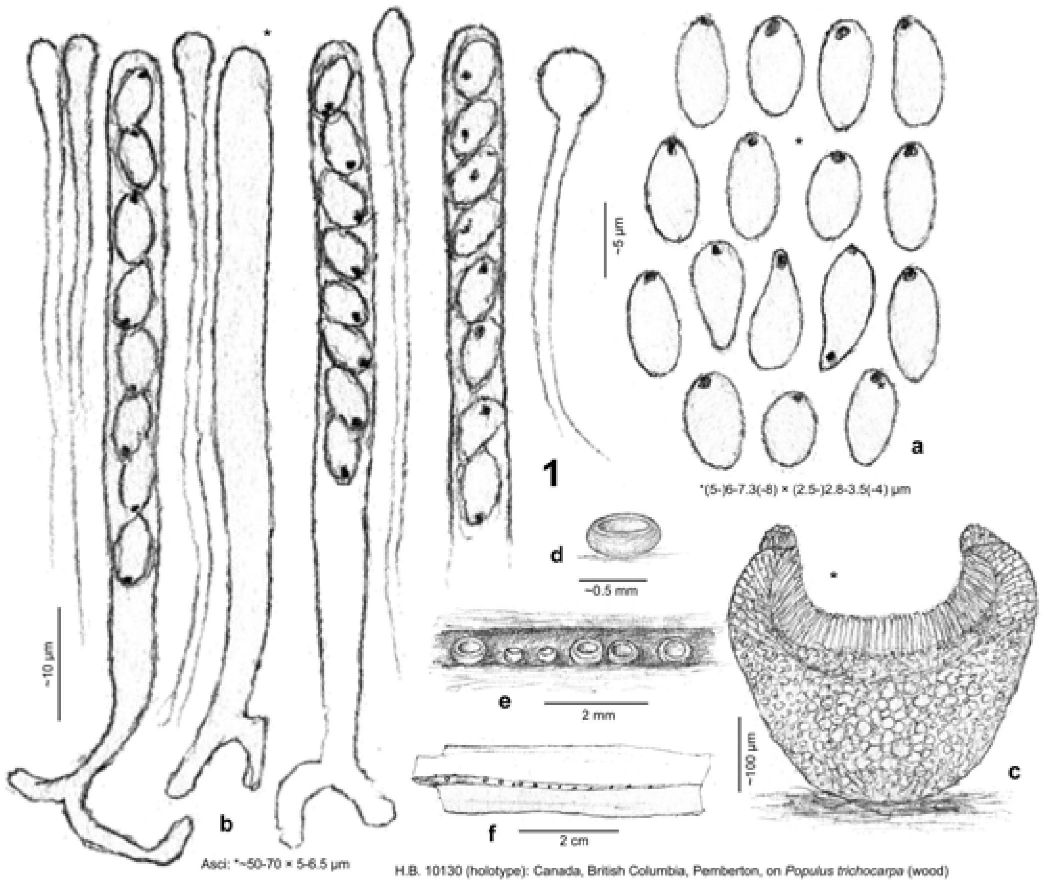


Plate 833. **1**: *Orbilia beatricis*. – **1a**. 2 rehydrated apothecia (with *Proliferodiscus tricolor*); **1b–c**. right apothecium of **1a**; **1d**. apothecium in median section; **1e–g**. id., marginal region, with glassy processes that form teeth; **1h**. mature asci (SBs in spores stained dark blue). – Living state, except for asci in **1h** (in CRB). — **1a–h**. H.B. 7977b (holotype): France, Vaucluse, Mont Ventoux, on *Quercus*.



H.B. 10130 (holotype): Canada, British Columbia, Pemberton, on *Populus trichocarpa* (wood)

Plate 834. **1**: *Orbilia brettii*. – **1a**. ascospores; **1b**. asci and paraphyses; **1c**. apothecium in median section; **1d–e**. apothecia; **1e**. piece of *Populus trichocarpa* branch. – del. O. Ceska.

*0.7–1 × (0.5–)0.7–0.9 µm, globose to subglobose, positioned close to lateral wall ± in centre of spore, attachment to wall invisible (even in CRB). **Paraphyses** apically slightly clavate-capitate, terminal cells †13–17 × 1.5–2.6 µm, lower cells †5–9 × 1–2 µm; unbranched at upper septum. **Medullary excipulum** ~50 µm thick, of dense textura intricata with many inflated cells, sharply delimited from ectal excipulum only at flanks. **Ectal excipulum** of thin-walled, vertically oriented t. angularis from base to mid flanks, 50 µm thick near base, cells *5–12 × 4–7 µm; 30 µm thick at flanks and margin, at margin oriented at a 20–40° angle to the surface, marginal cortical cells †8–15 × 2–3 µm; **glassy processes** 10–40 × 2–3 µm, rather high-refractive, indistinctly stratified, coherent to form distinct teeth. **Anchoring hyphae** sparse, †2–2.5 µm wide, walls 0.2–0.3 µm thick. **SCBs/VBs** unknown. **Exudate** over paraphyses 0.1–0.2 µm thick, granular to continuous, locally up to 1.3 µm thick, loosely attached; over glassy processes forming small granules or clods. **— ANAMORPH**: unknown.

Habitat: collected 1.5 m above the ground, on living, 20 cm thick standing trunk of *Quercus ?pubescens*, on medium rotten surface of bark, greyed, with some green algae below apothecia. **Associated**: *Frullania ?dilatata*, *?Orthotrichum* sp., *Proliferodiscus tricolor*. **Desiccation tolerance**: Some mature asci survived for at least 4 weeks. **Altitude**: 800 m a.s.l. **Geology**: Lower Cretaceous (Urgonian) limestone. **Phenology**: X (but probably long-lived).

Taxonomic remarks. *Orbilia beatricis* is very extraordinary in its almost straight, cylindrical ascospores with a centrally positioned spore body. The small, desiccation-tolerant, light reddish apothecia possess long glassy processes at the margin that form distinct whitish teeth. Because of the small cylindrical spores with central SBs, a relationship was assumed with *O. fabacearum* (series *Orbilia*), which differs in strongly curved spores and in the absence of glassy processes. However, the absence of H-shaped ascus bases makes such placement improbable.

Species around *O. cylindrospora* differ from *O. beatricis* in the absence of glassy processes and in apically inserted SBs. Yet, the Australian *O. austrocylindrica* (H.B. 8658c) occurred in a variant with distinct teeth of glassy processes. In the dead state this variant differs from *O. beatricis* mainly in wider spores.

Ecology. The only two discovered apothecia of *O. beatricis* grew on medium rotten xeric bark of a living trunk of *Quercus ?pubescens* in a suprasubmediterranean semihumid *Quercus pubescens* woodland with planted *Cedrus atlantica* on the south-exposed slope of Mont Ventoux in French southern Prealps of southern Europe.

Specimens included. **FRANCE**: **Provence-Alpes-Côte d'Azur**, **Vaucluse**, Préalpes du Dauphiné, Mont Ventoux, 5.7 km ENE of Bédouin, NE of St.-Estève, Forêt communale de Bédoin, 800 m, trunk of *Quercus ?pubescens*, on bark, 19.X.2005, B. Senn-Irlet (ex H.B. 7977b, M-0276441, **holotype**).

Orbilia brettii O. Ceska, Baral, G. Marson & E. Weber, **sp. nov.**, MB825638 — Pls 834–835

Etymology: in honour of M.Sc. Bob Brett, forest ecologist and environmental consultant in British Columbia.

Typification: Canada, British Columbia, Pemberton, branch of *Populus trichocarpa*, 3.VI.2017, O. & A. Ceska (ex H.B. 10130, M-0291755, holotype; sq.: MH221063).

Latin diagnosis: Orbiliae eucalypti *similis sed apothecia cupulata*, *margo leniter aspera vel coronata, excipulum marginale processis vitreis praeditum*, *ascosporae leniter latiores*, *corpusculum refringens ampulliforme, paraphyses ad apicem partim spathulatae. Habitat ad lignum putridum*, *rami sicci* Populi trichocarpae *in zona maritima humida Americae septentrionalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.3–0.6 mm diam., ~0.2–0.25 mm thick, light rose(-orange), slightly translucent, round, scattered to subgregarious; disc ± deeply concave, margin raised, ~50–100 µm protruding, finely rough to indistinctly crenulate; sessile on an obconical base, superficial; dry bright rose-orange. **Asci** *~50–70 × 5–6.5 µm, †45–65 × (4–)4.5–5(–5.7) µm, 8-spored, spores uniseriate, ~4–8 lower spores inverted (sometimes strongly mixed), pars sporifera *~35–40 µm; **apex** (†) medium to strongly truncate (not indented, laterally not inflated); **base** with short to long, thin or thick stalk, T- to Y- or h-shaped. **Ascospores** *(5–)6–7.3(–8) × (2.5–)2.8–3.5(–4) µm, †(3–)4–5 × 0.8–1.2 µm, ellipsoid, also fusoid or clavate, apex rounded to obtuse, base not or slightly to sometimes strongly attenuated, straight to slightly curved; **SBs** *1–1.3 × 0.5–0.8 µm, ampulliform (keyhole-shaped), attached to spore apex by a small point, usually in upper, wider end of spore (if heteropolar), also in narrower end or rarely at both ends. **Paraphyses** apically medium to strongly clavate-capitate or sometimes spathulate, apex †2.5–3(–4.5) µm wide.

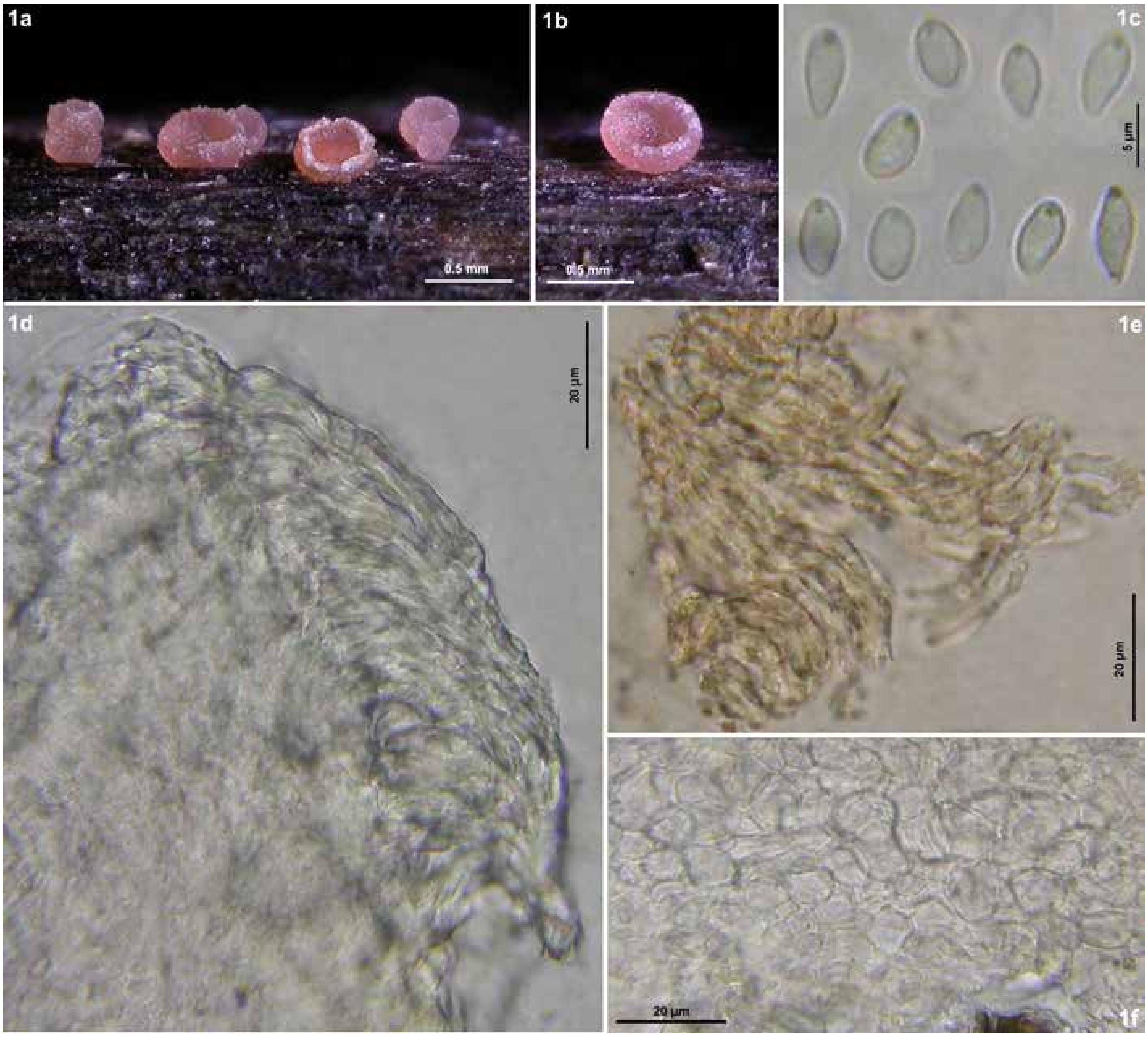


Plate 835. **1**: *Orbilia brettii*. – **1a–b**. rehydrated apothecia, **1c**. ascospores; **1d**. apothecium in median section, marginal ectal excipulum; **1f**. id., basal ectal excipulum; **1e**. glassy processes (in KOH +CR). – Living state, except for **1e**. — **1a–f**. H.B. 10130 (holotype): Canada, British Columbia, on *Populus*.

Medullary excipulum ~40–80 µm thick, of dense textura intricata with many small inflated cells, medium sharply delimited. **Ectal excipulum** of thin-walled, indistinctly oriented t. globulosa-angularis from base to margin, 50–150 µm thick near base, cells *~10–25 µm diam., †8–16 × 5–12 µm; ~20–50 µm thick at margin, indistinctly oriented at a ~40–90° angle to the surface, marginal cortical cells †~5–8 × 4–5 µm; **glassy processes** ~20–35 × (1.5–)2–2.5(–3) µm, medium refractive, rough, not dictinctly zonate, agglutinated but not forming distinct teeth, curved outwards. **Anchoring hyphae** medium abundant at base, †1.5–3(–4) µm wide, walls 0.2 µm thick, forming a 10–15 µm thick, dense layer of interwoven hyphae at flanks. **SCBs** no data available. **Exudate** over paraphyses and glassy processes ~0.2–0.5 µm thick, hyaline, granular, firmly attached. **— ANAMORPH**: unknown.

Habitat: collected 1.5 m above the ground, on decorticated, 14 mm thick, attached branch of *Populus trichocarpa*, on medium rotten, strongly greyed wood, at edge along longitudinal cleft, without algae. **Associated**: none observed. **Desiccation tolerance**: a few excipular cells and many ascospores still alive after 3 months. **Altitude**: 210 m. a.s.l. **Geology**: Cretaceous volcanic rock. **Phenology**: VI (but probably long-lived).

Taxonomic remarks. *Orbilia brettii* resembles under the microscope *O. eucalypti* at first glance in hymenial characters, but differs by cupulate apothecia with an often crown-like margin made up of prominent glassy processes, and paraphyses that partly tend to be spathulate, also by slightly larger, especially wider ascospores with minute ampulliform SBs. The species somewhat resembles members of series *Microsomates*, but our molecular analysis did not place it clearly in that series, but in the neighbourhood of *O. cylindrospora*, which differs from *O. brettii* in various morphological details.

Phylogeny. A sequence taken from apothecia of the holotype comprises a short part of SSU, S1506 intron, ITS, and LSU. In our combined analyses (Phyls 7, 22) or that of LSU (S27), *O. brettii* clustered in a strongly or medium supported clade with *O. cylindrospora*, and in the combined analyses also with unsupported connection to *Tridentaria subuliphora* and series *Microsomates*, whereas in analyses of ITS or the S1506 intron it clustered unresolved. The ITS distance to *O. cylindrospora* is 19 % and to the environmental Canadian strain 16 %. In the LSU

D1–D2 the distance is reverse: 3 % and 4.3 %, respectively.

Ecology. *O. brettii* is only known from the type collection on xeric wood of *Populus trichocarpa* in a cold-temperate humid alluvial forest with *Corylus cornuta* and mainly *Populus trichocarpa* in a valley of the Coast Mountains (Pacific Ranges) in the pacific maritime zone of southwestern Canada.

Specimens examined. **CANADA**: **British Columbia**, Coast Mountains, 26 km NNE of Whistler, 1 km NE of Pemberton, W of Mt. Currie, eastern bank of Lillooet river, 210 m, branch of *Populus trichocarpa*, on wood, 3.VI.2017, O. & A. Ceska (ex H.B. 10130, M-0291755, **holotype**; sq.: MH221063).

Series *Orbilia*

Orbilia Fr. subgenus ***Orbilia*** section ***Orbilia*** series ***Orbilia*** – Lectotype species: *Orbilia xanthostigma* (Fr.) Fr.

= *Dicranidion* Harkn., Bull. Calif. Acad. Sci. 1: 163 (1885) – Type species: *D. fragile* Harkn. [= *Orbilia eucalypti* (W. Phillips & Harkn.) Sacc.]

= *Pedilospora* Höhn., Sitzungsber. Kaiserl. Akad. Wiss. Wien, Math.-Naturwiss. Kl., Abt. 1, 111: 1047 [61 of repr.] (1902) – Type species: *P. parasitans* Höhn. [(?)= *O. eucalypti* (W. Phillips & Harkn.) Sacc.]

= *Orbilia* subgroup IV *Soleina* Velen., Mon. Discomyc. Bohem. p. 102 (1934, unranked) – Type species: *O. paradoxa* Velen. (= *O. xanthostigma*)

Etymology: *Dicranidion*: referring to the shape of conidia resembling a tuning fork; *Orbilia*: named after the orbicular shape of the apothecia; *Pedilospora*: apparently referring to the foot-shaped conidia; *Soleina*: because of the strongly curved ascospores (like a horseshoe).

Description: — **TELEOMORPH**: **Apothecia** fresh or rehydrated (0.15–)0.25–2(–4.5) mm diam., white or pale to bright yellow, orange or rose(-lilaceous), margin smooth, rarely very finely rough or crenulate, or notched to form small lobes, sessile or with a sometimes distinct stipe. **Asci** *(22–)27–55(–70) × (2.8–)3–4.5(–5.3) µm, 8-, rarely 16-spored (*O. coccinella*), (2–)3–5(–6) lower spores inverted (but often oriented in all directions), **apex** (†) slightly to often strongly truncate, not or ± indented and/or laterally inflated; **base** T-, L-, Y-, h-, or H-shaped. **Ascospores** *(1.8–)2.2–6(–7)((–9)) × (0.8–)1–2.5(–3) µm, subglobose, ovoid, ellipsoid(-clavate) or cylindric(-fusoid), apex rounded to obtuse, base not or slightly tapered, rarely with a short tail (*O. coccinella*), straight to very strongly curved (cashew-shaped, rarely helicoid), sometimes warted on dorsal side; **SBs** usually present, 0.3–1 × (0.2–)0.3–0.8(–0.9) µm, globose, rarely broadly tear-shaped, attachment to apical or sometimes lateral wall usually invisible, sometimes a very fine and short filum seen, rarely more broadly attached (*O. guyanensis*). **Paraphyses** uninflated or slightly to strongly capitate(-clavate) or lanceolate-spathulate at the apex, terminal cells (1–)2–4(–6)× longer than lower cells, unbranched near apex. **Ectal excipulum** (†) thin-walled to slightly or rarely medium gelatinized [common walls 0.3–1.5(–2) µm], of vertically or indistinctly oriented textura globulosa-angularis-prismatica from base to margin, cells near base *(5–)8–25(–35)((–75)) × (4–)6–15(–25)((–40)) µm, margin of oriented at 10–90°, **glassy processes** absent or sometimes 1–7 µm long. **SCBs** globose or absent; **VBs** absent or low- to high-refractive, hyaline to yellowish. **Exudate** 0–1(–2)((–4)) µm thick, granular or cloddy to continuous, often sparse, loosely or firmly attached, hyaline or pale yellowish. — **ANAMORPH**: dactylella-like, dicranidion-like, vermispora-like. **Conidiophores** reduced to rather long (1.5–105 µm), unbranched or branched. **Conidiogenous cells** monoblastic or sympodial. **Conidia** phragmosporous: *(5–)12–45(–67) × (2.2–)3–5(–6.5) µm (actual length), (0–)1–9-septate, straight or slightly to strongly curved; dicranidion-like: 2-armed, *(4–)8–39 × 4.5–19 µm, also 3–8-armed, *15–47 × (8–)10–37(–43) µm. **Trapping organs**: only observed in 2 taxa of uncertain relationship (*Tridentaria implicans*: adhesive branches that encircle nematodes; *Dicranidion dactylopagum*: small, apparently adhesive protuberances that trap rhizopods).

Habitat: hygric to xeric wood and bark, rarely herbaceous stems, leaves of gymno- and angiosperms, rarely polypores, humid to semiarid, boreal to tropical, desiccation-sensitive or -tolerant.

Recognized species: 26, plus 6 unnamed species ('affinis') and 1 species with uncertain affinity.

Taxonomic remarks. Series *Orbilia* represents the core of the genus *Orbilia*; its members strongly vary in apothecial colour and tolerance to drought. The comparatively small ascospores contain small, mostly globose SBs. The asci are almost always 8-spored and, therefore, also rather small. The paraphyses are usually strongly capitate, but in some species they are lanceolate to spathulate and in others not or only slightly inflated at the apex. The exudate is often absent or rather sparse. Glassy processes are rarely present at the margin and then very short. The included species are arranged according to shape and curvature of the spores (ellipsoid vs. cylindrical, straight to curved under a wide arch vs. cashew-shaped) and paraphysis shape (capitate vs. lanceolate) (keys A–D). Six described species (*O. leucostigma*, *O. xanthostigma*, *O. aureocrenulata*, *O. fabacearum*, *O. subfabacearum*, *O. coccinella*) have strongly curved (often for ~180°), cashew-shaped spores. In the former three species (*xanthostigma-leucostigma* complex) the dorsal side is distinctly warted, a feature not seen in any other member of *Orbiliomycetes* (see Fig. 55). *O. fabacearum* forms with its somewhat irregularly curved spores a transition to *O. renispora*, *O. umbilicata*, and *O. xanthoflexa*, which have spores curved under a more or less wider arch, and these form a bridge to species with straight, cylindrical or ellipsoid spores. *O. spirospora* is exceptional in having helicoid spores. There is also no sharp limit between ellipsoid-spored taxa and those with cylindrical spores.

In *O. eucalypti* the SBs are impossible to recognize without vital staining whenever LBs of a similar size are associated, and in some collections they could not even be discerned with that method. In *O. fabacearum* and *O.* cf. *subfabacearum* the SBs are consistently attached at the dorsal side of the spores. In the type of *O. subfabacearum*, however, SBs could not be found, instead, the small drop at the dorsal side was KOH-resistant. *O. guyanensis* is remarkable in having broadly tear- to almost plug-shaped SBs.

Four species deviate from the remaining in having lanceolate to spathulate paraphyses (*O. guyanensis*, *O. minutispora*, *O. spirospora*, *O. umbilicata*). They are grouped together here but whether they form a natural relationship is uncertain. Sometimes, particularly in *O. subfabacearum* and *O. fabacearum* and in some collections mentioned under *O. liliputiana*, the terminal cells of paraphyses tend to be unusually short, i. e., not or only slightly longer than the lower cells.

The thickest exudate was noted in *O. fabacearum*. Three species (*O. coccinella*, *O. dalmatica*, *O. subfabacearum*) possess glassy processes which are always very short and provoke a finely rough to crenulate margin. *O. aureocrenulata* is exceptional in its golden yellow apothecia with a very distinct stipe and a notched margin. *O. flexispora* resembles *O. xanthoflexa*, but shows also morphological similarities to sections *Arthrobotrys* or *Aurantiorubrae*. Because anamorph and molecular data were unavailable, this species is placed with hesitation in series *Orbilia*.

Species delimitation. Problems at the species level arose in almost every included species. All of the ellipsoid-spored taxa are difficult to delimit from each other, and mainly their anamorph and/or molecular data indicate that they do not belong to a single species. *O. dryadum* is not always easy to separate from *O. epipora* (section *Arthrobotrys*) and *O. cunninghamii*. The *xanthostigma-leucostigma* complex poses an unsolved enigma because of an extraordinary molecular heterogeneity in spite of a highly concordant micromorphology. Our recent results support the earlier distinction between colourless (*O. leucostigma*) and yellow populations (*O. xanthostigma*). Also *O. fabacearum* and *O. subfabacearum* appear to form a complex of difficult taxa.

Anamorph. Three types of conidia have been observed in series *Orbilia*. The typical conidia are branched (staurosporous, dicranidion-like), but some species possess unbranched, phragmosporous conidia, either straight (dactylella-like) or curved (vermispora-like). However, species with dicranidion-like conidia may also form a varying percentage of dactylella-like conidia.

(1) Dicranidion-like conidia typically resemble a tuning fork, characterized by 2 parallel or somewhat diverging arms and a longer or shorter stipe which can also be absent. They are formed on short to rather long conidiophores, either singly at the tip or often sympodially. The two arms sometimes tend to diverge like a V or Y, therefore, a sharp morphological separation between dicranidion- and trinacrium-like conidia is impossible. In some species the conidia tend to form 4 or up to 8 arms.

Dicranidion-like conidia are so far known with certainty from 10 species of series *Orbilia* (*O. battenii*, *O. cejpii*, *O. cunninghamii*, *O. eucalypti*, *O. fissilis*, *O. leucostigma*, *O. renispora*, *O. tremulae*, *O. xanthoflexa*, *O. xanthostigma*). The type species *Dicranidion fragile* is the anamorph of the very common *O. eucalypti*, while *D. gracile* and *D. tenue* appear to belong to the likewise ubiquitous *O. xanthostigma* aggregate. The morphologically assumed conspecificity of *O. tremulae* and *D. inaequale* is disproved by a considerable molecular mismatch. In the anamorph of *O. fissilis* (≡ *D. fissile*) the conidia deviate in having also 4 arms in equal frequency. In *O. frangulae* we assume an anamorph with 4–8-armed dicranidion-like conidia.

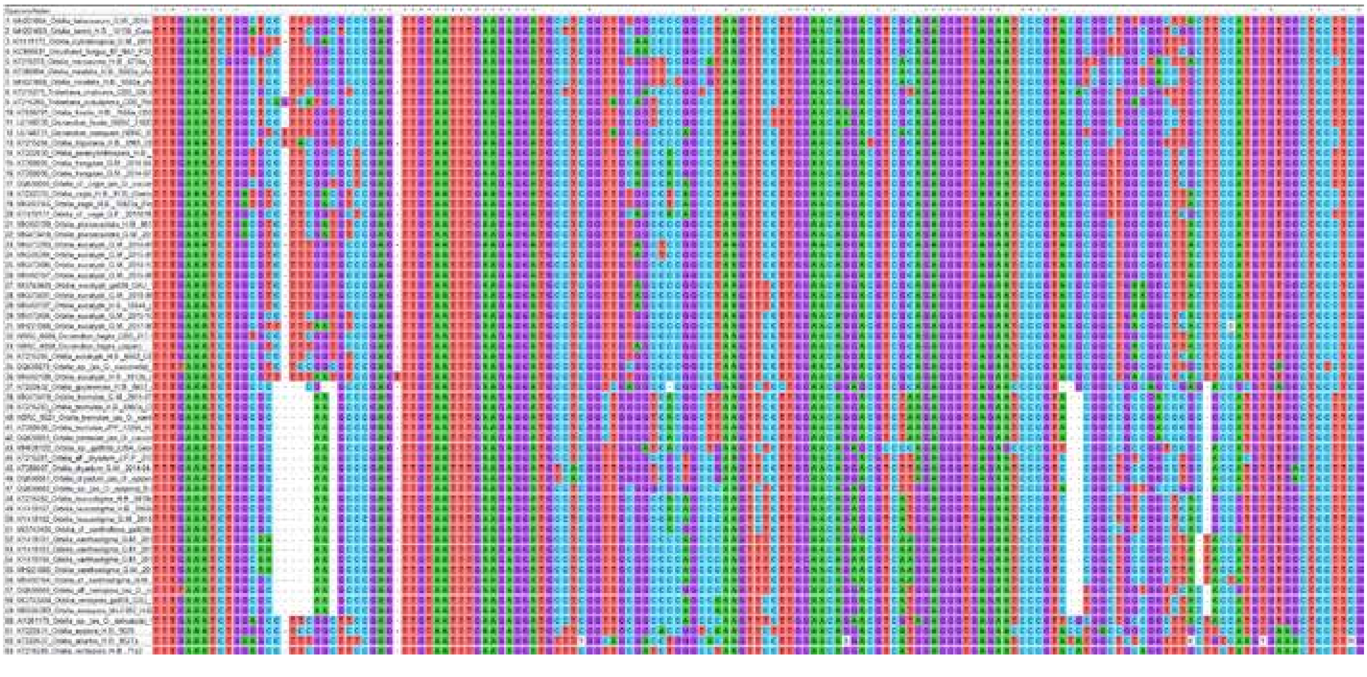
(2) The straight phragmoconidia of *O. dryadum* resemble those of *O. epipora* (series *Neodactylella*). Yet, molecular data suggest a relationship between *O. dryadum*, *O. tremulae* and *O. cunninghamii* (see Phyls 22–23). We conclude that the anamorph-typified genus *Dicranidion*, if used in a phylogenetic sense, should be enlarged to include also anamorphs which consistently lack branched conidia. This view is supported by the fact that in pure cultures unbranched and higher-branched conidia may simultaneously occur with 2-armed conidia. For example, conidia with 4 arms were rather frequently formed along with 2-armed ones in our and the type culture of *O. fissilis*, and unbranched conidia were rarely or frequently noted in the type culture of *D. inaequale* by Tubaki & Yokoyama (1971) and Butterfield (1973), depending on the agar medium. Also in the isolate of *O. cunninghamii* and the type culture of *D. fissile* dactylella-like conidia occurred along with dicranidion-like ones.

(3) Vermispora-like anamorphs were observed in pure culture of *O. liliputiana* and *O.* cf. *subfabacearum*, and on the natural substrate in *O. fabacearum*. Their phragmoconidia resemble dactylella-like conidia but are slightly to strongly curved. A sharp limit between type (2) and (3) does not exist. Within series *Orbilia*, data on conidiophores were so far unavailable for this type of conidia.

Dicranidion-like anamorphs very similar as in series *Orbilia* also occur in three quite distant groups: in series *Ovales* of section *Lentiformes* (subgenus *Hemiorbilia*), and in series *Xanthoguttulatae* and *Abutilones* of section *Aurantiorubrae* (subgenus *Habrostictis*). *Orbilia ovalis* of series *Ovales* resembles members of series *Orbilia* also in the teleomorph, including thin-walled, truncate ascus apices, but our molecular data from two different strains refer this species in section *Lentiformes*.

Phylogeny. According to our phylogenetic analyses of SSU+ITS+LSU, ITS, and LSU (Phyls 22, 23, S27), a division of series *Orbilia* according to ascospore and paraphysis shape as done in our keys A–D is not supported. In fact, various clades with more or less unresolved phylogenetic position are observed within series *Orbilia*. four of them contain at present more than one species or genotype: (1) the medium

Table 73. Alignment of LSU showing partial D1 domain (pos. 110–269) with three gappy regions, which appear to trace back to a common ancestor and mark the *xanthostigma-tremulae* clade.



(Phyl. 22) or weakly (S27) supported *O. eucalypti* clade (key A) includes the genetically variable *O. eucalypti*; (2) the medium (22, 23, S27) supported *cejpii-frangulae* clade includes four species with ellipsoid (key A) to subcylindrical (key B) spores (*O. cejpii*, *O. plurivacuolata*, *O. frangulae*, *O. paracylindrospora*); (3) *O. dryadum* and *O.* aff. *dryadum* have (sub)cylindrical spores (key B) and form a strongly supported clade (Phyls 22, 23, S27); (4) the strongly (22) or medium (23) supported *leucostigma-xanthostigma* clade comprises species with cashew-shaped, mostly warted spores (key D, spores smooth in *O. xanthoflexa*).

In the combined analysis in Baral et al. (2017b), *O.* aff. *dryadum* clustered with *O. tremulae* (spores ellipsoid, key A) and the *leucostigma-xanthostigma* clade in a strongly supported clade, and this clade is likewise seen in Phyls 7 and 22, though with only medium or weak support, respectively. *O. guyanensis* (with cylindric-ellipsoid spores and lanceolate paraphyses, key C) belongs here despite its high distance, and also *O. cunninghamii* with cylindric-clavate spores (key B), for which no LSU was available, might belong in this clade. This group, which is called *xanthostigma-tremulae* clade here, shares characteristic deletions in the LSU D1 domain which support its monophyly (see below).

O. eucalypti and the *cejpii-frangulae* clade clustered together in Phyls 22–23, but this clade did not receive support, and molecular motifs that would characterize the clade have not been found. Another association is observed for a group comprising *O. brettii*, *O. fissilis*, and *O. liliputiana* with ellipsoid to subglobose spores (key A), *O. cylindrospora* with cylindical spores (key B), *O. fabacearum* with smooth cashew-shaped spores (key D), *Tridentaria subuliphora*, and series *Microsomates*, but the clade did not receive support in our analyses (Phyls 22, S27), and in Baral et al. (2017b) it is paraphyletic.

Orbilia epipora and *O. atlantis*, both with rod-shaped spores similar as in *O. dryadum* or *O. cunninghamii*, clustered in series *Neodactylella* of section *Arthrobotrys*. Also *O. cupressi*, *O. fraxini*, and *O. rhamni*, which have cylindric to ellipsoid, partly allantoid spores, clustered in that series, although they resemble members of series *Orbilia* or section *Aurantiorubrae*.

Specific nucleotide positions. Characteristic positions in the rDNA which are unique for series *Orbilia* could only been found in the SSU V8 region: pos. 52 is CGAGT**TC** in most of the taxa, except for *O. liliputiana* and *Tridentaria subuliphora* which have CGAGT**AT** and herein concur with most other orbiliaceous groups which alternatively show the variants CGAGT**TT** and CGAGT**GT** (or rarely CGAGT**AC** in a few *Hyalorbilia* spp., *O. polyspora*, and clones U1–5).

Three positions in the 5.8S are informative within the series. Pos. 30 is usually TTC**T**CGC as in most remaining *Orbiliomycetes*, but in *O. dryadum* and *O. cunninghamii* it is TTC**C**CGC in concordance with *Hyalorbilia*, series *Abutilones*, section *Ovoideae*, and predacious members of section *Arthrobotrys*. Pos. 121 and 134, which belong to stem-loop B8, are correlated by base pairing (see Tab. 18) by providing two versions: G+C (mostly **G**TTGGTATTCCGA**C**) occurs in the *leucostigma-xanthostigma* clade and in *O. cunninghamii*, *O. dryadum*, *O. eucalypti* (subclade D1), *O. guyanensis*, *O. liliputiana*, *O. renispora*, *O. tremulae*, and *O. xiushanensis*, whereas A+T (mostly **A**TTGGTATTCCGA**T**) is observed in *O. brettii*, *O. cejpii*, *O. cylindrospora*, *O. eucalypti* (subclades A–C, D2), *O. fabacearum*, *O. fissilis*, *O. frangulae*, *O. paracylindrospora*, *O. plurivacuolata*, *D. inaequale*, and *Tridentaria* spp. Series *Microsomates* shows both versions, with *O. mirabilis* having G+C. A+T is also frequent, e. g., in sections *Ovoideae* (exception: *O. subovoidea* with G+C) and *Arthrobotrys* (including *O. epipora*).

The *xanthostigma-renispora* clade exhibits some characteristic motifs in the D1 domain of LSU: according to available LSU sequences (*xanthostigma-leucostigma* complex, *O.* cf. *xanthoflexa* ga026b, and the loosely associated *O. renispora* and *O.* aff. *renispora* B.L. 747), members of this aggregate differ at pos. 305 by **G** and after pos. 309 by a rare insert (**C**) from the rest of series *Orbilia*: GGTA**G**ATTT**C**CATC vs. GGTA**A**ATTT**-**CATC. Based on these 2 deviations, we include *O. renispora* s.l. in the *xanthostigma-renispora* clade, although their joint clade received no support (Phyl. 22). However, three exceptions occurred: *O. delicatula* YNUCC 6028 shows the latter variant although it clustered near *O. xanthostigma*; ‘*O. epipora*’ B.L. 6195 shows the combination GGTA**G**ATT**-C**CATC although it clustered near *O. leucostigma*; *O. fabacearum* deviates by GGTA**A**ATT**-C**CATC and shows an unresolved position outside the *xanthostigma-tremulae* clade. Of course, the exact position of the gap in these variants is not certain.

A relationship of the *xanthostigma-renispora* clade with *O. dryadum*, *O. tremulae*, *Orbilia* spp. (B.L. 6195 and ga055b), and *O. guyanensis* is supported in the D1 domain by 3 gappy regions that appear to trace back to a common ancestor (position of gaps ambiguous): (1) pos. 129–137 is **----AA-G**C (in *O. guyanensis* **---**C**G--G**C) vs. TTTT**AA**T**G**T, CTTT**GG**T**G**C, CTTC**GG**T**G**C, CTTC**GA**C**G**T, and some other variants in other taxa of section *Orbilia*; (2) 2 gaps between pos. 225 and 228; (3) 1 gap between pos. 243 and 245 (Tab. 73). These characteristic gaps suggest that the *xanthostigma-tremulae* clade is a monophyletic group, although its support in phylogenetic analyses was not strong.

Another motif which includes 4 gaps (LSU D2 domain at pos. 540–547, **--TC--GG**) occurs in the *xanthostigma-tremulae* clade but also in *O. eucalypti* and the *cejpii-frangulae* clade, the remaining species lack these gaps (CT**TC**GG**GG**, CC**TC**GG**GG**) or have only 2 gaps (*O. mirabilis*, *Tridentaria implicans*, YY**-C-**G**GG**).

Undoubtedly, also *O. xanthoflexa* and possibly *O. cunninghamii* (both without LSU) belong in this *xanthostigma-tremulae* clade which appears, e. g., in Phyl. 22 as a weakly supported clade. This clade is supported by stem-loop 8 of 5.8S, except that here also *O. liliputiana* shares the motif. In conclusion, cashew-shaped spores probably developed from cylindric-ellipsoid spores in two independent lineages, 1 represented by *O. fabacearum* with medium curved smooth spores, and the other by *O. renispora* and *O. xanthoflexa* as ancestral taxa with slightly to medium curved smooth spores, and the *xanthostigma-leucostigma* complex as an advanced group with strongly curved warted spores.

Ecology. Series *Orbilia* occurs worldwide, with a significant preference for hygric environments. As an exception, the very common *O. eucalypti* and some rarely collected taxa prefer more or less exposed (xeric) substrate. Most of the species were recorded in temperate to subalpine-boreal regions, but some in tropical (sub)humid and some in semihumid to semiarid, rarely arid zones.

Key to species of series *Orbilia*

1. Exudate over paraphyses often 1–2 µm thick, cloddy to continuous; SBs min. (0.8–)0.9 µm diam.; asci 8- up to 64-spored; apothecia always desiccation-tolerant ... see **section *Ovoideae***, p. 1241

1. Exudate over paraphyses absent or thin (0.2–0.5 µm), rarely 1(–2) µm thick, often sparse and finely granular; SBs max. 0.8(–0.9) µm diam.; asci 8-, rarely 16-spored; apothecia desiccation-sensitive or -tolerant ... 2

2. Paraphyses consistently slightly to distinctly spathulate-lanceolate or lageniform ... KEY C

2. Paraphyses clavate-capitate or uninflated, only exceptionally narrowed above ... 3

3. Spores cylindrical, always (very) strongly curved (by ~90–270°) under a narrow arch (C-shaped), *2.3–3.5(–4.5) µm long in situ, in some species warted ... KEY D

3. Spores straight or only slightly to medium curved, exceptionally strongly curved (over 90°) but under a wide arch (C- to L-shaped, also helicoid) and then *3.5–6 µm long in situ, always smooth ... 4

4. Spores ellipsoid(-fusoid) to ellipsoid-clavate, ovoid or (sub)globose, rarely some spores cylindrical(-ellipsoid), length/width ratio predominantly < 2.5(–3) ... KEY A

4. Spores cylindrical to cylindric(-ellipsoid) or cylindric(-clavate), length/width ratio mostly > 2.5 ... KEY B

If spores with ± eccentrical SBs see series *Drechslerella* and *Gamsylella* of section *Arthrobotrys*

KEY A (spores ellipsoid-ovoid, paraphyses uninflated to clavate-capitate)

1. Spores *(1.8–)2–2.5(–3) × (1–)1.2–1.4 µm; paraphyses capitate; apothecia 0.4–0.8 mm diam., pale yellowish; wood of *Pinus*, cold-temperate humid atlantic western Europe ... ***O. battenii***, p. 1333

1. Spores > *2.5 µm long and/or > *1.4 µm wide ... 2

2. Spores subglobose to broadly ellipsoid, max. *3.5(–4) µm long and min. *(1.6–)1.7 µm wide, length/width ratio ~(1–)1.3–1.6 ... 3

2. Spores ellipsoid(-subfusoid), length/width ratio ~1.6–3 ... 7

3. Marginal cortical cells with glassy processes (1–7 × 2.5–4.5 µm); paraphyses with firmly attached cap-like exudate; spores *(2.8–)3–3.5(–4) × 2–2.5 µm, with rather large SBs; apothecia bright orange; bark of *Juniperus*, mesomediterranean semihumid southern Europe ... ***O. dalmatica***, p. 1332

3. Marginal cortical cells without glassy processes; paraphyses without prominent cap-like exudate ... 4

4. Paraphyses uninflated to medium clavate, generally ± bent or hooked; spores *2–2.8 × 1.6–1.9 µm; SBs 0.3–0.4 µm wide; conidia vermispora-like; apothecia light to bright orange; wood of *Pinus*, mesomediterranean sub- to semihumid Macaronesia ... ***O. liliputiana***, p. 1331

4. Paraphyses slightly to strongly capitate, straight, if curved then spores distinctly > *3 µm in length; conidia dicranidion-like ... 5

5. Asci *(3.3–)3.8–4.5(–5.3) µm wide (†3–4.7 µm); spores *3–4.5 × 2–3 µm (†1.7–2.8 µm wide), broadly ellipsoid to (sub)globose; SBs often absent; apothecia desiccation-tolerant; wood & bark of angio- and gymnosperms, temperate humid to submediterranean semihumid Europe ... aberrant form of ***O. eucalypti*** with subglobose spores, p. 1357

5. Asci *3.2–4 µm wide (†2.5–3.5 µm); spores *2.5–3.5(–4) × 1.6–2.3 µm (†1.2–2 µm wide); SBs often present, 0.3–0.6 µm wide ... 6

6. Spores *(2–)2.3–3(–3.4) × (1.7–)1.9–2.3(–2.5) µm (†1.7–2 µm wide), broadly ellipsoid to subglobose, often with a few LBs 0.5–0.8 µm diam.; conidia with a distinct stipe and 2–4 arms that slightly to usually strongly diverge; paraphyses rarely strongly capitate; apothecia pale to light rose-orange, desiccation-sensitive; wood & bark of angiosperms, boreal to temperate humid Europe, subtropical humid eastern Asia ... ***O. fissilis***, p. 1350

Similar collections on xeric substrates without known anamorph are treated as *O.* (cf.) *cejpii* (p. 1340). Compare also '*Orbilia* sp.' with the anamorph *Arthrobotrys nonseptatus* (series *Arthrobotrys*, p. 1551) and species around *O. orientalis* (series *Drechslerella*, e. g., *O. tonghaiensis*, p. 1653)

6. Spores *1.6–2 µm wide (†1.2–2 µm), LBs sparse and minute or absent; conidia with 2 (exceptionally 4) arms that are parallel or diverge only slightly or sometimes moderately; paraphyses often very strongly capitate ... (try under 7)

7. Spores *1.3–1.6 µm wide ... 8

7. Spores predominantly > *1.7 µm wide ... 10

8. Spores †2.3–3.3 × (1.1–)1.2–1.5(–1.6) µm; SBs †0.7–0.9 µm wide; paraphyses strongly capitate, straight; apothecia 0.5–3 mm diam., bright orange; ?hygric wood of angiosperm trees, tropical humid South America ... ***O. gaillardii***, p. 1335

8. Spores *2.8–3.8 × 1.3–1.6 µm; SBs *0.3–0.4 µm wide; paraphyses slightly to medium capitate, often apically bent or hooked; apothecia (0.15–)0.3–1(–2) mm diam., whitish or pale to bright yellow or rose-orange; xeric wood or bark, Europe ... 9

If spores inequilateral to slightly curved, compare *O. renispora* (key D).

9. Spores *2.8–3.8(–4) × 1.3–1.6(–1.8) µm, ellipsoid to subcylindrical; apothecia pale cream-rose; wood of *Frangula*, warm- to cold-temperate humid western and central Europe ... ***O. frangulae***, p. 1345

9. Spores *(3–)3.7–4.5(–5) × 1.3–1.4(–1.6) µm, mainly subcylindrical; apothecia rose-orange; wood of *Euonymus*, warm-temperate humid western Europe ... ***O. paracylindrospora***, p. 1343

A collection on bark of *Corema* in thermomediterranean semihumid atlantic southwestern Europe deviates in wider SBs (0.4–0.6 vs. 0.3 µm, p. 1344).

10. Asci partly arising from croziers; apothecia 0.17–0.3 mm diam., pale greyish(-rosaceous) to cream; spores *3.2–4.4 × 1.7–2.1 µm; SBs absent; conidia (presumed) with diverging arms and long stipe; xeric wood of *Acer* & *Cornus*, oro- to cold-temperate (thermophilous) humid central Europe ... ***Hyalorbilia hergiswiliana***, p. 433

10. Asci consistently arising from simple septa; apothecia usually larger; spores *2.2–8 × 1.6–4 µm; SBs usually present, 0.3–0.8 µm wide; conidia with or without short stipe ... 11

11. Margin with 20–35 µm long glassy processes; spores *(5–)6–7.3(–8) × (2.5–)2.8–3.5(–4) µm; wood of *Populus*, cold-temperate humid western North America .... ***O. brettii*** (inc. sed.), p. 1323

11. Margin without glassy processes; spores *(1.6–)1.7–2.5(–3) µm wide 12

12. Conidia with truncate/rounded base without stipe, with small nodular scar, oblique basal septa absent or only singly (asymmetrical), arms parallel; spores *(2.7–)3–4.2(–4.5) × (1.5–)1.7–2(–2.2) µm, (subcylindric-)ellipsoid, sometimes fusoid(-clavate); SBs consistently present, *0.3–0.6 µm diam.; apothecia whitish, yellow-ochraceous, or yellow-orange; hygric, rarely xeric bark & wood of angiosperms, boreal to suprasubmediterranean humid Europe .... ***O. tremulae***, p. 1373

12. Conidia with a conical base or a distinct stipe, mostly 2 oblique basal septa present; apothecia whitish, yellow-orange, orange-rose, or pinkish........ 13

13. Spores *(2.2–)2.4–3.5(–4) × (1.4–)1.5–2(–2.2) µm, ellipsoid to ovoid or almost subglobose, sometimes ovoid; with 0.3–0.5(–0.6) µm wide SBs; conidia with distinct, partly septate stipe, arms diverging or not; apothecia white to yellowish-orange-rosaceous; hygric or xeric wood & bark of angiosperms, also gymnosperms, orotemperate to subtropical humid to semihumid Europe, Macaronesia, North America, eastern Asia, eastern Australia .... ***O. cejpii***, p. 1337

13. Spores *(3–)3.5–6(–8) × 1.8–2.5(–3) µm, ellipsoid- to fusoid(-clavate); with or without (0.4–)0.5–0.7(–0.8) µm wide SBs; conidia with conical base or rudimentary stipe, arms usually parallel, sometimes diverging; apothecia orange or rose, rarely whitish 14

14. Paraphyses containing many small to large (0.5–3 µm wide), globose to elongate, non- or slightly refractive vacuoles (sometimes also 1 globose SCB in apex); xeric (rarely hygric) wood & bark of angiosperms, also gymnosperms, oroboreal to thermomediterranean humid to arid, worldwide .... ***O. eucalypti***, p. 1352

14. Paraphyses containing numerous small (0.3–0.8 µm wide), globose, slightly to strongly refractive, hyaline vacuoles (VBs) but never SCBs; xeric bark & wood of *Salix* & *Rosa*, thermoboreal to mesosubmediterranean (semi)humid Europe ..... ***O. plurivacuolata***, p. 1347

KEY B (spores cylindrical, cylindric-clavate, straight to strongly curved under a wide arch, paraphyses uninflated to clavate-capitate) [compare also cylindric-spored species of section *Arthrobotrys*]

1. Spores mostly medium to strongly curved 2

1. Spores straight to slightly curved 3

2. Spores ± falcate, with obtuse base, subapically not constricted, †(3–)3.8–5.3(–5.7) × 0.9–1.3 µm (in situ); apothecia yellow, 0.18–0.7 mm diam.; paraphyses strongly capitate, with small yellow LBs; hygric wood of *Acer*, temperate to subtropical humid eastern North America .... ***O. xanthoflexa***, p. 1422

2. Spores falcate to helicoid, with acute base, often subapically slightly constricted, †4–5.3(–6) × 0.8–0.9 µm (in situ); hygric bark of *Melaleuca*, warm-temperate humid eastern Australia .... ***O. flexispora*** (inc. sed.), p. 1429

3. SBs in middle of spores; spores *(4.5–)5–6(–6.5) × 1.2–1.5 µm; apothecia rose-orange, margin distinctly dentate by glassy processes; xeric bark of *Quercus*, suprasubmediterranean semihumid southern Europe .... ***O. beatricis*** (inc. sed.), p. 1322

3. SBs near spore apex; apothecia with a smooth margin 4

4. Spores 4–8 µm long........ 5

4. Spores predominantly < 4.5(–5) µm long (in *O. acuum* rarely up to 6 µm); SBs close to apex 7

5. SBs globose, 0.3–0.5 µm diam., 0.4–0.8 µm away from apex, attachment invisible; Spores *(4.5–)5–6(–7) × (0.8–)0.9–1 µm, ± straight; asci †22–35 µm long; apothecia pale yellowish-chlorinaceous; paraphyses with chlorinaceous VBs; xeric to hygric bark of *Ilex*, cones of *Cupressus*, herbaceous stems, temperate to submediterranean atlantic Europe .... ***O. atlantis*** (section *Arthrobotrys*), p. 1442

5. SBs globose to broadly tear-shaped, rarely ampulliform, close to apex........ 6

6. Spores 4–7(–8) × (1–)1.1–1.3(–1.5) µm, ± subcylindrical, straight; mainly on wood of conifers; oroboreal to suprasubmediterranean humid Europe........ ***O. cylindrospora*** (inc. sed.), p. 1314

6. Spores *(4–)4.5–7.5(–8) × (1.1–)1.3–1.7(–1.9) µm, cylindrical to narrowly fusoid, ± straight; bark of angiosperm trees and shrubs, temperate humid western and subtropical semihumid to semiarid eastern Australia........ ***O. austrocylindrica*** (inc. sed.), p. 1317

7. SBs †1.2–1.8 µm long, elongate tear-shaped; spores †(3–)3.5–5(–6) × 0.8–1.2 µm; paraphyses uninflated to medium capitate; apothecia fresh whitish........ 8

7. SBs *0.4–1 µm long (total length), globose, attachment ± invisible; spores max. *4.3(–5) µm long 9

8. Spores mainly subcylindrical, straight; asci †27–31 µm long; needles and bark of *Pinus*, temperate humid central Europe .... ***O. acuum*** (section *Arthrobotrys*), p. 1658

8. Spores mainly cylindric-clavate, slightly curved; asci †30–40 µm long; stems of *Euphorbia*, temperate humid central Europe .... ***O. cyparissias*** (section *Arthrobotrys*), p. 1659

9. Spores gradually ± tapered towards base (cuneate), †(3–)3.3–4.2(–4.7) × 0.8–1 µm; SBs invisible in dead state; asci †30–40 µm long; paraphyses strongly capitate; apothecia fresh white or yellowish; hygric wood (rarely bark) of angiosperms, temperate to subtropical humid New Zealand .... ***O. cunninghamii***, p. 1392

9. Spores ± subcylindrical........ 10

10. Spores *(3–)3.7–4.5(–5) × 1.3–1.4(–1.6) µm; paraphyses without refractive VBs, apex uninflated to medium clavate-capitate; asci †32–38 µm long; apothecia light rose-orange or pale rose-cream; xeric wood & bark (*Euonymus*, *Corema*), warm-temperate humid western and thermomediterranean semihumid southern Europe........ ***O. paracylindrospora***, p. 1343

10. Spores max. *1.3(–1.5) µm wide; paraphyses containing ± refractive VBs; hygric wood........ 11

11. Spores *(1.8–)2–2.5(–3) × (1–)1.2–1.4 µm, subcylindric to ellipsoid; conidia dicranidion-like; wood of *Pinus*, cold-temperate humid atlantic western Europe ... ***O. battenii***, p. 1333
For small-spored samples on angiosperm wood see under *O. dryadum*.

11. Spores *(2.3–)2.7–4.3(–5) µm long, (sub)cylindric; conidia unbranched ... 12

12. Spores *(2.3–)2.7–3.9(–4.2) × (1–)1.1–1.3(–1.5) µm (l:w ratio around 3); paraphyses usually medium to very strongly capitate; asci †22–41 µm long; apothecia white to yellowish or often cream-rosaceous, scattered to gregarious in small groups; conidia *(16–)20–35(–56) × (3–)3.5–5.5(–6.5) µm, 3–7-septate; wood of angiosperms, rarely gymnosperms, orotemperate to mesomediterranean (sub)humid, worldwide ... ***O. dryadum***, p. 1385
Samples on bark of *Ulex* in cold-temperate atlantic Europe deviate in rather narrow spores (*1–1.2(–1.3) µm) and long conidia (*37–52 µm, p. 1389).

12. Spores *(2.8–)3.3–4.3(–5) × 0.8–1 µm (l:w ratio around 4); paraphyses mostly only slightly capitate; asci †18.5–26 µm long; apothecia white, often densely gregarious in large number; conidia *(13.5–)16–22(–25) × 2.2–3(–3.2) µm, 1–3-septate; wood of angiosperms, especially *Fagus* and *Salicaceae*, oro- to thermotemperate humid Europe, North America, western Asia ... ***O. epipora*** (series *Neodactylella* of section *Arthrobotrys*), p. 1446

KEY C (spores cylindrical, straight to strongly curved under a wide arch, paraphyses spathulate to lanceolate-lageniform, distinctly protruding)

1. Spores straight, rarely slightly curved, †2.7–3.6 × 0.9–1.1 µm; asci †18–26 × 2.4–2.7 µm; paraphyses lanceolate; apothecia flat, sessile, yellowish, 0.5–1 mm diam.; stem of *Cirsium*, temperate humid Europe ... ***O. minutispora***, p. 1385

1. Spores very slightly to distinctly curved, if straight then longer or wider; asci †20–35(–42) × 2.8–3.8 µm; apothecia ± saucer-shaped or umbilicate and/or margin ± distinctly protruding ... 2
If apothecia hairy and spores with ± eccentrical SBs see *O. pilosa* (section *Arthrobotrys*, p. 1629); if asci exceeding †35 µm in length and marginal cortical cells with short glassy caps compare *O. fraxini* (section *Arthrobotrys*, p. 1480).

2. Spores *1.2–1.8 µm wide, straight to slightly curved; Europe & America ... 3

2. Spores *0.8–1.2 µm wide, medium to strongly curved; eastern Asia ... 4

3. Spores *2.8–3.7 × 1.5–1.7(–1.8) µm; SBs 0.5–0.8 µm wide, subglobose to broadly tear-shaped, ± broadly attached, often with large LBs; paraphyses ± lanceolate; apothecia white; hygric angiosperm wood, tropical humid South America ... ***O. guyanensis***, p. 1380
A collection on ?wood from montane Asia (Sichuan, H.B. 5829) mentioned under *O. umbilicata* differs in larger asci (†40–50 × 3.5–4.4 µm), spathulate paraphyses, and longer spores (†3–4.3 × 1.2–1.4 µm, p. 1382).

3. Spores *4.5–6 × (1–)1.2–1.3(–1.5) µm; SBs 0.3–0.5 µm wide, globose with very fine filum, without large LBs; paraphyses ± lageniform; apothecia ± orange; xeric bark (& wood) of *Rhamnus* & *Ficus*, mesomediterranean semihumid Europe. ... ***O. rhamni*** (section *Arthrobotrys*), p. 1483

4. Spores allantoid, *(3–)3.5–4.5(–5) × (0.9–)1–1.2(–1.4) µm; asci †25–42 µm long; medullary excipulum 25–70 µm thick, of dense, not or only slightly gelatinized t. intricata; hygric angiosperm wood, temperate to subtropical humid eastern Asia ... ***O. umbilicata***, p. 1381

4. Spores helicoid, †(3.5–)4–4.2(–4.5) × 0.7–0.9 µm; asci †20–26 µm long; medullary excipulum 150–230 µm thick, of loose, strongly gelatinized t. intricata; hygric angiosperm wood, subtropical humid Japan ... ***O. spirospora***, p. 1384

KEY D (spores cashew-shaped, paraphyses uninflated to clavate-capitate)

1. Spores predominantly 4–5(–6) µm long (in situ), ± falcate ... see ***O. flexispora*** (p. 1429) & ***O. xanthoflexa***, (p. 1422)

1. Spores predominantly 2.5–3.5(–4) µm long (in situ), ± cashew-shaped ... 2

2. Asci predominantly 16-spored; spores smooth, †2.5–3.2(–4.5) × 1.1–1.3(–1.5) µm; marginal cortical cells with glassy caps; xeric bark of *Betula*, oroboreal humid Europe ... ***O. coccinella***, p. 1427

2. Asci 8-spored; marginal cortical cells usually without glassy caps (except for *O. subfabacearum*) ... 3

3. Spores distinctly warted on the curved dorsal side (exceptionally smooth), */†(2.2–)2.4–3(–3.3) × 1–1.6 µm, curved by ~(120–)160–180(–200)°; SBs globose, near one spore end; apothecia (0.2–)0.5–2(–4.5) mm diam. ... 4

3. Spores consistently smooth; apothecia 0.15–1.1 mm diam. ... 6

4. Apothecia ± gelatinous (excipular walls slightly gelatinized), with a well-defined cylindrical stipe which is usually about as long as wide; margin regularly notched by forming obtuse lobes, disc bright golden-yellow; hygric angiosperm wood; tropical humid Middle & South America ... ***O. aureocrenulata***, p. 1416

4. Apothecia non-gelatinous, sessile or with short thick, partly obconical stipe ~2–10× wider than long; margin even, in large apothecia sometimes lobate, disc whitish-rosaceous to yellow-orange; hygric, rarely xeric angio- and gymnosperm wood (rarely bark), boreal to warm-temperate humid but also mediterranean (semi)humid or tropical humid, worldwide ... 5

5. Apothecia whitish to very pale rosaceous-violaceous (usually growing on underside) ... ***O. leucostigma***, p. 1394

5. Apothecia pale to bright yellow-orange (growing ± exposed). ... ***O. xanthostigma***, p. 1394
Heterogenous complex of taxa with very different molecular characters. Within Europe the 2 above species are known which merely differ by colour and sometimes even grow intermingled. Extra-European records are frequently with yellow colours and represent different unnamed taxa.

6. SBs always situated at one end of the spore, globose (but partly also with 1–2 LBs); hygric wood & bark ... 7

6. SBs consistently situated at the dorsal side in the middle of the spore, globose to broadly tear-shaped; paraphyses uninflated to slightly capitate; apothecia whitish to rose-cream; mainly on xeric bark & wood ... 8

7. Spores slightly to medium curved, with or without 1-2 small LBs, *(2.4–)2.6–3.5(–3.7) × 1.1–1.8 µm; paraphyses slightly to strongly capitate; apothecia mostly bright yellow; hygric wood of angiosperms, cold-temperate to subtropical humid eastern North America ..... ***O. renispora***, p. 1418

7. Spores strongly to very strongly curved, with 1-2 large LBs, *3–3.3(–3.6) × 1.5–1.7 µm; paraphyses strongly capitate; apothecia yellowish; hygric bark of indet. angiosperm, subtropical humid eastern & southeastern Asia.......................... ***O*. aff. *renispora***, p. 1420

8. Spores curved by (70–)90–180(–220)°, *(2.3–)2.5–3.7(–4.2) × 1.1–1.6 µm; asci †24–36 µm long; apothecia (cream-)rose, 0.15–0.9 mm diam.; margin without glassy caps; bark & wood of *Faboideae* and other angiosperms, rarely gymnosperms, cold-temperate humid to mesosubmediterranean semihumid, mainly atlantic Europe .... ***O. fabacearum***, p. 1423

8. Spores curved by (120–)160–270° (often > 180°); apothecia 0.15–0.5 mm diam...9

9. Asci †27–35 µm long; margin with or without short glassy caps; spores *2.5–3.5 × 0.9–1.5 µm; apothecia pale rose; bark & wood of climber, subtropical subhumid Australia .... ***O. subfabacearum***, p. 1426

9. Asci †18–24 µm long; margin without glassy caps; spores *2.4–2.9 × 0.9–1.2 µm; apothecia whitish; bark of *Hibiscus* etc., (sub)tropical humid Australia and eastern Asia .... ***O*. cf. *subfabacearum***, p. 1427

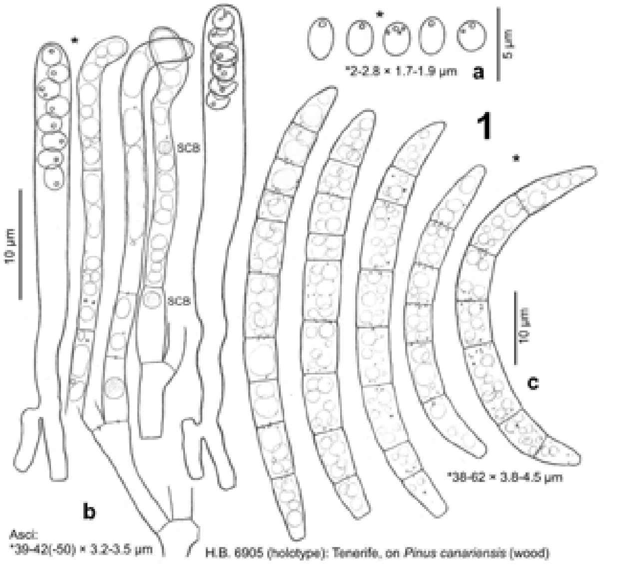


Plate 836. **1**: *Orbilia liliputiana*. – **a**. ascospores; **b**. asci and paraphyses; **c**. conidia from culture.

Orbilia liliputiana Baral, Quijada & E. Weber, **sp. nov.**, MB 814372 — Pls 836–837

Etymology: named after the small ascospores.

Typification: Macaronesia, Tenerife, La Esperanza, branch of *Pinus canariensis*, 31.III.2001, R. Galán (ex H.B. 6905, M-0276500, holotype; ex-type culture: CBS 116213; sq.: KT215284).

Latin diagnosis: *Apothecia hydratata 0.3–1.1 mm diam., dilute luteola vel salmonea, subsessilia, margine laevi. Ascosporae *2–2.8 × 1.6–1.9 µm, late ellipsoideae vel subglobosae, corpusculum refringens minutissimum, globosum ad apicem continentes. Paraphyses ad apicem non inflatae vel modice clavatae, plerumque curvatae vel uncinatae, exsudato nullo. Excipulum marginale absque processis vitreis. Status anamorphicus conidiis non ramosis, *38–62 × 3.8–4.5 µm, 5–9-septatis, leniter vel valde curvatis. Habitat ad lignum leniter putridum rami uvidi* Pini canariensis, *in zona mesomediterranea sub- ad semihumida Macaronesiae.*

Description: — **TELEOMORPH**: **Apothecia** fresh 0.3–1.1 mm diam., 0.15–0.2 mm high (receptacle 0.1–0.12 mm), whitish-yellowish or pale to light (cream-)salmon-rose when fresh, semitranslucent, round to slightly undulating, (sub)gregarious in small groups; disc flat, margin ± distinct, thin, 0–5 µm protruding, smooth; subsessile, superficial. **Asci** *37–44(–50) × 3–3.5 {2} → 37–46 × 3.6–4 µm {T}, †31–42 {2} × 2.3–2.6 {1} or 2.6–3.1 µm {T}, 8-spored, spores (*) uni- or subbiseriate († uniseriate), some lower spores inverted but often

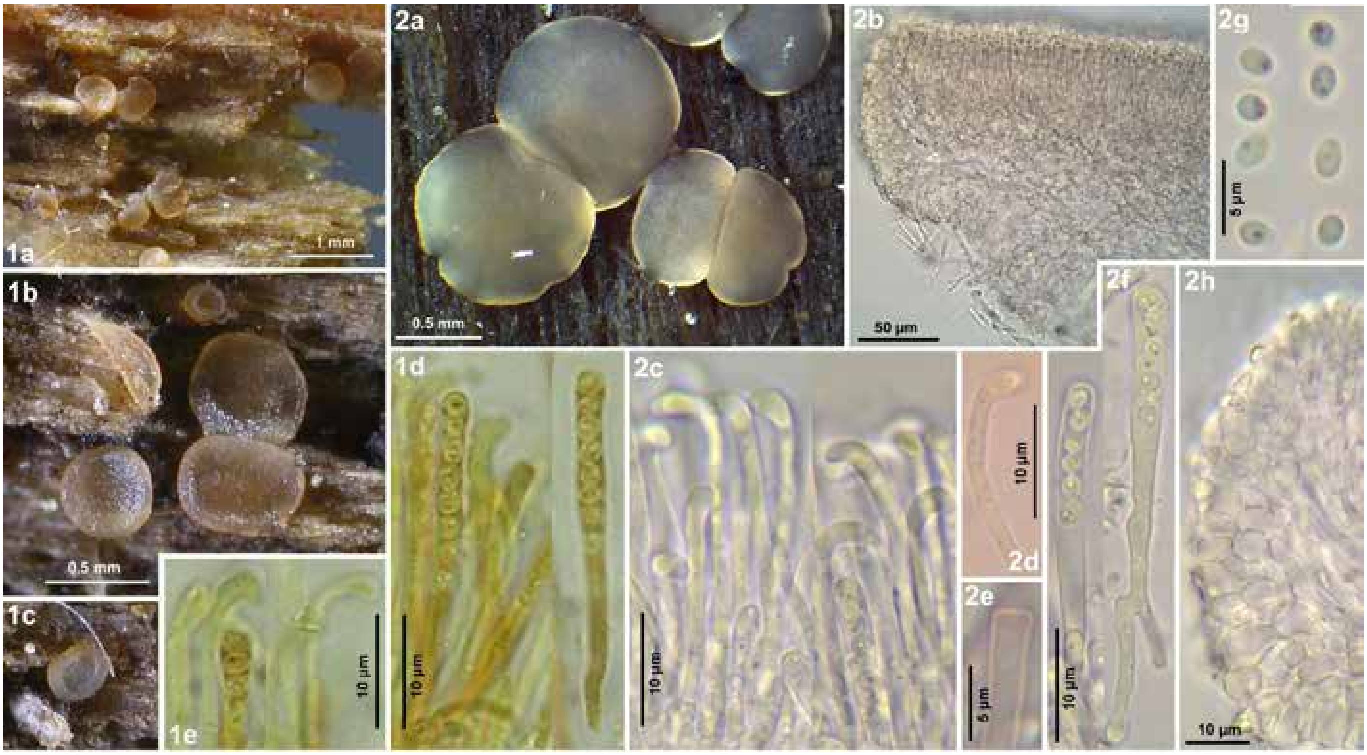


Plate 837. **1–2**: *Orbilia liliputiana*. – **1a–c**, **2a**. rehydrated apothecia; **2b**. apothecium in median section; **2h**. id., marginal ectal excipulum; **1d–e**, **2c–f**. asci and paraphyses; **2e**. ascus apex; **2g**. ascospores. – Living state except for **1d–e** (in KOH+IKI) and **2d–e** (in CR_{SDS}). – **2a–h**: phot. L. Quijada. — **1a–c**. H.B. 6905 (holotype): Tenerife, El Rosario, on *Pinus*; **2a–h**. TFC Mic. 24384: ibid., La Matanza de Ajentejo, on *Pinus*.

laterally oriented {2}, pars sporifera *12–15 → 9–10 µm long; **apex** (†) slightly to medium truncate (not indented, laterally hardly inflated); **base** with short to medium long, thick († thin), slightly flexuous stalk, L-, Y-, h- to H-shaped. **Ascospores** *(2–)2.2–2.6(–2.8) × 1.6–1.9 µm {2}, †2–2.3(–2.5) × 1.6–1.8 µm {T}, broadly ellipsoid to subglobose, exceptionally globose; **SBs** globose, *0.3–0.4 µm wide {T}, total length ~0.5–0.6 µm, quite close to wall but attachment invisible, with a few ± small LBs. **Paraphyses** apically uninflated or slightly to medium clavate, very often slightly to strongly bent, sometimes {T} or often {1} uncinate (~40–140°), terminal cells *(12–)17–24.5 {T} × 1.8–3 µm {2}, lower cells *6–10(–15) × 1.6–2.8 µm {T}; unbranched at upper septum. **Medullary excipulum** 50–100 µm thick, of medium dense textura porrecta-intricata with many inflated cells, sharply delimited. **Ectal excipulum** of thin-walled, vertically oriented t. globulosa-angularis from base to margin, 30–60 µm thick near base, cells *8–22 × 5–11 µm {2}; 15 µm thick near margin, oriented at an 80–90° angle to the surface, marginal cortical cells *6–12 × 4–7.5 µm {2}; **glassy processes** absent. **Anchoring hyphae** sparse, *2–2.5 µm wide, walls 0.2 µm thick {T}. **SCBs** in paraphyses globose, 1.3–2 µm diam., low-refractive, 0–1 per cell, in ectal excipulum absent; **VBs** absent (vacuoles in paraphyses non-refractive) {T}, or medium refractive, roundish to elongate {1}. **Exudate** over paraphyses absent, over margin with 1 µm thick, scattered small clods. **— ANAMORPH**: vermispora-like (from ascospore isolate {T}). **Conidiophores** not seen. **Conidia** unbranched, slightly to strongly curved, ± attenuated at the ends, *38–62 × 3.8–4.5 µm (in situ, actual length ~45–67 µm), 5–9-septate.

Habitat: lying tightly close to very wet ground, on upperside of decorticated, 3 cm thick branch of *Pinus canariensis* {2}, on slightly decayed wood {2}, partly splitted, medium greyed or darkened, no algae. **Associated**: *Hyaloscypha aureliella*. **Desiccation tolerance**: not tested but possibly tolerant. **Altitude**: 1300–1433 m a.s.l. **Geology**: pyroclasts of basalt & trachybasalt and mafic phonolite. **Phenology**: III, IX (perhaps long-lived).

Taxonomic remarks. *Orbilia liliputiana* resembles *O. cejpii* in the small ascospores with distinct though small, globose spore bodies, but differs in paraphyses with often curved apices and a vermispora-like anamorph. *O. frangulae* resembles *O. liliputiana* in the paraphyses, but has longer and somewhat narrower spores and a presumed anamorph with multiarmed conidia. *O. dalmatica* differs in larger spores and SBs, and in having glassy processes, and *O. battenii* in smaller spores and a dicranidion-like anamorph, both also in straight paraphyses. *O. tremulae* differs in longer, more elongate-ellipsoid spores, capitate paraphyses, and a dicranidion-like anamorph.

Several specimens mentioned under *O. cejpii* are not included in either description though possibly belonging to *O. liliputiana*. In most of them the paraphysis apices are more capitate and partly tend to be asymmetrical to almost hooked, and the SBs and partly also the spores are slightly larger than in *O. liliputiana* (Pls 844: 8–11; 846: 5). An Australian collection of *O. cejpii* (Pl. 844: 7) likewise differs from *O. liliputiana* in slightly larger spores and SBs; it has straight, not or only slightly inflated paraphysis apices, narrower marginal cortical cells (*7–10 × 3–4), and a presumed dicranidion-like anamorph. The spores in three North American collections mentioned under *O. cejpii* (Pl. 844: 6, IVV: H.B. 5644, 23.X.2017) are similar to *O. liliputiana* in size and small droplets, but the paraphyses are ± straight and partly rather strongly capitate.

A collection described in detail in Quijada et al. (2016) under the name *O. cejpii* (TFC Mic. 23631) occurred at a distance of only 1 km from the second locality of *O. liliputiana* but on another host (*Adenocarpus*, *Faboideae*). Its straight and partly rather strongly capitate paraphyses deviate from *O. liliputiana*, also its larger SBs (0.4–0.6 µm diam.). The apothecia were light yellow to medium orange. In spore size it is at the lower range of *O. cejpii*, under which name we have treated it. No anamorph was observed on the substrate.

Variation. The two collections concur rather well, particularly in the size of asci and ascospores, but a few deviations are worth mentioning: the fresh apothecial colour was salmon-rose in the holotype but whitish-yellowish in the paratype, and VBs were absent in the holotype but present in the paratype.

Anamorph. The vermispora-like phragmoconidia in the holotype of *O. liliputiana* were only obtained when the culture was flooded by water. This type of conidia is so far exceptional within series *Orbilia*. The only other species within this series with such an anamorph obtained in pure culture is *O.* cf. *subfabacearum* from China (Pl. 891: 2).

Phylogeny. A sequence of the extype-culture comprises SSU (without S1506 intron), ITS, and LSU. In the ITS region the distance to other members of series *Orbilia* lies in the range of 17–19%, except for *O. eucalypti* and *O. fissilis* (13–14.5%). To series *Microsomates* the distance is 16–17%. In the LSU D1–D2 a 3.8% distance to *O. fissilis* and 5% or more to the remaining species is noted.

Ecology. The two collections included in *O. liliputiana* were on slightly decayed wood at the upperside of hygric branches of *Pinus canariensis* in the north- and south-exposed slopes of the lower mesomediterranean subhumid to semihumid pine forest (*Sideritido solutae-Pinetum canariensis ericetosum arboreae*) in Monte de la Esperanza of Tenerife (Macaronesia). The two sites are only 2.7 km from each other. Though the branch of the holotype was lying on very wet ground, the reddish colour of the apothecia together with the partly rather long lower cells of paraphyses appear to indicate that *O. liliputiana* is a desiccation-tolerant species. It seems possible that apothecia were already present on the branch when it was still-attached. However, the second collection showed whitish apothecia and grew likewise on a hygric branch.

Specimens included. **MACARONESIA**: **Canary Islands**, **Tenerife**, El Rosario, 14 km WSW of Santa Cruz de Tenerife, 3.5 km SW of La Esperanza, Pico de las Flores, 1300 m, branch of *Pinus canariensis*, on wood, 31.III.2001, R. Galán-Marquez (AH 7350, **isotype**; ex H.B. 6905, M-0276500, **holotype**, CBS 116213, anam. cult., sq.: KT215284). – La Matanza de Ajentejo, 6 km SW of La Esperanza, Lomo Colorado, 1433 m, branch of *Pinus canariensis*, on wood, 30.XI.2013, L. & C. Quijada (TFC Mic. 24384, doc. vid.).

Orbilia dalmatica Baral, **sp. nov.**, MB 813953

— Pls 838–839

Etymology: named after the geographical origin, Dalmatia.

Typification: Croatia, Korčula island, Kočje, branch of *Juniperus macrocarpa*, 3.VI.2000, N. Matočec & H.O. Baral (ex H.B. 6676a, M-0276471, holotype).

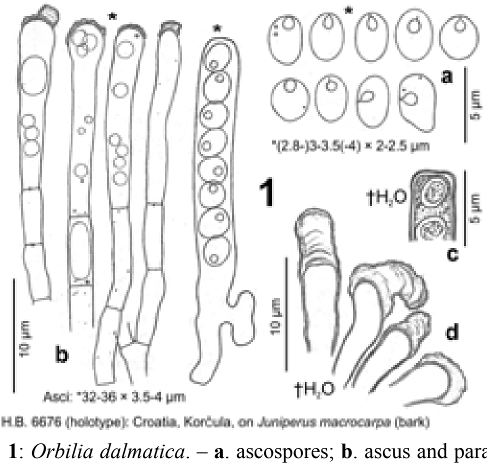


Plate 838. **1**: *Orbilia dalmatica*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apex; **d**. marginal ectal excipulum in median section, cortical cells with glassy processes.

Plate 839. **1**: *Orbilia dalmatica*. – **1a**. mediterranean maquis, *Juniperus macrocarpa* shrub with dead branches; **1b**. corticated xeric branch with apothecia, associated with (?)*Peniophora* sp.; **1c–h**. rehydrated apothecia, with *Frullania dilatata* (phot. after 7 years). — **1a–h**. H.B. 6676a (holotype): Croatia, Korčula, on *Juniperus*.

Latin diagnosis: *Apothecia rehydratata 0.2–0.5 mm diam., aurantio-rosea, sessilia, margine laevi vel subtiliter aspera. Ascosporae *2.8–4 × 2–2.5 µm, late ellipsoideae vel subglobosae, corpusculum refringens submagnum, subglobosum, ad apicem cuspide brevi affixum continentes. Paraphyses ad apicem non inflatae vel leniter capitatae, pileis vitreis tectae, in statu vivo vacuolis refringentibus carentes. Excipulum marginale processis vitreis brevibus, pallide luteis praeditum. Habitat ad corticem putridum rami sicci* Juniperi macrocarpae, *in zona mesomediterranea semihumida Europae meridionalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.2–0.5 mm diam., 0.11 mm high, bright orange-rose, semitranslucent, round to elliptical, scattered; disc slightly concave, margin distinct, very slightly protruding, smooth to very finely rough; broadly sessile, superficial. **Asci** *32–36 × 3.5–4 µm, †31–32 × 2.8–3.2(–3.7) µm, 8-spored, spores (*) uni- or subbiseriate, some spores inverted (very strongly mixed, laterally sometimes oriented); **apex** (†) medium to strongly truncate (scarcely indented and laterally inflated); **base** unstalked or with short, thin, subflexuous stalk, Y- or H-shaped. **Ascospores** *(2.8–)3–3.5(–4) × 2–2.5 µm, †2.2–3.2 × 1.8–2.1 µm, broadly ellipsoid to subglobose, rarely with a tapered base; **SBs** *0.8–1 × 0.5–0.8 µm, subglobose to broadly tear-shaped, apically (rarely laterally) attached either closely or narrowed to a very short filum; with or without a few minute LBs. **Paraphyses** apically uninflated or slightly (rarely medium) capitate(-clavate), terminal cells *14–17 × 1.7–3.2 µm, lower cells *5–9 × 1.5–2.3 µm; unbranched at upper septum. **Medullary excipulum** 40 µm thick, of dense textura intricata with many inflated cells, medium sharply delimited. **Ectal excipulum** of thin-walled, irregularly oriented t. angularis-prismatica from base to mid flanks, 30 µm thick near base, cells †6–10 × 4–7 µm; at flanks and margin oriented at a 40–60° angle to the surface, 15 µm thick near margin, of t. prismatica, marginal cortical cells †7–10 × 2.5–4 µm; **glassy processes** 1–7 × 2.5–4.5 µm, high-refractive, stratified, pale yellowish. **Anchoring hyphae** rather sparse, †1.3–2 µm wide, walls 0.2 µm thick. **SCBs** in paraphyses globose to ellipsoid, 0.6–2.3 µm diam., in ectal excipulum not examined; **VBs** absent. **Exudate** over paraphyses 0.3–2 µm thick, forming firmly attached caps, over glassy processes only as a firmly attached thin layer. **— ANAMORPH**: unknown.

Habitat: collected 1.5 m above the ground, corticated, 10 mm thick branch of *Juniperus macrocarpa*, on medium decayed bark (bast) in ± small holes of periderm, medium greyed, with many green algae. **Associated**: *Caloplaca* sp., *Frullania dilatata*, *Hysterium angustatum*, *Parmelia* ?*sulcata*, (?)*Peniophora* sp., *Sclerococcum* sp. **Desiccation tolerance**: asci still alive after 2 weeks (probably also after a much longer time). **Altitude**: 190 m a.s.l. **Geology**: Cretaceous limestone. **Phenology**: long-lived.

Taxonomic remarks. *Orbilia dalmatica* is recognized by small subglobose ascospores with comparatively large, broadly tear-shaped SBs, also by short glassy processes at the margin and small refractive caps on the paraphyses. Other species with subglobose spores such as *O. liliputiana*, *O. cejpii*, or *O. fissilis* have smaller, more globose SBs and are devoid of glassy processes and refractive caps. These species also differ in having less pigmented and probably much less desiccation-tolerant apothecia. *O. dalmatica* also resembles *O. ovalis* (section *Lentiformes*), particularly the collection on *Prunus* (Pl. 181: 5), which differs in larger spores with partly ampulliform SBs and in the absence of glassy processes. A collection from Canada mentioned under *O. cejpii* (Pl. 844: 8) has slightly smaller spores but similar SBs as in *O. dalmatica*.

Ecology. *O. dalmatica* was collected on medium decayed bark of a xeric branch of *Juniperus macrocarpa* in the mesomediterranean semihumid maquis in Dalmatia (southeastern Europe).

Specimens included. **CROATIA**: **Dubrovnik-Neretva**, **Korčula**, 3.5 km WSW of Korčula, 1.8 km NW of Žrnovo, Kočje, 190 m, branch of *Juniperus macrocarpa*, on bark, 3.VI.2000, N. Matočec & H.O. Baral (ex H.B. 6676a, M-0276471, **holotype**).

Orbilia battenii Baral & E. Weber, **sp. nov.**, MB 813954 — Pls 840–841

Etymology: *battenii*: named after Edward Batten who collected and studied this species.

Typification: Great Britain, Suffolk, Westleston, branch of *Pinus sylvestris*, 24.XI.2005, E. Batten (ex E.B. 4649 & ex H.B. 8004, M-0276440, holotype).

Latin diagnosis: *Apothecia hydratata 0.2–1 mm diam., albida ad pallide chlorinaceo-lutea, subsessilia, margine laevi. Ascosporae *1.8–3 × 1–1.4 µm, ellipsoideae vel (clavato-)subcylindricae, corpusculum refringens globosum, ad apicem cuspide brevi affixum continentes. Paraphyses ad apicem modice ad valde capitatae, rectae, in statu vivo vacuolas refringentes hyalinas continentes, exsudato nullo. Excipulum marginale absque processis vitreis. Status anamorphicus* Orbiliae cejpii *similis sed conidiophorae multo longiores et conidia multo longiora, stipitibus et ramis conidiorum longioribus. Habitat ad lignum putridum rami in aere prominentis* Pini sylvestris, *in zona temperata humida atlantica Europae occidentalis.*

Description: — **TELEOMORPH**: **Apothecia** fresh (0.2–)0.4–0.8(–1) mm diam., 0.18–0.19 mm high (receptacle 0.1–0.11 mm), whitish to pale yellowish-chlorinaceous, turning light cream-yellowish or partly orange-brown with age, semitranslucent, round to slightly undulating,

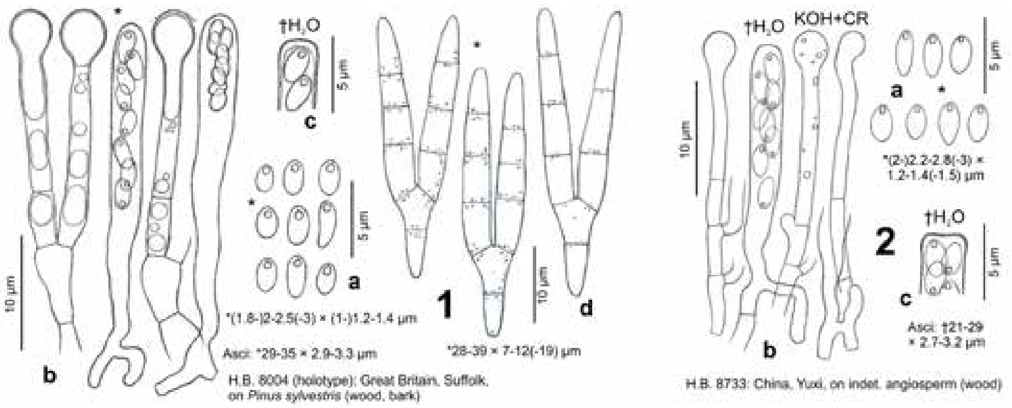


Plate 840. **1**: *Orbilia battenii*; **2**: *O.* cf. *battenii*. – **a**. ascospores; **b**. asci and paraphyses (right ascus fully turgescent); **c**. ascus apices; **d**. conidia from culture.

scattered to gregarious in rather small groups; disc flat to slightly convex, margin thin, not protruding, smooth; with a broad obconical stipe 0.08–0.09 × 0.2–0.3 mm, superficial. **Asci** *29–35 × 2.9–3.3 → 3.3–3.5 µm, 8-spored, spores (*) uni- or apically subbiseriate, 3–4 lower spores inverted (strongly mixed), pars sporifera *10–15(–18) → 7–8 µm long; **apex** (†) strongly truncate (never indented, laterally not or scarcely inflated); **base** with medium long, ± thick, slightly flexuous stalk, L- to h-shaped. **Ascospores** *(1.8–)2–2.5(–3) × (1–)1.2–1.4 µm, ellipsoid(-ovoid) to subcylindric(-clavate), apex rounded to obtuse, base sometimes slightly tapered, straight or rarely slightly inequilateral; **SBs** *0.7–0.8 × 0.4–0.6 µm, globose (to broadly tear-shaped), apically abruptly narrowed to a very short and fine, sometimes invisible filum, LBs not seen. **Paraphyses** apically medium to very strongly capitate, straight, terminal cells *14–20 × 3–4.5(–5) µm, lower cells *4.5–7 × 2–3.3 µm; sometimes branched at upper septum. **Medullary excipulum** 30–50 µm thick, of dense textura globulosa-angularis, very indistinctly delimited from ectal excipulum (or distinctly so by a narrow t. porrecta). **Ectal excipulum** of thin-walled, irregularly oriented t. globulosa from base to margin, 100 µm thick near base, cells *10–23 × 8–16 µm; 15 µm thick near margin, cells at mid flanks *8–12 × 7–9 µm, at margin oriented at an 80° angle to the surface, marginal cortical cells *5–8 × 3.5–5.5 µm; **glassy processes** absent. **Anchoring hyphae** medium abundant, †2–3.5 µm wide, walls 0.2 µm thick. **SCBs** in paraphyses small, globose, in ectal excipulum at margin and flanks

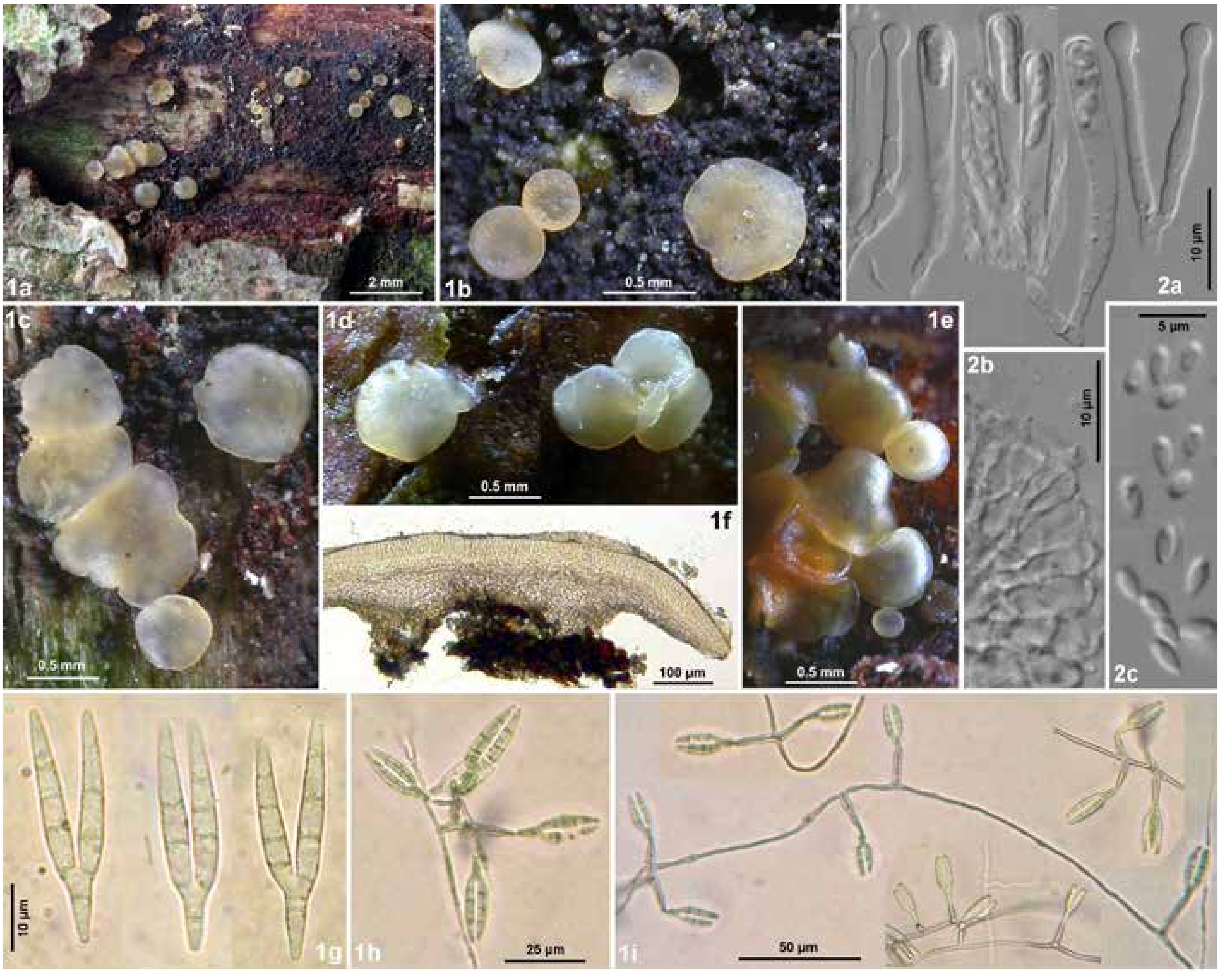


Plate 841. **1**: *Orbilia battenii*; **2**: *O.* cf. *battenii*. – **1a–e**. fresh apothecia; **1f**. apothecium in median section; **2b**. id., marginal ectal excipulum; **2c**. ascospores; **1g–i**. conidia and conidiophores. – Living state (**2a**: 3 asci fully turgescent), except for **2b** (in H_2O). – **2a–c**: phot. Z.F. Yu (DIC). — **1a–i**. H.B. 8004 (holotype): Great Britain, Suffolk, on *Pinus*; **2a–c**. Y.Z. jz-34: China, Yunnan, Dali, indet. ?angiosperm.

globose, 1–1.7 µm diam.; **VBs** medium refractive, mostly elongate, hyaline. **Exudate** over paraphyses absent or nearly so, over margin and flanks scattered granules 0.2–0.5 µm thick. — **ANAMORPH**: dicranidion-like (from ascospore isolate). **Conidiophores** *~7–18 × 3 µm, branched or unbranched, conidia formed terminally. **Conidia** 2-armed, *(28–)34–37(–39) × 7–12(–19) µm, stipe *8–11 × 2.6–3.5 µm, 1-septate, arms *16–26 × 3–4 µm, (2–)4(–6)-septate.

Habitat: collected 1.8 m above the ground, ± corticated, 18 mm thick branch of *Pinus sylvestris*, at small decorticated areas on 0.1 mm deep (rarely deeply) medium to strongly decayed wood, especially beneath bark, exceptionally on bark (periderm), slightly greyed, among blackish and red unidentified remains, sometimes close to abundant green algae. **Associated**: none observed. **Desiccation tolerance**: after 5 days only some cells of medullary excipulum and many spores still alive. **Altitude**: 10 m a.s.l. **Geology**: Pleistocene glaciofluvial sand and gravel. **Phenology**: XI.

Taxonomic remarks. The very small (subcylindric-)ellipsoid ascospores with a globose spore body in combination with a staurosporous dicranidion-like anamorph are the most striking features of *Orbilia battenii*. *O. cejpii* differs in distinctly larger, especially wider spores. The tropical *O. gaillardii* differs in larger, bright orange apothecia and slightly larger spores. *O. dryadum* differs in longer, more cylindrical spores, but two short-spored collections from Denmark (on *Fagus*, Pl. 870: 6, 871: 6) and Bretagne (on *Carpinus*, IVV: 6.XII.2013) closely resemble *O. battenii* except for the unbranched conidia observed near the apothecia and much longer asci in the Danish sample.

Not included collections. Two Chinese samples (Pls 840: 2; 841: 2) are not included in the description because of their geographical origin and deviating substrate (probably from angiosperms), also because of smaller SBs (0.3–0.5 × 0.25–0.35 µm) in the one from Yuxi. Likewise, a sample from Japan deviates in growing on angiosperm bark (*Tilia*, IVV: H.B. 9989); it fits well *O. battenii* in ascus (†22–25 × 2.4–2.8 µm) and spore size (†2.3–2.8 × 1.1–1.3 µm), but was only studied in the dead state and is without anamorph data. A specimen from tropical Australia included in *O. cejpii* (Pls 844: 3; 846: 1) closely resembles the Yuxi sample in ascospore shape whereas the larger ascospore size fits better *O. cejpii*. The same is true for a sample from subtropical North America (IVV: H.B. 5552a).

Anamorph. The dicranidion-like conidia of *O. battenii* grown in pure culture are of the 'gracile type' very similar to those of *O. cejpii* and the *xanthostigma-leucostigma* complex. For the difficulty to name this anamorph see under *O. xanthostigma*, p. 1408. The conidia of *O. cejpii* differ in having distinctly shorter arms and stipes, the arms being predominantly parallel. However, the mentioned Australian and North American collections showed conidia very similar to *O. battenii* (Pl. 846: 1n, 2a–b). *O. dryadum* sharply differs in unbranched conidia. The anamorphs of *O. gaillardii* and the Chinese samples are unknown.

Ecology. *O. battenii* grew on ± rotten wood (exceptionally bark) of a xeric branch of *Pinus sylvestris* in the cold-temperate humid atlantic lowlands of eastern England. Despite the exposed growth, the asci and paraphyses did not survive 5 days of drought. The not included collections were from subtropical humid (winter-dry) evergreen forests in southeastern Asia and continental temperate humid Japan.

Specimens included. **GREAT BRITAIN**: **East England**, **Suffolk**, ~7.5 km SW of Southwold, ~2.5 km NE of Westleston, Dunwich Forest (southwestern part), 10 m, branch of *Pinus sylvestris*, on wood & bark, 24.XI.2005, E. Batten (ex H.B. 8004, M-0276440, **holotype**, anam. cult.; E.B. 4649, K(M) 145642, **isotype**).

Not included. **CHINA**: **Yunnan**, **Dali**, Binchuan, ~42 km NNE of Dali, ~25 km NW of Binchuan, Jizushan, ~2400 m, on indet. wood (?angiosperm), IX.2005, Y. Zhang & M. Qiao (Y.Z. jz-34, YMFT, doc. vid.). – **Yuxi**, Yimen, 54 km NW of Yuxi, 3 km NW of Fangtunxiang, Dalongkou, Longquan, 1750 m, branch of indet. angiosperm, on wood, VI.2007, S.F. Li & J.W. Guo (J.W.G. lq2-35, YMFT, H.B. 8733). — **JAPAN**: **Hokkaido**, ~20 km NW of Tomakomai, Shikotsu lake, ~300 m, branch of *Tilia*, on bark, 28.VII.1990, T. Hosoya (TRL 146, TNS-F-55850, H.B. 9989 ø).

Orbilia gaillardii Sacc., Syll. Fung. 8: 629 (1889, as *O. gaillardi*, ICN Art. 60.8) — Pls 842–843

≡ *Orbilia tenuissima* Pat. & Gaillard, Bull. Soc. Mycol. Fr. 4: 99 (1889, '1888'), nom. illegit., ICN Art. 53.1 [non *Orbilia tenuissima* Speg.]

Etymology: named after the collector, Albert Gaillard.

Typification: Venezuela, Fortin El Zamuro, branch of indet. angiosperm, 28.V.1887, A. Gaillard (herb. Patouillard, FH 00304811, holotype).

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.5–3.2 mm diam., 0.12–0.35 mm high (receptacle 0.1–0.26 → 0.06–0.08 mm), fresh bright yellow-orange {T}, recently rehydrated bright orange(-ochraceous) {1}, pale to light cream-ochraceous(-chlorinaceous) when rehydrated after 8 or > 100 years, ± translucent, round or often undulating, subgregarious to densely gregarious; disc flat but always with a central depression (umbilicate), margin distinct, thin, slightly raised but not protruding, smooth; with a distinct broad stipe 0.02–0.2 × 0.25–0.7 mm, superficial; dry bright yellowish-ochre to orange-red (bright amber-brown with yellowish-ochre margin when old). **Asci** †30–41(–46) × 2.8–3.3 µm {2}, 8-spored, spores †1–2-seriate, especially the lower spores (e. g., 3) inverted {T} (mixed), pars sporifera

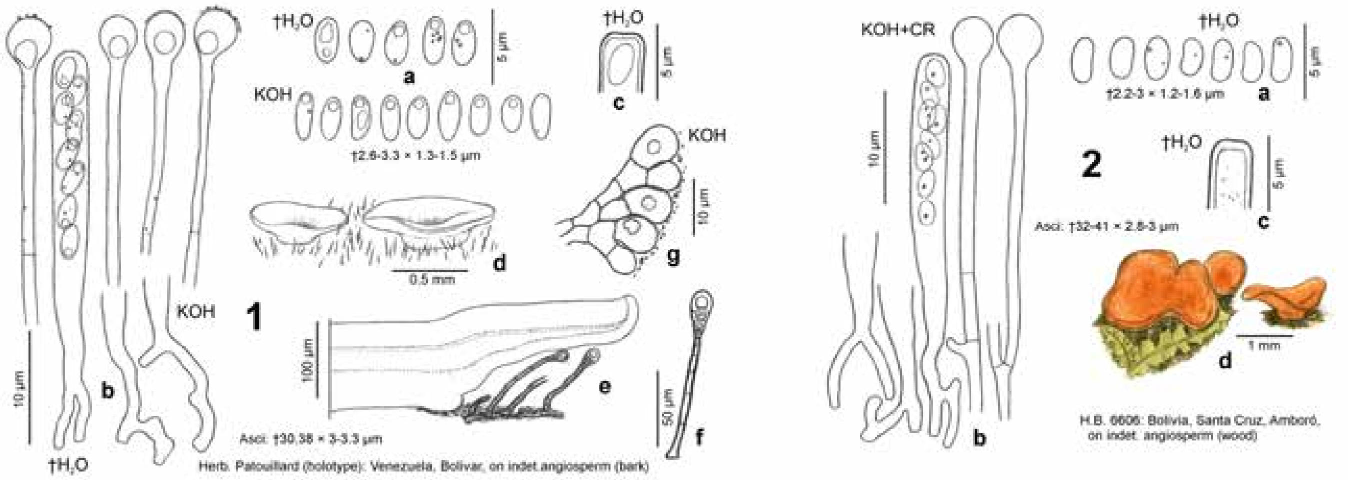


Plate 842. **1–2**: *Orbilia gaillardii*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. apothecia (rehydrated, **2d** with *Lophocolea* sp.); **e**. apothecium in median section; **f**. associated *Brachysporiella* ?*gayana*; **g**. marginal ectal excipulum in median section.

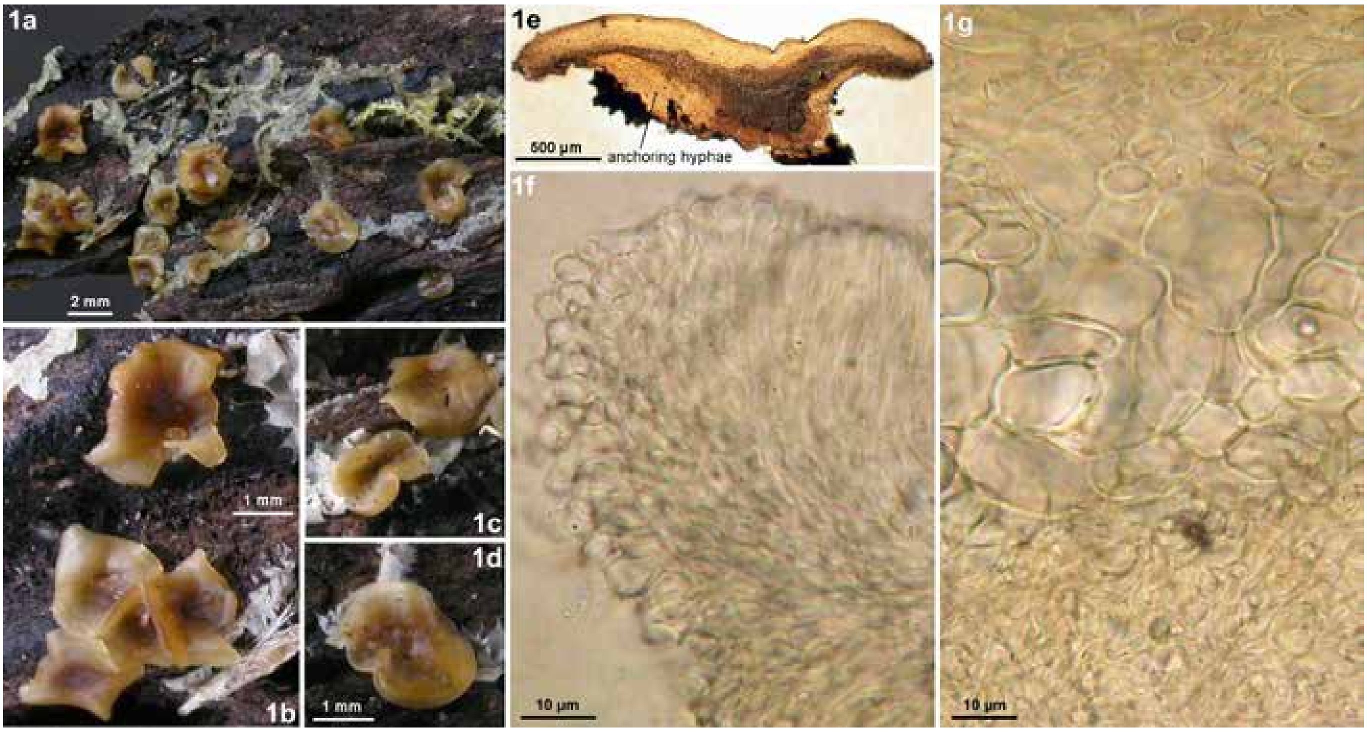


Plate 843. **1**: *Orbilia gaillardii*. – **1a–d**. rehydrated apothecia (with *Lophocolea*, after 8 years); **1e**. apothecium in median section; **1f**. id., marginal ectal excipulum; **1g**. id., basal ectal excipulum (below with thick compact tissue of anchoring hyphae). – Dead state (in KOH). — **1a–f**. H.B. 6606: Bolivia, on indet. angiosperm.

†15–20 µm long; **apex** (†) strongly truncate (not or distinctly indented, laterally not or very slightly inflated); **base** with short (to medium long), thin, flexuous stalk, Y-, h- or H-shaped. **Ascospores** †2.3–3.3 × (1.1–)1.2–1.5(–1.6) µm {2}, subcylindric to ellipsoid, sometimes (ob)ovoid, apex rounded to obtuse, straight to slightly inequilateral or curved; **SBs** †0.7–0.9 µm diam. {T} (~0.8–1 µm total length), visible as a globose transparent region a short distance from the apex, with a few minute LBs. **Paraphyses** apically medium or mostly strongly to very strongly capitate, terminal cells †(18–)20–25(–30) × (2–)3–4.2 µm {2} (septa difficult to see), lower cells †5–8 × 1–1.3 µm {1}; rarely branched at upper septum, lower part of hymenium and subhymenium pale orange. **Medullary excipulum** hyaline, 30–200 µm thick in centre, of medium dense horizontal textura porrecta with many inflated cells, very sharply delimited from ectal excipulum especially at flanks, near margin slightly gelatinized. **Ectal excipulum** hyaline, of (†) slightly gelatinized [common walls 0.8–1.5(–2) µm thick], irregularly, at flanks vertically oriented t. (globulosa-)angularis from base to margin, 50–100 µm thick near base, cells †10–30(–35) × 10–18(–25) µm {2}; 20–80 µm thick at lower flanks, 10–20 µm near margin, oriented at a 60–80° angle to the surface, cortical cells at flanks and margin †7–10 × 4–8 µm {2}; **glassy processes** absent. **Anchoring hyphae** abundant, †1.5–2.5(–3) µm wide, walls 0.2 µm thick {1}, forming a dense, slightly gelatinized t. intricata-porrecta 30–280 µm thick near base, partly covering also lower flanks as a 40–70 µm thick layer. **SCBs** no data available, in KOH globose ?SCBs in paraphysis apices seen, 1.5–1.8 µm diam. {T}. **Exudate** over paraphyses and margin absent or sparse, minutely granular, 0.1–0.2 µm thick. **— ANAMORPH**: unknown.

Habitat: lying on ground, corticated or decorticated, ?5–8 cm thick branches of indet. angiosperms {2}, on 1–2 mm deep strongly brown-rotten wood {1} or medium decayed bark (periderm) {T}, partially blackened, green algae sometimes present among anchoring hyphae. **Associated**: *Brachysporiella* ?*gayana* {T}, *Lophocolea* sp. {1}, pleurocarpous moss {1}. **Desiccation tolerance**: unknown, possibly desiccation-sensitive. **Altitude**: 45–1050 m a.s.l. **Phenology**: V (tropical belt).

Taxonomic remarks. *Orbilia gaillardii* is characterized by bright yellowish-orange apothecia, small subcylindric-ellipsoid ascospores and strongly capitate paraphyses. The orange colour is obviously located in minute LBs in the subhymenium and lower part of the paraphyses, and strongly fades in herbarium material within a few years. *O. dryadum* (with narrower, more cylindrical spores and less pigmented apothecia) and *O. eucalypti* (with larger spores) may be confused with *O. gaillardii* (see under these species). *O. tonghaiensis*, a member of series *Drechslerella* of section *Arthrobotrys*, has similar spores but more whitish apothecia. Among the species with small ellipsoid to subglobose spores (length/width ratio 1.3–1.6), *O. battenii* (with smaller spores) and *O. cejpii* are very similar to *O. gaillardii* but likewise differ in a pale colour of the apothecia. For the tropical *O. guyanensis* see p. 1380.

Variation. The Bolivian collection here referred to *O. gaillardii* differs from the type from Venezuela in somewhat more cylindrical, very slightly curved spores, and larger apothecia with larger excipular cells. The abundant tissue of densely interwoven anchoring hyphae at the apothecial base was not seen in the holotype.

Nomenclature and type studies. Patouillard & Gaillard (1889) described *O. gaillardii* under the illegitimate name *O. tenuissima*, with subglobose spores 0.25–0.5 µm diam., being uniseriately arranged in the asci. Due to the existence of the older *O. tenuissima* Speg., Saccardo (1889) introduced the new name *O. gaillardii* (ICN Art. 53.1, Turland et al. 2018). He and Dennis (1954: 297) copied Patouillard & Gaillard's wrong description of the spores, whereas Dennis later (VIII.1965, in sched.) examined the holotype (FH) and found the spores to be elliptical, 2 × 1 µm, 1–2-seriate, an observation which he used in his key (Dennis 1970: 352). Spooner (1987: 167, pers. comm.) examined a slide of this collection deposited in K, and found the spores 2.5–3 × (0.8–)1 µm. He believed that *O. gaillardii* was very closely related to *O. cunninghamii*, but the Australian specimen that he considered to be *O. cunninghamii* was perhaps *O. dryadum*.

The present examination of the holotype (FH) confirmed the spore length given by Spooner but revealed distinctly wider spores (Pl. 842: 1a). Possibly, Patouillard & Gaillard saw living spores inside the asci and misinterpreted the spore bodies as spores. The apothecia in the holotype grew on bark, not wood as stated in the protologue. Whether duplicate specimens of the type exist remains unclear.

Ecology. *O. gaillardii* was found on ± rotten wood and bark of hygric branches of unidentified broad-leaved trees. The holotype was collected in a lowland floodplain forest with tropical humid (wet and dry) savannah climate at the Orinoco river in the north of South America. The sample from Bolivia was made under a tropical humid highland broad-leaved forest at the southern base of the Los Volcanes mountain range in the Bolivian Andes in the mid west of South America.

Specimens included. **VENEZUELA**: **Bolivar**, Ciudad Bolivar, Fortin El Zamuro (as 'Puerto Zamuro'), 45 m, branch of indet. angiosperm, on bark, 28.V.1887, A. Gaillard (herb. Patouillard, 2^e sér. No. 23, FH 00304811, **holotype**, H.B. 5453 ø). — **BOLIVIA**: **Santa Cruz**, Amboró, 55 km SW of Santa Cruz de la Sierra, 30 km ENE of Samaipata, 4.5 km NE of Bermejo, Refugio Los Volcanes, 1050 m, branch of indet. angiosperm, on wood, 10.V.1998, L. Beenken & C. Hahn (L.B. 1202, H.B. 6606).

Orbilia cejpii Velen., Monogr. Discom. Bohem.: 92, pl. 11 fig. 8 (1934, as *O. cejpi*, ICN Art. 60.8, Ex. 31) — Pls 844–846, Map 135

Etymology: named after the collector, Karel Cejp.

Typification: Slovakia, Brezno, branch of indet. angiosperm, VIII.1930, K. Cejp (PRM 151734, holotype); Germany, Titisee, branch of *Sorbus aucuparia*, 16.VIII.2009, B. Liu & H.O. Baral (ex H.B. 9135, M-0291774, epitype, designated here, MBT385130; sq.: KT222370).

Misapplied names: Ginko (1986), as *O. leucostigma*; Korf (1992, MM 502A), as *O. alnea*; Liu (2006: 64 p.p.), as *O. coccinella*.

Description: — **TELEOMORPH**: **Apothecia** moist/rehydrated 0.15–0.4 up to 0.4–1.5(–2) mm diam., 0.07–0.1 or 0.1–0.28(–0.45) mm high (receptacle 0.065–0.15 mm), whitish or pale yellow-cream or orange-rosaceous-lilaceous, translucent, round, slightly lobate when large, very scattered to gregarious; disc slightly concave to flat, margin distinct, 0–5 µm protruding, smooth; broadly sessile or with an indistinct or distinct stipe 0.03–0.17 × 0.15–0.3 mm, superficial; dry pale yellowish to light reddish-ochraceous. **Asci** *(29–)32–47(–51) × (3–)3.2–4(–4.3) {9} → 3.8–4.3 µm, †(20–)24–42(–45)((–54)) × (2.6–)2.8–3.3(–3.5) µm {11}, 8-spored, spores (*) uni- or apically subbiseriate, 2–6 lower spores inverted {3} (often mixed, often also laterally oriented), pars sporifera *15–20 → 9.5–11 µm long; **apex** (†) medium to often strongly truncate (not or distinctly indented and laterally inflated); **base** with short to medium long, thin or thick, flexuous stalk, L-, h- or H-shaped. **Ascospores** *(2–)2.3–3.5(–4) × (1.4–)1.5–2(–2.2) µm {19}, †(1.9–)2.3–3.3(–3.7) × (1.3–)1.7–1.9(–2)((–2.3)) µm {9}, ellipsoid to ovoid or almost subglobose, rarely fusoid or subcylindrical, apex rounded, sometimes obtuse, base rarely ± tapered, straight or rarely slightly inequilateral; **SBs** *0.3–0.5(–0.6) µm wide {7} (0.5–1 µm total length), consistently present, (sub)globose, apically closely attached or narrowed to a very short fine, often invisible filum, without or with a few minute or small LBs. **Paraphyses** slightly or often medium to (very) strongly (clavate-)capitate at the apex, sometimes asymmetrical, usually straight or only slightly curved at apex, terminal cells */†9–16 {2} or */†15–20 {4} or 19–31 {1} × (1.5–)2–4(–4.8) {9} µm, lower cells *4–9(–11)((–17.5)) × 1.5–2.3(–2.6) µm {4}, †6–10 × 1.1–1.5 µm {T}; sometimes branched at upper septum. **Medullary excipulum** 35–150 µm thick, of dense textura intricata-globulosa-prismatica, indistinctly to sharply delimited from ectal excipulum, at flanks by a 10–30 µm thick layer of t. porrecta. **Ectal excipulum** of thin-walled, indistinctly vertically oriented t. globulosa(-prismatica) from base to margin, 25–120 µm thick near base, cells */†(7–)10–20(–25) × (4–)6–14(–17) µm {6}; 10–25 µm thick near margin, oriented at a 30–90° angle to the surface, marginal cortical cells */†(5–)6–12(–14) × (3–)4–6(–7) µm {7}; **glassy processes** absent. **Anchoring hyphae** sparse to abundant, *(1.5–)2–3 µm wide, walls 0.2(–0.3) µm thick {2}, partly forming strands or a dense t. intricata 50–70 µm thick. **SCBs** globose, in paraphyses (0.7–)1–1.8 µm diam., in medullary and ectal excipulum (near margin) 1.5–2.3 µm); **VBs** absent. **Exudate** over paraphyses absent {4} or as ± sparse granules 0.2–0.6 µm thick, over margin and flanks 0.2–1(–2) µm {4}, more abundant, granular to rough-cloddy, hyaline to pale yellowish. — **ANAMORPH**: dicranidion-like (from ascospore isolate {4} and natural substrate {5}). **Conidiophores** *1.5–16 × 1.5–2 µm, unbranched, apically not attenuated and often irregularly bent, with or without short denticles. **Conidia** 2-armed (exceptionally 4-armed by twice dichotomous branching, B.L. 6578), European collections: *(12.5–)16–21(–27) × (5.5–)6–7(–8) µm {2} or *23–26 × 8–9.5 µm {1}, stipe *4.5–9 × 2.5–2.8 µm {1} or *3.8–4.8 × 3–3.3 µm {1}, 0–1-septate, arms *(5–)8–15(–18) × 2.5–3.2(–3.7) µm {2} or *17–20 × 3.6–4.3 µm {1}, (1–)2–3(–4)-septate {2} or 4-septate {1}, ± parallel, sometimes slightly diverging; extra-European collections: */†25–38 × 6–9(–11.5) µm (11–20 µm if diverging or 4-armed), stipe */†6.5–11 × 2.5–3.5 {5} or 3.8–44.5 {1} µm, 1-septate, arms */†(11–)17–28 × 3–4(–5) µm, (2–)4–6-septate, ± parallel to slightly or medium diverging {6}.

Habitat: corticated or decorticated, 1–20 cm thick branches and logs lying on ± moist ground or 0.3–2.5 m above the ground, of *Adenocarpus foliolosus* {1}, *Barringtonia racemosa* {1}, *Campsis* (?)*radicans* {1}, *Carpinus betulus* {1}, *Clematis vitalba* {1}, ?*Crataegus* sp. {1}, *Eucalyptus globulus* {1}, *Fagus sylvatica* {5}, *Lavandula canariensis* {1}, *Melaleuca* sp. {1}, *Pinus niga* {1}, *Quercus* sp. {3}, *Q. mongolica* {1},?*Rosaceae* {1}, *Salix* sp. {3}, *Sorbus aucuparia* {3}, *Ulex europaeus* {2}, indet. angiosperm trees {3}, on upperside or laterally, on 0.5–2 mm deep strongly decayed wood {30} or bark {10}, with or without beetle galleries, inner surface of detaching bark, or in emergency holes, on hymenium of *Hymenochaetopsis tabacina* (on branches of *Salix*) {1}, leaf of *Cocos nucifera* {1}, greyed or darkened, without or with sparse green algae. **Associated**: *Calocera cornea* {1}, *Calycina citrina* {1}, *C. claroflava* {1}, *Capronia* sp. {1}, ?*Chaetosphaeria myriocarpa* {1}, *Dematioscypha olivacea* {1}, *Gloniopsis* ?*praelonga* {1}, *Hyalorbilia arcuata* {1}, *H. helicospora* {1}, *H. texensis* {1}, *Lecophagus vermicola* {1}, *Metzgeria* sp. {1}, *Orbilia arachnovinosa* {1}, *O. acaciae* {1}, *O.* ?*australiensis* {1}, *O. bambusina* {1}, *O. euonymi* {1}, *O. fabacearum* {1}, *O.* ?*fusiformis* {1}, *O. hesperidea* {1}, *O. nothovinosa* {1}, *O. orientalis* {4}, *O. pleioeuonymi* {1}, *O. trapeziformis* {1}, *O. xanthostigma* {1}, *Parmelia* sp. {1}, *Rhizodiscina lignyota* {1}, *Spadicoides bina* {1}, *Sclerococcum* sp. {1}, ?*Stictis* sp. {1}, ?*Ulota* sp. {1}, *Usnea* sp. {1}. **Desiccation tolerance**: fully viable after 10 days (Sweden), many spores still alive after 8 (Europe), some mature asci and spores still alive after > 2 years (Australia, H.B. 6823d). **Altitude**: 50–1600 m a.s.l. (Europe), 43–1521 m (Macaronesia), 35–150 m (North America), 5–278 m (Australia), 750–850 m (northern China), 2400 m (southern China). **Geology**: Paleozoic calcareous greywacke, Buntsandstein, Keuper (gypsum), Lower Jurassic and Cretaceous limestone & flysch, Tertiary molasse, Pleistocene sand, clay, mud & till; granite, (migmatitic) gneiss, basaltic flows and pyroclasts. **Phenology**: V–XII (temperate northern hemisphere).

Taxonomic remarks. *Orbilia cejpii* is characterized by comparatively small, mostly broadly ellipsoid (to subglobose) ascospores, usually strongly capitate paraphyses, and particularly by a dicranidion-like anamorph in which the mostly 2-armed conidia possess an often 1-septate stipe. The species is very closely related to *O. battenii*, *O. eucalypti*, *O. fissilis*, *O. tremulae*, *O. liliputiana*, and *O. paracylindrospora*. *O. eucalypti* and *O. tremulae* differ from *O. cejpii* in slightly longer spores and in conidia without a distinct stipe, *O. fissilis* in slightly wider spores and the frequent presence of 4-armed conidia, and *O. liliputiana* mainly in unbranched, curved (vermispora-like) conidia. *O. battenii* has smaller, especially narrower spores, while in conidial morphology it is very similar to some extra-European specimens (Pl. 846: 1n, 2) which we refer to *O. cejpii* because

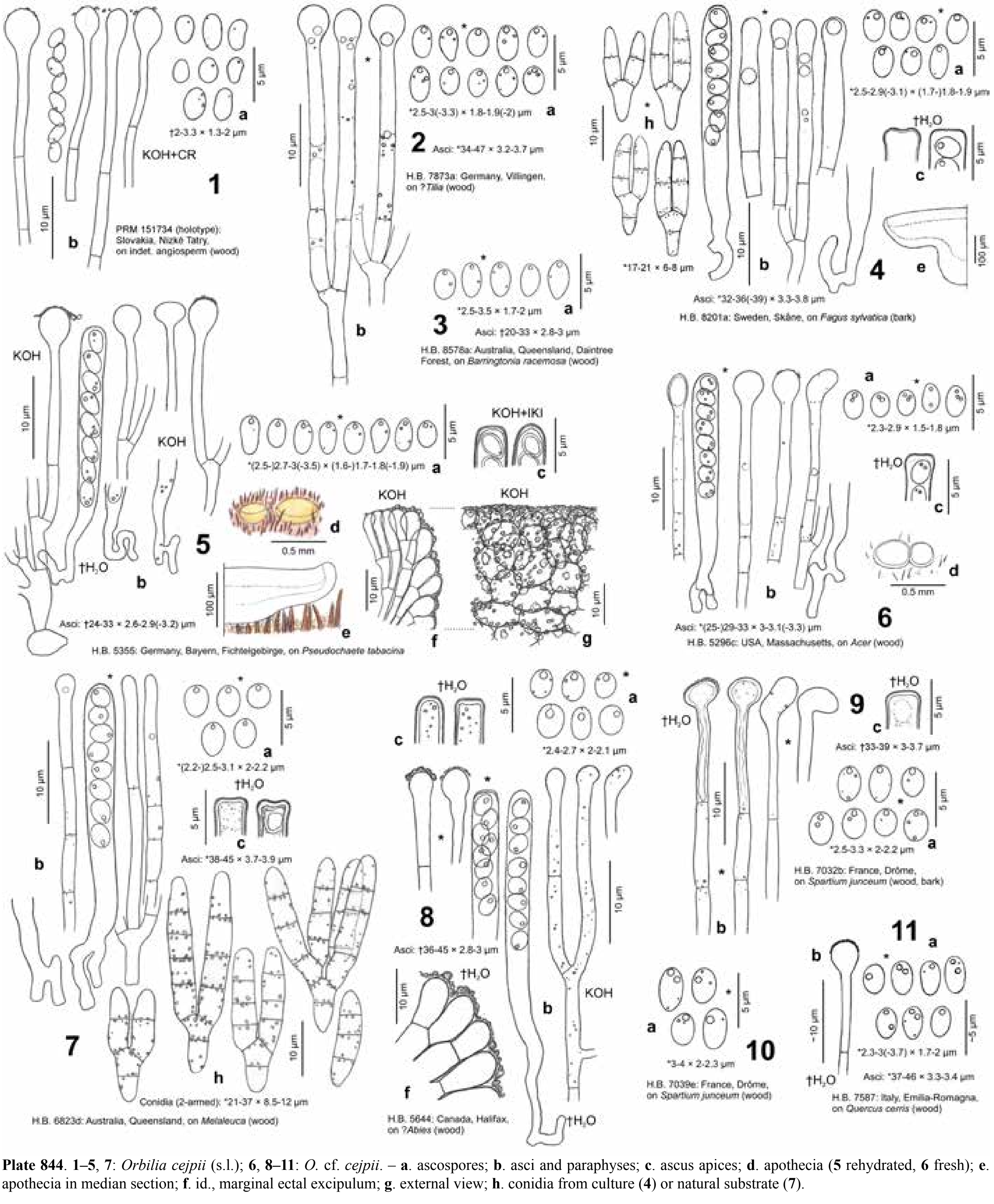


Plate 844. **1–5**, **7**: *Orbilia cejpii* (s.l.); **6**, **8–11**: *O.* cf. *cejpii*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. apothecia (**5** rehydrated, **6** fresh); **e**. apothecia in median section; **f**. id., marginal ectal excipulum; **g**. external view; **h**. conidia from culture (**4**) or natural substrate (**7**).

of larger, particularly wider spores. *O. gaillardii* is separated by its bright orange apothecia and a tropical distribution, while its anamorph is unknown. *O. paracylindrospora* is closely related to *O. cejpii* by molecular data, but differs in more cylindrical, distinctly narrower and slightly longer spores which exceed 4 µm in length, also in a thicker exudate over the paraphyses. Also *O. plurivacuolata* is closely related but differs in longer spores (*3.5–5.5 µm) and multiguttulate paraphyses (living state).

A sharp limit between *O. cejpii* and collections of *O. tremulae* with comparatively small spores is difficult to draw, but only if no anamorph data exist. Confusion with short-spored *O. frangulae* and even *Hyalorbilia hergiswiliana* is easily possible because of a similar spore size and shape (for the differences see there).

A collection from Massachusetts (IVV: H.B. 9998) would fit *O. cejpii* or *O. gaillardii* in the short spores (*2.8–3 × 1.6–1.8 µm), but it features bright yellow apothecia, and its molecular

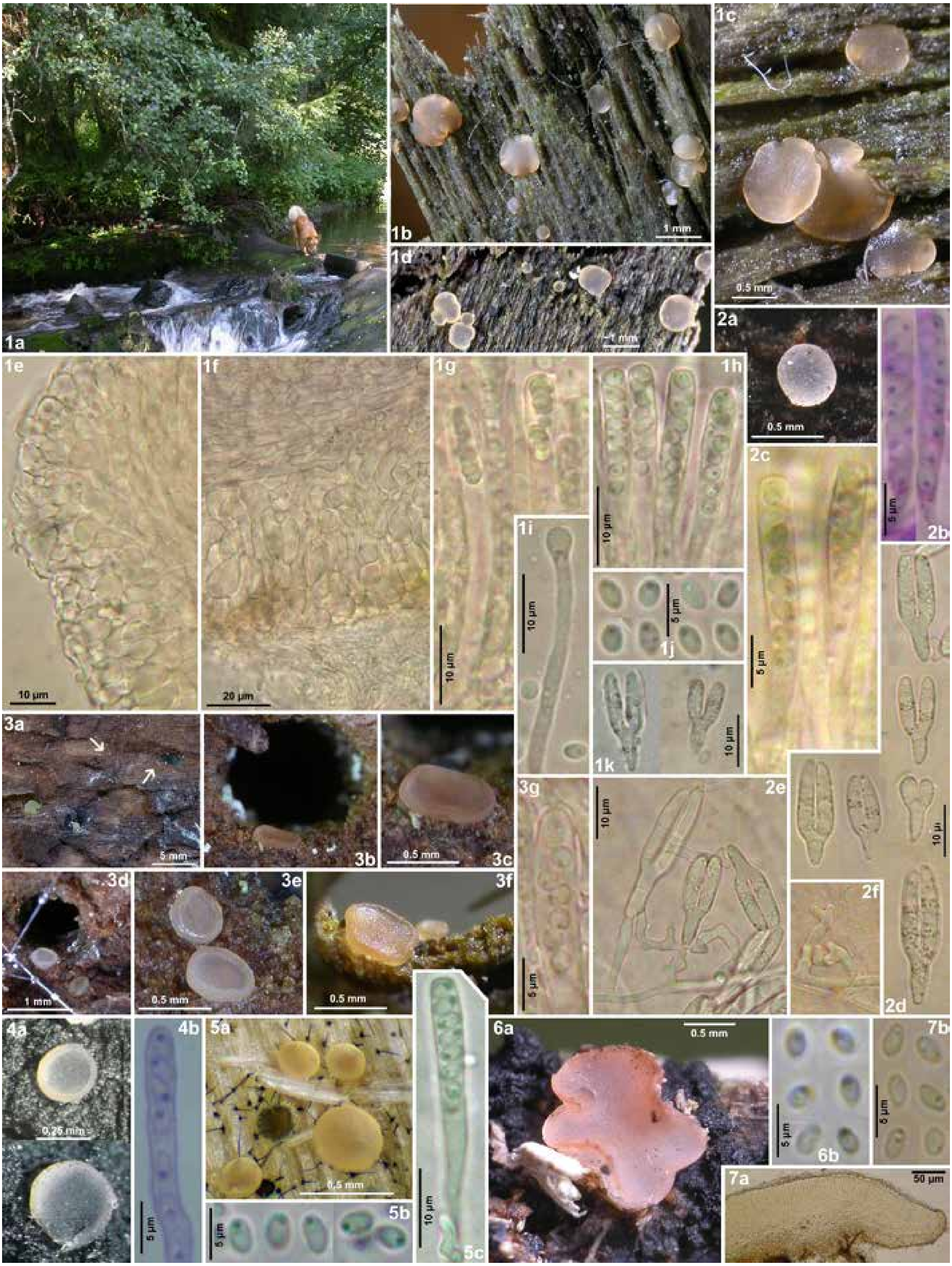


Plate 845. **1–7**: *Orbilia cejpii* (s.l.) – **1a**. submontane floodplain forest on acidic soil (Buntsandstein); **1b–f**, **4a**, **5a**, **6a**. fresh apothecia on hygric wood; **2a**, **3a–f**. rehydrated apothecia on inner surface of detaching xeric bark (**2**: log of *Fagus sylvatica*; **3**: trunk of *Sorbus aucuparia*, close to bark beetle emergency holes); **7a**. apothecium in median section; **1e**. marginal ectal excipulum in median section; **1f**. id., basal ectal and medullary excipulum, with anchoring hyphae below; **1g–h**, **2b–c**, **3g**, **4b**, **5c**. mature asci (**2b** + **4b**: SBs in spores deeply stained); **1i**. paraphysis; **1j**, **5b**, **6b**, **7b**. ascospores; **2e–f**. conidiophores; **1k**, **2d–e**. conidia (**1** from substrate, **2** from culture). – Living state, except for asci in **2b** and **4b** (in CRB), **7a–b**. – **4a–b**: phot. G. Friebes, **5a–c**. M. Bemmann. — **1a–k**. H.B. 7873a: Germany, Villingen, on ?*Rosaceae*; **2a–f**. H.B. 8201a: Sweden, Skåne, on *Fagus*; **3a–g**. H.B. 9135 (epitype): Germany, Titisee, on *Sorbus*; **4a–b**. G.F. 20150102: Austria, Graz, on *Fagus*; **5a–c**. 31.VII.2010: Germany, Heidelberg, on *Fagus*; **6a–b**. H.B. 10023a: France, Pyrenees, on *Salix*; **7a–b**. H.B. 212: Germany, Stuttgart, on *Carpinus*.

data refer it to *O. renispora* which normally has distinctly reniform spores.

Variation. Five sub- to altimontane samples on *Sorbus* and indet. ?*Rosaceae* from Schwarzwald (Villingen and Titisee), Massif central (St.-Étienne) and Somiedo, and one on *Salix* from Pyrenees (Escot) (Pls 844: 2; 845: 1, 3, 6) are characterized by ± rosaceous(-cream) apothecia (white in Somiedo) of 0.3–2 mm diam., slightly to strongly capitate paraphyses, and rather minute SBs, whereas four temperate to submontane samples on *Fagus* from Skåne, Heidelberg and Graz, and one on *Clematis* from Bratislava have whitish-greyish to ochraceous apothecia of 0.25–0.8 mm diam. (Pl. 844: 4), paraphyses with only slightly to medium inflated apex (in spite of being fully mature), and slightly larger, more distinct SBs.

The differences between the two groups are unsharp, however. Ascus and ascospore size is virtually the same, although the majority of spores in the *Fagus* and *Clematis* samples tend to be longer (often *3–3.8 µm), except for the one from Skåne which fits with *2.5–3 µm in the other group. The group with often rose colour shows perhaps a higher tolerance to drought judging from the more exposed apothecia growing 1–2.5 m above the ground, although those from Villingen and Somiedo grew on branches on the moist ground.

According to the six available European sequences, *O. cejpii* belong to two distinct taxa which appear to represent these two groups (see below). Yet, we refrained from splitting the species because many of the samples are without DNA data and difficult to assign based on their morphological and ecological data alone. For instance, a montane sample on *Pseudochaete* on *Salix* (Pl. 844: 5) has rather small, yellowish apothecia but in its strongly capitate paraphyses and minute SBs it appears to fit more the *Salix-Sorbus* group. Here a fine connection of the SBs to the spore wall could be seen.

In the *Fagus* sample from near Graz the apothecia were 0.2–0.4 mm diam. and the spores measured *(2.7–)3.3–3.7 × 1.9–2.2 µm (G. Friebes pers. comm., Pl. 845: 4). Apothecia were recollected from the same log by I. Wendelin 22 days later, and here the apothecia were 0.5–0.85 mm diam. and the spores only †2.5–3 × 1.5–2 µm (IVV: 24.VIII.2015). The sequence was taken from the latter collection under the assumption that both samples were conspecific. Among the four sequences of the *Salix-Sorbus* group, the Somiedo sample shows rather short and broad, subglobose spores of *(2–)2.2–2.5(–2.7) × (1.8–)2–2.2(–2.4) µm compared to *2.5–3 × (1.6–)1.7–1.9(–2) µm in the other three.

The paraphyses of *O. cejpii* are generally straight at the apex. Strongly curved apices were noted in a sample from Texas (IVV: H.B. 5552a). Occasionally or often ± curved or asymmetrical apices occurred especially in one of the not included samples from southern France (on *Spartium*, Pl. 844: 9), but also in the *Fagus* sample from Graz (IVV: G.F. 20150102) and that from Bratislava (on *Clematis*, A.P. 19/21), and more or less in the not included ones from North America.

Two collections from tropical northeastern Australia (Pls 844: 3; 846: 1, on *Barringtonia* branch; IVV: H.B. 8494b, on *Cocos* leaves) also fit well *O. cejpii*, except for the small (0.15–0.4 mm) and thin (0.07–0.1 mm) apothecia growing on more xeric substrate, and the paraphyses having shorter terminal cells (10–17 µm). The sample on *Melaleuca* from eastern Australia (Pls 844: 7) shows the widest ascospores. However, differences are also noted in the conidia (see below). A Chinese collection from Yunnan (Pl. 846: 4, on indet. ?angiosperm, Z.F. Yu pers. comm.) shows spores (*~3–4 × 1.8–2 µm) with rather large LBs, but the conidia obtained in culture fit well those of what we consider to be typical *O. cejpii* (Pl. 845: 2).

Type studies. *O. cejpii* was described by Velenovský with 0.2–0.3 mm large, glassy-translucent, colourless apothecia, asci with long and thin, flexuous, Y-shaped stalk, 2 µm large, subglobose spores, and paraphyses 5–6 µm wide at the very strongly capitate apex. Only a single, very senescent apothecium could be found in the present reexamination of the holotype which consists of a minute fragment of an unidentified angiosperm tree. The ascus walls have disappeared, but paraphyses and spores (some still in a row of 8) were visible (Pl. 844: 1). The spores are found to be distinctly larger than indicated by Velenovský, but also larger than given by Svrček (1954: 12) who measured them as †1.7–2.3 × 1.2–1.5 µm and the asci as †22–30 × 2.3–3 µm. Svrček described the apothecia on the small wood fragment as solitary, only visible under a lens, dry yellowish, thin-membranaceous.

Based on Rehm (1891: 454), Svrček believed that a small-spored form of *O. xanthostigma* s. Svrček (= *O. eucalypti*) existed, '*O. xanthostigma* f. *delicatula* Karst. (sensu Rehm)', and that *O. cejpii* represents this small-spored fungus.

Misapplication. A collection from Macaronesia reported by Korf (1992, CUP-MM-000502A, as *O. alnea*) appears to fit *O. cejpii* because of the small ascospores (†~2.5–3 × 1.2–1.5 µm, evaluated from scale) and the figured conidium. Other collections treated by Korf as *O. alnea* (CUP-MM-002675, 002726) might belong to *O. eucalypti*. Also Ginko's (1986) collection from Poland (as *O. leucostigma*, spores ellipsoid, 2.4–3 × 1–1.8 µm) could belong to *O. cejpii*.

Two samples from Beijing on indet. angiosperms, referred by Liu (2006) to *O. coccinella*, were reexamined (Pl. 846: 3; IVV: H.B. 9117). The former was assigned to *O. cejpii* because of its small spores (†2.7–3.3 × 1.7–1.8 µm) and the characteristic anamorph obtained in culture by B. Liu (pers. comm.). The latter has larger spores, but both clustered in the *cejpii-frangulae* clade and are considered here to be conspecific with *O. cejpii*.

Not included collections. Various samples are not included in the description. Some unillustrated, sparsely documented records from Germany and Luxembourg, also one from France (H.B. 6461b), mostly on xeric substrates, showed spores of about 3–3.5(–3.7) × 1.7–2 µm and thus fit *O. cejpii*, although a relationship to *O. tremulae* cannot be excluded. Also a record from Czechia by Velenovský under the name *O. tremulae* is not included. It might belong to *O. cejpii* according to his unpublished sketch showing broadly ellipsoid, 2–3 µm long spores, but the corresponding material preserved in PRM 149390 contains a species of section *Arthrobotrys* with arcuate spores (see also under *O. tremulae*, p. 1375).

Collections from (sub)mediterranean France and Italy (on *Spartium junceum*, *Quercus cerris*, Pls 844: 9–11; 846: 5) are somewhat intermediate to *O. liliputiana* but differ in slightly larger spores and SBs and more capitate paraphyses. In three collections from Massachusetts (Pl. 844: 6, IVV: H.B. 10001, 23.X.2017, anamorph unknown) the living spores are slightly smaller than in typical *O. cejpii* and seemingly only LBs could be found in them. The other features appear to concur with *O. cejpii*, while *O. battenii* differs in narrower spores with distinct SBs. A Canadian collection (Pl. 844: 8) deviates in rather large SBs, with or without a visible filum, only slightly capitate paraphyses, and in growing on conifer wood. Also a sample from Japan is exceptional in growing on coniferous wood; it fits

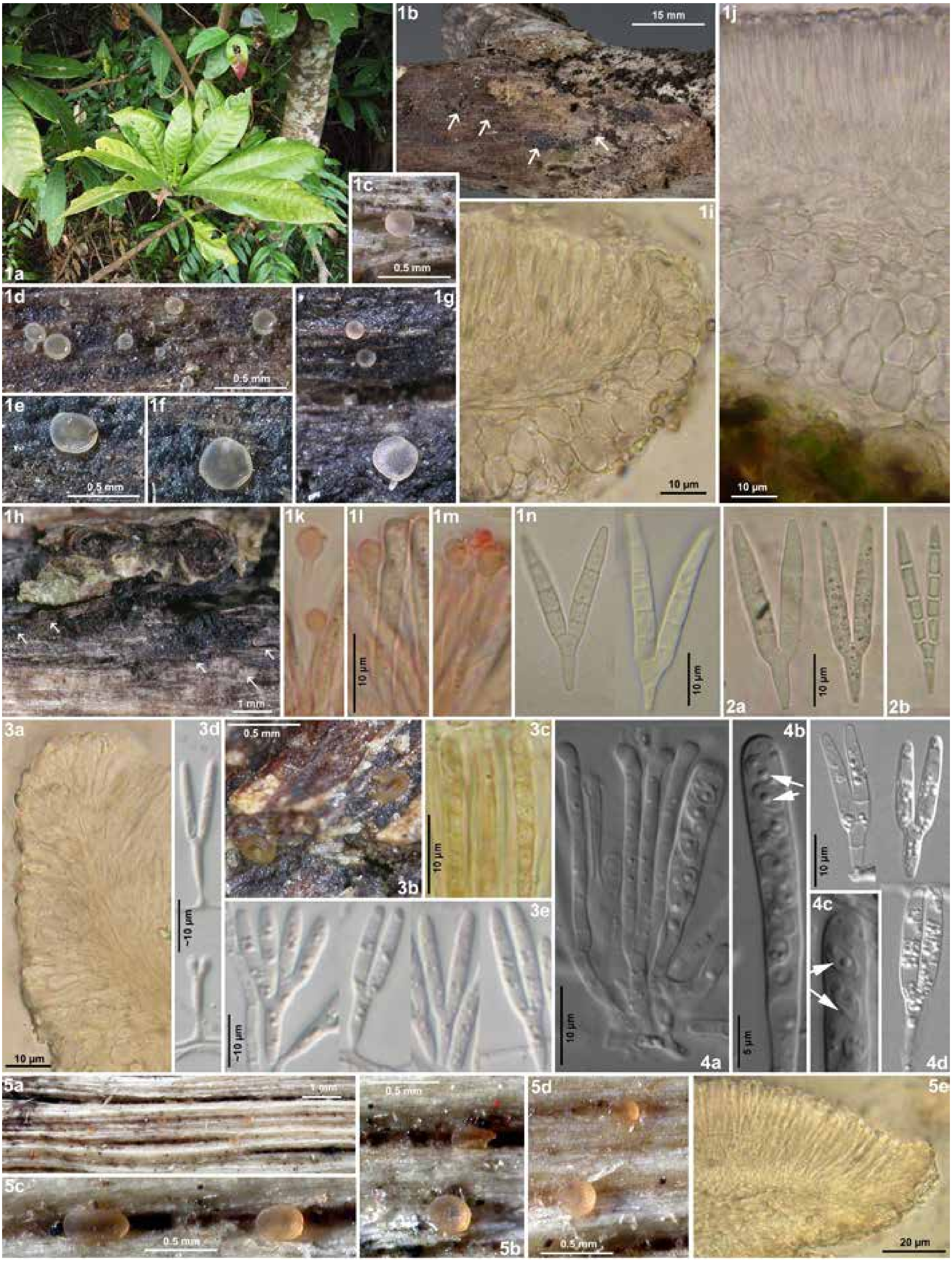


Plate 846. **1–4**: *Orbilia cejpii* s.l.; **5**: *O.* cf. *cejpii*. – **1a**. tropical rainforest (Daintree Forest), with *Barringtonia racemosa*; **1b**. decorticated xeric branch of *B. racemosa*; **1c–h**, **3b**, **5a–d**. rehydrated apothecia; **5e**. apothecium in median section; **1i**, **3a**. id., marginal region; **1j**. id., at lower flanks; **1k–m**, **3c**, **4a**. asci and paraphyses; **4b–c**. ascospores in submature asci; **1n**, **2a–b**, **3d–e**, **4d**. conidia (**1–2** from substrate, **3–4** from culture). – Living state, except for **2b**, **3d** (in H_2O); **1i–j**, **2a**, **3a**, **5e** (in KOH); **1k–m** (in KOH+CR); **3c** (in KOH+IKI). – **3d–e**: phot. B. Liu (DIC); **4a–d**: phot. Z.F. Yu (DIC). — **1a–n**. H.B. 8578a: Australia, Queensland, on *Barringtonia*; **2a–b**. H.B. 5552a: USA, Texas, on *Campsis*; **3a–e**. H.B. 9116, B.L. 6578: China, Beijing, on indet. angiosperm; **4a–d**. Y.Z. jz-46: China, Yunnan, Dali, on indet. angiosperm; **5a–e**. H.B. 7587: Italy, Northern Apennines, on *Quercus*.

well *O. cejpii* in ascus and spore size (IVV: TNS-F-55791), but was studied in the dead state only and is without anamorph data.

Anamorph. The conidia of *O. cejpii* resemble those of the closely related *O. eucalypti*, but differ in usually longer arms and a comparatively long and cylindrical instead of very short and conical stipe. In our two European culture isolates we consider the conidial state as being rather young with partly very small conidia: in the German sample only two conidia were found emerging from mycelium growing out from an apothecium fixed on the lid of a Petri dish (Pl. 845: 1k), while in the Swedish sample the conidia were sparsely formed in pure culture on agar (Pls 844: 4h; 845: 2d–e). In the sample from St.-Étienne (IVV: 13.IX.2018) the conidia from natural substrate had shorter, nonseptate stipes and longer and wider, mainly 4-septate arms.

Korf's (1992) report of a *Dicranidion* sp. associated with a teleomorph which he named *O. alnea* is considered here to represent *O. cejpii*, according to the figured conidium of †18.5 × 5 µm, with parallel, 1-septate arms and long, 1-septate stipe, along with small ascospores.

The conidia from pure culture of two Chinese collections (Pl. 846: 3d–e, 4d) fit well those of the European samples, except for their slightly longer arms. In the one from Beijing, B. Liu (pers. comm.) rarely observed 4-armed conidia (Pl. 846: 3e) reminiscent of *O. fissilis*, but with only slightly diverging arms. Distinctly wider arms and stipes (*3.8–5 µm) occurred on the natural substrate of the Australian sample on *Melaleuca* (Pl. 844: 7); these conidia were found in closer association with *O. ?livistonae*, and also here one of the conidia was 4-armed. In the tropical Australian sample on *Barringtonia* and subtropical North American on *Campsis* (Pl. 846: 1–2) the dicranidion-like conidia on the substrate have longer, more diverging arms with mostly 4–6 septa, which strongly resemble the anamorphs of *O. battenii* or the *xanthostigma-leucostigma* complex For the difficulty to name this type of anamorph see under *O. xanthostigma*, p. 1408.

No conidia were seen in the holotype of *O. cejpii*, therefore, the here assumed identity with the more recent collections is mainly based on spore size and shape. The mostly strongly capitate paraphyses in the holotype and its origin in the subalpine zone with *Pinus mugo* suggest conspecificity with the group on *Sorbus* and *Salix* rather than with that on *Fagus*. We here designate the sample from Titisee (on *Sorbus aucuparia*, ex H.B. 9135) as **epitype** of *O. cejpii*. Future research must clarify the morphological and ecological amplitude of the aberrant taxon on *Fagus*.

Phylogeny. Sequences were obtained from apothecia of three collections on *Sorbus aucuparia* (Titisee, Pl. 845: 3; St.-Étienne, IVV: 13.IX.2018; Somiedo, IVV: E.R.D. 7924), one on *Salix* (Escot, Pl. 845: 6), one on *Fagus* (Graz, Pl. 845: 4), and one on *Clematis* (Slovakia, IVV: 18.V.2019). They comprise ITS and often also LSU, that from St.-Étienne also SSU V8–V9. The four samples on *Salix* and *Sorbus* vary by only 0–0.4% in the ITS and lack the S1506 intron (in the LSU D1–D2 they are fully identical). In contrast, the samples on *Fagus* and *Clematis* possess the S1506 intron where they fully concur, while varying by only 0.2% in the ITS. Surprisingly, the two groups deviate by 16–16.5% (ITS) and 4% (LSU). Sequences were also available from two strains from Beijing: one (Yanqing, as *O. coccinella*, B.L. 6578, H.B. 9116, LSU) matches that on *Fagus* with a distance of only 0.3% (2 nt in D1–D2), suggesting conspecificity, while another (Huairou, B.L. 6176, as *O. coccinella*, H.B. 9117, ITS) clustered within the supported *cejpii-frangulae* clade but with a distance of 14–16% to the six European samples of *O. cejpii* s.l.

In analyses of SSU+ITS+LSU or LSU (Phyls 22, S27), *O. cejpii* on *Salix* and *Sorbus* clustered with *O. plurivacuolata* in a medium supported subclade, whereas *O.* cf. *cejpii* on *Fagus* and *Clematis* and the sample from Yanqing formed with *O. paracylindrospora* and *O. frangulae* a strongly supported subclade which forms a supported sister group to the former. In the SSU (not shown), *O. cejpii* on *Sorbus* clustered with *O. paracylindrospora* by a deviation of 1 nt.

In the ITS/LSU D1–D2, the two European genotypes of *O. cejpii* s.l. differ from *O. paracylindrospora* by 10/3.5% and 8/1.7%, respectively, and from *O. frangulae* by 12.7/3% and 10/1.3%, which are among the lowest distances of *O. cejpii* within series *Orbilia*. *O. plurivacuolata* is much more distant from the *Fagus*/*Clematis* taxon (16.5/4.5%) than from samples on *Salix* and *Sorbus* (9/2.8%). In comparison, *O. cejpii* s.l. differs from *O. eucalypti*, *O. fissilis*, *O. tremulae*, and *O. liliputiana* in the LSU by 4.5–7.5%. In the S1506 intron *O.* cf. *cejpii* shows a high distance to any other taxa of series *Orbilia* which possess it (16.5–17% to *O. plurivacuolata* with which it clustered in Phyl. S26).

In Liu et al.'s (2006a) analysis of LSU, the *O. cejpii* ('*O. coccinella*') strain from Yanqing clustered with rather high distance with a strain from Hunan uploaded under the same name *O. coccinella* (B.L. 748, ITS+LSU). This latter strain represents morphologically typical *O. eucalypti*, but it strongly deviates in the ITS from available sequences of European *O. eucalypti* and nested rather unresolved in our combined analysis (Phyl. 22).

Ecology. *O. cejpii* s.l. was recorded on ± rotten wood and bark of hygric but also xeric branches and trunks of different angiosperm trees and shrubs (particularly *Fagus*, *Quercus*, *Sorbus*, *Salix*), rarely on gymnosperms or perennial basidiomycetes (*Pseudochaete*). Within Europe the sites show an atlantic to subcontinental, cold- to warm-temperate humid climate at colline to altimontane altitudes. The holotype derives from a continental subalpine (orotemperate) *Pinus mugo* belt in the northwestern part of Carpathian Mountains in eastern Europe. In contrast, the two samples from the south of Northern America on *Campsis* and *?Crataegus* derive from the subtropical (sub)humid Oak and Coastal Prairies, and also the three eastern Australian records are from a tropical humid rainforest region (on *Barringtonia* and *Cocos*) and a subtropical subhumid eucalypt open woodland (on a xeric branch of *Melaleuca*); in the latter some mature asci were still viable after 25 months in the herbarium. Also the two Chinese collections include temperate to subtropical humid (winter-dry) climates. Within Macaronesia, the collections from Tenerife were in a lower mesomediterranean humid *Pinus canariensis* forest or fayal-brezal (*Myrica fayae-Ericetorum arboreae*), and at low altitude in an inframediterranean lower semiarid Euphorbia scrub (*Periploco laevigatae-Euphorbietum canariensis*); the sample from Madeira was in a mesosubmediterranean semihumid eucalypt forest.

Among the not included European samples are some from (sub)mediterranean regions on xeric branches of *Spartium junceum* and *Quercus cerris*. Those from northeastern North America were from cold-temperate to boreal humid areas. One of those from Massachusetts (H.B. 5296c) grew among abundant algae (*?Gloeocapsa*) on a water-soaked, decorticated, rotten, 30 cm thick log of *Acer* in association with *O. dryadum* and *O. polybrocha*. In contrast, that from Nova Scotia was on a

Map 135. Known distribution of *O. cejpii* in Europe (yellow = not included collections).

xeric, 4 mm thick coniferous twig, and also a sample from Japan was on coniferous wood.

Specimens included. **SWEDEN**: **Skåne**, Riseberga, Söderåsen, 4.7 km NW of Röstånga, WSW of Skäralid, Skärâns ravin, 75 m, trunk of *Fagus sylvatica*, on bark, 4.VI.2006, H.O. Baral (H.B. 8201a, anam. cult.). — **GERMANY**: **Baden-Württemberg**, 7 km E of Heidelberg, 1.5 km ESE of Ziegelhausen, Bärenbach, 175 m, branch of *Fagus sylvatica*, on wood, 31.VII.2010, M. Bemmann (ø, doc. vid.). – 3 km NW of Stuttgart, Kräherwald, ~350 m, branch of *Carpinus betulus*, on wood, 7.V.1975, H.O. Baral (H.B. 211 ø, 212). – 6 km NE of Tübingen, ENE of Pfrondorf, Tiefenbach, 410 m, branch of *Fagus sylvatica*, on wood, 16.IX.2001, F. Baral-Weber (ø). – Schwarzwald, Titisee, 3.8 km ESE of Neustadt, 3 km WNW of Rötenbach, 925 m, branch (trunk) of *Sorbus aucuparia*, on bark, 16.VIII.2009, B. Liu & H.O. Baral (ex H.B. 9135, M-0291774, **epitype**; sq.: KT222370). – 3 km WNW of Villingen, 4.3 km ESE of Unterkirnach, Brigach river, 732 m, branch ofd ?*Rosaceae*, on wood, 19.VIII.2005, H.O. Baral & E. Weber (H.B. 7873a, anam. apoth.). – **Bayern**, **Oberfranken**, Fichtelgebirge, 18 km NE of Bayreuth, 2.5 km NE of Warmensteinbach, WNW of Fleckl, Ochsenkopf, near Moorbad, 720 m, branches of *Salix*, on *Hymenochaetopsis tabacina*, 25.V.1995, W. Beyer (H.B. 5355). — **FRANCE**: **Nord-Pas-de-Calais**, **Pas-de-Calais**, 17 km WSW of Calais, 1.4 km SSW of Wissant, la Motte du Bourg, 10 m, branch of *Ulex europaeus*, on bark, 29.X.2016, J.P. Priou (J.P.P. 16277, doc. vid.). – **Pays-de-la-Loire**, **Vendée**, 8 km NNE of Fontenay-le-Comte, 1.7 km NW of Mervent, near Pont du Diet, along Mère river, 50 m, branch of *Salix*, on wood, 12.V.2009, N. Van Vooren (N.V. 2009.05.25, H.B. 9059c, doc. vid.). – **Rhône-Alpes**, **Loire**, 12 km ESE of St.-Étienne, 1.9 km NNE of Le Bessat, 1145 m, branch of *Sorbus aucuparia*, on wood & bark, 13.IX.2018, G. Marson (G.M. 2018-09-13.2, anam. substr.; sq.: MK473435). – **Aquitaine**, **Pyrénées Atlantiques**, 11 km WSW of Arudy, 3.8 km E of Escot, 545 m, branch of *Salix*, on wood, 8.X.2016, H.O. Baral (H.B. 10023a; sq.: MK493145). — **SPAIN**: **Asturias** 13.3 km ESE of Pola de Somiedo, NW of collado La Farrapona, 1572 m, branch of *Sorbus aucuparia*, on wood, 25.V.2019, E. Rubio (E.R.D. 7924, doc. vid., sq.: MN108146). – **Navarra**, 28 km N of Pamplona, 3 km SSW of Almandoz, Mendiola, 515 m, branch of *Ulex europaeus*, on wood, 18.X.2019, F.J. Balda (F.J.B. 71019, doc. vid.). — **AUSTRIA**: **Steiermark**, 10 km WNW of Graz, 2 km ENE of St. Oswald, Jägerberg, 650 m, log of *Fagus sylvatica*, on wood, 2.(& 24.)VIII.2015, I. Wendelin, vid. G. Friebes (G.F. 20150102, doc. vid.; sq.: KY419171). – 3.8 km NNW of Gratwein, 3.3 km WSW of Unterfriesach, E of Hörgasgraben, 560 m, branch of *F. sylvatica*, on wood, 9.XII.2017, G. Friebes (GJO 88900, doc. vid.). — **SLOVAKIA**: **Banská Bystrica**, Nizké Tatry, ~15 km N of Brezno, Ďumbier Mt., branch of indet. angiosperm, on wood, ~1600 m, VIII.1930, K. Cejp (PRM 151734, **holotype**, H.B. 6055 ø). – **Bratislava**, 10 km SE of Bratislava, 5 km S of Podunajské Biskupice, Topol'ové hony, 133 m, branch of *Clematis vitalba*, on wood, 18.V.2019, A. Polhorský (A.P. 19/21, BRA-CR31729, doc. vid., sq.: MN611700). — **SERBIA**: **Vojvodina**, Fruška Gora, 13 km S of Novi Sad, 6 km NNW of Irig, Iriški venac, WSW of WWII memorial, 460 m, log of *Pinus nigra*, on wood, 8.VII.2019, D. Savić (FG-1101, doc. vid.). — **MACARONESIA**: **Madeira**, 12.5 km NW of Funchal, 1.4 km N of Serra de Água, Faja dos Funhaticos, 790 m, branch of *Eucalyptus globulus*, on wood, 11.XII.2018, K. Gilbert & B. Wergen (ø, doc. vid.). – **Canary Islands**, **Tenerife**, La Orotava, ~7.5 km SSE of Puerto de la Cruz, ~S of Aguamansa, 1250 m, on bark of indet. plant, 11.I.1976, R.P. Korf et al. (CUP-MM-000502A, as *O. alnea*, anam. substr., doc. vid.). – El Rosario, 17 km WSW of Santa Cruz de Tenerife, 6.5 km SW of La Esperanza, Montaña la Morra, 1521 m, branch of *Adenocarpus foliolosus*, on wood, 3.X.2012, L. & C. Quijada (TFC Mic. 23631, doc. vid.). – La Matanza de Ajentejo, 8.5 km NE of Puerto de la Cruz, 1.5 km WNW of La Matanza de Acentejo, NW of Jagre, 43 m, twig of *Lavandula canariensis*, on wood, 2.III.2013, L. Quijada & I. Pérez-Vargas (TFC Mic. 23887, doc. vid.). — **CHINA**: **Beijing**, **Yanqing**, 83 km NW of Beijing, 14 km WNW of Yanqing, Songshan, Matsuyama forest, 750 m, branch of indet. angiosperm, on bark, 31.VIII.2003, B. Liu (B.L. 6578, HMAS 139709, as *O. coccinella*, anam. cult., H.B. 9116; sq.: DQ656690). – **Huairou**, 115 km N of Beijing, ~11 km WNW of Labagoumenxiang, Sunzhazi, 850 m, branch of *Quercus mongolica*, on wood, 10.VII.2002, B. Liu (B.L. 6176, HMAS 139698, as *O. coccinella*, H.B. 9117; sq.: DQ656626, as *O. alnea*). – **Yunnan**, **Dali**, Binchuan, ~42 km NNE of Dali, ~25 km NW of Binchuan, Jizushan, ~2400 m, on indet. wood (?angiosperm), IX.2005, Y. Zhang & M. Qiao (Y.Z. jz-46, YMFT, anam. cult., doc. vid.). — **AUSTRALIA**: **Queensland**, Wet Tropics, Daintree Forest, 21 km N of Mossman, 8 km ESE of Daintree, Cape Tribulation Rd, Daintree Swamp, 5 m, branch of *Barringtonia racemosa*, on wood & bark, 29.VIII.2006, G. Marson (H.B. 8578a, anam. substr.). – 43 km N of Port Douglas, Cape Tribulation, 14 m, leaves of *Cocos nucifera*, 30.VIII.2006, G. Marson (H.B. 8494b). – Brigalow Belt South, 80 km N of Goondiwindi, 10 km S of Moonie, 278 m, branch of *Melaleuca*, on wood, 23.X.1998, G. Marson (H.B. 6823d, anam. substr.). — **USA**: **Texas**, 32 km N of Houston, Spring, Motel 6, 35 m, branch of *Campsis* (?) *radicans*, on wood & bark, 20.VI.1996, G. Marson (H.B. 5552a, anam. substr.). – ~45 km E of Austin, ~35 km WNW of Giddings, 150 m, branches of (?) *Crataegus*, on wood & bark, 19.VI.1996, G. Marson (H.B. 6018b).

Not included. **LUXEMBOURG**: **Gutland**, **Esch-sur-Alzette**, 10 km ESE of Esch-sur-Alzette, 2.3 km SE of Dudelange, Därebësch, 270 m, branch of *Robinia pseudoacacia*, on wood, 31.X.1993, G. Marson (ø). — **GERMANY**: **Baden-Württemberg**, 6 km NE of Tübingen, ENE of Pfrondorf, Tiefenbach, 410 m, branch of *Quercus*, on wood, 14.X.2002, H.O. Baral (ø). – Schloss Hohentübingen, 360 m, branch of *Sambucus nigra*, on wood, 20.X.2002, E. Weber (ø). – **Bayern**, **Unterfranken**, 16 km NNW of Würzburg, 1.5 km NE of Retzbach, Eichenloh, ~240 m, branch of *Juglans regia*, on wood, 14.X.1994, L.G. Krieglsteiner (L.K.). — **CZECHIA**: **Central Bohemia**, 28 km SE of Praha, 3 km SE of Mnichovice, Hrusice, 360 m, branch of *Populus tremula*, on bark, 13.VI.1923, J. Velenovský (as *O. tremulae*, doc. vid., PRM 149390 [contains *O.* aff. *rubrovacuolata*, H.B. 6422]). — **FRANCE**: **Alsace**, **Haut-Rhin**, 25 km W of Basel, 2 km E of Bisel, W of Rehhof, 425 m, branches of *Quercus*, on wood, 19.IX.1999, H.O. Baral (H.B. 6461b ø). – **Rhône-Alpes**, **Drôme**, Préalpes du Dauphiné, 10 km ESE of Sederon, 0.7 km W of Curel, 765 m, branch of *Spartium junceum*, on wood & bark, 17.VIII.2001, G. Marson (H.B. 7032b, anam. substr.; ex H.B. 7039e, in M-0140892 [H.B. 7039e, type of *O. corculispora*]). — **ITALY**: **Emilia-Romagna**, **Reggio Emilia**, Northern Apennines, 57 km NE of La Spezia, 2.5 km NNW of Ligonchio, WNW of Caprile, 710 m, branch of *Quercus cerris*, on wood, 2.X.2004, J.P. Priou (J.P.P. 24155, H.B. 7587). — **USA**: **Massachusetts**, Middlesex, 2.8 km NNE of Concord, Punkatasset Hill, Hutchins Pond, 41 m, trunk of *Acer*, on wood, 20.VI.1995, D.H. Pfister (H.B. 5296c). – 6.5 km SE of Boston, Thompson Island, 0.6 km SSW of buildings, 5 m, branch of *Tilia*, on wood, 28.VIII.2015, L.A. Kappler, vid. D. Haelewaters (bhi-F544-2, FH, H.B. 10001). – 0.3 km SSW of buildings, 2 m, branch of *Prunus*, on wood, 23.X.2017, D. Haelewaters, J.K. Mitchell & L. Quijada (bhi-F999, doc. vid.). — **CANADA**: **Nova Scotia**, 81 km ENE of Halifax, Taylor Head, Provincial Park, ~20 m, twig of ?*Abies*, on wood, X.1996, C. Peller (H.B. 5644). — **JAPAN**: **Honshu**, **Ibaraki**, 11 km SE of Mito, S of Oarai, 4 m, branch of (?)*Pinus thunbergii*, on wood, 29.VI.1990, T. Hosoya (TRL 85, TNS-F-55791).

Orbilia paracylindrospora Baral & E. Weber, **sp. nov.**, MB 813958 — Pls 847–848

Etymology: named after the ascospores resembling those of *O. cylindrospora*.
Typification: France, Villiers-en-Bois, twig of *Euonymus europaeus*, 27.IV.2011, H.O. Baral (ex H.B. 9484, M-0276550, holotype; sq.: KT222430).

Latin diagnosis: Orbiliae cylindrosporae *similis sed apothecia distincte roseo-aurantia, ascosporae latiores, corpusculum refringens minus, ad apicem filo breve affixum, paraphyses apice saepe curvatae. Habitat ad lignum putridum rami sicci* Euonymi europaei, *in zona temperata humida atlantica in Europae occidentalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.3–0.4 mm diam., 0.1–0.12 mm high, light rose-orange, medium translucent, ± round, subgregarious; disc flat, margin distinct, thick, 10 µm protruding, smooth; broadly sessile, superficial; dry light rose-cream. **Asci** *36 × 3.5 µm, †32–38 × 2.8–3 µm, 8-spored, ~4 lower spores inverted (± strongly mixed); **apex** (†) medium to strongly truncate (not indented, laterally not inflated); **base** with medium to long, thin, flexuous stalk, L-shaped. **Ascospores** *(3–)3.7–4.5(–5) × 1.3–1.4(–

1.6) µm, subcylindric(-ellipsoid), apex rounded to obtuse, straight to (very) slightly curved; **SBs** *0.5–0.8 × 0.3 µm diam., globose, apically with a very delicate filum (or attachment invisible), with 1–2 minute **LBs**. **Paraphyses** apically uninflated or slightly to medium clavate-capitate, often asymmetrical or curved (sometimes hooked), terminal cells *14–20 × 1.6–3 µm, lower cells *4.5–8(–10) × 1.6–2 µm; rarely branched at upper septum. **Medullary excipulum** very pale cream-rose, 25–30 µm thick, of dense, horizontally oriented textura porrecta-prismatica with many inflated cells, sharply delimited. **Ectal excipulum** of (†) thin-walled, vertically oriented t. angularis-prismatica from base to margin, 25–33 µm thick near base, cells *6–12(–15) × 6–10(–12) µm; 20 µm thick at margin, oriented at a 70–80° angle to the surface, marginal cortical cells *7–10 × 3–3.5 µm; **glassy processes** absent. **Anchoring hyphae** abundant, *2–3 µm wide, walls 0.2 µm thick, forming strands. **SCBs** not observed. **Exudate** over paraphyses and margin 0.2–1.5(–2) µm thick, hyaline, granular-cloddy, firmly attached. **— ANAMORPH**: unknown.

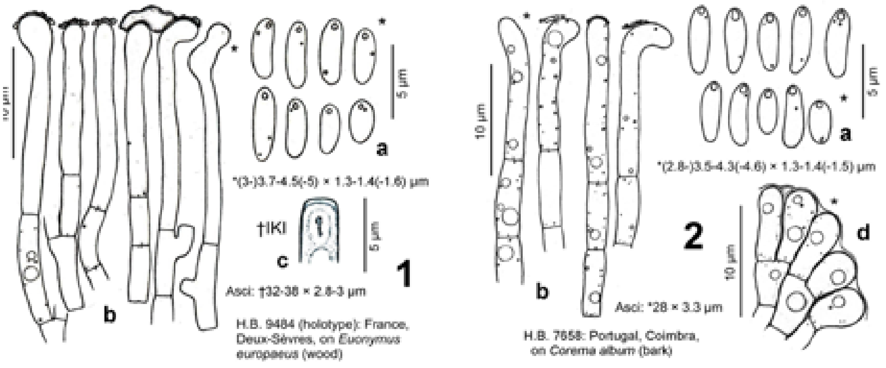


Plate 847. **1**. *Orbilia paracylindrospora*; **2**. *O.* cf. *paracylindrospora*. – **a**. ascospores; **b**. paraphyses; **c**. ascus apex; **d**. marginal ectal excipulum in median section.

Habitat: collected 1.5 m above the ground, partially to often entirely decorticated, 4 mm thick twig of *Euonymus europaeus*, on 0.1–0.3 mm deep strongly decayed wood, slightly greyed, with some green algae. **Associated**: none observed. **Desiccation tolerance**: some paraphyses and ascospores still viable after 2 weeks. **Altitude**: 72 m a.s.l. **Geology**: Upper Jurassic clayey lime- & marlstone. **Phenology**: IV.

Taxonomic remarks. *Orbilia paracylindrospora* closely resembles *O. cylindrospora* (incertae sedis) in the cylindrical ascospores which are, however, slightly shorter and wider (though partly almost identical), and contain much smaller spore bodies (but small SBs were also observed in one of the specimens referred to *O. cylindrospora*). It further differs in the paraphyses being apically often curved and in the broad-leaved substrate. *O. tremulae* differs from *O. paracylindrospora* in wider spores, strongly capitate paraphyses, and usually yellowish apothecia.

Not included collection: A collection from Portugal on *Corema* (Pl. 847: 2) closely resembles *O. paracylindrospora*, e.g., in spore size and shape and in curved paraphyses. It deviates in wider SBs (0.4–0.6 µm) being more directly attached to the apex, and very pale rosaceous-cream apothecia with a thin margin. Very similar spores and SBs occurred in the single sample on angiosperm substrate (*Quercus*) tentatively included in *O. cylindrospora* (Pl. 825: 3): this concurs with *O. paracylindrospora* in the rose(-orange) apothecia with a thick margin and in the atlantic habitat, also in the short and wide spores. However, the asci are much longer and the paraphyses straight. Globose SCBs were seen in these specimens on *Corema* and *Quercus*, but not in the holotype on *Euonymus*. It cannot be excluded that all three specimens are conspecific.

Phylogeny. A sequence was gained from apothecia of the holotype, comprising SSU (with S1506 intron), ITS, and LSU. The lowest distance was observed to *O. frangulae*: 4.2 % in the ITS and 3 nt (0.6 %) in the LSU (D1–D2). *O. paracylindrospora* further deviates from *O. frangulae* by an insert of 44 nt in the ITS2, which is also ± absent in other species of series *Orbilia*. To *O. cejpii* the distances are 8–10 % (ITS) and 3.5 % (LSU), and to *O. tremulae* 14.5 % (ITS) and 6–7 % (LSU). In the intron *O. paracylindrospora* shows a very high distance to any other species, except for *O. frangulae* (1.8–1.9 %).

O. paracylindrospora clustered with *O. frangulae* and *O. cejpii* (on *Fagus*) in a strongly supported subclade of the *cejpii-frangulae* clade (Phyls 22, S27).

Ecology. *O. paracylindrospora* was collected on rotten wood of an attached, xeric twig of *Euonymus* (spindle tree) in a shady warm-temperate to mesosubmediterranean humid, atlantic *Querco-Carpinetum* (with *Lithospermum* and *Melittis melissophyllum*) in the lowlands of western Europe. The not included collection on bark of *Corema* (Portuguese crowberry) was from a thermomediterranean semihumid low shrubland

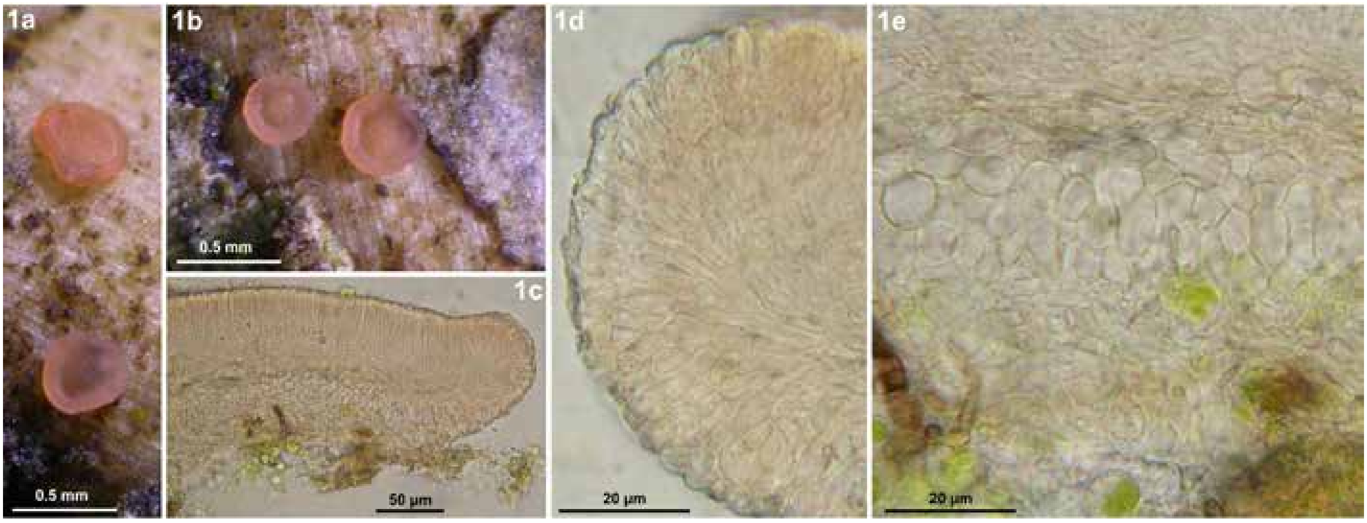


Plate 848. **1**: *Orbilia paracylindrospora*. – **1a–b**. rehydrated apothecia **1c**. apothecium in median section; **1d**. id., marginal ectal excipulum; **1d**. id., ectal excipulum, with medullary excipulum and anchoring hyphae. – Living state. — **1a–e**. H.B. 9484 (holotype): France, Deux-Sèvres, on *Euonymus*.

ahead of the pine forest at the atlantic coastal dune of the Iberian peninsula (southwestern Europe).

Specimens included. **FRANCE**: **Poitou-Charentes**, **Deux-Sèvres**, 4.5 km NW of Chizé, 1.3 km SSE of Villiers-en-Bois, Forêt de Chizé, 72 m, twig of *Euonymus europaeus*, on wood, 27.IV.2011, H.O. Baral (ex H.B. 9484, M-0276550, **holotype**; sq.: KT222430).

Not included. **PORTUGAL**: **Leiria**, Baixo Mondego, Beira, 47 km SW of Coimbra, 17 km SSW of Figueira da Foz, Osso da Baleia, 6 m, branch of *Corema album*, on bark, 26.XII.2004, J.P. Priou (J.P.P. 24285, H.B. 7658 ø).

Orbilia frangulae G. Marson, Baral & E. Weber, **sp. nov.**, MB 814008 — Pls 849–850

Etymology: named after the host tree, *Frangula alnus*.

Typification: Luxembourg, Mersch, Hovelange, on twigs & branches of *Frangula alnus*, 13.IV.2014, G. Marson (ex G.M. 2014-04-13.4 & ex H.B. 9970a, M-0276485, holotype; sq.: KT380095).

Latin diagnosis: Orbiliae paracylindrosporae *persimilis sed ascosporae leniter breviores et latiores, magis ellipsoideae. Habitat ad lignum et corticem putridum ramorum siccorum* Frangulae alni, *in zona* temperata humida *atlantica vel subcontinentale Europae.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.2–)0.3–0.6(–0.7) mm diam., 0.12–0.14 mm high (receptacle 0.1–0.12 mm), whitish-cream to pale or light rose(-orange), medium translucent, round to elongate or undulating, scattered to subgregarious in small groups; disc flat to slightly convex, margin distinct, thick, 0–10 µm protruding, smooth; broadly sessile, with obconical base, somewhat immersed in biofilm or rotten wood; dry pale bright rose-orange. **Asci** *37 × 3.4–3.7 µm {1}, †30–40 × 2.4–3 µm {T}, 8-spored, spores (*) ± obliquely (sub)biseriate, lower spores inverted (± strongly mixed), pars sporifera *11–13 µm long; **apex** (†) medium to strongly truncate, not indented, laterally not inflated; **base** with ± long, thin, flexuous stalk, L- to Y- or H-shaped. **Ascospores** *(2.7–)3–3.8(–4) × (1.1–)1.3–1.6(–1.8) µm {3}, ellipsoid to subcylindrical or subclavate, straight, apex rounded to obtuse; **SBs** globose, *0.3–0.4 µm diam. {1}, attachment invisible, total length 0.5–0.6 µm, with a few minute **LBs**. **Paraphyses** apically uninflated or mostly slightly to medium or (very) strongly capitate-clavate, often asymmetrical, also moniliform, sometimes or frequently hooked, terminal cells *10–15 × 2–3.5 µm {2}, 2–4(–5) µm wide {T}, lower cells †6–8 × 1.3–1.6 µm {1}, unbranched at upper septum. **Medullary excipulum** hyaline, 30–50 µm thick in centre (30 µm at flanks), of dense textura intricata-angularis, sharply delimited by a ~10 µm thick t. porrecta. **Ectal excipulum** of (†) thin-walled, vertically oriented t. angularis-prismatica from base to margin, 35–45 µm thick near base, cells *10–19 × 7–10(–13) µm {T}; 30 µm thick at flanks, 15–20 µm at margin, oriented at an 80–90° angle to the surface, marginal cortical cells †5–10 × 3–4.5 µm {T}; **glassy processes** absent. **Anchoring hyphae** rather sparse, *2,3–2,7 µm wide, walls 0.2–0.4 µm thick {T}. **SCBs** not observed. **Exudate** over paraphyses 0–0.2 µm thick, firmly attached, over margin continuous or cap-like, 0.2–0.8 µm thick. — **ANAMORPH**: dicranidion-like (presumed, from natural substrate {2}). **Conidiophores** not seen. **Conidia** *33–47 × (9–)23–37(–43) µm {2}, stipe *7–18 × 2–2.5 µm, (0–)1–2-septate {2}; 2–3 × dichotomously branched, with 4–8 ± diverging arms of *15–24 × 3–3.5(–4.2) µm, 3–5(–6)-celled {2}.

Habitat: collected 1–3 m above the ground, partially or entirely decorticated, 5–20 mm thick twigs and branches of *Frangula alnus* {4}, on 0.5–1 mm deep strongly decayed wood {3} or bark (bast and periderm) {4}, strongly greyed, green algae abundant. **Associated**: *Corticiaceae* {1}, *Helicogonium orbiliarum* (parasitic in *O. frangulae*) {1}, *Orbilia vinosa* {1}, *Parmelia sulcata* {1}. **Desiccation tolerance**: excipular cells, paraphyses and ascospores still viable after 17 months. **Altitude**: 45–405 m a.s.l. **Geology**: Bretagne: Cambrian siltstone & quartzitic wacke, Luxembourg: Lower Jurassic sandstone. **Phenology**: XII–I, IV, VII (probably throughout the year, rather long-lived).

Taxonomic remarks. *Orbilia frangulae* can hardly be distinguished morphologically from other taxa with small ellipsoid spores. From *O. paracylindrospora* it differs in slightly shorter and wider spores, and from *O. cejpii* and *O. tremulae* in slightly narrower spores. The paraphyses are frequently hooked, a remarkable feature which is usually not seen in *O. eucalypti*, *O. cejpii*, or *O. tremulae*, but which occurs in *O. paracylindrospora* and *O. liliputiana*, though less pronounced. Whether or not the pale cream-rose apothecial colour is a constant feature remains to be seen.

Variation. *O. frangulae* varied in ascospore size and shape between ellipsoid, *2.8–3.2 × 1.3–1.6(–1.8) µm (Koedange and La Gacilly, reminiscent of *O. cejpii*) and subcylindric-subclavate, *(3–)3.3–3.8(–4.2) × (1.1–)1.3–1.6 µm (Hovelange, holotype).

Not included collections. Five collections on hosts other than *Frangula* are not included in the description, mainly because of the taxonomic problems within this group of ellipsoid-spored taxa and the lack of molecular data: two from Luxembourg (on *Ulmus* and *Quercus*) fit very well *O. frangulae* in ascus and spore dimensions and in the often asymmetrical paraphysis apices [*Ulmus*: asci *41–44 × 3.4–3.8 µm, spores *2.5–3.8 × 1.5–1.8 µm; *Quercus*: Pl. 850: 4, spores *2.6–3.8 × 1.3–1.5(–1.7) µm]; a record from Ottawa on decayed *Fomitopsis* (*Piptoporus*) *betulinus* (J. Mack pers. comm., Pl. 850: 5), with often very strongly hooked paraphyses and pale pinkish to vivid pink apothecia, has broadly ellipsoid spores *~3 × 2 µm with larger LBs; a similar sample from Boston on a decayed ?*Schizopora* on *Acer* was only studied in the dead state (IVV: H.B. 10184); a sample from Japan (on *Salix*) has similar spores (†2.5–3.2 × 1.7–2 µm) though without LBs, and also here a majority of paraphyses is hooked at the inflated apex (IVV: H.B. 9988).

Anamorph. In the holo- and paratype from Luxembourg, 2–3 × dichotomously branched, dicranidion-like conidia occurred around the apothecia, which resemble the 2-armed conidia known from, e.g., *O. xanthostigma* and *O. battenii*, or *Hyalorbilia hergiswiliana*. Also in the not included *Ulmus* sample such conidia were observed (Pl. 849). With their 4–6–8 diverging arms and a narrow, medium long stipe they form a brush-like 3-dimensional structure. Similar conidia occurred in apothecia of *O. pleiomicrosoma*, (Pl. 814) but are there interpreted as parasitic.

Phylogeny. Sequences were taken from apothecia of two samples on *Frangula* (holo- and paratype from Luxembourg), comprising the S1506 intron, ITS, and LSU. In their entire overlapping part the two sequences are identical. In phylogenetic analyses of ITS, LSU, or (SSU+)ITS+LSU, *O. frangulae* always clustered with *O. paracylindrospora* and more distantly with *O. cejpii* on *Fagus* (Phyls 22–23, S27). Also when analysing the intron the two former species clustered with low distance

Table 74. Comparison between *O. frangulae* (2 strains) and *O. paracylindrospora* (1 strain) regarding 22 deviating nucleotides in the ITS1-5.8S-ITS2 and an insert of about 44 nt length in the ITS2 of *O. frangulae*, with which 2 nt of *O. paracylindrospora* ambiguously align. Position numbers starting after ATCATTA.

Pos. ITS	31	32	50	61	74	89	92	99	100	102	123	124	154	353	356	357	362–407	427	435	440	519	549	550
O. frangulae	T	C	T	T	A	T	G	T	C	A	G	C	A	T	G	A	insert	T	G	G	T	A	C
O. paracylindrospora	C	T	C	C	C	C	A	C	T	G	A	T	G	C	A	G	————	C	A	A	C	C	T

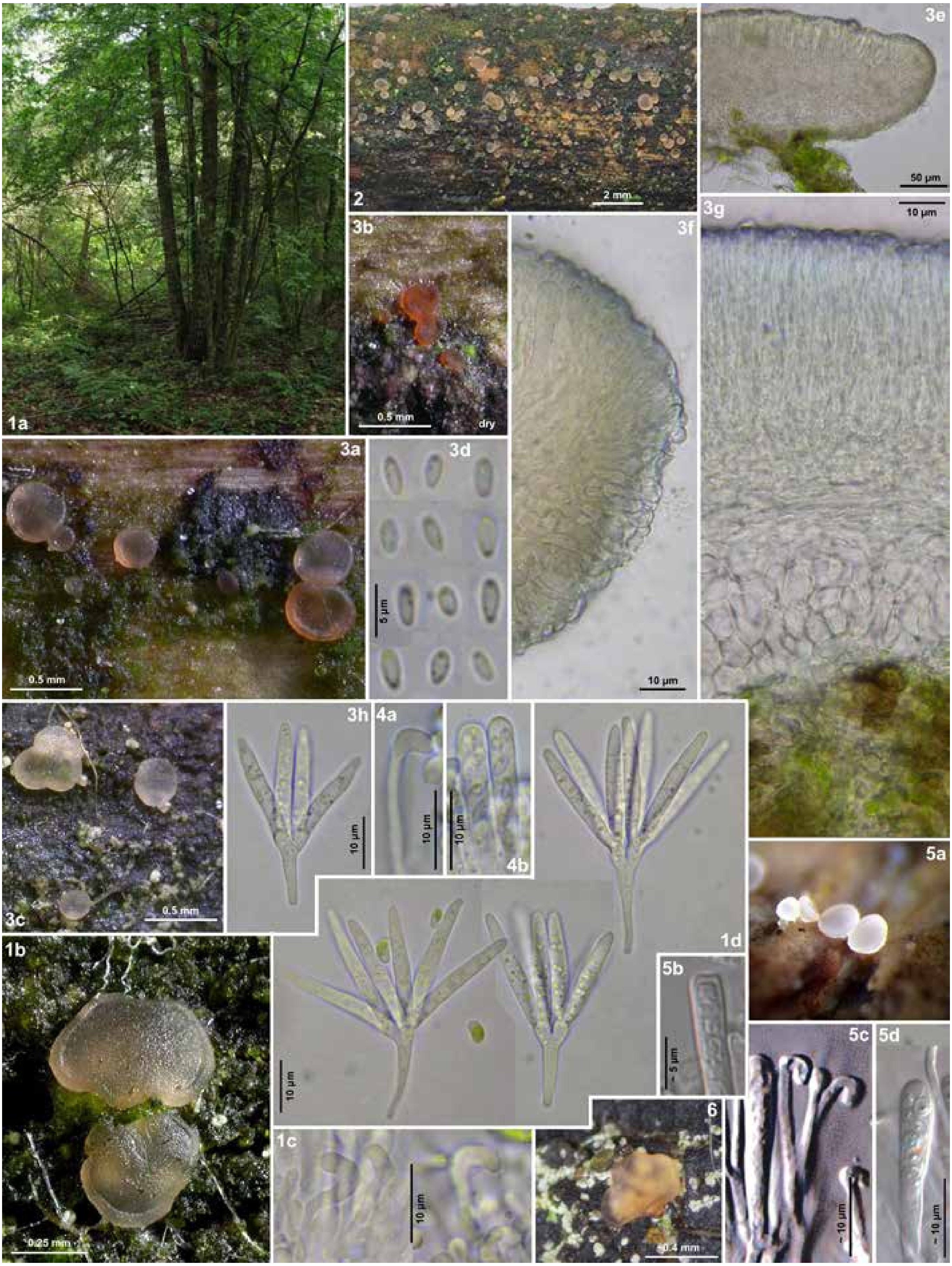


Plate 849. **1–3**, **6**: *Orbilia frangulae*; **4–5**: *O.* cf. *frangulae*. – **1a**. Clearing with *Sorbus aucuparia* and *Frangula alnus* trees in conifer forest; **5a**. fresh apothecia; **1b**, **2**, **3a**, **c**, **6**. rehydrated apothecia; **3b**. dry apothecia; **3e**. apothecium in median section; **3f**. id., marginal ectal excipulum; **3g**. id., lower flanks; **1c**, **4a**, **5c**. paraphyses; **4b**, **5b–d**. upper part of asci; **3d**. ascospores; **1d**, **3h**. conidia from substrate. – Living state, except for asci in **5b–d**. – **5a–d**: phot. J. Mack (DIC), **6**. J.P. Priou. — **1a–d**. G.M. 2014-07-12: Luxembourg, Koedange, on *Frangula*; **2**. G.M. 2016-01-23.1: ibid., on *Frangula*; **3a–h**. H.B. 9970a (holotype): ibid., Hovelange, on *Frangula*; **4a–b**. 11.X.2012: ibid., Senningerberg, on *Quercus*; **5a–d**. 2.XII.2013: Canada, Ottawa, on *Fomitopsis*; **6**. J.P.P. 14210: France, Morbihan, La Gacilly, on *Frangula*.

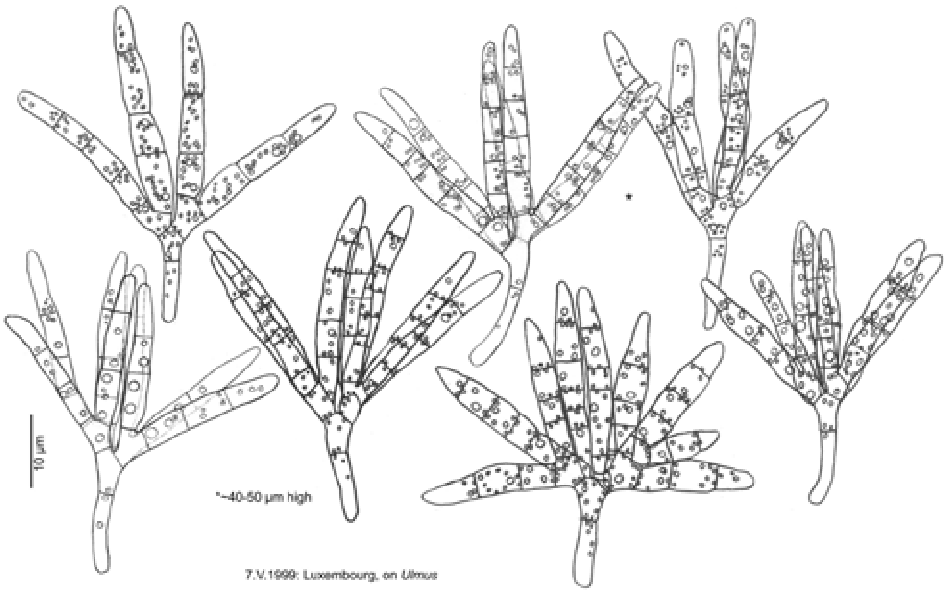


Plate 850. *Orbilia* cf. *frangulae*. – Conidia from substrate.

(1.8–1.9 %) in a strongly supported clade (S26), but very distant from any other species, including *O. cejpii* on *Fagus*. To *O. paracylindrospora* the distance in the ITS is 4.5 % (24 nt, Tab. 74; 0.6 % in LSU D1–D2), to *O. cejpii* 10–12.7 % (1.3–3 % in LSU), and to *O. tremulae* 17.3–18 % (6–7 % in LSU). The S1506 intron of *O. frangulae* is much longer than in *O. paracylindrospora*. An insert of about 44 nt occurs near the 5-end of ITS2 of *O. frangulae* in comparison to *O. paracylindrospora*, which also lacks in other species such as *O. cunninghamii*, *O. dryadum*, *O. fissilis*, *O. tremulae*, and *O. liliputiana* which are difficult to align with *O. frangulae* and *O. paracylindrospora* in this region.

Ecology. *O. frangulae* was collected on rotten wood and bark of xeric twigs and branches of *Frangula alnus*, in ± shady and moist, humid forests of warm-temperate atlantic western (Bretagne) and cold-temperate subcontinental central Europe (Luxembourg). The three sites in Luxembourg are on sandstone of lower lias, whereas that from Bretagne is on Cambrian (Brioverian) schist. One of the examined apothecia of the holotype was infected by *Helicogonium orbiliarum*. Not included collections were on branches of *Ulmus* and *Quercus* in Luxembourg, and on basidiocarps of *Fomitopsis* in cold-temperate to hemiboreal humid northeastern North America and northern Japan.

Specimens included. **LUXEMBOURG**: **Gutland**, 15 km WSW of Mersch, SSW of Hovelange, Haard, 350 m, twigs & branches of *Frangula alnus*, on wood & bark, 13.IV.2014, G. Marson (ex G.M. 2014-04-13.4 & H.B. 9970a, M-0276485, **holotype**, anam. substr.; sq.: KT380095). – 7 km ESE of Mersch, 1.2 km W of Koedange, NNE of Stuppicht, Breedschet, 405 m, branches of *F. alnus*, on wood & bark, 12.VII.2014, G. Marson (G.M. 2014-07-12.2, anam. substr.; sq.: KT380096). – ibid., 1 km NW of Koedange, Weyerpad, 400 m, branch of *F. alnus*, on wood & bark, 23.I.2016, G. Marson (G.M. 2016-01-23.1). — **FRANCE**: **Bretagne**, **Morbihan**, 4.5 km WNW of La Gacilly, SW of Haudiart, la Gourgandais, 45 m, branch of *F. alnus*, on bark, 7.XII.2014, J.P. Priou (J.P.P. 14210 ø, doc. vid.).

Not included. **LUXEMBOURG**: **L'Oesling**, 9 km NW of Redange, W of Holtz, Gebrannte Boesch, 400 m, branch of *Ulmus glabra*, on bark, 7.V.1999, G. Marson (ø, anam. substr.). – **Gutland**, 9 km NE of Luxembourg, 1.2 km N of Senningerberg, 405 m, branch of *Quercus*, 11.X.2012, G. Marson (ø). — **CANADA**: **Ottawa**, 14 km E of Ottawa, N of Chapel Hill South, 83 m, on *Fomitopsis betulina*, 2.XII.2013, J. Mack (ø, doc. vid.). – **USA**: **Massachusetts**, 12 km SE of Boston, Peddocks Island, West Head, 5 m, log of *Acer*, on wood and ?*Schizopora*, 10.V.2017, L.A. Kappler & J.K. Mitchell (bhi-F896, H.B. 10184). — **JAPAN**: **Hokkaido**, ~20 km NW of Tomakomai, Shikotsu lake, ~300 m, branch of *Salix*, on wood, 14.IX.1995, T. Hosoya (TRL 1364, TNS-F-57053, H.B. 9988 ø).

Orbilia plurivacuolata Baral, G. Marson & E. Weber, **sp. nov.**, MB 826934 — Pls 851–852, Map 136

Etymology: named after the numerous small, hyaline, refractive vacuolar guttules in paraphyses and marginal cortical cells.

Typification: Spain, Asturias, Pola de Somiedo, branch of *Rosa*, 7.VI.2013, T. Læssøe (ex H.B. 9817a, AH 52848, holotype; sq.: MK493139).

Latin diagnosis: Orbiliae eucalypti *similis sed paraphyses et cellulae marginales excipuli vacuolae numerosae minutae globosae hyalinae refringentia continentes. Habitat ad corticem vel lignum putridum siccum* Rosae *et* Salicaceae *in zona boreale, temperata et suprasubmediterranea (semi)humida Europae.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.25–)0.4–1(–1.5) mm diam., 0.12–0.19 mm high, light to deep yellow-orange, orange-rose, rose-red, or brick-red, not or slightly translucent, round, strongly undulating when large, scattered or mostly gregarious in groups; disc medium concave to flat, margin distinct, thin or thick, distinctly raised but not protruding, smooth; broadly sessile, superficial or indistinctly erumpent. **Asci** *45–62 {2} × 4–4.8 µm {3}, †50–55 × 3.4–4 µm {1}, 8-spored, spores (*) obliquely uniseriate or subbiseriate above, 2–6 lower spores inverted {4} (usually mixed), pars sporifera *19–24 → 15.5 µm long; **apex** (†) medium to strongly truncate (partly distinctly indented, laterally not inflated); **base** with short to medium long, ± thick, only slightly flexuous stalk, Y-, h- or H-shaped. **Ascospores** *(3–)3.5–5.5(–6.5) × (1.8–)2–2.4(–2.6) µm {9}, ellipsoid- to ellipsoid-clavate or fusoid, rarely subglobose, apex rounded to obtuse, base not or slightly to strongly attenuated, straight; **SBs** *0.4–0.6(–0.8) µm wide {3}, globose, total length 0.6–1 µm including invisible connecting part; without or often with 2–6 **LBs**, partly grouped around SB but often also near basal end, 0.3–0.7 µm diam. {7}. **Paraphyses** apically slightly to strongly clavate-capitate, sometimes moniliform, straight {6} or partly to predominantly asymmetrical to hooked {3}, terminal cells *(12–)18–22(–34) {2} × (2.2–)2.5–4(–4.7) µm {5}, lower cells *5.5–9(–17.5) × 1.5–2.2 µm {2}; unbranched at upper septum, subhymenium and lower part of hymenium hyaline to light orange or rose. **Medullary excipulum** hyaline to pale orange or rose, 30–40 µm thick, of ± dense textura intricata with many inflated cells, sharply delimited from ectal excipulum. **Ectal excipulum** of (†) thin-walled, vertical t. angularis(-prismatica) from base to margin, 25–50 µm thick near base, cells *12–22 × 8–13 µm {1}, †5.5–16 × 4.5–7 µm {1}; near margin 15–20 thick, oriented at a 70–80° angle, marginal cortical cells *5–8 × 4–6 µm {1}, †5–9.5 × 2.5–4 µm {2}; **glassy processes** absent {5}. **Anchoring hyphae** abundant, *2–3.5 µm wide, walls 0.2(–0.3) µm thick {1}, forming a ± dense t. intricata up to 50 µm thick. **SCBs** not observed; **VBs** 0.3–0.8 µm diam., globose, slightly to strongly refractive, densely filling the terminal and subterminal cells of paraphyses and the marginal cortical cells (multiguttulate) {8}, not showing Brownian motion; **LBs** ± abundant in lower part of paraphyses, subhymenium, medullary excipulum, and

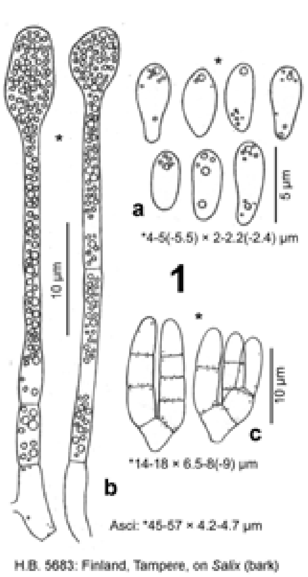


Plate 851. **1**: *Orbilia plurivacuolata*. – **a** ascospores; **b**. paraphyses; **c**. conidia formed on excipulum.

Plate 852. **1–5**: *Orbilia plurivacuolata*. – **4a**. Corticated *Salix* branch with *Hypogymnia physodes* and large periderm-free area; **1a**, **2a–b**, **3a–b**. rehydrated apothecia; **4b**. apothecium in median section; **4c**. id., marginal ectal excipulum; **1b–d**, **2c–h**, **3c**, **5a–d**. asci and multiguttulate paraphyses; **1d**, **2i**. ascospores. – Living state, except for **4b–c** (in KOH), some asci in **2h**, **3c**, **5b–d** (in H_2O). – **2**: phot. I. Wagner. — **1a–d**. H.B. 7825: Germany, Lenggries, on *Salix*; **2a–i**. 16.II.2013: Germany, Sonneberg, on *Salix*; **3a–c**. H.B. 9817a: Spain, Somiedo, on *Rosa* (holotype); **4a–c**. H.B. 5683: Finland, Tampere, on *Salix*; **5a–d**. G.M. 2016-02-10.2: Luxembourg, Géisselbierg, on *Salix*.

marginal excipular cells, containing carotenoids (light golden yellow-orange) {5}, LBs in pale-coloured apothecia sparse or subhyaline. **Exudate** over paraphyses absent or 0.2–0.3 µm thick, smooth to finely rough, firmly attached, over margin and flanks absent or 0.3–0.8(–2.5) µm thick, granular-cloddy to continuous. **— ANAMORPH**: dicranidion-like (presumed, from natural substrate {2}). **Conidiophores** not observed. **Conidia** 2-armed, the arms parallel, *14–18 × 6.5–8 µm {1}, base conical, with indistinct nodulous scar, basal cell ± deltoid, each arm delimited by a basal septum, the 2 septa forming a ~90° angle; arms *(7–)11–15 × 3–3.8 µm, 2–4-septate; rarely 3-armed, *9 µm wide.

Habitat: ~1–3 m above the ground, corticated to partially decorticated, 7–30 mm thick twigs and branches, rarely trunks, of *Populus tremula* {1}, *Rosa* sp. {1}, *Salix* sp. {2}, *S. aurita* {1}, *S. caprea* {3}, on bark {7} (bast), more rarely wood {3}, in small to large holes of periderm, partly hidden below detaching periderm, or on decorticated areas, little to rather strongly decayed, algae absent, rarely abundant. **Associated**: *Hypogymnia physodes* {1}, *Merismodes* sp. {1}, *Mollisia rosae* {1}, *Parmelia* sp. {1}, *Sclerococcum* ?*stygia* {1}. **Desiccation tolerance**: fully viable for at least ~5 days, excipular cells, ascospores, and conidia viable after at least 4 weeks. **Altitude**: Scandinavia: 77 m a.s.l., central & southern Europe: 293–1600 m. **Geology**: Precambrian & Cambrian greywacke, silt- & sandstone, Devonian & Carboniferous clayey schist etc., Buntsandstein, Keuper (Rhätsandstein), Lower Jurassic sand- & limestone, dolomite; granite, gneiss, amphibolite, mica schist, phyllite. **Phenology**: XII–II, VI.

Taxonomic remarks. The here included eight collections of *Orbilia plurivacuolata* deviate from *O. eucalypti* in multiguttulate paraphyses (living state!) being filled with numerous small, globose, hyaline, medium to strongly refractive VBs. These VBs do not tremble by Brownian motion, apparently because each droplet represents a single vacuole. They stain distinctly turquoise in CRB and disappear in KOH or after longer storage in the herbarium. Except for slight differences in the presumed anamorph, *O. plurivacuolata* fits in the other features *O. eucalypti* which has paraphyses with larger, partly elongate, non- or rarely slightly refractive vacuoles.

In seven samples the ascospores contained in varying frequency LBs of 0.3–0.7 µm diam. Although such comparatively large LBs occur mainly in aberrant spores of *O. eucalypti*, they appear to be typical of normally developed spores of *O. plurivacuolata*, in which aberrant spores have as yet not been observed.

It cannot be excluded that teleomorphs described by Velenovský (*O. microclava*, on *Populus*; *O. alnea*, lectotype on *Salix*; *O. succinea*, on *Rosa*) or Svrček (*O. roseofuscella*, on *Picea*), here placed in synonymy with *O. eucalypti*, represent *O. plurivacuolata*. In any case, guttulate paraphyses were not reported by these authors and the spores contained only a few minute LBs in the present reexamination (Pl. 855: 1–3, 5).

Variation. In three of the German samples the paraphysis tips were partly to predominantly hooked like a walking stick, a feature typical of *O. frangulae*. Apothecial colour varied among the samples between light to deep yellow-orange, orange-pink, and rose. Within the collection from Finland, all these striking colour variants were observed intermingled, but the microscopical features were the same. In this specimen the hyaline VBs were present in all paraphyses of four apothecia examined (with either yellow-orange or rose colour). However, they were completely absent in two other, ± orange apothecia, although the paraphyses were fully alive in all 6 apothecia tested.

Ascospore size mostly ranged at *(3–)3.5–5(–5.5) × (1.8–)2–2.4(–2.6) µm, except for the unillustrated sample from Vosges (*5–6 × 2–2.3 µm). In the holotype the spores measured *3.5–4.5 × 2–2.4 µm and often contained two LBs.

Anamorph. The conidia observed in the sample from Finland emerged from the excipulum of the two apothecia with non-guttulate paraphyses. Whether these apothecia belong to *O. plurivacuolata* or *O. eucalypti* remains unclear, but the slightly larger conidia with 2–4-septate arms might indicate a morphological difference to *O. eucalypti*. Also in the sample from Luxembourg a few dicranidion-like conidia were observed but not documented. In conidial characters *O. plurivacuolata* does not differ from the type of *Dicranidion fragile* on *Nerium* from California. Even if the limits of the *O. eucalypti* complex is better understood in the future, clarification of the identity of *D. fragile* in its original sense will hardly be possible without molecular methods.

Map 136. Known distibution of *O. plurivacuolata* in Europe.

Not included collection: A sample from Massachusetts (IVV: bhi-F948) shows multiguttulate paraphyses reminiscent of *O. plurivacuolata*. It is named *O.* aff. *plurivacuolata* because of a high genetical distance.

Phylogeny. Sequences of two samples were available: H.B. 9817a (holotype, Spain, Somiedo, *Rosa*, apothecia rose-pink) and G.M. 2016-02-10.2 (Luxembourg, *Salix*, apothecia yellow-orange), both comprising S1506 intron+ITS+LSU. They differ in the ITS by 1.1% (5 nt, 4 gaps), in the intron by 0.9% (4 nt, 1 gap), and in the LSU D1–D2 by 0.5% (3 nt), suggesting conspecificity.

O. plurivacuolata clustered with a 9–10% ITS distance with *O. cejpii* (on *Sorbus* and *Salix*) in a medium supported subclade (Phyls 22, S27), whereas the distance to *O. cejpii* on *Fagus* lies at 13.5–16.5% and to *O. eucalypti* in the range of 13–23% (the lower values to subclade D). *O.* aff. *plurivacuolata*, for which only ITS was available (intron absent), clustered distantly and unresolved between the *O. eucalypti* clade and the *cejpii-frangulae* clade (Phyl. 23) by showing an ITS distance of 9.5% to *O. plurivacuolata*.

Ecology. Apothecia of *O. plurivacuolata* grew on xeric bark or more rarely wood of *Populus*, *Salix*, and *Rosa*. Seven of the eight collections were on *Salicaceae* in supra- to orotemperate and thermoboreal humid areas of Europe. The sample from Vosges was a boggy *Salicetum*, that from Lenggries the subalpine *Pinus mugo* belt with some *Salix* and *Fagus*, that from Sonneberg a narrow forest belt with *Salix* and *Betula*, also *Populus tremula*, *Acer*, and *Picea*, and that from Luxembourg a thermophilous *Querco-Carpinetum* with *Crataegus*, *Cornus*, *Prunus spinosa*, *Populus tremula* etc. The holotype on *Rosa* was from a *Quercus ilex* forest with *Corylus avellana* in mesosubmediterranean semihumid southwestern Europe. The not included sample is from a cold-temperate humid angiosperm (*Acer*) forest in eastern North America.

Specimens included. **FINLAND**: **Pirkanmaa**, 15 km WSW of Tampere, 3.5 km S of Nokia, S of Keho, Kehonnokka, 77 m, branch of *Salix*, on bark, 29.XII.1996, U. Söderholm (U.S. 2663, H.B. 5683, anam. substr.). — **GERMANY**: **Sachsen-Anhalt**, 14.5 km S of Quedlinburg, 2.2 km NNE of

Harzgerode, Schiebecksbachtal, 300 m, trunk of *S. caprea*, on bark, 6.I.2013, G. Hensel & U. Täglich (ø). – **Thüringen**, 2.5 km SW of Sonneberg, S of Hönbach, 355 m, branch of *S. caprea*, on wood & bark, 16.II.2013, I. Wagner (ø, doc. vid.). – **Bayern**, **Oberfranken**, 6 km N of Marktredwitz, NW of Leutenberg, 583 m, branch of *Populus tremula*, on wood, 22.II.2020, M. Reul (M.R. 7582, doc. vid.). – **Oberbayern**, 12 km SSW of Bad Tölz, 6.3 km WSW of Lenggries, Latschenkopf, 1600 m, branch of *Salix*, on bark, 21.VI.2005, B. Fellmann & P. Karasch (H.B. 7825 ø). — **LUXEMBOURG**: **Gutland**, 5 km S of Luxembourg, 1.7 km WSW of Hesperange, W of Géisselbierg, 293 m, branch of *S. caprea*, 10.II.2016, G. Marson (G.M. 2016-02-10.2, anam. substr.; sq.: MK473418). — **FRANCE**: **Lorraine**, **Vosges**, 8.5 km ESE of Gérardmer, 5 km SE of Xonrupt-Longemer, Lac de Retournemer, 780 m, branch of *S. aurita*, on bark, 23.VI.1990, H.O. Baral & G. Marson (ø). — **SPAIN**: **Asturias**, 2.4 km N of Pola de Somiedo, 2 km S of Castro, 703 m, branch of *Rosa*, on wood & bark, 7.VI.2013, T. Læssøe (ex H.B. 9817a, AH 52848, **holotype**; sq.: MK493139).

Not included. **USA**: **Massachusetts**, 19 km SE of Boston, 2.7 km NE of Hingham, S of Rocky Neck, Weir River Road, 3 m, branch of indet. angiosperm, on bark, 6.X.2017, D. Haelewaters, J.K. Mitchell & L. Quijada (bhi-F948, doc. vid.; sq.: MH445966, as *O.* aff. *eucalypti*).

Orbilia fissilis (K. Ando & Tubaki) E. Weber & Baral, in Baral et al., Mycol. Progr. 17 (1–2): 20 (2017) — Pls 853–854

Basionym: *Dicranidion fissile* K. Ando & Tubaki, Trans. Mycol. Soc. Japan 25(1): 39 (1984)

Etymology: referring to the conidia being split into arms.

Typification: Japan, Tsuchiura, isolated from rainwater from the intact canopy of *Quercus myrsinifolia*, 8.VII.1983, K. Ando (TKB-F-5079, holotype; ex-type culture: TKB-C-1362; sq.: LC146730).

Description: — **TELEOMORPH**: **Apothecia** fresh (0.3–)0.4–1 mm diam., 0.1–0.28 mm high, pale to light rose-orange, ± translucent, round to slightly undulating, gregarious; disc flat to finally medium convex, margin thin, 0–5 µm protruding, smooth; subsessile or broadly sessile, superficial; dry light to bright pink-rose-orange. **Asci** 33–43(–50) × 3.3–4 → 3.8–4.4 µm {2}, †25–40 {4} or 35–45 {1} × 2.7–3.7(–4) µm {5}, 8-spored, spores (*) uniseriate, lower spores inverted (very strongly mixed), pars sporifera *17–20 → 12.5–15.5 µm long; **apex** (†) strongly truncate (not or slightly indented, laterally sometimes slightly inflated); **base** with short to medium long, thin or thick, flexuous stalk, T-, L-, Y- or h- to H-shaped. **Ascospores** *(2.1–)2.3–3(–3.4) × (1.8–)1.9–2.3(–2.5) µm {5}, †2.4–2.8 × 1.7–2 µm {1}, broadly ellipsoid to subglobose, ends rounded; **SBs** *0.3–0.5 µm diam., globose, attachment directly, or invisibly at a short distance, surrounded by a few large (0.5–0.8 µm) and small LBs. **Paraphyses** apically slightly to medium (rarely strongly) clavate-capitate, sometimes (sub)lageniform, terminal cells *(9.5–)15–20(–22.5) × 2.3–3.8(–4.5) µm {2}, lower cells *5–10 × 1.5–2.3 µm {2}; sometimes branched at upper septum, hymenium very pale rose. **Medullary excipulum** hyaline, 30–100 µm thick, of dense textura intricata-prismatica(-angularis), indistinctly to sharply delimited from ectal excipulum, partly by a 10–15 µm thick, pale greyish-rose layer of t. porrecta. **Ectal excipulum** hyaline, of thin-walled, vertically oriented t. globulosa-angularis(-prismatica) from base to margin, 25–130 µm thick near base, cells *8–25(–35) × 7–15(–17) µm {1}; cortical cells at submargin *6–22 × 5–9 µm, 20–30 µm thick near margin, oriented at a 60–80° angle to the surface, marginal cortical cells *5–9 × 4–5 µm {1}; **glassy processes** absent. **Anchoring hyphae** medium to very abundant, *1.8–2.8(–3.3) µm wide, walls *0.2(–0.3) µm thick (†0.2–0.4 µm) {1}. **SCBs** in paraphyses not observed, in medullary excipulum (near ectal excipulum) globose, 1.2–2 µm diam.; **VBs** sometimes present in paraphyses, elongate, hyaline, low-refractive. **Exudate** over paraphyses and exterior absent or sparse to abundant, ~0.2–0.5 µm thick, granular-cloddy. **— ANAMORPH**: dicranidion-like (from ascospore isolate {1} and natural substrate {1}). **Conidiophores** */†7–25 × (1–)2–3 µm {2}, unbranched, ± flexuous, conidia mainly terminally and sympodially formed. **Conidia** 1–2 × dichotomously branched (2- or 4-armed in about equal frequency, less often 3-armed), */†(12–)14–20(–22) µm long {3}, 2-armed conidia */†7–11 {2} or 10–16.5 {1, H.B. 9844} µm wide, 3-armed */†(8–)10–14 µm {2}, 4-armed */†(9–)11–19 µm {2}, stipe */†5–9.5(–11) × (1.6–)2–3 {3} [in Ando & Tubaki (1984b) as trunk (= main axis) of 7.5–10.5(–12) × 2.4–4 µm {T}], 0–1(–3)-septate, arms */†(2–)3.5–12(–15) × (1.7–)2–3(–3.5) {3} µm, (0–)1–3(–4)-septate, when 2-armed then arms parallel or diverging or only terminally curved outwards; rarely unbranched (T).

Habitat: collected 0–1 m above the ground, decorticated or corticated, 2.2–70 cm thick branches, stumps or logs of *Quercus* sp. {1}, *Q. myrsinifolia* {1}, indet. angiosperms {3}, on deeply strongly decayed wood {2} or bark {3} (outer and inner surface), somewhat greyed, with many green algae (especially *Gloeocapsa*). **Associated**: *Mollisia* ?*oblonga* {1}, *Gloeocapsa* sp. {1}, ?*Parmelia* sp. {1}. **Desiccation tolerance**: after 1 day only the cells of the ectal and medullary excipulum were still viable, but spores survived for at least 4 weeks. **Altitude**: 290–560 m a.s.l. (central Europe), 450 m (central Asia), 30 m (central Japan), 2700 m (southern China). **Geology**: France: Silurian-Devonian greywacke & ultrabasic olistolith; Germany: Keuper (Stubensandstein). **Phenology**: VII–X (teleomorph).

Taxonomic remarks. *Orbilia fissilis* strongly resembles *O. eucalypti* in characteristics of the teleomorph, but its ascospores tend to be subglobose, i.e., they are shorter and with a lower length/width ratio than is usually the case in *O. eucalypti*. *O. cejpii* differs from *O. fissilis* in slightly narrower spores with smaller LBs, but mainly in the anamorph.

A few collections of *O. eucalypti* showed a varying number of subglobose spores similar to those of *O. fissilis*, though with a tendency to being larger and sometimes fusoid or ovoid (see

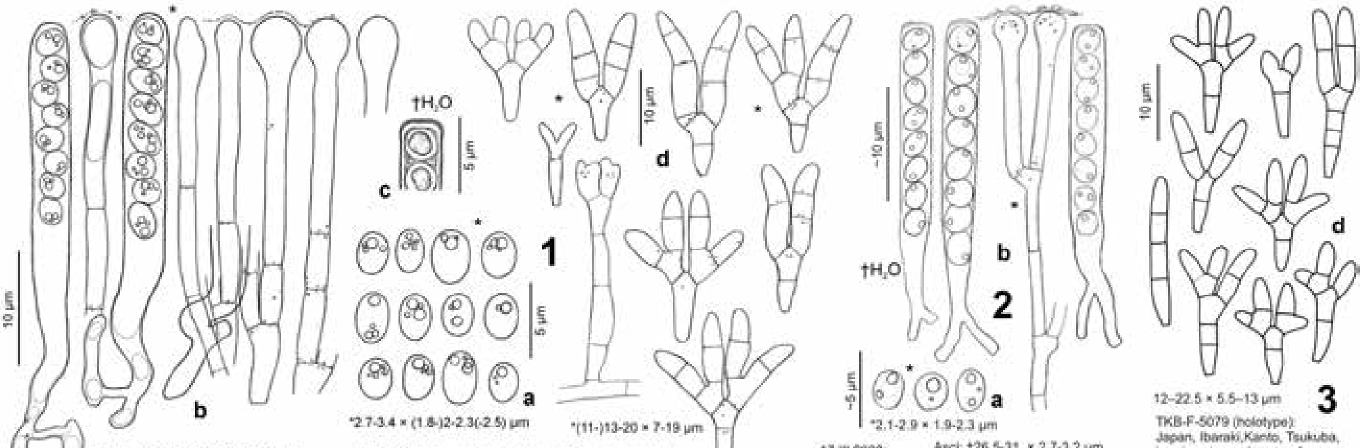


Plate 853. **1**: *Orbilia fissilis*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apex; **d**. conidia from culture. – **2**: del. E.S. Popov, **3**: from Ando & Tubaki (1984b).

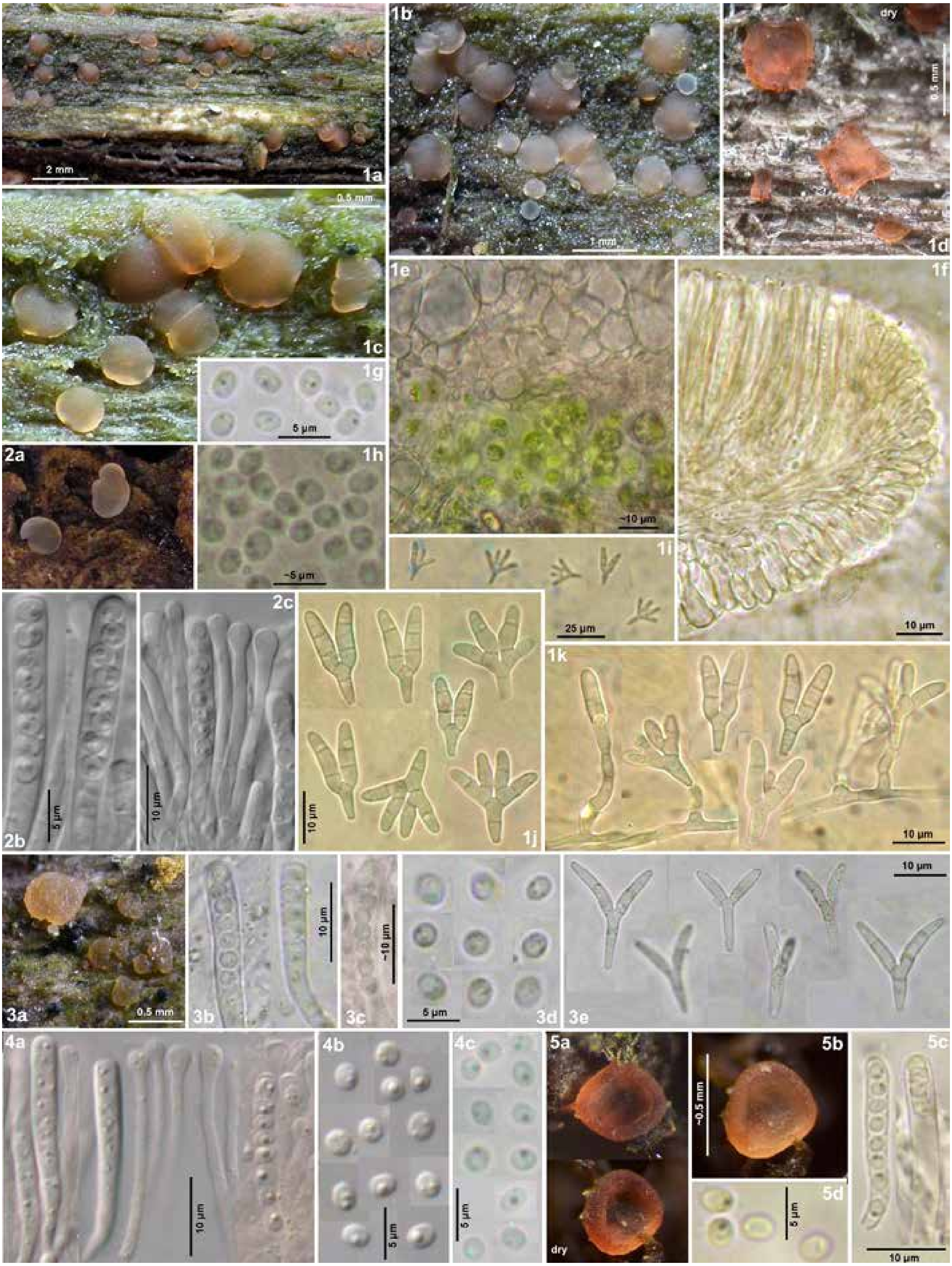


Plate 854. **1–4**: *Orbilia fissilis*; **5**: *O.* cf. *fissilis*. – **1a–c**, **2a**, **3a**, **5b**. fresh apothecia; **1d**, **5a**. dry apothecia; **1f**. ectal excipulum in median section (margin and mid flanks); **1e**. id. (near base, with *Gloeocapsa*); **2b–c**, **3b–c**, **4a**, **5c**. asci and paraphyses; **1g–h**, **3d**, **4b–c**, **5d**. ascospores; **1i–k**, **3e**. conidia and conidiophores (**1**: from culture, **3**: from natural substrate). – Living state, except for **1f–g** (in KOH), **3b–c** (asci), **4a** (asci & paraphyses), **5c** (left ascus). – **2a–c**: phot. Z.F. Yu (DIC), **3c**: N. Van Vooren, **4**: E.S. Popov (**4a–b**: DIC), **5**: G. Friebes. — **1a–j**. H.B. 7566a: Germany, Tübingen, on *Quercus*; **2a–c**. Y.Z. jz-36: China, Yunnan, Dali, indet. angiosperm; **3a–e**. H.B. 9844: France, Lyon, on ?*Salix*; **4a–c**. 17.VIII.2008: Russia, Altay, indet. angiosperm; **5a–d**. G.F. 20100313: Austria, Graz, on *Fagus*.

Pl. 858: 6–8). In contrast to *O. fissilis*, all these subglobose-spored variants of *O. eucalypti* grew on xeric substrate. In many collections here referred to *O. eucalypti* no associated anamorph could be found, therefore, especially those with small, broadly ellipsoid spores remain somewhat uncertain in their identity.

Variation. Although differing from the specimen from Tübingen in shorter asci, the other included collections are considered as conspecific because of a very similar ascospore size and shape containing large LBs, also because the apothecia grew on hygric substrate.

The SB in the spores of the specimen from Tübingen could only be distinguished from the surrounding LBs by a blue(-violet) stain in CRB, or by disappearing in KOH. However, this test was not applied to the drawn spores, therefore, the identity of each individual drop is not clear on the drawing. The presence of large LBs surrounding a smaller spore body was first thought to be characteristic of this species. However, E.S. Popov (pers. comm.) noted in his specimen that virtually all drops in the spores persist in KOH, whereas in G. Friebes' (pers. comm.) not included Austrian specimen a distinct SB is visible in the apex of each spore, while associated LBs are sparse. The Chinese specimen closely resembles the one from Tübingen in spore guttulation. A similar variation in spore guttulation between collections was frequently noted in *O. eucalypti*.

Not included collections: Two unillustrated records from Germany (ascospores 3–3.5 × 1.8–2.3 µm, on *Weigela*, 1.5 m above the ground) and France (orange apothecia, ascospores 3–3.3 × 2 µm, on *Fagus*, on the ground) are not included because of incomplete documentation, and a specimen from the Comoros (IVV: M.P. 13.167) because of bright chlorinaceous-yellow apothecia and rather small spores (2.2–2.4 µm diam.).

In the Austrian specimen large LBs in the ascospores did not occur, therefore, this could instead belong to *O. cejpii* in which, however, a light orange-red apothecial colour seems to be untypical. The asci were with *27.5–32.5 × 3.5–4 µm shorter than here reported for *O. fissilis* and *O. cejpii*, and the spores with *2–3.3 × 1.7–2.3 µm partly wider than in *O. cejpii*.

Anamorph. The dicranidion-like conidia of *O. fissilis* obtained in pure culture of the collection from Tübingen were frequently 4-armed, with ± diverging arms and a distinct, partly 1-septate stipe (Pls 853: 1d; 854: 1i–j). They herein sharply differ from the conidia of *O. eucalypti* with 2 (rarely 3) mostly not diverging arms and nearly absent or rather short stipe. The original description of *Dicranidion fissile* fits very well our strain in having 2-, 3- and 4-armed, though also unbranched conidia (Ando & Tubaki 1984b, Pl. 853: 3). The type differs from our strain in slightly longer conidiophores and conidial stipes, the latter with 1(–3) septa, also in narrower arms and stipes which might, however, be due to the dead state of the conidia. In the collection from Lyon 2-armed conidia were observed on the natural substrate (besides phragmoconidia which are of unclear relationship). They differ from the specimen from Tübingen in rather narrow arms and stipes (max. *2.2 µm), with the arms consistently diverging (Pl. 854: 3e), but they resemble those 2-armed conidia with diverging arms in the protologue. Also *O. cejpii*, *O. battenii* and *O. liliputiana* differ from *O. fissilis* in the anamorph (see there).

Phylogeny. A sequence taken from an ascospore isolate of the collection from Tübingen comprises SSU (with S1506 intron), ITS, and LSU. From the ex-type culture from Japan a sequence is deposited at NBRC and GenBank, which includes S1506 intron, ITS, and LSU. In the LSU the two sequences are identical, while in the ITS region the distance is 2.6% and in the intron 2.3%.

O. fissilis shows a high distance to any other species: in the LSU a minimum of 3.8% to *O. liliputiana* was noted, in the ITS min. 13.5% to *O. eucalypti,* and in the intron min. 18% to *O. leucostigma*. In the SSU V8–V9, however, it almost coincides with *Tridentaria implicans* and *O. tremulae*, showing to each a 1 nt deviation in the V8 (Phyl. S25). *D. inaequale* forms an unsupported clade with *O. fissilis* (Phyls 22–23), to which it shows a distance of 15%.

Ecology. *O. fissilis* is only known from a few records on hygric rotten wood and bark of angiosperms. The specimen from Tübingen grew on an old oak bench made of thick boards at a fireplace in a shady cold-temperate humid *Quercus-Fagus* forest. The Austrian sample on a *Fagus* stump originates from a probably similar forest. The specimen from France was on a recently fallen, completely rotten, corticated branch of an unidentified angiosperm in an almost warm-temperate *Quercus-Carpinus* forest, and that from Russia in an *Alnus fruticosa-Betula-Salix* forest in the boreal, cold-continental humid western Sayan Mountains. In contrast, the Chinese sample is from a subtropical humid (winter-dry) evergreen forest. The holotype of *D. fissile* was isolated from rainwater draining mainly from leaves of intact *Quercus myrsinifolia* trees in the subtropical humid central part of Honshu in Japan. Whether the conidia were formed on living leaves or on twig bark or dead wood in the canopy is unclear. The not included collection from southeastern Africa was in a tropical humid (wet & dry) rainforest in the Comoros.

Specimens included. **GERMANY**: **Baden-Württemberg**, 4.3 km WSW of Tübingen, NE of Hirschau, Spitzberg, Greut, 450 m, board of *Quercus*, on wood, 29.VIII.2004, E. Weber & H.O. Baral (H.B. 7566a; CBS 117019, anam. cult.; sq.: KT596781). — **FRANCE**: **Rhône-Alpes**, **Rhône**, 26.5 km NW of Lyon, 1.3 km W of Légny, bois de la Flachère, 290 m, branch of indet. angiosperm, on wood & bark, 11.X.2013, N. Van Vooren (N.V. 11.10.2013, H.B. 9844, anam. substr.). — **RUSSIA (East)**: **Altay**, Sayan Mts., 8.5 km ENE of Yaylyu, near Kamga cordon, mouth of Malyj Miokok river, 450 m, on bark of indet. angiosperm, 17.VIII.2008, E.S. Popov (ø, doc. vid.). — **JAPAN**: **Honshu**, **Ibaraki**, 60 km NE of Tokyo, 10 km WNW of Tsuchiura, Tsukuba University, near campus, 30 m, in rainwater from leaves of *Quercus myrsinifolia*, 8.VII.1983, K. Ando (TKB-F-5079, **holotype**; ex-type cultures TKB-C-1362, conid. isol., doc. vid.; sq.: LC146730, NBRC 31823). — **CHINA**: **Yunnan**, **Dali**, Binchuan, ~42 km NNE of Dali, ~25 km NW of Binchuan, Jizushan, ~2700 m, branch of indet. angiosperm, on bark, IX.2005, Y. Zhang & M. Qiao (Y.Z. jz-36, YMFT, doc. vid.).

Not included. **GERMANY**, **Baden-Württemberg**, Tübingen, Kloster Bebenhausen, 365 m, branch of *Weigela*, on wood, 20.V.2001, H.O. Baral (ø). — **AUSTRIA**: **Steiermark**, Grazer Bergland, 14 km NW of Graz, 4 km WNW of Gratkorn, NW of Stift Rein, 560 m, stump of *Fagus sylvatica*, on wood, 30.X.2010, G. Friebes (G.F. 20100313, doc. vid.). — **FRANCE**: **Poitou-Charentes**, **Charente-Maritime**, 25 km SSE of Niort, 2.5 km ESE of la Villedieu, Forêt d'Aulnay, 115 m, branch of *Fagus sylvatica*, on wood, 28.IV.2006, H.O. Baral (ø). — **COMOROS**: **Mayotte**, 6.5 km NW of Bandrele, 2.5 km NE of Ouangani, Crête de Benara, 240 m, branch of indet. angiosperm, on wood, 26.IV.2013, M. Pélissier, vid. J.P. Priou (M.P. 13.167, J.P.P. 13074, doc. vid.).

Orbilia eucalypti (W. Phillips & Harkn.) Sacc., Syll. Fung. 8: 628 (1889) — Pls 855–860, Map 137

≡ *Calloria eucalypti* W. Phillips & Harkn., Bull. Calif. Acad. Sci. 1(no. 1): 23 (1884)

(?)= *Dicranidion fragile* Harkn., Bull. Calif. Acad. Sci. 1(no. 3): 163 (1885)

(?)= *Pedilospora parasitans* Höhn., Sitzungsber. Kaiserl. Akad. Wiss. Wien, Math. Naturwiss. Kl., Abt. I, 111: 61 (1902)

(?)= *Dicranidion argentinense* Speg., Anal. Mus. nac. B. Aires, Ser. 3, 13: 459, fig. 71 (1911)

(?)= *Pedilospora ramularioides* Bubák, Ann. Mycol. 14: 156, fig. 2 (1916)

(?)= *Pedilospora episphaeria* Höhn., Centbl. Bakt. ParasitKde, Abt. II, 60: 26 (1923) [1924]

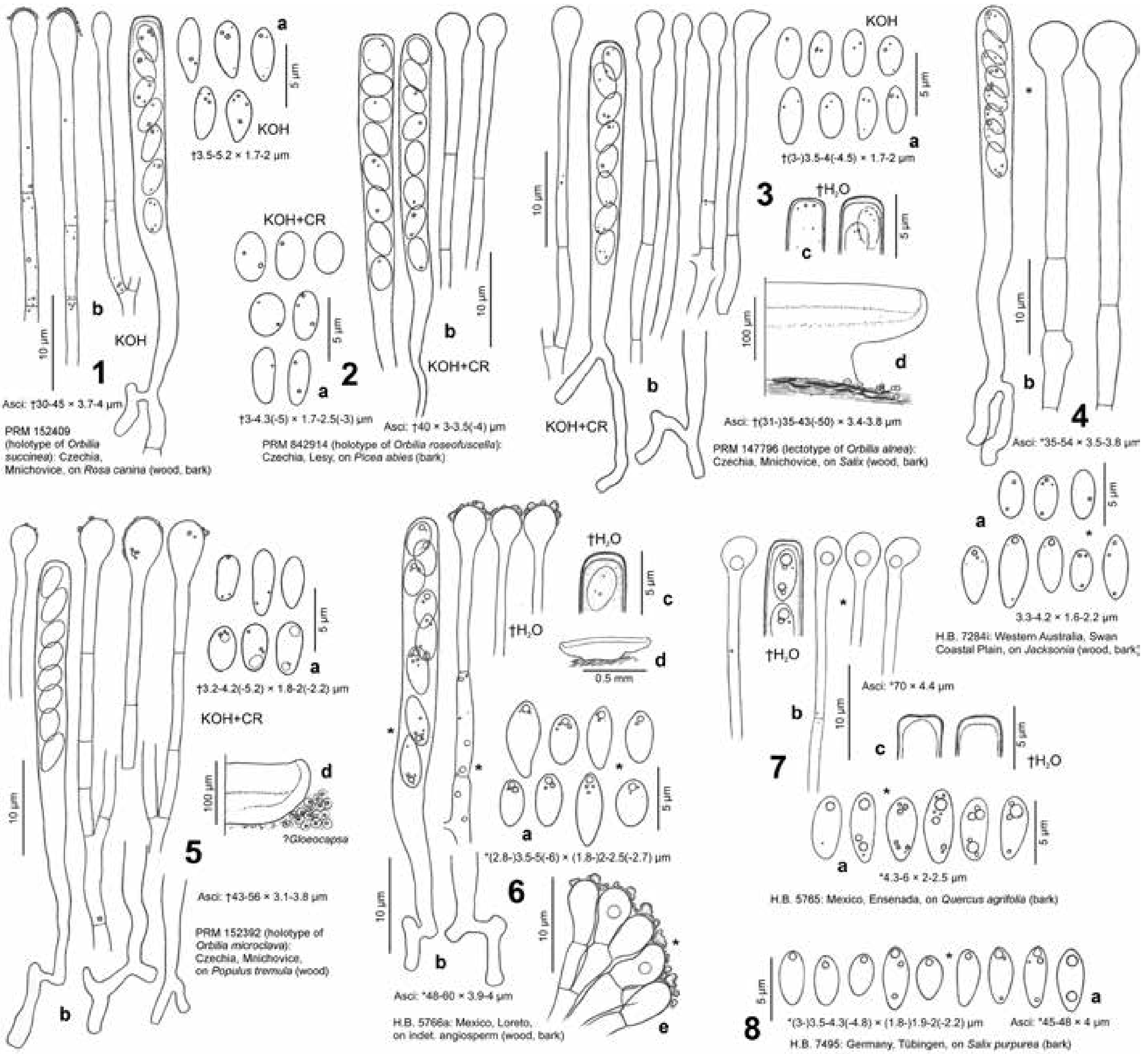


Plate 855. **1–8**: *Orbilia eucalypti*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. apothecia in median section; **e**. id., marginal ectal excipulum.

= *Orbilia microclava* Velen., Monogr. Discom. Bohem.: 92 (1934)
= *Orbilia alnea* Velen., Monogr. Discom. Bohem.: 93 (1934)
= *Orbilia succinea* Velen., Opera Bot. Čech. 4: 101 (1947), nom. illegit., ICN Art. 53.1 [non *Orbilia succinea* (Fr.) Quél., ≡ *Siroscyphella succinea* (Fr.) Höhn., see p. 1687]
= *Orbilia xanthostigma* s. Svrček (1954) p.p.
= *Orbilia roseofuscella* Svrček, Česká Mykol. 41: 91 (1987)

Etymology: named after the apothecial colour (*roseofuscella* = pale rose-brown, *succinea* = amber) or the substrate (*alnea*, *eucalypti* – from *Alnus* and *Eucalyptus*); *microclava*: referring to the somewhat clavate paraphysis apices in the centre of the disc; *fragile*: apparently after the minute, pulvinate tufts formed by the conidiomata; *parasitans*: after the seemingly erroneous belief of the anamorph growing as a parasite on the here presumed teleomorph; *argentinense*: after the geographical origin, Argentina; *ramularioides*: after the sympodially proliferating conidiophores similar as in *Ramularia*; *episphaeria*: growing on a pyrenomycete (*Thyronectria cucurbitula*).

Typification: USA, California, unlocalized, branch of *Eucalyptus globulus*, 1882, H.W. Harkness (Harkn. 2872, K(M) 36053, holotype of ***Calloria eucalypti***). — California, Oakland, branch of *Nerium oleander*, II.1882, H.W. Harkness (Harkn. 3631, CAS, holotype of ***Dicranidion fragile***, doc. vid.). — Austria, Hadersdorf, 'in *Helotio citrino* (?) parasitica', VII.1902, F. v. Höhnel (type of ***Pedilospora parasitans***, doc. vid.). — Argentina, La Plata, bark of *Eucalyptus globulus*, V.1906, C.L. Spegazzini (LPS, type of ***Dicranidion argentinense***, doc. vid.). — Italy, Riva del Garda, on mycelium of *Bispora pusilla* on wood of *Castanea vesca*, 1915, H.E. Diettrich-Kalkhoff (type of ***Pedilospora ramularioides***, doc. vid.). — Austria, Pressbaum, on *Thyronectria cucurbitula* on *Picea* bark, VII.1916, F. v. Höhnel (type of ***Pedilospora episphaeria***, doc. vid.). — Czechia, Mnichovice, branch of *Populus tremula*, IX.1933, J. Velenovský (PRM 152392, holotype of ***Orbilia microclava***). — Czechia, Hubáčkov, branch of *Salix*, VII.1926, J. Velenovský (PRM 147796, lectotype of ***O. alnea***, designated by Svrček 1954: 9). — Czechia, Mirošovice, branch of *Rosa canina*, 29.V.1941, J. Velenovský (PRM 152409, holotype of ***O. succinea***). — Czechia, Újezd nad Lesy, branch of *Picea abies*, 12.IV.1982, M. Svrček (PRM 842914, holotype of ***O. roseofuscella***).

Misapplied names: Nylander (1869), Karsten (1869) and most later authors, as *O. coccinella*; Gremmen (1960: 273), as *O. luteorubella*; Svrček (1954: 23), as *O. xanthostigma*.

Misinterpretation of *O. alnea* (= *O. eucalypti*) regarding anamorphs: Pfister (1997, fig. 6, as *Dactylella* sp./*O.* ?*alnea*), = *O. dryadum*; Pfister (1997, fig. 8, D.H.P. 81, as dicranidion fragile-like/*O. alnea*), ?= *O. xanthoflexa*; Liu (2006 p.p., as *O. coccinella*), = *O. cejpii*.

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.18–)0.2–0.6 mm up to 0.5–1(–1.3)((–1.8)) mm diam., (0.08–)0.1–0.23(–0.29) ((–0.37)) mm high (receptacle 0.11–0.19 → 0.08–0.09 mm), (pale to) light or bright (to deep) orange(-ochraceous), yellow- or rose-orange, also pale to light (greyish-)cream(-orange), (orange-)rose(-ochraceous), lilaceous, or even whitish, slightly to medium (to strongly) translucent, round to slightly, rarely strongly undulating, scattered or mostly medium to densely gregarious (to confluent) in small to large groups; disc slightly to medium concave or flat, rarely slightly convex, margin distinct, thin or often rather thick and distinctly raised, 0–10 µm protruding, smooth; mostly (very) broadly sessile, rarely with obconical or cylindrical stipe 0.025–0.2 × 0.1–0.4 mm, superficial, sometimes emerging in fascicles from cracks in bark; dry shallowly cupulate, more deeply orange-apricot to orange-red or blood-red, also yellow-orange, cream-ochraceous, orange-pink, or salmon-rose. **Asci** *((31–))(36–)40–60(–70)((–78)) × ((3.2–))(3.5–)3.8–4.8(–5.3)((–6)) µm {64} → (40–)48–66(–78) × 4.3–5.7 µm, †(30–)33–55(–60)((–70)) × (3–)3.2–4.3(–4.7) ((–5)) µm {31}, 8-spored, spores (*) obliquely uniseriate, sometimes subbiseriate above, (2–)3–5(–6) lower spores inverted {12} (very often mixed, sometimes apical spores inverted), pars sporifera *18–26 or 25–36 → (10–)11–18(–22) µm long, †(22–)25–36(–43) µm; **apex** (†) medium to strongly truncate (not or distinctly indented, laterally sometimes slightly inflated); **base** with short to medium long, ± thick, only slightly flexuous stalk, Y-, L-, h- or H-shaped. **Ascospores** *((2.8–))(3–)3.5–4.5 µm up to 5–6(–9)((–10.5)) × ((1.6–))1.8–2.5(–3) ((–3.5)) µm {240}, †((2.8–))(3–)3.3–6(–7)((–8.5)) × ((1.5–))1.7–2.5(–2.8)((–3)) µm {32}, ellipsoid(-clavate) to fusoid(-clavate), rarely narrowly ellipsoid to subcylindrical, apex rounded to often obtuse, base not or often slightly (rarely strongly) attenuated, here rarely slightly curved, exceptionally rarely or predominantly ovoid to subglobose, *(3–)3.3–4(–4.5) × 2.2–3(–3.5) µm {7}; overmature up to *5–6.5 × 3–4 µm, usually remaining non-septate but rarely 1-septate {H.B. 7430}, sometimes germinating; **SBs** *(0.4–)0.5–0.7(–0.8) µm wide {~15}, globose, total length 0.6–1(–1.2)((–1.4)) µm including mostly invisible connecting part, rarely a very short filum seen, SBs sometimes absent, in overmature spores frequently absent; with 1–5(–15) small **LBs**, mainly grouped around SB but partly also near basal end, at overmature stages with 1–2 larger LBs 0.5–1(–1.5)((–2)) µm diam. **Paraphyses** apically (slightly to) medium to strongly (rarely very strongly) clavate-capitate, rarely moniliform, rarely asymmetrical, terminal cells *((8–))(13–)15–30(–37) {17} × ((1.7–))(2–)2.5–4.5(–5)((–6)) µm {28}, †14–25 {3} × (2–)2.5–3.5(–4) {6} or 3.5–6 {T} µm, lower cells *(4–)5–10(–11) {6} or (8–)10–14(–16) {3}× (1.4–)1.6–2.2(–2.5) µm {9}, †5–12 × 1–1.6 µm {2}; very rarely branched at upper septum, subhymenium and lower part of hymenium often pale to light yellow-orange, sometimes rose or hyaline. **Medullary excipulum** hyaline to pale orange or sometimes rosaceous, 20–50(–80) µm thick, of medium loose or often dense, ± horizontal textura intricata with many inflated cells, sharply delimited from ectal excipulum only at flanks, often by a (5–)10–20(–40) µm thick layer of t. porrecta. **Ectal excipulum** hyaline to pale orange or rose, often pale to light orange towards margin, of (†) thin-walled to slightly (exceptionally strongly) gelatinized, vertically oriented t. (globulosa-)angularis(-prismatica) from base to mid flanks or margin, (20–)25–70(–100)((–140)) µm thick near base, cells *(5–)8–20(–25)((–33)) × (4–)6–14(–19) µm {20}, †(6–)8–16(–26) × (3–)5–12(–15) µm {12}; 15–30 µm thick at mid flanks, near margin (10–)15–20(–25) thick, of t. (angularis-)prismatica(-porrecta) oriented at a ((0–))(20–)40–80(–90)° angle to the surface, marginal cortical cells *(4–)5–11(–14) × 3–5 µm {7}, †5–10(–12) {8} × 2.5–5 µm {10}, in surface view tangentially elongated, often at upper margin forming a t. porrecta with *2–3.5 µm wide terminal cells; **glassy processes** absent. **Anchoring hyphae** sparse to often abundant, */†(1.8–)2–3(–4) µm wide (near insertion sometimes inflated to 5–7 µm), walls 0.2–0.3(–0.4) µm thick {15}, forming a loose or often dense, hyaline, non-gelatinized t. intricata ~20–70(–100) µm thick. **SCBs** usually not observed but sometimes present, globose {18}, 1.2–2.3(–3) µm diam. in paraphysis apices, (1.2–)2–2.6 µm in ectal excipular cells at flanks; **VBs** usually absent (vacuoles non-refractive), sometimes (very) slightly refractive, 0.5–3 µm wide, globose to elongate in paraphyses and marginal cortical cells; **LBs** ± abundant in lower part of paraphyses, subhymenium, medullary excipulum (inflated cells and t. porrecta) and marginal excipular cells, especially close to the septa, 0.2–0.5(–1) µm diam., often containing carotenoids (pale to light golden yellow-orange), LBs sparse in pale-coloured populations. **Exudate** over paraphyses 0.2–1.2(–2) µm thick, often also absent, finely rough to granular-cloddy or continuous, ± firmly attached, over margin and flanks 0.3–1.5(–2) µm thick, granular-cloddy to continuous, hyaline or pale yellowish. — **ANAMORPH**: dicranidion-like (from ascospore isolate {9}, natural substrate {24}, conidial isolate or anamorph only {10}). **Conidiophores** *~(6–)10–33(–60) × 2–3.5(–4) µm {3}, (0–)1–3-septate, branched or unbranched, also reduced, sometimes aggregated to form synnemata. **Conidiogenous cells** monoblastic or sympodial, with lateral pegs, *5–10 × 1.9–2.3(–5) µm. **Conidia** mostly 2-armed, the arms parallel, rarely slightly to strongly diverging, *(6–)8–14.5(–17)((–18)) × (4.7–)5.5–6.7(–7.3)((–8)) µm {21}, *6–8.5 µm wide if diverging {3}, †11.5–14 × 6–6.5 µm {1}, base conical, exceptionally with a short non-septate stipe, basal cell ± deltoid, often with small nodulous basal scar, each arm delimited by a basal septum, the 2 septa usually forming a ~90° angle, exceptionally only one arm with basal septum; arms *(5–)6.5–11(–12.5) × 2.5–3.5(–3.7) µm, ((1–))2((–3))-septate; exceptionally 3-armed (Pls 856: 5; 857: 4; 858: 9–10); young conidia *4–8 × 3.7–5.5 µm, subglobose to ellipsoid, changing to heart-shaped with very short arms, 0–1-septate (Pls 857: 1, 4, 6; 858: 3f–g); exceptionally unbranched, cylindrical, *13.5–16.5 × 3–4 µm, 2–3-septate {2} (Pl. 857: 4).

Habitat: collected (0.3–)1–6(–25) m above the ground, corticated to decorticated, 10–80 mm thick branches, also 15–40 cm thick trunks or 4–6 mm thick twigs, of *Abies alba* {1/1}, *Acacia* sp. {6}, *A. heterophylla* {1}, *A. mollissima* {1}, *Acer* sp. {1}, *A. platanoides* {1}, *A. pseudoplatanus* {2}, *Adenanthos sericeus* {2}, *Adenocarpus viscosus* {1}, *Aesculus hippocastanum* {2}, ?*Alnus* sp. {2}, *A. alnobetula* {2}, *A. glutinosa* {2}, *Baccharis halimifolia* {1}, *Banksia cuneata* {1}, *B. grandis* {1}, *B. menziesii* {2}, ?*Berberis vulgaris* {1}, *Betula* sp. {1}, *B. pendula* {1}, *B. pubescens* {2}, *Bupleurum salicifolium* {1}, *Carpinus* sp. {1}, *C. betulus* {21}, *Castanea sativa* {4}, *Castanopsis* sp. {1}, *Cornus* sp. {1}, *C. sanguinea* {4}, *C. stolonifera* {1}, *Corylus avellana* {17/1}, *C. cornuta* {1}, ?*Crataegus* sp. {1}, *Cytisus scoparius* {3}, *Eremaea pauciflora* {1}, *Eucalyptus* sp. {2}, *E. globulus* {4}, *Euphorbia balsamifera* {1}, *E. berthelotii* {1}, *Fagus sylvatica* {12}, *Forsythia* × *intermedia* {1}, *Frangula alnus* {5}, *Fraxinus excelsior* {9}, *Ilex aquifolium* {1}, *Jacksonia* sp. {2}, *Juglans regia* {2}, *Kleinia neriifolia* {1}, *Larix* sp. {1}, *L. decidua* {1}, *Ligustrum vulgare* {1}, *Liriodendron tulipifera* {1}, *Lonicera periclymenum* {2}, *Magnolia* sp. {1}, *Malus domestica* {6/1}, *Nerium oleander* {1}, *Olea europaea* {1}, *Paulownia tomentosa* {1}, *Picea abies* {3}, *Pinus* sp. {3}, *P. nigra* {1}, *P. sylvestris* {6}, *Platanus orientalis* {1}, *Populus* sp. {1/1}, *P. nigra* {2}, *P. tremula* {6}, *Prunus spinosa* {2}, *Pseudotsuga menziesii* {1}, *Punica granatum* {1}, *Quercus* sp. {39/1}, *Q. agrifolia* {1}, *Q. cerris* {2}, *Q. ilex* {4}, *Q. petraea* {2}, *Q. pubescens* {2}, *Q. pyrenaica* {1}, *Q. robur* {15}, *Q. rotundifolia* {1}, *Q. rubra* {1}, *Rosa* sp. {7}, *R. canina* {1/1}, *Rubus armeniacus* {1}, *R.* ?*bifrons* {1}, *R. fruticosus* agg. {4}, *Salix* sp. {25/2}, *S.* ?*alba* {1}, *S.* ?*atrocinerea* {1}, *S. aurita* × *caprea* {1/1}, *S. caprea* {8/3}, *S. cinerea* {9/2}, *S. fragilis* {1}, *S. glauca* {1}, *S.* ?*myrsinifolia* {1}, *S. phylicifolia* {1}, *S. purpurea* {1}, *S.* ?*viminalis* {2}, *Sambucus nigra* {2}, *S. racemosa* {1}, *Sorbus* ?*aria* {1}, *S. aucuparia* {4/1}, *Spartium junceum* sp. {2}, *Thymelaea hirsuta* {1}, *Tilia* sp. {4/1}, *T. cordata* {4}, *T. tomentosa* {1}, *Ulex* sp. {1}, *U. europaeus* {10}, *Ulmus* sp. {1}, *U. glabra* {2}, *U. minor* {1}, *Zelkova serrata* {1}, indet. angiosperm {11}, indet. gymnosperm {2}, on 0.3–3 mm deep up to entirely medium to strongly decayed wood {187} and bark {180} (periderm {39} and bast {75}), also on boring dust; rarely on galls {1}, cones {2}, bud scales {1}, textile {1}, herbaceous or slightly woody stems of *Astragalus lusitanicus* {1}, *Euphorbia* sp. {2}, *E. characias* {2}, *E. palustris* {1}, petioles of *Macrozamia riedlei* {1}, ± old fruitbodies of *Colpoma quercinum* {11}, *Diatrype* sp. {1}, *D. bullata* {1}, *Fomitopsis betulina* {1}, *Peniophora quercina* {1}, *Schizopora paradoxa* {1}, *Vuilleminia* (?)*comedens* {8}, *Xanthoporia nodulosa* {1}; not or slightly to medium greyed, covered by sparse to abundant green algae, also without. **Associated**: *Amphosoma atroolivaceum* {1}, *Arachnopeziza aurata* {1}, *Ascocoryne sarcoides*

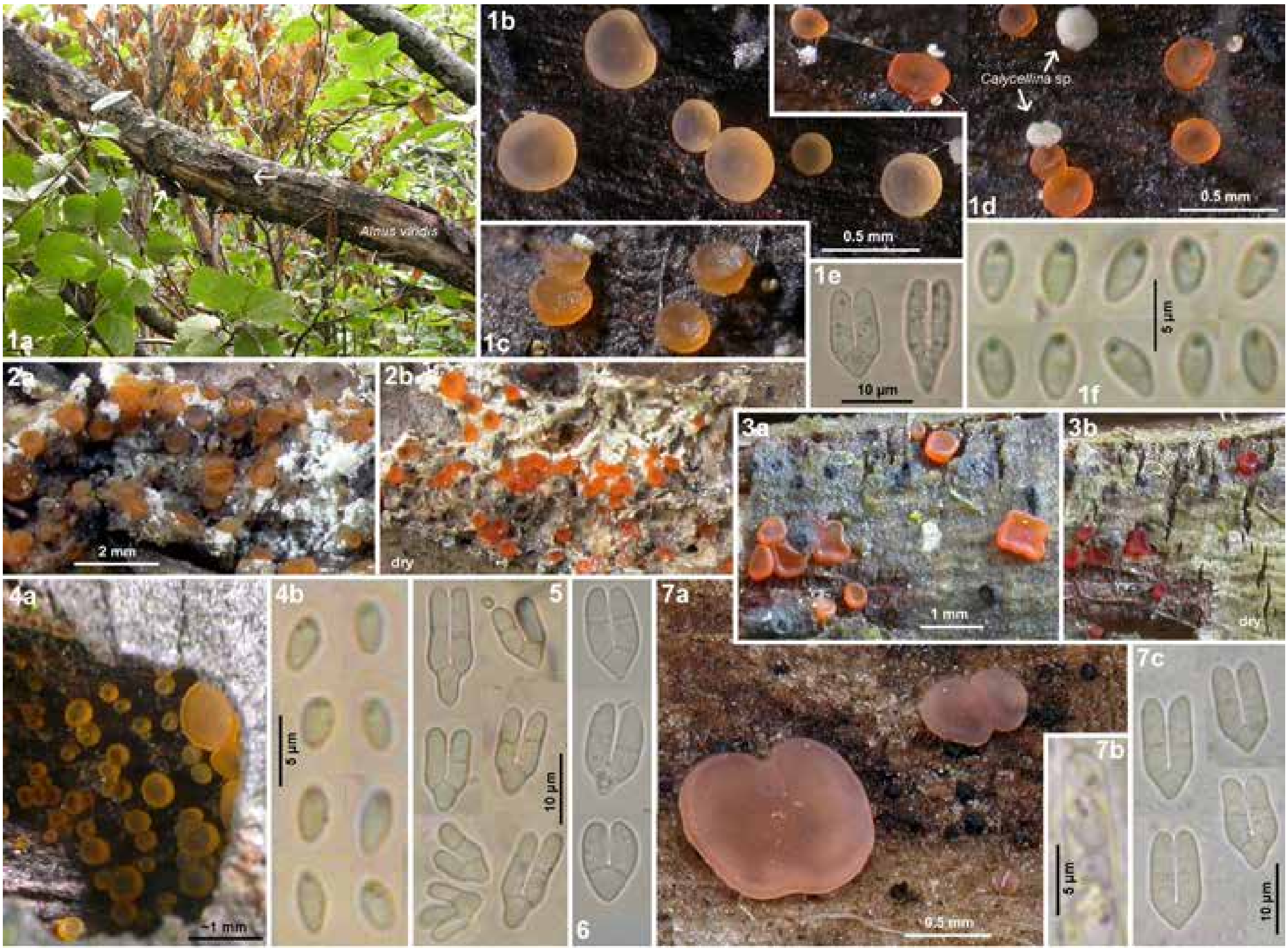


Plate 856. **1–7**: *Orbilia eucalypti*. – **1a**. subalpine alder scrub, dead xeric branch of *Alnus alnobetula* with detaching bark; **1b–d**, **2a**, **3a**, **4a**, **7a**. fresh or rehydrated apothecia; **2b**, **3b**. dry apothecia; **1f**, **4b**, **7b**. ascospores; **1e**, **5**, **6**, **7c**. conidia from substrate. – Living state. – **6**: phot. R. Tena. — **1a–e**. H.B. 8263b: Switzerland, Uri, on *Alnus*; **2a–b**. 17.IV.2004: Germany, Saarland, on *Sorbus*; **3a–b**. H.B. 7504: Germany, Tübingen, on *Salix*; **4a–b**. H.B. 8366: ibid., on ?*Sorbus*; **5**. H.B. 8052: Great Britain, Suffolk, on *Lonicera*; **6**. 5.II.2011: Spain, Valencia, on *Eucalyptus*; **7a–c**. 10.IV.2013: Luxembourg, on *Fraxinus*.

{1}, *Bertia moriformis* {1}, *Biscognauxia nummularia* {1}, *Brachysporium nigrum* {2}, *Bryoria* sp. {1}, *Bulbillomyces* sp. {1}, *Calycellina* sp. {1}, *Calycina citrina* {1}, *C. confluens* {1}, *C. lactea* {1}, *Capronia* sp. {4}, *Chaenothecopsis savonica* {1}, *Chaetosphaeria myriocarpa* {5}, '*Chlorosplenium*' *viridulum* {1}, *Ciliolarina pinicola* {1}, *Claussenomyces* spp. {6}, *C. atrovirens* {3}, *Coniochaeta* ?*malacotricha* {1}, *Corticium roseum* {1}, *Cosmospora* sp. {1}, *Crumenulopsis pinicola* {1}, *Cryptodiscus foveolaris* {3}, *C. pini* {1}, *Dacrymyces* sp. {1}, *Deltopyxis triangulispora* {3}, *Dematioscypha delicata* {1}, *D. olivacea* {1/1}, *Durella* spp. {2}, *D. atrocyanea* {2/2}, *D. connivens* {10}, *D.* aff. *connivens* {3}, *Encoelia furfuracea* {1}, *Endoxyla cirrhosa* {1}, *Exidia pithya* {1}, *Gelatinopsis exidiophila* {2}, *Gloniopsis praelonga* {6}, *Glyphium elatum* {1}, *Graphis scripta* {1}, *Helicogonium fusisporum* (parasitic in *O. eucalypti*) {1}, *Helminthosporium velutinum* {1}, *H. orbiliarum* (parasitic in *O. eucalypti*) {14}, '*Helotium*' *uvidulum* {1}, *Hyalorbilia berberidis* {1}, *H. orbiliicola* (parasitic on *O. eucalypti*) {7}, *H. fagi* {1}, *H. fusispora* {2}, *H. helicospora* {1}, *H. inflatula* {4}, *H. juliae* {6}, *H. latispora* {1}, *H. subfusispora* {5}, *H. ulicicola* {1}, *Hyaloscypha albohyalina* {1}, *H. minuta* {5}, *Hymenoscyphus salicellus* {1}, *Hyphodiscus* sp. {2/1}, *H. hemiamyloideus* {1}, *H. hymeniophilus* {2}, *H. theiodeus* {3}, *Hypoxylon rubiginosum* {1}, *Hysteropatella elliptica* {1}, *H. prostii* {1}, *Ionomidotis fulvotingens* {4}, *Karstenia lonicerae* {1}, *K. rhopaloides* {4}, *Lasiosphaeria* sp. {1}, *L. hirsuta* {1}, *Lecanora* sp. {1}, *Lecophagus ellipsoideus* {1}, *Letendraea helminthicola* {1}, *Lilapila oculisporella* {1}, *Lophiostoma macrostomum* {1}, *Lophium mytilinum* {1}, *Mariannaea elegans* {1}, *Melanelixia glabratula* {1}, *Melanomma pulvis-pyrius* {1}, *Mellitiosporiella* sp. {1}, *M.* sp. {1}, *Mollisia* sp. {3}, *M. ligni* {4}, *M.* ?*oblonga* {1}, *M.* ?*sublividula* {1}, *Monodictys* sp. {1}, *Nectria* sp. {1}, *Nemania chestersii* {1}, *Neodasyscypha cerina* {2}, *Nitschkia* ?*broomeana* {1}, *N. grevillii* {1}, *Octospora affinis* {1}, *Olla scrupulosa* {2}, *Orbilia albidorosea* {2}, *O. amberina* {2}, *O. angiosubvinosa* {2}, *O. aprilis* {8}, *O. arachnovinosa* {1}, *O. aristata* {12/1}, *O. astrovinosa* {1}, *O. aurantiorubra* {3}, *O. australiensis* {5}, *O. austrocylindrica* {3}, *O. aviceps* {3}, *O. breviaristata* {2}, *O. carpoboloides* {1}, *O. clavispora* {1}, *O. commarosa* {2}, *O. corculispora* {4}, *O. crenatomarginata* {1}, *O. curvatinavajoana* {1}, *O. curvativitalbae* {3}, *O. cylindrospora* {3}, *O. cylindrosoma* {1}, *O. dryadum* {1}, *O. ficicola* {1}, *O. filiformis* {2}, *O. flagellispora* {1/1}, *O. flavida* {1}, *O.* ?*graminis* {1}, *O. kingsiana* {1}, *O. macrotrapeziformis* {1}, *O. mali* {1}, *O. microserpens* {3}, *O. mirabilis* {1}, *O. multicurvula* {1}, *O. myrioeuonymi* {1}, *O. myriofusiclava* {5}, *O. myrioobliqua* {5}, *O. naumburgensis* {1}, *O. nothovinosa* {2/2}, *O. obtusispora* {3}, *O. orientalis* {2}, *O. phragmotricha* {3}, *O. pleiomicrosoma* {1}, *O.* ?*pleioserpens* {1}, *O. pleistovitalbae* {1}, *O. plurililacina* {1}, *O. polyspora* {1}, *O. pseudoaristata* {1}, *O. quaestiformis* {2}, *O. rubrovacuolata* {1}, *O. sarraziniana* {1}, *O. septispora* {1}, *O. subaristata* {1}, *O. subclavuliformis* {2}, *O. subtrapeziformis* {1}, *O. subvinosa* {2}, *O. trapeziformis* {2}, *O. tremulae* {1}, *O. vinosa* {22}, *O. vitalbae* {2}, *O. xanthoguttulata* {2}, *O. xanthostigma* {1}, *Orthotrichum* sp. {1}, *Otthia spiraeae* {1}, *Parmelia sulcata* {3}, *Patellaria atrata* {4}, *Peroneutypa scoparia* {1}, *Perrotia flammea* {1}, *Phragmiticola* sp. {1}, *Phyllactinia guttata* {1}, *Physcia* sp. {1}, *P. tenella* {1/2}, *Pirottaea imbricata* {1}, *Pleurosticta acetabulum* {1}, *Polydesmia pruinosa* {1}, *Pragmopora amphibola* {1},

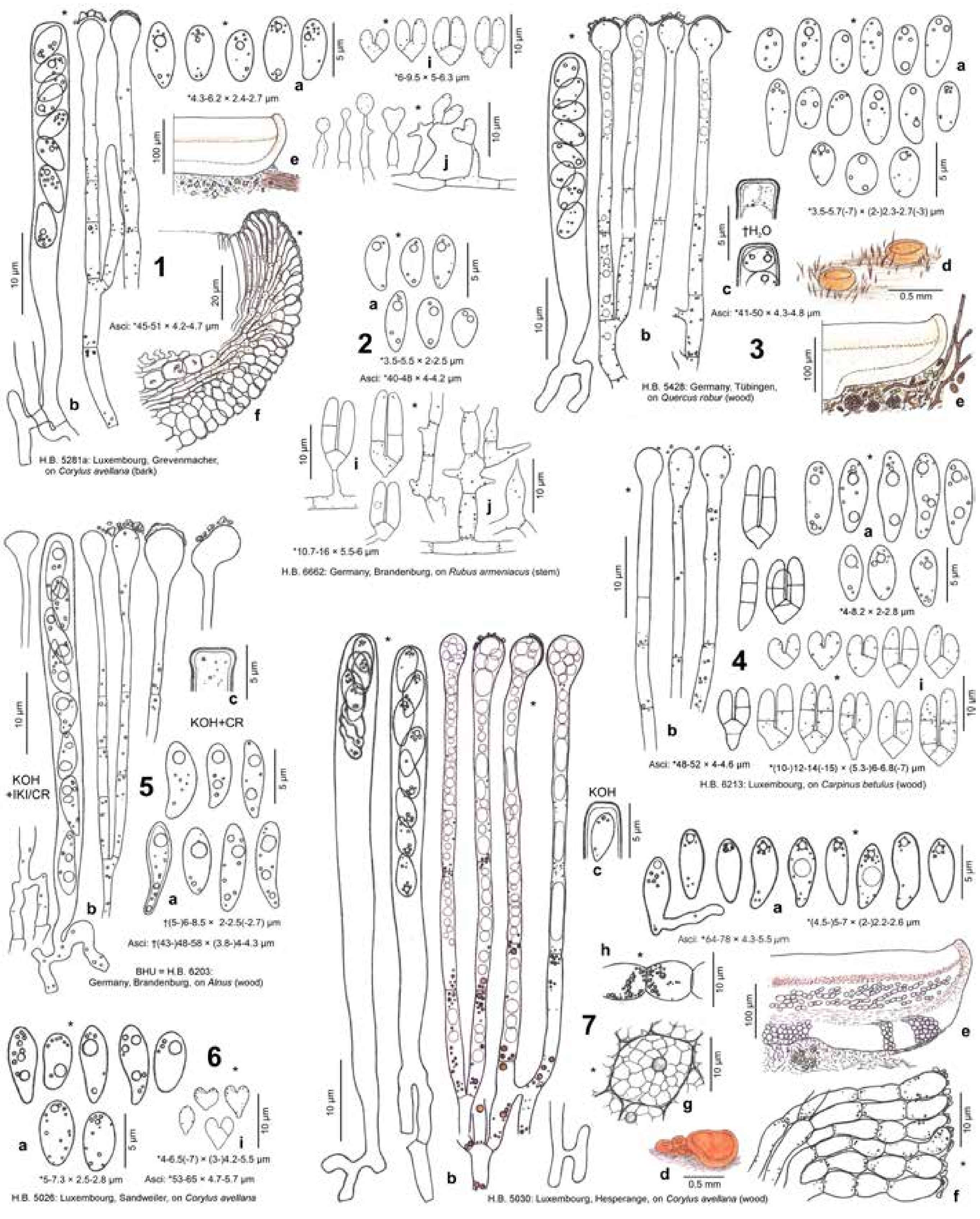


Plate 857. **1–7**: *Orbilia eucalypti*. – **a**. ascospores; **b**. asci and paraphyses (**7b** left: fully turgescent); **c**. ascus apices; **d**. rehydrated apothecia; **e**. apothecia in median section; **f**. id., ectal excipulum at margin and mid flanks; **g**. cell of ectal excipulum at lower flanks; **h**. chain-like inflated cells in medullary excipulum; **i**. conidia and conidiophores (**1–2**, **6** from culture, **4** from substrate).

Proliferodiscus olivaceoviridis {1}, *Propolis farinosa* {7}, *Pseudohelotium sordidulum* {1}, *Pseudolachnea hispidula* {1}, *Pyrenopeziza rubi* {1}, *P. caespiticia* {1}, *Resinomyces griseus* {1}, *R. kirschsteinianus* {1}, *Rhamphoria pyriformis* {1}, *Rhizodiscina lignyota* {4}, *Sarea difformis* {1}, *S. resinae* {1}, *Schizopora paradoxa* {2}, *Sclerococcum* spp. {5}, *S.* ?*epimyces* {1}, *S.* ?*stygia* {2}, ?*Skyttea* spp. {2}, *Stilbella* sp. {1}, ?*Teichospora* sp. {1}, *Tremella mesenterica* {1}, *Triblidium* sp. {1}, *Symbiotaphrina desertorum* {1}, *Tubeufia cerea* {1}, '*Tympanis*' *xylophila* {1/1}, *Unguiculariopsis* spp. {2}, *Xanthoria parietina* {1}. **Desiccation tolerance**: fully viable for at least

1–2 months, after 10 months some mature asci sometimes still alive, excipular cells and spores after 13 months, conidia after at least 1 month. **Altitude**: 1–1620 m a.s.l. (northern and central Europe), 1–1640 m (southern Europe), 600–2400 m (China), 40–2150 m (Macaronesia), 6–278 m (Australia), 10–2100 m (North America), 10–2700 m (South America). **Geology**: Precambrian & Paleozoic slate, silt- & sandstone, quartzite, greywacke, Permian (Rotliegend), Buntsandstein, Muschelkalk, Keuper, Jurassic, Cretaceous & Tertiary sand-, clay-, marl- & limestone, flysch, dolomite, Quaternary loess, till, silt & sand, peat; granite, migmatite, syenite, rhyolite, biotite, amphibolite, phonolite, basalt, gabbro, dolerite, serpentinite, gneiss, mica schist. **Phenology**: throughout the year (long-lived).

Phenology of *O. eucalypti* (temperate northern hemisphere)											
Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
39	33	39	53	22	21	23	23	27	25	25	21

Taxonomic remarks. *Orbilia eucalypti* is characterized by bright yellow-orange or rose-lilaceous but also whitish, desiccation-tolerant apothecia with smooth, often rather thick, ± raised margin, small to medium-sized, ellipsoid-fusoid ascospores, capitate paraphyses, and a dicranidion-like anamorph with deltoid basal cell with a conical base. However, delimitation from *O. tremulae* and *O. plurivacuolata* is problematic concerning both teleomorph and anamorph (see under these species), especially when studying herbarium material. *O. eucalypti* may also be confused with *O. battenii*, *O. cejpii*, *O. frangulae*, *O. gaillardii*, and *O. liliputiana*, which differ in shorter or narrower ascospores and a different anamorph (that of *O. gaillardii* is unknown). When studying dead herbarium material in which the spore bodies cannot be seen, large-spored collections of *O. eucalypti* may further be confused with some other species with orange apothecia on xeric wood and bark, e.g., *O. trapeziformis* and *O. vitalbae* (section *Habrostictis*), *O. ovalis* (section *Lentiformes*), and *O. subovoidea* (section *Ovoideae*). Collections of *O. eucalypti* with aberrant subglobose spores may be confused with *O. sphaerospora* (section *Ovoideae*) or *O. fissilis*. Yet, the spores of these species contain globose SBs whereas the aberrant spores of *O. eucalypti* possess merely KOH-resistant LBs.

Variation in colour. *O. eucalypti* has typically bright orange or sometimes yellow- or rose-orange apothecia, which misled earlier authors to identify a population as *O. coccinella*. However, the apothecial colour varies rather strongly in the present concept of *O. eucalypti*. Its typical colour is exclusively observed on exposed, xeric branches. Populations on branches and trunks on the moist ground are generally much paler rose or yellowish-cream, and then the distinction from *O. tremulae* becomes particularly problematic. Moreover, such pale colours were sometimes also observed on exposed xeric branches (e.g., Pl. 859: 4). In some collections on xeric or hygric substrates, closely associated or even intermingled populations strongly differ in colour between pale rose and bright orange (see Fig. 14: c), obviously due to a different concentration and composition of carotenoids inside LBs. Such colour variants of mixed populations of *O. eucalypti* have never been investigated by molecular methods.

Variation of ascospores. In the present concept of *O. eucalypti* great variation is noted in spore size and shape, also in content. This variation not only occurs among collections but sometimes also within a given population or even a single apothecium. We assume that these differences in spore size, shape, and content are not genetically fixed, but originate from some unknown environmental parameters, or perhaps the age of the apothecia. This assumption is based on the following phenomenon which includes the partial absence of SBs in living spores, and which seems to be rather exceptional within the *Orbiliomycetes*:

Living spores of *O. eucalypti* generally contain a globose spore body of ca. 0.5–0.7 µm diam., which is usually surrounded by a few similar-sized and refractive lipid bodies (Pls 855: 4, 6, 8; 856: 1f, 4b; 857: 7; 859: 6, 10; 860: 4a–b, 8d). The position of the SB and the associated LBs permits to recognize the upper spore end. However, LBs partly also occur at the lower spore end which results in a homopolar, sometimes biguttulate spore content. In *O. eucalypti* SBs and LBs can only be distinguished with certainty by vital staining (e.g., with Cresyl Blue, see Pl. 860: 4a) or by applying lethal agents such as KOH. This difficulty mainly concerns the case when LBs abundantly surround the SB at the spore apex (e.g., Pls 857: 1; 858: 2). In dead specimens usually only LBs can be seen when mounted in media such as H_2O or KOH. Exceptionally, SBs could unequivocally be discerned as a transparent region in the spore apex: in the holotype of *O. eucalypti* (in KOH or KOH+IKI, Pls 858: 1a; 860: 1c–d) and in some other collections, e.g., in an unillustrated sample which was reexamined 22 years later (H.B. 4653a, in H_2O).

However, particularly in desiccation-tolerant populations the spores are often without any trace of a spore body. Such seemingly aberrant spores tend to be larger, especially longer, and usually develop a higher number and/or larger size of lipid droplets which often attain a size of 1–1.5 µm. Aberrant spores with large LBs are shown in Pls 855: 7, right spore in 8; 857: 4–6; 858: 5a right; 859: 16a, c, but intermediate spores also occur (Pl. 857: 1–3). Sometimes the aberrant spores are only wider, or even of equal size with the normal spores. Wider, more ovoid to subglobose, rarely almost globose spores are illustrated in Pl. 858: 6–8 and where also observed in H.B. 4980, 5038b, and 5270 (unillustrated). They lie in the range of *3–4.5 × 2.2–3.5 µm, i.e., only the width exceeds the normal values. Ovoid to subglobose spores with a low lipid content and distinct SBs, have never been seen.

Although spores of the aberrant type have repeatedly been found inside living mature asci and are forcibly ejected like the normal spores, they might better be classified as overmature stages, contrary to the definition of maturity by Baral (1992: 375). This view is supported by the repeated observation within *Orbilia* that, during spore germination, the SBs gradually disappear while, contrary to the situation in many *Helotiales*, the number and size of LBs increases.

The observed differences in spore contents could reflect different strategies of colonization by giving more weight to either the formation of lipid bodies or a spore body (see p. 90). In several collections we have observed such aberrant lipid-rich spores together with the normal spores within an apothecium (sometimes even within a single ascus). Only exceptionally the asci contained less than 8 spores, hence the increased spore size is usually not a result of a reduced spore number. The percentage of aberrant spores strongly varies among the collections. A few or almost all asci of an apothecium may produce such spores, and this may affect the majority or only a few apothecia of a given collection.

Great variation in spore size is also noted among the normal spores when comparing different collections (Pls 855–860). Populations with smaller spores show a more or less ellipsoid spore shape and can hardly be delimited morphologically from

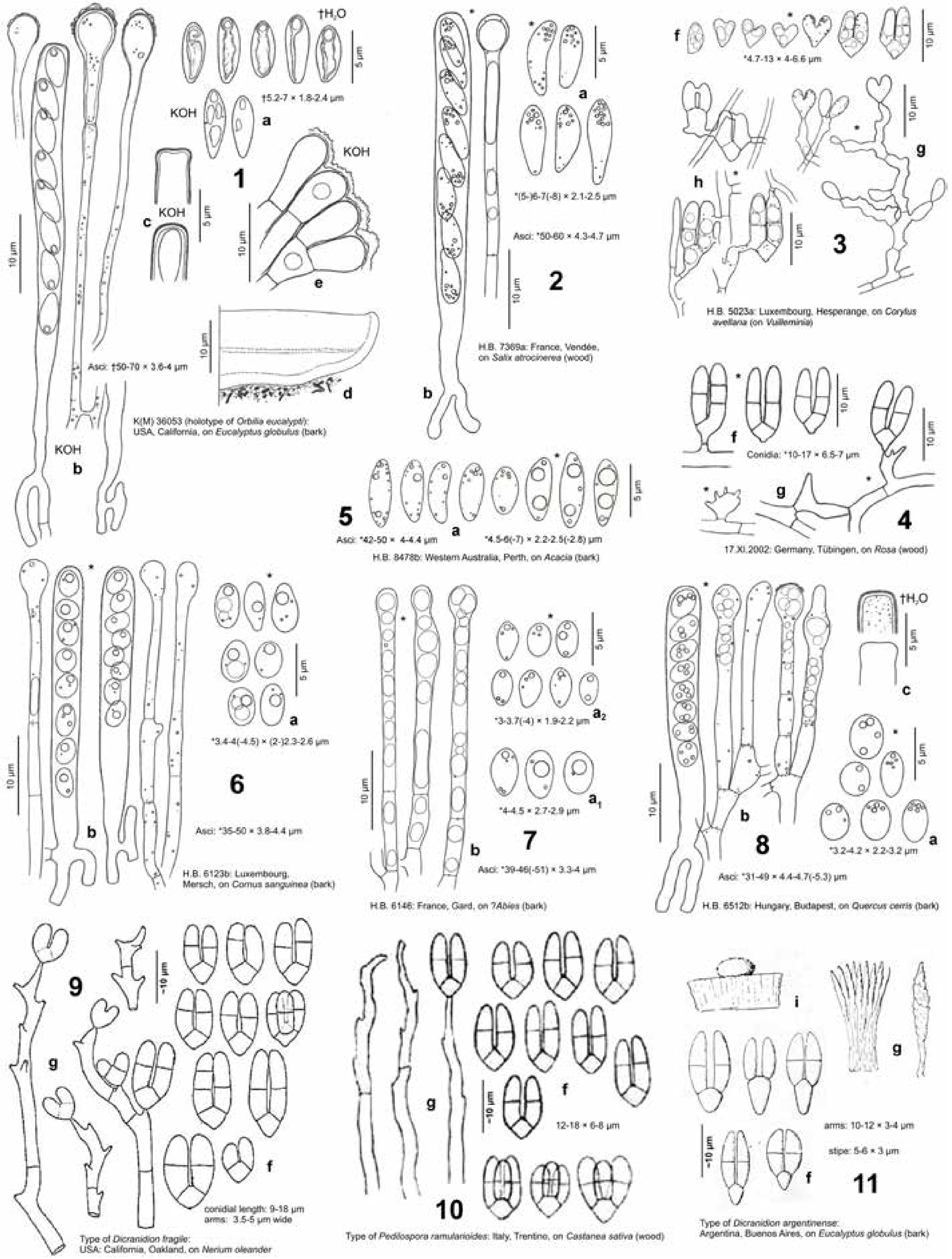


Plate 858. **1–8**: *Orbilia eucalypti*; **9–11**: *O.* cf. *eucalypti*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. apothecium in median section; **e**. id., marginal ectal excipulum; **f**. detached conidia; **g**. conidiophores and conidia; **h**. germinated conidia; **i**. sporodochium (**3–4**, **9–10** from culture; **9**. from Hughes 1953, **10**. from Bubák 1916, **11**. from Spegazzini 1911).

O. tremulae without the anamorph, whereas those with larger spores tend to be more heteropolar (subclavate), i.e., slightly more attenuated and sometimes slightly curved at the base or more subglobose. The range of spore size within the smaller-spored populations lies at *3–4.5 × 1.7–2.2 µm, that of large-spored ones around *4–7(–8.5) × 2.1–2.8 µm. 2 western Australian collections on bark of *Acacia* deviate by extremely long spores [*(6–)7–9.5(–10.5) × 2.2–2.5(–2.8) µm, H.B. 8996c (Pl. 860: 6), 9.XII.2001], but also the holotype of *O. eucalypti* from California and three European records show rather long spores although containing only small LBs (Pls 857: 7; 858: 1–2, IVV: 24.V.2015).

This mixed occurrence of different spore sizes within an apothecium indicate that collections with aberrant spores are conspecific with those with normal spores. For instance, in a specimen with subglobose spores (Pl. 858: 7), the majority of asci contained normal spores while only some showed distinctly larger, more ovoid spores. In another sample, subglobose spores strongly prevailed in two of the three tested apothecia growing on wood (Pl. 858: 8), while the third apothecium showed consistently narrower, ellipsoid spores, and also in an adjacent population on bark (H.B. 6512c, not figured) only ellipsoid spores were found (*3.5–4 × 2 µm). In the rare case of asci containing less than 8 spores, subglobose spores with an extraordinary width (*5–5.5 × 4–4.3 µm) were seen in the mentioned unillustrated sample H.B. 5038b.

Also in those specimens with large elongate spores, apothecia with much shorter spores occurred in association. For instance, in the one with the largest spores observed (Pl. 857: 5), a rather large out of 6 apothecia examined deviated in exclusively much smaller spores (†3.5–5 × 2–2.2 µm) with a very low lipid content, and asci at the lowermost end of the range (†32–40 × 3.2–3.5 µm). Quite the same situation was observed in the type of *O. eucalypti*, but here also the large spores showed a low lipid content and possessed distinct SBs. In both cases the apothecia seemed to be sharply separated by their microscopical features, though macroscopically indistinguishable.

Variation of asci, **paraphyses and excipulum**. In the present concept of *O. eucalypti*, the length of the living mature asci (prior to full turgescence) considerably varies between 31–40 and 50–60 or even 60–70 µm. Also the ascus width varies at normal turgescence between 3.5–4 and 4.3–5.3 µm, with the longest asci often showing also the largest width. Thereby, ascus and spore size is correlated to a certain degree.

The paraphyses vary between slightly to strongly capitate or clavate, and some of them show strongly asymmetrical shapes which more or less resemble the upper end of a femur; however, such asymmetrical paraphysis heads are more typical of *O. tremulae*. A thin or medium thick, often granular exudate usually covers the paraphyses and also the cortical excipular cells at margin and flanks. This exudate often occurs only scattered and is sometimes completely absent, especially from the paraphyses.

The living paraphyses and marginal cortical cells contain non- or very low- to low-refractive vacuoles which are only partly illustrated here because of their inconspicuousness (Pls 857: 3, 7; 858: 2, 7, 8; 859: 2b, 16b). Globose SCBs of varying refractivity were sometimes observed in these cells (Pls 855: 6e, 7b; 859: 2b, 13a–c, 16b).

The size of the basal ectal excipular cells may vary between *(5–)8–14(–18) × (4–)6–11(–14) and *(8–)15–25(–33) × (7–)10–16(–19) µm. Those populations with large excipular cells are reminiscent of *O. tremulae*, but were not transferred there because of over 2 µm wide ascospores and/or bright orange apothecia. The excipular cells are usually thin-walled, but in an Australian collection (H.B. 8658a) the common wall was partly quite thick (*1–2.5 µm).

Variation reported in the literature. The strong variation in colour and size of the apothecia as well as in size of the spores is indicated in the literature. Rehm (1891: 454, as *O. coccinella*) emphasized the variability in apothecial colour and imagined that *O. leucostigma* (s. Karsten) with whitish apothecia and narrower spores might be conspecific, but tentatively included also Karsten's f. *delicatula* (= *O. xanthostigma*). Breitenbach & Kränzlin (1981: 210) reported two collections with a very different spore size (3–4 × 1.5–2.5 vs. 5–6.5 × 2–2.5 µm). The present revision of the specimens revealed that both grew on old ascomata of *Colpoma quercinum* on *Quercus*, contrary to the author's notes. The colour photo obviously does not belong to either of them, whereas the reported difference in spore measurements is confirmed, the small-spored one approaching *O. tremulae*. Ellis & Ellis (1985: 11) made a distinction among British specimens between *O. alnea* with (peachy) orange apothecia and narrowly ellipsoid spores 3–5 × 1–1.5 µm with polar guttules, and *O. coccinella* with red apothecia of a smaller size and biguttulate spores 4–5 × 2.5 µm, both on angiosperms. Also Clark (1980a: 79) recognized these two taxa as distinct, but referred a sample on conifer to *O. coccinella*. Similarly, Ginko (1986) distinguished among Polish material between *O. coccinella* with orange-red apothecia and subglobose spores 3–5 × 2–2.5 µm (*O. eucalypti*) and *O. leucostigma* with whitish apothecia and ellipsoid spores 2.4–3 × 1–1.8 µm (?= *O. cejpii*).

Grelet (1948a: 52) reported extraordinarily wide spores of 4–7 × 3–4 µm for two collections on coniferous wood. However, some of the reported spore measurements did not very well concur with the provided illustrations, according to the given scale. For instance, Boudier (1904–10: 266, pl. 461) gave the spores as 4–5 × 2.5–3 µm, but from his plate a size of 3.5–4.3 × (1.8–)2.2–2.5 µm can be evaluated. Bell (2005: 20, fig. 32 E–J, as *O. alnea*) reported pink-coloured apothecia obtained on dung from Australia. The broadly ellipsoid-clavate spores are stated to measure 3–4 × 2–3 µm in the key but on the plate they are 2.3–3.4 × 1.5–2 µm, with some minute drops only at one end. Judging from spore size this is possibly *O. cejpii* rather than *O. eucalypti*.

Nomenclature and type studies of teleomorph. The name ***Orbilia coccinella*** Fr., cited also as '(Sommerf.) Fr.', was in use for a considerably long time for collections with small ellipsoid ascospores, which in majority appear to fit the present concept of *O. eucalypti*. After a restudy of the type material, the name *O. coccinella* now has to be used for a very different species which is characterized by strongly curved, cashew-shaped spores and 16-spored asci (see p. 1427).

Though apothecial colours were given a higher taxonomic weight in earlier times, the concept of *O. coccinella* s.auct. comprises very different colours: pale to bright rose-red, yellow-orange, and even whitish. The usage for an ellipsoid-spored fungus started with Karsten (1861: 36, 1869: 173) and Nylander (1869: 55), and was followed over the next hundred years by Gillet (1882: 129, with unbelievably large apothecia of 5–8 mm diam.), Rehm (1891: 453), Phillips (1887: 328, with small subglobose spores), Saccardo (1889: 628), Schröter (1893: 121), Massee (1895: 144), Boudier (1904–10: 266, pl. 461),

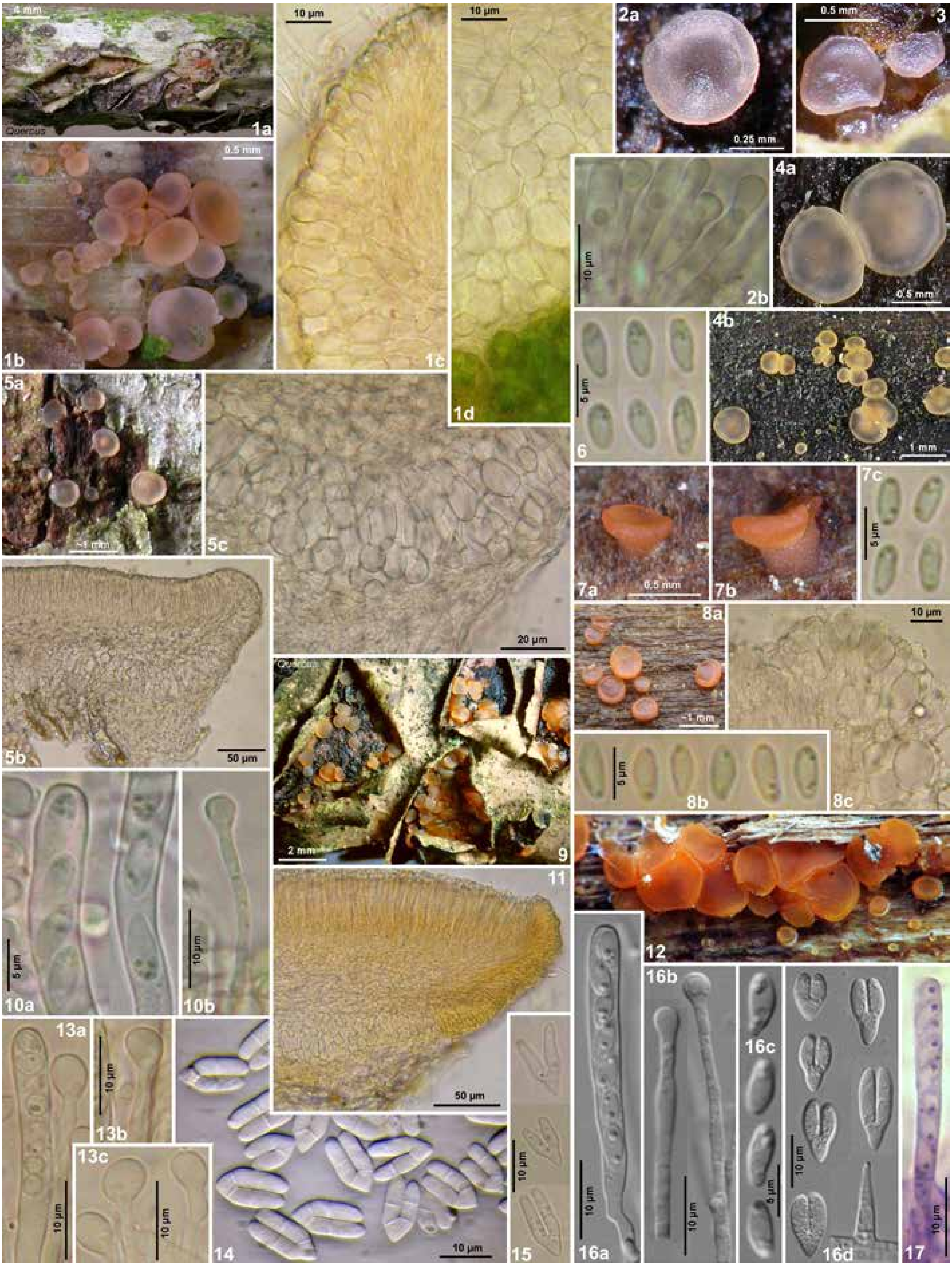


Plate 859. **1–17**: *Orbilia eucalypti*. – **1a–b**, **2a**, **3**, **4a–b**, **5a**, **7a–b**, **8a**, **9**, **12**. fresh or rehydrated apothecia; **5b**, **11**. apothecia in median section; **1c**, **8c**. id., marginal ectal excipulum; **1d**, **5c**. id., basal ectal excipulum; **2b**, **13a–c**, **16a–b**, **17**. asci and paraphyses (in **17** SBs selectively stained); **6**, **7c**, **8b**, **10**, **16c**. ascospores; **14**, **15**, **16d**. conidia and conidiophores (**14–15** from substrate, **16** from culture). – Living state, except for asci in **10**, **16a** (in H_2O), **17** (in CRB). – **2a–b**, **8a**: phot. A. Kujawa; **12**: P. Perz; **16a–d**: Y. Zhang (DIC); **17**: I. Wagner. — **1a–d**. H.B. 8798: Netherlands, Boxmeer, on *Quercus*; **2a–b**. A.K. 20091022: Poland, Poznań, on *Aesculus*; **3**. H.B. 8479a: Germany, Schwäbische Alb, on indet. angiosperm; **4a–b**. H.B. 7678: Germany, Gelsenkirchen, on *Populus*; **5a–c**.

Velenovský (1934: 92), Grelet (1948a: 52), and Seaver (1951: 157). The epithet *coccinella* was indeed only rarely applied in a different sense (see under Misapplication).

Even some recent authors retained this usage, although it was already Nannfeldt (1932: 252) who indicated in a footnote that the only authentic specimen of Sommerfelt in the UPS herbarium differed greatly from the current concept of *O. coccinella*. Nannfeldt's short note, which includes the erroneous assumption of an identity with *Hyalinia rubella*, was neglected in the following almost 50 years, perhaps because he did not mention any microscopic details of the type material. Clark (1980a: 79) appears to be the first to adopt the binomial *Orbilia alnea* Velen. for the ellipsoid-spored taxon (*O. coccinella* s.auct.), which he assumed to be the oldest available name. Clark's choice was followed by Ellis & Ellis (1985) and Korf (1992). Raitviir (1991: 357) erroneously believed that *O. microclava* Velen. had priority over *O. alnea* because it is described a page before *O. alnea* in Velenovský's (1934) monograph, and he consequently adopted that binomial to replace the misapplied name *O. coccinella*. However, all these authors overlooked a much earlier synonym, *O. eucalypti* (W. Phillips & Harkn.) Sacc., which was recognized in the present study as belonging in the current scope of *O. coccinella* s.auct.

Another solution was suggested by Svrček (1954: 12) who used for the ellipsoid-spored taxon (*O. coccinella* s.auct.) the name *O. xanthostigma*. Svrček's choice relies on the frequent occurrence of ellipsoid-spored collections with bright yellow-orange apothecia which differ only slightly in their macroscopy from yellow populations of the *xanthostigma-leucostigma* complex. Since there exists no syntype material of *O. xanthostigma*, one way of naming the ellipsoid-spored taxon would be to neotypify *O. xanthostigma* in Svrček's sense. When Svrček (1987b: 91) described his *O. roseofuscella*, he found that its 'microfeatures are similar to *Orbilia coccinella* sensu auct., a common *Orbilia* entirely different in its bright yellow colour and guttulate ascospores of another shape', but he did not mention the name *O. xanthostigma* here. On the other hand, it seems very unlikely that Fries never had yellow populations of *xanthostigma-leucostigma complex* in hand, and the frequent usage of the name *O. xanthostigma* in that sense argues against a neotypification in Svrček's sense (see under *O. leucostigma*, Nomenclature and type studies, p. 1401).

Another option to find a proper name for *O. coccinella* s.auct. would have been offered by the new rules of the Code (ICN) which attribute names of anamorphs equal priority rights. However, *O. eucalypti* antedates the oldest available name, *Dicranidion fragile* Harkn., by 1 year. As a consequence, we are forced to adopt the oldest available name *O. eucalypti*, despite the frequent usage of the name *O. coccinella* in the period of ~50–150 years ago.

Nylander's (1869: 55) report of *Peziza coccinella* concerns a collection with carneous-red ('carneo-coccinea') apothecia (on unidentified wood from Lake Onega), with asci 4–5 µm wide and short ellipsoid to subglobose spores. This record was not examined by us and its identity remains unclear. Nylander mentioned an externally similar, often corticolous 'var. *vinosella*' from 'central Europe (Germany, France)', which differed in narrower asci (generally 3 µm wide), based on a collection of Ravenel (Fung. Carol. IV: 19, as *P. vinosa*). It seems likely that Nylander referred to *P. vinosa* var. *vinosella* Fr., a taxon which we place in synonymy with *O. auricolor* based on the restudy of an authentic specimen of Fries (see p. 1528). However, Rehm (1891: 454) attributed 'O. *coccinella* var. *vinosella*' to Nylander, when he applied this name for an exsiccata cited under his specimens of *O. coccinella* (Sugenheim, wood of dead hanging branches of *Quercus*, 1871, H. Rehm, Ascomyc. 71). A restudy of this exsiccata revealed identity with *O. eucalypti*, with comparatively large asci (45–55 × 3.7–4.3 µm) and spores (4–5.3 × 2.2–2.8 µm). The collection is deposited in M and labelled '*Calloria coccinella* f. *vinosella* Nyl. Pez. Fen.: 55 = *Call. vinosa* Fckl. Symb. Mycol.: 283 sec. descript.'.

O. eucalypti was described by Phillips & Harkness (1884) as *Calloria eucalypti* based on a Californian collection on bark (periderm) of a thick branch of *Eucalyptus globulus*, with reddish flesh-coloured (on the watercolour drawing bright orange- or brick-red, Pl. 860: 1a), scattered apothecia with a paler, glabrous margin, ovate-ellipsoid spores 7 × 3.5 µm (an error for 7 × 2.5 µm, according to the sketch in the holotype convolute in K), and paraphyses with a pyriform apex. The present reexamination of the abundant specimen revealed extraordinarily long asci and spores (Pls 858: 1; 860: 1), which nevertheless more or less fit the large-spored collections of *O. coccinella* s.auct. The spores attain a size of max. 7 × 2.4 µm and contain rather well discernible SBs (as a transparent region ~0.5–0.8 µm diam., globose to tear-shaped) and no or only a few very minute LBs when viewed in water or KOH. The visibility of SBs is extraordinary because in most collections of this species they could not be seen in the dead state. Also the asci are with †60–70 µm extraordinarily long [max. †55(–60) µm in other collections examined]. Furthermore, the paraphyses are apically distinctly wider (in KOH 3.5–6 µm) than currently observed in this species (usually not over *4 or sometimes 4.5 µm). The widest paraphyses were otherwise seen in 1 aberrant collection from Germany with unusually large spores (Pl. 857: 5, paraphyses †2.5–4.8 µm wide) and in an Australian specimen in which the spores showed a normal size (Pl. 855: 4, paraphyses *4–5.5 µm wide, but only 2.5–3 µm when reexamined in KOH).

In a second examined, rather small apothecium in the holotype, the asci (†30–38 × 3–3.2 µm) and spores (†4 × 1.8 µm) were much smaller compared to the large, firstly examined apothecium, hence the type collection could represent a mixture of two different species. The small-spored one might represent *O. tremulae*, though it can be assumed that its apothecia have also been bright orange-red when fresh. Based on the spore size stated in the protologue, apothecia with small spores should not be regarded as part of the type, given that they belong to a different genotype. Apothecial size was given as 'minute' in the protologue, but on the watercolour drawing in the type convolute it is stated as '.1–.3 mm'. These values appear to refer to the dry state, in which the apothecia of both spore types are found to measure 0.2–0.35 mm here, while attaining a diameter of 0.2–0.5 mm when rehydrated. The substrate is erroneously declared as 'decorticated wood' in the protologue, although only bark is present in the holotype and no remnants of wood. Saccardo

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H.B. 7968: Germany, Tübingen, on *Cornus*; **6**. H.B. 9226f: ibid., on textile; **7a–c**. H.B. 9406c: Sweden, Lapland, on *Sorbus*; **8a–c**. H.B. 8655: Poland, Lublin, on *Salix*; **9**. H.B. 7303: Great Britain, London, on *Quercus* (old *Colpoma*); **10**. H.B. 7831: Great Britain, Suffolk, on *Carpinus*; **11**. H.B. 8159: France, Poitou, on *Quercus*; **12**. P.P. 20060423; **13a–c**. H.B. 8427: Germany, Lübeck, on *Salix*; **14**. 30.VIII.2005: Italy, on *Olea*; **15**. H.B. 8007: Germany, Tübingen, on *Carpinus*; **16a–d**. Y.Z. jz-41: China, Yunnan, Dali, on indet. angiosperm; **17**. 15.XII.2013: Austria, Feldbach, on *Quercus*.

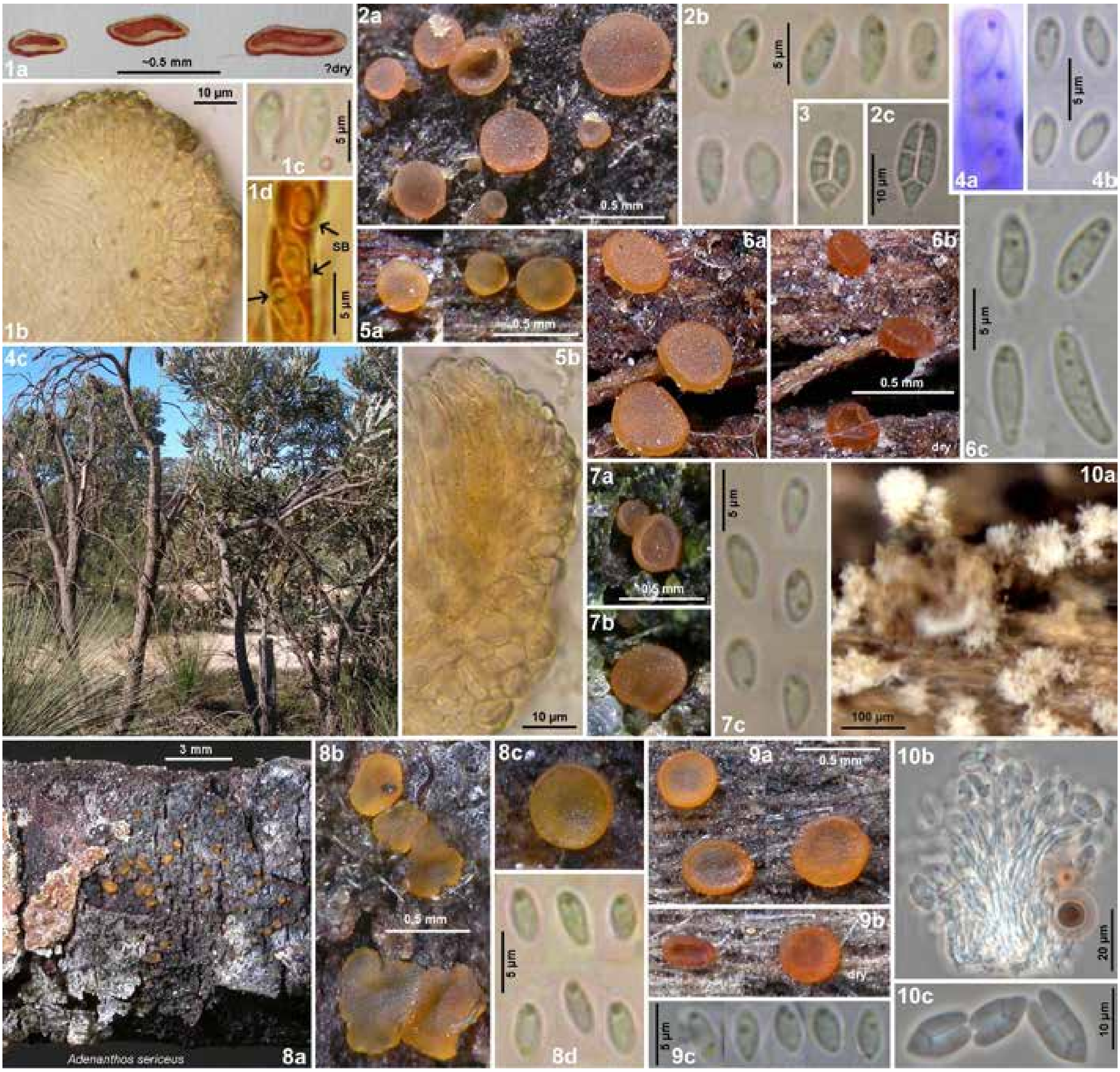


Plate 860. **1–10**: *Orbilia eucalypti*. – **4c**. banksia-eucalypt woodland, with *Banksia menziesii* and *Xanthorrhoea*; **2a**, **5a**, **6a**, **7a–b**, **8a–c**, **9a**. rehydrated apothecia; **1a**, **6b**, **9b**. apothecia in dry state (uncertain for **1a**); **10a**. synnematal anamorph in dry state; **1b**, **5b**. marginal ectal excipulum in median section; **1c–d**, **2b**, **4a–b**, **6c**, **7c**, **8d**, **9c**. ascospores; **2c**, **3**, **10c**. conidia from substrate; **10b**. conidiophores arranged in a synnema. – Living state (**4a** in CRB), except for **2c**, **3** (in H_2O); **1b–c**, **2b**, **10b–c** (in 85 % lactic acid); **1d** (in KOH+IKI). – **1a**: del. W. Phillips, **10a–c**: phot. K. Seifert. — **1a–d**. K(M) 36053 (holotype of *O. eucalypti*): USA, California, on *Eucalyptus*; **2a–c**. H.B. 5766a: Mexico, Loreto, on indet. angiosperm; **3**. H.B. 5765: Mexico, Ensenada, on *Quercus*; **4a–c**. G.M. 2006-09-03.2: Western Australia, Muchea, on *Banksia*; **5a–b**. H.B. 8478b: ibid., Perth, on *Acacia*; **6a–c**. H.B. 8996c: ibid., Geraldton, on *Acacia*; **7a–c**. H.B. 8611e: ibid., Perth, on *Jacksonia*; **8a–d**. H.B. 8658a: ibid., Swan Coastal Plain, on *Adenanthos*; **9a–c**. H.B. 8643i: ibid., on *Eremaea*; **10a–c**. DAOM 152586: Canada, Winnipeg, on *Acer*.

(1889) and Seaver (1951: 158) merely repeated the protologue. Seaver gave the spore size in error as 7 × 3–5 µm (and 5–7 × 3 µm in his key p. 153), but added *Salix* as a further substrate.

Velenovský (1934) described ***O. microclava*** with blood-red (‘*sanguinea*’) apothecia 0.5–1 mm diam., asci 25 × 2.5 µm (including stipe), and ellipsoid, eguttulate, 2–3 µm long spores. The single collection was on a cut, dry, sun-exposed trunk of *Populus*, and a later collection referred here was on unidentified dry angiosperm branches in the canopy 10 m above the ground (Velenovský, 1947: 102). Velenovský characterized the species on account of the abundance of filiform, uninflated paraphyses towards the margin, whereas those near the centre of the disc have a small apical ‘clavula’. This ‘feature’ seems to indicate that he examined a submature apothecium. Indeed, the present reexamination of the holotype revealed that nearly all paraphyses in the only remaining apothecium had 2.5–4 µm wide, ± strongly capitate-clavate apices (Pl. 855: 5), and a similar result was reported by Svrček (1954). Moreover, the asci and spores (Svrček: 4–4.5 × 1.5–2 µm) were found to be much larger than indicated by Velenovský. Svrček found the apothecial colour as yellowish when dry and placed the taxon in synonymy with *O. xanthostigma* s. Svrček. The rather narrow, subcylindric-ellipsoid spores on Velenovský’s drawing are reminiscent of *O. tremulae*, but the blood-red colour and a spore length of up to †5.2 µm point to *O. eucalypti*.

Velenovský (1934) described ***O. alnea*** based on a collection on trunks of *Alnus* from near Mnichovice and some further samples on *Salix*, *Frangula*, and *Fagus* from near Jevany, with wine-rose or orange ('vinoso-rosea, aurantiaca') apothecia 0.2–0.5 mm diam., and oblong-ellipsoid, 3–4 µm long spores. The text of the protologue represents a mixture of different collections, including that on *Salix*, and unpublished sketches of the *Salix* collection and an unspecified one (probably that on *Alnus*) can be found on Velenovský's manuscript plate of *O. alnea*. Although Velenovský stressed the spores as containing 'always 2 polar guttules', he figured this feature only in the *Salix* collection, whereas in that on ?*Alnus* the spores are drawn slightly narrower and without guttules. Svrček (1954: 9) designated the *Salix* specimen (VII.1926) as lectotype and synonymised it with *O. xanthostigma* s. Svrček. The collections on *Alnus* (14.VII.1924), *Frangula* (3.VII.1925), and *Fagus* could apparently not be found in Velenovský's herbarium, at least Svrček did not comment on the presence of any syntype material. It must be mentioned that Velenovský's (1934, pl. 11 fig. 9) published illustration is misleadingly referenced under '*O. alnea* sp. n.', but in fact represents *O. alnea* var. *vesiculosa* (= *O. xanthostigma*).

In the present reexamination of the lectotype (Pl. 855: 3), about 25 scattered apothecia were seen growing on a thin, obviously xeric branch, densely intermingled with immature *Mollisia caespiticia*. The apothecial colour was not stated by Velenovský on his manuscript plate, but it is now yellowish-cream(-rose) when rehydrated and bright orange-ochraceous when dry. The asci are distinctly longer than indicated by Svrček. Actually, Svrček excluded the ascus stipe, according to his revision note. He also found the spores a bit shorter (3–3.5 × 1.5–2 µm) than evaluated in the present study, in which they contained only a few minute LBs. The paraphysis apices were found to be 2–3 µm wide (Svrček: 2.5–3 µm), the basal cells of the ectal excipulum measured 8–14 × 4–7 µm, and the marginal cortical cells 6–10 × 4–5 µm. Svrček reported the apothecia as 'immarginate' and the marginal excipulum made up of 'up to 30 µm long cells' which seem to refer to cells being intermediate to paraphyses.

The lectotype of *O. alnea* resembles *O. tremulae*, but the xeric habitat, the comparatively narrow paraphysis apices, and the small basal excipular cells in the lectotype, also the rose or orange colour in the protologue point more to *O. eucalypti*.

O. succinea was described by Velenovský (1947) for amber-coloured apothecia 0.5–0.8 mm diam. growing on a twig of *Rosa*, with globose-ellipsoid, biguttulate spores 1–2.5 µm diam., and paraphyses which are slightly clavate only in the centre of the disc (similar as in *O. microclava*). Yet, much larger spores were found in the rather abundant though not fully mature holotype. Svrček (1954: 21) found the apothecia orange to reddish and measured the spores as 3–4 × 2–2.5 µm, while the spores in the present study were even longer and instead narrower compared to Svrček's data (Pl. 855: 1a). Svrček correctly synonymised *O. succinea* with *O. xanthostigma* s. Svrček. The rather long, partly basally pointed spores and medium clavate paraphyses refer this taxon to *O. eucalypti*.

Svrček (1987b) described ***O. roseofuscella*** for a collection on bark of a fallen branch of *Picea*, as a 'very distinctive species readily recognized by the peculiar colour of the fresh apothecia (0.5–0.8 mm diam.) being pale brown with a rose tint or pale flesh-brownish, without any trace of yellow'. According to Svrček, 'the microfeatures are similar to *O. coccinella* sensu auct., a common *Orbilia* entirely different by its bright yellow colour and guttulate ascospores of another shape'.

Svrček's measurements of the asci (35–40 × 3.5–4 µm) and ovoid to (fusoid-)ellipsoid spores (3–4 × 1.8–2 µm) are confirmed in the present reexamination of the rich holotype, which did not reveal any clear difference to the present concept of *O. eucalypti*. The apothecia are now (rehydrated) pale cream and are seated on abundant aggregates of brown globose cells of a black yeast together with some green algae. The semitranslucent apothecia probably obtain their brownish colour from the black yeast beneath. The spores vary between narrowly (cylindric-) ellipsoid and subglobose (Pl. 855: 2a), the latter corresponding to those aberrant populations shown in Pl. 858: 6–8. Svrček also mentioned this variation in spore shape but he did not report subglobose spores. The question remains open which kind of 'entirely different' spore shape he had observed in his yellow-fruiting specimens of *O. xanthostigma* s. Svrček.

Misapplication. Though the name *O. coccinella* (s.auct.) has frequently been applied in a rather consistent way, reports by four older authors differ hereof. (1) A specimen of unknown geographical origin in the herbarium of C.F.P. v. Martius (BR), collected by F.M.J. Welwitsch on inner surface of '*Tilia*' bark in 1839, turned out to be *O. comma* and the substrate probably *Ulmus* bark. (2) Two specimens in the Crouan Herbarium (CO) labelled '*Helotium coccinellum* (Sommerf.) Crouan' in sched., on stems of *Rubus fruticosus* agg. (VIII.1865 and 12.VIII.1869), belong to *O. rubrovacuolata* (J.P. Priou pers. comm., see also under *Orbilia infixa*, p. 1675). (3) A revision of Feltgen's (1899: 53, 1901: 35, 1903: 41) specimens under the name *O. coccinella* revealed that his records mainly concern *O. xanthostigma* in the here neotypified sense, but sometimes also *O. eucalypti*, and a single time (unpublished specimen) *O.* cf. *luteorubella*. (4) Bachman's (1909: 58) report of *O. coccinella* from Ohio, with globose spores 2–3 µm diam., apically capitate paraphyses, and possibly desiccation-sensitive apothecia 1–2 mm diam., could refer to *O. fissilis*. The phragmosporous anamorph described by Yang & Liu (2005) from a CBS culture under the name *O. coccinella* resembles that of *O. dryadum* much better than the dicranidion-like state of *O. eucalypti* or *O. tremulae* (see under *O. dryadum*, p. 1390). Gremmen's (1960) report on pine branches under the name *O. luteorubella* might refer to *O. eucalypti*, but the spores which he reported as ellipsoid, 6 × 2 µm, are drawn partly subcylindrical.

Anamorph. The connection between *Dicranidion fragile* and *O. eucalypti* was reported for the first time by Brefeld (1891: 304, fig. 68, as *O. coccinella*, anamorph unnamed), and later by Liu (2006: 64, fig. 21, B.L. 748). *O. plurivacuolata* and also *O. tremulae* have a very similar anamorph, therefore, we treat *D. fragile* and further tentative synonyms as an uncertain synonym of *O. eucalypti* as the identity of the types of *D. fragile*, *O. eucalypti*, and *O. tremulae* remained unsettled.

We obtained this anamorph 6× in ascospore isolates of European samples. Also Y. Zhang (pers. comm.) obtained *D. fragile* in a Chinese ascospore isolate of *O. eucalypti* (Pl. 859: 16). A connection reported by Pfister (1997: fig. 8) under the names *Dicranidion* ?*fragile*/*O. alnea* might refer to *O.* cf. *xanthoflexa*. In various collections of *O. eucalypti* we observed conidia of *D. fragile* on the natural substrate near apothecia, but in two further samples the conidia occurred either in association with a very different *Orbilia* species (*O. corculispora*, H.B. 8045a) or without orbiliaceous teleomorphs (Pl. 859: 14).

The conidia of *O. eucalypti* are characterized by a deltoid central cell with a conical base and 2 oblique septa above which delimit it from the two arms. The arms are mostly parallel, rarely diverging, and each arm usually consists of 2 cells. Young conidia are initially subglobose to ellipsoid and later become heart-shaped. Before the arms develop, a septum is formed at one of the two arm initials, while the septum at the other arm initial appears later and usually symmetrical to the other (Pl. 857: 1i–j, see also Matsushima 1975: pl. 341). Conidia with diverging arms occasionally occurred among the normal ones in our samples from Italy and Germany (Pl. 859: 14–15), England (IVV: E.B. 4584), France (IVV: J.P.P. 16280), and Australia (IVV: 22.XI.2001).

When mature, conidial size ranged at *(6–)8–14.5(–17) × (4.7–)5.5–6.7(–7.3) µm and arm size at *(5–)6.5–11(–12.5) × 2.5–3.5(–3.7) µm. In the mentioned Australian sample the conidia are distinctly longer (*19–21 µm) and have longer and wider arms (*14–16 × 3.7–4 µm) which consistently diverge (conidial width 10–13 µm). This deviation appears to point to a species different from European samples. Also in *O. plurivacuolata* the conidia are slightly larger compared to *O. eucalypti* (*14–18 × 6.5–8 µm) and have larger arms of *(7–)11–15 × 3–3.8 µm.

Also the number of septa appears to serve as a character at the species level. *O. eucalypti* conidia (including the Australian sample) have 2-septate arms, rarely 1-septate and very exceptionally 3-septate (Pl. 857: 4), whereas in *O. plurivacuolata* the arms are 2–4-septate (Pl. 851), which is also the case in *D. fragile* from Japan and Peru (see below).

Dicranidion fragile was described by Harkness (1885a, b, without illustration) as forming minute, scattered, rosy-white acervuli on decaying *Nerium oleander*, collected in February 1882 in Oakland, California. In the same year, Harkness collected the holotype of *O. eucalypti* on bark of *Eucalyptus* in California, which was published 1 year earlier (Phillips & Harkness 1884). The brief description of *D. fragile* includes 12–16 µm long, 5-celled conidia with 4–5 µm wide branches. Both taxa originate from California, and the present study considers them as possibly conspecific, although some doubts remain. Hughes (1953: fig. 36) provided a detailed drawing of the type collection of *D. fragile* (Pl. 858: 9), regrettably without scale and measurements. Also Peek & Solheim (1958) studied the type by emending Harkness' description and supplying photomicrographs (fig. 6) and drawings (fig. 7 with erroneous scale, see Pl. 11: b, left). They stated the substrate to be wood and found several associated fungi, including a *Bispora*, partly serving as support for the pulvinate tufts of the *Dicranidion*.

According to the mentioned drawings of the *D. fragile* holotype, conidial shape is mainly ellipsoid because the arms more or less converge, whereas the photos by Peek & Solheim show straight, parallel arms. Conidial size was given by Peek & Solheim as †9–18 × 6–8 µm (†14–18 × 9 µm when evaluated from their fig. 6c, with arms †7–12 × 3.5–4 µm). Particularly Harkness' statement of 4–5 µm wide arms would exclude conspecificity with European *O. eucalypti*. Instead, the larger conidia with a higher number of septa would fit the presumed anamorph of *O. plurivacuolata* (see p. 1349).

Several authors reported *D. fragile* from different regions: Tubaki (1958) and Matsushima (1975) from Japan, Butterfield (1973) from South Carolina, and Matsushima (1981) from Peru. Matsushima's samples tend to have slightly larger conidia than *D. fragile*: summarized (12–)13.5–18(–22)((–25)) × (6.5–)7–9(–10) µm, arms 9–15(–19) × 3–4.5 µm, 2-septate but infrequently 3- and sometimes 4-septate. The larger size and wider arms with more septa questions conspecificity with European *O. eucalypti*, and we preferred to list them as not included collections. However, a recent ascospore isolate from Georgia, USA (Shao et al. 2018, conidia *10.5–15.5 × 6.3–7.5 µm, arms 5.5–10.5 × 2.7–3.7 µm, 1–2-septate) and 2 conidia found in association with apothecia of *O. eucalypti* in Mexico (†11.5–14 × 6–6.5 µm) suggest that American populations exist that do not differ from European ones in conidial size and septation.

The description and illustration of ***Pedilospora ramularioides*** in Bubák (1916) includes (12–)16–18 × 6–8 µm large conidia with 2 or sometimes 3 parallel, 2-septate arms, formed on minute denticles on ~60 long and 3–4 µm wide conidiophores. The species was said to grow parasitic on brown hyphae of *Bispora pusilla* (= *B. betulina*) on wood of *Castanea sativa* in Tirol (now Trentino, Italy) (Pl. 858: 10). We agree that it is a synonym of *D. fragile* as stated by Peek & Solheim (1958) and Matsushima (1981), and also with their belief that the unillustrated *P. parasitans* and *P. episphaeria* are with hesitation conspecific with *D. fragile*. Already Hughes (1953: 607) synonymised *Pedilospora* with *Dicranidion*, though without commenting on this.

Pedilospora parasitans was described by Höhnel (1902) as growing 'in *Helotio citrino* (?) parasitica' (≡ *Calycina citrina*) in Austria (Wienerwald) with 5-celled, ellipsoid, bilobed conidia of 13–16 × 5–6 µm. Possibly Höhnel confused this helotialean discomycete with *O. eucalypti*. Bubák stressed the sympodial, ramularia-like conidiogenesis on up to 8 teeth-like nodules along the elongated flexuous conidiophores and the conidia being larger and with arms that never touch each other, but he admitted that Höhnel's *P. parasitans* might lack these nodules due to a less advanced development stage.

Pedilospora episphaeria was described by Höhnel (1924) as growing on old *Thyronectria cucurbitula* on *Picea* bark in Austria (Wienerwald), with bi-, rarely trilobed conidia of 11–18 × 6–6.5 µm, with a biconical basal cell 3–3.5 × 3–3.5 µm and mostly 3-celled, mostly parallel arms of 8–15 × 2.5–3 µm, formed on teeth-like protrusions of 1.5–2.5 µm wide hyphae. Höhnel expressed his doubts whether these three *Pedilospora* taxa are specifically distinct or only forms of a single species.

Matsushima (1981) considered ***Dicranidion argentinense*** (on bark of *Eucalyptus* from Buenos Aires, Pl. 858: 11) as a possible synonym of *D. fragile*. Indeed, according to Spegazzini's (1911) drawing of the conidia the identity with *D. fragile* seems probable (size ~12–16 × 5.5–8 µm, arms 10–12 × 3–4 µm, from drawing 8–12 × 2.5–3.5 µm). The arms form a convex, elliptical outline, the basal cell is partly elongated, very similar to Y. Zhang's Chinese isolate (Pl. 859: 16d). Spegazzini figured the conidiophores aggregated in fascicles by forming cushion-shaped, white, pruinose sporodochia of 0.25–0.5 mm diam., in concordance with Peek & Solheim (l.c.) and Matsushima (1975, 1981: fig. 72) who described *D. fragile* as 'effuse or aggregated into sporodochium-like units'. Also Seifert et al. (2011, pl. 300A) provided a drawing of these fructifications, but referred to them as synnemata, a possibly more appropriate term. A Canadian specimen without teleomorph (DAOM 152586), identified as *D. fragile* by S.J. Hughes, was studied by K. Seifert (pers. comm.), who kindly supplied his documentation (Pl. 860: 10). However, such synnemata have so far never been seen by us in association with the teleomorph of *O. eucalypti*, although the exact origin of the conidia on the natural substrate was mostly unclear in our

Table 75. Available sequences of the different genotypes of *Orbilia eucalypti* and *Dicranidion fragile* (A–D), and of the similar *O. plurivacuolata* s.l., *O. tremulae*, and *D. inaequale*. Abbreviations for apothecial colour: carn = carneous, ywsh = yellowish; S1506: intron length (number of nt), 0 = intron absent; DNA isolation: ap. = from apothecia, cult. = from ascospore isolate, con. = from conidial isolate, env. = environmental isolate from wood. Identity of NBRC 6886 and CBS 217.59 as belonging to the same strain of *D. fragile* is assumed based on identical ITS data and K. Tubaki as collector.

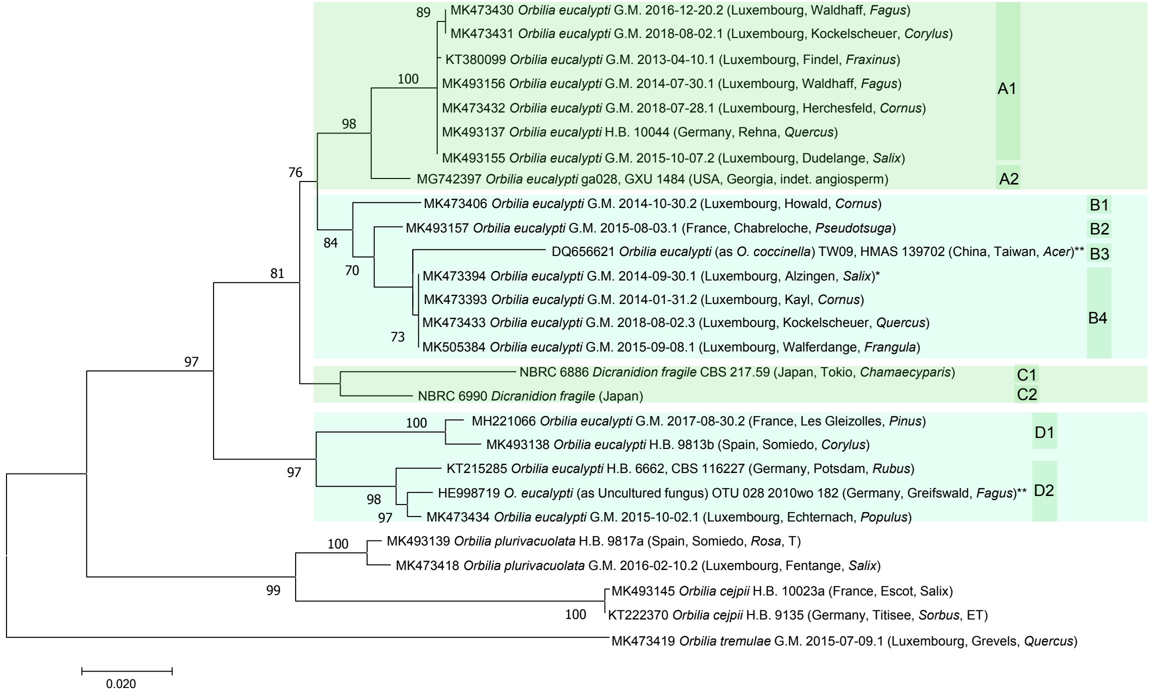
Species	Locality	Apoth.	Spores (*) [µm]	Host	Specimen number	Gene region	S1506	Isol.	Illustration	Accession number
eucalypti A1	Luxembourg, Findel	rose	3.5–4.3 × 2.5	*Fraxinus*	G.M. 2013-04-10.1	ITS+LSU	0	cult.	Pl. 856: 7	KT380099
eucalypti A1	Luxembourg, Waldhaff	?	?	*Fagus*	G.M. 2014-07-30.1	ITS+LSU	389	ap.	–	MK493156
eucalypti A1	Luxembourg, Waldhaff	carn	?	*Fagus*	G.M. 2016-12-20.2	SSU+ITS+LSU	389	ap.	–	MK473430
eucalypti A1	Luxembourg, Kockelsch.	?	?	*Corylus*	G.M. 2018-08-02.1	SSU+ITS+LSU	389	ap.	–	MK473431
eucalypti A1	Luxembourg, Herchesfeld	orange	?	*Cornus*	G.M. 2018-07-28.1	SSU+ITS+LSU	389	ap.	–	MK473432
eucalypti A1	Luxembourg, Dudelange	carn	4–5.2 × 1.8–2.2	*Salix*	G.M. 2015-10-07.2	ITS+LSU	389	ap.	IVV	MK493155
eucalypti A1	Germany, Rehna	carn	4–5.5 × 2	*Quercus*	H.B. 10044	ITS+LSU	390	ap.	IVV	MK493137
eucalypti A2	USA, Georgia	ywsh-orange	3.2–4.2 × 1.8–2.3	indet. gymnosp.	ga028	ITS+LSU	?	cult.	Shao et al. (2018)	MG742397/ MG742409
eucalypti B1	Luxembourg, Howald	?	?	*Cornus*	G.M. 2014-10-30.2	ITS+LSU	1233	ap.	–	MK473406
eucalypti B2	France, Chabreloche	?	?	*Pseudo-tsuga*	G.M. 2015-08-03.1	ITS+LSU	0	ap.	–	MK493157
eucalypti B3	Taiwan, Alishan	?	?	*Acer*	B.L. TW09, HMAS 139702	ITS	?	cult.	–	DQ656621
eucalypti B4	Luxembourg, Walferdange	?	?	*Frangula*	G.M. 2015-09-08.1	ITS+LSU	385	ap.	–	MK505384
eucalypti B4	Luxembourg, Kayl	?	?	*Cornus*	G.M. 2014-01-31.2	ITS+LSU	~385	ap.	–	MK473393
eucalypti B4	Luxembourg, Alzingen	ywsh	3.3–4.5 × 2–2.2	*Salix*	G.M. 2014-09-30.1	ITS+LSU	385	ap.	IVV	MK473394
eucalypti B4	Luxembourg, Kockelsch.	orange -rose	?	*Quercus*	G.M. 2018-08-02.3	SSU+ITS+LSU	385	ap.	–	MK473433
fragile C1	Japan, Tokio	–	–	*Chamae-cyparis*	NBRC 6886, CBS 217.59	ITS+LSU	> 378	?	–	NBRC 6886/ MH869384
fragile C2	Japan	–	–	?	NBRC 6990	ITS+LSU	~1290	?	–	NBRC 6990
eucalypti D1	France, Les Gleizolles	carn-orange	4.7–5.7 × 2.2–2.6	*Pinus*	G.M. 2017-08-30.2	SSU+ITS+LSU	0	ap.	IVV	MH221066
eucalypti D1	Spain, Somiedo	orange	4–5.7 × 2–2.4	*Corylus*	H.B. 9813b	ITS+LSU	384	ap.	IVV	MK493138
eucalypti D2	Germany, Potsdam	orange	3.5–5.5 × 2–2.5	*Rubus*	H.B. 6662, CBS 116227	SSU+ITS+LSU	381	cult.	Pl. 857: 2	KT215285
eucalypti D2	Germany, Greifswald	–	–	*Fagus*	OTU_028_2010wo _182	ITS	0	env.	–	HE998719
eucalypti D2	Luxembourg, Echternach	ywsh	?	*Populus*	G.M. 2015-10-02.1	ITS+LSU	382	ap.	–	MK473434
plurivacuolata	Spain, Somiedo	rose	3.5–4.5 × 2–2.4	*Rosa*	H.B. 9817a	ITS+LSU	418	ap.	Pl. 850: 3	MK493139
plurivacuolata	Luxembourg, Hesperange	yellow-orange	3.3–4.7 × 1.9–2.2	*Salix*	G.M. 2016-02-10.2	ITS+LSU	419	ap.	Pl. 850: 5	MK473418
aff. *plurivacuolata*	USA, MA, Boston	ywsh-orange	4.3–6 × 2.1–2.3	indet. angiosp.	bhi-F948	ITS	0	ap.	–	MH445966
inaequale	Japan, Ōtsu	–	–	*?Diaporthe*	NBRC 9366, CBS 564.71	ITS+LSU	~388	con.?	Tubaki & Yok. (1971)	LC146731
tremulae	Germany, Bayreuth	yellow	3–4 × 1.7–1.9	*Frangula*	H.B. 6963a	ITS+LSU	393	cult.		KT215283
tremulae	France, Samoens	?	?	*Alnus*	NBR C9521	ITS+LSU	393	cult.		NBRC 9521
tremulae	Luxembourg, Grevels	white	?	*Quercus*	G.M. 2015-07-09.1	ITS+LSU	393	ap.		MK473419
tremulae	France, Malestroit	yellow	3.5–4.2 × 2–2.2	*Cotone-aster*	H.B. 9870	ITS+LSU	> 383	ap.		KT380098/ UDB034366
tremulae	China, Qinghai	?	?	indet.	B.L. Q132, HMAS 139645	ITS+LSU	?	?		DQ656620/ DQ656693

samples. In any case, also in our pure cultures the conidiophores emerged always singly (Pls 857: 1–2; 858: 3–4).

A recent record from subtropical humid Mexico (Xalapa, 1400 m) identified as *D. fragile* (López et al. 2013) likewise formed cushion-shaped synnemata. Yet, the conidia are larger ('22–30 × 7–9 µm', but the given width is too low when considering the length:width relation on the photo) and have arms with 3–6 septa. They fit quite well *D. amazonense* Matsush., a species described without aggregated conidiophores.

The 'conidial state' obtained in an agar culture by Bell (2005, fig. 32 F) from an ascospore isolate of '*O. alnea*' looks like chlamydospores. Yang & Liu (2005) observed in a CBS-strain under the name *O. coccinella* (CBS 916.72) a phragmosporous anamorph which they described accordingly as *Dactylella coccinella*. However, its molecular data are very different from those now available for *O. eucalypti* (for further details see under *O. dryadum*, p. 1390).

Phylogeny. Sequences were gained in the present study from 17 European samples here referred to *O. eucalypti*, all from xeric or sometimes recently fallen branches, comprising ITS and



Phylogenetic analysis 24. Phylogram of *O. eucalypti* s.l. inferred from combined ML analysis of ITS+LSU (D1–D2) rDNA dataset (27 sequences, 1214 positions, aligned with MUSCLE) using the K2+G+I model in MEGA7 (500 replicates). The tree is rooted with *O. tremulae*. Asci 8-spored in all taxa; ET = epitype, * = without partial ITS2, ** = without LSU.

LSU, six also SSU (Tab. 75). Two were from ascospore isolates, the remaining from apothecia. An ITS sequence in GenBank that matches *O. eucalypti* was obtained by Unterseher et al. (2013) from a pure culture isolated from a dead attached branch of *Fagus* in Greifswald (Germany), but apothecia and conidia were not observed (M. Unterseher pers. comm.). A North American ascospore isolate (ITS+LSU) was referred to *O. eucalypti* by Shao et al. (2018), and a Taiwanese ascospore isolate (ITS) to *O. coccinella* by B. Liu (pers. comm.). Finally, sequences exist of two anamorphic Japanese strains under the name *Dicranidion fragile* (ITS+LSU). The S1506 intron in present in 16 of these strains and clearly absent in four.

All these sequences clustered in analyses of SSU+ITS+LSU, ITS+LSU, or ITS in a medium to strongly supported clade (Phyls 22, 24, S28) which, however, comprises four subclades (A–D) with 10 different genotypes. Among the four subclades a distance of 4–11.5 % (ITS, Phyl. S28) or 1.3–4.3 % (LSU D1–D2 domain, S27) is observed, which suggests that different taxa are involved. When analysing the intron, *O. eucalypti* even appears polyphyletic by forming three strongly supported clades that clustered distantly and unresolved among other taxa of series *Orbilia* (S26). Subclades A and D received strong support in Phyls 22, 24, D also in S27, S28; subclade B received only medium support (Phyl. 24), and subclade C only low support (S28).

Although our two European ascospore isolates (G.M. 2013-04-10.1, H.B. 6662) coincide in conidial as well as ascospore size and shape, they clustered in different subclades (A1 and D2). Based on the available data, the morphology of ascospores and conidia seems to play a subordinate role at the molecular level, also apothecial colour varied within each subclade (Tab. 75, subclade C was without teleomorph). Regrettably, apothecial colours and micromorphology were partly not documented in the specimens treated by molecular methods.

A high genetical homogeneity in the ITS region is noted within the genotypes A1 (0–0.4 %, 7 of our samples) and B4 (0 %, 4 of our samples). Despite this homogeneity, the inhabited substrate covers a wide range of woody angiosperms, with two genera occurring in both subclades. In contrast to A1 and B4, subclade D, which includes five of our samples with a likewise very wide host range, shows ITS heterogeneity in both genotypes (2 % in D1, 1.5–2.7 % in D2), although only 0–0.2 % variation is observed in the LSU. Finally, two of our samples represent genotypes B1 and B2, each containing only one strain, and four extra-European samples (USA, Japan, Taiwan) represent other four distinct genotypes (A2, B3, C1, C2). Gymnosperms occurred as hosts in three genotypes (B2, C1, D1).

The two genotypes of subclade A differ from each other in the ITS/LSU by 3/1.6 %, those of subclade B by 2.3–5/0.6–1.1 %, Japanese *D. fragile* (C1 and C2) by 6.5/1.6 %, and subclade D1 from D2 by 7–7.5/1.3–1.8 %. Among the subclades, the distance between A and B is 4–6/1.5–3 %, C differs from A and B by 5–9/1.3–3 %, and D from A–C by 9–11.5/2–4.3 %.

Even in the SSU V8 the six available sequences belonging to three genotypes (4 strains of A1, 2 strains of D1 & D2) differ at pos. 61 (A1: TG**G**CC, D1 & D2: TG**A**CC) and 90 (A1: AC**T**CT, D1 & D2: AC**C**CT).

Also the intron shows a high distance of up to 8–26 % among the 14 strains which have it. A similarly high distance is observed to other species of series *Orbilia* which possess the intron, the minimum being between the Potsdam strain (D2) and *D. inaequale* (14 %). Phylogenetically the intron behaves different from ITS and LSU: particularly subclades A and B clustered very distant from each other (S26). In accordance with the ITS region, genotypes A1 (6 strains) and B4 (4 strains) each possesses ± identical intron data. However, a 7th strain (from Howald) unexpectedly clustered with genotype A1 with only 3 nt and 2 gaps deviation, although it deviates in the ITS by 5.5–5.8 % and clustered in the analysis of that region in subclade B (B1, Phyls 24, S28). In this strain the intron has a much larger size (1233 nt) compared to the other strains of *O. eucalypti* (381–390 nt). Its long 3'-end aligns with the similarly large introns of *D. fragile* (NBRC 6990, ~1290 nt) and *O. frangulae* (1266, see Tab. 24), whereas *D. fragile* (NBRC 6886) appears to have an intron of normal length (below 400 nt). As a further surprise, the two *D. fragile* strains clustered in two very distant, partly strongly supported clades, C2 with A1, and C1 with B4 and D1, while genotype D2 clustered unresolved and distant from D1.

In Liu et al.'s (2006a) separate analyses of ITS an LSU, sequences of seven strains (5× ITS, 4× LSU) were included under the name *O. coccinella*, all of which showing high distances among each other. The heterogeneity of his species concept becomes apparent from the very different clades in which they clustered. Morphological data were available to us only for two of the seven strains (anamorph: B.L. 748, teleomorph: B.L. 6176). Among these seven strains, only that from Taiwan (B.L. TW09, ITS, genotype B3) fell in the *O. eucalypti* clade (Phyls 23, 24, S28) by showing a minimum distance of 4% to genotype B4. Two from Beijing (B.L. 6578, LSU; B.L. 6176, ITS) clustered in the medium supported *cejpii-frangulae* clade (Phyls 23, S27), whereby B.L. 6578 concurs with *O. cejpii* on *Fagus*. Two samples not treated in Liu (2006) clustered with low support and high distance with *O. renispora* and could belong to the same species: B.L. 6179 (Beijing, ITS, in Liu's unpublished list as *O. coccinella*) and B.L. 747 (unlocalized, LSU) (Phyls 23, S27). Among the remaining two Chinese strains, one from Qinghai (B.L. Q132, ITS+LSU) is found here to belong to *O. tremulae*, and B.L. 748 (Hunan, ITS+LSU) clustered unresolved in series *Orbilia* very distant from any other sequence (Phyls 22, 23, S27). This latter strain closely resembles *O. eucalypti* based on conidial morphology from culture (Liu 2006: 64, fig. 21), though deviating in rather long, predominantly 3-celled conidial arms.

A sample from Massachusetts (bhi-F948), reminiscent of *O. eucalypti* s.l., is named *O.* aff. *plurivacuolata* because of its multiguttulate paraphyses. Its sequence clustered distantly and unresolved between the *O. eucalypti* clade and the *cejpii-frangulae* clade, to which *O. plurivacuolata* belongs (Phyl. 23). It also deviates at the 5'-end of ITS2 by ATTA in contrast to ATTG in most other sequences of ellipsoid-spored members of series *Orbilia*, or ATGT in *O. renispora*, *O. fissilis*, and the *leucostigma-xanthostigma* clade (Tab. 20).

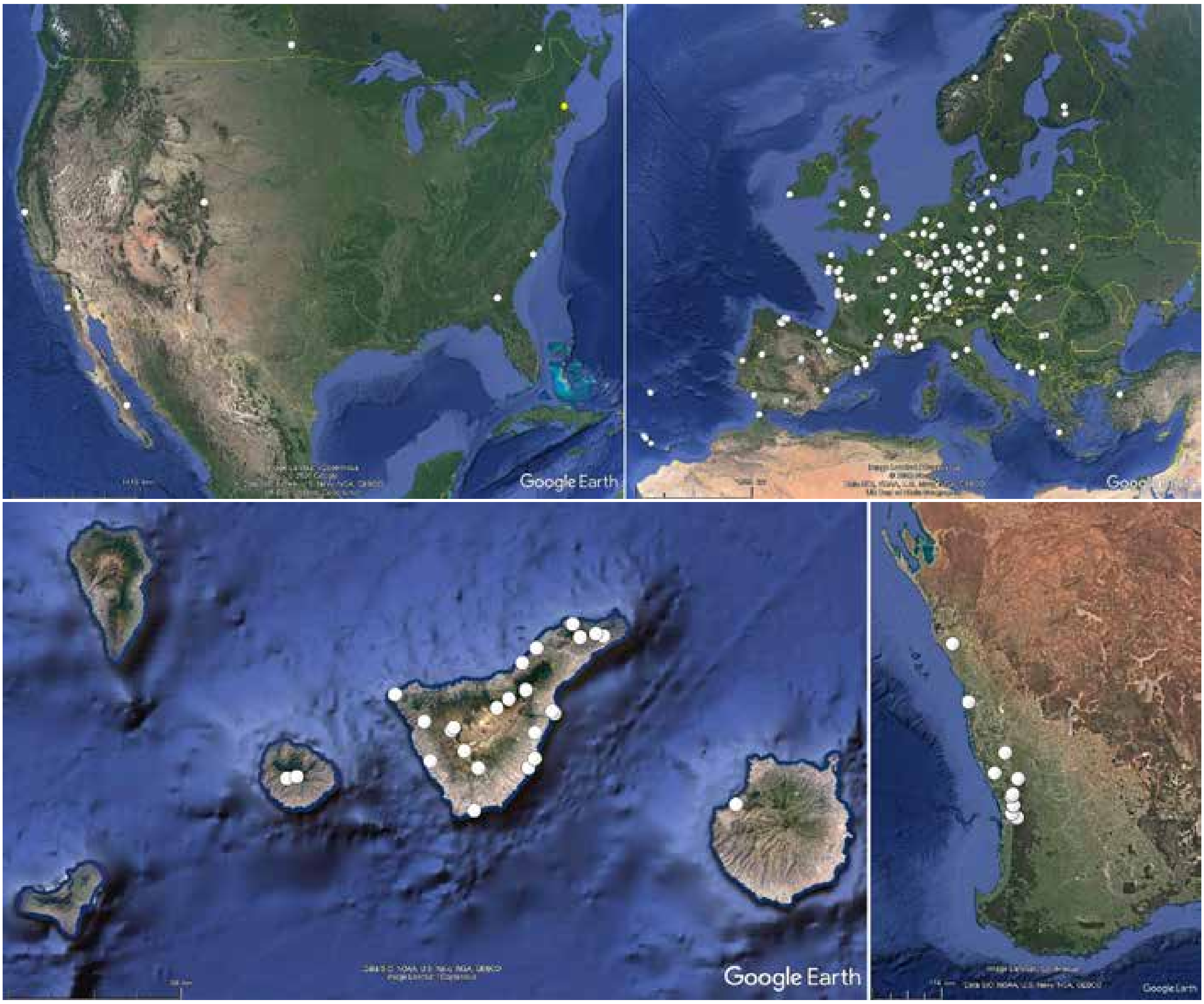
Due to the high molecular variation among strains of the *O. eucalypti* clade, we conclude that our present concept of *O. eucalypti* is heterogeneous. Even in the here presented narrow sense which excludes the similar *O. tremulae* and *O. plurivacuolata*, *O. eucalypti* includes within Europe six different genotypes that possibly represent six cryptic species. Remarkable is that even in the 5.8S two paired positions of stem-loop B8 differ in genotype D1 from the rest of *O. eucalypti* (see p. 1327). The future will show whether further, possibly intermediate genotypes exist within Europe, and also how many genotypes occur outside Europe and whether any of them concurs with the European ones.

Although *O. eucalypti* is morphologically not easily separable from *O. tremulae* and *O. plurivacuolata*, the ITS distance between these species ranges at 17–18.5% and 13–23%, respectively, and similar distances are observed to *O. fissilis* and *O. cejpii* s.l.

Ecology. *Orbilia eucalypti* is one of the commonest species of the genus. A total of about 400 collections are assigned to it here, including doubtful samples, and over 440 collections would be involved when including the similar *O. tremulae*. *O. eucalypti* occurs on ± rotten wood and bark of mainly xeric but also hygric twigs, branches and trunks of various angio-, rarely gymnosperm trees and shrubs, also on branches of succulents, stems of *Rubus fruticosus*, petioles of *Macrozamia*, and fruitbodies of aphyllophoralean basidiomycetes. Populations on herbaceous stems have almost never been encountered, with the exception of slightly woody stems of the perennial *Astragalus lusitanicus*, *Euphorbia characias* and *E. palustris*. Extraordinary substrates are bamboo (Liu et al. 2006b, as *O. coccinella*) and dung (Bell 2005, as *O. alnea*). Favourite hosts were *Quercus* {69} and *Salix* {60}, followed by *Carpinus* {22}, *Corylus* {19}, *Fagus* {12}, *Ulex* {11}, and *Pinus* {10}. Bark and wood were quite equally often recorded as substrate.

O. eucalypti shows a worldwide distribution, being recorded from Europe, Asia, Australia, North and South America, and Africa. Within Europe the species occurs in a wide range of climatic zones, from atlantic to continental, thermomediterranean semihumid to cold-temperate humid and even thermo- to oroboreal regions from planar up to subalpine altitudes. In Macaronesia and Morocco (northwestern Africa) it occurs in thermo- to inframediterranean semihumid to arid as well as meso- to supra(sub)mediterranean semihumid xerophytic scrublands, also (sub)humid cloud forests (Quijada et al. 2016), and a single sample from Réunion (Mascarene islands east of Madagascar) was from a temperate humid (winter-dry) forest. Collections from Australia were so far exclusively from the southwest of the continent in subtropical semihumid banksia-eucalypt or acacia (open) woodlands from the Geraldton Sandplains, Swan Coastal Plain, and Jarrah Forest in the northern part of Darling Range. The few records from North America are from humid hemiboreal forests in the north and northeast (Canada, *D. fragile* synnemata) and from the subarctic tundra in western Greenland, from the midwest in the cold-temperate humid Douglas fir mixed forest of the Southern Rocky Mountains and from the southwest in a subtropical semihumid chaparral and semiarid desert scrubs of the Sonoran Desert of Baja California. Two old records from the pacific west represent the types of *O. eucalypti* and *D. fragile* which were in a mediterranean, mild-maritime semihumid region of California. A record of *D. fragile* by Butterfield (1973) was from the humid subtropical coastal region of South Carolina. Two samples from South America were in warm-temperate altimontane and subtropical planar (type of *D. argentinense*) humid regions.

The fact that this omnipresent species was not recorded by Dennis (1978) for Great Britain indicates that collectors of the 20th century have ignored dry attached branches on which a majority of the present about 400 collections were made, whereas a small part derives more or less from the moist ground. Under the names *O. coccinella*, *O. alnea* and *O. microclava*, the species was reported for North America by Seaver (1951), for arctic Alaska by Korf (in Kobayasi et al. 1967, on *Salix alaxensis*), for Macaronesia by Korf (1992, on bark and palm leaves) and Quijada (2010, on phylloclades of *Euphorbia* spp.), for mediterranean southwestern Europe by Sierra López (1987, on wood of *Pinus halepensis*, *Cistus* sp., *Quercus ilex* and *Spartium junceum*), for the Far East of Russia by Raitviir (1991), for Tibet by Liu et al. (2006b), for southeastern Asia by Liu (2006), Z.F. Yu, Y. Zhang and H. Su (pers. comm.), and for southeastern Australia by Bell (2005).



Map 137. Known distribution of *O. eucalypti* in North America, Europe, Macaronesia, and southwestern Australia (yellow = not included collection).

Specimens included. **GREENLAND**: **Qeqqata**, 13 km WSW of Kangerlussuaq, close to Lake Helen, 200 m, branch of *Salix glauca*, on wood, 14.VIII.2000, A. Raitviir (TAAM 137783, H.B. 6828). — **IRELAND**: **Cork**, 12.5 km WSW of Glengariff, 1.5 km N of Adrigole, 65 m, branch of *Ulex europaeus*, on bark, 7.V.2016, J.P. Priou (J.P.P. 16149, doc. vid.). — **GREAT BRITAIN**: **Yorkshire**, **West Yorkshire**, 8.5 km SSE of Halifax, 1.8 km NW of Huddersfield, Edgerton, 150 m, branch of *Quercus*, on old *Colpoma*, 5.I.2013, C. Yeates (C.Y. F/2272, doc. vid.). – **South Yorkshire**, 7.5 km NNW of Sheffield, 1 km NW of Grenoside, Wharncliffe Wood, 245 m, branch of *Quercus petraea*, on wood, 18.V.2011, H.O. Baral (ø). – 18 km ESE of Sheffield, 1.5 km SE of South Anston, Anston Stones Wood, 95 m, branch of *Ulmus glabra*, on bark, 16.V.2011, T. Læssøe (ø). – 8 km NNW of Barnsley, 6.5 km S of Wakefield, Seckar Wood, 75 m, branch of *Quercus*, on bark, 19.V.2011, H.O. Baral (ø). – 3.5 km S of Barnsley, 1.3 km SW of Worsbrough, Worsbrough Country Park, 70 m, branch of *Salix cinerea*, on bark, 20.V.2011, H.O. Baral & S. Rogerson (ø). – ibid., branch of *Salix*, on *Schizopora paradoxa*, T. Læssøe (K(M)70825). – 3.5 km SW of Barnsley, ENE of Wentworth Castle, 140 m, branch of *Quercus petraea*, on wood, 16.V.2011, H.O. Baral (ø). – **East England**, **Suffolk**, 3.7 km ENE of Halesworth, 2.5 km N of Wenhaston, Blyford wood, 35 m, branch of *Quercus robur*, on wood, 5. VIII.2004, E. Batten (E.B. 4547, K(M) 158855, doc. vid.). – ibid., branch of *Carpinus betulus*, on wood, 22.VI.2005, E. Batten (H.B. 7831 ø). – 0.4 km NNW of Wenhaston, Bicker's Heath, 15 m, branches of *Ulex europaeus*, on bark, 10.I.2004, S.M. Francis & E. Batten (ø). – ibid., branch of *U. europaeus*, on bark, 3.II.2004 (ø). – ibid., 10.I.2006, E. Batten & S.M. Francis (H.B. 8045b, anam. only). – ibid., branch of *Cytisus scoparius*, on bark, 24.XI.2006, S.M. Francis (ø). – ibid., Blyford Lane, Garden Hill Cottage, 12 m, branch of *Ulex europaeus*, on bark, 3.II.2005, S.M. Francis (E.B. 4584, anam. substr., doc. vid.). – 5.5 km SW of Southwold, 2.3 km NNW of Dunwich, Dunwich Forest, 7 m, branches of *Lonicera periclymenum*, on wood, 13. & 31.I.2006, E. Batten (E.B. 4665, H.B. 8052 ø, anam. substr.). – 1 km NW of Dunwich, 16 m, branch of *Ulmus minor*, on bark, 13.XII.2005, E. Batten (E.B. 4657, K(M) 227386, doc. vid.). – 1 km W of Dunwich, 14 m, branch of *Salix cinerea*, on bark, 21.VIII.2004, E. Batten & S.M. Francis (E.B. 4554, K(M) 159077, doc. vid.). – 1.5 km WSW of Dunwich, Dunwich Forest, 10 m, branch of *Quercus robur*, on wood, 28.VII.2004, E. Batten (E.B. 4546, K(M) 227419, doc. vid.). – ibid., branch of *Q. robur*, on wood, 14.VIII.2004, E. Batten (E.B. 4550, doc. vid.). – 12.5 km SSW of Southwold, 2.5 km NE of Leiston, NW of Sizewell, Kenton Hills, 4 m, branch of *Salix cinerea*, on bark, 23.XII.2005, E. Batten (E.B. 4658, doc. vid.). – **Cambridgeshire**, 11 km N of Huntingdon, 6 km E of Sawtry, Woodwalton Fen, branch of *Quercus robur*, on bark (old *Vuilleminia*), 7 m, 17.IV.2017, H.O. Baral (ex H.B. 10063a, K(M) 263139). – 9.5 km SSW of Huntingdon, 1 km NE of Little Paxton, Rory's Wood, 20 m, branch of *Salix ?alba*, on wood,18.IV.2017, H.O. Baral (ex H.B. 10068, K(M) 263140). – **Bedfordshire**, 14 km ESE of Bedford, 2.5 km SE of Sandy, Sandy Warren, 70 m, branch of *Quercus robur*, on wood, 19.IV.2017, H.O. Baral (ø). – **South East England**, **London**, 13 km WSW of London, 1.3 km N of Richmond, Kew Royal Botanic Garden, behind Queens Cottage, 14 m, branch of *Q. robur*, on bark & old *Colpoma quercinum*, 2.III.2003, A. Henrici (H.B. 7303). – **Wales**, **Powys**, 7.5 km W of Rhayader, Craig Goch reservoir, 324 m, branch of *Ulex europaeus*, on wood, 27.IX.2017, J.P. Priou (J.P.P. 17208, doc. vid.). — **NORWAY**: **Sør-Trøndelag**, 43 km SW of Trondheim, 12 km NNE of Meldal, NE of lake Stavelitjørn, 220 m, on wood of ?*Salix*, 9.IX.1993, H. Holien (H.Ho. 5929). — **SWEDEN**: **Västerbotten**, 21 km NW of Saxnäs, NE of Grundfors, Marsfjället, S of Kraejhpiesvaerie, ~650 m, branch of *Betula pubescens*, on wood, 25.VII.2010, H.O. Baral (ø). – ibid., twig of *Salix* (?)*myrsinifolia*, on bark, 25.VII.2010, T. Læssøe (ø). – 4.5 km SW of Saxnäs, Satsfjället, Pojken, 715 m, branch of *Betula pubescens*, on wood & bark, 24.VII.2010, H.O. Baral (H.B. 9360c ø). – 6 km ESE of Saxnäs, Trappstegsforsen, 525 m, branch of *Sorbus aucuparia*, on bark, 28.VII.2010, H.O. Baral (H.B.

9406c). – **Skåne**, 3.2 km NW of Röstånga, 1.2 km W of Härsnäs, Härsnäsdammen, 145 m, branch of (?)*Sorbus aucuparia*, on bark, 5.VI.2006, H.O. Baral (ø). — **FINLAND**: **Pirkanmaa**, 15 km SSE of Tampere, 7 km NE of Lempäälä, Hulikankulma, 110 m, branch of *Salix*, on bark, 1.I.1998, U. Söderholm (U.S. 2740, H.B. 6005b). – **Kanta-Häme**, ~8 km E of Forssa, N of Tammela, around Mustiala, 110 m, branch of *Salix phylicifolia*, on bark, 28.XI.1868, P.A. Karsten (herb. Karsten 4854b, H-6008811, mixture with *O. phragmotricha* [4854a]). — **LITHUANIA**: **Kaunas**, 7.5 km E of Jonava, 3 km NNE of Rukla, Upninkai forest, 60 m, branch of *Quercus robur*, on *Colpoma quercinum*, 2.IX.2004, E. Kutorga (M, BILAS 46681, in type of *Helicogonium fusisporum*). — **POLAND**: **Greater Poland**, 37 km SSW of Poznań, 3 km NW of Turew, SE of Stary Gołębin, 82 m, bud scales of *Aesculus hippocastanum*, 22.X.2009, A. Kujawa (AK 20091022-1). – 40 km S of Poznań, 9 km WSW of Śrem, 2 km ENE of Rąbiń, Uroszysko Rąbiń, 103 m, branch of *Quercus*, 25.VIII.2007, A. Kujawa & P. Perz (A.K., P.P. 20070825-5, non vid.). – **Lublin**, 23 km ENE of Lublin, N of Łęczna, Wieprz river, 165 m, branch of *Salix*, on wood, 27.IX.2007, J. Węcławski (H.B. 8655 ø). – **Łódź**, 5.7 km SE of Radomsko, 2 km W of Orzechówek, 245 m, branch of *Quercus*, on wood, 21.II.2010, J. Nowicki, vid. P. Perz (P.P. 20100221-1 JN, doc. vid.). – **Lower Silesia**, 3.3 km ENE of Kłodzko, 1 km S of Wojciechowice, W of hotel Kukulka, 420 m, branch of *Quercus*, on bark & old *Colpoma*, 13.IV.2006, P. Perz (P.P. 20060413-3, doc. vid.). – 10 km SSE of Bystrzyca Kłodzka, 1.5 km E of Domaszków, Polna ulica, 445 m, branch of *Tilia cordata*, on wood, 6.X.2007, P. Perz (P.P. 20071006-1, non vid.). – **Lesser Poland**, 32 km SW of Kraków, 7 km ENE of Wadowice, 390 m, branch of *Fagus sylvatica*, on wood and pyrenomycete, 16.VII.2014, S. Helleman (S.H. 803, anam. substr., doc. vid.). — **CZECHIA**: **Central Bohemia**, 20 km E of Praha, 2 km ESE of Újezd nad Lesy, Škvorecká obora, 285 m, branch of *Picea abies*, on bark, 12.IV.1982, M. Svrček (PRM 842914, **holotype** of *O. roseofuscella*, H.B. 6938 ø). – 27 km SE of Praha, ~3 km SSE of Mnichovice, pond near Hubáčkov, 330 m, branch of *Salix*, on wood & bark, VII.1926, J. Velenovský (PRM 147796, **lectotype** of *O. alnea*, H.B. 6056 ø). – ~2.5 km NE of Mnichovice, Plecháč Mt., ~490 m, branch of *Populus tremula*, on wood, IX.1933, J. Velenovský (PRM 152392, **holotype** of *O. microclava*, H.B. 6189 ø). – 3 km SSE of Mnichovice, 0.5 km E of Mirošovice, viaductus, 350 m, branch of *Rosa canina*, on bark, 29.V.1941, J. Velenovský (PRM 152409, **holotype** of *O. succinea*, H.B. 6417 ø). – **South Moravia**, 12 km NNE of Brno, Adamov, ~270 m, on wood of indet. angiosperm, undated, G. Niessl v. Mayendorf (herb. Niessl 20430, M, as *Calloria chrysophaea*). — **HUNGARY**: **Pest**, Danube-Ipoly National Park, 42 km NNW of Budapest, 5.5 km NNE of Szob, 2 km E of Márianosztra, 260 m, branch of *Quercus cerris*, on bark, 15.X.1999, L. Beenken (H.B. 6512b, c). — **CROATIA**: **Dubrovnik-Neretva**, **Korčula**, 3.5 km WSW of Korčula, 1.8 km NW of Žrnovo, Kočje, 190 m, branch of *Q. ilex*, 29.VIII.1999, N. Matočec (CNF 2/4336, doc. vid.). — **SERBIA**: **Voivodina**, Fruška Gora, 11.5 km S of Novi Sad, 5.5 km NNW of Irig, 422 m, branch of indet. angiosperm, on wood, 9.IV.2013, D. Savić (doc. vid.). – ibid., 452 m, branch of *Sambucus nigra*, on wood, 26.XI.2019, D. Savić (doc. vid.). – 8 km S of Novi Sad, 4.5 km SE of Ledinci, Paragovo, 210 m, branch of *Carpinus betulus*, on bark, 7.III.2016, D. Savić (doc. vid.). – 13 km SSW of Novi Sad, 1 km E of Brankovac, 430 m, branch of *Rosa*, on wood, 7.III.2019, D. Savić (FG-1011, doc. vid.). – ibid., branch of *Salix caprea*, on wood, 7.III.2019, D. Savić (FG-1015, doc. vid.). – 11.5 km S of Novi Sad, 5.7 km NNW of Irig, Iriški venac, SW of WWII memorial, 430 m, branch of *Tilia tomentosa*, on bark, 27.II.2019, D. Savić (FG-1010, doc. vid.). – 10.7 km E of Šid, 3.5 km WNW of Erdevik, Vorovo, 130 m, branch of *Juglans regia*, on bark, 22.X.2019, D. Savić (doc. vid.). — **MONTENEGRO**: 51 km NNE of Podgorica, 5 km ENE of Kolašin, SE of Mušovića Rijeka, 1130 m, branch of *Corylus avellana*, on wood & bark, 5.III.2016, B. Perić (B.P. Dgf/C7D05-03-16, doc. vid.). – 1.5 km NW of Herceg Novi, SW of Trebesinj, 185 m, stem of *Euphorbia*, 21.VI.2019, D. Savić (FG-1089, doc. vid.). – ibid., 4.5 km NW of Herceg Novi, NW of Ratiševina, 170 m, branch of *Punica granatum*, on wood, D. Savić (FG-1092, doc. vid.). — **DENMARK**: **Sjælland**, Møn, 17 km E of Stege, 1.7 km E of Busene, Møns Klinteskov, 800 m SSE of GeoCenter, Graederen, 1 m, trunk of *Fagus sylvatica*, on bark, 30.V.2007, H.O. Baral (ø). — **NETHERLANDS**: **Flevoland**, 6 km SW of Kampen, 9 km E of Dronten, Revebos, 9 m, branch of *Fraxinus excelsior*, on bark, 20.III.2005, H.O. Baral (ø). – ibid., branch of *Salix*, on wood, 20.III.2005, H.O. Baral (ø). – **Noord-Brabant**, 1 km W of Boxmeer, Brestbos, 18 m, branch of *Quercus*, on bark, 10.IV.2008, S. Helleman (H.B. 8798 ø). – 5.5 km S of Boxmeer, 2.7 km ESE of Stevensbeek, forest N of Overloon, 25 m, cone of *Pinus nigra*, 30.XII.2016, S. Helleman (ø, doc. vid.). — **BELGIUM**: **Vlaanderen**, **Antwerpen**, 25 km SW of Tilburg, 4.5 km ENE of Hoogstraten, Bootjesven, 20 m, branch of ?*Alnus*, on bark, 23.V.2014, L. Rommelaars (L.R. 14-011, doc. vid.). – **Wallonie**, **Namur**, 10.5 km ENE of Couvin, S of Vierves-sur-Viroin, 134 m, branch of *Malus domestica*, on bark, 10.III.2014, B. Clesse (B.C. 20150310C, doc. vid.). – **Luxembourg**, 8 km SE of Arlon, SE of Sterpenich, 325 m, branch of *Salix*, on bark, 23.IV.2001, H.O. Baral & G. Marson (ø). — **LUXEMBOURG**: **L'Oesling**, **Wiltz**, 7 km W of Wiltz, Doncols, rue de village, 465 m, branch of *Carpinus betulus*, on wood, 14.I.1989, G. Marson, H.O. Baral & C. Besch (H.B. 3662). – ibid., twig of *Carpinus betulus*, on bark, 13.V.2001, M.T. Tholl (ø). – **Diekirch**, 3.3 km NNW of Diekirch, 2.2 km W of Tomm, NE of Fridhaff, Hooldaer, 365 m, branch of *Betula*, on wood, 23.IV.1995, H.O. Baral (ø). – **Redange**, 11 km W of Ettelbruck, 1.8 km NW of Grosbous, W of Bruch, 390 m, branch of *S. cinerea*, on bark, 26.III.2001, G. Marson (H.B. 6990a). – **Gutland**, **Diekirch**, 3.5 km E of Diekirch, 1.7 km SW of Bettendorf, Schoofsboesch, Carrières de Gilsdorf (Steinbruch), 313 m, branch of *Rosa*, on boring dust. 26.IV.1994, H.O. Baral (ø). – 5.5 km ENE of Diekirch, 1.5 km NE of Bettendorf, Niderbierg, 390 m, branch of *Corylus avellana*, on wood, 27.IV.1995, H.O. Baral & G. Marson (H.B. 5270). – **Mersch**, 7 km SE of Mersch, 1.2 km NE of Blaschette, Seitert, 330 m, branch of *Salix caprea*, 5.VII.2006, G. Marson (ø, anam. substr.). – 8 km ENE of Mersch, 1 km SW of Larochette, Manzebach, 307 m, branch of *Fraxinus excelsior*, on bark, 27.IV.1994, G. Marson & H.O. Baral (ø). – 6 km SW of Mersch, 1.5 km ESE of Tuntange, Himel, 355 m, branch of *Cornus sanguinea*, on bark, 21.IV.1998, G. Marson (H.B. 6123b). – **Echternach**, 7.5 km W of Echternach, 3.3 km SW of Berdorf, NNE of Müllerthal, Schnellert, 230 m, branch of *Carpinus betulus*, on wood, 28.IV.1994, H.O. Baral (ø). – ibid., branches of (?)*Salix caprea*, on bark, 13.IX.1998, G. Marson (ø). – 4.7 km WSW of Echternach, 1.7 km N of Scheidgen, Deisterbaach, 330 m, branch of *Frangula alnus*, 1.II.2003, G. Marson (ø). – ibid., branch of *Corylus avellana*, 1.II.2003, G. Marson (ø). – 3.7 km ESE of Echternach, ESE of Manertchen, 350 m, branch of *Populus tremula*, on wood, 2.X.2015, G. Marson (G.M. 2015-10-02.1 ø, non vid.; sq.: MK473434). – 1.5 km E of Scheidgen, N of Michelshaff, 320 m, stem of *Rubus fruticosus*, 27.I.2007, G. Marson (ø). – **Grevenmacher**, 1.7 km ENE of Manternach, WNW of Fielsmillen, 185 m, twig, branch of *Liriodendron tulipifera*, on bark, 22.IV.1995, G. Marson & H.O. Baral (ø). – ibid., branch of *Acer platanoides*, on bark, 22.IV.1995, G. Marson & H.O. Baral (H.B. 5279). – 4 km NNE of Grevenmacher, 2 km NW of Mertert, Schlaufiels, 220 m, branch of *Corylus avellana*, on bark, 19.III.1995, G. Marson (H.B. 5281a, anam. cult.). – 1 km NW of Mertert, Karel, 190 m, branch of *Malus domestica*, on bark, 2.II.1997, G. Marson (ø). – **Remich**, 5 km NNW of Remich, 1.5 km W of Greiveldange, Guddekaafswis, 230 m, branch of *Quercus*, on wood, 14.IV.1992, H.O. Baral (H.B. 4653a). – 6 km S of Remich, 1 km E of Remerschen, Mosel river, 145 m, branch of *Salix* ?*viminalis*, 16.VII.2001, G. Marson (ø). – 8.5 km S of Remich, SW of Schengen, N of Stroumberg, 225 m, stem of *Rubus* (?)*bifrons*, on bark, 11.II.2007, G. Marson (ø). – **Luxembourg**, 6.3 km NNE of Luxembourg, 2 km E of Walferdange, Waldhaff, 405 m, branch of *Frangula alnus*, on wood, 8.IX.2015, G. Marson (G.M. 2015-09-08.1, non vid.; sq.: MK505384). – ibid., 1 km NE of Waldhaff, 430 m, trunks of *Fagus sylvatica*, on bark, 30.VII.2014, G. Marson (G.M. 2014-07-30.1, non vid.; sq.: MK493156). – ibid., 20.XII.2016 (G.M. 2016-12-20.2, non vid.; sq.: MK473430). – 3 km NW of Luxembourg, 0.3 km N of Reckendall, Bambësch, 290 m, stump of *Fagus sylvatica*, on wood, 16.XI.1899, J. Feltgen (LUX 42519, as *O. coccinella*). – 6 km NNE of Luxembourg, 3 km E of Walferdange, Gréngewald, Stafelter, 425 m, trunk of *Fagus sylvatica*, on bark, 25.I.2007, G. Marson (ø). – 4 km ENE of Luxembourg, NW of Kalchesbrück, E of Findel, 333 m, trunk of *Fraxinus excelsior*, on bark, 10.IV.2013, G. Marson (G.M. 2013-04-10.1, anam. substr.; sq.: KT380099). – 3.5 km S of Luxembourg, 1 km SW of Howald, 295 m, branch of *Cornus*, on bark, 30.X.2014, G. Marson (G.M. 2014-10-30.2 non vid., ø; sq.: MK473406). – 5 km S of Luxembourg, 1.5 km W of Hesperange, Biersak/Géisselbierg, 290 m, branch of *Corylus avellana*, on *Vuilleminia comedens*, 16.XII.1993, G. Marson (H.B. 5023a, anam. cult.). – ibid., on wood & old *V. comedens*, 27.II.1994, G. Marson (H.B. 5030). – ibid., branch of *Quercus*, on wood, 27.II.1994, G. Marson (ø). – ibid., 22.III.2005, G. Marson (ø). – 1.8 km SW of Hesperange, Fennerholz, 292 m, branch of *Salix* (?) *cinerea*, 31.I.2003, G. Marson (ø). – Hesperange, unlocalized, branch of *Quercus*, on wood, 10.VII.1897, J. Feltgen (LUX 42514, as *O. coccinella*). – ibid., stump of *Carpinus betulus*, on wood, 27.IV.1897, J. Feltgen (LUX 42515, as *O. coccinella*). – ~3 km ESE of Luxembourg, ~1 km ENE of Schleifmillen, Huerbaach, ~290 m, on wood of *Quercus*, 11.VI.1900, J. Feltgen (LUX 42417, as *O.* ?var. *delicatula*). – 6.5 km E of Luxembourg, 2 km S of Sandweiler, Weierboesch, 330 m, branch of *Corylus avellana*, on old *Vuilleminia comedens*, 25.II.1994, G. Marson (H.B. 5026, anam. cult.). – ibid., branch of *Carpinus betulus*, on bark, 16.III.1994 (H.B. 5038a, b ø). – 7 km SE of Luxembourg, 2 km ESE of Alzingen, Héid, 300 m, branch of *Rosa* (?)*canina*, 10.I.1989, H.O. Baral & G. Marson (H.B. 3627). – ibid., branch of *Carpinus betulus*, on wood & bark, 22.VII.1993, G. Marson (ø). – ibid., trunk of *Quercus*, on wood, 22.VII.1993, G. Marson (ø). – ibid., branch of *Salix cinerea*, on wood, 30.IX.2014, G. Marson (G.M. 2014-09-30.1; sq.: MK473394). – 6 km WSW of Luxembourg, 1 km N of Schléiwenhaff, NW of railway station, ënneschte Bësch, 320 m, branch of *Larix decidua*, on bark, 12.II.2000, G. Marson (ø). – **Esch-sur-Alzette**, 5 km SSW of Luxembourg, N of Kockelscheier, Haus der Natur, 305 m, branch of *Salix* (?) *aurita* × *caprea*, on bark & wood, 29.II.1996, G. Marson (H.B. 5419b). – W of Kockelscheier, Houbësch, 320 m, branches of *Carpinus betulus*, on wood, 22.VIII.1998, G. Marson (H.B. 6213, anam. substr.). – SE of Kockelscheier, Angelsbierg, 310 m, branch of *Corylus avellana*, on bark & wood, 2.VIII.2018,

G. Marson (G.M. 2018-08-02.1, non vid.; sq.: MK473431). – ibid., branch of *Quercus*, on wood (G.M. 2018-08-02.3 ø, non vid.; sq.: MK473433). – 8 km S of Luxembourg, 1 km WNW of Berchem, Léngeboesch, 300 m, stem of *Rubus fruticosus*, 17.XII.2006, G. Marson (ø). – 8.5 km SW of Luxembourg, 1.6 km WSW of Leudelange, Guedesbiirchen (Prunetum), 320 m, branch of *Corylus avellana*, on wood, 4.I.1992, G. Marson (H.B. 4581b). – 3.7 km ENE of Bettembourg, 1.2 km SSE of Roeser, Herchesfeld, 288 m, branch of *Cornus*, on bark, 28.VII.2018, G. Marson (G.M. 2018-07-28.1, non vid.; sq.: MK473432). – 3 km E of Esch-sur-Alzette, 2 km NW of Kayl, Brucherbierg, 375 m, branches of *C. sanguinea*, on wood, 31.I.2014, G. Marson (G.M. 2014-01-31.2; sq.: MK473393). – 6.5 km ESE of Esch-sur-Alzette, 1.5 km SW of Dudelange, Haard, 375 m, branch of *Populus tremula*, on wood, 2.I.2005, G. Marson (ø). – 10 km ESE of Esch-sur-Alzette, 2.3 km SE of Dudelange, Därebësch, 270 m, branch of *Prunus spinosa*, on bark, 12.XII.1991, G. Marson (H.B. 4565a). – ibid., on wood, 11.IV.1992, E. Weber (ø). – ibid., branch of *Salix* (?)*cinerea*, on wood, 7.X.2015, G. Marson (G.M. 2015-10-07.2; sq.: MK493155). – 2.3 km SSE of Dudelange, Gënzebierg, 387 m, branch of *Aesculus hippocastanum*, on bark, 8.XI.1993, G. Marson (H.B. 4980). – 2 km SE of Dudelange, Bloklapp, 290 m, on *Salix aurita* × *caprea*, ~11.III.2001, G. Marson (H.B. 7043 ø, anam. cult.). – **Capellen**, 6.5 km ESE of Arlon, 1.5 km NW of Steinfort, Barrage de Steinfort, 305 m, branch of *S. cinerea*, on wood, 13.II.1989, G. Marson (G.M. 3856, H.B. 3681c). – 1.7 km SSE of Eischen, 1.5 km ENE of Clairefontaine (Belgium), Aechels, Eisch river, 310 m, branch of *Fraxinus excelsior*, on bark & wood, 10.V.1997, H.O. Baral (ø). – ibid., branch of *Salix*, on bark, 22.IX.1998, G. Marson (ø). – ibid., branch of *S.* (?)*caprea*, on bark, 15.VII.2000 (H.B. 6726b). — **GERMANY**: **Mecklenburg-Vorpommern**, 18 km NNW of Grevesmühlen, 1.3 km NE of Brook, 12 m, stems of *Rubus fruticosus* agg., 29.XI.2015, T. Richter, vid. I. Wagner (ø, doc. vid.). – 6.3 km WSW of Rehna, 2.2 km ESE of Carlow, Schaddingsdorf, 62 m, branch of *Quercus robur*, on wood, 20.III.2016, T. Richter, vid. I. Wagner (doc. vid.). – 6 km SSW of Rehna, Borner Moor, 60 m, twig of *Quercus robur*, on old *Colpoma quercina*, 2.I.2017, T. Richter (H.B. 10044; sq.: MK493137). – 8 km SW of Rehna, 2.7 km NE of Dechow, Staatsforst Rehna, 60 m, on wood of *Salix*, 17.II.2006, T. Richter (H.B. 8427 ø). – 3.7 km E of Greifswald, 1.2 km S of Eldena, Elisenhain, 20 m, branch of *Fagus sylvatica*, IV.2010, M. Unterseher (OTU_028_2010wo_182, wood isolate, only mycelium in pure culture; sq.: HE998719). – **Sachsen-Anhalt**, 24 km NNW of Magdeburg, 3.5 km WNW of Colbitz, Colbitzer Heide, 85 m, log of *Tilia*, on wood, 1. XI.2018, T. Richter (doc. vid.). – **Brandenburg**, 7 km WNW of Potsdam, Golm, near railway station, 34 m, branch of *Rubus armeniacus*, on bark, 21.III.2000, V. Kummer (V.K., H.B. 6662, CBS 116227, anam. cult.; sq.: KT215285). – 10 km WSW of Potsdam, 1.5 km NW of Werder, Stadtpark, 50 m, trunk of *Picea abies*, on bark, 24.II.1974, D. Benkert (BHU). – ibid., branch of *Salix*, on bark, 13. XI.1967, D. Benkert (BHU). – 12 km SE of Potsdam, 5 km W of Ludwigsfelde, Siethener Elsbruch, 45 m, branch of ?*Alnus*, on bark, 6.XI.1975, D. Benkert (BHU, H.B. 6203 ø). – **Berlin**, 8.5 km SSE of Berlin, Arboretum Baumschulenweg, stump of *Zelkova serrata*, on wood, 2.XII.1991, D. Benkert (BHU). – ~10 km NW of Berlin, Jungfernheide, branch of *Carpinus betulus*, on wood, ~35 m, spring 1898, E. Jahn (herb. Jahn 5381, M, as *O. coccinella*). – **Sachsen**, 20 km W of Görlitz, 3.5 km NNE of Löbau, Löbauer Wasser, Georgewitzer Skala, 240 m, branch of ?*Populus*, on wood, 30.VIII.1984, D. Benkert (BHU). – 6 km NW of Leipzig, 1 km SW of Wahren, Burgaue, 100 m, branch of *Tilia cordata*, on wood, 27.VII.2002, M. Unterseher (LZ, H.B. 7432). – ibid., on bark, 22.IV.2003 (ø, anam. substr.). – ibid., branch of *Carpinus betulus*, on wood, 13.XI.2002 (LZ, H.B. 7430). – 15 km W of Niesky, 2.3 km WNW of Wartha, Gleinsche Heide, 157 m, branch of *Salix caprea*, on wood, 21.IX.2018, H.O. Baral (H.B. 10177). – 0.6 km SW of Wartha, Guttauer Teiche, 162 m, branch of *Carpinus betulus*, on wood & bark, 20.IX.2018, H.O. Baral (ø). – ibid., branch of ?*Crataegus*, on wood (ø). – 7.5 km SSW of Chemnitz, 2 km SE of Neukirchen, W of Klaffenbach, Tiergarten, 355 m, twig of *Quercus*, on bark, 5.VII.2010, B. Mühler (ø). – 12 km SSE of Chemnitz, NNW of Gelenau, 500 m, branch of *Quercus*, on bark & old *Colpoma quercinum*, 17.III.2010, B. Mühler (H.B. 9249 ø). – 4.5 km ESE of Chemnitz, N of Adelsberg, Drei Eichen, 377 m, branch of *Salix*, on bark, 18.XI.2009, B. Mühler (ø). – 5 km E of Chemnitz, 2 km WSW of Euba, Eibsee, 405 m, branch of *Rosa*, on bark, 13.I.2011, B. Mühler (ø). – 18.5 km SSW of Annaberg, 1.3 km WSW of Oberwiesenthal, Zechengrund, branch of *Sorbus aucuparia*, 940 m, on bark, 17.V.2013, B. Mühler (H.B. 9780). – **Thüringen**, 4 km N of Erfurt, Roter Berg S of Erfurter Zoo, 180 m, branch of ?*Tilia*, on old *Lasiosphaeria* ?*caudata*, 21.X.1999, P. & B. Otto (LZ 211099-7, H.B. 6613). – 19 km SSW of Gotha, 2 km W of Tambach-Dietharz, Spittergrund, 560 m, branch of *Picea abies*, on bark, 21.IV.2017, T. Roedel, vid. I. Wagner (doc. vid.). – 17 km NE of Coburg, 2 km W of Sonneberg, Schillings-Sandgrube, 368 m, branch of *Quercus*, on wood, 13.I.2010, I. Wagner (ø, doc. vid.). – 3 km W of Sonneberg, 1 km W of Bettelhecken, Mürschnitzer Sack, 370 m, branch of *Frangula alnus*, on bark, 24.I.2012, I. Wagner (ø, doc. vid.). – ibid., 1.5 km W of Bettelhecken, 355 m, twig of *F. alnus*, on bark, 23.II.2012, I. Wagner (ø, anam. substr., doc. vid.). – 0.8 km SSE of Bettelhecken, Stolze, 363 m, twig of *Salix*, on bark, 25.I.2009, P. Püwert & I. Wagner (ø, doc. vid.). – **Hessen**, ~5 km NW of Biedenkopf, ~1.5 km N of Wallau, Hainbachtal, 370 m, branch of *Salix*, on bark, 1.V.2000, H.O. Baral & L.G. Krieglsteiner (ø). – 4.8 km S of Eschwege, ~1.3 km E of Langenhain, Schlierbachswald, Lotzenkopf, 400 m, branch of ?*Salix*, on wood, 26.V.1967, H. Hertel (herb. Hertel 7147, M). – 7 km NNE of Gießen, 1.8 km ESE of Lollar, Lollarer Kopf, 205 m, branch of *S.* ?*caprea*, on wood, 21. XII.2013, W. Schößler (ø). – **Nordrhein-Westfalen**, 43 km N of Münster, 4 km SE of Hopsten, Heiliges Meer, branch of *Alnus glutinosa*, on bark, 15.IV.2018, U. Lindemann. – 2 km NE of Gelsenkirchen, 2.5 km SSW of Herten, Im Schloßpark, 50 m, branch of *Populus nigra*, on wood, 5.II.2005, F. Kasparek (H.B. 7678). – SE of Bottrop, Tetraederhalde, 95 m, indet angiosperm, on wood, 25.V.2015, B. Sontopski, vid. I. Wagner (doc. vid.). – **Rheinland-Pfalz**, 3.3 km SSW of Koblenz, 2 km SE of Güls, Laubachtal S of Kaltebornsbrünnchen, 140 m, branch of *Fraxinus excelsior*, on wood, 2.II.1974, H.O. Baral (H.B. 1236a). – 14 km SE of Pirmasens, SE of Dahn, military cemetery, 250 m, branch of *Quercus*, on wood, 2.X.1994, H.O. Baral & G. Marson (H.B. 5159b). – ibid., branch of *Sorbus aucuparia*, on bark, 17.IV.2004, H. Aeberhard (ø). – 15 km W of Idar-Oberstein, 7.7 km NW of Birkenfeld, NE of Thranenweier, Riedbruch, 582 m, branch of *Salix cinerea*, on wood, 16.IV.2004, H. Aeberhard & H.O. Baral (ø). – 7 km S of Merzig, NW of Eimersdorf, Heiligenkopf, 310 m, branch of ?*Salix*, on bark, 18.IV.2004, G. Marson (ø). – **Baden-Württemberg**, 6.5 km ENE of **Heidelberg**, 1 km NNE of Ziegelhausen, Hirtenaue below Pferchelshütte, 240 m, branch of *Fagus sylvatica*, on wood, 16.XII.2009, M. Bemmann (ø, doc. vid.). – 1.5 km SE of Ziegelhausen, Bärenbach, 237 m, branch of *Castanea sativa*, on wood, 2.VI.2011, M. Bemmann (ø, anam. substr., doc. vid.). – ibid., Kleingemünderstraße, 128 m, branch of *Forsythia*, on bark, 11.III.2012, M. Bemmann (ø, doc. vid.). – ibid., 1 km SE of Ziegelhausen, Rängle-Weg, 131 m, branch of *Carpinus betulus*, on bark, 4.IV.2011, M. Bemmann (ø, anam. substr., doc. vid.). – 9 km SE of Heidelberg, 3 km SSW of Neckargemünd, 1.8 km NE of Bammental, Hollmuth, 163 m, branch of *C. betulus*, on wood, 10.VII.2011, M. Bemmann (ø, doc. vid.). – 12.5 km NE of Mosbach, ~5 km NE of Dallau, Rittersbach, Elzbachtal, 275 m, twig of *Quercus*, on bark & old *Colpoma quercinum*, 1.III.1997, A. Kaiser (H.B. 5726a). – 5 km NW of **Stuttgart**, 1.8 km S of Weilimdorf, Neue Burg Dischingen, 405 m, branch of *Tilia*, on wood, 18.V.1997, H.O. Baral (ø). – 1.5 km SSW of Weilimdorf, Frauenholz, 365 m, branch of *Quercus*, on wood, 22.II.1975, H.O. Baral (H.B. 83 ø). – 1.8 km W of Feuerbach, Triebweg, 320 m, branch of *Fraxinus excelsior*, on bark, 20.I.1976, H.O. Baral (H.B. 84 ø). – ibid., Freizeitheim, 312 m, branch of *Malus domestica*, on bark, 23.VIII.1993, H.O. Baral & E. Weber (ø). – 3.5 km SSE of Stuttgart, 1.5 km E of Degerloch, E of Haus des Waldes, 465 m, branch of *Carpinus betulus*, on wood, 17.IV.2010, H.O. Baral (H.B. 9263 ø). – 5.5 km NNW of **Tübingen**, 2.3 km NW of Bebenhausen, Goldersbach, 390 m, branch of *Fagus sylvatica*, on bark & wood, 1.V.2002, H.O. Baral (ø). – ibid., 370 m, branch of *Salix caprea*, on bark, 28.III.2004 (H.B. 7504 ø). – 1.5 km ENE of Tübingen, SW of Lustnau, Österberg, 340 m, trunk of *Salix*, on wood, 3.II.1994, H.O. Baral (ø). – 3 km NE of Tübingen, 1 km NE of Lustnau, Stauden, 400 m, branch of *Quercus*, on bark, 11.X.1992, H.O. Baral & G. Marson (ø). –ibid., branch of *S. caprea*, on wood & bark, 16.XI.2003, H.O. Baral (H.B. 7434b ø). – 1.8 km WNW of Pfrondorf, Hägnach, 450 m, trunk of *Fagus sylvatica*, on bark, 2.X.2005, H.O. Baral (ø). –1.5 km NW of Pfrondorf, N of Sophienpflege, 460 m, branch of *Quercus*, on wood & bark, 23.I.1993, H.O. Baral (ø). – 4 km N of Pfrondorf, Eisenbachhain, 485 m, branch of *Betula pendula*, on wood, 3.X.2006, H.O. Baral (ø). – 2.8 km NNE of Pfrondorf, Büchelersklinge, 450 m, branch of *Sambucus racemosa*, on wood, 28.IV.2002, H.O. Baral (ø). – 0.5 km NE of Pfrondorf, Gähklinge, 410 m, branch of *Populus tremula*, on wood & bark, 7.III.2007, H.O. Baral (H.B. 8440 ø). – Pfrondorf, Blaihofstraße, 430 m, branch of *Juglans regia*, on wood, 18. IX.1995, H.O. Baral (ø). – ibid., branch of *Ligustrum vulgare*, on bark & wood, 31.III.2004, H.O. Baral (ø). – ibid., on a rope, 24.XI.2009, H.O. Baral (H.B. 9226f ø). – Einsiedlerweg, 415 m, branch of ?*Sorbus aria*, on wood, 18.XI.2006, E. Weber (H.B. 8366 ø). – ibid., branch of *Tilia cordata*, on bark, 3.IV.1990 (ø). – ibid., branch of *Quercus rubra*, on wood, 1.II.1995 (ø). – ibid., 1.III.1996 (H.B. 5428). – ibid., 4.I.2004 (ø). – ibid., on wood & bark, 16.XII.2005 (H.B. 8018b ø). – ibid., branch of *Populus tremula*, on wood, 11.VII.2000 (ø). – 0.5 km E of Pfrondorf, Auchtert, 400 m, branch of *Cornus sanguinea*, on wood, 24.V.2003, H.O. Baral (ø). – 1.2 km E of Pfrondorf, Stangenhölzlesklinge, 430 m, branch of *Salix caprea*, on bark, 25.XI.2001, H.O. Baral (ø). – ibid., branch of *Acer pseudoplatanus*, on bark (ø). – ibid., branch of *Quercus*, on bark, 23.XI.2003 (ø). – 1 km ESE of Pfrondorf, Hinterpfand, 420 m, trunk of *Carpinus betulus*, on bark, 4.XII.2005, H.O. Baral (H.B. 8007 ø, anam. substr.). – ibid., branch of *Fagus sylvatica*, on wood, 16.VII.2006, H.O. Baral (H.B. 8224c ø). – 0.6 km S of Pfrondorf, Obere Mähder, 390 m, branch of *Rosa*, on wood, 17.XI.2002, H.O. Baral (ø, anam. cult.). – ibid., branch of *Salix purpurea*, on bark, 7.III.2003, H.O. Baral (H.B. 7495 ø). – 5.5 km ENE of Tübingen, 1.6 km SE of Pfrondorf, Neckar, 320 m, branch of *Cornus sanguinea*, on bark, 30.X.2005, H.O. Baral (H.B. 7968 ø). – 3 km ENE of Tübingen, 1 km ENE of Lustnau, Weiherhalde, 345 m, branch of *Rosa*, on wood & bark, 5.XI.2000, H.O. Baral (ø). – 2.5 km ESE of Tübingen, 2 km SSE of Lustnau, Ramslache, 330 m, branch of *Ulmus glabra*, on bark & old pyrenomycete, 4.IX.1993, H.O. Baral (ø). –3 km W of Tübingen, 2 km SSE of Hagelloch, Schweigbrühl, 335 m, twig of *Salix*, on bark, 27.IV.1989, H.O. Baral (ø). – 6.7 km SSE of Tübingen, 2 km WNW of Gomaringen, Wiesaz SSE of Pulvermühle, 370 m, branch of *S.* ?*viminalis*, on bark, 19.III.2009, H.O. Baral (ø). – **Schwäbische Alb**, 17.5 km SSW of Münsingen, 2.2 km SW of Hayingen, NNE of Wimsen, Schloss Ehrenfels, 585 m, branch of indet. angiosperm, on bark, 28.IV.2007, H.O. Baral (H.B. 8479a ø). – **Bodensee**, 9 km ENE of Radolfzell, 4.5 km SE of Bodman, NW of Marienschlucht, 405 m, branch of *Acer pseudoplatanus*, on bark, 30.VIII.2001, H.O. Baral (ø). – **Bayern**, **Unterfranken**, 15 km SE of Schweinfurt, 1 km S of Alitzheim, Hörnauwald, 230 m, branch of *Populus tremula*, on wood, 12.XI.1995, H.O. Baral (H.B. 5382b, anam. substr.). – ibid., branch of *Quercus*, on bark, 1.V.1996, L.G. Krieglsteiner (L.K.). – 23 km NW of Würzburg, 1 km W of Karlstadt, N of Mühlbach, Ruine Karlburg, 180 m, branch of *Corylus avellana*, on bark, 11.XI.1995, L.G. Krieglsteiner & H.O. Baral (L.K.). – 17 km NW of Würzburg, 2 km W of Zellingen, Hügelspitz, 260 m, branch of *Rosa*, 11.XI.1995, H.O. Baral & L.G. Krieglsteiner (ø). – 18 km E of Würzburg, 4.5 km NE of Kitzingen, Klosterforst, 220 m, log of *Pinus*, 22.II.2013, U. Speer, vid. I. Wagner (ø). – **Mittelfranken**, 14.5 km SE of Nürnberg, 2.5 km SSW of Feucht, Schwarzachklamm, 362 m, branch of *Quercus*, on wood, 16.IV.2009, H.O. Baral (H.B. 9043b ø). – ~12 km WNW of Neustadt a. d. Aisch, forest near Sugenheim, ~340 m, branch of *Quercus*, on wood, 1871, H. Rehm (Rehm 71, M, as *Calloria coccinella* f. *vinosella*). – **Oberpfalz**, 12.5 km NE of Tirschenreuth, 1.2 km S of Neualbenreuth, SE of Platzermühle, 550 m, branch of *Quercus*, on bark & wood, 3.VIII.1995, H.O. Baral (H.B. 5311). – ibid., branch of *Sorbus aucuparia*, on wood, 3. VIII.1995, H.O. Baral (ø). – 2 km NNW of Hirschau, Hintere Peneslohe, 445 m, branch of *Salix*, on bark, 17.IV.2001, H.O. Baral (ø). – 21 km ESE of Regensburg, N of Pfatter, Altdonauarm, 325 m, branch of ?*Malus domestica*, on wood, 2.V.1992, L.G. Krieglsteiner (ø). – **Niederbayern**, 12 km SE of Zwiesel, 4 km NNE of Spiegelau, Schöner Ort, 890 m, trunk of *Fagus sylvatica*, on bark and *Hypoxylon fragiforme*, 21.XI.1989, N. Luschka (REG). – **Oberbayern**, 9 km NW of München, 1.5 km ESE of Allach, Angerlohe, 515 m, on *Xanthoporia nodulosa*, 14.III.2000, L. Beenken (Beenken, H.B. 6599 ø). – 8.5 km SE of München, 1 km ESE of Neuperlach, 543 m, branch of *Quercus*, on wood and old pyrenomycete, 16.I.2011, B. Fellmann (MAMU 1221, doc. vid.). – ibid., branch of *Salix*, on bark, 12.III.2015, B. Fellmann (doc. vid.). – 4.3 km E of Neuperlach, 1.3 km N of Solalinden, 550 m, indet. angiosperm, on wood, 11.II.2018, B. Fellmann (doc. vid., anam. substr.). – 8.5 km NNW of Traunreut, NW of Trostberg, 560 m, branch of conifer, on wood, 28.V.2016, I. Rößl (doc. vid.). – 12.5 km NNE of Traunstein, E of Hörgassing, Wabach, 560 m, branch of *Quercus*, on bark, 29.III.1989, T.R. Lohmeyer (T.R.L. 89/5). – 8 km SW of Burghausen, SE of Wechselberg, Salzach-Leitenwald, 450 m, branch of *Abies alba*, on wood & bark, 12.II.1995, T.R. Lohmeyer (H.B. 5240a). — **SWITZERLAND**: **Schaffhausen**, 2.5 km NE of Schaffhausen, 1.8 km W of Gennersbrunn, Rheinhardt, 480 m, branch of ?*Quercus*, on bark, 2.I.1986, P. Blank (ø, doc. vid.). – 4 km NW of Schaffhausen, 2.3 km WSW of Thayngen, Moos, 430 m, branch of *Salix*, on wood & bark, 28.VII.1988, G. Marson (ø). – ibid., branch of *S. cinerea*, on bark, H.O. Baral & G. Marson (ø). – **Aargau**, 8 km NNE of Wettingen, ~1.7 km NNW of Schneisingen, Bowald/Chüeboden, 600 m, branch of *Tilia*, on wood & bark, 5.X.1992, H.O. Baral & G. Marson (H.B. 4761b). – 2.2 km NNW of Bremgarten, W of Eggenwil, Hegnau, 365 m, branch of *Carpinus betulus*, on wood, 26.V.2018, U. Graf (doc. vid.). – **Luzern**, 24 km NNW of Luzern, 1.2 km E of Aesch, Gitzitobel, 540 m, branch of *Fraxinus excelsior*, on bark, 9.I.2010, U. Graf (ø). – 9 km NNE of Luzern, N of Inwil, Lehmgrube, 450 m, branch of *Quercus*, on old *Colpoma quercinum*, 5.I.1980, F. Kränzlin (NMLU 0501-80 K, as *Corylus*, anam. substr.). – 4 km NE of Küssnacht, 1.7 km NE of Immensee, Zugersee, Chieme, 430 m, branch of *Quercus*, on old *Colpoma quercinum*, 4.II.2017, U. Graf (doc. vid.). – **Uri**, 4 km NW of Andermatt, 2.5 km WSW of Göschenen, Steglaui, 1300 m, branch of *Alnus alnobetula*, on bark, 20.VIII.2006, E. Weber & H.O. Baral (H.B. 8263b, anam. substr.). – **Bern**, 11 km E of Thun, 3.8 km E of Schwanden, Sigriswilergrat, NW-slope of Rothorn, 1620 m, branch of *A. alnobetula*, on wood, 27.VIII.2008, H.O. Baral (H.B. 8915c ø). — **LIECHTENSTEIN**: 4 km WNW of Feldkirch, 1.8 km NE of Ruggell, Ruggeller Riet, 430 m, branch of *Salix cinerea*, on wood, 8. VII.1997, H.O. Baral (ø). — **AUSTRIA**: **Steiermark**, 13 km SE of Bruck a. d. Mur, 2.4 km E of Mixnitz, 1200 m, branch of *Larix*, on bark, 7.VIII.2015, G. Friebes (GJO 76309, doc. vid.). – 6 km WNW of Feldbach, ENE of Rohr a. d. Raab, 335 m, log of *Quercus*, on wood, 15.XII.2013, A. Gallé, vid. I. Wagner (ø, doc. vid.). – ibid., NE of Rohr, 375 m, stump of *Fagus sylvatica*, on wood, 15. II.2014, A. Gallé, vid. I. Wagner (ø, doc. vid.). – ibid., E of Rohr, 305 m, branch of *Magnolia*, on bark, 18.I.2019, A. Gallé (anam. substr., doc. vid.). – ~9 km W of Jennersdorf, Fehring, ~300 m, branch of *Quercus*, on *Colpoma quercinum*, 13.XII.1992, W. Maurer, vid. G. Friebes (W.M.). – 2.8 km S of Voitsberg, 1.3 km WSW of Teigitschgraben, W of Kraftwerk Arnstein, 396 m, branch of *Salix*, on bark, 15.XII.2017, G. Friebes (GJO 88895, anam. substr., doc. vid.). – **Burgenland**, 5.5 km WSW of Eisenstadt, SSW of Müllendorf, 200 m, branch of ?*Berberis vulgaris*, on bark, 19.I.2013, Z. Jorgovanovic, vid. I. Wagner (ø, doc. vid.). – **Kärnten**, 12.5 km SE of Klagenfurt, SW of St. Margareten im Rosental, NE of Sabosach, 580 m, branch of *Fraxinus excelsior*, on bark, 2.XII.1994, W. Jaklitsch (ø). – ibid., branch of *Quercus robur*, on wood (ø). – **Wien**, Wienerwald, N of Hadersdorf, Kolbeter, 'in *Helotio citrino*', VII.1902, F. v. Höhnel (**type** of *Pedilospora parasitans*, anam. only, doc. vid.). – 5 km SSE of Wien, Laaer Wald, 235 m, ?branch of *Quercus*, on wood, 27.XII.2018, R. Moosbeckhofer, vid. B. Wergen (doc. vid.). – **Niederösterreich**, Wienerwald, 22 km W of Wien, Pressbaum, Viehhoferinwald, ~350 m, *Picea abies* bark, on *Thyronectria cucurbitula*, VII.1916, F. v. Höhnel (**type** of *Pedilospora episphaeria*, anam. only, doc. vid.). – 21 km SW of Wien, W of Gaaden, Dürnbach, 337 m, wood of *Salix fragilis*, 5.III.2016, M. Mann (M.M. 20160305-1, doc. vid.). — **FRANCE**: **Nord-Pas-de-Calais**, **Pas-de-Calais**, 17 km WSW of Calais, 1.4 km SSW of Wissant, la Motte du Bourg, 10 m, 29.X.2016, branch of *Ulex europaeus*, on bark, J.P. Priou (J.P.P. 16280, anam. substr., doc. vid.). – **Haute-Normandie**, **Seine-Maritime**, 1 km WSW of Yvetot, rue de Couvent, 137 m, branch of *Cornus stolonifera*, on bark, 30.III.2014, J.P. Priou (J.P.P. 14060, doc. vid.). – **Bretagne**, **Côtes-d'Armor**, 8 km SW of Paimpol, 2 km W on Penhoat, Coat Ermit, 60 m, branches of *Ulex europaeus*, on bark, 24.I.2019, M. Hairaud (M.H. 50119, doc. vid.). – **Morbihan**, 9.5 km SE of Malestroit, 2.7 km WNW of St.-Martin-sur-Oust, Beauvais, Rieux, 8 m, stem of *Euphorbia characias*, on wood, 20.IV.2014, J.P. Priou (J.P.P. 14074, doc. vid.) – 1.4 km WNW of La Gacilly, SW of Talhuart, Buhan, 50 m, branch of *Quercus*, on wood, 7.I.2004, J.P. Priou (J.P.P. 24010 ø, doc. vid.). – 0.4 km NW of La Gacilly, ESE of Gazeau, Les Bresles, 12 m, branch of *Alnus glutinosa*, 11.I.2004, J.P. Priou (J.P.P. 24016, doc. vid.). – 5.7 km WSW of La Gacilly, 1.8 km NNE of Les Fougerêts, 65 m, branch of *Paulownia tomentosa*, on wood, 7.V.2013, J.P. Priou (J.P.P. 13100, doc. vid.). – 2.5 km WSW of La Gacilly, southwestern end of Étang de La Roquenerie, 35 m, branch of *Salix caprea*, on bark, 11.VI.2003, H.O. Baral (ø). – 2.5 km SSE of La Gacilly, 2 km NNE of Glénac, Pré Naval, 8 m, branch of *Ulex europaeus*, on bark, 20.II.2005, J.P. Priou (J.P.P. 25044 ø, doc. vid.). – 1.3 km SE of La Gacilly, 1.6 km NW of Cournon, Château de la Ville Janvier, 37 m, branch of *Castanea sativa*, on bark, 7.VI.2003, H.O. Baral (ø). – 4 km SE of La Gacilly, 1.2 km ESE of Cournon, S of La Buissonaie, 73 m, branch of *Frangula alnus*, on wood, 9. II.2003, J.P. Priou (J.P.P. 23013, doc. vid.). – 12 km S of Auray, 1.5 km SW of Locmariaquer, Breneguy, 2 m, twig of *Baccharis halimifolia*, 29.XII.2003, J.P. Priou & A. Delannoy (J.P.P. 23156, non vid.). – 3 km S of Baud, 1.2 km W of Camors, Etang du Petit Bois, 75 m, branch of *Ilex aquifolium*, on wood, 23.X.2004, J.P. Priou (J.P.P. 24172). – **Ille-et-Vilaine**, 12 km E of La Gacilly, 1 km W of St.-Just, Moulin de Cojoux, 67 m, branch of *Ulex europaeus*, on wood, 26.III.2001, J.P. Priou (J.P.P. 21072, H.B. 6902a). – 11.5 km WSW of Bruz, 3.3 km ESE of Baulon, Landes blanches, 64 m, branch of *U. europaeus*, 22.II.2008, J.P. Priou (J.P.P. 28029, non vid.). – 14.5 km NE of Redon, 1.6 km WSW of St.-Just, Cojoux, 37 m, branch of *Sambucus nigra*, on wood, 17.III.2006, J.P. Priou (ø, non vid.). – **Pays-de-la-Loire**, **Loire-Atlantique**, 8 km NNE of Nantes, 3 km WSW of Carquefou, river l'Erdre, 10 m, branch of *Elaeagnus pungens*, on bark, 18.IV.2009, P. Ribollet (H.B. 9085). – **Vendée**, 21 km SSW of La Roche-sur-Yon, 2.3 km NNW of Avrillé, Bois de la Garde, 35 m, branch of *Carpinus betulus*, on bark, 5.VI.2003, H.O. Baral (ø). – ibid., branches of *Quercus robur*, on wood, 5.VI.2003, H.O. Baral (H.B. 7372b). – 33 km NW of La Rochelle, 1.5 km WNW of La Tranche-sur-Mer, Forest W of Savinière, 12 m, branch of *Q. ilex*, on wood, 2.VI.2003, H.O. Baral (H.B. 7380). – marsh NE of La Savinière, 4 m, branch of *Salix* (?)*atrocinerea*, on wood, 2.VI.2003, C. Lechat (H.B. 7369a). – **Poitou-Charentes**, **Deux-Sèvres**, 3 km E of Villiers en Chizé, Forêt de Chizé, SE of Puymardier, 78 m, branch of *Carpinus betulus*, on wood, 24.IV.2006, H.O. Baral & G. Marson (ø). – ibid., branch of *Quercus pubescens*, on wood, 24. IV.2006, S. Helleman (H.B. 8159 ø). – 4.5 km NW of Chizé, 1.3 km SSE of Villiers-en-Bois, Forêt de Chizé, 72 m, branch of *C. betulus*, on boring dust, 27.IV.2011, H.O. Baral (H.B. 9483). – 12.5 km WSW of Niort, 1 km ENE of Le Vanneau-Irleau, Marais Poitevin, 3 m, branch of *Salix*, on bark, 15.IV.2008, H.O. Baral (ø). – ibid., branch of *Fraxinus excelsior*, on bark (ø). – ibid., stem of *Euphorbia palustris*, on wood & bark, 29.IV.2011, L. Bailly (H.B. 9487). – 10.5 km SSW of Niort, 1.8 km NW of Granzay-Gript, La Courance, S of Bassée, 25 m, branches of *Salix*, on wood, 17.III.2007, M. Hairaud (M.H. 120307). – **Vienne**, 30 km SW of Poitiers, 6 km E of St.-Sauvant, Forêt de St.-Sauvant, 153 m, branch of *Quercus*, on bark, 18.IV.2008, H.O. Baral (ø). – Île de Ré, 2 km SE of St.-Martin-de-Ré, 1.8 km W of La Flotte, Les Maraises, 19 m, branch of *Q. ilex*, on bark & old *Vuilleminia*, 26.IV.2006, H.O. Baral (ø). – 2.5 km NNE of St.-Clément-des-Baleines, Forêt de St.-Clément, 7 m, stem of *Rubus fruticosus*, on wood, 26.IV.2006, H.O. Baral & G. Marson (H.B. 8138a ø). – ibid., branch of *Rosa*, on bark, 26.IV.2006, S. Helleman (ø). – ibid., branch of *Populus*, on wood, 26.IV.2006, H.O. Baral (ø). – **Centre**, **Loiret**, Montargis, ~5.5 km NNE of Cepoy, ~1.5 km NNW of Les Ricordelles, Bois de Vaux, Loing river, 77 m, branch of indet. angiosperm, on old *Vuilleminia*, 26.I.1985, A. Reynaud (ø). – 3 km NNE of Cepoy, 3 km ENE of Girolles, La Vallée, 78 m, branch of *Ulmus*, on

bark, 23.I.1999, L. Gauthier (ø). – 70 km ENE of Orleans, 5 km NNE of Combreux, near le Chêne à Deux Jambes, 150 m, branch of *Malus domestica*, on bark, 12.IX.1998, A. Reynaud (L.G. 649). – **Champagne-Ardenne**, **Marne**, 14 km W of Sézanne, 2.3 km WSW of Esternay, Bois de Nogentel, 185 m, branch of *Corylus avellana*, on old *Vuilleminia*, 15.V.1993, G. Marson & H.O. Baral (ø). – **Lorraine**, **Vosges**, 10 km WNW of Gérardmer, 1.8 km ESE of Rehaupal, SE of Varinfête, 630 m, branch of *Malus domestica*, on bark, 7.IX.1996, H.O. Baral (ø). – 2 km NNW of Gérardmer, E of Pépinière des Xettes, la Chennezelle, 925 m, branch of *Salix caprea*, on wood, 19.VI.1989, H.O. Baral & J. Deny (ø). – **Alsace**, **Haut-Rhin**, 13 km ENE of Gérardmer, 3.5 km NE of Col de la Schlucht, Tourbière du Tanet, 1225 m, branch of *Fagus sylvatica*, on wood, 3.IX.1996, H.O. Baral (H.B. 5568). – **Bourgogne**, **Nièvre**, 6 km ESE of Château-Chinon-Ville, 1 km WSW of Arleuf, 605 m, branch of *Corylus avellana*, on wood, 30.IV.2011, E. Weber (ø). – **Franche-Comté**, **Doubs**, 5 km SE of Besançon, E of La Vèze, marais de Saône, ruisseau des Moulins, 385 m, branch of *Salix*, on bark and stromata of *Diatrype bullata*, 6.II.2014, G. Moyne (ø). – **Auvergne**, **Haute-Loire**, 19 km SW of St.-Étienne, ~4.5 km S of Aurec-sur-Loire, S of La Chapelle-d'Aurec, 700 m, branches of *Pinus*, on wood & bark, 20.IX.1993, G. Marson (ø). – **Puy-de-Dôme**, 2.5 km N of Chabreloche, N of Laspiaux, 790 m, branch of *Pseudotsuga menziesii*, on wood, 3.VIII.2015, G. Marson (G.M. 2015-08-03.1, non vid.; sq.: MK493157). – **Rhône-Alpes**, **Loire**, 25 km NNW of St.-Étienne, Bellegarde-en-Forêt, 400 m, *Quercus*, on wood, 4.XI.1984, A. Ayel (doc. vid.). – **Savoie**, 19 km ENE of Albertville, 4.5 km ESE of Beaufort, N of Lac de Roseland, ~1320 m, on *Corylus avellana*, 4.VIII.1995, G. Marson (ø). – **Drôme**, Préalpes du Dauphiné, 1 km N of Nyons, Col du Pontias, 460 m, branches of *Spartium junceum*, on wood, 11.X.2002, G. Marson (ø). – 20 km W of Serres, 4.3 km NNW of Rosans, Col de Pommerol, 1045 m, branch of *Pinus sylvestris*, on wood, 22.VIII.2000, G. Marson (ø). – 20 km SW of Serres, 8 km WNW of Ballons, Col de Perty, 1300 m, branch of *Pinus sylvestris*, on wood, 23.VIII.1996, G. Marson (H.B. 5626c). – **Provence-Alpes-Côte d'Azur**, **Vaucluse**, 14 km SE of Carpentras, 4 km SE of Venasque, D4, Aire de Pic-Nique de Venasque, 485 m, branch of *Sorbus aucuparia*, on bark, 9.X.2002, G. Marson (ø). – 18 km SE of Carpentras, 9 km NNW of Roussillon, 1km ESE of Col de Murs, 552 m, branch of *Spartium junceum*, on wood, 9.X.2002, G. Marson (ø). – 9 km SE of Apt, 2.5 km SSE of Auribeau, Mourre Nègre, 1100 m, branches of *Corylus avellana*, on wood, 28.IX.1993, G. Marson (H.B. 4993a). – **Hautes-Alpes**, 11.5 km NW of Briançon, 1.6 km SE of Le-Monêtier-les-Bains, NW of Les Guibertes, 1445 m, branch of *Salix*, on bark, 14.VII.1994, G. Marson (H.B. 5126c). – 24 km SE of Gap, 5 km E of Turriers, SW of Col des Garcinets, 1147 m, branch of *Pinus sylvestris*, on bark, 25.VIII.1996, G. Marson (H.B. 5621g). – 7 km NNE of Jausiers, 3.2 km WNW of Meyronnes, NNW of Les Gleizolles, 1347 m, branch of *Pinus sylvestris*, on wood, 30.VIII.2017, G. Marson (G.M. 2017-08-30.2; sq.: MH221066). – **Alpes Maritimes**, 7.5 km NW of Grasse, 2 km NE of St.-Vallier-de-Thiey, Col du Ferrier, 1045 m, branch of *P. sylvestris*, on wood, 24.IX.2009, G. Marson (ø). – 24 km N of Nizza, 1.5 km WSW of Utelle, Madone d'Utelle, 1160 m, branch of *P. sylvestris*, on wood, 3.X.1993, G. Marson (H.B. 4991). – 25 km NNW of Monte Carlo, 6.5 km E of Lantosque, Col du Turini, 1640 m, branch of *Salix*, 3.X.1993, G. Marson (ø). – **Languedoc-Roussillon**, **Gard**, 15 km NNW of Le Vigan, 3 km ESE of St.-Sauveur-Camprieu, WSW of Mt. Aigoual, 1168 m, trunk of ?*Abies*, on bark, 22.V.1998, M. Lutz (H.B. 6146). – **Hérault**, ~13 km SE of Bédarieux, ?2.5 km NW of Neffiès, ?SSE of Vailhan, Le chateau d'eau, ~150 m, stem/root of *Euphorbia characias*, on bark, 16.I.2004, G. Garcia (ø). — **SPAIN**: **Asturias**, 3.5 km ESE of Gijón, Jardín Botánico Atlántico, 21 m, cone of *Pinus sylvestris*, 14.III.2015, E. Rubio (E.R.D. 6406). – 6 km SE of Avilés, 1.2 km W of Corvera de Asturias, SE of Núñez, 200 m, on bark of *Eucalyptus globulus*, 14.III.2009, A. Suárez (E.R.D. 4723, doc. vid.). – 15 km SSW of Avilés, 9.7 km ENE of Grado, Trascañedo, Las Regueras, 205 m, branch of *Quercus ilex*, on wood, 21.XII.2013, J. Linde, vid. E. Rubio (E.R.D. 6082, doc. vid.). – 35 km SSW of Oviedo, 3.4 km SE of Páramo, Puerto de Ventana, 1180 m, of *Salix caprea*, on wood, 28.VIII.2008, E. Rubio (E.R.D. 4565, doc. vid.). – ibid., 2.2 km SE of Páramo, branch of *Corylus avellana*, on wood, 28.IV.2007, M.A. Miranda (E.R.D. 4111, doc. vid.). – 4.2 km ESE of Pola de Somiedo, 1 km NE of Valle de Lago, 1195 m, trunk of *Corylus avellana*, on bark & wood, 4.VI.2013, J. Ormad (ø). – ibid., branch of *C. avellana*, on wood, 4.VI.2013, T. Læssøe (H.B. 9813b; sq.: MK493138). – 2.2 km SE of Pola de Somiedo, SW of Coto de Buenamadre, Hayedo de Mumián, 1155 m, branch of ?*C. avellana*, on wood, 3.VI.2013, M.A. Ribes (ø). – **País Vasco**, **Gipuzkoa**, 6.5 km WNW of Zarautz, 1 km ESE of Zumaia, 53 m, branch of *Quercus ilex*, on *Peniophora quercina*, 9.I.2016, J. Martin (ARAN-F 02768, doc. vid.). – **Navarra**, 11 km NE of Pamplona, SSE of Sarasibar, branch of *Cornus sanguinea*, 520 m, 26.I.2013, F.J. Balda (ø, doc. vid.). – **Aragón**, **Zaragoza**, 47 km SW of Jaca, 1.7 km SSW of El Frago, 550 m, branch of indet. angiosperm, on wood, 1.V.2018, R. Blasco (doc. vid.). – **Cataluña**, **Barcelona**, 5.5 km ENE of Camprodon, 1.5 km NE of Font-Rubí, 1092 m, branch of *Populus tremula*, on wood, 27.XI.2014, J. Bometón (J.B. 556/14, doc. vid.). – 15 km SW of Barcelona, El Remolar Filipines, branch of *Thymelaea hirsuta*, on wood, 1 m, 28.12.2014, J. Bometón (J.B. 566/14, doc. vid.). – 19 km NW of Barcelona, 5.5 km SSE of Terrassa, S of Les Fonts, 170 m, branch of *Spartium junceum*, on wood, 30.V.2014, J. Bometón (J.B. 0491/14, doc. vid.). – 10 km SW of Girona, 2 km NNW of Sant Dalmai, 180 m, log of *Eucalyptus*, on bark, 24.X.2015, M.À. Pérez-de-Gregorio & J. Carbó, vid. J. Bometón (J.B. 621/15, doc. vid.). – **Castilla-La Mancha**, **Guadalajara**, 38 km NNW of Guadalajara, 4 km S of Tamajón, Retiendas, 1030 m, branch of *Quercus*, on wood, 3.XII.1991, R. Galán-Marquez & A. Raitviir (AH 6798, TAAM). – 55 km NNW of Guadalajara, km NW of Majaelrayo, Arroyo La Matilla, 1180 m, branch of *Populus nigra*, on wood, 17.V.1985, M.N. Blanco & G. Moreno (AH 6468). – ibid., branch of *Q. pyrenaica*, on wood, 14.V.1996, H.O. Baral (ø). – **Com**. **Valenciana**, **Valencia**, 13.5 km SSE of Valencia, 3.3 km S of El Saler, Les Gavines, 2 m, stump of *Eucalyptus globulus*, on bark, 13.I. & 5.II.2011, J. Ormad & R. Tena (ø, anam. substr., doc. vid.). – 1 km SE of El Saler, Tallafoc de la Rambla, 3 m, branch of *Malus domestica*, on bark, 11.VI.2011, R. Tena (ø, doc. vid.). – **Andalucía**, **Jaén**, 18 km SSE of Jaén, 3 km SE of El Parrizoso, 1015 m, branch of *Quercus rotundifolia*, on wood, 4.X.2013, S. Tello (JA-CUSSTA 7787, doc. vid.). – **Huelva**, 23 km SE of Huelva, 4 km ESE of Mazagón, 45 m, stem of *Astragalus lusitanicus*, 17.I.2015, F. Pancorbo, S. Tello, P. Sepúlveda, J.F. Mateo, T. Illescas, J.C. Campos & M.A. Ribes (M.A.R. 170115 167, doc. vid.). — **PORTUGAL**: **Guarda**, 26 km SE of Guarda, 3.5 km NE of Sabugal, SW of Rendo, 820 m, branches of *Cytisus scoparius*, on wood, 1.I.2005, J.P. Priou (J.P.P. 25003, 25004, H.B. 7655a ø). – **Santarém**, 10 km NNW of Santarém, 2.5 km SW of Achete, Val de Flores, SSE of Trindade, 50 m, *Quercus pubescens*, on galls of ?*Cynips kollari*, 29.XII.2004, J.P. Priou (H.B. 7661). — **ITALY**: **Trentino-Alto Adige**, **Trento**, 5 km NE of Riva del Garda, Arco, ?100 m, on wood of *Castanea sativa*, 1915, H.E. Diettrich-Kalkhoff, vid. F. Bubák (**type** of *Pedilospora ramularioides,* anam. only, doc. vid.). – **Emilia-Romagna**, 25 km WSW of Cesena, S of Tontola, 230 m, on wood of indet. angiosperm, 1.V.2011, E. Camporesi (E.C. 20110501-1, doc. vid.). – **Toscana**, 4.5 km WNW of Montaione, NNE of Tonda, 190 m, on wood of *Olea europaea*, 30.VIII.2005, P. Thill (ø, anam. only, doc. vid.). — **GREECE**: **Peloponnese**, 17 km ESE of Pyrgos, 1 km SE of Olympia, Ancient Olympia, 30 m, branch of *Platanus orientalis*, on wood, 2.VI.2009, S. Helleman (H.B. 9099b ø). — **TURKEY**: **Marmara**, **Balıkesir**, 28 km N of Balıkesir, 1.2 km W of Hisaralan, NE of Toybelen Köyü, 250 m, branch of *Carpinus*, on bark, 15.XI.2003, T. Askun (T.A. 71, doc. vid.). — **MOROCCO**: **Tangier-Tétouan**, ~7 km WNW of Tanger, E of Cap Spartel, Parc de Donabo, ~220 m, branch of *Acacia mollissima*, on bark, 16.X.1965, R. Bertault (MPU 14095, herb. Malençon, Bertault Champ. Maroc 7358, as *O. inflatula*, H.B. 5598 ø). — **MACARONESIA**: **Madeira**, 9 km SSW of Ponta Delgada, 1 km SW of Boca da Encumeada, 760 m, branch of *Cytisus scoparius*, 13.X.2009, J.P. Priou (J.P.P. 29186, doc. vid.). – 9 km NNW of Funchal, Pico de Arieiro, S of Belvedere, 1790 m, branches of *Bupleurum salicifolium*, on wood, 14.X.2009, J.P. Priou (J.P.P. 29181, H.B. 9215). – **Canary Islands**, **Tenerife**, Arico, 3 km NNE of Abades, 0.7 km NNE of Porís de Abona, Llanos de Porís, 40 m, on wood of *Euphorbia balsamifera*, 22.III.2009, L. Quijada, R. Castro & F. Rodríguez García (TFC Mic. 21760, doc. vid.). – Guía de Isora, Las Cañadas del Teide, 6.3 km WSW of Teide, Montaña de la Cruz de Tea, 2150 m, branch of *Adenocarpus viscosus*, on wood, 14.III.2008, E. Beltrán-Tejera, A. Losada & L. Quijada (TFC Mic. 19428, doc. vid.). – **Gran Canaria**, 6.3 km NNE of La Aldea de San Nicolás, 3 km WSW of El Risco, Anden Verde, 600 m, branch of *Kleinia neriifolia*, on wood, 26.XI.2015, S. Feusi (H.B. 9977b). – **Gomera**, Vallehermoso, 7.8 km S of Vallehermoso, 1155 m ('1090 m'), on *Euphorbia berthelotii*, 20.I.2001, E. Beltrán-Tejera et al. (TFC Mic. 14352, non vid., Quijada et al. 2016). – For further 23 collections from Tenerife see Quijada et al. (2016). — **MASCARENE ISLANDS**: **Réunion**, 17 km SE of Le Port, 15.5 km E of St.-Gilles, Route du Maïdo, 2040 m, branch of *Acacia heterophylla*, on bark, 22.IX.2011, R. Reuter (H.B. 9722b ø, anam. substr.). — **CHINA**: **Yunnan**, **Dali**, Binchuan, ~42 km NNE of Dali, ~25 km NW of Binchuan, Jizushan, ~2400 m, on bark of indet. angiosperm, IX.2005, Y. Zhang & M. Qiao (Y.Z. jz-41, YMFT, anam. cult., doc. vid.) – **Taiwan**, **Taichung**, Tashueshan, 2200 m, branch of *Castanopsis*, on bark and *Diatrype*, 19.III.1994, C.J. Chen (C.C. 911, H.B. 6066). – **Chiayi**, Alishan, 2400 m, *Acer*, on bark, 27.VIII.2005, B. Liu (B.L. TW09, HMAS 139702, as *O. coccinella*, non vid.; sq.: DQ656621). – For further 10 Chinese collections (including Beijing, Heilongjiang, Hunan, Tibet, and Qinghai) see Liu (2006, as *O. coccinella*). — **AUSTRALIA**: **Western Australia**, Geraldton Sandplains, 60 km N of Geraldton, 12 km N of Northampton, 278 m, branch of *Acacia*, 9.XII.2001, G. Marson (ø). – 90 km SSE of Geraldton, 21 km N of Illawong, 6 m, branches of *Acacia*, on bark, 9.XI.2007, G. Marson (H.B. 8996c ø). – Swan Coastal Plain, 15 km ENE of Perth, 1.7 km S of Midland, 16 m, branch of *Eucalyptus*, on wood, 22.XI.2001, G. Marson (ø, anam. substr.). – 48 km NNE of Perth, 4.5 km NE of Muchea, Reserve Road, 97 m, branch of *Banksia menziesii*, 3.IX.2006, G. Marson (G.M. 2006-09-03.2 ø). – 66 km NNE of Perth, 59 km SW of Moora, 8 km NE of Cowalla, Moore River, Orange Springs Rd, 77 m, branches of *Eremaea pauciflora*, on bark, 5.IX.2006, G. Marson (H.B. 8643i ø). – ibid., branches of *Adenanthos sericeus*, on bark & old *Corticiaceae*, 5.IX.2006, G. Marson (H.B. 8658a). – ibid., 23.X.2007 (ø). – 13 km WNW of Moora, Dandaragan Road, 235 m, branch of *Acacia*, on bark, 24.X.2007, G. Marson (ø). – Jarrah Forest, 54 km NNE of Perth, 11 km NE of Muchea, 188 m, trunk of *B. menziesii*, on bark, 23.XI.2001, G. Marson (H.B. 7209d ø). – Swan Valley, 28 km E of Perth, 8 km ESE of Kalamunda, 4 km E of Bickley, junction of Lockwood and Gunjin Road, 370 m, branch of *Banksia grandis*, on bark, 7. IX.2006, G. Marson (H.B. 8659g). – 30 km NE of Perth, 4 km NE of Upper Swan, W of Walyunga, 76 m, branches of *Acacia*, on bark, 2.IX.2006, G. Marson (H.B. 8478b). – ibid., branches of *Jacksonia*, on bark (H.B. 8611g ø). – ibid., branches of *Banksia cuneata*, on bark (ø). – ibid., 37 m, branches of *Jacksonia*, on bark & wood, 23.XI.2001, G. Marson (H.B. 7284i). – 25 km NNE of Bindoon, 12 km ESE of Wannamal, 272 m, leaves of *Macrozamia riedlei*, on petioles, 3. IX.2006, G. Marson (ø). — **CANADA**: **Québec**, 17 km N of Québec, 1 km NE of Lac Beauport village, E of Lac Neigette, 225 m, on *Fomitopsis betulina*, 22.VI.2013, J. Cimon (J.C. 50567, anam. substr., doc. vid.). – **Manitoba**, Winnipeg, Agriculture Canada lab., 230 m, wood of *Acer*, 31.V.1933, M.E. Marchaud, vid. S.J. Hughes, revid. K. Seifert (DAOM 152586, anam. only, doc. vid.). — **USA**: **Colorado**, Southern Rocky Mountains, 25 km SW of Denver, ~11.5 km NE of Conifer, around Tiny Town, ~2100 m, branch of *Corylus cornuta*, 14.VI.1996, G. Marson (ø). – **California**, Alameda, ~15 km E of San Francisco, Oakland, ?10 m, branch of *Nerium oleander*, on wood, II.1882, H.W. Harkness (Harkn. 3631, CAS, **holotype** of *D. fragile*, conid. isol., doc. vid.). – unlocalized ('California'), branch of *Eucalyptus globulus*, on bark, 1882, H.W. Harkness (Harkn. 2872, as wood, K(M) 36053, **holotype** of *O. eucalypti*, H.B. 5448 ø). – **South Carolina**, Surfside Beach, rotten log, ~10 m, VIII.1970, W. Butterfield (ATCC 22497, 22626, conid. isol., doc. vid.). – **Georgia**, ~9 km E of Douglas, ~11.5 km W of Nicholls, General Coffee State Park, 70 m, branch of indet. gymnosperm, on bark, 24.IX.2015, Y.Y. Shao & H.F. Zheng (UGA ga028, GXU 1484, anam. cult., doc. vid.; sq.: MG742397, MG742409). — **MEXICO**: **Baja California**, California Chaparral, 16 km NW of Ensenada, 10 km N of El Sauzal, NW of Antonio de las Minas, Las Lomas, Rancho La Cruz, ~350 m, branch of *Quercus agrifolia*, on bark, 2.II.1996, R. Galán-Marquez (AH 6985, H.B. 5765, anam. substr.). – 11 km SSW of Loreto, near Nopoló, 100 m, branch of indet. angiosperm, on wood & bark, 27.I.1996, F.E. Clements & R. Galán-Marquez (AH 6986, H.B. 5766a, anam. substr.). — **COLOMBIA**: **Cundinamarca**, Cordillera oriental, ~68 km NNE of Bogotá, ~30 km NE of Sopó, ~2700 m, branch of *Acacia*, on bark, 25.IX.1994, W. Jaklitsch (H.B. 5167). — **ARGENTINA**: **Buenos Aires**, 40 km SE of Buenos Aires, 12 km NW of La Plata, Parque La Plata, 10 m, bark of *Eucalyptus globulus*, V.1906, C.L. Spegazzini (LPS, **type** of *Dicranidion argentinense*, anam. only, doc. vid.).

Not included. **CHINA**: **Hunan**, **Zhangjiajie**, ~27 km N of Zhangjiajie, Suoxiyu river, altitude 600 m, on indet. wood, 15.IX.2005, B. Liu & X.Z. Liu (B.L. 748, HMAS 139644, anam. cult.; sq.: DQ656625, DQ656679). — **JAPAN**: **Honshu**, **Kyoto**, Kyoto City, ?100 m, on dead twig of *Cryptomeria japonica*, III.1966, T. Matsushima (MFC 1663, as *Dicranidion fragile*, conid. isol., doc. vid.). – **Mie**, 60 km SW of Tsu (University of Mie), Hirakura Experimental Forest, ?1000 m, dead twig of angiosperm tree, VII.1967, T. Matsushima (MFC 2091, as *D. fragile*, conid. isol., doc. vid.). – **Hyogo**, Kobe City, ?100 m, *Quercus* sp., from bark, III.1968, T. Matsushima (MFC 2356, as *D. fragile*, conid. isol., doc. vid.). – **Gunma**, Kirizumi Spa, petiole of angiosperm tree, X.1968, T. Matsushima (MFC 2477, as *D. fragile*, conid. isol., doc. vid.). – **Tokyo**, S of Tokyo, Shinagawa, ?50 m, stem of *Chamaecyparis obtusa*, IX.1956, K.Tubaki (CBS 217.59, as *D. fragile*, conid. isol., doc. vid.; sq.: NBRC 6886, CBS ined., MH869384). – unlocalized, K. Tubaki (as *D. fragile*, conid. isol., sq.: NBRC 6990). — **PERU**: **Loreto**, Amazon river 80 km down from Iquitos, Yanamono peninsula, ~100 m, on rotten wood, 26.IV.1978, T. Matsushima (as *D. fragile*, 8551, conid. isol., doc. vid.).

Orbilia tremulae Velen., Monogr. Discom. Bohem.: 92, pl. 11 fig. 10 (1934) — Pls 861–862, Map 138

?= *Orbilia coccinella* var. *versicolor* Grelet & Croz., Bull. Trimest. Soc. Mycol. Fr. 44: 336 (1928)
= *Orbilia coccinella* var. *abietina* Velen., Monogr. Discom. Bohem.: 92 (1934)
= *Orbilia xanthostigma* s. Svrček (1954: 12) p.p.
?= *Dicranidion inaequale* Tubaki & T. Yokoyama [as '*inaequalis*'], Trans. Mycol. Soc. Jpn. 12(1): 22, fig. 4 (1971)

Etymology: *tremulae*, *abietina*: referring to the substrate (*Abies alba*, *Populus tremula*); *inaequale*: referring to the conidia having an often asymmetrical basal cell; *versicolor* = changing in colour.

Typification: Czechia, Hrusice, Hubáčov, branch of *Prunus spinosa*, VII.1931, J. Velenovský (PRM 152382, lectotype of ***Orbilia tremulae***, designated here, MBT202381); Germany, Bayreuth, Heinersreuth, branch of *Frangula alnus*, 29.IV.2001, W. Beyer (ex H.B. 6963a, M-0276602, epitype, designated here, MBT202382, ex-epitype culture: CBS 116232; sq.: KT215283) — France, Savigné, branch of *Quercus*, VI.1913, L.J. Grelet (PC 0001042, holotype of ***O. coccinella*** var. ***versicolor***). — Czechia, Třemblat, log of *Abies alba*, X.1931, J. Velenovský (PRM 152389, holotype of ***O. coccinella*** var. ***abietina***). — Japan, Ōtsu, on diaporthe-like fungus, VI.1969, T. Yokoyama (IFOH-11610, holotype of ***Dicranidion inaequale***; ex-type cultures: NBRC IFO-9366, ATCC 22517, IMI 158983, CBS 564.71 etc.; sq.: LC146731).

Misapplied names: Karsten (1861, 1869 p.p.), as *Peziza*/*Orbilia coccinella*; Velenovský (1934:92, pl. 11 fig. 7, p.p.), as *O. coccinella*; Berthet (1964a: 126, 1964b: 23), as *O. xanthostigma*; Liu (2006, p.p.), as *O. coccinella*.

Description: — **TELEOMORPH**: **Apothecia** fresh (0.13–)0.2–1.3 mm diam., (0.09–)0.12–0.16(–0.22) mm high (receptacle 0.08–0.1 → 0.05–0.075 mm), whitish-greyish to light (or bright) (honey-)yellow-amber to yellow-orange(-rosaceous) or cream to ochraceous-yellow, or whitish with irregular pale yellow colours, translucent, ± round to slightly undulating, subgregarious to densely gregarious; disc medium concave to flat or slightly convex, margin indistinct or distinct, thin, 0–5 µm protruding, smooth; broadly sessile or with an indistinct obconical stipe 0.04–0.1 × 0.15–0.25 mm, superficial; dry yellow-orange to honey-yellow. **Asci** *(34–)38–50(–56) × 3.4–4.2(–4.4) µm {9} → 4.1–4.5 µm, †(25–)30–45(–51) × 2.8–3.5(–4) µm {10}, 4–8 µm protruding at full turgescence, 8-spored, spores (*) obliquely uniseriate or subbiseriate in upper part, (2–)3–5(–7) lower spores inverted {6} (often mixed), pars sporifera *14–25 → 10–13 µm long; **apex** (†) (medium to) strongly truncate (sometimes indented, laterally hardly inflated); **base** with absent to long, thin or thick, ± flexuous stalk, h- to H-shaped. **Ascospores** *(2.7–)3–4.2(–4.5)((–4.8)) × (1.5–)1.7–2(–2.2) µm {31}, †(2.8–)3–4(–4.2) × (1.5–)1.6–1.9(–2.1) µm {10}, subcylindric to ellipsoid, sometimes fusoid(-clavate), both ends rounded or obtuse, straight, rarely slightly inequilateral, exceptionally slightly curved at base; **SBs** consistently present, *(0.3–)0.4–0.5(–0.7) µm diam. {8} (0.5–1 µm total length), globose, with or without very short, indistinct filum, LBs absent or 1–3(–5) minute droplets especially close to SB. **Paraphyses** apically slightly to mostly medium to (very) strongly capitate(-clavate), sometimes asymmetrical, terminal cells *(14–)18–24(–27) × (2.5–)3–5(–6) µm {7}, †(2–)2.5–4(–5.3) µm wide {3}, lower cells *6–10(–15) × 1.3–2.4 µm {3}; sometimes branched at upper septum, subhymenium and lower part of hymenium pale yellow(-orange). **Medullary excipulum** subhyaline to pale yellow, 35–80 µm thick, of loose to dense, horizontally oriented textura intricata with many inflated cells, very sharply delimited from ectal excipulum, especially at flanks, partly by a thin t. porrecta. **Ectal excipulum** hyaline, towards margin pale yellow, of (†) thin-walled, vertically oriented t. angularis-prismatica from base to margin, (20–)40–70(–90) µm thick near base, cells at first *4–8 × 3–6 µm, later */†10–30(–36) × (6–)8–17(–20) µm {7}; 10–30 µm thick at flanks, 6–20 µm at margin, oriented at a 45–80° angle to the surface, marginal cortical cells */†(2.5–)5–10(–16) {4} × (2.5–)4–7(–9) µm {5}; **glassy processes** absent. **Anchoring hyphae** medium to very abundant, †1.5–3(–4) µm wide, walls 0.2(–0.3) µm thick {4}, non-gelatinized, forming a 15–50 µm thick t. intricata(-angularis). **SCBs** globose, in paraphyses near apex 0.8–1 µm diam., in ectal excipulum at margin absent {3} or ~1–2 {3} up to 3–4 µm {1} diam.; **VBs** absent {4} or slightly to medium refractive, hyaline or very pale yellowish {2}; **LBs** at septa of paraphyses and marginal excipulum minute, often yellow-orange (carotenoids). **Exudate** over paraphyses absent or minutely granular, loosely attached, over margin and flanks very scattered, thin, granular, 0.2–0.5 µm thick. **— ANAMORPH**: dicranidion-like (from ascospore isolate {2}. **Conidiophores** reduced (integrated), ~2.5–5 × 2 µm. **Conidia** 2-armed, U-shaped without stipe, ± rounded-truncate below, with small nodulous scar, *(8–)9–14(–16) × (5.8–)6–6.8(–7.2) µm {2}, arms *(5–)7–12.5 × 2.5–3 µm, (0–)1–2(–3)-septate, basal cell mostly asymmetrical (with only 1 oblique to almost vertical basal septum), rarely symmetrical (then all septa horizontal); unbranched conidia infrequent (~8%), *(8–)12–15 × 2.5–3 µm {2}, 1(–2)-septate.

Habitat: usually lying on moist ground or on a pile, partly on underside, sometimes 0.5–3 m above the ground, corticated to decorticated, 8–80 mm thick branches or logs of *Abies alba* {1}, ?*Alnus* sp.{1}, *A. alnobetula* subsp. *alnobetula* {6}, *A. alnobetula* subsp. *fruticosa* {1}, *Betula* sp. {1/1}, *B. pubescens* {1}, *Buddleja* sp. {1}, *Carpinus betulus* {11/3}, *Corylus avellana* {2/1}, *Cotoneaster* sp. {2}, *Fagus*

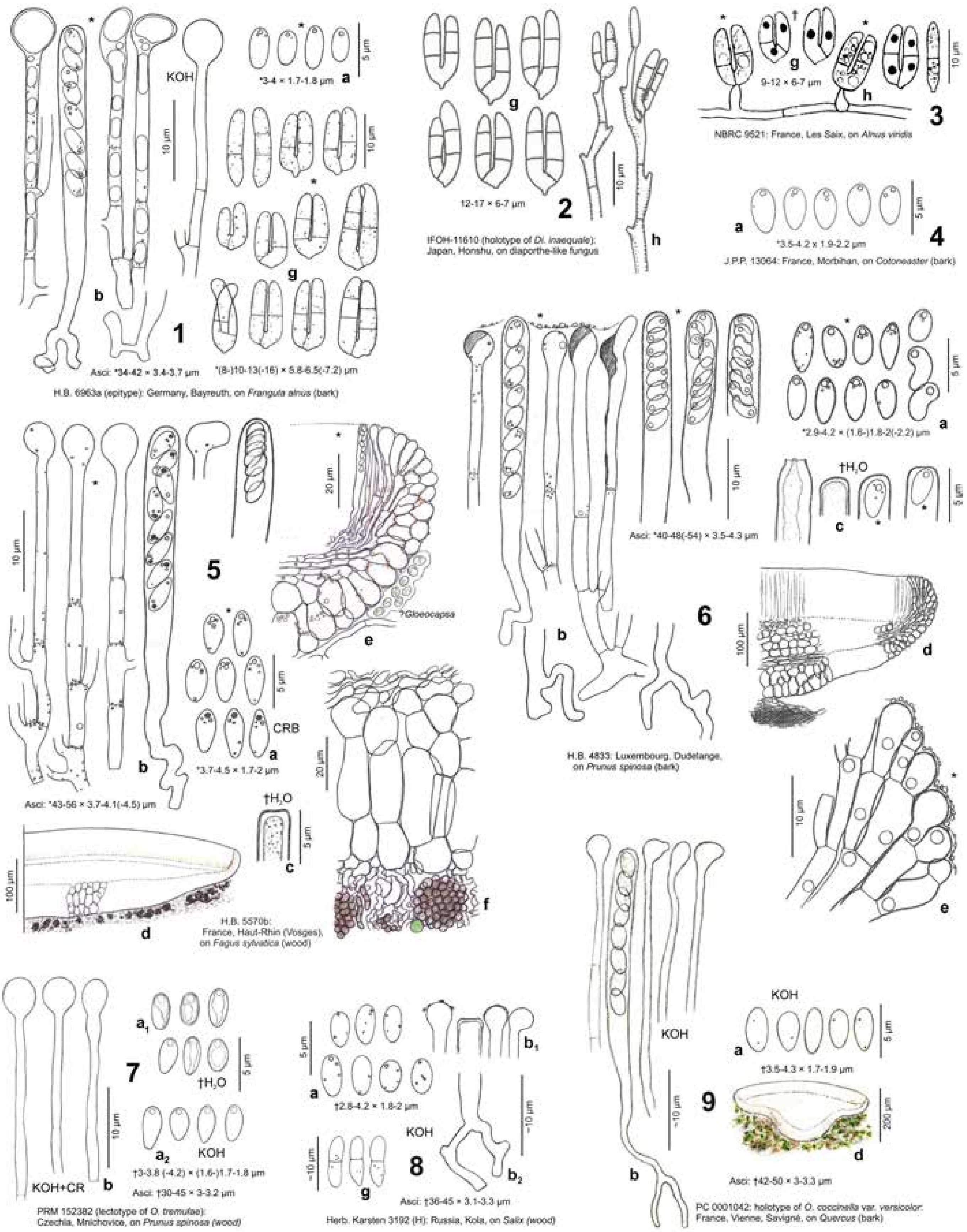


Plate 861. **1**, **3–7**: *Orbilia tremulae*; **2**, **8–9**: *O.* cf. *tremulae*. – **a** ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. apothecia in median section; **e**. id., ectal excipulum at margin and mid flanks; **f**. id. near base, with aggregates of black yeasts; **g**. conidia; **h**. conidiophores and conidia (**1** & **3** from ascospore isolates, **2** from conidial isolate, **8** from natural substrate). – **2**: from Tubaki & Yokoyama (1971), **3**: from Berthet (1964a: 126).

sylvatica {4/3}, *Frangula alnus* {1}, *Picea abies* {2}, *Pinus sylvestris* {1}, *Prunus avium* {1}, *P. spinosa* {2}, *Quercus* sp. {5/3}, *Q. robur* {1/2}, *Salix* sp. {4/1}, *S. caprea* {1}, *Sorbus* sp. {1}, *S. aucuparia* {2}, *Tilia cordata* {1}, *Ulex europaeus* {1}, indet. tree {1}, on wood {39} and bark {12} (periderm & bast), mostly medium to strongly decayed, often darkened or blackened, sometimes with many green algae, sometimes on very senescent *Corticiaceae* {2}, *Peniophora* sp. {1}, *Colpoma quercinum* {1}, indet. pyrenomycete {1}. **Associated**: *Ceratostomella cirrhosa* {1}, *Chaetosphaeria myriocarpa* {1}, *Dematioscypha olivacea* {2}, *Durella atrocyanea* {1}, *D. connivens* {2}, *Endoxyla* sp. {1}, *Exarmidium inclusum* {1}, *Helicogonium orbiliarum* (parasitic in *O. tremulae*) {1}, *Hyalopeziza alni* {1}, *Hyalorbilia ?fagi* {1}, *H. helicospora* {1}, *H. inflatula* {1}, *H. juliae* {1}, *Hyaloscypha aureliella* {1}, *H. ?leucostigma* {1}, *H. quercicola* {1}, *Hymenoscyphus kathiae* {1}, *Hyphodiscus* sp. {1}, *Hypocreales* {1}, *Leptodontidium trabinellum* {1}, *Mollisia discolor* {1}, *M. ligni* {1}, *M. ?lividofusca* {1}, *M. ?oblonga* {2}, *Orbilia eucalypti* {1}, *O. flagellispora* {1}, *O. naumburgensis* {1}, *O. pleistoeuonymi* {1}, *O. vinosa* {3}, *Proliferodiscus pulveraceus* {1}, *Protounguicularia transiens* {1}, *Sclerococcum* sp. {1}, *Taeniolella ?faginea* {1}, *Trichaptum abietinum* {1}. **Desiccation tolerance**: only ascospores and a few excipular cells viable after 2–14 days, some ascospores survived 2.5 or over 3 years (test from samples on the ground). **Altitude**: 15–1945 m a.s.l. **Geology**: Ordovician siltstone, Devonian quartzitic sandstone, Carboniferous greywacke, Buntsandstein, Muschelkalk, Keuper (gypsum, marl- & sandstone), Lower to Upper Jurassic sand- & limestone, Cretaceous & Tertiary sand, molasse, marlstone & flysch, Pleistocene loess & till, peat; granite, basalt, biotite-amphibolite, gneiss, mica schist. **Phenology**: throughout the year (but mainly from spring to autumn).

Phenology of *O. tremulae*											
Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
3	0	4	4	10	2	10	11	4	2	1	0

Taxonomic remarks. *Orbilia tremulae* is difficult to distinguish from *O. eucalypti* and *O. cejpii*. It is treated here as a separate species especially because of the distinctive dicranidion-like anamorph and deviating molecular data. Further features that differentiate it from *O. eucalypti* are the often yellow-ochraceous-amber-coloured apothecia, comparatively small (< 4–4.5 µm), especially narrow (< 2–2.2 µm) ascospores, often very strongly inflated and sometimes asymmetrical paraphysis apices, a tendency of the ectal excipulum to larger, vertically elongated basal cells and slightly wider marginal cortical cells, and a predominantly hygric habitat.

O. cejpii (and *O. fissilis*) differ from *O. tremulae* in slightly shorter, more broadly ellipsoid to subglobose or sometimes ovoid spores. The spores of *O. eucalypti* are usually larger than in *O. tremulae* and often tend to be fusoid or fusoid-clavate, the paraphysis heads are only rarely asymmetrical, and the apothecia mostly bright orange or rose and grow on xeric substrate. However, all these features are too variable to permit a clear distinction in every case based on the teleomorph alone. Therefore, many of the here reported collections are only tentatively included in either of these four species.

A rather sharp separation was observed between *O. tremulae* and *O. dryadum*, the latter differing in narrower ascospores but also in consistently unbranched conidia. Also *O. paracylindrospora* deviates from *O. tremulae* in narrower spores, light rose-orange, desiccation-tolerant apothecia, and less inflated paraphysis apices, but its anamorph is unknown.

Variation. A typical colour of fresh apothecia seems to be a pale to light yellow(-orange) (Pl. 862: 3, 5, 7), but many collections had whitish-greyish or cream apothecia or showed a varying and irregular degree of yellowish (Pl. 862: 2a–b, 6a–b). A (yellowish-)orange colour was also noted in, e. g., H.B. 9879 (holotype of *O. coccinella* var. *abietina*) and E.B. 4558.

Ascospore shape varies between cylindric-ellipsoid (Pl. 861: 1) ellipsoid (4) and ellipsoid-fusoid (5–6). The globose SCBs in the marginal excipular cells strongly vary in size among the populations, being largest in the epitype on *Frangula* (3–4 µm) but usually smaller (1–2 µm) or even lacking (Pl. 861: 5e, 6e).

Type studies. Velenovský (1934) described ***O. tremulae*** based on populations on damp, shaded wood of '*Tremula*, *Populus*, *Aesculus* etc.', with glassy-translucent, colourless or pale yellowish apothecia 1–2 mm diam., asci 25 µm long (excluding stipe), [paraphyses] strongly clavate, 5–6 µm wide, marginal ('external') paraphyses uninflated, and ovate spores 2–4 µm long. He stated to have frequently found this species during summer on various substrates. Three collections are described on his two manuscript plates, one as *O. tremulae* (on *Populus tremula*, 13.VI.1923, Hrusice) and two as *O. ektophysa* (on *Populus tremula*, 21.VII.1926, Mnichovice; on *Prunus spinosa*, VII.1931, Hubáčov). Both plates contain cross-references which appear to indicate that he considered the three samples to be conspecific. *O. ektophysa* is an unpublished name, whereas the similar name *O. ektophysata* was published for a collection on stems of *Cirsium* which is considered here to belong to *O. oxyspora* (section *Arthrobotrys*).

Two specimens were studied by Svrček (1954: 21), whereas the third (21.VII.1926) does not appear to have been preserved. Svrček designated the collection labelled *O. tremulae* (PRM 149390, 13.VI.1923) as lectotype. Yet, in our opinion Svrček's lectotypification is against the Code (ICN Art. 9.19), for two reasons:

(1) The data on Velenovský's manuscript plate of this collection ('*Orbilia Tremulae* sp. n.', apothecia 3–4 mm diam., pale amber, asci 30–40 × 4 µm, drawn without bifurcate base, paraphyses medium capitate-clavate, spores 2–3 µm long, ovoid) were only used by him in the protologue of *O. tremulae* regarding the spores. Moreover, the protologue says 'on wood' whereas this sample as here reexamined is on bark. Instead, the protologue data are a compilation of those two collections illustrated on his manuscript plate under the name '*Orbilia ektophysa* sp. n.'. This name is derived from the 'external' (probably marginal) paraphyses being filiform, a feature which he illustrated for the two specimens and mentioned in the protologue of *O. tremulae*. One of them (on *Prunus spinosa*, asci 25 × 3–4 µm excluding stipe, spores 2–3 µm long, narrowly ellipsoid, paraphyses strongly capitate, 5–6 µm wide) has predominantly influenced the protologue and seems to have been the basis of his pl. XI fig. 10. The other, unpreserved sample (on *Populus tremula*, apothecia 0.3–0.6 mm diam., amber-coloured, asci 25–30 × 3–4 µm, spores 3–4 µm long) influenced the protologue merely concerning the spore size of '2–4 µm'. The apothecial size of 1–2 mm in the protologue is in conflict with this sample as well as to PRM 149390.

(2) The lectotype designated by Svrček must have been a mixture or a mistake. This now contains an *Orbilia* with completely different, arcuate spores which Svrček identified as *O. curvatispora* (= *O. auricolor*). The present reexamination confirms that it belongs to section *Arthrobotrys*, though it deviates from typical *O. auricolor* in the margin having 2–12 × 3.5–5 µm large glassy processes, therefore, a relation to a species of series *Dactylellina*, e. g., *O. rubrovacuolata* or *O. mammillata*, cannot be excluded. Velenovský's manuscript drawing of this specimen shows ovoid spores which are also figured inside an ascus, hence Velenovský very probably studied a species of series *Orbilia*, possibly *O. cejpii*. For this reason and because the original data of this record were not included in the protologue, the preserved material cannot be used as lectotype.

Plate 862. **1–7**: *Orbilia tremulae*; **8**: *O.* cf. *tremulae*. – **1c**. corticated branch of *Frangula alnus*; **2a–b**, **3a–b**, **5**, **6a–b**, **7a–b**. fresh apothecia; **1a–b**, **4b**, **8a–b**. rehydrated apothecia (**1**. after 6 years, **4**. after 33 years, **8**. after 3/4 year); **1d**. apothecium in median section; **1e**. id., ectal excipulum from base to margin; **1f**. do, at lower flanks; **3c**, **4a**, **8c**. id., marginal ectal excipulum; **2c**. ascospores. – Living state, except for **1d–f**, **4a** (in KOH). – **5–6**: phot. J.P. Priou, **7**: phot. I. Wagner. — **1a–d**. H.B. 6963a (epitype): Germany, Bayreuth, on *Frangula*; **2a–c**. H.B. 8262: Switzerland, Uri, on *Sorbus*; **3a–c**. H.B. 8258: ibid., on *Alnus*; **4a–b**. H.B. 2337: Germany, Tübingen, on *Fagus*; **5**. J.P.P.13064: France, Morbihan, on *Cotoneaster*; **6a–b**. J.P.P.13010: ibid., on *Cotoneaster*; **7a–b**. I.W. 130628: Germany, Thüringen/Hessen, on ?*Carpinus*; **8a–c**. H.B. 8497a: Australia, Queensland, Daintree Forest, on *Bambusa*.

The other specimen studied by Svrček (on *Prunus spinosa*, PRM 152382) was apparently thought by him to be without apothecia, because he relied on Velenovský's description when he concluded that it belongs to *O. xanthostigma* s. Svrček. A small number of apothecia indeed occurred in this specimen, and their reexamination revealed that they closely match, e.g., the here designated epitype of *O. tremulae* (Pl. 861: 1). We here designate PRM 152382 as **lectotype** of *O. tremulae*, because it has predominantly influenced the protologue.

In mounts of H_2O as well as KOH the spore body could be discerned as a transparent region in the lectotype (Pl. 861: 7). Although we did not find any conidia in this specimen, we conclude that it is conspecific with the collection of W. Beyer from Germany (Bayreuth, on *Frangula*, ex H.B. 6963a, M-0276602), from which an ascospore isolate (CBS 116232) and a sequence were gained, and which we here designate as **epitype** of *Orbilia tremulae*.

Velenovský (1934: 92) separated from his concept of *O. coccinella* a collection on log of *Abies* as ***O. coccinella* var. *abietina***, with smaller, orange, hardly lobate apothecia, without giving any microscopic details. This taxon is mentioned but not described or figured on his manuscript plate. Svrček (1954: 12) reexamined the holotype and stated that it represented typical *O. xanthostigma* s. Svrček, but also he did not provide microscopic features. The present reexamination revealed asci †37–45 × 3 µm, spores †3–3.5 × 1.5–1.8 µm, and medium to strongly clavate-capitate paraphyses, which well fit *O. tremulae* (the apothecia were described by Velenovský as orange but are now whitish-cream when rehydrated, 0.3–0.6 mm diam., IVV: H.B. 9879).

Because of a deviating colour of the apothecia (brownish, then brown-bloodred; in contrast to scarlet red in *O. coccinella* s.auct.), and more regularly shaped, eguttulate spores, Grelet & Crozals (1928) described ***O. coccinella* var. *versicolor*** based on a French collection (Poitou-Charentes). A single apothecium was detected in the holotype from PC (Pl. 861: 9) which grew on the periderm of a fallen, 9 mm thick, corticated branch of *Quercus* (associated with *Capitotricha bicolor*). The spores are found somewhat smaller, especially narrower compared to the protologue which gives *4–5 × 2.5 µm. From the original drawing a size of *4.3–4.8 × 2.4–2.6 µm can be evaluated for the 3 free spores, while those inside the ascus measure only *3–3.5 × 1.5–1.8 µm. The asci are found here to measure †42–50 × 3–3.3 µm including the long and thin stipe, while the authors gave a size of *35–45 × 5 µm (*48 × 4.7 µm evaluated from drawing) and described and figured them as hardly attenuated towards the bifurcate base. The figured ascus is obviously in the living state according to its width and ample lumen below the spores. The taxon seems to fit the present concept of *O. eucalypti*, e.g., the small-celled basal ectal excipulum, but the brownish colour and the partly small size and symmetrical shape of the spores are more reminiscent of *O. tremulae*.

Misapplication. A specimen from eastern Lapland (Kola Peninsula, on wood of *Salix*, 27.VII.1861, herb. P.A. Karsten 3192) was examined and tentatively included in the description of *O. tremulae* because of its small ellipsoid spores (Pl. 861: 8). Some unbranched, 1-septate conidia (†9.5 × 3.3–3.5 µm) were observed in the squash mount, but their affiliation is not clear. Although referred by Karsten and W. Nylander to *P.*/*O. leucostigma* on the label, Karsten (1861: 36, 1869: 173) apparently reported the same specimen under the name *O. coccinella*. As substrate he gave in 1861 wood and bark of *Salix*, but included also a specimen on a polypore (both from Kola), and in 1869 he included a lignicolous specimen of Nylander from Lake Onega. Karsten described the apothecia in 1861 as obscurely rose, disc yellowish, and in 1869 as moist rose-coloured, dry translucent red, but could not find any spores. A possibility would be that this specimen represents a member of series *Drechslerella*, e.g., *O. yunnanensis* or *O. tonghaiensis*, which possess very similar didymosporous microconidia.

Velenovský (1934: 92, pl. 11 fig. 7) applied the name *O. coccinella* to populations with amber-yellowish apothecia 2–4 mm diam., becoming strongly lobate with age, a large-celled basal excipulum, strongly capitate paraphyses, and (narrowly) ellipsoid, 3–5 µm long spores. His collections derive from damp logs of gymnosperms (*Pinus* and *Picea*) from planar to montane areas throughout Bohemia. A manuscript plate on them exists, but Velenovský did not state the localities and apparently did not preserve material. His description appears to match *O. tremulae* very well, apart from the large apothecial diameter and the possibly inexact spore length (the figured spores do not show such variation). Also Liu's (2006) concept of *O. coccinella* includes *O. tremulae*. Judging from conidial morphology (Pl. 861: 3), Berthet (1964a, b) applied the name *O. xanthostigma* in a sense as already favoured by Svrček (1954), which predominantly matches the present concept of *O. tremulae*.

Not included collections. Various doubtful records with intermediate spore size and orange or reddish apothecia growing predominantly on xeric substrates are not included in the description (see Pls 861: 2, 8–9; 862: 8; IVV). For the type of the anamorphic *Dicranidion inaequale* see under Anamorph, and for *O. coccinella* var. *versicolor* see under Type studies.

Anamorph. Conidia were only observed in two of the included records. Both were gained from ascospore isolates, from samples from Rhône-Alpes (P. Berthet) and Bayern (W. Beyer, epitype of *O. tremulae*). Morphologically both fit very well the type culture of *Dicranidion inaequale*: in all three strains the conidia lack a stipe-like base, and most of them possess only 1 oblique to almost vertical basal septum (Pl. 861: 1g, 2g, 3g). In contrast to this, a majority of conidia of *O. eucalypti* (*D. fragile*) show 2 oblique basal septa (e.g., Pls 856: 5, 6, 7c; Pl. 858: 9f, 10f). The single septum in *O. tremulae* provokes an asymmetry of the basal cell, whereas the 2 septa in *O. eucalypti* result in a symmetrical conidial base. The epithet *inaequale* was introduced by Tubaki & Yokoyama (1971) according to this asymmetry. because the conidial base of *O. eucalypti* is more conical instead of rounded-truncate, the nodulous basal scar characteristic of *O. tremulae* is less pronounced in *O. eucalypti*.

Compared to the type of *D. inaequale*, the bilobed conidia in the epitype of *O. tremulae* are slightly shorter, while those obtained by Berthet are distinctly shorter. The conidial arms are mainly 2–3-septate in the type, but 0–2-septate in the other two isolates (rarely 3-septate in the epitype). In addition to the branched conidia, Berthet observed also unbranched, 1-septate conidia (8–15 × 2–3 µm) in his culture, and also we have seen them in our epitype culture in ~8% of the conidia (1–2-septate, *13–14.5 × 2.6–3 µm). Also Tubaki & Yokoyama and Butterfield found unbranched conidia in the type culture of *D. inaequale* (12–19 × 2.3–3 and 11–26.5 × 3–4 µm, respectively), whereas on the natural substrate Tubaki & Yokoyama saw purely bilobed conidia. Yet, Butterfield's rather large phragmoconidia possessed 3–7 septa, while Tubaki & Yokoyama did not illustrate phragmoconidia, nor did they mention the number of septa.

Butterfield (1973), followed by Matsushima (1981), synonymised *D. inaequale* with *D. fragile*, because in the type culture of *D. inaequale* conidia with symmetrical basal cells also occurred. However, in Butterfield's study only 26–32% of the bilobed conidia of *D. inaequale* showed symmetrical basal cells, whereas in *D. fragile* 94–99% did so. Moreover, 0–55% of the conidia of *D. inaequale* were unbranched, depending on the culture medium, whereas in *D. fragile* only 1–12% were unbranched. The bilobed conidia illustrated by Butterfield from the type culture of *D. inaequale* (ATCC 22517) are very different from the protologue but resemble instead those of *O. cejpii* in having partly a 1-septate stipe. Conidial size is difficult to evaluate from Butterfield's fig. 1 since the given photos are said to have six different magnifications, some of which appearing to be untrustworthy.

In summary, the type strain of *D. inaequale* shows slightly longer bilobed conidia, and phragmoconidia with more septa. Also the reduced conidiophores illustrated by Berthet are in contrast to the comparatively long, sympodially proliferating conidiophores in the type of *D. inaequale*. Because of the rather high molecular distance between Japanese and European strains (see below), we consider *D. inaequale* as specifically distinct from *O. tremulae* and give here a modified version of the protologue of ***D. inaequale*** by Tubaki & Yokoyama (1971): Conidiophores 20–50 µm long, 1.5–2.6 µm wide at base, septate, unbranched, straight to zigzag-shaped, sympodial, conidia terminally formed and from lateral, 0.5–1 µm wide pegs. Bilobed conidia 12–17 × 6–7 µm, arms 7–12 × 2.5–3.5 µm, 2–3-septate, basal cell mostly very asymmetrical (one arm 2-septate, the other 3-septate), but in 26–32% of conidia symmetrical, rarely with a stipe-like 1-septate base or with more than two arms.

Phylogeny. Available sequences of *O. tremulae* derive from four European ascospore isolates. In two of them the substrate was mesic to xeric (branches 0.5–1.5 m above the ground), while one (epitype) was more hygric and one (Berthet's) is unclear in this respect. They all comprise S1506 intron, ITS, and LSU (1 also SSU). In the ITS region the four are highly concordant: the strain from Bretagne on *Cotoneaster* fully matches Berthet's strain from Haute-Savoie on *Alnus* (NBRC 9521), whereas the isolate from Bayreuth on *Frangula* merely deviates by 1 gap in the ITS2 region. A Chinese strain under the name *O. coccinella* from Qinghai on undetermined wood (B.L. Q132) differs by only 3 nt (0.6%) in the ITS region and obviously belongs to *O. tremulae*. A sequence of the type culture of *Dicranidion inaequale* in NBRC 9366 comprises S1506 intron, ITS, and LSU and turned out to be very distantly related to *O. tremulae*. On the other hand, an LSU sequence under the name *D. fragile* (CBS 467.73, France, unlocalized) fully concurs with *O. tremulae* in the D1–D2 but differs by 2 nt and 1 gap in the D3 domain.

The almost absent variation in the ITS region among the available sequences of *O. tremulae* is astonishing since the ascospores in the Bretagne strain are shorter and wider than in that from Bayreuth (microscopic data of the Haute-Savoie strain were not taken and the material was lost, P. Berthet pers. comm.), and morphologically similar taxa, which are very difficult to distinguish from *O. tremulae*, are highly distant in that region: *O. eucalypti* and *O. fissilis* differ from *O. tremulae* by 17–19%, *O. cejpii* s.l. by 15.5–19.5%, and also *O. paracylindrospora* and *O. frangulae* show similar distances, depending on the alignment.

The overlapping parts of LSU (558 nt) are identical between the four strains of *O. tremulae* (except for 1 gap in H.B. 6963a). In this region the distance to other members of series *Orbilia* ranges at 5–8%. The three European sequences contain the S1506 intron of 414 nucleotides, while the Chinese strain does not cover this region. Also this intron is highly concordant, differing only by 1 nt, whereas other members of series *Orbilia* show high distances of ~14–20% or more.

O. tremulae clustered in the weakly supported *xanthostigma-tremulae* clade (Phyl. 22). Despite its very similar conidia, *D. inaequale* is from a molecular point of view very different from any other strain of series *Orbilia* (intron and ITS min. 15–16%, LSU min. 4%). It did not cluster with *O. tremulae* in all our analyses, but unsupported with *O. fissilis* (Phyls 22–23) or *O. eucalypti* (S27). The distance to *O. tremulae* is 16.5% in the ITS and 5% in the LSU D1–D2. In the D1 domain, *D. inaequale* concurs at pos. 129–137 with *O. eucalypti* p.p.maj. and *O. fissilis* (CTTT**GG**T**G**C) while *O. tremulae* has 5 deletions (----**AA**-**G**C) in concordance with other members of the *xanthostigma-tremulae* clade, to which *D. inaequale* does not belong. Further Asian records should be studied in order to clarify this surprising result.

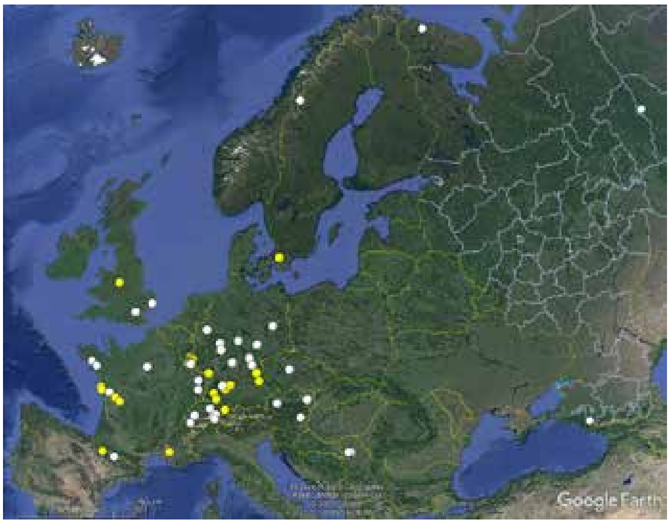
Ecology. *O. tremulae* was found on rotten wood, less often on bark, of hygric but also xeric branches and logs of various angiosperm trees and shrubs. Favourite hosts were *Carpinus* {11}, *Alnus* {6}, *Quercus* {6}, *Fagus* {6}, and *Salix* {5}. Rarely the species was found on gymnosperms or on fungi (resupinate basidiomycetes, pyrenomycetes). *O. tremulae* appears to be predominantly a desiccation-sensitive species, with the substrate lying on moist or wet ground, but some of the included collections were on projecting branches and such populations are assumed to tolerate drought for some time.

O. tremulae is reported here from Europe and Asia. Collections derive from planar to montane and subalpine-boreal, atlantic to subcontinental, humid regions of Europe. The climate types include cold- and orotemperate, also sometimes warm-temperate and orosub- to suprasubmediterranean, and in Scandinavia supra- to oroboreal. It occurs also in orotemperate to boreal eastern Russia. The vegetation includes *Querco-Carpinetum*, *Galio-Carpinetum*, *Crataego-Prunetum*, *Salicetum*, *Alnetum glutinosae*, *Alnetum viridis*, acidic *Sphagnum*-rich peat bogs, and many others. The Chinese sample was in an orotemperate humid (winter-dry) forest at the eastern edge of the Qinghai-Tibet Plateau.

Among the sequenced European strains, the epitype of *O. tremulae* grew on an old corticioid basidiomycete that covers the periderm of a hygric branch of *Frangula alnus* in a boggy *Frangula* plantation along a rivulet in a colline subcontinental area in Oberfranken (northern Bayern), while Berthet's strain was on *Alnus alnobetula* in a subalpine alder shrub in Haute-Savoie in eastern France (P. Berthet pers. comm.), and that from western France on bast and periderm of a mesic branch of *Cotoneaster* in atlantic lowlands of Bretagne.

In a not included collection from Luxembourg the apothecia grew on xeric bark of a vital trunk of *Fagus*, but also in the three included ones from Luxembourg (5.V.1999, H.B. 4833, G.M. 2015-07-09.1) the branches were attached 0.5–3 m above the ground (the sequence of the latter concurs with the hygric and mesic samples).

The not included holotype of *D. inaequale* grew on a decaying fruitbody of a diaporthe-like fungus in the subtropical humid more southern part of Honshu (Shiga Pref., Japan). Not included are also the two Australian collections, which grew



Map 138. Known distribution of *O. tremulae* in Europe (yellow = not included collections).

on xeric *Xanthorrhoea* fruits on a sand dune in the subtropical semihumid southwest and on xeric bamboo in the tropical humid northeast, both showing a much higher drought tolerance of up to 9 months regarding the excipular cells.

Specimens included. **RUSSIA (West)**: **Murmansk**, **Kola Peninsula**, Lapponia tulomensis, unlocalized, branch of *Salix*, on wood, 27.VII.1861, P.A. Karsten (Karsten 3192, H-6008812, as *Peziza leucostigma* or *O. coccinella*). – **Adygea**, ~63 km NE of Sochi, ~7 km NE of Guzeripl, Tsornõi Shahan, 700–1300 m, log of *Quercus*, on wood, 16.VII.1975, M. Murdvee (TAAM 69733). — **RUSSIA (East)**: **Sverdlovsk**, Ural Mts., ~75 km WSW of Serov, ~NE of Kytlym, 334 m, branch of *Sorbus*, on wood, 20.VII.1973, E. Parmasto & A. Raitviir (TAAM 62980, H.B. 8709 ø). – **Irkutsk**, Sayan Mts., ~SW of Baykalsk, S-end of lake Baykal, ~1000 m, branch of *Alnus alnobetula* subsp. *fruticosa*, on wood, 17. VIII.1975, E. Parmasto (TAAM 96057, H.B. 8710a ø). — **SWEDEN**: **Jämtland**, 60 km WSW of Saxnäs, 3 km SW of Leipikvattnet, Bjurälven, Lillälven waterfall, 500 m, stump of *Betula pubescens*, on bark, 27.VII.2010, S. Huhtinen (H.B. 9379). — **GREAT BRITAIN**: **East England**, **Suffolk**, 0.4 km NNW of Wenhaston, Bicker's Heath, 15 m, branch of *Quercus robur*, on wood, 5.IX.2004, E. Batten (E.B. 4558, K(M) 158851, doc. vid.). – ibid., branches of *Ulex europaeus*, on bark & wood, 3. & 10.I.2004, S.M. Francis & E. Batten (E.B. 4473, K(M) 199155). — **FRANCE**: **Bretagne**, **Morbihan**, 12 km S of Pontivy, Pluméliau, garden of P. Hérivaux, 117 m, branch of *Buddleja*, on wood, 14. III.2013, J.P. Priou (J.P.P. 13071, doc. vid.). – 3 km WSW of Malestroit, St.-Marcel, 58 m, on branch of *Cotoneaster*, on bark, 14.I.2013, J.P. Priou (J.P.P. 13010, doc. vid.). – ibid., 3.IV.2013 (J.P.P. 13064, H.B. 9870, TU(M) 104716; sq.: KT380098, UDB034366). – **Pays-de-la-Loire**, **Vendée**, 8.7 km NNE of Fontenay-le-Comte, 1.5 km N of Mervent, Pont du Déluge, 60 m, ?branch of (?) *Carpinus betulus*, on wood & ?*Schizopora paradoxa*, 12.V.2009, N. Van Vooren (H.B. 9072). – **Île-de-France**, **Essonne**, 17 km SW of Paris, Palaiseau, Parc d'Ardenay, 130 m, branch of *Quercus*, on bark, 11.XI.1998, J. Deny (ø). – **Rhône-Alpes**, **Haute-Savoie**, 45 km ESE of Genève, 3 km SW of Samoëns, Les Saix, 1200 m, ?branch of *Alnus alnobetula*, 9.IX.1961, P. Berthet (n° 466 [lost], as *O. xanthostigma*; doc. vid., NBRC 9521, anam. cult.; sq.: NBRC). – **Lorraine**, **Vosges**, 10 km SE of Gérardmer, 4 km SW of Le Hohneck, S of Lac de Blanchemer, Route des Crêtes, 1200 m, branch of *Fagus sylvatica*, on wood, 9.IX.1998, F. Baral-Weber & H.O. Baral (ø). – **Alsace**, **Haut-Rhin**, 13 km ENE of Gérardmer, 3.5 km NE of Col de la Schlucht, Tourbière du Tanet, 1225 m, branch of *F. sylvatica*, on wood, 3.IX.1996, H.O. Baral (H.B. 5570b). — **LUXEMBOURG**: **L'Oesling**, **Diekirch**, 12 km W of Ettelbruck, 1.5 km NE of Grevels, 515 m, branch of *Quercus*, on wood, 9.VII.2015, G. Marson (G.M. 2015-07-09.1, non vid.; sq.: MK473419). – **Gutland**, **Capellen**, 4.3 km SW of Steinfort, S of Grass, Rommeboesch, 335 m, branch of *Carpinus betulus*, on wood, 9.V.1998, H.O. Baral (ø). – 2.8 km E Clairefontaine, 326 m, branch of *Carpinus betulus*, on wood, 5.V.1998, H.O. Baral (ø). – **Esch-sur-Alzette**, 9 km WNW of Esch-sur-Alzette, 2 km W of Differdange, Tillebierg, 412 m, stump of *Salix*, on wood, 5.V.1999, H.O. Baral (ø). – 10 km ESE of Esch-sur-Alzette, 2.3 km SE of Dudelange, Därebësch, 270 m, branch of *Prunus spinosa*, on bark, 29.I.1993, G. Marson (H.B. 4833). — **GERMANY**: **Nordrhein-Westfalen**, Höxter, ~200 m, branch of *Carpinus betulus*, on bark, III.1878, collector unknown (herb. H. Wilms, M, as *Peziza chrysocoma*, *Fagus*). – 7 km NE of Gelsenkirchen, 2.5 km S of Herten, Emscherbruch, 55 m, log of *Picea abies*, on wood, 29.VIII.2016, F. Kasparek (doc. vid.). – **Hessen**, ~5 km NW of Biedenkopf, ~1.5 km N of Wallau, Hainbachtal, 370 m, ~5 km NW of Biedenkopf, ~1.5 km N of Wallau, Hainbachtal, 370 m, branch of *Carpinus betulus*, on wood, 1.V.2000, L.G. Krieglsteiner (L.K.). – 3.5 km WSW of Gießen, 1 km S of Heuchelheim, Silbersee, 157 m, branch of *Salix caprea*, on wood, 21.IV.2016, W. Schößler, vid. I. Wagner (doc. vid.). – **Brandenburg**, 14 km S of Potsdam, SW of Fresdorf, Fresdorfer Moor, 40 m, branch of *Corylus avellana*, on wood, 6.IV.1994, L.G. Krieglsteiner (L.K.). – **Sachsen-Anhalt**, 2.7 km WSW of Naumburg, S of Almrich, Sperlingsholz, 195 m, branch of *Tilia cordata*, on wood, 13.VIII.2019, W. Huth (W.H., doc. vid.). – **Thüringen**, 4.5 km NNE of Eschwege, SW of Kella, Silberklippe (border to Hessen), 470 m, branch of ?*Carpinus betulus*, on wood, 28.VI.2013, I. Wagner (I.W. 130628 ø, doc. vid.). – 3 km NNE of Sonneberg, 1.3 km NNW of Neufang, 650 m, branch of *Picea abies*, on wood, 29.VII.2017, C. Möhring & I. Wagner (doc. vid.). – 6 km SSW of Sonneberg, E of Gefell, Föritz, 340 m, branch of *Betula*, on wood, 1.VIII.2016, I. Wagner (I.W. 160801 ø, doc. vid.). – **Baden-Württemberg**, 5 km ENE of Tübingen, 1.2 km NNE of Kirchentellinsfurt, Blaulache, 315 m, branch of *Salix*, on wood & bark, 4.VIII.1989, H.O. Baral (ø). – 6 km NNE of Tübingen, 3 km NW of Pfrondorf, SE of Mauterswiese, 440 m, branch of *Fagus sylvatica*, on wood, 11.VII.1978, H.O. Baral (H.B. 2337). – **Bayern**, **Oberfranken**, Obermainisches Hügelland, 6 km WNW of Bayreuth, 3 km WSW of Heinersreuth, 2 km W of Tannenbach, Dühlbach, 350 m, branch of *Frangula alnus*, on *Corticiaceae* over bark, 29.IV.2001, W. Beyer (ex H.B. 6963a, M-0276602, **epitype**, CBS 116232, anam. cult.; sq.: KT215283). – **Unterfranken**, 26 km NW of Würzburg, Karlburg, Lange Lage, 260 m, log of *Carpinus betulus*, on wood, 23.X.1993, L.G. Krieglsteiner (L.K.). — **AUSTRIA**: **Wien**, 6 km NW of Wien, Döbling, Bellevuestraße, 330 m, branch of *Prunus avium*, on *Endoxyla*, 11.III.1995, W. Jaklitsch (ø). – **Oberösterreich**, 55 km SW of Linz, 1 km NE of Gmunden, Krottensee, 470 m, branch of (?)*Alnus*, on bark, 26.V.1993, W. Dämon (DÄ 36/93 ø). – **Steiermark**, 14 km SW of Hartberg, WNW of St. Johann bei Herberstein, Feistritzklamm, 380 m, branch of *Quercus*, on wood, 30.VIII.2013, G. Friebes (G.F. 20130071, doc. vid.). — **SWITZERLAND**: **Luzern**, 10 km NW of Luzern, 3 km ESE of Sempach, Chüserainwald, 580 m, branch of *Quercus*, on bark on disappeared *Colpoma quercinum*, 28.V.1979, J. Breitenbach (NMLU 2805-79 BR8). – **Fribourg**, 15 km NNE of Montreux, 7 km WSW of Gruyères, Gros Plané E of Moléson Mt., 1500 m, branch of *Alnus alnobetula*, on wood, 19.VII.1989, P. Blank & R. Dougoud (ø). – **Uri**, 4 km NW of Andermatt, 2.5 km WSW of Göschenen, Steglaui, 1300 m, branch of *A. alnobetula*, on wood, F. Müller (H.B. 8258 ø). – 1.7 km SSW of Unterschächen, N of Vorder Boden, 1620 m, branches of *A. alnobetula*, on wood, 21.VIII.2006, H.O. Baral (H.B. 8270a). – 4 km NW of Andermatt, 2.5 km WSW of Göschenen, Steglaui, 1300 m, branch of *Sorbus aucuparia*, on wood, 20.VIII.2006, H.O. Baral (H.B. 8262 ø). – **Ticino**, 8 km ENE of Airolo, 4 km N of Quinto, S of Lago di Cadagno, 1945 m, branch of *Alnus alnobetula*, on wood, 27.VIII.2018, J.P. Priou (J.P.P. 18033 ø, doc. vid.). — **SPAIN**: **Aragón**, **Huesca**, Pyrenees, 3 km NE of Benasque, 1290 m, branch of ?*Betula*, on leaf and pyrenomycete over wood, 17.V.2014, R. Blasco (R.B. 17-05-14-642-BE, doc. vid.). – ibid., indet. tree, on wood, 2.V.2015 (R.B. 02-05-15-803-BE, doc. vid.). – 5 km NE of Benasque, Paso Nuevo, 1345 m, branch of *Pinus sylvestris*, on wood, 19.V.2016, R. Blasco (R.B. 19-05-16-932/933-BE, doc. vid.). — **CZECHIA**: **Central Bohemia**, Praha-Východ, ~3 km SSE of Mnichovice, W of Hrusice, Hubáčov, ~325 m, branch of *Prunus spinosa*, on wood, VII.1931, J. Velenovský (PRM 152382, **lectotype** of *O. tremulae*, H.B. 9877 ø). – 3.5 km ESE of Mnichovice, SW of Třemblat, Kožený vrch, 470 m, log of *Abies alba*, on wood, X.1931, J. Velenovský (PRM 152389, **holotype** of *O. coccinella* var. *abietina*, H.B. 9879 ø). — **SERBIA**: **Voivodina**, Fruška Gora, 12 km SE of Novi Sad, 3 km SSE of Bukovac, Stražilovo, 217 m, bark of *Corylus avellana*, 11.VII.2019, D. Savić (doc. vid.). – 15.5 km SW of Novi Sad, Orlovac, 470 m, branch of *Fagus sylvatica*, on wood, 19.VII.2019, D. Savić (doc. vid.). — **CHINA**: **Qinghai**, **Huzhu**, 15 km NNW of Huzhu, 3.7 km SSW of Nanmenxia, Nanmenxia reservoir, 2900 m, on indet. wood, 13.VIII.2004, M.H. Sun (B.L. Q132, HMAS 139645, as *O. coccinella*, non vid., sq.: DQ656620, DQ656693).

Not included. **GREAT BRITAIN**: **West Midlands**, **Staffordshire**, 14 km NNW of Stafford, 2.3 km N of Stone, Dawns Bank, 130 m, twig of *Quercus*, on *Colpoma quercinum*, 21.IX.2013, P. Thompson (23/9/13-16, doc. vid.). — **SWEDEN**: **Skåne**, Söderåsen, 6 km WNW of Röstånga, Kohagahus, Kvärk, Kvärkabäckens ravine, 135 m, branch of *Fagus sylvatica*, on wood, 3.VI.2006, F. Baral-Weber (H.B. 8210 ø). — **FRANCE**: **Pays-de-la-Loire**, **Vendée**, 1.3 km NW of St.-Georges-de-Pointindoux, WNW of Les Moulières, 55 m, branch of ?*Salix*, on wood, 18.III.2011, R. Pacaud (R.P., H.B. 9498 ø). – 21 km SSW of La Roche-sur-Yon, 2.3 km NNW of Avrillé, Bois de la Garde, 35 m, branch of *Castanea sativa*, on wood, 5.VI.2003, H.O. Baral (ø). – **Poitou-Charentes**, **Deux-Sèvres**, 13 km N of Melle, 1.8 km S of Fonfreroux, Forêt de L'Hermitain, 180 m, branch of *C. sativa*, on bark, 27.IV.2006, H.O. Baral & G. Marson (ø). – **Vienne**, Poitou, 45 km S of Poitiers, 2 km NNW of Savigné, bois des Loges, 145 m, branch of *Quercus*, on bark, VI.1913, L.J. Grelet (PC 0001042, **holotype** of *O. coccinella* var. *versicolor*, H.B. 7725 ø). — **SPAIN**, **Aragón**, **Huesca**, 15 km N of Jaca, N of Canfranc, Puente de Arriba, 1060 m, branch of *Rosa*, on wood, 13.X.2010, J.P. Priou (J.P.P. 10171, doc. vid.). — **LUXEMBOURG**: **Gutland**, **Mersch**, 6 km SW of Ettelbruck, 1 km SE of Michelbouch, Haerenhecken, Biischtert, 360 m, branch of *Carpinus betulus*, on bark, 26.IV.2001, H.O. Baral (ø). – 4 km N of Mersch, 2.3 km SW of Cruchten, Rouscht, 280 m, branch of *Salix caprea*, on bark & wood, 5.XII.1999, G. Marson (ø). – 9 km NE of Mersch, NNW of Larochette, Osterbour, 310 m, branch of ?*Carpinus betulus*, 27.IV.1994, E. Weber (ø). – ibid., branches of *Carpinus betulus*, on wood, 24.IV.1995, H.O. Baral (H.B. 5265). – **Capellen**, 2.5 km SW of Capellen, 2 km NNE of Garnich, Melzer-Schilzenheck, 318 m, branch of *Salix*, on wood, 7.V.1997, H.O. Baral, G. Marson & B. Declercq (ø). – 2.8 km E Clairefontaine, branch of *Quercus*, on old *Vuilleminia*, 6.V.1998, G. Marson (ø). – **Luxembourg**, 7 km SE of Luxembourg, 2 km ESE of Alzingen, Héid, 300 m, branch of *Salix caprea*, on bark, 13.VIII.1998, G. Marson (H.B. 6209b). – ibid., branches of *Cornus*, on bark, 6.VI.2009, G. Marson (ø). – 7 km S of Mersch, 1.5 km NNW of Steinsel, SW of Zapp, Kaylbaach, 255 m, branch of *Corylus avellana*, on wood, 10.IV.1992, G. Marson & H.O. Baral (ø). – N of Kockelscheier, Haus der Natur, 305 m, Weier, 300 m, branch of *Salix aurita* × *caprea*, on wood, 25.X.1997, G. Marson (H.B. 5964b). – 4.5 km SW of Luxembourg, 1.5 km SW of Cessange, Bois de Cessange, 305 m, branch of *S. aurita* × *caprea*, on bark, 10.XI.2000, G. Marson (ø). – **Esch-sur-Alzette**, 3.7 km ENE of Bettembourg, 1.6 km SSE of Roeser, Weierboesch, 275 m, trunk of *Fagus sylvatica*, on bark, 28.XI.2004, G. Marson (ø). — **GERMANY**: **Rheinland-Pfalz**, 14 km SE of Pirmasens, SE of Dahn, military cemetery, 250 m, branch of *Salix caprea*, on bark, 1.X.1994, H.O. Baral & G. Marson (H.B. 5155c). – **Saarland**, 2.5 km SE of Weiskirchen, 1.5 km NE of Thailen, Bildchen, 325 m, branch of *Sorbus aucuparia*, on bark, 17.IV.2004, H. Aeberhard (ø). – **Bayern**, **Oberpfalz**, 13 km NNE of Amberg, 1.8 km WNW of Hirschau, Eschenbach, 440 m, branch of *Quercus robur*, on wood, bark & *Calosphaeria dryina*, 8.VIII.1993, H.O. Baral (ø). – ~11 km NNE of Regensburg, ~4.5 km SE of Regenstauf, ?E of Hauzenstein, 480 m, stump of *Alnus*, on wood, VI.1926, S. Killermann (Killermann, M, as *O. coccinella*). – **Baden Württemberg**, 5.5 km NE of Tübingen, ENE of Pfrondorf, Tiefenbach, 410 m, branch of *Quercus robur*, on wood, 2.II.1996 (ø). – 1.3 km SW of Pfrondorf, quarry near Bitzle, 420 m, branch of *Salix caprea*, on wood, 26.III.1996, H.O. Baral (ø). – 1.5 km NNE of Pfrondorf, Brand, 460 m, branch of *S. caprea*, on wood, 21.VII.2002, H.O. Baral (ø). – 2.5 km WSW of Tübingen, 2 km N of Weilheim, Spitzberg, Sonnenhalde, 445 m, branch of *Corylus avellana*, on wood, 29.X.2002, H.O. Baral (ø). – 2.5 km NE of Tübingen, 1.5 km NNW of Lustnau, Goldersbach, Auchtert, 340 m, branch of *Carpinus betulus*, on wood, 12.VI.2005, H.O. Baral (ø). – 8 km ESE of Göppingen, 1 km N of Süßen, Eichholz, 400 m, branch of *C. betulus*, on wood, 1.XI.2005, H.O. Baral (ø). – 4 km NNE of Tübingen, 1.6 km SE of Bebenhausen, Kirnbachtal, 390 m, branch of *Fagus sylvatica*, on bark, 27.IX.1993, H.O. Baral (ø). – 2 km SE of Tübingen, Wennfelder Garten, 340 m, twig of *Malus domestica*, on bark, 6.VIII.2002, H.O. Baral (ø). – 9.3 km WSW of Münsingen, 1.5 km SW of Gomadingen, Sternberg, 780 m, branch of *Sorbus aucuparia*, on bark, 5.X.2006, H.O. Baral (ø). – Schwarzwald, 3.5 km WNW of Villingen, SW of Bahnhof Kirnach, Kapf, 750 m, branch of *Carpinus betulus*, on wood, 19.VIII.2005, E. Weber (ø). — **SWITZERLAND**: **Schaffhausen**, 4 km NW of Schaffhausen, 2.3 km WSW of Thayngen, Moos, 430 m, branch of *Salix*, on bark, H.O. Baral (H.B. 3500). – **Uri**, 9 km ESE of Altdorf, 1.2 km SW of Unterschächen, N of Sittlisalp, 1650 m, branch of *Alnus alnobetula*, on bark, 21.VIII.2006, H.O. Baral (ø). — **LIECHTENSTEIN**: 7 km NNW of Vaduz, 1 km SW of Bendern, Bannriet, 450 m, branch of *Alnus incana*, on bark, 5.VII.1997, H.O. Baral (ø). — **CZECHIA**: **Central Bohemia**, unlocalized (from planar to montane areas throughout Bohemia), logs of *Pinus* and *Picea*, 1931, J. Velenovský (1934: 92 and manuscript plate, as *O. coccinella*, doc. vid.). — **JAPAN**: **Honshu**, **Shiga**, ~8 km SE of Ōtsu, ?2.5 km S of Ishiyama, Terabe-cho, ~120 m, on diaporthe-like fungus, VI.1969, T. Yokoyama (IFOH-11610, **holotype** of *Dicranidion inaequale*; ex-type cultures in NBRC IFO-9366, ATCC 22517, IMI 158983, CBS 564.71 etc., conid. isol., doc. vid.; sq.: LC146731). — **AUSTRALIA**: **Western Australia**, Geraldton Sandplains, 23 km SE of Jurien Bay, 19 km NE of Cervantes, Munbinea Road, 92 m, infructescence and stems of *Xanthorrhoea preissii*, 11.XII.2001, G. Marson (H.B. 7157). – **Queensland**, Wet Tropics, border of Daintree forest, 43 km N of Port Douglas, Cape Tribulation, 14 m, stem of *Bambusa*, 30.VIII.2006, G. Marson (H.B. 8497a).

Orbilia guyanensis Baral, **sp. nov.**, MB 813961 — Pls 863–864

Etymology: named after the origin of the holotype, French Guiana.

Typification: French Guiana, Cayenne, branch of indet. angiosperm, 1.III.2007, C. Lechat (ex H.B. 8453, M-0276490, holotype; sq.: KT222432).

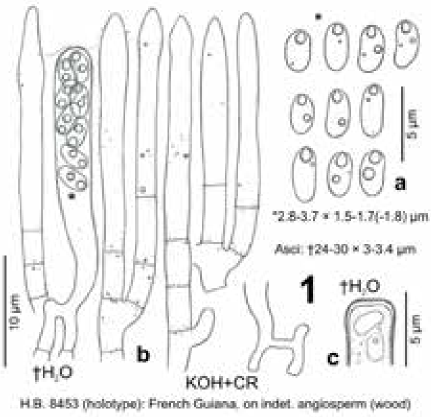


Plate 863. **1**: *Orbilia guyanensis*. – **a**. ascospores; **b**. ascus and paraphyses, ascus base; **c**. ascus apex.

Latin diagnosis: *Apothecia rehydratata 0.3–1.4 mm diam., pallide vel subvivide lutea, breviter stipitata, margine elevata, laevi. Ascosporae *2.8–3.7 × 1.5–1.8 µm, (ellipsoideo-)subcylindricae, rectae vel paulo curvatae, corpuscula refringentia 0.6–1 × 0.5–0.8 µm. Paraphyses ad apicem leniter vel modice obtuse lanceolatae, paulo protrudentes, exsudato nullo. Excipulum marginale absque processis vitreis. Habitat ad lignum putridum uvidum angiospermae in zona tropica humida Americae meridionalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.3–)0.5–1.4 mm diam., 0.3 mm high (receptacle 0.09–0.13 → 0.06 mm), pale to light yellow, semitranslucent, round, scattered to subgregarious in small groups; disc slightly to medium concave, finally flat with raised margin, margin thin, 5 µm protruding, smooth; with a cylindrical to obconical stipe 0.1–0.2 × 0.15–0.35 mm, superficial; dry pale to bright yellow, receptacle partly strongly inrolled. **Asci** †24–30 × 3–3.4 µm, 8-spored, spores †(1–)2-seriate, 2–6 lower spores inverted (very strongly mixed); **apex** (†) medium to strongly truncate (not indented, laterally not inflated); **base** with short to medium long and thin, flexuous stalk, T- or often h- to H-shaped. **Ascospores** *2.8–3.7 × 1.5–1.7(–1.8) µm, subcylindric(-ellipsoid), both ends rounded to slightly obtuse, straight to slightly inequilateral or curved; **SBs** *0.6–1 × 0.5–0.8 µm, broadly tear-shaped to almost plug-shaped, apically narrowed to a ± wide point, often with a lateral LB of 0.4–0.8 µm diam. **Paraphyses** slightly to medium lanceolate, apex obtuse to acute, terminal cells †(12–)15–20(–22) × 1.6–2.5 µm, exceeding the dead asci by 2–4 µm, lower cells †3.5–7 × 1.8–2.6 µm; unbranched at upper septum. **Medullary excipulum** hyaline, 170 µm thick in centre, 40–70 µm in receptacle, of dense textura porrecta, horizontally oriented in receptacle, upwards in stipe, without inflated cells but with many solid (glassy), 2–4 µm wide elements mainly in upper part, very sharply delimited. **Ectal excipulum** hyaline, of vertically oriented t. angularis from base to margin, (†) medium gelatinized (common walls 1–1.5 µm thick, cortical wall 1–2 µm), 30–45 µm thick in stipe, 15–35 µm at flanks, cells †(9–)15–25 × (6–)10–18 µm; 15 µm thick near margin, oriented at a 70–90° angle to the surface, marginal cortical cells †6–10 × 5–7 µm, firm-walled; **glassy processes** absent. **Anchoring hyphae** abundant at base of stipe, †2.5–4.3 µm wide, walls 0.2–0.3 µm thick, forming a loose t. intricata. **SCBs** & **VBs** no data available. **Exudate** over paraphyses and excipulum absent. — **ANAMORPH**: unknown.

Habitat: lying on moist ground, decorticated, 2–4 cm thick piece of timber from an unidentified broad-leaved tree, on 0.2–0.5 mm deep strongly decayed wood, eroded, partially blackened, no algae. **Associated**: none observed. **Desiccation tolerance**: desiccation-sensitive, but many spores still viable after 4 weeks. **Altitude**: 23 m a.s.l. **Phenology**: III (tropical belt).

Taxonomic remarks. In the lanceolate paraphyses and smooth apothecia *Orbilia guyanensis* is similar to *O. umbilicata*, but also *O. alba* (series *Gamsylella*). It differs in distinctly shorter and wider, only very slightly curved ascospores, larger, apically

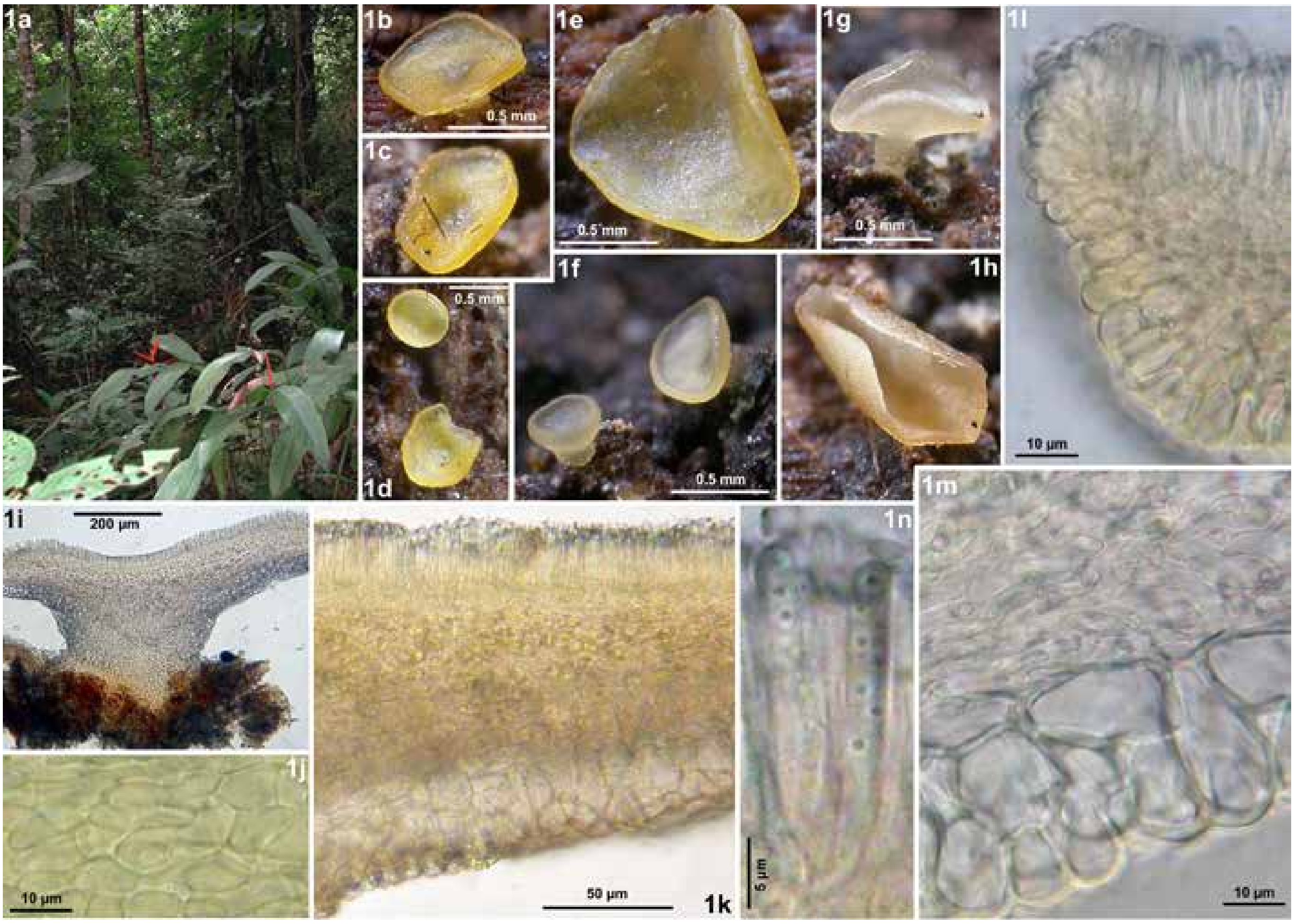


Plate 864. **1**: *Orbilia guyanensis*. – **1a**. tropical rainforest at the type locality; **1b–h**. rehydrated apothecia; **1i**. apothecium in median section; **1k**, m. id., at lower flanks; **1l**. id., marginal region; **1j**. external view on ectal excipulum at mid flanks, cells horizontally elongated; **1n**. mature asci and paraphysis. – Dead state (**1k**, **n** in H_2O; **1i–j**, **l–m** in KOH), except for ascospores in asci of **1n** (with SBs or LBs). – **1a**: phot. C. Lechat. — **1a–n**. H.B. 8453 (holotype): French Guiana, Cayenne, on indet. angiosperm.

more broadly attached SBs, and in thick-walled excipular cells. A Chinese collection mentioned under *O. umbilicata* differs from *O. guyanensis* in slightly longer and narrower spores and longer asci; yet, the shape of the SBs is unknown. *O. dryadum* and *O. gaillardii* have similar spores but differ in capitate paraphyses, globose SBs with a very fine, usually invisibly filum (unknown in *O. gaillardii*), and an ectal excipulum with thinner walls. Also species around *O. orientalis* (series *Drechslerella*) have similar spores but differ in smaller, ± rod-shaped, often eccentric SBs attached by a thin filum, in the frequent presence of glassy processes, and in uninflated to capitate paraphyses.

Phylogeny. A sequence was gained from apothecia of the holotype, comprising SSU (without S1506 intron), ITS, and LSU. In our analyses of SSU+ITS+LSU, ITS, or LSU (Phyls 7, 22–23, S27), *O. guyanensis* clustered in section *Orbilia* with a very high distance to any other species, ranging between 23 and over 30% depending on the alignment. Even the 5.8S differs by a minimum of 4 nt from *O. dryadum* p.p. and by 5 nt from various other members of *Orbiliomycetes*. The lowest distance in the LSU D1–D2 is 10% to the *xanthostigma-leucostigma* complex and *Dicranidion inaequale*. These results support an isolated position of *O. guyanensis*.

However, in Phyls 22 and S27, *O. guyanensis* clustered weakly or unsupported in the *xanthostigma-tremulae* clade, and molecular motifs in the LSU D1 domain strongly suggest that it belongs in this group (see p. 1327).

Ecology. *O. guyanensis* was found on rotten wood of a hygric piece of timber of an unidentified angiosperm tree in a tropical humid coastal rainforest in northeastern South America.

Specimens included. **FRENCH GUIANA**: 7 km WSW of Cayenne, Secteur Crique Macouria, N of Pont du Larivot and Rivière de Montsinéry, 23 m, branch of indet. angiosperm, on wood, 1.III.2007, C. Lechat (ex H.B. 8453, M-0276490, **holotype**; sq.: KT222432).

Orbilia umbilicata Baral, Ying Zhang & K.Q. Zhang, in Zhang et al., Fungal Diversity 36: 146 (2009) — Pls 865–866

Etymology: referring to the depressed centre of the apothecial disc.
Typification: Japan, Sugadaira, branch of indet. angiosperm, 13.VIII.1997, W. Gams (ex H.B. 5903, M-0140895, holotype)

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.4–1.4 mm diam., 0.12–0.17 mm thick (receptacle 0.07–0.1 → 0.06–0.07 mm), whitish to pale cream-chlorinaceous (light honey-yellow with age), translucent (partly dark brownish in centre), round to slightly undulating, scattered or often gregarious over small to large areas; disc slightly to medium concave, flattened to slightly convex when large but still distinctly depressed and concave in centre, margin thin, 5 µm protruding, smooth; subsessile or often with distinct obconical stipe 0.1–0.15 × 0.35–0.5 mm, superficial; dry light chlorinaceous-yellowish-ochraceous. **Asci** †(25–)28–35 × 2.8–3.5(–3.8) µm {2}, 8-spored, spores 3-seriate, lower spores inverted, pars sporifera †9.5–16 µm long; **apex** (†) medium to strongly truncate (rarely very slightly indented, laterally not distinctly widened); **base** with very short to

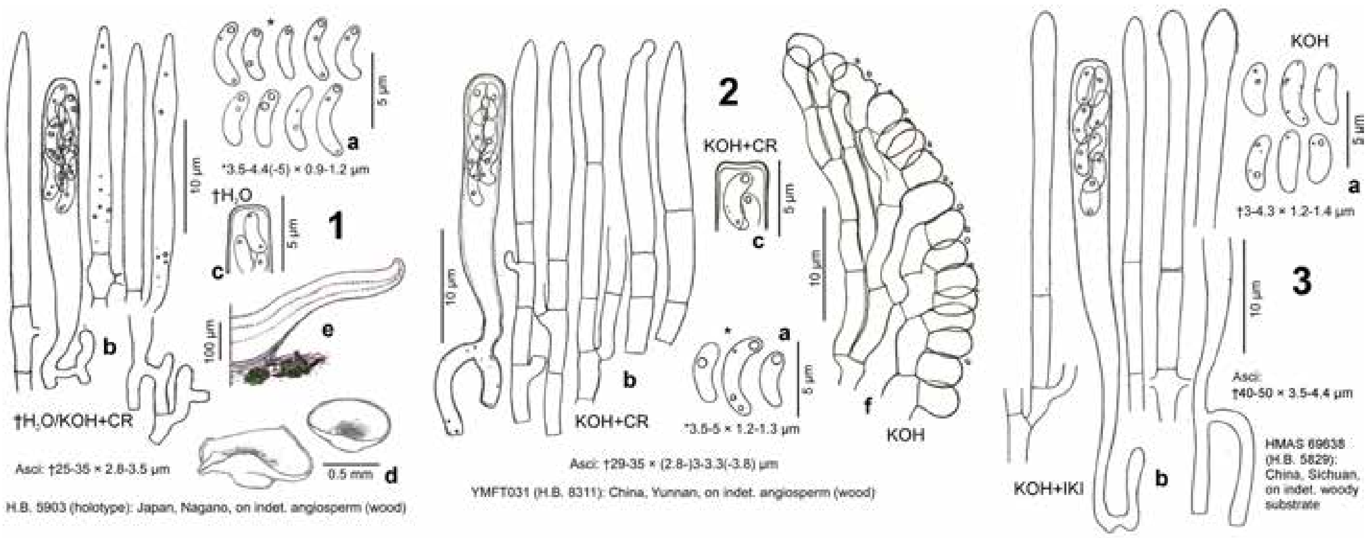


Plate 865. **1–2**: *Orbilia umbilicata*; **3**. *O.* aff. *umbilicata*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. rehydrated apothecia; **e**. apothecium in median section; **f**. id., marginal ectal excipulum.

medium long, thick or thin, flexuous stalk, h- to H-shaped. **Ascospores** *(3–)3.5–4.5(–5) × (0.9–)1–1.2(–1.4) µm {2}, †3–5 × 1 µm {1}, cylindrical, both ends rounded, slightly to strongly curved (allantoid or sometimes slightly helicoid); **SBs** *0.3–0.5(–0.6) µm diam., globose, a short distance from apex, attachment not seen (total length 0.6–0.7(–1) µm). **Paraphyses** (narrowly) lanceolate, terminal cells †(10–)20–28 × (1.5–)2–2.5(–2.8) µm {2}, exceeding the asci by 2–4(–5) µm, lower cells †(3–)4–6 × 1.3–2.5 µm {2}. **Medullary excipulum** 25–70 µm thick, of dense or medium loose, partly horizontally oriented, not or slightly gelatinized textura intricata(-porrecta), very sharply delimited. **Ectal excipulum** of (†) thin-walled to slightly gelatinized, vertically oriented t. angularis(-prismatica) from base to margin, 50–70 µm thick near base, cells †10–18 × 8–15 µm {T} or †12–30(–40) × 10–20(–25) µm {1}; 15–30 µm thick at lower flanks, 10 µm towards mid flanks, 5–8 µm near margin, here oriented at a 10–80° angle, marginal cortical cells †(4–)6–11(–13) × 2.5–3.5 {1} or 3.5–6 µm {T}, thin-walled (0.2 µm), **glassy processes** absent. **Anchoring hyphae** abundant, forming a dense, medium gelatinized t. intricata-porrecta 40–60 µm thick, hyphae †1.5–3 µm wide, walls 0.2 µm thick (common walls 0.4–1.3 µm) {2}. **SCBs** and **VBs** no data available. **Exudate** over paraphyses absent; over margin and flanks 0.2–0.5 µm thick, continuous and smooth, or as scattered granules. — **ANAMORPH**: unknown.

Habitat: branches or logs of indet. angiosperm trees {2}, lying on ground, decorticated, on entirely strongly decayed wood {2}, soaked with water, upperside, without or with many green algae. **Associated**: leafy liverwort {1}. **Desiccation tolerance**: only ascospores were viable after 6 weeks. **Altitude**: 1250–2550 m a.s.l. **Geology**: Jurassic sedimentary rock; mafic volcanic rock. **Phenology**: VII–VIII.

Taxonomic remarks. *Orbilia umbilicata* is characterized by allantoid ascospores and lanceolate paraphyses. The species seems to be related to *O. guyanensis* (for the differences see p. 1380), although a possible relationship could instead exist to *O. pilosa* (section *Arthrobotrys*) which has similarly shaped spores and paraphyses. *O. epipora* (section *Arthrobotrys*) and *O. dryadum* differ from *O. umbilicata* in cylindrical to capitate paraphyses and straight or only slightly curved spores. *O. fraxini* (section *Arthrobotrys*) differs in hair-like marginal cortical cells tipped by 1–4 µm thick exudate caps and in wider and less curved, more ellipsoid to clavate spores.

Variation. *O. umbilicata* s.l. was so far only studied in the dead state, except for the spores which were still alive in the two included samples. The abundant Japanese holotype (Pls 865–866: 1) fits very well the Chinese paratype (Pls 865–866: 2) in many respects, though it differs in longer terminal cells of paraphyses, smaller basal excipular cells, and wider marginal cortical cells, and in flat to convex, centrally depressed (umbilicate) apothecia.

Not included collections. Two samples from Primorje (Russian Far East, Pl. 866: 3) and Nara (Japan, IVV: H.B. 9982) differ from *O. umbilicata* in cylindrical to narrowly lanceolate paraphyses, slightly longer asci (†30–42 × 3.3–3.8 µm), and wider, less curved spores (†3.2–5 × 1.2–1.4 µm). A collection from Daba Mts. in Chongqing (before 1997 a part of Sichuan) (Pl. 865: 3) deviates from *O. umbilicata* in somewhat shorter and wider, distinctly less curved spores, less acute, ± spathulate paraphyses, and distinctly longer asci, and seems to be intermediate to *O. guyanensis*. A similarity exists also with *O. fraxini*, but regrettably the marginal excipulum of the single received apothecium was not studied. This and another sample from the same site (HMAS 69639) were reported by Zhuang (1997: 9) under the name '*O. xanthostigma* s. Svrček 1954', with flat, sessile, very thin, cream white, semitranslucent apothecia 1–3 mm in diam., ellipsoid to rod-shaped spores 3.5–4.5 × 1.2–1.5 µm, and asci 27–32 × 3.7–4 µm (probably excluding stipe). Liu (2006) erroneously included both Sichuan samples in his concept of *O. epipora* (spores 2.5–3 × 1.2–1.3 µm, straight to sometimes slightly curved), which otherwise comprised *O. dryadum* and an unidentified taxon.

Ecology. *O. umbilicata* s.l. was found on deeply rotten wood of hygric decorticated logs of angiosperm trees in continental, cold- to warm-temperate humid (winter-dry) forests of the Far East of Russia and the large central island of Japan, but also in subtropical humid (winter-dry), montane evergreen forests of central and southern China. In the sample from Primorje the forest was composed of *Abies holophylla*, *Acer* spp., *Fraxinus mandshurica*, *Quercus mongolica*, *Tilia mandshurica*, and *T. amurensis* (E.S. Popov pers. comm.), in that from Sugadaira (holotype) it was a montane forest with a rivulet in a ravine.

Specimens included. **JAPAN**: **Honshu**, **Nagano**, Chiisagata-gun, 12 km NE of Ueda, 9.5 km SSE of Sugadaira, Kakuma Valley, 1250 m, branch of indet. angiosperm, on wood, 13.VIII.1997, W. Gams (M-0140895, **holotype**; **isotype** in H.B. 5903). — **CHINA**: **Yunnan**, **Dali**, Yongping, ~38 km ENE of Baoshan, Jinguangsi virgin forest, 2550 m (erron. as 863 m in Zhang et al. 2009b, Z.F. Yu pers. comm.), log of indet. angiosperm, on wood, 14.VII.2006, Y. Zhang (Y.Z. yp-2, YMFT 031, H.B. 8311).

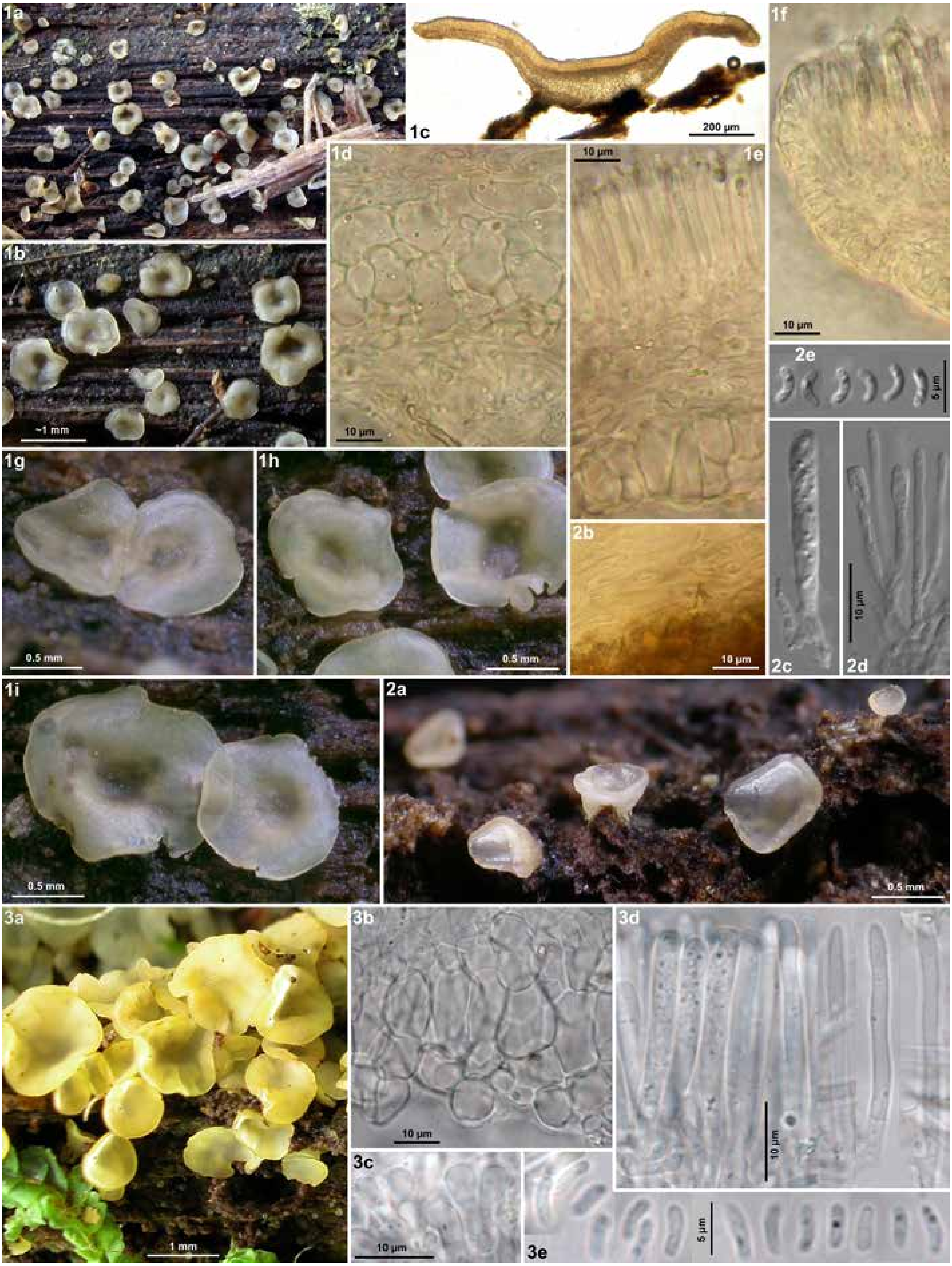


Plate 866. **1–2**: *Orbilia umbilicata*; **3**. *O.* cf. *umbilicata*. – **1a–b**, **g–i**, **2a**. rehydrated apothecia; **1c**. apothecium in median section; **1d**. id., basal ectal excipulum with anchoring hyphae; **1e**, **3b**. id., at lower flanks; **1f**. id., marginal region; **3c**., marginal cells in external view; **2b**. gelatinized anchoring hyphae; **2c–d**, **3d**. paraphyses and asci; **2e**, **3e**. ascospores. – Dead state: **1c**, **2c–e** (in H_2O, except for spores); **1d–f**, **2b**, **3b–e** (in KOH). – **2c–e**: from Zhang et al. (2009b, DIC); **3a–e**: phot. E.S. Popov. — **1a–f**. H.B. 5903 (holo/isotype): Japan, Nagano, on indet. angiosperm; **2a–e**. YMFT 031: China, Yunnan, on indet. angiosperm; **3a–e**. 20.VIII.2005: Russia, Primorje, on indet. angiosperm.

Not included. **RUSSIA (East)**: **Primorje**, **Khasansky**, 33 km W of Wladiwostok, 8 km S of Barabasch, Kedrovaya Pad, 120 m, log of indet. angiosperm, on wood, 20.VIII.2005, E.S. Popov (LE 248025, doc. vid.). — **CHINA**: **Chongqing**, Daba Mts., ~16 km NE of Wuxi, 1800 m, on indet. woody plant, 3.VIII.1994, X.Q. Zhuang (HMAS 69638, as *O. xanthostigma*; H.B. 5829 ø). — **JAPAN**: **Honshu**, **Nara**, 14.5 km NNW of Owase, Odai-gahara, 1660 m, fragment of *Fagus crenata*, VIII.1994, Kawasaki (TRL 1079, TNS-F-56771, H.B. 9982 ø).

Orbilia spirospora Baral & E. Weber, **sp. nov.**,

MB 813960 — Pls 867–868

Etymology: named after the strongly twisted, *Spirillum*-like ascospores.

Typification: Japan, Kōchi, log of indet. angiosperm, VII.1994, Kawasaki et al. (TNS-F-56764, holotype).

Latin diagnosis: *Apothecia rehydratata 0.3–0.9 mm diam.*, *pallide cremea*, *subsessilia*, *margine laevi. Ascosporae †3.5–4.5 × 0.7–0.9 µm*, *cylindricae*, *basi raro parum attenuatae*, *valde helicoideae*, *sinistrorsum convolutae. Paraphyses ad apicem modice vel valde obtuse lanceolatae*, *distincte protrudentes*, *exsudato nullo. Excipulum marginale absque processis vitreis*, *excipulum medullare percrassum*, *valde gelatinosum*, *hyphae basales muco circumdatae. Habitat ad lignum putridum trunci uvidi angiospermae in zona subtropica humida Japoniae meridionalis.*

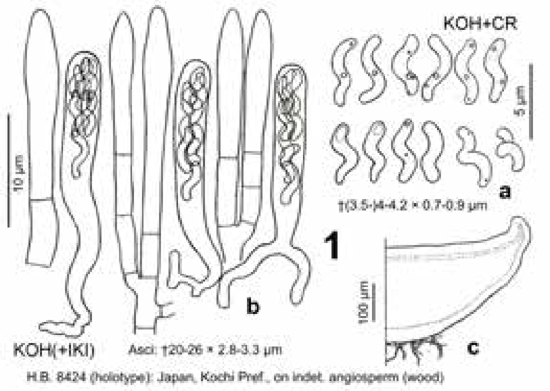


Plate 867. **1**: *Orbilia spirospora*. – **a**. ascospores; **b**. asci and paraphyses; **c**. apothecium in median section.

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.3–0.9 mm diam., 0.25–0.33 mm high, now pale cream, medium translucent, round, somewhat gelatinous, subgregarious; disc slightly concave to flat, margin medium thick, distinctly raised, not protruding, smooth; with an ill-defined, short, obconical stipe, superficial; dry light yellowish-cream. **Asci** †20–26 × (2.8–)3–3.3(–3.7) µm, 8-spored, spores †3–4-seriate, inversion not clearly seen, pars sporifera †10.5–12.5 µm long; **apex** (†) slightly to medium truncate (never indented, laterally not inflated); **base** with short to medium long, gradually tapered, somewhat flexuous stalk, L-, Y-, h- or H-shaped. **Ascospores** †(3.5–)4–4.2(–4.5) × 0.7–0.9 µm, cylindrical, rarely slightly clavate, both ends rounded or base sometimes slightly attenuated, strongly helicoid (always twisted like a left-hand thread); **SBs** rarely seen as transparent subglobose region near 1 end. **Paraphyses** medium to broadly lanceolate with ± obtuse apex, terminal cells †12.5–20 × 2–3.2 µm wide, exceeding the dead asci by 2–5 µm, lower cells †3–7 × 1.5–2.3 µm; unbranched at upper septum. **Subhymenium** very pale cream, 10 µm thick, of non-gelatinized, dense horizontal textura prismatica-porrecta. **Medullary excipulum** hyaline, 150–230 µm thick, of very loose t. intricata with abundant medium refractive intercellular gel, without inflated cells, very sharply delimited. **Ectal excipulum** hyaline, of slightly gelatinized, irregularly oriented t. (globulosa-)angularis from base to margin, 30–40 µm thick near base, cells †10–18 × 7–12 µm; 15–20 µm thick at flanks and margin, marginal cortical cells †6–7 × 3–5 µm; **glassy processes** absent. **Anchoring hyphae** rather sparse, only at base, projecting, †1.8–3 µm wide (excluding gel sheath), walls 0.2 µm thick, covered by a gel sheath that swells in KOH to a thickness of 1–1.5 µm (in water much thinner and more refractive). **SCBs** & **VBs** no data available. **Exudate** over paraphyses and excipulum absent. **— ANAMORPH**: unknown.

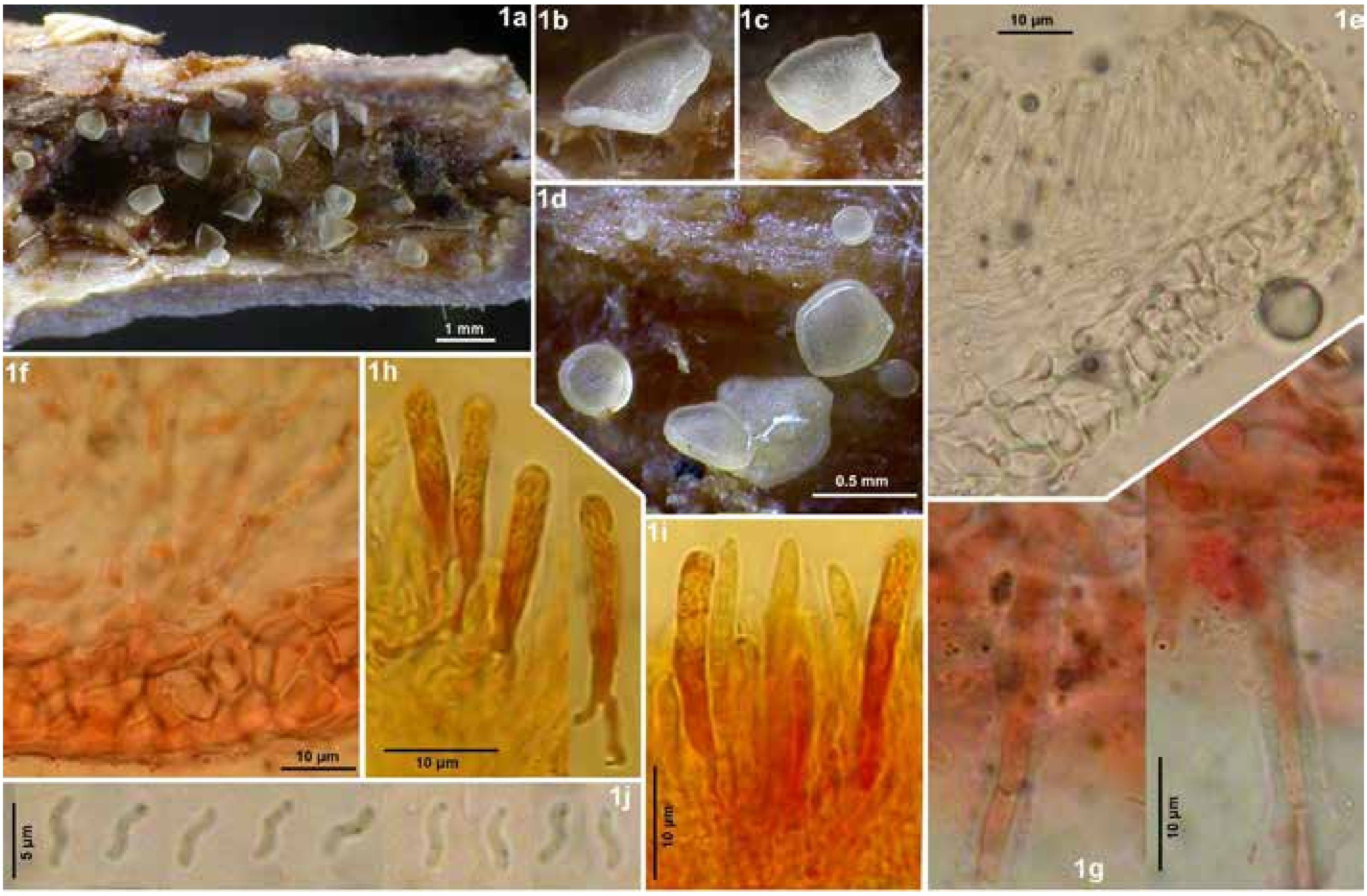


Plate 868. **1**: *Orbilia spirospora*. – **1a–d**. rehydrated apothecia; **1e**. median section of marginal region; **1f**. id., ectal and gelatinized medullary excipulum at flanks; **1g**. anchoring hyphae with gel sheath; **1h–i**. asci and paraphyses; **1j**. ascospores. – Dead state (**1e**, **j** in KOH; **1f–g** in KOH+CR; **1h–i** in KOH+IKI). — **1a–h**. TNS-F-56764 (H.B. 8424, holotype): Japan, on indet. angiosperm.

Habitat: on uneven decorticated surface of a probably thick log of unidentified broad-leaved tree on the moist ground, on deeply medium decayed wood, ungreyed, no algae. **Associated**: none observed. **Desiccation tolerance**: unknown (probably desiccation-sensitive). **Altitude**: ~100 m a.s.l. **Phenology**: VII.

Taxonomic remarks. *Orbilia spirospora* is characterized by small, cylindrical, strongly helicoid ascospores and obtusely lanceolate paraphyses, also by a very thick, strongly gelatinized medullary excipulum, and anchoring hyphae with a thick gel sheath (in KOH). *O. umbilicata* resembles *O. spirospora* in the paraphyses, but differs in wider, allantoid spores, longer asci, and a much less gelatinized, thinner medullary excipulum.

The spores of *O. spirospora* are consistently twisted like a left-hand thread. This is a rare feature of taxa of *Orbiliomycetes* with helicoid spores, being otherwise noted only in a few species of some other sections of *Orbilia* (*O. bomiensis*, *O. curvatiobliqua*, *O. helicoobliqua*, *O. helicovinosa*).

Ecology. *O. spirospora* occurred on medium rotten wood of a hygric log of an unidentified angiosperm tree in a subtropical humid (winter-dry) floodplain rainforest in southern Japan.

Specimens included. **JAPAN**: **Shikoku**, **Kōchi**, Shimanto River, ~100 m, log of indet. angiosperm, on wood, VII.1994, Kawasaki et al. (TRL 1072, TNS-F-56764, **holotype**, H.B. 8424 ø).

Orbilia minutispora Velen., Monogr. Discom. Bohem.: 98, pl. 11 fig. 40 (1934) — Pl. 869

Etymology: named according to the small spores.
Typification: Czechia, Mělník, stems and leaves of *Cirsium palustre*, 14.VIII.1924, J. Velenovský (PRM 149655, holotype).

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.5–1 mm diam., thin, light honey-yellowish-ochraceous (Velenovský: white), translucent, round to slightly undulating, gregarious; disc flat, margin thin, scarcely protruding, smooth; broadly sessile, superficial. **Asci** †18–26 × 2.4–2.7 µm, 8-spored, spores biseriate, orientation unclear, pars sporifera †11.5–12.5 µm; **apex** (†) hemispherical to slightly truncate; **base** with very short stalk, h- to H-shaped. **Ascospores** †2.7–3.6 × 0.9–1.1 µm, subcylindrical to narrowly ellipsoid, ends rounded to obtuse, straight (rarely slightly curved); **SBs** invisible in dead state. **Paraphyses** narrowly to mostly broadly lanceolate, with ± obtuse tips, terminal cells †15.5–21 × (1.8–)2.2–3 µm, exceeding the dead asci by 2.5–3.5 µm, lower cells †4–6 × 1.7–2.5 µm. **Medullary excipulum** not studied. **Ectal excipulum** of very thin-walled textura globulosa-angularis from base to lower flanks, cells †11–19 × 10–12 µm, 15 thick near margin, of t. prismatica oriented at a 60–90° angle to the surface, marginal cortical cells †10–14 × 4–5.5 µm, clavate, **glassy processes** absent. **Anchoring hyphae** not observed. **SCBs** & **VBs** no data available. **Exudate** granular, ~0.2–1 µm thick, hyaline, scattered between tips of paraphyses; on margin and flanks more abundant. — **ANAMORPH**: unknown.

Habitat: 4–5 mm thick stem and ?petiole of *Cirsium palustre*, medium decayed, with a rose-red stain. **Associated**: none observed. **Desiccation tolerance**: unknown (possibly intolerant). **Altitude**: ~180 m a.s.l. **Geology**: Upper Cretaceous clay- & marlstone. **Phenology**: VIII.

Taxonomic remarks. *Orbilia minutispora* is characterized by lanceolate, protruding paraphyses, and very small asci and ascospores. Also Svrček emphasized the paraphysis shape as most characteristic. Apart from this feature the microanatomy of *O. minutispora* recalls *O. epipora* or *O. atlantis* (section *Arthrobotrys*), the latter deviating also in much longer spores. The species might also be related to the more tropical *Orbilia alba* and *O. pilosa* (section *Arthrobotrys*). From the former it differs, e. g., in shorter spores and smaller apothecia, from the latter in broadly sessile apothecia and the complete absence of hairs.

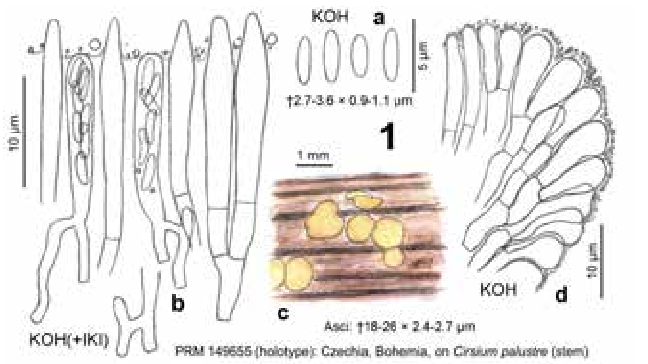


Plate 869. **1**: *Orbilia minutispora*. – **a**. ascospores; **b**. asci and paraphyses; **c**. rehydrated apothecia; **d**. marginal ectal excipulum in median section.

Type studies. Velenovský described and figured the paraphyses as filiform, apically obtuse, hardly inflated, covered by a 'vanishing epithecium', whereas Svrček found them to be mostly narrowly lanceolate and without exudate. In the present study small scattered granules were found lying over inconspicuous gel which is penetrated by the protruding parts of the distinctly lanceolate paraphyses. Only a few free straight spores were encountered; yet, within the asci they were also slightly curved. Svrček found them 'rather abundant, 2.5–4 × 0.8–1 µm, short acicular, straight or nearly so'. Also Velenovský described the spores as 'narrowly linear, often very slightly curved', 1–2.5 µm long (manuscript). He reported the fresh apothecia as translucent, white, 1–1.5 mm diam., whereas the rehydrated apothecia were found to be pale yellow (Svrček) or light honey-yellowish-ochraceous (present study).

Ecology. *O. minutispora* is only known from the holotype on hygric 'stems and leaves' (petioles?) of *Cirsium palustre* in a marsh with *Geoglossum fechtneri* in cold-temperate humid, subcontinental central Bohemia (eastern Europe).

Specimens included. **CZECHIA**: **Central Bohemia**, ~11 km SE of Mělník, Všetaty, ~180 m, stem & ?petiole of *Cirsium palustre*, 14.VIII.1924, J. Velenovský (PRM 149655, **holotype**, H.B. 6184 ø).

Orbilia dryadum (Velen.) Baral & E. Weber, in Quijada et al., Phytotaxa 284(4): 245 (2016) — Pls 870–872, Map 139

Basionym: *Orbilia alnea* var. *dryadum* Velen., Monogr. Discomyc. Bohem.: 93 (1934)

Etymology: named after the dryads (tree nymphs) who are said to dance at night under the waterfalls, referring to the type locality, Bubovické vodopady.
Typification: Czechia, Karlštejn, log of *Tilia*, X.1926, J. Velenovský (PRM 151745, holotype); Germany, Tübingen-Pfrondorf, branch & log of *Fagus sylvatica*, 16.VII.2006, E. Weber & H.O. Baral (ex H.B. 8224a, M-0291769, epitype, designated here, MBT385131; sq.: KT222358).
Misapplied names: Bachman (1909: 58), as *O. xanthostigma*; Beaton & Weste (1979), as *O. epipora*, Spooner (1987: 166, fig. 20), as *O. cunninghamii* (?= *O. dryadum*); Korf (1992, p.p.), as *O. epipora*; Liu (2006: 76, p.p.), as *O. epipora*; Pfister (1997: fig. 6, D.H.P. 184), as *O. ?alnea*; Spooner (in Kirk & Spooner 1984: 573, fig. 9 A), as *O.* cf. *acuum*.

Description: — **TELEOMORPH**: **Apothecia** fresh (0.25–)0.3–1(–1.5) mm diam., 0.12–0.25 mm high (receptacle 0.07–0.13 → 0.05–0.1 mm), white or usually pale to light carneous-cream, yellowish or (isabelline-)rosaceous(-lilaceous), translucent, round, sometimes strongly undulating-lobate when large, scattered to subgregarious, sometimes densely gregarious in small groups; disc slightly (to medium) concave, finally flat, margin distinct, thin or thick, somewhat raised, 0–5 µm protruding, smooth; subsessile or often with a broad obconical stipe 0.05–0.1(–0.13) × 0.2–0.4 mm, superficial, sometimes with white subiculum; dry light to bright cream to rose or apricot.

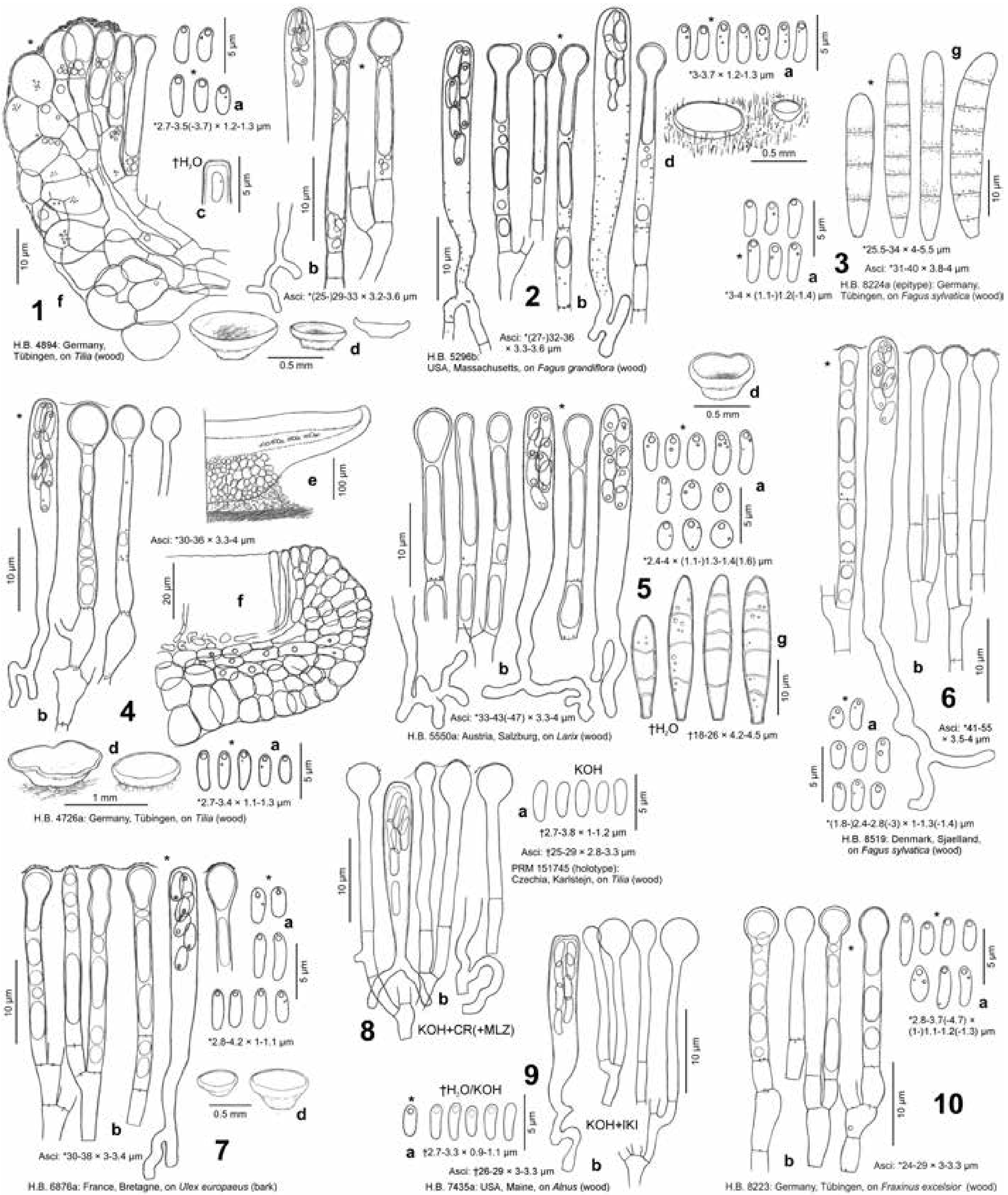


Plate 870. **1–6**, **8–10**: *Orbilia dryadum*; **7**: *O.* aff. *dryadum*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apex; **d**. fresh apothecia; **e**. apothecium in median section; **f**. id., ectal excipulum at margin and flanks; **g**. conidia from substrate.

Asci *((24–))(25–)29–41(–45)((–55)) × (2.8–)3.2–4(–4.5) µm {17}, †(22–)23–33(–41) × (2.3–)2.7–3.3(–3.8) µm {14}, 8-spored, spores *2–3-seriate, ((1–))(2–)3–5(–6)((–7)) lower spores inverted {15} (often mixed), pars sporifera *(8–)10–14(–16) µm long; **apex** (†) medium or mostly strongly truncate (not or rarely slightly indented, laterally not widened); **base** mostly with short to long, thin, flexuous stalk, T-, L-, Y- or often h- to H- shaped. **Ascospores** *((1.8–))(2.3–)2.7–3.9(–4.2)((–4.7)) × (1–)1.1–1.3(–1.5) µm {29}, †(2–)2.5–3.5(–4) {12} × 0.8–1 {3} or (0.8–)1–1.2(–1.3) µm {9}, (sub)cylindrical, some slightly cuneate (wedge-shaped), rarely ellipsoid, both ends rounded, straight to (very) slightly inequilateral or curved; **SBs** *(0.2–)0.3–0.6(–0.8) µm diam. {15}, total length (0.4–)0.5–0.8(–0.9) µm, globose, sometimes with a thin, very short filum, with a few minute **LBs**. **Paraphyses** apically slightly or usually medium to (very) strongly capitate, terminal cells *(15–)16–24(–28) {12} × (2–)2.5–4.5((–5)) µm {16}, †13–22 {2} × (2.2–)3–4.2(–4.5) µm {3}, lower cells *(3–)4–8(–10) × (1.3–)1.5–2.8(–3.5) µm {8}, †3–7 × 1.3–1.9 µm {2}; sometimes branched at upper septum. **Medullary excipulum** hyaline, 30–50 µm thick, of medium dense textura globulosa-prismatica-intricata, ± horizontally oriented, medium sharply delimited from ectal excipulum only at flanks by a 5–10 µm thick layer of t. porrecta. **Ectal excipulum** hyaline, of thin-walled (to slightly gelatinized), vertically oriented t. globulosa-angularis(-prismatica) from base to margin, 40–120 µm thick near base, cells */†9–20 {6} or 20–35(–45) {5} × 7–15 {6} or 10–26 {7} µm; 15–40 µm thick at flanks, 10–20 µm near margin, oriented at a 30–70 {5} or 90° {2} angle to the surface, marginal cortical cells *(3–)4–9(–12) × (2.7–)4–6(–8) µm {7}; **glassy processes** absent. **Anchoring hyphae** medium (to very) abundant, */†(1.5–)2–4(–5)((–6)) µm wide, walls 0.2(–0.3) µm thick {7}, forming a loose or dense, hyaline, 20–30 µm thick t. intricata. **SCBs** globose, in paraphyses 0.3–1 µm diam., inconspicuous between VBs, often in small groups, in marginal excipulum ~0.6–2 µm diam., in medullary excipulum exceptionally with globose, medium to strongly refractive guttules (?SCBs) 1–2.5 µm diam. {2}; **VBs** globose to strongly elongate, very low- to high-refractive, hyaline {13}, sometimes absent (especially in more mature paraphyses) {5}. **Exudate** over paraphyses absent, over margin 0.2–1 µm thick, sparse, granular to cloddy-continuous. — **ANAMORPH**: dactylella-like (from ascospore isolate {3} and natural substrate {9}). **Conidiophores** *10–105 × 2–3(–4) µm, (0–)1–3(–9)-septate, branched or unbranched, 1.3–1.7 µm wide above, conidia formed terminally {including data from Liu 2006, Pfister 1997, and M. Bemmann pers. comm.}. **Conidia** cylindric-ellipsoid to fusoid, straight; in pure culture 23–33 × 5–6.3 µm, 3–4(–6)-septate {Pfister 1997}, 22.5–56 × 4–6.5 µm, 2–8-septate {Liu 2006}, *(16–)24–30 × (3.2–)3.5–4 µm, (0–)1–3-septate {H.B. 8223}; on natural substrate *(16–)22–35(–42) × (2.8–)3.2–5(–5.5) µm {9}, †18–26 × 4.2–4.5 {1} µm, (1–)3–6-septate {10}.

Habitat: lying on (medium dry to) moist or wet soil, partially to mostly entirely decorticated, 3–30 cm thick branches and logs of *Acer* sp. {2}, *Adenocarpus foliolosus* {3}, *Alnus* sp. {2}, *A. glutinosa* {2}, *Betula* sp. {1}, *Carpinus betulus* {1/2}, *Chamaecytisus proliferus* {1}, *Corylus avellana* {1}, *Erica platycodon* {1}, *Fagus sylvatica* {8}, *Fraxinus excelsior* {2}, (?)*Larix* sp. {1}, *Myrica faya* {1}, *Ocotea foetens* {1}, *Pinus canariensis* {1}, *Populus* sp. {1}, *Salix* sp. {1}, *S.* ?*caprea* {1}, *Sambucus nigra* {1}, *Tilia* sp. {1}, *T. cordata* {1}, indet. angiosperm {8}, on very deep medium to strongly decayed wood {46}, rarely on *Hymenochaete fuliginosa* {1}, without algae. **Associated**: *Ascocoryne inflata* {1}, *Botryobasidium aureum* {1}, *Brachysporium bloxamii* {1}, *B. nigrum* {2/1}, *B. obovatum* {1}, *Calycina citrina* {1}, *Capronia* sp. {1}, *Chaetosphaeria* sp. {1/1}, *Dematioscypha delicata* {1/3 - anamorph}, *Diaporthales* {3}, *Diatrype flavovirens* {1}, *Graphium calicioides* {1}, *Holwaya mucida* {1}, *Hyalorbilia fagi* {1}, *H. polypori* {2}, *Hyaloscypha* ?*albohyalina* {1}, *H. aureliella* {1}, *H. leucostigma* {1}, *Jackrogersella multiformis* {1}, *Lasiosphaeria hirsuta* {1}, *Leptodontidium trabinellum* {1}, *Lophocolea* sp. {1}, *Mollisia* sp. {8}, *Nemania chestersii* {1}, *Orbilia* ?*brochopaga* {1}, *O.* ?*cejpii* {1}, *O. crenatomarginata* {1}, *O. eucalypti* {1}, *O. flavovacuolata* {1}, *O. leucostigma* {3}, *O. mammillata* {1}, *O. polybrocha* {1}, *O. xanthostigma* {2/1}, *Psilocistella quercina* {2}, *Sphaeriales* {1}, *Strossmayeria basitricha* {1}, *Trichosphaeriaceae* {1}. **Desiccation tolerance**: fully viable for 12–14 days {2, H.B. 8519, 8530}, or dead after 11 days {1, H.B. 7848b}, ascospores survive for at least 1 month. **Altitude**: 14–500 m a.s.l. (temperate Europe), 1750 m (subalpine, Austria, on *Larix*), 850–1520 m (Macaronesia). **Geology**: Cambrian & Ordovician siltstone & quartzitic wacke, Silurian & Devonian sedimentary rock, Buntsandstein, Keuper (marl & sandstone), Cretaceous, Paleogene & Miocene sand- & limestone, till & tuff; granite, migmatite, gneiss; tephritic, phonolitic and basaltic flows or pyroclasts. **Phenology**: IV–X(–XII) (in Macaronesia I, III–IV, VI, IX).

Phenology of *O. dryadum* (temperate northern hemisphere)											
Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
0	0	0	3	2	4	9	6	4	7	0	2

Taxonomic remarks. *Orbilia dryadum* is characterized by cylindrical to somewhat cuneate (wedge-shaped), almost straight, small, comparatively wide ascospores with globose SBs very close to the apex, and medium to mostly strongly capitate paraphyses without exudate. The similar *O. epipora* (section *Arthrobotrys*) is separated by slightly longer and narrower spores, somewhat shorter asci, never strongly capitate paraphyses (in the living state), consistently white apothecia which often grow densely gregarious over large areas (a feature never seen in *O. dryadum*), and in distinctly smaller, especially narrower conidia with fewer septa. *O. cunninghamii* from New Zealand differs from *O. dryadum* in longer spores that tend to be slightly curved.

The tropical *O. gaillardii* resembles *O. dryadum*, but differs in shorter and wider, more ellipsoid spores, and bright (yellow-) orange apothecia. *O. eucalypti* differs in more ellipsoid and distinctly wider spores and in its dicranidion-like anamorph. *O. battenii* differs in shorter spores and branched conidia, but two samples included in *O. dryadum* (Denmark, Sjælland, Pl. 870: 6; France, Finistère, IVV: 6.XII.2013, spores *2.2–2.7 × 1–1.2 µm) have a spore size as in *O. battenii*, but are treated under *O. dryadum* because of the associated unbranched conidia. *O. acuum* (tentatively assigned to section *Arthrobotrys*) differs in longer spores with apparently tear-shaped SBs. *O. orientalis* (section *Arthrobotrys*) differs, e.g., in wider spores with very different SBs, and usually also in the presence of glassy processes, in addition to its drechslerella-like anamorph.

Variation. Apothecial colour varied among the collections from white to often light isabelline-rosaceous-lilaceous or rosaceous-carneous-cream. Apothecial size ranged between (hydrated) 0.25–0.45 and 0.5–1.5 mm diam. (in the type 0.4–1.2 mm). This variation in size was even observed within a collection (Pl. 871: 2a–d vs. 2e), though on different branches. At a single site near El Pico (Asturias) a population of light yellow-ochraceous apothecia grew on *Salix* (IVV: E.R.D. 5978) while another of white apothecia grew a year later on the same host genus (IVV: E.R.D. 6172). In their microscopy no clear differences could be found (E. Rubio pers. comm.), but because of the strong macroscopic resemblance of the white population with *O. epipora* (section *Arthrobotrys*) and the absence of clear microscopic differences to that species, we tentatively placed E.R.D. 6172 in *O. epipora*.

The asci were mainly around *30–40 µm long, but in a sample from Denmark (Pl. 870: 6) they were much longer (*41–55 µm), and a few samples had extraordinarily short asci (*24–30 µm, e. g., Pl. 870: 10). Great variation in the size of the basal and marginal excipular cells was noted among the populations, partly even at the same collection site, but this was hardly correlated with other features. Ascospore length varied between *2.4–3 (Pl. 870: 6) and *3–4 µm (Pl. 870: 3), and intermediate values were also frequent. Irrespective of spore length, spore width varied between *1–1.1 and *1.2–1.4 µm. The presence of rather long and narrow spores thereby complicated delimitation from *O. epipora*.

Collections from Tenerife (Macaronesia) are somewhat intermediate between *O. dryadum* and *O. epipora*. They show a spore width at the lower end of the range of *O. dryadum*, but fit this species better because spore length is below that of *O. epipora* and the paraphyses more capitate. For instance, in

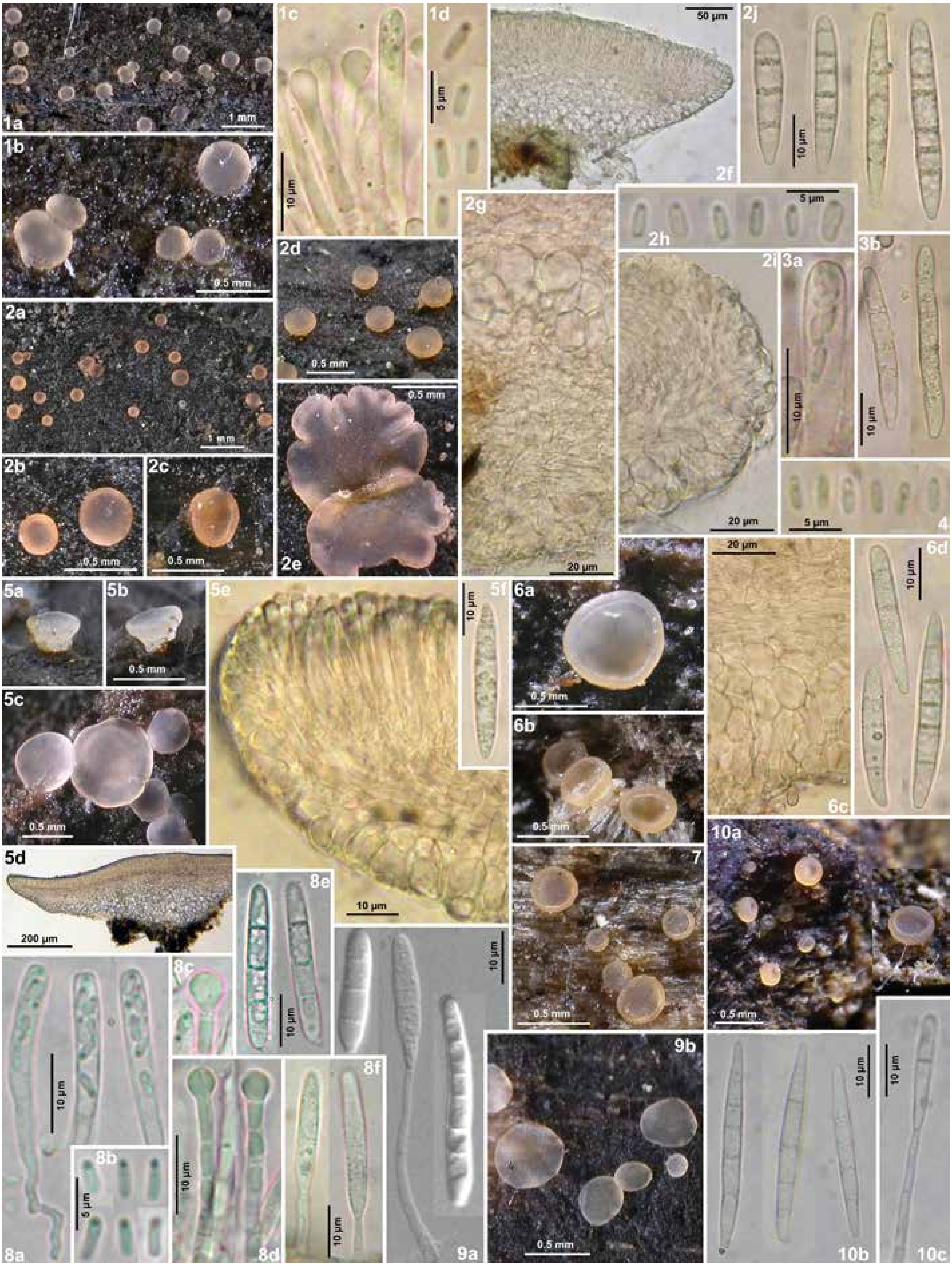


Plate 871. **1–10**: *Orbilia dryadum*. – **1a–b**, **2a–e**, **5a–c**, **6a–b**, **10a**. fresh apothecia; **7**, **9b**. rehydrated apothecia; **2f**, **5d**. apothecia in median section; **2i**, **5e**. id., ectal excipulum at margin and flanks; **2g**, **6c**. id., near base (**2g** with anchoring hyphae); **1c**, **3a**, **8a**, **c–d**. asci and paraphyses (**3a** fully turgescent); **1d**, **2h**, **4**, **8b**. ascospores; **2j**, **3b**, **6d**, **8e–f**, **10b–c**. conidia from substrate, partly on conidiophores; **5f**, **9a**. conidia & conidiophore from culture. – Living state, except for **4**, **9a** right conidium (in H_2O). – **8a–f**: phot. M. Bemmann; **9a**: from Liu (2006, fig. 26, DIC). — **1a–d**. H.B. 7848b: Germany, Tübingen, on *Fagus*; **2a–j**. H.B. 8224a (epitype): ibid., on *Fagus*; **3a–b**. H.B. 7954b: ibid., on *Fagus*; **4**. H.B. 8707: Russia, Tuva, on *Alnus*; **5a–f**. H.B. 8223: Germany, Tübingen, on *Fraxinus*; **6a–d**. H.B. 8519: Denmark, Sjælland, on *Fagus*; **7**. H.B. 8530: ibid., on *Salix*; **8a–f**. 25.IX.2010: Germany, Heidelberg, on *Fagus*; **9a–b**. H.B. 7805: China, Altay Mts., on *Betula*; **10a–b**. H.B. 9978: Germany, Rehna, on *Alnus*.

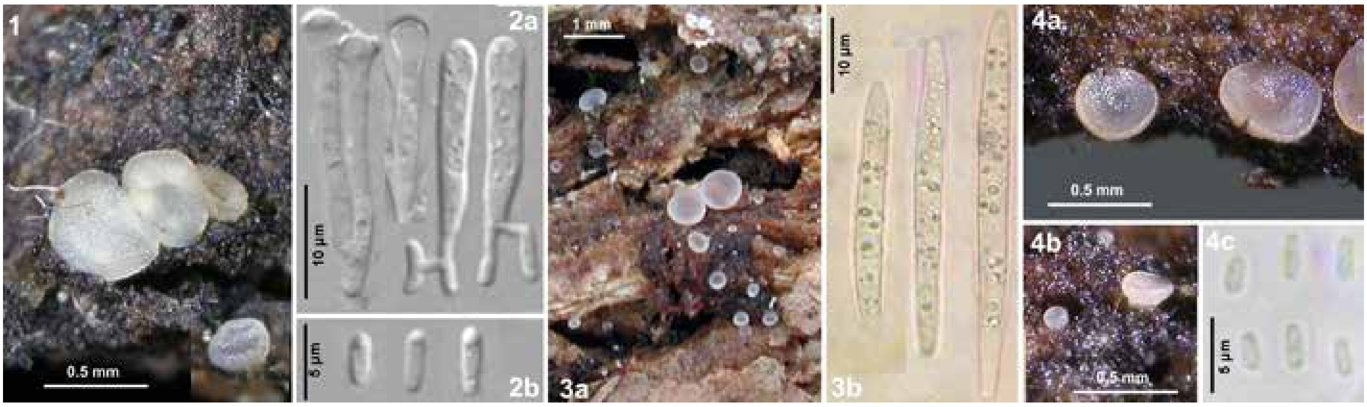


Plate 872. **1–2**: *Orbilia* cf. *dryadum*; **3–4**: *O.* aff. *dryadum*. – **1**, **3a**. fresh apothecia; **4a–b**. rehydrated apothecia; **2a**. asci and paraphyses; **2b**, **4c**. ascospores; **3b**. conidia from substrate. – Living state, except for **3b** (in KOH), **4c**, asci in **2a** (in H$_2$O). – **2a–b**: phot. Z.F. Yu (DIC), **3a**: phot. J.P. Priou. **— 1**. H.B. 8736: J.W.G. lq2-45. China, Yunnan, Yuxi, on indet angiosperm; **2a–b**. Y.Z. jg-4: China, Jiangxi, Ji'an, on indet. angiosperm; **3a–b**. H.B. 6876a: France, Bretagne, Glénac, on *Ulex*; **4a–c**: H.B. 6878: id., Talhuart, on *Ulex*.

CUP-MM-000245 (on angiosperm wood) the spores measured †2.7–3.5 × 0.8–1 µm, and in three samples on wood of *Pinus* (H.B. 6904a = A.H. 7349), *Ocotea* and *Chamaecytisus* *2.3–3.2(–3.8) × 1–1.2(–1.3) µm. In their gross morphology in the living state the three latter samples do not differ from typical European specimens. Also ascus size fits *O. dryadum* (*27–41 × 2.7–3.5 µm, Quijada et al. 2016), though ascus width is at the lower end of the range of European samples of that species, whereas asci of *O. epipora* are with *22–29(–32.5) × 2.8–3.5 µm distinctly shorter.

In some European collections (Pl. 870: 5, wood of *Larix*; 870: 7, bark of *Ulex*; IVV: 6.XII.2013, wood of *Carpinus*) the paraphyses are only slightly to medium capitate, reminiscent of *O. epipora*. Yet, the degree of apical inflation generally varies rather strongly within an apothecium. The collection on *Larix* represents the only known subalpine record referred by us to *O. dryadum*. Here some of the asci contained distinctly broader, often ellipsoid spores of *2.2–3 × 1.6–2 µm. Such anomalous ellipsoid spores inside living mature asci were exceptionally also seen in a colline specimen from Tübingen on *Fraxinus* (H.B. 8223, Pl. 870: 10).

Conspicuous globose ?SCBs in the medullary excipulum were seen in two collections (H.B. 4726a, Pl. 870: 4f; H.B. 4894a) which both originate from the same trunk of *Tilia* though gathered in different years. No other collection was noted in which such cell contents were seen.

Type studies. Velenovský's very brief description of *O. alnea* var. *dryadum* includes 1–1.5 mm large apothecia with a rose tint, and ochraceous, thick-walled, 15–17 µm large 'corpuscules'. The latter are spores of an unknown fungus (Svrček 1954: 9). On Velenovský's manuscript plate these spores are drawn ellipsoid and non-septate. In the present reexamination of the holotype they could not be found, instead dark brown setae and medium red-brown, 2-septate pyriform conidia of *Brachysporium obovatum* occur in association.

The rather rich holotype (Pl. 870: 8) fits well Velenovský's manuscript plate on which the spores are depicted cylindrical to narrowly ellipsoid, 2–3 µm long, with 2 rather large globose drops, one at each end. These drops are very probably SBs, and it seems likely that Velenovský was incorrect in placing them at both ends of the spore. Svrček (1954: 9) identified this taxon as *O. xanthostigma* s. Svrček (= *O. eucalypti* or *O. tremulae*).

A specimen from Germany (Tübingen-Pfrondorf, on *Fagus*, ex H.B. 8224a, Pls 870: 3; 871: 2) from which a sequence was gained, is designated here as **epitype** of *O. dryadum*.

Misapplication and literature reports. Kirk & Spooner (1984: 573, fig. 9A, erroneously as 'B' in legend and text) reported under the name *O.* cf. *acuum* a collection on decorticated wood from Scotland (Isle of Arran, 8.IX.1980, P. Kirk) with consistently 'cylindric-clavate' (wedge-shaped) ascospores (2.5–3 × 0.8–1 µm, from scale 2.7–3 × 1–1.2 µm). This appears to fit very well our concept of *O. dryadum*. The same is true regarding the teleomorph of Pfister's (1997: fig. 6) *Dactylella* sp. from Maine (as *O. ?alnea*), which shows predominantly slightly wedge-shaped spores according to our reexamination (Pl. 870: 9). Likewise, Bachman's (1909: 58, pl. IV figs 9–12) report of two samples under the name *O. xanthostigma* (from Ohio, on old logs, apothecia 1–3 mm, reddish-yellowish, spores 3–4 × 1.5 µm, cylindric-clavate, paraphyses capitate) probably represents *O. dryadum*, judging from the illustration.

Under the name *O. cunninghamii*, Spooner (1987: 166) redescribed a collection from Australia that was first identified as *O. epipora* by Beaton & Weste (1979). However, it resembles also *O. dryadum*, to which it perhaps better fits (for more details see p. 1393). Under the name *O. epipora* Liu (2006: 74) reported several collections from China with spores 2.5–3 × 1.2–1.3 µm. One of them (from Xinjiang, B.L. 6516, Pl. 871: 9) was found to fit well European *O. dryadum* (spores †2.5–3.2 × 1.1–1.3 µm), including its anamorph and molecular data (see below), whereas a strain from Guangxi (B.L. 6195, not illustrated in Liu l.c.) is genetically very distant and of unclear identity (Phyl. 22), and at least one of the samples from Chongqing (earlier Sichuan) belongs with its slightly curved spores and ± spathulate paraphyses more in vicinity of *O. umbilicata* (Pl. 865: 3).

Not included collections. Four samples from Bretagne on bark of *Ulex* represent the only records of *O. dryadum* on bark known to us (Pls 870: 7; 872: 3–4). The microscopic features are quite the same as in those on wood [spores *(2.5–)3–3.5(–4.2) × 1–1.2(–1.3) µm]. The paraphyses were often only medium capitate, but strongly capitate apices also partly occurred. However, differences in conidial length and sequence data of one of them were observed (see below). The two samples from subtropical Yunnan and Jiangxi (Pl. 872: 1–2) differ in extraordinarily long spores of */†3.5–4.5(–4.8) × 1–1.4 µm. For the not included Australian specimen see under Misapplication and literature reports.

Anamorph. Pfister (1997, fig. 6) reported a *Dactylella* sp. which he obtained from an ascospore isolate of '*O. ?alnea*' (D.H.P. 184, = D.H.P. 107 fide Pfister pers. comm., USA, Maine, on wood of *Alnus*) which was here reidentified as *O. dryadum* (see above). Also its subcylindrical conidia as figured by Pfister fit quite well in size, shape and septation those conidia we have found in some of our collections on the natural substrate (e. g., Pls 870: 3g; 871: 2j, 3b, 6d, 8e–f, 10b), except that Pfister's conidia are slightly wider, and conidia observed by us sometimes tend to be fusoid. From the mentioned collection from Xinjiang (B.L. 6516, on wood of *Betula*), Liu (2006) obtained a very similar anamorph in culture (as *Dactylella* cf. *coccinella*, Pl. 871: 9a), with conidia as wide as in Pfister's strain, though partly longer and with more septa.

In a subalpine collection on wood of *Larix*, conidia were observed on the natural substrate (Pl. 870: 5g) which differ from planar to montane records on angiosperm substrates, including Pfister's and Liu's strains, in being rather short and consistently fusoid in shape. Also in pure culture of a specimen collected in Tübingen (on wood of *Fraxinus*, same site as Pl. 870: 3), a few rather narrow, ± fusoid conidia with a moderate to high lipid content were formed (Pl. 871: 5f). Similar fusoid conidia with a moderate lipid content were found close to apothecia on wood of *Corylus* (IVV: J.N. 06-228, †32–34.5 × 3.4–3.9 µm, ~3-septate), and on bark of *Ulex* (Pl. 872: 3b), while in one on *Alnus* from northern Germany the fusoid and rather narrow conidia are with a low lipid content (Pl. 871: 10a–b). In the *Ulex* specimen conidial length was at the upper end of the range (*37–52 × 3.5–4 µm, 6-septate), and also its molecular data deviate (see below), therefore, we refrained from including records on bark in the description of *O. dryadum*.

The conidiophores varied in length: they were rather short on the natural substrate (10–33 µm, Pl. 871: 8f, 10c), but partly rather long in pure culture (10–105 µm, Liu 2006). Also in Pfister's (1997) culture they tend to be long.

Yang & Liu (2005) observed a dactylella-like anamorph in a strain (CBS 916.72, CCRC/BCRC 33148) that was isolated by R.G. Benedict in or before 1972. It was probably gained from ascospores and was misidentified at that time as *Orbilia coccinella*, probably by the finder. The geographical origin of this strain could not be clarified. Probably it derives from USA, since Benedict worked at that time at the University of Washington in Seattle (the same applies to a strain which was named *O. vinosa*, see under *O. sinensis*, section *Helicoon*., p. 1006).

Yang & Liu (2005) described Benedict's strain as a new anamorph-typified species which they named after the specific epithet of the teleomorph as *Dactylella coccinella* Ying Yang & Xing Z. Liu (holotype HMAS 87787, dried culture). The figured conidia are very similar to those reported by Pfister (1997) and Liu (2006), showing a (sub)cylindrical shape and a size of *22.5–32.5 × 5–6.5 µm, with (1–)3–6(–7) septa. The features of the teleomorph are unknown, however. Judging from its anamorph, Benedict's strain is certainly not conspecific with *O. coccinella* s.auct. (= *O. eucalypti* or *O. tremulae*, with a dicranidion-like anamorph), and most probably also not with the type of *O. coccinella*, a rare fungus known only from the type collection from northern Norway (see p. 1427). For its molecular data see below.

Phylogeny. Sequences of *O. dryadum* were available from five strains. Four derive from ascospore isolates: USA, Maine, wood of *Alnus* (D.H.P. 107 = 184, ITS); China, Xinjiang, on wood of *Betula* (B.L. 6516, ITS+LSU); Germany, Gießen, wood of ?*Carpinus* (F.P. 390, ITS); Germany, Mönchengladbach, wood of *Alnus* (G.M. 2014-04-23, ITS+LSU), and one from apothecia: Germany, Tübingen, wood of *Fagus* (H.B. 8224a, ITS). A further sequence was gained from an ascospore isolate from France, Morbihan, bark of *Ulex* (H.B. 6876a, SSU+ITS+LSU), here referred to as *O.* aff. *dryadum*. The S1506 intron is absent in the strains from *Fagus* and *Ulex*, but present in the German strain from *Alnus*. The strains D.H.P., F.P., and B.L. do not cover the intron region.

In our analysis of ITS (Phyl. 23) the six strains of *O. dryadum* s.l. clustered together in a strongly supported clade which nested in our combined analysis (Phyl. 22) weakly supported in the *xanthostigma-tremulae* clade. *O. dryadum* s.str. falls into two close groups which differ in the ITS by 1.4% (7 nt): thereby, the Chinese strain fully concurs with German strains on *Fagus* and ?*Carpinus*, and the German strain on *Alnus* completely matches Pfister's strain on the same host. This is very surprising, considering the high geographical distance between the strains with identical ITS data and comparatively low distance (180–340 km) among the three German strains. Despite the observed 1.4% deviation, the five strains, which all were from apothecia on decorticated wood, are considered by us to represent typical *O. dryadum*.

The collection on *Ulex* bark shows a distance of 6.5–6.7% in the ITS region to *O. dryadum* s.str., which indicates that two species are involved. In the LSU (D1–D2) *O. dryadum* varies by 1 nt (0.2%) but differs from the *Ulex* strain by 1.4–1.6%. Compared to these distances, European *O. epipora* differs from *O. dryadum* s.l. by ~23–26% in the ITS and 9–9.5% in the LSU, and from another Chinese strain under the name *O. epipora* (B.L. 6195) by 22.5% in the ITS and 5–6% in the LSU; it clustered in Phyl. 22–23 unsupported near *O. guyanensis* but in S27 weakly supported sister to *O. leucostigma*). *O. cunninghamii* differs from *O. dryadum* by 18–18.5% (17.5% from *O.* aff. *dryadum* on *Ulex* bark).

In Yang & Liu's (2005) molecular analysis of the ITS region, Benedict's strain of '*Orbilia*/*Dactylella coccinella*' (CBS 916.72) clustered together with Pfister's North American strain of *O. dryadum* (as *O. alnea*). Also in our ITS analysis (Phyl. 23) *O. dryadum* clustered with Benedict's strain, though unsupported. Yang & Liu concluded that this indicates a close relationship between *O. coccinella* and *O. alnea*, with 3 nt difference in the 5.8S rDNA. However, this gene region is very conservative. When comparing the complete ITS region, the two strains show a distance of 17%, as was also stated by Liu (2006: 75), hence their conspecificity can be excluded. Due to this distance, Liu (2006) named the anamorph of his Chinese strain B.L. 6516 *Dactylella* cf. *coccinella*. *O.* aff. *dryadum* on *Ulex* is only slightly closer to Benedict's strain, differing by 15.3%.

Ecology. *O. dryadum* is known from rotten decorticated wood of hygric branches and logs of various angiosperm trees and shrubs, exceptionally gymnosperms or resupinate basidiomycetes. The species was mainly recorded from humid, cold-temperate, rarely suprasubmediterranean or orotemperate (subalpine), subcontinental but also warm-temperate atlantic Europe. The recorded vegetation includes shady forests (*Querco-Fagetum*, *Aceri-Fraxinetum*), partly close to rivulets or forest ponds, the substrate being sometimes flooded. The observed drought tolerance in two samples from Denmark is surprising since the apothecia grew on the underside of logs lying on the moist ground.

Collections from Macaronesia include lower mesomediterranean (sub)humid laurel forest (*Lauro novocanariensis-Perseetum indicae*), and subhumid and pine forest (*Sideritido solutae-Pinetum canariensis*). Two samples from central Asia (Sayan and Altay Mountains) represent an altimontane cold-continental humid climate. Records from a tropical humid (winter-dry) region in Taiwan and an altimontane site in central Honshu in Japan, together with collections from (north) eastern North America from cold-temperate humid lowland forests suggest a worldwide distribution of *O. dryadum*.

Among the not included samples, those on hygric bark of *Ulex* are from atlantic, warm-temperate humid lowlands of northwestern France, one on hygric angiosperm bark from subtropical humid (winter-dry) montane evergreen forests in southern China, and one on hygric wood from an oceanic, warm-temperate humid eucalypt tall open forest in the southernmost part of southeastern Australia.

Map 139. Known distribution of *O. dryadum* in Europe and Tenerife (Macaronesia, cyan = *O.* aff. *dryadum* on *Ulex* bark).

Specimens included. **GREAT BRITAIN**: **Scotland**, **North Ayrshire**, Isle of Arran, 3 km NNE of Brodick, Merkland Point, near old quay, ~5 m, indet. wood, 8.IX.1980, P. Kirk (K, as *O.* cf. *acuum*, Kirk & Spooner 1984: 573). — **DENMARK**: **Sjælland**, 6.5 km S of Sorø, 4 km S of Frederiksberg, Suserup Skov, 30 m, log of *Fagus sylvatica*, on wood, 25.V.2007, H.O. Baral (H.B. 8519, T.L. 13057 [in C and S], anam. substr.). – 6 km S of Sorø, 3 km S of Frederiksberg, N of Suserup, 33 m, branch of *Salix*, on wood, 28.V.2007, J.G.B. Nielsen (H.B. 8530). – Falster, 11 km WNW of Nørre Alslev, 4 km W of Vålse, Resle Skov, 14 m, branch of *Corylus avellana*, on wood, 30.X.2006, J.G.B. Nielsen (J.N. 06-228, anam. substr.). — **CZECHIA**: **Central Bohemia**, 6.3 km ESE of Beroun, 2.8 km NW of Karlštejn, Velká hora NE of Bubovické vodopady, 380 m, log of *Tilia*, on wood, X.1926, J. Velenovský (PRM 151745, **holotype**, H.B. 7178 ø). — **GERMANY**: **Mecklenburg-Vorpommern**, 2 km NW of Rehna, Löwitzer Holz, 20 m, branch of *Alnus glutinosa*, on wood, 12.XII.2015, T. Richter (H.B. 9978, anam. substr.). – 7.5 km E of Sternberg, 2.3 km SSE of Witzin, Mildenitz-Durchbruchtal, 40 m, 14.IV.2019, T. Richter (H.B. 10197 ø) – **Nordrhein-Westfalen**, 2.5 km E of Mönchengladbach, Volksgarten, 55 m, branch of *A. glutinosa*, on wood, 23.IV.2014, H. Bender (G.M. 2014-04-23.1, anam. substr., doc. vid.; sq.: KT380097). – **Hessen**, 12 km ESE of Gießen, 4 km NNE od Lich, Kohlstrauch, 222 m, log of (?)*Carpinus betulus*, on wood, 15.VI.2017, F. Prell, vid. I. Wagner (F.P. 390 ø, doc. vid.; sq.: MK504337). – **Baden-Württemberg**, 11 km ESE of Heidelberg, 1.5 km ENE of Wiesenbach, Fuchsberg, 195 m, branch of *Fagus sylvatica*, on wood, 25.IX.2010, D. Bandini (ø, anam. substr., doc. vid.). – 5 km ENE of Tübingen, 0.9 km S of Pfrondorf, Bitzle, 350 m, branch of *F. sylvatica*, on wood, 25.VII.2004, E. Weber & H.O. Baral (ø). – 1.4 km SE of Pfrondorf, Poppelesloch, 335 m, branch of *F. sylvatica*, on wood, 30.X.2005, E. Weber (H.B. 7954b ø, anam. substr.). – E of Pfrondorf, Tiefenbach, 385 m, log of *Fraxinus excelsior*, on wood, 2.VII.2012, E. Weber (H.B. 9696). – ibid., 410 m, log of *Tilia cordata*, on wood, 4.VIII.1992, H.O. Baral & K. Siepe (H.B. 4726a). – ibid., 5.IX.1992, H.O. Baral (H.B. 4738a). – ibid., 9.VI.1993, H.O. Baral (H.B. 4894a). – 1 km ESE of Pfrondorf, Hinterpfand, 420 m, branch of *Fagus sylvatica*, on wood, 23.VII.2005, H.O. Baral & F. Baral-Weber (H.B. 7848b). – ibid., 22.X.2005, E. Weber (ø). – ibid., branch & log of *F. sylvatica*, on wood, 16.VII.2006, E. Weber & H.O. Baral (ex H.B. 8224a, M-0291769, **epitype**, anam. substr.; sq.: KT222358). – ibid., log of *Fraxinus excelsior*, on wood, 16.VII.2006, H.O. Baral (H.B. 8223, anam. cult.). – **Bayern**, **Oberbayern**, München, unlocalized, ~500 m, branch of ?*Carpinus betulus*, on wood, IX.2017, collector unknown, vid. B. Fellmann (doc. vid.). — **AUSTRIA**: **Salzburg**, 80 km SSW of Salzburg, Hohe Tauern, 16 km SW of Rauris, E of Litzlhofalm, Vorderweißtürchlwald, 1750 m, branch of (?)*Larix*, on wood, 19.VII.1996, W. Dämon (H.B. 5550a, anam. substr.). – **Steiermark**, 6 km WNW of Feldbach, ENE of Rohr a. d. Raab, 335 m, log of *Populus*, on wood, 20.VIII.2015, A. Gallé, vid. G. Friebes (G.F. 20150049, doc. vid.). — **SERBIA**: **Voivodina**, Fruška Gora, 17 km SW of Novi Sad, 6 km WSW of Beočin, Testera, 152 m, branch of *Sambucus nigra*, on wood, 2.X.2019, D. Savić (doc. vid.). — **FRANCE**: **Bretagne**, **Finistère**, 6 km ESE of Quimperlé, WSW of Rédené, Rosbigot, 40 m, branch of *Carpinus betulus*, on wood, 6.XII.2013, P.Y. Courio (P.Y.C. 13145, doc. vid.). — **SPAIN**: **Asturias**, 9.5 km SW of Cangas de Onís, 2 km SE of El Pico, NE of Casa de Fontecha, 775 m, log of *Salix ?caprea*, on wood, 30.VIII.2013, E. Rubio (E.R.D. 5978, doc. vid.). — **MACARONESIA**: **Canary Islands**, **Tenerife**, Santa Cruz de Tenerife, 4.3 km E of Taganana, 2 km SW of Chamorga, Chinobre, 895 m, branch of *Erica platycodon*, on wood, 20.I.2011, L. Quijada, E.V. Rodríguez & J. Díaz-Armas (TFC Mic. 23057, 23204, non vid.). – El Rosario, 14 km WSW of Santa Cruz de Tenerife, 3.5 km SW of La Esperanza, Pico de las Flores, 1300 m, branch of *Pinus canariensis*, on wood, 31.III.2001, E. Beltrán-Tejera, vid. R. Galán-Marquez (AH 7349, H.B. 6904a). – 2.8 km SW of La Esperanza, Montaña Grande, 1200 m, branch of *Adenocarpus foliolosus*, on wood, 3.X.2012, L. & C. Quijada (TFC Mic. 23601, doc. vid.). – ibid., 20.IX.2013, L. & C. Quijada (TFC Mic. 24302, non vid.). – La Matanza de Ajentejo, 6.5 km SW of La Esperanza, Montaña la Morra, 1520 m, branch of *Chamaecytisus proliferus*, on wood, 3.X.2012, L. & C. Quijada (TFC Mic. 23627, doc. vid.). – ibid., branch of *Adenocarpus foliolosus*, on wood, 20.VI.2014, L. & C. Quijada (TFC Mic. 21216, non vid.). – San Cristóbal de La Laguna, 8 km NNW of Santa Cruz, 1.8 km NE of Las Mercedes, Monte de las Mercedes, Cruz del Carmen, ~930 m, branch of indet. angiosperm, on wood, 7.I.1976, R.P. Korf, W.C. Denison & L.M. Kohn (CUP-MM-000245, as *O. ?epipora*, doc. vid.). – ibid., Las Hiedras, ?800 m, on indet. wood, 7.I.1976, R.P. Korf et al., vid. L. Quijada (CUP-MM-000273, 000299, as *O. ?epipora*, doc. vid.) – 9 km NNE of Santa Cruz, 2 km SSW of Taganana, Roque se los Pasos, ?900 m, *Myrica faya*, 10.I.1976, R.P. Korf et al., vid. L. Quijada (CUP-MM-000434, as *O. ?epipora*, doc. vid.). – ibid., 1.4 km NE of Las Mercedes, Hoya del Llano los Viejos (Hija Cambada), 850 m, branch of *Ocotea foetens*, on wood, 18.IV.2013, L. & C. Quijada (TFC Mic. 24109, doc. vid.). — **RUSSIA (East)**: **Tuva**, **Todzha**, Sayan Mts., 140 km NE of Kyzyl, ~1 km S/W of Toora-Khem, Toora-Khem river flowing in Bolshoy Yenisey, 900 m, branch of *Alnus*, on wood, 28.VII.1972, A. Raitviir & B. Kullman (TAAM 62404, H.B. 8707 ø, anam. substr.). — **CHINA**: **Xinjiang**, **Altay**, Altay Mts., 112 km NNE of Burqin, 6 km NE of Hemukanasi, 1175 m, branch of *Betula*, on wood, 5.VIII.2003, B. Liu (B.L. 6516, H.B. 7805, HMAS 139689, anam. cult.; sq.: DQ656618, DQ656681). — **Taiwan**, **Kaohsiung**, 46 km NNE of Pingdong, ~1 km N of Jiaxian, 300 m, branch of indet. angiosperm, on wood, 6.VII.2002, R. Kirschner & C.J. Chen (R.K. 1343 ø, H.B. 7257). — **JAPAN**: **Honshu**, **Nagano**, Chiisagata-gun, 11 km SSE of Suzuka, 3 km NNE of Sugadaira, Hinotaki waterfall, 1380 m, branch of indet. angiosperm, on wood, 24.VIII.1997, W. Gams (H.B. 5904). – ibid., log of indet. angiosperm, on wood, 24.VIII.1997, W. Gams (H.B. 5905a). — **USA**: **Maine**, 25 km E of Brunswick, 6 km NNW of Boothbay, Oven's Mouth Preserve, 10 m, log of *Alnus*, on wood, 30.VII./1.VIII.1994, D.H. Pfister (D.H.P. 107/184 [0.104] [soc. *O.* cf. *brochopaga*], FH 00458098, H.B. 7435a ø, as *O. ?alnea*, anam. cult.; sq.: U72601). – **Massachusetts**, Middlesex, 2.8 km NNE of Concord, Punkatasset Hill, Hutchins Pond, 41 m, log of *Acer*, on wood, 20.VI.1995, D.H. Pfister (in D.H.P. 133 [0.117] [*O. polybrocha*], FH 00458180, H.B. 5296b). – ibid., log of indet. angiosperm, on wood, 12.VII.1995, D.H. Pfister & S.H. Goldbarg (D.H.P. O.129, FH, H.B. 5305a). – ibid., log of *Acer*, on wood, 12.VII.1995, D.H. Pfister & S.H. Goldbarg (FH, D.H.P. 0.130, H.B. 5304a). – **Ohio**, 5 miles around Oxford, logs of indet. trees, 6.VI.1908, B. Fink, 4.VII.1908, F.M. Bachman (Bachman 1908: 58, doc. vid.).

Not included. ***O*. cf. *dryadum***: **CHINA**: **Yunnan**, **Yuxi**, Yimen, 54 km NW of Yuxi, 3 km NW of Fangtunxiang, Dalongkou, Longquan, 1750 m, branch of indet. angiosperm, on bark, VI.2007, S.F. Li & J.W. Guo (J.W.G. lq2-45, YMFT, H.B. 8736). – **Jiangxi**, **Ji'an**, ~13 km SW of Ji'an, Jinggangshan, 848 m, indet. angiosperm, on bark, 1.X.2005, Y. Zhang (Y.Z. jg-4, YMFT, doc. vid.).

O*. aff. *dryadum: **AUSTRALIA**: **Victoria**, South Eastern Highlands, 7 km ENE of Glenaire, 15 km SE of Lavers Hill, Hordern Vale road, ~50 m, indet. wood, 17.XI.1962, G. Beaton (Beaton & Weste 1979 as *O. epipora*, Spooner 1987: 166, as *O. cunninghamii*, doc. vid.).

***O*. aff. *dryadum* on *Ulex* bark** (all on branches of *Ulex europaeus*): **FRANCE**: **Bretagne**, **Finistère**, 5 km W of Dinéault, Ménez-Hom, 320 m, 8.III.2002, J.P. Priou (J.P.P. 22051, H.B. 7108). – **Morbihan**, 2.5 km SSE of La Gacilly, 2 km NNE of Glénac, Pré Naval, 8 m, 6.III.2001, J.P. Priou (J.P.P. 21051 ø, H.B. 6876a, BBA 69348, anam. cult., anam. substr.; sq.: KT215281). – 1.4 km WNW of La Gacilly, SW of Talhuart, Buhan, 50 m, 1.III.2001, J.P. Priou (J.P.P. 21040-41, H.B. 6878). – 6 km W of La Gacilly, 3 km N of Les Fougerêts, Couesme, 80 m, 23.XI.2003, J.P. Priou (J.P.P. 23106, doc. vid.).

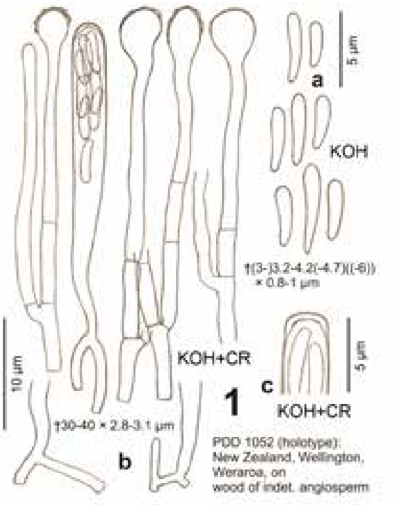
***Orbilia* sp.**: **CHINA**: **Guangxi**, **Xishan**, Guiping, 180 m, indet. wood, 2.VIII.2002, B. Liu (B.L. 6195, HMAS 139540, as *O. epipora*, non vid.; sq.: DQ656619).

Orbilia cunninghamii Syd., Ann. Mycol. 22: 308 (1924) — Pls 873–874, Map 140

Etymology: after the collector G.H. Cunningham, a New Zealand mycologist.
Typification: New Zealand, Wellington, Weraroa, branch of indet. angiosperm, 16.IX.1919, G.H. Cunningham (PDD 1052, holotype).
Misinterpretation of *O. cunninghamii*: Spooner (1987: 166 fig. 20), ?= *O. dryadum*; Liu et al. (2002, cited in Zhang & Mo 2006: 20), = *Orbilia quercus*.
Misapplication: Dennis (1956: 296, as *O. epipora*), ?= *O. cunninghamii*.

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.5–)0.8–1.3(–1.6) mm diam., 0.15–0.25 mm high (receptacle 0.2 → 0.1 mm), white when fresh (Sydow: rehydrated yellow-ochraceous to egg-yellow), medium translucent, round, to slightly undulating, (sub) gregarious; disc young medium concave to flat, with a slight to distinct central depression, margin somewhat thickened, 10–20 µm protruding, smooth; with an indistinct stipe 0.04–0.8 × 0.25–0.5 mm, superficial; dry almost orange (Sydow). **Asci** †30–40 × 2.8–3.1 µm {2}, 8-spored, spores 3–4-seriate above, lower spores inverted {1}, pars sporifera †14–15 µm; **apex** (†) medium to strongly truncate (not indented, laterally not inflated); **base** with short to long, thin, flexuous stalk, L-, Y-, h- or H-shaped. **Ascospores** †(3–)3.3–4.2(–4.7)((–6)) × 0.8–1((–1.1)) µm {3}, narrowly cylindric-clavate, apex rounded, slightly to distinctly tapered towards base (cuneate), straight to often slightly curved; **SBs** unknown, **LBs** not seen. **Paraphyses** apically (medium) strongly (very strongly) capitate-clavate, terminal cells †15–20 × 2.2–3.5(–4) µm {T}, lower cells *4–7 × 1.2–1.5(–1.7) µm {T}; never branched at upper septum. **Medullary excipulum** 70–90 µm thick, of dense, horizontal textura intricata with many slightly inflated cells, sharply delimited from ectal excipulum, towards margin with or without a 5–10 µm thick layer of loose t. porrecta. **Ectal excipulum** of (†) thin-walled, slightly gelatinized in basal cortex and especially near medullary excipulum, vertically oriented t. globulosa-angularis-prismatica from base to margin, 60–80(–90) µm thick near base, cells †(8–)10–21(–26) × 8–17 µm {2}, 25–30 µm thick near margin, oriented at a 40–60° angle to the surface, marginal cortical cells †5–9 × 4–5.5 µm {T}; **glassy processes** absent {T} or as ~0.5–1 µm thick caps {1}. **Anchoring hyphae** abundant near base, †1.5–3 µm wide, walls 0.15–0.2 µm thick {2}, forming a 10–60 µm thick, dense t. intricata. **SCBs** and **VBs** no data available. **Exudate** over paraphyses absent or 0.2–0.4 µm thick, rough, firmly attached, over margin and flanks ± absent. — **ANAMORPH**: dicranidion- & dactylella-like (from ascospore isolate {1}, P.R. Johnston pers. comm.). **Conidiophores** unbranched. **Conidia** of 2 types: (1) unbranched, cylindric-clavate, 2–4-septate, straight; (2) branched, with parallel, 1–2-septate arms and a basal nodulous scar [measurements not given].

Habitat: lying on ground, branches and logs of *Beilschmiedia tawa* {2}, *Weinmannia racemosa* {1}, indet. angiosperms {3}, indet. woody plant {13}, on medium rotten wood {15} and bark {2}, pores of ?*Phellinus* {1}. **Associated**: *Hyalorbilia* ?*ulicicola* {1}, *Rhizodiscina lignyota* {1}. **Desiccation tolerance**: unknown (probably intolerant). **Altitude**: 47–790 m a.s.l. **Phenology**: IX–VI (southern hemisphere).



Pl. **873**. **1**: *Orbilia cunninghamii* (holotype). – **a**. ascospores; **b**. ascus and paraphyses, ascus bases; **c**. ascus apex

Taxonomic remarks. *Orbilia cunninghamii* was so far studied only in the dead state. It resembles *O. epipora* (section *Arthrobotrys*) and *O. dryadum* in ascospore morphology, but differs in longer asci and basally consistently gradually tapered spores. Typical *O. epipora* further deviates from *O. cunninghamii* by paraphyses with only slightly inflated apex and rather wide lower part, and *O. dryadum* by shorter and wider spores. The genetically related *O. tremulae* differs from *O. cunninghamii* in much wider, more ellipsoid spores. Within series *Neodactylella* of section *Arthrobotrys*, *O.* cf. *atlantis* (on *Phragmites* in Australia) and *O. acuum* resemble *O. cunninghamii* but have larger spores with a more tapered (obtuse) apex.

Type studies. *O. cunninghamii* was described by Sydow (1924) for a specimen collected on 16.IX.1919 by G.H. Cunningham on unidentified [angiosperm] wood near Wellington (New Zealand). Sydow characterized it by asci 32–38 × 2.5–3 µm, paraphyses hardly 1 µm wide, apically capitate, 3 µm wide, spores bacilliform, straight, 3–3.5 × 0.75 µm, minutely biguttulate. The present reexamination of the holotype (Pl. 873, Pl. 874: 1) concurs quite well except for slightly larger spores. Apothecial colour was yellow-ochraceous to egg-yellow in the type when rehydrated by Sydow a few years after it was collected, and when dry it was almost orange (Sydow 1924). In the present reexamination this colour was not clearly perceptible anymore.

During 1989–2006 P.R. Johnston (pers. comm.) collected in New Zealand six specimens, which he cultured and identified as *O. cunninghamii*. In the fresh state the apothecia were (greyish-) white. two of them (Pl. 874: 2–3) were here reexamined and found to match the holotype very well (asci †30–39 × 2.8–3 µm, spores †3.3–4 × 0.8–1.1 µm). Their apothecia displayed a light chlorinaceous-ochraceous colour when rehydrated 9 and 22 years after they have been collected.

A North American collection mentioned under *O. epipora* (Pl. 901: 7) fits the holotype of *O. cunninghamii* except for shorter asci and ± homopolar spores. When studied almost 70 years after it was collected, it displayed pale yellowish-ochraceous (dry deep ochre) apothecia unlike *O. epipora* (the previous identification as *O. xanthostigma* suggests that they were yellow when fresh). Also samples reported as O. *epipora*

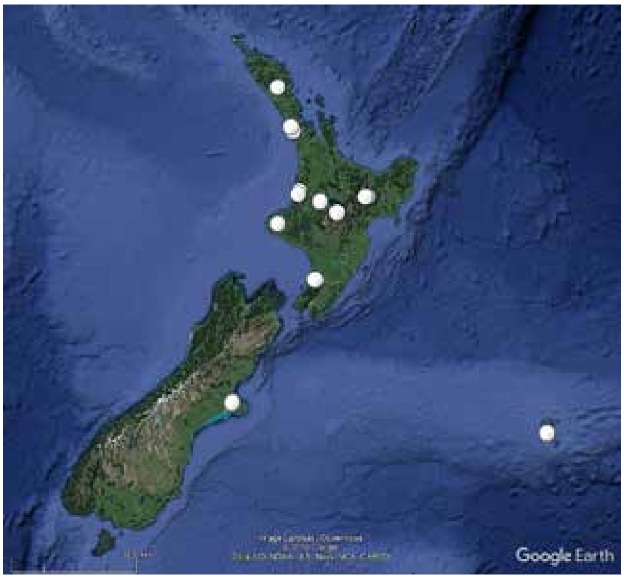
Pl. 874. 1–3: *Orbilia cunninghamii*. – **1a–c**, **2b–c**, **3a–b**. rehydrated apothecia; **2a**. dry apothecia; **3c**. median section of apothecium; **1d**. id., basal ectal excipulum and anchoring hyphae; **1e**. id., lower flanks; **3d**. id., margin region; **1f**. ascospores. – Dead state (**1d–f** in KOH, **3c–d** in H_2O). — **1**. PDD 1052 (holotype): New Zealand, Wellington, Weraroa, on indet. angiosperm; **2**. PDD 93943: Bay of Plenty, Ruatahuna, on indet. angiosperm; **3a–d**: PDD 60056: Auckland, Cornwallis, on ?*Phellinus*.

by Dennis (1956: 296) from Panama and Cuba might belong to *O. cunninghamii* because of their partly basally tapered spores of '3–4.5 × 0.5 µm'.

Because he was unable to locate holotype material, Spooner (1987: 166, fig. 20) described a specimen collected by G. Beaton in Australia (Victoria, near Laver's Hill, Hordern Vale road, on dead wood, 17.XI.1962, G. Beaton 43, as *O. epipora*, Beaton & Weste 1979). Spooner referred this sample to *O. cunninghamii* and thought that it 'agrees in all respects with the original description'. His description includes pale amber to orange-yellow apothecia, asci 32–40 × ~3 µm, and spores 3–4(–4.5) × 0.8(–1) µm, slightly curved, gradually tapered towards the rounded base (wedge-shaped). The given spore size would fit the here redescribed lectotype of *O. epipora*, but the spores are too wide when evaluating their size from Spooner's drawing (3.3–4.3 × 1–1.2 µm), and also the yellow colour and the longer asci exclude *O. epipora* but are in the range of *O. dryadum*, to which Beaton's specimen possibly belongs.

Spooner believed that *O. epipora* deviated from *O. cunninghamii*, besides apothecial colour and smaller asci, also by smaller apothecia (< 0.5 mm diam.), slightly longer and narrower spores (3.5–5 × 0.6–0.8 µm), and paraphyses usually immersed in a 'thin encrusting epithecium'. This conclusion was based on a specimen of *O. epipora* in Lundell & Nannfeldt, F. exs. Suecici 1780, with extraordinarily long spores, whereas the present restudy of the types revealed that *O. epipora* actually has spores of equal or even very slightly shorter length compared to *O. cunninghamii*. A sparse granular exudate ('epithecium') was only occasionally seen in the present study of both *O. dryadum* and *O. epipora*.

Anamorph. In one isolate (PDD 60056) P.R. Johnston (pers. comm.) observed an anamorph which he briefly illustrated with one dicranidion- and three dactylella-like conidia, the former resembling *Dicranidion fragile*. *Monacrosporium parvicolle* was



Map 140. Known distribution of *O. cunninghamii* in New Zealand.

reported by Liu et al. (2002) as anamorph of *O. cunninghamii*, but this refers to the type collection of *O. quercus*/*Dactylellina quercus* (B. Liu pers. comm.).

Phylogeny. ITS sequences were taken by P.R. Johnston (pers. comm.) from all of his six ascospore isolates of *O. cunninghamii*. Five of them cover the 3'-end of SSU, which always lacks the S1506 intron. In the ITS region they show a high molecular concordance, varying by only 0.2–0.4% (0–2 nt), which confirms that they belong to a single species (4 are shown in Phyl. 23). The closest species appear to be *O. tremulae*, *O. cejpii*, and the morphologically similar *O. dryadum* s.l., showing a rather high distance (15.5–16%, ~15–20%, and 17.5–18.5%, respectively), whereas *O. epipora* is distinctly more distant (23–23.5%). In our analysis of the ITS region, *O. cunninghamii* clustered with *O. dryadum* and *O. tremulae* in an unsupported clade, the latter two forming in Phyl. 24 the weakly supported *xanthostigma-tremulae* clade.

Ecology. *O. cunninghamii* is so far only known with certainty from New Zealand. It was collected on ± rotten, hygric wood or rarely bark of branches of different angiosperms, mostly unidentified (in the holotype the wood shows rather broad radial rays). Four collections were on identified hosts: *Beilschmiedia* (*Lauraceae*) and *Weinmannia* (*Cuneaceae*). The substrate appears to have always been lying on the moist ground. The species was especially collected in various regions of the North Island, from which all sequenced and studied strains derive, but also from the South Island and Chatham Island. The vegetation comprises cold-temperate to subtropical humid, oceanic (marine), indigenous forests and scrubs of *Nothofagus* or mainly of *Podocarpus*, sometimes mixed with *Agathis*, at colline to montane altitudes.

Specimens included. **NEW ZEALAND**: **North Island**, Northland, 23 km SW of Whangarei, Tangihua Forest, 260 m, indet. wood, 23.V.1992, P.R. Johnston (PDD 60164, non vid.). – Auckland, 21 km SW of Auckland, 2.5 km N of Cornwallis, Waitakere Ranges, Mill Bay, 47 m, on pores of ?*Phellinus*, 17.III.1992, P.R. Johnston (P.R.J. D795, PDD 60056, H.B. 9885b ø, anam. cult., sq.: MG593182). – ibid., 8 km N of Cornwallis, Rangemore Track, 185 m, indet. wood, 7.XII.1990, P.R. Johnston (PDD 58173, non vid.). – ibid., 4.5 km SSW of Waitakere, Cascades Track, 55 m, indet. wood, 29.IV.2004, P.R. Johnston (PDD 81792, non vid.). – Waikato, 38 km SSW of Taupo, 16.5 km ESE of Turangi, Kaimanawa, Kiko Road, 745 m, on wood of *Weinmannia racemosa*, 1.II.1993, P.R. Johnston & I. Gamundí (P.R.J. D865, PDD 61844, non vid.; sq.: MG593184). – 27 km NNE of Mokau, Basil Hewett, 160 m, branch of *Beilschmiedia tawa*, 20.II.2007, B.C. Paulus & A.J. O'Donnell (PDD 93879, non vid.). – ibid., branch of *B. tawa*, on bark, 25.III.2006 (PDD 93880, non vid.). – 15 km NE of Awakino, Rauroa Bush, 145 m, indet. wood, 29.X.2007, P.R. Johnston & A.J. O'Donnell (PDD 95165, non vid.). – Manawatu-Wanganui, 54 km WSW of Taupo, Pureora Forest, Totara Walk, 681 m, indet. wood, 29.I.1993, P.R. Johnston & I. Gamundí (PDD 61853, non vid.). – Taranaki, 29 km SSE of New Plymouth, 12 km WNW of Stratford, Egmont, Potaema Swamp, 685 m, indet. tree, on bark, 12.XII.1989, P.R. Johnston (P.R.J. D465, PDD 58166; sq.: MG593186; non vid.). – Bay of Plenty, 28 km SE of Murupara, NW of Ruatahuna, School Road, 452 m, branch of indet. angiosperm, on wood, 7.II.2005, P.R. Johnston (P.R.J. D1923, PDD 93943, H.B. 9936 ø; sq.: MG593183). – ibid., indet. angiosperm, on wood, 2.XII.2006, & B.C. Paulus (P.R.J. D2013, PDD 91760, non vid.; sq.: MG593187; D2014, PDD 91761, non vid.; sq.: MG593185). – ibid., 416 m, indet. wood, 2.XII.2006, B.C. Paulus & P.R. Johnston (PDD 92175, non vid.). – 7.7 km W of Ruatahuna, Te Urewera, Mangapae, 720 m, indet. wood, 11.X.2004, P.R. Johnston & B.C. Paulus (PDD 83508, non vid.). – Gisborne, Te Urewera, 7 km W of Ruatahua, Tarapounamu, 790 m, indet. branch, 9.VI.2004, B.C. Paulus & P.R. Johnston (PDD 81420, non vid.). – Wellington, ~80 km NNE of Wellington, [Levin], Weraroa, ~200 m, branch of indet. angiosperm, on wood, [16.]IX.1919, G.H. Cunningham (PDD 1052, **holotype**; H.B. 9890 ø). – **South Island**, Mid Canterbury, 7 km S of Christchurch, Victoria Park, 365 m, indet. wood, 18.IV.2003, J.A. Cooper (PDD 80047, non vid.). – 11 km S of Christchurch, Kennedy's Bush, 400 m, indet. wood, 30.IX.2001, J.A. Cooper (PDD 80173, non vid.). – Chatham Islands, 15 km SSW of Waitangi, Taiko Camp, 160 m, indet. wood, 2.IV.1993, P.R. Johnston & E.H.C. McKenzie (PDD 62657, non vid.). – 18 km SSW of Waitangi, Tuku, 120 m, indet. wood, 19.XI.1992, P.R. Johnston (PDD 62625, non vid.).

Orbilia leucostigma (Fr.) Fr., Summa Veg. Scand.: 357 (1849) — Pls 875, 877, 879, Map 141

≡ *Peziza leucostigma* Fr., Observ. Mycol.: 165 (1815); – Fr., Syst. Mycol.: 146 (1822), nom. sanct.

≡ *Mollisia leucostigma* (Fr.) Gillet, Champ. Fr., Discomyc.: 126 (1882) [non *Mollisia leucostigma* (Fuckel) Rehm, ≡ *Hyaloscypha leucostigma* (Fuckel) Baral, see p. 1676]

≡ *Cistella leucostigma* (Fr.) Quél., Enchir. Fung.: 320 (1886)

≡ *Calloria leucostigma* (Fr.) W. Phillips, Man. Brit. Discomyc.: 330 (1887)

= *Orbilia vitrea* Velen., Opera Bot. Čech. 4: 102 (1947)

?= *Orbilia faginea* Velen., Opera Bot. Čech. 4: 102 (1947)

Etymology: *leucostigma*: apothecia looking like white spots; *vitrea*: referring to the glassy-translucent apothecia; *faginea*: found on *Fagus*.

Typification: Sweden, unlocalized, on blackened, very rotten wood of *Fagus sylvatica* in autumn and spring, ?E.M. Fries (type of ***Peziza leucostigma***, unlocated); Germany, Tübingen-Pfrondorf, log of *F. sylvatica*, 28.VI.2015, H.O. Baral (ex H.B. 9958a, M-0276499, neotype, designated here, MBT382109; sq.: KY419187). — Czechia, Jevany, log of *F. sylvatica*, 7.VII.1941, L. Hostáňyová (PRM 151693, holotype of ***Orbilia faginea***). — Czechia, Hrusice, branch of *Juniperus communis*, 7.VI.1942, J. Velenovský (PRM 152439, holotype of ***O. vitrea***).

Orbilia xanthostigma (Fr.) Fr., Summa Veg. Scand.: 357 (1849) — Pls 875–879, Map 141

≡ *Peziza xanthostigma* Fr., Observ. Mycol.: 166 (1815); – Fr., Syst. Mycol. 2(1): 146 (1822), nom. sanct.

≡ *Peziza leucostigma* subsp. *xanthostigma* (Fr.) P. Karst., Not. Sällsk. Fauna Fl. Fenn. Förh. 10: 174 (1869)

≡ *Orbilia leucostigma* subsp. *xanthostigma* (Fr.) P. Karst., Not. Sällsk. Fauna Fl. Fenn. Förh. 11: 248 (1870)

≡ *Orbilia leucostigma* var. *xanthostigma* (Fr.) P. Karst., Bidr. Känn. Finl. Nat. Folk 19: 99 (1871)

≡ *Mollisia xanthostigma* (Fr.) Gillet, Champ. Fr., Discomyc.: 125 (1882)

≡ *Calloria xanthostigma* (Fr.) W. Phillips, Man. Brit. Discomyc.: 329 (1887)

= *Peziza aurea* Pers., Observ. Mycol. I: 41 (1796), unavailable for use (ICN Art. F.3.2, F.3.4) [non *Peziza aurea* (Pers.) Fr., Syst. Mycol. 2(1): 156 (1822), sanctioned name ICN Art. F.3.1, ≡ *Helotium aureum* Pers., Syn. Fung. p. 678 (1801), ≡ *Eustilbum aureum* (Pers.) S.E. Carpenter & Seifert, anamorph of '*Bisporella*' *resinicola* (Baranyay & Funk) S.E. Carpenter & Seifert (fide Seifert & Carpenter 1987); nec *Peziza aurea* (Bolton) Sowerby, Col. fig. Engl. Fung. Mushr. 2: 64, pl. 150 (1799), nom. illegit., ICN Art. 53.1, ≡ *Helvella aurea* Bolton, Hist. Fung. Halifax III: no. 118, pl. 98 fig. 2 (1789), ?= *Hymenoscyphus serotinus* (Pers.) W. Phillips (synonymised by Nees von Esenbeck 1820: CXLVIII); nec *Peziza aurea* s. Sowerby 2: 64, pl. 150 (1799), 3: 132, pl. 320 (1803), = *Calycina citrina* (Hedw.) Gray (see Saccardo 1889: 224, on p. 225 as *Helotium lenticulare* (Bull.) Fr., erroneously as 'Sow. t. 156')].

≡ *Helotium persoonii* Mont., in Gay, Historia Fisica y Politica Chile, Botanica 7: 410 (1853) [non *Helotium aureum* Pers., ≡ *Calycina persoonii* Kuntze, ≡ *Eustilbum aureum*]

?= *Peziza rufula* Schwein., Trans. Am. Philos. Soc. 4: 177 (1832)

≡ *Pezizella rufula* (Schwein.) Sacc., Syll. Fung. 8: 283 (1889)

≡ *Orbilia rubella* var. *rufula* (Schwein.) Sacc., Syll Fung. 8: 621 (1889)

≡ *Hymenoscyphus rufulus* (Schwein.) Kuntze, Revis. Gen. Pl. 3: 486 (1898)

= *Peziza delicatula* P. Karst., Not. Sällsk. Fauna Fl. Fenn. Förh. 10: 173 (1869)

≡ *Orbilia delicatula* (P. Karst.) P. Karst., Not. Sällsk. Fauna Fl. Fenn. Förh. 11: 248 (1870)

≡ *Orbilia coccinella* subsp. *delicatula* (P. Karst.) P. Karst.; Bidr. Känn. Finl. Nat. Folk 19: 98 (1871)

≡ *Orbilia coccinella* var. *delicatula* (P. Karst.) Boud., Hist. Class. Discom. Eur. (Paris): 102 (1907)

= *Orbilia coccinella* f. *undulata* Feltgen, Rec. Mém. Trav. Soc. Bot. G.-D. Luxemb. 15: 35 (1901)

= *Orbilia botulispora* Höhn., Sitzungsber. Kaiserl. Akad. Wiss. Wien, Math. Naturwiss. Kl., Abt. I, 116: 131 (1907)

= *Orbilia millispora* Velen., Monogr. Discom. Bohem.: 92, pl. 11 fig. 11 (1934)

= *Orbilia alnea* var. *vesiculosa* Velen., Monogr. Discom. Bohem.: 93, pl. 11 fig. 9 (1934)

= *Orbilia microspora* Velen., Monogr. Discom. Bohem.: 95, pl. 11 figs 16, 43 (1934)

= *Orbilia paradoxa* Velen., Monogr. Discom. Bohem.: 102, pl. 11 fig. 4 (1934), nom. illegit., ICN Art. 53.1 [non *O. paradoxa* Ade]

= *Orbilia hypothallosa* Velen., Opera Bot. Čech. 4: 101 (1947) (non *O. arundinacea* var. *hypothallosa* Velen. 1934)

Etymology: *leucostigma*, *xanthostigma*, *aurea*: referring to the white or (golden) yellow apothecial colour; *rufula*: named after the reddish apothecia; *persoonii*: in honour of C.H. Persoon; *delicatula*: apparently after the comparatively thin, submembranaceous apothecia; *undulata*: according to the undulating margin; *botulispora*: after the sausage-shaped spores; *millispora*: after the small spores; *paradoxa*: possibly because of the extraordinary horseshoe-shaped spores; *hypothallosa*: apothecia seated on prominent hyphae (which in fact belong to a basidiomycete); *vesiculosa*: after the ovoid conidia on the excipulum (belonging to a basidiomycete).

Typification: Unlocalized, ?*Ulmus*, on bark, undated, C.H. Persoon (herb. Persoon, L 910.261-262, lectotype of ***Peziza aurea***, designated here, MBT382112). — Poland, unlocalized, on *Abies alba*, undated, ?E.M. Fries (type of ***P. xanthostigma***, unlocated); Germany, Tübingen-Pfrondorf, log of *Fagus sylvatica*, 30.VII.2000, H.O. Baral (ex H.B. 6749, M-0177061, neotype, designated here, MBT382111; ex-neotype culture: CBS 116210; sq.: CBS ined.). — USA, Pennsylvania, Bethlehem, log of ?*Quercus*, undated (< 1880), M.J. Berkeley (K(M) 48767, holotype of ***P. rufula***). — Finland, Mustiala, wood of *Betula*, 1.X.1868, P.A. Karsten (Karsten 2351, H, holotype of ***P. delicatula***). — Luxembourg, Bridel, Roudenhaff, wood of *Fagus sylvatica*, 18.VIII.1899, J. Feltgen (LUX 42518, holotype of ***Orbilia coccinella* f. *undulata***). — Austria, Pressbaum, wood of *Fagus sylvatica*, 3.VIII.1906, F. v. Höhnel (FH 00304813, holotype of ***O. botulispora***). — Czechia, Rokycany, ~450 m, log of *Abies alba*, VIII.1924, K. Cejp (PRM 149285, holotype of ***O. millispora***). — Mnichovice, branch of *Alnus*, 30.VII.1926, J. Velenovský (PRM 152398, holotype of ***O. alnea* var. *vesiculosa***). — Ukraine, Podkarpacka Ruś, log of *Corylus avellana*, VIII.1929, A. Pilát (PRM 151768, lectotype of ***O. microspora***, designated here, MBT202385). — Czechia, Hrusice, branch of *Abies*, VII.1933, J. Velenovský (PRM 152388, lectotype of ***O. paradoxa***, designated by Svrček 1954: 18). — Czechia, Mnichovice, log of *Robinia pseudoacacia*, 26.XI.1940, J. Velenovský (PRM 152421, holotype of ***O. hypothallosa***).

Misapplied names: Feltgen (1899: 53, 1901: 35, 1903: 41, p.p.maj.), as *O. coccinella*; (1899: 54, p.p.), as *O. luteorubella*.

Misinterpretation of *O. leucostigma*: Ginko (1986), ?= *O. cejpii*; Nylander (1869) and Karsten (1869 p.p., as *P. leucostigma*), = *O. eucalypti*; Ekanayaka et al. (2018), = *Orbilia* sp. (mentioned under *O.* aff. *renispora*).

Misinterpretation of *O. xanthostigma* (selected cases): Bachman (1909: 58), ?= *O. dryadum*; Berthet (1964a: 126, 1964b: 23), = *O. tremulae*; Feltgen (1901: 35 p.p., on *Sorbus*), = *Hyalorbilia inflatula*; Fries and Bommer & Rousseau (in sched., as *P. xanthostigma*), = *O. auricolor*; Persoon (1796, 1801, 1822, p.p., as *P. aurea*), = *O. comma*; Svrček (1954: 23), = *O. eucalypti*; Thind & Sharma (1980), ?= *O.* aff. *luteorubella*; Zhuang (1997: 9), = *O.* cf. *umbilicata*; Guo et al. (2014b), = *Orbilia* sp. (?section *Arthrobotrys*).

Anamorph synonyms:

?= *Dicranidion gracile* Matsush., Microfungi of the Solomon Islands and Papua-New Guinea (Osaka): 24, fig. 47 (1971)

?= *Dicranidion tenue* Matsush., Matsush. Mycol. Mem. **7**: 49, fig. 725 (1993)

?= *Dicranidion dactylopagum* (Drechsler) Peek & Solheim, in Peek, University of Wyoming Publ. Sci., Bot. 19: 92 (1955)

≡ *Pedilospora dactylopaga* Drechsler, Journ. Washington Acad. Sci. 24(9): 400 (1934)

Etymology: *gracile* and *tenue*: according to the slender conidia, *dactylopaga*: after the finger-shaped conidia and the ability to trap rhizopods.

Typification: Solomon Islands, Honiara, wood of indet. angiosperm, 5.I.1970, T. Matsushima (MFC 2894, holotype of ***Dicranidion gracile***). — Peru, Rio Negro, palm petioles, XI.1990, T. Matsushima (MFC OP-460, holotype of ***D. tenue***). — USA, Washington D.C., decaying rootlets, undated, C. Drechsler (holotype of ***Pedilospora dactylopaga***, illustration in Drechsler 1934: fig. 1).

Combined description of *O. leucostigma* and *O. xanthostigma* (including extra-European specimens): — **TELEOMORPH**: **Apothecia** fresh (0.2–)0.35–2(–4.5) mm diam., 0.14–0.35 mm high (receptacle 0.11–0.2 mm), mostly pale to bright golden yellow-orange, yellow-ochraceous, or honey-yellow(-amber) {> 150}, more rarely (glassy) watery-white, pale chlorinaceous to yellowish-cream, or even pale isabelline to rosaceous-lilaceous-carneous {> 50}, centre often translucent (pale to light olivaceous), round to ± lobate when large, then sometimes with translucent concentric rings, often densely gregarious; disc slightly concave to flat, finally sometimes convex, margin thin or ± thick, 0–10 µm protruding, smooth; sessile or with an obconical base, also with a short and broad stipe of 0.02–0.2 × 0.15–0.8 mm, superficial; dry light to deep golden- or honey-yellow (with dark grey-brown centre), rose-orange-red or cream-ochraceous-isabellinea, margin not or often somewhat inrolled, colour fading in the herbarium. **Asci** *(25–)30–45(–53) × 3.2–4.3 {18} → 40–55 × (3.8–)4–4.8(–5.3) µm {3}, 0–5 → 3–10 µm projecting beyond asci, †(24–)27–41(–45) {36} or 45–52 {1} × (2.5–)2.7–3.7(–4.3) µm {37}, 8-spored, spores uniseriate, some of the 8 spores inverted (sometimes the basal ones, often oriented in various directions), pars sporifera *12–16(–19) → (8–)9–12(–15) µm long; **apex** (†) strongly truncate (sometimes slightly to distinctly indented, laterally indistinctly inflated); **base** with short to long, thin, flexuous stalk, h- to often H-shaped, rarely T- or L-shaped. **Ascospores** *((2–))(2.2–)2.4–3(–3.3) × (1–)1.1–1.4(–1.6) µm in situ (excluding warts) {~60} (~3.5–4.2 µm actual length), †((2–))(2.2–)2.3–2.8(–3) × ((0.8–))(0.9–)1–1.3(–1.5) µm {~37}, (reniform to) cashew-shaped, curved by ~(90–)120–180° (± semicircular), ends rounded to obtuse, basal end rarely slightly more tapered, dorsal side (and also laterally) with a row of ± distinct warts {> 200}, very rarely ± smooth {4}; **SBs** *(0.4–)0.5–0.7(–0.9) µm diam. {11}, globose, rarely broadly tear-shaped, attachment invisible, rarely a short fine filum seen (total length 0.8–1 µm). **Paraphyses** apically slightly or mostly medium to very strongly capitate (rarely clavate or moniliform), terminal cells *15–25(–28) {5} × (2–)2.5–4.4(–4.7) µm {7}, †14–23(–25) × (1.3–)2.2–4(–4.5) µm {10}, below inflated apex *(1–)1.2–1.5 µm wide (†0.8–1.4 µm), lower cells *4.5–10 × 1.7–2.3(–2.8) µm {5}, †4–10 × (1–)1.5–2.1 µm {4}; unbranched at upper septum; contents hyaline or in lower part and near apex light to bright yellow. **Medullary excipulum** 35–80(–150) µm thick, of a dense, somewhat horizontally oriented, hyaline or pale yellow textura globulosa-angularis-prismatica with some prismatic-hyphoid cells, sometimes with a lower part of loose t. intricata, sharply delimited from ectal excipulum only towards margin by a 10–20 µm thick layer of t. porrecta. **Ectal excipulum** hyaline to light yellow, of (†) thin-walled to slightly gelatinized, vertically oriented t. globulosa-angularis(-prismatica) from base to margin, 40–120(–150) µm thick at base, cells */(/†) (9–)12–45(–75) × (8–)10–30(–40) µm {10}; 15–60 µm thick at lower flanks, 10–15 µm at mid flanks and margin, oriented at a (50–)70–90° angle, marginal cortical cells *6–11(–15) × 4–7(–9) µm {4}, **glassy processes** absent. **Anchoring hyphae** sparse to abundant, */†2–3.5 µm wide, walls 0.2(–0.3) µm thick {4}, sometimes forming a compact, hyaline, small-celled, up to 50–60 µm thick (rarely 100–200 µm) t. intricata-porrecta or t. angularis at base. **SCBs** in paraphyses apparently sometimes present, globose, up to 1 µm diam.; in ectal

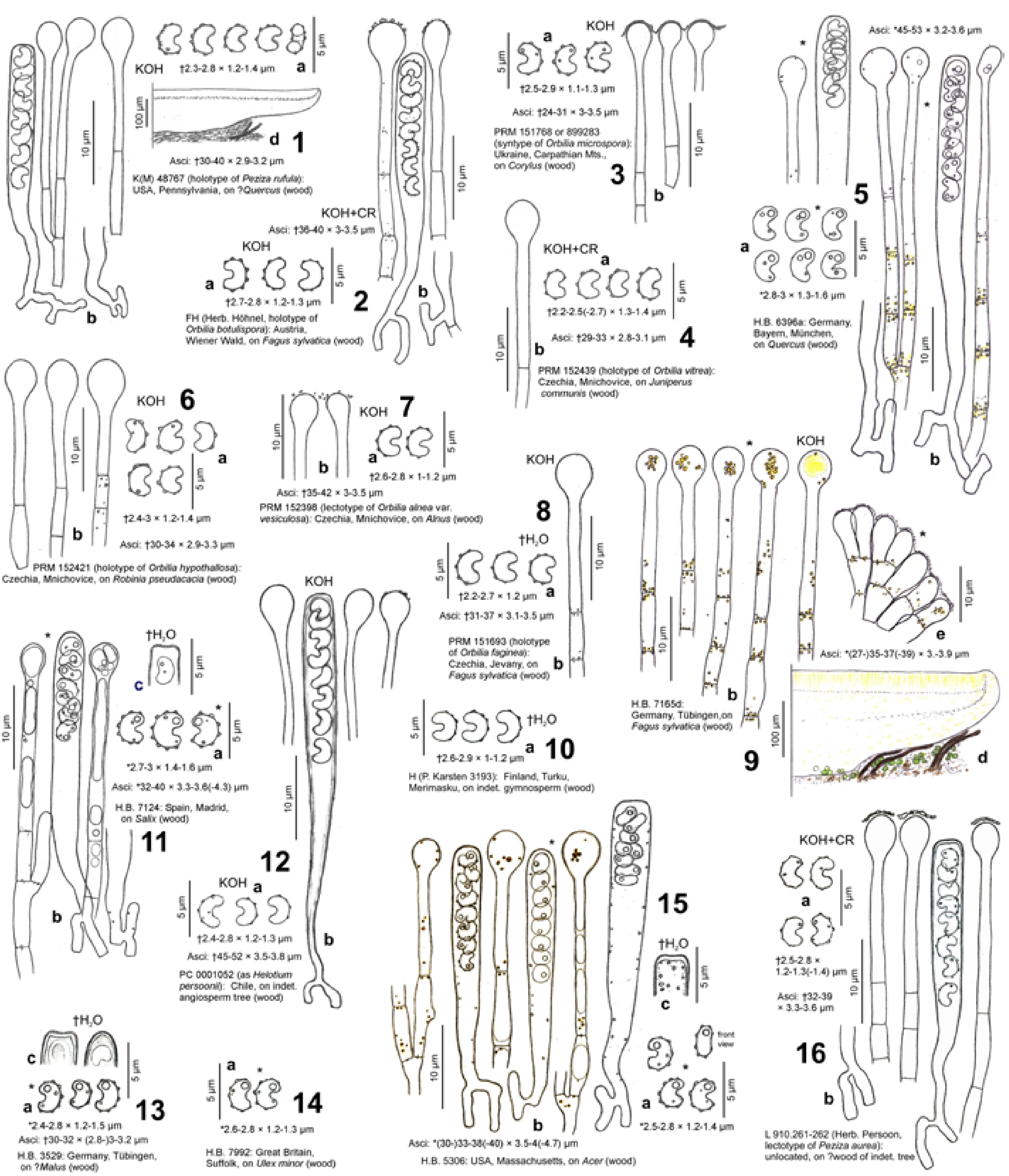


Plate 875. **1–16**: The *xanthostigma-leucostigma* complex. **1**, **12**, **15**: *Orbilia* cf. *xanthostigma*; **2–3**, **5–7**, **9**, **11**, **13–14**, **16**: *O. xanthostigma*; **4**, **10**: *O. leucostigma*; **8**. *O. leucostigma* + *O. xanthostigma*. – **a**. ascospores; **b**. asci and paraphyses (**5** left and **15** right: fully turgescent); **c**. ascus apices; **d**. apothecia in median section; **e**. id., marginal ectal excipulum.

and medullary excipulum usually absent, sometimes sparsely present, globose (or ring-shaped), ± refractive, 1–2 µm or up to 6.5 µm diam.; **VBs** in young paraphyses multiguttulate, medium refractive, later elongate or angular, low-refractive, hyaline or (in yellow apothecia) pale golden to yellow-chlorinaceous, also marginal cells often with pale yellow vacuolar sap; at later stages the pigment concentrates in bright golden yellow(-orange), refractive, groups of small droplets that tremble within the large vacuoles in cells of paraphyses, ectal excipulum, and inflated cells of medullary excipulum; **LBs** especially in lower cells of paraphyses and in upper part of medullary excipulum, near septa, small, refractive, in yellow apothecia pale to bright golden-yellow(-orange) (carotenoids); staining pale to light (dirty) blue-green in IKI or MLZ. **Exudate** over paraphyses, margin and flanks absent or sometimes present as sparse, 0.1–0.6 µm thick granules or clods, also ± continuous. **— ANAMORPH**: dicranidion-like (from ascospore isolate {5} and natural substrate {12}). **Conidiophores** on natural

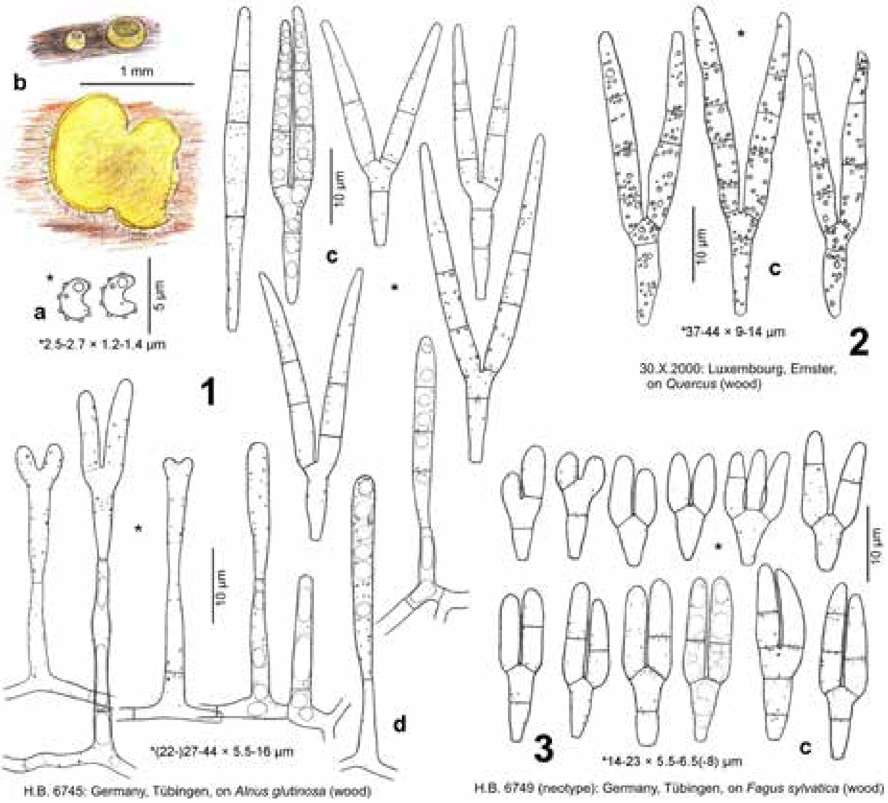


Plate 876. **1**, **3**: *Orbilia xanthostigma*; **2**. *O.* ?*xanthostigma*. – **a**. ascospores; **b**. fresh apothecia, margin of large apothecium fringed by conidiophores; **c**. detached conidia (**1–2** from substrate, **3** from culture); **d**. conidiophores with young conidia.

substrate */†8–40 × 1.7–2.8 µm {3}, straight, slightly attenuated above, 0–3-septate, unbranched or 1–2× branched, conidia terminally formed. **Conidiogenous cells** *10–20 × 2–2.5 µm. **Conidia** from pure culture (Pl. 876: 3) shaped like a tuning fork, total size *14–23 × 5.5–6.5(–8) µm (Pfister 1997, fig. 7: 19–30 × 4–12 µm; Liu 2006: ~21–25 × 6–8 µm, Pl. 878: 5), stipe *5.5–9 × 3–3.5 µm {1}, 0–1-septate, arms 5–21 × 2.6–3.5 µm {1}, (0–)1–2(–3)-septate, very rarely with 3 arms (2 conidia seen) {1}; conidia from substrate (Pls 876: 1–2; 878: 1d) predominantly Y-shaped, more rarely almost like a tuning fork, rarely 3-, exceptionally 4-armed (twice dichotomously branched), total size *(20–)23–36(–44) × (5.5–)7–17 µm, stipe *7–12 × 2–3 µm, (0–)1(–2)-septate, arms *(10–)15–28(–32) × 2.4–3.5 µm, 2–5-septate {7}; unbranched conidia on natural substrate sparse, *19–46 × 2.5–3 µm, straight, 2–5-septate {1}.

Habitat: lying on moist or sometimes wet ground, also in 0.3–0.5 or rarely 1–2 m above the ground (especially when on water-soaked, deeply rotten wood), on lower, lateral or upper side, decorticated, rarely corticated, (1–)3–35 cm thick branches or often logs, trunks and stumps (often on cut area), also roots, rarely cones, of *Abies* sp. {1}, *A. alba* {4}, *A. sibirica* {1}, *Acer* sp. {3/1}, *A. platanoides* {1}, *A. pseudoplatanus* {2}, *Alnus* sp. {15}, *A. alnobetula* {2}, *A. cordata* {1}, *A. glutinosa* {7/1}, *A. incana* {5}, *Bambusa* sp. {1}, *Betula* sp. {20}, *B. pendula* {5}, *B. pubescens* {5}, ?*Carpinus* sp. {3}, *C. betulus* {8/7}, *Castanea sativa* {1}, *C. avellana* {6}, *Erica arborea* {1}, *Eucalyptus globulus* {1}, ?*Fagus* sp. {2}, *F. sylvatica* {71}, *Fraxinus excelsior* {4/2}, *Juniperus communis* {1}, *Kalopanax* sp. {1}, ?*Laurus* sp. {1}, *L. novocanariensis* {1}, *Leptospermum scoparium* {1}, *Malus domestica* {1/1}, *Myrica faya* {1}, *Nothofagus* sp. {2/1}, *N. cunninghamii* {1}, *N. fusca* {1}, *Ocotea foetens* {3}, ?*Picea* sp. {1}, *P. abies* {13}, *Pinus* sp. {13/2}, *P. nigra* {2}, *P. strobus* {1}, *P. sylvestris* {8}, *Platanus* sp. {1}, ?*Podocarpaceae* {2}, *Populus* sp. {3/3}, *P.* (?)*nigra* {1}, *P. tremula* {2}, *Prunus padus* {2}, *Quercus* sp. {40/3}, *Q. alba* {1}, *Q. cerris* {1}, *Q. rotundifolia* {1}, *Q. pyrenaica* {1}, *Q. robur* {4}, *Robinia pseudoacacia* {1}, *Salix* sp. {10/1}, *S. alba* {1}, *S. caprea* {1}, *S. cinerea* {1}, *S. fragilis* {1}, *Sorbus aria* {2}, ?*S. aucuparia* {1}, *Tilia* sp. {3/1}, *Ulex minor* {2}, *Ulmus* sp. {2/1}, *U. glabra* {1}, *Weinmannia racemosa* {1}, indet. angiosperm trees {33/6}, indet. gymnosperms {18}, indet. woody plants {32}, on wood {387}, rarely bark (bast, exceptionally periderm) {23}, outer 0.2–3 mm or very deeply (1–10 cm) (slightly to) medium or mostly strongly decayed (both brown and white rot), partly eroded, sometimes in old beetle galleries; exceptionally on fruitbodies of *Fuscoporia* ?*ferrea* {1}, indet. *Corticiaceae* {8} (partly overgrown by them), stromata of ?*Diatrype* {1}, *Hypoxylon macrocarpum* {1}; completely without algae or often covered by a dense layer of green algae (algal cells sometimes even on hymenium) or with *Gloeocapsa*. **Associated**: *Anteaglonium abbreviatum* {1}, *Arachnopeziza aurata* {3}, *Ascocoryne cylichnium* {1}, *A. inflata* {4}, *A. lilacina* {5/3}, *A. sarcoides* {1}, *A. solitaria* {1}, *Bispora betulina* {1}, *Bisporella subpallida* {1}, *Botryobasidium* sp. {1}, *B. aureum* {2}, *B. candicans* {1}, *B. conspersum* {1}, *Brachysporium bloxamii* {1}, *B. nigrum* {4}, *B. obovatum* {1/1}, *Cacumisporium capitulatum* {3/1}, *Calocera cornea* {2}, *Calycina citrina* {1}, *Capronia pilosella* {3}, ?*Chaetosphaerella* sp. {1}, *Chaetosphaeria* sp. {1}, *C. myriocarpa* {4/1}, *Chlorociboria aeruginascens* {1}, *Claussenomyces* sp. {3}, *C. atrovirens* {5}, *C. prasinulus* {1}, *Coenogonium pineti* {1}, *Dematioscypha delicata* {7}, *D. olivacea* {4}, *Diatrype flavovirens* {1}, *Durella connivens* {1}, *Endoxyla cirrhosa* {2}, *Euepixylon udum* {1}, *Graphium calicioides* {1}, *Hyalorbilia inflatula* {1}, *H. japonica* {1}, *H. polypori* {3}, *H. subfusispora* {1}, *H. tortuosa* {2}, *H. ulicicola* {1}, *Hyaloscypha* sp. {1}, *H. albohyalina* {1}, *H. aureliella* {5}, *H. fuckelii* {1}, *H. leucostigma* {1/1}, *H. minuta* {1}, *Hyphoderma setigerum* {1}, *Hyphodiscus hymeniophilus* {1}, *Hypoxylon* sp. {2}, *Kirschsteiniothelia aethiops* {3}, *Lachnum brevipilosum* {1}, *Lasiosphaeria* sp. {2/2}, *L. hirsuta* {1}, *Lentomitella cirrhosa* {2}, *Leptodontidium subtrabinellum* {1}, *L. trabinellum* {3/1}, *Lophocolea* sp. {2}, *Mollisia* sp. {14}, *M. elegantior* {1}, *M.* ?*oblonga* {10/3}, *Ophiostoma* ?*piceae* {1}, *Orbilia bembicodes* {1}, *O. cejpii* {1}, *O. dryadum* {4/1}, *O. eucalypti* {1}, *O. flavovacuolata* {1}, *O. luteorubella* {1}, *O. mammillata* {1}, *O. orientalis* {1}, *O. polybrocha* {2}, *O. rubrovacuolata* {1}, *O. vinosa* {2}, *Pellediscus pallidus* {1}, *Phleogena faginea* {1}, *Placynthiella icmalea* {1}, *Psilocistella quercina* {4}, *Rhizodiscina lignyota* {5}, *Schizopora paradoxa* {1}, *Stereum hirsutum* {1}, *Strossmayeria basitricha* {1}, *Taeniolella alta* {1}, *T. scripta* {1}, *Trichopeziza* sp. {1}, *Trichosphaeriaceae* {1}, *Tubeufia cerea* {1}, '*Tympanis*' aff. *xylophila* {1}. **Desiccation tolerance**: mature asci and conidia survived for at least 12 h dry on the slide, rarely some or many mature asci up to 1–2 weeks (e.g., Taiwan, M.W. 030628), but usually asci did not survive drying; some inflated cells of medullary excipulum and all ascospores still viable after 12 days (leu & xan); conidia survived for min. 10 days (xan). **Altitude**: 1–1500 m a.s.l. (temperate to orotemperate Europe), 5–1600 m (southern Europe), 1–180 m (western Russia), 5–1800 m (Caucasus), 250–1120 m (Ural and eastern Russia), 400–1200 m (northeastern China), 2950–3100 m (Tibet), 180–1750 m (southern China), 2–720 m (New Zealand), 520–1200 m (Macaronesia), 1–530 m (northeastern USA), 15–450 m (Middle America). **Geology**: Cambrian, Silurian, Devonian & Carboniferous sandstone, quartzite, shale & greywacke, Permian (Rotliegend), Buntsandstein, Muschelkalk, Keuper, Jurassic & Cretaceous marl, sand- & limestone, dolomite, Tertiary molasse and flysch, Quaternary loess, sand, marl, till, peat; granite, diorite, migmatite, syenite, biotite-amphibolite, tephrite, phonolite, basalt, mica schist, gneiss. **Phenology**: throughout the year.

Phenology of *O. leucostigma* within Europe											
Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	0	2	8	7	9	12	5	8	8	2	1

Phenology of *O. xanthostigma* within Europe											
Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
10	6	5	8	15	25	29	35	21	25	18	9

Phenology of *O. xanthostigma* within Macaronesia											
Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
7	5	3	15	7	2	–	7	2	11	2	2

Taxonomic remarks. Species of the *xanthostigma-leucostigma* complex are readily recognized under the microscope (oil immersion) by small, cashew-shaped, semicircular ascospores of about 2.5–3 µm length (in situ), with distinct warts on the rounded dorsal side (see also Fig. 55) and a single globose SB at one of the two ends. However, this species complex varies in apothecial colour between whitish to pale chlorinaceous or pale rosaceous-lilaceous and pale to bright yellow(-orange). Strong molecular differences among populations with such spores resulted in a number of well-defined clades which tend to include only one of the two main colour variants. The '*xanthostigma-leucostigma* complex' is applied in a morphological sense here, comprising species with curved and warted ascospores related to *O. xanthostigma* s.l. and *O. leucostigma* s.l. Included in this complex is the very similar tropical *O. aureocrenulata*, which can macroscopically be recognized by a notched margin and a distinct stipe. The North American *O. xanthoflexa* which genetically falls in the *leucostigma-xanthostigma* clade, and *O. renispora* which appears to be related to it but also to *O. tremulae*, are excluded from the *xanthostigma-leucostigma* complex because of larger, often less curved ascospores which are consistently completely smooth.

Based on very strong molecular differences among European samples, which correlate with apothecial colour, we are forced to distinguish two here neotypified taxa: *O. leucostigma* s.str. with colourless or pale rosaceous-lilaceous apothecia, and *O. xanthostigma* s.str. with pale to bright yellow(-orange) apothecia. A further, so far unnamed and apparently rare European variant is genetically close to *O. xanthostigma* but differs in growing on xeric branches. Molecular data from Tenerife (Canary Islands) recently gained by L. Quijada indicate that *O. xanthostigma* s.str. occurs also in the Macaronesian archipelago (Baral et al. in prep.). On other continents, however, some further cryptic species with mainly yellow pigmented apothecia exist. Therefore, and because we did not recognize any micromorphological differences between specimens from Europe, North America, Asia, and New Zealand, we refrained from presenting separate descriptions for these cryptic taxa at the present stage (see also Baral et al. in prep.).

To recognize population identity within Europe proved difficult in various cases of freshly photographed samples which showed intermediate, pale yellow to almost white apothecial colours (e.g., Pl. 877: 4–5; IVV: H.B. 9451). Since our experience was that both pale and bright yellow apothecia belong genetically to *O. xanthostigma*, only those populations were identified as *O. leucostigma* which lack any yellow tints. Together with the frequent occurrence of mixed populations of both colour variants, identification based on colour alone was often problematic.

In addition to this, the bright yellow pigment fades away in the herbarium with the decades by getting more or less cream-ochraceous, while colourless apothecia appear to attain a similar colour. Thus, striking colour differences in the fresh state eventually become obscure in the preserved specimens, while notes on the colour of fresh samples are often lacking. As a consequence, older specimens cannot be identified in such a case, and mixed populations with originally very different colours (Pl. 877: 7a–b) later caused problems in recognizing the individual populations, for instance in the type of *O. faginea* (see also Baral et al. in prep.). Identification was possible in those old specimens for which a single apothecial colour was noted by the collector or could be assumed based on the applied name (e.g., yellow to orange in *xanthostigma* or *coccinella*). In order to provide an idea of the possible identity of each sample, abbreviations are used in the below list of specimens examined which are, however, to be used with caution.

Taxa related to the *xanthostigma-leucostigma* complex but with completely smooth spores are, *O. xanthoflexa*, *O. renispora* s.l., *O. fabacearum*, *O. subfabacearum*, and *O. coccinella*. Their spores are partly larger and more variable in shape, with a tendency of some spores to be less curved. Additionally, in *O. fabacearum* the SBs are inserted at the dorsal side of the spores, and the paraphyses are apically only slightly inflated. *O. subfabacearum* differs in sometimes having glassy caps on the marginal excipular cells and in a distinct exudate over the paraphyses, also in a tendency of the spores to be curved by over 180°. Also *O. coccinella* has small glassy processes at the margin but deviates from all mentioned species in 16-spored asci.

Variation. Size and also shape of the spores in the *xanthostigma-leucostigma* complex was quite constant in the many collections examined, irrespective of apothecial colour. Spore length was always within the limits of *(2.2–)2.4–3(–3.3) × 1–1.6 µm (in situ). The spores were found to shrink only very slightly in the dead state to a size of †2.2–3 × 0.9–1.5 µm. As an exception from this, Quijada et al. (2016) observed in collections from Macaronesia slightly shorter spores of *(1.9–)2.2–2.5(–2.7) × 1–1.4 µm (†2.1–2.3 × 1.1–1.2 µm) (measurements from four collections, L. Quijada pers. comm.). Also in one of the studied collections from New Zealand (PDD 59160) the spores measured only †2.2–2.5 × 0.8–1 µm.

The warts on the spores were consistently present in the numerous European, African, Asian, Australasian, and American specimens, with very few exceptions: smooth or almost smooth spores were observed in the small-spored collection from New Zealand (PDD 59160) and in three collections from Bayern with a normal spore size (München-Allach, Pl. 875: 5; Salzburg-Sam, 9.VIII.1990, 20.VII.1991), but at the Salzburg site also records with slightly (10.IV.1991) or distinctly (24.VIII. & 24.X.1990) warted spores occurred. A few unpreserved collections from Germany and Austria studied between 1975–77 were recorded as smooth-spored, but here the warts were probably overlooked. The same applies to some further records documented by others.

The shape of the paraphysis apex did not markedly differ among the specimens, whereas ascus length strongly varied between the extremes of †24–31 and †35–42 µm (Pl. 875: 3, 7) or even †38–45 µm (5). The remarkably long asci of the latter sample measured in the living state *45–53 × 3.2–3.6 µm, or *50–55 × 4–4.4 µm when fully turgescent; also the terminal cells of paraphyses were here extraordinarily long (*18–28 µm). In spite of this and the almost smooth spores we have included this specimen in the description. Even longer asci of †45–52 µm were found in a specimen from Chile (Pl. 875: 3, 7, 12) which is, therefore, included only with hesitation. Rather strong variation was noted in size and thickness of the apothecia and also in thickness of the basal tissue formed by the anchoring hyphae.

Variation in colour is most remarkable, but is not correlated with micromorphological features. The frequent *O. xanthostigma* with pale to mostly bright yellow-ochraceous to golden yellow-orange apothecia, illustrated, e. g., in Breitenbach & Kränzlin (1981, fig. 253), can be recognized within Europe even in the field with rather high certitude. When pale chlorinaceous, *O. leucostigma* may easily be confused with *Hyalorbilia inflatula*, and when pale rose-lilaceous it strongly resembles *O. sarraziniana* or *O. rosea*. Completely hyaline (whitish) populations of *O. leucostigma* do not markedly differ macroscopically from species such as *O. epipora* or whitish populations of *O. auricolor*. *O. leucostigma* is distinctly less frequent in Europe than *O. xanthostigma*. About 250 European collections with yellow apothecia are recorded in the present study, but only ca. 75 with whitish ones.

Boudier (1904–10: 266, pl. 460) described the apothecia of *O. xanthostigma* as bright orange-reddish, but his illustration shows the typical yellow(-orange) colour. Liu (2006) described the apothecia of his *O. delicatula* from China as 'dark orange or orange-grey, the colour lighter after rehydration', so that all of his many specimens listed appear to have had a more or less orange or perhaps yellow colour when fresh. Among them are also those two for which sequences were available.

In at least 25 collections listed below, whitish and pale to bright yellow apothecia occurred in close association, either in separate populations on the same piece of substrate or more or less densely aggregated or even intermingled. Although *O. xanthostigma* predominantly forms its apothecia on the upper and lateral sides of the branches and logs and *O. leucostigma* preferably on the shadowed underside, colourless and bright yellow apothecia grew sometimes together on the exposed upper side (Pl. 877: 7a–b), being sharply separated by their colour. This was also the case in two of the samples with rDNA data (H.B. 6810c, G.M. 2015-08-15.4a/b). The exposed growth of colourless apothecia allows to conclude that the absence of the yellow pigment is not a result of low intensity of illumination but has a genetical basis.

The yellow pigment occurs in the paraphyses, subhymenium, medullary and ectal excipulum (Pl. 877: 12b). It originates from two apparently very different chemical compounds, one being lipid-soluble, the other water-soluble. The predominant part of the pigment locates as carotenoids in small LBs which occur especially near the septa, e. g., in the lower part of the paraphyses (Pl. 875: 5b, 9b, 15b). These yellowish LBs are KOH-resistant including their pigmentation which stains blue-green with iodine. The water-soluble pigment occurs more in the centre of the cells, e. g., in the inflated paraphysis apices and in the excipular cells, often as a pale yellow vacuolar sap. This vacuolar pigment may also precipitate during maturation to form bright yellow, more or less strongly trembling groups of small granules located in the vacuoles (Pls 875: 9b; 877: 7f; 878: 1c). In fully developed apothecia these granules are especially found in cells of the medullary and ectal excipulum at the flanks, but also in the paraphysis apices. The granules instantly disappear in KOH whereas their pigment is stable and again forms a homogeneous yellowish sap inside the dead cells in that medium.

Literature reports on the *xanthostigma-leucostigma* complex. *O. leucostigma* with whitish apothecia and *O. xanthostigma* with yellow-orange apothecia represent one of the most often reported species of *Orbiliomycetes* in the literature. Judging from the reported microscopic features, many of these records clearly refer to one of these two species, for which the name *O. delicatula* has been adopted by Spooner (1987). Records under the name *O. xanthostigma* in this sense are those of Boudier (1904–10), Bayliss Elliott (1920), Moser (1963), Dennis (1978), Ellis & Ellis (1985), Breitenbach & Kränzlin (1981: 212), Huhtinen (1985b: 496), Schmid-Heckel (1985: 62), Baral & Krieglsteiner (1985: 28), and Grauwinkel (1987: 128). However, a couple of other reports under the name *O. xanthostigma* clearly do not represent *O. xanthostigma* as neotypified in the present study (see below).

Mainly because of the absence of the yellow pigment, the more rare whitish populations have been separated as *O. leucostigma*, e.g., by Dennis (1978) and Ellis & Ellis (1985) at the species level. Other authors like Karsten (1869: 174, 1870, 1871: 99), Rehm (1891: 455), Massee (1895: 148), and Grelet (1948a: 54) recognized the yellow taxon only at different infrageneric levels, and Seaver (1951: 154) took it even as a synonym of *O. leucostigma*. All of these latter authors report the spores as ellipsoid, which leaves the question open whether they overlooked the curvature of the spores or described a truly ellipsoid-spored species such as *O. eucalypti*. Also Feltgen (1899: 53) overlooked spore curvature when stating that *O. leucostigma* and its var. *xanthostigma* differed from *O. eucalypti* (as *O. coccinella*) mainly in colour.

During the present study, reexamination of various herbarium specimens revealed that *O. leucostigma* and *O. xanthostigma* in the here neotypified sense have been deposited under the epithets *leucostigma* (Petrak, Killermann, Bommer & Rousseau) and *xanthostigma* (W. Phillips 130, J. B. Ellis Reliqu. Farlow. 912, H. Schmid 2141, F. Kränzlin NMLU 2507-75, F. Doveri 193) but also *coccinella* (F. Höhnel A 4945, H. Rehm 71b, A. Allescher, J. Poelt, 6 specimens of J. Feltgen) and other names. Feltgen's material may serve as an example of the high confusion concerning these taxa: he subsumed under the epithet *coccinella* frequently members of the *xanthostigma-leucostigma* complex but also *O. eucalypti*, and under the epithets *leucostigma*/*xanthostigma* taxa here referred to *O. crenatomarginata*, the *xanthostigma-leucostigma* complex, and *Hyalorbilia inflatula*.

Although spore shape and ornamentation in the *xanthostigma-leucostigma* complex are quite easily seen under oil immersion at 1000×, these characters are frequently overlooked even in recent times. Boudier (1904–10: pl. 460), Bayliss Elliott (1920), and Velenovský (1934: pl. 11 fig. 4, as *O. paradoxa*) correctly illustrated deeply reniform or cashew-shaped spores. Also Höhnel (1907a) and Svrček (1954: 7) appropriately described the shape of the spores of *O. botulispora* as 'allantoid, nearly semicircular'. Bayliss Elliott drew attention to the fact that the strongly curved spores mislead to describe them as ellipsoid when seen in dorsal view and as two circles when seen in ventral view. Nevertheless, all these authors overlooked the warts on the spores.

Others, like Grelet (1948a: 54), Dennis (1978: 187, pl. XXV A), Chacón & Guzmán (1984), Ellis & Ellis (1985) and Korf (1992), reported the spores as only slightly curved or slightly

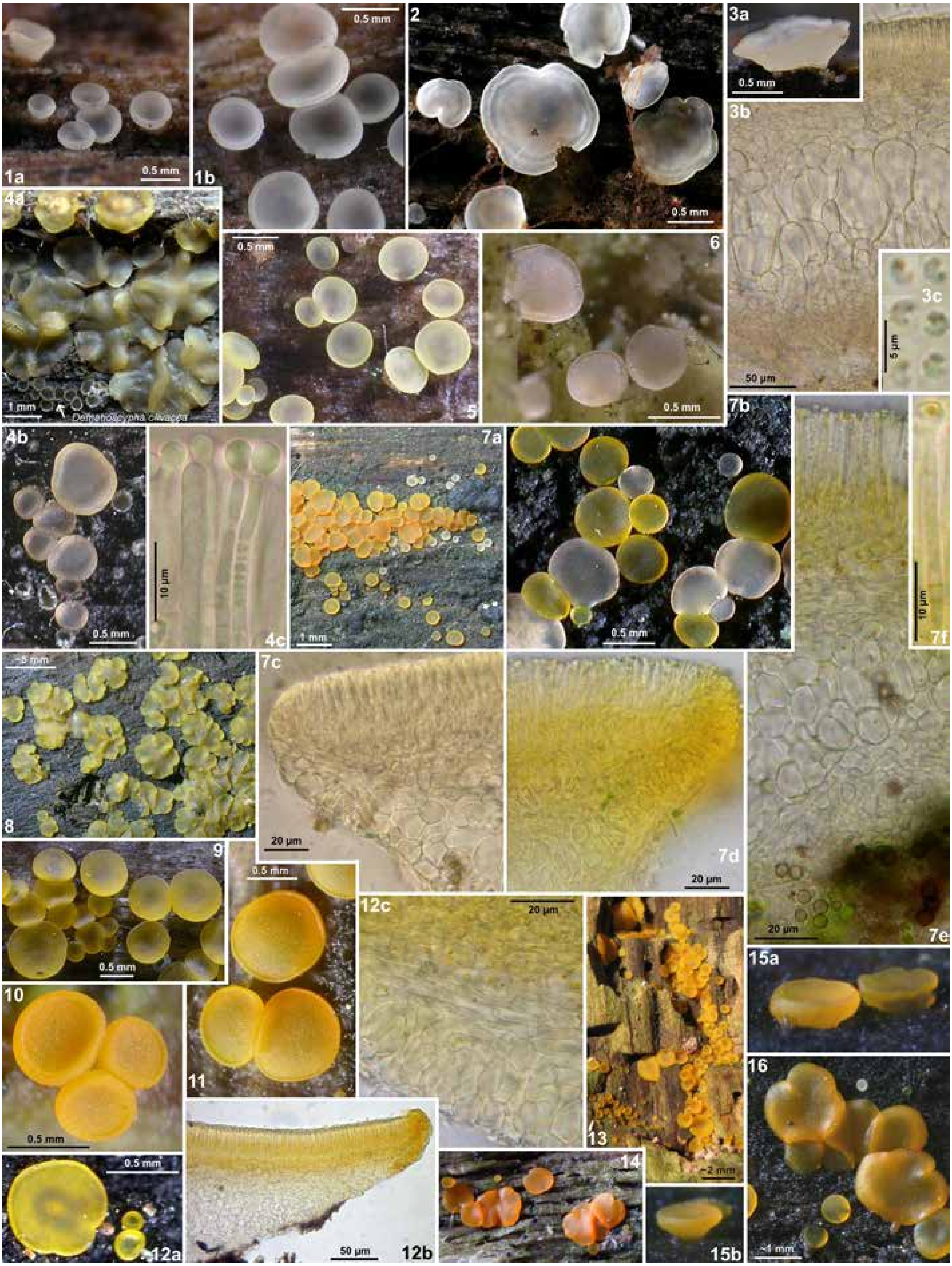


Plate 877. **1–16**. The *xanthostigma-leucostigma* complex in Europe. **1–3**, **6**: *Orbilia leucostigma*; **5**, **8–16**: *O. xanthostigma* (**5** pale form); **4**, **7**: mixture of both. – **1a–b**, **2**, **3a**, **4a–b**, **5**, **6**, **7a–b**, **8–11**, **12a**, **13**, **14**, **15a–b**, **16**. fresh apothecia; **12b**. apothecium in median section; **3b**, **7e**. id., central part of apothecium; **7c–d**. id., marginal region; **12c**. id., ectal and medullary excipulum at lower flanks; **4c**, **7f**. ascus and paraphyses (**4c** with hyaline VBs, **7f** with yellow granular VBs in apex); **3c**. ascospores. – Living state. – **8**: phot. M. Theiß; **13**: M. Bemmann; **14**. P. Karasch; **15a–b**, **16**: K. Homble. — **1a–b**. 28.IV.2006: France, Niort, on *Fagus*; **2**. H.B. 7958: Germany, Tübingen, on *Fagus*; **3a–c**. H.B. 8259: Switzerland, Andermatt, on *Alnus*; **4a–c**. H.B. 7951b: Germany, Tübingen, on ?*Populus*; **5**. H.B.

kidney-shaped, therefore, some uncertainty remains about the identity of the treated material. Doubtful are those reports of Karsten (1869: 174), Phillips (1887: 329), Massee (1895: 147), and Rehm (1891: 454) who described the spores as globose-ellipsoid, (elongate-)ellipsoid, or egg-shaped. Some reports suggest a gradual variation from straight to strongly curved spores which led some authors (e. g., Bayliss Elliott 1920: 264), especially in the case of yellow to orange apothecia, to consider *O. coccinella* and *O. leucostigma* var. *xanthostigma* as possible synonyms. Due to the small spore size, reports of ellipsoid spores are often doubtful, particularly in the older literature. As an example, Velenovský erroneously described globose or ellipsoid spores in *O. alnea* var. *vesiculosa*, *O. faginea*, *O. hypothallosa*, *O. microspora*, *O. millispora* and *O. vitrea*. When Svrček (1954) revised the types of these taxa, he found allantoid, cashew-shaped spores and referred all of them (except for *Orbilia alnea* var. *vesiculosa*, see below) to synonymy with *O. botulispora* (= *O. xanthostigma*). A recent report of *O. xanthostigma* by Akata & Doğan (2015: fig. 3d) figures cylindrical straight spores, but reexamination of this sample revealed strongly cashew-shaped warted spores, thus fig. 3d shows alien spores.

Spore size of *O. leucostigma* and its synonyms (in a wide sense) as stated in the literature lies in the range of (1.5–)2–3(–4) × 1–2(–3) µm. Although in the present study the spores almost never exceeded 3 µm in length (in situ), Dennis (1978: 187), Breitenbach & Kränzlin (1981: pl. 253), and Ellis & Ellis (1985: 12) uniformly give a spores size of 3–4 × 1–1.5 µm for *O. xanthostigma*. Similarly, Boudier (l.c.: 266), followed by Grelet (1948a: 54), gave the spore size for *O. xanthostigma* as 3–4 × 2–3 µm (3–3.7 × 1.1–1.7 µm when evaluated from Boudier's plate; the value of 2–3 µm obviously refers to the total width of the curved spore). Reexamination of the material figured by Breitenbach & Kränzlin revealed a size of 2.5–2.7 × 1 µm, therefore, it can be assumed that values of 3–4 µm refer to the actual spore length (measured along the curvature).

Svrček (1954) gave for *O. xanthostigma* a spore size of 2.5–5 × 1.5–3 µm because his interpretation of this name concerns *O. eucalypti* and includes perhaps also *O. tremulae* (see below, also under these two species), while he used the name *O. botulispora* with spores of 2.5–3.5 × 1–1.5 µm for the present concept of *O. xanthostigma*. A report under the name *O. xanthostigma* by Zhuang (1997: 9), with cream-white apothecia and ellipsoid to rod-shaped spores (3.5–4.5 × 1.2–1.5 µm) was restudied and found to have slightly curved spores; it is referred to as *O.* aff. *umbilicata* here (Pl. 865: 3). Three collections reported by Thind & Sharma (1980) from temperate to tropical India under the name *O. xanthostigma*, with golden yellow apothecia, suggests a relation to section *Helicoon* because of fusoid, straight to slightly curved spores of 3–6.5(–7.5) × 1–2.5 µm. Guo et al. (2014b) used the name *O. xanthostigma* for a collection of unclear identity from subtropical China, with reddish or whitish apothecia and falcate spores of *6–8.5(–10) × 1–1.4 µm, reminiscent of section *Arthrobotrys*, although the strongly refractive VBs in the paraphyses would be a rare case in that group; alternatively it could be a member of series *Xanthoguttulatae*, in which VBs occur in *O. nemaspora*.

It was in the holotype of *O. delicatula* when Spooner (1987, fig. 21 A–C) reported for the first time the warts on the ascospores. In the present study this characteristic feature could indeed be seen, e. g., in all of Velenovský's type specimens here referred to synonymy with *O. leucostigma* or *O. xanthostigma* (Pl. 875: 3–4, 6–8). The warts are visible in every mature, living or dead spore, both inside or outside living or dead asci, not only on some spores as Spooner's drawing might mislead to think. The warts are also clearly visible on LM photographs (Pls 877: 3c; 878: 3, 4b, 8). In several specimens from Argentina, Romero (1994, fig. 15 M) confirmed Spooner's observation. Also Liu (2006: 69, fig. 23) reported the spores to be warted in all of his many Chinese specimens, although the warts are not clearly visible on his photos. Matočec & Focht (2000) described and figured the spores of a specimen from Montenegro as 'finely punctate at dorsal part, readily visible in water mount under oil immersion', and likewise Matočec et al. (2005: 324) found spores with ornamented dorsal part in an Austrian sample.

SEM micrographs (Pfister 1997, fig. 2; Wang & Pei 2001, fig. 2b; see Fig. 55: c–d) showed that these warts also occur on the sides of the spores, and a TEM study (Müller 1998, fig. 21c; Fig. 55: a–b) revealed that they are protrusions of the spore wall rather than deposits on the wall, and this appears to be the reason why they are not stainable by dyes.

Although the mature living spores always contain a single globose spore body at one end, literature reports do not account for this feature. Either the spores are described as empty, mainly because of herbarium studies but also by vital taxonomists like Boudier, or they are reported to contain 2 drops, one at each end (e. g., in the type of *O. paradoxa* by Velenovský 1934: 102, pl. XI fig. 4 and Svrček 1954: 18, or under *O. xanthostigma* by Bride & Caillet 1975: 72 and Dennis 1978: 187). Velenovský undoubtedly saw the spore bodies, but it seems to have been a matter of imagination that he depicted two at each spore end (in profile view). Although 1–3 small LBs frequently accompany the SBs, the LBs are nearly always much smaller and not strictly near the poles. When viewing the spores in front view, the two spore ends may simulate drops which could be the case in Dennis' drawing (1978: pl. XXV A) and also in Velenovský's (1934: pl. XI figs 9, 16) report of oblong-ellipsoid spores in *O. alnea* var. *vesiculosa* and *O. microspora* (p.p.).

Nomenclature and type studies. The brief protologues of the four oldest epithets *aurea* (Persoon 1796), *leucostigma* and *xanthostigma* (Fries 1815), and *rufula* (Schweinitz 1832) present only macroscopical characters which do not even allow to decide whether an asco- or basidiomycete was described. Because of the unclarified identity and/or inconsistent application of these names, Spooner (1987: 167) selected the epithet *delicatula* (Karsten 1869) to replace the currently applied epithet *xanthostigma*. He rejected the two Friesian taxa as nomina ambigua because, according to Nannfeldt (1932: 253), no authentic material of them has been preserved.

During the present study, several authentic specimens of *Peziza aurea* and the presumed holotype of *P. rufula* were examined. Moreover, an authentic non-type specimen of *Peziza xanthostigma* could be studied, while no specimen identified as *P. leucostigma* by Fries could be located. Accordingly, *P. rufula* and *P. aurea* p.p. were found to have cashew-shaped warted

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7790b: Germany, Neuffen, on *Fagus*; **6**. H.B. 8280: Switzerland, Luzern, on *Corylus*; **7a–f**. H.B. 7852: Germany, Tübingen, on *Carpinus*; **8**. 19.IX.2006: North Macedonia, Bitola, on indet. angiosperm; **9**. H.B. 8536: Denmark, Sjælland, on *Alnus*; **10**. 15.VI.2007: Luxembourg, Alzingen, on *Quercus*; **11**. 16.VI.2007: Luxembourg, Hesperange, on *Quercus*; **12a–c**. H.B. 7848: Germany, Tübingen, on *Fagus*; **13**. 31.X.2010: Germany, Heidelberg, on *Corylus*; **14**. 10.X.2002: Germany, Tutzing, on *Sorbus*; **15a–b**. 3.V.2008: Norway, Arendal, on *Betula*; **16**. 19.X.2008: ibid., on *Betula*.

Plate 878. **1–8**: The *xanthostigma-leucostigma* complex in Europe, Middle America and China. **1**, **3**, **6–8**: *Orbilia xanthostigma*; **2**, **4–5**: *O.* cf. *xanthostigma*. – **6a**. oak-hornbeam forest with decorticated *Quercus* log; **2**, **6b**. fresh apothecia; **1a**. rehydrated apothecia (with abundant conidiophores and conidia); **1b**. apothecium in median section; **1c**. aggregates of minute yellow VBs in cells of ectal excipulum; **4a**, **7**. fully turgescent asci, paraphysis; **3**. truncate ascus apices; **3**, **4b**, **8**. ascospores; **1d**, **5a**. detached conidia; **5b**. conidiophore with young conidium. – Living state, except for asci in **3**. – **2**: phot. C. Lechat; **3**: J.L. Cheype; **4a–b**: M.H. Mo (DIC); **5a–b**: Liu (2006, fig. 24, DIC); **8**: M. Bemmann. — **1a–d**. H.B. 9193: Luxembourg, Syren, on *Fagus*; **2**. H.B. 8028: Martinique, on indet. angiosperm; **3**. 3.VII.2006: France, Rhône-Alpes, on *Fagus*; **4a–b**. 15.VIII.2003 (M.H. Mo): China, Yunnan, on *Pinus*; **5a–b**. HMAS 139665: China, Hunan, on *Kalopanax* (from Liu 2006); **6a–b**. H.B. 9081a: Luxembourg, Kockelscheier, on *Quercus*; **7**. 2.III.2007: Germany, Chemnitz, on *Quercus*; **8**. 31.X.2010: Germany, Heidelberg, on *Corylus*.

spores, but *P. aurea* was heterogeneous and comprised also *O. comma* and *Dacrymyces chrysocomus*. The authentic specimen of *P. xanthostigma* represents *O. auricolor*, but this specimen was probably collected after the sanctioning protologue was published by Fries and cannot, therefore, be considered as type material.

The here proposed neotypification of *O. leucostigma* and *O. xanthostigma* is based on two recent European collections with cashew-shaped, warted ascospores, and with white or yellow apothecia, respectively, from which molecular data were gained. With this neotypification we believe to have found an acceptable solution for the necessary name change of *O. delicatula* (because of the priority of *P. aurea* and *P. rufula*) and the necessary clarification of the identity of *O. xanthostigma* (the lectotype of the genus *Orbilia*). The reintroduction of the commonly used epithet *xanthostigma* as the correct name for *O. delicatula* was possible because *O. leucostigma* as here neotypified was molecular-biologically very different. Would the result have been that the two taxa were conspecific, Seaver (1951) had to be followed who gave *O. leucostigma* priority at the species level by listing *O. xanthostigma* as a synonym (ICN Art. 11.5, Turland et al. 2018). Because the oldest name, *Peziza aurea* Pers., was not sanctioned by Fries, but listed as a synonym of *Dacrymyces chrysocomus*, its reintroduction in the here lectotypified sense of *O. xanthostigma* would only be possible if *P. xanthostigma* (which has priority over *P. aurea*) would have been redefined in a sense different from *P. aurea*, or retained as a nomen ambiguum.

Peziza leucostigma is one of the two species that Fries included when erecting the genus *Orbilia*. The taxon was designated as lectotype of *Orbilia* by Clements & Shear (1931), but these authors were unaware of the earlier lectotypification on *O. xanthostigma* by Bachman (1909). Authentic material of *P. leucostigma* in GH and UPS could not be traced. In the absence of a type specimen, Nannfeldt (1932: 253), followed by Spooner (1987: 161), referred to the interpretation of *P. leucostigma* by Nylander (1869) when suggesting *P. leucostigma* [sensu] Nyl.

as ‘neotypus’ of the genus *Orbilia*. Nannfeldt obviously did not examine Nylander’s material himself, but relied on Nylander’s description which is likewise too brief to allow recognition of the species, though including microscopic characters.

The original description of *Peziza leucostigma* provided by Fries (1815, 1822) refers to a fungus with the following macroscopic characters (Pl. 879): gregarious, sessile, whitish-hyaline with a slightly greyish disc, ¾–1¼ lin. (= ~1.5–2.5 mm) diam. (1815) or scarcely over ½ lin. (= ~1.2 mm) large (1822), concave, then nearly flat, submembranaceous, coriaceous, margin smooth, growing on blackened, very rotten wood of *Fagus* in autumn and spring in Sweden.

The interpretation of *P. leucostigma* by later authors is highly heterogeneous, as it was mainly based on the whitish colour of the apothecia. For instance, five specimens from P.A. Karsten’s herbarium in H bearing the epithet *leucostigma* were examined and found to belong to four different species. Nylander (1869: 54) partly detected this confusion when reviewing Karsten’s specimens. Three of them turned out to have narrowly cylindrical spores and became syntypes of *P. epipora* (however, Nylander overlooked that one of them represents *Hyalorbilia inflatula*, see p. 1449).

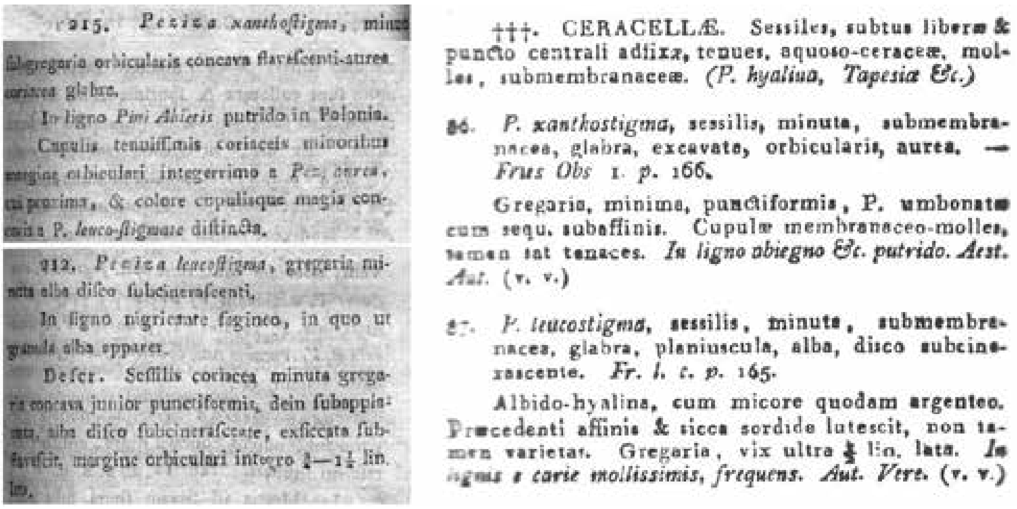
The remaining two specimens Nylander found to be ellipsoid-spored, so he continued to assign it to *O. leucostigma*. The descriptions in Nylander (l.c.) and Karsten (1869: 174) run about as follows: fresh whitish-hyaline, dry yellowish, paraphyses ~1 µm wide, with a subglobose apical inflation 2–2.5 µm wide, spores ellipsoid or oblong, 3–4 × 1–1.5 µm, asci narrowly clavate, 30–35 × 3–3.5 µm. The described shape of the paraphyses excludes a short-spored member of *Hyalorbilia*, and the spores are suggestive of *O. dryadum* or a pale-coloured specimen of *O. tremulae*. Reexamination of these two specimens revealed that they belong to two different species: *O. tremulae* (Kola Peninsula, *Salix* wood, 27.VII.1861, Karsten 3192) with ellipsoid spores (Pl. 861: 8), and *O. leucostigma* in the here neotypified sense (Turku, Merimasku, coniferous wood, 21.VI.1860, Karsten 3193), with cashew-shaped, dorsally warted spores of †2.6–2.9 × 1–1.2 µm (Pl. 875: 10a). Although now pale cream-ochraceous(-orange) when dry, the fresh colour was whitish-hyaline fide Nylander and Karsten (l.c.). A further, apparently duplicate specimen in H bearing the same collection data (Karsten 3193) is from Nylander’s herbarium and was not received. This specimen was identified by Svrček (1989, in sched.) as *O. epipora*, therefore, it seems unlikely to be conspecific with *O. leucostigma* as neotypified here.

When Karsten (1869) separated *Peziza delicatula* from *P. leucostigma*, he saw not only a difference in apothecial colour (golden-yellow vs. whitish), but also in spore size and shape (1–2.5 µm long, ellipsoid-subglobose vs. 3–4 µm long, ellipsoid-oblong). However, reexamination of the holotype of *P. delicatula* by Spooner (1987) revealed cashew-shaped, dorsally warted spores, indistinguishable from those here seen in Karsten 3193. Hence, both Karsten and Nylander overlooked the curvature and ornamentation of the spores, while the reported spore size of 3–4 µm seems to refer to *O. tremulae* rather than *O. leucostigma*.

Many later authors adopted the name *O. leucostigma*. However, their diagnoses are often more or less exact copies of those of Nylander and Karsten (Saccardo 1889: 629, Rehm 1891: 454, Grelet 1948a: 53, Seaver 1951: 154, Ahmad 1978: 210), which permits to conclude that they did not perform personal studies. Rehm suggested that *O. leucostigma* was possibly only a small-spored form of *O. coccinella* (in the sense of *O. eucalypti* s.l.), whereas Feltgen (1899: 53) saw only differences in colour between the two taxa. Regrettably, the three collections reported by Feltgen under the name *O. leucostigma* in his herbarium in LUX were found to be devoid of apothecia, whereas those reported under the name *O. coccinella* mainly belong to *O. xanthostigma* and sometimes to *O. eucalypti*. The two specimens in the herbarium of E.C. Bommer & M.H. Rousseau (Belgium, BR) under the name *O. leucostigma* also contained different species, *O. leucostigma* (IX.1884, wood of *Quercus*) and *O. auricolor* (VI.1913, bark of *Fraxinus*). Specimens named *O. leucostigma* in the herbaria of Petrak (VIII.1934, U.S.A, New York, Old Forge, wood of ?*Fagus*, M) and Killermann (15. VI.1918, Bayern, Regensburg, Pfatter, wood of *Quercus*, M) are confirmed here.

Clear microscopic differences between *O. leucostigma*, *O. xanthostigma* and *O. eucalypti* are quite wanting in the older literature. For instance, Phillips’ (1887: 330) diagnoses define these three taxa mainly by their colour (white, yellow, or flesh-red, respectively) whereas the microscopic features differ only slightly. Often the statement can be found that *O. leucostigma* is merely a colourless form of *O. xanthostigma* (Karsten l.c., Saccardo 1889: 629, Grelet l.c., Dennis 1978: 188). Also Ellis & Ellis (1985: 11) distinguish the two taxa only by colour. A similar opinion is expressed by Karsten (1869) who reduced *O. xanthostigma* to a subspecies, and later (1871) to a variety of *O. leucostigma*. Seaver (1951) even synonymised *O. xanthostigma* under *O. leucostigma*.

Almost all consulted authors prior to 1960 who provided microscopic data, but also Ginko (1986: 201), reported under the epithet *leucostigma* ellipsoid-oblong or globose-ellipsoid spores. Those who did not merely copy Karsten’s description might likewise have overlooked the curvature of the spores, but Ginko’s



215. *Peziza xanthoſtigma*, minu

ſubgregaria orbicularis concava flaveſcenti-aurea coriacea glabra.

In ligno *Pini Abietis* putrido in Polonia.

Cupulis tenuiſſimis coriaceis minoribus margine orbiculari integerrimo a *P. aurea*, cui proxima, & colore cupulisque magis concavis a *P. leuco-ſtigmate* diſtincta.

212. *Peziza leucoſtigma*, gregaria minuta alba diſco ſubcineraſcenti.

In ligno nigricante fagineo, in quo ut guttula alba apparet.

Deſcr. Seſſilis coriacea minuta gregaria concava junior punctiformis, dein ſubapplanata, alba diſco ſubcineraſcente, exſiccata ſub[illegible], margine orbiculari integro ¾—1¼ lin. lin.

†††. CERACELLÆ. Sessiles, subtus liberæ & puncto centrali adfixæ, tenues, aquoso-ceraceæ, molles, submembranaceæ. *(P. hyalina, Tapesiæ &c.)*

86. *P. xanthostigma*, sessilis, minuta, submembranacea, glabra, excavata, orbicularis, aurea. — *Fries Obs* 1. *p.* 166.

Gregaria, minima, punctiformis, P. umbonatæ cum sequ. subaffinis. Cupulæ membranaceo-molles, tamen sat tenaces. *In ligno abiegno &c. putrido. Aest. Aut.* (v. v.)

87. *P. leucostigma*, sessilis, minuta, submembranacea, glabra, planiuscula, alba, disco subcinerascente. *Fr. l. c. p.* 165.

Albido-hyalina, cum micore quodam argenteo. Præcedenti affinis & sicca sordide lutescit, non tamen varietas. Gregaria, vix ultra ½ lin. lata. *In lignis e carie mollissimis, frequens. Aut. Vere.* (v. v.)

Plate 879. Left: protologue of *Peziza xanthostigma and P. leucostigma* in Observationes Mycologicae (Fries 1815: 165–167). Right: redescription in Symbolae Mycologicae (Fries 1822: 146).

illustration of ellipsoid spores suggests that he was dealing with *O. cejpii* or a similar species. Contrary to the situation before 1960, Dennis (1960, 1978) and Ellis & Ellis (1985) reported under the name *O. leucostigma* British specimens with consistently slightly curved (allantoid) spores. These records obviously refer to *O. leucostigma* although the spores are described as smooth and too long, perhaps by referring to the actual length.

Some further interpretations of *Peziza leucostigma* are mentioned in the following. Although described by Fries as having a plane hymenium, Cooke (1871: 703) reported the young apothecia of *P. leucostigma* as cupulate and with a visible subiculum which suggests a *Hyalorbilia* (no microscopic data are given). Also Karsten identified a polyporicolous collection (Tampere, Ruovesi, 4.VIII.1859, H) as *P. leucostigma* (and later as *O. epipora*) which represents *H. inflatula*. Schulzer (1878) referred a collection on wood of an old *Quercus* stump to *P. leucostigma*. The ascospores are described as cylindrical, 5 µm long, and the conidiophores and conidia (24–26 × 6 µm, 1–5-septate) emerging from the hymenium obviously belonging to a *Dactylella*, which suggests that the species under study might belong to series *Neodactylella.* A specimen on wood of *Fagus* (Höhnel A 4946, Wienerwald, Großer Stiefelberg, 1906, M) was reexamined and found to represent *O. epipora*. A specimen on *Phylica* (*Rhamnaceae*) from Tristan da Cunha (south Atlantic Ocean), identified as *O. leucostigma* by Dennis (1955: 1), was described with yellowish apothecia (when soaked up), cylindrical, straight to slightly allantoid spores of 3 × 0.75 µm, truncate ascus apices, capitate paraphyses, cortical cells with a yellow oily matter, and 4–5 µm wide anchoring hyphae. The spores suggest identity with *O. epipora*, but the yellow cortical pigment points to a different species. A report of *O. leucostigma* from Bayern (Berchtesgaden Nr. 2509, *Alnus alnobetula*, 28.IX.1982, H. Schmid-Heckel, M) was found to be *O. sarraziniana*.

In order to settle the identity of *O. leucostigma*, a neotype needs to be chosen. In our opinion, a solution with the lowest nomenclatural changes would be gained by neotypifying *P. leucostigma* based on a European population with white apothecia and cashew-shaped warted spores. This selection would partly concur with Nylander's interpretation of the epithet, and would also be in accordance with the general use of the name *O. leucostigma* since 1960. We here designate a specimen from Germany (Tübingen, on *Fagus*, ex H.B. 9958a, M-0276499), from which a sequence was gained, as **neotype** of *O. leucostigma*. A documentation of this collection will be given in a separate paper (Baral et al. in prep.).

Peziza xanthostigma is the other of the two species on which Fries (1835) based the genus *Orbilia*. The taxon was designated as lectotype of *Orbilia* by Bachman (1909). Although the epithet *xanthostigma* has been used over more than a century for the common species with small cashew-shaped spores, e.g., by Boudier (1904–10: pl. 460), Dennis (1978: pl. XXV A), and Breitenbach & Kränzlin (1981: pl. 253), Spooner (1987) abandoned the name as a nomen dubium because no type material could be located and the epithet has not consistently been applied by older authors due to inexact microscopic data. Our search for authentic material in GH and UPS revealed a single specimen in the Fries Herbarium (see below).

Actually, the name *O. xanthostigma* has been applied in different ways. A frequent interpretation concerns *Orbilia eucalypti* or *O. tremulae*, 2 common taxa with ellipsoid spores, although the name *xanthostigma* (= yellow) is in contrast to the often orange- to rose-red or cream to almost whitish, but sometimes also yellow-orange apothecia of *O. eucalypti*. For instance, Velenovský (1934: 92, apothecia pale rose), Svrček (1954: 23, 1987b: 93, apothecia yellow), and Korf & Zhuang (1985: 503) favoured this interpretation of *O. xanthostigma.* The cashew-spored species was reported by these authors under various new (Velenovský 1934, 1947) or established names such as *O. botulispora* Höhn. (Svrček 1954) or *O. delicatula* (Korf 1992). A North-American specimen labelled *O. xanthostigma* (X.1925, herb. Petrak, M) appears to belong to *O. epipora* (Pl. 901: 7).

A surprise was the identity of the only authentic specimen of *P. xanthostigma* that we have received ('Tyskland, Sauter', undated, herb. E. Fries, F–015650, UPS 247614), on bark of a branch of ?*Salix*. This contains three apothecia which belong to *O. auricolor* (see Pl. 951: 2), a species which has often whitish apothecia but may occur in a more or less bright golden yellow, somewhat desiccation-tolerant form to which the epithet '*auricolor*' better fits. A.E. Sauter (1800–1881) started to publish on fungi around 1841 (Keißler 1917). Hence, this collection probably dates later than 1815 (or 1822, the sanctioning description) and, therefore, cannot be considered as type material of *O. xanthostigma*.

In the protologue of *Peziza xanthostigma*, Fries (1815: 166) described the apothecia as 'minute, subgregarious, round, concave, golden yellowish, coriaceous, glabrous', growing on wood of *Abies alba* ('in ligno *Pini Abietis*') in Poland (Pl. 879 left). Later, Fries (1822: 146) emended the description to 'sessile, minute, soft-membranaceous though quite tough, smooth, excavated (cupulate), round, golden yellow, gregarious, on rotten wood of *Abies* etc. in summer and autumn' (Pl. 879 right). In 1815 Fries believed that the species differed from *Peziza leucostigma* in its colour and more concave discs, and from *P. aurea* in smaller and thinner, coriaceous apothecia with an even margin, whereas in 1822 he stated *P. umbonata* and *P. leucostigma* to be somewhat similar to *P. xanthostigma*.

Fries' concept of *Peziza xanthostigma* was purely based on macroscopy, therefore, it might have comprised several, rather distant though macroscopically similar species. Among those European *Orbiliomycetes* with comparatively large apothecia and a partly more or less yellow pigmentation, at least six possible candidates must be considered: *Orbilia xanthostigma* in the here adopted sense, *O. eucalypti*, *O. tremulae*, *O. auricolor*, *O. xanthoguttulata*, and *Hyalorbilia inflatula*. Fries' (1836) statement of moniliform asci in the protologue of *Orbilia* indicates, however, that he was not dealing with a member of section *Arthrobotrys* (*O. auricolor*), nor with 1 of section *Aurantiorubrae* (*O. xanthoguttulata*) or *Hyalorbilia*: due to the falcate, helicoid, or rod-shaped spores in these taxa, the dead, overmature asci never attain a moniliform shape.

When leaving ascus shape aside, the original description of *Peziza xanthostigma* appears to fit *Hyalorbilia inflatula*, a common species with rod-shaped spores and membranaceous apothecia with often concave disc and yellowish colour, which becomes even more intense in the dry state but also under more bluish illumination. No doubt, Fries must have known this common species which has comparatively large apothecia. Actually, the discrepancy between Fries' description and Boudier's interpretation of *O. xanthostigma* concerning the apothecial shape and thickness was also noted by Nannfeldt (in sched., fide Spooner 1987: 172). The *xanthostigma-leucostigma* complex and *O. eucalypti* are more fleshy instead of membranaceous, mainly near the margin, and never have distinctly concave discs in the hydrated state (except for a depression in the centre), although in the dry state *O. eucalypti* gets shallowly cupulate. However, the words 'tough' and 'coriaceous' in Fries' descriptions hardly match the fragile consistency of *H. inflatula*.

Both the cashew-spored species (*O. xanthostigma*) and the ellipsoid-spored species (*O. eucalypti*/*O. tremulae*) are fungi which Fries should have seen. According to Spooner (1987: 172), the cashew-spored species was stated by Nannfeldt to be common in Sweden. Spooner concluded that 'it is therefore one with which Fries must have been familiar'. Actually, this species represents roughly half of the specimens of *Orbiliomycetes* deposited in the consulted public herbaria. As this is the only known common European species which frequently forms bright yellow(-orange) apothecia, we may assume that Fries used the name *xanthostigma* for it. *O. eucalypti* is surely also frequent there, but whether Fries became familiar with it depends on his collection methods since bright-coloured *O. eucalypti* is more or less restricted to xeric substrate. The helicoid-spored *O. xanthoguttulata* with its bright yellow to orange colour would also fit, but seems unlikely to have met Fries' attention because of its comparative rarity in addition to growing on xeric substrate.

As already stated above, Boudier (1904–10: 266, pl. 460), followed by most British authors, applied the name *O. xanthostigma* to the cashew-spored species, whereas Velenovský (1934) and Svrček (1954) used it for species with ellipsoid ascospores, and named the cashew-spored taxon *O. paradoxa* or *O. botulispora*, respectively. Because of different apothecial colours, Spooner (1987: 172) believed that 'the fungus [with ellipsoid spores] to which Svrček applied the name [*O. xanthostigma*] has been variously described as amber to pink and thus seems unlikely to be that described by Fries'. Probably, Spooner referred to Boudier's (l.c.: pl. 461) plate of *O. coccinella* which shows bright pink apothecia. However, Spooner seems to have been unaware of collections of *O. eucalypti* from xeric habitats with often bright yellow-orange to orange-red apothecia (Pls 856, 859, 860). Svrček (1987: 93) considered a yellow pigmentation even as typical of the ellipsoid-spored taxon.

In order to conserve the current usage, we consider selection of the *O. auricolor* specimen as neotype of *O. xanthostigma* as counterproductive, since we are unaware of any later usage of the name in that sense. *H. inflatula* was at least a single time identified as *O. xanthostigma* by Feltgen, according to our revision of Feltgen's specimens, but no further report of *O. xanthostigma* in that sense came to our notice. Fries' generic diagnosis of *Orbilia* in regard to moniliform asci excludes these two species. Among the remaining taxa, *O. xanthostigma* was distinctly more often attached to the cashew-spored species than to the ellipsoid-spored species. We here designate a specimen from Germany (Tübingen, on *Fagus*, ex H.B. 6749, M-0177061), from which an ascospore isolate (CBS 116210) and a sequence (CBS ined.) were gained, as **neotype** of *O. xanthostigma*. For the anamorph obtained in pure culture of this collection see Pl. 876: 3. A documentation of the teleomorph based on a reexamination from the herbarium specimen is given in a separate paper (Baral et al. in prep.).

Persoon (1796: 41) briefly described the apothecia of ***Peziza aurea*** as: 'crowded, minute, sessile, flat, subgelatinous, shining yellowish-brown (fulvo nitido). Habitat frequently on logs of various trees; of fleshy-gelatinous consistency, therefore slightly wrinkled and less fleshy when dry, from *Peziza lenticularis* Bull. sufficiently different by the submarginate fruitbodies when flattened. Scarcely 1 line [ca. 2 mm] wide'. Later, Persoon (1801: 635, 1822: 304) considered *P. aurea* to be a possible synonym of *P. chrysocoma* Bull. Apparently therefore, Fries (1822: 140, 1874: 699) listed *P. aurea* Pers. as a synonym of *P. chrysocoma* or *Dacrymyces chrysocomus*, respectively, and this opinion was followed also by Sommerfelt (1826), Saccardo (1888: 799), and Mussat (1901: 246).

During a revision of specimens under the epithets *aurea* and *chrysocoma* in Persoon's herbarium, Donk (1964: 97) revealed that one (L 910.261-259, labelled '*Peziza chrysocoma* Fries / *P. aurea* ? Pers.') represents the basidiomycete *Dacrymyces chrysocomus* (Bull.) Tul. in the sense of Fries (see *P. chrysocoma*, p. 1665). Among the remaining five specimens bearing the epithet *aurea*, Donk found four to contain members of the superficially similar genus *Orbilia*, while one contained hardly any fruitbodies. For three of these specimens (including the latter) Persoon applied the name *aurea* without question mark. Among these, Donk designated the specimen L 910.261-29 (labelled '*Peziza aurea.* Syn. fung. / – *chrysocoma* Bull.') as lectotype of *Peziza aurea*. Reexamination of this specimen (Pl. 422: 1) revealed identity with *Orbilia comma*. The abundant apothecia grew on bark, obviously of *Ulmus*, judging from the appearance of the inner bark surface. However, examination of the other specimen which was available for selection (L 910.261-262) turned out to be *O. xanthostigma* (Pl. 875: 16). Also a specimen labelled '*Peziza chrysocoma*' by Persoon (L 910.261-249) was examined and found to represent *O. xanthostigma* (IVV: H.B. 7709); this collection was obviously not studied by Donk. Both collections have cashew-shaped warted ascospores and, because of the attached names *aurea* and *chrysocoma*, they are assumed here to represent European *O. xanthostigma* with pale to bright golden yellow apothecia.

The protologue of *P. aurea* provides features which appear to refer to a *Dacrymyces*, especially a fleshy-gelatinous consistency and a wrinkled hymenium in the dry state. This is no surprise as microscopes with immersion objectives did not yet exist when Persoon studied these collections, therefore, he confused *Dacrymyces* and *Orbilia*. In our opinion, Donk's selection was unfortunate, however, because apothecial colour in the numerous recent specimens of *O. comma* studied in the present work was never with a distinct yellow component. Instead, it varied from rose over orange to amber-coloured (Pl. 422: 1). Art. 9A.2 (ICN) recommends that designation of a lectotype should be undertaken only in the light of an understanding of the group concerned. According to ICN Art. 9.19, the choice of a lectotype is superseded if it is in serious conflict with the protologue and another element is available that is not in conflict with the protologue. *P. aurea* was described as yellowish-brown, and the specific epithet suggests a golden-yellow colour, therefore, we here designate L 910.261-262 (Pl. 875: 16) as **lectotype** of *Peziza aurea* Pers. The fragment of substrate appears to be *Ulmus* bark where it abundantly grew on its inner surface, partly in beetle galleries (IVV: H.B. 8776).

According to ICN Art. F.3.2 and F.3.4, the combination *Peziza aurea* Persoon (1796) is not illegitimate but nevertheless unavailable for use, because Fries (1822) sanctioned the homonym *Peziza aurea* (Pers.) Fr. The former taxon may, therefore, be made available by a nomen novum or new combination based on the here designated lectotype, if arguments were presented that it is not conspecific with *O. xanthostigma* (Art. F.3.4 ICN). Such a combination was made long ago in the genus *Helotium*, as *H. persoonii* (see below).

The sanctioned homonym of *Peziza aurea* Pers., *P. aurea* (Pers.) Fr. is based on a different binomial, *Helotium aureum* Pers. (Persoon 1801: 678), and represents a stipitate anamorphic fungus connected to '*Bisporella*' *resinicola* as teleomorph (Seifert & Carpenter 1987). *Peziza aurea* (Bolton) Sowerby is a further homonym. Bolton's fungus, originally published as *Helvella aurea* Bolton, refers to ?*Hymenoscyphus serotinus* (see Fries 1822: 119, Saccardo 1889: 222) while Sowerby's interpretation concerns *Calycina citrina* (see Saccardo 1889: 224). *Calycina aurea* (Bolton) Kuntze published by Kuntze (1898: 448) is another combination of this taxon.

Montagne (1853) described under the name ***Helotium persoonii*** a collection on ligneous substrate (indet. angiosperm) from Chile, with brownish-yellow to reddish apothecia. He observed asci and paraphyses but could not clearly see any spores. Dumont (1981: 358) stated that 'the description is suggestive of an *Orbilia*', but 'the holotype specimen cannot now be located at PC'. When ordered by us, 2 well-preserved authentic specimens were received from PC, with 'Chili' as the only collection data, obviously duplicates of the same collection on wood of indet. angiosperm. This collection fits the *xanthostigma-leucostigma* complex in most respects (Pl. 875: 12), but deviates by unusually long asci (†45–52 × 3.5–3.8 µm).

Helotium persoonii was believed by Dumont (1981) to have been published as a new species. Saccardo does not seem to have mentioned this binomial at all. Montagne (1853) listed *Peziza aurea* Pers. as a synonym of *H. persoonii*, hence we conclude that *H. persoonii* was intended as a nomen novum to avoid homonymy with *Helotium aureum* Pers. [≡ *Eustilbum aureum*]. Although he had not clearly seen any spores, Montagne was sure about the identity of his collection with Persoon's *Peziza aurea*, based on examination of an authentic specimen of Persoon under that name. He was also sure about the identity of *P. aurea* and *P. chrysocoma* s. Sowerby, but he felt uncertain concerning *P. chrysocoma* s. Bulliard in the lack of a type specimen.

Schweinitz (1832) briefly described ***Peziza rufula*** for a collection on ligneous substrate from Pennsylvania (USA), with reddish ('e rubro rufa') apothecia but with a more whitish margin, and compared it with *P. rubella* (= *Orbilia rubella*). A single specimen labelled 'type' (probably holotype) could be located at K and is found here to fit *O. xanthostigma* s.l. in every respect (Pl. 875: 1). The taxon was accepted by Cooke & Ellis (1877: 91) who referred to it a collection on a log of *Quercus* from New Jersey (USA). Based upon this latter report, Saccardo (1889: 621) combined it as *O. rubella* var. *rufula*, with a reference to p. 283 where he recombined the same taxon in *Pezizella*. Such 'alternative names' are considered to be valid when published before 1953 (Art. 36.3 ICN). Massee (1894b: 99) placed *P. rufula* and several other taxa in synonymy with *O. cruenta* Schwein., for which he described the spores as cylindric-oblong (see p. 1668). As he stated that he studied the 'specimens from Schweinitz' which comprise *P. citrinella*, *P. cruenta* and *P. rufula*, it can be assumed that he saw type material of all of them.

A reddish apothecial colour without a yellow component is unusual for *O. xanthostigma* s.l. When the presumed holotype was reexamined in 1997 during the present study, the apothecia were dry orange-brownish and rehydrated very pale ochraceous-yellowish. The unidentified host resembles a member of *Quercus*, judging from the ring-pored wood with broad radial rays.

Karsten (1869) described ***Peziza delicatula*** based on a collection on moulded wood of *Betula* from Finland (P.A. Karsten 2351) with golden yellow apothecia 1–2 mm diam., and 'short ellipsoid to subglobose' spores 1–2.5 µm long. He separated this species from the also yellow *O. leucostigma* subsp. *xanthostigma* by much larger apothecia and smaller, subglobose spores. Later, Karsten (1871) considered *P. delicatula* as a subspecies of *O. coccinella*, because of seemingly similar spores. Spooner (1987, fig. 21 A–C) reexamined the holotype, and his detailed documentation includes cashew-shaped, dorsally warted spores of †2.3–2.9 × 0.9–1.2 µm when evaluated from his drawing (2.5–3 × ~1 µm in the description which includes further collections). Spooner's description leaves no doubt about the conspecificity with *O. xanthostigma* in the present sense, therefore, this collection was not restudied here.

O. coccinella* f. *undulata was described by Feltgen (1901) from Luxembourg (Bridel, on rotten wood), based on apothecia with an undulating margin (colour not stated), but without any microscopic characters. The holotype in LUX was reexamined and found to have the typical cashew-shaped, warted spores. As Feltgen assigned this as a form of *O. coccinella*, it can be assumed that the apothecia were of some yellow-orange colour, therefore, we treat it as a synonym of *O. xanthostigma*.

Höhnel (1907a) described ***O. botulispora*** for a specimen with egg-yellow apothecia on wood of *Fagus* from Austria (Wienerwald). Höhnel correctly reported the cashew-like shape of the spores (2–3 × 1 µm) but did not see the warts on them which were demonstrated from the holotype in the present study (Pl. 875: 2). Based on apothecial colour, *O. botulispora* is a synonym of *O. xanthostigma*.

Velenovský (1934) described ***O. millispora*** for a collection from Rokycany (Czechia) on log of *Abies*, with pale yellow, strongly lobate apothecia 3–10 mm diam., and globose to ovate, 1–2 µm long spores. The holotype consists of a few apothecia of very different size (rehydrated 0.5–4.5 mm diam., now light yellowish-ochraceous). The asci were found to be 28–38 × 2.7–3.2 µm, and the spores 2.3–2.6 × 1.1–1.3 µm, cashew-shaped, with distinct warts. Svrček (1954: 17) correctly referred the taxon to synonymy with *O. botulispora* (= *O. xanthostigma*).

O. alnea* var. *vesiculosa was described by Velenovský (1934) for several Czech collections (on *Fraxinus*, *Alnus*, *Carpinus*, and *Quercus*), with egg-yellow apothecia and 4 µm long, oblong-ellipsoid spores with 1 quite large drop at each end. Without providing a description, Svrček (1954: 9) designated the *Fraxinus* specimen from Mnichovice as lectotype and assigned it to *O. xanthostigma*, a name applied by him to collections with ellipsoid, smooth spores here referred to *O. eucalypti* or *O. tremulae*. However, the present reexamination of this material revealed cashew-shaped, warted spores (Pl. 875: 7). Furthermore, the substrate is not *Fraxinus* as indicated by Velenovský but the wood anatomy fits *Alnus*. Velenovský's (l.c., pl. 11 fig. 9) illustration clearly refers to this collection, following his manuscript plate. The corpuscules on the excipulum, from which the name of the taxon is derived, represent conidia of a hyphomycete (fide Svrček). They were also seen in the present study and belong to *Haplotrichum* Link, the anamorph of a species of *Botryobasidium* Donk.

Velenovský (1934) described ***O. microspora*** based on two samples from different forests in the Transcarpathians (now Ukraine), both on wood of *Corylus* logs (according to the wood anatomy), collected by A. Pilát in VIII.1929. The two specimens contain abundant apothecia and now exist under the numbers PRM 151768 and 899283. When Svrček (1954: 17) concluded that they contain typical *O. botulispora* (= *O. xanthostigma*), the two specimens have been merged in one convolute under a single number 151768, labelled 'holotype'. Svrček's identification is confirmed here for PRM 151768, which originally had lemon-yellow apothecia, whereas PRM 899283 appears to contain *O. leucostigma* based on its originally wine-reddish apothecia (colours according to Velenovský's manuscript plates). When the 'holotype' was reexamined in 1998, it still carried only one number, PRM 151768, and no distinction was made between the two convolutes. Both were examined, but regrettably it is now impossible to say from which PRM number the drawing in Pl. 875: 3 was made. In one of the convolutes (PRM 899283) also four apothecia of *O. polybrocha* were found, which Velenovský seems to have overlooked (see Pl. 1006: 2).

Because of differences in apothecial colour and microscopic features, Velenovský (1934: pl. XI fig. 16 & 43) made two sketches. These can also be found on two separate manuscript plates which carry two different diagnoses. These two diagnoses can be assigned to the two convolutes, but only because of different notes for the (misidentified) substrate, as the apothecial colour is now uniformly pale yellowish-chlorinaceous in both: one convolute is labelled 'Habr', which means *Carpinus*, and corresponds to the plate with the note 'Na habrovém dřevě' (= on wood of *Carpinus*), whereas the other does not indicate the substrate and thus seems to correspond to the plate with the note 'Na listn. dřevu' (= on wood of broad-leaf tree). The former was from a montane virgin forest ('v pralesích horských') and the latter from an alpine virgin forest ('v alpin. pralesích'). Due to these circumstances, the two convolutes were now given two different numbers.

Although Velenovský's sketches on the two manuscript plates hardly suggest a single species, he merged them under one, and also Svrček (l.c.) did not comment on the strong divergences between the sketches. PRM 151768 (Velenovský 1934, pl. 11 fig. 16) relates to lemon-yellow ('citrónově žluté') apothecia of 1 mm diam., non-furcate asci 25 × 2 µm, distinctly capitate paraphyses, and broadly ellipsoid, biguttulate spores up to 1 µm long and PRM 899283 (pl. 11 fig. 43) to 'wine-reddish apothecia of 1 mm diam., bifurcate asci 20–24 × 2 µm, apically uninflated paraphyses, and narrowly ellipsoid, eguttulate spores 1–1.5 µm long'. The protologue contains data from both diagnoses: the apothecia are described as 'wine-reddish, yellow', and also the spore data are a mixture of both ('ellipsoid, 1–1.5 µm, biguttulate'). However, data on asci and paraphyses are solely taken from the wine-reddish specimen.

The depicted biguttulate spores are apparently a misinterpretation of the cashew-shaped spores of *O. xanthostigma* when seen in front view. Apothecia with uninflated paraphyses could not be found in the present examination of both convolutes, also a thick exudate ('epithecium') as mentioned in the protologue could not be seen. In both samples the mostly strongly capitate paraphysis apices (2.5–3.7 µm wide) are covered only by a very thin refractive exudate. Because of the capitate paraphyses and cashew-shaped spores (as 'biguttulate') reported only for the 'lemon-yellow' fungus, we here designate the specimen PRM 151768 as **lectotype** of *O. microspora*, which becomes a synonym of *O. xanthostigma*.

Four apothecia of *Orbilia polybrocha*, with rehydrated dark brown, crenulate margins and ochraceous-greyish discs, occur in association in PRM 899283 (see Pl. 1003: 4). However, this can hardly be the typifying taxon on account of the apothecial margin and the much more elongated spores (6–6.5 × 1–1.1 µm).

O. paradoxa was described by Velenovský (1934) for several Czech and Slovakian collections (mainly on wood of *Fagus*, one on log of *Abies*), with 'sulphur or pale or egg-yellow' apothecia and 1.5–2.2 µm long, ± semicircular spores ('resembling a horseshoe'), with one quite large drop at each end. Svrček (1954: 18) designated the *Abies* collection from Mnichovice as lectotype, which he correctly referred to synonymy with *O. botulispora*. The present reexamination of the lectotype (unillustrated) revealed cashew-shaped, warted spores 2.5 × 1 µm (Svrček: 2–2.5 × 1–1.5 µm). Here the apothecia are distinctly larger (up to 2 mm diam. fide Svrček, in present study dry 1–2.5 mm, ochre honey-brown) than Velenovský indicated in the protologue (0.4–1 mm). That size derives from the first collection from 13.VI.1925, according to Velenovský's manuscript plate, which shows illustrations for this and the lectotype. Velenovský placed *O. paradoxa* in a subgroup of its own, named *Soleina* after the horseshoe-like spores which he sketched with a curvature of partly over 180° in both populations.

O. hypothallosa was described by Velenovský (1947) from Mnichovice (Czechia, on wood of *Robinia*), with amber-yellow apothecia and globose spores 2–3 µm in diam. Svrček (1954: 15) found allantoid spores in the holotype and correctly referred it to synonymy with *O. botulispora*. Distinctly warted spores were seen in the present study (Pl. 875: 6). *O. hypothallosa* was named after the presence of very thick hyphae (8–10 µm) which were thought to emerge from the basal ectal excipulum. However, Svrček discovered conidia formed on them and referred this to a hyphomycete which is identified in the present study as the anamorph (*Haplotrichum*) of a species of *Botryobasidium*.

O. faginea was described by Velenovský (1947) from Jevany (Czechia, on log of *Fagus*), with white or pale lemon-yellow ('alba vel citrinella') apothecia and short ellipsoid spores scarcely 2 µm long. Svrček (1954: 14) correctly referred it to synonymy with *O. botulispora*. Again, the present study revealed warted spores (Pl. 875: 8). The asci are distinctly larger than indicated in the protologue ('25–27 µm including the bifurcate stipe'), and the capitate paraphysis apices 2.5–4 µm wide (Velenovský: '2.5 µm'). Based on the original colour, it seems that *O. faginea* represents a mixture of *O. leucostigma* and *O. xanthostigma*. A lectotypification on a part of the population is impossible because the very abundant and densely aggregated apothecia are now uniformly light yellowish-cream (when rehydrated). DNA extracts would be necessary to clarify the identity of individual apothecia of this collection. Velenovský's manuscript plate of *O. faginea* does not show the type but 2 much older collections with the note that he considered them as synonymous with *O. alnea*.

O. vitrea Velenovský (1947) was described from Mnichovice (Czechia, on rotten wood of *Juniperus communis*), with subhyaline apothecia of 1–2 mm diam. and globose-ellipsoid to globose spores 1–2 µm diam. Although the holotype was stated to be empty by Svrček (1954: 23), a single apothecium with now ochre(-orange) colour when dry could be found, which contained mature asci with cashew-shaped, warted spores

(Pl. 875: 4). Because of the apothecia originally described as subhyaline, *O. vitrea* is considered here to be a synonym of *O. leucostigma*. A manuscript plate with a brief sketch and a Latin diagnosis exists, which corresponds to the protologue except for ascus size (20–25 × 2.5 µm) which is erroneously given as 20–35 × 2.5 µm in the protologue.

Anamorph. From two different ascospore isolates under the name *O. delicatula*, Pfister (1997: fig. 7) and Liu (2006, fig. 24, see Pl. 878: 5) presented illustrations of a dicranidion-like anamorph, which Pfister referred to as '*Dicranidion* sp. of the gracile type' (D.H.P. 111 = 105), and Liu as *D. tenue* (HMAS 139665). On his fig. 8, Pfister considered an anamorph isolated from '*O. alnea*' (D.H.P. 81) as of the 'fragile type', although the conidia possess a distinct stalk contrary to *D. fragile* (note that Pfister erroneously applied on p. 13 the epithets '*fragile*' and '*gracile*' in contradiction to the legends under his figs 7 and 8). Pfister's fig. 8 resembles the anamorphs of *O. cejpii* or less so *O. renispora* but could instead belong to *O.* cf. *xanthoflexa* (see p. 1423). For another sample under the name *O. alnea* (D.H.P. 91) from another county in Massachusetts a sequence exists which clustered distant from the topotype of *O. xanthoflexa* (D.H.P. 130, as *Orbilia* sp.) and is named *O.* cf. *xanthoflexa* here. D.H.P. 91 and D.H.P. 130 formed a dicranidion-like anamorph with undocumented morphology, and clustered in a supported clade with European *O. leucostigma* and North American *O.* cf. *leucostigma* (see Phyl. 23). It appears possible that the illustrated D.H.P. 81 represents also *O.* cf. *xanthoflexa*.

In our two ascospore isolates of *O. xanthostigma* (neotype, Pl. 876: 3) and *O. leucostigma* (H.B. 6810c) we obtained dicranidion-like conidia (in H.B. 6810c without documentation), but we observed them also rather frequently on the natural substrate in close association with the apothecia or even on their margin and hymenium (Pls 876: 1–2; 878: 1d). Similarly, Arnaud (1952, fig. 7A) figured an anamorph found on an *Orbilia* sp. growing on a *Pinus* log, which he referred to *Pedilospora parasitans* (as *P.* '*parasitica*'). This is very probably not a parasite but a dicranidion-like anamorph that belongs to the apothecia on which it grows, and the conidial morphology fits the anamorph of *O. xanthostigma*. Conidia were also obtained by P.R. Johnston (pers. comm.) in ascospore isolates of two collections from New Zealand (PDD 58571, PDD 64847). They occur in the dried culture of PDD 58571, but we found them also on the natural substrate in PDD 59160. Sequences of these three strains clustered in three different clades (I–III, see below).

Some differences in conidial size and shape among the observed anamorphs were noted, even between populations from the very same geographical area. Conidia formed in our pure culture of *O. xanthostigma* showed a tendency to shorter, ± parallel arms with fewer septa similar as those cultured by Liu (2006, fig. 24), whereas conidia from the natural substrate in both *O. xanthostigma* and *O. leucostigma* generally had longer and mostly diverging arms (V-shaped). However, the conidia in one of Pfister's (1997: fig. 7, D.H.P. 111) cultures predominantly resemble those larger conidia with diverging arms, and only some conidia had ± parallel arms. The latter type of conidia, especially in Liu's and our strain, resemble more *Dicranidion tenue*, whereas those on the natural substrate and in D.H.P. 111 better fit *D. gracile*. *D. gracile* as described by Matsushima (1971, fig. 47; 1975: pl. 344 fig. 3; 1981, fig. 73) somewhat deviates from the anamorph of *O. xanthostigma* s.l. in having 0–5-septate conidiophores of 5–23 × (2–)3 µm, with 1–5 conical denticles (sympodial proliferation, see Pl. 11: g), whereas, in contrast, the conidiophores of *O. xanthostigma* s.l. on the natural substrate (Pl. 876: 1) and in culture (Pl. 878: 5b) were unbranched, 0–3 septate, with only terminally formed conidia. However, in Pfister's culture D.H.P. 111 sympodial proliferation also occurred.

For the type of *D. tenue* 3-septate conidiophores of 45–100 × 2–3 µm are reported (Matsushima 1993: 49, fig. 725), which rarely proliferate at the apex. *D. dactylopagum* was described with slightly longer, unbranched, only basally septate conidiophores (75–125 × 2–3 µm) with strictly terminally formed conidia. Apart from conidiophore length, this matches the anamorph of *O. xanthostigma* s.l. quite well. In the presence of testaceous rhizopods, the species produced adhesive protuberances on the mycelium which capture these invertebrates (Drechsler 1934). No rhizopods were added to our two ascospore isolates (H.B. 6810c, *O. leucostigma*; H.B. 6749, *O. xanthostigma*), but only nematodes which did not induce trapping organs.

Due to the similarity of the anamorphs observed in association with *O. leucostigma*, *O. xanthostigma*, and *O. xanthoflexa*, and the absence of sequence data in the types of *D. dactylopagum* and the similar *D. gracile* and *D. tenue*, these three anamorph-typified taxa are treated here as possible synonyms of the *xanthostigma-leucostigma* complex and require further investigation, particularly a molecular analysis of their type cultures. The predacious capabilities of *D. dactylopagum* are reminiscent of anamorphs of *Hyalorbilia*. However, in this genus dicranidion-like anamorphs and long, unbranched conidiophores are unknown at present, although similar staurosporous anamorphs do occur.

Phylogeny. Sequences of the ITS region were available for 36 samples of the *xanthostigma-leucostigma* complex (with warted ascospores, including *O. aureocrenulata* s.l.), which represent no less than 14 different genotypes and derive from five different continents (15 from New Zealand, 13 from Europe, 3 from USA, 2 from China, 1 from Brazil; see Baral et al. in prep.). Within Europe three genotypes have so far been observed: *O. xanthostigma* from nine samples, *O.* cf. *xanthostigma* from one sample (on a xeric branch), and *O. leucostigma* from three samples.

No other gene region was available for most of these 36 samples, except for 10 from Europe, which include also LSU D1–D2(–D12) (6× *xanthostigma*, 1× cf. *xanthostigma*, 3× *leucostigma*) and partly SSU (V1–)V8–V9 (1 × *xanthostigma*, 2 × *leucostigma*). For a further North American sample (D.H.P. 111) only SSU (V1–V8) was available in GenBank, but for it exists also unpublished LSU, and for about a dozen additional North American samples ITS and/or LSU (R. Healy pers. comm.).

In the present ML analysis of the ITS region (Phyl 24) we have used a reduced data set for *O. xanthostigma* (4 out of 9 sequences) and for *O.* cf. *xanthostigma* from New Zealand (5 out of 15 sequences, representing 5 different genotypes). The only environmental sequence, a DNA isolate from a *Picea* log from Sweden, which falls in this group, belongs to *O. xanthostigma* (Phyl 24). A comprehensive study on all sequences, including those from North America, will be published in a separate paper (Baral et al. in prep.).

The reduced data set of overall 20 strains formed together with three samples of the smooth-spored *O. xanthoflexa* s.l. a monophyletic group, the *leucostigma-xanthostigma* clade, which received medium support in our ITS analysis (Phyl. 23) and strong support in the ITS+LSU tree (Phyl. 22), whereas it was paraphyletic when analysing solely LSU (S27). Another species with smooth spores, *O. renispora*, clustered unsupported sister to this clade in Phyl. 22–23 but sister to the *xanthostigma* subclade (= *O. xanthostigma* s.l.) in S27. Its relationship with the *leucostigma-xanthostigma* clade is supported by characteristic motifs in the LSU D1 domain (see p. 1327). Based on these motifs we here use the name *xanthostigma-renispora* clade for the entire group.

Despite the high micromorphological homogeneity within the *xanthostigma-leucostigma* complex, a remarkable diversity in the rDNA is observed among these 36 samples. The *leucostigma-xanthostigma* clade consists of two medium (ITS) or strongly (ITS+LSU) supported subclades with about 16 genotypes, which represent four recognized species (*O. aureocrenulata*, *O. leucostigma*, *O. xanthostigma*, *O. xanthoflexa*) and 12 unnamed genotypes ('cf.'). Among the many synonyms listed under *O. leucostigma* and particularly *O. xanthostigma*, only one is of extra-European origin, *Peziza rufula* from Pennsylvania, and could represent an available name for one of the unnamed North American genotypes with pigmented apothecia.

Neither in the teleomorph nor the anamorph we have observed notable morphological deviations among the 14 genotypes of the *xanthostigma-leucostigma* complex, except for differences in pigmentation between *O. leucostigma* and *O. xanthostigma* within Europe and a different apothecial shape in *O. aureocrenulata*. A majority of available sequences derive from more or less yellow apothecia, but notes on the fresh colour were not available in every case. In the three European strains of *O. leucostigma* with sequence data the colour was whitish or sometimes pale violaceous-rosaceous, whereas in *O. aureocrenulata* s.str. and the nine European sequenced strains of *O. xanthostigma* it was pale to bright yellow. In samples from New Zealand the apothecia varied from pale chlorinaceous to bright golden yellow(-orange) when fresh (P.R. Johnston & J.A. Cooper pers. comm.), and in those from North America they were either white with sometimes pink tinge, pale to bright yellow, or orange (R. Healy pers. comm.).

According to Phyls 22 & 23), the *xanthostigma* subclade, as we call one of the two main clades of the *xanthostigma-leucostigma* complex, includes at present European (and Macaronesian, not shown) *O. xanthostigma*, European *O.* cf. *xanthostigma*, and different clades of *O.* cf. *xanthostigma* from New Zealand and North America. The other clade includes the tropical *O. aureocrenulata* and the *leucostigma-xanthoflexa* subclade which consists of two subgroups: (1) European *O. leucostigma* and two genotypes from USA and China (*O. leucostigma* s.l.), and (2) North American taxa with smooth spores (*O. xanthoflexa* s.l.). A strong correlation with the geographical origin is seen at the moment when focusing on all 14 genotypes of the *xanthostigma-leucostigma* complex: five genotypes are Australasian (New Zealand), three European, four North American (northeastern USA), one South American, and two eastern Asian. According to unpublished phylogenetic analyses (R. Healy pers. comm.), a majority of North American samples with white to yellow or orange apothecia represent two genotypes in the *xanthostigma* subclade, one of which including strain bhi-F037 from Massachusetts in Phyl. 23. Two samples with white apothecia belong with D.H.P. 108 from Maine to a genotype in the *O. leucostigma-xanthoflexa* subclade (for a comprehensive analysis see Baral et al. in prep.).

The affiliation of *O. xanthoflexa* s.l. from North America with *O. leucostigma* (ITS distance 7–8%) was unexpected, because this somewhat heterogeneous species sharply differs from the *xanthostigma-leucostigma* complex in longer, partly less curved, smooth ascospores. Its placement near *O. leucostigma* is surprising, considering the high ITS distance of 16.5% between *O. leucostigma* s.str. and *O. xanthostigma* s.str.

In the LSU D1–D2 the distance between *O. leucostigma* s.str. and *O. xanthostigma* s.str. lies at 3.5% and in the SSU V8–V9 at 0.8%. An overview of the ITS distances among the various genotypes within the *leucostigma-xanthostigma* clade is given in Baral et al. (in prep.).

The **S1506 intron** is present within the *leucostigma-xanthoflexa* subclade in *O.* cf. *xanthoflexa* (ga026b) and the three samples of European *O. leucostigma*, and within the *xanthostigma* subclade in 10 samples from New Zealand (4 shown in Phyl. S26), one from Luxembourg (G.M. 2018-04-28.1) and one from Massachusetts (bhi-F037). The intron is absent in nine European *O. xanthostigma* samples, two from Macaronesia, one from New Zealand (D2007), and in *O. aureocrenulata*. Some sequences are unclear in this respect as they were gained with the ITS1 primer or with the ITS4 primer alone. In conclusion, the presence/absence of the S1506 intron and its phylogenetic analysis permit distinction among the different genotypes, except that in one genotype from New Zealand with seven strains (including D660) the intron was 6× present and 1× absent (D2007).

When analysing the intron phylogenetically (Phyl. S26), strains bhi-F037 and G.M. 2015-12-12.1, members of the *xanthostigma* subclade, clustered with strong support sister to *O. leucostigma*, although other members of the *xanthostigma* subclade (i.e., samples from New Zealand) formed with unresolved relationship a strongly supported clade of their own (for more details see Baral et al. in prep.).

Three **group I introns** occur in the LSU D9–D11 domain (see Tab. 28) in both *O. xanthostigma* and *O. leucostigma*. The L1921 intron was not obtained in *O. leucostigma*, but appears to exist according to the PCR product on the agarose gel (sequencing of the D9 domain so far failed). The other two introns differ between *O. xanthostigma* and *O. leucostigma* by 23% (L2449) and 7% (L2563). The high distance in the L2449 intron is accompanied by numerous gaps in both sequences.

A correlation between molecular data and conidial shape seems unlikely. The conidia seen in two collections from New Zealand (IVV: PDD 58571, PDD 59160) did not differ from those observed in Europe. Regrettably, DNA data were unavailable for Liu's HMAS 139665, therefore, a molecular comparison of the samples with different conidial shapes was impossible. The inofficial LSU of D.H.P. 111 ('gracile type') belongs to one of the two mentioned unique North American genotypes of *O.* cf. *xanthostigma*, according to an unpublished phylogenetic analysis by R. Healy (pers. comm.).

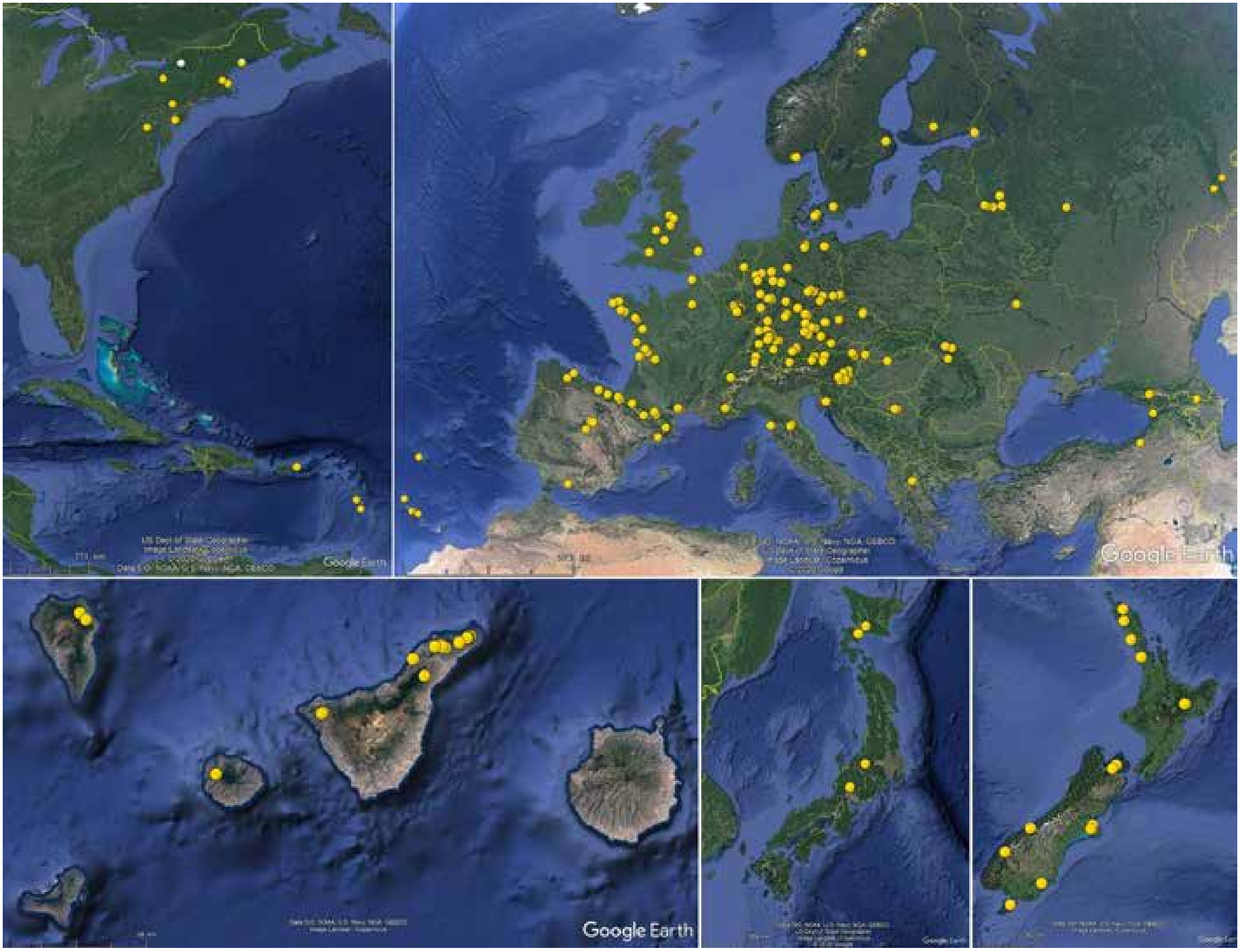
In view of the high distances observed in the ITS region within the *leucostigma-xanthostigma* clade, it appears that a couple of different cryptic species will need to be segregated in the future. Only *O. aureocrenulata* we have segregated here because of its macroscopic differences, although the hymenial features do not differ.

***O.** leucostigma* and O. *xanthostigma* possibly differ in the **relative DNA content**. In her study on the DNA content of nuclei, Weber (1992) found one of the three studied collections of

'*O. delicatula*' (from Wunsiedel, REG 143) to be heterogeneous within a single population, showing fruitbodies with the lowest relative DNA content (1 ×) and others with the double content (2 ×), whereas in the other two samples (REG 134, 138) she observed only the double content. No micromorphological differences were observed between the fruitbodies. Regrettably the apothecial colour was not noted, though she remembers mainly yellow apothecia. A possible explanation would be that REG 143 contained both *O. leucostigma* and O. *xanthostigma*, and the rarer *O. leucostigma* had the 1 × content.

Ecology. Judging from the literature and the consulted herbaria, the *xanthostigma-leucostigma* complex is among the most frequently collected species of *Orbilia*. A total of over 450 collections are assigned here to this complex. Within *xanthostigma-leucostigma complex*, yellow populations (marked by 'xan') were much more frequently encountered than white populations (marked by 'leu'). Among the European specimens listed below, 246 samples were assigned to *O. xanthostigma* and 74 to *O. leucostigma*. However, this distinction is based in most cases on apothecial colour alone, which was in *O. xanthostigma* partly only a faint yellow. Further 38 collections remained unclarified because notes on colour were lacking.

Species of the cosmopolitan and plurivorous *xanthostigma-leucostigma* complex grow on rotten wood, rarely bark (~6.5 %) of ± hygric to mesic branches or mainly on trunks/logs and stumps of both gymno- and angiosperm trees (rarely shrubs), rarely (~1 %) on xeric branches. Exceptionally it grew on cones of *Pinus*, perennial basidiomycetes, or pyrenomycetes. Favourite host genera can hardly be determined. Within Europe the species aggregate was predominantly recorded on *Fagus* {73 [43/25/5]}, followed by *Quercus* {51 [37/12/2]}, *Alnus* {32 [24/4/4]}, *Betula* {31 [23/3/5]}, *Carpinus* {22 [12/5/5]}, and *Salix* {17 [11/5/1]} (by omitting uncertain hosts, numbers in square brackets refer to *O. xanthostigma*/*O. leucostigma*/ undetermined). However, coniferous host genera (mainly *Pinus*) were also very frequently recorded {63 [47/8/8]}. The observed frequency of *O. xanthostigma* and comparative rareness of *O. leucostigma* on gymnosperms is in conflict with observations



Map 141. Known distribution of *O. xanthostigma* s.l. (yellow) and *O. leucostigma* (white) in Northern America, Europe (including Macaronesia and eastern Asia), Japan, and New Zealand.

by Ellis & Ellis (1985) who reported *O. leucostigma* mainly on coniferous wood (*Pinus nigra* var. *maritima* = Corsican Pine, a commonly planted forest tree in the lowlands of Britain), whereas they found *O. xanthostigma* to be more common on deciduous trees and only occasionally on conifers (*Pinus radiata*). In Macaronesia *O. xanthostigma* (and rarely *O. leucostigma*) were quite frequently collected by L. Quijada and J.P. Priou in the mesosub- to mesomediterranean semihumid to humid laurel forest and *Erica platycodon* ridge-crest evergreen forest, also in the humid pine forest, and the identified hosts include *Lauraceae* (*Laurus* 13 ×, *Ocotea* 3 ×, *Apollonias* 1 ×), *Ericaceae* (*Erica* 10 ×), *Myricaceae* (*Myrica* [= *Morella*] 8 ×), *Rosaceae* (*Prunus* 6 ×), and *Aquifoliaceae* (*Ilex* 6 ×) (for the list of collections see Quijada et al. 2016).

In about 15 of the European collections (~ 10 %) the inhabited region of the branches, trunks or logs was without contact to the soil. However, when growing on deeply rotten wood of standing, dead, ± decorticated trunks, the apothecia need not to be desiccation-tolerant since their water supply is provided by the substrate over a long time (marked below by 'mes'), similar as on the upper side of logs lying tightly on the ground. Only when growing on thin branches up to 0.5–3 m above the ground, the substrate is periodically dry and the apothecia should expectedly be drought-tolerant (marked below by 'xer'). This situation was only exceptionally observed, e. g., in a collection from Oberpfalz (H.B. 4929a) made in August 1993, in which ca. 25 bright honey-yellow apothecia of *O. xanthostigma* and *Brachysporium nigrum* grew closely together with the desiccation-tolerant *O. vinosa* on a 13 mm thick, partially decorticated, attached branch of *Quercus* in 1–2 m above the ground at the base of a south-exposed slope in a shady forest. However, all asci were dead when the dry specimen was examined a few days later. In another collection (H.B. 6396a, Oberbayern) 14 bright yellow(-orange) apothecia grew 0.5 m above the ground in association with the desiccation-tolerant *Claussenomyces atrovirens* on an arm-thick branch attached to a fallen tree, and here the rare case of nearly smooth spores was observed (Pl. 875: 5).

Whether members of the *xanthostigma-leucostigma* complex are able to trap invertebrates, in particular testaceous rhizopods, remains to be clarified. This behaviour was reported by Drechsler (1934) in *Pedilospora dactylopaga* (≡ *Dicranidion dactylopagum*), which might be a member of this group.

The *xanthostigma-leucostigma* complex appears to occur in all climatic regions that provide sufficient and prolonged humidity (humid to subhumid or semihumid) and woody substrate of a minimum thickness of (1–)3 cm. The altitude includes all levels from planar to subalpine. The species aggregate occurs from oroboreal to tropical, and from maritime to continental climates. Within Europe, a rather dense distribution is reported, e. g., for the Netherlands (http://www.verspreidingsatlas.nl/657030), Great Britain (http://www.fieldmycology.net/GBCHKLST/gbchklst.asp), Germany (Krieglsteiner 1993), Austria (http://www.austria.mykodata.net), and Switzerland (http://www.wsl.ch/dienstleistungen/inventare/pilze_flechten/swissfungi/verbreitungsatlas/index_DE). Outside of Europe its distribution includes eastern Asia (Raitviir 1991: 357, Liu 2006: 69, Wu 1998), southeastern Australia and New Zealand (Spooner 1987), Northern America (e. g., Schweinitz 1832, Pfister 1997), Middle America (present study), South America (Montagne 1853), Macaronesia (Quijada et al. 2016), and southeastern Africa (present study).

The occurrence within Europe mainly includes nemoral, cold-temperate to hemiboreal humid regions, with forests like *Querco-Fagetea*, *Alno-Fraxinetea*, and *Salicetea*, but also conifer forests, on calcareous as well as acidic soils. Collections are also known from warm-temperate to mesomediterranean regions of southern Europe (map). Within Macaronesia the known records are from the north-exposed thermomediterranean (sub)humid laurel forest and *Erica platycodon* ridge-crest forest but also the humid pine forest (map).

In (north)eastern North America the *xanthostigma-leucostigma* complex was recorded from cold- to warm-temperate humid forests, and in the northwest from a mild-maritime humid mixed evergreen forest. A few collections were studied from the tropical humid rainforests of the Antilles archipelago (map). Asia. In Australia and New Zealand (map) the vegetation mainly includes warm-temperate to subtropical humid *Nothofagus* forests. The single record from Africa was from a subtropical humid (winter-dry) broad-leaved forest in a ravine of a savannah plateau in the Drakensberg Mountains.

Specimens included (xan = *O. xanthostigma* s.l., with very pale to bright yellow apothecia [or clade genetically determined], leu = *O. leucostigma* s.l., with whitish or wine-reddish apothecia, leu & xan: mixed population of both colours, *leu = no information on apothecial colour available; xer = xeric, mes = mesic, no remark = hygric or unknown): **NORWAY**: **Aust-Agder**, 4 km N of Arendal, 2.7 km N of Vrengen, Sørsvann, 52 m, *Betula*, 19.X.2008, T.H. Dahl (xan, K.H. 161/08, doc. vid.). – 5 km ENE of Arendal, Tromøy, Alvekilen, 20 m, *Betula*, 3.V.2008, T.H. Dahl (xan, K.H. 95/08, doc. vid.). — **SWEDEN**: **Västerbotten**, 21 km NW of Saxnäs, NE of Grundfors, S of Kraejhpiesvaerie, ~620 m, log of *Betula pubescens*, on wood, 25.VII.2010, T. Læssøe (xan, ø). – **Uppsala**, 35 km WNW of Uppsala, around Knutby, ~30 m, log of *Picea abies*, before 2011, M.T. Banik (xan, 0521Banik_04G_31, uncultured clone; sq.: HQ611325). – **Skåne**, Söderåsen, 4.5 km NW of Röstånga, NW of Lierna, Lia mad, 120 m, log of ?*Carpinus betulus*, on wood, 4.VI.2006, J.G.B. Nielsen (xan, ø). – unlocalized, *Fagus sylvatica*, on wood, autumn and spring, ?E.M. Fries (leu, **type** of *Peziza leucostigma*, non vid., unlocated). — **FINLAND**: **Varsinais-Suomi**, 21 km W of Turku (Abo), Merimasku, ~10 m, log of indet. gymnosperm, on wood, 21. VI.1860, P.A. Karsten (leu, herb. Karsten 3193 & W. Nylander, H-6051956, as *Peziza leucostigma*). – **Kanta-Häme**, ~8 km E of Forssa, N of Tammela, Mustiala, 110 m, wood of *Betula*, 1.X.1868, P.A. Karsten (xan, Karsten 2351, H-6051979, **holotype** of *O. delicatula*, doc. vid.). — **ESTONIA**: **Tartumaa**, ~7 km SW of Tartu, Ropka Forest, 80 m, log of *Picea abies*, on wood, 30.VIII.1976, B. Kullman (*leu, TAAM 68861). — **DENMARK**: **Sjælland**, 6.5 km S of Sorø, 4 km S of Frederiksberg, Suserup Skov, 30 m, log of *Fagus sylvatica*, on wood, 25.V.2007, H.O. Baral (leu, H.B. 8513 ø). – ibid., shore of Tystrup Lake, 15 m, branch of *Alnus glutinosa*, on bark, 25.V.2007, W. Jaklitsch (leu & xan, ø). – 8 km NNW of Ringsted, 1 km S of Allindelille, Fredskov, 65 m, log of *Ulmus glabra*, on wood, 26.V.2007, J.G.B. Nielsen (leu & xan, ø). – ibid., log of *Fagus sylvatica*, on wood and *Hypoxylon macrocarpum*, 26.V.2007, J.G.B. Nielsen (*leu, ø). – ibid., log of ~*Alnus glutinosa*, on wood, 26.V.2007, J.G.B. Nielsen (xan, H.B. 8536 ø). — **GREAT BRITAIN**: **Scotland**, **Highland**, ~45 km W of Fort William, ?4.5 km NNW of Acharacle, Loch Moidart, Doirlinn (as 'Dorlin'), ~100 m, branch of *Fraxinus excelsior*, on wood, 7.X.1984, R.W.G. Dennis (*leu, H.B. 5753b ø, K(M) 48777, soc. holotype of *Hyaloscypha minuta*, as *Quercus*). – **Yorkshire**, **South Yorkshire**, 8 km NNW of Barnsley, 6.5 km S of Wakefield, Seckar Wood, 70 m, branch of *Betula pubescens*, on bark, 19.V.2011, M. Gregory & T. Læssøe (leu & xan, H.B. 9548a/b ø). – ibid., branch of *Quercus*, 19.V.2011, H.O. Baral (*leu, ø). – ibid., 78 m, log of *B. pubescens*, on wood, 10.VIII.2018, C. Hobart (xan, doc. vid.). – **West Yorkshire**, 9.3 km W of Halifax, 1.7 km SW of Mytholmroyd, Broadhead Clough, 205 m, branch of *Quercus*, on wood, 12.VII.2013, C. Yeates (xan, mes, ø, doc. vid.). – **West Midlands**, **Shropshire**, Shrewsbury, ~70 m, log of *Quercus*, on wood, undated, W. Phillips (xan, M, Phillips 130). – **Warwickshire**, 9.5 km NW of Warwick, SE of Baddesley Clinton, branch of *Betula pendula*, on wood, 18.VI.2019, P. Thompson (xan, ø, doc. vid.). – **East Midlands**, **Derbyshire**, 12 km W of Chesterfield, 1.2 km N of Beeley, NE of Chatsworth House, 140 m, stump of *Acer pseudoplatanus*, on wood, 28.VIII.2012, C. Hobart (xan, doc. vid.). – **East England**, **Suffolk**, 6.5 km SW of Southwold, 3 km NW of Dunwich, Fen Covert, 10 m, log of *Betula pubescens*, on wood, 9.X.2005, E. Batten (xan, E.B. 4636, doc. vid.). – 1.3 km W of Dunwich, Dunwich Forest S of Frederick's Mount, 10 m, log of *Pinus nigra*, on wood, 17.X.2005, E. Batten (xan, E.B. 4637, K(M) 200415, doc. vid.). – ibid., 1 km NW of Dunwich, 14 m, branch of *Ulex minor*, on wood, 17.IX.2005, S.M.

Francis (xan, E.B. 4627, H.B. 7992 ø). – NNE of Leiston, Minsmere, N of Scott's Hall, 15 m, branch of *U. minor*, on wood, 23.IX.2005, E. Batten (*leu, E.B. 4631, doc. vid.). –**South West England**, **Somerset**, ~8 km W of Bristol, forest E of Tyntesfield, ~130 m, branch of indet conifer, on wood, 31.VIII.2012, J. Oliver (xan, H.B. 9723 ø). — **NETHERLANDS**: **Gelderland**, ?4 km NE of Arnhem, motorway service area, ~65 m, log of *Fagus sylvatica*, 17.V.1975, H.O. Baral (xan, ø). – **Noord-Brabant**, 1 km W of Boxmeer, Brestbos, 18 m, *Quercus* branch, on wood, 24.X.2006, S. Helleman (leu, ø, doc. vid.). – 5.5 km S of Boxmeer, 2.7 km ESE of Stevensbeek, forest N of Overloon, 25 m, trunk of *Pinus strobus*, on wood, 26.XII.2016, S. Helleman (leu, S.H. 891 ø, doc. vid.). — **BELGIUM**: **Vlaanderen**, **Vlaams-Brabant**, 10.5 km SE of Brussels, 2.5 km W of Hoeilaart, Groenendaal, 100 m, log of *Quercus*, on wood, IX.1884, M.H. Rousseau (leu, BR, herb. Bommer & Rousseau, H.B. 8857 ø). — **LUXEMBOURG**: unlocalized, indet. wood, undated (< 1905), J. Feltgen (xan, LUX 42448, as *O. rubella*, herb. Tinant). – **L'Oesling**, **Diekirch**, 3.3 km NNW of Diekirch, 2.2 km W of Tomm, NE of Fridhaff, Hooldaer, 365 m, log of *Betula*, on wood, 23.IV.1995, H.O. Baral (leu, ø). – 25 km W of Ettelbruck, 1.9 km NE of Martelange, SE of Grumelange, Bruch, 372 m, branch of *Salix caprea*, on wood, 28.IV.2018, G. Marson (xan, xer, G.M. 2018-04-28.1, sq.: MK493154). – **Gutland**, **Diekirch**, 5.5 km ENE of Diekirch, 1.5 km NE of Bettendorf, Niderbierg, 390 m, log of indet. gymnosperm, on wood, 27.IV.1995, G. Martin (*leu, ø). – 5.5 km SE of Diekirch, 1.8 km WSW of Ermsdorf, Kieselshéicht, 320 m, log of indet. gymnosperm, on wood, 28.IV.1995, A. Lauron (xan, ø). – **Echternach**, 4 km WSW of Echternach, 1.5 km NE of Scheidgen, Juckebësch, 300 m, on wood of ?*Salix*, 26.V.2007, B. Schultheis (xan, doc. vid.). – **Mersch**, 6.5 km NW of Mersch, 2 km WNW of Bissen, Fleerchers Säitert, 310 m, log of *Fagus sylvatica*, on wood, 25.IV.1995, H.O. Baral (leu, ø). – ~1.5 km ENE of Mersch, ~E of Beringen, ~300 m, stump of indet. angiosperm, on wood, 3. III.1897, J. Feltgen (xan, LUX 42446, as *O. luteorubella*, *Fagus*). – ~2.5 km E of Mersch, Bierschbaach, ~300 m, on wood of *Salix alba*, 11.IX.1894, J. Feltgen (*leu, LUX 42470). – **Redange**, 15 km WSW of Mersch, 0.8 km SSW of Hovelange, Haard, 336 m, log of *Fagus sylvatica*, on wood, 15.VIII.2015, G. Marson (leu, G.M. 2015-08-15.4a; sq.: KY419182; xan G.M. 2015-08-15.4b; sq.: KY419181). – ibid., 12.XII.2015 (xan, G.M. 2015-12-12.1, sq.: MG372376). – ibid., 1 km S of Hovelange, 385 m, log of *F. sylvatica*, on wood, 12.XII.2015 (xan, G.M. 2015-12-12.2, sq.: MH221065). – **Luxembourg**, 10.5 km NE of Luxembourg, 1.2 km W of Ernster, Wuurzelwis, 350 m, branch of *F. sylvatica*, on wood, 5.V.2000, H. Mervielde (*leu, ø). – ibid., log of *Quercus*, on wood, 30.X.2000, G. Marson (*leu, ø, anam. substr.). – ~4 km NW of Luxembourg, N of Reckendall, Bambësch, Siweburen, ~310 m, stump of *Picea abies*, on wood, 1.X.1901, V. Noppeney (xan, LUX 42521, Feltgen as *O. coccinella*). – ibid., stumps of *Pinus*, on wood, 14.VIII.1900, J. Feltgen (xan, LUX 42451, Feltg. as *O. coccinella*). – [6 km NNW of Luxembourg, E of Bridel], Roudenhaff (as 'Rodenhof'), ~340 m, on wood of *Fagus sylvatica*, 18.VIII.1899, J. Feltgen (xan, LUX 42518, as *O. coccinella* on *Taxus*, **holotype** of *O. coccinella* f. *undulata*). – ~5 km ENE of Luxembourg, ~2.5 km NE of Neudorf, Gréngewald, ~350 m, stump of *Quercus*, on wood, 8.VIII.1901, V. Noppeney (xan, LUX 42520, as *O. coccinella*, *Picea*). – ~8.5 km E of Luxembourg, ~W of Schrassig, ~300 m, stump of *Pinus*, on wood, 1.VII.1897, J. Feltgen (xan, LUX 42450, as *O. coccinella*). – 5 km S of Luxembourg, 1.5 km W of Hesperange, Biersak/Géisselbierg, 290 m, log of *Quercus*, on wood, 16.VI.2007, G. Marson (xan, ø). – ibid., Kockelscheier, ~300 m, stumps of *Pinus*, on wood, 14.VIII.1900, J. Feltgen (xan, LUX 42452, as *O. coccinella*). – 7 km SE of Luxembourg, 2 km ESE of Alzingen, Héid, 300 m, trunk of *Quercus*, on wood, 15.VI.2007, G. Marson (xan, mes, ø). – ibid., branch of *Fagus sylvatica*, on wood, 19.IX.2009, G. Marson (xan, H.B. 9193, anam. substr.). – ibid., log of *F. sylvatica*, on wood, 16.VIII.2015, G. Marson (xan, G.M. 2015-08-16.1; sq.: KY419183). – ibid., log of *Quercus*, on wood, 16.VIII.2015, G. Marson (xan, G.M. 2015-08-16.2; sq.: KY419184). – **Esch-sur-Alzette**, 6.5 km S of Luxembourg, 1.7 km NW of Berchem, SE of Kockelscheier, Gemengebësch, 300 m, log of *Quercus*, on wood, 22.VI.2009, G. Marson (xan, H.B. 9081a ø). – 2.2 km S of Esch-sur-Alzette, 1.5 km ENE of Audun-le-Tiche, Ellergronn, 345 m, log of *Carpinus betulus*, on wood, 26.IV.2001, G. Ouvrard (*leu, H.B. 6921e). – **Remich**, 5.5 km NNW of Remich, 1.5 km WNW of Greiveldange, Néisbësch, 255 m, trunk of *Quercus*, on wood, 28.VI.2007, G. Marson (xan, mes, ø). — **GERMANY**: **Schleswig-Holstein**, 4.5 km S of Itzehoe, 2.3 km NW of Daegeling, Nordoe, 20 m, stump of *Pinus sylvestris*, on wood, 5.XI.2016, T. Richter (leu, H.B. 10036 ø). – **Mecklenburg-Vorpommern**, 20 km NNE of Rostock, Graal-Müritz, near Graal, ~5 m, log of *Alnus*, on wood, VIII.1909, H. Sydow (*leu, M, MPU, Rehm Ascom. 1881, as *O. botulispora*). – 16 km E of Teterow, ~NE of Salem (NW of Kummerower See), ~5 m, log of ~*Quercus*, on wood, 2.IX.2000, R. Kirschner (xan, H.B. 6750). – 2 km NW of Rehna, Löwitzer Holz, 20 m, branch of *Quercus*, on wood, 8.III.2018, T. Richter, vid. I. Wagner (leu, ø, doc. vid.). – 2.2 km SSE of Rehna, ENE of Nesow, Benziner Tannen, 35 m, log of ?*Fraxinus excelsior*, on wood, 16.VIII.1992, T. Richter (xan, T.R.). – 12 km ESE of Ratzeburg, 2 km SW of Kneese, Dohlen, 50 m, log of *Fagus sylvatica*, on wood, 30.IX.2007, T. Richter (xan, ø). – 8.5 km NE of Zarrentin, 1.3 km E of Neuenkirchen, Altes Moor, 45 m, log of ?*Populus*, on wood, 20.V.1993, T. Richter (xan, T.R.). – ibid., log of *Betula*, on wood (xan, ø). – **Sachsen-Anhalt**, 4 km NNE of Merseburg, 1 km E of Schkopau, Kollenbeyer Holz, 90 m, on wood of *Ulmus*, 31.III.1992, U. Richter (xan, ø). – 15 km SW of Merseburg, 1.5 km WNW of Gröst, Hakenholz, 160 m, log of *Ulmus*, on wood and old ?*Diatrype*, 9.IV.1992, U. Richter (xan, ø). – **Sachsen**, Leipzig, unlocalized, ~115 m, log of *Pinus sylvestris*, on wood, V.1875, G. Winter (xan, M, herb. Niessl 20428, as *Calloria chrysocoma*). – ibid., stump of indet. gymnosperm, on wood, IV.1872, G. Winter (xan, M, herb. Niessl 20429, as *C. chrysocoma*). – ~25 km NE of Dresden, Pulsnitz, pheasantry, ~300 m, on wood of *Abies excelsa* & *Alnus* (stump), summer 1881/82, autumn 1884, R. Staritz (xan, M, Rehm Ascom. 71b, Rabenh.-Winter, Fungi europaei, as *Calloria*/*Orbilia coccinella*, *P. abies*). – 35 km NNE of Chemnitz, ENE of Döbeln, Amselbachgrund, 195 m, on wood of indet. angiosperm, 25.XII.2012, S. Pohlers (xan, ø, doc. vid.). – ~4 km ENE of Chemnitz, Zeisigwald, ~370 m, log of *Quercus*, on wood, 2.III.2007, B. Mühler (xan, ø). – ibid., log of *Populus* (?) *nigra*, on wood, 25.VI.2010, B. Mühler (xan, ø). – **Thüringen**, 25 km W of Meiningen, 2 km S of Oberweid, Rhön, 724 m, branch of *Fagus sylvatica*, on wood, 20.V.2016, I. Wagner (xan, doc. vid.). – 2.3 km NW of Sonneberg, 1 km NNE of Bettelhecken, 480 m, log of *Quercus*, on wood, 9.XI.2014, I. Wagner (xan, ø, doc. vid.). – 1.2 km SSW of Bettelhecken, 370 m, trunk of *Betula*, on wood, 10.I.2014, I. Wagner (leu & xan, mes, ø, doc. vid.). – ibid., branch of *Quercus*, on wood, 10.I.2014, I. Wagner (xan, ø, doc. vid.). – 4.2 km SSW of Sonneberg, 2.5 km E of Neustadt, Unterlind, 345 m, log of *Alnus*, on wood, 16. XII.2008, P. Püwert & I. Wagner (xan, ø, doc. vid.). – 2.2 km SE of Neustadt, Heubischer Müß, 340 m, branch of *Betula*, on wood, 27.XII.2009, I. Wagner (xan, ø, doc. vid.). – **Hamburg**, 13 km ESE of Hamburg, SW of Lohbrügge, Boberger Niederung, Geesthang, 20 m, on wood of indet. angiosperm, 26. VI.1980, T.R. Lohmeyer (xan, T.R.L. 80/57). – **Niedersachsen**, ~3 km ENE of Hannover, Eilenriede, 65 m, log of *Quercus*, on wood, X.1916, C. Engelke (xan, M, Flora hannoverana 4945, as *O. coccinella*). – **Nordrhein-Westfalen**, 8 km WNW of Bielefeld, 4.5 km SE of Halle, Jakobsberg, 200 m, branch of *Carpinus betulus*, on wood, 19.X.2003, K. Siepe & I. & W. Sonneborn (xan, ø). – 18.5 SSW of Paderborn, 8 km E of Büren, SE of Altenböddeken, 380 m, on wood of *Fagus sylvatica*, 15.X.1994, K. Siepe (xan, K.S., doc. vid.). – 11 km SSW of Münster, 3.3 km SSW of Amelsbüren, Davert, Inkmannsholz, 70 m, log of *Fraxinus excelsior*, on wood, 29.X.2010, K. Siepe & F. Kasparek (xan, ø). – 11 km NNW of Recklinghausen, 4 km N of Marl, Sickingmühle, 34 m, log of *Salix*, on wood, 20.XI.2014, J.A. Mentken, vid. I. Wagner (xan, ø, doc. vid.). – 11 km ESE of Bochum, 1.3 km SSE of Witten, Hohenstein, 125 m, log of *Quercus*, on wood, 13.XII.2012, T. Hülsewig, vid. I. Wagner (xan, ø, doc. vid.). – **Rheinland-Pfalz**, ~13 km ENE of Altenkirchen, Gebhardshain, ~400 m, on indet. host, 20.IX.1985, O. Baral (xan, ø, anam. substr., doc. vid.). – 12.5 km SSE of Kaiserslautern, 4.8 km ESE of Trippstadt, Schwarzbach, 400 m, branch of *Picea abies*, on wood, 1.X.1994, J. Haedeke (leu, ø). – **Hessen**, 27 km NNW of Kassel, 6.5 km NNE of Hofgeismar, NNE of Hümme, Hümmer Bruch, 130 m, log of ?*Populus*, on wood, ~13.XI.1999, P. Schirmer (xan, L.K.). – 5.5 km NE of Gießen, 2.6 km SSE of Lollar, Hangelstein, 300 m, log of *Populus*, on wood, 7.I.2014, W. Schößler, vid. I. Wagner (xan, ø, doc. vid.). – 12 km ESE of Gießen, 4 km NNE od Lich, Kohlstrauch, 222 m, log of (?)*Carpinus betulus*, on wood, 15.VI.2017, F. Prell, vid. I. Wagner (xan, F.P. 389 ø, doc. vid.; sq.: MK504334). – 3 km NE of Wetzlar, 1.3 km NE of Garbenheim, 155 m, log of *Malus domestica*, on wood, 2.XI.2014, W. Schößler, vid. I. Wagner (xan, ø, doc. vid.). – unlocalized [?ENE of Rüdesheim], on wood of indet. gymnosperm, undated (spring), L. Fuckel (xan, M, herb. Fuckel Fungi Rhen. Exs. 1130, as *Calloria chrysocoma*). – **Baden-Württemberg**, 7 km E of **Heidelberg**, 1.5 km SE of Ziegelhausen, Bärenbach, 237 m, trunk of *Betula pendula*, on wood, 7.XI.2010, M. Bemmann (xan, mes, ø, doc. vid.). – ibid., 175 m, branch of *Corylus avellana*, on wood, 24.X.2010, M. Bemmann (xan, xer, ø, doc. vid.). – ibid., trunk of *Corylus avellana*, on wood, 31.X.2010, M. Bemmann (xan, mes, ø, doc. vid.). – 9 km ESE of Heidelberg, 1.5 km S of Neckargemünd, Hollmuth, 230 m, stump of *Quercus*, 9.VIII.2010, D. Bandini (xan, ø, doc. vid.). – ~2 km SW of Baden-Baden, E of Fremersberg, 300 m, on wood of indet. angiosperm, 28.V.?1975, P. Hausmann (xan, ø). – ~12 km ESE of Pforzheim, ~2 km NE of Wimsheim, 400 m, stump of *Quercus*, 12.VII.1975, H.O. Baral (xan, H.B. 310 ø). – 4.5 km SW of Sinsheim, WNW of Hammerau, 235 m, log of *Carpinus betulus*, on bark & *Lophocolea heterophylla*, IV.1999, L.G. Krieglsteiner (leu, H.B. 6350b). – 16 km S of Schwäbisch Hall, 3.3 km S of Gaildorf, SSW of Unterrot, Mohnwiesgehrn, 410 m, branch of ?*Fagus sylvatica*, on wood, 13.VII.1994, K. Siepe (leu, ø). – 7.5 km NW of **Stuttgart**, 1.3 km WSW of Weilimdorf, Fasanenwald, 345 m, branch of *Betula*, on wood, 23.XII.1975, H.O. Baral (*leu, ø). – 1.5 km SSE of Weilimdorf, Lindenbach, 340 m, log of *Alnus*, 18.IV.1976, H.O. Baral (*leu, ø). – ibid., stump of *Populus*, 25.I.1977, H.O. Baral (xan, H.B. 1616 ø). – 1.8 km S of Weilimdorf, Neue Burg Dischingen, 405 m, stump of *Pinus*, on wood, 2.I.1976, H.O. Baral (*leu, ø). – 1.3 km S of Weilimdorf, SE of Wolfbusch, Waldfriedhof, 360 m, branch of *Betula*, 21.II.1976, H.O. Baral (*leu, ø). – 1.2 km

SW of Wolfbusch, Vogelsang-Hirschbiegel, 400 m, log of *Betula*, 3.X.1975, H.O. Baral (*leu, ø). – 5 km S of Stuttgart, ~N of Asemwald, Ohnhold, 390 m, log of *Fraxinus excelsior*, on wood, 10.VI.1993, A. Gminder (xan, ø). – ~3 km WSW of **Tübingen**, Spitzberg, unlocalized, indet. wood, 2.X.1977, H.O. Baral (~leu, ø). – 4.5 km NW of Tübingen, ~1 km N of Hagelloch, Hornkopf, ~460 m, log of *Pinus*, on wood, 19.IV.1977, R. Agerer (leu, H.B. 2002). – 8 km NE of Tübingen, 4 km N of Pfrondorf, Eisenbachhain, 485 m, log of *Fagus sylvatica*, on wood, 20.VIII.1974, H.O. Baral (xan, H.B. 1237 ø, anam. substr.). – ibid., branch of *F. sylvatica*, on wood, 3.X.2006, H.O. Baral (leu, H.B. 8317b, anam. substr.). – ibid., log of *Quercus robur*, on wood, 3.X.2006, H.O. Baral (xan, ø). – 3.3 km NNW of Pfrondorf, Eichenfirst, 500 m, stump of *F. sylvatica*, on wood, 8.X.2000, E. Weber & H.O. Baral (xan, ø). – 2 km NNW of Pfrondorf, Ziegelhäule, 465 m, log of *F. sylvatica*, on wood, 8.X.2000, E. Weber & H.O. Baral (leu & xan, ø). – ibid., 1.XI.2000 (leu, H.B. 6810c, anam. cult., CBS 116212; sq.: KT215282; xan, H.B. 6810d, anam. substr.). – 1.5 km NW of Pfrondorf, N of Sophienpflege, 460 m, stump of ?*Malus domestica*, on wood, 22.VIII.1988, H.O. Baral (xan, H.B. 3529). – 1.2 km N of Pfrondorf, Brandklinge, 450 m, log of indet. tree, on wood, 11.VI.1992, H.O. Baral (leu & xan, ø). – 1.5 km NNE of Pfrondorf, 460 m, log of *Fagus sylvatica*, on wood, 30.VII.2000, H.O. Baral (xan, ex H.B. 6749, M-0177061, **neotype** of *O. xanthostigma*, CBS 116210, anam. cult.; sq.: CBS ined.). – 0.5 km E of Pfrondorf, Tiefenbach, S of Einsiedlersteg, 385 m, log of *Pinus sylvestris*, on wood, 19.IX.1993, H.O. Baral (xan, ø). – ibid., stump of *Quercus*, on wood, 19.IX.1993, H.O. Baral (xan, ø). – ibid., 410 m, of *Acer pseudoplatanus*, on wood, 25.VIII.1988, H.O. Baral & L.G. Krieglsteiner (leu, H.B. 3543b). – ibid., branch of *Carpinus betulus*, on wood, 25.VIII.1988, H.O. Baral & L.G. Krieglsteiner (leu & xan, ø). – ibid., 27.VI.1991, G. Marson & H.O. Baral (leu, ø). – ibid., branch of *Betula pendula*, on wood, 5.IX.1992, H.O. Baral & E. Weber (xan, ø). – ibid., 4.X.1992, H.O. Baral (leu, ø). – ibid., log of *Alnus glutinosa*, on wood, 12.VIII.2000, H.O. Baral (xan, H.B. 6745, anam. substr.). – ibid., branch of *Fagus sylvatica*, on wood, 30.IX.2004, E. Weber (leu, ø). – 0.9 km E of Pfrondorf, 430 m, 7.VII.1993, H.O. Baral (xan, H.B. 4913a). – ibid., log of *F. sylvatica*, on wood, 17.VIII.1993, H.O. Baral (xan, ø). – ibid., branch of *Quercus*, on wood, 20.IV.1997, H.O. Baral (leu & xan, H.B. 5758b/c). – ibid., 385 m, log of *Quercus*, on wood, 11.VI.2016, H.O. Baral (xan, H.B. 10009 ø). – 1 km ESE of Pfrondorf, Hinterpfand, 420 m, branch of *Fagus sylvatica*, on wood, 23.VII.2005, F. Baral-Weber & H.O. Baral (leu & xan, H.B. 7848c/a ø). – ibid., 22.X.2005, E. Weber (*leu, ø). – ibid., 6.VI.2010, H.O. Baral & E. Weber (leu, H.B. 9335 ø, anam. substr.). – ibid., branch of *F. sylvatica*, on wood, 11.VI.2016, E. Weber (xan, H.B. 10010 ø). – ibid., E. Weber & H.O. Baral (leu, H.B. 10011 ø). – SSE of Pfrondorf, Haldenbach, 340 m, log of *Salix*, on wood, 24.XI.2002, E. Weber & H.O. Baral (xan, ø). – ibid., log of ?*Populus*, on wood, 30.X.2005, E. Weber (leu & xan, H.B. 7951b). – ibid., log of indet. gymnosperm, on wood (xan, ø). – ibid., branch of *F. sylvatica*, on wood, H.O. Baral (leu, H.B. 7958 ø). – SE of Pfrondorf, 345 m, log of *Carpinus betulus*, on wood, 18.X.2004, H.O. Baral & F. Baral-Weber (leu & xan, ø). – ibid., log of *Fraxinus excelsior*, on wood, 14.XI.2010, H.O. Baral (xan, H.B. 9451 ø). – S of Pfrondorf, Bitzle, 350 m, branch of *Fagus sylvatica*, on wood, 20.IX.1992, H.O. Baral (leu, ø). – ibid., branch of *F. sylvatica*, on wood, 12.VII.2002, E. Weber (leu & xan, H.B. 7165g/d ø, anam. substr.). – ibid., branch of *Carpinus betulus*, on wood, 24.XI.2002, H.O. Baral (*leu, ø). – ibid., branch of *Fagus sylvatica*, on wood, 25.VII.2004, E. Weber & H.O. Baral (leu, ø). – ibid., log of *Carpinus betulus*, on wood, 27.VII.2005, I. Kušan, H.O. Baral & N. Matočec (leu & xan, H.B. 7852d/a). – ibid., log of *Fagus sylvatica*, on wood, 28.VI.2015, H.O. Baral (leu & xan, M-0276499, **neotype** of *O. leucostigma*, isotype in H.B. 9958a; sq.: KY419187; *O. xanthostigma*: H.B. 9958b; sq.: KY419188). – ibid., 16.V.2016, log of *F. sylvatica*, on wood (xan, H.B. 10002 ø). – ibid., branch of *F. sylvatica*, on wood (leu, H.B. 10003 ø). – 3 km SW of Nürtingen, E of Raidwangen, Reigerwäldle, 335 m, branch of *Acer*, on wood, 25.IX.1992, H.O. Baral (*leu, ø). – 5.5 km SE of Nürtingen, 3.3 km WNW of Owen, Tiefenbachtal, 355 m, log of *F. sylvatica*, on wood, 29.IX.1990, H.O. Baral (leu & xan, ø). – **Schwäbische Alb**, 5 km E of Metzingen, 2 km SW of Neuffen, Hörnle, 690 m, log of *F. sylvatica*, on wood, 25.V.2005, E. Weber (leu & xan, H.B. 7790b/a ø). – 1.5 km WSW of Münsingen, SE of Lerchenhof, Alenbrunnenhütte, 750 m, of *F. sylvatica*, on wood, ~23. IX.1988, F. Glöckner (*leu, ø). – 4 km SSW of Mössingen, 1.5 km NE of Beuren, Dreifürstenstein, 850 m, stump of *Abies alba*, on wood, 23.VI.2002, F. Baral-Weber (xan, mes, ø). – 17 km W of Ulm, ~3 km NNE of Schelklingen, Tiefental, ~580 m, branch of *Carpinus betulus*, on wood, 27.I.1990, H.O. Baral & L.G. Krieglsteiner (xan, ø). – **Schwarzwald**, 5.2 km WNW of Villingen, 2.3 km ESE of Unterkirnach, Ruine Kirnegg, 778 m, log of bench of *Quercus*, on wood, 5.VIII.2009, B. Liu, E. Weber & H.O. Baral (xan, mes, H.B. 9121 ø). – **Oberschwaben**, 2.3 km NW of Ulm, SE of university, Eselsberg, 620 m, branch of indet. gymnosperm, on wood, 22.XII.1988, H.O. Baral (xan, ø). – ibid., on wood of *Quercus*, 22.XII.1988, H.O. Baral & L.G. Krieglsteiner (leu & xan, ø). – 9 km WSW of Bad Waldsee, 6 km S of Aulendorf, Röschenwald, 530 m, log of *Picea abies*, on wood, 3.VI.1998, E. Weber (xan, H.B. 5946). – **Bayern**, **Unterfranken**, 12 km SE of Schweinfurt, 2.5 km SSE of Grettstadt, Holzspitze, 240 m, fragment of indet. angiosperm, on wood, 5.VII.1996, L.G. Krieglsteiner (leu, ø). – 15 km SE of Schweinfurt, 1 km S of Alitzheim, Hörnauwald, 230 m, branch of *Quercus*, on bark, 12.XI.1995, H.O. Baral & L.G. Krieglsteiner (xan, L.K.). – 18 km E of Würzburg, 4.5 km NE of Kitzingen, Klosterforst, 220 m, log of *Pinus*, 22.II.2013, U. Speer (xan, vid. I. Wagner, ø). – **Oberfranken**, 14 km W of Wunsiedel, E of Bischofsgrün, 710 m, log of (?)*Quercus*, on wood, 27. IX.1987, E. Weber (xan, REG 134). – 8 km NNW of Bamberg, 2 km S of Baunach, Zöllnerholz, 300 m, branch of *Quercus*, on wood, 6.VI.1992, H. Engel, vid. M. Eckel (leu, H.B. 4954a, M.E. 92/11-12, as *O. vinosa*). – **Oberpfalz**, 13 km NNE of Amberg, 1.8 km WNW of Hirschau, Eschenbach, 440 m, branch of *Quercus robur*, on wood, 8.VIII.1993, H.O. Baral (xan, H.B. 4929a). – 13.7 km NE of Regensburg, 3.5 km NW of Bernhardswald, SW of Kürn, Lindenallee, 535 m, on wood of *Tilia*, 11.VI.1965, J. Poelt (*leu, M). – 13.5 km ESE of Regensburg, E of Roith, Mooshof, 340 m, branch of *Salix*, on wood, 1.II.1990, H.O. Baral & E. Weber (xan, ø). – ~20 km ESE of Regensburg, Pfatter, ~330 m, on wood of *Quercus*, 15.VI.1918, S. Killermann (leu, M, herb. Killermann). – 13.7 km NW of Regensburg, 1 km NW of Pielenhofen, Naab valley, Osterstube, 400 m, log of *Abies alba*, on wood, 30.I.1990, H.O. Baral, E. Weber & L.G. Krieglsteiner (xan, ø). – ~9 km SW of Regensburg, ~N of Matting, Mattinger Hänge, 400 m, branch of *Fagus sylvatica*, on wood, 22.VI.1987, A. Rott (leu & xan, REG 143). – ~7.5 km ENE of Neunburg vorm Wald, ~3.5 km NW of Rötz, Schwarzwihrberg, ~600 m, branch of indet. gymnosperm, on wood, 4.IV.1934, S. Killermann (xan, M, herb. Killerm., as *Microscypha incerta*). – 16 km NE of Cham, 5.3 km NW of Furth im Wald, W of Drei Wappen, 900 m, branch of *F. sylvatica*, on wood, 5.VIII.2005, F. Baral-Weber (xan, ø). – **Niederbayern**, Bayerischer Wald, 12 km SE of Zwiesel, 4 km NNE of Spiegelau, Schöner Ort, 890 m, log of *Picea abies*, on wood, 7.VII.1989, N. Luschka (*leu, REG). – 4 km NE of Spiegelau, Feistenhäng, 875 m, on wood of *Fagus sylvatica*, 10.VIII.1988, N. Luschka (*leu, REG). – 3 km NNW of Spiegelau, Hahnenfalz, 760 m, stump of *Picea abies*, on wood, amidst *Botryobasidium*, 21.XI.1989, N. Luschka (xan, REG). – 4.5 km NNE of Spiegelau, Lärchenberg, S-slope of Rachel, 890 m, log of *Acer*, on wood amidst *Corticiaceae*, 19.VI.1989, N. Luschka (xan, REG). – 6.5 km NE of Spiegelau, 2.8 km N of Guglöd, Racheldiensthütte, 875 m, log of *Fagus sylvatica*, on wood, 28.VIII.1984, A. Bresinsky (xan, REG). – 8.5 km NE of Spiegelau, 4.5 km WNW of Lusen, SW of Großer Spitzberg, 1250 m, root of *Picea abies*, on wood, 19.VIII.1987, N. Luschka (xan, REG 138). – Spiegelau, Mitternau, 840 m, log of *Betula*, on wood amidst *Corticiaceae*, 11.VIII.1989, N. Luschka (xan, REG). – **Oberbayern**, 9 km NW of München, 1.5 km ESE of Allach, Angerlohe, 515 m, log of *Carpinus betulus*, on wood, 19.IX.1993, D. Triebel & G. Rambold (xan, D. Triebel MFE 278, M-0040239). – 11 km NW of München, 1 km NE of Allach, Allacher Forst, N of Waldkolonie, 505 m, branch of *Quercus*, on wood, 11.VI.1999, L. Beenken (xan, mes, H.B. 6396a). – ~6.5 km WSW of München, Holzapfelkreuth, 545 m, on wood of indet. angiosperm (as *Quercus*), 27.IX.1883, A. Allescher (xan, M, herb. Allescher, as *O. coccinella*). – 13 km WSW of München, ~1 km W of Planegg, Maria-Eich, 560 m, log of *Fagus sylvatica*, on wood, 23.VII.1854, F. Kummer (xan, M, herb. Reg. Monac., as *C. chrysocoma*). – 7.5 km SSW of München, Großhessellohe, 540 m, log of indet. gymnosperm, on wood, 2. VII.1854, F. Kummer (xan, M, herb. reg. Monac., as *Calloria chrysocoma*). – München, unlocalized, ~500 m, branch of ?*Carpinus betulus*, on wood, IX.2017, collector unknown, vid. B. Fellmann (xan, doc. vid.). – 8 km NW of Tutzing, 3.5 km S of Andechs, Goaslweide, 720 m, branch of *Sorbus aria*, on wood, 10.X.2002, P. Karasch (xan, ø). – ibid., branch of *Pinus*, on wood, 7.III.2003, P. Karasch (xan, ø). – ibid., log of *Abies alba*, on wood, 6.VI.2003, P. Karasch (xan, ø). – ibid., log of *Quercus*, on wood, 14.VI.2003, P. Karasch (leu, ø). – ibid., of *Fagus sylvatica*, on wood, 20.VI.2003, P. Karasch (xan, ø, doc. vid.). – ibid., branch of *Sorbus aria*, on wood, 15.X.2005, H.O. Baral (xan, H.B. 7931b). – 16 km WSW of Berchtesgaden, 4 km SW of Hintersee, Schaflsteig, 1220 m, log of *Fagus sylvatica*, on wood, 9.IX.1982, H. Schmid (xan, M, H.S. 2150). – 9 km SW of Berchtesgaden, ~3.5 km SSE of Ramsau, W of Mitterkaseralm, 1250 m, log of *F. sylvatica*, on wood, 15.IX.1982, H. Schmid (xan, M, H.S. 2141). – 10 km WSW of Berchtesgaden, 2 km WSW of Ramsau, above Datzmann, 840 m, log of *F. sylvatica*, on wood, 23.X.1982, H. Schmid (xan, M, H.S. 2386, as *O. coccinella*). — **SWITZERLAND**: **Aargau**, 17 km WSW of Zürich, 1.5 km NE of Waltenschwil, Churzholz, 475 m, of ?*Acer*, on wood, ~30.VIII.2011, U. Graf (xan, H.B. 9592 ø). – **Luzern**, 2.5 km NE of Luzern, NW of Dietschiberg, Hombrig, 635 m, branch of *Fagus sylvatica*, on wood, 2.VII.2011, U. Graf (leu, ø, doc. vid.). – ~2.5 km S of Luzern, Bireggwald, 500 m, log of *Quercus*, on wood, 25.VII.1975, F. Kränzlin (xan, NMLU 2507-75 K). – 6 km S of Luzern, 1 km NW of Hergiswil, Bruustried, 600 m, branch of *Corylus avellana*, on wood, 22.VIII.2006, U. Graf (leu, xer, H.B. 8280). – **Uri**, 4 km NW of Andermatt, 2 km WSW of Göschenen, Steglaui, 1250 m, branch of *Alnus alnobetula*, on wood, 20.VIII.2006, F. Müller (leu, H.B. 8259 ø). — **LIECHTENSTEIN**: 4 km WNW of Feldkirch, 1.8 km NE of Ruggell, Ruggeller Riet, 430 m, branch of *Salix cinerea*, on wood, 8.VII.1997, H.O. Baral (leu, ø). — **AUSTRIA**:

Oberösterreich, 55 km SW of Linz, NE of Gmunden, Krottensee, 470 m, log of *Alnus glutinosa*, on bark & wood, 23.IX.1993, W. Dämon (xan, H.B. 4953, W.D. 88/93). – ibid., branch of indet. angiosperm, on wood, 26.V.1993, W. Dämon (xan, W.D. 34/93). – ibid., branch of *A. glutinosa*, on wood (& bark), 7.VIII.1991, 29.VI. & 7.VIII.1993, W. Dämon (xan, W.D. 34/93). – ~15 km SW of Steyr, ~2 km SSE of Steinbach, 600 m, branch of *Salix*, on wood, 19.VII.1993, K. Helm (leu, ø). – 7.5 km WSW of Salzburg, 1 km SW of Wals, 437 m, log of *Alnus incana*, on wood, 10.VII.1993, W. Dämon (xan, W.D. 46/93). – 3 km NE of Salzburg, Sam, Samer Mösl, 433 m, branch of (?)*Sorbus aucuparia*, on wood, 9.VIII.1990, W. Dämon (*leu, W.D. 50/90). – ibid., branch of (?)*Fraxinus excelsior*, on wood, 20.VII.1991, W. Dämon (*leu, W.D. 50/90). – ibid., branch of *Prunus padus*, on ?*Peniophora cinerea*, 24.X.1990, W. Dämon (xan, W.D. 232/90). – ibid., branch of *Prunus padus*, on bark & wood, 24.VIII.1990, W. Dämon (*leu, W.D. 232/90). – ibid., branch of *Betula*, on wood, 10.IV.1991, W. Dämon (*leu, W.D. 14/91). – **Niederösterreich**, ~25 km W of Wien, ~3 km W of Pressbaum, Rekawinkel, ~350 m, indet. gymnosperm, on wood, 1907, F. v. Höhnel (xan, M, as *O. coccinella*). – ibid., *Fagus sylvatica*, on wood, 3.VIII.1906, F. v. Höhnel (xan, FH 00304813, H.B. 6287 ø, **holotype** of *O. botulispora*). – ~2.5 km W of Pressbaum, Rekawinkel-Dürrwien, ~350 m, branch of indet. angiosperm, on wood, 28.VII.1907, F. v. Höhnel (*leu, herb. Höhnel, FH 00458351, as *O. botulispora*). – 22 km SW of Wien, 1.3 km SSW of Gaaden, 375 m, trunk & log of *Betula*, on wood, 18.IX.2012, M. Mann (xan, mes, M.M. 20120918, doc. vid.). – **Steiermark**, ~5.5 km W of Bad Aussee, ~2 km W of Sarstein, ~1500 m, log of *Fagus sylvatica*, on wood, 6.VIII.2010, G. Friebes (xan, ø, non vid.). – 14 km NW of Graz, 4 km WNW of Gratkorn, NW of Stift Rein, 560 m, branch of *F. sylvatica*, on wood, 4.VII.2010, G. Friebes (leu, ø, doc. vid.). – 14 km SW of Hartberg, WNW of St. Johann bei Herberstein, Feistritzklamm, 380 m, trunk of *Carpinus betulus*, 6.XI.2010, G. Friebes (xan, mes, ø, doc. vid.). – 6 km NNW of Graz, 2 km NW of Andritz, 500 m, branch of indet. plant, on wood, 13.XI.2010, G. Friebes (xan, ø, non vid.). – Graz, unlocalized, on wood of indet. gymnosperm, IX.1861, G. Niessl v. Mayendorf (xan, M, herb. Niessl 20431, as *Peziza chrysocoma*). – 2.3 km NE of Graz, Hilmteich, 388 m, log of *Alnus*, on wood, VIII.1860, G. Niessl v. Mayendorf (xan, M, herb. Niessl 20432, als *P. chrysocoma*). – 30 km ESE of Graz, ENE of Rohr a. d. Raab, 375 m, trunk of *Alnus*, on wood, 15.II.2014, A. Gallé, vid. I. Wagner (xan, mes, ø, doc. vid.). – ibid., 380 m, branch of indet. angiosperm, on wood, 12.XI.2017, A. Gallé, vid. G. Friebes (leu, GJO 88306, doc. vid.). – 22 km SE of Graz, ~4 km ENE of Wildon, Pesendorf, ~320 m, log of indet. angiosperm, on wood, 29.VI.1980, J. Poelt (xan, M, Pl. Graec. Fungi 353, as *O. coccinella*). – 17 km E of Wolfsberg, 1.7 km W of Gschrepl, NE of Glashütten, 1280 m, stump of *Picea abies*, on wood, 31.VII.2010, G. Friebes (xan, ø, non vid.). – 35 km SW of Graz, Trahütten, ~900 m, on indet. gymnosperm, on wood, 8.X.1999, D. Baloch & W. Maurer, vid. G. Friebes (leu, W.M., doc. vid.). – 45 km S of Graz, ~2 km W of Leutschach, Eichberg, ~350 m, indet. angiosperm, on wood, 19.IX.1996, W. Maurer, vid. G. Friebes (leu, W.M., doc. vid.). – 44 km SSE of Graz, ~1 km S of Spielfeld, ~300 m, *Betula*, on wood, 18.VII.1995, W. Maurer, vid. G. Friebes (xan, W.M., doc. vid.). – 50 km SSW of Graz, ~4 km SW of Eibiswald, Radlpassstraße, ~450 m, indet. angiosperm, on wood, 16.IX.1996, W. Jaklitsch & W. Maurer, vid. G. Friebes (xan, W.M., doc. vid.). – **Tirol**, 26 km WNW of Innsbruck, ~3.3 km N of Telfs, S of Hohe Munde, ~1400 m, on indet. woody plant, 28.VI.1977, P. Hausmann (xan, ø, doc. vid.). — **SLOVAKIA**: **Bratislava**, Bratislava ('Posonium'), floodplain ('in der Au'), ~140 m, on wood of *Pinus*, XI.1898, J.A. Bäumler (xan, M, herb. Bäumler, herb. Allescher, as *Orbilia luteorubella*). — **HUNGARY**: **Pest**, Danube-Ipoly National Park, 24 km NNW of Budapest, 6 km NE of Szob, E of Márianosztra, 285 m, log of *Carpinus betulus*, on wood, 15.X.1999, L. Beenken (xan, ø). – 5 km E of Szob, 2 km NE of Zebegény, ~200 m, branch of *Quercus cerris*, on wood, 11.X.1999, L. Beenken (xan, ø). — **CZECHIA**: **Plzeň**, ~15 km E of Plzeň, Rokycany, ~450 m, log of *Abies alba*, on wood, VIII.1924, K. Cejp (xan, PRM 149285, **holotype** of *O. millispora*). – **Central Bohemia**, 27 km SE of Praha, Mnichovice, ~370 m, branch of *Alnus* (as *Fraxinus excelsior*), on wood, 30.VII.1926, J. Velenovský (xan, PRM 152398, **holotype** of *O. alnea* var. *vesiculosa*, H.B. 6421 ø). – 0.3 km W of Mnichovice, 'in our garden', 370 m, log of *Robinia pseudoacacia*, on wood, 26.XI.1940, J. Velenovský (xan, PRM 152421, **holotype** of *O. hypothallosa*, H.B. 6182 ø). – ~3 km SE of Mnichovice, Hrusice, ~360 m, branch of *Abies*, on wood, VII.1933, J. Velenovský (xan, PRM 152388, **lectotype** of *O. paradoxa*). – 3 km SSE of Mnichovice, W of Hrusice, Hubáčov, ~325 m, branch of *Juniperus communis*, on wood, 7.VI.1942, J. Velenovský (leu, PRM 152439, **holotype** of *O. vitrea*, H.B. 6398 ø). – 30 km ESE of Praha, around Jevany, ~450 m, log of *Fagus sylvatica*, on wood, 7.VII.1941, L. Hostáňyová (leu & xan, PRM 151693 [mixture], **holotype** of *O. faginea*, H.B. 6126 ø). – **South Bohemia**, 20 km SSW of Krumlov, around Lipno nad Vltavou, reservoir Lipno, ~750 m, log of indet. angiosperm, on wood, 15.VIII.1994, K. Helm (xan, ø). — **POLAND**: unlocalized, *Abies alba*, undated, ?E.M. Fries (xan, **type** of *P. xanthostigma*, non vid., unlocated). – **Lower Silesia**, 9 km S of Kłodzko, 2 km S of Żelazno, Bielica Mt., 430 m, log of ?*Pinus*, on wood, 27.XI.2006, P. Perz (xan, P.P. 20061127-1, doc. vid.). – 3.3 km ENE of Kłodzko, ~1 km N of Jaszkowka, 450 m, log of *Picea abies*, on wood, 30.XI.2006, P. Perz (xan, P.P. 20061130-1, anam. substr., doc. vid.). – ?**Poland (Warmia-Masuria)**, or **RUSSIA (Kaliningradskaya)**, 'Ostpreußen', log of *Alnus*, on wood, 1923, [G.] Reddig (xan, M, herb. Bresadola, as *Orbilia coccinella*). — **FRANCE**: **Nord-Pas-de-Calais**, **Pas de Calais**, 30 km SSW of Calais, 8 km ESE of Boulogne-sur-Mer, Forêt domaniale, 130 m, branch of *Betula*, on wood, 11.VIII.2002, R. Courtecuisse (xan, H.B. 7198b). – **Basse-Normandie**, **Orne**, 3 km NNW of Bellême, La Herse, 190 m, branch of *Salix*, on wood, 23.IX.2005, J.P. Priou (leu, J.P.P. 25137, doc. vid.). – **Picardie**, **Oise**, 11 km W of Clermont, 1.7 km ESE of Froidmont, SSE of Ancienne Abbaye, 77 m, indet. wood, 20.V.2012, M. Chiaffi (xan, J.P.P. 12130, doc. vid.). – **Île de France**, **Essonne**, 4.5 km WNW of Dourdan, N of St.-Mesme, branch of indet. angiosperm, on wood, 27.V.2018, F. Valade (leu, doc. vid.). – **Bretagne**, **Finistère**, 1.3 km N of Quimperlé, SW of Mauduit manufactures, 48 m, on wood of *Betula*, 28.II.2012, Y. Quelenn, vid. J.P. Priou (xan, J.P.P. 12084, doc. vid.). – 6.5 km WSW of Douarnenez, 3 km NE of Poullan-sur-Mer, Kérière, 50 m, on wood of *Pinus*, 2.VI.2012, Y. Quelenn (xan, J.P.P. 12133, doc. vid.). – 41 km ESE of Brest, 1 km NE of Brasparts, NW of Poul ar Gurun, 100 m, indet. wood, 1.IX.1993, J. Mazé (xan, J.P.P. 9319, non vid.). – **Ille-et-Vilaine**, 10.5 km NE of Redon, 2 km SW of La Chapel-de-Brain, Marais de Gannedel, 3 m, on wood of *Salix*, 28.II.2012, A. Poncelet (xan, J.P.P. 12087, doc. vid.). – **Morbihan**, 1.9 km WSW of La Gacilly, SE of Mabio, La Naveterie, 38 m, on wood of *Salix*, 9.VIII.1984, J.P. Priou (xan, J.P.P. 84103, non vid.). – 19.5 km NE of Lorient, 6.3 km NW of Languidic, Ecluse de Manervern, 21 m, on wood of *Tilia*, 22.I.2012, Y. Quelenn (xan, J.P.P. 12031, doc. vid.). – **Pays-de-la-Loire**, **Maine-et-Loire**, 12 km SE of Cholet, S of Maulévrier, Parc de Maulévrier, 130 m, on cones of *Pinus*, 17.VI.1984, J. Mornand (leu, J.M. 8424A). – 24 km ENE of Nantes, St.-Sauveur-de-Landemont, Vallée de la Divatte, ~50 m, on wood of *Alnus*, 16.V.1993, T.R. Lohmeyer (xan, ø). – **Vendée**, 21 km SSW of La Roche-sur-Yon, 2.3 km NNW of Avrillé, Bois de la Garde, 35 m, branch of *Quercus robur*, on wood, 5.VI.2003, J. Mornand, P. Leroy & J. Fournier (xan, ø). – **Poitou-Charentes**, **Charente-Maritime**, Poitou, 25 km SSE of Niort, 2.5 km ESE of la Villedieu, Forêt d'Aulnay, 115 m, log of *Fagus sylvatica*, on wood, 28.IV.2006, N. Van Vooren (leu, ø). – 3 km E of Villiers en Chizé, Forêt de Chizé, SE of Puymardier, 78 m, log of *F. sylvatica*, on wood, 24.IV.2006, N. Van Vooren (xan, ø). – 14 km WSW of Niort, 1.2 km NNE of Amuré, Marais Poitevin, Port Goron, 5 m, log of *Populus*, on wood, 24.IX.2011, M. Hairaud (xan, M.H. 90911, doc. vid.). – 19 km S of Rochefort, 2 km NE of Cadeuil, NW of la Petite Vergne, 17 m, indet. wood, 15.III.2013, P. Tanchaud (xan, doc. vid.). – 1.5 km NNW of Cadeuil, 18 m, log of *Quercus*, on wood, 12.III.2019, P. Tanchaud (leu & xan, doc. vid.). – 13 km WNW of Saintes, 1.2 km NNW of Soulignonne, NW of Les Jamets, Bois Fombedeau, 23 m, wood of angiosperm tree, 8.I.2012, P. Tanchaud (xan, doc. vid.). – **Charente**, 30 km NE of Angoulême, S of Cellefrouin, forêt domaniale, 130 m, branch of *Fagus sylvatica*, on wood, 27.X.2015, P. Tanchaud (xan, doc. vid.). – **Rhône-Alpes**, **Loire**, 10 km SW of Boën, 1 km SE of St.-Georges-en-Couzan, le Pont du Diable, 570 m, log of *Betula*, on wood, 5.V.2010, N. Van Vooren (*leu, ø). – **Haute-Savoie**, 3.5 km NNE of Sallanches, 0.2 km E of Luzier, 600 m, branch of *Fagus sylvatica*, on wood, 3.VII.2006, J.L. Cheype (leu & xan, J.L.C., doc. vid.). – **Provence-Alpes-Côte d'Azur**, **Alpes Maritimes**, 3.5 km N of Colmars-les-Alpes, 3 km S of Allos, La digue d'Allos, 1350 m, branch of *Picea abies*, on wood, 6.VI.2010, J.P. Priou (xan, J.P.P. 10122, non vid.). – **Languedoc-Roussillon**, **Hérault**, 9.5 km WSW of Bédarieux, SE of Combes, Ruisseau de La Capoulade, 360 m, branch of *Castanea sativa*, on wood, 5.I.2007, G. Garcia (xan, ø, anam. substr., doc. vid.). – **Midi-Pyrénées**, **Ariège**, 12 km ENE of St.-Girons, ~2 km NE of Rimont, Ruisseau de Peyrau, ~430 m, indet. wood, 27.X.2011, Y. Mourgues (xan, J.P.P. 11167, doc. vid.). – 11 km WNW of Tarascon-sur-Ariège, 4.7 km W of Saurat, SW of Prat Communal, Loumet, 1020 m, indet. wood, 29.X.2011, J.P. Priou (xan, J.P.P. 11168, non vid.). — **SPAIN**: **Asturias**, 2.2 km SE of Pola de Somiedo, SW of Coto de Buenamadre, Hayedo de Mumián, 1155 m, branch of *Fagus sylvatica*, on wood, 3.VI.2013, M.A. Ribes (xan, ø). – 9.5 km SW of Cangas de Onís, 2 km SE of El Pico, NE of Casa de Fontecha, 775 m, branch of *Salix caprea*, on wood, 17.IV.2014, E. Rubio (leu & xan, E.R.D., non vid.). – **País Vasco**, **Vizcaya**, 29 km SE of Bilbao, 8 km S of Durango, E of Urkiola, 750 m, on wood of ?*Betula*, 2.IX.2010, R. Tena (xan, doc. vid.). – 44 km WSW of Bilbao, ~11 km SW of Karrantza, ?WSW of La Calera del Prado, 800 m, on wood of *Quercus robur*, 8.XII.1986, C. Aranda (xan, AH 6799). – 6 km SSW of Zarautz, 4.5 km ESE of Zestoa, NW of Altzola, 110 m, branch of indet. tree, on wood, 9.V.2015, J. Martin (leu, ø, doc. vid.). – **Navarra**, ~21 km SE of San Sebastián, Artikutza, 800 m, branch of *Fagus sylvatica*, on wood, 12.XI.1983, G. Moreno, F. Esteve-Raventós & R. Galán-Marquez (xan, AH 6257). – 31 km N of Pamplona, 1 km E of Almandoz, 350 m, branch of *Corylus avellana*, on wood (xan) & bark (leu), 22.IV.2015, F.J. Balda (leu & xan, F.J.B. 22415, doc. vid.). – ibid., log of *Salix*, on wood (leu & xan, F.J.B. 16916, doc. vid.). – **Aragón**, **Huesca**, 3.2 km NE of Benasque, 1295 m, branch of ?*Pinus*, on wood, 6.VI.2012, R. Blasco (xan, ø, doc. vid.). – 4 km SW of

Benasque, S of Eriste, Embalse de Linsoles, 1130 m, branch of *Corylus avellana*, on wood, 19.VI.2019, R. Blasco (leu, doc. vid.). – 12 km S of Benasque, 4.5 km SE of Castejón de Sos 1500 m, wood of *Pinus sylvestris*, 7.IX.2014, R. Blasco (leu, ø, doc. vid.). **– Cataluña**, **Barcelona**, 5.5 km ENE of Camprodon, 1.5 km NE of Font-Rubí, 1092 m, log of *Betula pendula*, on wood amidst *Corticiaceae*, 27.XI.2014, J. Bometón (xan, J.B. 557/14). – 9 km NNW of Terrassa, 3.7 km NW of Matadepera, NW of la Barata, 650 m, branch of *Tilia*, on wood, 24. XII.2014, J. Bometón (xan, J.B. 565/14). – **Castilla-La Mancha**, **Guadalajara**, 65 km N of Guadalajara, 3.5 km SE of Cantalojas, Arroyo de la Dehesa, ~1300 m, of *Quercus pyrenaica*, on wood, 18.XI.1983, G. Moreno, M.N. Blanco & R. Galán-Marquez (xan, AH 6411). – **Castilla y León**, **Segovia**, Sierra de Guadarrama, 66 km ENE of Segovia, 4.5 km SE of Riofrío de Riaza, Puerto de la Quesera, 1600 m, on wood of *Fagus sylvatica*, undated (< 1984), G. Moreno & J. Checa (xan, AH 6186). – **Madrid**, 31 km NNE of Madrid, 1 km N of San Agustín de Guadalix, Arroyo del Caño, 645 m, log of *Salix*, on wood, 24.IV.2002, J.C. Campos & F. Prieto (xan, H.B. 7124, AH 7442, as *Populus*). – **Andalucía**, **Granada**, 43 km SW of Granada, 4 km SW of Alhama de Granada, Cortijo del Navazo, 1145 m, branch of *Quercus rotundifolia*, on wood, 24.II.1982, A. Ortega & R. Galán-Marquez (xan, AH 6029). — **ITALY**: **Emilia-Romagna**, 8.5 km SSW of Corniolo, 5.7 km NE of Stia, Montemezzano, 860 m, branch of *Alnus cordata*, on wood, 30.X.2011, E. Camporesi (xan, doc. vid.). – 36 km SSW of Forli, 5 km WSW of Santa Sofia, S of Cabelli, 360 m, indet. wood, 16.X.2011, E. Camporesi (xan, doc. vid.). – **Toscana**, ~9 km W of Pisa, Parco di San Rossore, ~5 m, log of indet. gymnosperm, on wood, 17.I.1993, G. Cacialli (xan, F. Doveri 193). — **CROATIA**: **Primorje-Gorski Kotar**, 17 km NW of Rijeka, 12 km N of Opatija, ~NE of Veli Brgud, ~400 m, on wood of indet angiosperm and on *Fuscoporia ?ferrea*, 27.VII.1985, B. Grauwinkel (xan, B.G.). — **SERBIA**: **Voivodina**, Fruška Gora, 17 km SW of Novi Sad, 6 km WSW of Beočin, Testera, 152 m, branch of *Acer platanoides*, on wood, 2.X.2019, D. Savić (doc. vid.). – 12 km SE of Novi Sad, 2.8 km SE of Bukovac, NNE of Stražilovo, 225 m, wood of indet. angiosperm, 18. & 23.V.2014, D. Savić (xan, FG-148, doc. vid.). – 13 km S of Novi Sad, 6 km NNW of Irig, Iriški venac, WSW of WWII memorial, 460 m, log of *Pinus nigra*, on wood, 8.VII.2019, D. Savić (FG-1100, doc. vid.). — **NORTH MACEDONIA**: **Bitola**, W of Bitola, Baba Mts., Pelister Mt., 1350 m, log of indet. angiosperm, on wood, 19.IX.2006, M. Theiß (xan, doc. vid.). — **ROMANIA**: **Maramureş**, 5.5 km SE of Sighetu Marmaţiei, NE of Vadu Izei, 280 m, log of *Salix*, on wood, 7.VII.2014, J.P. Priou (xan, ø, doc. vid.). — **TURKEY**: **Trabzon**, 11 km SSE of Çaykara, 2 km SSE of Taşkıran, 850 m, stump of *Alnus glutinosa*, on wood, 24.VIII.2011, I. Akata (xan, I.A. 4036, in Akata & Doğan 2015, H.B. 9955 ø). — **UKRAINE**: **Zakarpattia**, Ukrainian Carpathians, Podkarpacka Ruś [Sub-Carpathian Ruthenia], unlocalized, ~1200 (altimontane forest), log of *Corylus avellana*, on wood, VIII.1929, A. Pilát (xan, PRM 151768, **lectotype** of *Orbilia microspora*, as *Carpinus*, H.B. 6183a ø). – ibid., ~1500 m (alpine forest), log of *C. avellana*, on wood, VIII.1929, A. Pilát (leu, PRM 899283, as indet. angiosperm, H.B. 6183c ø). – **Ivano-Frankivsk**, **Nadvirna**, 51 km WSW of Kolomyya, 9.5 km NW of Palyanytsya, Gorgany, Chernigivske forest, Dovbushanka Mt., 1350 m, branch of *Alnus alnobetula*, on wood, 22.VII.2012, A.Y. Akulov (leu, CWU Myc 4905, H.B. 9733). – 55 km W of Kolomyya, 5 km SE of Maksymets, Gorgany forest, 1020 m, log of *Alnus incana*, on wood, 20.VII.2012, A.Y, Akulov (xan, CWU Myc 4909, H.B. 9720, anam. substr.). – ibid., log of *Fagus sylvatica*, on wood, 19.VII.2012, A.Y. Akulov (xan, CWU Myc 4910, H.B. 9760; sq.: MK493124). – ibid., log of *?Picea*, on wood, 19.VII.2012, A.Y. Akulov (xan, CWU Myc 4912, H.B. 9761) – ibid., branch of *?Carpinus betulus*, on wood, 19.VII.2012, A.Y. Akulov (*leu, CWU Myc 4906, H.B. 9762). – **Kyiv**, ~16 km NW of Kyiv, Puscha-Vodytsia, 130 m, on wood of indet. angiosperm, 8.VIII.1927, Z.K. Girzhitska, vid. E.S. Popov (xan, LE 142142, as *O. coccinella*, non vid.). — **RUSSIA (West)**: **Leningrad**, **Vyborg**, Gulf of Finland, 34 km SW of Vyborg, 12.5 km NW of Primorsk, Severny Berezovy Island, 1 m, log of *Picea abies*, on wood amidst *Corticiaceae*, 14.VII.2005, E.S. Popov (xan, LE 294565, doc. vid.). – ibid., on wood of *Alnus glutinosa*, 14.VII.2005, E.S. Popov (xan, LE 248019, non vid.). – 12 km WNW of Primorsk, Maly Berezovy Island, 1 m, indet. wood, 6.VII.2004, E.S. Popov (xan, LE 248022, non vid.). – 7.5 km WSW of Primorsk, Zapadny Berezovy Island, 33 m, indet. wood, 3.VII.2004, E.S. Popov (xan, LE 248018, non vid.). – **Moskow**, **Podolsk**, 47 km SW of Moscow, 25 km W of Podolsk, Mikhailovskoye, 180 m, on wood of indet. tree or on pyrenomycete stroma, 20./21.VIII.1905, N.A. Mosolov, vid. E.S. Popov (xan, LE 142141, 142137, non vid.). – on wood of indet. angiosperm, 20.VII.1906, N.A. Mosolov, vid. E.S. Popov (xan, LE 142150, ø, non vid.). – **Pskov**, **Loknya**, 41 km NW of Velikiye Luki, 8.5 km N of Nasva, W of Bashovo, 135 m, on wood of *Populus tremula*, 30.VI.2001, E.S. Popov (xan, LE 249566, non vid.). – SW of Bashovo, 130 m, on wood of *P. tremula*, 11.VII.2004, E.S. Popov (leu, LE 247094, non vid.). – ibid., on wood of *Betula pendula*, 11.VII.2004, E.S. Popov (xan, LE 247093, non vid.). – **Nevel**, 39 km W of Nevel, Yazno Lake, 157 m, on wood of *Alnus incana*, 21.VII.2003, E.S. Popov (xan, LE 294568, non vid.). – **Sebezh**, 21 km SE of Sebezh, Lake Osyno, 150 m, on wood of *A. incana*, 15.VI.2000, E.S. Popov (xan, LE 222145, 146-6-Seb, ø, non vid.). – 10 km SW of Sebezh, Lake Midino, 130 m, on wood of *A. incana*, 23.VII.2002, E.S. Popov (xan, LE 222221, non vid.). – ibid., 136 m, on wood of *A. glutinosa*, 19.VII.2002, E.S. Popov (xan, LE 222222, non vid.). – **Velikoluksky**, 20 km ENE of Newel, ~1.5 km NW of Borki, 165 m, *Pinus sylvestris*, on wood, VIII.2013 (xan, Kazartsev et al. 2016, denovo492, mol. extr., sq.: KT881277). – **Bashkortostan**, **Meleuz**, southwestern end of Ural Mts., 35 km ENE of Meleuz, Nugush, ~250 m, log of *Quercus*, on wood, 13.VIII.1974, A. Raitviir (xan, TAAM 63149). –11.5 km WSW of Askarovo, S of Kazmashevo, Belaya river, 490 m, indet. wood, 14.IX.1946, E. Selivanova-Gorodkova, vid. E.S. Popov (xan, LE 236177, as *O. coccinella*, non vid.). – **Sverdlovsk**, Ural Mts., ~68 km WSW of Serov, Kytlym, ~600 m, log of indet. gymnosperm, on wood, 20.VII.1973, A. Raitviir (*leu, TAAM 62958). – **Adygea**, Caucasus Mts., ~63 km NE of Sochi, ~7 km NE of Guzeripl, Tsornõi Shahan, 700–1300 m, log of ?*Carpinus*, on wood, 16.VII.1975, M. Murdvee (*leu, TAAM 69745, as *Fagus orientalis*). – ~78 km ENE of Sochi, near Umpyr, 1400 m, log of ?*Carpinus*, on wood, 10.VIII.1976, V. Puusepp (*leu, TAAM 109037, as *Picea orientalis*, H.B. 7991 ø). – 3 km NNE of Umpyr, Malaya Laba, 1100 m, log of indet. gymnosperm, on wood, 12.VIII.1976, M. Pallo (*leu, TAAM 64388, H.B. 8702 ø). – ibid., branch of *Alnus*, on wood, 12.VIII.1976, M. Pallo (leu, TAAM 64384, as *Populus tremula*, H.B. 8701 ø). – **Karachayevo-Cherkesiya**, Caucasus Mts., 90 km SW of Tscherkessk, 32 km WNW of Teberda, Arkhyz, ~1400 m, branch of indet. gymnosperm, on wood, 24.IX.1968, A. Raitviir (*leu, TAAM 60670). – 7 km S of Teberda, 1360 m, indet. wood, 10. VIII.2009, E.S. Popov (xan, LE 236082, non vid.). – 7 km ESE of Teberda, Dzhemagat gorge, Goralykol river, 1800 m, on wood of indet. woody tree, 22.VIII.2012, M.A. Zykova, vid. E.S. Popov (xan, LE 247830, non vid.). — **AZERBAIJAN**: **Shaki-Zaqatala**, Caucasus Mts., ?N of Zaqatala, 'Kordon', 800 m, log of ?*Tilia*, on wood, 9.VIII.1974, B. Kullman (xan, TAAM 68133). — **GEORGIA**: **Samegrelo-Zemo Svaneti**, Caucasus region, Kolkheti (as Colchis), around Poti, ~5 m, log of *Eucalyptus ?globulus* on wood, 1.VIII.1977, E. Parmasto (xan, TAAM 97001, as *E. globatus*). — **RUSSIA (East)**: **Altay**, 18 km SW of Gorno-Altaysk, Manzherok, log of *Pinus sylvestris*, on wood, 6. VIII.1977, L. Järva (*leu, TAAM 92485). – 118 km ESE of Gorno-Altaysk, Yaylyu, 440 m, on wood of *P. sylvestris*, 14.VIII.2008, E.S. Popov (xan, LE 304403, non vid.). – **Tuva**, Eastern Sayan Mts., Ush-Bel'dir (border to Mongolia), 1120 m, log of indet. gymnosperm, on wood, 8.VIII.1972, A. Raitviir & B. Kullman (xan, TAAM 66025). – **Irkutsk**, 63 km SE of Irkutsk, Listvjanka, Lake Baikal, ~500 m, log of *P. sylvestris*, on wood, 3.VIII.1975, E. Parmasto (xan, TAAM 90707). – ibid., log of *Abies sibirica*, on wood, 8.VIII.1975, E. Parmasto (xan, TAAM 90778). — **JAPAN**: **Hokkaido**, ~20 km NW of Tomakomai, Shikotsu lake, ~300 m, branch of indet. angiosperm, on bark, 28.VII.1990, T. Hosoya (xan, TRL 145, TNS-F-55849). – 55 km ESE of Sapporo, ~11 km SSE of Yubari-shi, Numa-no-sawa, ~200 m, branch of ?*Carpinus*, on wood, 29. VII.1990, T. Hosoya (xan, TRL 169, TNS-F-55871). – **Honshu**, **Nagano**, Chiisagata-gun, 16.5 km NE of Ueda, 1 km SE of Sugadaira, Arboretum in Sugadaira Montane Research Center, 1325 m, ?log of indet. conifer, on wood, 22.VII.1990, T. Hosoya (xan, TRL 109, TNS-F-55815). – ibid., on wood fragment of indet. angiosperm, X.1990, T. Hosoya (xan, TRL 232, TNS-F-55931). – ibid., ?log of indet. conifer, on wood, 27.VI.1992, collector unknown (xan, TRL 581, TNS-F-56277). – ibid., ?log of indet. angiosperm, on wood, 31. VII.1992, collector unknown (xan, TRL 601, TNS-F-56297). – ibid., branch of *Alnus*, on wood, 21.VIII.1997, T. Hosoya (xan, H.B. 5902a). – **Gifu**, unlocalized, ?log of indet. conifer, on wood, 25.VI.1995, collector unknown (xan, TRL 1294, TNS-F-56983). — **CHINA**: **Heilongjiang**, Cold Water, 400 m, indet. tree, on wood, 13.IX.2004, B. Liu (xan, HMAS 96808, doc. vid.). – **Hunan**, **Zhangjiajie**, Golden Whip Stream, 600 m, wood of *Kalopanax*, 16.IX.2005, B. Liu & X.Z. Liu (xan, HMAS 139665, anam. cult., doc. vid.). – **Fujian**, **Longyan**, Shanghang, 28 km NW of Longyan, 9 km NNE of Gutian, Meihua Shan, 1180 m, indet. tree, on wood, 17.IV.2003, B. Liu (leu, B.L. 6420, HMAS 139541, doc. vid.; sq.: DQ656623). – **Yunnan**, **Dali**, Yongping, 35 km ENE of Baoshan, Jinguangsi, 2730 m, branch of indet. angiosperm, on bark, 25.X.2008, H.Y. Su, X.M. Gao & Y.G. Yan (xan, H.Y.S jgs-26, CBCD, H.B. 8930 ø). – **Kunming**, Yiliang, ~35 km W of Kunming, ~8 km WNW of Yiliang, Xiaobailong Mt., ~1900 m, on wood of *Pinus*, 15.VIII.2003, M.H. Mo (xan, ø, doc. vid.). – **Taiwan**, **Hsinchu**, 30 km SE of Zhunan, Kuanwu, trail down to Kuanwu waterfall, 2090 m, log of indet. gymnosperm, on wood, 28.VI.2003, M.L. Wu (xan, M.W. 030628 T3/T4, TNM). – For further 40 samples from across China see Liu (2006, as *O. delicatula*). — **AUSTRALIA**: **Victoria**, South Eastern Highlands, 160 km ESE of Melbourne, 27 km SE of Morwell, Tarra Bulga, ~600 m, branch of *Nothofagus cunninghamii*, on bark, 9.XI.2008, T.R. Lohmeyer (xan, H.B. 8959). – South East Coastal Plain, Melbourne, indet. wood, 1914, collector unknown (*leu, WNC, Spooner 1987: fig. 21 D–F, doc. vid.). — **NEW ZEALAND**: **Northisland**, Northland, 12.5 km SW of Totara North, 2 km WSW of Otangaroa, Puhoi Far North, 80 m, branch of *Leptospermum scoparium*, on bark, 7.IX.2006, P.R. Johnston, B.C. Paulus & S.R. Pennycook (xan, B.C.P. 3901, P.R.J. TTT1344, PDD 89969, H.B. 9884 ø; sq.: MG593177). – 22 km SSW of Kaikohe, Cynthia Hewett, Mataraua forest, 564 m, indet. tree, on wood, 28.XI.2006, P.R. Johnston (xan, P.R.J. D2007, PDD 92041, non vid.; sq.: MG593175). – North Kaipara Heads, 85 km NW of Auckland, 3.5 km SW of Pouto, 1 km S of Phoebes Lake, Tapu Bush, 133 m, branch of indet. angiosperm, on wood, 23.V.1991, P.R. Johnston (xan, P.R.J. D721, PDD 59160, H.B. 9888 ø; sq.: MG593178; D706, PDD 58790, non vid.; sq.: MG593181). – Auckland, 18 km SW of Auckland, 2 km NW of Laingholm, Big Muddy Creek, 56 m, indet. wood, 28.VIII.2012, J.A. Cooper (xan, J.A.C. 12587, PDD 96711, doc. vid.). – Bay of Plenty, 28 km SE of Murupara, 0.7 km NW of Ruatahuna, School Road Reserve, 452 m, branch of indet. angiosperm, on wood, 14.XII.2004, P.R. Johnston (xan, P.R.J. D1902, PDD 94111, H.B. 9889 ø; sq.: MG593179). – 7 km W of Ruatahuna, Tarapounamu Mt., east of road, 720 m, branch of *Nothofagus fusca*, on bark, 15.XII.2004, P.R. Johnston, G. Bills & K. McDermott (xan, P.R.J. D1907, PDD 93935, H.B. 9887 ø; sq.: MG593172). – ibid., indet. ?*Podocarpaceae*, on bark, & B.C. Paulus (xan, D1917, PDD 93938, non vid.; sq.: MG593169). – ibid., indet. tree, on wood (xan, D1911, PDD 93939, non vid.; sq.: MG593188). – Te Urewera, Mangapae UA1, indet. tree, on bark, 8.II.2005, P.R. Johnston (xan, P.R.J. D1926, PDD 93942, non vid.; sq.: MG593171). – 29 km SE of Murupara, 0.8 km SE of Ruatahuna, Te Waiiti, 378 m, indet. angiosperm, on bark, ?XII.2006, B.C. Paulus (xan, B.C.P. 4302, TTT1584, PDD 116627, sq.: MK389277). – **Southisland**, Marlborough, Marlborough Sounds, 50 km ENE of Richmond, 16.5 km NNW of Havelock, Opouri Saddle, 525 m, indet. tree, on wood, 12.V.1997, P.R. Johnston (xan, D1337, PDD 104557, non vid.; sq.: MG593180). – 17 km W of Havelock, 1 km NW of Pelorous Bridge, 210 m, branch of ?*Nothofagus*, on wood, 14.V.1994, P.R. Johnston (xan, P.R.J. D1087, PDD 64847, H.B. 9883 ø; sq.: MG593176). – Canterbury, 7 km NE of Christchurch, 1 km SW of Parklands, Travis Wetland, 2 m, branch of *Salix fragilis*, on wood, 6.III.2010, J.A. Cooper (xan, J.A.C. 11274, PDD 95699, doc. vid.). – 11 km S of Christchurch, 2.5 km WSW of Governors Bay, Port Hills, Kennedy's Bush, 298 m, indet. wood, 17.IV.2010, J.A. Cooper (xan, J.A.C. 11292, PDD 96381, doc. vid.). – Westcoast, Lake Paringa, 10 m, *Weinmannia racemosa*, 5.III.1992, P.R. Johnston (xan, P.R.J. D769, PDD 59992, non vid.; sq.: MG593174). – Southland, Fiordland, 3 km E of Milford Sound, Tutoko River, 65 m, branch of *Nothofagus*, on bark, 18.III.1991, P.R. Johnston (xan, P.R.J. D660, PDD 58571, as *O. cunninghamii*, H.B. 9886 ø; sq.: MG593173). – Otago, 40 km W of Dunedin, Waipori Falls Village, Crystal Falls Track, 190 m, *Nothofagus* bark, 13.V.2008, P.R. Johnston & R.E. Beever (xan, P.R.J. D2122, PDD 104559, non vid.; sq.: MG593170). – Stewart Island, 4 km N of Oban, 30 m, ?*Podocarpaceae*, on bark, 24.IV.2002, P.R. Johnston, R. Leschen & S. Whitten (xan, P.R.J. D1675, PDD 104558, non vid.; sq.: MG593168). — **MACARONESIA**: **Madeira**, 5.7 km NW of Santa Cruz, 4 km E of Col du Poiso, 920 m, *Erica arborea*, on wood, 13.X.2009, J.P. Priou (leu, J.P.P. 29177, non vid.). – 4.7 km SSE of Ribeira da Janela, 3.5 km SW of Seixal, 1136 m, *Ocotea foetens*, 15.X.2009, J.P. Priou (xan, J.P.P. 29187, non vid.). – 2.8 km WSW of Seixal, Fanal, 1190 m, branch of *O. foetens*, on wood, 24.IX.2015 (xan, J.P.P. 15166, doc. vid.). – 4.5 km W of Seixal, 2.5 km S of Ribeira da Janela, ER 209, 885 m, *O. foetens*, 15.X.2009, J.P. Priou (leu, J.P.P. 29184, non vid.). **– Canary Islands**, **Tenerife**, Los Silos, Teno 5 km SE of Buenavista del Norte, 2.3 km SE of El Palmar, 1010 m, indet. angiosperm, on bark, 2.IX.1987, E. Beltrán-Tejera, vid. L. Quijada (TFC Mic. 3207, non vid.). – Santa Cruz de Tenerife, Anaga, 5 km E of Taganana, ~1.3 km SW of Chamorga, E of Chinobre, ~750 m, log of indet. angiosperm, on wood, 23.II.1978, L. Kisimova-Horovitz (xan, H.B. 2287). – 2.5 km SSW of Taganana, Descansaderos de Tierra, 861 m, log of *Laurus novocanariensis*, on wood, 7.III.2012, L. & C. Quijada (xan, TFC Mic. 23393, doc. vid., sq.: MT644596). – 1.5 km NE of Tegueste, Hoya el Palomo, 665 m, log of *Myrica faya*, on wood, 2.V.2012, L. & C. Quijada (xan, TFC Mic. 23476, non vid., sq.: MT644597). **– La Palma**, 8.5 km NNW of Santa Cruz, Cubo de la Galga, 520 m, log of ?*Laurus*, on wood, 23.II.2013, H. Andersson (xan, ø). – For further ca. 40 samples from Tenerife, Gomera and La Palma see Quijada et al. (2016) and Map. 141 — **SOUTH AFRICA**: **KwaZulu-Natal**, Drakensberg Mts., Oribi Gorge, 120 km SW of Durban, 8.5 km WNW of Murchison, SW of Samango Falls, 275 m, log of indet. angiosperm, on wood, 21.III.1990, D. Triebel & G. Rambold (xan, G.R. 7347, M-0229707). — **CANADA**: **British Columbia**, 11 km NNW of Victoria, Observatory Hill, 105 m, log of *Acer macrophyllum*, on wood, 17.IX.2013, O. & A. Ceska (xan, UBC F26068, doc. vid.). — **USA**: **Maine**, 23 km ESE of Brunswick, 5.2 km NW of Boothbay Harbor, Barters Island, Porter Preserve, 10 m, indet. angiosperm, 6.VIII.1994, D.H. Pfister (leu, D.H.P. 108 [O.107], FH, anam. cult., non vid.; sq.: U72595). – ibid., log of *Betula*, on wood, 10.X.1994, D.H. Pfister (xan, H.B. 5165). – 9 km N of Boothbay Harbor, Oven's Mouth, 15 m, on *Betula* wood, 22.IX.1994, D.H. Pfister, (xan, D.H.P. 111 [= D.H.P. 105], anam. substr., non vid., sq.: U72603). – **Massachusetts**, 27 km NW of Boston, 2.8 km NNE of Concord, Punkatasset Hill, Hutchins Pond, 40 m, log of *Acer*, on wood, 12.VII.1995, D.H. Pfister & S.H. Goldbarg (xan, H.B. 5306). – 19 km SE of Boston, 3 km NNE of Hingham, Boston Harbor Islands, World's End peninsula, Rocky Neck, 10 m, log of *Quercus alba*, on wood, 14.IX.2013, D. Haelewaters, K. & R. Healy, S. Verhaeghen (xan, bhi-F037, FH 00458338, H.B. 9996, sq.: MF161166). – ibid., 3.4 km NNE of Hingham, Slate Island, 1 m, branch of *Betula*, on wood, 20.IV.2017, A.C. Dirks, L.A. Kappler & J.K. Mitchell, vid. L. Quijada (xan, bhi-F830b, FH, doc. vid.). – **New York**, 70 km NNE of Utica, Old Forge, ~530 m, log of ?*Fagus*, on wood, VIII.1934, C.L. Shear (leu, M, herb. Petrak). – 11 km E of Ithaca, 7.5 km SW of Dryden, Ellis Hollow, Ringwood Reserve, 470 m, indet. tree, on wood, 24.X.1994, D.H. Pfister (xan, D.H.P. 120 [O.112], FH, anam. cult., non vid.; sq.: U72593). – **New Jersey**, 7 km N of Vineland, Newfield, ~35 m, log of *Fagus*, on wood, VII.1883, J.B. Ellis (xan, M, Reliquiae Farlowianae 912, as *O. botulispora*). – **Pennsylvania**, Bethlehem, ~100 m, log of ?*Quercus*, on wood, undated (< 1880), M.J. Berkeley (xan, K(M) 48767, **holotype** of *Peziza rufula*, H.B. 5750 ø). – **Maryland**, 15 km NW of Washington, Potomac river, Plummers Island, 25 m, log of *Platanus*, on wood, VI.1929, C.L. Shear (xan, M, herb. Petrak, as '*Ombrophila luteorubella*'). — **PUERTO RICO**: El Yunque, 30 km ESE of St. Juan, Rio Grande, El Verde Field Station, 15 m, log of indet. angiosperm, on wood, 16.I.1996, D.H. Pfister, F.A. Harrington & D.J. Lodge (xan, D.H.P. PR 10, FH 00458096). — **LESSER ANTILLES**: **Dominica**, St. Paul, ~3.5 km NE of Canefield, between Springfield and Corona Estate, ~450 m, stem of *Bambusa*, 23.VI.1970, R.P. Korf, J.B. Benson & J.B. Dixon (xan, CUP-DO-000148). – **Martinique**, 5 km SE of La Sérénité, 3 km ENE of Petit-Bourg, Le Bois La Charles, 100 m, log of indet. angiosperm, on wood, 29.VIII.2005, C. Lechat (xan, H.B. 8028, C.L.L. 5257). — **CHILE**: ?around Santiago, branch of indet. angiosperm, on wood, undated, C. Gay (xan, PC 1052, 1053, as *Helotium persoonii*, H.B. 7743 ø). — **UNLOCALIZED**: branch of indet. woody plant, undated (< 1865), F.W. Junghuhn (xan, L 910.261-249, as *Peziza chrysocoma*, H.B. 7709 ø). – ?*Ulmus*, on bark, undated, C.H. Persoon (xan, L 910.261-262, herb. Persoon, **lectotype** of *Peziza aurea*, H.B. 8776 ø).

Not included anamorphs. **USA**: **Washington D**.**C**., unlocalized, decaying rootlets, undated, C. Drechsler (**holotype** of *Pedilospora dactylopaga* [illustration], conid. isol., doc. vid.). — **PERU**: **Junín**, Rio Negro, ~700 m, palm petioles, XI.1990, T. Matsushima (MFC OP-460, dried culture, **holotype** of *Dicranidion tenue*, conid. isol., doc. vid.). — **MICRONESIA**: **Solomon Islands**, Honiara, wood of indet. broad-leaved tree, 5.I.1970, T. Matsushima (MFC 2894, dried culture, **holotype** of *Dicranidion gracile*, conid. isol., doc. vid.).

Orbilia aureocrenulata Baral, **sp**. **nov**., MB 813962 — Pls 880–881

Etymology: named after the golden yellow colour and the notched margin.
Typification: Puerto Rico, El Yunque, trunk of indet. angiosperm, 18.I.1996, D.H. Pfister & F.A. Harrington (ex D.H.P. PR 42, FH 00458097, holotype).

Latin diagnosis: *Apothecia rehydratata 1–3 mm diam.*, *vivide aureo-lutea*, *distincte abrupte stipitata*, *margine exigue crenulato. Ascosporae †2.5–3 × 1.1–1.3 µm*, *valde curvatae (semicirculares)*, *dorsaliter minute verrucosae. Paraphyses ad apicem modice ad valde capitatae*, *exsudato nullo. Excipulum in parte basali cellulis paulo crassitunicatis*, *margine absque processis vitreis. Habitat ad lignum putridum truncorum uvidorum angiospermarum in zona tropica (per)humida Americae centralis et australis.*

Description: — **TELEOMORPH**: **Apothecia** moist/rehydrated (0.5–)1–2.2(–3) mm diam., (0.3–)0.5–0.9 mm high (receptacle 0.15–0.2 → 0.1 mm), light to bright golden yellow(-ochraceous), rarely pale yellowish to chlorinaceous, medium translucent, hygrophanous, round to slightly undulating, distinctly gelatinous, scattered or subgregarious to gregarious in small groups; disc slightly concave to flat or finally

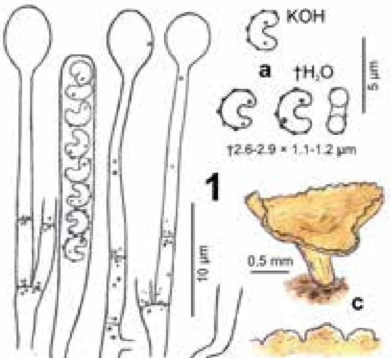


Plate 880. **1**: *Orbilia aureocrenulata*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. apothecium (rehydrated 21 months after collecting); **d**. dentate margin.

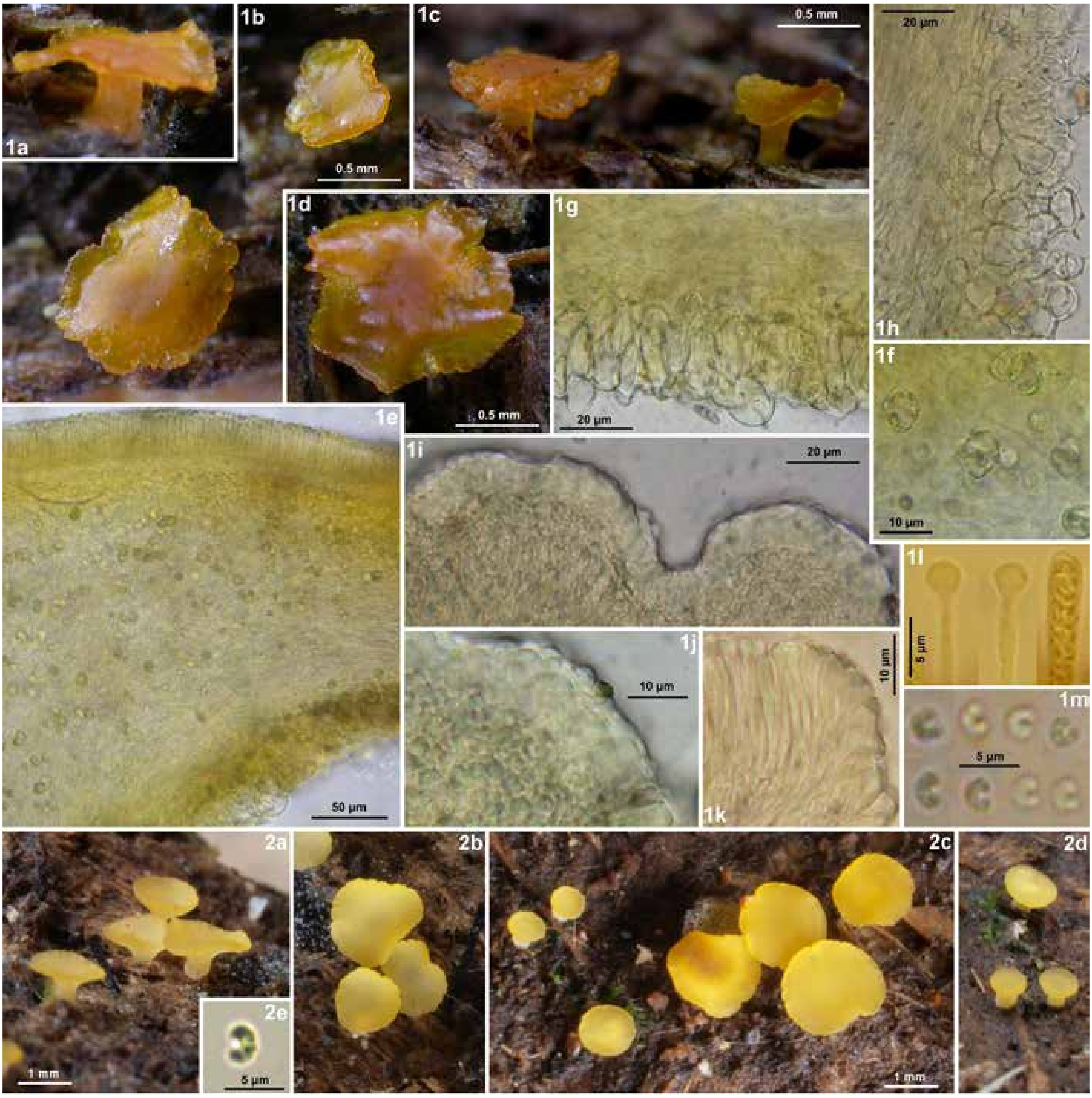


Plate 881. **1–2**: *Orbilia aureocrenulata*. – **2a–d**. fresh apothecia; **1a–d**. rehydrated apothecia (1 month after collecting); **1e**. apothecium in median section near stipe; **1f**. closeup of medullary excipulum in **1e**, with druses-like exudate; **1g**. median section of ectal excipulum at lower flanks; **1h**. id., in stipe; **1i–j**. marginal lobes in top view; **1k**. margin in median section; **1l**. apices of ascus and paraphyses; **1m**, **2e**. ascospores. – Dead state (**1e–f** in H_2O; **1g–j**, **m** in KOH, **1l** in KOH+IKI), except for **2e**. – **2a–e**: phot. M. Mann. — **1a–m**. H.B. 8027: Lesser Antilles, Martinique, on indet. angiosperm (wood); **2a–e**. H.B. 9672: Brazil, Rio de Janeiro, on indet. angiosperm (bark).

± convex, margin not protruding, regularly notched by forming small, obtuse yellow lobes; always with an abrupt, ± cylindrical, sometimes slightly eccentric, whitish to pale yellow stipe (0.1–)0.3–0.8 × 0.2–0.7 mm, superficial; dry bright yellow-ochre. **Asci** †(26–)30–38 × (2.7–)3–3.3(–3.5) µm {3}, 8-spored, spores †uniseriate, irregularly oriented; **apex** (†) strongly truncate (not or sometimes slightly indented, laterally not inflated); **base** with short to medium long, thin or thick, ± flexuous stalk, Y-, h- or H-shaped. **Ascospores** †2.4–3 × 1–1.3 µm {4}, cashew-shaped, very strongly curved (± semicircular, for ~160–200°), both ends rounded to obtuse, dorsal side with 4–7 minute warts {6}; **SBs** probably near 1 end, globose. **Paraphyses** apically medium to very strongly capitate, terminal cells †19–25 × (2–)2.5–4.2 µm {2} (0.7–1.5 µm below head), lower cells †5–7.5 × 1.2–1.7 µm {2}; unbranched at upper septum, lower part of hymenium light yellow. **Medullary excipulum** subhyaline, ~100–200 µm thick in receptacle, of dense textura intricata with a few inflated cells, sometimes with intercellular druses-like balls of pale yellowish exudate, sharply delimited from ectal excipulum, upper 20–30 µm (subhymenium) light yellow. **Ectal excipulum** hyaline to pale yellow, of (†) slightly gelatinized, vertically oriented t. globulosa-angularis(-prismatica) from stipe to flanks, 40–90 µm thick near base, cells †19–25 × 10–19 µm {1}; at flanks 35–40 µm thick, at margin 10 µm, of t. globulosa-prismatica oriented at a (20–)40–70° angle to the surface, marginal cortical cells †7–10 × 3–6 µm {1}, thin-walled; **glassy processes** absent. **Anchoring hyphae** abundant, †1–3 µm wide, walls 0.2 µm thick {1}, forming a dense, hyaline t. intricata-porrecta 50–70 µm thick below base of stipe. **SCBs** no data available. **Exudate** over paraphyses, margin and flanks absent. — **ANAMORPH**: unknown (but see below).

Habitat: lying on ground, on the underside of decorticated or corticated, ~8 cm thick branches or thick logs of indet. angiosperm trees {6}, on deeply strongly decayed wood {4} or bark {2}, no algae. **Associated**: *Ascocoryne* sp. {2}, ?*Dicranum* sp. {1}, *O. martinicensis* (on different branch) {1}, indet. pleurocarpous moss {3}, black setae of hyphomycete. **Desiccation tolerance**: not tested, probably desiccation-sensitive. **Altitude**: 15–1475 m a.s.l. **Phenology**: X, XII–I, IV (tropical belt and southern hemisphere).

Taxonomic remarks. *Orbilia aureocrenulata* differs from the remaining members of the *xanthostigma-leucostigma* complex in apothecia with a comparatively long, cylindrical stipe (at least about as long as wide), and a distinctly and regularly notched margin, also in a tendency to more thick-walled cells of the ectal excipulum, finally in the tropical distribution. The only documented living spore of *O. aureocrenulata* (Pl. 881: 2e) suggests that 2 globose SBs occur, one at each end, but we assume that one of them represents an oil drop.

Most of the seven studied collections of *O. aureocrenulata* showed a golden yellow colour very similar to *O. xanthostigma*. Since also the microscopic characters perfectly concur in the two species, the delimitation from tropical records here included in the *xanthostigma-leucostigma* complex requires further molecular research. For instance, in the El Yunque National Forest in Puerto Rico, besides *O. aureocrenulata* (D.H.P. PR 42, 58, 76) also *O. xanthostigma* s.l. with sessile, yellow apothecia was collected (D.H.P. PR 10), according to brief notes by the first author, but this remained without sequence.

Not included collection. The sample from tropical China (B. Liu, IVV: B.L. 6212) concurs with *O. aureocrenulata* in spore characters, but its yellow, apparently sessile apothecia have a smooth margin and its molecular data strongly deviate.

Anamorph. An ascospore isolate of the not included collection from tropical China formed dicranidion tenue-like conidia in culture (B. Liu pers. comm.) but we did not see photos of them.

Phylogeny. An ITS sequence from apothecia of the Brazilian specimen clustered strongly or medium supported but unresolved in the *leucostigma-xanthostigma* clade (Phyls 22–23), with a minimum distance of 13.5% to *O. leucostigma* and 15.5% to *O. xanthostigma*. This result and an unavailable LSU sequence of the holotype of *O. aureocrenulata* (D. Pfister pers. comm.) support the taxonomic distance of this species. However, the various, morphologically indistinguishable unnamed clades within the *leucostigma-xanthostigma* clade show similar distances among each other which lie in the range of 5–18%. The S1506 intron is absent in concordance with *O. xanthostigma* s.str., whereas it is present in European *O. leucostigma* and some American and New Zealand strains of this aggregate. An ITS sequence of a sample from tropical southern China under the name *O. delicatula* (B.L. 6212) clustered strongly supported but with ~17% distance with *O. aureocrenulata* (Phyl. 23).

Ecology. *O. aureocrenulata* was found on rotten wood of hygric mossy branches or logs of broad-leaved trees. All six known records studied by the first author are from tropical humid (wet and dry) atlantic rainforests in Middle and South America. A recent collection examined by L. Quijada (pers. comm.) was from a subtropical humid (mesophilic) rainforest in Mexico. Also the not included Chinese sample was made in a tropical humid rainforest.

Specimens included. **COSTA RICA**: **Cartago**, Canton de Paraíso, 19 km km SE of Cartago, 9 km SE of Orosi, Tapantí, Sendero Oropendola, ~1290 m, on wood of indet. angiosperm, 14.IV.1992, G. Kost (G.K. 7559). — **PUERTO RICO**: Sierra de Luquillo Mts., El Yunque, trail from Sierra Palm to Mt. Britton, ~650 m, trunk of indet. angiosperm, on wood, 18.I.1996, D.H. Pfister & F.A. Harrington (D.H.P. PR 42, FH 00458097, **holotype**, H.B. 5944 ø, sq.: ined.). – El Yunque, 30 km ESE of St. Juan, Rio Grande, El Verde Field Station, 15 m, log of indet. angiosperm, on wood, 20.I.1996, D.H. Pfister, F.A. Harrington, M. Liftik & D. Potter (D.H.P. PR 76, FH). – ibid., log of indet. angiosperm, on bark, 20.I.1996, S.M. Hundorf (D.H.P. PR 58, FH 00458348). — **LESSER ANTILLES**: **Martinique**, 12 km NNW of St.-Pierre, 5 km SW of Grand'Rivière, Anse Couleuvre, ~100 m, branch of indet. angiosperm, on wood, 5.XII.2005, C. Lechat (C.L.L. 5537, H.B. 8027). — **MEXICO**: **Veracruz**, 8.5 km WSW of Xalapa, 1 km SW of Rancho Viejo, Rancho Agüita Fría, 1475 m, branch of indet. angiosperm, on ?wood, 22.X.2018, L. Quijada & R. Medel (doc. vid.). — **BRAZIL**: **Rio de Janeiro**, ~145 km WNW of Rio de Janeiro, 9.5 km N of Itatiai, N of Penedo, 690 m, branch of indet. angiosperm, on bark, 9.X.2011, M. Mann (H.B. 9672; sq.: KT222359).

Not included. **CHINA**: **Yunnan**, **Xishuangbanna**, 19 km NNE of Jinghong, 10 km NNW of Mengyangzhen, Wild Elephant Valley, 1000 m, branches of indet. tree, 9.XI.2002, B. Liu, Y. Yang & B. Wang (B.L. 6212, HMAS 139670, as *O. delicatula*, anam. cult., doc. vid.; sq.: DQ656622).

Orbilia renispora Y.Y. Shao, Quijada, Baral, Haelew. & Bin Liu, in Shao et al., Mycol. Progr. 17(11): 1229 (2018) — Pls 882–883

Etymology: according to the reniform ascospore shape.

Typification: USA, Georgia, Fargo, Stephen C. Foster Park, branch of indet. angiosperm, 24.IX.2015, Y.Y. Shao & H.F. Zheng (UGA ga038, GXU 1487; sq.: MG742403, MG742404).

Description: — **TELEOMORPH**: **Apothecia** fresh (0.25–)0.4–0.8(–1.1) or sometimes 0.8–1.6 mm diam., 0.16–0.32 mm high (receptacle 0.11–0.25 → 0.08 mm), whitish to often bright yellow to yellow-orange, medium translucent, round, subgregarious to gregarious; disc slightly concave, finally flat with umbilicate centre, margin distinct, smooth, thin or thick, not protruding; sessile on a broad base, superficial; dry slightly contracted, yellow-orange or pale cream. **Asci** *28–38 × 3.1–3.6 µm {2}, †(24–)28–35(–39) × 2.7–3.5(–3.8) µm {6}, 8-spored, spores ± 1-seriate, ~3–5 lower spores inverted (often strongly mixed) {~4 }, pars sporifera *9–10.5 µm long, †16–20 µm; **apex** (†) strongly truncate (often distinctly indented, laterally not widened); **base** with very short to long, flexuous stalk, L-, Y- or often h- to H-shaped. **Ascospores** *(2.4–)2.6–3(–3.5) × (1.1–)1.2–1.4 µm {2} or *2.8–3.7 × 1.6–1.8 µm {2}, †(2.8–)3–3.6(–3.9) × 1.5–1.8(–2) µm {3}, ellipsoid-clavate, upper end rounded to obtuse, lower end not or slightly to medium, rarely strongly attenuated, smooth, slightly to medium, rarely strongly curved (reniform); **SBs** 0.3–0.5(–0.6) µm diam., globose, in the upper end close to the wall; **Paraphyses** apically uninflated to mostly slightly to strongly capitate(-clavate), terminal cell */†14–21 × (1.7–)2–3.3 µm {3}, lower cells */†4–8 × (1.2–)1.5–2.2 µm {3}, unbranched in upper part. **Medullary excipulum** 40–70 µm thick, of ± loose t. intricata with ± inflated cells, sharply delimited. **Ectal excipulum** (†) thin-walled to slightly gelatinized, of vertically oriented textura globulosa-angularis (to t. prismatica) from base to mid flanks, 35–55 µm thick near base, cells *(8–)12–21(–28) × (5–)10–14(–18) µm {3}, at margin 15 µm thick, oriented at 0–20°, marginal cortical cells *5–7 × 2.5–3.5 µm {1}; **glassy processes** absent. **Anchoring hyphae** sparse to medium abundant, 2–3 µm wide, walls ~0.2–0.3 µm thick {1}. **SCBs** in apex of paraphyses not seen for sure; **VBs** roundish to elongate, partly strongly divided, slightly to medium refractive, hyaline {4}; small golden yellow-orange **LBs** present at septa of paraphyses, also in ectal excipular cells at margin and flanks {3}, or absent {2}. **Exudate** overall absent or thin (0.1–0.2 µm), granular, firmly attached. — **ANAMORPH** (dicranidion-like, from pure culture {1}): **Conidiophores** unbranched, erect, *3.5 × 1–2.8 µm, 1.0–1.5 µm wide at apex. **Conidia** Y-shaped, with 2 straight, parallel or distinctly diverging arms of ± equal length, total size *9.3–12.3 × 4–5.8 µm, stipe *1.5–3 × 1.4–1.6 µm, obconical, aseptate, arms *5.5–8.5 × 1.8–2.2 µm, cylindrical but slightly tapering above, 1–2-septate; some conidia unbranched, narrowly fusoid, e.g., *15.5 × 2.6 µm, 3-septate {1}.

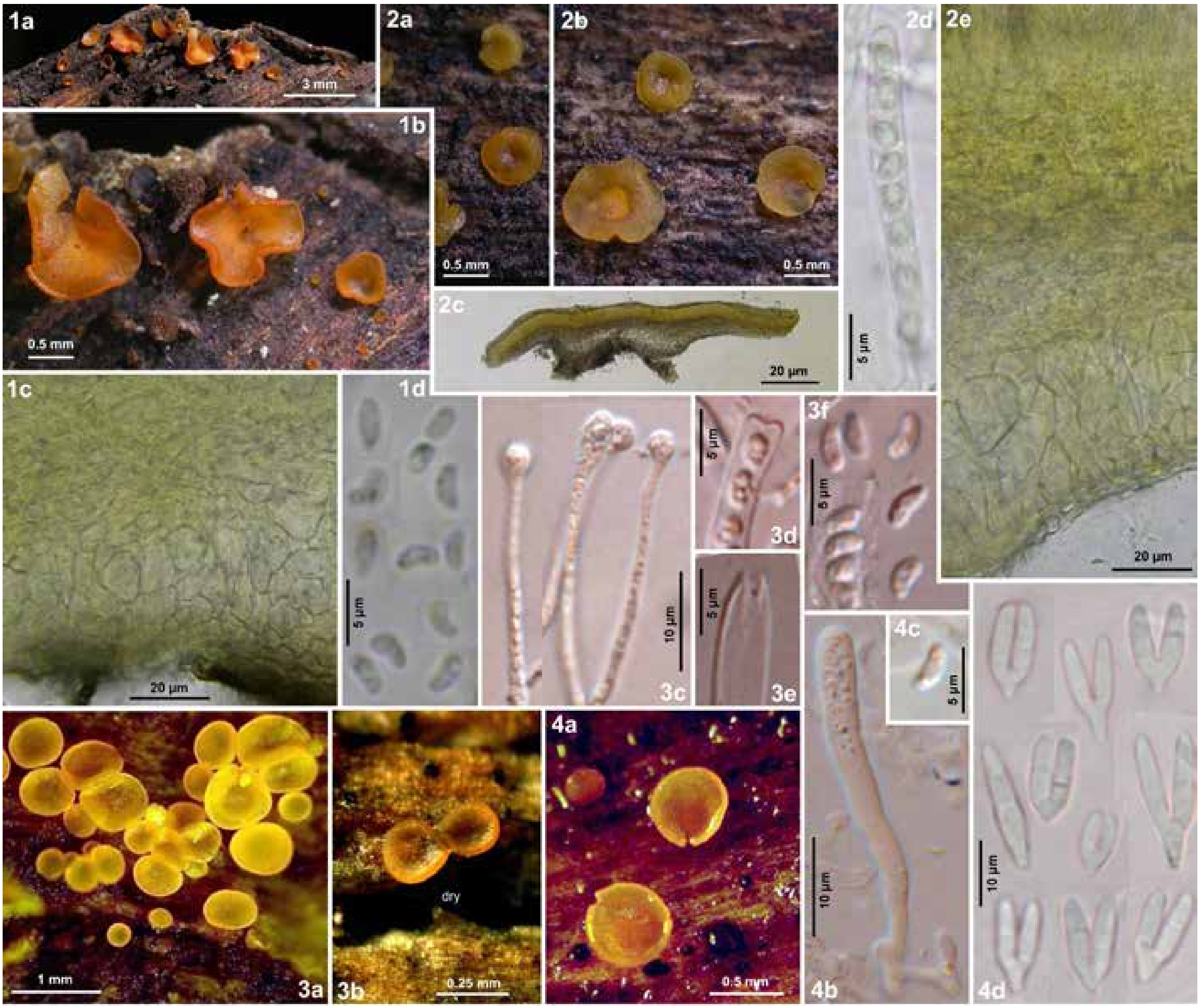


Plate 882. **1–4**: *Orbilia renispora*. – **3a**, **4a**. fresh apothecia; **1a–b**, **2a–b**. rehydrated apothecia; **3b**. dry apothecia; **2c**. apothecium in median section; **1c**. id., ectal and medullary excipulum in central part of apothecium; **2e**. id., at lower flanks; **2d**, **4b**. asci; **3d**. ascus apex in front view; **3e**. apex of emptied ascus with slit-like opening; **3c**. paraphyses; **1d**, **2d**, **3f**, **4c**. ascospores; **4d**. conidia. – Dead state (in H_2O), except for **2d** (spores), **4c–d**. – **3–4**: phot. Y.Y. Shao. — **1a–d**. H.B. 9997: USA, Massachusetts, Boston Harbor Islands, on *Quercus*; **2a–e**. H.B. 9998: id., on *Acer*; **3a–f**. ga031: USA, Georgia, Douglas, on indet. angiosperm; **4a–d**. ga038: id.

Habitat: on moist ground, ± decorticated, ~2–10 cm thick branches and logs or stumps of *Acer* {1}, *Quercus* {4}, indet. angiosperm {3}, indet. tree {1}, on slightly to strongly decayed wood {8}, sometimes below detaching bark, partially blackened, no algae seen. **Associated**: *Hyalorbilia japonica* {1}. **Desiccation tolerance**: probably intolerant but some ascospores survived for 2.5 years. **Altitude**: 5–70 m a.s.l. **Geology**: Miocene to Quaternary sediments; granite. **Phenology**: V–X.

Taxonomic remarks. In its ascospore shape and size and the dicranidion-like anamorph, *Orbilia renispora* somewhat resembles *O. xanthostigma*, *O. leucostigma*, *O. xanthoflexa*, and *O. eucalypti*. From the former two species it differs in larger, much less curved, smooth spores, and from the latter in slightly smaller, predominantly curved spores. *O. xanthoflexa* differs in much longer and narrower spores and in strongly capitate paraphyses. Macroscopically, *O. renispora* appears to be hardly distinguishable from these species. The Asian *O.* aff. *renispora* (Pls 884–885) differs in shorter, more strongly curved spores with a higher lipid content and more strongly inflated paraphyses. In Haelewaters et al.'s (2018) checklist of fungi at the Boston Harbor Islands *O. renispora* is referred to as *Orbilia* sp. 2.

Variation. In the four recent samples from Boston the spores are slightly shorter and especially narrower, and also the asci are shorter and narrower than in the two earlier samples from Boston and in those from Georgia.

Phylogeny. Sequences were available for three samples from Boston (bhi-F097, F108, F880a), one from Georgia (ga038, type), and one from Florida (FLAS-F-61526). All comprise S1506 intron, whereas the ITS is only complete in ga038 (ITS2 lacks in the others). For bhi-F097 and ga038 also LSU exists. In the intron the variance is 0.3–1 % (1–3 nt out of 348 nt) among the five samples. In the ITS1 four strains are identical, and bhi-F108 deviates by 1 nt. In the LSU D1–D2 the two available sequences are identical.

O. renispora clustered weakly supported with two unillustrated Chinese samples under the name *O. coccinella* (here referred to as *O.* aff. *renispora*). For one of them only ITS exists (B.L. 6179, Phyl. 23) and for the other only LSU (B.L. 747, Phyl. S27). The distance to *O. renispora* was in the ITS 17 % and in the LSU D1–D2 4.6–4.8 % (4.8–4.9 % to *O. leucostigma*). Whether they belong to the same genotype is unclear. In our

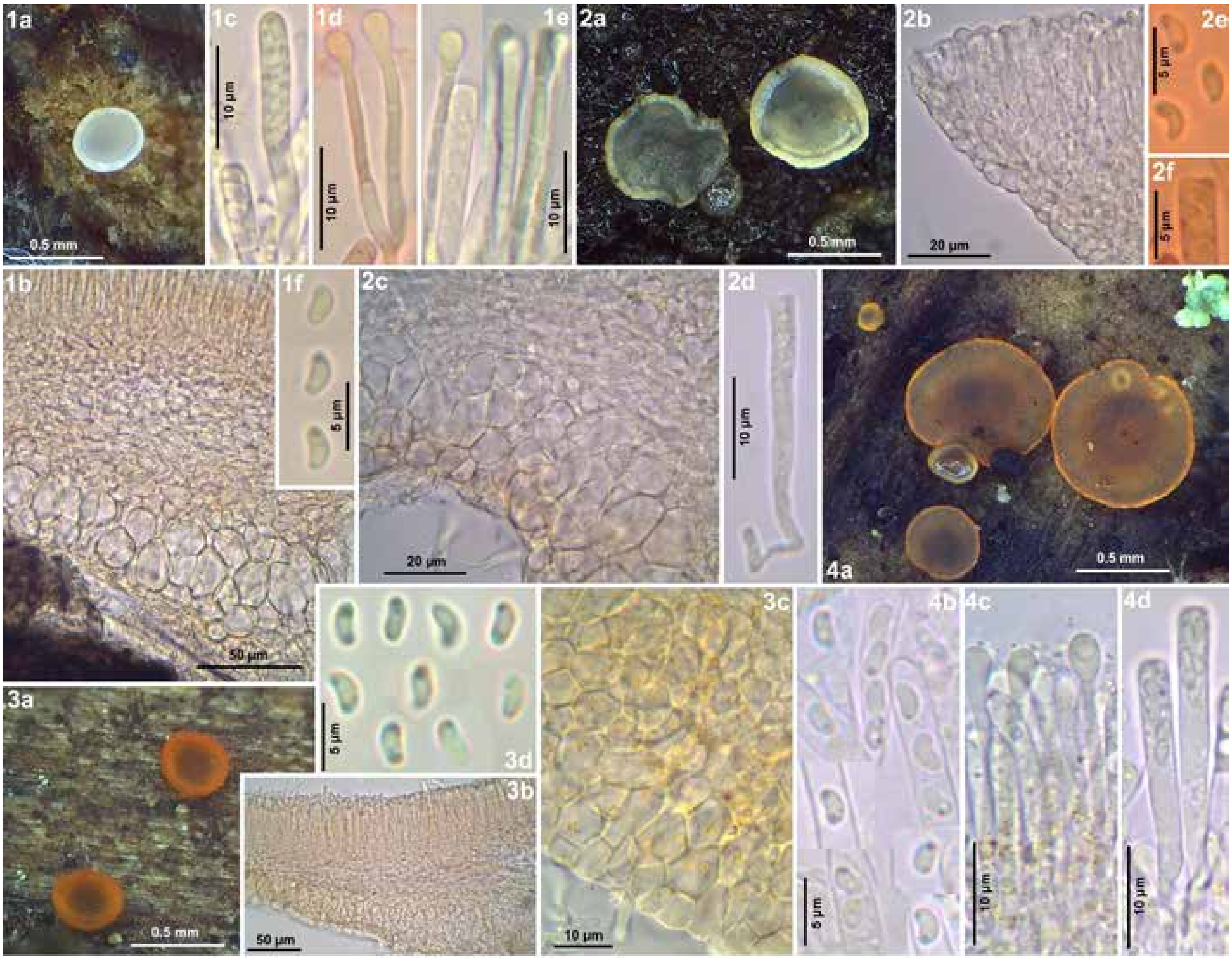


Plate 883. **1–4**: *Orbilia renispora*. – **1a**, **2a**, **3a**, **4a**. fresh apothecia; **3b**. apothecium in median section; **2b**. id., marginal region; **1b**, **2c**, **3c**. id., ectal (and medullary) excipulum at lower flanks (**3c** with carotenoids); **1c**, **2d**, **4d**. asci; **2f**. ascus apex in front view; **1d–e**, **4c**. paraphyses; **1f**, **2e**, **3d**, **4b**. ascospores. – Living state (**1d**, **2e** in CR) except for **2d** (in H_2O), **1d** (upper left cell) and **2f** (in CR). – phot. L. Quijada. — **1a–e**. bhi-F905a: USA, Massachusetts, Boston, Thompson Island, on *Quercus*; **2a–f**. bhi-F880a: id., World's End, on indet. angiosperm; **3a–e**. bhi-F943: id., on indet. angiosperm; **4a–d**. bhi-F1000.2: id., Thompson Island, on *Quercus*.

combined analysis (Phyl. 22) a chimeric combination of both sequences received distinctly less support for the *O. renispora* s.l. clade (not shown).

In our analyses of ITS+LSU and ITS (Phyls 22–23), *O. renispora* s.l. clustered unsupported sister to the *leucostigma-xanthostigma* clade and unresolved when analysing LSU (Phyl. S27). When comparing the intron region, *O. renispora* showed a very high distance of min. 20 % to any other *Orbilia* species. Because of a characteristic motif in the LSU (see p. 1327), we consider *O. renispora* s.l. as belonging in a monophyletic clade which we call *xanthostigma-renispora* clade.

Ecology. *O. renispora* was found on hygric, little to strongly rotten wood of *Quercus* but also *Acer* and other, unidentified angiosperms. In Massachusetts the species occurred in cold-temperate humid lowland forests with *Quercus alba*, *Q. rubra*, *Q. velutina*, *Acer rubrum*, *Carya cordiformis*, *Ostrya virginiana* etc., but in Georgia and Florida in subtropical humid lowland forests (in Florida *Quercus-Acer-Liquidambar* dominated).

Specimens included. **USA**: **Massachusetts**, Boston Harbor Islands, 19 km SE of Boston, 2.5 km NNE of Hingham, World's End peninsula, 5 m, stump of *Quercus*, on wood, 29.IX.2013, D. Haelewaters (bhi-F097, FH, H.B. 9997; sq.: MH445964). – ibid., log of *Acer*, on wood, 29.IX.2013, D. Haelewaters (bhi-F108, FH, H.B. 9998; sq.: MF161173). – 2.5 km NE of Hingham, 7 m, trunk of indet. angiosperm, on wood (sections), 6.X.2017, D. Haelewaters, J.K. Mitchell & L. Quijada (bhi-F943, doc. vid.). – 3 km NNE of Hingham, World's End peninsula, off Brewer Road, near The Bar, 15 m, stump of indet. angiosperm, on wood, 9.V.2017, A.C. Dirks, D. Haelewaters & L.A. Kappler (bhi-F880a, doc. vid.; sq.: MN339160). – 6.5 km SE of Boston, Thompson Island, 0.5 km SSW of buildings, 7 m, ?branch of *Quercus*, on wood, 23.X.2017, D. Haelewaters, J.K. Mitchell & L. Quijada (bhi-F1000.2). – ibid., 0.8 km SW of buildings, 7 m, branch of *Quercus*, on wood, 17.V.2017, L.A. Kappler & J.K. Mitchell (bhi-F905a, H.B. 10201, doc. vid.). – **Georgia**, 88 km NW of Jacksonville, ~25 km NE of Fargo, Stephen C. Foster Park, 40 m, branch of *Quercus*, on wood, 24.IX.2015, Y.Y. Shao & H.F. Zheng (UGA ga038, GXU 1487, **holotype**, anam. cult., doc. vid.; sq.: MG742403, MG742404). – ~9 km E of Douglas, ~11.5 km W of Nicholls, General Coffee State Park, 70 m, branches of indet. angiosperm, on wood, 24.IX.2015, Y.Y. Shao & H.F. Zheng (UGA ga031, GXU 1486, doc. vid.). – **Florida**, 5.5 km E of Melrose, NE of Ross Lake, 47 m, indet. woody plant, 28.VIII.2017, B. Kaminsky & D. Borland (FLAS-F-61526, as *Orbilia* sp., non vid.; sq.: MH211951).

Orbilia* aff. *renispora — Pls 884–885

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.5–1 mm diam., up to 0.19 mm high (receptacle 0.1–0.13 mm), whitish to pale yellowish-cream, subgregarious; disc flat or finally slightly convex, margin distinct, thin, smooth, not protruding; sessile. **Asci** *32–39(–41) × 4–4.5 µm, †29–35 × 3.3–3.8 µm, 8-spored, spores *subbiseriate, †uniseriate, irregularly oriented, pars sporifera *12–15 → 9–11 µm long; **apex** (†) strongly truncate (not or slightly indented, laterally

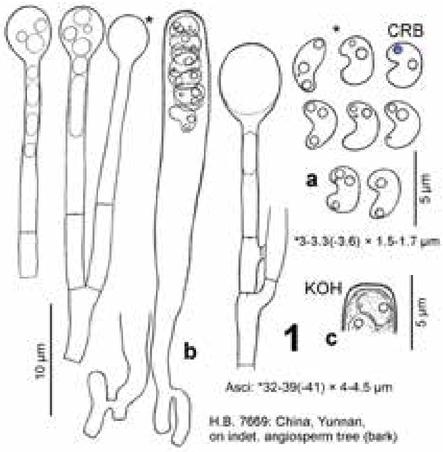


Plate 884. **1**: *Orbilia* aff. *renispora* (with smooth ascospores). – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apex.

not inflated); **base** with short to medium long, ± flexuous stalk, L-, h- or H-shaped. **Ascospores** *3–3.3(–3.6) × 1.5–1.7 µm, cashew-shaped, strongly to very strongly curved (by ~100–180°), both ends rounded to obtuse, smooth; in front view ellipsoid to ovoid, 1.7–2 µm wide; **SBs** *0.4–0.6 µm diam., globose, close to 1 spore end, only seen in some spores, indistinguishable from LBs without staining, containing 1–3 **LBs** 0.4–0.8 µm diam. (KOH-resistant). **Paraphyses** apically (very) strongly capitate, terminal cells *(10–)16–21 × 3–4.7(–5.5) µm, lower cells *4–8 × 1.4–2 µm; rarely branched at upper septum. **Medullary excipulum** ~30–40 µm thick in receptacle, of dense textura angularis-intricata, at base unsharply delimited, at flanks very sharply delimited by a 10–15 µm thick t. porrecta. **Ectal excipulum** hyaline, of (†) thin-walled to slightly gelatinized, vertically or irregularly oriented t. globulosa from base to flanks, 100 µm thick near base, cells *12–22 × 8–17 µm; at lower flanks 50 µm thick, at submargin of t. globulosa-angularis oriented at a 70–90° angle to the surface, at margin 15 µm thick, of t. globulosa-prismatica oriented at 40–70°, marginal cortical cells *7–11 × 3–5 µm; **glassy processes** absent. **Anchoring hyphae** abundant, †2–4 µm wide, walls 0.2–0.4 µm thick. **SCBs** absent; **VBs** in paraphyses slightly to medium refractive or absent; many cells of ectal excipulum at flanks and margin contain small groups of pale to light golden-yellow granules (?LBs). **Exudate** over paraphyses absent, over margin 0.3–1 µm thick, pale yellowish, continuous. — **ANAMORPH**: unknown.

Habitat: lying on ground, on corticated, ~2 cm thick branch of indet. angiosperm tree, on strongly decayed bark (periderm), no algae. **Associated**: brown hyphomycete. **Desiccation tolerance**: not tested, probably desiccation-sensitive. **Altitude**: ?1300 m a.s.l. **Phenology**: X.

Taxonomic remarks. A small portion of the Chinese collection from Yunnan on hygric bark (Pls. 884; 885: 1) was received in the living state, showing whitish to very pale yellowish apothecia. It possibly represents a species distinct from North American *O. renispora*, while from the *xanthostigma-leucostigma* complex it appears to differ by rather large, smooth ascospores containing medium-sized LBs. Regrettably, neither cultural nor molecular data were available, therefore, we refrain from describing a new species. *O. subfabacearum* and *O. fabacearum* differ in spores with a dorsal SB and less inflated paraphyses.

Not included collections. A sample from Japan differs in larger, partly less curved, cashew-shaped spores (†3–4.3 × 1.7–2 µm, Pl. 885: 2) and herein appears to be intermediate to *O. renispora*. The asci measured †50 × 3–3.5 µm and the apothecia rehydrated 0.3–0.7 mm, being now rather pale while the original colour was not stated. A collection from northern Thailand on bark of unidentified angiosperm twig reported by Ekanayaka et al. (2018) under the name *O. leucostigma* concurs with *O. renispora* and the sample from Japan in spore size (†3–3.5 × 1.2–1.6 µm), but differs in more strongly curved (~180–270°) and basally partly much thinner spores, and in much wider asci (†35–45 × 5.5–6.5 µm, 5–6 µm according to scale in their fig. 6g–h). The apothecia are described as yellow, 0.35–0.4 mm diam., with smooth margin. In spore shape this collection resembles the 16-spored *O. coccinella*. The author's fig. 6 contains erroneous scales (d: ~15 instead of 35 µm, e–f: ~10 instead of 5 µm).

No documentation was available for two Chinese samples of which sequences exist in GenBank. They were originally identified by B. Liu as *O. coccinella*, which suggests that their spores were ellipsoid. Nevertheless, they clustered with low support near *O. renispora* (for further data see p. 1419).

Ecology. The South Chinese collection of *O.* aff. *renispora* grew on rotten bark of a hygric branch of an unidentified angiosperm in a montane, subtropical humid (monsoonal) evergreen forest, that from Thailand in a monsoonal tropical forest, and that from Japan in a cold-temperate humid forest with *Quercus*.

Specimens included. **CHINA**: **Yunnan**, **Pu'er**, Ning'er, ~64 km N of Puér, ?25 km SE of Jinggu, Xiaoheijiang, ?1300 m, branch of indet. angiosperm, on bark, 15.X.2004, Y. Zhang & M. Qiao (Y.Z. pe-1, YMFT, H.B. 7669).

Not included. **JAPAN**: **Honshu**, **Nagano**, Chiisagata-gun, 11.5 km NE of Ueda, 9 km SSE of Sugadaira, Kakuma Valley, 1245 m, branch of *Quercus*, on bark, 21.VI.1991, T. Hosoya & A. Nakagiri (TRL 337, TNS-F-56036, H.B. 9986 ø). — **THAILAND**: **Northern Thailand**, **Chiang Rai**, 16 km NNE of Chiang Rai, Mae Fah Luang University, ~460 m, twig of indet. angiosperm, on bark (as 'wood'), 20.IV.2015, A.H. Ekanayaka (hd035, MFLU 16-1861, as *O. leucostigma*, doc. vid.). — **CHINA**: **Beijing**, data unavailable (B.L. 6179, HMAS 139699, as *O. coccinella*, non vid.; sq.: DQ656624). – unlocalized (B.L. 747, as *O. coccinella*, non vid.; sq.: DQ656680).

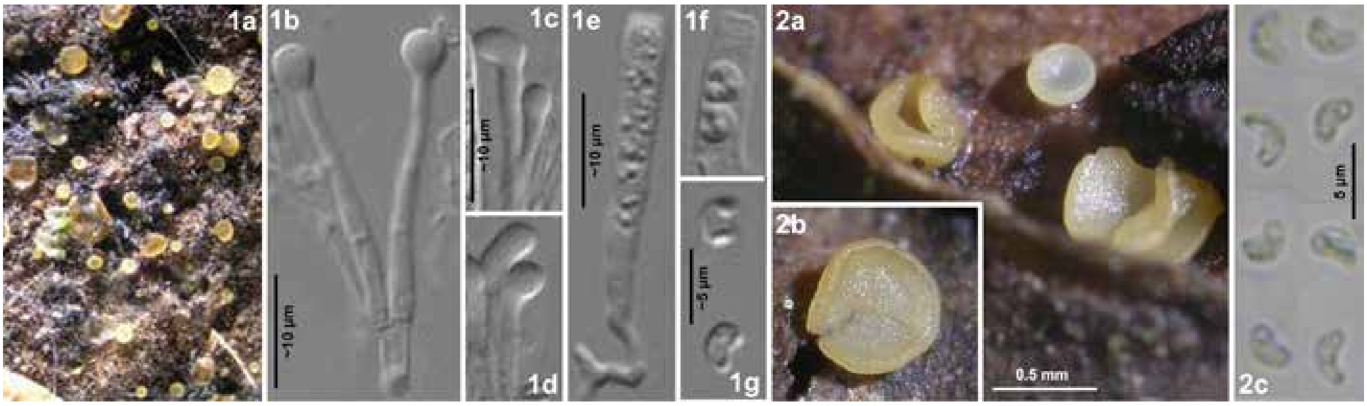


Plate 885. **1–2**: *Orbilia* aff. *renispora* (with smooth ascospores). – **1a**. fresh apothecia; **2a–b**. rehydrated apothecium; **1b–d**. paraphyses; **1e**. ascus; **1f–g**, **2c**. ascospores. – Living state, except for asci (**1e–f**) and spores in **2c**. – **1a–g**: phot. Z.F. Yu (DIC). — **1a–g**. H.B. 7669: China, Yunnan, Pu'er, on indet. angiosperm; **2a–c**. H.B. 9986: Japan, Honshu, on *Quercus*.

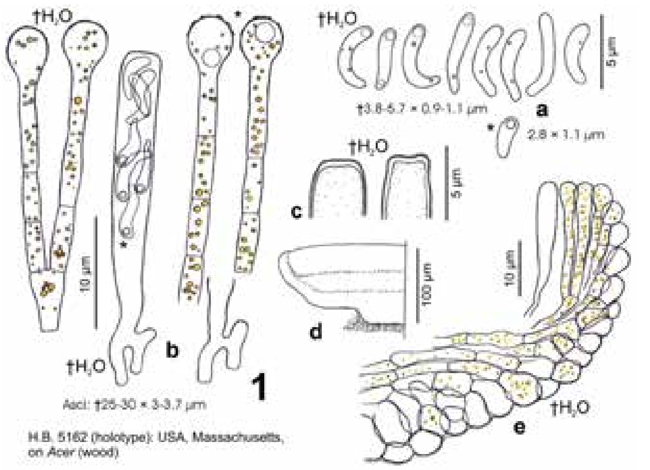


Plate 886. **1**: *Orbilia xanthoflexa*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apices; **d**. apothecium in median section; **e**. id., ectal excipulum at margin and flanks. Dead state, except for two right paraphyses, spores in asci, and one spore in a.

Orbilia xanthoflexa Baral, Pfister & Healy, **sp. nov.**, MB 813957 — Pls 886–887

Etymology: referring to the yellow carotenoids in the oil drops, and the flexuous shape of the ascospores.

Typification: USA, Massachusetts, Concord, log of *Acer*, 1.X.1994, D.H. Pfister (ex D.H.P. O.109 & ex H.B. 5162, M-0276608, holotype).

Latin diagnosis: *Apothecia rehydratata 0.18–0.5 mm diam.*, *vivide aureo-lutea*, *subsessilia*, *margine laevi. Ascosporae †3.8–5.7 × 0.9–1.1 µm*, *cylindricae*, *apice rotundatae*, *basi interdum leniter attenuatae*, *modice ad valde curvatae vel geniculatae*, *in statu vivo corpusculum refringens globosum continentes. Paraphyses ad apicem valde capitatae. Cellulae viventes excipuli marginalis et paraphysium guttulas minutas luteas oleosas*, *modice abundantes continentes. Margo excipuli absque processis vitreis. Habitat ad lignum putridum in trunco uvido* Aceris *in zona temperata vel subtropica humida Americae septentrionalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.18–0.7 mm diam., 0.11 mm thick (receptacle 0.08–0.09 mm), deep golden yellow(-orange), ± translucent, ± round, scattered to subgregarious; disc flat, margin thin, scarcely protruding, smooth; sessile or with an indistinct, short and thick stipe 0.02 × 0.12 mm, superficial. **Asci** †25–36 × 3–3.7 µm {2}, 8-spored, spores †~3-seriate, ~4 lower spores inverted (sometimes mixed) {2}, pars sporifera †12.5–15 µm long; **apex** (†) strongly truncate (partly distinctly indented, laterally not or scarcely widened); **base** with short to medium long, thick stalk, h- to H-shaped. **Ascospores** *(2.8–)4–5.3(–6) × 1.1–1.6 µm {2}, †(3.3–)3.8–5.3(–5.7) × 0.9–1.3 µm {2}, cylindric(-clavate), apex rounded to obtuse, base (very) slightly (to medium) attenuated, medium to strongly curved (falcate) or geniculate, often slightly helicoid, smooth; inflated to a width of *~1.7–2 µm during germination; **SBs** *0.7–0.8(–1) µm diam. {2}, globose, close to apex, attachment invisible (but clearly visible under TEM, total length ~0.8–1 µm), with a few minute **LBs**. **Paraphyses** apically strongly capitate(-clavate), terminal cells *10.5–17 × 3.5–4.4 µm {T}, †2–4.2 µm wide {2}, lower cells *4.5–6 × 1.5–2 µm {T}, †1–1.8 µm wide {2}; unbranched at upper septum, hymenium bright yellow-orange. **Medullary excipulum** hyaline to pale yellow, 20–30 µm thick, of loose to dense textura intricata with many inflated cells, sharply delimited from ectal excipulum near margin by a layer of t. porrecta. **Ectal excipulum** hyaline, of thin-walled, indistinctly vertically oriented t. globulosa-angularis from base to margin, 30–50 µm thick near base, cells †8–18 × 7–13 µm {2}; 15–25 µm thick at lower flanks, 8–12 µm near margin, oriented at a 40–60° angle to the surface, marginal cortical cells †6–10 × (3–)4–5(–6) µm {2}; **glassy processes** absent. **Anchoring hyphae** sparse, †1.8–2.7 µm wide, walls 0.3 µm thick {T}. **SCBs** in apex of paraphyses globose, 1–1.4 µm diam. {T}; **VBs** not seen; small golden yellow-orange **LBs** medium abundant in terminal and lower cells of paraphyses, also in marginal medullary excipulum and partly in ectal excipular cells on margin and flanks {T}. **Exudate** minute (0.1–0.2 µm), granular, firmly attached; over margin absent. **— ANAMORPH**: dicranidion-like (no further data available).

Habitat: lying on rather wet ground, decorticated, ?15 cm thick logs of *Acer* sp. {2}, indet. tree {1}, on deeply very rotten wood {3}, partly darkened, with some green algae (including *Gloeocapsa*). **Associated**: dark setose conidiophores of hyphomycete {1}, *Gloeocapsa* sp. {1}. **Desiccation tolerance**: a few paraphyses and spores survived for ~1 week. **Altitude**: 40–65 m a.s.l. **Geology**: Ordovician & Miocene sedimentary rock, Quaternary sediment; granite. **Phenology**: VI–VII, X.

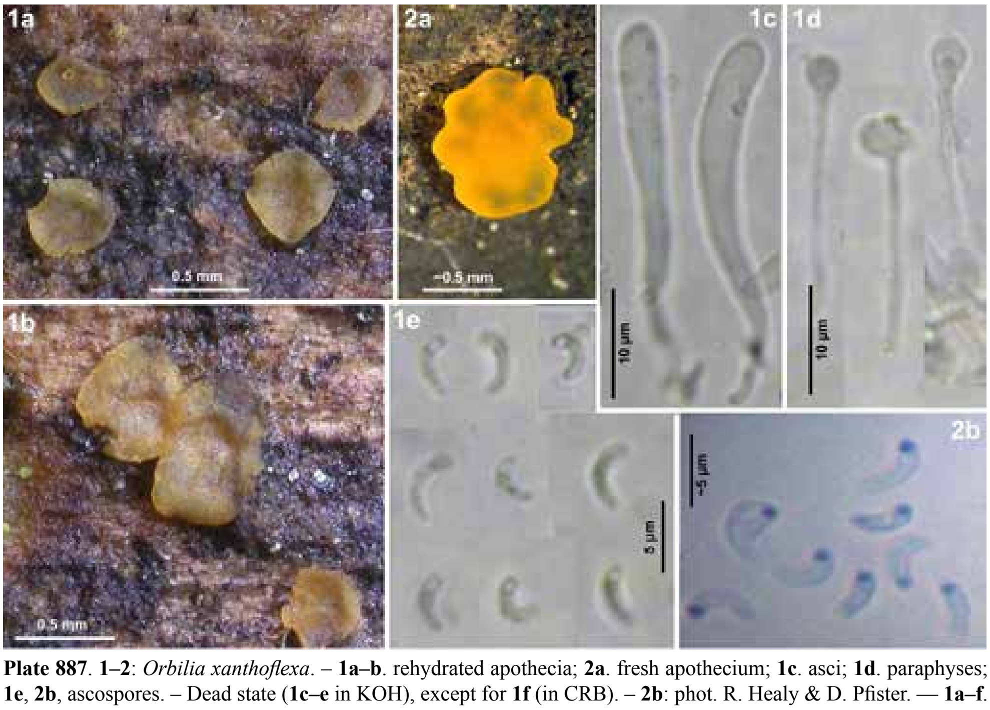


Plate 887. **1–2**: *Orbilia xanthoflexa*. – **1a–b**. rehydrated apothecia; **2a**. fresh apothecium; **1c**. asci; **1d**. paraphyses; **1e**, **2b**, ascospores. – Dead state (**1c–e** in KOH), except for **1f** (in CRB). – **2b**: phot. R. Healy & D. Pfister. — **1a–f**. D.H.P. 130, H.B. 9961: USA, Massachusetts, on *Acer*; **2a–b**. V.R. 13 (FH 00458182): ibid., on indet. tree.

Taxonomic remarks. *Orbilia xanthoflexa* is characterized by abundant yellow-orange LBs in paraphyses and marginal excipular cells, in combination with small, cylindric(-clavate), allantoid to helicoid ascospores containing a comparatively large, globose SB at the broader end. The spore features suggest a relation to the *xanthostigma-leucostigma* complex. However, the species resembles also *O. flexispora* in having similarly sized and curved spores, though differing in several respects (see p. 1430). *O. renispora* mainly deviates in shorter and wider spores and less strongly capitate paraphyses. *O. comma* and *O. neocomma* (section *Aurantiorubrae*) somewhat resemble *O. xanthoflexa* in the spores which are, however, helicoid with a tail-like base, and the paraphyses are covered by much thicker exudate. *O. epipora* (section *Arthrobotrys*) differs in ± straight spores, less inflated paraphyses, and white apothecia (however, a North American collection referred to *O. epipora* has capitate paraphyses and a yellow pigmentation, Pl. 901: 7).

Variation. In the holotype the spores are slightly narrower than in the other two included samples, also the paraphyses are wider in their lower part, but otherwise they concur quite well. Whether all of them contained yellow LBs in the living vegetative cells was not examined. Only a few spores and paraphyses could be studied in the living state because the specimen was received in dry condition. In other samples, R. Healy and D.H. Pfister (pers. comm.) observed a rather high variation in spore size, particularly in width (Pl. 887: 2b), which was always larger than in the holotype.

Not included collections. Three samples from USA are without teleomorph data. Two of them possess molecular data and cluster distantly from the topotype of *O. xanthoflexa*. For the third (D.H.P. 81) the anamorph was documented and its close relationship to the former two is assumed here.

Anamorph. Pfister (1997) listed the species (as *Orbilia* sp., D.H.P. 130) with a dicranidion-like anamorph, but did not provide an illustration or description. His illustration of D.H.P. 81 (Pfister 1997: fig. 8, as *Dicranidion* sp. of the 'fragile type') is assumed here to represent the anamorph of *O.* cf. *xanthoflexa* (see under *O. xanthostigma*, p. 1408), but molecular data were not available for it.

Phylogeny. An ITS sequence of a paratype of *O. xanthoflexa* in GenBank (D.H.P. 130) fully concurs with the unpublished sequence of a more recent sample of this species from the same region (V.R. 13, D.H. Pfister pers. comm., not shown in phylotree). The S1506 intron region is not covered in D.H.P. 130. In our phylogenetic analysis (Phyl. 23) the species is part of the strongly supported *leucostigma-xanthoflexa* subclade, which comprises *O. leucostigma* s.l. (including D.H.P. 108 and B.L. 6420) and *O. xanthoflexa* s.l. (including D.H.P. 91 and ga026b).

Regrettably, no morphological data exist for *O.* cf. *xanthoflexa* (D.H.P. 91 and ga026b), which deviate by only 0.7% in the ITS, whereas *O. xanthoflexa* (D.H.P. 130) differs from them by 5.3–6%. D.H.P. 91 probably had smooth ascospores, because it was named '*O. alnea*' by Pfister (1997). D.H.P. 108 possessed the typical cashew-shaped warted spores (D.H. Pfister pers. comm.), and also for B.L. 6420 this is probable. Strain ga026b was gained from an ascospore isolate of an overlooked mixture with *O. georgiana* and its apothecia might therefore be unpreserved. The ITS distance between *O. xanthoflexa* and *O.* cf. *xanthoflexa* lies at 5.3–6.1%, whereas *O. leucostigma* s.l. differs from them by 6.5–8.3%.

Ecology. *O. xanthoflexa* is only known from two localities near Concord (Massachusetts) in the lowlands of northeastern North America. It was repeatedly collected on rotten wood of decorticated hygric logs of *Acer* and unidentified trees at rather wet places, along a rivulet or near a pond, in a cold-temperate humid mixed forests (Hutchins Pond: *Quercus-Acer* dominated with *Fagus grandifolia* and *Pinus strobus* on acidic soil). The not included samples come from the same region (including the type locality), but also from the subtropical humid southeast.

Specimens included. **USA**: **Massachusetts**, Middlesex, 28.5 km NW of Boston, 4.3 km N of Concord, Estabrook Woods, 65 m, log of *Acer*, on wood, 1.X.1994, D.H. Pfister (ex H.B. 5162, M-0276608, **holotype**; D.H.P. O.109, FH 00458344, **isotype**). – ibid., log of *Acer*, on wood, 20.VI.1995, D.H. Pfister (D.H.P. 130 [O.115], FH, H.B. 9961, anam. cult.; sq.: U72597, **topotype**). – 2.8 km NNE of Concord, Punkatasset Hill, Hutchins Pond, 40 m, ?log of indet. tree, on wood, 10.VII.2014, V. Rodriguez & R. Healy (V.R. 13, FH 00458182, doc. vid., sq.: ined.).

Not included. **USA**: **Massachusetts**, Norfolk, 17 km SW of Boston, 3 km NE of Westwood, Purgatory Tract Area, 60 m, indet. tree, 14.VII.1994, D.H. Pfister (D.H.P. 91, FH 00304898, as *O. alnea*, anam. cult., non vid.; sq.: U72600). – Middlesex, 28.5 km NW of Boston, 4.3 km N of Concord, Estabrook Woods, 65 m, wood of indet. tree, 7.VII.1994, D.H. Pfister (D.H.P. 81, as *O. alnea*, anam. cult., doc. vid.). – **Georgia**, 88 km NW of Jacksonville, ~25 km NE of Fargo, Stephen C. Foster Park, 40 m, branch of *Acer*, on wood, 24.IX.2015, Y.Y. Shao (UGA ga026b, GXU 1493 [mixture with *O. georgiana* ga026a], non vid.; sq.: MG742405, MG742400).

Orbilia fabacearum Baral & G. Marson, **sp. nov.**, MB 813963 — Pls 888–889, Map 142

Etymology: named after the predominant substrate, *Fabaceae*.

Typification: France, Annot, branch of *Laburnum alpinum*, 17.VIII.2001, G. Marson (ex H.B. 7025b, M-0276479, holotype).

Latin diagnosis: *Apothecia rehydratata 0.15–0.9 mm diam., dilute cremeo-rosea ad rosea, raro albida, sessilia, margine laevi. Ascosporae *2.3–4.2 × 1.1–1.6 µm, valde curvatae (semicirculares), laeves, corpusculum refringens globosum, tunicam dorsalem cuspide brevi affixum continentes. Paraphyses ad apicem non vel paulo clavato-capitatae, cellulae vivae absque vacuolis refringentibus. Excipulum marginale absque processis vitreis, exsudato tenui ad valido tectum. Habitat ad lignum vel corticem putridum ramorum vel truncorum siccorum, raro uvidorum fruticum vel arborum angiospermarum, plerumque* Fabacearum, *raro coniferarum, plerumque in zona atlantica temperata ad submediterranea (semi)humida Europae.*

Description: — **TELEOMORPH**: **Apothecia** fresh (0.15–)0.2–0.7(–0.9) mm diam., 0.1–0.17 mm high (receptacle 0.1–0.11 mm), (very) pale to light cream-rose(-orange) or pure rose, rarely whitish, translucent, round, very scattered to subgregarious or gregarious in small groups; disc flat (to slightly convex), margin medium thick, 0–5 µm protruding, smooth; broadly sessile or with ill-defined, obconical, hidden stipe up to 0.06 × 0.18 mm, superficial or half immersed in biofilm; dry light to bright rose-orange(-apricot). **Asci** *(29–)32–38(–43) {6} or 43–48 {1} × 3.2–4 {7} → 3.5–4.3 µm, †24–36 × 2.8–3.5 µm {4}, 8-spored, spores (*) ± uniseriate, SBs mostly laterally oriented, pars sporifera *11–23 → 7–18 µm long; **apex** (†) slightly to strongly truncate (indistinctly indented, laterally not widened); **base** with short to medium long, medium thick, flexuous stalk, L-, h- to H-shaped. **Ascospores** *(2.3–)2.5–3.7(–4.2) × (1.1–)1.2–1.5(–1.6) µm {8}, cashew-shaped, (very) strongly curved (± semicircular, exceptionally only slightly curved), ~(70–)90–180(–220)°, sometimes somewhat geniculate (V- or L-shaped) or slightly to distinctly helicoid, ends rounded, rarely obtuse, smooth; **SBs** *0.6–1 × 0.4–0.7 µm {4}, globose to broadly tear-shaped, narrowed to a small point, often with a very short filum, attached to the dorsal side of the spore {8}, usually ± in the middle, also more towards 1 end. **Paraphyses** apically uninflated to slightly clavate-capitate, sometimes sublageniform, terminal cells *10–22 × (1.7–)2–3(–3.5) µm {6}, lower cells *6–12 × 1.7–2.5(–3) µm {6}, 4–8 µm long at base; never or rarely branched at upper septum. **Medullary excipulum** subhyaline, 30–60 µm thick in centre, of dense textura globulosa-prismatica-intricata, very indistinctly to rather sharply delimited. **Ectal excipulum** hyaline to very pale rose, of (†) thin-walled, irregularly to vertically oriented t. globulosa-angularis(-prismatica) from base to margin, 25–80 µm thick near base, cells *(5–)10–20(–25) × (3–)7–15 µm {5}; 20–60 µm thick at flanks, 15–40 µm near margin, here of t. prismatica(-angularis) oriented at a 30–80° angle, marginal cortical cells *4–10 × (2–)3–5(–7.5) µm {5}, **glassy processes** absent. **Anchoring hyphae** sparse to abundant, */†1.7–3(–5) µm wide (short-celled if 4–5 µm wide), walls 0.2(–0.3) µm thick {4}. **SCBs** absent or infrequently present, globose, (very) low-refractive, in paraphyses 0.8–2.2 µm diam., sometimes elongate; in excipular cells 1.5–3(–4) µm, globose; **VBs** absent {8}. **Exudate** (very) pale yellowish-chlorinaceous, over paraphyses 0.2–1(–2) µm thick, continuous to cloddy or granular, also sparse to absent, loosely or firmly attached; over margin and flanks (0.3–)1–3(–4) µm thick, granular to cloddy. **— ANAMORPH**: unknown (but see below).

Habitat: 0.3–4 m above the ground, also lying on ground under grass, moss or herbaceous vegetation (on underside), corticated or rather decorticated, 12–40 mm thick branches, also cut exposed wood of ~50 cm thick stump, of *Clematis vitalba* {1}, *Laburnum alpinum* {1},

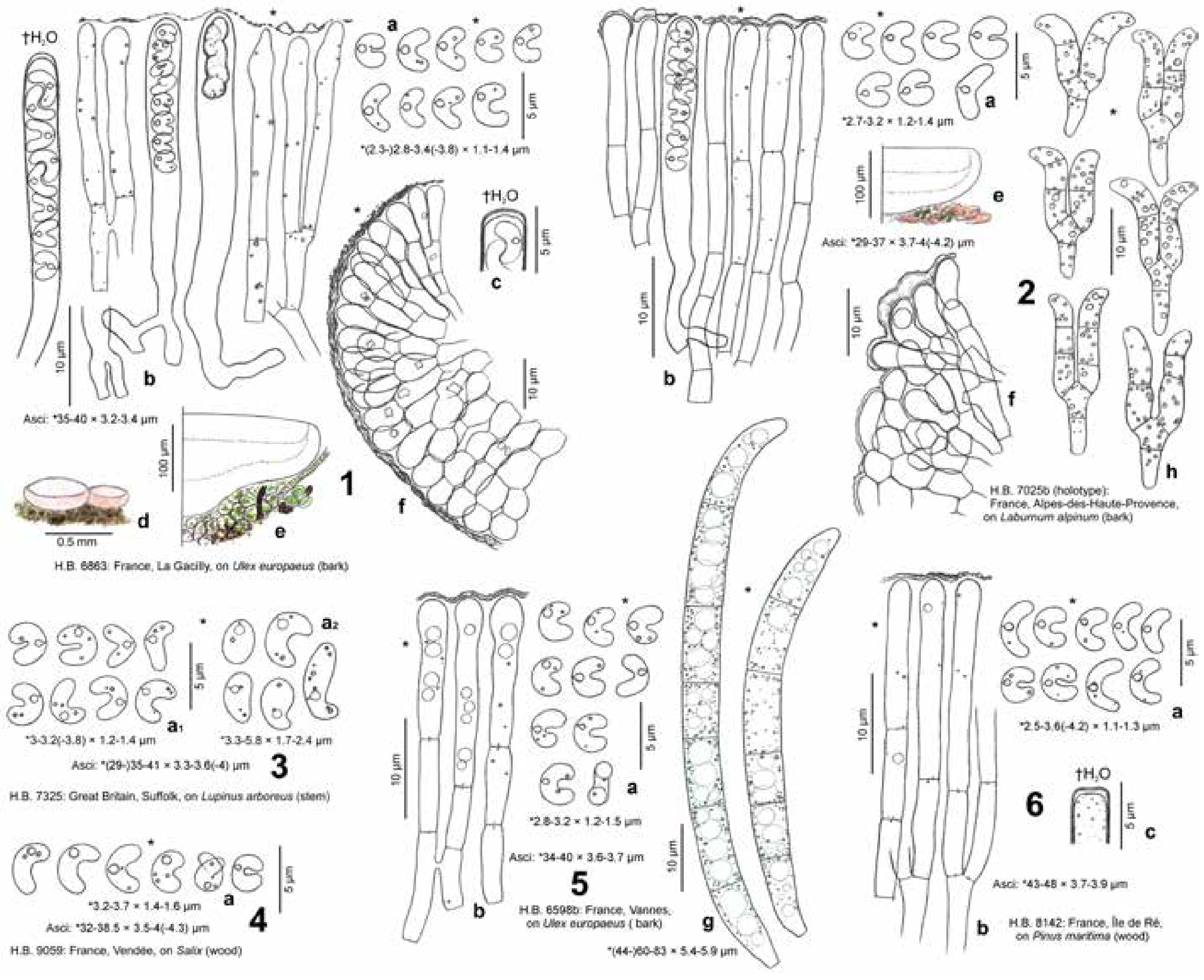


Plate 888. **1–6**: *Orbilia fabacearum*. – **a**. ascospores (5 spores in **3a$_2$** abnormally oversized, partly from 6-spored asci); **b**. asci and paraphyses (1 ascus in **1b** fully turgescent); **c**. ascus apices; **d**. fresh apothecia; **e**. apothecia in median section; **f**. id., ectal excipulum at margin and mid flanks; **g–h**. 2 types of conidia of uncertain relationship from substrate.

Lupinus arboreus {1}, *Pinus pinaster* {1}, *Quercus* sp. {1}, *Salix* sp. {1}, *S.* ?*alba* {1}, *Ulex europaeus* {3}, *Ulmus* sp. {1}, on medium to very decayed wood (7) and bark {5} (periderm and bast), not or slightly greyed, with a few or many green algae. **Associated**: *Chaetosphaerella phaeostroma* {1}, *Hymenoscyphus infarciens* {1}, *Orbilia aristata* {1}, *O. cejpii* {1}, *O. rubrovacuolata* {1}, *O. subtrapeziformis* {1}, *Parmelia sulcata* {1}, ?*Stictis* sp. {1}, pleurocarpous moss {1}. **Desiccation tolerance**: fully viable for at least 1 month. **Altitude**: 1–87 m a.s.l. (western Europe), 290–475 m (central Europe), 1475 m (southern Europe). **Geology**: Cambrian silt, sandstone & quartzitic wacke, Lower Jurassic shale, Upper Cretaceous lime-, clay- & marlstone, Quaternary marine clay, silt & sand; granite, gneiss. **Phenology**: XII–V, VII–VIII (probably throughout the year, rather long-lived).

Taxonomic remarks. *Orbilia fabacearum* closely resembles members of the *xanthostigma-leucostigma* complex in the shape of ascospores which are, however, consistently smooth and have the SBs inserted ± in the middle of the spore away from the ends (similar as in the very distant *O. corculispora*), also the spores tend to be longer and the paraphyses have only slightly inflated apices.

The similar extra-European *O. subfabacearum* (Pls 890–891) is only tentatively separated from *O. fabacearum* by more strongly curved spores (often for > 180°), more capitate paraphyses, and in the type by the partial presence of glassy caps on the marginal cortical cells. Collections from southeastern Asia with smooth spores described here as *O.* aff. *renispora* (Pls 884–885) differ from both species in the partial presence of a spore body at one end of the spores which contain 1–2 rather large LBs, also in strongly capitate paraphyses and in whitish to yellowish apothecia.

Variation. Apothecia vary in size between 0.2–0.3 mm (*Laburnum*, Pl. 888: 2, type) and 0.5–0.9 mm (*Lupinus*, Pl. 889: 1). The specimen on *Pinus* (Pl. 888: 6) well concurs with those on angiosperm hosts, except that it showed distinctly longer asci when compared in the living state. However, the size of dead asci was with †33–36 × 3–3.5 µm quite the same as in H.B. 6863 (on *Ulex*, †31–36 × 2.9–3.3).

Anamorph. The anamorph of *O. fabacearum* is unclear. In two collections we observed very different types of conidia on the natural substrate. In the collection on *Ulex*, vermispora-like phragmoconidia occurred in great number near the apothecia (Pl. 888: 5g); similar but shorter and much narrower, less curved conidia were obtained in pure culture of Chinese *O.* cf. *subfabacearum* by Z.F. Yu (pers. comm., Pl. 891: 2f). In the holotype on *Laburnum*, lyra-shaped dicranidion-like conidia occurred (Pl. 888: 2h) together with T-shaped trinacrium-like

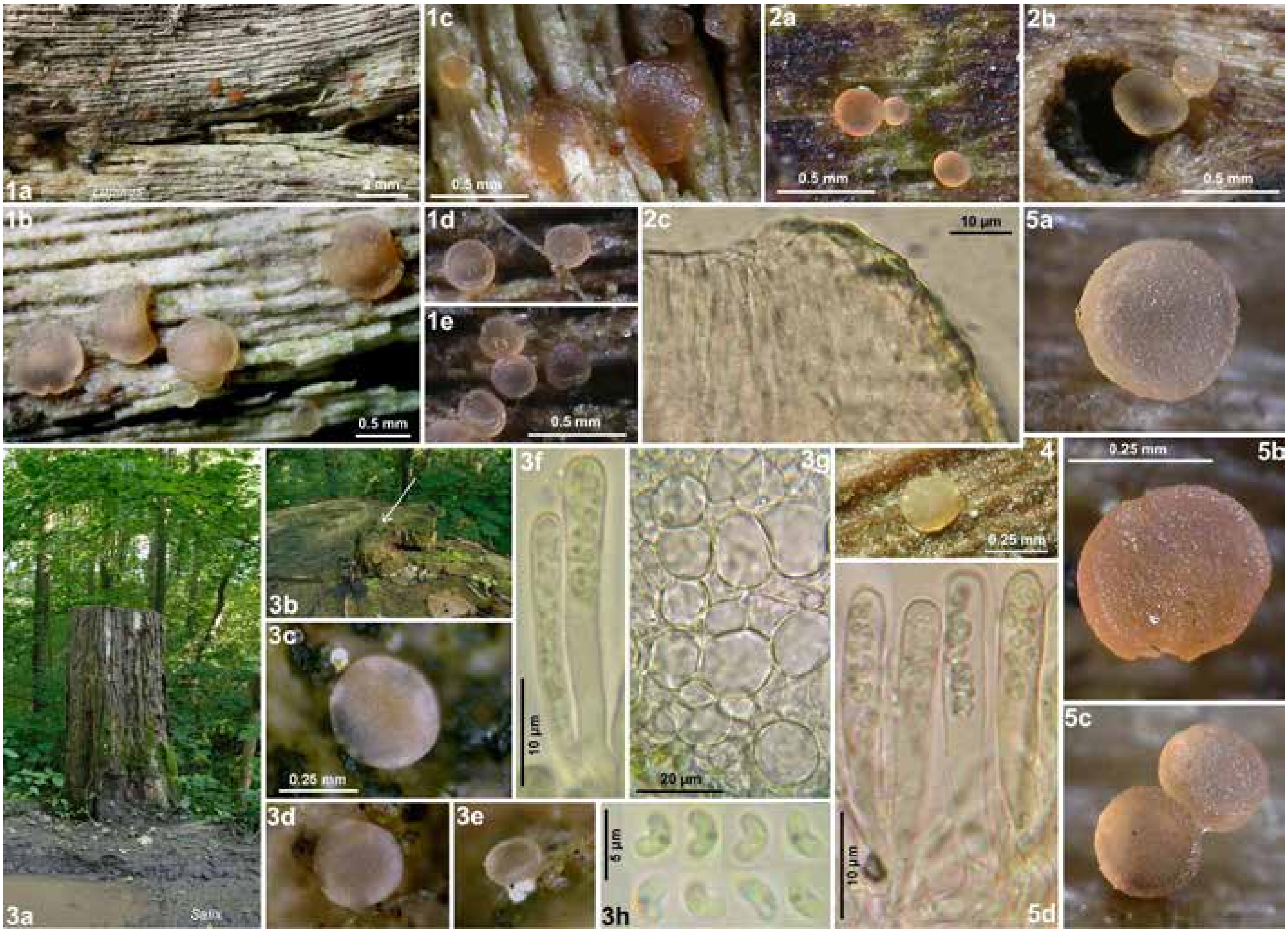


Plate 889. **1–5**: *Orbilia fabacearum*. – **3a–b**. cut *Salix* stump in a forest with *Acer* and *Fagus*; **1a–e**, **2a–b**, **3c–e**, **4**, **5a–c**. fresh or rehydrated apothecia; **2c**. marginal ectal excipulum in median section; **3g**. id., basal ectal excipulum; **3f**, **5d**. mature asci; **3h**. ascospores. – Living state, except for left ascus in **3f**. – **3a–h**: phot. P. Perz; **4**: phot. J.P. Priou. — **1a–e**. H.B. 7325: Great Britain, Suffolk, on *Lupinus*; **2a–c**. H.B. 8142: France, Île de Ré, on *Pinus*; **3a–h**. P.P. 20080720: Poland, Kłodzko, on *Salix*; **4**. J.P.P. 24011: France, Morbihan, on *Quercus*; **5a–d**. H.B. 9059a: France, Vendée, on *Salix*.

conidia and many 5-septate vermispora-like C-shaped conidia. The latter are with *28–32 × 2.8–3.3 µm much smaller than those on *Ulex*, and much more curved than those from China. Dicranidion-like anamorphs are rather frequent in series *Orbilia* and occur, e. g., in the closely related *xanthostigma-leucostigma* complex, whereas vermispora-like conidia resemble the anamorph of *O. liliputiana*.

The genetically distantly related anamorph-typified ***Orbilia xiushanensis*** Z.F. Yu & M. Qiao nom. prov. (Zhang et al. ined., IVV: YMF 1.03033) possesses similar vermispora-like conidia with curved ends formed on very short conidiophores. Its teleomorph is unknown because the ascospore isolate was erroneously thought to originate from a *Hyalorbilia*, *H. japonica* s.l. (IVV, 15.VIII.2008), a species with straight fusiform conidia which clusters in the core clade of *Hyalorbilia*.

Phylogeny. A sequence comprising SSU (without S1506 intron), ITS, and LSU was gained from apothecia of *O. fabacearum*. When analysing SSU+ITS+LSU or LSU (Phyl. 22. S27), the species clustered unsupported and with high distance in a clade containing, e. g., *Tridentaria subuliphora* and series *Microsomates*. When analysing ITS (Phyl. 23) it formed with *O. xiushanensis* a medium supported clade (ITS distance 16 %).

Ecology. *O. fabacearum* grew on ± decayed bark and wood of xeric, rarely hygric branches and stumps of trees and shrubs of *Faboideae* (*Fabaceae*) {5} but also non-fabaceous angiosperms {5} and even gymnosperms {1}. The species was repeatedly found in humid or rarely semihumid, warm-temperate or rarely mesosubmediterranean atlantic western Europe, e. g., in coastal *Ulex* shrubs or a pine forest. It occurred also in an

Map 142. Known distribution of *O. fabacearum* in Europe

orosubmediterranean mixed conifer forest with *Laburnum* and *Lavandula* in the Southern French Alps and in two supratemperate subcontinental sites in central Europe: a colline *Prunus spinosa* shrub with *Clematis* (Luxembourg) and a submontane deciduous forest with *Fagus*, *Acer*, and *Salix* (Poland).

Specimens included. **GREAT BRITAIN**: **East England**, **Suffolk**, 4.5 km NE of Leiston, Minsmere Haven, S of Sluice Chapel, 1 m, stem of *Lupinus arboreus*, on wood, 31.III.2003, E. Batten (E.B. 4399, K(M) 145648, H.B. 7325). — **LUXEMBOURG**: **Gutland**, 2 km SE of Dudelange, Bloklapp, 290 m, branches of *Clematis vitalba*, on wood & bark, 24.XII.2016, G. Marson (G.M. 2016-12-24.1; sq.: MH221064). — **FRANCE**: **Bretagne**, **Ille-et-Vilaine**, 7 km E of Rennes, 2.2 km SE of Cesson-Sévigné, Forgé, 47 m, branch of *Ulmus*, on wood, 24.V.2013, J.P. Priou (J.P.P. 13122, doc. vid.). – **Morbihan**, 8.7 km W of Ploërmel, 3.7 km SE of Josselin, NE of St.-Gobrien, Écluse de Clan, 26 m, branch of *Quercus*, on wood, 9.I.2004, J.P. Priou (J.P.P. 24011, doc. vid.). – 7.5 km NNE of La Gacilly, 3 km ENE of Carentoir, Le Gouta, 87 m, branch of *Ulex europaeus*, on bark, 3.III.2004, J.P. Priou (J.P.P. 24080, doc. vid.). – 4.5 km NW of La Gacilly, 3 km SW of Carentoir, NNE of l'Hôtel Portier, 25 m, branch of *Ulex europaeus*, on bark, 17.II.2001, J.P. Priou (J.P.P. 21036 ø, H.B. 6863). – 12 km SW of Vannes, 2.5 km SE of Larmor-Baden, Île de Creïzic, 14 m, branch of *Ulex europaeus*, on bark, 11.III.2000, J.P. Priou (J.P.P. 2088 ø, H.B. 6598b, anam. substr.). – **Pays-de-la-Loire**, **Vendée**, 8 km NNE of Fontenay-le-Comte, 1.7 km NW of Mervent, near Pont du Diet, along Mère river, 50 m, branch of *Salix*, on wood, 12.V.2009, N. Van Vooren (N.V. 2009.05.25, H.B. 9059a). – **Poitou-Charentes**, **Charente-Maritime**, Île de Ré, 2.5 km NNE of St.-Clément-des-Baleines, Forêt de St.-Clément, around parking area, 7 m, branch of *Pinus pinaster*, on wood, 26.IV.2006, S. Helleman (H.B. 8142). – **Provence-Alpes-Côte d'Azur**, **Alpes-de-Haute-Provence**, 9.7 km ESE of St.-André-les-Alpes, 3.2 km WSW of Annot, Colle Basse NE of Col de l'Iscle, 1475 m, branch of *Laburnum alpinum*, on bark, 17.VIII.2001, G. Marson (ex H.B. 7025b, M-0276479, **holotype**, anam. substr.). — **POLAND**: **Lower Silesia**, Kłodzko, 15.5 km S of Bystrzyca Kłodzka, 1.7 km NW of Miedzylesie, 475 m, stump of *Salix ?alba*, on wood, 20.VII.2008, P. Perz (P.P. 20080720-4, doc. vid.).

Not included. **CHINA**: **Yunnan**, **Yuxi**, Tonghai, 35 km SE of Yuxi, ~2 km S of Tonghai, Xiushan Forest Park, ~1900 m, twigs of indet. angiosperm, 15.VIII.2008, Z.F. Yu & S.F. Li (YMFT 1.03033, proposed holotype of *O. xiushanensis*, sq.: KF824762/MF948538, as *Hyalorbilia* sp./*Dactylella* sp.; reported teleomorph belongs to *Hyalorbilia japonica* s.l.).

Orbilia subfabacearum Baral & G. Marson, **sp. nov.**, MB 813964 — Pls 890–891

Etymology: named after the close resemblance to *O. fabacearum*.
Typification: Australia, Queensland, Mingela, branches of indet. climber, 17.X.1998, G. Marson (ex H.B. 6280e, BRI AQ799181, holotype).

Latin diagnosis: *Similis* Orbiliae fabacearum *sed paraphyses ad apicem modice ad valde capitatae, excipulum marginale processis vitreis brevibus praeditum. Habitat ad lignum vel corticem putridum rami sicci volubilis angiospermae in zona tropica subhumida Australiae septentrio-orientalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.2–0.5 mm diam., 0.08–0.13 mm high, pale to light rose, round, subgregarious; disc flat, margin thin, not protruding, smooth; sessile to substipitate, slightly immersed in biofilm. **Asci** †27–35 × 3–3.5(–4) µm, 8-spored, spores (†) uniseriate, irregularly oriented; **apex** (†) strongly truncate (not indented, laterally sometimes inflated); **base** with medium long and thick, flexuous stalk, h- to H-shaped. **Ascospores** *2.5–3.5 × (0.9–)1–1.3(–1.5) µm, ± semicircular, very strongly curved [for ~(120–)160–270°], ends rounded; **SBs** apparently absent, often 1 small **LB** in middle part and 1–2 further LBs. **Paraphyses** apically medium to strongly capitate, terminal cells †9–18 × 2.5–4.5 µm, lower cells †6–9 × 1–1.8 µm; unbranched at upper septum. **Medullary excipulum** 25 µm thick, of medium dense textura intricata-angularis, medium sharply delimited. **Ectal excipulum** of thin-walled, indistinctly vertically oriented t. angularis at base and lower flanks, 25–70 µm thick near base, cells †8–17 × 7–11 µm; 15 µm thick at mid flanks and margin, oriented at a 60–70° angle to the surface, marginal cortical cells †6–10 × (2–)3–4(–5) µm, with ± conical ?**glassy processes** 1–4 × 2.5–4 µm, strongly refractive, not stratified, with a rough surface, partly completely absent. **SCBs & VBs** no data available. **Anchoring hyphae** sparse, †1.8–2.3 µm wide, walls 0.2 µm thick. **Exudate** over paraphyses 0.2–0.5(–1) µm thick, granular-cloddy, hyaline, firmly attached; on margin and flanks unclear (perhaps the entire processes represent exudate). — **ANAMORPH**: unknown (but see below).

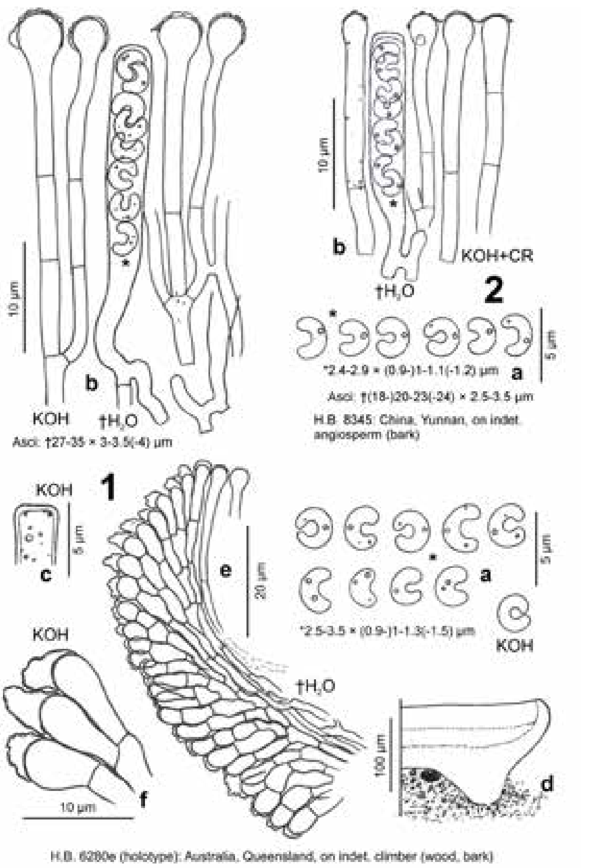


Plate 890. **1**: *Orbilia subfabacearum*; **2**: *O.* cf. *subfabacearum*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apex; **d**. apothecium in median section; **e**. id., ectal excipulum at margin and flanks; **f**. id., marginal cortical cells with short glassy processes.

Habitat: collected 0.5–3 m above the ground, partially corticated to decorticated, 9–13 mm thick branches of indet. climber, on 1 mm deep strongly decayed wood, also on bark (periderm), scarcely greyed, with very few green algae. **Associated** (remotely or on separate branches): *Hysteropatella ?prostii* {1}, *Orbilia mammifera* {1}, *O. neocomma* {1}, *O. paracaudata* {1}, *O. scandens* {1}, *Rhytidhysteron ?rufulum* {1}. **Desiccation tolerance**: unknown (probably desiccation-tolerant), ascospores survive for at least 2 months. **Altitude**: 286 m a.s.l. **Geology**: granite. **Phenology**: X (possibly long-lived).

Taxonomic remarks. *Orbilia subfabacearum* resembles *O. fabacearum* but also the *xanthostigma-leucostigma* complex in the cashew-shaped ascospores. It differs in the presence of refractive caps on the marginal excipular cells and in the absence of distinct SBs in the spores, from the *xanthostigma-leucostigma* complex also in smooth spores and from *O. fabacearum* in more capitate paraphyses.

When the type specimen was examined, merely the spores in numerous asci were viable. Their abundance suggests that the spores were mature. They apparently lack a spore body, contrary to the similar *O. fabacearum*. Often a small droplet was seen at their dorsal side which, however, did not stain in CRB and was apparently always KOH-resistant. The short glassy processes at the margin stained turquoise in CRB and rose in CR, therefore they consist at least in their outer region of exudate.

Not included collections: A Chinese collection (Pls 890: 2; 891: 2) differs from the type of *O. subfabacearum* in distinctly

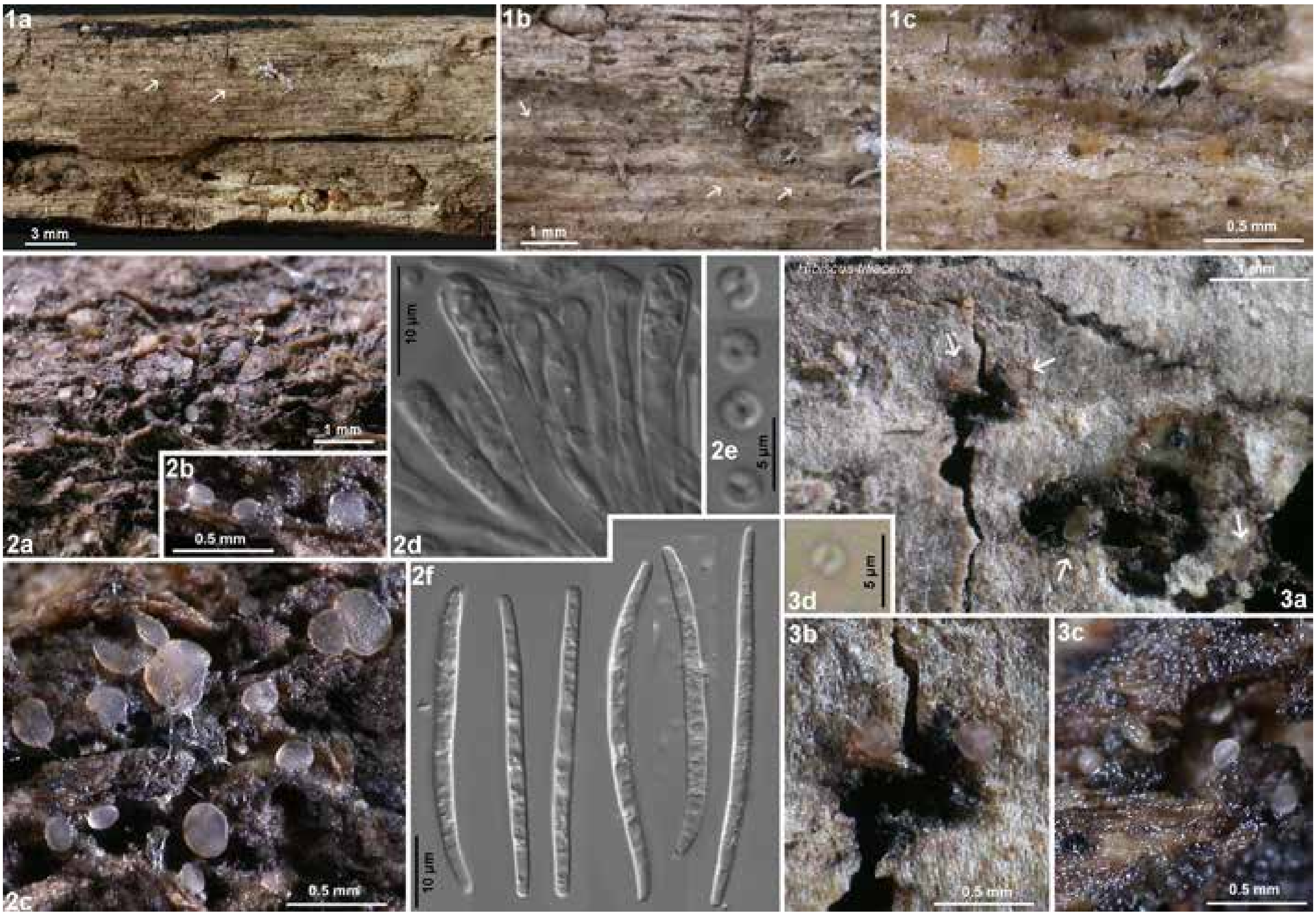


Plate 891. **1**: *Orbilia subfabacearum*; **2–3**: *O.* cf. *subfabacearum*. – **1a**, **2a**, **3a**. dead corticated (**2–3**) or decorticated (**1**) xeric (**1**, **3**) or hygric (**2**) branches; **1b–c**, **2a–c**, **3a–c**. rehydrated apothecia; **2d**. asci and paraphyses; **2e**, **3d**. ascospores; **2f**. conidia from culture. – Living state, except for **3d** (in H_2O). – **2d–f**: phot. Z.F. Yu (DIC). — **1a–c**. H.B. 6280e (holotype): Australia, Queensland, Einasleigh Uplands, on indet. climber; **2a–f**. H.B. 8345: China, Yunnan, on indet. angiosperm; **3a–d**. H.B. 8487b: Australia, Queensland, Daintree Forest, on *Hibiscus*.

shorter asci, and especially in the spores containing SBs at their dorsal side which disappear in KOH. An Australian sample (Pl. 891: 3) closely resembles the Chinese one, but here only dead spores could be studied, and the asci were narrower (†22 × 2.3–2.6 µm). Both differ from the type of *O. subfabacearum* also in less inflated paraphyses and in the cortical cells being consistently without refractive caps. From *O. fabacearum* the two differ in shorter asci, and in smaller, a bit more strongly curved spores. For the time being, these two samples are not included in either description.

A sample from Vietnam with sparse, ochraceous apothecia (0.15–0.3 mm) growing on angiosperm bark was briefly studied (IVV: H.B. 5256a). Only some spores were still alive, but SBs could not be seen. The sample appears to fit best *O. subfabacearum* in spore size and shape (*2.8–3 × 1 µm, asci †28–38 × 2.8–3.5 µm) but its correct identity remains uncertain.

Anamorph. Unbranched, straight to slightly curved vermispora-like phragmoconidia were obtained in pure culture of the Chinese collection (Pl. 891: 2f, *41–53 × 2.4–3 µm, 4–5-septate). Data about the conidiophores was not available.

Ecology. The sparse holotype was collected on rotten bark and wood of a xeric branch of an unidentified climber in a dry riverbed in a tropical subhumid (winter-dry savannah climate) eucalypt open woodland in northeastern Australia east of Great Dividing Range. The not included collections were on rotten bark of xeric or hygric branches of *Hibiscus tiliaceus* (Cottonwood) on Devonian sedimentary rock and an indetermined angiosperm in subtropical to tropical humid (winterdry), monsoon-dominated evergreen forests in northeastern Australia and southern China. The sample from Vietnam is from a tropical humid (wet and dry) rainforest.

Specimens included. **AUSTRALIA**: **Queensland**, Einasleigh Uplands, 75 km SSW of Townsville, 2 km WSW of Mingela, 286 m, branch of indet. climber, on bark & wood, 17.X.1998, G. Marson (ex H.B. 6280e, BRI AQ 799181, **holotype**).

Not included. **AUSTRALIA**: **Queensland**, Wet Tropics, 47 km N of Port Douglas, 5 km N of Cape Tribulation, 15 m, branch of *Hibiscus tiliaceus*, on bark, 30.VIII.2006, G. Marson (ex H.B. 8487b, in BRI AQ799192, H.B. 8487a, type of *O. spirillospora*). — **CHINA**, **Yunnan**, **Yuxi**, Yimen, 54 km NW of Yuxi, 3 km NW of Fangtunxiang, Dalongkou, 1750 m, branch of indet. angiosperm, on bark, VIII.2006, Z.F. Yu (Z.F.Y. ym-25, YMFT, H.B. 8345). — **VIETNAM**: **Phú Quốc island**, 14.5 km NNE of Dương Đông, 5.5 km ESE of Rạch Vẹm, 40 m, branch of indet. angiosperm, on bark, I.1995, N. Petit (H.B. 5256a).

Orbilia coccinella Fr., Summa Veg. Scand.: 357 (1849) — Pls 892–893

≡ *Peziza coccinella* Sommerf., Suppl. Fl. Lapp.: 296 (1826), nom. illegit., ICN Art. 53.1; – Fr., Elenchus Fung. 2: 12 (1828), nom. illegit., ICN Art. F.3.3 – [non *Peziza coccinella* Fr. 1822, ≡ *Helotium coccinellum* (Fr.) Boud. 1907, see below and p. 1666]
≡ *Mollisia coccinella* (Fr.) Gillet, Champ. Fr., Discomyc.: 129 (1882)
≡ *Calloria coccinella* (Fr.) W. Phillips, Man. Brit. Discomyc.: 328 (1887)

Etymology: a diminutive of scarlet red (*coccinea*), referring to the colour of the dry apothecia, perhaps also in comparison to the ladybird beetle genus *Coccinella*.

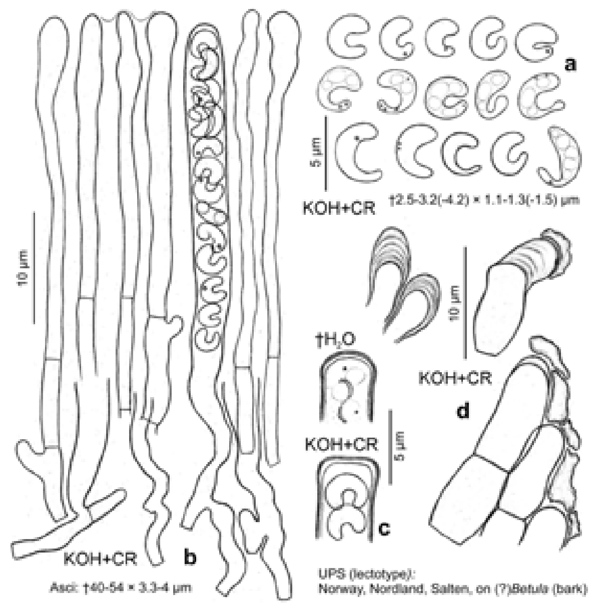


Plate 892. **1**: *Orbilia coccinella*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apices; **d**. marginal cortical cells with short glassy processes.

Typification: Norway, Nordland, Salten, bark of (?)*Betula*, undated, S.C. Sommerfelt (herb. E. Fries, UPS, lectotype, designated here, MBT202386).

Misapplied name: Nannfeldt (1932: 252), as very closely related to *Hyalinia rubella* or perhaps even conspecific.

Misinterpretation of *O. coccinella*: Nylander (1869), Karsten (1869) and most later authors, = *O. eucalypti* or *O. tremulae*; Bachman (1909: 58), ?= *O. eucalypti*; Crouan (in sched.), = *O. rubrovacuolata*; Feltgen (1899: 53, 1901: 35, 1903: 41), = *O. xanthostigma* and *O. eucalypti*; Yang & Liu (2005), ?= *O. dryadum*.

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.4–0.8 mm diam., bright rose (protologue), now pale yellowish-cream, ± translucent, round to laterally compressed, scattered or in small groups; disc slightly concave to flat, margin distinct, finely rough or crenulate; sessile, superficial or immersed in clefts; dry translucent red (fide Sommerfelt). **Asci** †40–54 × 3.3–4 µm, 16-spored (~14–16 spores counted, sometimes apparently only 8-spored), spores (†) biseriate above, uniseriate below, oriented in all directions, pars sporifera †25–33 µm long; **apex** (†) medium, rarely strongly truncate (not indented, laterally not or rarely slightly inflated); **base** with short to long, thin or thick, ± flexuous stalk, T-, L- or h-, rarely H- or M-shaped. **Ascospores** †2.5–3.2 or rarely 3.3–4.2 × 1.1–1.3(–1.5) µm [4.5–6.5(–7) µm actual length], very strongly curved (± semicircular, curved by ~160–270°), not or partly somewhat helicoid, apex rounded to obtuse, below often slightly to strongly narrowed to a short tail that is rarely bulbous at the end; **SBs** not observed. **Paraphyses** apically uninflated or often slightly to rather strongly clavate or ± moniliform, also somewhat spathulate to lageniform, terminal cells †20–32 × 1.5–3 µm, hardly exceeding the dead asci, lower cells †6–12 × 1.2–2.2 µm; usually unbranched at upper septum. **Medullary excipulum** not examined. **Ectal excipulum** only examined near margin, here of textura prismatica oriented at a 40° angle, cortical cells †8–10 × 3–4.5 µm; **glassy processes** 1–5 × 3–4 µm, cap-like, ± high-refractive, stratified. **Anchoring hyphae** not examined. **SCBs & VBs** no data available. **Exudate** over paraphyses ± absent, over margin 1–2 µm thick, cloddy. **— ANAMORPH**: unknown.

Habitat: on apparently xeric bark of (?)*Betula*, outer surface of medium decayed bast being fragmented in scales, also at edges and below, partly darkened. **Associated**: *Hysterium angustatum*. **Desiccation tolerance**: probably drought-tolerant. **Altitude**: unknown (0–700 m). **Geology**: sand, wacke, mica schist, granitoid. **Phenology**: unknown.

Taxonomic remarks. *Orbilia coccinella* in its original sense is easily recognized by 16-spored asci and small, very strongly curved (cashew-shaped), smooth ascospores which are partly strongly attenuated at the lower end by often forming a short tail. The marginal cortical cells carry short glassy processes, which cause the finely rough or crenulate margin.

O. coccinella somewhat resembles the 8-spored *O. fabacearum* and *O. subfabacearum* which have similarly shaped spores, though never as heteropolar as in *O. coccinella*. No trace of the spore body could be discerned in *O. coccinella*. A few oversized spores were seen (3.3–4.2 × 1.3–1.5 µm) which might originate from asci with a reduced spore number. Following the protologue (see below), the epithet *coccinella* refers to the colour of the dry fruitbodies, which is generally much more intense than in the hydrated state.

Nomenclature and type studies. When Sommerfelt described *Peziza coccinella* in 1826, he appears to have been unaware of *Peziza coccinella* Fries (1822: 125), an obviously cyphelloid fungus (see p. 1666), although he compared his fungus with *P. xanthostigma* described in the same work (Fries 1822: 146). Even Fries (1828: 12) himself did not mention *Peziza coccinella* Fr. when he sanctioned Sommerfelt's *Peziza coccinella*, hence he seems to have overlooked this homonymy as well. Therefore, Fries' combination *Orbilia coccinella* is to be considered as a nomen novum (ICN Art. 58.1), and to be cited as *O. coccinella* Fr. instead of *O. coccinella* (Sommerf.) Fr. as was currently done.

Nannfeldt (1932: 252) appears to be the first and only person

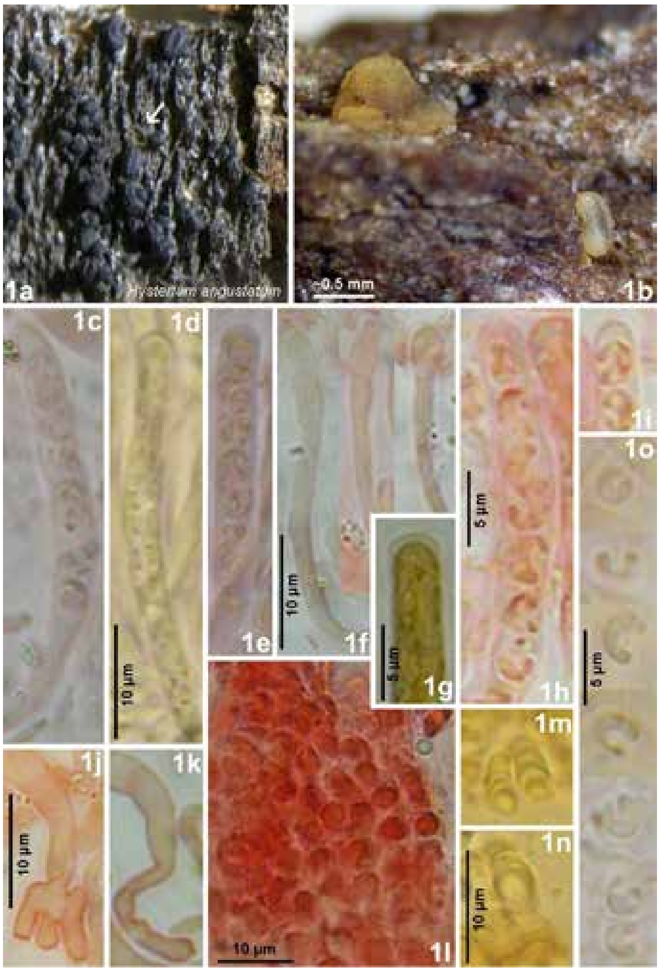


Plate 893. **1**: *Orbilia coccinella*. – **1a**. outer surface of bark of (?)*Betula*, with *Hysterium angustatum* and one destroyed apothecium; **1b**. rehydrated apothecia at edge of bark; **1c–e**. mature asci; **1f**. paraphyses; **1g**, **i**. ascus apices; **1j–k**. ascus bases; **1h–i**, **o**. ascospores; **1l**. glassy processes covering marginal ectal excipulum (external view); **1m–n**. glassy processes. – Dead state (**1d** in H_2O; **1m–n** in KOH; **1g**. KOH+IKI; **1c**, **e–f**, **h–l**, **o** in KOH+CR). — **1a–o**. UPS (lectotype): Norway, Nordland, on (?)*Betula*.

who ever reexamined authentic material of *Peziza coccinella* Sommerf. in herb. E. Fries (UPS). He found this species to differ greatly from the current concept of *Orbilia coccinella* (= *O. eucalypti*) as introduced by 'Nylander, Karsten, Rehm, Boudier and others'. Instead, he believed it to be 'very close to and perhaps even conspecific with *Hyalinia rubella*'. However, the latter species (= *Orbilia rubella*) and the similar *O. phragmotricha*, which Nannfeldt merged with *O. rubella*, sharply differ from the types of *O. coccinella* and *O. eucalypti* in having very distinctive, thick-walled hairs at the margin, and narrowly fusoid-clavate, only slightly curved ascospores. Regrettably, Nannfeldt did not provide any diagnostic features of Sommerfelt's material, therefore, the reasons for his conclusion remain obscure.

When asking in 2002 for authentic material of *O. coccinella* at UPS (and also at C, O, GH, GB, E), no such material was said to exist in all these herbaria. Later (2010) the specimen was rediscovered at UPS (S. Ryman pers. comm.), and it was studied in July 2010 by the first author during a mycological meeting in Saxnäs (Lapland). The label bears a note by Arendholz (in sched.) who had examined it in 1980, albeit only macroscopically because of the paucity of apothecia. The single envelope contains a few pieces of bark, probably of *Betula*, with a total of about 7 apothecia.

The present reexamination of two of them was a surprise: the asci were found to be 16-spored, the spores cashew-shaped, and the marginal cortical cells provided with short glassy processes, features being previously unreported as characteristics of Sommerfelt's fungus. Undoubtedly, Nannfeldt did not see the spores when he proposed a similarity to *Hyalinia rubella*, but he should have noticed the absence of distinct hairs in this material.

Peziza coccinella was originally described with glabrous apothecia. The translation of Sommerfelt's (1826) protologue reads as follows: '1722 *Peziza coccinella*: sessile, minute, submembranaceous, glabrous, flat, suboblong, bright rose, dry translucent red ('*coccinea*'), margin thin. ?*P. xanthostigma* Fr. Syst. [Mycol.] II[(1)] p. 146, Observ. [Mycol.] 1 p. 166? Habitat on bark of *Betula* being fragmented in scales, and on dead branches of *Populus*, widespread in the district Salten in Nordland county. Scarcely 1 line [~2 mm] diam. Sometimes in summer subirregular [possibly referring to an irregular occurrence]. Very closely related to *Dacrymyces urticae* [= *Calloria neglecta*], but this more gelatinous.' No illustration was supplied by Sommerfelt to his diagnosis.

Fries (1828: 12) merely copied Sommerfelt's description, but he added two German taxa which he considered as synonymous: *Peziza diluta* γ. *fungorum* Albertini & Schweinitz (1805: 338), on rotten *Boletus sistotremoides* (= *Phaeolus schweinitzii*) in Saxonia, and *P. dispersa* Wallroth (1833: 469), on *Sphaeria stigma* (= *Diatrype stigma*) in Thüringen. Fries stated that the colour of Sommerfelt's *P. coccinella* strikingly differed from his *P. xanthostigma*, and referred Swedish collections on rotten polypores to *P. coccinella*. Saccardo (1889: 628) followed Fries in citing *P. dispersa* Wallr. Crypt. N. 2503 as a synonym of *O. coccinella* and mentioned in the habitat also Fries's polypores, besides Italia and Galicia.

Since Sommerfelt reported his taxon on two different substrates, and also Fries cited Sommerfelt's fungus as growing on 'bark of *Betula* and *Populus*', the present material, which seems to contain remnants of a single host tree only, is not automatically the holotype. Therefore, the specimen in herb. Fries (UPS) labelled '*Peziza coccinella* Somf.', leg. Sommerfelt, is designated here as **lectotype** of *Orbilia coccinella* Fr.

Ecology. *O. coccinella* is so far only known with certainty from the sparse type collection on rotten xeric bark of a possibly standing trunk of (?)*Betula*. Judging from the rose-red colour of the apothecia and the polysporous asci, the species is most probably a desiccation-tolerant fungus. This is confirmed by the coexistence with *Hysterium angustatum*, but also by the appearance of the decayed bark. The species was collected in in the traditional district Salten, a prefecture at Sommerfelt's time which comprised also Ofoten (K. Homble pers. comm.), with the municipality Saltdal (with the main village Rognan) where Sommerfelt operated as a parson in his early years (1818–1824). Here, Sommerfelt most probably collected primarily in the chalk-rich Saltdal area, with the well known species-rich Junkerdal (K. Homble pers. comm.). Saltdal is just north of the arctic circle and represents one of the driest areas of Norway because it lies in a valley in the rainshadow of the surrounding mountains. Nevertheless, its oroboreal summer-warm forests are to be considered as humid. It seems probable that *O. coccinella* was collected in the widespread *Betula* forests of that area.

Specimens included. **NORWAY**: **Nordland**, Salten, ?Saltdal, unlocalized, 0–500 m, branch of (?)*Betula*, on bark, undated, S.C. Sommerfelt (herb. Fries, UPS, **lectotype**, H.B. 9402a ø).

Incertae sedis

Orbilia flexispora Spooner, Bibl. Mycol. 116: 173 (1987) — Pls 894–895

Etymology: referring to the flexuous shape of the ascospores.
Typification: Australia, Victoria, Colac, branch of *Melaleuca*, 6.IX.1964, G. & K. Beaton (K(M) 48775, holotype).

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.4–0.85 mm diam., 0.18 mm thick (receptacle 0.1–0.12 mm), whitish to pale yellowish (Spooner: whitish), slightly translucent, ± round, superficial, scattered or a few densely aggregated; disc strongly concave, margin distinct, smooth, ~10 µm protruding, with a ± indistinct, short and thick stipe; dry light chlorinaceous (Spooner: pale orange). **Asci** †30–41 × 2.9–3.1 µm, 8-spored, spores †~3-seriate, usually lower (e.g., 5) spores inverted (± mixed), pars sporifera †12.5–14 µm

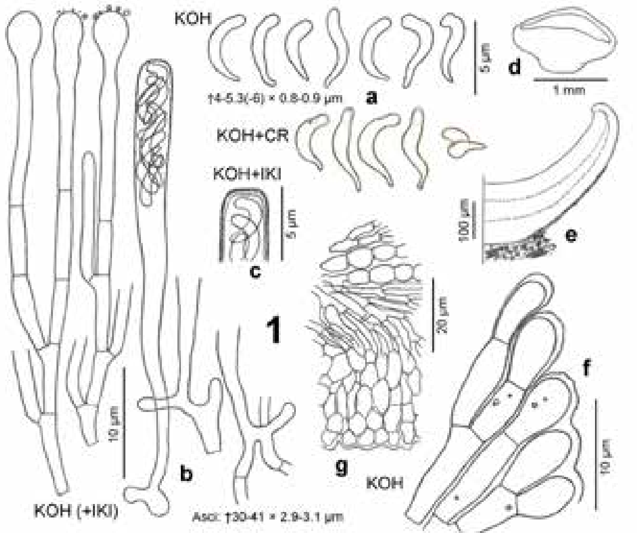


Plate 894. **1**: *Orbilia flexispora*. – **a**. ascospores (1 in bottom view); **b**. ascus and paraphyses; **c**. ascus apex; **d**. rehydrated apothecium; **e**. apothecium in median section; **f**. median section of marginal ectal excipulum; **g**. id., ectal and medullary excipulum at lower flanks.

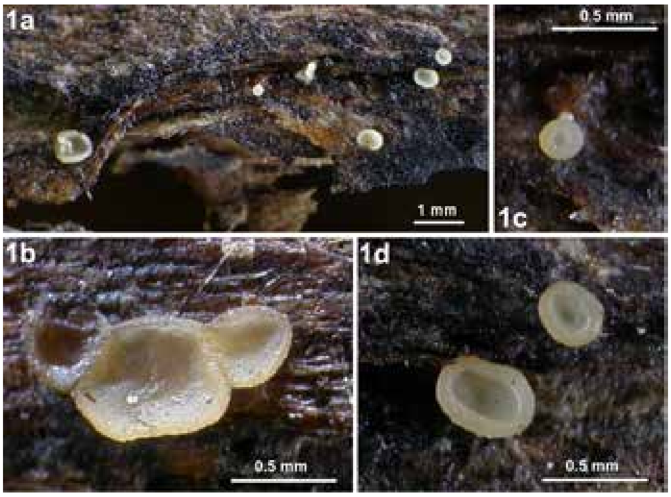


Plate 895. **1**: *Orbilia flexispora*. – **1a–d**. rehydrated apothecia. — **1a–d**. K(M) 48775 (holotype): Australia, Victoria, on *Melaleuca*.

long; **apex** (†) strongly truncate (not distinctly indented, laterally not widened); **base** with medium to very long, thin, flexuous stalk, T-, Y- or H-shaped. **Ascospores** †4–5.3(–6) × 0.8–0.9 µm, narrowly cylindric- to fusoid-clavate (subulate), apex rounded, not or slightly tapered, often subapically slightly constricted to form a knob-like end, base strongly attenuated (often tail-like), strongly curved (falcate to distinctly helicoid); **SBs** visible as a very faint, broadly ellipsoid area in the broad spore end. **Paraphyses** apically medium to strongly clavate-capitate, rarely moniliform, terminal cells †16–20 × 2–3.3 µm, lower cells †3.5–7.5 × 1–1.5 µm; unbranched at upper septum. **Medullary excipulum** hyaline, 50 µm thick, of medium loose horizontal textura porrecta-intricata with many inflated cells, sharply delimited from ectal excipulum by a layer of t. porrecta. **Ectal excipulum** hyaline, of thin-walled, vertically oriented t. angularis(-prismatica) from base to mid flanks, 50 µm thick near base, cells †5–15 × 4–10 µm; 30–35 µm thick at lower flanks, 15–20 µm near margin, of t. prismatica oriented at a 40–60° angle to the surface, marginal cortical cells †6–8 × 2.5–4 µm; **glassy processes** absent. **SCBs** & **VBs** no data available. **Anchoring hyphae** abundant, 1.5–2.7 µm wide, walls 0.2–0.3 µm thick, forming a dense, 5–15 µm thick layer at lower flanks. **Exudate** over paraphyses mostly absent, sometimes as scattered, loosely attached granules; over lower flanks up to margin ∼0.5–1 µm thick, continuous, firmly attached. **— ANAMORPH**: unknown.

Habitat: probably lying on ground, corticated, ∼20 mm thick branch of *Melaleuca* sp., on medium decayed bark (periderm), indistinctly greyed, with some algae. **Associated**: none observed. **Desiccation tolerance**: unknown (possibly intolerant). **Altitude**: ?230 m a.s.l. **Geology**: Cenozoic regolith. **Phenology**: IX (southern hemisphere).

Taxonomic remarks. *Orbilia flexispora* is characterized by comparatively small, rather strongly falcate to helicoid ascospores with one end rounded and the other strongly tapered and acute to acuminate. The SBs appear to be located in the rounded end, judging from the few spores in which a faint, transparent, broadly ellipsoid area could be discerned (Pl. 894: 1a below row).

A slight constriction is frequently seen near the rounded spore end, resulting in a knob-like spore apex, a feature which is quite unusual in *Orbilia*. Actually, this knob-like spore end is reminiscent of the basal spore ends in, e. g., *O. milinana* (series *Abutilones*), but a slight constriction near the spore apex is also seen in some members of section *Arthrobotrys*, e. g., in *O. elegans* (Pl. 961: 1a), and the flexuous shape of the tapered end indicates that it can hardly represent the spore apex.

O. xanthoflexa has a similar spore size and curvature, but deviates in having only slightly tapered spore bases, smaller asci, and bright yellow apothecia with a flat disc. *O. neocomma* (series *Commatoideae* of section *Aurantiorubrae*) resembles *O. flexispora* in spore shape and might be closely related. It differs in longer and especially wider, more fusoid spores with more tapered apices without subapical constriction, also in the presence of exudate caps on the paraphyses, furthermore in the absence of H-shaped ascus bases and in flatter apothecia. The presence of H-shaped ascus bases in *O. flexispora* supports its position within section *Orbilia*, though section *Arthrobotrys* would be another possibility for this species. Because of this uncertainty we did not include this species in the description of series *Orbilia*.

The thick and refractive walls of the cortical excipular cells are apparently made up of exudate, since this layer stains deep rose-red in CR. However, the possibility cannot be excluded that the rose-red stain is restricted to the surface, whereas the matrix is composed of a gel or a glassy wall substance.

Type studies. The present redescription fits quite well the protologue (Spooner 1987: apothecia 0.5–1 mm diam., asci 30–36 × 2.5–3 µm, spores 4.5–6 × 0.6–1 µm, paraphyses not encrusted). Spooner described the asci as apically rounded, although his illustration shows ± distinctly truncate apices. The original colour of the apothecia was not noted by the finder, and the material was restudied by Spooner maybe 20 years after the specimen was collected.

Ecology. *O. flexispora* is only known from the holotype. It grew on medium rotten, probably hygric bark of a *Melaleuca* branch in southeastern Australia. The collection site was given as 'Victoria, Pipeline Road'. There are several Pipeline Roads in Victoria, but it seems quite probable that the one not far from Cape Otway was meant, the southernmost part of southeastern Australia. The natural vegetation around this road appears to be an oceanic, warm-temperate humid eucalypt tall open forest which lies in the South East Coastal Plain ecoregion.

Specimens included. **AUSTRALIA**, **Victoria**, **South East Coastal Plain**, ?95 km WSW of Geelong, ?27 km SW of Colac, Pipeline Road, ?230 m, branch of *Melaleuca*, on bark, 6.IX.1964, G. & K. Beaton (Beaton 258, K(M) 48775, **holotype**, H.B. 5752 ø).

Unidentified psammina-like anamorphs with possible relationship with series *Orbilia*:

Collections from Europe and North America: **Conidiophores** not observed. **Conidia** hyaline, */†19–31 µm diam., with 8–13 arms of */†(6–)8–30 × 2–3.5 µm, each arm with 0–3 septa.

Collections from Australia: **Conidiophores** not observed. **Conidia** hyaline, */†43.5–58 × 47.5–71 µm, with 16–21 arms of */†6–13 × 2–3.5(–4) µm, each arm with 3–7 septa.

Taxonomic remarks. Psammina-like conidia seem to represent a multibranched variant of the genus *Dicranidion*. We have observed them on xeric wood and bark of different gymno- and angiosperms, partly in association with *Orbilia* spp. They resemble some members of the genus *Psammina* as surveyed by Lee & Crous (2003) and Earland-Bennett & Hawksworth (2005) who provided a dichotomous key. This genus is listed in Index Fungorum and Species Fungorum with nine species which occur saprobic on monocots or more or less parasitic on lichens and in close association with green coccoid algae on xeric wood and bark of angiosperms. One species, *P. palmatum* Earl.-Benn. & D. Hawksw., was considered to be lichenized

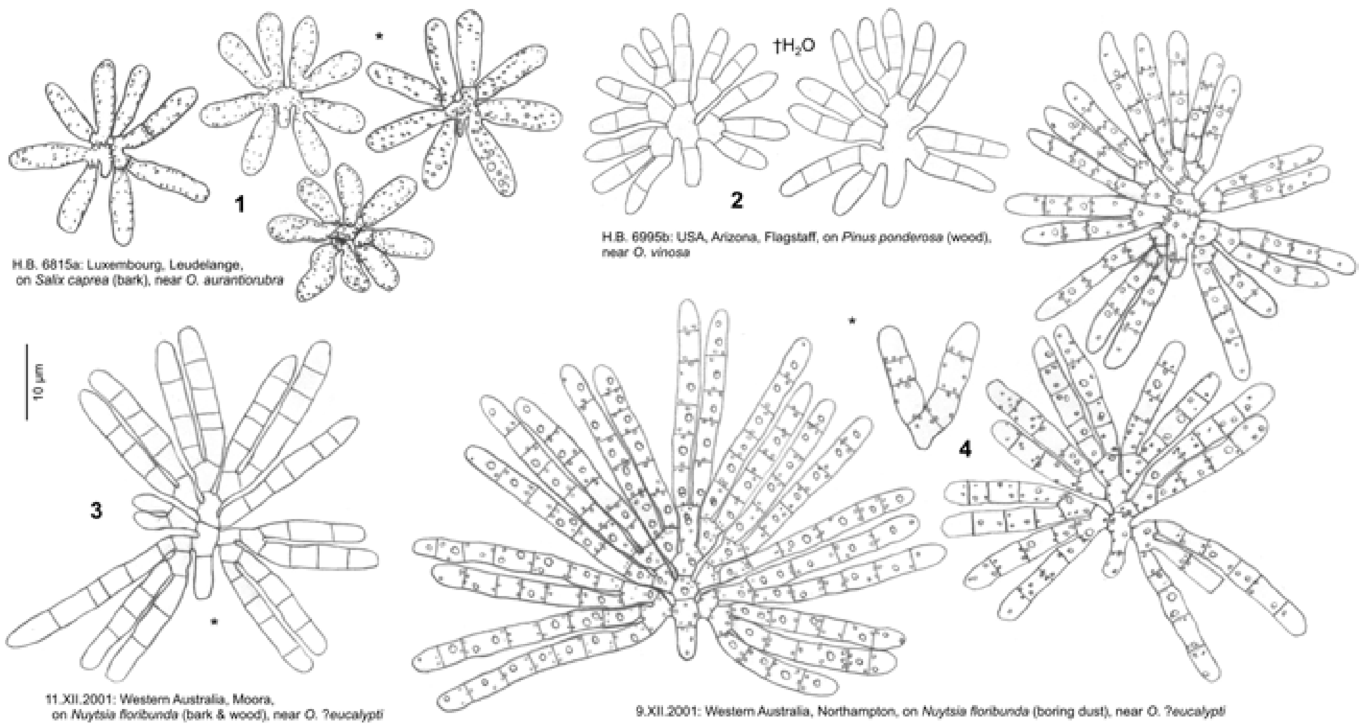


Plate 896. Psammina-like conidia from natural substrate (in **4** also dicranidion-like).

(Earland-Bennett & Hawksworth 2005). Conidia are hyaline or pale brown and are formed on short monoblastic conidiophores in dispersed colonies or within conidiomata.

The specimens studied here differed from each other in conidial size and number of septa. The smaller ones have been collected in Europe (with few septa) and North America (with many septa), the larger multiseptate ones in Australia. The latter resemble *Dicranidion incarnatum* which regularly forms conidia with 3–8 arms (see Pl. 11: l) except that the arms point in all directions. In the material from Luxembourg and France, septa occurred mainly at the base of the arms, possibly because these conidia are juvenile. In the collection on *Nuytsia* rarely 2-armed dicranidion-like conidia occurred with the multiarmed ones (Pl. 896: 4), which resemble those of *O. eucalypti* and allied species.

Different species of *Orbilia* with different anamorphs grew in association with our samples of psammina-like conidia but all are excluded as teleomorph of them because they produce different conidia in pure culture: in one from Luxembourg it was *O. aurantiorubra* with vermispora-like conidia, in one from USA it was *O. vinosa* which has trinacrium-like conidia, and in two from Australia *O. ?eucalypti* (9.XII.2001 with oversized spores) and *O. ?tremulae* (11.XII.2001) occurred, which both typically have dicranidion-like conidia. Only within the species complex of ellipsoid-spored taxa around *O. eucalypti* and *O. tremulae* it seems possible that psammina-like conidia belong to the associated teleomorph.

Phylogeny. An LSU sequence of the type species, *P. bommeriae* Sacc. & M. Rousseau (with hyaline conidia), was available in GenBank (MH878435), which refers this species near *Torula* Pers. and *Corynespora* Güssow in the *Pleosporales*, *Dothideomycetes*. Further molecular studies are unknown to us.

Specimens included (all without presumed teleomorph): **AUSTRALIA**: **Western Australia**, Jarrah Forest, 56 km NNE of Perth, 14 km NNE of Muchea, Great Northern Hwy, 230 m, branch of *Pinus radiata*, on boring dust, 23.XI.2001, G. Marson (ø) – Geraldton Sandplains, 60 km N of Geraldton, 12 km N of Northampton, 278 m, branch of *Nuytsia floribunda*, on boring dust near *O. ?eucalypti*, 9.XII.2001, G. Marson (ø), – 145 km NNW of Perth, 48 km WSW of Moora, 2.5 km NW of Cataby, Brand Hwy, branch of *Nuytsia floribunda*, on bark & wood with *O. ?eucalypti*, G. Marson, 11.XII.2001 (ø), — **LUXEMBOURG**: **Gutland**, 4.5 km SW of Luxembourg, 1.5 km SW of Cessange, Bois de Cessange, 305 m, branch of *Salix caprea*, on bark near *O. aurantiorubra*, 5.XI.2000, G. Marson (H.B. 6815e). – 6 km S of Luxembourg, 1.5 km WSW of Fentange, Mierchesfeld, 283 m, branch of *Acer pseudoplatanus*, 21.VII.2008, G. Marson (ø). – 6.5 km SE of Luxembourg, 2 km ESE of Alzingen,

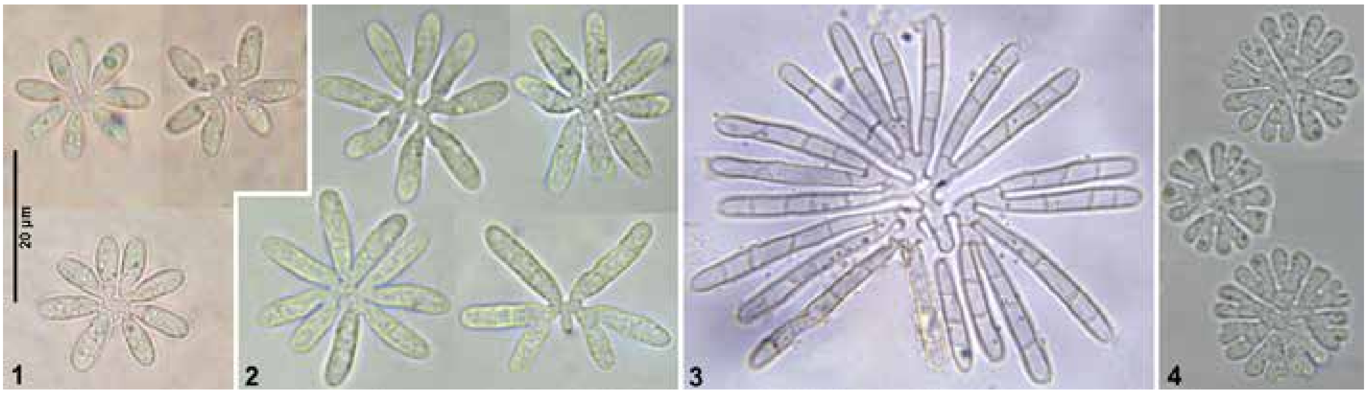


Plate 897. **1–4**: Psammina-like conidia from natural substrate. – Living state except for **3**, all in H_2O. — **1**. H.B. 8136: France, Niort, on *Salix*; **2**. 21.VII.2008: Luxembourg, Fentange, on *Acer*; **3**. 9.XII.2001: Western Australia, Northampton, on *Nuytsia*; **4**. 8.VI.2009: Luxembourg, Alzingen, on *Cornus*.

Héid, 290 m, branch of *Cornus*, on boring dust near *O.* ?*eucalypti*, 8.VI.2009, G. Marson (ø). — **FRANCE**: **Poitou-Charentes**, **Charente-Maritime**, 21 km W of Niort, 4 km NW of St.-Hilaire-La-Palud, Marais Poitevin, 4 m, branch of *Salix aurita*, on bark with *Hyalorbilia fusispora*, 25.IV.2006, H.O. Baral (H.B. 8136d). — **USA**: **Arizona**, Mogollon Rim, 9 km NW of Flagstaff, San Francisco Peaks, 9 km SSW of Humphreys Peak, Rte. 180, 2250 m, branch of *Pinus ponderosa*, on wood near *O. vinosa*, 12.VI.2000, G. Marson (H.B. 6995b).

Section *Arthrobotrys*

Orbilia subgenus ***Orbilia*** section ***Arthrobotrys*** (Corda) Baral, E. Weber & Hagedorn, **comb. & stat. nov.**, MB 814997 – Type species: *A. superbus* Corda [= *Orbilia* ?*auricolor* (A. Bloxam) Sacc.]

Basionym: *Arthrobotrys* Corda, Pracht-Fl. Eur. Schimmelbild.: 43 (1839)

Emended diagnosis: **TELEOMORPH**: Apothecia with smooth or denticulate to hairy margin, sessile or stipitate, desiccation-sensitive or -tolerant. Asci 8-spored, apex (†) ± truncate, thin-walled, base furcate, often H-shaped. Ascospores ellipsoid, fusoid, narrowly cylindrical or subulate, straight to strongly curved; spore bodies globose to filiform. **— ANAMORPH**: Conidiophores usually ± long, unbranched or branched in upper part (sympodial), conidiogenous loci apical, singly, or on aggregated denticles or nodules (multiple). Conidia straight or sometimes curved, exceptionally branched, 0–multiseptate, with or without inflated middle cells. Trapping organs present or absent.

TELEOMORPH: **Apothecia** moist/rehydrated (0.15–)0.25–2(–6) mm diam., whitish or pale to bright rosaceous or yellow-orange to blood-red or purplish-brownish, margin smooth or finely to distinctly crenulate or denticulate, sessile or with a short to comparatively long stipe. **Asci** *24–67 × 3–5(–6) µm, 8-spored, lower or upper (1–)3–5(–6) spores inverted; **apex** (†) slightly to strongly truncate in front view, not or ± distinctly indented and laterally inflated, hemispherical in profile view, thin-walled; **base** generally H-shaped in a part of the asci. **Ascospores** *(2.7–)5–14(–17)((–20.5)) × (0.6–)0.8–1.7(–2.3)((–3.5)) µm, ellipsoid-ovoid to subcylindrical or often narrowly fusiform to fusoid-clavate (subulate), apex rounded to obtuse or subacute to acuminate, base not or slightly to strongly tapered, sometimes with a tail, straight or slightly to strongly curved (falcate), usually strongest near base; **SBs** apically affixed to spore wall, central or ± eccentrical, (0.4–)0.8–2(–3) × 0.15–1 µm, globose to tear-shaped or subulate to rod-shaped, narrowed to a small to wide point, with or without short filum, attachment visible or not. **Paraphyses** not or slightly to strongly inflated at apex, clavate-capitate, sometimes obtusely lanceolate, terminal cells (1–)2–5(–6)× longer than lower cells, unbranched near apex. **Ectal excipulum** of vertically oriented textura globulosa-angularis-prismatica; **glassy processes** absent or 1–5 µm up to 50–70 µm long, **hairs** absent, rarely 12–110 µm long, thick-walled, septate. **SCBs** absent or globose, never crystalloid (exception: strain from *O. senegalensis* in series *Neodactylella*); **VBs** absent or slightly to medium, rarely strongly refractive; **LBs** without **carotenoids** (very pale yellowish in *O. terrestris*). **Exudate** (0.1–)0.3–2(–8) µm thick, continuous to cloddy-granular, loosely or firmly attached, hyaline to bright yellowish, rarely reddish or brownish, sometimes absent. **— ANAMORPH**: arthrobotrys-like, dactylella-like, dactylellina-like, drechslerella-like, gamsylella-like, presumably also anguillospora- or vermispora-like. **Conidiomata** absent, rarely synnematous (*Roigiella*). **Conidiophores** erect, medium long to very long (30–600 µm), apically unbranched, with a single acrogenous conidium, or sympodially branched (geniculate, candelabrelloid or arthrobotryoid). **Conidiogenous cells** monoblastic or sympodial, or aggregated as denticles or nodules. **Conidia** unbranched, exceptionally trinacrium-like, cylindric-ellipsoid, clavate, obovoid, fusiform, or top-shaped, aseptate or usually oligo- to multiseptate, straight or sometimes curved; **conidial dimorphism** present or absent. **Trapping organs** formed or not formed in the presence of nematodes (or other invertebrates), including adhesive knobs, adhesive columns and bridges, adhesive nets, non-constricting rings, and constricting rings. **Habitat**: on wood and bark, herbaceous stems, leaves or fruits of both gymno- and angiosperms, sometimes fungicolous or on dung, temperate to tropical, humid to semihumid, sometimes semiarid to arid, desiccation-sensitive or sometimes -tolerant.

Recognized series: *Arthrobotrys*, *Dactylellina*, *Drechslerella*, *Gamsylella*, and *Neodactylella*, with 88 recognized species (35 of them without known teleomorph) plus 1 with a provisional name, 18 unnamed species ('affinis'), and 6 species of uncertain affinity (2 of them unnamed); further ~67 anamorphic species not treated here.

Taxonomic remarks. Section *Arthrobotrys* includes five series: *Neodactylella*, *Arthrobotrys*, *Dactylellina*, *Gamsylella*, and *Drechslerella*, which have been treated as different anamorph-typified genera before the ICN came into effect in 2012. It is circumscribed here for species with predominantly desiccation-sensitive apothecia, often narrowly falcate but also rod-shaped or ellipsoid ascospores, often very long conidiophores, and almost exclusively unbranched, often rather broad conidia. Except for series *Neodactylella*, all members form trapping organs on their mycelia, which are able to catch nematodes and other invertebrates.

Anamorph, **series delimitation**. Various molecular studies indicate that the type of trapping organ (or its absence) represents the key character of each of the five recognized groups (see below). To classify a species into a series solely by the teleomorph proved difficult if not impossible, and even the conidiophores and conidia observed on the natural substrate or in pure culture usually do not provide enough characteristics, unless the trapping organs are unequivocally detected as belonging to the fungus.

Earlier classification systems to distinguish anamorph-typified genera of nematophagous fungi have been based on conidiophore (Fig. 103) but also conidial morphology (for a review of the generic names see Baral et al. 2017b). However, these morphological traits were largely not supported by molecular data. In fact, three of the four main conidiophore types that occur within section *Arthrobotrys* are found in all of the five recognized series. Merely the arthrobotryoid type is exclusively observed in series *Arthrobotrys*, with one exception, *Dactylellina ferox*, which is tentatively placed here in series *Gamsylella*. Yet, series *Arthrobotrys* comprises also the candelabrelloid, geniculate, and acrogenous type.

Although four series with predacious capabilities are recognized, the observed trapping organs can be classified into five main types: adhesive sessile or stalked knobs (*Gamsylella*, *Dactylellina*), adhesive columns and bridges (*Gamsylella*), adhesive nets (*Arthrobotrys*), non-constricting rings (*Dactylellina*), and constricting rings (*Drechslerella*), the latter two being non-adhesive. Except for adhesive nets and constricting rings, these trap types may sometimes occur together within a strain: adhesive knobs and non-constricting rings occur in several species of series *Dactylellina*, and adhesive knobs and columns or bridges in some of series *Gamsylella* (and *Dactylellina*). Non-constricting rings appear never to occur alone in a species.

Species concept. Numerous misidentifications were discovered within section *Arthrobotrys* when comparing morphology-based species concepts with those inferred from rDNA sequences. Such misidentified strains generally clustered very distant from the correct clades, their molecular deviation being far beyond the accepted, often rather high infraspecific variability of frequently studied taxa. Nevertheless, species delimitation remained unsettled in some taxa with strong variability, such as *O. oligospora*, *O. elegans*, and *G. cionopaga*, in which different, closely related cryptic taxa appear to exist. For further details see under the series.

Nomenclature. From 1839 until recently the name *Arthrobotrys* has been attributed a feminine gender. However, the traditional usage of the suffix *-aster* is masculine [see ICN Art. 62.2 (a)], therefore, all names with a different feminine final epithet had to be corrected to masculine. According to ICN Art. 62.1 'A generic name retains the gender assigned by nomenclatural tradition, irrespective of classical usage or the author's original usage'.

Phylogeny. The first four molecular phylogenetic studies on nematode-trapping orbiliaceous fungi based on rDNA (Liou & Tzean 1997, Ahrén et al. 1998, Tanabe et al. 1999, Hagedorn & Scholler 1999, Scholler et al. 1999) provided striking evidence for a high taxonomic value of trapping organs, which have earlier been underestimated. The two main conidiophore types (arthrobotryoid vs. acrogenous/genicularioid/candelabrelloid) turned out to have a polyphyletic origin in various clades.

Based on the five main types of trapping devices, Scholler et al. (1999) distinguished four anamorph-typified genera: *Arthrobotrys*, *Dactylellina* (with two types of traps), *Drechslerella*, and *Gamsylella*. We here adopt these four taxa but reduce them to series level and include the non-predacious genus *Dactylella* as a further series (*Neodactylella*) of section *Arthrobotrys*.

Three exceptions in which the molecular result was contradictory to the trapping organs are possibly due to a mistake. *Dactylellina multiseptata* and *D. varietas* were described as having stalked adhesive knobs, but the sequences of the ex-type strains clustered in series *Neodactylella* (see *Neodactylella* without teleomorph, p. 1513). Similarly, the ex-type strain of *Dactylella zhongdianensis* was described with adhesive networks but clustered in series *Neodactylella* (see p. 1472). A case of misidentifications concerns *Dactylellina asthenopaga*: some strains under this name fell in series *Neodactylella* and actually do not form adhesive knobs, whereas others clustered in series *Dactylellina* (see *Dactylellina* without teleomorph, p. 1607).

In various published phylogenetic analyses, the four predacious series of section *Arthrobotrys* formed four monophyletic clades, which predominantly included isolates of the anamorph state. In our combined phylogenetic analysis of the entire *Orbiliomycetes* (Baral et al. 2017b, SSU+ITS+LSU), series *Arthrobotrys* and *Drechslerella* received very high but series *Dactylellina* and *Gamsylella* only low support. Series *Neodactylella* formed a paraphyletic basal sister clade to the four predacious series, with *O. epipora* positioned sister to all of them. When restricting the analysis of the same gene region to section *Arthrobotrys*, *O. epipora* clustered unresolved, and series *Drechslerella* received only low support (Phyl. 25).

The monophyly of the two series *Arthrobotrys* and *Drechslerella* already becomes evident when restricting the analysis to one gene region, such as ITS, LSU, *TUBB*, or the S1506 intron. Even when analysing merely the SSU V8–V9 region, some of the five series can more or less be differentiated. When inferring a phylogeny from the 5.8S region, only series *Arthrobotrys* was sharply recognized, based on the combination of a few deviating nucleotides.

The position of the five series within section *Arthrobotrys* varied among different analyses, nevertheless, strong tendencies can be observed. In the combined analysis of rDNA in Baral et al. (2017b), series *Dactylellina* clustered in a monophyletic but unsupported clade with the morphologically similar series *Gamsylella*. Series *Arthrobotrys* clustered as a sister group of them, and the three series formed a medium supported monophyletic clade for all taxa with adhesive traps. Series *Drechslerella* appeared in sister position of the adhesive trap formers and formed with them a strongly supported clade for all predacious taxa. The non-predacious series *Neodactylella* nested in a paraphyletic basal sister position to them, supporting its ancestral status to the predacious series.

In Phyl. 25, taxa with adhesive traps clustered in an unsupported monophyletic group, with series *Drechslerella* forming a sister clade to them. Two nucleotides in the SSU V8 region (109, 126, Tab. 76) underline the result of a common ancestor of the three series with adhesive traps and also suggest a link between series *Neodactylella* and *Drechslerella*, in concordance with the analysis in Baral et al. (2017b).

A basal position of series *Drechslerella* within the nematode-trapping taxa appears to indicate that constricting rings were an early evolved morphological trait. This was also suggested by various previous single gene analyses of ITS (Hagedorn & Scholler 1999, Liu et al. 2006a, Wang et al. 2011, Yang & Liu 2006, Yang et al. 2007, Yu et al. 2009a, Li et al. 2016), SSU (Ahrén et al. 1998, Tanabe et al. 1999), LSU (Liu et al. 2006a, Wang et al. 2011), *TUBB* (Li et al. 2005), and *MAD1* (Li et al. 2016), and in combined analyses of ITS, *RPB2*, *TEF1*, and *TUBB* (Yang & Liu 2006, Yang et al. 2007). In all those studies which include members of series *Neodactylella*, series *Drechslerella* diverged either directly after it (Hagedorn & Scholler l.c., Liu et al. 2006a, Wang et al. l.c.), or even before (Ahrén et al. 1998, Zhang et al. 2010, Li et al. 2005) or within the paraphyletic *Neodactylella* clade (Tanabe et al. 1999). Yet, these branching points have partly low or no bootstrap support, which was also emphasized by Hagedorn & Scholler. In any case, different authors concluded from their analyses that 'no secondary loss of predacity could be detected', which is confirmed by our analyses.

In any case, the basal position of constricting rings does not imply that the other types of trapping devices evolved from it. Their common ancestor could as well have been adhesive, and trapping devices intermediate to constricting rings have not been found. A somewhat different result was obtained by Li et al. (2005, 5.8S+LSU and 5.8S+LSU+*TUBB*), Yu et al. (2007a, ITS), and Swe et al. (2008b, LSU, ITS, ITS+*TUBB*). Their phylogenetic analyses suggest that adhesive traps evolved prior to non-constricting rings and constricting rings, a phylogenetic concept presented by Li et al. (2005) in their fig. 4. In Li et al.'s (2005: fig. 3) combined analysis of rDNA and *TUBB*, series *Drechslerella* and *Neodactylella* (partly as *Dactylellina*) formed a monophyletic sister clade to series *Dactylellina*, while series *Arthrobotrys* and *Gamsylella* (also as *Arthrobotrys*) diverged prior to them.

The entire section *Arthrobotrys* formed in the combined analyses of Baral et al. (2017b) and in Phyl. 7 a strongly or medium supported monophyletic group, but its position within the genus *Orbilia* varied among different analyses and never received bootstrap support. Despite the high support that the clade received, its morphological separation is not sharp. Members with straight, rod-shaped or ellipsoid ascospores

Table 76. Nucleotide positions in SSU (V8–V9), 5.8S, ITS2, and LSU (D1) within section *Arthrobotrys* found to be specific at the series level (in bold). Ambiguous nucleotides: Y = C/T, R = A/G, V = A/C/G, M = A/C, B = C/G/T. Position numbers evaluated by starting with CCTTAGAT (SSU), AAAACTTT (5.8S), after GAGCGTC (ITS2), and with TGACCT (LSU) by omitting predominant gaps in alignment of all groups of *Orbiliomycetes*. * = also in *Arthrobotrys nonseptatus*, ** = also in *A. reticulatus* (6 strains) and *O.* aff. *auricolor* (H.B. 10024/denovo367, G.M. 2017-09-25.1/2018-11-27.1).

Series	SSU V8 (pos. 105–111)	SSU V8 (pos. 119–130)	5.8S (pos. 25–35)	5.8S (pos. 105–114)	ITS2 (pos. 9–15)	LSU D1 (pos. 328–336)
Neodactylella	ATAGAGC	TTATTGCTCTTC	GGTTCTCGCAT	AACGCACATT	CCTCAGC	GGCGAGAGA
Arthrobotrys p.p.maj.	ATAGGGC	TTATTGCCCTTC	GGTTCCCVCAT	AACGCACATT	CCTCAGC	GGBGGGAGA
*Dactylellina**	ATAGGGC	TTATTGCCCTTC	GGTTCCCGCAT	AACGCACATT	CCTCGGT	GGCGGGAGA
Gamsylella	ATAGGGC	TTATTGCCCTTC	GGTTCCCGCAT	AACGCACATT	CCTCGAC	GGCGGGAGA
D. aff. *phymatopaga***	ATAGGGC	TTATTGCCCTTC	GGTTCCCGCAT	AACGCACATT	CCTCGGC	GGCGGGAGA
Drechslerella p.p.maj.	ATAGAGC	TTATTGCTCTTC	GGTTCCCGCAT	AACGCATATT	CCTCGAC	GGCGGGAGA
Drechslerella p.p.min.	ATAGAGC	TTATTGCTCTTC	GGCTCTCGCAT	AACGCACMTT	CCTY**RR**C	GGCGGGAGA

closely resemble taxa of series *Orbilia* in the teleomorph and partly also anamorph. For instance, *O. epipora* and *O. atlantis* (series *Neodactylella*) can easily be confused with *O. dryadum* and *O. cylindrospora*, or *O. orientalis* (series *Drechslerella*) can be confused with ellipsoid-spored taxa of series *Orbilia*. However, available molecular data, and in *O. orientalis* also the trapping organs, suggest that they belong in section *Arthrobotrys*.

In summary, the present molecular data provide valuable hints on the evolutionary lineages for the different trapping organs (see also p. 121, Phylogeny of trapping organs). The predominant basal position of series *Neodactylella* within section *Arthrobotrys* suggests that taxa with trapping organs evolved from non-predacious ancestors of that series. On the other hand, it appears easier to conceive that all these taxa forming trapping organs have an ancestor with predacious capabilities in common with the predacious genera *Lecophagus* and *Hyalorbilia*. In this case, members of series *Neodactylella* should have lost the ability of trap formation, or got adapted to trap animals other than nematodes. Constricting rings show a high grade of complexity, and a regression to non-constricting rings or adhesive networks appears improbable. Possibly, constricting rings evolved from adhesive ring- or peg-like structures typical of series *Gamsylella* by losing their adhesive properties.

Specific nucleotide positions. A unique nucleotide for the entire section *Arthrobotrys* or for taxa that form trapping organs within that section could hardly be found. There exists in the LSU D1 domain a single position (326, TAAATA**T**TGG) which is quite consistent within this section, but it occurs also in some other groups of *Orbiliomycetes*, such as *Lilapila* and *Hyalorbilia* p.p. Most of the remaining *Orbiliomycetes* have instead TAAATA**C**TGG, and a few show some further variants: TAAATA**CC**GG (e.g., *Amphosoma*, *Lecophagus*, *Hyalorbilia*, *Orbilia aprilis*), rarely TAAATA**C**A**G**G (*Amphosoma*) or TAAATA**TC**TG (*Vermispora*). Another motif is at pos. 162–163: TG**TT**T in section *Arthrobotrys* (rarely TG**CT**T), in contrast to TG**CC**T (rarely TG**TC**A or TG**CT**T) in section *Orbilia*; yet, TG**TT**T occurs also in many members of subgenus *Habrostictis* and some of subgenus *Hemiorbilia*.

A search for series-specific nucleotides of frequently recorded regions of the rDNA within section *Arthrobotrys* yielded the following result (Tab. 76):

(1) Series *Neodactylella* can unequivocally be recognized by T vs. C at pos. 30 of 5.8S (except for a few *Drechslerella* spp. that have T) and by A vs. G at pos. 332 of LSU (D1).

(2) In the SSU (V8–V9) series *Drechslerella* and *Neodactylella* share 2 positions (109 A, 126 T) with all other members of *Orbilia* outside section *Arthrobotrys*, whereas taxa with adhesive traps (series *Arthrobotrys*, *Dactylellina*, *Gamsylella*) consistently deviate in having at pos. 109 G and at pos. 126 C, by which they concur with members of *Hyalorbilia* (see Tab. 60)

Table 77. Nucleotide positions in stem-loop B8 of 5.8S rDNA within section *Arthrobotrys* (series *Neodactylella*, *Arthrobotrys*, *Dactylellina*, *Gamsylella*, *Drechslerella*): eight symmetric positions (120–123, 132–135, in bold) form different motifs within the otherwise conservative loop. # = concurring with two taxa of section *Aurantiorubrae*, *O. jugulospora* (China) and *O. rubella*; § = coinciding with three taxa of section *Aurantiorubrae* (*O. aurantiorubra*, *O. jugulospora* from Ethiopia, *O. phragmotricha)*; * = coinciding with series *Xanthoguttulatae*, series *Regales*, section *Hemiorbilia* p.p. and others; ssp./str. = number of species/strains.

Species	5.8S, pos. 115–150	spp./str.
cardui-rhopalota clade	GCGCC**TATT**GGTATTCC**ATTA**GGCATGTCTGTTTGA	4/15
D. qiluensis	GCGCC**TATA**GGTATTCC**TTTA**GGCATGTCTGTTTGA	1/1
oxyspora-heptameres clade, *D. cylindrospora*	GCGCC**CATA**GGTATTCC**TTTG**GGCATGTCTGTTTGA	11/36
rectispora-beltraniae clade p.p. (*O. beltraniae*, *O. xinjiangensis*, *D. clavata, D. ramosa*, *O. longquanensis*, *D. panlongana* etc.), *Arthrobotrys* p.p.maj.	GCGCC**CATT**GGTATTCC**TTTG**GGCATGTCTGTTTGA#	10/12, 38/199
rectispora-beltraniae clade p.p. (*O. rectispora* s.l., *O. cotoneastri*, *O. senegalensis*), *O. cupressi*, *O. epipora*, *Orbilia* sp. XJ-2009 *cladodes-botryosporus* clade, *A. koreensis*	GCGCC**CATC**GGTATTCC**TTTG**GGCATGTCTGTTTGA§	7/11, 5/16
rhamni-fraxini clade, *O. pseudeuphorbiae*, *O. atlantis*, *O.* aff. *clavispora*, *Dactylellina* p.p.maj., *Gamsylella* sp. 8178, *Drechslerella* p.p.maj.	GCGCC**CATT**GGTATTCC**ATTG**GGCATGTCTGTTTGA	7/9, 24/67, 1/1, 18/61
O. auricolor CBS 340.94 (subclade A1)	GCGCC**CATT**GGTATTCC**CTTG**GGCATGTCTGTTTGA	1/1
D. haptotyla s.l.	GCGCT**CACC**GGTATTCC**GGTG**AGCATGTCTGTCTGA	2/12
D. aff. *haptotyla* BRC 34374, YMF 1.00543	GCGCC**CACC**GGTATTCC**GGTG**GGCATGTCTGTTTGA	1/2
D. haptospora	GCGCC**CACT**GGTATTCC**ATTG**GGCATGTCTGTTTGA	1/2
Gamsylella p.p.maj.	GCGCC**CATC**GGTATTCC**GTTG**GGCATGTCTGTTTGA	7/28
Gamsylella cionopaga CBS 228.52	GAGCC**CATC**GGTATTCC**GTTG**GGCATGTCTGTTTGA	1/1
D. aff. *phymatopaga*, *O. bembicodes* H.B. 7165b, *A. nonseptatus, A. polycephalus*	GCGCC**CATT**GGTATTCC**GATG**GGCATGTCTGTTTGA*	1/2, 1/1, 2/2
O. bembicodes CCRC 33278, SG070	GCGCC**CATC**GGTATTCC**GATG**GGCATGTCTGTTTGA	1/2

Phylogenetic analysis 25. Phylogram of section *Arthrobotrys* inferred from combined ML analysis of SSU (V8–V9)+ITS+LSU (D1–D2) rDNA dataset (77 sequences, 1881 positions, aligned with MAFFT) using the GTR+G+I model in MEGA6 (500 replicates). The tree is rooted with *Lilapila oculispora* and *O. patellarioides*. Asci 8-spored in all teleomorph taxa; T = type, ET = epitype, NT = neotype, * = without SSU.

Key to series of section *Arthrobotrys* based mainly on the teleomorph

1. Spores distinctly helicoid; without trapping organs .... **series *Hyalinia*** (p. 868) ***& Xanthoguttulatae*** (p, 845, section *Aurantiorubrae*)
1. Spores straight or slightly to strongly falcate, never distinctly helicoid 2

2. Spores *(11.5–)14–17.5(–20.5) × (2.4–)2.6–3(–3.5) µm, almost straight; SBs completely absent .. ***O. asomatica*** (series *Neodactylella*), p. 1487
2. Spores not exceeding 13 × 1.7 µm; SBs present near apex 3

3. Spores always distinctly (slightly to strongly) curved, rather long and narrow, length/width ratio > (7–)8 based on actual length [e. g., 10 × 1–1.3 µm] 4
3. Spores straight or curved, shorter and wider, length/width ratio < 7(–8) based on actual length [e. g., 10 × 1.4–1.5 µm] 7

4. Ectal excipulum near margin oriented at a ± low angle (10–50°) to the surface, at least in the outermost region, cells here often forming distinct cell rows; cortical cells partly protruding to form small teeth or short hairs; without trapping organs .... **series *Neodactylella***, p. 1437
4. Ectal excipulum near margin oriented at a high angle (60–90°) to the surface, even in the outermost region; margin ± smooth, rarely finely crenulate, never forming distinct cell rows 5

5. Apothecia usually bright red (rarely whitish); SBs consistently rod-shaped, 0.2–0.6 µm wide, apical attachment broad or narrow but never with a filum; paraphyses never lanceolate; with stalked adhesive knobs as trapping organs .... ***O. rubrovacuolata*** (series *Dactylellina*), p. 1587
5. Apothecia never bright red; SBs globose to oblong, rarely rod-shaped, 0.5–0.8 µm wide, attached by a mostly invisible, very fine filum of about the length of the inflated part 6

6. With adhesive networks as trapping organs .... **series *Arthrobotrys***, p. 1513
6. Without trapping organs .... ***Orbilia* sp. XJ-2009** (series *Neodactylella*), p. 1500

7. Spores medium to strongly curved, mostly gradually and strongly tapered below 8
7. Spores straight to strongly curved, only slightly to medium (or only infrequently strongly) tapered below 9

8. Ectal excipulum near margin oriented at a high angle (50–90°), not forming distinct cell rows ....
O. terrestris (p. 1583), ***O. multiformis*** (p. 1547), ***O. neglecta*** (p. 1568, series *Arthrobotrys*) or ***O. cocois*** (p. 1474, series *Neodactylella*)
8. Ectal excipulum near margin oriented at a 10–60° angle in the outermost region, forming distinct cell rows ....
.... ***O. desertorum*** (p. 1507, series *Neodactylella*) or ***O. javanica*** (p. 1550, series *Arthrobotrys*)

9. Apothecial margin with 12–45 µm up to 70–100 × 5–9 µm large, septate, thick-walled hairs; apothecia ± stipitate; spores *3.5–5 × 1–1.4 µm, cylindrical, straight to very slightly curved; SBs globose; with constricting rings as trapping organs .... ***O. pilosa*** (series *Drechslerella*), p. 1629
9. Apothecial margin without prominent septate hairs; spores *2.7–10 × 0.8–2 µm 10

10. SBs partly distinctly eccentrical (± adjacent to lateral spore wall, depending on the viewing direction), shortly rod- to tear-shaped, rarely subglobose, filum often invisible; spores straight or rarely slightly curved near base 11
10. SBs central at the spore apex, globose or ± tear- to rod-shaped 12
If spores subglobose see *A. nonseptatus*, Pl. 960.

11. With constricting rings as trapping organs (as far as known) .... **series *Drechslerella***, p. 1623
11. With stalked adhesive knobs covered by thick gel being able to swell .... **series *Gamsylella*** (p.p.), p. 1610
See also two unidentified taxa without known trapping organs: Pls 1021 (H.B. 8963) & 1023 (H.B. 8749).

12. SBs rod- to tear-shaped, apically narrowed to a smaller or larger point, never with a filum; with stalked adhesive knobs as trapping organs (or unknown) .... **series *Dactylellina***, p. 1584
12. SBs globose to tear-shaped, with a distinct or invisible filum (length ½–1 × as long as inflated part); without trapping organs
.... **series *Neodactylella***, p. 1437

Key to series of section *Arthrobotrys* based mainly on the trapping organs

1. Not forming trapping organs upon contact with nematodes .... **series *Neodactylella***, p. 1437
1. Capturing nematodes (or arthropods) by various trapping organs 2

2. With knobs or columns, capturing nematodes or arthropods 3
2. With ring- to net-like structures (scalariform bridges, arches, rings, ladders, networks), capturing nematodes 5

3. With sessile knobs, superimposed (proliferating) knobs, or columns, capturing nematodes .... **series *Gamsylella***, p. 1610
3. With stalked knobs 4

4. Knobs covered by thin invisible gel, capturing mainly nematodes .... **series *Dactylellina***, p. 1584
4. Knobs covered by thick gel being able to strongly swell, capturing arthropods .... **series *Gamsylella***, p. 1610

5. Rings ± circular, 3- (very rarely 4–5-)celled, singly at the tip of a 1–3-celled stalk **6**
5. Rings circular to rectangular, without a stalk, branched by repeated ring formation or by bridges between columns, partly forming 3-dimensional networks **7**

6. Rings actively constricting, inner wall with triangular wall thickenings at the septa, individual cells ± fusoid, narrowed near septa, instantly swelling, stipe 2.5–6.5 µm wide, above with 2 septa connected to 2 adjacent ring cells .... **series *Drechslerella***, p. 1623
6. Rings non-constricting, without triangular wall thickenings at the septa, individual cells cylindrical, unable to swell, stipe 1.5–2.5 µm wide, above with a single septum connected to a ring cell .... **series *Dactylellina***, p. 1584

7. Rings ± circular, repeatedly branched to form a 3-dimensional network .... **series *Arthrobotrys***, p. 1513
7. Rings ± rectangular, formed by bridges between columns .... **series *Gamsylella***, p. 1610

and two environmental strains of unclear relationship.

(3) A majority of *Drechslerella* spp. deviate from all other members of section *Arthrobotrys* at position 111 of 5.8S (T vs. C), but a minority (*D. bembicodes*, *D. stenobrocha*, *D. coelobrocha*, *D. doedycoides*), being phylogenetically positioned more at the base of that series, concur here with the other series.

(4) Position 14 of the variable ITS2 region behaves extraordinarily stable and informative: All investigated *Gamsylella* sequences and most of *Drechslerella* have here the character A, whereas all members of *Dactylellina*, *Arthrobotrys* and *Neodactylella*, but also the aberrant *Drechslerella bembicodes* (4 strains) have G. This position represents one of the 3 ITS positions found to be variable among three strains of *O. anigozanthi* (Tab. 91), one species having the character G (not shown in Tab. 76) but two the character A.

(5) Position 13 concurs in *Neodactylella* and *Arthrobotrys* (A) and in *Dactylellina* and *Gamsylella* (G), while *Drechslerella* shows mainly G but also A.

(6) Position 15 is mostly C, but T in all *Dactylellina* sequences, except for the two critical Chinese strains of *D.* aff. *phymatopaga* which do not clearly cluster in a series.

The two nucleotide positions mentioned under (1) and (2) remarkably correlate with other *Orbiliomycetes*: (1) the combination T+A is characteristic of *Neodactylella* but also occurs in most other groups of the class, whereas C+G, which characterizes the nematode-trapping taxa of section *Arthrobotrys*, is also consistently found in all strains of series *Abutilones*, section *Ovoideae*, and the genus *Hyalorbilia*. However, three exceptions were observed: in some species of series *Drechslerella* the rare combination T+G occurs, and within series *Orbilia O. dryadum* shows the combination C+G and *O. cunninghamii* the very unusual combination C+A, whereas all other taxa have T+A. (2) the combination G+C is characteristic of those species of section *Arthrobotrys* with adhesive traps, but is also consistently observed within the genus *Hyalorbilia*, whereas all other groups of *Orbiliomycetes* without known adhesive traps, but also *Lecophagus*, have the combination A+T (see Tab. 60).

The motif ATTA at the 5'-end of ITS2 (pos. 1–4) occurs in most members of section *Arthrobotrys* but is frequent also in various other *Orbiliomycetes*. The deviation ATTT occurs in *Drechslerella* p.p. (not correlated with pos. 11–15) und ATCA in *Gamsylella gephyropaga* (Tab. 20.

Ecology. Section *Arthrobotrys* occurs worldwide, with a significant preference for a hygric environment. This preference seems to be due to the fact that many nematodes, the predominant prey of predacious members of this section, are adapted to a more or less stable water supply. Some taxa of series *Neodactylella* and one of *Gamsylella* (*O. anigozanthi*) are restricted to xeric substrate, some of them being adapted to semihumid and arid zones. Yet, also the predacious *O. auricolor* is sometimes found on exposed xeric substrate.

Series *Neodactylella*

Orbilia subgenus ***Orbilia*** section ***Arthrobotrys*** series ***Neodactylella*** Baral & E. Weber, **ser. nov.**, MB 814993 – Type species: *Monacrosporium oxysporum* Sacc. & Marchal [≡ *Orbilia oxyspora* (Sacc. & Marchal) E. Weber & Baral]

?= *Dactylella* Grove, J. Bot. 22: 199 (1884) – Type species: *D. minuta* Grove

= *Drechsleromyces* Subram., Kavaka 5: 93 (1978, '1977') – Type species: *Dactylella atractoides* Drechsler

= *Gangliophragma* Subram., Kavaka 5: 94 (1978, '1977') – Type species: *Dactylella rhopalota* Drechsler

Etymology: *Neodactylella*: named after the anamorph-typified genus *Dactylella*; *Dactylella*: referring to the conidia at the conidiophore apex resembling fingers; *Drechsleromyces*: named after the mycologist Charles Drechsler; *Gangliophragma*: referring to the holoblastic, septate conidia.

Latin diagnosis: *Apothecia margine laevi vel crenulato, siccitatem tolerantia vel non tolerantia. Ascosporae subcylindricae ad fusoideo-clavatae vel subulatae, rectae ad valde falcatae, in statu vivo corpusculum refringens globosum ad lacrimiformem, non excentricum continentes. Paraphyses non vel leniter ad valde clavato-capitatae. Conidia ellipsoidea vel cylindrico- ad fusoideo-clavata vel fusiformia, recta vel raro curvata, 1–14-septata, numquam dimorpha, cellulis numquam inflatis. Hyphae laqueos non formantes.*

TELEOMORPH: **Apothecia** hydrated (0.1–)0.3–1.5(–2.3) mm diam., white to pale rose, yellow-ochraceous, orange, or brownish, margin smooth or finely rough to crenulate, sometimes with distinct teeth, sessile or with a ± indistinct short stipe. **Asci** *(26–)30–60(–67) × (2.7–)3–5(–6) µm, 8-spored, lower (2–)3–5(–7) spores inverted; **apex** (†) slightly to strongly truncate, not or slightly indented and laterally inflated; **base** usually partly H-shaped. **Ascospores** *(3.5–)5–12(–13.2) × (0.8–)1–1.8(–2.3) µm (rarely 11.5–20.5 × 2.4–3.5 µm), broadly or narrowly subcylindrical to fusoid-clavate or subulate, apex rounded to obtuse (exceptionally subacute), base sometimes with indistinct or distinct tail, straight to strongly curved (falcate) or only curved below; **SBs** never distinctly eccentrical, (0.6–)0.8–1.7(–1.9) × 0.3–1 µm (rarely absent), globose to tear-shaped, mostly with a fine, short, often invisible filum. **Paraphyses** uninflated or slightly to strongly clavate-capitate at apex, sometimes spathulate-lageniform, terminal cells about (1–)2–4(–6)× longer than lower cells. **Ectal excipulum** of (†) thin-walled or rarely slightly gelatinized (common walls 0.3–1 µm thick), vertically or indistinctly oriented textura globulosa-angularis(-prismatica), cells near base *(4–)8–30(–40) × (3–)6–23(–30) µm, at margin either of t. globulosa-angularis oriented at a (40–)60–90° angle or of t. angularis or t. prismatica(-porrecta) oriented at a 0–30(–60)° angle by forming rows of often thick-walled cells; **glassy processes** absent or 2–18, rarely 50–70 µm long. **SCBs** globose or absent, exceptionally crystalloid (*O. senegalensis* in series *Neodactylella*); **VBs** absent or slightly to sometimes medium or strongly refractive. **Exudate** 0.1–3(–5) µm thick, continuous to cloddy or granular, loosely or firmly attached, hyaline to bright yellow. — **ANAMORPH**: dactylella-like, rarely vermispora- to anguillospora-like. **Conidiophores** ((10–))(40–)60–200(–300) µm long, 2–4 µm wide near base, 1.5–2.5 µm at the tip, conidia arising singly at the unbranched tip, rarely in clusters of 2–4 at the sympodially proliferating tip (geniculate to candelabrelloid). **Conidia** *(16–)25–100(–143) × 3.5–11(–13) µm, ellipsoid or often cylindrical or cylindric- to fusoid-clavate or fusiform, rarely rostrate above, straight, rarely curved, (1–)3–14(–21)-septate, never with 1 cell much larger than the others; **conidial dimorphism** not observed. **Trapping organs**: absent.

Habitat: on hygric or sometimes xeric, rarely semiaquatic wood and bark (rarely fruits) of angiosperms (rarely gymnosperms), herbaceous stems and leaves of mono- and dicotyledons, also on dung, isolated also from rhizosphere of herbs, boreal to tropical, humid to arid, desiccation-sensitive or often ± -tolerant.

Recognized species: 25 (3 of them without a known teleomorph), plus 1 species with a provisional name and 3 unnamed species ('affinis'); for further 20 species see Tabs 45 and S8.

Taxonomic remarks. Series *Neodactylella* cannot with certainty be recognized by the teleomorph alone, but requires cultural studies and/or molecular data. Yet, in six species (*O. oxyspora*, *O. dorsalis*, *O. clavispora*, *O.* aff. *clavispora*, *O. desertorum*, *O. tenuissima*) the marginal cortical cells of the ectal excipulum form more or less striking rows of quadrate to prismatic cells with often slightly thickened walls, running under a more or less low angle to the surface. These were generally not observed in the other series of section *Arthrobotrys*, with the exception of *O. bambusina* p.p. (incertae sedis) and *O. javanica* (series *Arthrobotrys*). These cell rows are sometimes terminated by glassy processes (see, e.g., Pls 933, 942, 946) and produce a minutely crenulate apothecial margin. Similar hair-like marginal hyphae are observed in *O. fraxini*, *O. lamarcheae*, and *O. asomatica*. Webster et al. (1998) erroneously believed that the whole *O. auricolor* complex possessed such cell rows (see also under *O. oxyspora*, p. 1494).

The six mentioned species with marginal cell rows further deviate from the remaining members of series *Neodactylella* in longer and more curved (falcate) ascospores with a higher length/width ratio. Since they are also phylogenetically related by forming a supported clade (except for *O. tenuissima*, see p. 1511), they are referred to as *oxyspora-heptameres* clade here. The hair-like marginal hyphae of *O. fraxini* resemble the cell rows of this group, but the ascospores are very different and the species does not cluster in this clade. *O. cocois* is somewhat exceptional within section *Arthrobotrys* in its terminal cells of paraphyses being not always longer than the lower cells. Some species show similarities to sections *Aurantiorubrae* or *Habrostictis* (*O. pseudeuphorbiae*, *O. asomatica*) and were placed by us in series *Neodactylella* mainly because of their molecular data.

Anamorph (see also p. 220–223 and Tab. S8). Members of series *Neodactylella* have a dactylella-like anamorph which is characterized in pure culture by not forming trapping organs upon treatment with nematodes. Conidia are unbranched, straight, cylindrical, clavate, or fusiform, rarely apically with a short to long rostrum, mostly 3- to multiseptate, usually medium- to large-sized. More or less curved, multiseptate conidia occur in *O. fraxini* (vermispora-like) and *O. rhamni* (anguillospora-like), but these anamorphs are not confirmed by pure culture. Microconidia have so far not been observed in this series. A single observation of small, 1-septate conidia on very short conidiophores formed on the anchoring hyphae in a collection mentioned under *O. clavispora* (Pl. 941: 2) requires confirmation. Conidiophores are usually very long, but their length strongly varies within a culture. Rarely they measured only 40–50 µm (*O. epipora*, 15–30 µm in the possible synonym *D. polyctona*). Also the recently described South African, possibly drought-tolerant *D. bolusanthi* (Crous 2019) has only 10–50 µm long conidiophores (the reported phialidic conidiogenesis is an error since the micrographs clearly show a holoblastic development).

Conidial shape shows a remarkable conformity within series *Neodactylella*, being cylindrical or often cylindric-clavate, except for fusiform conidia which exclusively occur in the *oxyspora-heptameres* clade. Anamorphs of series *Neodactylella* with cylindric-clavate conidia appear to be indistinguishable from those connected to members of series *Xanthoguttulatae* p.p. and *Hyalinia* of section *Aurantiorubrae*, and also from some of series *Orbilia*. Molecular data are lacking for several species described in *Dactylella* (including the type) and their relationship within *Orbilia* remained unsettled.

The absence of trapping organs has previously been ascertained in a majority of taxa of *Dactylella* by adding nematodes to a pure culture, except for the type species. Among the species of series *Neodactylella* treated here, the absence of trapping organs was demonstrated, e.g., by Webster et al. (1998) for *O. fimicoloides* (= *O. oxyspora*), Rubner (1996: 114) for *Dactylella oxyspora*, Yu et al. (2007) for *O. dorsalis*, Z.F. Yu (pers. comm.) for *O.* aff. *clavispora* (Y.Z. bn1-14), and *O. cotoneastri* (H.B. 7241a).

Nomenclature. Because of the similar morphology of dactylella-like anamorphs in different sections of *Orbiliomycetes*, the phylogenetic relationship of the type species of *Dactylella*, *D. minuta*, which is only known from the old type collection, remains uncertain. Its holotype specimen is said to be located in K (Rubner 1996), consisting of a piece of dead wood without any trace of the fungus. A culture was probably not made by Grove, and unambiguous further records of this species are unknown.

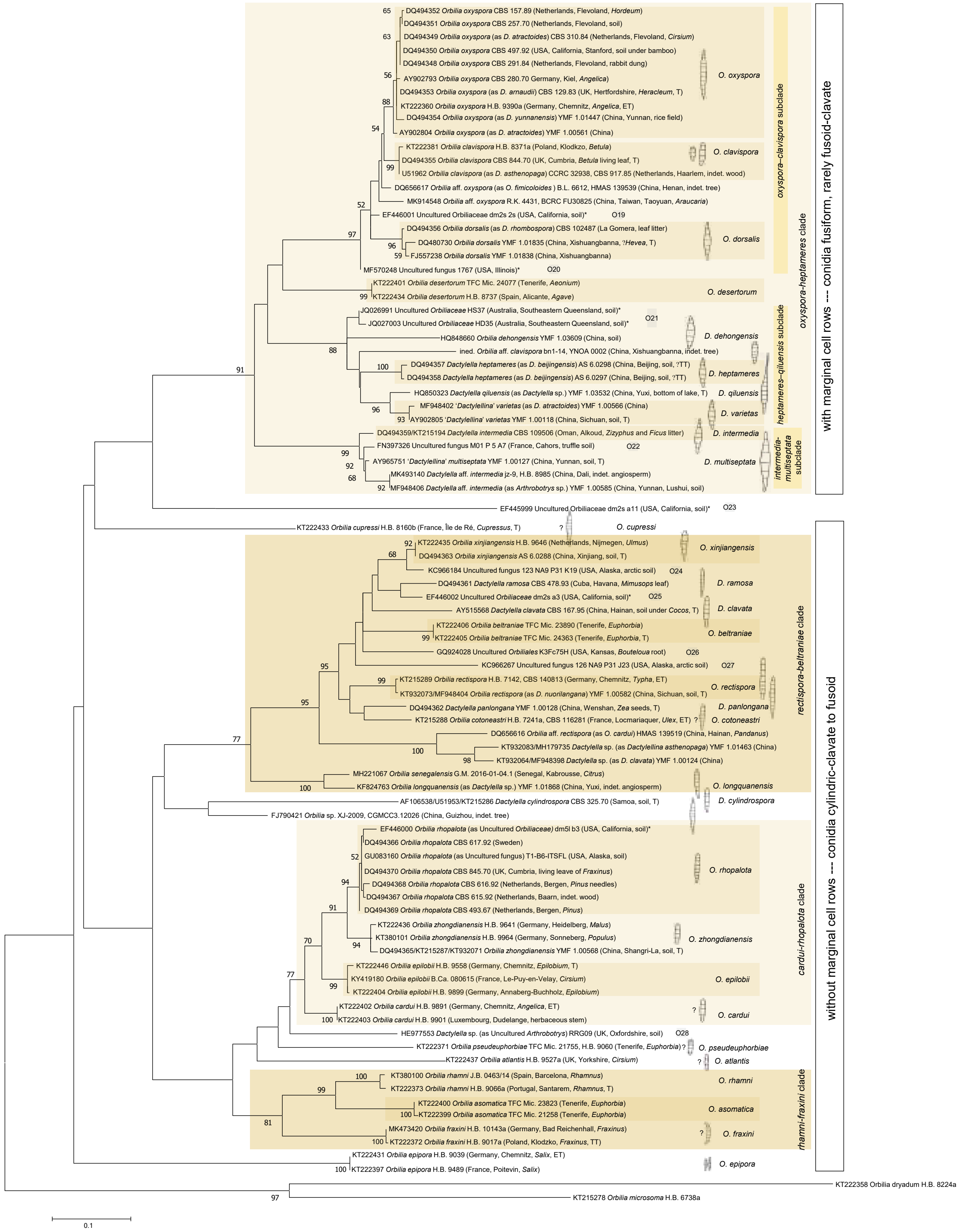
Therefore, the name *Neodactylella* is proposed here at the series level to include phylogenetically related, non-predacious taxa within section *Arthrobotrys*. Because no recent record was available that could be considered as conspecific with *D. minuta* and proposed as epitype, we here typify *Neodactylella* by *O. oxyspora*. We have based the new name *Neodactylella* on the well-established name *Dactylella* instead of resurrecting the rarely used alternative names *Drechsleromyces* or *Gangliophragma*.

Species delimitation. Although many of the included species appear to be recognizable from the teleomorph, some require conidial morphology and some DNA data to permit their recognition. For instance, *O. oxyspora* and *O. dorsalis* were thought by us to represent a single species, but DNA showed that they are distinct. *O. cardui*, *O. zhongdianensis*, and *O. xinjiangensis* are rather similar in both morphs, differing mainly in conidial shape. DNA data gained from European ascospore isolates enabled their separation and connection to two described Chinese anamorph-typified taxa. *O. cardui* and *O. rectispora* were considered as synonymous by earlier authors, but differ in ascospore width and presence/absence of short glassy processes, also they show a remarkable host specificity (dicots vs. monocots, although *O. luzularum* appears to belong to *O. cardui*) and differ in their DNA data. Quite a few species are only known from a single collection and their independency is, therefore, to be considered as more or less tentative.

Phylogeny. In phylogenetic analyses of (SSU)+ITS+LSU, series *Neodactylella* as here circumscribed formed a paraphyletic group (Baral et al. 2017b, Phyls 7, 25) which clustered with medium support in a monophyletic clade with the nematode-trapping taxa. Its position was usually at the base of section *Arthrobotrys*, where it formed a sister group of the remaining series (see p. 1433). In the ITS analysis of Chen et al. (2007a), series *Neodactylella* formed a monophyletic group, but in this work only members of *Hyalorbilia* and *Vermispora* but no predacious taxa were compared (except for '*Dactylella tenuis*', a member of series *Drechslerella*). A monophyletic group, though without support, is also obtained when analysing the S1506 intron (S30).

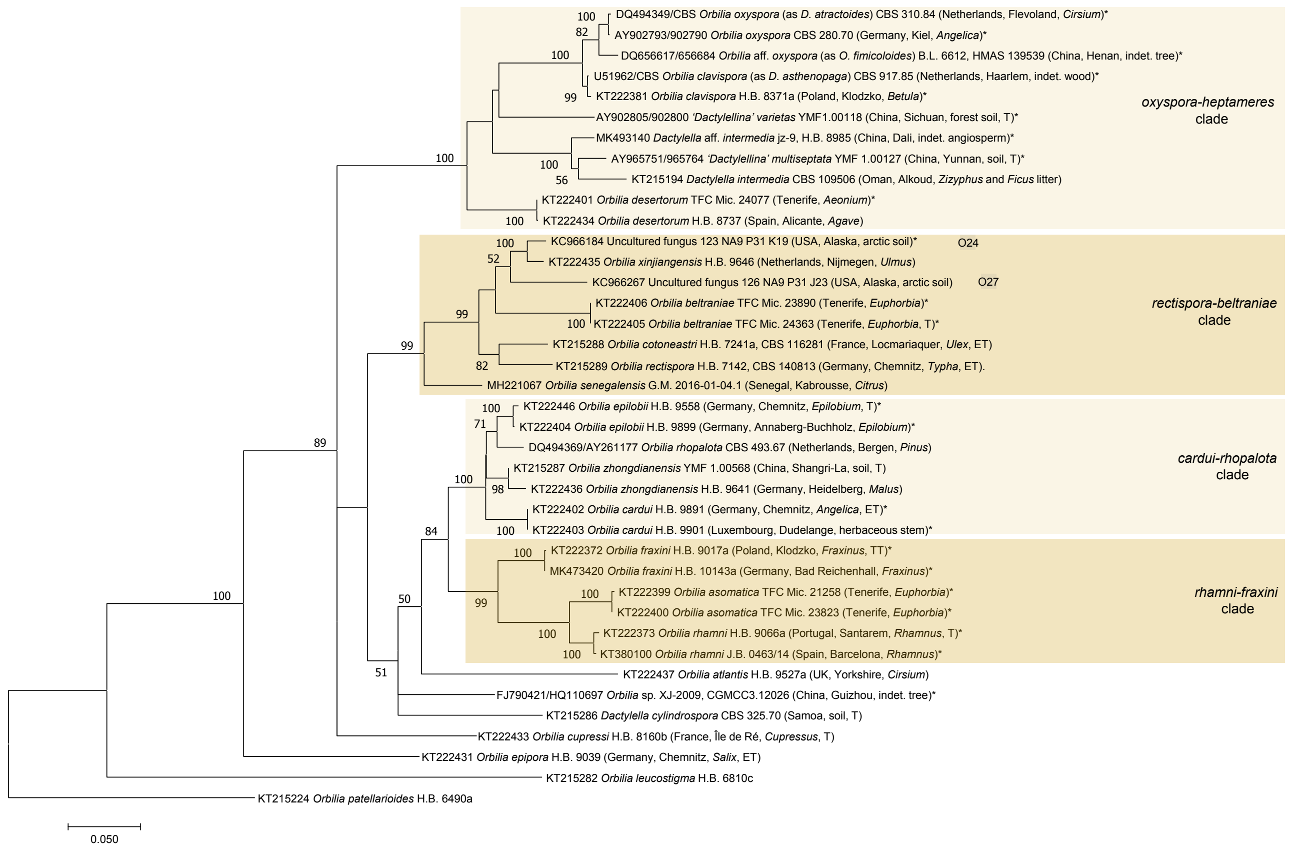
In our combined analysis (Phyl. 27) four strongly supported clades can be recognized within series *Neodactylella*: the *oxyspora-heptameres* clade, the *cardui-rhopalota* clade, the *rhamni-fraxini* clade, and the *rectispora-beltraniae* clade. Yet, six species (*Dactylella bolusanthi*, *O. cupressi*, *D. cylindrospora*, *Orbilia* sp. XJ-2009, *O. atlantis*, *O. epipora*) did not cluster in either of them. When separately analysing ITS (Phyl. 26) only the *oxyspora-heptameres* clade received strong support. When analysing LSU (S31) only the *rhamni-fraxini* clade received strong support while the *cardui-rhopalota* clade and *rectispora-beltraniae* clade were paraphyletic.

The *oxyspora-heptameres* clade comprises taxa with marginal cell rows, rather long and narrow, falcate ascospores, and large, fusiform but also cylindric-clavate conidia. In



Phylogenetic analysis 26. Phylogram of series *Neodactylella* inferred from ML analysis of ITS1-5.8S-ITS2 rDNA dataset (88 sequences, 663 positions, aligned with MAFFT) using the GTR+G+I model in MEGA7 (500 replicates). Thirteen environmental strains from GenBank are included, 11 of them representing 10 unidentified species (O19–O28). The tree is rooted with *O. microsoma* and *O. dryadum*. Asci 8-spored in all teleomorph taxa; T = type, ET = epitype, TT = topotype, * = without ITS1 and partial 5.8S.

the analysis of the ITS region it formed two subclades, the strongly supported *oxyspora-clavispora* subclade and the weakly supported *heptameres-qiluensis* subclade, besides two smaller subclades for *Dactylella intermedia* (?= ‘*Dactylellina*’ *multiseptata*, *intermedia-multiseptata* subclade) and *O. desertorum*. The *cardui-rhopalota* clade and *rectispora-beltraniae* clade include taxa without marginal cell rows, rather short, partly straight ascospores, and cylindric-clavate or only slightly fusoid conidia, which seemingly cannot morphologically be differentiated. Taxa of the *rhamni-fraxini*



Phylogenetic analysis 27. Phylogram of series *Neodactylella* inferred from combined ML analysis of SSU (V8–V9)+ITS+LSU (D1–D2) rDNA dataset (39 sequences, 1614 positions, aligned with MAFFT) using the GTR+G+I model in MEGA7 (500 replicates). The tree is rooted with *O. patellarioides* and *O. leucostigma*. Asci 8-spored in all teleomorph taxa; T = type, ET = epitype, TT = topotype. * = SSU incomplete or absent.

Key to species of series *Neodactylella* with known teleomorph

(for a key based on anamorphs see Chen et al. 2007b)

1. Spores *(11.5–)14–17.5(–20.5) × (2.4–)2.6–3(–3.5) µm, almost straight; SBs completely absent; xeric wood of *Euphorbia*, thermo- to mainly inframediterranean semi- to hyperarid Macaronesia ...... ***O. asomatica***, p. 1487
1. Spores not exceeding 13 × 1.8(–2.3) µm; SBs always present in apex of living mature spores 2

2. Spores always distinctly (slightly to strongly) curved, rather long and narrow, length/width ratio > (7–)8 based on actual length [e.g., 10 × 1–1.3 µm] 3
2. Spores straight to slightly (rarely medium) curved, shorter and wider, length/width ratio < 7(–8) based on actual length [e.g., 10 × 1.4–1.5 µm] 8

3. Excipular cells near margin oriented at a high angle (80–90°), not forming distinct cell rows, cortical cells without glassy processes; spores strongly arcuate, *7.2–13 × 1.1–1.4 µm; conidia narrowly fusoid, attenuated in a long and narrow apical part, *47–87(–100) × 4.3–6.5 µm, 8–19-septate; hygric bark, subtropical humid eastern Asia ...... ***Orbilia* sp. XJ-2009**, p. 1500
Compare also *O. fimicola* on dung, with short glass processes and spores of †8–10 × 1.2–1.4 µm (anamorph unknown, see under *O. oxyspora*, p. 1493).
3. Excipular cells at mid flanks and margin oriented at a low angle (0–50°), at least in outermost region, here usually forming ± distinct cell rows 4

4. Spores †(7–)7.5–10.5(–11) × 0.8–1.1 µm, mostly strongly tapered at base; no SB data available; asci †22–35 × 2.5–3.4 µm; apothecia light yellow-chlorinaceous; hygric petioles, fruits of woody plants, stems of bamboo, (sub)tropical (semi)humid America, Africa, ?Macaronesia, ?eastern Asia ...... ***O. tenuissima***, p. 1510
4. Spores †(1–)1.1–1.3(–1.4) µm wide [*1.1–1.5(–1.7) µm], slightly to strongly tapered towards base; asci †28–45 × 3–4.2 µm 5

5. SBs with distinct filum; spores *(6–)8–10(–11.5) × (1.1–)1.2–1.5(–1.7) µm; apothecia pale orange-ochraceous; xeric branches & stems of *Aeonium*, *Agave*, *Ferocactus*, *Yucca*, thermomediterranean semiarid or rarely warm-continental subhumid southwestern North America, southern Europe, Macaronesia ...... ***O. desertorum***, p. 1507
5. SBs mostly without visible filum; spores *(7–)8–11(–12) × (1–)1.2–1.4(–1.6) µm 6

6. Spores strongly tapered towards base, often with a distinct tail; apothecia whitish to light amber-brownish; conidia cylindric-ellipsoid-clavate, *22–40 × 6.5–9.5 µm, 2–4-septate; ± hygric wood & bark of *Betula* & *Tilia*, cold-temperate humid, atlantic to subcontinental Europe ...... ***O. clavispora***, p. 1501
6. Spores slightly to strongly tapered towards base but never tail-like; conidia fusiform, *40–110 × (6.3–)8–10(–13) µm, 4–12-septate 7

7. Apothecia whitish, rarely yellowish; conidia *(45–)50–95(–110) µm long, (5–)7–11(–12)-septate; hygric herbaceous stems, angiosperm wood & bark, dung, hemiboreal to subtropical humid to semihumid Europe & North America, cool-continental to tropical humid eastern Asia, Australasia .... ***O. oxyspora***, p. 1489

7. Apothecia cream to yellowish; conidia *(40–)50–75(–85) µm long, (4–)5–8(–9)-septate; hygric angiosperm wood & bark, (sub)tropical humid eastern Asia, Macaronesia .... ***O. dorsalis***, p. 1498

8. Paraphyses apically cylindrical to ± lanceolate-lageniform (though with obtuse tip), distinctly protruding 9

8. Paraphyses apically cylindrical to capitate-clavate but not tapered, not distinctly protruding 14

9. Spores *(5–)6–7.5(–8) × 1.3–1.7 µm, straight to slightly curved; apothecia whitish to pale cream; hygric stems of *Epilobium* & *Cirsium*, (oro)temperate humid Europe .... ***O. epilobii***, p. 1468

9. On xeric bark or wood; apothecia pale cream to ochraceous or orange 10

10. Spores *4.5–6.5 × (1–)1.1–1.6(–1.7) µm, cylindrical, ± allantoid; marginal cortical cells not forming cell rows 11

10. Spores longer or wider, partly distinctly tapered and often slightly to medium curved below; marginal cortical cells tending to form cell rows with exudate caps or glassy processes 13

11. Margin with short protruding thin-walled hairs; SBs 0.7–0.9 µm wide; conidia unknown; xeric bark of *Lamarchea*, subtropical semiarid Australia .... ***O. lamarcheae***, p. 1485

11. Margin hairless; SBs 0.3–0.9 µm wide 12

12. Margin smooth or finely powdered by small glassy caps; spores *4.5–6 × 1–1.5 µm, straight to strongly curved; SBs 0.3–0.5 µm wide; conidia anguillospora-like (presumed), *85–127 × 3.6–4.3 µm; xeric bark (& wood) of *Rhamnus*, *Ficus*, mesomediterranean semihumid southern Europe .... ***O. rhamni***, p. 1483

12. Margin smooth, without glassy caps; spores *4.7–7 × 1.2–1.7 µm, straight to slightly curved; SBs 0.6–0.9 µm wide; conidia unknown; xeric wood of *Euphorbia canariensis*, inframediterranean semi- to hyperarid Macaronesia .... ***O. beltraniae***, p. 1466

13. Spores *(6.3–)7–9(–10) × 1.3–1.9 µm, curved below, SBs 0.5–1 µm wide; conidia (presumed) straight, *24–26 × 5.3–7.5 µm; xeric wood of *Euphorbia*, inframediterranean semi- to hyperarid Macaronesia, ?Australia .... ***O. pseudeuphorbiae***, p. 1476

13. Spores *(3.5–)4.5–6.5(–7.5) × 1.6–2.1 µm, SBs 0.3–0.6 µm wide; conidia (presumed) curved at the ends, *35–45.5 × 4.3–5.5 µm; xeric bark of *Fraxinus*, cold- to warm-temperate humid Europe .... ***O. fraxini***, p. 1480

Similar European collections on xeric bark of *Populus* differ in only *(1.3–)1.4–1.6(–1.8) µm wide spores.

14. Marginal excipular cells oriented at a low angle (20–40°); spores *6.5–7.3(–8) × (1.3–)1.4–1.5 µm; conidia ellipsoid-clavate, *20–47.5 × 6.5–9.3 µm, 3–7-septate; hygric indet. bark, tropical humid China .... ***O*. aff. *clavispora***, p. 1506

O*. *senegalensis on xeric bark of *Citrus* from western Africa (Pl. 910) with spores */†5–6.5 × 1–1.4 µm keys out here but differs from all species of section *Arthrobotrys* known in the living state by excipular cells containing crystalloid SCBs (p. 1465).

14. Marginal excipular cells oriented at a ± high angle (50–90°) 15

15. Spores *0.8–1.2(–1.3) µm wide 16

15. Spores min. *(1.1–)1.2–1.4 µm wide 19

16. SBs rod- to tear-shaped, apically narrowed to a smaller or larger point, never with a filum; conidia broadly fusiform, *9–14.5 µm wide .... see ***O. mammillata*** (p. 1594, series *Dactylellina*) and ***O. bambusina*** **(**inc. sed., p. 1656)

16. SBs globose to tear-shaped, with a distinct or invisible filum (½–1 × the length of inflated part); conidia *2–8 µm wide 17

17. Spores *(5–)6.5–9.5(–11) × 1–1.2(–1.3) µm, often slightly curved; VBs in paraphyses hyaline; conidia *37–67 × 5.3–8 µm, 3–7-septate; semiaquatic leaves of monocots, oro- to mesotemperate humid Europe, eastern Asia .... ***O. rectispora***, p. 1451

17. Spores max. 6(–7) µm long, *0.8–1 µm wide; conidia *2.2–4.8 µm wide, ± straight 18

18. Spores *(2.8–)3.3–4.3(–5) × 0.8–1 µm; VBs in paraphyses hyaline; conidia *13.5–25 × 2.2–3.2 µm, (0–)1–3-septate; apothecia white, mostly densely gregarious; hygric wood of angiosperms, predominantly *Fagus* and *Salicaceae*, boreal to thermotemperate humid Europe, North America, Asia .... ***O. epipora***, p. 1446

The North American collection (on ?*Fraxinus* wood) differs from typical *O. epipora* in yellowish apothecia. An Australian collection on a xeric monocot culm mentioned under *O. acuum* differs from *O. epipora* in much smaller apothecia and a thicker exudate (p. 1659).

18. Spores *(4.5–)5–6(–7) × (0.8–)0.9–1 µm; VBs in paraphyses mostly yellowish; conidia (presumed) *24–47 × 4.2–4.8 µm, 2–4-septate; xeric to hygric herbaceous stems & leaves, bark of *Ilex*, cones of *Cupressus*, cold-temperate humid to submediterranean semihumid atlantic western Europe .... ***O. atlantis***, p. 1442

Two collections deviate in slightly wider spores (*1–1.2 µm): one on *Zea* from northwestern France also in whitish apothecia and absent VBs, and one on *Phragmites* from Australia in more ochraceous apothecia due to brownish VBs and in very short glassy caps at the margin (p. 1445).

19. Conidia (presumed) *60–74 × 5–6 µm, 8–14-septate, narrowly fusiform; apothecial margin lacking glassy processes; spores *(3.7–)5–8.5(–9.3) × (1.5–)1.8–2(–2.3) µm, ± curved; xeric wood of *Cupressus*, submediterranean semihumid western Europe .... ***O. cupressi***, p. 1479

19. Conidia max. 40–60 µm long, (3–)5–7-septate 20

20. Apothecial margin without glassy processes, conidia (3–)5–7-septate 21

20. Apothecial margin with short to long glassy processes, conidia (1–)3(–4)-, 4–5- or 5–7-septate 25

21. Paraphyses apically ± uninflated; spores *(4.8–)6–9(–10) × (1.1–)1.2–1.6(–1.7) µm, slightly to medium curved; conidia unknown; apothecia whitish; hygric stems of *Ranunculus*, leaves of *Carex*, orotemperate humid central Europe .... ***O*. cf. *epilobii***, p. 1469

21. Paraphyses apically slightly (to medium) capitate-clavate; mainly lignicolous (also on dung) 22

22. Conidia narrowly fusoid to fusiform with cylindrical middle part, *40–60.5 × 4–5.5 µm; spores *6–8.5 × 1.3–1.5 µm, slightly tapered at base, straight to slightly curved; apothecia yellowish; hygric bark of angiosperm, subtropical humid China .... ***O. longquanensis*** (see under *O. senegalensis*), p. 1465

22. Conidia cylindric-ellipsoid-clavate, min. *6.5–8 µm wide; apothecia whitish 23

23. Spores *6–9(–10) × (1.4–)1.6–2(–2.3) µm, often with tail-like base, straight to slightly curved; conidia *40–59 × 7–12 µm; hygric bark of *Ulmus*, cold-temperate humid atlantic western Europe and continental eastern Asia .... ***O. xinjiangensis***, p. 1456

23. Spores *1.3–1.6 µm wide, base partly tapered but not tail-like; conidia *(23–)31–45 × 6–8.2 µm 24

24. Exudate over paraphyses forming 0.3–1 µm thick caps; spores †(6–)7–8(–9.2) × 1.1–1.3(–1.4) µm, consistently tapered at base, slightly to medium curved; conidia 3–7-septate; on dung, temperate humid Europe .... ***O. leporina***, p. 1473

24. Exudate over paraphyses absent; spores *5.2–7.5 × 1.4–1.6 µm, only partly tapered at base, straight to slightly curved; conidia (4–)7-septate; hygric bark & wood of angiosperms, cold- to warm-temperate humid Europe .... ***O. cotoneastri***, p. 1462

A sample on bark of *Eucalyptus* in thermotemperate humid southern Europe deviates in more cylindric(-clavate), 3–5-septate conidia and in paraphyses covered by exudate (p. 1464).

25. Spores *(6.3–)7–9(–10) × 1.3–1.9 µm, curved below; paraphyses partly slightly spathulate-lageniform; conidia (presumed) cylindric-ellipsoid, *24–26 × 5.3–7.5 µm, 5–6-septate; xeric wood of *Euphorbia*, inframediterranean semi- to hyperarid Macaronesia, ?Australia .... ***O. pseudeuphorbiae***, p. 1476

25. Spores *(5–)6–7(–8) × (1.2–)1.3–1.5(–1.7) µm 26

26. Conidia cylindric(-clavate), *(17.5–)22–34(–37.5) × 5–7(–8) µm, (1–)3(–4)-septate; spores ± straight; hygric to mesic bark of angiosperms, cold-temperate to cold-continental humid Europe & eastern Asia .... ***O. zhongdianensis***, p. 1470

26. Conidia cylindric-clavate to clavate, *30–46 × (5–)6–8(–8.8) µm, 4–7-septate 27

27. Apothecia whitish to pale cream; spores straight or only very slightly curved; terminal cells of paraphyses (1.5–)2–3(–4)× longer than lower cells, with or without VBs, without SCBs, apices covered by cloddy exudate; conidia (presumed) cylindric- to ellipsoid-clavate, (3–)5–7-septate; ± hygric herbaceous stems & leaves, also bark & wood of gymno- & angiosperms, polypores, warm- to cold-temperate or oroboreal humid Europe, Asia .... ***O. cardui***, p. 1457

27. Apothecia bright yellow-orange; spores ± distinctly curved; terminal cells of paraphyses 1–2 × longer than lower cells, with small globose SCBs, apices with firmly attached glassy caps 0.3–1.5 µm thick; conidia (presumed) clavate, 4–5-septate; xeric petiole of *Cocos*, tropical humid Middle America .... ***O. cocois***, p. 1474

A sample on xeric leaf of *Zea* from thermotemperate (semi)humid Spain deviates by a very thick, gelatinized subiculum below the apothecia (p. 1476).

clade have also straight, short to long ascospores but deviate in lageniform paraphyses, often hair-like marginal projections, and anguillospora- or vermispora-like conidia.

Three of these clades were also obtained in Chen et al.'s (2007a: fig. 1) neighbour joining analysis of the ITS region. *D. cylindrospora* formed here with strong support a sister taxon to the *cardui-rhopalota* clade. '*Dactylella tenuis*' (AS6.0287, DQ494360) clustered unresolved among the three clades, but this strain appears to be misidentified as it belongs to series *Drechslerella* (near *O. brochopaga*).

Phylogenetic analyses of the entire *Orbiliomycetes* (Baral 2017b, Phyl. 7) suggest that the current morphological concept of the anamorph-typified genus *Dactylella*, being based on the absence of trapping organs and on straight phragmoconidia, is polyphyletic, as it includes also taxa which cluster in series *Xanthoguttulatae* and *Hyalinia* of section *Aurantiorubrae* (*Dactylella vermiformis*, *D. pseudobrevistipitata*) and series *Orbilia* (section *Orbilia*). Already Chen et al. (2007a) observed this polyphyly when referring some taxa to the genus *Brachyphoris* (= *Hyalorbilia*) which were previously assigned to *Dactylella*.

Specific nucleotide positions. As discussed under section *Arthrobotrys*, series *Neodactylella* shares with series *Drechslerella* 2 positions in the SSU and 1 in the 5.8S, and with series *Arthrobotrys* one in the ITS2; in the LSU pos. 332 is unique within the section while concurring with most other groups of non-predacious *Orbiliomycetes* (Tab. 76). Four symmetric nucleotide positions in stem-loop B8 of the 5.8S region vary to form six different variants which are diagnostic for different relationships within series *Neodactylella* (Tab. 77). Three of these variants are consistent within monophyletic clades (*cardui-rhopalota* clade, *oxyspora-heptameres* clade, *rhamni-fraxini* clade). The latter variant characterizes also a majority of series *Dactylellina* and *Drechslerella*. Two other variants represent the *rectispora-beltraniae* clade but also a majority of series *Arthrobotrys*.

Ecology. 17 out of ~25 species of series *Neodactylella* with a known teleomorph possess more or less desiccation-tolerant apothecia. These are *O. atlantis*, *O. asomatica*, *O. beltraniae*, *O. cardui*, *O. clavispora*, *O. cocois*, *O. cupressi*, *O. desertorum*, *O. dorsalis*, *O. fraxini*, *O. lamarcheae*, *O. oxyspora*, *O. pseudeuphorbiae*, *O. rhamni*, *O. senegalensis* nom. prov. *O. xinjiangensis*, and *O. zhongdianensis*. Depending on the species and habitat, this tolerance lasts a few days or many months. Some species are only known from moist or wet habitats and did not survive 1 day in the dry state: *O. cotoneastri*, *O. epilobii*, *O. epipora*, and *O. rectispora*. Series *Neodactylella* occurs worldwide, from boreal to tropical and from humid to arid regions. The substrate can be woody or herbaceous, or even dung.

1. Marginal excipular cells oriented at a high angle, usually not forming distinct cell rows, ascospores rod-shaped to allantoid, mostly < 8–9 µm long, conidia cylindric-clavate to fusoid

Orbilia atlantis Baral, Spooner & Hairaud, **sp. nov.**,
MB 813969 — Pls 898–900, Map 143

Etymology: named after the atlantic distribution of the so far known collections.

Typification: Great Britain, Farnham, branch of *Ilex aquifolium*, 27.X.2002, B.M. Spooner (ex H.B. 7239a, M-0276436, holotype).

Latin diagnosis: *Apothecia rehydratata 0.2–1.5 mm diam., pallide succineo-chlorina vel luteo-cremea, (sub)sessilia, margine laevi. Ascosporae *4.5–7 × 0.8–1 µm, anguste cylindricae, basi non vel parum attenuatae, subrectae, corpusculum refringens minutum globosum, sat distans ab apice continentes. Paraphyses ad apicem non vel modice capitatae, exsudato tenui tectae, in statu vivo vacuolas pallide-luteas continentes. Excipulum marginale absque processis vitreis. Habitat ad corticem* Ilicis, *strobilos* Cupressi, *caules vel folios herbarum, in aere prominens vel ad terram humidam, in zona atlantica temperata ad submediterranea (semi)humida Europae occidentalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.1–)0.3–0.9(–1.4) mm diam., 0.08–0.14 mm high (receptacle 0.08–0.11 → 0.07–0.08 mm), pale amber-chlorinaceous to yellowish-cream, translucent, round, sometimes lobate when large, ± loosely gregarious,

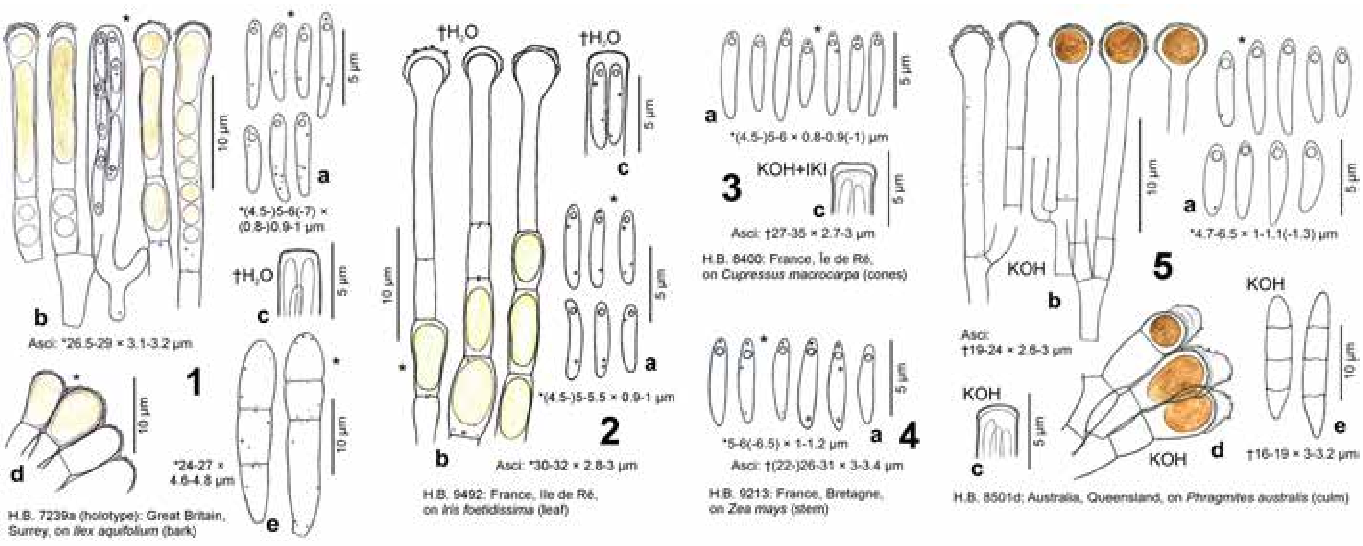


Plate 898. **1–3**: *Orbilia atlantis*; **4–5**: *O.* cf. *atlantis*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apices; **d**. marginal ectal excipulum in median section (**5d**: cortical cells with glassy caps); **e**. conidia from substrate.

sometimes in aggregated in small groups; disc flat to medium convex, margin thick or thin, 0–25 µm protruding, smooth; broadly sessile, or subsessile on a ± obconical stipe, superficial; dry light to bright yellow-amber to orange-ochraceous. **Asci** *26–32 × (2.7–)2.9–3.2(–3.6) µm {5}, †(22–)25–30(–35) × 2.4–3 µm {4}, 8-spored, spores *3–4-seriate, 4–5(–6) lower spores inverted {3} (± mixed), pars sporifera *17–18 µm long; **apex** (†) medium to strongly truncate (not indented, laterally not or slightly inflated); **base** with short to long, thin or thick, flexuous stalk, Y-, h- or H-shaped. **Ascospores** *(4.5–)5–6(–7) × (0.8–)0.9–1 µm {9}, †4.5–5.5(–6) × 0.7–0.9(–1) µm {2}, narrowly cylindric(-fusoid), rarely cylindric-clavate, apex rounded to obtuse, base not or slightly attenuated, straight, sometimes slightly curved; **SBs** globose, *(0.25–)0.35–0.5(–0.7) µm diam., 0.4–0.8 µm away from apex, total length 0.7–1.5 µm (including invisible attachment) {5}. **Paraphyses** apically uninflated or mostly slightly to medium (rarely strongly) capitate, terminal cells *(13.5–)15–20(–22) × 2.2–3 µm {2}, †10–19 × 2–3.5 µm {2}, lower cells *4–8 × 2.2–2.7 µm {3}, †4–6 × 1.6–2.2 µm {1}, up to *3–4 µm wide near base; not branched at upper septum, hymenium pale chlorinaceous (in KOH hyaline). **Medullary excipulum** hyaline, 15–50 µm thick, of dense, horizontally oriented textura prismatica-angularis-globulosa or medium loose t. intricata with many inflated cells, indistinctly to very sharply delimited. **Ectal excipulum** of (†) thin-walled, indistinctly to vertically oriented t. angularis-globulosa from base to margin, 30–70 µm thick near base, cells */†(8–)10–25(–32) × (6–)8–18(–21) µm {5}; 10–20 µm thick near margin, oriented at a 70–90° angle to the surface, marginal cortical cells */†5–8 × 3–6 µm {2}; **glassy processes** absent {6}. **Anchoring hyphae** sparse to abundant, *(1.5–)2–3(–4) ((–5)) {2} µm wide, †1.5–2(–2.5) µm {1}, walls */†0.1–0.2 µm thick {3}, forming either a 10–20 µm thick t. intricata below the basal excipulum, or sometimes a 60–90 µm thick layer of globose cells *5–13 µm diam. {2}. **SCBs** absent; **VBs** in paraphyses pale yellowish-chlorinaceous(-olivaceous), very low- to low-refractive {8}, globose to very elongate, also in upper part of medullary excipulum and/or in ectal excipulum at margin and flanks. **Exudate** over paraphyses and margin 0.1–0.3(–1) µm thick, pale yellowish, finely rough or granular, continuous, firmly attached, covering paraphyses like a hemispherical cap. — **ANAMORPH**: dactylella-like (presumed, from natural substrate {1}). **Conidiophores** not seen. **Conidia** unbranched, cylindric-ellipsoid-clavate, straight, *24–27(–47) × 4.2–4.8 µm, 2(–4)-septate {1}.

Habitat: on moist ground or 0.2–2.5 m above the ground, corticated, 9 mm thick branch of *Ilex aquifolium* {1} (on bark, mostly over narrow cracks in periderm formed by *Corynespora*, also on small periderm-free areas on bast), cones of *Cupressus sempervirens* {1}, standing or lying herbaceous stems of *Cirsium palustre* {2}, *Oenanthe crocata* {4}, leaves of *Helleborus niger* {1}, *Iris foetidissima* {1}, *I. pseudacorus* {1}; medium decayed, medium greyed, green algae sparse or absent. **Associated**: *Cistella grevillei* {2}, *Corynespora smithii* {1}, *Orbilia auricolor* {3}, *O. oxyspora* {1}, *Psilachnum rubicundum* {1}, *P. rubrotinctum* {1}, *Pyrenopeziza atrata* {2}, *P. ?imbricata* {1}. **Desiccation tolerance**: many medullary excipular cells, a few paraphyses and mature asci survived for 3–4 days, spores still viable after 3 weeks, conidia after 10 days. **Altitude**: 6–185 m a.s.l. **Geology**: Ordovician-Silurian-Devonian sand- & siltstone, Carboniferous lime-, sand- & mudstone and coal, Upper Cretaceous limestone, Quaternary marine sand; granite, mica schist & gneiss. **Phenology**: III–VI, X, XII (possibly throughout the year).

Taxonomic remarks. A number of species of section *Arthrobotrys* closely resemble *Orbilia atlantis* in spore size and shape and in the globose SBs situated a good distance from the apex, for instance, *O. rectispora* and *O. cardui*, from which it differs in smaller spores, pigmented VBs, from the former also in a drier habitat, and from the latter in the absence of glassy processes. *O. cotoneastri* resembles *O. atlantis* but differs in hyaline apothecia, longer asci, and wider spores with larger SBs. *O. bambusina* (incertae sedis) differs in tear-shaped, visibly attached SBs and short glassy processes. *O. acuum* (incertae sedis) differs in shorter, also partly wider spores, wider asci, and apparently narrowly tear-shaped SBs. *O. flavovacuolata* (series *Drechslerella*) is very similar especially regarding the yellowish VBs, but differs in distinctly wider asci, partly non-globose and eccentrical SBs, a tendency to basally tapered spores, paraphyses without exudate, and smaller apothecia. *O. quercus* (series *Dactylellina*) has slightly wider, more clavate spores with SBs close to the apex, and wider asci.

O. atlantis resembles also *O. epipora*, which mainly differs in distinctly shorter spores with SBs close to the apex, and in hyaline VBs. Also the Australasian *O. cunninghamii* (series *Orbilia*) differs in distinctly shorter spores, though the asci are longer (SBs are unknown since living spores were not studied). The desiccation-tolerant *O. cylindrospora* (section *Orbilia*) has a spore size and shape very similar to *O. atlantis*, but also here the SBs are much closer to the spore apex, and VBs are consistently absent.

Variation. The included collections show a rather high conformity, particularly in spore size and presence of yellowish VBs. However, SBs varied in size between 0.25–0.35 µm (on

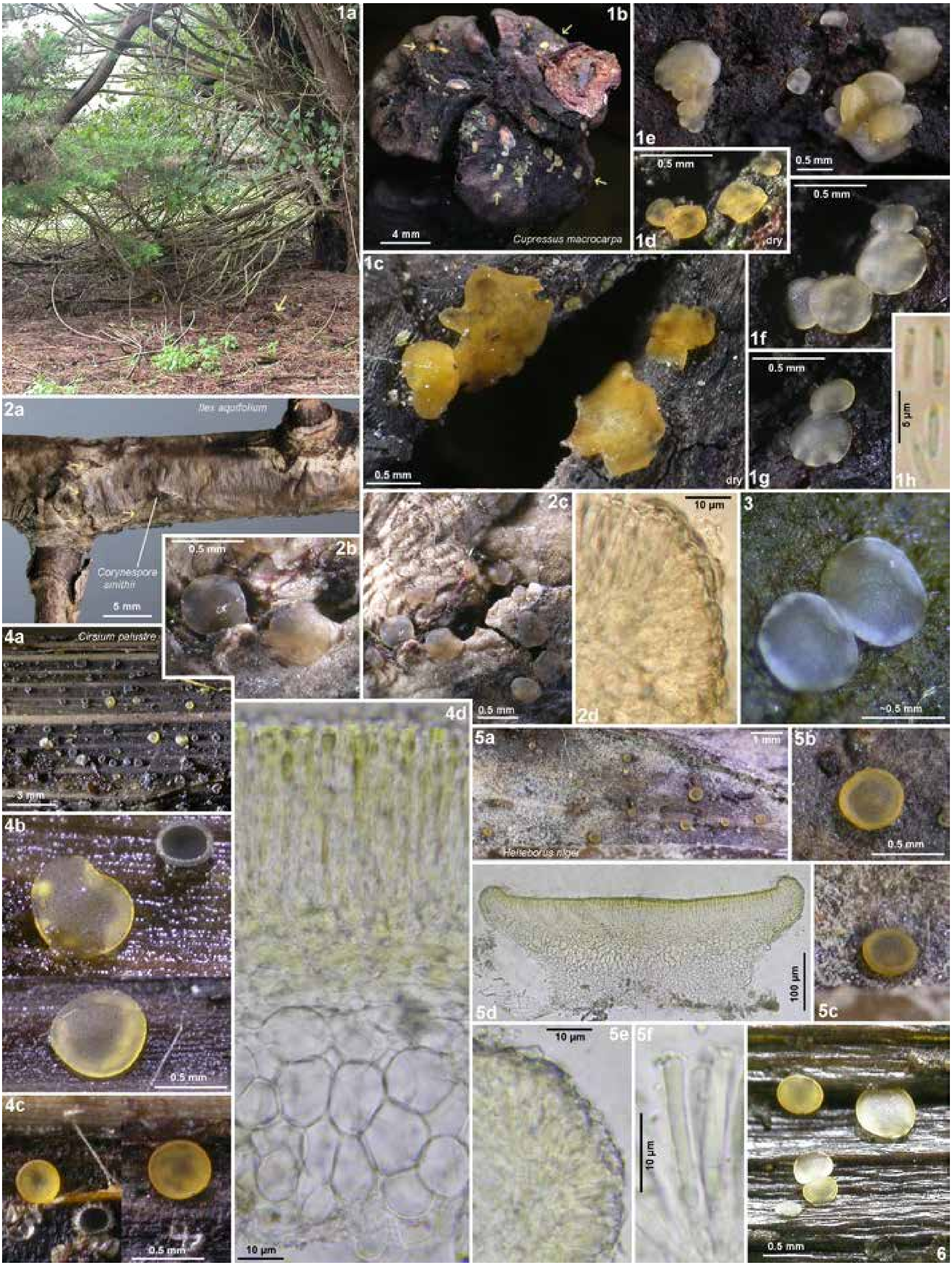


Plate 899. **1–2**, **4–6**: *Orbilia atlantis*; **3**: *O.* cf. *atlantis*. – **1a**. submediterranean coastal *Cupressus macrocarpa* woodland with cones lying in litter; **1b**. fallen cone with apothecia; **2a**. dead corticated xeric branch of *Ilex aquifolium*; **4a**. dead standing stem of *Cirsium palustre* (fresh); **5a**. underside of *Helleborus niger* leaf (fresh); **1e–g**, **2b–c**. rehydrated apothecia: **3**, **4a–c**, **5a–c**, **6** fresh apothecia (**4** with *Pyrenopeziza atrata*); **1c–d**. dry apothecia; **5d**. apothecium in median section; **2d**, **5e**. id., marginal region: **4d**. id., lower flanks; **5f**. paraphyses; **1h**. ascospores. – Living state, except for **2d** (in KOH). – **1a**: phot. M. Hairaud. **3**: phot. J.P. Priou. — **1a–h**. H.B. 8400: France, Île de Ré, on *Cupressus*; **2a–d**. H.B. 7239a (holotype): Great Britain, Surrey, on *Ilex*; **3**. H.B. 9213: France, Bretagne, on *Zea*; **4a–d**: H.B. 9527a: Great Britain, Barnsley, on *Cirsium*; **5a–f**. H.B. 9509: id., on *Helleborus*; **6**. H.B. 9492a: France, Saintes, on *Iris*.

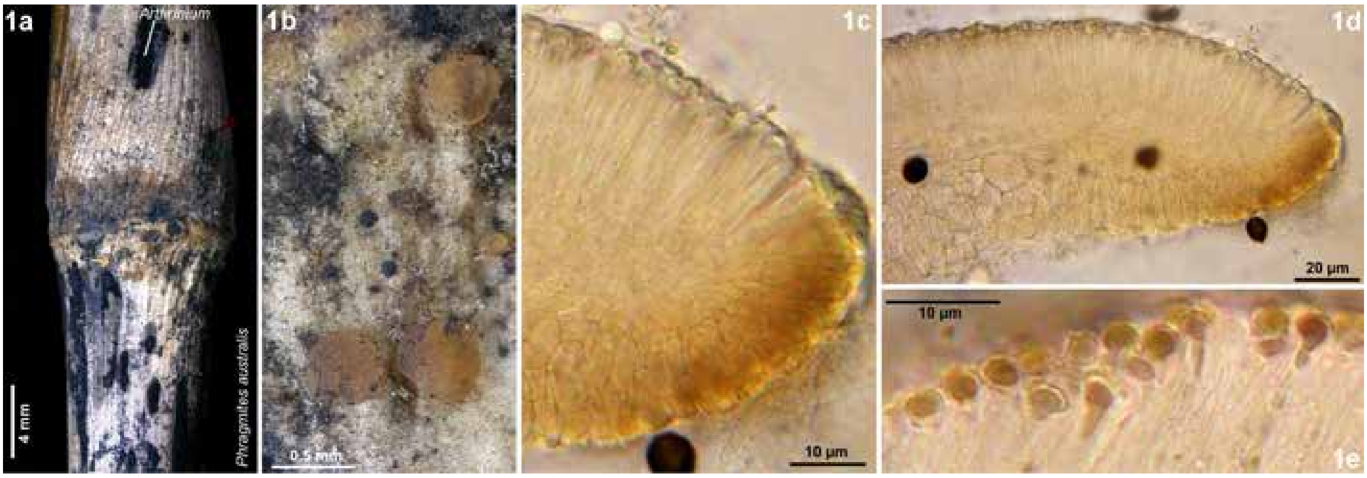


Plate 900. **1**: *Orbilia* cf. *atlantis*. – **1a**. dead xeric (standing) culm of *Phragmites australis*, with black mould (*Arthrinium arundinis*); **1b**. rehydrated apothecia: **1d**. apothecium in median section; **1c**. id., marginal region; **1e**. apices of paraphyses with brown contents. – Dead state (**1e**. in H_2O, **1c–d** in KOH). — **1a–e**. H.B. 8501d: Australia, Queensland.

Iris foetidissima) and 0.7 µm (on *Helleborus*), though being mainly 0.35–0.5 µm in diam. Further variation includes ascus width (from *2.7–2.8 µm up to 3.2–3.6 µm) and apical inflation of paraphyses. The collections on *Helleborus* and *Cirsium* from Barnsley differed from the others in a thick layer of basal textura globulosa that formed a pseudostipe below the ectal excipulum (Pl. 899: 5d), the *Helleborus* collection also in a thick protruding margin. The size of hydrated apothecia varied among the samples between 0.25–0.45 mm (*Helleborus*) and 0.6–1.2 mm (*Iris foetidissima*); in that on *Cupressus* an extremely wide range of (0.1–)0.3–1(–1.4) mm was observed.

Not included collections. Three caulicolous samples on *Poaceae* differ by slightly wider spores [*(0.9–)1–1.1(–1.3) µm] compared to typical *O. atlantis* [*(0.8–)0.9–1 µm]. Two from Europe (Pls 898: 4, 899: 3, on *Zea*; IVV: 11.VI.2019, on *Poaceae*) differ also in the lack of pigmented VBs and, therefore, more whitish apothecia, also by slightly wider asci (no data available for the latter sample). One from Australia (Pls 898: 5, 900, on *Phragmites*) differs in VBs that turn bright brown in the dead state (no living VB-containing cells seen), also in larger SBs with a partly visible fine filum, and in short glassy caps at the margin.

Anamorph. Only three phragmoconidia were seen on the natural substrate (in the holotype, Pl. 898: 1e); one was much longer than the other two and had 4 septa, but was damaged at the upper end. In the deviating Australian collection on *Phragmites* similar though smaller, 3-septate conidia were detected (Pl. 898: 5e).

Map 143. Known distribution of *O. atlantis* in Europe (yellow = not included collections on *Poaceae*).

Phylogeny. A sequence was gained from apothecia of a specimen from Yorkshire (H.B. 9527), which comprises SSU (without S1506 intron), ITS, and LSU. In our combined analyses (Phyls 25, 27), *O. atlantis* clustered unresolved in none of the four clades, with a minimum distance of 11.5 % to *O. pseudeuphorbiae* and 12 % to *O. rhopalota*, *O. zhongdianensis*, and *O. epilobii*. Species such as *O. rhamni*, *O. cotoneastri*, or *O. cardui* show a distance of ~ 12–18 %. In the LSU the lowest distance was 6.5 % to *O. xinjiangensis*, *O. cotoneastri*, *O. epilobii* etc.

Ecology. *O. atlantis* was found on a variety of different substrates: bark of an *Ilex* branch, cones of *Cupressus*, stems and leaves of herbaceous mono- and dicots. Some of the collections were made on hygric substrate close to the moist or wet ground (*Cirsium* from Sussex, *Cupressus*, *Helleborus*, *Iris*, *Oenanthe*), but two were on xeric substrate: on a standing stem in ~ 20–30 cm above the ground (*Cirsium* from Yorkshire), on a still-attached branch 2.5 m above the ground (holotype). *O. atlantis* is at least slightly desiccation-tolerant, since some asci survived for a few days in the dry state. *Corynespora smithii* occurred in abundance on the *Ilex* branches, though only sparsely on that branch which carried the *Orbilia* (B. Spooner pers. comm.). In the *Cupressus* collection the apothecia grew mainly over small cracks in the scales, on dark brown hyphae of unknown identity.

Collections were made in atlantic, cold- to warm-temperate humid northwestern and warm-temperate humid to mesosubmediterranean semihumid western Europe. The vegetation was quite diverse. The holotype locality in southern England was a damp shaded mixed woodland of *Quercus*, *Betula*, *Corylus* and *Ilex*, with some *Pinus* and *Castanea*. Samples from Île de Ré in western France were from coastal cypress woodlands and those on *Oenothera* from ± coastal wood-, shrub- and marshland in Wales and Bretagne, along ditches, rivers and lakes in a meadow among rocks or in wet *Salix* woodlands in a moist *Quercus* forest with *Buxus* and *Ruscus*. Collections from Yorkshire were on *Cirsium* in an ancient estate with *Rhododendron* in a moist *Alnus-Betula* forest and on *Helleborus* in a cultivated *Rhododendron* park.

The not included collection from northeastern Australia was on standing, dead, xeric culms of *Phragmites* being covered over large areas by a black conidial layer of *Arthrinium arundinis* in a tropical (semi)humid floodplain between savannah and rainforest on Devonian sedimentary rock, and that on *Zea* from western France was in a ditch in an atlantic, mesosubmediterranean humid forest, into which the substrate was transported by floodwater.

Specimens included. **GREAT BRITAIN**: **Yorkshire**, **South Yorkshire**, 4 km SW of Barnsley, W of Wentworth Castle, Stainborough Park, 185 m, leaves of *Helleborus niger*, 14.V.2011, T. Læssøe & J.H. Petersen (J.H.P. 11.095, H.B. 9509). – 8 km NNW of Barnsley, 6.5 km S of Wakefield, Seckar Wood, 70 m, stem of *Cirsium palustre*, 19.V.2011, H.O. Baral (H.B. 9527a, J.H.P. 11.177; sq.: KT222437). – **Wales**, **Pembrokeshire**, 7 km WNW of Pembroke, 3.3 km SSW of Waterston, Pwllcrochan Marsh, 10 m, stems of *Oenanthe crocata*, 9.V.2009, P. Thompson (K(M) 163314, doc. vid.). – **South East England**, **Surrey**, 55 km SW of London, 3 km NNW of Farnham, Rowhill, 135 m, branch of *Ilex aquifolium*, on bark, 27.X.2002, B.M. Spooner (K(M) 105703 **isotype**; ex H.B. 7239a, M-0276436, **holotype**, anam. substr.). – **West Sussex**, 6.5 km S of Crawley, SE of Handcross, 130 m, stem of *Cirsium palustre*, 25.V.2017, N. Aplin (N.A. 675, doc. vid.). — **FRANCE**: **Bretagne**, **Finistère**, 6.5 km WSW of Plouay, 1.7 km ENE of Arzano, Pont Kerlo, 35 m, stem of *Oenanthe crocata*, 12.V.2014, P.Y. Courio (P.Y.C. 14050, doc. vid.). – 6 km ESE of Quimperlé, 1 km WSW of Rédené, Rosbigot, 38 m, stem of *O. crocata*, 21.III.2020, P.Y. Courio (P.Y.C. 20041, doc. vid.). – **Morbihan**, Île de Groix, 2 km WSW of Le Bourg, WNW of Quéhello, Port St.-Nicolas, 17 m, stem of *O. crocata*, 6.VI.2015, J.P. Priou (J.P.P. 15135 ø, doc. vid.). – **Poitou-Charentes**, **Charente-Maritime**, Île de Ré, 1.7 km WNW of Ars-en-Ré, 1.5 km SSE of St.-Clément-des-Baleines, Forêt de la Combe à l'Eau, 6 m, leaves of *Iris foetidissima*, 28.IV.2011, B. Capoen (H.B. 9492a). – 2 km E of La-Flotte-en-Ré, SSW of L'Abbaye des Châteliers, 14 m, fruits of *Cupressus sempervirens*, 16.XII.2006, M. Hairaud & N. Van Vooren (H.B. 8400). – 2.5 km NE of Saintes, SE of Lormont, 20 m, stem of *Iris pseudacorus*, 26.V.2012, M. Hairaud & P. Tanchaud (M.H. 210512, H.B. 9686).

Not included. **FRANCE**: **Bretagne**, **Morbihan**, Bretagne, 1.7 km SSW of La Gacilly, 2.4 km WNW of Cournon, La Chevée, 7 m, culms of *Zea mays*, 4.IX.2009, J.P. Priou (J.P.P. 29163 ø, H.B. 9213). — **SERBIA**: **Vojvodina**, Fruška Gora, 13 km SSW of Novi Sad, 1 km E of Brankovac, 430 m, leaf of *Poaceae*, 11.VI.2019, D. Savić (doc. vid.). — **AUSTRALIA**: **Queensland**, Einasleigh Uplands, 22 km SSW of Mossman, 2 km N of Mount Molloy, Mossman Mt. Molloy Rd, 390 m, culms of *Phragmites australis*, 28.VIII.2006, G. Marson (ex H.B. 8501d, mixture in BRI AQ799195 [type of *O. stilbospora*]).

Orbilia epipora (Nyl.) P. Karst., Not. Sällsk. Fauna Fl. Fenn. Förh. 11: 248 (1870) — Pls 901–902, Map 144

≡ *Peziza epipora* Nyl., Not. Sällsk. Fauna Fl. Fenn. Förh. 10: 58 (1869)
= *Orbilia sericea* Henn., Hedwigia 45: 29 (1905)
= *Orbilia connata* Velen., Monogr. Discom. Bohem.: 95, pl. 11 fig. 13 (1934)
(?)= *Trichothecium polyctonum* Drechsler, Mycologia 44(4): 550 (1952)
≡ *Dactylella polyctona* (Drechsler) K.Q. Zhang, Xing Z. Liu & L. Cao, Mycosystema 7: 113 (1995) [1994]

Etymology: *epipora*: growing on the pores of *Phellinus igniarius*; *sericea*: from the silky appearance of the apothecia; *connata*: according to the densely gregarious apothecia; *polyctona*: referring to a wide scope of parasitism (literally: much slaying).

Typification: Finland, Ruovesi, on bark of indet. angiosperm tree and on *Phellinus igniarius*, 4.VIII.1859, P.A. Karsten (herb. Karsten 5278, H-6003825, as *Peziza leucostigma*, lectotype of ***Peziza epipora***, designated here, MBT202383); Germany, Chemnitz, branch of *Salix*, 20.IV.2009, B. Mühler (ex H.B. 9039, M-0291771, epitype, designated here, MBT385132; sq.: KT222431). — Russia (west), Podolsk, trunk of (?)*Populus*, VIII.1904, N.A. Mosolov (S, herb. Sydow, lectotype of ***Orbilia sericea***, designated here, MBT202384). — Ukraine, Swydiwec (Svitovec) mountain range, trunk of *Fagus sylvatica*, VIII.1930, A. Pilát (PRM 151704, holotype of ***O. connata***).

Misinterpretation of *O. epipora*: Beaton & Weste (1979), ?= *O. dryadum*; Korf (1992), = *O. dryadum* & *Hyalorbilia inflatula*; Liu (2006: 76 p.p.), = *O. dryadum*; Nylander (1869: 58 p.p.), = *H. inflatula*; Svrček (1954: 8 p.p.), ?= *Hyalorbilia* sp.; Dennis (1956: 296, as *O. epipora*), = *O.* ?*cunninghamii*.
Misapplied name: Otani (1990), as *Orbilia inflatula* [= *O.* ?*epipora*].

Description: — **TELEOMORPH**: **Apothecia** fresh (0.2–)0.3–1(–1.5) mm diam., (0.08–)0.11–0.16(–0.2) mm high (receptacle 0.07–0.12 → 0.05–0.06 mm), (greyish-)white, pale to light cream to yellowish-ochraceous with age, translucent, round, mostly densely gregarious in large numbers; disc young slightly to medium concave, later flat, rarely medium convex, margin thin, 0–5 µm protruding, smooth; with a broad obconical stipe 0.02–0.1 × 0.25–0.5 mm, superficial; dry pale to light or bright cream-yellowish(-chlorinaceous) or ochraceous. **Asci** *22–29(–32.5) × 2.8–3.5 µm {7}, †18.5–26((–28)) × (2.2–)2.4–2.8(–3) µm {5}, 8-spored, spores *4-seriate [†(1–)2(–4)-seriate], 3–5 lower spores inverted {6} (mostly mixed), pars sporifera *10–12 µm long (†9–18 µm); **apex** (†) medium to strongly truncate (not indented, laterally not or rarely slightly inflated); **base** with short to medium long, rather thin, somewhat flexuous stalk, T-, Y-, h- or H-shaped. **Ascospores** *(2.8–)3.3–4.3(–5) × 0.8–1((–1.2)) µm {17}, †(2.7–)3.2–4.3(–4.7) × (0.6–)0.7–0.9(–1) µm {8}, narrowly (sub)cylindrical, rarely slightly fusoid, ends rounded or obtuse, straight to often slightly curved; **SBs** *0.6–1 × 0.3–0.6 µm {4}, globose, apically abruptly narrowed to a minute, mostly invisible, very short filum, with a few minute LBs. **Paraphyses** apically uninflated or usually slightly to medium, only sometimes a few strongly capitate when in the dead state, terminal cells *13–22 × (2.2–)2.5–3.2(–3.5) µm {7}, †(11–)13–18(–20) × (2–)2.3–3(–3.4) µm {5}, lower cells *(2.5–)4–6(–7.5) × 2–3(–3.5) µm {6}, †3.5–6 × (1.3–)1.5–2.3(–2.6) µm {4}; sometimes branched at upper septum. **Medullary excipulum** 15–30 µm thick, of dense textura (intricata-)globulosa, indistinctly delimited from ectal excipulum, towards margin with or without a 5–10 µm thick layer of loose t. porrecta. **Ectal excipulum** of (†) not or very slightly gelatinized, indistinctly vertically oriented t. globulosa(-angularis) from base to margin, (25–)50–100(–150) µm thick near base, cells *10–32(–38) × 8–22(–30) µm {5}, †9–32 × 8–19 {4}; 10–15 µm thick near margin, oriented at a 45–90° angle to the surface, marginal cortical cells */†6–12(–15) × (4–)5–6(–7) µm {5}, at submargin 6–9 µm wide; **glassy processes** absent. **Anchoring hyphae** partly abundant at base, *2–5 µm wide, walls 0.2–0.3 µm thick {3}, forming a quite dense 10–50 µm thick texture of intricate hyphae, towards excipulum sometimes forming a paraplectenchyma of 6–8 µm wide cells, on stipe sometimes forming projecting hairs. **SCBs** not seen; **VBs** in paraphyses globose to mostly elongate, slightly to strongly refractive {18}. **Exudate** over paraphyses absent or as scattered, loosely attached, 0.1–0.5 µm thick granules, over margin and flanks ± absent. — **ANAMORPH**: dactylella-like (from ascospore isolate and natural substrate {1}). **Conidiophores** *~40–50 × 2–3 µm, branched or unbranched, conidia terminally formed, partly also on 1–3 lateral denticles (sympodial). **Conidia** unbranched, cylindrical to narrowly ellipsoidal, straight, *(13.5–)16–22(–25) × 2.2–3(–3.2) µm, (0–)1–3-septate {1}.

Habitat: mostly lying on the ground, corticated or decorticated, 3.5–30 cm thick branches and trunks, rarely a 3–4 mm thick twig, of *Acer* sp. {1}, *Betula obscura* {1}, *Buddleja davidii* {1}, *Carpinus betulus* {1}, *Fagus sylvatica* {8}, ?*Fraxinus* sp. {1}, *F. angustifolia* {1}, *Populus* sp. {5/1}, *P. tremula* {1}, *Salix* sp. {8}, *S. aurita* {1}, *S. fragilis* {1}, *Sambucus racemosa* {2}, *Tilia* sp. {2}, *Ulmus* sp. {1}, indet. angiosperms {4}, on lower side on 1–4 mm deep or entirely strongly decayed (white- or brown-rotten) wood {34}, rarely on bark {6}, often darkened, no algae, upper side partly covered by pleurocarpous mosses, often water-soaked, also on pores of old *Fomitiporia punctata* {1}, *Phellinus igniarius* {1}, indet. perennial basidiomycete {1}. **Associated**: *Hypnum cupressiforme* {1}, *Lasiosphaeria* sp. {1}, *L. hirsuta* {1}, *Lentomitella cirrhosa* {1}, *Orbilia crenatomarginata* {1}, *O. sinensis* {1}, *Pleurothecium* sp. {2}, *Pulvinula convexella* {1}. **Desiccation tolerance**: asci did not survive for 1 h in the dry state, but excipular and paraphysis cells survived sometimes 1 day (some cells even 3 days), and the ascospores were still viable after 1 month. **Altitude**: 3–595 m a.s.l. (atlantic to subcontinental Europe), 190–1020 m (continental Europe, Caucasus, central Asia). **Geology**: Ordovician & Carboniferous mud-, silt- & sandstone, Permian (Rotliegend), Middle Keuper & Lower Jurassic sandstone, Cretaceous limestone & flysch, Tertiary molasse, Quaternary loess, till, silt & sand; granite, pegmatite, serpentinite, gneiss, mica schist. **Phenology**: (III–)IV–X.

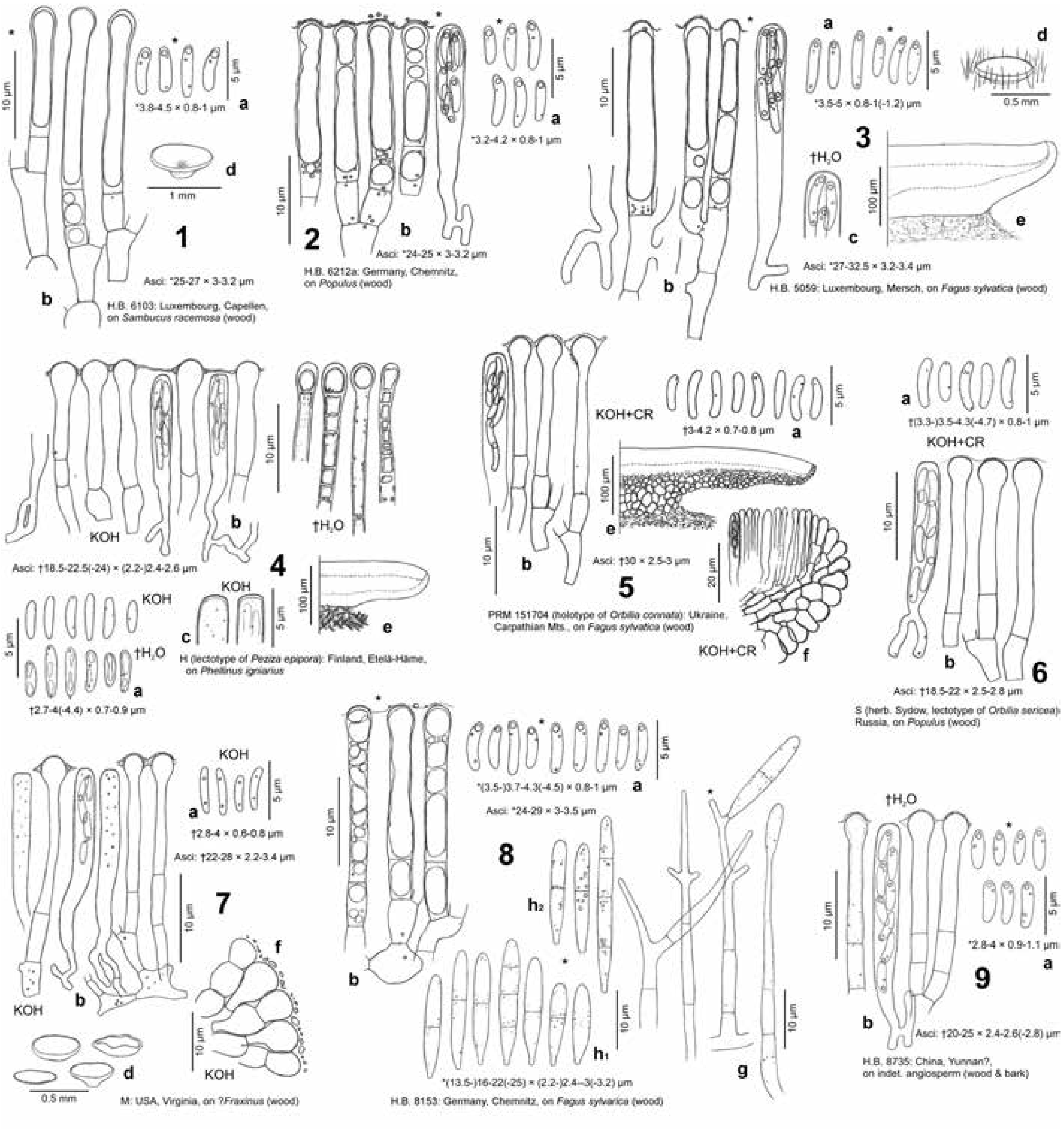


Plate 901. **1–9**: *Orbilia epipora*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. fresh apothecia; **e**. apothecia in median section; **f**. id., ectal excipulum at margin and mid flanks; **g**. conidiophores from substrate; **h**. conidia from substrate ($\mathbf{h_1}$) and culture ($\mathbf{h_2}$).

Phenology of *O. epipora*											
Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
0	0	1	10	8	3	4	6	2	3	0	0

Taxonomic remarks. *Orbilia epipora* is characterized by narrowly cylindrical, often slightly curved ascospores with a globose spore body at one end, and by whitish, translucent, desiccation-sensitive apothecia which grow mostly densely in large populations. *O. atlantis* differs in longer spores with the globose SBs more remote from the apex, in yellowish-chlorinaceous VBs and in apothecia growing in small groups, also in wider conidia. *O. cylindrospora* (section *Orbilia*) differs in longer and wider spores and asci, a thicker exudate, cells of the marginal ectal excipulum running under a lower angle, and in desiccation-tolerant, scattered apothecia often with a rose tint. *O. acuum* (incertae sedis) differs in larger asci and spores, and apparently in more tear-shaped spore bodies. The Australasian *O. cunninghamii* (section *Orbilia*) differs in much longer asci and in basally tapered spores. The Asian *O. yuanensis* (section *Helicoon*) has distinctly larger spores and tear-shaped SBs with a distinct filum.

Delimitation between *O. epipora* and the very similar *O. dryadum* (section *Orbilia*) was unclear in some intermediate populations, due to a pronounced variability in the latter species (see p. 1387).

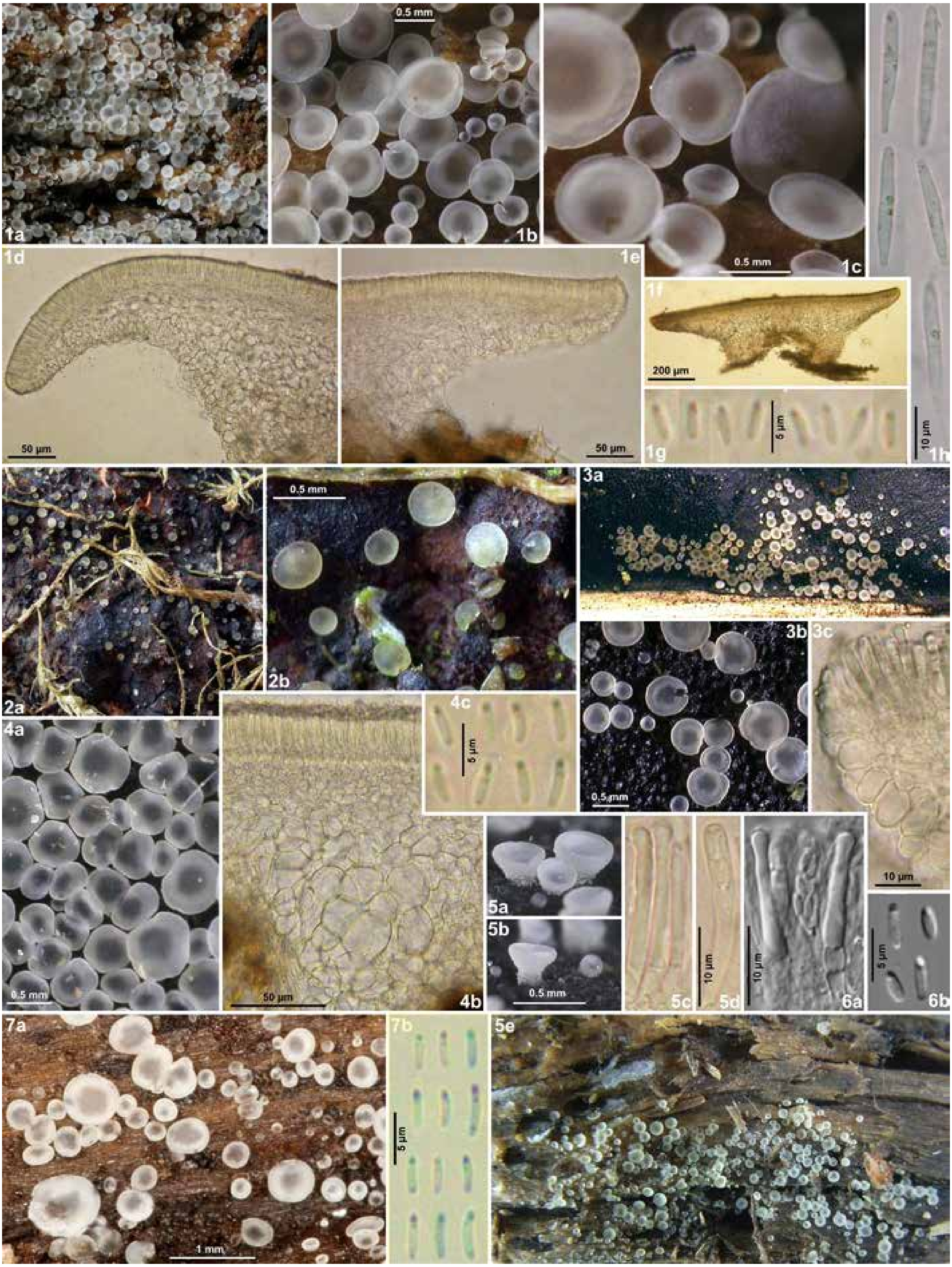


Plate 902. **1–6**: *Orbilia epipora*. – **1a–c**, **2a–b**, **3a–b**, **4a**, **5a–b, e**, **7a**. fresh apothecia; **1d–f**. apothecia in median section; **3c**. id., marginal ectal excipulum; **4b**. id., central part of apothecium; **5c–d**, **6a**. asci and paraphyses; **1g**, **4c**, **6b**, **7b**. ascospores; **1h**. conidia from culture. – Living state. – **6a–b**: phot. Z.F. Yu (DIC), **7a–b**: phot. D. Savić. — **1a–h**. H.B. 8153: Germany, Chemnitz, on *Fagus*; **2a–b**. H.B. 7766: Denmark, Aalborg, on *Salix*; **3a–c**. H.B. 8195b: Sweden, Skåne, on *Fagus*; **4a–c**. H.B. 8186: Germany, Chemnitz, on *Populus*; **5a–e**. H.B. 9039 (epitype): ibid., on *Salix*; **6a–b**. H.B. 8735: China, Sichuan, Jiuzhaigou, indet. angiosperm; **7a–b**. 20.VIII.2019: Serbia, Fruška Gora, on *Fagus*.

Variation. *O. epipora* seems to exhibit little variation in ascus and spore dimensions. The species varies mainly in the apical inflation of paraphyses between scarcely inflated to usually slightly to medium (types of *O. epipora* and *O. sericea*), rarely partly strongly capitate (type of *O. connata*). However, paraphysis shape appears to depend on the method: in recent specimens here depicted in the living state the paraphyses are apically not or only slightly inflated, whereas in herbarium specimens studied only in the dead state they are predominantly medium to rarely strongly inflated (Plate 901).

No difference between lignicolous and polyporicolous collections was observed. A specimen from mountainous central China (Pls 901: 9; 902: 6) fits well European samples, though the apothecia grew on a twig, and partly on bark, and the spores were slightly wider. Alternatively, this collection could belong to the narrow-spored *O.* aff. *dryadum* (e. g., Pl. 870: 7). A North American collection from Virginia (Pl 901: 7) fits rather well *O. epipora* but was only studied in the dead state. It shows pale yellowish-ochraceous apothecia (rehydrated, dry deep ochraceous) and might have been more intensely yellow in the fresh state as it was labelled by F. Petrak '*O. xanthostigma*', perhaps similar to *O. xanthoflexa*. The paraphyses are rather strongly capitate, similar as in the type of *O. connata*. From *O. cunninghamii* it seems to differ in shorter asci and in spores which are hardly tapered below.

Literature reports. Nannfeldt (1932: 254, fig. 40a–b) gave a description and illustration of the excipulum of a Swedish sample of *O. epipora* (on wood of *Populus tremula*, Lundell & Nannfeldt, F. exs. Suecici 1780), and Spooner (in Kirk & Spooner 1984: 573, fig. 9 C [as 'B']) added the hymenial characters of this sample, with asci 22–26 × 2.5 µm and slightly curved, basally ± tapered spores 3.5–5 × 0.6–0.8 µm (4.5–5.5 × 0.8–1 µm according to scale). The rather long, heteropolar spores would better fit *O. cunninghamii* (section *Orbilia*) from New Zealand, but the short asci exclude this species. Also Spooner (1987: 167) characterized *O. epipora* by small asci, but he saw a 'thin encrusting epithecium' over the paraphyses in F. exs. Suecici 1780, while in our studied collections of *O. epipora* no or only sparse and minutely granular exudate was present.

Also the reports by Seaver (1951: 155, as '*O. epispora*', eastern USA) and Raitviir (1991: 359, Far East of Russia) might fit the present concept of *O. epipora*, although Seaver's brief diagnosis (apothecia whitish-translucent) lacks data on paraphyses, and the Russian sample deviates by yellowish apothecia and strongly capitate paraphyses. Dennis (1954: 296, figs D–E) compared a collection made in Cuba (C. Wright 355, fig. E) with an authentic specimen from Finland (P.A. Karsten 725, fig. D, not examined by us), but his sketches show too narrow, partly basally tapered spores of '3–4.5 × 0.5 µm' in both samples, reminiscent of *O. cunninghamii*.

Type studies. ***O. epipora*** was described by Nylander (1869) for a polypore inhabiting fungus collected in August at Ruovesi (Tampere, Finland), with white, flat, gregarious apothecia 0.3–0.5 mm diam., clavate asci of 16–19 × 2–2.5 µm, bacilliform or acicular-fusiform spores of 3–6 × 0.5 µm, and clavate, apically flattened paraphyses. Three authentic specimens were received from H, all being collected by P.A. Karsten at Ruovesi at the same day (4.VIII.1859). Two of them are duplicates in which the apothecia grew on the pores of *Phellinus igniarius*, one bearing Nylander's handwriting, the other Karsten's. The third specimen is on an unidentified, apparently different polypore, and bears only Karsten's notes. Karsten (1861: 39) referred his two collections to *Peziza leucostigma* (see Karsten 1869: 174), whereas Nylander (1869) distinguished them by smaller apothecia, smaller asci, and narrower spores. Nylander appears to have also seen the specimen on unidentified polypore, judging from his statement in the protologue 'Supra *Polyporum igniarium* et alios'.

The present reexamination of the three specimens revealed that the two duplicates represent an *Orbilia* species with (rehydrated) flat apothecia of 0.2–0.55 mm diam., stipitate asci with a furcate base, cylindrical spores, and distinctly capitate paraphyses (Pl. 901: 4), whereas the specimen on unidentified polypore contained *Hyalorbilia inflatula*, with (rehydrated) cupulate apothecia 0.2–0.65 mm, non-stipitate asci 19–28 × 3.3–4 µm arising from croziers, cylindrical to subfusoid spores 6–7 × 0.8–1 µm, and uninflated paraphyses. Obviously, the original description predominantly refers to the *Orbilia* but appears to be also influenced by the *Hyalorbilia*, at least concerning spore length. In order to stabilize the application of Nylander's taxon, we here designate that part of the duplicate specimen which bears Nylander's notes (labelled 'In paroecia Ruovesi', H) as **lectotype** of *Peziza epipora*. The lectotype fits quite well the present concept of *O. epipora* which, however, comprises predominantly lignicolous collections. A specimen from Germany (Chemnitz, on *Salix*, ex H.B. 9039, Pl. 902: 5), from which a sequence was gained, is designated here as **epitype** of *O. epipora*.

In a syntype of ***O. sericea*** (on wood of *Populus*, Moscow, S) the apothecia measure (rehydrated) 0.3–0.8 mm diam., the paraphyses have a distinctly capitate, 2–3.3 µm wide apex, and the spores are cylindrical and slightly allantoid (Pl. 901: 6). Hennings reported the apothecia as 0.3–0.35 mm diam., the paraphyses as filiform, 0.5 µm wide, and the spores as 4–5 × 0.5 µm, fusoid. The abundant material looks homogeneous and well concurs with the type of *O. epipora*. Type material in B was destroyed during the Second World War, therefore, the examined specimen in S (herb. Sydow) is herewith designated as **lectotype** of *O. sericea* (ICN Art. 9.11, Turland et al. 2018).

Svrček (1954: 12) stated ***O. connata*** to be a synonym of *O. epipora*. This is confirmed here based on the reexamination of the holotype which contains about 1 thousand overmature apothecia growing densely gregarious on ± darkened wood of a decorticated log of *Fagus* among black setae of a hyphomycete. Although the apothecia were given by Velenovský as 1–1.5 mm diam. (rehydrated 0.3–1 mm in the present study), Svrček emphasized their 'very small' size (in the dry state), but did not provide values. He corrected Velenovský's too small spore measurements of 1–2 µm in the protologue (1–2.5 µm in the manuscript) to 3–4.5 × 0.5–0.8 µm which concurs with the present result (Pl. 901: 5).

Both Velenovský and Svrček reported the asci to be (very) coherent. Yet, this feature is due to apothecial senescence and results in the difficulty to clearly see the ascus base. Therefore, the available ascus measurements are uncertain (Svrček: †22–25 × 3 µm, 30 × 2.5–3 µm in present study). Velenovský's (1934) sketch of the asci shows long and thin, basally short bifurcate stalks but he gave too small values also here (16–20 × 2 µm). The ectal excipulum is of textura angularis up to the margin, whereas Svrček saw at the margin a t. prismatica. The paraphyses are always medium to strongly capitate, although Velenovský's protologue and sketch displays them as apically uninflated (Svrček did not clearly see them). The characters given by Svrček (1954: 8) in the key suggest that he used the name *O. epipora* in the sense of a *Hyalorbilia*.

Misapplication. *O. epipora* has repeatedly been confused with *Hyalorbilia inflatula* in the past, mainly because of its rod-shaped spores also based on the growth on a polypore. Already Nylander or Karsten confused the two species: in the protologue of *O. epipora*, Nylander cited a collection made by Karsten at the same day and site as the lectotype, but which represents *H. inflatula*. Also Saccardo (1889: 626) referred an Italian specimen on *Polyporus squamosus* to *O. epipora* which might be *H. inflatula* because of the long spores (7 × 0.75 µm). On the other hand, Otani's (1990: 260) report of *Orbilia inflatula* from Japan might refer to *O. epipora* base don the isodiametrical excipular cells, except for its wider spores.

The two Macaronesian specimens reported by Korf (1992) under the name *O. epipora* show very different spores in Korf's drawing. The present reexamination revealed that the sample with acicular spores (CUP-MM-001537, Madeira, on bark, erroneously as MM 1145 in the legend, S. Gruff pers. comm.) represents *Hyalorbilia inflatula*. The one with rod-shaped spores (CUP-MM-000245, Tenerife, on angiosperm wood) fits rather well *O. dryadum* in showing many strongly capitate paraphyses (sometimes asymmetrical) and a spore length typical of *O. dryadum* (†2.7–3.5 × 0.8–1 µm). Yet, spore width is unusually narrow and corresponds to recent records from Tenerife in being somewhat intermediate between *O. epipora* and *O. dryadum* but apparently better fitting *O. dryadum*. Also Beaton & Weste's (1979) and Liu's (2006) interpretation of *O. epipora* better fit *O. dryadum* (see p. 1389).

Not included collection. A sample on *Salix caprea* from Spain is intermediate to *O. dryadum* in having partly strongly capitate paraphyses and rather short spores of 3–3.7 × (0.9–)1 µm. For the not included type of *Dactylella polyctona* see under Anamorph.

Anamorph. The dactylella-like anamorph of *O. epipora* was so far only observed in a single collection, and here both in pure culture and on the natural substrate (Pls 901: 8g–h; 902: 1h). From the similar *O. dryadum* (section *Orbilia*) this deviates in smaller, especially narrower conidia with fewer septa.

This anamorph shows a very good match with *Dactylella polyctona* as described by Drechsler (1952, see Pl. 5: a). Conidial size and shape perfectly fit Drechsler's data (12.7–21 × 2.3–2.8 µm), also the conidiophores fit well except for being shorter in Drechsler's strain (15–30 × 2–3 µm).

Phylogeny. Two sequences of *O. epipora* were gained from apothecia: one comprising SSU (V7–V9), ITS, and LSU (D1–D2, Chemnitz, H.B. 9039), and one SSU (V9), ITS, and LSU (D1–D3, Deux-Sèvres, H.B. 9489). In their overlapping parts the two sequences are completely identical. In both the S1506 intron is absent.

The phylogenetic analyses of SSU+ITS+LSU in Baral et al. (2017b) and Phyl. 7 placed *O. epipora* with medium or low support sister to the rest of section *Arthrobotrys* and more distant from section *Orbilia*. The ITS distance to any other member of section *Arthrobotrys* is rather high, the lowest percentage being to 14.5% to *Orbilia* sp. XJ-2009, 15.5–16% to *O. cupressi* and *O. fraxini*, and 18% to *O. atlantis*. Unexpectedly high distances were noted to *O. dryadum* s.l. (~23–26%) and *O. cunninghamii* (23–23.5%). On the contrary, the minimum distance in the LSU is around 6–7% to members of series *Orbilia*, but 7–8% to those of series *Neodactylella*.

Map 144. Known distribution of *O. epipora* in Europe.

Specific nucleotide positions. When looking at characteristic nucleotide positions of the 5.8S region, *O. epipora* shows affinities to different groups of *Orbiliaceae* but not to section *Orbilia*: pos. 132–133 has CC**TT**T which is typical of many species of series *Neodactylella* and *Arthrobotrys* (besides CC**A**T**T** and CC**GG**T, see Tab. 18), whereas all members of section *Orbilia* have CC**GA**C or CC**GA**T; pos. 140 has GCA**T**G in concordance with all members of section *Arthrobotrys* and many of other groups, whereas all members of section *Orbilia*, some other groups of *Orbilia*, and *Hyalorbilia* p.p. have GCA**C**G.

Characteristic motifs also occur in the LSU D1–D2 domain, some of which being more or less unique to *O. epipora*. Further nucleotides support placement in section *Arthrobotrys*: (1) at pos. 163 *O. epipora* has **T** (GC**T**TC) in common with many other *Orbiliomycetes*, including all members of section *Arthrobotrys* (mostly GT**T**TC), whereas almost all of section *Orbilia* have **C** (mostly GC**C**TC); (2) at pos. 253 *O. epipora* has **A** (GA**A**GC) as many other *Orbiliomycetes*, including all members of section *Arthrobotrys* (which have mostly GA**A**AC), whereas section *Orbilia* has always **G** (mostly GT**G**GC).

Within section *Arthrobotrys*, *O. epipora* fulfils all specific nucleotide positions listed for series *Neodactylella* in Tab. 76. For example, at pos. 30 of 5.8S (TTC**T**CGC) and pos. 332 of LSU (G**A**GAGA) *O. epipora* concurs with series *Neodactylella* but differs from all nematophagous species of *Arthrobotrys* having TTC**C**CGC and G**G**GAGA. However, the 2 positions in *O. epipora* are also typical of series *Orbilia* and most other groups of *Orbiliomycetes*.

Ecology. *O. epipora* was found on rotten wood (rarely bark) of hygric branches and logs (rarely twigs) of predominantly *Salicaceae* {17} and *Fagus* {8}, also on polypores, in thermoboreal (type), atlantic to continental, planar to colline, cold- to warm-temperate humid Europe. The vegetation comprises (boreo) nemoral forests such as *Fagetea*, swampy forests with *Salix*, *Populus*, *Betula*, *Alnus* etc., or a *Pinus-Betula* forest in a quarry. *O. epipora* occurs also in warm-temperate humid eastern North America, orotemperate southeastern Europe (Caucasus, forest with *Tilia platyphyllos* and *Ulmus*), boreal (cold-continental) humid central Asia (Altay, *Pinus sibirica-Abies sibirica* forest), and in warm-temperate humid (monsoon-influenced) continental central China. Cash (1938) listed for Hawaii collections on *Artocarpus* and *Mangifera*, but these need reexamination.

D. polyctona was isolated from forest humus near Hermiston (Oregon, North America) and was found to parasitize testaceous rhizopods (*Arcella vulgaris*), oospores of *Pythium spinosum*, and cysts of a myxobacterium (*Polyangium* sp.).

Specimens included. **GREAT BRITAIN**: **Wales**, **Pembrokeshire**, 7 km E of Haverfordwest, 2.5 km S of Wiston, Slebech, 70 m, branch of *Acer*, on wood, 30.IX.2011, J.P. Priou (J.P.P. 11118, doc. vid.). – **East England**, **Hertfordshire**, 5.5 km W of Hoddesdon, NW of Brickendon, Great Groves Wood, 85 m, log of *Carpinus betulus*, on wood, 22.IV.2019, K. Robinson (doc. vid.). — **SWEDEN**: **Uppsala**, 8 km S of Uppsala, Vårdsätra, 20 m, wood of *Populus tremula*, 30.V.1929, S. Lundell, vid. J.A. Nannfeldt & B.M. Spooner (Lundell & Nannfeldt, F. exs. Suecici 1780, doc. vid.). – **Skåne**, Riseberga, Söderåsen, 4.5 km NW of Röstånga, NW of Lierna, Lia mad, 120 m, log of *Salix aurita*, on wood and *Fomitiporia punctata*, 4.VI.2006, S.Å. Hanson (H.B. 8195b). – ibid., Liagården slopes, 120 m, log of *Fagus sylvatica*, on wood, 4.VI.2006, H.O. Baral (H.B. 8195a). — **FINLAND**: **Pirkanmaa**, 57 km NNE of Tampere, Ruovesi, ~130 m, on bark of indet. angiosperm tree and on *Phellinus igniarius*, 4.VIII.1859, P.A. Karsten (Karsten 5278, H-6003825, as *Peziza leucostigma*, **lecto- & isolectotype** of *O. epipora*, H.B. 5223 ø). – **Varsinais-Suomi**, 15 km SE of Somero, NE of Halkjärvi, 97 m, log of *Salix*, on wood, 31.VII.2019, S. Jakobsson (doc. vid.). — **DENMARK**: **Nordjylland**, Jutland, 24 km NNW of Aalborg, 7 km NNE of Aabybro, Store Vildmose, S of Blokhusvej, 6 m, branch of *Salix*, on bark, 16.V.2005, T. Borgen (H.B. 7766). — **GERMANY**: **Nordrhein-Westfalen**, 3.2 km ENE of Mönchengladbach, Volksgarten, 55 m, branch of *Populus*, on wood, 28.III.2011, H. Bender, vid. I. Wagner (ø, doc. vid.). – 9 km WSW of Mönchengladbach, SW of Merreter, 73 m, branch of *Fagus sylvatica*, on wood, 19.VII.2019, J. Maassen, vid. H. Bender (doc. vid.). – **Sachsen**, 4.5 km SW of Dresden, NW of Coschütz, Plauenscher Grund, 190 m, on old perennial basidiomycete, 4.V.2014, E. Tomschke, vid. S. Pohlers (doc. vid.). – 6 km NNE of Chemnitz, 1 km E of Glösa, Indianerteich, 325 m, log of *Populus*, on wood, 22.VIII.1998, M. Eckel (H.B. 6212a). – 3 km NE of Chemnitz, NE of Heinrich-Schütz-Straße, SW of Zeisigwald, 340 m, branch of *Tilia*, on wood & bark, 25.VI.2012, B. Mühler (ø). – 1 km NNW of Yorckgebiet, Zeisigwald, 355 m, branch of *Populus*, on wood, 23.V.2006, B. Mühler (H.B. 8186). – ibid., log of *Fagus sylvatica*, on wood, 1.V.2006, B. Mühler (H.B. 8153, anam. substr., anam. cult.). – 7.5 km SE of Chemnitz, E of Einsiedel, Einsiedler Wald, Fischzuchtgrund, 390 m, branch of *Salix*, on wood, 20.IV.2009, B. Mühler (ex H.B. 9039, M-0291771, **epitype**; sq.: KT222431). – ibid., branch of *Tilia*, on wood, 25.IV.2011, B. Mühler (ø, doc. vid.). – **Bayern**, **Unterfranken**, Steigerwald, 26 km SE of Schweinfurt, 5.5 km E of Michelau, SW of Weilersbach valley, Kleinengelein, 440 m, log of *Fagus sylvatica*, on wood, 25.IV.1999, L.G. Krieglsteiner (L.K.). — **AUSTRIA**: **Niederösterreich**, Wienerwald, ~23 km W of Wien, ~2.5 km WNW of Pressbaum, E of Rekawinkel, Großer Stiefelberg, ~400 m, log of *Fagus sylvatica*, on wood, 1906, F. v. Höhnel (herb. Höhnel A 4946, M, as *O. leucostigma*). – 21 km SW of Wien, 1.2 km W of Gaaden, Schlößlwald, Dürnbach, 348 m, log of *Salix fragilis*, on wood, 10.IV.2012, M. Mann (ø, doc. vid.). — **SERBIA**: **Vojvodina**, Fruška Gora, 12 km SSW of Novi Sad, 5.5 km SSE of Racovac, Zmajevac, 472 m, branch of *Fagus sylvatica*, on wood, 20.VIII.2019, D. Savić (doc. vid.). — **NETHERLANDS**: **Noord-Brabant**, 6 km WNW of Veghel, 2.5 km NE of Schijndel, Wijboschbroek, 24 m, fragment of *Populus*, on wood, 23.IX.2018 L. Rommelaars (L.R. 18-041, doc. vid.). — **LUXEMBOURG**: **Gutland**, **Diekirch**, 9.5 km NE of Mersch, 2 km NW of Medernach, Seitert, 330 m, log of *Fagus sylvatica*, on wood, 24.IV.1994, B. Declercq (B.D. 94041, H.B. 5059). – **Capellen**, 6.7 km ESE of Arlon, 1.3 km NW of Steinfort, Aechels, 326 m, branch of *Sambucus racemosa*, on wood, 5.V.1998, B. Schultheis & B. Declercq (B.D. 98053, H.B. 6103). — **FRANCE**: **Bretagne**, **Morbihan**, 1.3 km NE of Ploemeur, E of Kerihuer, 23 m, log of *Salix*, on wood, 6.VII.2012, P.Y. Courio (J.P.P. 12141, doc. vid.). – 17 km S of Vannes, 3.4 km SE of Sarzeau, SW of Suscinio, 4 m, log of *Salix*, on bark, 31.V.2014, G. Ouvrard (J.P.P. 14099, doc. vid.). – 30 km ENE of Vannes, 1.5 km WNW of Pleucadeuc, Petit Gournava, 52 m, branch of *Salix*, on wood, 26.X.2010, A. Gardiennet (J.P.P. 10177, doc. vid.). – **Poitou-Charentes**, **Charente-Maritime**, 4 km SE of Saintes, 1.4 km E of Les Gonds, 3 m, branch of *Fraxinus angustifolia*, on wood, 6.IV.2012, P. Tanchaud (ø, doc. vid.). – **Deux-Sèvres**, 12.5 km WSW of Niort, 1 km ENE of Le Vanneau-Irleau, Marais Poitevin, 3 m, branch of *Salix*, on wood, 29.IV.2011, I. Kušan (H.B. 9489; sq.: KT222397). – **Champagne-Ardenne**, **Marne**, ~9 km WNW of Reims, Chalons-sur-Vesle, log of *Populus*, on wood, 6.IV.1997, M. Langlois (H.B. 5777). – **Bourgogne**, **Côte-d'Or**, 11 km S of Dijon, 3 km WSW of Fenay, Grand Étang de Sotenoy, 228 m, on *Salix*, 25.X.2009, A. Gardiennet (J.P.P. 29202, doc. vid.). — **SPAIN**: **Asturias**, 3.7 km ESE of Gijón, Jardín Botánico Atlántico, 27 m, branch of *Buddleja davidii*, on bark, 5.V.2017, M. González (E.R.D. 7023, doc. vid.). – **Navarra**, 17 km N of Pamplona, 1 km W of Olague, 595 m, branch of indet. angiosperm on wood, 5.IV.2015, F.J. Balda (F.J.B. 50415, doc. vid.). — **AZERBAIJAN**: **Shaki-Zaqatala**, Caucasus Mts., ?N of Zaqatala, 'Kordon', 800 m, log of *Ulmus*, on wood, 12.VIII.1974, E. Parmasto (TAAM 90672, as *Carpinus caucasica*, H.B. 8708). — **UKRAINE**: **Zakarpattia**, Carpathian Mts., Swydiwec (Svitovec) mountain range, unlocalized, ~600–1300 m, log of *Fagus sylvatica*, on wood, VIII.1930, A. Pilát (PRM 151704, **holotype** of *O. connata*, H.B. 6093 ø). – **Ivano-Frankivsk**, Nadvirna, 55 km W of Kolomyya, 5 km SE of Maksymets, Gorgany forestry, 1020 m, log of *Betula obscura*, on wood, 20.VII.2012, A.Y. Akulov (ex CWU(MYC) 4914, H.B. 9717). — **RUSSIA (West)**: **Moskow**, **Podolsk**, 47 km SW of Moscow, 25 km W of Podolsk, Mikhailovskoye, 190 m, log of (?)*Populus*, on wood, VIII.1904, N.A. Mosolov (S, herb. Sydow, **lectotype** of *Orbilia sericea*, H.B. 7689 ø). — **RUSSIA (East)**: **Altay**, **Turochak**, 67 km SSE of Turochak, Telezkoje Lake, 5.5 km S of Yaylyu, valley of Ydyp river, 730 m, indet. angiosperm, on wood, 15.VIII.2008, E.S. Popov (LE 247095, doc. vid.). — **USA**: **Virginia**, Arlington, Falls Church, Campbell's Woods, ~100 m, log of ?*Fraxinus*, on wood, X.1925, W.W. Diehl & B.O. Dodge (herb. Petrak, M, as *O. xanthostigma*, H.B. 5074 ø). — **CHINA**: **Sichuan**, **Ngawa**, Jiuzhaigou, ?Shuzheng, Baojingya, ~2100 m, twig of indet. angiosperm, on bark & wood, 8.X.2006, J.W. Guo (bjy-4, H.B. 8735).

Not included. **SPAIN**: **Asturias**, 9.5 km SW of Cangas de Onís, 2 km SE of El Pico, NE of Casa de Fontecha, 775 m, branch of *S. caprea*, on wood, 17.IV.2014, E. Rubio (E.R.D. 6172 ø, doc. vid.). — **USA**: **Oregon**, Hermiston, ~150 m, leaf mold from forest soil, 20.VIII.1947, C. Drechsler (**holotype** of *Trichothecium polyctonum*, conid. isol., doc. vid.).

Orbilia rectispora (Boud.) Baral, in Liu et al., Fungal Diversity 22: 116 (2006) — Pls 903–904, Map 145

≡ *Hyalinia rectispora* Boud., Hist. Class. Discom. Eur: 103 (1907)
≡ *Pezizella rectispora* (Boud. 1907) Sacc. & Traverso in Traverso, Syll. Fung. 20: 321 (1911)
= *Orbilia arundinacea* Velen., Monogr. Discomyc. Bohem.: 99, pl. 11 fig. 32 (1934)
?= *Orbilia arundinacea* var. *hypothallosa* Velen., Monogr. Discomyc. Bohem.: 99, pl. 11 fig. 33 (1934) (non *O. hypothallosa* Velen. 1947)
= *Dactylella nuorilangana* X.F. Liu & K.Q. Zhang, in Zhang & Mo, Fl. Fung. Sinicorum (Beijing) 33: 79 (2006)

Etymology: *rectispora*: referring to the straight ascospores; *arundinacea*: growing on reed; *hypothallosa*: after the hyphae around the apothecia; *nuorilangana*: referring to the Nuorilang waterfall in the north of Sichuan.

Typification: France, Paris, leaves of *Scirpus silvaticus*, VII., É. Boudier (holotype of ***Hyalinia rectispora***, illustration in Boudier 1909: pl. 467); Germany, Chemnitz, *Typha* leaves, 1.VI.2002, B. Mühler (ex H.B. 7142, M-0276578, epitype, designated here, MBT202388; ex-epitype culture: CBS 140813; sq.: KT215289, MH878185). — Czechia, Kosoř, *Phragmites australis* culms, VI.1927, J. Velenovský (PRM 151743, lectotype of ***Orbilia arundinacea***, designated by Svrček 1954: 10). — Czechia, Zvánovice, *Juncus communis*, V.1927, J. Velenovský (holotype of ***O. arundinacea* var. *hypothallosa***, illustration in Velenovský 1934). — China, Sichuan, Jiuzhaigou, Nuorilang, 7.VI.2003, soil isolate, X.F. Liu (type of ***Dactylella nuorilangana***, YMF 1.00582).

Misapplied names: Beyer (1998: 191), as *O. luzularum*; Svrček (1954: 11 p.p.), as *O. cardui*.

Misinterpretation of *O. rectispora*: Grelet (1948b: 107, as *Hyalinia rectispora* var. *majuscula*), = *Hyalorbilia inflatula*; Liu (2006: 102 p.p.), Liu et al. (2006b: 116 p.p.), Liu et al. (2006a p.p.), = *O. sinensis* & *O. tenuispora*.

Description: — **TELEOMORPH**: **Apothecia** moist/rehydrated (0.15–)0.3–1(–1.5)((–2.3)) mm diam., 0.08–0.25 mm high (receptacle 0.06–0.16 mm), whitish to pale cream to isabelline, medium to strongly translucent, round, somewhat lobate when large, medium scattered to densely gregarious; disc flat, slightly to medium convex with age, margin distinct, thin, not protruding, smooth; broadly sessile or with a (very) broad stipe ~0.02–0.04 × 0.1–0.27 mm, superficial; dry light cream to yellowish-ochre. **Asci** *(30–)33–41 × 3.3–4.2 µm {4}, †(24–)27–34(–38) × (2.7–)2.9–3.4(–3.8) µm {11}, 8-spored, spores *4-seriate, 3–4 lower spores inverted {5} (not or rarely mixed), pars sporifera *14–19 → 8–11 µm long; **apex** (†) slightly to strongly truncate (not or slightly indented, laterally not or slightly inflated); **base** with short to medium long, thin or thick, slightly flexuous stalk, Y- to h- or H-shaped. **Ascospores** *(5–)6.5–9.5(–11) × (0.9–)1–1.2(–1.3) µm {11}, †5–9 × (0.8–)0.9–1.2 µm {6}, narrowly (sub)cylindric(-clavate) to fusoid-clavate, apex rounded to obtuse, base not or slightly to medium (to strongly) attenuated, straight to often slightly (to medium) curved especially towards base, sometimes very slightly helicoid; **SBs** *0.5–0.9 µm diam. {7} (1–1.8 µm total length), globose, with a short and fine, mostly invisible filum. **Paraphyses** apically uninflated to mostly slightly (rarely medium) capitate(-clavate), terminal cell *14–23 × (2.5–)3–4(–5) µm {4}, †15–22 × 2–3.3 µm {3}, lower cells *(3.5–)4.5–7(–9) × (2–)2.5–3(–4.5) µm {4}, †(2.2–)3.5–6(–9) × 1.8–2.2(–2.5) µm {2}; unbranched at upper septum. **Medullary excipulum** 15–70 µm thick, of dense textura globulosa-angularis(-intricata),

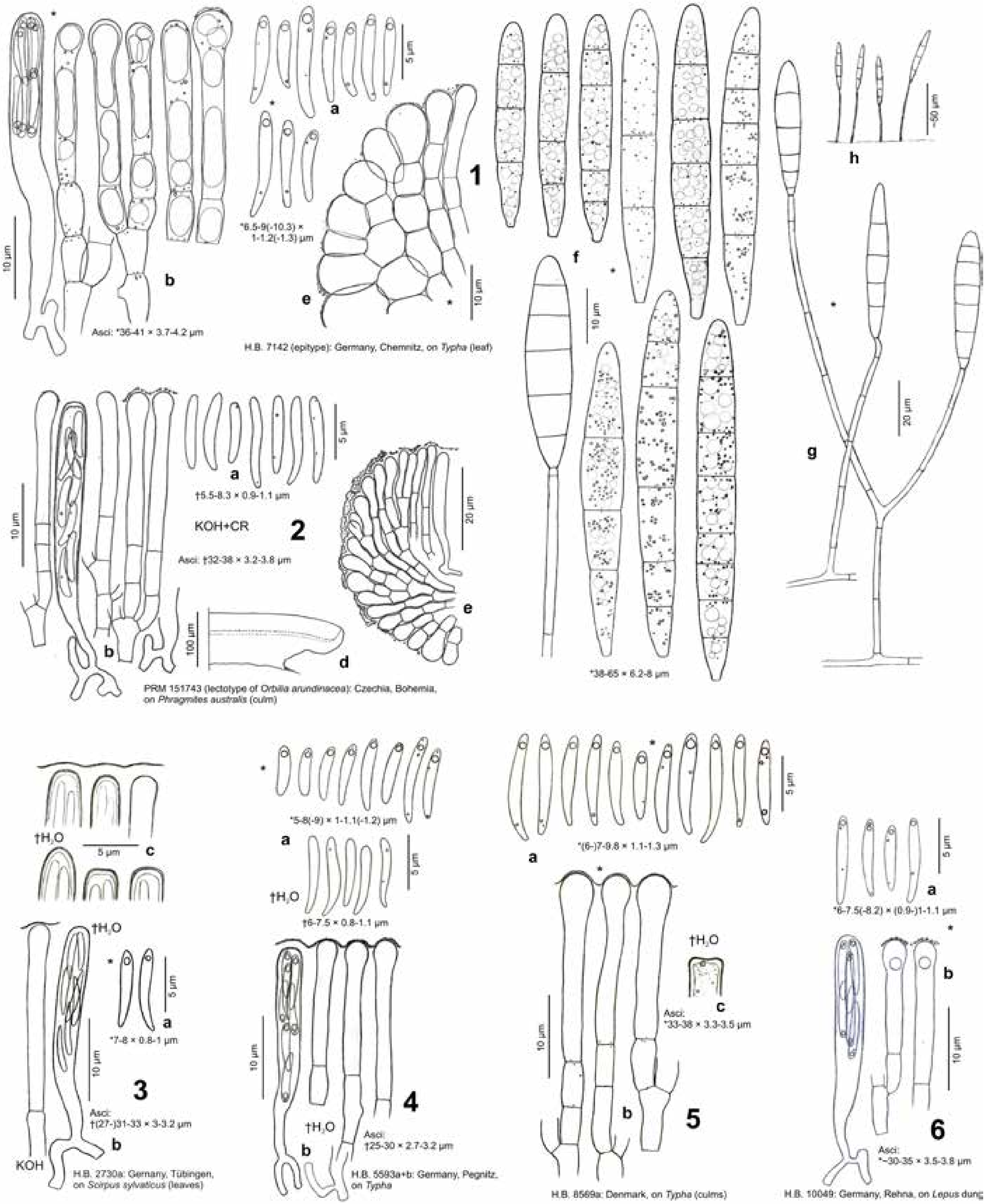


Plate 903. **1–6**: *Orbilia rectispora*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices (**3c** with 1 paraphysis apex); **d**. apothecium in median section; **e**. id., ectal excipulum at margin; **f–h**. conidia and conidiophores (all from culture; **h**: in situ on agar surface).

medium to sharply delimited from ectal excipulum. **Ectal excipulum** of thin-walled, vertically oriented t. globulosa-angularis(-prismatica) from base to margin, 25–150 µm thick near base, cells *10–30(–40) × (7–)10–25(–30) µm {4}, †(9–)13–25(–45) × (6–)10–20(–30) µm {2}, 10–20 µm thick near margin, oriented at a 45–90° angle to the surface, marginal cortical cells *7.5–16.5 {4} × 4–4.5(–6.5) {1} or 5–8(–9) µm {3}, †7–12 × (3–)4–5.5(–6.5) µm {2}; **glassy processes** absent {11}. **Anchoring hyphae** (very) abundant, */†1.5–3(–3.5) µm wide (4–5 µm near insertion), walls 0.2 µm thick {5}, forming a ± dense to very loose, slightly gelatinized t. intricata(-porrecta) 10–100 µm thick. **SCBs** not observed {3}; **VBs** (very) slightly refractive, globose to elongate {1}, or absent {3}; excipular cells near base often with some 1–3.5 µm large **LBs** in each cell {4} but also without. **Exudate** over paraphyses 0.1–0.3(–0.5) µm thick, finely granular to almost smooth, scattered to continuous, sometimes absent, loosely attached; over margin and flanks very sparse to contiuous, 0.2–2 µm thick, granular to cloddy or almost absent. — **ANAMORPH**: dactylella-like (from ascospore isolate {1} and natural substrate {4}). **Conidiophores** *85–170 {1, Europe} or 30–80 µm long {China}, 2–2.5 µm wide near base, 1.5–1.7 µm at the tip {1}, rarely branched in lower or middle part. **Conidia** phragmosporous, *37–67 × 5.3–8 µm {1, Europe}, 42–62 × 4.5–7.5 µm {1, China}, cylindric- to fusoid-clavate or often cylindric-fusoid, rounded to obtuse at the tip, (1–)3(–7)-septate {1, China}, 3–7-septate {3, Europe}.

Habitat: lying on wet ground or standing in water (above water level), on decayed previous year's leaves, leaf sheaths and culms of *Glyceria* sp. {1}, *Iris pseudacorus* {2}, *Phragmites communis* {1}, *Typha* sp. {7}, *T. angustifolia* {1}, *T. latifolia* {6}, *Scirpus silvaticus* {6}, *Sparganium erectum* {1}, dung of *Lepus europaeus* {1}, with or without blue and green algae and diatoms. **Associated**: *Acanthophiobolus helicosporus* {1}, *Cistella albidolutea* {1}, *Psilachnum lateritioalbum* {2}, *Pyrenopeziza inapiculata* {1}, *Rodwayella citrinula* {1}, *Scutellinia ?scutellata* {1}. **Desiccation tolerance**: drought-intolerant, ascospores still viable after 1 month. **Altitude**: 1–450 m a.s.l. (Europe), 2350 m (China). **Geology**: Devonian limestone & shale, Permian (Rotliegend), Buntsandstein, Keuper (gypsum & sandstone), Middle Jurassic & Cretaceous limestone, Tertiary & Quaternary marl, silt & sand; granite. **Phenology**: III–X (teleomorph).

Taxonomic remarks. *Orbilia rectispora* is characterized by narrowly cylindrical to fusoid-clavate, often slightly curved ascospores with a globose spore body somewhat below the apex, mostly only slightly capitate paraphyses with sparse exudate, and by the absence of glassy processes. For the closely related *O. xinjiangensis*, the plurivorous *O. cardui* and *O. atlantis*, and the coprophilous *O. leporina* see under these species. The lignicolous *O. longquanensis* (p. 1465) has similar conidia as *O. rectispora* but differs in yellowish apothecia and smaller, basally less tapered spores. The lignicolous *O. mammillata* (series *Dactylellina*) resembles *O. rectispora* in spore size and shape, but differs in elongate, visibly attached SBs which, however, may become subglobose with age, wider asci, presence of glassy processes, and in a dactylellina-like anamorph. *O. auricolor* (series *Arthrobotrys*) differs in longer, consistently curved spores and an arthrobotrys-like anamorph. An altimontane collection on *Carex* (Pl. 912: 3) differs from *O. rectispora*, e.g., in much longer asci and wider spores.

Variation. *O. rectispora* varies rather strongly in spore length, also in the strength of tapering and curvature of the spore bases, even within a collection. The lectotype of *O. arundinacea* differs from the other included specimens in rather abundant exudate on the margin, also it has rather thin apothecia and small basal excipular cells (†9–18 × 6–10 µm), whereas in collections with thicker apothecia, including the epitype, the cells showed often, though not always, about the double diameter. The collection on hare dung did not differ from those on monocots (Pl. 903: 6).

Type studies. Boudier (1907: 103) described ***O. rectispora*** based on a single collection (Paris, Bois d'Ecouen, base of rotten leaves of *Scirpus sylvaticus*, in July). Shortly later, Boudier (1909: 270, pl. 467) published a colour drawing showing the holotype collection. Here he mentioned to have found the species also in Forêt de Montmorency. Grelet (1948b: 106) merely copied Boudier's description. Regrettably, neither of Boudier's collections could be located at PC. In the absence of type material, Boudier's illustration (pl. 467) is considered here as **holotype** of *O. rectispora* (ICN Art. 8.1, 40.4, Turland et al. 2018).

Boudier described the species as follows: apothecia 0.3–0.6 mm diam., gregarious, flat then convex, pale greyish-yellowish, with indistinct smooth margin; asci 33–38 × 2.5–3 µm [30–32 × 3 µm when evaluated from his plate], with a truncate apex and a narrowed base with often 2 long and thin branches (bifurcate); spores cylindrical, 7–9 × 1.5 µm [7–9.5 × 1–1.4 µm according to his plate], both ends obtuse to subacute, straight or sometimes (very) slightly curved, rarely subflexuous, eguttulate; paraphyses uninflated at apex, 1–1.5 µm wide. Although the description does not provide information on the spore body and on the absence of glassy processes at the margin, the holotype appears to fit very well the present concept of the species as being already applied in Baral & Krieglsteiner (1985: 25). We here designate a recent collection from Sachsen (on *Typha*, H.B. 7142, M-0276578) as **epitype** of *Orbilia rectispora*. From this specimen a pure culture (CBS 140813) and a sequence was gained.

Velenovský (1934) described ***O. arundinacea*** for collections on various monocotyledonous plants (*Phragmites*, *Glyceria*, *Juncus*, *Sparganium*, *Acorus*, *Triticum*), with sparse, convex, white to rose or wine-yellowish apothecia of 1–5 mm diam., with an often slightly lobate margin and a large-celled excipulum, asci 25–30 × 5–6 µm, uninflated paraphyses covered by rather thick exudate, and straight, acicular spores of 6–10 µm. Except for that on *Sparganium*, Svrček examined all of them, which he considered to be conspecific with *O. cardui*. Apparently, Svrček did not compare Boudier's *Hyalinia rectispora*, the description of which much resembles *O. arundinacea*. The lectotype of *O. arundinacea* on *Phragmites* contains six mature apothecia (rehydrated 0.4–0.8 mm diam., Pl. 903: 2). It fits well the present concept of *O. rectispora*, except for the more abundant exudate on the margin. On his manuscript plate of that specimen Velenovský measured and depicted the spores much too narrow ('6–10 × 1/4 µm').

Under the name O. *arundinacea* Ellis & Ellis (1985) reported *O. rectispora* on *Typha*, with very large apothecia (1–5 mm) and narrow spores (6–10 × 0.5–1 mm). Except for spore width these data seem to be copied from Velenovský's protologue.

No material of ***O. arundinacea* var. *hypothallosa*** exists fide Svrček (1954). Velenovský separated this variety from *O. arundinacea* by an abundant subiculum and wider spores. According to his manuscript plate, the single collection was made in the valley of Zvánovice in May 1927 in a swamp on culms of *Juncus communis*. These data are lacking in the very brief protologue which contains the misprint 'in Juneo' instead of 'in Junco'. On his manuscript plate some paraphyses are figured with a row of distinct guttules (VBs), and the ascus bases as H-shaped. The question remains open whether this represents *O. rectispora* or perhaps *O. cardui* which was once found on a monocot (*Luzula*).

Misapplication. Previous authors have not distinguished between *O. rectispora*, which is adapted to monocots, and *O. cardui*, which almost exclusively growing on dicots. E. g., Svrček (1954, 1986b) considered *O. arundinacea*, a taxon here referred to synonymy with *O. rectispora*, to be (probably) conspecific with *O. cardui* (see p. 1460). Beyer (1998: 191) reported under the name *O. luzularum* a fungus on *Typha* (4 collections, all from the same locality, W. Beyer pers. comm), which is referred here to *O. rectispora*. Beyer illustrated and measured the spores unusually wide (*6–8 × 1.8–2 µm), contrary to the present examination of two of these specimens which yielded much narrower spores, although his ascus measurements (†25–32 × 3 µm) match those gained here (Pl. 903: 4).

Due to a similar size and shape of the spores, *O. rectispora* has sometimes been confused with *Hyalorbilia inflatula*. Grelet

Plate 904. **1–7**: *Orbilia rectispora*. – **2a**. *Phragmitetum* marshland with *Iris pseudacorus* (not on photo); **1a–c**, **2b–e**, **4**, **7a–b**. fresh apothecia; **1d**, **2f**. apothecia in median section; **1e**, **2h**, **6**. id., marginal ectal excipulum; **2g**. id., basal excipular cells; **1f**, **3b**, **5**, **7c**. ascospores; **3a**. ascus apices; **7e**. ascus with H-shaped base; **7d**. paraphysis; **1g**, **2i**. conidia from substrate. – Living state, except for **6** (KOH), asci in **3a**, **7e**. – **2a**: phot. T. Richter, **7a–e**: phot. E. Rubio. — **1a–g**. H.B. 8529a: Denmark, Frederiksberg, on *Typha*; **2a–i**. H.B. 8871a: Germany, Ratzeburg, on *Iris*; **3a–b**. H.B. 9554: Germany, Chemnitz, on *Typha*; **4**. H.B. 7142 (epitype): ibid., on *Typha*; **5**. H.B. 9549: Great Britain, Barnsley, on *Typha*; **6**. H.B. 2730a: Germany, Tübingen, on *Scirpus*; **7a–e**. E.R.D. 4770: Spain, Avilés, on *Typha*.

(1948b) described *Hyalinia rectispora* var. *majuscula* on the basis of several lignicolous specimens which bear the label '*Hyalinia rectispora*'. One of them shows the remark 'vidit Boudier'. Five such specimens identified by Grelet were received from PC, all of which belong to *Hyalorbilia inflatula* (see p. 345).

Liu (2006: 102) reported 10 Chinese collections under the name *O. rectispora* which grew mainly on wood and bark, a single time also on a polypore. Two of them are from Tibet and were separately desecribed in Liu et al. (2006b: 116). Based on a later reexamination of a few of them during the present study, and on molecular data gained by B. Liu, they belong to series *Pseudotripoconidium* of section *Helicoon*, either to *O. sinensis* or to *O. tenuispora* (see under these species).

Not included collections. A Chinese specimen growing on leaves of *Pandanus tectorius* was reported by Liu (2006: 62) and Liu et al. (2007a) under the name *O. cardui* (HMAS 139519). With its straight, basally slightly tapered spores (5.2–6.2 × 1.1–1.6 µm) it seems indeed to fit *O. cardui*, but it differs in much shorter asci (†21–28.2 × 3–4.2 µm), sparse exudate, and in the absence of glassy processes. *O. rectispora* resembles this collection but differs in longer and narrower spores, also *O. quercus* (series *Dactylellina*) and *O. bambusina* (incertae sedis) differ in narrower spores. No anamorph was obtained in pure culture. Based on its molecular data, this collection belongs neither to *O. rectispora* nor to *O. cardui* (see below). For the not included *O. rectispora* var. *hypothallosa* see under Type studies.

Anamorph. The dactylella-like anamorph of *O. rectispora* obtained in pure culture deviates from that of *O. cardui*, *O. cotoneastri*, and *O. crenatomarginata* in somewhat longer conidia of a more fusoid shape (Pl. 903: 1f–h). Similar conidia are found in two Chinese taxa, *Dactylella panlongana* Xing Z. Liu & K.Q. Zhang (from soil, Yunnan) and *D. nuorilangana* (from soil, Sichuan). The former has somewhat longer conidia with more septa (up to 11–12, mostly 8–9), while the latter matches the anamorph of *O. rectispora* quite well (see Pl. 5: o). The also similar *D. ramosa* Matsush. (on *Ficus* leaf, Solomon Islands) differs in slightly narrower conidia and much more branched conidiophores. *D. submersa* (Ingold) Sv. Nilsson (on *Quercus* leaves in streams, Great Britain) differs in conidia with less attenuated bases, being 0–1-septate when liberated.

Phylogeny. A sequence comprising SSU (with S1506 intron), ITS, and LSU was gained from the ex-epitype culture of *O. rectispora* (H.B. 7142). In the combined analysis in Baral et al. (2017b) *O. rectispora* clustered in a strongly supported clade with *O. cotoneastri* and *O. xinjiangensis*, which is referred to as *rectispora-beltraniae* clade here. In the present ITS and combined analyses which include more taxa (Phyls 26, 27), the *rectispora-beltraniae* clade received medium or strong support and comprises also *Dactylella panlongana*, *D. ramosa*, *D. clavata*, and *O. beltraniae*, and *O. longquanensis* and *O. senegalensis* in a sister-positioned subclade. When analysing LSU (S31), the *rectispora-beltraniae* clade was paraphyletic and included also *D. implexa*, for which only LSU was available.

Sequences also exist of the ex-type strain of *D. nuorilangana* (SSU V1–V3, S1506 intron, ITS, *MAD1*, *TEF1*, *RPB2*, mtLSU). In the ITS it differs from the epitype of *O. rectispora* by only 0.2 %, i. e., 1 nt in the ITS2 and 3 gaps or inserts. Hence, we consider both taxa as conspecific. An environmental sequence from soil of the Tibet Plateau (OTU138) differs by 1.6 % from the epitype and 1.8 % from *D. nuorilangana*. The next close match was *D. panlongana* with a 6 % distance, and the other taxa of the clade showed distances of 7–10 %. *D. rhopalota*, *O. cardui*, and *O. epilobii* clustered in a separate clade and show distinctly higher distances. No sequence of *D. submersa* exists.

In the S1506 intron, however, the distance between *D. nuorilangana* and the epitype of *O. rectispora* is 5 %. In this region *O. rectispora* differs from *O. cotoneastri* by 12.5–15 % and from other members of section *Arthrobotrys* by min. ~16 %. For OTU138 the intron is unavailable because of the used ITS1 primer. In the LSU (D1–D2) the lowest distance of *O. rectispora* was to *O. cotoneastri* (2.2 %), whereas other available strains differ by > 3.5 %.

Map 145. Known distribution of *O. rectispora* in Europe.

A sequence of the Chinese '*O. cardui*' specimen on *Pandanus* (HMAS 139519) comprises the ITS region (the S1506 intron is absent). It clustered in the phylogenetic analysis of Liu et al. (2006a) with the type of *Dactylella clavata*. In our analysis (Phyl. 26), both fall in the *rectispora-beltraniae* clade, HMAS 139519 forming with 7–8 % distance a strongly supported clade with 2 unnamed Chinese strains with incomplete ITS, the clade showing a 10–11.5 % distance to *O. rectispora*.

Ecology. *O. rectispora* appears to be restricted to monocotyledonous hosts at ponds and in marshes such as *Caricetea*, *Phragmitetea*, and *Filipendulion ulmariae*. The inhabited dead leaves and culms are soaked with the usually very near groundwater, and in swamps with standing water the apothecia occur just above the water level. Also the sample on hare dung was close to water and regularly flooded. The species was recorded from atlantic to subcontinental, supra- to thermotemperate humid Europe at planar to colline altitude. In contrast to this, the type of *D. nuorilangana* was isolated from soil below the Nuorilang water fall in a orotemperate humid, altimontane region of the Jiuzhaigou mountain range in northern Sichuan at the northeastern end of Himalaya (X.Z. Liu pers. comm.). Unpreserved and undocumented records of *O. rectispora* by Deny (2002) were also from an orotemperate region in central Europe (Vosges, on *Scirpus sylvaticus*, see also under *O. epilobii*, p. 1470). B. Liu's deviating Chinese collection on *Pandanus* is from a tropical humid (winter-dry) area in the southern part of the Hainan island which represents the southernmost part of China, and the Qinghai soil sample is from a continental subhumid tree- and shrubless grassland in a mountain steppe in eastern China.

Specimens included. **GREAT BRITAIN**: **Yorkshire**, **South Yorkshire**, 3.5 km S of Barnsley, 1.5 km SW of Worsbrough, Worsbrough Country Park, 72 m, leaves of *Typha latifolia*, 20.V.2011, H.O. Baral (H.B. 9549 ø) — **FRANCE**: **Bretagne**, **Finistère**, 7 km WSW of Concarneau, 4 km S of Fouesnant, Marais de Mousterlin, 1 m, *Typha*, 11.VII.1993, J. Deny (ø, non vid.). – **Île-de-France**, **Val d'Oise**, 18 km N of Paris, in the bogs at Bois d'Écouen, ~70 m, leaves of *Scirpus silvaticus*, VII., É. Boudier (**holotype** of *O. rectispora*, not located, doc. vid.). – ~20 km N of Paris, Forêt de Montmorency, 100–150 m, leaves of *Scirpus silvaticus*, undated, É. Boudier (Boudier 1909, ø, non vid.). — **BELGIUM**: **Vlaanderen**, **Oost-Vlaanderen**, 16 km NE of Gent, ESE of Wachtebeke, De Reepkens, 10 m, leaf of *Glyceria*, 22.V.1993, B. Declercq (B.D. 93/076, doc. vid.). – **Limburg**, 4.5 km SW of Genk, De Maten, 44 m, stem of *Typha latifolia*, 29.VI.1992, B. Declercq (B.D. 92/070, doc. vid.). — **NETHERLANDS**:

Noord-Brabant, 1.5 km SW of Boxmeer, Schraalzand, 12 m, leaves of *Typha*, 9.VIII.2014, S. Helleman (S.H. 805, doc. vid.). — **DENMARK**: **Sjælland**, Sorø, 2.5 km SW of Frederiksberg, 1.5 km WSW of Lynge, W of Topshøj, bog E of main road, leaves of *Typha latifolia*, 28.V.2007, T. Læssøe & J.H. Petersen (H.B. 8529a, T.L. 13082, S, K(M) 147811, anam. substr.). — **GERMANY**: **Mecklenburg-Vorpommern**, 26 km N of Stralsund, Hiddensee, 2.9 km S of Vitte, 2 m, leaves of *Typha latifolia*, 5.X.2018, T. Richter, vid. M. Reul (doc. vid.). – 14 km ESE of Ratzeburg, 1 km SW of Kneese, Schaalsee, Dohlen, 50 m, leaves of *Iris pseudacorus*, 14.VI.2008, T. Richter (H.B. 8871a ø, anam. substr.). – 0.5 km SE of Rehna, Radegasttal, 24 m, culms of *Sparganium erectum*, 11.VII.2015, T. Richter (H.B. 9962, anam. substr.). – 7.5 km SW of Rehna, NW of Breesen, 55 m, dung of *Lepus europaeus*, 19.III.2017, T. Richter (H.B. 10049). – **Sachsen**, 5 km E of Chemnitz, 2 km WSW of Euba, Um den Eibsee, 410 m, leaves of *Typha*, 1.VI.2002, B. Mühler (ex H.B. 7142, M-0276578, **epitype** of *O. rectispora*, anam. cult., CBS 140813; sq.: KT215289, MH878185). – 6 km NNE of Chemnitz, 1 km E of Glösa, Indianerteich, 325 m, leaves of *Typha*, 15.VI.2011, B. Mühler (H.B. 9554). – **Thüringen**, 3.3 km W of Sonneberg, 1.5 km WSW of Bettelhecken, lake S of Mürschnitzer Sack, 358 m, leaves of *T. latifolia*, 3.VIII.2018, I. Wagner (ø, anam. substr., doc. vid.). – **Baden-Württemberg**, 5 km WNW of Stuttgart, 1.2 km NE of Solitude, Sandkopf, Daimlerplatz, 426 m, leaves of *Typha*, 11.VI.1975, H.O. Baral (H.B. 273). – 2.5 km W of Tübingen, Schweigbrühl, 340 m, leaves of *Scirpus silvaticus*, 2.VI.1983, H.O. Baral (H.B. 2730a). – **Bayern**, **Oberfranken**, 8 km NE of Pegnitz, 3.5 km SW of Creußen, Craimoos, 450 m, *Typha*, 4.VIII.1992 & 8.VIII.1996 (also 30.VII.94 & 10.VIII.95), W. Beyer (H.B. 5593a/b, W. Beyer 1998 as *O. luzularum*). — **SWITZERLAND**: **Schaffhausen**, 4.5 km NW of Schaffhausen, 1.5 km SW of Thayngen, Moos, 430 m, stem of *Iris pseudacorus*, 28.VII.1988, P. Blank (P.B. 718 ?ø). — **CZECHIA**: **Central Bohemia**, 13 km SW of Praha, near Kosoř, 300 m, culm of *Phragmites australis*, VI.1927, J. Velenovský (PRM 151743, **lectotype** of *O. arundinacea*; H.B. 6060 ø). — **SERBIA**: **Vojvodina**, 24 km W of Novi Sad, 2 km N of Susek, 71 m, leaf of *Typha angustifolia*, 28.V.2018, D. Savić (FG-878, doc. vid.). — **SPAIN**: **Asturias**, Castrillón, 2.8 km WNW of Avilés, S of Salinas, 30 m, leaves of *T. latifolia*, 28.IV.2009, E. Rubio (E.R.D. 4770, doc. vid.). — **CHINA**: **Sichuan**, **Ngawa**, 34 km WSW of Jiuzhaigou, 4 km SSE of Shuzheng, Nuorilang waterfall, 2345 m, forest soil isolate, 7.VI.2003, X.F. Liu (YMF 1.00582, **holotype** of *D. nuorilangana*, conid. isol., doc. vid.; sq.: KT932073).

Not included. **CZECHIA**: **Central Bohemia**, 30 km SW of Praha, ~5 km E of Mnichovice, Zvánovice, on culms of *Juncus communis*, V.1927, J. Velenovský (**holotype** of *O. rectispora* var. *hypothallosa* [illustration], non vid.). — **CHINA**: **Qinghai**, Tibetan Plateau, 4550 m (as 4600 m), ~16 km W of lake Yaxing Co, uncultured soil isolate, Qin et al. ined. (OTU138, mol. extr., sq.: MF971189). – **Hainan**, ~65 km NE of Sanya, Diaoluoshan, 950 m, leaves of *Pandanus tectorius*, 12.XII.2003, B. Liu et al. (B.L. 261, HMAS 139519, as *O. cardui*; sq.: DQ656616, doc. vid.).

Orbilia xinjiangensis (J. Chen, L.L. Xu, B. Liu & Xing Z. Liu) E. Weber, Baral & Helleman, **comb. nov.**, MB 831502 — Pl. 905

Basionym: *Dactylella xinjiangensis* J. Chen, L.L. Xu, B. Liu & Xing Z. Liu, Fungal Diversity 26(1): 113 (2007)

Etymology: named after the geographical origin of the type, Xinjiang province (China).

Typification: China, Xinjiang, Huocheng, soil isolate, VIII.2003, X.Z. Liu (HMAS 140511, holotype; ex-type culture: CGMCC (AS) 6.0288; sq.: DQ494363).

Description: — **TELEOMORPH**: **Apothecia** moist/rehydrated (0.3–)0.4–1(–1.3) mm diam., 0.2–0.25 mm high (receptacle 0.15–0.22 mm), whitish-greyish to pale yellowish-cream, medium translucent, ± round, slightly lobate when large, subgregarious; disc flat to medium convex, margin distinct, thin, 5 µm protruding, smooth; broadly sessile, superficial; dry flat, light ochraceous(-cream). **Asci** †(40–)45–55(–60) × 4–5 µm, 8-spored, spores †2-seriate, lower spores inverted; **apex** (†) medium truncate (not indented, laterally not inflated); **base** with short to long, thin to thick, ± flexuous stalk, L-, h- or H-shaped. **Ascospores** *6–9(–10)((–12.2)) × (1.4–)1.6–2(–2.3) µm, †7–9(–10) × 1.8–2(–2.2) µm, narrowly (ellipsoid-)clavate, apex obtuse, base medium to strongly attenuated, often tail-like, straight to (very) slightly curved; **SBs** *0.6–0.7 µm diam., globose, partly ± eccentric, attachment invisible (total length 1.1–1.5 µm). **Paraphyses** apically slightly to medium (clavate-)capitate, terminal cell †13–20 × 2–3.3(–4) µm, lower cells †9–12 × 1.5–2(–2.5) µm; sometimes branched at upper septum. **Medullary excipulum** 40–70 µm thick, of dense textura intricata with inflated cells, indistinctly or sharply delimited from ectal excipulum. **Ectal excipulum** of thin-walled, irregularly to vertically oriented t. globulosa-angularis from base to margin, 120–140 µm thick near base, cells *8–19 × 8–14 µm; 40–110 µm thick at lower flanks, cells *8–13 × 6–11 µm; 25–20 µm thick near margin, oriented at an 80–90° angle to the surface, marginal cortical cells *(6–)8–11(–13) × 4.5–7(–8) µm; **glassy processes** absent. **Anchoring hyphae** medium abundant, †1.7–3.5 µm wide, walls 0.2 µm thick. **SCBs** not observed; **VBs** absent. **Exudate** over paraphyses, margin and flanks 0.2–0.5(–1.5) µm thick, granular-cloddy, hyaline to pale yellowish, firmly attached. **— ANAMORPH**: dactylella-like (from soil isolate {1} and natural substrate {1}, connection proved by DNA). **Conidiophores** 60–132 µm long, 2.5–4.5 µm wide at base, 1–2 µm at apex, unbranched. **Conidia** unbranched, straight, ellipsoid-clavate, ± obtuse at apex, *(39.5–)45–54(–59) × (7–)8–11(–12) µm, ((3–))(5–)7-septate {2}. **Chlamydospores** often produced abundantly in culture.

Habitat: 15 cm thick cut stump of *Ulmus* sp. {1}, 10 cm above the ground, on detaching, slightly undecayed bark {1} (bast), on inner surface and on edge. **Associated**: none observed. **Desiccation tolerance**: after ~3 weeks excipular cells and a few ascospores viable. **Altitude**: 12–700 m a.s.l. **Geology**: Netherlands: Pleistocene fluviatile deposits. **Phenology**: XII (teleomorph).

Taxonomic remarks. *Orbilia xinjiangensis* resembles *O. zhongdianensis*, particularly in the shape of the basally tapered ascospores which contain near the apex a small, globose, partly eccentrical spore body. It differs in distinctly larger spores and larger conidia with more septa. In gross morphology the species is difficult to distinguish from other taxa of this group, such as *O. rectispora*, *O. cardui*, and *O. leporina* (including the type of *O. luteorubella* f. *charticola*). *O. cardui* differs in glassy processes at the margin and smaller, basally often untapered spores which contain larger SBs, and the other two in predominantly curved, partly narrower spores.

On the cut upper edge of bark a small population of immature apothecia occurred (Pl. 905: 1d) which undoubtedly belong to the same species. They differed mainly in a more intense, yellowish-cream colour when fresh, probably because they were more exposed to light.

Anamorph. Conidial size and shape in the sample from the Netherlands (*40–59 × 7.5–11.5 µm, mainly 5–7-septate, Pl. 905: 1g) fit quite well the type of *Dactylella xinjiangensis* (*39.5–54 × 7–12 µm, mainly 7-septate, Pl. 905: 2). The conidia were observed by S. Helleman on the natural substrate, but only in association with those immature apothecia growing on the edge of bark. On the plate of *D. xinjiangensis* in Chen et al. (2007b) we believe that fig. 18C and F have the same scale as E, though bearing the shorter scale of B and D which is only 83 % of that in E. Therefore, we have reduced in Pl. 905: 2 the image size of C and F accordingly.

Phylogeny. Sequences were available for the ex-type strain from soil (ITS, presence of S1506 intron unclear because of the used ITS1 primer) and for the *Ulmus* specimen (from apothecia; SSU without S1506 intron, ITS, LSU). In the ITS region the ex-type strain fully matches the collection from the Netherlands by only 1 gap difference. Strain CBS 232.51 under the unpublished name *Dactylella horrida* (Vu et al. 2019: suppl. 1) or *Dactylella* sp. (GenBank) differs by 2 nt and 1 gap (0.4 %). The minimum distance to other species is 6.3 % to *O. beltraniae*, 7 % to *D. clavata*, and 8–9 % to *O. cotoneastri*, *D. panlongana*, *D. ramosa*, and *O. rectispora*. Although morphologically similar to *O. xinjiangensis*, *O. zhongdianensis*

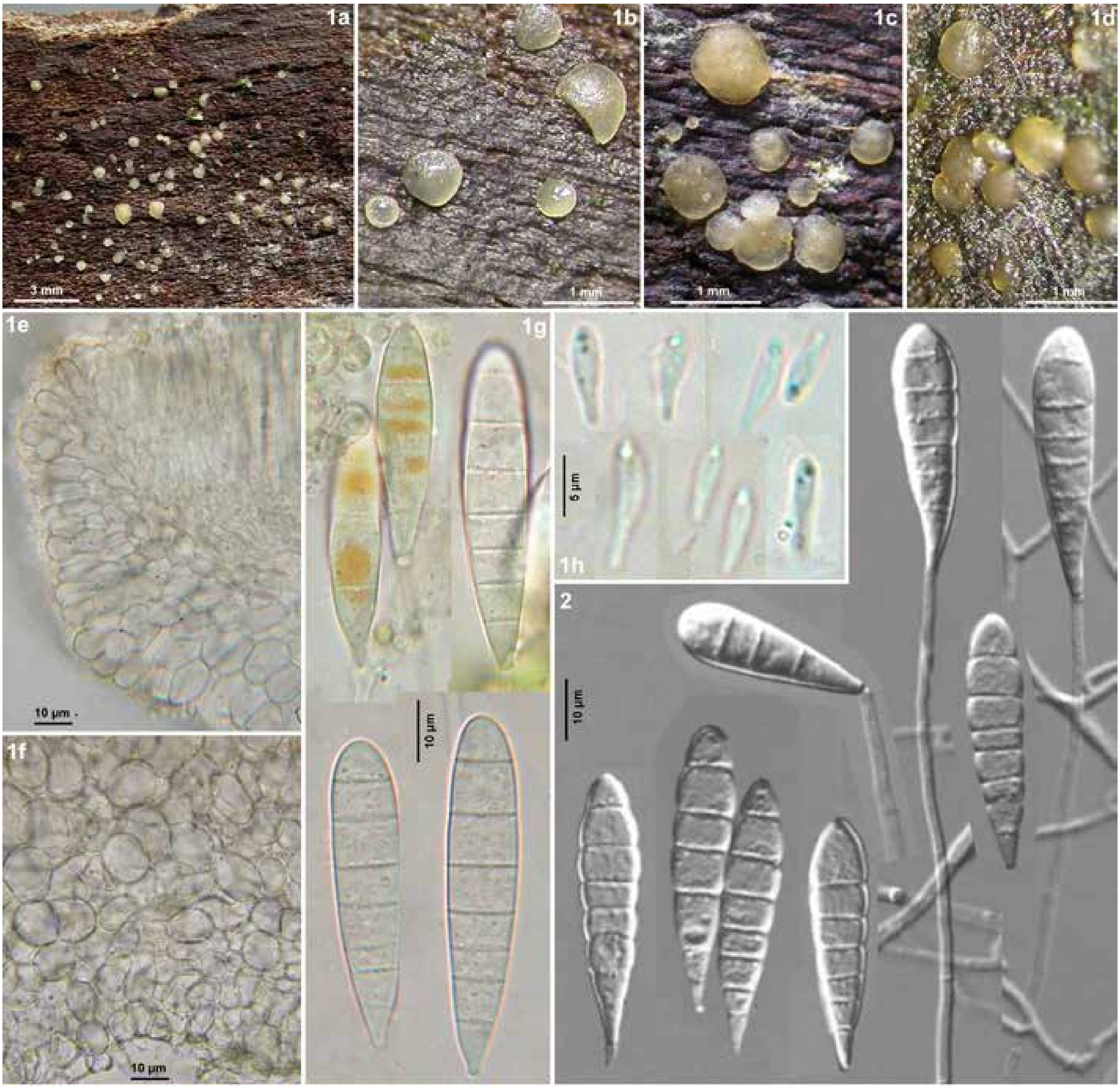


Plate 905. **1–2**: *Orbilia xinjiangensis*. – **1a**. inner surface of *Ulmus* bark with rehydrated apothecia; **1b–d**. fresh or rehydrated apothecia; **1e**. marginal ectal excipulum in median section; **1f**. id., ectal excipulum at base; **1h**. ascospores; **1g**, **2**. conidia and conidiophores (**1g** from substrate, **2** from soil isolate). – Living state. – **1b**, **d–e**, **g–h**: phot. S. Helleman, **2**: from Chen et al. (2007b). — **1a–h**. H.B. 9646: Netherlands, Nijmegen, on *Ulmus*; **2**. HMAS 140511 (holotype): China, Xinjiang, from soil.

and *O. epilobii* clustered in the *cardui-rhopalota* clade by showing a high distance to *O. xinjiangensis*. When analysing LSU, *O. xinjiangensis* shows to *D. implexa* and *D. clavata* a distance of 3.2–3.4 % in the overlapping region of D1–D2 (533 nt), and 5.3 % (584 nt) to *O. zhongdianensis*. *O. xinjiangensis* clustered in the *rectispora-beltraniae* clade (Phyls 25–27).

Ecology. Apothecia of *O. xinjiangensis* were found on slightly decayed, hygric bark of an *Ulmus* stump in an open park vegetation in subatlantic, cold-temperate humid northwestern Europe. The type was isolated from soil at the continental, cold-temperate (sub)humid northern foothills of the Tian Shan mountain range in eastern Xinjiang not far from the border to Kazakhstan in central Asia.

Specimens included. **CHINA**: **Xinjiang**, **Ili Kazakh**, Tian Shan Mts., 18 km NNW of Huocheng, Qingshuihezhen, 700 m, soil isolate, VIII.2003, X.Z. Liu (HMAS 140511, **holotype**; CGMCC (AS) 6.0288 ex-type culture [erron. as 6.0287 in Chen et al. 2007b: 113, J. Chen pers. comm.], conid. isol., doc. vid.; sq.: DQ494363). — **NETHERLANDS**: **Gelderland**, 5.5 km SW of Nijmegen, W of Meijhorst, Staddijkpark, 12 m, stump of *Ulmus*, on bark, 18.XII.2011, S. Helleman (H.B. 9646, anam. substr.; sq.: KT222435). — **GREAT BRITAIN**: unlocalized, 1948, collector unknown (CBS 232.51, IMI 24480, as *Dactylella horrida*, see Vu et al. 2019, sq.: MH856835, MH868351).

Orbilia cardui Velen., Monogr. Discom. Bohem.: 98, pl. 11 fig. 24 (1934) — Pls 906–907, Map 146

= *Orbilia pellucida* Velen., Monogr. Discom. Bohem.: 96, pl. 11, fig. 12 (1934)
  ≡ *Orbilia luteorubella* f. *pellucida* (Velen.) Svrček, Acta Mus. Natl. Pragae, 10B (1): 12 (1954)
= *Orbilia luzularum* Velen., Monogr. Discom. Bohem.: 99 (1934)
= *Orbilia cardui* var. *farfarae* Velen., Monogr. Discom. Bohem.: 401 (1934)
?= *Orbilia cardui* var. *verbasci* Velen., Monogr. Discom. Bohem.: 401 (1934)

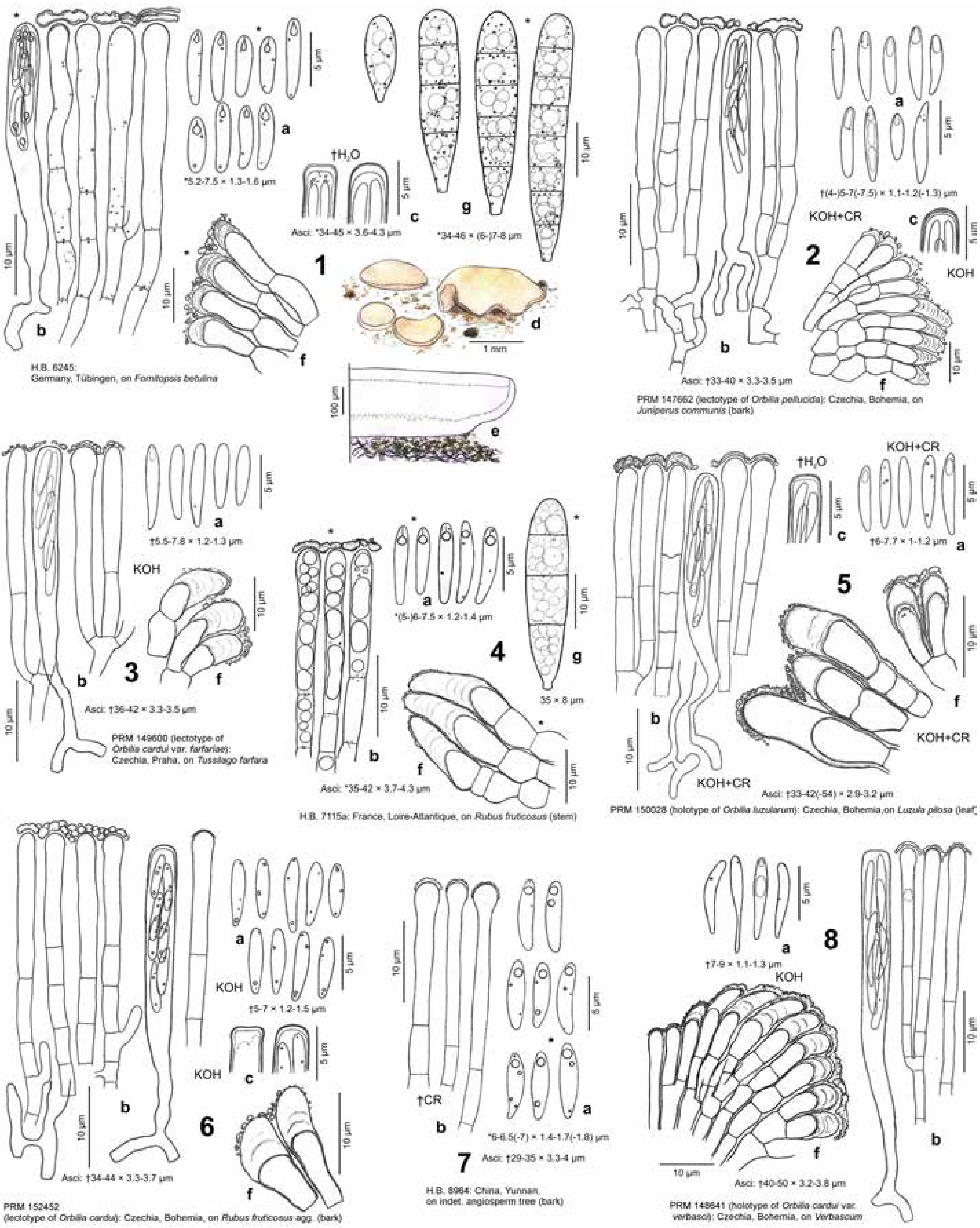


Plate 906. **1–6**: *Orbilia cardui*; **7–8**: *O.* cf. *cardui*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. fresh apothecia; **e**. apothecia in median section; **f**. id., marginal ectal excipulum, cortical cells with glassy processes; **g**. conidia from substrate.

Etymology: *cardui*, *farfarae*, *luzularum*, *verbasci*: referring to the host; *pellucida*: named after the translucent apothecia.

Typification: Czechia, Menčice, stem of *Rubus fruticosus*, VII.1929, J. Velenovský (PRM 152452, lectotype of ***Orbilia cardui***, designated by Svrček 1954: 11); Germany, Chemnitz, stem of *Angelica sylvestris*, 15.VI.2014, B. Mühler (ex H.B. 9891, M-0291778, epitype, designated here, MBT385133; sq.: KT222402). — Czechia, Motol, (?)rhizomes of *Tussilago farfara*, 11.VI.1924, J. Velenovský (PRM 149600, lectotype of ***O. cardui* var**. ***farfarae***, designated here, MBT382143). — Czechia, Černošice, stem of *Verbascum*, VI.1926, F. Fechtner (PRM 148641, holotype of ***O. cardui* var**. ***verbasci***). —

Czechia, Mnichovice, twig of *Juniperus communis*, IX.1925, J. Velenovský (PRM 147662, lectotype of ***O. pellucida***, designated by Svrček 1954: 18). — Czechia, Hrusice, leaves of *Luzula pilosa*, 18.VIII.1924, J. Velenovský (PRM 150028, holotype of ***O. luzularum***).

Misinterpretation of *O. cardui*: Beyer (1998: 191, as *O. luzularum*), = *O. rectispora*; Liu et al. (2006: 62, 2007a), = *O.* aff. *rectispora*; Raitviir (1991: 359 p.p.), = *O. cookei*; Svrček (1954: 11 p.p.), = *O. rectispora* & *O. oxyspora*.

Description: — **TELEOMORPH**: **Apothecia** moist/rehydrated (0.3–)0.5–1.5(–2.3) mm diam., 0.17–0.35(–0.5) mm high (receptacle 0.18–0.2 → 0.09–0.13 mm), whitish to very pale (yellowish-) cream(-isabelline), slightly to medium translucent, round, slightly lobate when large, scattered to subgregarious; disc flat to slightly (to medium) convex, margin distinct, not or slightly protruding, smooth or often rough to finely crenulate; broadly sessile, superficial; dry light yellowish-ochraceous(-orange). **Asci** *34–45 × 3.6–4.3 µm {2}, †31–44((–54)) × (3–)3.3–3.5(–3.7) µm {6}, 8-spored, spores *3–5-seriate, (2–)3–4 lower spores inverted {3} (sometimes mixed), pars sporifera *12.5–21 µm long (†17–20 µm); **apex** (†) slightly to medium (rarely strongly) truncate (rarely very slightly indented and laterally inflated); **base** mostly with short to long, thin, flexuous stalk, L-, Y-, h- or H-shaped. **Ascospores** *(5–)5.5–7.5 × (1.2–)1.3–1.5(–1.7) µm {5}, †(4–)5–7.3(–7.8) × (1–)1.2–1.3(–1.5) µm {4}, subcylindric to sometimes fusoid-clavate, apex rounded to obtuse, base not or slightly to medium attenuated, straight to very slightly curved; **SBs** *1.2–1.7 × 0.4–0.9 µm {3}, globose to tear-shaped, apically narrowed to a (very) short filum. **Paraphyses** apically uninflated or (very) slightly (exceptionally medium) clavate-capitate, terminal cell *16–21(–26) × 2.3–3.5 µm {2}, †(10–)13–20(–24) × (1.7–)2–3.4 µm {4}, lower cells *4.5–9 × 1.8–2.5(–2.8) µm {2}, †(2.5–)4–8(–10) × 1.6–2.2(–2.7) µm {3}; rarely branched at upper septum. **Medullary excipulum** 30–100(–300) µm thick, of dense textura globulosa-angularis(-prismatica), distinctly delimited from ectal excipulum mainly at flanks by a horizontal t. prismatica-porrecta, towards hymenium of a sharply delimited, 20–30 µm thick horizontal t. porrecta-intricata. **Ectal excipulum** of thin-walled, vertically oriented t. globulosa-prismatica from base to margin, 70–150 µm thick near base, cells *13–31 × 11–23 µm {2}; 50–60 µm thick at lower flanks, cells †6–18 × 5–11 µm {2}; 15–30(–60) µm thick near margin, oriented at a 40–90° angle to the surface, marginal cortical cells */†(5–)6–13(–15) × 3–7 µm {7}; **glassy processes** 2–15 × (3–)4–5(–6) µm {8}, or only 1–2 µm long {2}, low- to highly-refractive, stratified, ± coherent, straight to ± outwards curved. **Anchoring hyphae** ± abundant, */†1.5–4 µm wide (at insertion up to 4 µm), walls (0.15–)0.2(–0.3) µm thick {5}, forming a 15–35 µm thick, loose or dense, partly slightly gelatinized t. intricata(-porrecta). **SCBs** not observed; **VBs** absent {2} or slightly to medium or sometimes strongly refractive, hyaline, multiguttulate to elongate {2}. **Exudate** over paraphyses (0.2–)0.5–2(–3) µm thick, granular-cloddy, hyaline, firmly to loosely attached, over margin and flanks dense or scattered granular clods. — **ANAMORPH**: dactylella-like (presumed, from natural substrate {3}). **Conidiophores** not seen. **Conidia** unbranched, straight, (fusoid-)ellipsoid- to cylindric-clavate, rounded to obtuse at apex, *34–46 × (5–)6–8 µm, (3–)5–7-septate {3}.

Habitat: lying on ± moist ground or at base of standing stems, corticated, 5–8 mm thick twigs of *Juniperus communis* {1}, *Salix* sp. {1}, *Suaeda vera* {1}, on very undecayed to medium decayed bark {3} (periderm) or wood {1}; stems of *Angelica sylvestris* {1}, ?*Asteraceae* {1}, *Rubus fruticosus* agg. {2}, *Thalictrum flavum* {1}, rhizomes of *Tussilago farfara* {1}, leaves of *Luzula pilosa* {1}, *L. sylvatica* {1}; on upper side of basidiocarp of *Fomitopsis betulina* {1}; green algae absent or sparse. **Associated**: *Calycellina luzulae* {1}, *Mollisia* sp. {1}, *Orbilia sarraziniana* {1}, *Pirottaea* sp. {1}, *Pyrenopeziza* ?*atrata* {1}. **Desiccation tolerance**: nearly fully viable after 1 day dry (or almost all cells dead), after 1 week only ascospores viable, also conidia survive drying for at least 1 day. **Altitude**: 2–460 m a.s.l. (central Europe), 30 m (central Russia). **Geology**: Cambrian-Ordovician silt, shale & sandstone, Permian (Rotliegend), Lower Jurassic shale, Cretaceous flysch, Quaternary loess and marine sand; biotite-amphibolite & quartz diorite. **Phenology**: III, VI–XI.

Taxonomic remarks. *Orbilia cardui* resembles *O. rectispora* in its rather large, whitish-cream apothecia and narrowly cylindrical ascospores. Besides different hosts (dicots vs. monocots), *O. cardui* differs in more straight, somewhat shorter ascospores, but particularly in the quite consistent presence of short glassy processes at the margin and ± thick exudate over paraphyses and glassy processes, also in thicker apothecia due to a more bulky medullary excipulum. Their anamorphs slightly deviate in conidial shape (see below). For the similar *O. atlantis*, *O. cocois*, *O. cotoneastri*, *O. epilobii*, *O. leporina*, *O. xinjiangensis*, and *O. zhongdianensis* see there.

O. quercus (series *Dactylellina*) differs from *O. cardui* in smaller asci and spores, absent glassy processes, and a dactylellina-like anamorph. Likewise, species of series *Drechslerella* (*O. polybrocha*, *O. flavovacuolata*) may have spores similar to *O. cardui*, but differ in eccentrical, often rod-shaped SBs, also in short stipitate apothecia with often brown or yellow pigmentation. With herbarium material, however, most of these characters become very obscure and delimitation from *O. cardui* problematic.

O. epipora, *O. cylindrospora* (section *Orbilia*), and some species of sections *Aurantiorubrae* (*O. pseudocylindrospora*, *O. caulicola*) and *Helicoon* (*O. yuanensis*) differ in the absence of glassy processes at the margin, and (as far as known) in the anamorph having narrower or longer conidia. The spores of *O. epipora* are distinctly smaller than in *O. cardui*. *O. cylindrospora* and *O. pseudocylindrospora* differ in more desiccation-tolerant apothecia, the former also in spores with SBs positioned at the very apex. *O. yuanensis* much resembles *O. cardui* in the spores, but differs in somewhat longer and narrower SBs, paraphyses with strongly refractive VBs, and much longer conidia. *O. caulicola* differs in more tapered spore apices and smaller, pale reddish, desiccation-tolerant apothecia.

The caulicolous *O. rosella* (section *Aurantiorubrae*) also resembles *O. cardui*, e.g., in the crenulate margin. It differs in marginal cells oriented at a rather low angle to the surface by forming hair-like structures, also in capitate paraphyses and broader spores. The apothecia deviate by their reddish colour and are possibly desiccation-tolerant. The unclear *O. rubella* s. Beyer (1994, 1998) on *Rumex* resembles in the spores *O. cardui* or rather *O. rectispora* but was described with up to 50 × 5 µm large ?thin-walled or perhaps glassy hairs.

No clear microscopical differences between the lectotypes of *O. pellucida* (on *Juniperus*, Pl. 906: 2) and *O. cardui* (on *Rubus*, Pl. 906: 6) could be detected, according to the present reexamination, therefore, they are treated here as synonymous. Velenovský (1934) separated them mainly because of the ligneous vs. herbaceous substrate, and this seems also to have been one reason for Svrček (1954) to keep them apart. Yet, Svrček believed that *O. pellucida* was very closely related to *O. luteorubella*, from which it differed in apically less inflated paraphyses covered by a thick exudate ('epithecium'). For this reason he regarded it as a form of *O. luteorubella*. Svrček actually included a specimen in his concept of f. *pellucida* which is referred here to *O. sarraziniana* (see under *O. carpathica*, p. 1664). The characteristics which distinguish *O. cardui* (= *O. pellucida*) from *O. luteorubella* and *O. sarraziniana* are: (1) rather short SBs which are (2) located in the more obtuse spore end, (3) less truncate ascus apices (never indented), and (4) glassy caps on the marginal cells. Both Velenovský and Svrček were unaware of the very different spore bodies in these two groups of taxa.

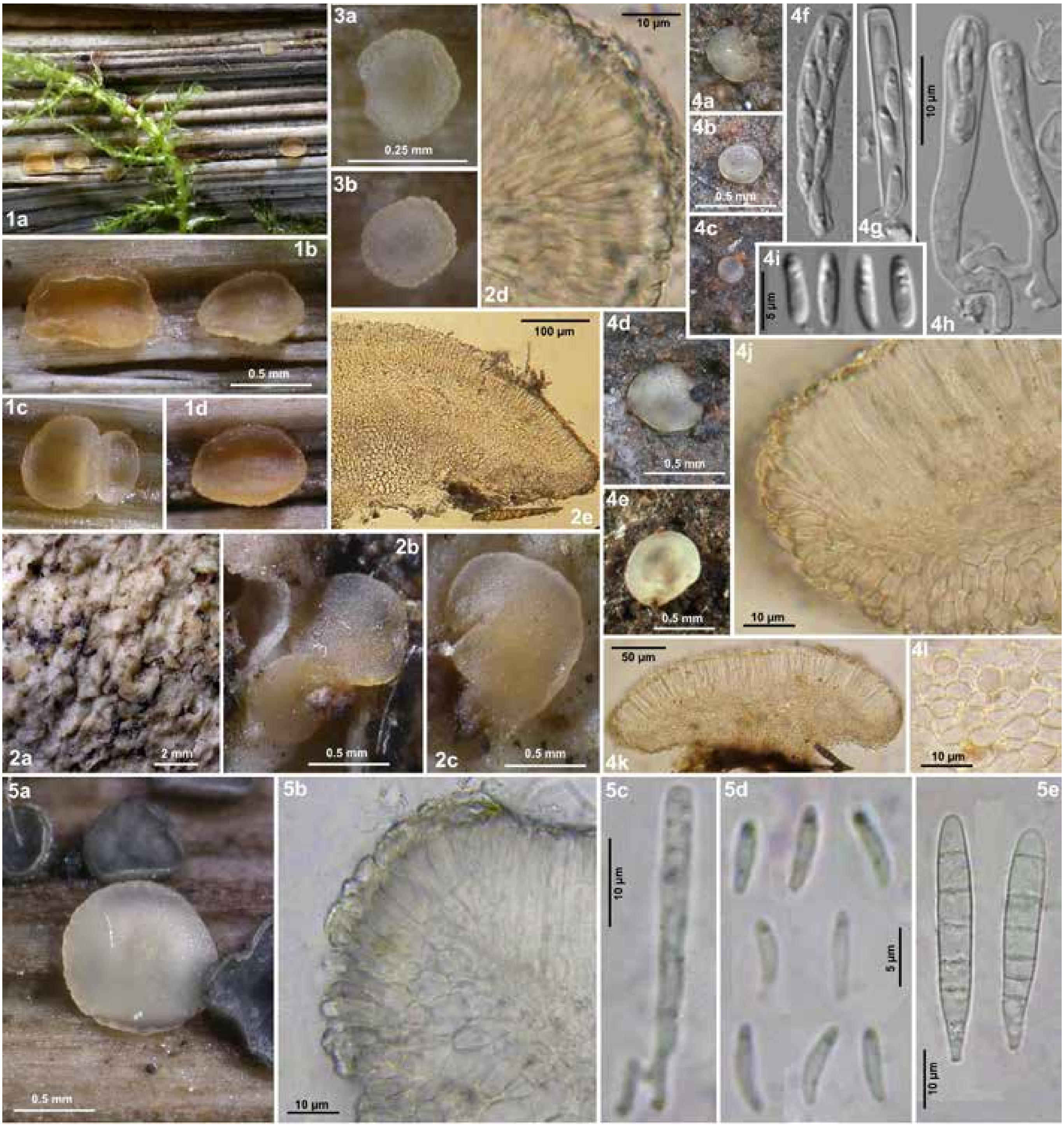


Plate 907. **1–3**, **5**: *Orbilia cardui*; **4**: *O.* cf. *cardui*. – **4e**, **5a**. fresh apothecium; **1a–d**, **2a–c**, **3a–b**, **4a–d**. rehydrated apothecia (**1–3**: after 5–31 years, **4**: after 2 months); **2e**, **4k**. apothecia in median section; **2d**, **4j**, **5b**. id., marginal ectal excipulum; **4l**. margin in external view; **4f–h**, **5c**. asci; **4i**, **5d**. ascospores; **5e**. conidia from substrate. – Living state, except for **2d–e** (in KOH), **4j–l**, **5c** (in H_2O), asci in **4f–g**, **4h** right ascus. – **4e–i**: phot. H.Y. Su (DIC). — **1a–d**. H.B. 7115a: France, Loire-Atlantique, on *Rubus*; **2a–e**. H.B. 6245: Germany, Tübingen, on *Fomitopsis*; **3a–b**. H.B. 8721b: Russia, Yamalia, on *Salix*; **4a–n**. H.B. 8964: China, Yunnan, on indet. woody angiosperm; **5a–e**. H.B. 9891 (epitype): Germany, Chemnitz, on *Angelica*.

Svrček (1954) accepted *O. cardui* in a rather broad sense, including Velenovský's *O. arundinacea* (= *O. rectispora*), *O. lupini* (?= *O. oxyspora*), *O. sambuci* (= *O. oxyspora*), and *O. luzularum* (= *O. cardui*), but excluded *O. pellucida*. Also Raitviir (1991: 359) accepted *O. cardui* in a broad sense by including *Peziza exigua* Cooke. For the latter species, which we consider to be distant from *O. cardui* but very close to *O. caulicola* (series *Commatoideae*), we here establish the new name *O. cookei* (see p. 807). We here consider *O. pellucida*, *O. cardui*, and *O. luzularum* as belonging to a single species, and adopt the more often used name *O. cardui*, which herewith receives priority over the other two (ICN Art. 11.5).

Variation. *O. cardui* varies somewhat in the ascospore bases from slightly to strongly tapered, though often within a collection, whereas spore size is rather consistent. Only three collections were documented in the living state (Pls 906: 1, 4; 907: 5): they differ in SB shape (lower part tear-shaped vs. globose) and in the absence vs. presence of VBs in the paraphyses. Possibly, the visibility of a short filum is characteristic for SBs of *O. cardui*. In two collections (Luxembourg, H.B. 9901; France, J.P.P. 27121) glassy processes were only 1–2 µm long and, therefore, easily overlooked. Yet, H.B. 9901 fully concurs in the ITS region with H.B. 9891 with 4–9 µm long processes, hence, the length of these processes is taxonomically unimportant (see below).

Type studies. Velenovský (1934: 98) described ***O. cardui*** from herbaceous stems of various plant genera (*Carduus*, *Cirsium*, *Sarothamnus*, *Rubus*, *Tussilago*, *Galeopsis*, *Verbascum*, *Papaver*), with 'mainly wax-golden but also rose, brick-coloured or white' apothecia. The indicated wide range in spore length (6–12 µm) is due to variation among the included collections but apparently also due to a measuring error. In his 'Additamenta' (Velenovský 1934: 401) he reduced his concept of *O. cardui* to specimens with 4–7 × 1–2 µm large spores growing on *Carduus*, *Cirsium*, *Sarothamnus*, *Rubus*, and *Caltha*, by excluding three varieties: *O. cardui* var. *rutae* on *Ruta graveolens* (spores 3–5 µm, see p. 1684), *O. cardui* var. *farfarae* on *Tussilago farfara* and *Galeopsis* (spores 4–5 × 3 µm, but on manuscript plate ~1–1.5 µm wide), and *O. cardui* var. *verbasci* on *Verbascum* (spores 6–10 × 2 µm).

Svrček (1954: 11) designated as lectotype of *O. cardui* the collection on stem of *Rubus* which contains about 10 mature apothecia (the other syntype collections were stated by Svrček to be immature and were not reexamined here). In the reexamined lectotype (Pl. 906: 6) the rehydrated light yellowish(-ochraceous) apothecia measure 0.7–1.5 mm diam. and possess medium refractive glassy caps 2–6 × 4–5.7 µm on the marginal excipular cells. Ascospore length was found to concur exactly with Svrček's data, whereas width was larger (Tab. 38). Svrček described the paraphyses as apically 'gradually clavate', a character which he used in his key, although they are 'not inflated' in Velenovský's and hardly so in the present study.

A specimen from Germany (Chemnitz, on *Angelica*, ex H.B. 9891, M-0291778, Pl. 907: 5, spores *(5–)6–7.5 × 1.4–1.7 µm), from which a sequence was gained, is designated here as **epitype** of *O. cardui*.

The lectotype of ***O. cardui* var. *farfarae*** (on rhizomes of *Tussilago farfara*) was stated to be empty by Svrček (1954). A single mature apothecium could be discovered, however. Velenovský's very brief diagnosis is quite incorrect: the short-cylindrical spores ('4–5 × 3 µm') actually have a width of only ~1–1.3 µm when estimated from his manuscript plate. The present reexamination (Pl. 906: 3) revealed distinctly longer spores which are partly attenuated at the base. The microscopic characters, including the glassy caps at the margin, fit well the present concept of *O. cardui*. Velenovský (1934 and manuscript plate) reported this variety also from *Galeopsis versicolor* and stated a 'clear identity' with *Pezizella orbilioides* Feltgen (see p. 1681). The '*Galeopsis*' sample (PRM 824943) was not mentioned by Svrček (1954) and is found to be empty here; the substrate is likely a twig of a broad-leaved tree. Svrček (1954) incorrectly referred to the specimen on *Tussilago* as 'holotype'. We here designate the collection on *Tussilago farfara* (PRM 149600) as **lectotype** of *O. cardui* var. *farfarae*.

Velenovský (1932) separated ***O. cardui* var. *verbasci*** from typical *O. cardui* by longer, often slightly curved, basally more tapered spores (8–10 µm; in manuscript plate 5–8–10 × 0.9–1.2 µm, width estimated from drawing). His illustration of the single collection well corresponds in the spores with the present reexamination of the holotype (Pl. 906: 8). Together with milky-white apothecia in the fresh state and a partly very finely crenulate margin due to the here observed glassy processes, the taxon might be conspecific with *O. oxyspora*. Since the marginal cells are oriented at a high angle to the surface and the spores rather short and only slightly curved, we doubt such identity. *O. cardui* var. *verbasci* could perhaps be a synonym of *O. fimicola*, if that taxon is considered to be different from *O. oxyspora*. Svrček (1954) saw a high conformity between *O. cardui* var. *verbasci* and *O. cardui*, but mentioned its longer spores as deviating.

Three localities and at least four collections are cited in the protologue of ***O. pellucida*** (on 'wood of broad-leaved trees' and *Juniperus*). Among Velenovský's manuscript plates, the oldest (VII.1924, Mnichovice, on decayed trunk of *Malus*) is entitled '*Orbilia pellucida* sp. n.' and is said to have translucent, hyaline, umbilicate apothecia 1–2 mm diam., and unstalked, non-furcate asci. In IX.1933 he added the remark '= *cyathea*' (= *Hyalorbilia inflatula*) to this plate, and actually his illustration shows a *Hyalorbilia*, possibly *H. inflatula*. Velenovský (1934) did not clearly cite this *Malus* collection under *O. cyathea*, but he also did not include its characters in the protologue of *O. pellucida* for which he reports the apothecia as '0.3–1 mm' and the asci 'with a thin bifurcate stalk'. Obviously Velenovský decided to use the name *pellucida* for a different species, and for this reason Svrček (1954: 18) designated the *Juniperus* specimen (as *Orbilia juniperina* [*nom. ined.*] on Velenovský's manuscript plate) among the remaining collections as lectotype.

The rather abundant apothecia in this lectotype (Pl. 906: 2) grew on very undecayed periderm of an 8 mm thick branch (Svrček: 'on rotten branch') of an old trunk of *Juniperus* in a moist and shady young spruce forest, according to the manuscript plate. Svrček gave smaller values for the spore width (5.5–7 × 0.5–0.8 µm, but 0.8–1 µm on the lectotype label) than measured here. Velenovský (1934) described the apothecia of *O. pellucida* as 'wine-red, violaceous, rarely uncoloured'. The latter statement obviously refers to the sample on *Juniperus*, since his manuscript plate reads 'apothecia gregarious, 0.5–1 mm diam., ..., glassy-translucent, white'. Later, Velenovský (1947: 104) referred to *O. pellucida* a collection on *Salix aurita* with red apothecia. Svrček obviously designated as lectotype of *O. pellucida* a hyaline fungus which Velenovský mentioned in the protologue as exceptional. Since Svrček did not cite further authentic material of *O. pellucida* we assume that none existed. Svrček's synonymisation of *O. silvatica* with *O. pellucida* is doubtful (see under *O. rosea*, p. 965). A possible identity of *O. pellucida* with *D. rhopalota* is considered under that species.

The holotype of ***O. luzularum*** contained only two mature apothecia (Pl. 906: 5). The asci are much longer than indicated by Velenovský and Svrček, and the marginal cortical cells bear 3–10 × 5–6 µm large, high-refractive glassy processes. Svrček's synonymisation with *O. cardui* is confirmed here. The monocot substrate and the rather narrow spores would suggest identity with *O. rectispora*, but glassy processes have never been seen in that species.

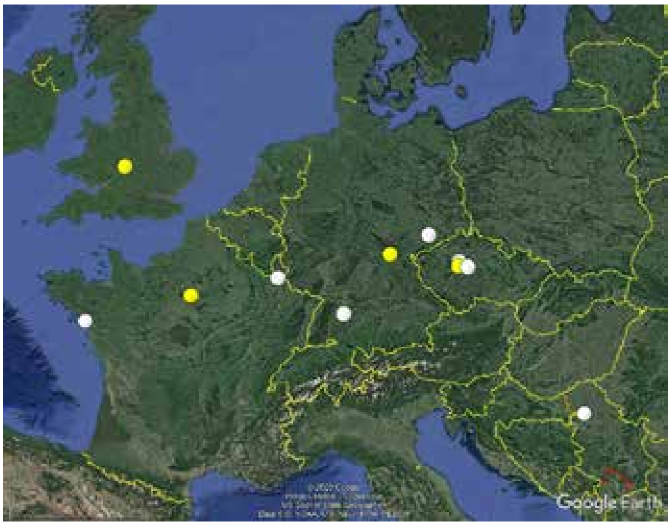
Not included collections. In a French sample on *Pinus* cone, glassy processes were very distinct, but we did not include it in the description because of larger conidia (see below). Also we did not include a German sample on *Solidago* with short glassy processes because it deviates by longer spores (*7–10 × 1.3–1.5 µm) and larger conidia (see below). An immature sample from altimontane central Asia (Kyrgyzstan) seemed to be *O. cardui* because of its short glassy processes, but the single observed conidium appears to exclude this species (see below).

In a Chinese sample (Pls 906: 7; 907: 4) the spores are slightly wider and more fusoid, and glassy processes are absent; the globose SBs are without visible filum and slightly eccentrical. This collection resembles a specimen from dung treated as an unclear taxon (*Orbilia* sp. H.B. 8749, incertae sedis, Pls 1023–1024), whereas a Chinese specimen on *Bambusa* (*Orbilia* sp. H.B. 8963, incertae sedis, Pls 1021–1022) differs in distinctly narrower spores. In the two latter specimens the SBs tend to be slightly elongated and more eccentrical, however.

No documentation of the British sample under the name *O. luzularum* reported by Clark (1980a: 79) was seen. For the not included *O. cardui* var. *verbasci* see under Type studies.

Anamorph. Ellipsoid- to cylindric-clavate conidia were observed in three of the included specimens of *O. cardui* (Pls 906: 1g, 4g; 907: 5e, all from natural substrate). These conidia seem to be indistinguishable from those of *O. cotoneastri*, but are clearly different from those of *O. rectispora* which are longer and more ellipsoid-fusoid. On the other hand, conidia of the presumed anamorph of *O. crenatomarginata* (section *Aurantiorubrae*) resemble those of *O. cardui*, though being larger, especially wider, and more clavate. Also the so far purely anamorphic *Dactylella rhopalota* shows hardly any morphological differences to the anamorph of *O. cardui*, except that its conidia tend to be longer, but molecular data support its distinction. Also *D. clavata* (from soil under *Cocos*, Xisha islands, China) matches *D. rhopalota* in conidiophore and conidial morphology but is divergent from both species by its molecular data. The three not included collections on *Pinus* from France (unillustrated), *Solidago* from Germany (IVV: 29.VI.2015), and indet. dicot from Kyrgyzstan (unillustrated) showed distinctly larger conidia (*50–53 × 8.3 µm, 7-septate, †50–68 × 7–10 µm, 7–9-septate, and †52 × 6 µm, ~10-septate, respectively) in comparison to the other three records of anamorphs in *O. cardui*, and might instead belong to *D. rhopalota.* The conidia of *D. xinjiangensis* show about the size of these aberrant samples, but never possess more than 7 septa. The conidia of *D. cylindrospora* resemble those of typical *O. cardui* (and *O. cotoneastri*) in size (22.5–45 × 6.5–8.5 µm) and shape, but have only 1–4 septa and the conidiophore tips are strongly branched (candelabrelloid).

Phylogeny. Molecular data (ITS and LSU) were obtained from apothecia of two collections (Chemnitz, H.B. 9891; Luxembourg, H.B. 9901). In both the S1506 intron is absent. The two sequences are completely identical in the entire overlapping part. *O. cardui* clustered in the *cardui-rhopalota* clade (Phyls 25–27, S31). The distance to morphologically similar species is 5.5–6% to *O. epilobii*, 7% to *O. zhongdianensis*, and 7.5% to *D. rhopalota* 7.5%, whereas the similar *O. atlantis*, *O. cotoneastri*, *O. rectispora,* and *O. beltraniae* show a 12.5–17.5% distance. In the LSU (D1–D2) the distance to *O. zhongdianensis* is 1% and to *O. epilobii* 1.5%.



Map 146. Known distribution of *O. cardui* in Europe (yellow = not included collections).

Ecology. A broad range of substrates is inhabited by *O. cardui*, including bark and wood of trees and shrubs, herbaceous stems and leaves of both mono- and dicotyledonous plants, and polypores. Contrary to *O. rectispora*, *O. cardui* is not confined to swamps and shows a slight desiccation tolerance. The vegetation includes shady forests, ruderal places (railway), wetlands (*Filipenduletum*, meadow with *Thalictrum*), and salt marshes. Clark (1980a: 79) and Ellis & Ellis (1985: 553) reported *O. cardui* on leaf bases of *Luzula sylvatica* in central England (as *O. luzularum*), and Raitviir (1991: 359, as *O. cardui*) on stems of larger herbs from the Far East of Russia, but these records require reexamination. The examined collections of *O. cardui* range from atlantic to subcontinental, warm- to cold-temperate humid Europe at planar to colline altitudes. One included collection is from continental oroboreal northern Asia and two not included ones are from orotemperate (altimontane) humid, continental central and subtropical humid (winter-dry) eastern Asia.

Specimens included. **LUXEMBOURG**: **Gutland**, **Esch-sur-Alzette**, 2 km NNE of Dudelange, 1.5 km S of Bettembourg, Triage, 275 m, stem of ?*Asteraceae*, 25.VII.2014, G. Marson (H.B. 9901; sq.: KT222403). — **FRANCE**: **Pays-de-la-Loire**, **Loire-Atlantique**, 2.3 km NE of Mesquer, l'Île de Rostu, 2 m, twigs & branches of *Suaeda vera*, on bark, 9.XI.2007, J.P. Priou (J.P.P. 27121, doc. vid.). – ibid., stem of *Rubus fruticosus*, 23.III.2002, J.P. Priou (H.B. 7115a, anam. substr.) — **GERMANY**: **Sachsen**, 6 km NNE of Chemnitz, 1 km E of Glösa, Indianerteich, 325 m, stem of *Angelica sylvestris*, 15.VI.2014, B. Mühler (ex H.B. 9891, M-0291778, **epitype**, anam. substr.; sq.: KT222402). – **Baden-Württemberg**, 6.5 km NE of Tübingen, 1.5 km NNE of Pfrondorf, Brand, 460 m, on *Fomitopsis betulina*, 3.X.1998, H.O. Baral (H.B. 6245, anam. substr.). — **CZECHIA**: **Central Bohemia**, 23 km SE of Praha, 2.5 km NNW of Mnichovice, near Menčice, 400 m, stem of *Rubus fruticosus*, on bark, VII.1929, J. Velenovský (PRM 152452, **lectotype** of *O. cardui*; H.B. 6059 ø). – Mnichovice, ~370 m, twig of *Juniperus communis*, on bark, IX.1925, J. Velenovský (PRM 147662, **lectotype** of *O. pellucida*, H.B. 6269 ø). – 3 km SE of Mnichovice, near Hrusice, 360 m, leaves of *Luzula pilosa*, 18.VIII.1924, J. Velenovský (PRM 150028, **holotype** of *O. luzularum*; H.B. 6193 ø). – 5 km WSW of Praha, near Motol, ?300 m, (?)rhizomes of *Tussilago farfara*, 11.VI.1924, J. Velenovský (PRM 149600, **lectotype** of *O. cardui* var. *farfarae*, H.B. 7177 ø). — **SERBIA**: **Vojvodina**, Fruška Gora, 13 km SSW of Novi Sad, 1 km E of Brankovac, 430 m, stem of *Thalictrum flavum*, 3.VI.2019, D. Savić (doc. vid.). — **RUSSIA (East)**: **Yamalia**, 130 km SSW of Shuryshkary, near Ovgort, 30 m, branch of *Salix*, on wood, 2.VIII.1976, M. Murdvee (TAAM 110147; H.B. 8721b ø).

Not included. **GREAT BRITAIN**: **West Midlands**, **Warwickshire**, 1.5 km SE of Alcester, Oversley wood, 100 m, leaves of *Luzula sylvatica*, 1.III.1970, M.C. Clark (non vid.). — **FRANCE**: **Île-de-France**, **Essonne**, 17 km SW of Paris, Palaiseau, Parc d'Ardenay, 130 m, cone of *Pinus nigra*, 26.I.1997, J. Deny (ø, anam. substr.). — **GERMANY**: **Thüringen**, 3.3 km SSW of Sonneberg, ENE of Ebersdorf, Oberlinder Müß, 350 m, stem of *Solidago canadensis*, 29.VI.2015, I. Wagner (ø, anam. substr., doc. vid.). — **CZECHIA**: **Central Bohemia**, 15 km SW of Praha, near Černošice, ?250 m, stem of *Verbascum*, VI.1926, F. Fechtner (PRM 148641, **holotype** of *O. cardui* var. *verbasci*; H.B. 6420 ø). — **KYRGYZSTAN**: **Jalal-Abad**, western part of Tian Shan, Chatkal Range, 140 km NW of Jalal-Abad, 70 km SSW of Talas, Lake Sary-Chelek, ~1900 m, herbaceous stem of indet. angiosperm, 26.V.1968, A. Raitviir (TAAM 60134, immature, anam. substr.). — **CHINA**: **Yunnan**, **Dali**, 42 km NNE of Dali, Jizushan, 2700 m, branch of indet. angiosperm, on bark, 20.X.2008, X.M. Gao, H.Y. Su & X.J. Su (H.Y.S. jz-6, CBCD, H.B. 8964).

Orbilia cotoneastri Velen. [as '*cotoneastris*'], Monogr. Discom. Bohem.: 401 (1934) — Pls 908–909

Etymology: referring to the type substrate.

Typification: Czechia, Praha, St. Prokop, branch of *Cotoneaster integerrima*, 24.X.1925, J. Velenovský (PRM 148957, holotype); France, Locmariaquer, branch of *Ulex europaeus*, 3.XI.2002, J.P. Priou (ex J.P.P. 22122 & H.B. 7241a,

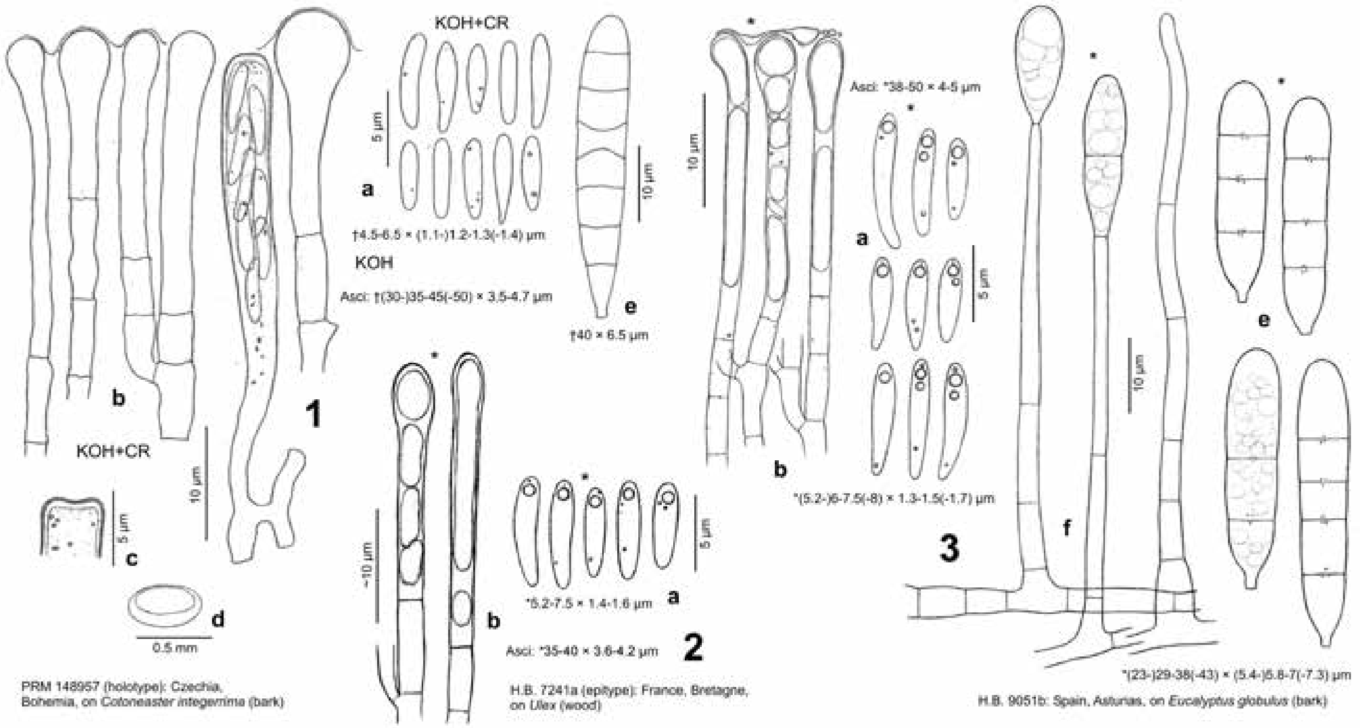


Plate 908. **1–2**: *Orbilia cotoneastri*; **3**: *O.* cf. *cotoneastri*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apex; **d**. rehydrated apothecium; **e**. conidia; **f**. conidiophores with young conidia (**1e** from substrate, **2e–f** from culture).

M-0177060, epitype, designated here, MBT382108, ex-epitype culture: CBS 116281; sq.: KT215288).
Misapplied name: Svrček (1954: 13), as *O. inflatula*.

Description: — **TELEOMORPH**: **Apothecia** moist/rehydrated 0.5–1 mm diam., 0.12 mm high, whitish with pale cream-isabelline or yellowish-chlorinaceous tint, medium translucent, round to somewhat lobate, gregarious; disc flat to slightly convex, margin distinct, thin or thick, not protruding, smooth; broadly sessile, superficial. **Asci** *35–40 × 3.6–4.2 µm {1}, †(30–)35–40(–50) × 3.5–4.3(–4.7) µm {2}, 8-spored, (1–)2–4 lower spores inverted {2} (mixed or not); apex strongly truncate (sometimes indented, laterally hardly inflated), thin-walled; **base** with short to long, thin stalk, T-, Y-, h- or H-shaped. **Ascospores** *5.2–7.5 × 1.4–1.6 µm {1}, †(4.5–)5.5–6.8(–7.8) × (1.1–)1.2–1.3(–1.4) µm {2}, cylindric- to fusoid-clavate, apex (rounded to) obtuse, base hardly or slightly to strongly attenuated, straight to slightly curved; **SBs** *1.3–1.5 × 0.6–0.8 µm {1}, globose, apically with a hardly visible filum. **Paraphyses** apically uninflated or slightly to medium, rarely strongly capitate-clavate, terminal cell *22–30 × 2.5–3.8 µm {1}, †15–28 × 3–5(–7) µm {T}, lower cells †4–9(–11) × 2–4 µm {T}; unbranched at upper septum. **Medullary excipulum** 40 µm thick, sharply delimited. **Ectal excipulum** of thin-walled, vertically oriented t. globulosa-angularis-prismatica from base to margin, 35 µm thick near base, cells *9–16 × 6–10 µm {1}, †15–24 × 13–19 µm {T}; ~25 µm thick at lower flanks, cells †9–13 µm wide {T}, 10–15 µm thick near margin, oriented at an 70–80° angle to the surface, marginal cortical cells †7–15 × 3.5–6 µm {T}, thin-walled; **glassy processes** absent {T} or up to 1 µm thick {1}. **Anchoring hyphae** */†(2–)2.5–4(–5) µm wide, walls 0.2(–0.3) µm thick {2}. **SCBs** not observed; **VBs** present or absent, slightly refractive, hyaline, globose to elongate {1}. **Exudate** over paraphyses, margin and flanks absent or 0.1–0.2 µm thick, smooth or finely granular {2}. — **ANAMORPH**: dactylella-like (from natural substrate {2} and ascospore isolate {1, not studied in detail}). **Conidiophores** not seen. **Conidia** unbranched, straight, (cylindric- to) ellipsoid-clavate, obtuse at apex, */†37–40 × 6.5–8.2 µm, (4–)7-septate {2}.

Habitat: on corticated or decorticated, ~15–20 mm thick branches of *Cotoneaster integerrima* {T}, *Ulex europaeus* {1} lying on moist ground (partly buried), on medium to very rotten bark (bast) (1) and wood (1). **Associated**: ?*Hyaloscyphaceae* {1}. **Desiccation tolerance**: not tested, possibly intolerant. **Altitude**: 2–250 m a.s.l. **Geology**: Czechia: Devonian limestone & calcareous shale, silt- & sandstone; France: granite. **Phenology**: X–XI.

Taxonomic remarks. *Orbilia cotoneastri* differs from *O. cardui* in the absence of glassy processes at the margin and in a much thinner or absent exudate over the partly more inflated, capitate-clavate paraphyses. The sparse records of *O. cotoneastri* were on woody substrates, except for a not included sample on *Reynoutria*. *O. senegalensis* on bark of *Citrus* differs by prominent crystalloid SCBs in the excipular cells (Pl. 910).

Variation. The collection on *Ulex* (Pls 908: 2, 909: 1) fits rather well the holotype of *O. cotoneastri* but their conspecificity is not certain due to lack of molecular data of the holotype. In the spores the two are very similar when considering the shrinking effect, whereas the dead asci in the holotype are slightly larger than the living asci in the *Ulex* sample. The marginal excipular cells show thick glassy walls in the *Ulex* sample, while they are thin-walled in the holotype. Despite these differences we feel justified to designate the collection on *Ulex* (France, Locmariaquer, ex J.P.P. 22122 & H.B. 7241a, M-0177060) for which a pure culture (CBS 116281) and sequence exists, as **epitype** of *O. cotoneastri*.

Type studies. The sparse holotype of ***O. cotoneastri*** was thought by Svrček (1954: 13) to represent typical *O. inflatula* (≡ *Hyalorbilia inflatula*). However, both the protologue and Velenovský's unpublished manuscript plate describe the asci with a thin, 2–3-furcate stalk. This clearly indicates that *O. cotoneastri* does not belong to *Hyalorbilia*. Velenovský actually compared *O. cotoneastri* with *O. pellucida* (= *O. cardui*), from which he appears to have distinguished it mainly because of wider asci (5 and 3–4 µm, respectively) and more inflated paraphyses without exudate.

According to the present reexamination of the holotype (Pl.

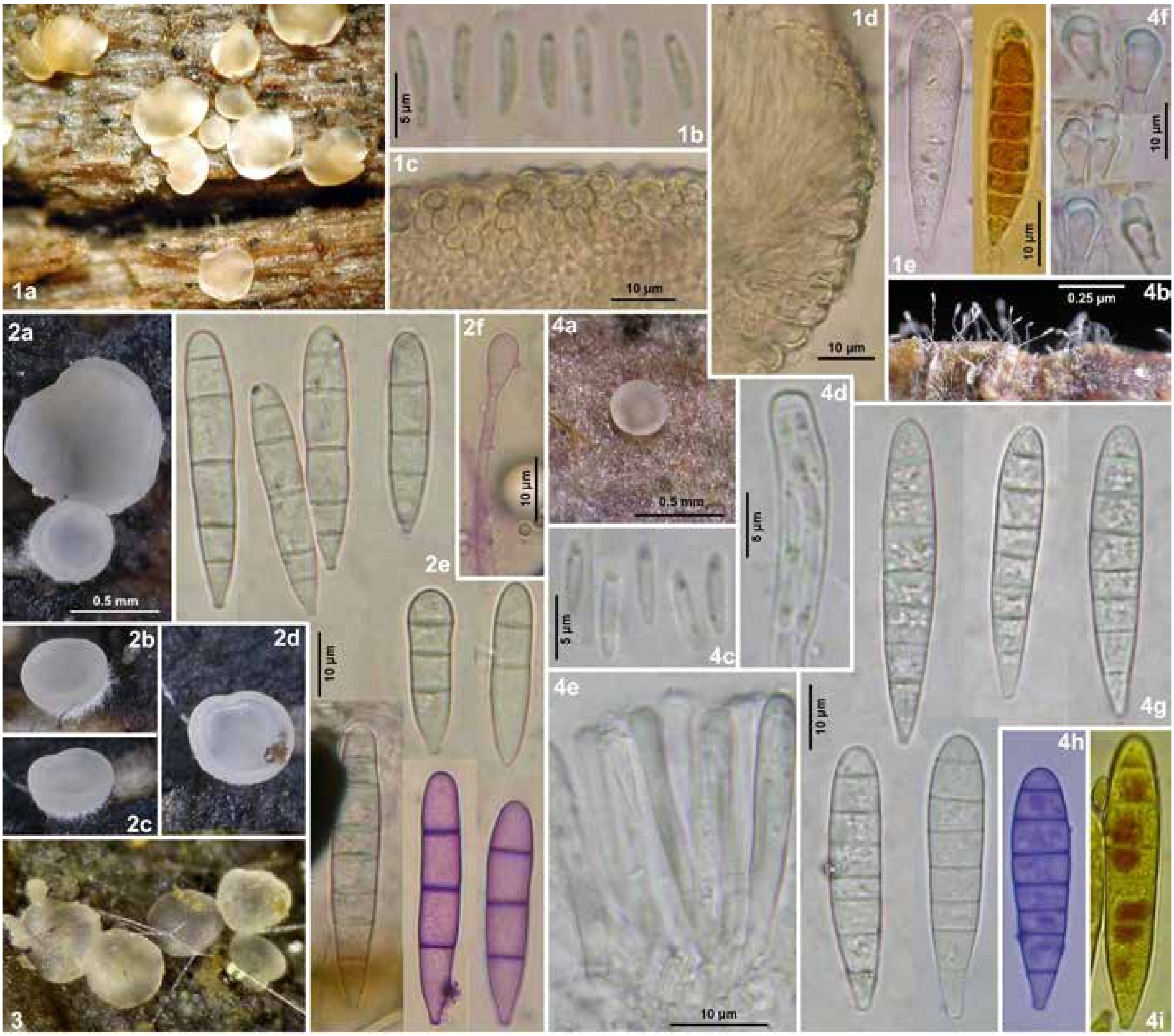


Plate 909. **1**: *Orbilia cotoneastri*; **2–4**: *O*. cf. *cotoneastri*. – **1a**, **2a–d**, **3**, **4a**. fresh apothecia; **1c**. marginal cortical cells in top view; **1d**. marginal ectal excipulum in median section; **4f**. short glassy processes on marginal cortical cells; **4d–e**. asci and paraphyses; **1b**, **4c**. ascospores; **2f**. conidiophore with young conidium; **4b**. conidiophores with mature conidia on bark; **1e**, **2e**, **4g–i**. conidia (**1** & **4** from substrate, **2** from culture). – Living state (**4i** in IKI, **2e** below and **4h** in CRB), except for **1b–d**, **1e** left (KOH), **1e** right (KOH+IKI). – **1a**, **3**: phot. J.P. Priou. — **1a–e**. H.B. 7241a (epitype): France, Bretagne, on *Ulex*; **2a–f**. H.B. 9051b: Spain, Asturias, on *Eucalyptus*; **3**. J.P.P. 28122: France, Bretagne, on *Reynoutria*; **4a–i**: H.B. 9645b: Spain, Galicia, on *Quercus*.

908: 1), *O. cotoneastri* resembles *O. cardui* in its short and wide, straight spores. However, no glassy caps could be found on the marginal cells, also the paraphysis apices are very variable in this specimen, ranging from slightly to strongly clavate, 3–5(–7) µm wide. Moreover, both paraphyses and excipulum are devoid of exudate. The entire ectal excipulum is composed of a rather large-celled, thin-walled textura angularis. The asci are much longer and the spores wider than indicated by Velenovský (25–30 × 5 and 4–5 × 0.8–1 µm, spore width estimated from his drawing) as well as Svrček (30 × 4–4.5 µm and 5–5.5 × 1 µm). However, the ascus length in the protologue was obviously taken by exclusion of the stalk, judging from Velenovský's free-hand drawing, which shows narrowly ellipsoid-fusoid spores with a medium-sized drop near each end similar as drawn for *O. pellucida*.

Not included collections. Some samples more or less resemble *O. cotoneastri*. Two from Spain (Asturias: on *Eucalyptus*, spores *6–7.5 × 1.3–1.5 µm, Pls 908: 3; 909: 2; Galicia: on *Quercus*, spores *6–6.7 × 1.1–1.3 µm, Pl. 909: 4) both grew in association with the rare *Orbilia alba*, but slightly differ from each other in spore width and anamorph (see below). That on *Eucalyptus* lacks glassy processes but shows 1–1.5 µm thick exudate; that on *Quercus* has only 0.2–0.4 µm thick exudate as a maximum but possesses glassy processes of 2–6 × 4–6.5 µm (Pl. 909: 4). The *Quercus* sample might in fact represent a narrow-spored lignicolous population of *O. cardui* with rather short glassy processes. Two further samples were studied by J.P. Priou (Valenciana, on *Eucalyptus*, IVV: J.P.P. 27143; Bretagne, on *Reynoutria*, IVV: J.P.P. 28122), and another by N. Matočec (Croatia, on cardboard, IVV: N.M. 3800) which all lack glassy processes but show distinct exudate over the paraphyses.

Anamorph: The anamorph of *O. cotoneastri* closely concurs with that of *O. cardui* and *Dactylella rhopalota*. Ellipsoid- to cylindric-clavate conidia were observed on the natural substrate in the holotype of *O. cotoneastri* (Pl. 908: 1e, 1 conidium seen) and in the epitype (Pl. 909: 1e, */†35–38 × 7–8.2 µm, 4–7-septate). Conidia developed in the latter sample also in pure culture, but the anamorph was not studied in detail.

Conidia were also observed in some of the not included collections, either on the natural substrate (Galicia, Pl. 909: 4b, g–i; Valenciana, IVV: J.P.P. 27143) or in pure culture (Asturias, Pls 908: 3e–f; 909: 2e–f). The conidia from Asturias are mainly cylindrical, rather narrow and with only (2–)3–5(–7) septa, compared to those from Galicia which measured *(30–)35–48.5 × (7.5–)8–8.5(–9) µm and were ((4–6–))7((–8))-septate. Therefore, these two samples might be specifically distinct. The single clavate conidium seen in the sample from Andalucía measured 40 × 10 µm and was 5-septate.

Phylogeny. A sequence from pure culture of the epitype on *Ulex* comprises SSU (with S1506 intron), ITS, and LSU. *O. cotoneastri* formed with *O. rectispora* a strongly to medium supported clade (Phyls 25, 27, S31), with a distance of 6.7–7% in the ITS region to *D. panlongana*, *D. ramosa*, and *O. rectispora* (all these species have more fusoid conidia), 8% to *D. xinjiangensis*, and 9–9.5% to *O. beltraniae* and *D. clavata*. Species of the *cardui-rhopalota* clade show much higher distances, e.g., 14.5% to *O. cardui*. In the intron the lowest distance was 12.5% to *O. rectispora*.

Ecology. *O. cotoneastri* grew on rotten hygric branches of angiosperm shrubs. The holotype was on bark of *Cotoneaster* in cold-temperate humid subcontinental Europe (Bohemia), and the epitype on wood of *Ulex* in a warm-temperate humid coastal open shrubland in atlantic Europe (Bretagne). The not included collections were, besides a further sample from Bretagne (on herbaceous stems of *Reynoutria*), from atlantic, thermotemperate humid coastal forests in northern Spain (with *Castanea sativa*, *Laurus nobilis*, *Quercus robur*, *Eucalyptus*), from a thermomediterranean semiarid coastal saline shrubland in southern Spain, and from a mesomediterranean semihumid shrubland in a depression of an ancient lake in the Dalmatic islands.

Specimens included. **CZECHIA**: **Central Bohemia**, 7 km SW of Praha, St. Prokop (Prokopské údolí, Prokop valley), ~250 m, branch of *Cotoneaster integerrima*, on bark, 24.X.1925, J. Velenovský (PRM 148957, **holotype**, H.B. 6132 ø, anam. substr.). — **FRANCE**: **Bretagne**, **Morbihan**, 12 km S of Auray, 1.6 km SW of Locmariaquer, Breneguy, 2 m, branch of *Ulex europaeus*, on wood, 3.XI.2002, J.P. Priou (ex J.P.P. 22122 & H.B. 7241a, M-0177060, **epitype**, CBS 116281, anam. substr.; sq.: KT215288).

Not included. **FRANCE**: **Bretagne**, **Morbihan**, 5.3 km S of La Gacilly, 2 km N of St.-Vincent-sur-Oust, La Provostaie, 4 m, stem of *Reynoutria sachalinensis*, 3.VI.2008, J.P. Priou (J.P.P. 28122, doc. vid.). — **SPAIN**: **Galicia**, **La Coruña**, 18 km SE of La Coruña, SE of Betanzos, N of Calle de Concepción Arenal, 40 m, branch of *Quercus robur*, on bark, 31.XII.2011, B. Amarante Rodríguez (H.B. 9645b). – **Asturias**, 5 km WSW of Avilés, 2 km SSW of Piedras Blancas, Las Bárzanas, 80 m, branch of *Eucalyptus globulus*, on bark, 25.IV.2009, E. Rubio & A. Suárez (E.R.D. 4772, H.B. 9051b). – **Com**. **Valenciana**, **Alicante**, 4 km N of Torrevieja, 2.2 km WSW of La Mata, Laguna de La Mata 4 m, branch of *Eucalyptus*, on wood, ~27.XII.2007, J.P. Priou (J.P.P. 27143, anam. substr., doc. vid.). — **CROATIA**: **Zadar**, Dugi Otok island, 2.2 km SSW of Žman, Malo jezero, 5 m, on cardboard, 1.VI.1998, N. Matočec (CNF 2/3800, doc. vid.).

Orbilia senegalensis Baral, G. Marson & E. Weber, **nom. prov.** — Pl. 910

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.18–0.25 mm diam., 0.1 mm thick (receptacle 0.06–0.07 mm), whitish-greyish to light cream-brownish, medium translucent, round to somewhat undulating, gregarious in small groups; disc flat, margin thin, ± smooth, not protruding, sessile on a broad base, superficial. **Asci** †(27.5–)33–35(–43) × 3.7–4.2 µm, 8-spored, 4–6 lower spores inverted {4}, pars sporifera *16–20 → 15–16.5 µm long; **apex** strongly truncate (not indented, not inflated), thin-walled; **base** with short to medium long stalk, h- or H-shaped. **Ascospores** */†5–6.5 × 1–1.4 µm, cylindrical to slightly fusoid-clavate, with rounded to obtuse ends, only slightly (rarely medium) tapered below, straight or slightly curved; **SBs** *0.7 × 0.4 µm, globose, often ± eccentrical, sometimes with distinct filum (total SB length 1.5 µm). **Paraphyses** uninflated to often slightly to medium lanceolate-lageniform with rounded tip, terminal cell *(13.5–)17.5–19.5(–25) × 2–3 µm {5}, 3–5 µm protruding beyond living asci, lower cells *(4.5–)7–9.5(–10.5) × 1.5–2.5(–2.8) µm {5}, unbranched at upper septum, rarely with a bifurcate apex. **Medullary excipulum** 20–45 µm thick, of dense textura intricata with inflated cells, sharply delimited. **Ectal excipulum** of indistinctly vertically oriented, thin-walled t. globulosa-angularis, at base 30 µm thick, cells *7–12.5 × 5–9.5 µm, at margin 12–15 µm thick, oriented at a high angle, marginal cortical cells †4–5.5 × 3.5–5 µm, at upper margin with or without hair-like outgrowths ~14 × 3.5 µm oriented at a ~20–45° angle; **glassy processes** absent. **Anchoring hyphae** sparse, ~1.5–2.5 µm diam., wall ~0.2 µm thick. Crystalloid **SCBs** in excipular cells at flanks, 2.5–5 × 0.5–2.5 µm, refractive, spool- to C-shaped, very pale rose. **VBs** probably absent. **Exudate** 0.3–1.5 µm thick, cloddy, firmly attached, over paraphyses and marginal excipulum. — **ANAMORPH**: unknown.

Habitat: on corticated, xeric, 12–14 mm thick branch of *Citrus* × *limon*, on medium rotten bark (bast). **Associated**: none observed. **Desiccation tolerance**: only excipular cells survived at least 1 week. **Altitude**: 15 m a.s.l. **Phenology**: I.

Taxonomic remarks. This species differs from all other species of series *Neodactylella* studied in the living state by very distinct crystalloid SCBs in the excipular cells (Pl. 910: 1k–n), a so far unique character within the entire section *Arthrobotrys*. However, because the specimen was lost after study, this exceptional feature could later not be confirmed in order to exclude a mixture or confusion. Otherwise the species resembles *O. cardui* and *O. cotoneastri* in its rod-shaped spores, which are partly somewhat attenuated and curved below and contain a minute, globose SB attached to the apex by a short filum.

The genetically close south Chinese ***Orbilia longquanensis*** M. Qiao & Z.F. Yu nom. prov. (Zhang et al. ined., IVV: YMF 1.01868) differs in much larger (0.5–1 mm diam.), yellow, gregarious, possibly drought-intolerant apothecia which lack any exudate, and in slightly larger ascospores; whether its excipular cells contained SCBs is unknown.

Anamorph. No conidia were found on the natural substrate. The closely allied *O. longquanensis* possesses fusiform, (3–)6–7 septate conidia of *40–60.5 × 4–5.5 µm with cylindrical middle part, formed at the tip of 50–150 µm long, simple or basally branched conidiophores.

Phylogeny. A sequence was gained comprising SSU V3, V6–V9, S1506 intron, ITS, and LSU D1–D8. The species formed with *O. longquanensis* a strongly supported clade with a distance of 5% (ITS) or ~6.5% (intron). This clade clustered with medium or strong support sister to the remaining species of the *rectispora-beltraniae* clade, to which it shows a high distance (Phyls 26–27, S31).

Ecology. The species was found on bark of a xeric branch of *Citrus* in the tropical monsoon climate of northwestern Africa, with strong change between humid (summer) and arid (winter). *O. longquanensis* grew on bark of a hygric angiosperm twig in subtropical humid (monsoon-influenced) eastern Asia.

Specimens included. **SENEGAL**: **Ziguinchor**, 55 km WSW of Ziguinchor, 2.5 km NW of Kabrousse, Cap Skirring, 15 m, branch of *Citrus* × *limon*, on bark, 4.I.2016, R. Reuter (G.M. 2016-01-04.1; sq.: MH221067).

Not included. **CHINA**, **Yunnan**, **Yuxi**, Yimen, ~2.5 km WNW of Yimen, Longquan, 1750 m, twig of broad-leaved tree, on bark, 26.VI.2009, Z. F. Yu & S. F. Li (YMFT1.01868, proposed holotype of *O. longquanensis*, ex-type culture YMF1.01868, CGMCC3.18831, sq.: KF824763/MF948419.

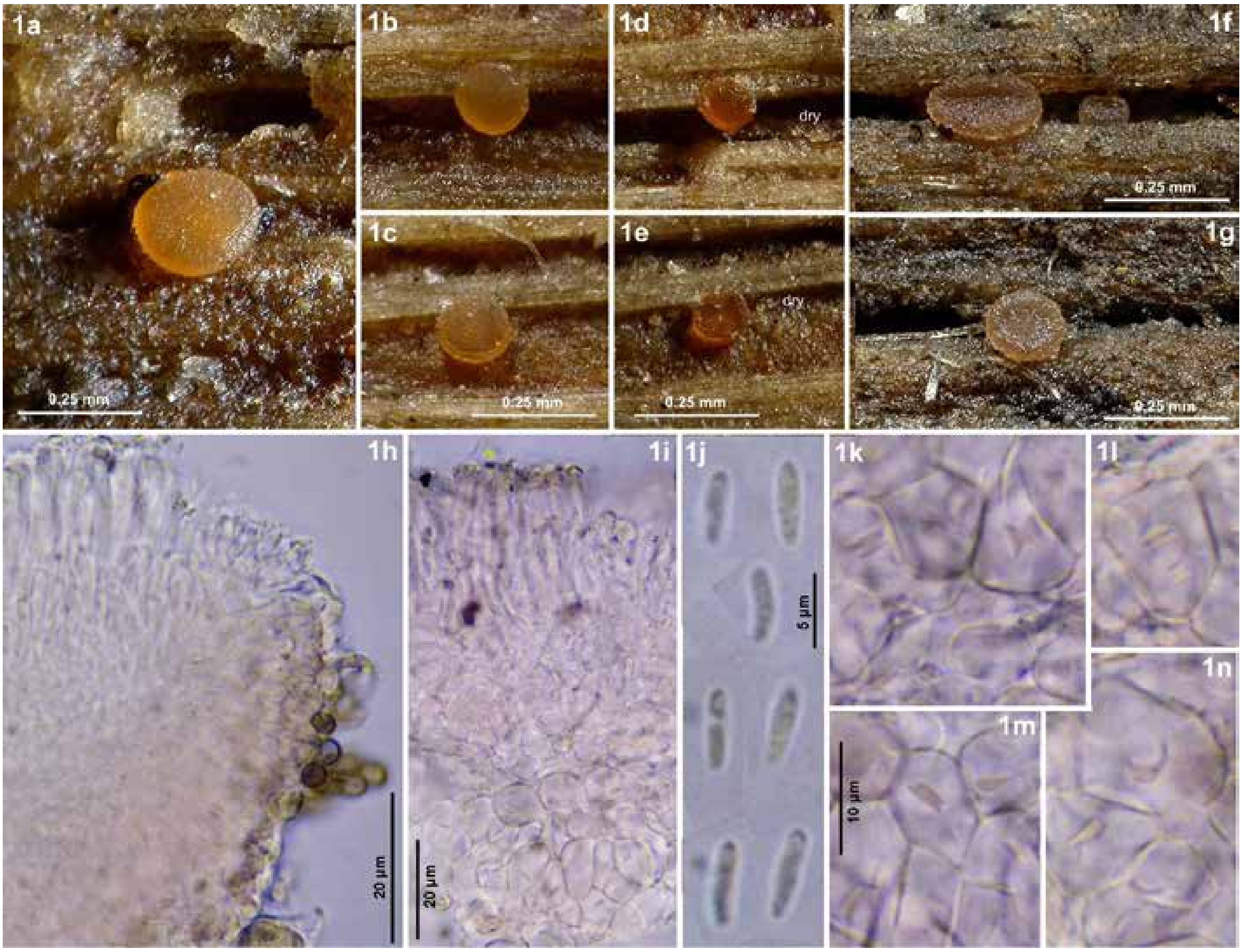


Plate 910. **1**: *Orbilia senegalensis*. – **1a–c**, **f–g**. rehydrated apothecia; **1d–e**. dry apothecia; **1h**. apothecium in median section, marginal ectal excipulum; **1i**. hymenium, medullary and ectal excipulum, flank region; **1j**. ascospores; **1k–n**. crystalloid SCBs in cells of ectal excipulum at flanks. – Dead state, except for ectal excipulum at flanks. — **1a–n**. G.M. 2016-01-04.1: Senegal, Kabrousse, on *Citrus*.

Orbilia beltraniae Quijada, Baral & G. Marson, in Quijada & Baral MycoKeys 25: 6 (2017) — Pl. 911, Map 147

Etymology: referring to the mycologist Esperanza Beltrán-Tejera.

Typification: Macaronesia, Tenerife, Mesa del Mar, branch of *Euphorbia canariensis*, 30.X.2013, L. Quijada (TFC Mic. 24363, holotype; sq.: KT222405).

Description: — **TELEOMORPH** (from Quijada et al. 2017, modified): **Apothecia** moist 0.4–1.2(–1.5) mm diam., 0.1–0.2 mm thick (receptacle 0.06–0.07 mm), whitish-greyish to light cream-brownish, medium translucent, round to somewhat undulating, gregarious in small groups; disc flat, margin thin, ± smooth, not protruding, sessile on a broad base, superficial. **Asci** *(32–)38–43(–46) × (3–)3.5–4(–4.5) µm {6}, †(27.5–)33–35(–43) × 3–3.7 µm {6}, 8-spored, 4–6 lower spores inverted {4}, pars sporifera *16–20 → 15–16.5 µm long; **apex** strongly truncate (not indented, not inflated), thin-walled; **base** with short to medium long stalk, h- or H-shaped. **Ascospores** *(4.5–)5–6.5(–7) × (1.2–)1.4–1.6(–1.7)((–1.9)) µm {6}, †(4–)4.5–5.2 × 1–1.4 µm {3}, cylindrical to slightly fusoid-clavate, with rounded to obtuse ends, straight or slightly curved, only slightly (rarely medium) tapered below; **SBs** *(1–)1.5–2 × 0.6–0.9 µm {5}, globose, often ± eccentrical, sometimes with distinct filum. **Paraphyses** uninflated to often slightly to medium lanceolate-lageniform with rounded tip, terminal cell *(13.5–)17.5–19.5(–25) × 2–3 µm {5}, 3–5 µm protruding beyond living asci, lower cells *(4.5–)7–9.5(–10.5) × 1.5–2.5(–2.8) µm {5}, unbranched at upper septum, rarely with a bifurcate apex. **Medullary excipulum** 20–45 µm thick, of dense textura intricata with inflated cells, sharply delimited. **Ectal excipulum** of indistinctly vertically oriented, thin-walled t. globulosa-angularis, at base 40–70(–105) µm thick, cells *(7.5–)11–13(–18) × (4.5–)8–9.5(–13) µm, at margin 10–28 µm thick, oriented at a 40–80° angle, marginal cortical cells *(5.5–)7.5–8.5(–12.5) × (2.5–)3.5–4.5(–7) µm {5}, not forming distinct cell rows; **glassy processes** absent {6}. **Anchoring hyphae** rather sparse, *1.5–3.5 µm diam., wall 0.2 µm thick {2}. Many globose, very low- to low-refractive globose (?)**SCBs** filling terminal cells of paraphyses {5}, **VBs** absent. **Exudate** forming a 0.2–0.3(–1) µm thick, firmly attached layer over paraphyses and marginal excipulum. **— ANAMORPH**: unknown.

Habitat: lying on the ground or semierect, 2–6 cm thick, partially corticated branches of *Euphorbia canariensis* {7}, on medium to very decayed wood {7}. **Associated**: *Orbilia amarilla* {1}, *O. asomatica* {1}, *O.* aff. *farnesianae* {1}, *O. pisciformis* {1}. **Desiccation tolerance**: fully alive for at least ~1 week. **Phenology**: X–V, but possibly throughout the year. **Altitude**: 35–345 m a.s.l. **Geology**: basaltic flows. **Phenology**: III, V, X, XII (apparently throughout the year).

Taxonomic remarks. *Orbilia beltraniae* was collected and studied by L. Quijada. The species resembles *O. rhamni* in the lanceolate-lageniform paraphyses but differs in the ascospores (see p. 1483). *O. epilobii* resembles *O. beltraniae* in similar spores and partly lanceolate paraphyses, but differs in paraphyses not covered by exudate and mostly containing VBs, and in thicker apothecia. Also *O. cardui*, *O. cotoneastri*, *O. rectispora*, and *O. zhongdianensis* resemble *O. beltraniae*

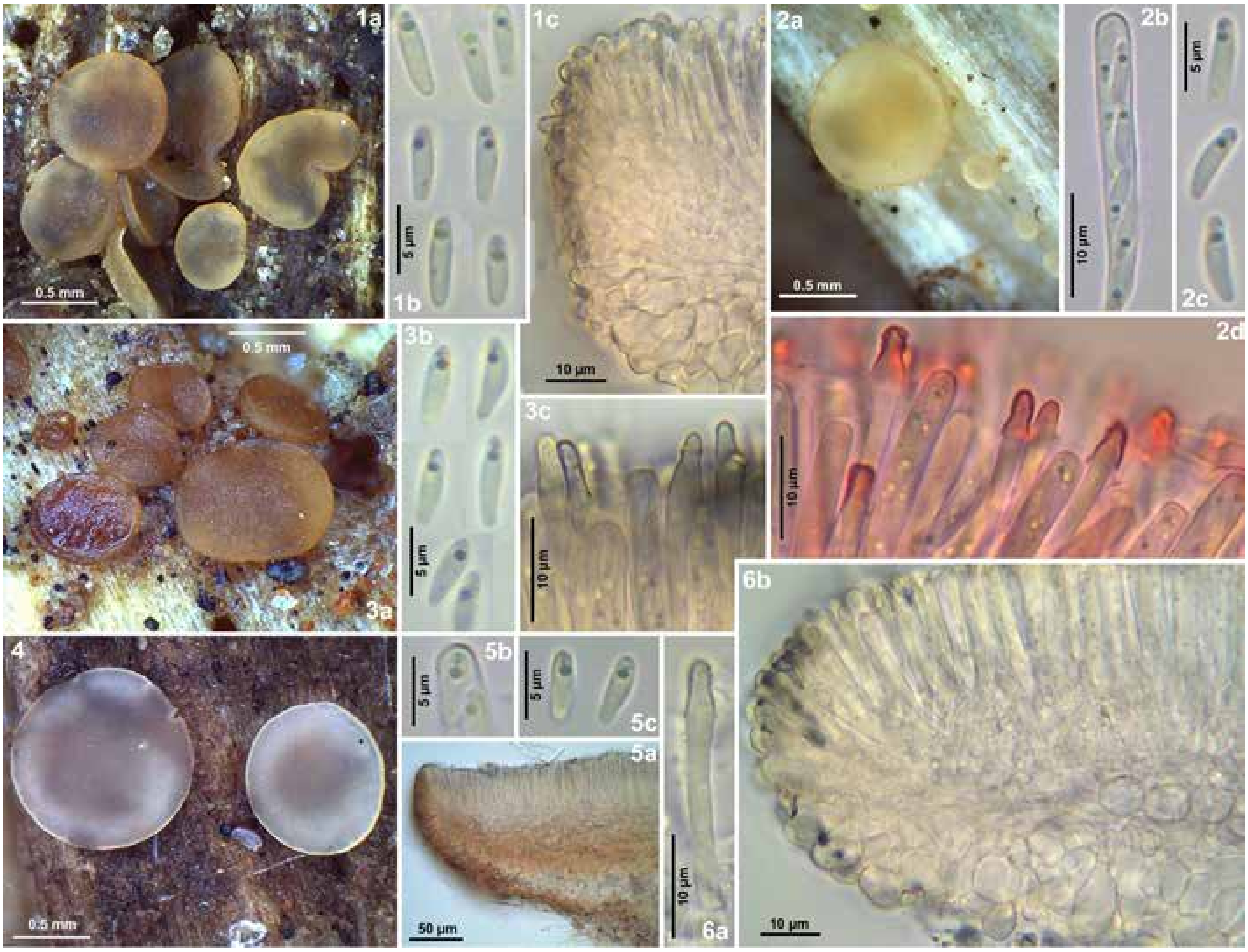


Plate 911. **1–6**: *Orbilia beltraniae* (all from Tenerife on *E. canariensis*). – **1a**, **2a**, **3a**, **4**. apothecia rehydrated after 1–2 weeks; **5a**. apothecium in median section; **1c**, **6b**. id., marginal region; **2b**, **d**, **3c**, **6a**. asci and paraphyses; **5b**. ascus apex in profile view; **1b**, **2c**, **3b**, **5b–c**. ascospores. – Living state. – **1–6**: phot. L. Quijada (**1a**, **3a**, **4**, **6a**: from Quijada & Baral 2017). — **1a–c**. TFC 24363 (holotype): Mesa del Mar; **2a–d**. TFC 23836: Punta de Teno; **3a–c**. TFC 23771: Montaña Amarilla; **4a–c**. TFC 24449: Punta de Hidalgo; **5a–c**. TFC 23902: Hoya el Laurel; **6a–b**. TFC 24231: Punta de Hidalgo.

in the spores but differ in cylindrical to capitate paraphyses, *O. rectispora* also in longer and narrower spores, and *O. zhongdianensis* in smaller SBs. Especially the spores of *O.* cf. *cardui* (Pl. 906: 7) with their globose, slightly eccentrical SBs without a visible filum match well those of *O. beltraniae*. For the similar *O. pseudeuphorbiae* see p. 1476.

Phylogeny. Sequences were gained from apothecia of two collections of *O. beltraniae*, comprising ITS and LSU (D1–D4, the S1506 intron is absent in both). The two sequences are completely identical in their overlapping part. In our phylogenetic analyses (Phyls 25–27) *O. beltraniae* clustered in the *rectispora-beltraniae* clade, though showing a minimum ITS distance of 6.3% to *O. xinjiangensis*, 8.5% to *O. rectispora* and *D. panlongana*, and 9% to *O. cotoneastri*, but 17.5% to *O. cardui*. In the LSU (D1–D2) the lowest distance is 5% to *O. rectispora* and 6% to *O. xinjiangensis*, and here *O. beltraniae* clustered separate from the rest of the *rectispora-beltraniae* clade (S31).

Ecology. *O. beltraniae* was recorded from xerophytic succulent scrublands at six different sites of Tenerife (L. Quijada & E. Beltrán-Tejera pers. comm.). It grew always on ± decayed wood of dead, xeric branches of *Euphorbia canariensis*. The sites are mainly located in the northern part of the island in the inframediterranean semiarid to arid cardonal vegetation (*Periploco laevigatae-Euphorbietum canariensis*), but one is from the very south in the hyperarid tabaibal dulce (*Ceropegio fuscae-Euphorbietum balsamiferae*).

Specimens included (all on wood of *Euphorbia canariensis* branches): **MACARONESIA**: **Canary Islands**, **Tenerife**, San Cristóbal de La Laguna, Anaga, 6 km NE of Tegueste, 2.3 km E of Punta de Hidalgo, NW of Chinamada, 345 m, 20.V.2013, L. Quijada (TFC Mic. 24231, doc. vid.). – ibid., 29.XII.2013, L. Quijada (TFC Mic. 24449, doc. vid.). – Santa Cruz de Tenerife, 3 km NNW of San Andrés, Hoya el Laurel, 307 m, 5.III.2013, L. Quijada (TFC Mic. 23902,

Map 147. Known distribution of *O. beltraniae* in Tenerife (Macaronesia).

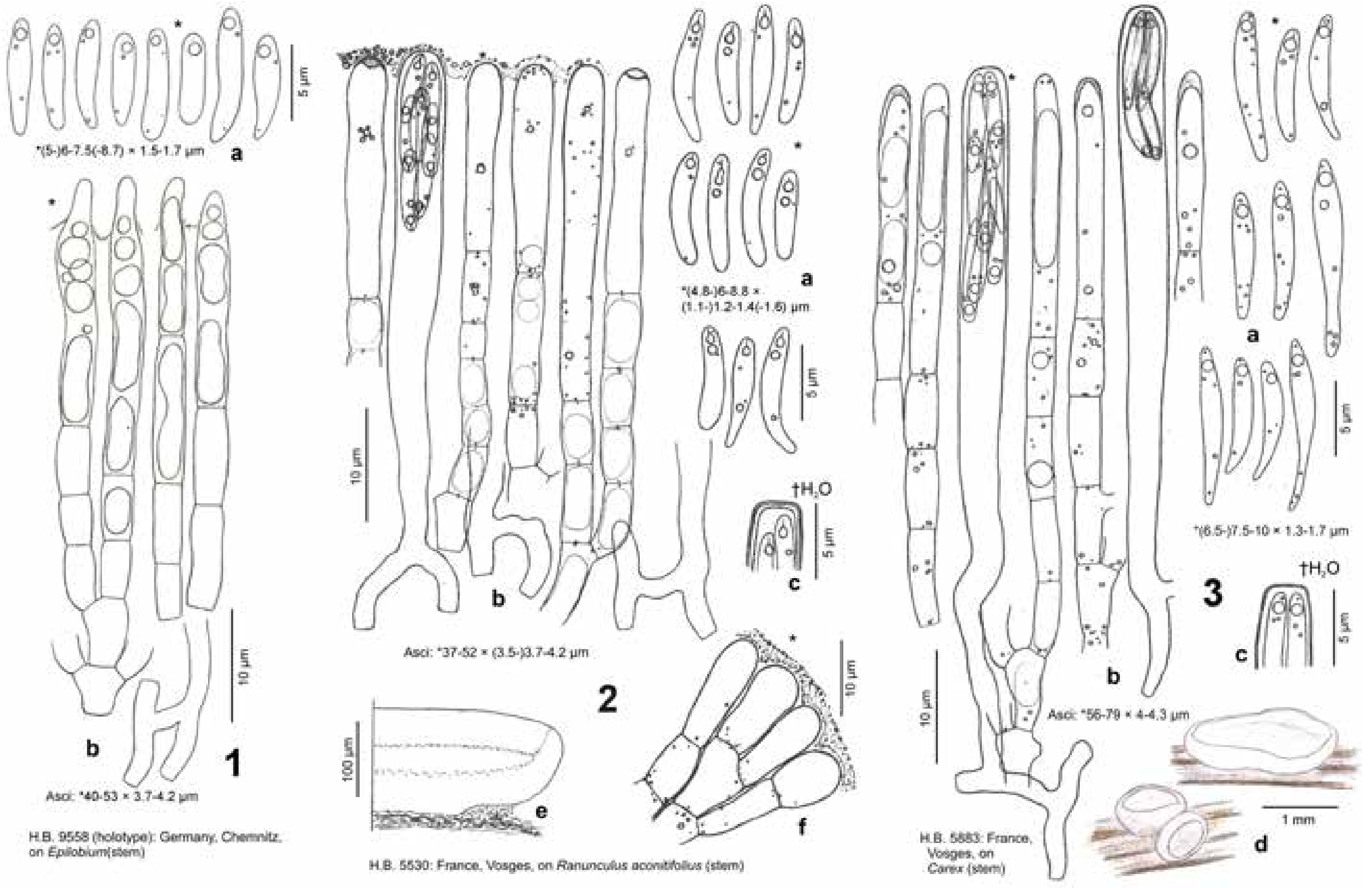


Plate 912. **1**: *Orbilia epilobii*; **2–3**: *O.* cf. *epilobii*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. fresh apothecia; **e**. apothecium in median section; **f**. id., ectal excipulum at margin.

doc. vid.). – Tacoronte, 2.7 km NNE of El Sauzal, SSW of Mesa del Mar, Hoya las Higueras, 60 m, 30.X.2013, L. Quijada (TFC Mic. 24363, **holotype**, doc. vid.; sq.: KT222405; TFC Mic. 24359, **isotype**). – La Matanza de Ajentejo, 1.5 km WNW of La Matanza de Acentejo, NW of Jagre, Punta del Sol, 43 m, 2.III.2013, L. Quijada (TFC Mic. 23890, doc. vid.; sq.: KT222406). – Buenavista del Norte, Teno, 5 km WSW of Buenavista del Norte, 2.9 km NW of Teno Alto, Punta de Teno, Lomo las Toldas, 175 m, 27.XII.2012, L. Quijada (TFC Mic. 23836, doc. vid.). – San Miguel de Abona, 4 km SSW of Las Chafiras, 1.5 km NE of Costa del Silencio, Montaña/Llanos de Amarilla, 35 m, 16.XII.2012, L. Quijada & R. Castro (TFC Mic. 23771, doc. vid.).

Orbilia epilobii Baral & E. Weber, **sp. nov.**, MB 813973 — Pls 912–913

Etymology: referring to the substrate, stems of *Epilobium*.

Typification: Germany, Chemnitz, stem of *Epilobium hirsutum*, 15.VI.2011, B. Mühler (ex H.B. 9558, M-0276478, holotype; sq.: KT222450, KT222446).

Latin diagnosis*: Similis* Orbiliae cardui *sed paraphyses ad apicem haud inflatae, sublanceolatae, excipulum marginale absque processis vitreis. Habitat ad caules uvidos* Epilobii *et* Cirsii *in zona (oro)temperata humida Europae.*

Description: — **TELEOMORPH**: **Apothecia** fresh 0.3–2(–2.4) mm diam., ~0.2–0.4 mm high (receptacle ~0.15–0.2 mm), whitish to pale cream, finally light ochraceous, not or slightly translucent, round to slightly lobate, scattered to gregarious; disc flat, finally medium convex, margin distinct, not or up to 50–60 µm protruding, smooth; broadly sessile, superficial. **Asci** *40–48(–53) × (3.5–)3.8–4.5 µm {3}, †30–44 × 3–4.2 µm {2}, 8-spored, 3–5 lower spores inverted {2} (often mixed), pars sporifera *14–17 µm long; **base** with short to long, thin, flexuous stalk, h- or H-shaped. **Ascospores** *(5–)6–8(–9) × (1.2–)1.4–1.7(–1.8)((–2)) µm {3}, †5.5–7.5 × 1.3–1.5 µm {1}, cylindrical to sometimes slightly fusoid(-clavate), apex rounded to obtuse, base not or slightly to medium attenuated, straight to slightly curved; **SBs** *1–1.5(–1.7) × 0.5–0.8 µm {2}, globose, apically with a hardly visible filum. **Paraphyses** apically uninflated {3} or often slightly to distinctly lanceolate-lageniform or subspathulate-submammiform {3}, terminal cell *(14–)18–21(–27) × 2.5–3.2(–3.5) µm {2}, 1–5 µm longer than living asci, lower cells *4–9(–12) × (2–)2.5–3.5(–4.2) µm {3}; unbranched at upper septum. **Medullary excipulum** 90–150 µm thick, of ± dense textura intricata with many large globose cells especially in upper part, medium sharply delimited. **Ectal excipulum** of thin-walled, vertically oriented t. globulosa-prismatica from base to margin, 120–250 µm thick near base, cells *11–30(–40) × 8–20(–25) µm {3}; 40–90 µm thick at lower flanks, cells *(5–)7–12(–14) × 5–11 µm {3}, 25–60 µm thick near margin, oriented at an 80–90° angle to the surface, marginal cortical cells *9–17 × 4–6(–7) µm {3}, thin-walled; **glassy processes** absent {4}. **Anchoring hyphae** abundant, *(2–)2.5–3.5(–5) µm wide, walls 0.2 µm thick {2}, forming a 20–100 µm thick, ± dense, non-gelatinized t. intricata. **SCBs** not observed; **VBs** in terminal (and lower) cells of paraphyses mostly present, slightly to medium (to strongly) refractive, hyaline, globose to elongate {3}. **Exudate** over paraphyses, margin and flanks absent or 0.1–0.2 µm thick, ± smooth, hyaline to pale yellowish {3}. **— ANAMORPH**: dactylella-like (presumed, from natural substrate {2}). **Conidiophores** not seen. **Conidia** unbranched, straight, ellipsoid-clavate, obtuse at apex, *25 × 6 µm, 3-septate or *~48 × 7 µm, 6-septate {only 2 conidia seen, 1 per sample}.

Habitat: on previous year's herbaceous stems of *Cirsium palustre* {1}, *Epilobium* sp. {1}, *E. hirsutum* {3}, lying on damp to wet ground or at the base of standing stems. **Associated**: *Pyrenopeziza carduorum* {1}, *P. chamaenerii* {2}. **Desiccation tolerance**: asci and paraphyses do not survive half a day. **Altitude**: 153–193 m a.s.l. (England), 325–520 m a.s.l. (Germany), 1115 m (Auvergne). **Geology**: Cambrian, Silurian & Carboniferous lime-, sand- & mudstone, Permian (Rotliegend), Pleistocene sand & gravel; mica schist. **Phenology**: V–VII.

Taxonomic remarks. *Orbilia epilobii* differs from the similar *O. cardui*, *O. cotoneastri*, and *O. zhongdianensis* in the paraphyses having uninflated to slightly tapered (sublanceolate

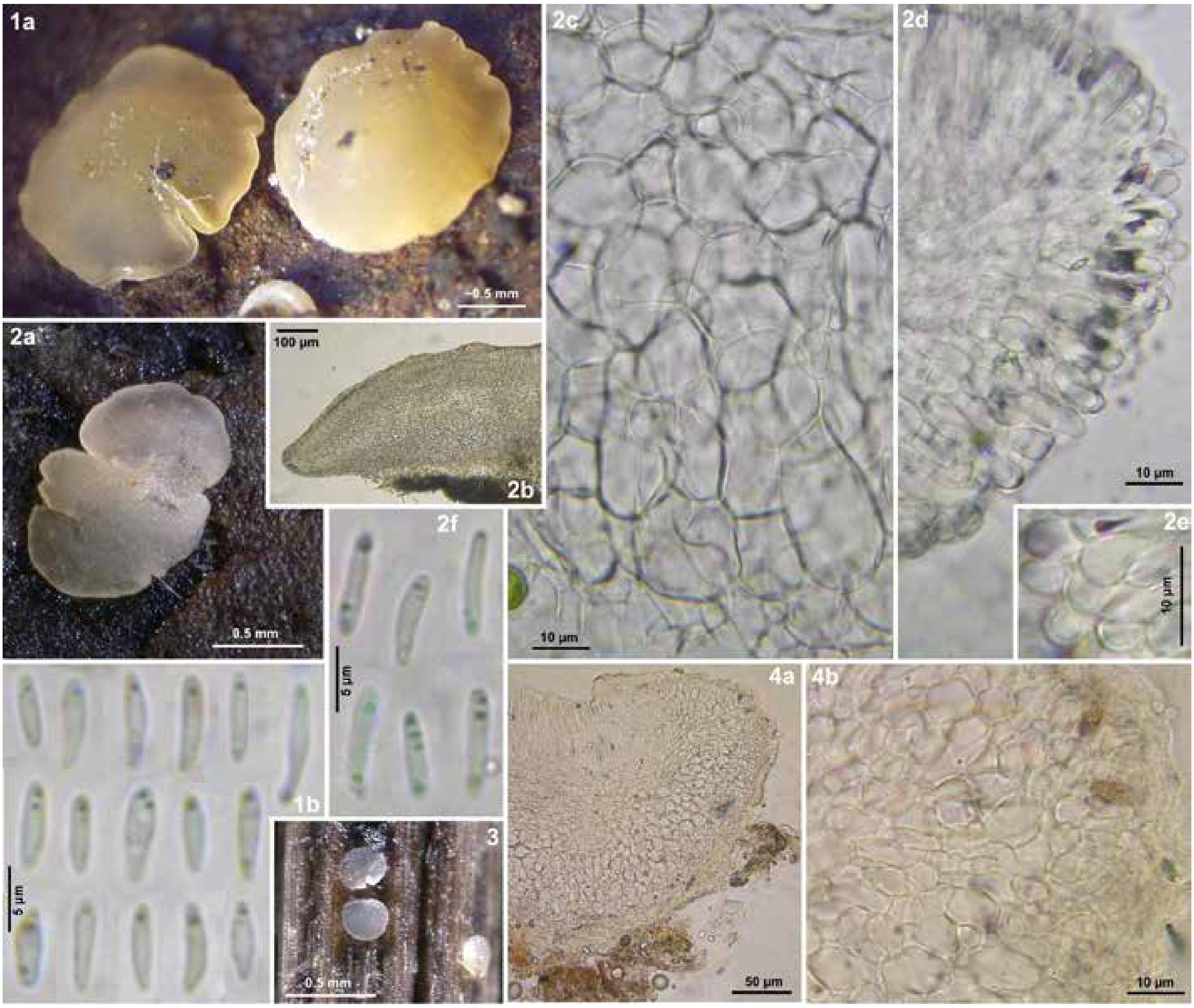


Plate 913. **1–2**: *Orbilia epilobii*; **3–4**: *O.* cf. *epilobii*. – **1a**, **2a**, **3**. apothecia (**1a**, **2a** fresh, **3** rehydrated); **2b**, **4a**. apothecium in median section, **2c**. id., ectal excipulum at flanks; **2d**, **4b**. id., at margin; **2e**. marginal cortical cells; **1b**, **2f**. ascospores. – Living state, except for **4a–b** (in KOH). – **1a**: phot. B. Mühler. – **1a–b**. H.B. 9558 (holotype): Germany, Chemnitz, on *Epilobium*; **2a–f**. H.B. 9899: Annaberg-Buchholz, on *Epilobium*; **3**. H.B. 5530: France, Vosges, on *Ranunculus*; **4a–b**. H.B. 5883: ibid., on *Carex*.

to sublageniform) but never distinctly capitate apices, from *O. cardui* and *O. zhongdianensis* also in the absence of glassy processes. When the paraphyses are tapered, they overtop the living submature asci distinctly more than in the latter three species, while the lower cells tend to be broader than there. However, no tapered paraphyses were seen in the collection on *Cirsium*, and here a morphological distinction from the lignicolous *O. cotoneastri* is problematic. Ascus and spore size as well as spore and SB shape are very similar in all four species. *O. epilobii* is proposed here as a new species because of the sublanceolate paraphyses but mainly for molecular reasons.

At the type locality of *O. epilobii* (on *Epilobium*) also *O. cardui* (on *Angelica*) and *O. rectispora* (on *Typha*) occurred. Because of their similarity one might think that these three hosts carry one and the same *Orbilia* species, but this is disproved by the different sequence data gained for the former two species from this locality. These findings suggest also a certain host specificity within this group of fungi, particularly in that *O. rectispora* is restricted to monocots.

Variation. The four included collections are very similar, although the paraphyses differ in shape, those from Annaberg and Auvergne being partly cylindrical, those of the holotype more lageniform, and those from England more spathulate-lanceolate. In the collection on *Cirsium* the asci and spores were rather narrow (*3.5 and *1.2 µm, respectively).

Not included collections. Two orotemperate (altimontane) samples from a single site near Les Vazenées (Gérardmer, Vosges, on *Ranunculus* and *Carex*, Pls 912: 2–3; 913: 3–4) resemble *O. epilobii* in their consistently uninflated paraphyses and paucity of exudate. The one on *Ranunculus* resembles also *O. cardui*, particularly when comparing the sample on *Fomitopsis* (Pl. 906: 1), both sharing somewhat tear-shaped SBs with a visible filum. The *Carex* collection differs from that on *Ranunculus* in much longer asci and longer spores, much larger apothecia (0.8–2.5 vs. 0.25–0.6 mm), and in showing hyphoid elements covering the marginal cortical cells (Pl. 913: 4a–b). Because of its rather wide spores this sample cannot belong to *O. rectispora*. Also three samples on *Oenanthe* from two sites in Bretagne (IVV: J.P.P. 13123, 15154, 15155) resemble *O. epilobii*, but also the montane collection on *Ranunculus*. They might well belong to *O. epilobii*, but molecular data were not avaiable. From *O. atlantis* they differ in larger, basally ± curved and more tapered spores and whitish apothecia (but in J.P.P. 15155 the spores match *O. atlantis* except for their length of *5.2–8 µm).

Three unpreserved records from Les Vazenées but on *Scirpus sylvaticus*, the type substrate of *O. rectispora*, were only studied by J. Deny (pers. comm., see also Deny 2002). They were said to have rather short asci and spores, but since all typical European records of *O. rectispora* so far showed a planar to colline occurrence, those from altimontane areas need to be recollected and documented (note that the type of *D. nuorilangana*, a synonym of *O. rectispora*, derives from altimontane central China).

Anamorph. A rather short, 3-septate conidium seen in the sample from Annaberg (IVV: H.B. 9899) would fit in the scope of *O. zhongdianensis*, whereas a rather long, 7-septate conidium in an apothecium of the sample from Walsall (IVV: 29.VI.2017) would fit *O. rhopalota*. A few fusoid-clavate conidia of *32–44 × 6.7–7.2 µm with 3–6 septa were seen in one of the not included collections on *Oenanthe* (IVV: J.P.P. 15155), while in the other on that host a larger broken conidium with min. 7 septa occurred (IVV: J.P.P. 15154). Whether all these conidia belong to *O. epilobii* and how representative they are remains unclear.

Phylogeny. Sequences were gained from apothecial fragments of the two sparse German records on *Epilobium* and the abundant French one on *Cirsium*, comprising ITS and LSU, in the holotype also SSU. The S1506 intron is absent in the sample from Annaberg, but present in the other two. Between the two strains on *Epilobium* an ITS distance of 0.8 % is observed, while the *Cirsium* collection differs by only 0.2–0.4 % from them. In the LSU D1–D2 the three strains differ from each other by 1 nt or 1 gap.

O. epilobii clusters in the *cardui-rhopalota* clade (Phyls 25–27, S31). The closest distance in the ITS/LSU (D1–D2) was to *D. rhopalota* (4.5–5.8/0.4–0.7 %), *O. zhongdianensis* (5.8–6.5/0.8–0.9 %), and *O. cardui* (5.5–6/1.5–1.8 %), whereas *O. cotoneastri* and *O. rectispora* show distances of 15.5–16/4.3 % and 19/3.9 %, respectively. A different result is obtained in the SSU (V7–V9), with 0.4 % (*Dactylella cylindrospora*) and 0.7 % (*O. desertorum*, *O. cupressi*, *D. intermedia*) as closest match, while this region was not available for *D. rhopalota*. In the S1506 intron *O. epilobii* shows a high distance to other members of series *Dactylella*, the lowest percentage being to European *O. zhongdianensis* (14 %).

Ecology. *O. epilobii* is so far with certainty known from five locations in cold- to orotemperate humid, atlantic to subcontinental Europe, where it was found on hygric herbaceous stems of *Epilobium*, once also *Cirsium*. The type locality near Chemnitz is a colline wet meadow (abundant *Filipenduletum ulmariae* with *Typha*) surrounded by oak and poplar trees. That from Erzgebirge (ca. 35 km south of the type locality) is a montane, periodically dry pond between a pasture and small woods, and that from Auvergne a dense altimontane forest on moist ground. The two colline sites in England include a marshy place with *Filipendula ulmaria* at a small pond, surrounded by a deciduous forest with, e. g., *Ulmus glabra*, *Acer campestris*, *Fraxinus excelsior*, *Crataegus monogyna*, *Juncus effusus*, *Carex remota* etc. (Fishpool Valley), and a ditch with only *Epilobium hirsutum* at a pond in a forest (Merrions Wood). Perhaps all these locations are flooded during heavier rainfalls, e. g., in winter.

Specimens included. **GREAT BRITAIN**: **West Midlands**, 8.7 km NNW of Birmingham, 4.5 km SE of Walsall, Merrions Wood, 153 m, stem of *Epilobium hirsutum*, 29.VI.2017, P. Thompson (ø, anam. substr., doc. vid.). – **Herefordshire**, 10.5 km SW of Ludlow, 8.5 km NNW of Leominster, N of Croft Castle, Fishpool Valley, 193 m, stem of *E. hirsutum*, 4.V.2017, P. Thompson (H.B. 10079a). – ibid., 8.VII.2017 (ø, non vid.). — **GERMANY**: **Schleswig-Holstein**, 13.5 km SE of Ratzeburg, NNW of Groß Zecher, Küchensee, 40 m, stem of *E. hirsutum*, 26.VI.2018, T. Richter (H.B. 10167). – **Sachsen**, 6 km NNE of Chemnitz, 1 km E of Glösa, Indianerteich, 325 m, stem of *E. hirsutum*, 15.VI.2011, B. Mühler (ex H.B. 9558, M-0276478, **holotype**; sq.: KT222450, KT222446). – Erzgebirge, 31 km S of Chemnitz, 10 km WSW of Annaberg-Buchholz, 2.5 km S of Elterlein, 520 m, stem of *Epilobium* sp., 23.VII.2014, B. Mühler (H.B. 9899, anam. substr.; sq.: KT222404). — **FRANCE**: **Auvergne**, **Haute-Loire**, 29 km NNW of Le-Puy-en-Velay, NE of Sembadel Gare, Les Bois Noirs, 1115 m, stem of *Cirsium palustre*, 8.VI.2015, B. Capoen (B.Ca. 080615, doc. vid.; sq.: KY419180).

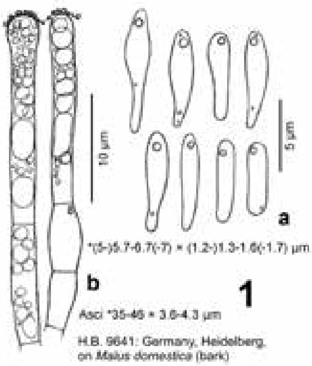


Plate 914. **1**: *Orbilia zhongdianensis*. – **a**. ascospores; **b**. paraphyses.

Not included. **FRANCE**: **Lorraine**, **Vosges**, 3.5 km ESE of Gérardmer, S of Les Vazenées, La Chaume Francis, 960 m, stem of *Ranunculus aconitifolius*, 27.VI.1996, J. Deny (H.B. 5530). – ibid., SE of Les Vazenées, Le Cerceneux Marion, 960 m, leaves of *Carex*, 12.VIII.1997, L. Deny (H.B. 5883). – **Bretagne**, **Finistères**, 4 km N of Quimperlé, 1.3 km NE of Kerfelès, 30 m, stem of *Oenanthe crocata*, 1.VI.2013, Y. Quelenn (J.P.P. 13123, doc. vid.). – **Morbihan**, 0.3 km ESE of La Gacilly, sentier des Libellules, 8 m, stem of *O. crocata*, 3.VII.2015, B. Capoen (J.P.P. 15154, anam. substr., doc. vid.). – ibid., 6.VII.2015, J.P. Priou (J.P.P. 15155, anam. substr., doc. vid.).

Orbilia zhongdianensis (J. Zhang & K.Q. Zhang) Baral, E. Weber & M. Bemmann, **comb. nov.**, MB 813974 — Pls 914–915

Basionym: *Dactylella zhongdianensis* J. Zhang & K.Q. Zhang, Mycotaxon 92: 290 (2005)

Etymology: in reference to the geographical origin of the type, Zhongdian (= Shangri-La), Yunnan province, China.

Typification: China, Yunnan, Shangri-La, soil isolate, 7.IX.2003, J. Zhang (YMF 1.00568, holotype; sq.: DQ494365, KT215287).

Description: — **TELEOMORPH**: **Apothecia** moist/rehydrated 0.5–1.7 mm diam., 0.23–0.32 mm high (receptacle 0.18–0.24 → 0.1–0.13 mm), milky-white to light cream-isabelline(-apricot), ± translucent, round, subgregarious; disc flat, margin distinct, thin or thick, 0–10 µm protruding, smooth to very finely crenulate; sessile on a broad or narrow base, superficial; dry bright dull orange, with thick protruding margin. **Asci** *35–46 × 3.6–4.3 µm {1}, †32–45 × 3.1–4 µm {2}, 8-spored, spores *2–3-seriate, lower ~4 spores inverted {2}, pars sporifera → 9–14 µm long; **apex** (†) medium to strongly truncate (not indented, laterally not inflated); **base** with short to long, thin or thick, flexuous stalk, Y-, h- or H-shaped. **Ascospores** *(5–)5.7–7(–8) × (1.2–)1.3–1.5(–1.7) µm {2}, cylindrical to ellipsoid-fusoid(-clavate), apex rounded to obtuse, base partly medium to strongly attenuated, sometimes with a tail, straight to slightly inequilateral; **SBs** *0.3–0.6 µm diam., ± globose, partly ± eccentrical, attachment invisible (total length 0.8–1.5 µm) {2}. **Paraphyses** apically not or slightly capitate, terminal cell *16–24 × 2–3.5 µm, lower cells *5–11 × 2–2.5(–3) µm. **Medullary excipulum** 30–40 µm thick, of dense textura intricata horizontally oriented, with inflated cells, medium or sharply delimited from ectal excipulum. **Ectal excipulum** of thin-walled, indistinctly oriented t. globulosa from base to margin, 110–150 µm thick near base, cells *13–28 × 11–19(–24) µm {2}; 50–80 µm thick at lower flanks, *7–15 × 6–12 µm, 30–40 µm thick near margin, oriented at an 80–90° angle to the surface, marginal cortical cells *(5–)6–11(–13) × 3.5–6 µm {2}; **glassy processes** 2–17 × 4–6 µm {2}, strongly refractive, stratified, ± straight. **Anchoring hyphae** medium abundant, †1.7–2.5(–3) µm wide, walls 0.2(–0.3) µm thick {1}. **SCBs** not observed; **VBs** medium refractive, globose to elongate, filling entire terminal cell. **Exudate** over paraphyses, margin and flanks 0.2–1 µm thick, granular

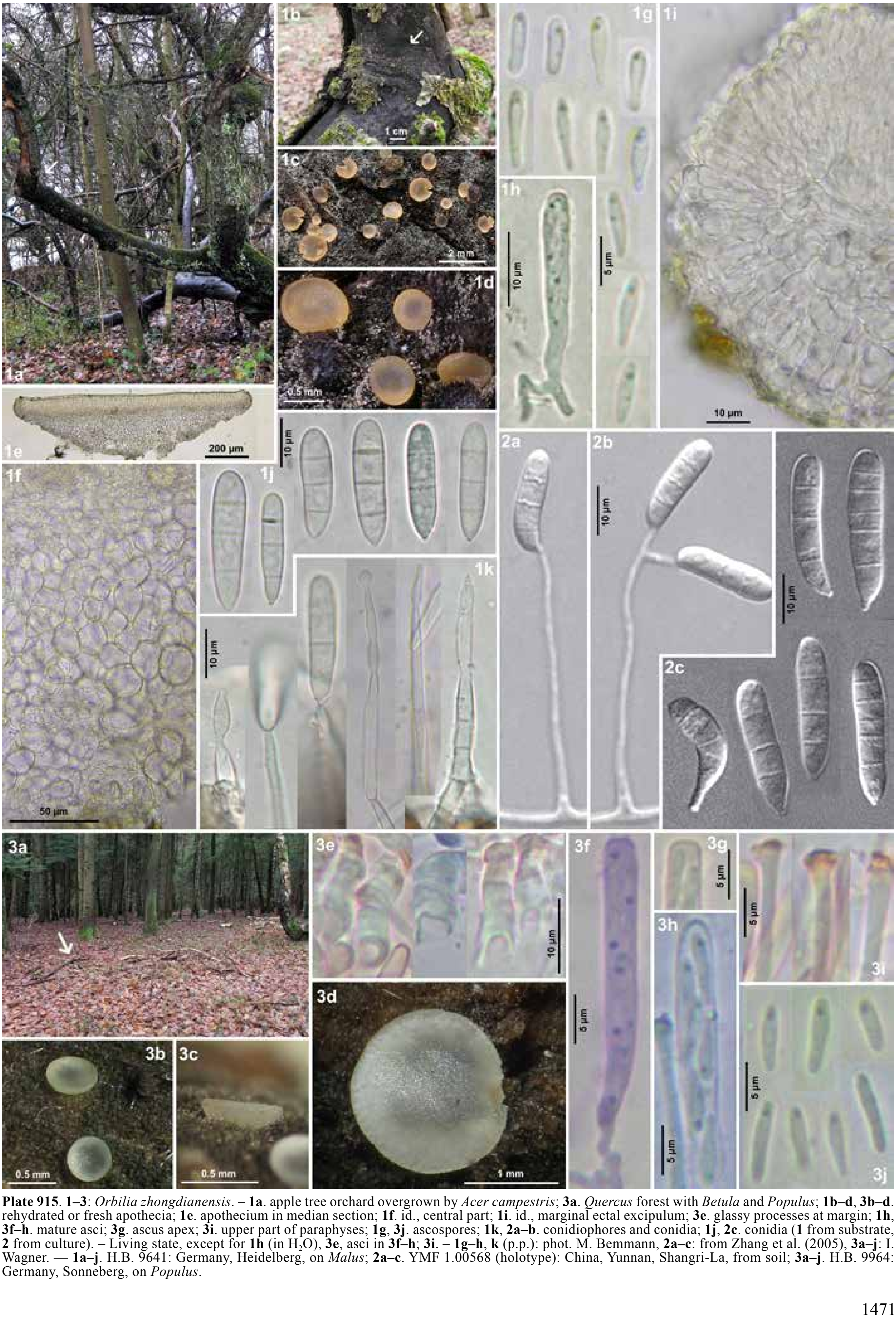


Plate 915. **1–3**: *Orbilia zhongdianensis*. – **1a**. apple tree orchard overgrown by *Acer campestris*; **3a**. *Quercus* forest with *Betula* and *Populus*; **1b–d**, **3b–d**. rehydrated or fresh apothecia; **1e**. apothecium in median section; **1f**. id., central part; **1i**. id., marginal ectal excipulum; **3e**. glassy processes at margin; **1h**, **3f–h**. mature asci; **3g**. ascus apex; **3i**. upper part of paraphyses; **1g**, **3j**. ascospores; **1k**, **2a–b**. conidiophores and conidia; **1j**, **2c**. conidia (**1** from substrate, **2** from culture). – Living state, except for **1h** (in H_2O), **3e**, asci in **3f–h**; **3i**. – **1g–h**, **k** (p.p.): phot. M. Bemmann, **2a–c**: from Zhang et al. (2005), **3a–j**: I. Wagner. — **1a–j**. H.B. 9641: Germany, Heidelberg, on *Malus*; **2a–c**. YMF 1.00568 (holotype): China, Yunnan, Shangri-La, from soil; **3a–j**. H.B. 9964: Germany, Sonneberg, on *Populus*.

to cloddy, hyaline, ± firmly attached. — **ANAMORPH**: dactylella-like (from soil isolate {1} and natural substrate {1}, connection proved by DNA). **Conidiophores** *(20–)40–118(–132) µm {T} or *50–75 µm {1} long, 2.5–5 wide at base, 1–2 µm at apex, unbranched or sometimes branched in middle or upper part. **Conidiogenous cells** monoblastic, rarely sympodial. **Conidia** unbranched, straight to slightly or sometimes strongly curved near base, cylindric(-ellipsoid) to cylindric(-clavate), rounded (to obtuse) at apex, base often with a small basal protrusion, *(17.5–)22–34(–37.5) × (5–)5.7–7(–8) µm, (2–)3(–4)((–6))-septate {T}, or *22.5–27 × 5–6.7 µm, (1–)3(–4)-septate {1}.

Habitat: lying on ground or 1.5 m above, 17–90 mm thick branches of *Malus* sp. {1}, *Populus tremula* {1}, on outer surface of ± detaching, medium decayed remnants of bark (bast) {2}. **Associated**: *Hypnum cupressiforme* {1}, anamorph of *Thaxteriella pezizula* {2}. **Desiccation tolerance**: asci do not survive a few days, after ~3 weeks excipular cells and a few ascospores still viable. **Altitude**: 128–480 m a.s.l. (Germany), 3538 m (Yunnan). **Geology**: Germany: Lower Carboniferous sediment, Upper Buntsandstein; China: mafic volcanic rock. **Phenology**: XI–XII (teleomorph).

Taxonomic remarks. *Orbilia zhongdianensis* resembles the herbicolous *O. cardui*, from which it differs in the ascospores containing smaller, ± eccentrical, invisibly attached SBs (Pls 914: 1a; 915: 1g, 3j), also in shorter conidia with fewer septa. In spore characters the species resembles *O. xinjiangensis* which, however, has larger spores and much larger conidia. *O. clavispora* resembles *O. zhongdianensis* in its anamorph but differs in longer, curved ascospores and a marginal ectal excipulum of distinct, obliquely oriented cell rows.

Anamorph. Zhang et al. (2005) described *Dactylella zhongdianensis* as a 'new predacious antagonist of nematodes', with a 3-dimensional adhesive network. Nevertheless, the authors placed it in *Dactylella* following the generic concept of Subramanian (1964) based on conidial morphology and simple conidiophores. However, Chen et al. (2007b) did not find trapping organs in the type isolate when challenged with nematodes, and also the obtained molecular data support placement in *Dactylella* in the modern sense. The anamorph observed on the natural substrate in the sample from Heidelberg (Pl. 915: 1j–k) concurs very well with the ex-type strain (2a–c).

Zhang et al. (2005) gave a conidial size of 17.5–35 × 5–10 µm, with an average of 28.3 × 7.2 µm. From their scale, however, the conidia measure *17.5–33.5 × 5–7 µm. Chen et al. (2007) measured them as 22–37.5 × 5–8 µm (average 28 × 7 µm), therefore, we have restricted conidial width to a maximum of *8 µm.

Dactylella cylindrospora, isolated from soil under cocoa in Samoa, resembles *O. zhongdianensis* and *O. cotoneastri* in conidial morphology (22.5–45 × 6.5–8.5 µm, (1–)3(–4)-septate) but differs in forming 6–12 conidia at the candelabrelloid conidiophore tip. However, in Chen et al.'s (2007b) redescription of the type strain the conidia are 3(–7)-septate and measure 29–51 × 8.5–13 µm.

Phylogeny. Sequences were gained in the present study from the Chinese ex-type culture (soil isolate) and the two German samples (from apothecia), comprising S1506 intron, ITS, LSU, and in two strains also SSU. The ex-type culture was also sequenced by Chen et al. (2007a) for the ITS region, and their sequence fully agrees with ours, and also the German samples correspond quite well to them (0.8 % distance), except for a few gaps in the ITS1 and particularly a deviating motif at its 5'-end (AAA**TTT**AT vs. AAA**C--**AT). However, the *Malus* sample was incompletely sequenced in the ITS1, with some uncertain and ~83 missing nt). In the available parts of SSU (V8–V9) and LSU (D1–D2) the German samples do not differ at all from the type. Obviously, the three strains are conspecific. However, in the S1506 intron the Chinese strain differs from the two from Germany by 15.3 % in the overlapping region, while the two latter are completely identical, also the length is 1565 nt in the ex-type strain but only 385 in the German strains.

In our analysis of ITS (Phyl. 26), but not in the LSU and combined tree (Phyl. 27, S31), *O. zhongdianensis* formed with *D. rhopalota* a strongly supported clade, showing an ITS distance of only 2.9–3.7 % (LSU D1–D2 1.5 %). Although *O. cardui* and *O. epilobii* show to *O. zhongdianensis* a lower LSU distance of 0.8–1 %, a much higher ITS distance of 5.8–7 % is observed. *D. cylindrospora* clustered unresolved and with high distance to other species of series *Neodactylella*.

Ecology. The type strain was isolated from soil in a highland forest (probably coniferous with *Rhododendron*) in the eastern Himalaya near Zhongdian in northwestern Yunnan (China), which shows a orotemperate humid (winter-dry), continental climate. The two European collections were on rotten, hygric or mesic angiosperm bark in colline, subcontinental, cold-temperate humid shady forests on acidic soil. In the sample on *Malus* the apothecia occurred on the main trunk of a standing dead tree 1.5 m above the ground. The orchard was overgrown by *Acer campestris*, which possibly caused the death of the *Malus* tree. The apothecia grew amongst conidiophores of *Thaxteriella pezizula*, and the anchoring hyphae of *O. zhongdianensis* seemed to be parasitic on the conidiophores. Also in the sample on a branch of *Populus* lying on the ground in a *Quercus* forest with *Betula* and *Populus*, numerous sigmoid conidia occurred which might belong to *T. pezizula*.

Specimens included. **GERMANY**: **Thüringen**, 2.3 km NW of Sonneberg, 1 km NNE of Bettelhecken, Wehd, 480 m, branch of *Populus tremula*, on bark, 9.XI.2014, I. Wagner (H.B. 9964; sq.: KT380101). – **Baden-Württemberg**, 12.5 km E of Heidelberg, 1 km SE of Neckarsteinach, 128 m, branch of *Malus domestica*, on bark, 30.XII.2011, M. Bemmann (H.B. 9641, anam. substr.; sq.: KT222436). — **CHINA**: **Yunnan**, **Dêqên**, 32 km E of Shangri-La (Zhongdian), Bitahai, 3538 m, soil isolate, 7.IX.2003, J. Zhang (YMF 1.00568, **holotype**, conid. isol., doc. vid.; sq.: DQ494365, KT215287).

Orbilia rhopalota (Drechsler) Baral & E. Weber, **comb. nov.**, MB 813975 — Pl. 5: q

Basionym: *Dactylella rhopalota* Drechsler, Mycologia 35: 357 (1943)
≡ *Gangliophragma rhopalota* (Drechsler) Subram., Kavaka 5: 94 (1977)

Etymology: *rhopalota*: named after the clavate conidial shape.
Typification: USA, Maryland, Beltsville, forest litter, I.1938, C. Drechsler (holotype, illustration in Drechsler 1943: fig. 3 H–O).

Description: — **TELEOMORPH**: unknown. **ANAMORPH** (from Drechsler 1943 and Rubner 1996): dactylella-like (from environmental isolates). **Conidiophores** unbranched or sympodially branched, 50–200 µm long, 2.5–4 µm wide at base, 1–2 µm at apex. **Conidia** unbranched, straight, cylindric-clavate, rounded to obtuse at apex, *36–60 × (6–)7.5–8.5(–9.5) µm, (3–)7(–10)-septate.

Taxonomic remarks. Thakur & Zachariah (1989) isolated from the rhizosphere of soybeans in Ontario a dactylella-like anamorph which they identified with Drechsler (1943b) as *Dactylella rhopalota*. The culture produced in the presence of bacteria apothecia of an *Orbilia* which the authors could not identify at the species level. Although the description of the teleomorph is too inaccurate to recognize the species, we believe that it was a member of series *Neodactylella*, based on the †~4.5–6 × 0.8 µm large, rod-shaped ascospores (evaluated from scale) that are sometimes slightly tapered and bent at the base, and the apparently H-shaped ascus base, together with the anamorph. An earlier assumption that it could be *Hyalorbilia inflatula* (Baral in Rubner 1996: 22, as *O. inflatula*) is obviously unfounded. Thakur & Zachariah's photo shows clavate conidia with a stipe-like basal protrusion, which are seemingly surrounded by a halo. The authors measured them as 42.5–55 × 5–6.5 µm and observed 8 septa, whereas in the type of *D. rhopalota* Drechsler (1943b) gave distinctly wider conidia (*36–60 × 6.7–9.6 µm) with mainly 7 septa. Rubner (1996) examined and identified several CBS cultures as *D. rhopalota* (e. g., CBS 493.67 and 615.92), most of which were first named *D. minuta* and erroneously thought to be nematophagous. Her conidial data are similar to Drechsler's: 36–60 × 6–8.5 µm, (3–)7(–10)-septate.

In conidial shape and number of septa, these *D. rhopalota* strains resemble the anamorphs of *Orbilia cardui* and *O. cotoneastri*, except that these species have smaller, especially shorter conidia on average, and septal numbers higher than 7 were not encountered. An unpreserved, submature specimen from France, identified as *O.* cf. *cardui* (26.I.1997, on *Pinus* cone, with 3–12 µm long glassy processes), would fit well the type of *D. rhopalota* based on the distinctly larger conidia (*50–53 × 8.3 µm, 7-septate, clavate-cigar-shaped, not illustrated) found in association with the teleomorph. Possibly, this record represents *D. rhopalota*, especially when considering the repeated isolation of *D. rhopalota* from coniferous substrate. It seems further possible that the type of *O. pellucida* represents *D. rhopalota*, because it grew on a twig of *Juniperus*. *D. rhopalota* also resembles the presumed anamorph of *O. crenatomarginata* (section *Aurantiorubrae*, see p. 872). Based on our broad concept of *Orbilia*, and because it will be difficult to clarify the identity of *O. pellucida* which would have priority over *D. rhopalota*, we here propose a new combination for *D. rhopalota* into *Orbilia*.

Phylogeny. For the North American holotype of *O. rhopalota* no culture or sequence seem to exist. Six European strains, mostly isolated from plant substrate, were identified as *D. rhopalota* by Rubner (1987). Except for that from UK, all carried the name *D. minuta*. Five were sequenced by Chen et al. (2007a) for the ITS region, and one (CBS 664.75) exists only inofficially at CBS. All of them agree by a 0.2–0.6% distance. Whether any of them possesses the S1506 intron is unclear because the ITS1 primer was used.

Sequences from two uncultured soil isolates from Alaska (GU083160, ITS) and California (dm5l_b3, ITS2+LSU) are obviously conspecific with those, the former differing by 0–0.4% in the entire ITS, the latter by 2–4 nt in the ITS2. *O. rhopalota* clustered strongly supported with *O. zhongdianensis* (Phyl. 26), with an ITS distance of 2.9–3.7%. *O. epilobii* deviates by 4.5–5.8% and *O. cardui* by 7.5%. One of the European strains (CBS 493.67) comprises also SSU V1–V9 (lacking the 3'-end with the S1506 position) and LSU. In the LSU D1–D2 the distance is 0.7% to *O. epilobii*, 1.5 % to *O. zhongdianensis*, and 2.5% to *O. cardui*.

Ecology. *O. rhopalota* was isolated from not further specified forest litter near Beltsville (type, warm-temperate humid eastern North America), but DNA extracts indicate occurrence in boreal and mild-maritime humid western North America. The CBS strains studied by Rubner (1996) were from subatlantic Netherlands, atlantic England, and from Sweden, and include decaying wood and leaf litter of *Juniperus* and *Pinus*, and living leaves of *Fraxinus*.

Specimens included. **USA**: **Maryland**, Beltsville, forest litter, I.1938, C. Drechsler (**holotype** [illustration], conid. isol., doc. vid.). – **Alaska**, unlocalized, from soil, undated (K.M.E. Stone et al., T1-B6-ITSFL, mol. extr.; sq.: GU083160). – **California**, ~30 km WSW of Santa Rosa, Bodega Bay, ~30 m, soil under *Lupinus arboreus* (Smith & Jaffee 2009, dm5l_b3, sq.: EF446000). — **NETHERLANDS**: **Noord-Holland**, Bergen, on wood of *Pinus sylvestris*, 8.X.1967, W. Gams, vid. A. Rubner (CBS 493.67, conid. isol., non vid.; sq.: AJ001992, DQ494369, AY261177, MH870756). – ibid., from needle of *Pinus* sp., 1968, W. Gams, vid. A. Rubner (CBS 616.92, conid. isol., non vid.; sq.: DQ494368). – **Drenthe**, Lheedorp near Wijster, from litter of *Juniperus communis*, XI.1975, W. Gams, vid. A. Rubner (CBS 664.75, as *D. minuta*, conid. isol., non vid., sq.: CBS ined.). – **Utrecht**, Baarn, from decaying wood, X.1967, W. Gams, vid. A. Rubner (CBS 615.92, as *D. minuta*, conid. isol., doc. vid.; sq.: DQ494367). — **SWEDEN**, unlocalized, X.1975, G.L. Hennebert, vid. A. Rubner (CBS 617.92, as *D. minuta*, conid. isol., non vid.; sq.: DQ494366). — **GREAT BRITAIN**: **North West England**, **Cumbria**, Meathop Wood, Intern. Biol. Programme site, Westmoreland, on a living leaf of *Fraxinus excelsior*, VIII.1970, J.C. Frankland, vid. A. Rubner (CBS 845.70 [as 'CBS 475.70' in Rubner 1996], conid. isol., non vid.; sq.: DQ494370, MH871769).

Orbilia leporina Velen., Opera Bot. Čech. 4: 103 (1947) — Pl. 916

?= *Orbilia leucostigma* var. *charticola* Feltgen, Rec. Mém. Trav. Soc. Bot. G.-D. Luxemb. 14: 54 (1899)
≡ *Orbilia luteorubella* f. *charticola* (Feltgen) Feltgen, Rec. Mém. Trav. Soc. Bot. G.-D. Luxemb. 15: 36 (1901).

Etymology: *leporina*: named after the substrate, hare droppings, *charticola*: after its growing on a cardboard.

Typification: Czechia, Mnichovice, dung of *Lepus*, 6.VIII.1941, J. Velenovský (PRM 152419, holotype of ***Orbilia leporina***). — Luxembourg, Mersch, on cardboard, 29.VI.1896, J. Feltgen (LUX 042447, holotype of ***O. luteorubella* f. *charticola***).

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.4–0.5 mm diam. (Velenovský: 0.5–1 mm), 0.14 mm high, now pale yellowish-cream (Velenovský: yellowish), translucent, round; disc slightly concave then flat, margin indistinct, not protruding, smooth; broadly sessile, superficial. **Asci** †32–45 × 3.5–3.7 µm, 8-spored, spores †2–3-seriate, 4 lower spores inverted (not mixed); **apex** (†) strongly truncate (not indented, laterally hardly inflated); **base** with medium long, thin, flexuous stalk, L- to Y-shaped (rarely seen). **Ascospores** †(6–)7–8(–9.2) × 1.1–1.3(–1.4) µm, narrowly fusoid-clavate (to fusoid), apex rounded to obtuse (rarely subacute), base medium to strongly attenuated, slightly curved to geniculate, especially in lower part; **SBs** very indistinctly seen in dead spores. **Paraphyses** apically uninflated to medium capitate, terminal cell †12.5–15 × 2–3.3 µm, lower cells †4–8.5 × 1.4–1.9 µm; unbranched at upper septum. **Medullary excipulum** 60 µm thick. **Ectal excipulum** of (†) thin-walled, vertically oriented textura globulosa-angularis from base to margin, 35–40 µm thick near base, cells †8–12 × 8–10 µm; 30 µm thick near margin, outer part of t. prismatica oriented at a 80–90° angle to the surface, marginal cortical cells †6–14 × 3–4.5 µm; **glassy processes** absent. **Anchoring hyphae** sparse, †2.2.7 µm wide, walls 0.2–0.25 µm thick. **SCBs** and **VBs** no data available. **Exudate** over paraphyses 0.3–1 µm thick, rough, firmly attached, over margin and flanks ~0.2–0.5 µm thick, granular. — **ANAMORPH**: dactylella-like (presumed, from natural substrate). **Conidiophores** not seen. **Conidia** ellipsoid-clavate, straight, †31–45 × 7.5–7.7 µm, 3–7-septate.

Habitat: collected on the forest floor, on droppings of *Lepus europaeus*. **Associated**: *Coprotus sexdecimsporus*, *Saccobolus dilutellus*, *Sporormiella australis*, *S. octomera*. **Desiccation tolerance**: unknown. **Altitude**: 360 m a.s.l. **Geology**: amphibole biotite & tonalite, quartz diorite. **Phenology**: VIII.

Taxonomic remarks. *Orbilia leporina* seems to be closely related to *O. cardui* and *O. cotoneastri*, from which it is tentatively separated here by basally more attenuated and curved ascospores and the occurrence on dung, from *O. cardui* also in the absence of glassy processes. *O. leporina* differs

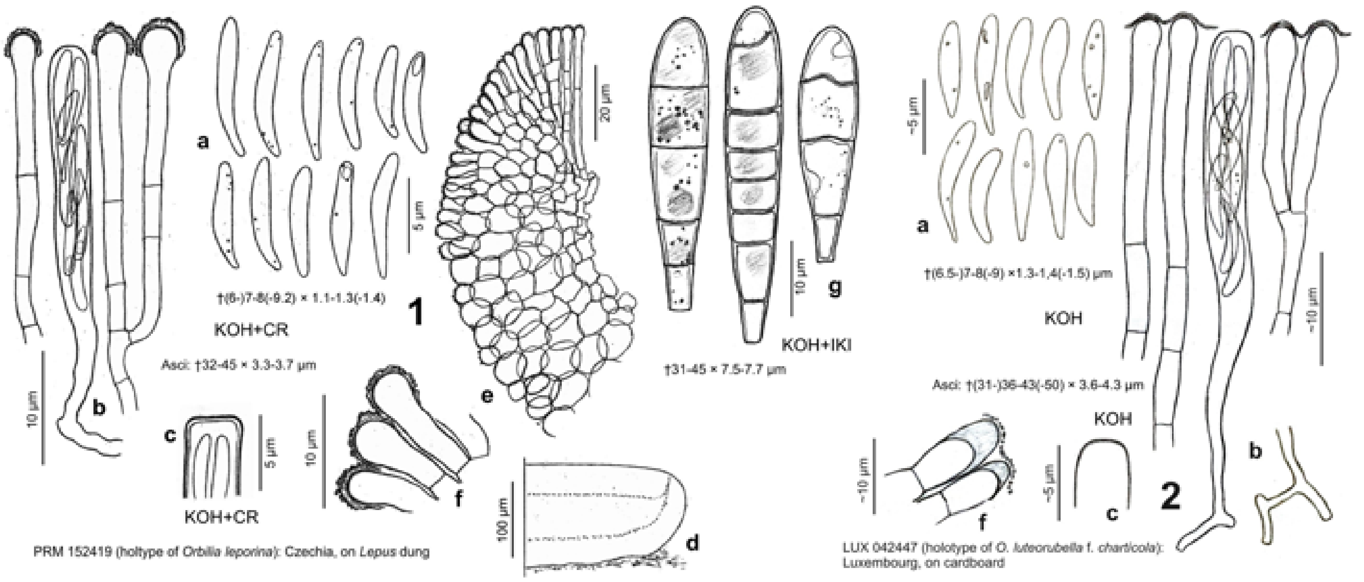


Plate 916. **1**: *Orbilia leporina*; **2**: *Orbilia* cf. *leporina*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. apothecia in median section; **e**. id., ectal excipulum at margin and mid flanks; **f**. id., marginal cortical cells, with or without glassy processes; **g**. conidia from substrate.

from the caulicolous *O. rectispora* in slightly longer asci and wider spores, also in an exudate forming individual caps on the paraphyses, finally in conidial shape (see below). The lignicolous *O. mammillata* differs from *O. leporina* in slightly longer and narrower spores, shorter asci, short glassy processes at the margin, and especially in very differently shaped conidia. The tropical *O. cocois* is only tentatively separated from *O. leporina* (see p. 1474).

Type studies. Contrary to Svrček (1954), the holotype of ***O. leporina*** is not empty. In the present study two apothecia could be found which belong to *Orbilia* section *Arthrobotrys*, not to *Hyalorbilia* as suggested by Svrček (as *O. inflatula*) based on Velenovský's brief description. In fact, the spores are much longer than Velenovský indicated, and also at least slightly curved (Velenovský described them as '3–5 × 1 µm, narrowly linear, straight'). Velenovský saw also the associated conidia (see below).

The holotype of ***O. luteorubella* var. *charticola*** (on rotten cardboard, Pl. 916: 2) resembles *O. leporina* in many respects. The ascospores are slightly (to medium) curved, apically obtuse and basally often strongly tapered. Feltgen (1899) reported them as 'straight to slightly flexuous, rod-shaped, 6–8 × 1–1.5 µm'. The apothecia were described as whitish-yellowish, 0.2–0.5 mm diam., but in the present study they were rehydrated 0.3–1 mm diam., finally convex and up to 350 µm thick, white to light yellow-ochraceous. The cells of the marginal excipulum are oriented at a 60–70° angle and terminated by glassy caps of 3–6 × 3.5–4.5 µm (Pl. 916: 2f). These and the scarcely inflated paraphysis apices are covered by a thin granular exudate. The taxon is clearly not related to section *Helicoon* but resembles *O. leporina* and also *O. cocois* and *O. cardui*, from which it deviates in a ± gelatinized basal ectal excipulum and abundant anchoring hyphae forming a gelatinized layer, from *O. leporina* also in the presence of cap-like glassy processes at the margin, from *O. cardui* in longer, more attenuated and curved ascospores, and from *O. cocois* in, e. g., longer terminal cells of paraphyses.

Anamorph. The conidia found on the substrate of *O. leporina* were also seen by Velenovský who described them as 'cylindrical corpuscules 50 × 8 µm, attenuated at both ends, 6–8-septate, emerging from the yellowish anchoring hyphae'. They fit well those of other members of series *Neodactylella*, such as *O. cardui* and *O. cotoneastri*, but also in *O. cocois* we found very similar conidia. Identity with the coprophilous '*Monacrosporium*' *subtile* Oud. seems to be excluded, because this taxon was described with longer conidia (45–70 × 5–7 µm) with up to 13 septa. Type material of '*M.*' *subtile* could not be located (Rubner 1996).

Ecology. *O. leporina* was collected in a colline *Picea* forest on droppings of *Lepus europaeus* ('ad excrementa leporina') in subcontinental, cold-temperate humid eastern Europe. *O. leucostigma* var. *charticola* grew on cardboard lying in a moist wastewater gutter in a comparable, almost subatlantic climate.

Specimens included. **CZECHIA**: **Central Bohemia**, 26 km SE of Praha, W of Mnichovice, above Zítův mlýn (ancient mill), 360 m, dung of *Lepus europaeus*, 6.VIII.1941, J. Velenovský (PRM 152419, **holotype** of *O. leporina*, H.B. 6187 ø, anam. substr.).

Not included. **LUXEMBOURG**: **Gutland**, 15 km N of Luxembourg, Mersch, 230 m, cardboard, 29.VI.1896, J. Feltgen (LUX 042447, **holotype** of *O. luteorubella* f. *charticola*; H.B. 5359 ø).

Orbilia cocois Baral, **sp. nov.**, MB 813976 — Pls 917–918

Etymology: named after the host, *Cocos nucifera*.

Typification: Mexico, Cancun, petiole of *Cocos nucifera*, 16.II.2004, M. Eckel (ex H.B. 7647, M-0276458, holotype).

Latin diagnosis: *Similis* Orbiliae leporinae *sed ascosporae leniter breviores et latiores, paraphyses ad apicem haud inflatae, cellulae terminales partim non longiores quam cellulis aliis, excipulum marginale processis vitreis, apothecia aurantio-lutea. Habitat ad petiolum* Cocois *in zona tropica humida Americae centralis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.25–0.75(–1) mm diam., 0.11–0.19 mm high (receptacle near margin 0.07–0.08 mm), light to bright yellowish-orange, medium translucent, round, subgregarious; disc slightly concave to flat, margin thick, slightly raised but not protruding, smooth; sessile on a narrow or broad base, superficial; dry bright to deep orange(-red). **Asci** †37–46 × (3.6–)3.8–4 µm, 8-spored, spores †2–3-seriate, 3–4 lower spores inverted (sometimes mixed); **apex** (†) medium to strongly truncate (not indented, laterally not or scarcely inflated); **base** with short to medium long, ± thin and flexuous stalk, L- to h- (?and H-)shaped.

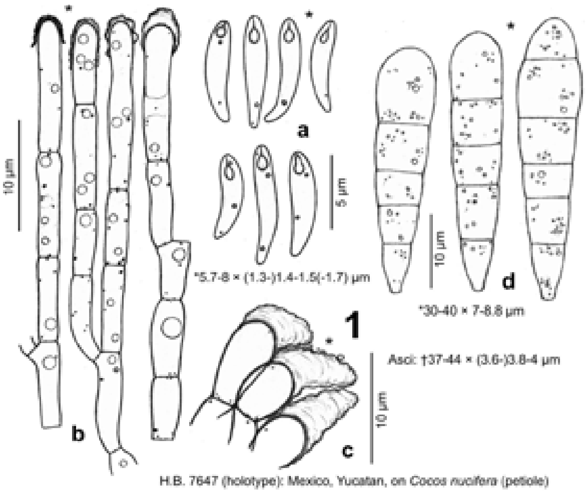


Plate 917. **1**. *Orbilia cocois*. – **a**. ascospores; **b**. paraphyses; **c**. marginal cortical cells of ectal excipulum in median section, tipped by glassy processes; **d**. conidia from substrate.

Ascospores *5.7–8 × (1.3–)1.4–1.5(–1.7) µm, †6–7.8 × 1.3–1.5 µm, cylindric- to fusoid-clavate, apex (rounded to) obtuse, base slightly to often ± strongly attenuated, entirely or towards base slightly to medium curved; **SBs** *(1.3–)1.5–1.7(–1.9) × (0.4–)0.5–0.7 µm, nearly globose to mostly tear- (to pear–)shaped, apically narrowed to a fine, (very) short filum. **Paraphyses** apically uninflated or sometimes very slightly clavate, terminal cell *(7.5–)12–17 × 2–2.5(–3) µm, †3–5 µm longer than asci, lower cells *6.5–12(–14) × 2–2.5 µm, near base also *4–7 × 3.3 µm; unbranched at upper septum, hymenium hyaline. **Medullary excipulum** hyaline to pale orange, 25–30 µm thick, of dense textura globulosa-intricata, medium sharply delimited from ectal excipulum. **Ectal excipulum** of thin-walled, vertically oriented t. angularis(-prismatica) from base to mid flanks, 30–60(–110) µm thick near base, cells *8–23 × 7–15 µm; 20–30 µm thick at flanks, 20–25 µm thick near margin, of t. (angularis-)prismatica-porrecta oriented at a 50–80° angle to the surface, marginal cortical cells *6–10 × 3.5–4 µm; **glassy processes** 4–6 × 4–5 µm, medium refractive and stratified, at margin often only 0–2 µm long. **Anchoring hyphae** quite abundant, *1.5–2.3 µm wide, at insertion up to 3(–4) µm, walls 0.2 µm thick, partly forming projecting strands. **SCBs** in paraphyses globose, 0.6–1.8 µm diam.; **VBs** absent. **Exudate** over paraphyses 0.2–1.5 µm thick, forming rough, firmly attached caps on each tip, mostly also laterally (4–7 µm from tip), sometimes loosely attached, pale yellowish; over margin and flanks more scattered, cloddy-granular. — **ANAMORPH**: dactylella-like (presumed, from natural substrate). **Conidiophores** not observed. **Conidia** *30–40 × 7–8.8 µm, (cylindric-)clavate, 4–5-septate.

Habitat: lying on ground, on inner surface of petiole of *Cocos nucifera*, slightly decayed, on white layer of fibrous hairs covering the epidermis,

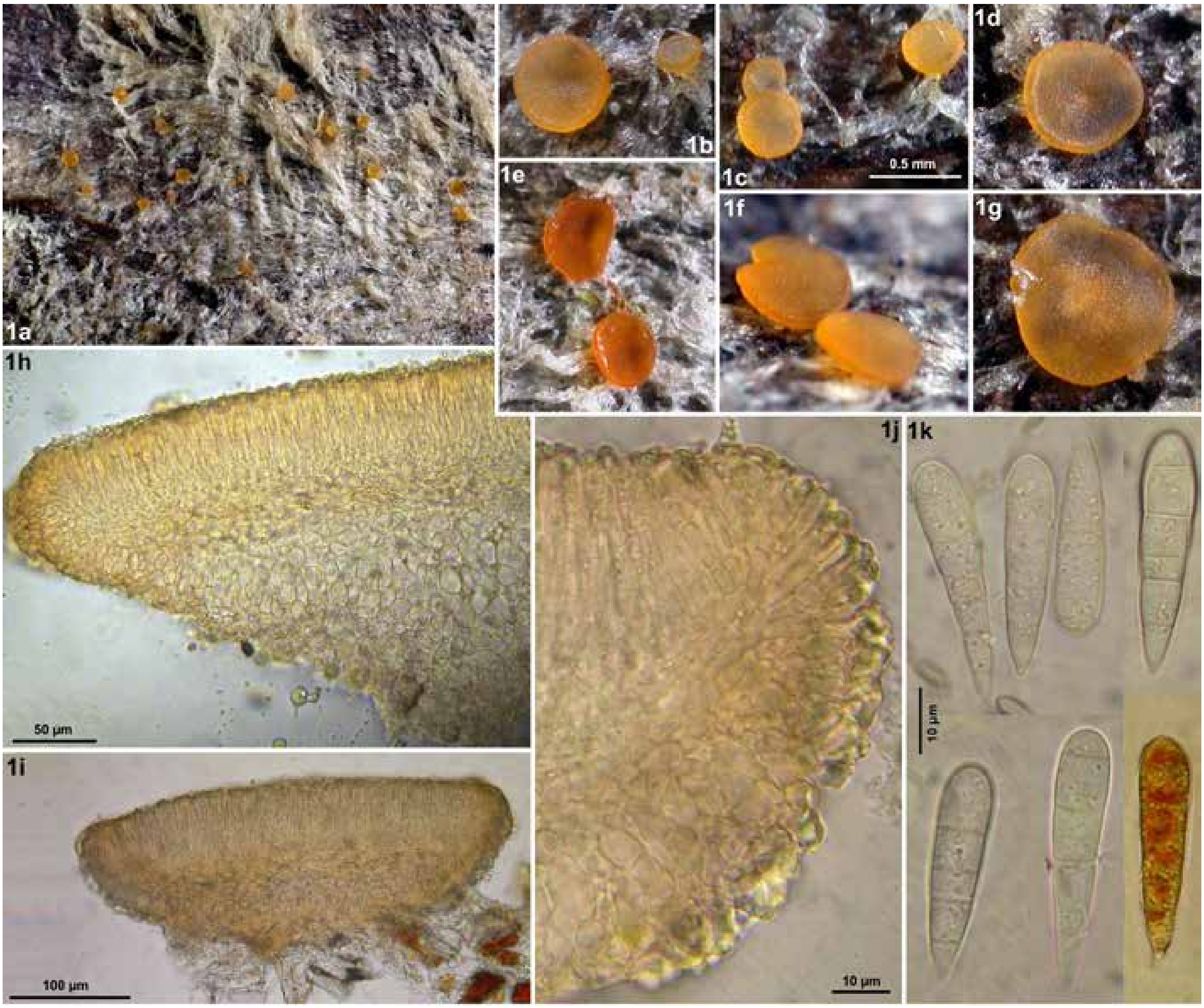


Plate 918. **1**: *Orbilia cocois*. – **1a–d**, **f–g**. rehydrated apothecia; **1e**. dry; **1h–i**. apothecia in median section; **1j**. id., marginal region of ectal excipulum; **1k**. conidia from substrate. – Most cells in the living state (including the conidium stained in IKI). — **1a–k**. H.B. 7647 (holotype): Mexico, on petioles of *Cocos*.

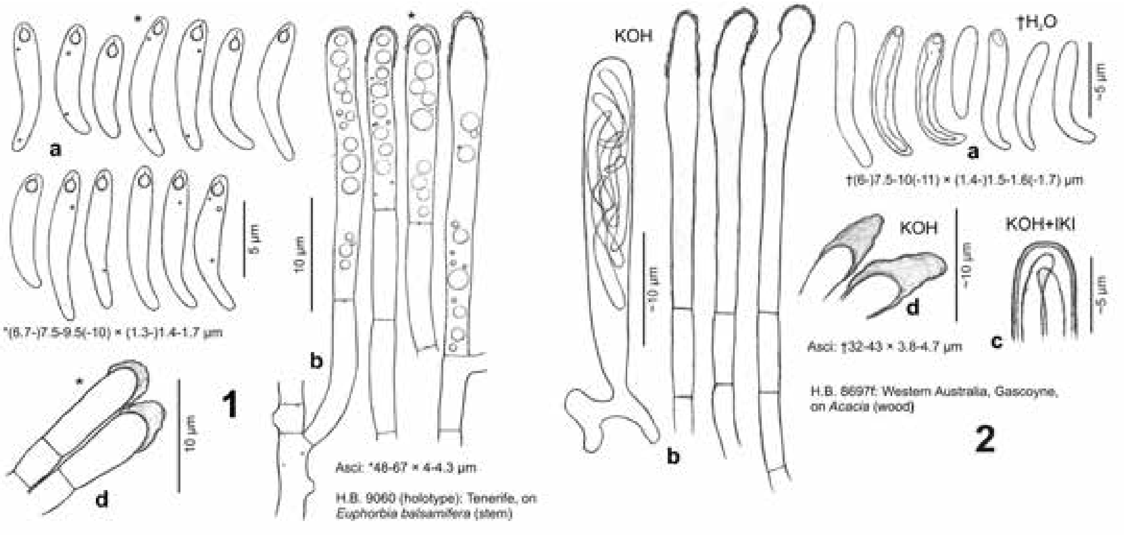


Plate 919. **1**: *Orbilia pseudeuphorbiae*; **2**: *O.* cf. *pseudeuphorbiae*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apex; **d**. marginal cortical cells with glassy processes in median section.

slightly greyed, green algae sparse (on outer surface very sparse). **Associated**: none observed. **Desiccation tolerance**: spores and cells of ectal and medullary excipulum still viable after 11 months, after 25 months a few excipular cells still viable. **Altitude**: 5 m a.s.l. **Phenology**: II (tropical belt).

Taxonomic remarks. *Orbilia cocois* is tentatively separated from *O. leporina* because of slightly shorter and wider ascospores, short glassy processes at the margin, paraphyses with less inflated apices and more equally distributed septa, and more orange apothecia, also because of a very different ecology. However, the associated conidia hardly differ from those of *O. leporina*.

O. cocois strongly resembles *O. cardui* and especially the type of *O. luteorubella* f. *charticola* in the spores, but deviates in shorter terminal cells of paraphyses, light orange apothecia, a pronounced desiccation tolerance, and a tropical occurrence, from the former also in more curved spores. The similar *O. desertorum* differs in longer, more curved spores, and in smaller, less clavate conidia with fewer septa.

O. cocois shows some similarity with members of series *Regales* (section *Aurantiorubrae*), e. g., the European *O. aradi*, which differs in spores with globose SBs and in the associated vermispora-like anamorph, or the Australian *O. kingsiana* which differs in wider SBs with a thicker filum, much longer terminal cells of paraphyses with more inflated apices covered by thicker glassy caps, and in apothecial colour.

Not included collection. A sample on leaf sheaths of *Zea* in Galicia (IVV: H.B. 10189) has basally less tapered spores of *~6.2–7.5 × 1–1.2 µm (J. Castillo pers. comm.). Its dry bright orange apothecia are seated on a very thick (100–180 µm), strongly gelatinized subiculum which is restricted to the area below each apothecium.

Ecology. *O. cocois* was found on a slightly decayed xeric petiole of *Cocos nucifera* close to the coastline of the tropical humid (dry in late winter) Caribbean Sea in Middle America.

Specimens included. **MEXICO**: **Yucatán peninsula**, Cancun, Riviera Maya, ~2 km from coastline, near golf course, 5 m, petiole of *Cocos nucifera*, 16.II.2004, M. Eckel (ex H.B. 7647, M-0276458, **holotype**, anam. substr.).

Not included. **SPAIN**: **Galicia**, 2.5 km SW of O Grove, WSW of Estonllo, 15 m, on leaves of *Zea mays*, 18.II.2019, M.A. Delgado, vid. J. Castillo (H.B. 10189).

Orbilia pseudeuphorbiae Baral, Quijada & Beltrán-Tej., **sp. nov.**, MB 813977 — Pls 919–920, Map 148

Etymology: after the similarity to *O. euphorbiae* (section *Aurantiorubrae*).

Typification: Macaronesia, Tenerife, Arico, branches of *Euphorbia balsamifera*, 22.III.2009, L. Quijada, R. Castro & F. Rodríguez (ex H.B. 9060, M-0276569, holotype; sq.: KT222371).

Latin diagnosis: *Similis* Orbiliae euphorbiae *sed corpuscula refringentia ascosporarum latiora, paraphyses ad apicem haud lageniformes, excipulum marginale processis vitreis brevioribus, apothecia pallide colorata. Habitat ad lignum putridum ramulorum siccorum* Euphorbiarum *in zona inframediterranea (semi)arida Macaronesiae.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.4–)0.6–1.3(–1.6) mm diam., 0.15–0.22(–0.27) mm high (receptacle 0.13–0.15 → 0.06–0.09 mm), whitish to pale or light cream-ochre to chestnut-brownish, slightly to medium translucent, round, finally slightly lobate, scattered to gregarious in ± small groups; disc slightly concave, margin rather thick, 5–10 µm protruding, smooth to very finely rough; broadly sessile or with very short and broad stipe, superficial; dry bright cream-ochre to brownish-orange, strongly contracted, with inrolled margin. **Asci** *(42–)45–60(–67) × (3.5–)3.8–4.3 µm {3}, 8-spored, spores *2-seriate, 3–6 lower spores inverted {3} (± strongly mixed), pars sporifera *(22–)26–30(–40) µm long; **apex** (†) medium to strongly truncate (not or only very slightly indented and laterally widened); **base** with a very short to medium long, thin or thick, flexuous stalk, L-, Y-, h- or H-shaped. **Ascospores** *(6.3–)7–9(–10) × (1.3–)1.4–1.7(–1.9) µm {3}, narrowly cylindric- to fusoid-clavate, apex rounded to obtuse, base slightly to medium attenuated, often tail-like, slightly to medium curved or geniculate at lower third of spore; **SBs** *(1.1–)1.2–1.5(–1.8) × (0.5–)0.6–0.8(–1) µm {3}, globose to broadly tear-shaped, apically abruptly narrowed to a short, sometimes invisible filum, usually slightly eccentrical; with a few minute LBs. **Paraphyses** uninflated or very slightly spathulate-lageniform, terminal cells *16–22(–36) × (2–)2.3–3(–3.7) µm {3}, ± equalling the living, not fully turgescent asci, exceeding the dead asci by ~1–3 µm, lower cells *6–14 × 1.7–2.5 µm {3}; exceptionally branched at upper septum. **Medullary excipulum** hyaline, 30–60 µm thick (up to 130 µm in centre), of dense textura intricata with many inflated cells, sharply delimited by a 10 µm thick layer of t. porrecta. **Ectal excipulum** pale ochraceous, of thin-walled, vertically oriented t. globulosa-angularis(-prismatica), 50–90 µm thick near base, cells *(4–)7–18 × (3–)6–12(–15) µm {3}; 20–30 µm thick at flanks and margin, at margin of t. prismatica-angularis oriented at a 60–80° angle to the surface, sometimes forming indistinct cell rows, marginal cortical cells *(6–)8–12(–14) × 2.7–4 µm {2} (5–9 µm long at submargin); **glassy processes** 1–3(–10) × 3–4(–5) µm {3}, strongly refractive, ± stratified. **Anchoring hyphae** abundant, *1.5–3 µm wide {1}, walls 0.2

Plate 920. **1–3**: *Orbilia pseudeuphorbiae* (on *E. balsamifera*); **4**: *O.* cf. *pseudeuphorbiae* (on *Acacia*). – **1a**. tabaibal dulce (with *Astydamia* and *Salsola*, in foreground large shrub of *Euphorbia balsamifera*); **1b**. dead *E. balsamifera*; **1c–e**, **4a–c**. rehydrated apothecia; **1f**. dry apothecia; **1g**. apothecium in median section; **3a–b**. id., ectal excipulum at lower and mid flanks; **3c**. id., at margin; **1h**. id., at base; **1i**. upper part of paraphyses; **2a–b**. asci and paraphyses; **1j**, **2c**, **3d**. ascospores; **3e**. conidia (from substrate). – Living state, except for left ascus in **2b**, some cells in **3a–b**. – **1a–b**, **d–f**, **i**, **2a–c**, **3a–e**: phot. L. Quijada. — **1a–n**. H.B. 9060 = TFC 21755 (holotype): Tenerife, Arico; **2a–c**. TFC 22852: Tenerife, Montaña Amarilla, on *E. balsamifera*; **3a–e**. TFC 22646–8: Tenerife, Tejina, on *E. balsamifera*; **4a–c**. H.B. 8697f: Western Australia, Meekatharra.

µm thick {1}, forming a loose t. intricata(-porrecta) 30–60 µm thick at base, embedded in non-refractive gel. **SCBs** in paraphyses and marginal excipulum globose, 0.7–2 µm diam. {2}, singly or sometimes densely filled (partly VBs?). **Exudate** over paraphyses 0.3–0.7 µm thick, rough to granular-cloddy, hyaline, firmly attached, covering also the sides of the tips; over margin and flanks 0.2–1(–2) µm thick, very pale yellowish to bright honey-yellow. — **ANAMORPH** dactylella-like (presumed, from natural substrate {1}): **Conidiophores** not seen. **Conidia** *24–26 × 5.3–7.5 µm {1}, straight, cylindric-ellipsoid, with rounded apex and hardly tapered base, 5–6-septate, containing a few minute LBs.

Habitat: lying on dry ground, on 10–140 mm thick branches of *Euphorbia balsamifera* {14}, *E. canariensis* {7}, *E. lamarckii* {1}, on medium decayed wood {22}, ± ungreyed, no algae. **Associated** (L. Quijada pers. comm.): *Orbilia eucalypti* {2}, *O. pisciformis* {4}, ?*Hysteropatella* sp. {2}, *Patellaria atrata* {6}, ?*Unguiculella* sp. {1}. **Desiccation tolerance**: fully alive for at least 2 months. **Altitude**: 6–225 m a.s.l. **Geology**: basaltic & trachybasaltic and phonolitic flows and pyroclasts, ignimbrite. **Phenology**: X–VI (possibly throughout the year, long-lived).

Taxonomic remarks. *Orbilia pseudeuphorbiae* resembles *O. leporina* in the ascospores but deviates in uninflated to spathulate instead of capitate paraphyses and a different substrate. *O. cocois* mainly differs in shorter terminal cells of paraphyses and marginal excipulum, and in shorter spores, and *O. cupressi* in wider spores. All these species differ from *O. pseudeuphorbiae* in the conidia of the presumed anamorph. *O. pseudeuphorbiae* and *O. cupressi* were at first tentatively included by us in

O. euphorbiae (series *Regales* of section *Aurantiorubrae*), a species with bright yellowish-orange apothecia with a distinctly crenulate, more protruding margin due to longer glassy processes, paraphyses with a more inflated, lageniform to mammiform apex without SCBs, thicker-walled anchoring hyphae, and particularly spores with a distinctly narrower, 0.3–0.5(–0.6) µm wide spore body. In contrast to *O. euphorbiae* the ascus base in *O. pseudeuphorbiae* is often H-shaped, which supports its placement in section *Arthrobotrys*. *O. arachnopus* (series *Microsomates* of series *Orbilia*) remarkably resembles *O. pseudeuphorbiae* in microscopic features, but differs, e. g., in much smaller, usually broadly attached SBs.

O. beltraniae, which also grows on *Euphorbia canariensis* in Macaronesia and is macroscopically quite similar (Pl. 911), differs in shorter asci (*32–46 × 3–4.3 µm) and shorter, more or less straight, basally only slightly tapered ascospores (*4.7–7 × 1.2–1.7 µm). As in *O. pseudeuphorbiae*, the spores contain rather large, globose, more distinctly eccentrical SBs with a fine filum. The paraphyses are partly more sublanceolate to lageniform and usually protrude 2–4 µm beyond the living, not fully turgescent asci, and the marginal cortical cells are without glassy wall thickenings.

A collection on *Aeonium pseudourbicum* at high altitude in Tenerife referred to *O. desertorum* differs from *O. pseudeuphorbiae* in much larger basal excipular cells [*11–25(–28) × 10–22(–25) µm], equally curved spores reminiscent of *O. oxyspora* though smaller (*6.5–8 × 1.3–1.4 µm), slightly capitate paraphyses, and in more round and flat, yellowish-brownish-orange apothecia with a thinner margin (see Pl. 945: 4).

Variation. *O. pseudeuphorbiae* seems to be rather constant in its microscopical features, varying only slightly in spore length between *6.3–8 and 7–9 µm and in width between *1.3–1.4 and 1.4–1.7 µm.

Not included collection. An Australian sample on *Acacia* (Pl. 919: 2) resembles *O. pseudeuphorbiae* in most features, including pale-coloured, ± smooth apothecia, spore size, and indistinctly spathulate paraphyses, but it was studied only in the dead state. Its spores tend to be slightly longer and more strongly curved, the asci shorter and wider, and the apothecia smaller (0.25–0.7 mm). In some spores SBs could be discerned, which seem to be smaller than in Macaronesian specimens and do not with certainty exclude an identity with *O. arachnopus* (series *Microsomates* of section *Orbilia*) or a member of series *Regales*.

Anamorph. Straight, dactylella-like conidia were found near the apothecia of *O. pseudeuphorbiae* (Pl. 920: 3e). They resemble those of *Dactylella coccinella* and *D. pulchra*, being wider than the former and smaller than the latter. *O. euphorbiae* sharply differs in the anamorph having straight to strongly curved (C-shaped), longer and narrower, vermispora-like conidia.

Phylogeny. A sequence taken from apothecia of the holotype of *O. pseudeuphorbiae* comprises the S1506 intron and the ITS region. In our ITS analysis (Phyl. 26) it clustered in series *Neodactylella*, but unresolved among the main clades and with rather high distance, the lowest percentage being 10.5–11.5 % to *O. epilobii*, *D. rhopalota*, *O. atlantis*, and *O. zhongdianensis*. Also an analysis of the intron shows *O. pseudeuphorbiae* in the unsupported *Neodactylella* clade, but with high distance to other species. Also when analysing the entire section *Arthrobotrys*, *O. pseudeuphorbiae* clustered within this clade (not shown).

Ecology. *O. pseudeuphorbiae* is so far only known with certainty from Tenerife (Macaronesia), where it was recorded at 12 main collection sites on rotten wood of ± xeric branches of different *Euphorbia* species in inframediterranean, semi- to hyperarid xerophytic scrublands around the island (Quijada 2010). The species mainly occurred in the sweet spurge scrub dominated by *Euphorbia balsamifera* (tabaibal dulce, *Ceropegio fuscae-Euphorbietum balsamiferae*), rarely also in the cardon scrub dominated by *E. canariensis* (cardonal, *Periploco laevigatae-Euphorbietum canariensis*) and the hyperarid *Frankenio ericifoliae-Zygophylletum fontanesii*, *Frankenio ericifoliae-Astydamietum latifoliae*, and *Launaeo arborescentis-Schizogynetum sericeae.* The not included sample was on rotten bark of a xeric branch of *Acacia* in a subtropical arid acacia open woodland (mulga) in northwestern Australia.

Map 148. Known distribution of *O. pseudeuphorbiae* in Tenerife (Macaronesia).

Specimens included (all on wood of branches of *Euphorbia*, leg. L. Quijada & E.V. Rodríguez if not otherwise stated): **MACARONESIA**: **Canary Islands**, **Tenerife**, La Matanza de Acentejo, 8.5 km NE of Puerto de la Cruz, 1.5 km WNW of La Matanza de Acentejo, NW of Jagre, Puntillo del Sol, 43 m, *E. canariensis*, 21.XI.2009 (TFC Mic. 22545, 22548, 22551–22552, 22555, 22559, non vid.). – St. Cristóbal de la Laguna, 2 km NNW of Valle Guerra, Playa de Arena, 6 m, *E. balsamifera*, 3.XI.2009, L. Quijada, E.V. Rodríguez & C. Quijada (TFC Mic. 22452, non vid.). – 5.7 km NNE of Tegueste, 1.5 km E of Punta de Hidalgo, 75 m, *E. canariensis*, 8.X.2009 (TFC Mic. 22356, non vid.). – Candelaria, 5.5 km NE of Güímar, 1 km S of Candelaria, Barranco Samarines, 40 m, *Euphorbia balsamifera*, 12.XI.2009 (TFC Mic. 22500–22503, non vid.). – ibid., SSE of Candelaria, 25 m, *E. balsamifera*, 12.XI.2009 (TFC Mic. 22510, 22512, non vid.). – Güímar, 4.5 km E of Güímar, 2.6 km S of El Socorro, Malpais de Güímar, 7 m, *E. balsamifera*, 5.XI.2009 (TFC Mic. 22468, 22470, 22472, non vid.). – ibid., 2.2 km S of El Socorro, 42 m *E. canariensis*, 5.XI.2009 (TFC Mic. 22476, non vid.). – Arico, 3 km NNE of Abades, 0.7 km NNE of Porís de Abona, Llanos de Porís, 40 m, *E. balsamifera*, 22.III.2009, L. Quijada, R. Castro & F. Rodríguez (ex H.B. 9060, M-0276569, **holotype**; sq.: KT222371; TFC Mic. 21755, **isotype**; TFC Mic. 21748–21754, 21756–21758, 21767–21770, **topotypes**). – ibid. *E. balsamifera*, 13.XI.2009 (TFC Mic. 22514, 22518–22519, 22542, non vid.). – 1 km WSW of Abades, Barranco la Vera, 50 m, *E. balsamifera* 12.VI.2009 (TFC Mic. 22425, non vid.). – ibid., *E. lamarckii*, (TFC Mic. 22430, non vid.). – ibid., *E. canariensis* (TFC Mic. 22150, 22154, 22160, 22216, 22222, 22227, 22230–22232, non vid.). – 2.2 km NW of Abades, Montaña Centinela, 160 m, *E. balsamifera*, 23.I.2010 (TFC Mic. 22762, 22765, non vid.). – Granadilla de Abona, 1.8 km SSW of El Médano, ENE of Montaña Roja, El Bocinegro, 30 m, *E. balsamifera*, 26.XII.2009 (TFC Mic. 22672, non vid.). – San Miguel de Abona, 4 km SSW of Las Chafiras, 1.5 km NE of Costa del Silencio, Montaña Amarilla, 30 m, *E. balsamifera*, 27.XII.2009 (TFC Mic. 22683, non vid.). – ibid., *E. canariensis* (TFC Mic. 22685, non vid.). – ibid., 1.2 km ENE of Costa del Silencio, 10 m, *E. balsamifera*, 7.II.2010, L. Quijada (TFC Mic. 22852, doc. vid.). – ibid., 1.1 km ENE of Costa del Silencio, 17 m, *E. balsamifera*, 12.IV.2009 (TFC Mic. 22040–22042, 22044–22049, 22059–22061, 22063, 22064–22072, non vid.). – ibid., *E. canariensis*, 12.IV.2009 (TFC Mic. 22035–22037, 22053, 22058, 22073–22076, 22078, 22199, 22203–22204, 22208–22209, non vid.). – Guía de Isora, 4 km WSW of La Vera de Erques, 3 km SW of Tejina de Guía, 225 m, *E. balsamifera*, 6.XII.2009, L.

Quijada (TFC Mic. 22644–22648, anam. substr., doc. vid.). – Buenavista del Norte, 7 km WSW of Buenavista del Norte, ~4 km W of Teno Alto, Punta de Teno, 20–200 m, *E. balsamifera*, 3.V.2009, L. Quijada, E.V. Rodríguez & C. Quijada (TFC Mic. 22092–22094, 22096–22100, 22102, 22104–22113, 22116–22117, 22120–22127, non vid.). – ibid., *E. canariensis*, 3.V.2009, L. Quijada, E.V. Rodríguez & C. Quijada (TFC Mic. 22252, 22260–22261, non vid.).

Not included. **AUSTRALIA**: **Western Australia**, Gascoyne, southern border of Collier Range, 175 km NE of Meekatharra, 41 km SW of Kumarina Roadhouse, Great Northern Hwy, 560 m, branch of *Acacia*, on bark, 26.XI.2001, G. Marson (H.B. 8697f).

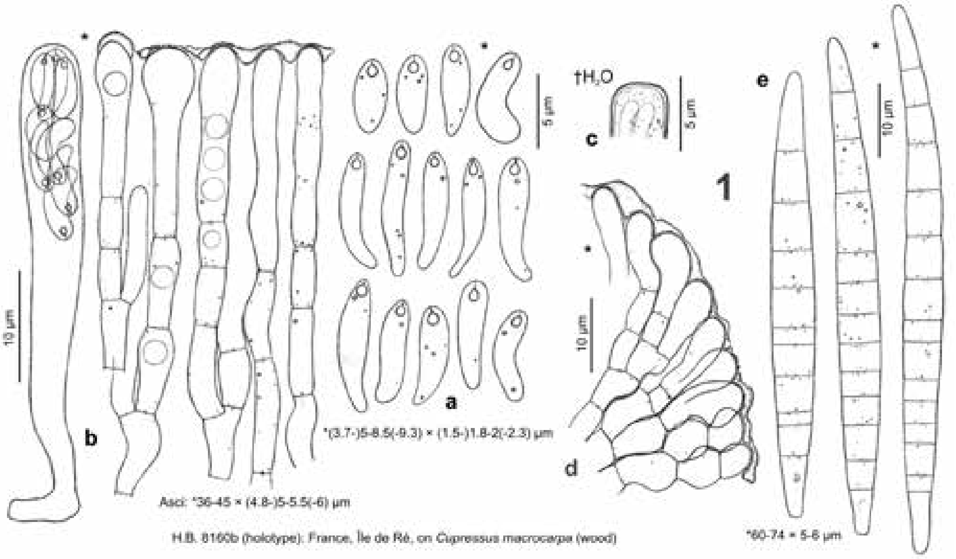


Plate 921. **1**: *Orbilia cupressi*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apex; **d**. ectal excipulum in median section (margin and mid flanks); **e**. conidia from substrate.

Orbilia cupressi Baral & E. Weber, **sp. nov.**, MB 813978 — Pls 921–922

Etymology: after the host, *Cupressus sempervirens*.

Typification: France, Île de Ré, branch of *Cupressus macrocarpa*, 26.IV.2006, S. Helleman & G. Marson (ex H.B. 8160b, M-0276466, holotype; sq.: KT222433).

Latin diagnosis: *Similis* Orbiliae pseudeuphorbiae *sed ascosporae breviores et latiores, paraphyses ad apicem magis inflatae, partim capitatae, excipulum marginale absque processis vitreis, apothecia minora. Habitat ad lignum putridum rami sicci* Cupressi *in zona mesosubmediterranea semihumida Europae occidentalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.25–0.8 mm diam., 0.11–0.17 mm high, pale cream-ochraceous(-orange), ± translucent, round or slightly undulating, scattered to subgregarious in small groups; disc flat to slightly convex, margin distinct, thin, not protruding, smooth; broadly sessile, superficial but partly deeply immersed in biofilm; dry also cream-brown. **Asci** *36–45 × (4.8–)5–5.5(–6) µm, †32–44 × 4–4.5 µm, 8-spored, spores *~3-seriate, 3–5(–7) lower spores inverted (often ± mixed), pars sporifera *16–18 µm long; **apex** (†) medium truncate (not indented, laterally not inflated); **base** with short to medium long, thick stalk, L-shaped. **Ascospores**

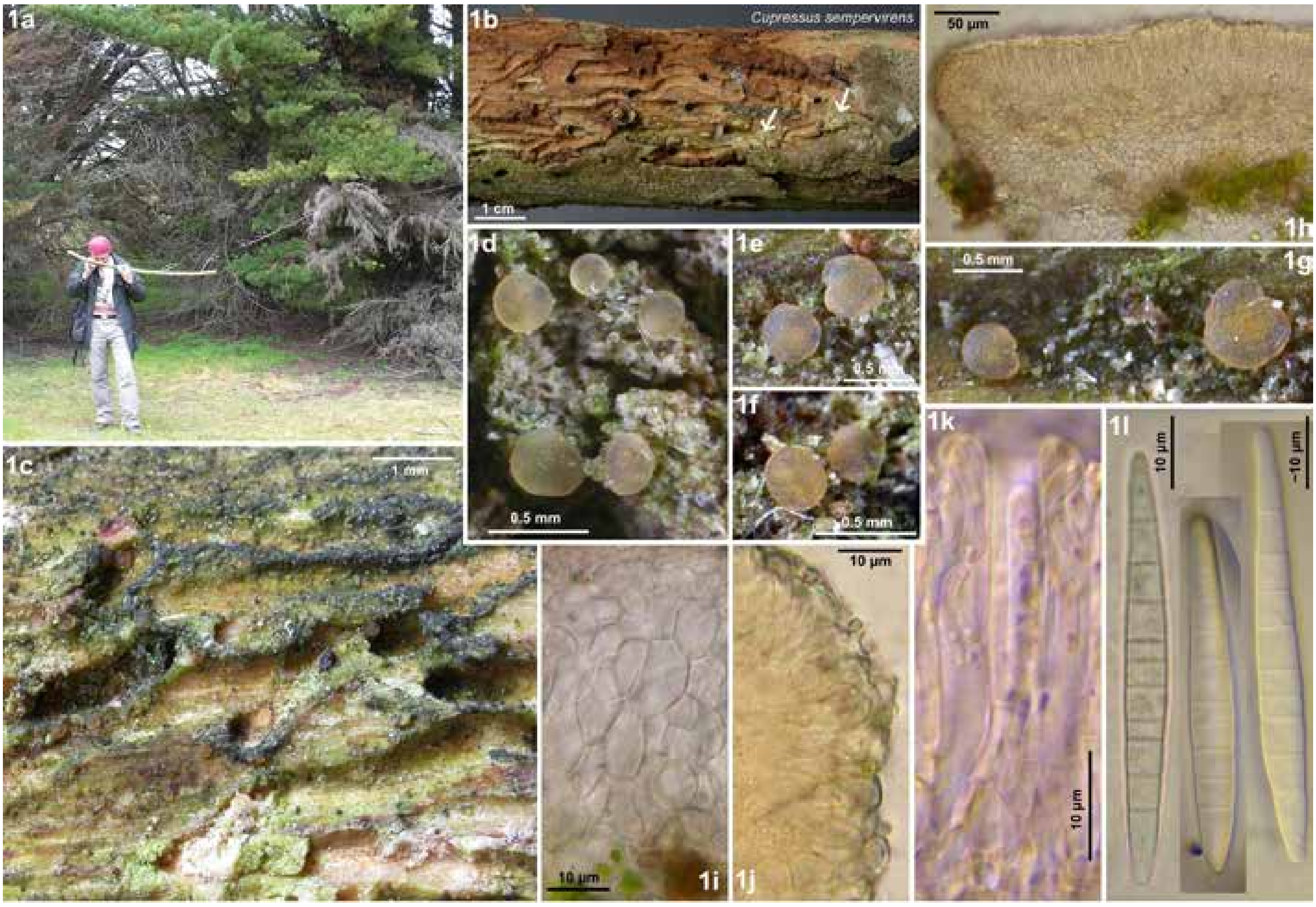


Plate 922. **1**: *Orbilia cupressi*. – **1a**. atlantic submediterranean open forest with *Cupressus macrocarpa*, decorticated xeric branch of holotype shortly after harvesting; **1b–c**. closeup of branch showing beetle galleries; **1d–g**. rehydrated apothecia (**1d**: on boring dust); **1h**. apothecium in median section; **1i**. id., basal ectal excipulum; **1j**. id., marginal ectal excipulum; **1k**. asci; **1l**. conidia. – Living state, except for **1j** (in KOH). — **1a–l**. H.B. 8160b (holotype): France, Île de Ré, on *Cupressus*.

*(3.7–)5–8.5(–9.3) × (1.5–)1.8–2(–2.3) µm, †5.7–7.7 × 1.7–1.8 µm, subcylindrical to fusoid-clavate, rarely ± ellipsoid, apex rounded to obtuse, sometimes subacute, base not or slightly to strongly attenuated, straight or mostly slightly to strongly curved (often geniculate in lower part); **SBs** *1–1.4 × 0.6–0.8 µm diam., globose to broadly tear-shaped, with a short, thin or thick filum. **Paraphyses** apically uninflated or slightly, sometimes medium inflated, clavate-capitate to ellipsoid, terminal cells *13–20 × 2.3–5 µm, lower cells *3.5–10 × 2–3 µm; unbranched at upper septum. **Medullary excipulum** hyaline to pale yellowish-cream, 25–35 µm thick, of dense textura intricata-angularis, sharply delimited from ectal excipulum. **Ectal excipulum** of hyaline, thin-walled, vertically oriented t. globulosa-angularis from base to margin, 30–70 µm thick near base, cells *8–19 × 6–14 µm; 20 µm thick near margin, of t. globulosa-prismatica oriented at a 45–90° angle to the surface, marginal cortical cells *5–12 × 3–6 µm; **glassy processes** absent. **Anchoring hyphae** ± abundant, †1.5–2.5(–3) µm wide, walls 0.2 µm thick. **SCBs** in paraphyses globose, very faintly refractive, 1.5–2.2 µm diam.; in ectal excipulum not seen. **Exudate** over paraphyses 0.2–1.5 µm thick, cloddy-continuous, ± loosely attached; over margin and flanks (0.2–)1–3(–5) µm thick, hyaline. — **ANAMORPH**: dactylella-like (presumed, from natural substrate). **Conidiophores** not seen. **Conidia** straight to (very) slightly curved, narrowly fusiform, gradually tapered towards the ends, *60–74 × 5–6 µm, 8–14-septate.

Habitat: collected ~1–1.5 m above the ground, 27 mm thick branch of *Cupressus macrocarpa*, one side partially corticated, on 0.1–0.2 mm deep strongly decayed wood, in galleries or on boring dust of a bark beetle, somewhat greyed, with abundant green algae. **Associated**: *Orbilia subdelphinus* {1}. **Desiccation tolerance**: fully viable for at least 3 weeks. **Altitude**: 19 m a.s.l. **Geology**: Quaternary marine sand over Upper Jurassic limestone. **Phenology**: IV (but rather long-lived).

Taxonomic remarks. *Orbilia cupressi* resembles *O. cardui* s.l., *O. pseudeuphorbiae*, or *O. cocois*, from which it differs, e.g., in wider ascospores and/or non-spathulate paraphyses, smaller apothecia, and particularly in the presumed anamorph. *O. cupressi* differs from *O. subcylindrospora* (section *Ovoideae*) in longer SBs with a short filum, paraphyses being never strongly capitate, and apothecia without a rose colour. *O. oxyspora* matches *O. cupressi* in the anamorph, but differs in much longer and narrower spores and in the marginal excipulum forming distinct cell rows.

Variation. Size and shape of the spores vary rather strongly within the only known collection. The observed short and wide, ellipsoid spores are to be considered as more or less abnormal, while elongate spores with a curved lower part represent the typical spores.

Anamorph. The conidia of the presumed anamorph of *O. cupressi* closely resemble those of *O. oxyspora*, but are narrower and tend to have more septa. *Orbilia* sp. XJ-2009 is very similar to *O. cupressi* in size and shape of conidia which exceed those of *O. cupressi* in the number of septa (8–19), but sharply differs in much longer and narrower, strongly falcate ascospores. Species related to *O. cardui* differ in shorter, cylindric-clavate conidia with fewer septa.

Phylogeny. A sequence from apothecia of the holotype comprises SSU (without S1506 intron), ITS, and LSU. In our combined analyses (Phyls 25, 27), *O. cupressi* clustered unresolved within the paraphyletic series *Neodactylella*, without connection to the four main clades. Also when analysing ITS or LSU separately, the result is similar (Phyls 26, S31). To all other species it shows a high distance, the lowest to the *cardui-rhopalota* clade (ITS 15.5–16.5 %, LSU 3–3.3 %).

Ecology. *O. cupressi* was found in beetle galleries on rotten wood of an attached xeric branch of *Cupressus sempervirens* in a coastal atlantic, mesosubmediterranean semihumid open cypress woodland in coastal western Europe.

Specimens included. **FRANCE**: **Poitou-Charentes**, **Charente-Maritime**, Île de Ré, 2 km SE of St.-Martin-de-Ré, 1.8 km W of La Flotte, Les Maraises, 19 m, branch of *Cupressus macrocarpa*, on wood, 26.IV.2006, S. Helleman & G. Marson (M-0276466, **holotype**; **isotype** in H.B. 8160b, anam. substr.; sq.: KT222433).

Orbilia fraxini Baral & P. Perz, **sp. nov.**, MB 813979 — Pls 923–925

Etymology: named after the host, *Fraxinus excelsior*.

Typification: Poland, Miedzylesie, branches of *Fraxinus excelsior*, 3.II.2008, P. Perz (ex H.B. 8754, M-0276486, holotype).

Latin diagnosis: *Apothecia rehydratata 0.5–2 mm diam., ochraceo-aurantiaca, (sub)sessilia, margine glabro vel subtiliter aspero. Ascosporae *3.5–7.5 × 1.6–*

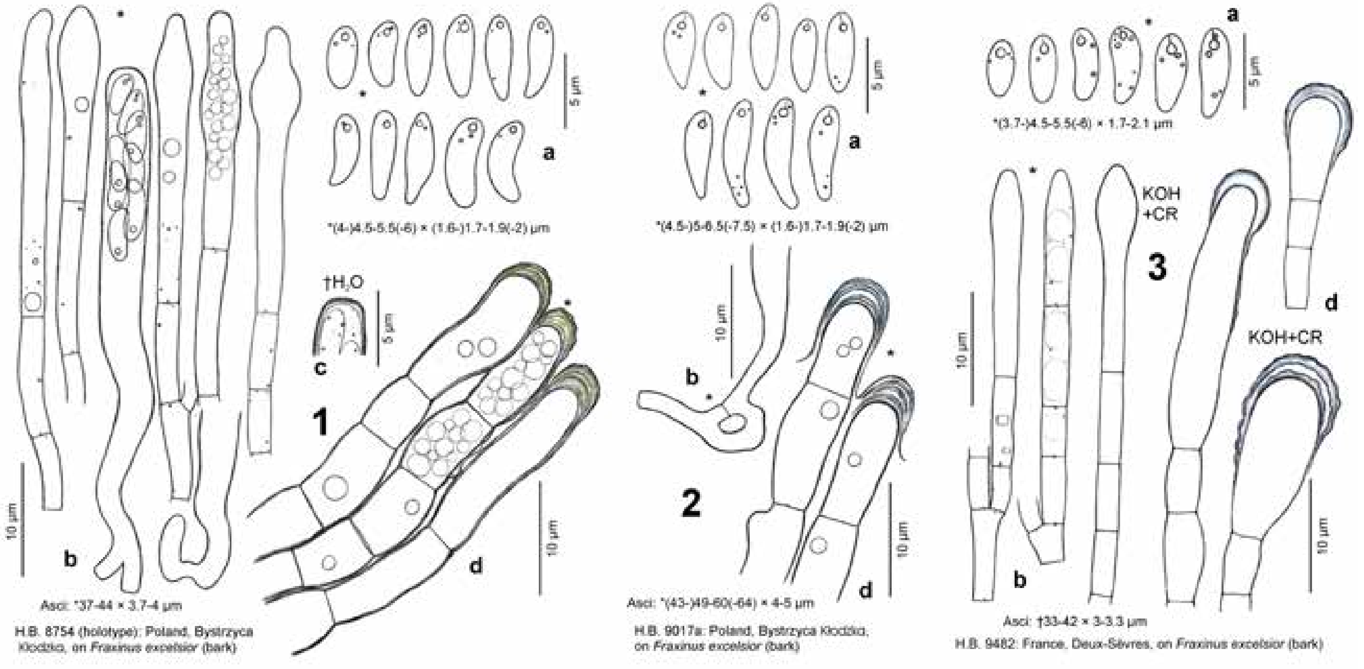


Plate 923. **1–3**: *Orbilia fraxini*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apex; **d**. marginal ectal excipulum composed of hair-like cells, in median section.

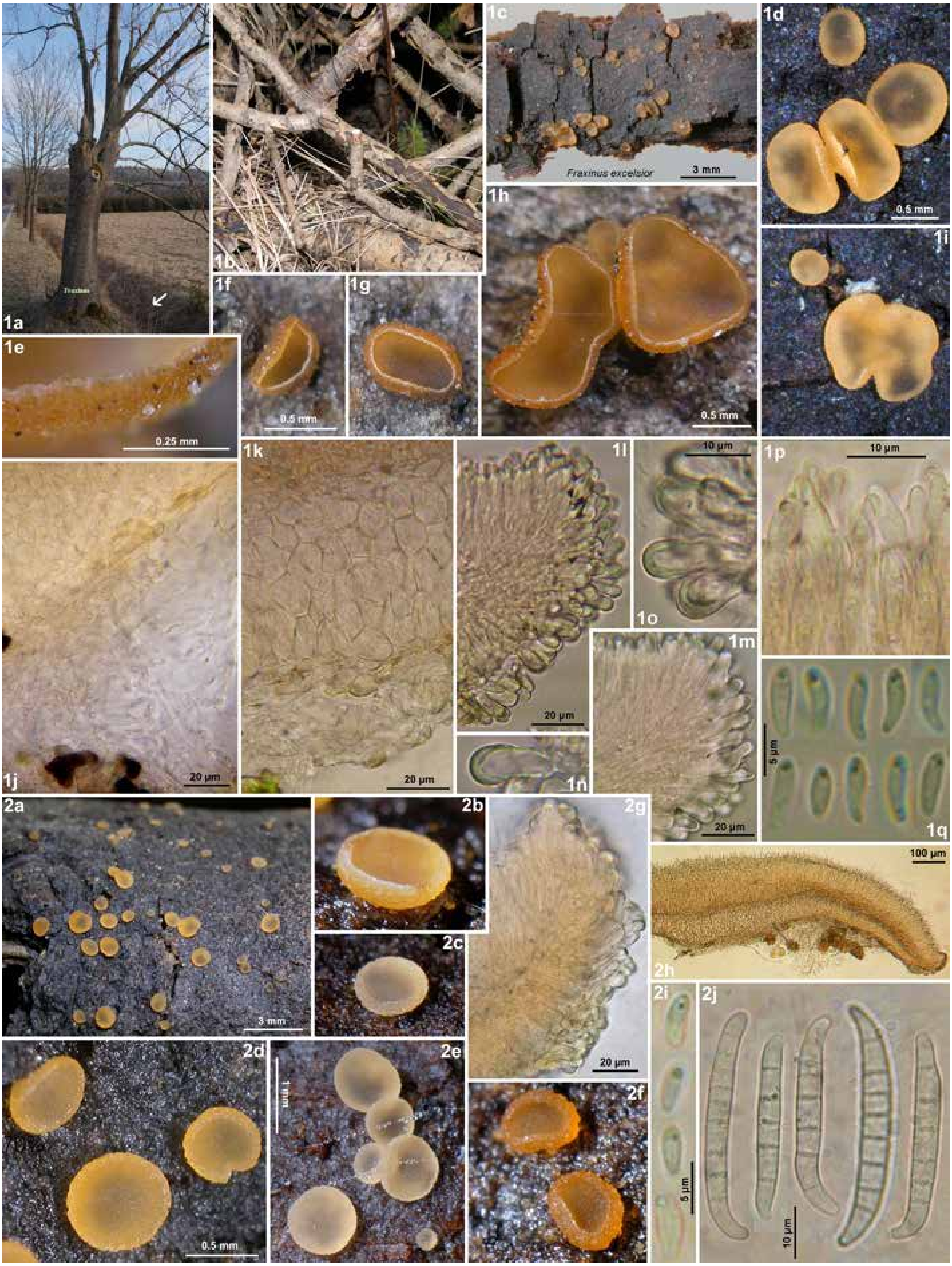


Plate 924. **1–2**: *Orbilia fraxini*. – **1a**. roadside with *Fraxinus* alley trees; **1b**. cut branches thrown in the ditch; **1c–i**, **2a–f**. fresh or rehydrated apothecia (**1e** closeup of margin); **2h**. apothecium in median section; **1k**. id., ectal excipulum at lower flanks, with anchoring hyphae; **1l–m**, **2g**. id., marginal ectal excipulum; **1n–o**. marginal hair-like cells with glassy caps; **1j**. abundant anchoring hyphae at base; **1p**. protruding apices of paraphyses; **1q**, **2i**. ascospores; **2j**. conidia from substrate. – Living state. – **1a–b**, **d**, **i**, **l**, **n–o**, **q**, **2a–f**: phot. P. Perz. — **1a–q**. H.B. 8754 (holotype): Poland, Bystrzyca Kłodzka, on *Fraxinus*; **2a–j**. H.B. 9017a: ibid., on *Fraxinus*.

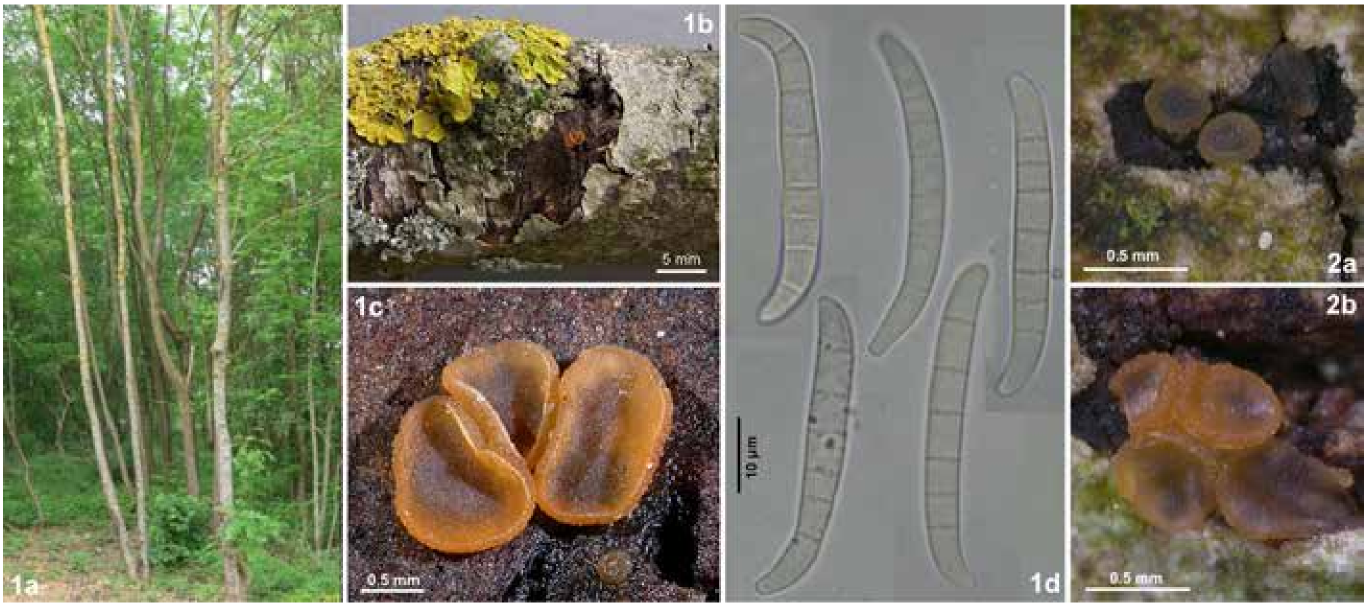


Plate 925. **1–2**: *Orbilia fraxini*. – **1a**. south-exposed forest border with *Fraxinus* trees; **1b**. dead xeric branch of *F. excelsior*, with *Xanthoria parietina*; **1c**, **2a–b**. rehydrated apothecia; **1d**. conidia from substrate (living state). — **1a–d**. G.M. 2011-05-09: Luxembourg, Kalchesbrück, on *Fraxinus*; **2a–b**. H.B. 9482a: France, Deux-Sèvres, on *Fraxinus*.

2 µm, subcylindrico-ellipsoideae, apice obtusae, ad basim plus minusve attenuatae, rectae vel basi leniter curvatae, in statu vivo corpusculum refringens minutum globosum, ad apicem filo breve affixum continentes. Paraphyses ad apicem distincte spathulatae vel lageniformes. Margo excipuli pilis agglutinatis, septatis, subcrassitunicatis compositus, absque processis vitreis. Habitat ad corticem putridum ramorum Fraxini excelsioris, *leniter in aere prominulum, in zona atlantica ad subcontinentale temperata humida Europae.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.5–1.5(–2.2) mm diam., 0.12–0.22 mm high (receptacle 0.12–0.16 → 0.09–0.12 mm), very pale to light (rose-)orange- to yellow-ochraceous, non- or medium translucent, round to slightly, rarely strongly undulating, subgregarious to gregarious; disc medium concave to flat, eventually medium convex, margin 10–25 µm protruding, almost smooth to finely rough; broadly sessile or on a narrow, stipe-like base 0.05–0.07 × 0.35 mm, superficial; dry light orange-ochraceous. **Asci** *(37–)40–60(–64) × (3.7–)4–4.5(–5) µm {2}, †31–42 {2} or 46–58 {2} × (2.5–)3–3.8(–4.2) µm {4}, 8-spored, spores (*) obliquely biseriate, (1–)3–5(–6) lower spores inverted {4} (strongly mixed or not), pars sporifera *16–23 µm long; **apex** (†) slightly to medium truncate (not indented, laterally not inflated); **base** with short to long, ± thin, flexuous stalk, Y-, h- or H-shaped, rarely with perforated croziers. **Ascospores** *(3.5–)4.5–6.5(–7.5) × (1.6–)1.7–1.9(–2.1) µm {7}, subcylindric-ellipsoid to fusoid-clavate, apex (rounded to) obtuse (rarely subacute), base not or slightly to strongly attenuated, rarely tail-like, straight to ± inequilateral or slightly (to medium) curved below; **SBs** *0.8–1.4 × (0.3–)0.4–0.5(–0.6) µm diam. {3}, globose, with a fine, short, sometimes invisible filum, inflated part sometimes ± eccentrical. **Paraphyses** apically slightly or mostly distinctly spathulate to usually lageniform-lanceolate with rounded to obtuse apex, terminal cells *12–27 × (2–)2.7–3.7(–4.3) µm {5}, †15–19 × 2–2.5(–3.6) µm {1}, exceeding the living asci by 3–7 µm (the dead asci by 2–4 or 4–10 µm), lower cells *4–13.5 × 1.6–2.8 µm {4}; unbranched at upper septum, with scattered minute yellowish LBs in the cells (hymenium very pale orange). **Medullary excipulum**, 20–100 µm thick, very pale orange or cream, of dense or loose textura intricata with many inflated cells, sharply delimited from ectal excipulum (partly by a ± distinct, 10 µm thick t. porrecta). **Ectal excipulum** hyaline, of (†) thin-walled to slightly gelatinized (common walls 0.3–1 µm thick), vertically oriented t. angularis-prismatica from base to mid flanks, 40–80 µm thick near base, cells *9–20(–33) × 7–15(–19) µm {3}; 15–20 µm thick near margin, of t. prismatica(–globulosa) oriented at a 45–70° angle to the surface; running out into ~20–30 µm long, ± agglutinated or ± free, (1–)2(–4)-celled rows of **hair**-like hyphae oriented at 10–80°, lateral wall */†0.2–0.4 µm thick (0.5–0.8 including exudate), terminal cells */†6–19 × (3–)3.5–6(–7.5) µm {4}; **glassy processes** apparently absent, but hairs tipped by exudate caps {3}. **Anchoring hyphae** medium to very abundant, *(1.5–)2–3(–4) µm wide, walls 0.1–0.2 µm thick {3}, forming a loose hyaline textura intricata 10–100 µm thick, embedded in non-refractive gel. **SCBs** in paraphyses and ectal excipulum (near margin) globose, 1.2–2 µm diam. {5}, low-refractive, usually solitary but in some paraphyses and marginal hairs densely filling the cells; **VBs** absent. **Exudate** over paraphyses absent, on hair tips 1–4 µm thick {3}, cap-like, composed of several 0.2–0.7 µm thick refractive layers. **— ANAMORPH**: vermispora-like (presumed, from natural substrate {2}). **Conidiophores** not seen. **Conidia** phragmosporous, slightly to often strongly curved at the ends, with straight (to slightly curved) middle part, *(35–)38–45.5 × (4.3–)4.5–5.2(–5.5) µm {2} (in situ and actual length), (5–)6–8(–9)-septate {2}.

Habitat: 0–3 m above the ground, corticated, 8–50 mm thick branches or 15–20 cm thick trunks of *Fraxinus excelsior* {8}, on outer and inner side of ± strongly decayed, sometimes detaching bark {8} (periderm {1} and bast {7}), often over small or large holes or cracks in periderm or on periderm-free areas, at edge of bark, in beetle galleries when on inner surface, greyed (bast dark brown to blackish), without or with some green algae, sometimes close to old pyrenomycete {1}. **Associated**: *Lecanora* sp. {2}, *L. ?argentata* {1}, *Lecidella elaeochroma* {1}, *Melanomma* (?)*pulvis-pyrius* {1}, *Orbilia aristata* {1}, *O. xanthoguttulata* {1}, *Physcia adscendens* {2}, *Sclerencoelia fraxinicola* {1}, *Xanthoria parietina* {2}. **Desiccation tolerance**: immature asci survive for 3 weeks, ectal and medullary excipulum, paraphyses and spores still alive after 4 months. **Altitude**: 5–610 m a.s.l. **Geology**: Upper Cretaceous calcareous clay- & marlstone and flysch, Pleistocene moraine, peat over Jurassic. **Phenology**: I–VIII (but rather long-lived).

Taxonomic remarks. *Orbilia fraxini* resembles *O. cupressi* in ascospore morphology, but differs in larger apothecia, spathulate to lageniform paraphyses, and the presumed anamorph forming curved conidia. Similar paraphyses are found in *O. rhamni* which differs in narrower spores and thin-walled marginal excipular cells. A certain similarity is also seen with *O. phragmotricha* (section *Aurantiorubrae*), from which *O. fraxini* differs in shorter and wider spores without tails, smaller, globose SBs with a fine filiform attachment, shorter, thin-walled, ± agglutinated hairs, and in the absence of crystalloid SCBs. *O. pseudocylindrospora* (on *Salix*, section *Aurantiorubrae*) differs in slightly longer spores and SBs, only sometimes spathulate-lageniform paraphyses, marginal cortical cells tipped by thinner exudate, and pinkish apothecia. The short-haired form of *O. pilosa* (section *Arthrobotrys* series *Drechslerella*) differs in smaller spores, more thick-walled hairs, larger, isodiametric, thick-walled excipular cells, and white apothecia. *O. fraxini* may also be confused with *O. eucalypti* (section *Orbilia*) which differs, e. g., in capitate paraphyses and in lacking thick-walled, protruding marginal cells.

The layered refractive caps on the hair tips of *O. fraxini* are stained by CR or CRB and are, therefore, apparently exudate rather than glassy processes.

Variation. A high difference in ascus length was noted between the two samples from Poland (Pl. 923). Also the ascospores show a high variability in length and shape within the collections. Apothecial colour varied between orange, ochre, yellow, and fawn, sometimes within a collection. Nevertheless, the samples from the four collection sites concur very well in most respects.

Not included collections. Two samples on *Populus* bark from Austria and Serbia differ in slightly longer and particularly narrower spores of *(4.8–)5.2–6.5(–7.2) × (1.3–)1.4–1.6(–1.8) µm.

Anamorph. We found two times curved, vermispora-like phragmoconidia near apothecia of *O. fraxini* (Pls 924: 2j; 925: 1d). Due to their curved ends this type of conidia is reminiscent of members of section *Aurantiorubrae* (series *Regales*) or section *Orbilia* (*O. xiushanensis*) rather than section *Arthrobotrys*.

Phylogeny. Sequences comprising ITS and LSU D1–D2 were gained from apothecia of the topotype from Lower Silesia and the sample from Oberbayern. The S1506 intron is absent in both. The two sequences are identical, except for 1 deviating nucleotide in the ITS1.

In spite of its presumed vermispora-like anamorph, *O. fraxini* clustered in our analyses (Phyls 25–27, S31) with *O. rhamni* and *O. asomatica* in a medium to strongly supported clade (here called *rhamni-fraxini* clade) within series *Neodactylella*. *O. fraxini* shows an ITS/LSU distance of 11/1.6–1.8 % to *O. rhamni*, and 12/2.1 % to *O. asomatica*, but the distance to species of the *cardui-rhopalota* clade is also only 9–12/2.5–3 %.

Ecology. *O. fraxini* is so far only known from rotten bark of hygric and xeric branches and trunks of *Fraxinus excelsior* at four very remote sites of Europe. In the type collection from southern Poland the inhabited branches were deposited in a ditch between road and pasture, when large alley trees were pruned in their lower part about 2–3 years ago. Although the apothecia developed on branches close to the ground, they are desiccation-tolerant. In the samples from France and Luxembourg the fungus grew on still-attached branches and in that from Germany on detaching bark of standing isolated trunks. The climate is subcontinental cold-temperate humid, but in western France atlantic warm-temperate humid. The vegetation in Luxembourg was a forest bordered to a farmland in the south by *Fraxinus* trees, that in France a large marshy forest area with many ash trees at very low altitude, and that in Germany a row of ash and willow trees along a small rivulet bordered by a pasture and farmland. The two not included samples grew under a similar subcontinental climate on xeric, very rotten, ± detaching bark (bast) of corticated attached branches or fallen trunks of *Populus* in association with various lichens, including *Xanthoria parietina*, in Austria on crystalline rock (mica schist) and in Serbia on Cretaceous flysch.

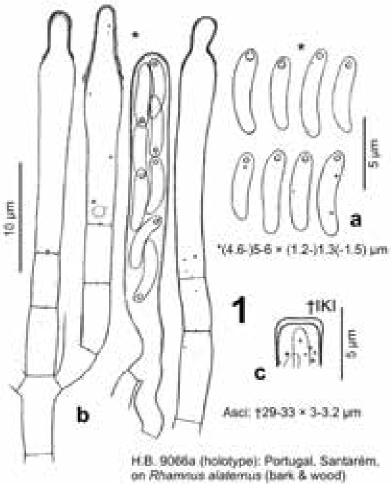


Plate 926. **1**: *Orbilia rhamni*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apex.

Specimens included. **POLAND**: **Lower Silesia**, Kłodzko, 11.5 km S of Bystrzyca Kłodzka, 6 km NNW of Miedzylesie, ESE of Gniewoszów, 437 m, branches of *Fraxinus excelsior*, on bark, 3.II.2008, P. Perz (ex H.B. 8754, M-0276486, **holotype**; P.P. 20030203-6, **isotype**). – ibid., branches of *F. excelsior*, on bark, 7.III.2009, P. Perz (H.B. 9017a, **topotype**, anam. substr.; sq.: KT222372). — **GERMANY**: **Bayern**, **Oberbayern**, 5.5 km N of Bad Reichenhall, S of Aufham, Reitweg, 505 m, trunk of *F. excelsior*, on bark, 20.I.2018, I. Rößl (doc. vid.). – ibid., 7.III.2018 (H.B. 10143a; sq.: MK473420). – ibid., 17.III.2018, I. Rößl & T.R. Lohmeyer (T.R.L. 2018-006, doc. vid.). – ibid., 13.VIII.2018, H.O. Baral (H.B. 10171a). — **SWITZERLAND**: **Graubünden**, 2.5 km NE of Landquart, ESE of Malans, 610 m, branch of *F. excelsior*, on bark, 7.V.2020, U. Roffler (U.R. 1227, doc. vid., sq.: ined.). — **LUXEMBOURG**: **Gutland**, 4.3 km ENE of Luxembourg, S of Kalchesbrück, between Cents & Findel, 355 m, branch of *F. excelsior*, on bark, 9.V.2011, G. Marson (G.M. 2011-05-09, anam. substr.). — **FRANCE**: **Poitou-Charentes**, **Deux-Sèvres**, 14.5 km WSW of Niort, 1.5 km NNW of Amur, Marais Poitevin, Port Goron, 5 m, branch of *F. excelsior*, on bark, 26.IV.2011, E. Weber (H.B. 9482a).

Not included. **AUSTRIA**: **Steiermark**, 14.5 km WSW of Hartberg, NW of Herberstein castle, Buchberg, 512 m, trunk of *Populus ?tremula*, on bark, 8.XII.2018, G. Friebes (G.F. 20180348, doc. vid.). – **SERBIA**: **Vojvodina**, Fruška Gora, 12.5 km S of Novi Sad, 6 km NNW of Irig, Iriški venac, W of WWII memorial, 415 m, branch of *Populus alba*, on bark, 12. & 15.VII.2019, D. Savić (doc. vid.).

Orbilia rhamni Baral & Priou, sp. nov., MB 813980 — Pls 926–927

Etymology: named after the type host genus.

Typification: Portugal, Santarém, twigs of *Rhamnus alaternus*, 6.V.2009, J.P. Priou (ex H.B. 9066a, M-0276579, holotype; sq.: KT222373).

Latin diagnosis: *Apothecia rehydratata 0.25–1 mm diam., aurantiaca, sessilia, margine glabro vel subtiliter aspero. Ascosporae *4.5–6 × 1–1.5 µm, (sub) cylindricae, apice rotundatae ad obtusae, basi non vel indistincte attenuatae, leniter curvatae, in statu vivo corpusculum refringens minutum globosum, filo brevissime affixum continentes. Paraphyses ad apicem leniter inflatae, distincte lageniformes. Cellulae excipuli marginalis et paraphysium guttulas paucas minutas luteas oleosas continentes. Margo excipuli processis vitreis brevissimis praeditus. Habitat ad lignum vel corticem putridum ramulorum siccorum* Rhamni alaterni *in zona mesomediterranea semihumida Europae meridio-occidentalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.25–0.7(–1) mm diam., 0.1–0.13 mm high (receptacle 0.08 → 0.06 mm), pale to bright (yellowish-)orange(-ochraceous), slightly translucent, round to ellipsoid or somewhat undulating, scattered to subgregarious; disc flat or somewhat concave near margin, margin thin or thick, 5–20 µm protruding, smooth to finely rough or powdered; sessile on a narrowed base, superficial or slightly erumpent from cracks; dry slightly contracted, bright orange-ochraceous. **Asci** *~35 × 3.7–4 µm {T}, †25–34 × 3–3.8 µm {3}, 8-spored, spores (†) biseriate, ~3–4 lower spores inverted {T} (strongly mixed), pars sporifera †22.5 µm long; **apex** (†) medium to strongly truncate (hardly indented or laterally inflated); **base** with short, flexuous stalk, h-shaped. **Ascospores** *4.5–6 × (1–)1.1–1.3(–1.5) µm {3}, (sub)cylindrical, homopolar, apex rounded to obtuse, base not or indistinctly attenuated, slightly but also medium to strongly curved (entirely or only near base), sometimes slightly

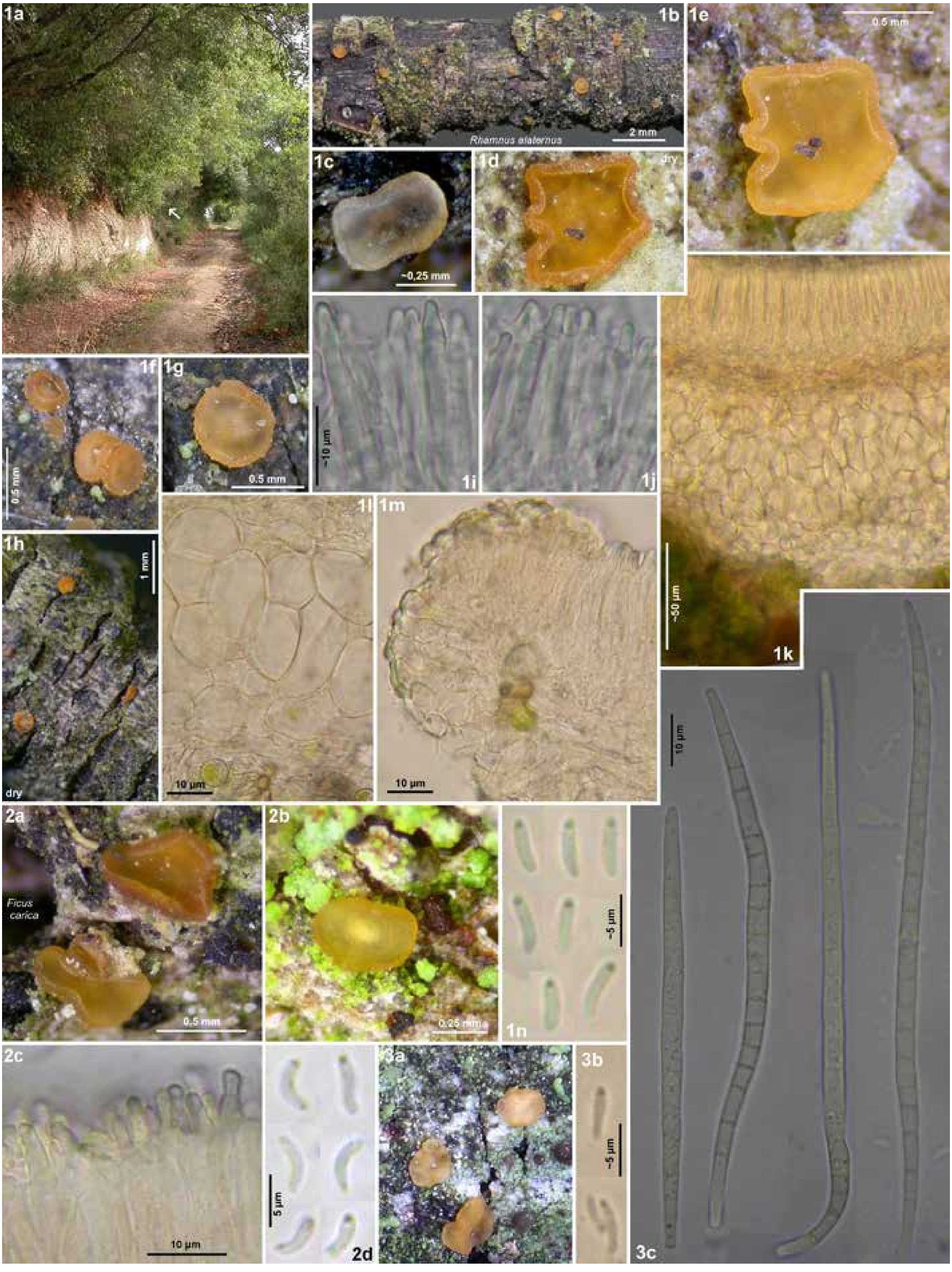


Plate 927. **1–3**: *Orbilia rhamni*. – **1a**. mediterranean woodland with *Quercus rotundifolia* trees and *Rhamnus alaternus* shrubs at edge of slope above forest track; **1b–c**, **e–h**, **2a–b**, **3a**. rehydrated apothecia; **1d**, **h**. dry apothecia; **1k**. central part of apothecium in median section; **1l**. id., basal ectal excipulum; **1m**. id., marginal region; **1i–j**, **2c**. (asci and) paraphyses; **3c**. conidia from substrate; **1n**, **2d**, **3b**. ascospores. – Living state, except for **2c** (in H_2O), 2 middle spores in **2d**. – **1a**, **c–e**, **h–k**, **n**, **2a–b**: phot. J.P. Priou, **3a–b**: phot. J. Bometón — **1a–n**. H.B. 9066a (holotype): Portugal, Santarém, on *Rhamnus*; **2a–d**. H.B. 9683: ibid., on *Ficus*; **3a–c**. J.B. 0463/14: Spain, Cataluña, on *Rhamnus*.

helicoid; **SBs** *0.7–0.8 × 0.3–0.5 µm {2}, globose to indistinctly tear-shaped, with a very short and fine, often invisible filum. **Paraphyses** apically (vry) slightly inflated, consistently lageniform or lanceolate with rounded tips, terminal cells *15–24 × 2.5–3.5 µm {T}, †(14–)19–24 × 2.2–2.8 µm {1}, exceeding the dead asci by (3–)5–7 µm, lower cells *5–7 × 2–2.7 µm {T}, †3.5–6 × 1.5–2.4 µm {1}; unbranched at upper septum. **Medullary excipulum** pale orange, 15–40 µm thick, of dense or loose textura intricata with some or many inflated cells, sharply delimited. **Ectal excipulum** hyaline to very pale orange, of (†) thin-walled, vertically oriented t. globulosa-angularis-prismatica from base to margin, 30–60 µm thick near base, cells *(8–)10–20(–24) × (7–)8–13(–15) µm {2}; 12–20 µm thick near margin, of pale orange t. prismatica oriented at a 70–80° angle to the surface, marginal cortical cells †6–15 × 3.5–6 µm {2}; **glassy processes** 0–5 × 3–5 µm {2}, high-refractive, forming broad caps. **Anchoring hyphae** sparse to abundant, *2–3 µm wide, walls 0.2(–0.3) µm thick {2}, forming a dense t. intricata up to 25 µm thick. **SCBs** in paraphyses and ectal excipulum absent, exceptionally globose. **Exudate** over paraphyses 0.1–0.3 µm thick, finely rough, hyaline to pale yellow, firmly attached on tapered part of apex, over margin and flanks forming a thin layer over glassy caps (hardly differentiated from glassy matrix). — **ANAMORPH**: anguillospora-like (presumed, from natural substrate {1}). **Conidiophores** not observed. **Conidia** *85–127 × 3.6–4.3 µm (actual length), 16–21-septate, narrowly cylindric-fusoid, straight to slightly and irregularly curved, rarely strongly bent at base, with some minute LBs especially at septa.

Habitat: collected 0–1.8 m above the ground, ± corticated, 4–43 mm thick twigs and branches of *Rhamnus alaternus* {3}, *Ficus carica* {2}, on strongly decayed bark {4} (periderm), rarely wood {1}, slightly to strongly greyed, with some to many green algae. **Associated**: *Lophiostoma quadrinucleatum* {1}, *Trichopeziza perrotioides* {1}. **Desiccation tolerance**: almost fully viable for at least 1 month (but only a few living asci seen). **Altitude**: 50–340 m a.s.l. **Geology**: Portugal: Miocene schist, sand- & limestone, marl & gypsum; Spain: alluvial deposits from siltstone. **Phenology**: IV–VI (but long-lived).

Taxonomic remarks. The distinctly lanceolate-lageniform paraphyses in combination with small, slightly or sometimes distinctly allantoid ascospores allow to recognize *Orbilia rhamni* easily. For the similar *O. fraxini* (p. 1480) and the Australian *O. lamarcheae* (p. 1485) see there. With its cylindrical spores with globose SBs, *O. rhamni* also resembles *O. cylindrospora* (section *Orbilia*) and *O. subcylindrospora* (section *Ovoideae*) or some species of series *Microsomates*. *O. umbilicata* (series *Orbilia*) is also similar, differing in desiccation-sensitive, hyaline apothecia, and lanceolate paraphyses which are completely devoid of exudate.

O. beltraniae from Macaronesia (on *Euphorbia canariensis*) is similar but has slightly larger, ± straight spores (*4.5–7 × 1.2–1.7 µm) containing much larger (0.6–0.9 µm wide, total length 1–2 µm), distinctly eccentrical SBs (Pl. 911).

Variation. The specimen on *Ficus* differs from the two on *Rhamnus* in more strongly curved, allantoid ascospores.

Anamorph. The anguillospora-like conidia observed on the natural substrate near the apothecia are narrower and much longer than those of *O. fraxini*, and only exceptionally bent at the ends. They resemble those of *O. caulicola* (section *Aurantiorubrae*).

Phylogeny. Sequences comprising the S1506 intron, ITS, and LSU were gained from apothecia of the holotype and from pure culture of the Spanish sample. They differ by 1 % in the ITS (4 nt in ITS1, 1 nt in ITS2) and by 1 nt in the D2 domain of LSU. In the intron they differ by 1.3 % in the overlapping 320 nt, whereas the distances among species of series *Neodactylella* lie in the range of 8–28 %.

O. rhamni clustered in all analyses with *O. asomatica* and *O. fraxini* in a supported clade (for the molecular distances see under these species), but only in the combined and LSU analyses the *rhamni-fraxini* clade received high support (Phyls 27, S31).

Ecology. The five known collections of *O. rhamni* grew on bark (& wood) of xeric twigs and branches of *Rhamnus alaternus* and *Ficus carica* in southwestern Europe. The samples from Portugal were in a mesomediterranean semihumid *Quercetum ilicis* woodland on a west-exposed slope with planted *Olea europaea* and *Pinus pinea*, that from Barcelona was a similar woodland with *Quercus coccifera* and *Pinus halepensis*.

Specimens included. **PORTUGAL**: **Santarém**, Ribatejo, 10 km NNW of Santarém, 2.3 km NE of Romeira, Val de Flores, 60 m, twigs of *Rhamnus alaternus*, on bark & wood, 6.V.2009, J.P. Priou (ex H.B. 9066a, M-0276579, **holotype**; **isotype** in J.P.P. 29098; sq.: KT222373). – ibid., 50 m, branch of *Ficus carica*, on bark, 1.V.2012, J.P. Priou (J.P.P. 12100, H.B. 9683). – ibid., 56 m, branch of *F. carica*, 12.VI.2017, J.P. Priou (J.P.P. 17145, non vid.). — **SPAIN**: **Cataluña**, **Barcelona**, 27 km NW of Barcelona, 3 km NW of Terrassa, Torrent de Gaià, 340 m, branches of *Rhamnus alaternus*, on bark, 5. & 21.IV.2014, J. Bometón (J.B. 0463/14, anam. substr.; sq.: KT380100). – 19 km NW of Barcelona, 5.5 km SSE of Terrassa, 175 m, branch of *R. alaternus*, on bark, 30.V.2020, J. Bometón (doc. vid.).

Orbilia lamarcheae Baral, sp. nov., MB 813981 — Pls 928–929

Etymology: named after the host, *Lamarchea hakeifolia*.

Typification: Western Australia, Nerren Nerren, trunk of *Lamarchea hakeifolia*, 8.XI.2007, G. Marson (ex H.B. 9020g, MEL 2389276, holotype).

Latin diagnosis: *Similis* Orbiliae rhamni *sed apothecia margine breviter pilosa, ascosporae corpusculum refringens multo majorem continentes. Habitat ad corticem separatum putridum siccum trunci vivi* Lamarcheae hakeifoliae *in zona subtropica semiarida Australiae occidentalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.3–0.4 mm diam., 0.14–0.2 mm high, light yellowish-ochraceous, slightly translucent, round, very scattered; disc strongly concave, margin thick, 20–40 µm protruding, finely whitish pubescent; sessile on a narrowed base, ± superficial. **Asci** *38–45 × 3.7–4(–4.5) µm, 8-spored, spores *1–2-seriate, 3–5 lower spores inverted (sometimes strongly mixed, rarely upper spores inverted), pars sporifera *18–26 µm long; **apex** (†) strongly truncate (slightly indented and laterally inflated); **base** with short to medium long, flexuous stalk, h- to H-shaped. **Ascospores** *5.2–6 × 1.2–1.4 µm, subcylindrical, homopolar, apex rounded to obtuse, base not or indistinctly attenuated, slightly (to medium) curved, often only near base; **SBs** *1–1.2 × 0.7–0.9 µm, globose, apically narrowed to a very short, indistinct filum. **Paraphyses** apically cylindrical or often spathulate to lageniform, terminal cells *19–27 × 2.6–3.6 µm, exceeding the living asci by ~1–3 µm, lower cells *4.5–9 × 2–3 µm; unbranched at upper septum. **Medullary excipulum** 50–70 µm thick, of medium dense textura intricata with many inflated cells, medium sharply delimited. **Ectal excipulum** pale ochraceous-orange, of (†) thin-walled, vertically oriented t. (globulosa-)angularis-prismatica from base to mid flanks, 50–70 µm thick

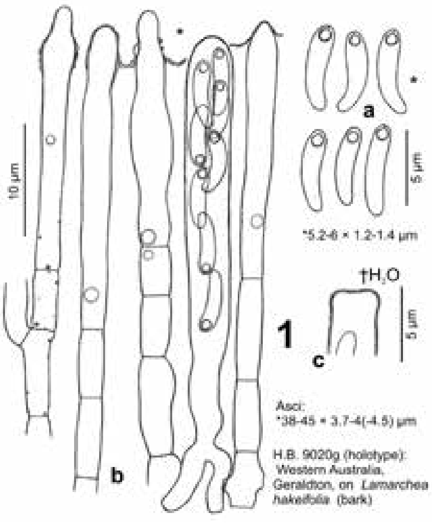


Plate 928. **1**: *Orbilia lamarcheae*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apex.

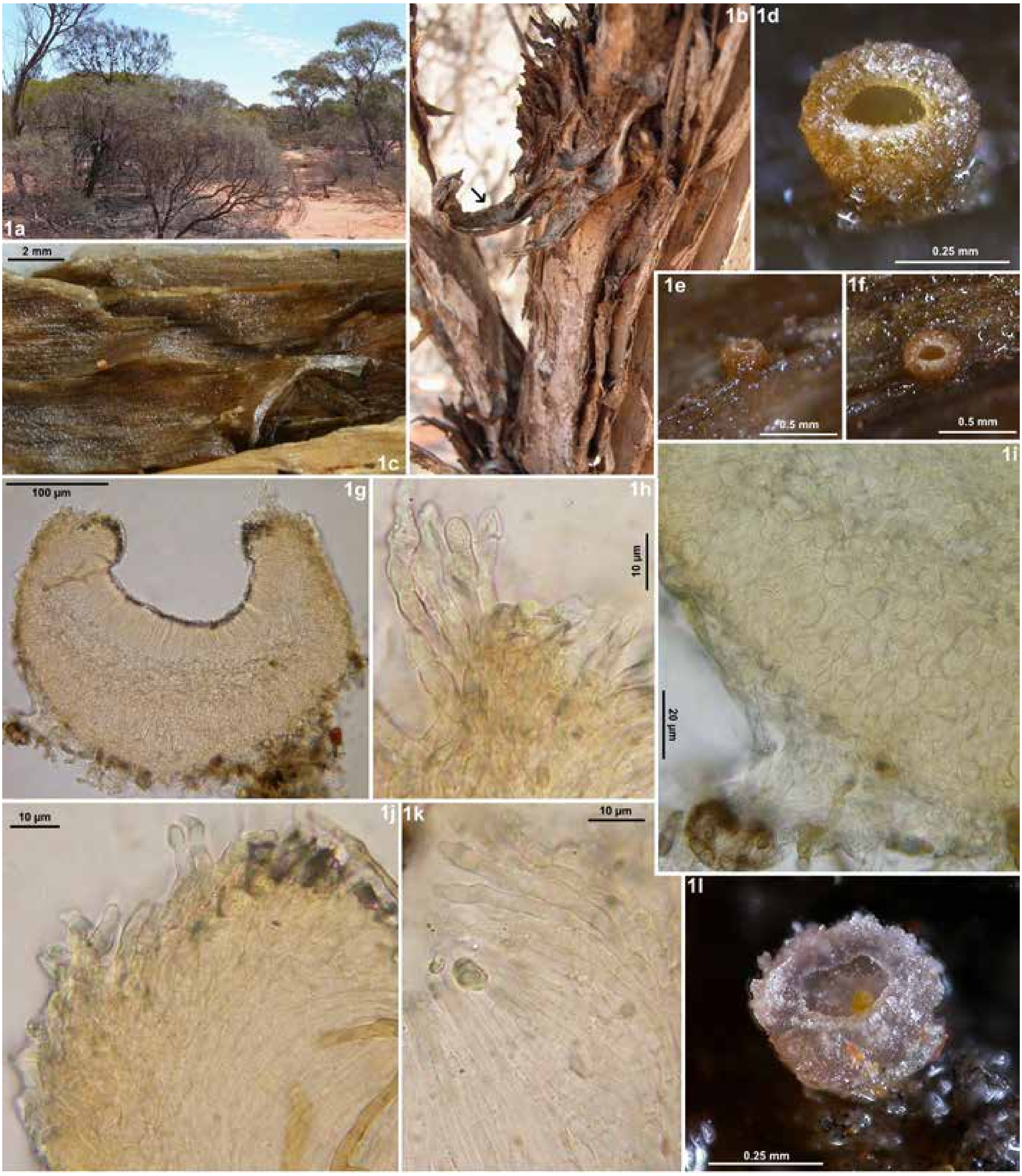


Plate 929. **1a–j**: *Orbilia lamarcheae*; **1k–l**: *O.* cf. *lamarcheae*. – **1a**. semiarid *Acacia* shrubland with *Lamarchea* (left, with fruits), *Acacia*, *Dodonaea*, *Callitris*; **1b**. living trunk with detaching paper-like bark; **1c**. bark with scattered rehydrated apothecia; **1d–f**, **l**. rehydrated apothecia; **1g**. apothecium in median section; **1h**, **j–k**. id., marginal ectal excipulum; **1i**. id., basal ectal excipulum. – Living state. — **1a–j**. H.B. 9020g (holotype): Western Australia, Yalgoo, on *Lamarchea*; **1k–l**. H.B. 9020o: ibid.

near base, cells *(8–)10–18(–22) × 7–12 µm; 20–25 µm thick near margin, of pale orange t. prismatica oriented at a 30–50° angle to the surface, marginal cortical cells *6–10 × 3–4 µm, terminating in thin-walled (†0.3–0.4 µm), irregularly flexuous, ~1–3-septate free **hairs** of */†20–45 × (3–)3.5–5(–6) µm; glassy processes absent. **Anchoring hyphae** not observed. **SCBs** in paraphyses globose, in ectal excipulum not observed. **Exudate** over paraphyses 0.1–0.3 µm thick, indistinctly granular, continuous, firmly attached, on marginal cells among hairs 0.5–3 µm thick, pale yellow. — **ANAMORPH**: unknown.

Habitat: collected 0.5–1.5 m above the ground, corticated, ~10–18 cm thick, standing, living trunk of *Lamarchea hakeifolia*, on strongly decayed, almost entirely detached, paper-like bark, ± greyed, without algae. **Associated**: *Capronia* spp. {2}, *Claussenomyces* sp., *Hyalorbilia pleioerythrostigma*, *Orbilia austroobtusispora*, *O. gemma*, *O. kingsiana*, *O. myriolilacina*, *O. pseudoflagellispora*, *O.* ?*pubescens*, *Ostropales*, *Symbiotaphrina desertorum*, ?*Xerotrema* sp. **Desiccation tolerance**: fully viable for at least 20 months. **Altitude**: 190 m a.s.l. **Geology**: Cretaceous sedimentary rock (red-brown sandy soil). **Phenology**: long-lived.

Taxonomic remarks. *Orbilia lamarcheae* is very similar to the south European *O. rhamni*, from which it differs in the presence of distinct, short marginal hairs, much larger SBs, also in thicker apothecia, the latter feature being, however, perhaps an accidental difference.

Not included collection. A single immature apothecium associated with *O. lamarcheae* in ~2 cm distance differs in a distinct pale rose colour, also a partly thicker exudate over paraphysis and hair apices (Pl. 929: 1k–l). It belongs only doubtfully here and is, therefore, not included in the description.

Ecology. *O. lamarcheae* grew very sparsely on loose bark of a xeric trunk of *Lamarchea hakeifolia* in a subtropical semiarid open acacia shrubland in western Australia.

Specimens included. **AUSTRALIA**: **Western Australia**, Yalgoo, 187 km N of Geraldton, W of Toolonga, Nerren Nerren, NW Coastal Hwy, 190 m, trunk of *Lamarchea hakeifolia*, on bark, 8.XI.2007, G. Marson (ex H.B. 9020g, MEL 2389276, **holotype**).

Not included. ibid. (H.B. 9020o).

Orbilia asomatica Baral, Quijada & Beltrán-Tej., in Quijada et al., Nova Hedwigia 96: 241 (2012) — Pls 930–931, Map 149

Etymology: named after the absence of a spore body.

Typification: Macaronesia, Tenerife, Abades, branch of *Euphorbia canariensis*, 5.VI.2009, L. Quijada, R. Castro & E.V. Rodríguez (TFC Mic. 22165, holotype).

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.4–0.9 {T} or 0.8–1.5(–1.9) mm diam., 0.13–0.2 or 0.3–0.4 mm high (receptacle 0.13–0.18 → 0.09–0.13 mm), light ochre-orange, hardly translucent, round, slightly gelatinous, subgregarious; disc medium to strongly concave, margin thin, concolorous or more reddish-brown, rough to distinctly crenulate or fimbriate by whitish, ± conglutinate or free hairs, ~5–50 µm protruding (incl. hairs); broadly sessile or with an obconical stipe, superficial to slightly erumpent; dry strongly contracted, bright dirty (olivaceous- to maroon-)brown, externally covered with dirty whitish granules. **Asci** *(48–)60–72(–76) × 5.5–6.5 µm {2}, †54–67 × 5–6 µm {T}, (5–)8-spored, spores *2–3-seriate, ~3–5 lower spores inverted {T}, pars sporifera *(30–)33–42(–47) µm long; **apex** (†) medium to strongly truncate (partly very slightly indented, laterally not or hardly inflated); **base** with short to medium long, thin or thick, flexuous stalk, L-, h- to H-shaped. **Ascospores** *(11.5–)14–18(–21.5) × (2.4–)2.6–3.2(–3.5) µm {3}, †13–15 × 2.2–2.7(–3) µm {T}, subcylindrical to narrowly fusoid to fusoid-clavate, apex obtuse, base slightly to rather strongly attenuated, sometimes with a short and thick tail, inequilateral to slightly curved, especially near base, rarely 1-septate (apparently freshly ejected) {2}; **SBs** absent at all stages of development. **Paraphyses** apically slightly to medium inflated, consistently lageniform, sometimes lanceolate, terminal cells *(16.5–)22–31(–38) × 2.3–3.8 µm {2}, beak *2–4.5 × 1.7–2.3 µm, partly ± flexuous, exceeding the dead asci by 3–7 µm, lower cells *(6.5–)9–15(–19) × (1.5–)2–2.5(–3) µm {2}; unbranched at upper septum. **Medullary excipulum** 40–80 µm thick, of ± dense textura intricata, horizontally oriented, with many inflated cells, sharply delimited. **Ectal excipulum** of (†) slightly gelatinized, ± vertically oriented t. angularis(-prismatica) near base, 30–60 µm thick, cells *10–22 × 7–14 µm {T}; 15–20 µm thick at flanks and margin, of t. globulosa-angularis up to mid flanks, at upper margin of t. prismatica-porrecta oriented at a 0–10° angle to the surface, marginal cortical cells *8.5–12 × (2.3–)3.5–4.5 µm {1}, †5–10 × 2.5–3 µm {T}, partly terminating in thin-walled hairs *13–22 (0-septate) or 35–45(–54) (2-septate) × (2–)3–5 µm {2}; **glassy processes** absent. **Anchoring hyphae** abundant, *2–3 µm wide, walls 0.2 µm thick {T}. **SCBs** in paraphyses and ectal excipulum not observed; **VBs** in terminal cells of paraphyses globose, 0.5–1.8(–2.2) µm diam., abundant, very low- to low-refractive {T}, dead plasma turning pale amber-yellow. **Exudate** over paraphyses 0.1–0.2(–0.5) µm thick, smooth to somewhat rough, firmly attached, over margin and flanks 0.2–0.5 µm up to ~1–2 µm thick, continuous, smooth to rough, hyaline to bright maroon-yellow. **— ANAMORPH**: unknown.

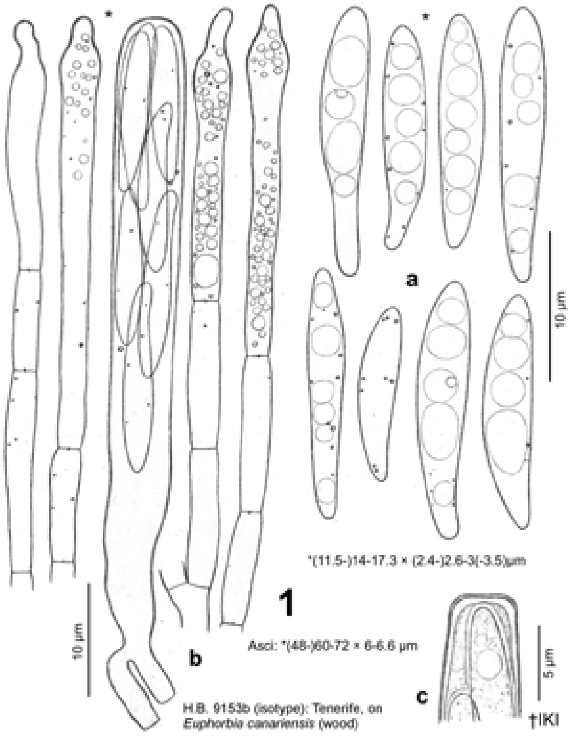


Plate 930. **1**: *Orbilia asomatica*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apex.

Habitat: close to the ground with contact to soil or up to 1 m above the ground, ± decorticated, terminal and hollow branches of *Euphorbia canariensis* {6}, *E. lamarckii* {1}, on strongly decayed wood {4}, usually on underside, very slightly greyed, no algae. **Associated**: *Orbilia acaciae* {1}, L. Quijada (pers. comm.): especially *O. pisciformis*, also *O. amarilla*, *O. beltraniae*, *O. eucalypti*, *O.* aff. *farnesianae*, *O. succulenticola*, ?*Unguiculella* sp. **Desiccation tolerance**: fully tolerant for at least 8 weeks (but not tolerating repeated rewetting), mature asci still alive after 2.5 months and spores after 3 months. **Altitude**: 15–640 m a.s.l. **Geology**: basaltic and trachybasaltic flows. **Phenology**: IV–VI, X, XII (probably throughout the year, long-lived).

Taxonomic remarks. *Orbilia asomatica* is very exceptional within the *Orbiliomycetes* because it entirely lacks a spore body. When the holotype was studied by the first author 8 weeks after collecting, the apothecia were viable concerning most of their elements, even many of the mature asci were alive and also a single fully turgescent ascus was seen (Pl. 931: 1l). All spores inside the living asci and also many viable free spores were consistently without any trace of a spore body. Several further collections have been studied by L. Quijada who confirmed the consistent absence of SBs in this species (Quijada et al. 2012).

With its large ascospore size *O. asomatica* exceeds all the other species of section *Arthrobotrys*. Recognition of this discomycete as orbiliaceous was possible due to the structure of the ascus apex and base, whereas placement in a section of *Orbilia* was quite impossible by morphology alone because of the lack of SBs. Only its molecular data permitted to place this species in series *Neodactylella*, while the lageniform paraphyses and concave, cup-shaped apothecia suggested a relationship to series *Habrostictis* or *Piliferae*. Three trinacrium robustum-like conidia were detected near the apothecia, but they might rather belong to the associated *O. acaciae*. Because of the absence of

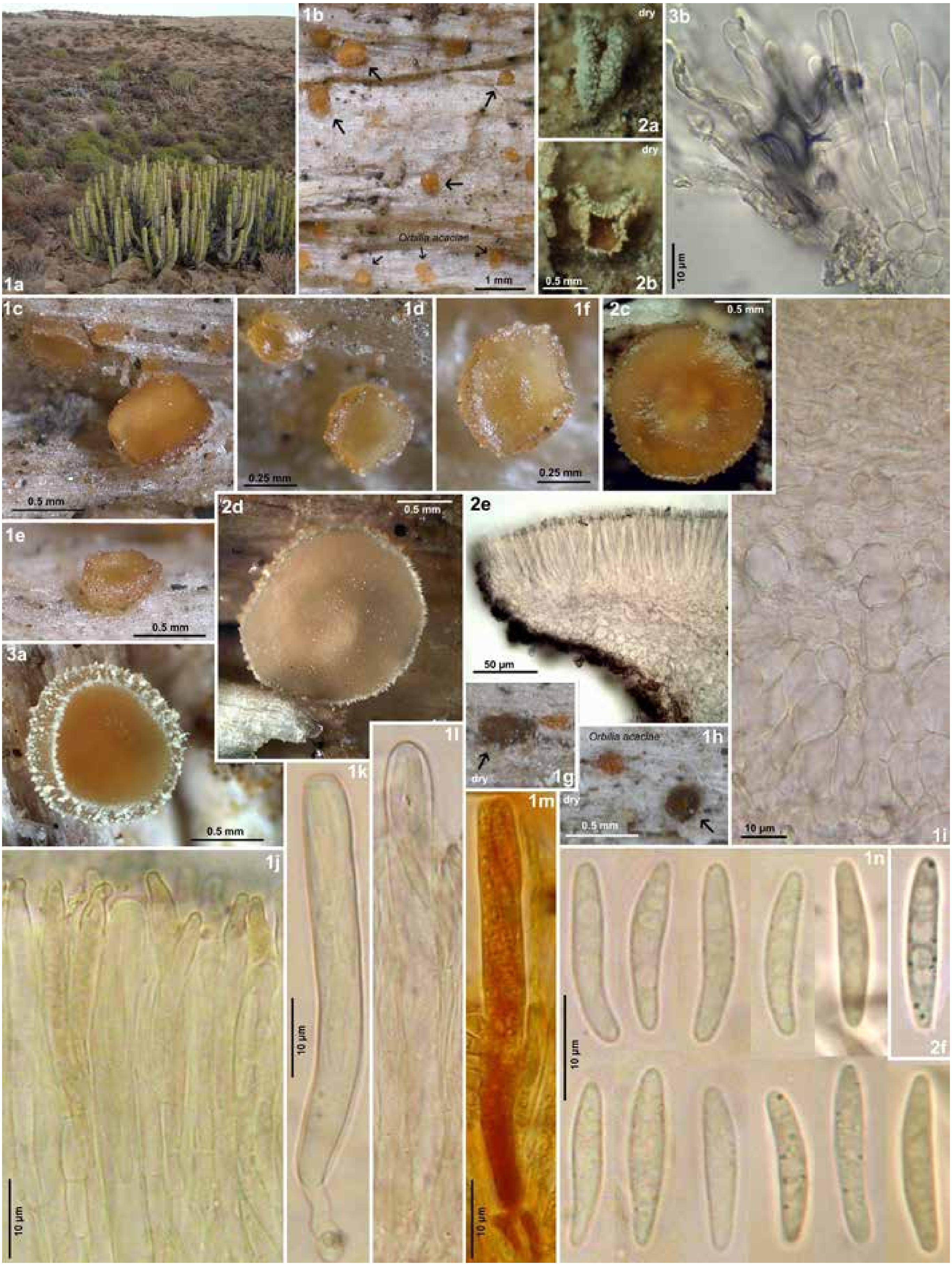


Plate 931. **1–3**: *Orbilia asomatica*. – **1a**. tabaibal dulce (*Ceropegio fuscae-Euphorbietum balsamiferae*) with *Euphorbia canariensis* in foreground; **1b–f**, **2c–d**, **3a**. rehydrated apothecia (light orange apothecia with smooth margin in **1b** belong to *O. acaciae*, marked by smaller arrows); **1g–h**, **2a–b**. dry apothecia (in **1** with orange apothecia of *O. acaciae*); **2e**. apothecium in median section; **3b**. id., marginal ectal excipulum; **1i**. id., basal ectal excipulum; **1j–m**. asci and paraphyses; **1n**, **2f**. ascospores. – Living state, except for **1m** (in IKI) (terminal cells), **3b** (outer hairs on left). – **1a**, **2a–f**, **3a–b**: phot. L. Quijada (**2e**: from Quijada et al. 2012, **3a**: from Quijada et al. 2016). — **1a–n**. H.B. 9153b (isotype): Tenerife, Abades, on *Euphorbia canariensis*; **2a–f**. TFC 22052, 22054: Montaña Amarilla, on *E. canariensis*; **3a–b**. TFC 23823: Punta de Teno, on *E. canariensis*.

Map 149. Known distribution of *O. asomatica* in Tenerife (Macaronesia).

a spore body the species was first classified by the finder as a possible member of the *Hyaloscyphaceae* (*Helotiales*).

Variation was mainly observed in apothecial size, being rather small in the holotype, while the microscopic features were rather concordant among the collections. Some extreme values in the protologue were not included in the above description, for instance *1.5 µm wide terminal cells refer to young paraphyses, or *5.7 × 3.3 µm large basal excipular cells concern rare, often external, very small elements that were consistently omitted in the present study.

Phylogeny. Sequences (ITS+LSU) were taken from apothecia of two specimens. Both lack the S1506 intron. Phylogenetic analyses provide strong evidence for a relationship with series *Neodactylella*, particularly with *O. rhamni*, with which it formed a supported clade irrespective of analysing ITS or LSU (Phyls 25–27, S31), with *O. fraxini* as sister clade. In the ITS region the two *O. asomatica* strains differ by 0.4 % (2 nt), while the distance to *O. rhamni* is 7 % and to *O. fraxini* 12 %. In the LSU (D1–D2) the two *O. asomatica* strains are identical, and the distance to *O. rhamni* is 0.7–0.9 % and to *O. fraxini* 2.1 %.

Ecology. *O. asomatica* was repeatedly encountered between 2009–2014 by L. Quijada (pers. comm.) on rotten wood of xeric branches of *Euphorbia* spp. in infra- to rarely thermomediterranean xerophytic scrublands at four sites in Tenerife (Macaronesia). The vegetation includes the semiarid cardonal (*Periploco laevigatae-Euphorbietum canariensis*) in the northwest of the island, a semiarid juniper woodland in the west, and an arid tabaibal dulce (*Ceropegio fuscae-Euphorbietum balsamiferae*) and hyperarid *Frankenio ericifoliae-Zygophylletum fontanesii* in the south. Although the inhabited branches were often more or less lying on the shaded ground, they are nevertheless dry for most time of the year.

Specimens included. **MACARONESIA**: **Canary Islands**, **Tenerife**, Buenavista del Norte, 5 km WSW of Buenavista del Norte, 3 km NW of Teno Alto, Punta de Teno, Lomo las Toldas, 190 m, branch of *Euphorbia canariensis*, on wood, 27.XII.2012, L. & C. Quijada (TFC Mic. 23823, doc. vid.; sq.: KT222400). – Guía de Isora, 5 km NNW of Guía de Isora, 1.7 km NW of Chío, Los Corchos, 640 m, branch of *E. lamarckii*, on wood, 24.X.2014, L. Quijada, C. Quijada & J. Kout (TFC Mic. 21258, non vid.; sq.: KT222399). – **Arico**, 1 km WSW of Abades, Baranco la Vera, 50 m, branch of *E. canariensis*, on wood, 5.VI.2009, L. Quijada, R. Castro & E.V. Rodríguez (TFC Mic. 22165, **holotype**; H.B. 9153b, **isotype**). – ibid., 5.V.2009 (TFC Mic. 22158, non vid.). – ibid., 12.VI.2009 (TFC Mic. 22233, doc. vid.). – San Miguel de Abona, 4.5 km SSW of Las Chafiras, 1.2 km ENE of Costa del Silencio, Montaña Amarilla, 15 m, branch of *E. canariensis*, on wood, 16.IV.2009, L. Quijada, J. Diaz Armas & E.V. Rodríguez (TFC Mic.22052, 22054, 22055, doc. vid.). – ibid. 11.VI.2009 (TFC Mic.22175, 22180, doc. vid.). – ibid., 35 m, branch of *E. canariensis*, 16.XII.2012, L. Quijada & R. Castro (TFC Mic. 23770).

2. Marginal excipular cells oriented at a low angle, forming distinct cell rows, ascospores generally falcate and mostly > 8 µm long, conidia fusiform, rarely fusoid-clavate

Orbilia oxyspora (Sacc. & Marchal) E. Weber & Baral, **comb. nov.**, MB 813982 — Pls 932–935, Map 150

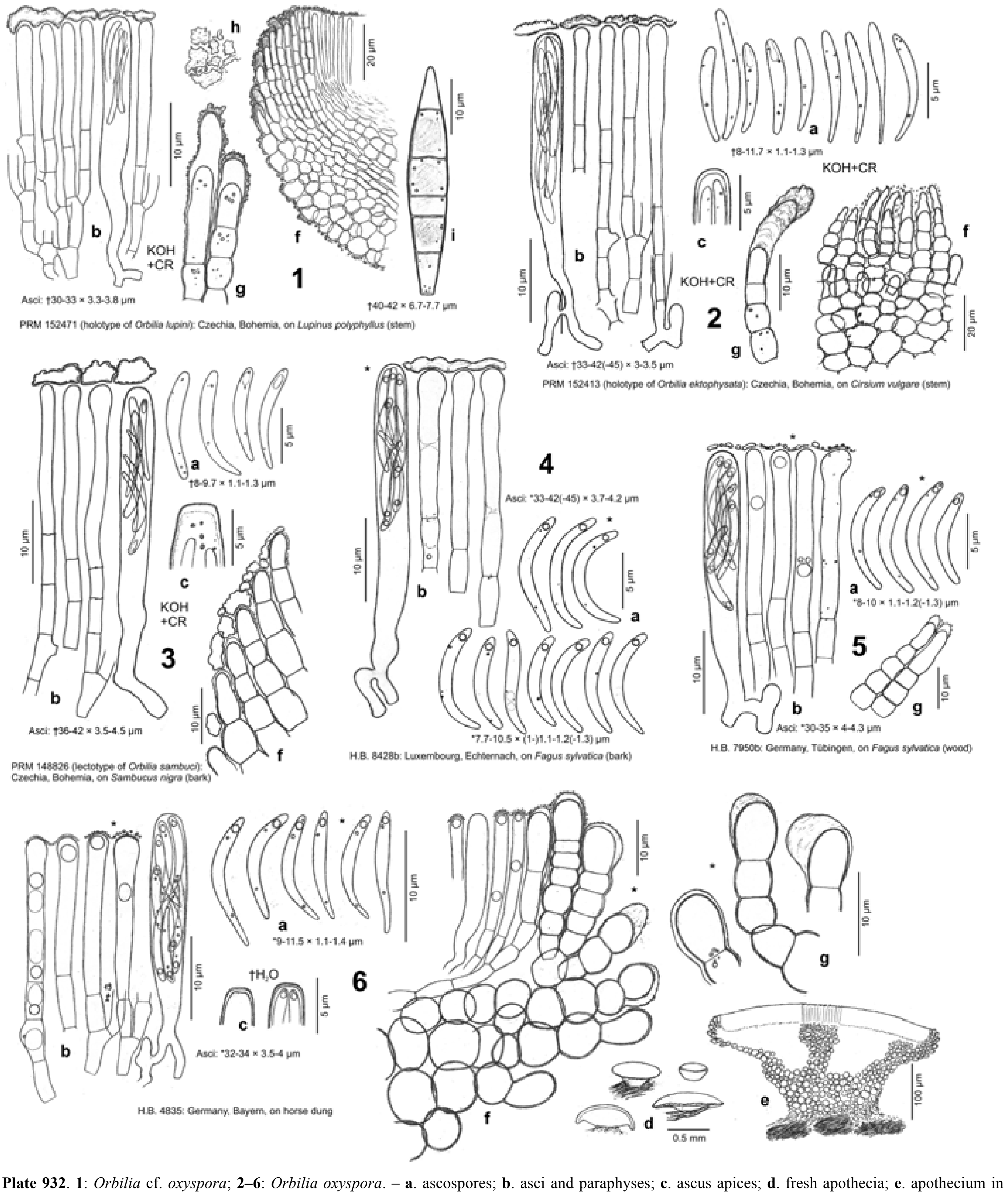
Basionym: *Monacrosporium oxysporum* Sacc. & Marchal, in Marchal, Bull. Soc. R. Bot. Belg. 24: 63, pl. 3 figs 5–6 (1885)
≡ *Dactylella oxyspora* (Sacc. & Marchal) Matsush., Microfungi of the Solomon Islands and Papua-New Guinea: 22 (1971)
?= *Dactylella minuta* var. *fusiformis* Grove, J. Bot. 24: 200, pl. 266 fig. 10 (1886)
≡ *Dactylella fusiformis* (Grove) Mussat, in Saccardo, *Syll. fung.* (Abellini) **15**: 109 (1901), nom. inval., ICN Art. 36.1(b)
= *Orbilia sambuci* Velen., Monogr. Discom. Bohem.: 101 (1934)
(?)= *Dactylella atractoides* Drechsler, Mycologia 35: 360, fig. 4 (1943)
≡ *Drechsleromyces atractoides* (Drechsler) Subram., Kavaka 5: 93 (1978, '1977')
= *Orbilia ektophysata* Velen., Opera Bot. Čech. 4: 103 (1947)
(?)= *Orbilia lupini* Velen., Opera Bot. Čech. 4: 104 (1947)
= *Dactylella arnaudii* Yadav, Trans. Br. Mycol. Soc. 43: 603 (1960)
?= *Orbilia fimicola* Jeng & J.C. Krug, Mycologia 69: 832 (1977)
(?)= *Dactylella yunnanensis* K.Q. Zhang, Xing Z. Liu & L. Cao, Mycosystema 7: 113 (1995) [1994]
= *Orbilia fimicoloides* J. Webster & Spooner, in Webster et al., Mycol. Res. 102: 99 (1998)
(?)= *Dactylella rhombospora* s. Drechsler (1937a: 539)

Etymology: *arnaudii*: after the mycologist G. Arnaud; *atractoides*, *fusiformis*, *oxyspora*: according to the fusiform, distaff-shaped conidia with strongly attenuated ends; *ektophysata*: referring to marginal apothecial elements; *fimicola*, *fimicoloides*: named after the coprophilous habit; *lupini*, *sambuci*: referring to the substrate; *yunnanensis*: after the province Yunnan in China.

Typification: Belgium, Brussels, dung of caterpillar, autumn 1884, E. Marchal (holotype of ***Dactylella oxyspora***, illustration in Marchal 1885: pl. III figs 5–6); Germany, Chemnitz, stem of *Angelica sylvestris*, 30.VII.2010, B. Mühler (ex H.B. 9390a, M-0276548, epitype, designated here, MBT202636; sq.: KT222360). — Great Britain, Sutton Coldfield, stem of *Carduus*, undated, W.B. Grove (holotype of ***D. minuta* var. *fusiformis***, illustration in Grove 1886: pl. 266 fig. 10). — Czechia, Hvězdonice, branch of *Sambucus nigra*, 1.VII.1925, J. Velenovský (PRM 148826, lectotype of ***Orbilia sambuci***, designated here, MBT382142). — USA, Beltsville, leaves of *Solanum lycopersicum*, undated, C. Drechsler (holotype of ***D. atractoides***, illustration in Drechsler 1934: fig. 4). — Czechia, Tehov, stem of *Cirsium vulgare*, 8.VI.1940, J. Velenovský (PRM 152413, holotype of ***O. ektophysata***). — Czechia, Mnichovice, stem of *Lupinus polyphyllus*, 14.VI.1942, J. Velenovský (PRM 152471, holotype of ***O. lupini***). — Great Britain, London, St. Albans, stems of *Heracleum sphondylium*, 25.VIII.1958, A.S. Yadav (IMI 77850, holotype of ***D. arnaudii***; ex-type culture: CBS 129.83, doc. vid.; sq.: DQ494353, MH873289). — Venezuela, Cantaura, *Equus asinus* dropping, 2.VIII.1972, K.P. Dumont et al. (TRTC 52084, holotype of ***O. fimicola***). — China, Yunnan, Xishuangbanna, forest soil, 11.XII.1993, D.R. Yang (HMGAC 511-1, holotype of ***D. yunnanensis***, doc. vid.). — Great Britain, London, Perivale Wood, dung of ?mice, 18.II.1996, A. Henrici (K(M) 48656, holotype of ***O. fimicoloides***).

Misinterpretation of *O. oxyspora*: Pfister (1994, as *O. fimicola*), = *O. auricolor*.

Description: — **TELEOMORPH**: **Apothecia** fresh or rehydrated (0.18–)0.3–1(–2) mm diam., (0.12–)0.15–0.25(–0.35) mm high (receptacle 0.08–0.2 → 0.06–0.1 mm), white or whitish-cream, pale cream-yellowish with age (Velenovský: vinaceous-yellowish), medium translucent or not, round to somewhat undulating, scattered to gregarious; disc flat, soon slightly to strongly convex (pulvinate), margin distinct, thin, 0–20 µm protruding (incl. minute teeth), smooth or mostly finely rough to minutely crenulate; broadly sessile or with a ± broad and indistinct stipe 0.04–0.1 × 0.2 mm, superficial. **Asci** *30–43(–47) × 3.5–4.3 µm {4}, †28–40(–45) × (2.7–)2.9–3.5 {7} or 3.5–4.5 µm {1}, 8-spored, spores *3–4-seriate, 3–4(–5) lower spores inverted {5} (rarely mixed), pars sporifera *16–19(–21) µm long; **apex** (†) medium to strongly truncate (never indented nor



PRM 152471 (holotype of *Orbilia lupini*): Czechia, Bohemia, on *Lupinus polyphyllus* (stem)

PRM 152413 (holotype of *Orbilia ektophysata*): Czechia, Bohemia, on *Cirsium vulgare* (stem)

PRM 148826 (lectotype of *Orbilia sambuci*): Czechia, Bohemia, on *Sambucus nigra* (bark)

H.B. 8428b: Luxembourg, Echternach, on *Fagus sylvatica* (bark)

H.B. 7950b: Germany, Tübingen, on *Fagus sylvatica* (wood)

H.B. 4835: Germany, Bayern, on horse dung

Plate 932. **1**: *Orbilia* cf. *oxyspora*; **2–6**: *Orbilia oxyspora*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. fresh apothecia; **e**. apothecium in median section; **f**. id., ectal excipulum at margin and mid flanks (**2f** in surface view); **g**. hair-like marginal cortical cells tipped by glassy processes; **h**. exudate on hymenium (surface view); **i**. conidium from substrate.

laterally inflated); **base** with short to medium long, thin or thick, slightly flexuous stalk, Y-, L-, h- or H-shaped. **Ascospores** *(7–)8–11(–11.5) × (1–)1.1–1.4 µm {13} (~9–13 µm actual length), †7.5–10.5(–11.7) × (1–)1.1–1.2(–1.3) µm {4}, narrowly fusoid-clavate (subulate), apex rounded to obtuse, base gradually slightly to strongly attenuated, (slightly) medium to strongly curved (falcate) when alive, slightly to medium curved when dead; **SBs** *0.4–0.8 µm wide {7}, globose to subglobose, with a fine, mostly invisible filum, total length 1–1.5 µm. **Paraphyses** apically uninflated to (very) slightly (rarely medium) capitate, terminal cell *14–22 × (1.8–)2–3(–4) µm {3}, †(11–)15–20(–22) × 1.7–2.3(–3) µm {2}, lower cells *3.5–6.5 × 1.8–2.5 µm {3}, †3.5–6.5(–9.5) × 1.4–1.8 µm {3}; unbranched at upper septum. **Medullary excipulum** 15–40(–100) µm thick, of ± dense textura globulosa(-intricata), sometimes with a horizontal t. porrecta below, very indistinctly to sharply delimited from ectal excipulum. **Ectal excipulum** of thin-walled, indistinctly vertically oriented t.

globulosa from base to submargin, 50–150 µm thick near base, cells */†10–32 × 10–22(–26) µm {6}; 40–50 µm thick at upper flanks, oriented at a 45° angle to the surface, 15–25 µm near margin, oriented at 10–30(–45)°, marginal cells forming ± agglutinated rows of ± isodiametric cells {19}, terminal cells *6–10(–12) {4} × 3.3–5(–6) µm {5}, †5–12 × 3–5 µm {3}, cell rows 15–35 µm long, (2–)3–6-celled, straight or usually curved inwards, apically also outwards, slightly coherent to form indistinct teeth; **glassy processes** absent {5} or present {9}, cap-like or cylindrical, 1–5(–10) {8} or 5–15 {3} × 3–4 µm, slightly to medium refractive, not or slightly stratified, ± straight, also curved outwards. **Anchoring hyphae** (sparse to) abundant at base, */†(1.5–)2–3(–5) µm wide, walls 0.2(–0.3) µm thick {6}, rarely thick-walled, near insertion sometimes forming moniliform rows of *5–11 µm wide cells, sometimes forming strands. **SCBs** in paraphyses absent {1} or globose, 1–2 µm diam. {5}, in ectal excipulum absent, in medullary excipulum present {1}; **VBs** absent. **Exudate** over paraphyses and marginal cells 0.2–0.5(–1) {5} or 0.5–1.5(–2) {6} or (1–)2–3(–4) µm {4} thick, granular to cloddy or continuous, hyaline to pale yellowish, loosely attached. **— ANAMORPH**: dactylella-like (from ascospore isolate {1}, apothecium in Petri dish {1}, natural substrate {10}, and environmental isolate {9}; including data from Marchal 1885, Drechsler 1937a, Yadav 1960, Matsushima 1971, Rubner 1996, Zhang et al. 1995, Webster et al. 1998, and Chen et al. 2007b). **Conidiophores** (25–)50–200(–300) µm long {8}, mostly erect, septate, 2–4.5(–5.5) µm wide at base and (1–)1.5–2.5(–3) µm at apex, unbranched or apically branched. **Conidiogenous cells** monoblastic or sympodial (with conidia in clusters of 2–4). **Conidia** young clavate, mature mostly fusiform, straight, both ends medium to very strongly attenuated, apex rounded, base ± truncate, widest part in the middle but also more below, *((45–))(50–)60–90(–95)((–112)) × ((7–))8–10(–11) µm {8}, †50–83 × 7–10 µm, ((3–))(7–)8–10(–11)((–12))-septate {6}, in purely anamorphs (from literature) ((28–))(45–)60–90(–110) × ((4–))7.5–11(–12)((–13.5)) µm; ((1–))(5–)7–11(–12)-septate {10}. **Chlamydospores** absent or present.

Habitat: lying at the moist ground or often at base of standing stems or in 0.5–2 m above the ground, corticated or decorticated, 1–15 cm thick branches and trunks of *Corylus avellana* {1}, *Fagus sylvatica* {2}, *Sambucus nigra* {1}, on slightly to strongly, partly deeply decayed wood {1} and bark {3} (periderm {3} and bast {2}, bark ± detached), hardly to strongly greyed or darkened, without or with a few green algae; herbaceous stems (rarely leaves) of *Angelica* sp. {1}, *A. archangelica* {1}, *A. sylvestris* {3}, *Arctium minus* {1}, *Cirsium arvense* {1}, *C. vulgare* {1}, *Foeniculum vulgare* {1}, ?*Helianthus tuberosus* {1}, *Heracleum* sp. {1}, *H. sphondylium* {1}, *Hordeum vulgare* {1}, *Impatiens glandulifera* {1}, *Oenanthe crocata* {2}, *Pastinaca sativa* {1}, *Smyrnium olusatrum* {1}, *Symphytum officinale* {1}, *Urtica dioica* {2}; on dung of *Equus caballus* {1}, *Oryctolagus cuniculus* {1}, ?mice {1}, caterpillar {1}; soil/forest litter isolates {3}. **Associated**: *Cistella* ?*aconiti* {1}, *C. grevillei* {1}, *Hyalorbilia fagi* {1}, *Urceolella* ?*pani* {1}, *Leptospora rubella* {1}, *Mollisia revincta* {1}, *Orbilia atlantis* {1}, *O. auricolor* {1/1}, *Pyrenopeziza atrata* {1}, *Trichosphaeria notabilis* {1}. **Desiccation tolerance**: paraphyses, immature asci, and conidia survive for at least 2 days. **Altitude**: -4–1175 m a.s.l. (Europe), 1100 m (Papua New Guinea). **Geology**: Cambrian, Ordovician & Carboniferous shale, silt- & sandstone, quartzitic & carbonaceous greywacke, Permian (Rotliegend), Keuper (sandstone & marl), Lower Jurassic sandstone, Upper Cretaceous clayey sand, Quaternary sand, marl & till; granite, quartzite, amphibolite, phyllite, mica schist, sericitic shale, gneiss. **Phenology**: II–X (teleomorph).

Taxonomic remarks. *Orbilia oxyspora* is characterized by its marginal excipular cells that form distinct rows oriented at a low angle to the surface, in combination with a dactylella-like anamorph with large, fusiform, multiseptate conidia. With its falcate ascospores the species resembles *O. auricolor* (series *Arthrobotrys*), which differs in the absence of marginal cell rows and an arthrobotrys-like anamorph with 1-septate conidia. However, there are other species with marginal cell rows: *O. dorsalis* hardly differs morphologically, except for its anamorph showing a slight tendency to shorter conidia with fewer septa; this species is accepted here as separate mainly for molecular reasons and a subtropical to tropical distribution. *O. clavispora* differs in subcylindrical conidia with obtuse ends and in strongly, often abruptly attenuated spore bases that form distinct tails. *O. tenuissima* differs in distinctly narrower ascospores, more yellow apothecia, and a tropical distribution, and *O. desertorum* in slightly wider spores, in the presumed anamorph having smaller, subcylindrical conidia with fewer septa, and in occurring in semiarid subtropical areas. Narrow spore tails were occasionally also seen in *O. oxyspora*, namely in the type of *O. ektophysata* (Pl. 932: 2a), but so far only in dead spores. Finally, a member of series *Arthrobotrys* (*O. javanica*, see p. 1550) strongly resembles *O. oxyspora* in the teleomorph characters but has a very different anamorph. For the possibly synonymous but not included *O. fimicola* and *O. lupini* see below.

Variation. The collections here included in the description of *O. oxyspora* show variation in some features. The exudate is rather thin in the specimens from Tübingen and Salzburg, and thickest in the type of *O. sambuci*. The latter shows also the highest ascus width and deviates in fresh vinaceous-yellowish apothecia. In the specimen from Luxembourg and the type of *O. sambuci* the glassy processes are ± absent, whereas the type of *O. ektophysata* belongs to those with the longest processes. In the specimen from Salzburg they form rather broad caps, and this is apparently also the case in the type of *O. fimicoloides*, which Webster et al. (1998) described as 'the apical cell often with greatly thickened refractive walls'. Perhaps because it was not fully mature, a sample from Bretagne (IVV: J.P.P. 15134, on *Ulex*) had straight to slightly curved living spores; it is included as it showed the typical conidia.

Type studies (teleomorph). Velenovský (1934) described ***O. sambuci*** based on two collections (on *Sambucus nigra* and *Rosa canina*). Svrček redescribed the *Sambucus* specimen (as 'holotype'), but he did not mention that on *Rosa*, probably because it could not be found at PRM. Since two collections are mentioned in the protologue and since the epithet *sambuci* does not automatically imply that the *Sambucus* collection is the holotype (ICN Art. 9A.2), we here designate the collection on *Sambucus* (PRM 148826) as **lectotype**.

This lectotype (Pl. 932: 3) consists of ~22 scattered apothecia which are rehydrated 0.25–0.55 mm in diam., now pale cream (Velenovský: vinaceous-yellowish, according to his manuscript plate which treats mainly the *Sambucus* sample). Svrček placed the taxon in synonymy with *O. curvatispora* (= *O. auricolor*), with the remark that the exudate ('epithecium') over the paraphyses is strongly developed (up to 5.5 µm thick, 1.5–3 µm in the present study). In the present reexamination the spores were wider than reported by Velenovský (8–10 × 0.7–1 µm, width evaluated from manuscript plate) and Svrček (9–11 × 0.8 µm). Velenovský's drawing shows much more curved (arcuate) spores than here observed, but this discrepancy seems to be due to the living vs. dead state. The marginal excipulum forms rather distinct, somewhat free rows of prismatic cells oriented at a 30–40° angle to the surface. This and the rather narrow anchoring hyphae of 2–2.5(–4) µm exclude *O. auricolor*. Although conidia were not found on the substrate, *O. sambuci* is considered here to be conspecific, e.g., with *O. fimicoloides*.

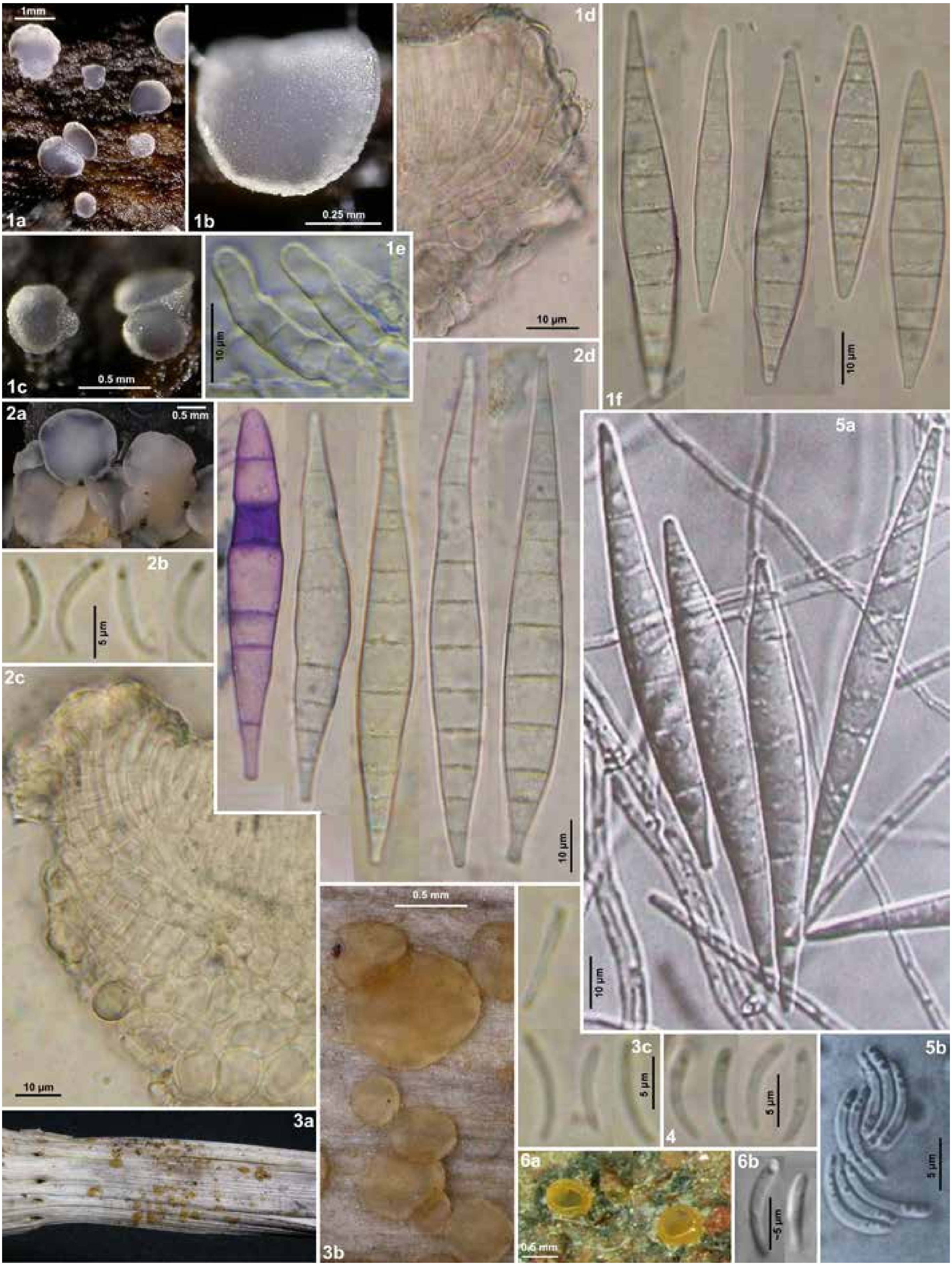


Plate 933. **1–5**: *Orbilia oxyspora*; **6**: *O.* aff. *oxyspora*. – **1a–c**, **2a**. fresh apothecia (**1a–c** grown in moist box); **3a–b**, **6a**. rehydrated apothecia; **1d**, **2c**, ectal excipulum in median section at mid flanks and margin; **1e**. hair-like rows of marginal cortical cells; **2b**, **3c**, **4**, **5b**, **6b**. ascospores; **1f**, **2d**. conidia from substrate; **5a**. conidia from culture (DIC). – Living state, except for **3c** (in KOH) and **6b** p.p. —**1a–f**. H.B. 8428b: Luxembourg, Echternach, on *Fagus*; **2a–d**. H.B. 9390a (epitype): Germany, Chemnitz, on *Angelica*; **3a–c**. H.B. 5299: France, Ardennes, on *Angelica*; **4**. H.B. 9447: France, Morbihan, on *Oenanthe*; **5a–b**. 18.II.1996: England, Middlesex (type of *O. fimicoloides*, from Webster et al. 1998: fig. 4); **6a–b**. HMAS 139539: China, Henan, on indet. wood (from Liu 2006, as *O. fimicoloides*).

O. ektophysata remained a dubious species in Svrček's (1954) revision because the author failed to find spores in the 'only two apothecia' of the holotype. In the present reexamination (Pl. 932: 2), about 10 apothecia were discovered. Two of them were examined, which showed abundant mature asci but no free spores. Strong pressure on the cover slip broke some asci, and their spores became discernible. Velenovský (1947) described the spores as '1–2.5 µm long, narrowly ellipsoid, straight, eguttulate' and compared the species with *O. minutispora*. His spore description might refer to the spore body, but his false calibration in the case of small elements excludes this possibility. Svrček gave an ascus size of 28–30 × 2.5 µm, probably by omitting the stipe. The margin shows a very fine crenulation due to short, conglutinate, 1–4-celled hairs tipped by ca. 3–10 × 3–3.5 µm large glassy processes. The hair cells are partly isodiametric and closely resemble those cell rows described in the protologue of *O. fimicoloides*. In concordance with Velenovský the paraphyses have a cylindrical to only slightly clavate apex 1.7–2.3 µm wide, covered by 0.5–1.5 µm thick exudate. The rehydrated apothecia are 0.3–0.7 mm diam., now whitish to light cream-yellowish (Svrček: [?dry] lemon-yellow, Velenovský wax-coloured). The 'ektophyses' which Velenovský described as 'numerous, straight, 25–30 × 2–3 µm, fusoid, septate, very thick-walled' appear to refer to the very distinctly developed marginal cell rows. No conidia could be found in this specimen. It must be noted that Velenovský earlier used the name *O. ektophysa* (ined.) on a manuscript plate for two collections here referred to *O. tremulae* (see p. 1375).

The holotype of ***O. lupini*** (Pl. 932: 1) was found at an arid, sun-exposed site on the top of a hill, growing densely gregarious at the base of a stem of *Lupinus polyphyllus*. The apothecia were described by Velenovský (1947) as translucent white, 0.5–1.5 mm diam. and by Svrček (1954) as dry yellow. In the present reexamination ~8 apothecia were found, being rehydrated light yellow-ochraceous, 0.8–1.4 mm diam. Five of them were tested but, despite their size, all were immature by showing only a few young asci. The ascospores could only faintly be seen in a single ascus (Pl. 932: 1b). They seem to be curved, with a size of about 8 × 0.7 µm. The ~100 µm thick basal excipulum is large-celled (15–25 × 10–17 µm) and the marginal cells form a textura prismatica-porrecta at a ~20° angle, with cortical cells 5–12 × 3–4 µm and glassy caps 2–7 × 3–4.5 µm. 2 fusiform conidia of the presumed anamorph were encountered close to the apothecia (see also below).

Svrček discovered a few straight spores 5.5–6 × 1 µm, whereas Velenovský (1947 and manuscript plate) reported them as 2–2.5 × 0.3 µm, cylindrical, often slightly to medium curved, with 3–4 rather large guttules. Even when considering an error of 50% in Velenovský's calibration, the length of these spores would better fit Svrček's than our data. Velenovský described the asci as 25 × 2.5 µm, with truncate unstalked base, and the paraphyses as filiform, features suggestive of a *Hyalorbilia*, but Svrček found the asci 30 × 2.5–3 µm, stipitate, and the paraphyses apically clavate, features suggestive of an *Orbilia*. The projecting hyphae at the apothecial base (6–9 µm wide, thick-walled, yellowish) illustrated by Velenovský support the former idea though the excipulum of isodiametric cells as stated by Svrček fits better an *Orbilia*. Possibly *O. lupini* was a mixture of two species.

Velenovský compared *O. lupini* with *O. cardui*, and Svrček even synonymised the two taxa because he found full concordance between them. Velenovský's report of 'erect, hyaline, subcylindrical, multiseptate tentacles (120–150 × 8–10 µm)' might represent the conidia of *O. lupini*, though those two ones discovered here are much shorter and fusiform. Based on the present reexamination, *O. lupini* is not conspecific with *O. cardui* but might well belong to *O. oxyspora* because of the marginal excipulum oriented at a low angle. Since spore morphology could not clearly be studied, we refrain from including this material in the description of *O. oxyspora*.

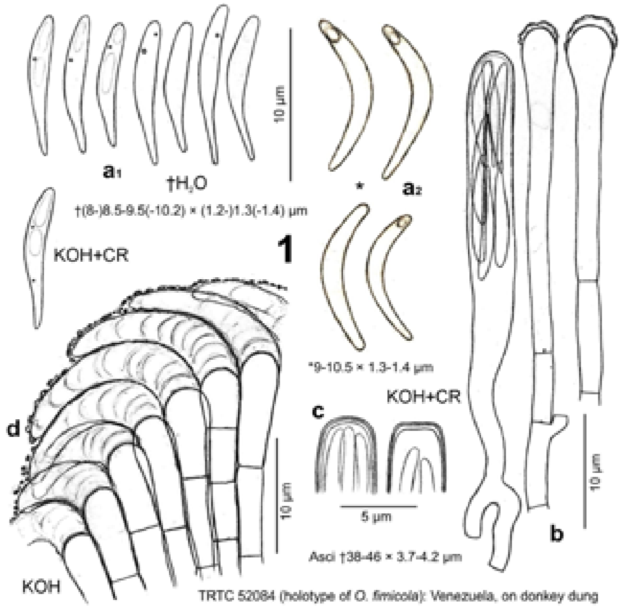


Plate 934. **1**: *Orbilia* cf. *oxyspora*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apices; **d**. marginal cortical cells tipped by glassy processes, (living spores redrawn from photo in Jeng & Krug 1977: fig. 5).

O. fimicola (Pl. 934–935) was reported by Jeng & Krug (1977) for apothecia found on donkey dung in Venezuela. It was described as a new species mainly because of its coprophilous habitat. Though the given microscopic features somewhat resemble those of *O. auricolor*, Jeng & Krug compared it only with *O. leporina* which was described from hare dung. The authors believed that *O. leporina* differed in much smaller, straight spores, and in apically hardly inflated paraphyses covered by more abundant exudate. However, according to the present revision of the holotype of *O. leporina*, the spores are distinctly curved, basally attenuated, and only slightly shorter than in *O. fimicola*, also the paraphyses are apically distinctly inflated (Pl. 916: 1).

The present reexamination of the holotype of *O. fimicola* revealed that the protruding marginal ectal excipulum forms a textura prismatica oriented at a ca. 45° angle (also illustrated by Jeng & Krug), and the cortical cells are tipped by prominent glassy processes (Pls 934: 1d; 935: 1l). In conclusion, *O. fimicola* seems indeed not conspecific with *O. leporina*, in which the marginal cells are oriented at a high angle and without glassy processes, though the other features are very similar.

O. fimicola could well be a synonym of *O. oxyspora* or perhaps *O. clavispora*. The prominently arcuate and subulate spores on Jeng & Krug's photograph (redrawn in Pl. 934: 1a$_2$) resemble those of *O. oxyspora* quite well. Spore size is reported as 7–8.5 × 1.2–1.8 µm, but from the photo a size of *~9–10.5 × 1.3–1.4 µm (in situ) can be evaluated, also a globose (or tear-shaped?) spore body can be discerned in some spores. In the present reexamination (1a$_1$), the spores were distinctly less curved, which is obviously a consequence of the dead state.

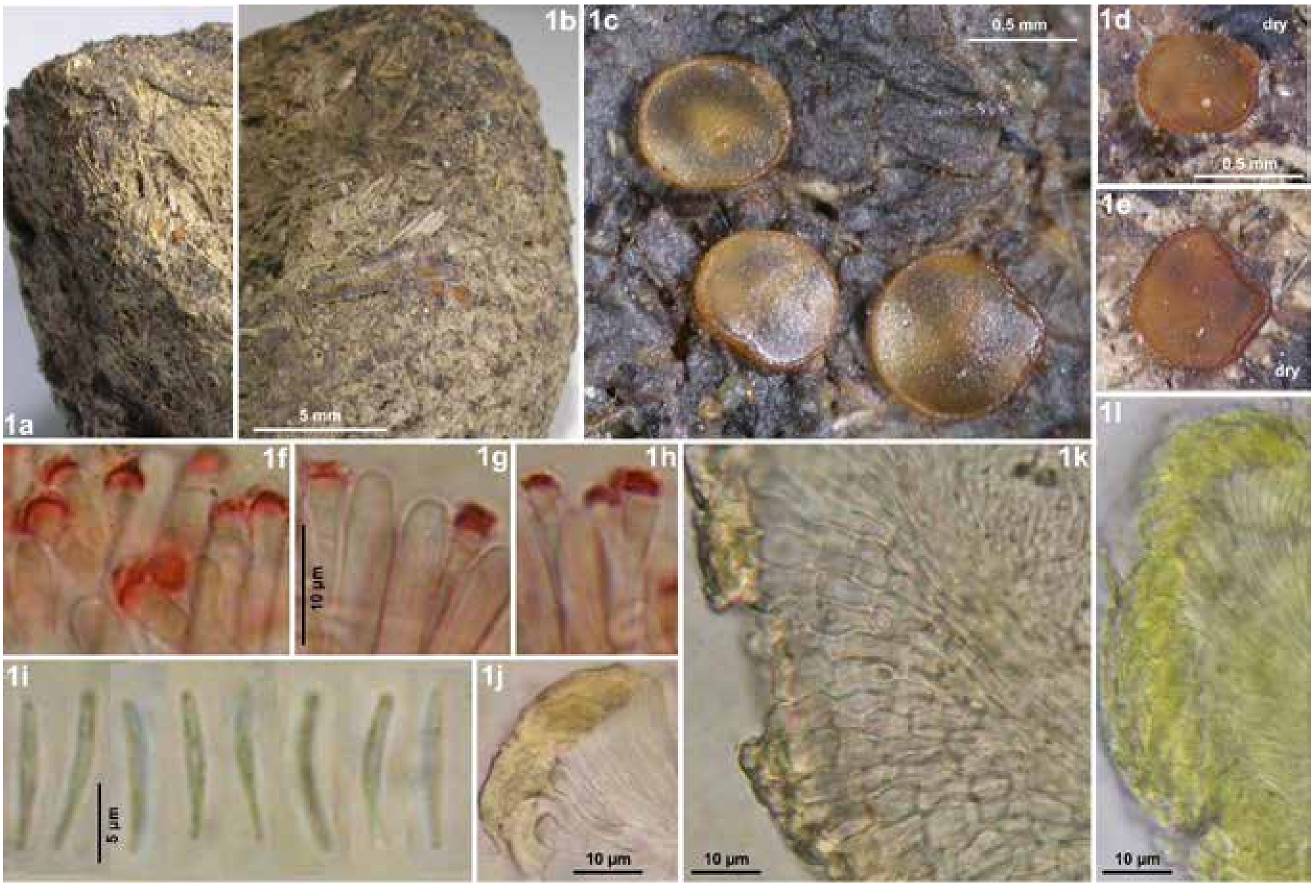


Plate 935. **1**: *Orbilia* cf. *oxyspora*. – **1a–b**. dung of donkey (in dry state); **1c**. rehydrated apothecia; **1d–e**. dry apothecia; **1f–h**. tips of asci and paraphyses (exudate stained red in CR); **1i**. ascospores; **1j–l**. marginal ectal excipulum in median section, cortical cells with glassy processes (yellow in **1l**). – Dead state (**1i–l** in H_2O, **1l** illuminated with Luxeon-LED, **1f–h** in KOH+CR-SDS). — **1a–l**. TRTC 52084 (holotype of *O. fimicola*): Venezuela, on donkey dung.

No anamorph was originally reported for *O. fimicola*, and no conidia could be detected on the substrate, therefore, synonymy with *O. clavispora* cannot be excluded. A sequence taken from the type material would help in clarifying the identity of *O. fimicola*. Pfister (1994) obtained an arthrobotrys-like anamorph in a collection which he identified as *O. fimicola*. The teleomorph of this strain was reexamined (Pl. 949: 2) and found to belong to the scope of *O. auricolor* (series *Arthrobotrys*) because of a vertically oriented marginal excipulum and longer spores, a result which is confirmed by molecular data.

O*. *fimicoloides was described by Webster et al. (1998) from droppings of probably mice from Great Britain. The type was not reexamined here, but the characteristics of the anamorph and teleomorph leave little doubt about its conspecificity with the here assigned, mainly lignicolous and herbicolous collections. Due to the coprophilous habitat, Webster et al. compared their taxon with *O. leporina* and *O. fimicola*. The authors described the apothecial margin as being composed of rows of short (quadrate), somewhat thick-walled cells which extend as free hair-like structures (15–35 × 6–8 µm), their apical cell often bearing a hyaline refractive cap, producing a minutely crenulate margin. However, Webster et al. erroneously believed that also *O. auricolor* possessed this feature. Like in *O. fimicola*, the authors of *O. fimicoloides* thought that *O. leporina* has much smaller, straight spores. In fact, the spores of *O. leporina* are rather similar to those of *O. fimicoloides*, but the marginal excipulum of *O. leporina* is different, and the conidia found on the substrate are shorter and distinctly heteropolar (ellipsoid-clavate, see Pl. 916).

Webster et al. concluded that *O. fimicola* differs from *O. fimicoloides* in light brown vs. white to yellow apothecia, shorter and much wider spores (7–8.5 × 1.2–1.8 µm vs. 8–10.5 × 0.9–1 µm), paraphyses apically inflated (2.8–3 µm wide) vs. non-inflated (1–1.5 µm wide), and a different anamorph (*Arthrobotrys superbus* vs. *Dactylella oxyspora*). However, when evaluating spore size from the photos in Jeng & Krug and Webster et al., the differences become quite vague. In fact, the corrected spore values of *O. fimicoloides* according to the given magnification (*8.8–10.7 × 1.1–1.4 µm) concur quite well with the corrected values of *O. fimicola* (*9–10.5 × 1.3–1.4 µm). The given width of 1–1.5 µm at the paraphysis apices is perhaps incorrect, and the difference in the anamorph is obsolete since the arthrobotrys-like anamorph originates from a misidentified collection.

Not included collections. An unillustrated sample from Tübingen (on *Ononis*) deviates by narrow spores [*8–10.5(–12.5) × 0.8–1.1 µm]. Liu (2006: 80) and Liu et al. (2007a) reported under the name *O. fimicoloides* two collections on unidentified wood from a single site and date in temperate humid China (Jigongshan, Henan, Pl. 933: 6), with yellow apothecia 0.6–1.5 mm diam. with a smooth margin. Although the texture of the marginal excipulum was not studied, a close relationship to *O. oxyspora* or *O. dorsalis* is quite certain because the typical fusiform conidia were found on the substrate (see below). Liu (l.c.) gave the spore size as 9.2–12 × 1–1.4 µm, but his spore photo suggests a lower l:w ratio, while from his scale the spores measure 7–9.5 × 1.2–1.3 µm. For the types of *O. fimicola* and *O. lupini* see under Type studies, *Dactylella atractoides*, *D. minuta* var. *fusiformis*, and *D. yunnanensis* see under Anamorph.

Table 78. Comparison of conidial characters of different collections of *O. oxyspora* (white) and *O. dorsalis* (yellow). $^{+}$ = values modified according to scale of illustration, $^{++}$ = conidial size corrected by Z.F. Yu (pers. comm.); ^{T} = from holotype, ^{ET} = from epitype, √ = identity ascertained by molecular data.

Author	Ecology	Original name	Length of conidia [µm]	Width of conidia [µm]	Number of septa
Marchal 1885	Belgium, caterpillar dung	*D. oxyspora* ^{T}	96–105	9–10.5	10–12
Matsushima 1971	Papua New Guinea, leaf litter	*D. oxyspora*	(45–)60–100	9–13	6–12
Rubner 1996	California, soil under bamboo	*D. oxyspora* √	43–80	7.5–10.5	5–10
Webster et al. 1998	England, ?mice dung	*O. fimicoloides* ^{T}	*45–112	*9–10.5	7–10
H.B. 8428b	Luxembourg, *Fagus* bark	*O. oxyspora*	*(46–)50–66(–73)	*(7–)8–10(–11)	8–9(–11)
H.B. 9390a	Germany, Sachsen, stem of *Angelica sylvestris*	(*O. sambuci*) *O. oxyspora* ^{ET} √	*(48–)70–95(–103)	*(8–)9–10.5(–11)	(3–)7–11(–12)
Yadav 1960, Chen et al. 2007b	England, stem of *Heracleum sphondylium*	*D. arnaudii* ^{T} √	(28–)50–80(–110)	(4–)5–10(–11.5)	(1–)5–10(–12) $^{+}$
Zhang et al. 1995	China, Yunnan, forest soil	*D. yunnanensis* ^{T}	66.5–106	8.5–13.5	7–10
Chen et al. 2007b	China, Yunnan, paddy field	*D. yunnanensis* √	59.5–92	9–11	7–10
Drechsler 1937a	USA, *Commelina* leaves & stems	*D. rhombospora*	*(46–)60–71(–77)	*9.5–11.8	(5–)7–9(–10) $^{+}$
Drechsler 1943b	USA, leaves of *Solanum*	*D. atractoides* ^{T}	*(26–)55–70(–76)	*(7.2–)8–10.2	(3–)7–13
Chen et al. 2007b	Macaronesia, Gomera, leaf litter	*D. rhombospora* √	*(34–)40–66(–70)	*(8.5–)10–13(–15)	(2–)5–7(–8) $^{+}$
Yu et al. 2007	China, Xishuangb., ?*Hevea* bark	*O. dorsalis* ^{T} √	*(27–)50–75(–81)	*(6.3–)8–9.5(–12.3)	(5–)6–9 $^{++}$
H.Y. Su, H.B. 8782	China, Dali, angiosperm wood	*O. dorsalis*	* (31–)55–62(–85)	10–11(–12.5)	(2–)3–5(–8)

Anamorph. *Dactylella oxyspora* was described in Marchal (1885) from excrements of caterpillars in Belgium. The type description and illustration shows 120–170 × 4–5 µm large conidiophores (1 unbranched conidiophore figured) and large, strongly fusiform conidia (2 conidia figured) which are very attenuated and sharply pointed at both ends. This taxon fits quite well the anamorph reported for *O. fimicoloides* from England by Webster et al. (1998). The latter grew on dung of a small mammal, probably field mouse (*Apodemus*) or field vole (*Microtus*), and its conidia measured in pure culture *63–112 × 9–10.5 µm, with 8–10 septa, but on the natural substrate 45–63 × 9–10 µm, with 7–10 septa (Pl. 933: 5a).

Webster et al. concluded that the anamorph of *O. fimicoloides* matches well *D. oxyspora* as described and illustrated by Matsushima (1971: 22, fig. 18) and Rubner (1996: fig. 58), but the authors did not explain why they named it '*D.* cf. *oxyspora*'. Differences actually exist in conidiophore branching. Matsushima and Rubner figured apically sympodially proliferating conidiophore tips, whereas Webster et al. reported the conidiophores with long and unbranched tips, below occasionally with 1–2 widely spaced branches, each bearing a single conidium at the tip. But also in Marchal's (l.c.) and Drechsler's (1937a: fig. 18 O–Q, as *D. rhombospora*) illustrations the conidia emerge singly on unbranched conidiophores. The only conidiophore seen by us (in H.B. 8428b, unillustrated) was also unbranched, with a single apical conidium.

In two of the studied collections we have seen conidia in abundance on the natural substrate near the apothecia (Pl. 933: 1f, 2d), but conidia were also seen by various collectors in their specimens. With their shape, size, and number of septa they fit well the reports in Tab. 78. In the type material of *O. lupini* two conidia were found on the substrate ~100 µm away from the apothecia. Both were 5-septate and somewhat too small to fit well into the present concept of *O. oxyspora* (Pl. 932: 1i).

Type material of *D. oxyspora* was not mentioned by Matsushima (1971), Rubner (1996), and Chen et al. (2007b), and appears never to have been located. In order to fix the name, an **epitype** is designated here: Germany, Chemnitz, on *Angelica*, ex H.B. 9390a, M-0276548 (Pl. 933: 2). In the ITS region this collection is virtually identical with the type of *D. arnaudii* (see below).

Liu (2006) and Liu et al. (2007a) applied the name *D. rhombospora* to an anamorph found on the natural substrate in one of Liu's collections from Henan (HMAS 139562, as *O. fimicoloides*), with 51.4 × 11 µm large, 7-septate conidia. Other possible synonyms of the anamorph of *O. oxyspora* are *Dactylella atractoides*, *D. heptameres*, *D. arnaudii*, *D. yunnanensis*, and *D. minuta* var. *fusiformis* (for illustrations see p. 223). According to Drechsler (1943b), *D. atractoides* and *D. heptameres* differ from *D. oxyspora* in considerably shorter conidia with more rounded ends, formed on strongly proliferating conidiophore tips. However, *D. heptameres* s. Drechsler is a dubious taxon which might belong instead to *Dactylellina* (see Rubner 1996: 111). *D. arnaudii* and *D. yunnanensis* were distinguished from *D. oxyspora* because of their apically often or consistently rostrate or at least strongly tapered conidia, with the widest part of the conidium below the middle (Chen et al. 2007b). Concerning *D. arnaudii*, Chen et al. believed that the observed variability in conidial shape was a specific character of that species. *D. minuta* var. *fusiformis* was separated by Grove (1886) from *D. minuta* by fusiform, 9–12 septate conidia of 60–75 × 7–9 µm and more aggregated hyphae (probably conidiophores). Based on Grove's illustration it might well belong in the scope of *O. oxyspora*.

Considering the morphological variation in the anamorph observed within a given population of this group of non-predacious species with fusiform conidia, we presume that too much emphasis has been put on features such as conidial size, shape and septation, and that the noted differences are partly also due to a different thoroughness of documentation.

In conclusion and based on the molecular data treated below, we believe that the type of *D. arnaudii* represents a clear synonym of *D. oxyspora* as currently interpreted, and also the Chinese strains of *D. atractoides* and *D. yunnanensis* can be considered as conspecific. Strains under these names often originated from herbaceous substrates but also from dung, and some of the here included samples of apothecia were also on such substrates. Conspecificity is supported by a high similarity in the ITS region of the available sequence data. We also conclude that the dung-inhabiting *O. fimicoloides* is a synonym of *O. oxyspora*, although molecular evidence is lacking here.

A collection of an anamorph on *Araucaria* twig from Taiwan fits *O. oxyspora* perfectly based on the drawing by R. Kirschner (IVV: R.K. 4431), with conidiophores 40–70 × 3–4 µm and strongly fusiform conidia (38–)48–72(–82) × 7–9 µm, with 8–11 septa. A culture from these conidia did not sporulate but gave a sequence distant from existing sequences of *O. oxyspora* (see below). Judging

Table 79. Diagnostic motifs in the ITS region which separate *O. oxyspora* s.l. from *O. clavispora* and *O. dorsalis*. Position numbers according to alignment of listed strains (*oxyspora-clavispora* subclade) by starting after ATCATTA and including rare inserts. ^{T} = ex-type strain, ^{ET} = ex-epitype strain.

Strains	Original name	14–28 (ITS1)	79–90 (ITS1)	119–128 (ITS1)	374–389 (ITS2)
O. oxyspora (H.B. 9390a ^{ET})	(*O. sambuci*)	TT-TTATGATTATTT	CCCTTCATTGGG	TTCAAA-CTA	ACTTCTGTT-TACAGA
O. oxyspora (CBS 497.92)	*D. oxyspora*	TT-TTATGATTATTT	CCCTTCATTGGG	TTCAAA-CTA	ACTTCTGTT-TACAGA
O. oxyspora (CBS 157.89)	*D. oxyspora*	TT-TTATGATTATTT	CCCTTCATTGGG	TTCAAA-CTA	ACTTCTGTT-TACAGA
O. oxyspora (CBS 310.84)	*D. oxyspora*	TTCTTATGATTATTT	CCCTTCATTGGG	TTCAAA-CTA	ACTTCTGTT-TACAGA
O. oxyspora (CBS 129.83 ^{T})	*D. arnaudii*	TT-TTATGATTATTT	CCCTTCATTGGG	TTCAAA-CTA	ACTTCTGTT-TACAGA
O. oxyspora (YMF 1.00561)	*D. atractoides*	TT-TTATGATTATTT	CCCTTCATTGGG	TTCAAA-CTA	ACTTCTGTT-TACAGA
O. oxyspora (CBS 280.70)	*D. rhombospora*	TT-TTATGATTATTT	CCCTTCATTGGG	TTCAAA-CTA	ACTTCTGTT-TACAGA
O. oxyspora (CBS 291.84)	*D. oxyspora*	TT-TTATGATTATTT	CCCTTCATTGGG	TTCAAA-CTA	ACTTCTGTT-TACAGA
O. oxyspora (CBS 257.70)	*D. oxyspora*	TT-TTATGATTATTT	CCCTTCATTGGG	TTCAAA-CTA	ACTTCTGTT-TACAGA
O. oxyspora (YMF 1.01447)	*D. yunnanensis*	TT-TTATGATTATTT	CCCTTCATTGGG	TTCAAA-CCA	ACTTCTGTT-TACAGA
O. aff. *oxyspora* (HMAS 139539)	*O. fimicoloides*	TT-TTATGATTATTT	CCCTTCACTGGG	TTCAAA-CCA	ACTTCTGTT-TACAGA
O. aff. *oxyspora* (BCRC FU30823)	*D.* aff. *oxyspora*	T--TTATGATTATTT	-TCTTCGTTGAG	TTCAAA-CCA	ACTTCTGTTCCGCAGA
O. clavispora (CBS 844.70 ^{T})	*D. clavispora*	TT-TTATGATTATTT	-CCTTC--TGGG	TTCAAA-CCA	ATCTCTGTT-TACAGA
O. clavispora (CBS 917.85)	*D. asthenopaga*	TT-TTATGATTATTT	-CCTTC--TGGG	TTCAAACCCA	ATCTCTGTT-TACAGA
O. clavispora (H.B. 8371a)	(*O. vestimenti*)	TT-TTATGATTATTT	-CCTTC--TGGG	TTCAAA-CCA	ATCTCTGTT-TACAGA
O. dorsalis (YMF 1.01838)	'*O. dorsalia*'	T--TT-TGACCTTTT	-CCTTC--TGGG	TTTATAACCA	ACTTTTGCTCTGCAAA
O. dorsalis (YMF 1.01835 ^{T})	'*O. dorsalia*'	T--TT-TGACCTTTT	-CCTTC--TGGG	TTTATAACCA	ACTTTTGCTCTGCAAA
O. dorsalis (CBS 102487)	*D. rhombospora*	T--TT-TGACCTTTT	-CCTTC--TGGG	TTTATAACCA	ACTTTTGCTCTGCAAA

from this, associated adhesive knobs and nematodes on the natural substrate appear not to be connected to this fungus.

Phylogeny. A number of sequences, mainly under the name *Dactylella oxyspora* but also *D. arnaudii*, *D. atractoides* and *D. yunnanensis*, can be found in GenBank, which belong in the scope of *O. oxyspora*. Most of them derive from European strains (mainly from Netherlands), but some from California and China. They were taken from culture isolates from soil, plant, or dung and mainly include the ITS region, a few also SSU and/or LSU. ITS was gained from apothecia of the here designated epitype from Chemnitz. The S1506 intron is present in the epitype and in strains from Kiel (CBS 280.70) and China (YMF 1.00561), but it is lacking in the Californian isolate (CBS 497.92) (the remaining sequences are unclear in this respect).

In the ITS region these sequences are either identical or show variation only at 1–5 positions (Phyl. 26). Even the two sequences from California gained from the same strain (CBS 497.92) deviate from two European strains (CBS 291.84, CBS 310.84) by only 1 gap or not at all, whereas three further European strains (CBS 257.70, CBS 157.89, CBS 280.70) deviate hereof at 1–3 positions. Strain CBS 280.70 was originally named *D. rhombospora* by W. Gams, then reidentified as *D. oxyspora* by Rubner (1996: 115), but retained as *D. rhombospora* by Liu et al. (2006a). Also the ex-type strain of *D. arnaudii* deviates merely by 2 nt from some of the *O. oxyspora* sequences.

Several of these records were made on herbaceous stems, including the epitype of *O. oxyspora*. The epitype sequence matches the above strains very well: it shows full identity in the ITS region with the ex-type strain of *D. arnaudii*, except for 2 uncertain gaps. Two Chinese strains (YMF 1.00561, as *D. atractoides*; YMF 1.01447, as *D. yunnanensis*) also deviate from the *D. oxyspora* sequences only by 2–5 nt. This close match of a 0–1% distance in the ITS region supports, in our opinion, conspecificity of all these strains. In the region of the intron, the epitype of *O. oxyspora* shows a 1.4% distance to the strain from Kiel (CBS 280.70) and 2.2% to *D. atractoides* (YMF 1.125), while the latter two deviate by 1.9%. LSU was available for two Chinese strains (*D. oxyspora*, YMF 1.10000; *D. atractoides*, YMF 1.125) and that from Kiel, which fully match each other in the D1–D3 domain, except for 1 nt in the *D. atractoides* strain.

The high molecular homogeneity in the ITS region in *D. arnaudii*, *D. yunnanensis*, and *D. oxyspora* is also obvious in Chen et al.'s (2007a) phylogenetic analysis. Nevertheless, Chen et al. (2007b) accepted them as three different species, although they synonymised *D. atractoides* with *D. oxyspora*. The authors based their opinion about *D. atractoides* on strain CBS 310.84 from Flevoland, which was deposited under that name by W. Gams. Its sequence indeed shows full ITS identity with other strains of *O. oxyspora*. However, Chen et al. did not mention a Chinese strain named *D. atractoides* in GenBank (YMF 1.00561) which shows a deviation of 6 nt and 1 gap in the ITS region to typical *O. oxyspora* strains. Regrettably, sequences of the ex-type strains of *D. atractoides*, *D. yunnanensis*, and *O. fimicoloides* were not available.

In our analysis of ITS or SSU+ITS+LSU (Phyls 25–27, S31), *O. oxyspora* formed with *O. dorsalis* and *O. clavispora* a strongly supported clade, here called *oxyspora-clavispora* subclade (no LSU was available for *O. dorsalis*). This group forms together with *O. desertorum*, the *heptameres-qiluensis* subclade and the *intermedia-multiseptata* subclade the strongly supported *oxyspora-heptameres* clade (Phyls 25–27).

Sequences of *O. oxyspora* in the present circumscription deviate in the ITS region from *O. clavispora* by 2.2–3.6% and from *O. dorsalis* (including *D. rhombospora* s. Chen et al.) by 4.3–6.2%. In the S1506 intron the lowest distance between *O. oxyspora* and other species of series *Neodactylella* is 7.5–9.5% to *D. intermedia* (CBS 109506) and 10.5–12% to *O. clavispora*. In the LSU D1–D2 domain (590 nt) the lowest distance is 1.6% to *O. clavispora*, and one of the next close species is *O. desertorum* with a 3.7–3.9%.

In a phylogenetic analysis of ITS or LSU by Liu et al. (2006a), a Chinese collection identified by Liu (2006) as *O. fimicoloides* (Henan, HMAS 139539, Pl. 31 Fig. 6, with anamorph '*D. rhombospora*' from natural substrate) clustered with *O. oxyspora* from Kiel (as *D. rhombospora*) and *D. oxyspora* from China (YMF 1.10000), respectively. In our ITS analysis (Phyl. 26) it clustered unsupported close to *O. oxyspora*, to which it shows a distance of 1.8–2.8%. HMAS 139539 differs from *O. dorsalis* by 4.2–4.8%, but from the morphologically more deviating *O. clavispora* only by 2.6–3%. In the LSU D1–D2 it differs from *O. oxyspora* by 5 nt and 3 gaps. Placement near *O. oxyspora* is supported by 4 diagnostic motifs in the ITS region (Tab. 79).

Besides Liu's *O.* '*fimicoloides*', three further strains clustered distinct from *O. oxyspora*, *O. clavispora*, and *O. dorsalis* though without forming a joint clade (Phyl. 26): the anamorphic isolate of *O.* aff. *oxyspora* from Taiwan, and two uncultured soil isolates without ITS1 (clone dm2s_2s from California: ITS2, LSU; clone 1767 from Illinois: ITS2). In the diagnostic motifs of Tab. 79, *O.* '*fimicoloides*' and the Taiwanese strain are closer to *O. oxyspora* but share 1 position (127) with *O. clavispora* and *O. dorsalis*, although *D. yunnanensis* (= *O. oxyspora*) shows this deviation as well. The Taiwanese strain shows at pos. 80–89 and 383–385 considerable deviations, which were unambiguously verified from the chromatogram. Due to the missing ITS1 the two uncultured clones were not included in the table. In the ITS2 clone dm2s_2s fits *O.* '*fimicoloides*' and *O. oxyspora* regarding pos. 375–376 (A**CT**TCTG), whereas clone 1767 matches *D. clavispora* (A**TC**TCTG).

Ecology. *O. oxyspora* is a plurivorous species which occurs on hygric and mesic, slightly to strongly rotten wood and bark of angiosperm trees and shrubs but particularly on herbaceous stems of dicots, rarely monocots, also on dung. Previous hypotheses on the restriction of some orbiliaceous fungi to coprophilous habitats could not be confirmed in the present case.

O. oxyspora s.l. was mainly recorded from warm- to cold-temperate regions of atlantic to subcontinental humid, rarely also hemiboreal, or mesosubmediterranean semihumid Europe. A few collections were made in the cool-continental humid (winter-dry) Far East of Russia, in subtropical humid (winter-dry) southern China, in tropical humid Papua New Guinea and northern South America, also in subtropical semihumid California (probably irrigated during summer) and warm-temperate humid eastern North America.

Map 150. Known distribution of *O. oxyspora* in Europe (yellow = not included collections).

Specimens included. **GREAT BRITAIN**: **East England**, **Hertfordshire**, ~30 km NNW of London, St. Albans, ~100 m, stems of *Heracleum sphondylium*, 25.VIII.1958, A.S. Yadav (IMI 77850, **holotype** of *D. arnaudii*, CBS 129.83, conid. isol., doc. vid.; sq.: DQ494353, MH873289). – **South East England**, **London**, 15 km WNW of London, N of Perivale, Perivale Wood, dung of ?mice, 30 m, 18.II.1996, A. Henrici (K(M) 48656, **holotype** of *O. fimicoloides*, anam. substr. & anam. cult., doc. vid.). – ibid., 10.VII.1997 (K, non vid.). — **NETHERLANDS**: **Flevoland**, 23 km E of Amsterdam, Almere, Bossen, 0 m, stems of *Cirsium arvense*, 31.III.1984, W. Gams (as *D. atractoides*, CBS 310.84, conid. isol., non vid.; sq.: DQ494349). – ~5 km SE of Almere, Almeerderhout F61, on dung of *Oryctolagus cuniculus*, 15.II.1984, H.A. van der Aa (CBS 291.84, conid. isol., non vid.; sq.: DQ494348). – ~60 km ENE of Amsterdam, Oostelijk (eastern Flevoland), 0 m, agricultural soil, 7.X.1969, J.W. Veenbaas-Rijks (CBS 257.70, conid. isol., non vid.; sq.: DQ494351). – Noordoostpolder, 8 km E of Emmeloord, ESE of Marknesse, Lovinkhoeve, -4 m, root of *Hordeum vulgare*, 1988, M. Barth (CBS 157.89, conid. isol., non vid.; sq.: DQ494352). – **Noord-Brabant**, 7 km NE of Tilburg, 1 km N of Udenhout, Nieuwe Tiend, 10 m, stem of *Angelica sylvestris*, 13.IX.2013, L. Rommelaars (L.R. 13-068, anam. substr., doc. vid.). — **BELGIUM**: **Vlaanderen**, **Vlaams-Brabant**, Brussels, dung of caterpillar, autumn 1884, E. Marchal (**holotype** of *D. oxyspora*, doc. vid.). — **LUXEMBOURG**: **Gutland**, **Echternach**, 10 km WNW of Echternach, 1.2 km SW of Beaufort, Längt, 340 m, trunk of *Fagus sylvatica*, on bark, 3.II.2007, G. Marson (H.B. 8428b, anam. substr.). — **FRANCE**: **Bretagne**, **Morbihan**, Île de Groix, 2 km WSW of Le Bourg, WNW of Quéhello, Port St.-Nicolas, 17 m, stem of *Oenanthe crocata*, 6.VI.2015, J.P. Priou (J.P.P. 15134 ø, anam. substr., doc. vid.). – 9.5 km SE of Malestroit, 2.7 km WNW of St.-Martin-sur-Oust, Beauvais, 8 m, stem of *O. crocata*, 28.X.2010, Y. Mourgues (J.P.P. 10180, H.B. 9447, anam. substr.). – 4.7 km SSE of La Gacilly, 1.2 km ESE of Glénac, Le Port Corbin, 12 m, stem of *Foeniculum vulgare*, 2.V.2013, J.P. Priou (J.P.P. 13096, anam. substr., doc. vid.). – **Poitou-Charentes**, **Charente-Maritime**, Île de Ré, 1.5 km WNW of Ars-en-Ré, 1.8 km SSE of St.-Clément-des-Baleines, Forêt de la Combe à l'Eau, 8 m, stem base of *Smyrnium olusatrum*, A. Brissard (H.B. 9495 ø). – **Champagne-Ardenne**, **Ardennes**, 10 km ENE of Vouziers, ~1.5 km WNW of Boult-aux-Bois, 240 m, stem of *Angelica*, 16.VI.1995, R. Collot (H.B. 5299, M.L. 95/06/16/1). — **SPAIN**: **Navarra**, 7.5 km SE of Irun, 3.5 km WNW of Bera, SE of Endarlatsa, 34 m, petioles of *Arctium minus*, 4.IX.2015, F.J. Balda (F.J.B. 40815, anam. substr., doc. vid.). – **Aragón**, **Huesca**, 2.8 km SSW of Benasque, S of Linsoles, 1175 m, branch of *Corylus avellana*, on bark, 1.VIII.2016, R. Blasco (ø, doc. vid.). — **GERMANY**: **Schleswig-Holstein**, ~5 km NE of Kiel, Kitzeberg, ~20 m, on *Angelica archangelica*, X.1965, W. Gams (CBS 280.70, as *D. rhombospora*, conid. isol., non vid.; sq.: AY902797, AY902793, AY902790). – **Nordrhein-Westfalen**, 4 km E of Mönchengladbach, Volksgarten, 45 m, stem of *Impatiens glandulifera*, 2.VI.2014, H. Bender (ø, doc. vid.). – **Sachsen**, 11 km E of Chemnitz, S of Erdmannsdorf, Zschopau, 290 m, stem of *Symphytum officinale*, 24.V.2010, B. Mühler (H.B. 9327b ø, anam. only). – 8 km SW of Chemnitz, 2.5 km W of Neukirchen, 390 m, stem of *Angelica sylvestris*, 30.VII.2010, B. Mühler (ex H.B. 9390a, M-0276548, **epitype** of *O. oxyspora*, anam. substr. & anam. apoth.; sq.: KT222360). – **Baden-Württemberg**, 2 km W of Tübingen, Schweigbrühl, 340 m, stem base of *Pastinaca sativa*, 8.VI.1993, H.O. Baral (H.B. 4893a). – 5.5 km E of Tübingen, 1.4 km SE of Pfrondorf, Poppelesloch, 320 m, branch of *Fagus sylvatica*, on wood, 30.X.2005, E. Weber (H.B. 7950b, ø). – **Bayern**, **Oberbayern**, 19 km NE of Traunstein, SE of Fridolfing, In der Point, 400 m, dung of *Equus caballus*, 22.XII.1992, T.R. Lohmeyer (grown in moist box, H.B. 4835). — **AUSTRIA**: **Steiermark**, 10 km WNW of Graz, 2.5 km ENE of St. Oswald, NE of Burg Plankenwarth, 600 m, stem of *Urtica dioica*, 26.VII.2015, I. Wendelin, vid. G. Friebes (GJO 75968, anam. substr., doc. vid.). — **CZECHIA**: **Central Bohemia**, 21 km SE of Praha, ~4 km NNW of Mnichovice, Tehov, 450 m, stem of *Cirsium vulgare*, 8.VI.1940, J. Velenovský (PRM 152413, **holotype** of *O. ektophysata*; H.B. 6127 ø). – 35 km SE of Praha, 8 km W of Sázava, Hvězdonice, 300 m, branch of *Sambucus nigra*, on bark, 1.VII.1925, J. Velenovský (PRM 148826, **lectotype** of *O. sambuci*, H.B. 6271 ø). — **POLAND**: **Łódź**, 3.5 km WSW of Pabianice, Cechło Pierwsze, Wąska street, 186 m, stem of ?*Helianthus tuberosus*, 29.IV.2016, B. Lyszkowska, vid. P. Perz (P.P. 20160501-1, anam. substr., doc. vid.). — **SERBIA**: **Vojvodina**, Fruška Gora, 21 km SE of Novi Sad, 2.2 km NNE of Grgurevci, stem of *Urtica dioica*, 25.IX.2015, D. Savić (FG-286, doc. vid.). — **ESTONIA**: **Lääne-Virumaa**, 32 km SE of Rakvere, 2 km NW of Tudu, Tuduküla forest distr., 80 m, stem of *Angelica sylvestris*, 14.VIII.1958, A. Raitviir (TAAM 251, as *O. cardui*, H.B. 8712). — **RUSSIA (East)**: **Sachalin**, 30 km NW of Yuzhno-Sakhalinsk, near Sinegorsk, ?250 m, stem of *Heracleum*, 30.VIII.1970, B. Kullman & A. Raitviir (TAAM 62226, as *O. cardui*; H.B. 8711 ø). — **CHINA**: **Yunnan**, unlocalized, paddy field, 2004, Y.E. Hao (as *D. yunnanensis*, YMF 1.01447, conid. isol., doc. vid.; sq.: DQ494354). – unlocalized (YMF 1.00561, as *D. atractoides*; sq.: AY902804). — **PAPUA NEW GUINEA**: **Morobe**, 75 km SSW of Lae, Wau, ~1100 m, forest litter, 25.I.1970, T. Matsushima (MFC 2686, conid. isol., doc. vid.). — **USA**: **California**, Stanford, university campus, soil under bamboo, 26 m, III.1991, L. Smith, vid. A. Rubner (A.R. 922, CBS 497.92, conid. isol., non vid.; sq.: DQ494350, AF106537, AJ001993).

Not included. **GREAT BRITAIN**, Sutton Coldfield, stem of *Carduus*, undated, W.B. Grove (**holotype** of *Dactylella minuta* var. *fusiformis*, anam. only, doc. vid.). — **GERMANY**: **Baden-Württemberg**, 4.5 km E of Tübingen, S of Pfrondorf, Mähder, 395 m, stem of *Ononis spinosa*, 13.VII.1992, H.O. Baral (ø). — **CZECHIA**: **Central Bohemia**, ~26 km SE of Praha, Mnichovice, Plecháč Mt., ~400 m, stem base of *Lupinus polyphyllus*, 14.VI.1942, J. Velenovský (PRM 152471, **holotype** of *O. lupini*, H.B. 6192 ø, anam. substr.). — **VENEZUELA**: **Anzoátegui**, 44 km SSE of Barcelona, ~1 km N of Cantaura, ~230 m, dropping of *Equus asinus*, 2.VIII.1972, K.P. Dumont et al. (TRTC 52084, **holotype** of *O.*

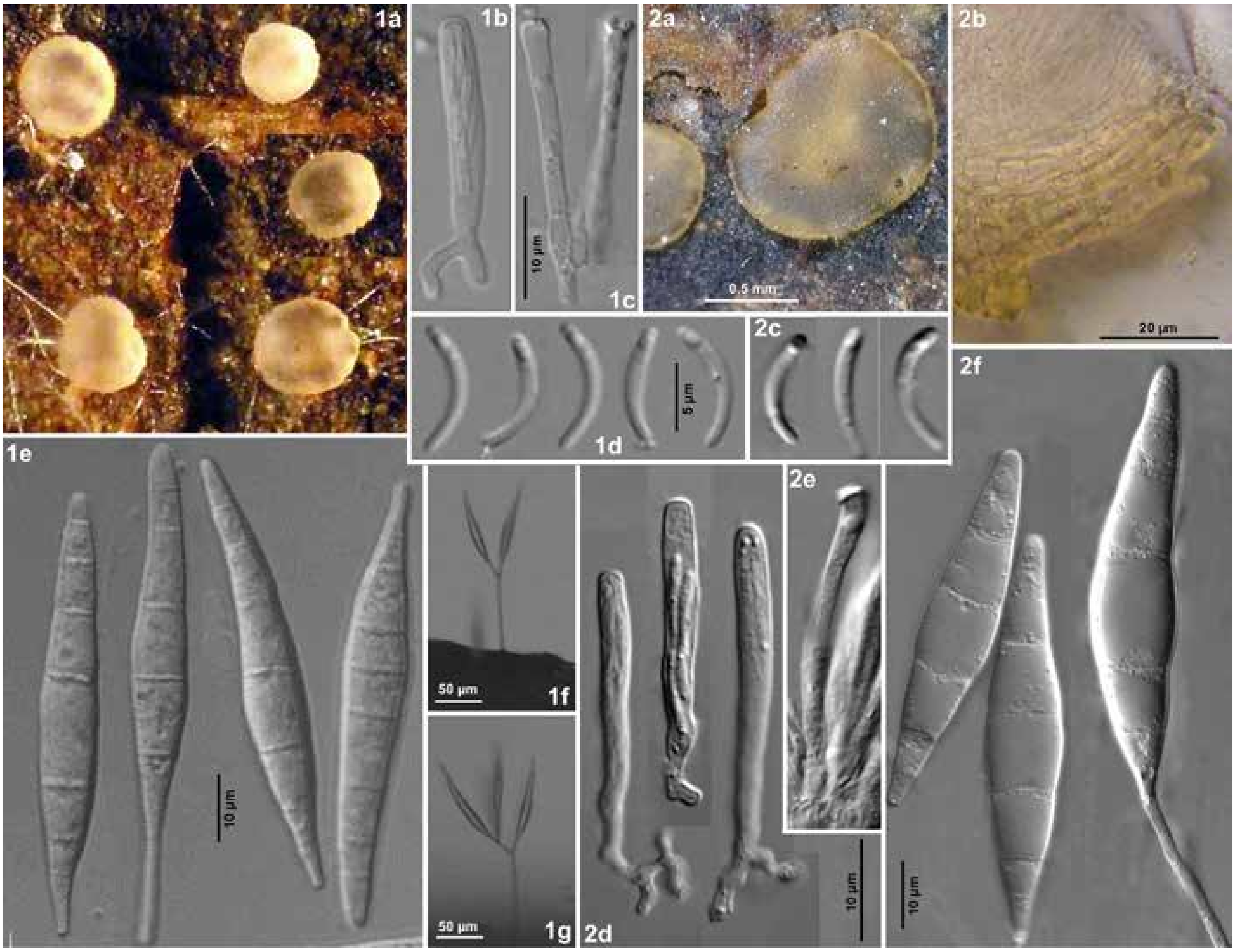


Plate 936. **1–2**: *Orbilia dorsalis*. – **1a**. fresh apothecia; **2a**. rehydrated apothecia; **2b**. ectal excipulum in median section at mid flanks and margin; **1b**, **2d**. immature asci; **1c**, **2e**. paraphyses; **1d**, **2c**. ascospores; **1f–g**. conidiophores with conidia; **1e**, **2f**. conidia (from culture). – Living state, except for **1c** right paraphysis, **2b**, **d–e** (in H_2O). – **1a–g**: from Yu et al. (2007b) (DIC), **2c–f**: phot. H.Y. Su (DIC). — **1a–g**. YMF 1.01835 (Y.Z. bn1-7, holotype): Yunnan, Xishuangbanna, on ?*Hevea*; **2a–f**. H.B. 8782 (H.Y.S. jgs-19): Yunnan, Dali, on indet. angiosperm.

fimicola, H.B. 9250a ø). — **USA**: **Maryland**, near Beltsville, ~40 m, leaves of *Solanum lycopersicum*, undated, C. Drechsler (**holotype** of *D. atractoides*, conid. isol., doc. vid.). — **CHINA**: **Yunnan**, **Xishuangbanna**, unlocalized, forest soil, 11.XII.1993, D.R. Yang (HMGAC 511-1, **holotype** of *D. yunnanensis*, conid. isol., doc. vid.). – **Henan**, **Xinyang**, 35 km S of Xinyang, Jigongshan, 750 m, indet. wood, 14.XI.2003, B. Liu & W.Y. Zhuang (B.L. 6612, HMAS 139539, sq.: DQ656617, DQ656684; HMAS 139562; as *O. fimicoloides*/*D. rhombospora*, anam. substr., doc. vid.). – **Taiwan**, **Taoyuan**, 12.5 km WSW of Taoyuan, Zhongli, Central University, Jhong-Da Lake, 130 m, twig of *Araucaria cunninghamii*, on nematodes, 1.VI.2017, R. Kirschner (R.K. 4431, BCRC FU30823, conid. isol., doc. vid., sq.: MK914548).

Orbilia dorsalis Ying Zhang, Z.F. Yu & K.Q. Zhang in Yu et al. [as '*dorsalia*'], Cryptog. Mycol. 28: 56 (2007) — Pls 936–937

= *Dactylella dorsalis* Ying Zhang, Z.F. Yu & K.Q. Zhang [as '*dorsalia*'], Cryptog. Mycol. 28: 58 (2007)

= *Dactylella rhombospora* s. Chen et al. (2007b: 108)

Etymology: *dorsalis*: according to the growth on the inner (reverse) side of bark; *rhombospora*: after the rhomboid conidia.

Typification: China, Yunnan, Jinghong, branch of ?*Hevea brasiliensis*, 5.VIII.2005, Y. Zhang (YMFT 1.01835, holotype of *Orbilia dorsalis*). — ibid. (YMFT 1.01835, holotype of *Dactylella dorsalis*; sq.: DQ480730).

Description: — **TELEOMORPH**: **Apothecia** fresh (0.3–)0.6–1.4 mm diam., ~0.1–0.17 mm thick, subgregarious, pale to light cream or yellow, medium translucent; disc slightly concave to slightly convex, margin minutely denticulate; sessile on a narrow base, superficial. **Asci** †25–29 {T} or 31–37 {1} × 3–3.5(–3.8) µm {2}, 8-spored, lower ?3 spores inverted {2}; **apex** medium truncate, thin-walled; **base** with very short, thick stalk, h- to H-shaped. **Ascospores** *(7–)8–10(–10.5) × 1.1–1.4 µm (~9.5–12 µm actual length) {2}, subulate, apex rounded, base gradually slightly to medium tapered, strongly curved (falcate); **SBs** 0.8–1.3 × 0.7–0.8 µm {2}, globose to broadly ellipsoid, attachment invisible (total length 1.7–2 µm). **Paraphyses** not or very slightly inflated (capitate-clavate), terminal cells */†13–17 × 2–3 µm {2}; lower cells *4.5–6 × 2–2.2 µm. **Medullary excipulum** ~20–40 µm thick, of textura globulosa-intricata, indistinctly delimited. **Ectal excipulum** of non- or slightly gelatinized t. angularis, ~50–80 µm thick at base, cells †10–30(–35) × 6–15(–22) µm diam. {2}, at flanks oriented at 40–50°, at margin of t. prismatica oriented at 10–30°, cells forming distinct rows, marginal cortical cells †7–8 × 3–4 µm, thick-walled, ± protruding with their tips; **glassy processes** absent {T} or 10–14 × 4–5 µm {1}, pale yellowish, zonate, slightly curved outwards. **Anchoring hyphae** abundant, †2–3(–4) µm wide, wall 0.2–0.3 µm {1}. **SCBs** in paraphyses globose {2}. **Exudate** cloddy, ~0.5–3.5 µm thick, loosely attached. — **ANAMORPH**: dactylella-like (from ascospore isolate {2} and environmental isolate {1}. **Conidiophores** (50–)100–250(–300) µm long, erect, 3.5–4.5 µm wide at base, gradually tapered to (1–)1.5–2.5(–3) µm, apically with 1(–3) conidia on short sympodial branches (geniculate). **Conidia** fusiform, straight, *(40–)50–75(–85)((–93)) × (6.3–)8–10(–13) µm, ((2–))(4–)5–8(–9)-septate {3}, rarely clavate, *27–38 × 6.3–8 µm, 3-septate. **Chlamydospores** present in aged cultures, in chains or clusters, (sub)globose, ~6–8 µm wide {1}.

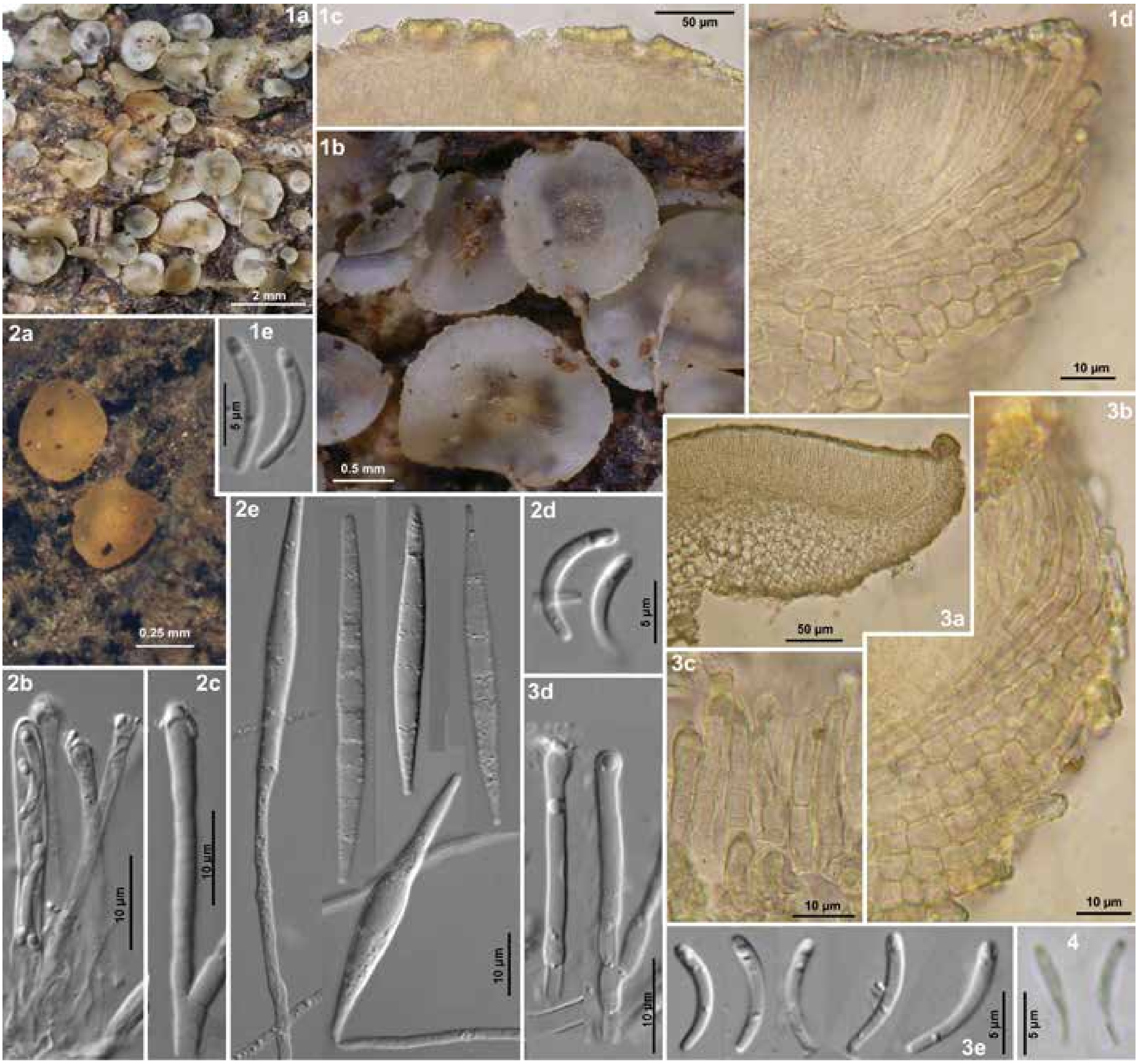


Plate 937. **1–4**. *D*. aff. *intermedia*/*dorsalis*. – **1a–b**. rehydrated apothecia; **2a**. fresh apothecia; **3a**. apothecium in median section; **1d**, **3b**. id., ectal excipulum at mid flanks and margin; **3c**. hair-like rows of marginal cortical cells, partly tipped by glassy processes; **1c**. crenulate margin in top view; **2b–c**, **3d**. ascus and paraphyses; **1e**, **2d**, **3e**, **4**. ascospores, **2e**. conidia and conidiophores (from culture). – Living state, except for **1c–d**, ascus and paraphyses in **2b**, **3a–c**, **4** (in H_2O), **2e** (p.p.). – **1e**, **2a–e**, **3d–e**: phot. Z.F. Yu (DIC). — **1a–e**. H.B. 8985 (H.Y.S. jz-9): China, Yunnan, Dali, on indet. angiosperm; **2a–e**. H.Y.S. jz-10: ibid.; **3a–d**. H.B. 8742 (J.W.G. ym3-62): Yunnan, Yuxi, on indet. angiosperm; **4**. H.B. 9536 (M.W. 990825T17): Taiwan, Taipei, on *Calamus*.

Habitat: lying at the moist ground, corticated or decorticated branches, 20–30 mm thick or more, of ?*Hevea brasiliensis* {1}, indet. angiosperms {3}, on very decayed wood {1} and bark {2}, partially blackened; leaf litter {anamorph}. **Desiccation tolerance**: Ectal excipular cells still alive after 4 months. **Altitude**: 550–2730 m (southern China). **Geology**: Jurassic to Cretaceous sedimentary rock. **Phenology**: VIII, XI (teleomorph).

Taxonomic remarks. The above description of *Orbilia dorsalis* and its anamorph *Dactylella dorsalis* is copied from that of the holotype from Xishuangbanna (Yu et al. 2007b) with some alterations, but includes also data from the teleomorph sample from Dali (H.B. 8782) and from the anamorph sample from La Gomera described by Chen et al. (2007b) as *Dactylella rhombospora*. *O. dorsalis* was proposed as a new species mainly because of its conidial dimensions which were thought to be much smaller than reported for the otherwise very similar *O. fimicoloides* (= *O. oxyspora*). Yet, conidial size in Yu et al. (2007b) was based on an erroneous calibration, and with the corrected values any clear biometrical differences to *O. oxyspora* disappeared. However, molecular data of *O. oxyspora* and *O. dorsalis* are sufficiently different in order to consider them as two distinct species (see below).

The teleomorph of *O. dorsalis* corresponds quite well to the protologue of *O. fimicoloides*, including marginal cell rows oriented at a low angle. Differences in spore width as indicated by Zhang et al. are eliminated when evaluating spore size from the plate in Webster et al. (1998), whereas the length of dead asci as stated for *O. dorsalis* is indeed below the values of dead asci as reported for *O. fimicoloides*, and below the values of all specimens assigned to *O. oxyspora* in the present study. However, the specimen from Dali here included in *O. dorsalis* has an ascus length typical of *O. oxyspora*, but no molecular data were available.

Nomenclature. The orignal specific epithet '*dorsalia*' is improper because the adjective *dorsalis* is unaltered in the masculine and feminine nominative singular case, whereas *dorsalia* would be the neuter plural in nominative and accusative case.

Not included collections. Two Chinese specimens are not included because one formed distinctly narrower conidia in culture (see below) and the other is without conidia but was from the same location. Two further Chinese specimens (H.B. 8742, Yuxi, Pl. 937: 3; H.B. 9536, Taiwan, 4) are uncertain because neither their anamorph nor molecular data were available. Another Chinese sample (*Orbilia* sp. XJ-2009, Guizhou, on unidentified bark, B. Liu, IVV: VII.2008) sharply differs from both *O. oxyspora* and *O. dorsalis* in marginal excipular cells oriented at a high angle and in differently shaped conidia (see also under Anamorph and Phylogeny).

Anamorph. *Dactylella dorsalis* was described with elongate fusiform conidia very similar to *O. oxyspora*, with (5–)6–8(–9) septa (mainly 7). In the protologue all conidia taken at high magnification (figs A–C, F–J) are wrongly calibrated, their 10 µm bars being 2.5 × too long, therefore, the values of 22–30.3(–32.5) × 3.3–4 µm given in the protologue are much too low. This becomes obvious when comparing figs D-E: according to the 50 µm bar the conidia here yield a size of 80–93 × 8–9 µm. After our request about this discrepancy, Z.F. Yu (pers. comm.) corrected the dimensions to 51.8–**66.5**–75.5 × 7.8–**10.3**–12.3 µm, which is about the 2.5-fold of the published values. When using the corrected data, *D. dorsalis* fits quite well the anamorph in the type of *O. fimicoloides*, particularly those conidia from natural substrate (45–63 × 9–10 µm, 7–10-septate), but also those observed in other specimens here referred to *O. oxyspora* (Pl. 933: 1f, 2d). Conidial length and number of septa in *O. oxyspora* partly exceed the values of *O. dorsalis*, but the data mainly overlap in the two taxa. A stronger tendency to fewer septa can be noted in the isolate from Dali (Pl. 936: 2), showing (2–)3–5(–8) septa, which is therefore thought to belong to *O. dorsalis*. On the photographs of the type of *D. dorsalis* the conidiophores are partly apically branched (Pl. 936: 1f–g), but this occurs also in *O. oxyspora*.

Based on Grove's (1885) insufficient description, the name *D. rhombospora* was applied with hesitation by different authors to isolates similar to *D. oxyspora*, for instance by Drechsler (1937a: 539), Liu (2006), and Liu et al. (2007a, see under *O. oxyspora*, p. 1495), but also to a strain from Germany (CBS 280.70) which was renamed to *D. oxyspora* by Rubner (1996). Chen et al. (2007b: 108) used the name *D. rhombospora* for the collection on leaf litter from La Gomera (CBS 102487), which was originally identified as *D. oxyspora*, but which the authors thought to be distinct from *D. oxyspora* because of shorter conidia (40–66 × 8.5–13 µm) with only (5–)7(–8) septa. very similar conidia occur in members of the *heptameres-qiluensis* clade (Phyl. 26).

In any case, the identity of *D. rhombospora* in its original sense remains doubtful. In Grove's (1885) protologue (on rotten wood and bark) the conidia are figured as 7-septate and with a pronounced rhomboid shape, and seem to have cells with an ocellate lumen enclosed by thick walls. Microscopical measurements were not given, but from the magnification indicated in the legend a size of 52 × 14.5–17 µm can be evaluated for the two conidia figured at 500 ×, but ~60–70 × 17–19 µm for the smaller, much less precise figure at 120 ×, with a conidiophore length of 95–190 µm. Rubner (1996) examined the holotype but could not detect elements of the fungus. We conclude that the large conidial width and the ocellate appearance of the cells exclude conspecificity with *O. oxyspora* or *O. dorsalis*, and the question is raised whether *D. rhombospora* was orbiliaceous at all.

Conidia similar to those of *O. dorsalis* (or *O. oxyspora*) though narrower were obtained in pure culture of a Chinese specimen from Dali (Pl. 937: 2): *37–89 × (3.6–)4–5(–8) µm, 4–5(–7)-septate. As in *O. dorsalis*, chlamydospores were formed in abundance. Due to the deviating conidial size the specimen is not included in either description. Another specimen from the same locality (Pl. 937: 1) is possibly conspecific but without data on its anamorph. Its sequence refers it in affinity with *D. intermedia* (see below). Conidia of a similar size were obtained in the sample from Guizhou (*Orbilia* sp. XJ-2009, *47–87(–101) × 4.3–6.6 µm), but with a fusoid-obclavate shape and 8–19 septa (B. Liu, IVV: VII.2008).

Phylogeny. Two sequences of Chinese *O. dorsalis* were available in GenBank. They derive from ascospore isolates of the holotype (YMF 1.01835) and a topotype (YMF 1.01838) which was not mentioned by Yu et al. (2007b). Both comprise the ITS region, the former also the 3'-end of SSU which lacks the S1506 intron. In the ITS region the two sequences differ by only 1 gap. *O. dorsalis* clustered in our analysis in a clade with *D. rhombospora* s. Chen et al. from La Gomera (CBS 102487), to which it differs by only 1 % (5 nt) and 2–3 gaps, suggesting conspecificity. Note, however, that in the CBS database an unofficial sequence of CBS 102487 exists which differs from the GenBank sequence of that strain by 3.5 % but also does not come closer to other sequences treated here.

The three sequences here referred to *O. dorsalis* clustered in the strongly supported *oxyspora-clavispora* subclade (Phyl. 26). They deviate from *O. oxyspora* by 4.3–6.2 % and from *O. clavispora* by 4.3–5 %. Also in the analysis of Chen et al. (2007a) a rather high distance between *D. oxyspora* and *D. rhombospora* is obvious, and two Chinese strains under the name *D. heptameres* (topotypes of *D. beijingensis*) likewise clustered in a clade distant from these taxa.

There are 4 diagnostic motifs in the ITS1 and ITS2 that are worth mentioning (Tab. 79): *O. clavispora* more or less concurs with *O. oxyspora* at 3 of these motifs, but it concurs with *O. dorsalis* at the remaining motif (pos. 79–90 of ITS1).

A sequence (S1506 intron, ITS, LSU) from apothecia of one of the not included samples (Yunnan, Dali, Jizushan, jz-9, H.B. 8985) clustered strongly supported with *D. intermedia*, though with a 4.7 % ITS distance. When assuming that it is conspecific with jz-10 from the same locality, which developed much narrower conidia (Pl. 937: 2e) than described for *D. intermedia* (Pl. 6: h), it cannot be conspecific with *D. intermedia*. A sequence from an unidentified *Dactylella* in pure culture (02SH140612-829-B, Y. Zhang pers. comm.) fully concurs with jz-9 in the S1506 intron and ITS, except for 2 gaps in the ITS (Phyl. 26). Its chromatogram (ab1) bears the number YMF 1.00585 and the name *Drechslerella inquisitor*, but this must be a confusion because YMF 1.00585, a soil isolate from Lushui, Yunnan, formed top-shaped conidia and constricting rings (Yu et al. 2014).

Orbilia sp. XJ-2009 from Guizhou (ITS+LSU) clustered in our combined analysis unsupported near *D. cylindrospora* outside the *oxyspora-heptameres* clade, with an ITS distance of 19–23 % to species of that clade (Phyls 25–27,). In the LSU analysis (S31) it clustered unsupported near the *cardui-rhopalota* clade and the *rhamni-fraxini* clade.

Ecology. *Orbilia dorsalis* is known from two collection sites in southern China, where it grew on rotten bark and wood of hygric branches of angiosperms in subtropical to tropical humid (winter-dry) evergreen forests. The holotype was at much lower altitude than the sample from Dali. The four not included collections were from a similar climate. The isolate from Macaronesia indicates a wider geographical range of the species.

Specimens included. **CHINA**: **Yunnan**, **Xishuangbanna**, Menglun, 47 km ESE of Jinghong, 1 km S of Menglun, Tropical Botanical Garden (Lushilin), 550 m, on bark of ?*Hevea brasiliensis*, 5.VIII.2005, Y. Zhang (Y.Z. bn1-7, YMFT 1.01835, **holotype** of *O. dorsalis*; YMFD 1.01835 permanent slide of culture, **holotype** of *D. dorsalis*, YMF 1.01835 culture, anam. cult.; sq.: DQ480730, doc. vid.). – ibid., date and substrate not stated (YMF 1.01838; sq.: FJ557238, non vid.). – **Dali**, Yongping, 35 km ENE of Baoshan, virgin forest around Golden Light temple (Jinguangsi), 2730 m, branch of indet. angiosperm, on wood, 18.XI.2007, H.Y. Su et al. (H.Y.S. jgs-19, anam. cult., H.B. 8782). — **MACARONESIA**: **Canary Islands**, **La Gomera**, unlocalized, leaf litter, X.1999, R.F. Castañeda Ruíz (as *D. oxyspora*, Chen et al. as *D. rhombospora*, CBS 102487, conid. isol., doc. vid.; sq.: DQ494356). – ?ibid., 5.I.1995 (CBS 321.95, conid. isol., non vid.).

Not included. **CHINA**: **Yunnan**, **Dali**, Yongping, 42 km NNE of Dali, Jizushan, 2700 m, branch of indet. angiosperm, on bark, 20.X.2008, X.M. Gao et al. (H.Y.S. jz-9, YMFT, H.B. 8985; sq.: MK493140). – ibid. (H.Y.S. jz-10, YMFT, anam. cult. [conidia narrower]). – **Yuxi**, Yimen, 54 km NW of Yuxi, 3 km NW of Fangtunxiang, Dalongkou, 1750 m, on ?branch of indet. angiosperm, VIII.2007, S.F. Li & J.W. Guo (J.W.G. ym3-62, YMFT, H.B. 8742). – **Taiwan**, **Taipei**, N of Taipei, Yamingshan, Lujiankengshi, 510 m, stem of *Calamus quiquesetinervius* {1}; 24.VIII.1999, M.L. Wu (M.W. 990825T17, TNM, H.B. 9536).

***Orbilia* sp**. **XJ-2009**: **CHINA**: **Guizhou**, **Zunyi**, Suiyang, ~62 km NNE of Zunyi, ~38 km ENE of Tongzi, Kuankuoshui, 1420 m, bark of indet. tree, VII.2008, X.Z. Jiang (XJ-2009, CGMCC 3.12026; sq.: FJ790421, HQ110697).

Orbilia clavispora (J. Chen, L.L. Xu, B. Liu & Xing Z. Liu) Baral, E. Weber, P. Perz & G. Marson, **comb**. **nov**., MB 813983 — Pls 938–942, Map 151

Basionym: *Dactylella clavispora* J. Chen, L.L. Xu, B. Liu & Xing Z. Liu, Fungal Diversity 26(1): 93 (2007)

?= *Orbilia vestimenti* Velen., Monogr. Discom. Bohem.: 93, pl. 11 fig. 23 (1934)

Etymology: *clavispora*: referring to the clavate conidia; *vestimenti*: named after the substrate of the type, rotten textile.

Typification: Great Britain, Cumbria, Meathop Wood, leaf of *Betula*, VIII.1970, J.C. Frankland (HMAS 140510, holotype of ***Dactylella clavispora***, ex-type culture: CBS 844.70; sq.: DQ494355). — Czechia, Jevany, on textile, 10.X.1925, J. Velenovský (PRM 151613, lectotype of ***Orbilia vestimenti***, designated here, MBT382141).

Misapplied name: Rubner (1996: 50, CBS 917.85), as *Monacrosporium asthenopagum*.

Description: — **TELEOMORPH**: **Apothecia** fresh 0.5–1.2(–1.4) mm diam., (0.14–)0.2–0.3(–0.38) mm high (receptacle 0.11–0.2 → 0.08–0.12 mm), pale rose-cream to light yellowish-amber-brownish, medium translucent, round, densely gregarious; disc flat (to slightly convex), margin thin, 0–10 µm protruding, almost smooth to finely crenulate; sessile on a narrow or broad base or with an abrupt stipe 0.11–0.23 × 0.18–0.6 mm, superficial; dry light ochre to bright red-brown. **Asci** *35–50 × (3.7–)4–4.5(–4.8) µm {3}, †32–36 × 3.5–4 µm {1}, 8-spored, spores *4-seriate, ~4 lower spores inverted {2} (not mixed), pars sporifera *15–17 µm long; **apex** (†) strongly truncate (not indented, laterally not inflated); **base** with very short to medium long,

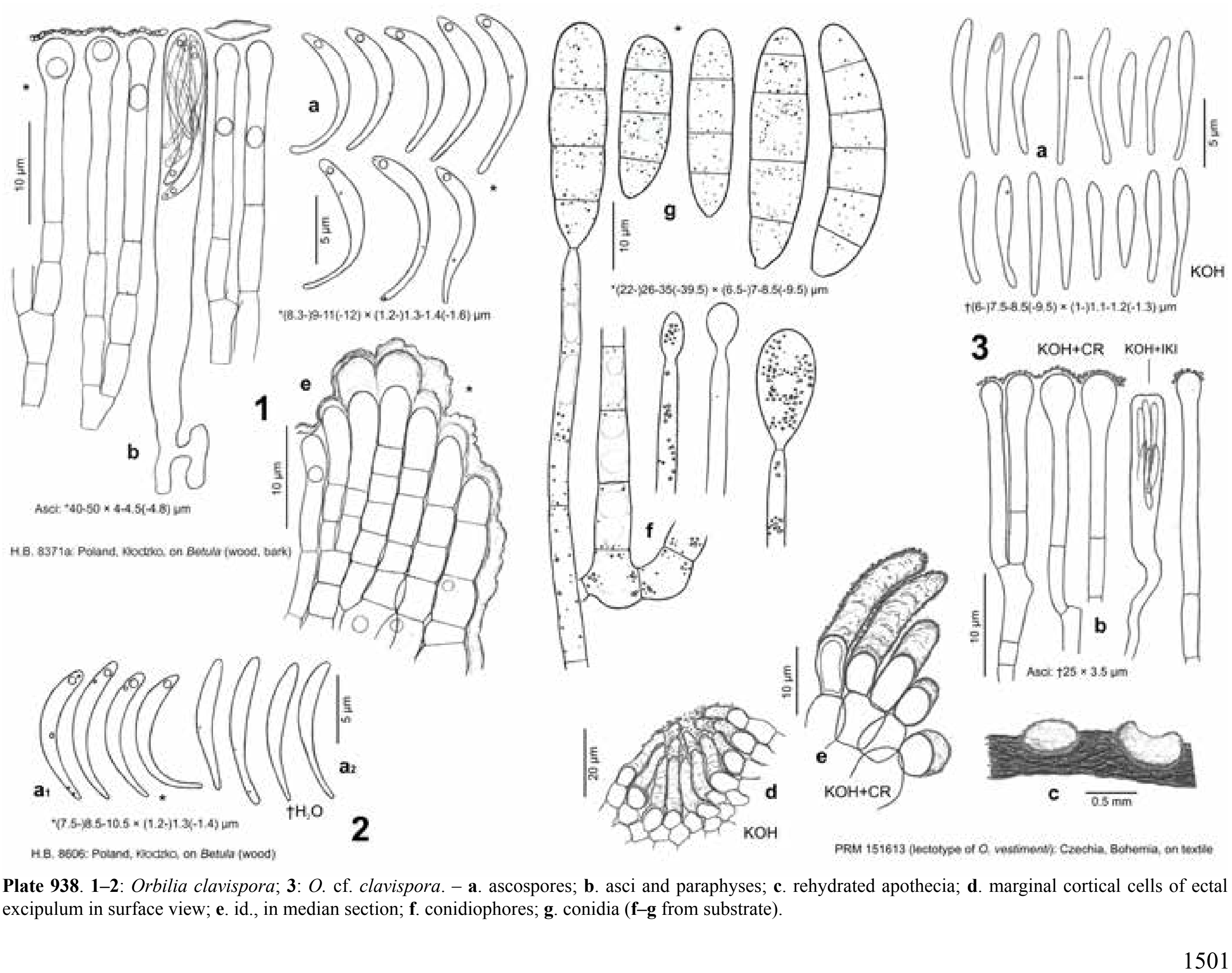


Plate 938. **1–2**: *Orbilia clavispora*; **3**: *O.* cf. *clavispora*. – **a**. ascospores; **b**. asci and paraphyses; **c**. rehydrated apothecia; **d**. marginal cortical cells of ectal excipulum in surface view; **e**. id., in median section; **f**. conidiophores; **g**. conidia (**f–g** from substrate).

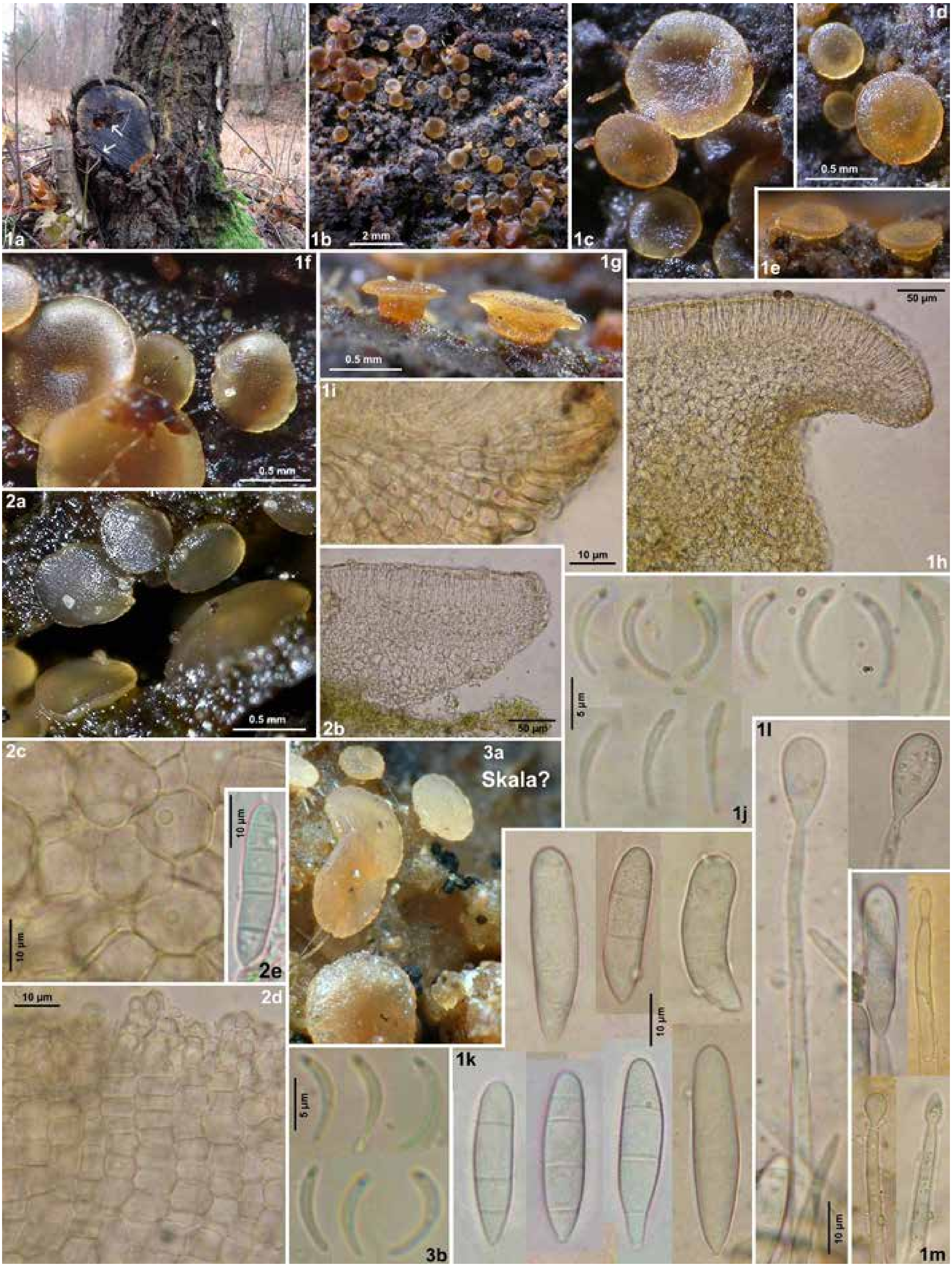


Plate 939. **1–3**: *Orbilia clavispora*. – **1a** *Betula* stump (apothecia on cut wood surface and inner surface of bark); **1b–g**, **2a**, **3a**. fresh apothecia; **1h**, **2b**. apothecia in median section; **2c**. id., cells of basal ectal excipulum containing SCBs; **1i**. id., cells of marginal excipulum oriented in rows; **2d**. marginal excipulum in external view showing cell rows; **1j**, **3b**. ascospores; **1k**, **2e** conidia; **1l–m**. conidiophores (from substrate). – Living state, except for **3** lower spores in **1j** (in KOH). – **1a**, **f**, **2e**, **3a–b**, **1k** (p.p.): phot. P. Perz. — **1a–m**. H.B. 8371a: Poland, Kłodzko, Żelazno, on *Betula*; **2a–e**. H.B. 8606: ibid., on *Betula*; **3a–b**. P.P. 20071006: Poland, Kłodzko, Domaszków, on *Tilia*.

thin or thick, slightly flexuous stalk, L- to h- or H-shaped. **Ascospores** *(7.5–)8–11(–12) × (1.1–)1.2–1.4(–1.6) µm {3} (~9–14 µm actual length), †8.5–11 × 1.1–1.2 µm {2}, fusoid-subulate, apex obtuse (to subacute), base always strongly attenuated (often as distinct tail ~⅓ of spore length), (medium to) strongly (to very strongly) curved (falcate) when viable, slightly to medium curved in dead state; **SBs** globose, 0.4–0.7 µm diam. {2}, 0.5–1 µm away from apex, total length 1–1.5 µm, attachment invisible. **Paraphyses** apically (uninflated to) slightly to medium (to strongly) capitate-clavate, terminal cell *15–23 × 2.3–3.7 µm {2}, lower cells *(3–)4–8(–10) × 1.7–2.5 µm {2}; unbranched at upper septum. **Medullary excipulum** 10–100 µm thick, of medium-sized t. globulosa-angularis, rather sharply delimited from ectal excipulum. **Ectal excipulum** of thin-walled, indistinctly oriented textura globulosa-angularis(-intricata) at base and lower flanks, 50–110(–320) µm thick near base, cells *12–25(–30) × 10–23 µm {2}; 15–30 µm thick at mid flanks and margin, of t. globulosa-angularis, usually forming distinct moniliform cell rows oriented at a 10–40° angle to the surface, marginal cortical cells *4.5–11 × 2.7–4.5(–5.5) µm {3}, cylindrical to ± lageniform; **glassy processes** absent {1} or 1–4 {1} or 10–17 {1} × 3–4(–4.5) µm {2}, ± straight, low-refractive, slightly stratified, cell rows and processes forming indistinct minute teeth. **Anchoring hyphae** medium to very abundant, *2–3(–4) µm wide, walls 0.2(–0.3) µm thick {2}, with or without light honey-yellow gel, forming strands, sometimes with a 20–70 µm thick t. prismatica-globulosa near base. **SCBs** in paraphyses globose to ellipsoid, medium refractive, 0.8–1.5 µm diam., also in entire ectal excipulum, 1.5–3.3 µm diam.; **VBs** absent or low-refractive. **Exudate** over paraphyses 0.3–0.6(–1.8) µm thick, granular to continuous to cloddy, loosely to firmly attached; over margin and flanks 0.3–3 µm thick, continuous, rough, pale chlorinaceous-yellowish. — **ANAMORPH**: dactylella-like (from natural substrate {3}, from leaf isolate [type of *D. clavispora*, values in square brackets, after Chen et al. 2007b], connection proved by DNA): **Conidiophores** septate, unbranched (rarely 1 × branched above), *43–110 µm long [60–148 µm], (3.5–)4–5(–5.5) µm wide at base [2.5–5.5 µm], 2.2–2.6 µm at tip [1.5–2.5 µm], forming 1(–2) conidia. **Conidia** *(22–)26–35(–39.5) × (6.5–)7–8.5(–9.5) µm [*18–32.5 × 7.5–11 µm], cylindric-ellipsoid(-clavate), straight, sometimes slightly curved, (1–)3–4(–5)-septate {4} [(1–)3-septate].

Habitat: collected 0.5 m above the ground, corticated, ?5–20 cm thick cut branches or stumps of *Betula* sp. {2}, *Tilia cordata* {1}, on min. 2–3 mm deep medium to strongly decayed splitted wood {3}, also on inner surface of detaching bark {1}, blackened, with many green algae. **Associated**: *Cosmospora vilior* {1}, *Cryptodiscus foveolaris* {1}, *Hyalorbilia juliae* {1}, *Hysterium angustatum* {1}, *Orbilia eucalypti* {1}, *O. orientalis* {1}. **Desiccation tolerance**: many lower cells of paraphyses and some immature asci still alive when dry since 1 day, after 3 weeks many excipular cells and after 11 months some ascospores still viable. **Altitude**: 10–445 m a.s.l. **Geology**: Lower Carboniferous lime- & sandstone, Upper Cretaceous calcareous clay- & marlstone, Quaternary sand; mica schist & gneiss. **Phenology**: VIII, X–XI (teleomorph).

Taxonomic remarks. *Orbilia clavispora* resembles *O. oxyspora*, *O. dorsalis*, and *O. desertorum* in having more or less distinct marginal cell rows oriented at a ± low angle to the surface, strongly falcate ascospores (in the living state) which contain globose SBs, and a dactylella-like anamorph. It differs in spores with comparatively wide upper parts and strongly attenuated bases with partly distinct tails, apparently also in a brownish colour of the fresh apothecia. With *O. desertorum* it shares ellipsoid-oblong conidia, in contrast to *O. oxyspora* and *O. dorsalis* which have fusiform conidia. *O. auricolor* has similar falcate ascospores though without distinct tails, and further differs in the absence of marginal cell rows and an arthrobotrys-like anamorph with 1-septate conidia. *O. mammillata* differs from *O. clavispora* in less curved ascospores without distinct tails, rod-shaped SBs, wider and more short-stalked asci, and a dactylellina-like anamorph with broadly fusiform conidia. *O. cardui* resembles *O. clavispora* in the glassy processes but differs in ± straight spores without tails when compared in the living state. A montane specimen on *Carex* mentioned under *O. epilobii* (Pl. 912: 3) has spores similar to *O. clavispora*, but wider and less curved, and the marginal ectal excipulum is almost vertically oriented. *O.* aff. *clavispora* (Pl. 943) resembles *O. clavispora* in its marginal excipulum and conidia but its ascospores are similar as in *O. cardui*.

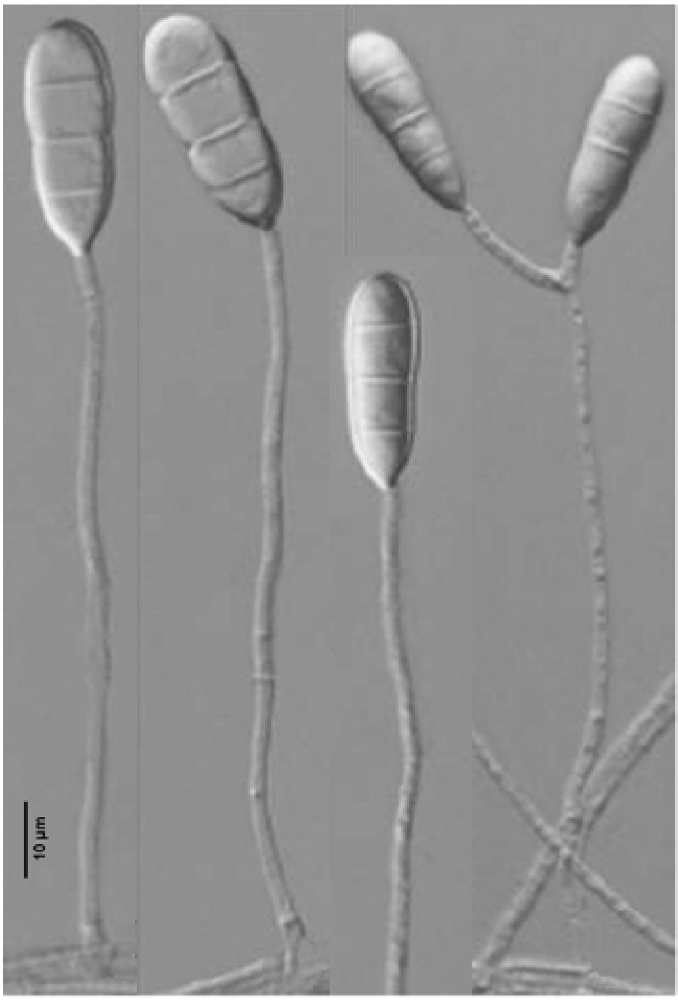


Plate 940. *Orbilia clavispora*. – Conidiophores and conidia, from pure culture (CBS 844.70, type of *Dactylella clavispora*, from Chen et al. 2006b).

Variation. Two collections from Poland were made on the very same stump of *Betula* but differ somewhat from each other: H.B. 8606 has slightly shorter spores and a thicker medullary excipulum than H.B. 8371a but, in contrast, a thinner basal ectal excipulum. Glassy caps or processes on the marginal cortical cells were absent in H.B. 8606, but were partly present in H.B. 8371a below the exudate at the uppermost margin (Pl. 938: 1e). In a third Polish record (on *Tilia*, Pl. 939: 3) the spores were at the lower end of the range (*8–9.5 × 1.1–1.2 µm) and the glassy processes 10–17 µm long.

Type studies. Velenovský (1934) described *O. vestimenti* based on two collections on moist ground (on textile and on stems of *Urtica*). No material on *Urtica* could be found at PRM, therefore, Svrček (1954) incorrectly referred to the other specimen as 'holotype'. In order to unequivocally fix the name to a specimen, the collection on textile (PRM 151613) is designated here as **lectotype** of *O. vestimenti*.

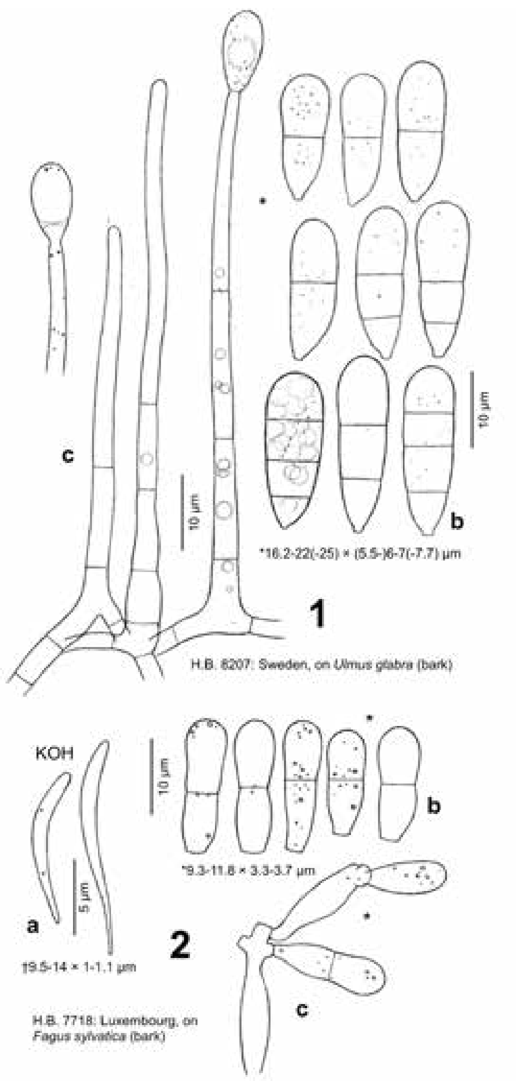


Plate 941. **1–2**: *Orbilia* cf. *clavispora*. – **a**. ascospores; **b**. conidia; **c**. conidiophores (**b–c** from substrate).

The apothecia of *O. vestimenti* were originally described as white and convex. They are now (rehydrated) cream-brownish, 0.3–1 mm diam., with a distinctly crenulate margin. Velenovský (1934 and manuscript plate) gave the spores as 10–15 × 0.7–1.2 µm (width estimated from drawing), and Svrček reported even narrower spores (10–12 × 0.5 µm). Though described as ‘straight to nearly straight’ by Svrček, the probably dead spores in Velenovský’s drawing show a partly distinct though slight curvature, and gradually taper towards an acute base.

Our reexamination revealed wider, straight or often slightly curved spores with an often distinct narrow tail. In the two Polish collections on *Betula*, the strongly curved living spores lose much of their curvature when losing turgor, in water (Pl. 938: 2a) as well as KOH (Pl. 939: 1j). Therefore, we may assume that the spores in the lectotype of *O. vestimenti* were also distinctly more curved in the living state. Velenovský described the asci with a very long and narrow stipe, but Svrček wrote ‘without elongate stipe’. In the present study only a few asci were found, and these had a thin and long stipe, the basis of which could not be discerned due to senescence of the material. The paraphysis apices were found to be narrower (†2–3.5 µm) than indicated by Velenovský (4–5 µm, probably in living state). Glassy processes have a length of 10–18 µm and are agglutinated as small teeth to form a distinctly crenulate margin. The ectal excipulum forms a textura globulosa up to the margin, and marginal cell rows oriented at a low angle were not observed. Yet, cell rows were also partly indistinct in the Polish sample on *Tilia*. The spores are ± straight or only slightly curved, i. e., less curved than in the Polish samples when compared in the dead state (Pl.938: 2a$_2$, 3a).

Svrček accepted *O. vestimenti* as distinct from *O. cardui* and *O. luteorubella* due to longer spores, coherent asci, and a deviating substrate, from the latter also because of encrusted paraphyses and hyaline apothecia. Conglutinate hymenial elements are confirmed in the present study of the lectotype, but certainly originate from senescence of the material. Although the features of *O. vestimenti* closely resemble those of *O. cardui*, including the glassy processes, we believe with Svrček that the spores are too different to consider the two taxa as conspecific. Because of the apparent absence of marginal cell rows, *O. vestimenti* might instead belong in the relationship of *O. rectispora* or *O. leporina*. Because of this uncertainty we refrained from including *O. vestimenti* in the description.

Not included collections. A sample from Serbia on *Betula* bark without conidia (IVV: 20.IX.2019) differs in a marginal excipulum of vertically oriented rows of roundish cells or, in another section, under a 45° angle, also in slightly shorter and wider (*7–9 × 1.3–1.6 µm), less curved spores. From *O. xinjiangensis* it differs in narrower, more curved spores.

Two collections on more xeric substrate (Sweden, bark of *Ulmus*; Luxembourg, bark of *Fagus*; Pls 941–942) are also not included in the description, especially because of smaller conidia. The abundant apothecia in the Swedish collection looked mature but spores could hardly be found inside the asci. A comparable collection with the very same ecology was made in Germany (Rhön, H.B. 7441, unillustrated, no conidia observed).

Anamorph. The conidia in the three specimens from Poland resemble in size and shape *Dactylella clavispora*, *D. cylindrospora*, *D. tenuis*, and *D. zhongdianensis*. The type of *D. clavispora* (from Great Britain) differs only insignificantly in having slightly shorter and wider conidia with max. 3 septa. Also *D. tenuis*, originally described from North America, concurs quite well with the Polish samples and might offer an earlier name for *O. clavispora*. *D. zhongdianensis* (from China) and *D. cylindrospora* (from Polynesia) have conidiophores with up to 3–5 branches, either in their middle part, or more apically (candelabrelloid), but apical branches were rarely also observed in the type of *D. clavispora*. *D. cylindrospora* is the only species that was compared with *D. clavispora* by Chen et al. (2007b). Compared to *O. cardui* or *O. rectispora*, *O. clavispora* possesses somewhat wider and shorter conidia but the other features of their anamorph are similar. No conidia have been found in the type of *O. vestimenti*.

The type of *D. clavispora* deviates from the anamorph observed in the Polish samples by slightly longer conidiophores and by shorter and wider conidia which were only 3-septate as a maximum. The conidia in the two not included, more xeric collections are distinctly smaller than in the specimens from Poland: in the Swedish sample (Pls 941: 1; 942: 1) the anamorph grew abundantly over the apothecia and the bark around. The medium-sized cylindric-clavate conidia were 1–2(–3)-septate; in the collection from Luxembourg (Pls 941: 2; 942: 2) some 1-septate small conidia were formed in small clusters at the tip of very short conidiophores which arose from the anchoring hyphae.

Phylogeny. A sequence which includes the S1506 intron, ITS, and LSU was gained from apothecia of one of the Polish collections. An ITS sequence that does not cover the intron region was obtained by Chen et al. (2007b) from the ex-type culture of *D. clavispora* from Great Britain, and an ITS sequence with S1506 intron was gained by Liou & Tzean from a strain under the name *D. asthenopaga* or *M. asthenopagum* from the Netherlands (CBS 917.85, Rubner 1996). That strain matches perfectly the type of *D. clavispora* in the ITS region except for a gap in the ITS1, and is thus obviously conspecific.

The Polish sample of *O. clavispora* differs from the two sequences with identical ITS by 1 nt in ITS1 and 1 nt in ITS2. Also in the available LSU it differs from CBS 917.85 by 2 nt in the D2 domain. We conclude that all three strains are conspecific. To *O. oxyspora* the ITS distance is 2.2–3.6% (1.6% in LSU) and to *O. dorsalis* 4.3–5%. In the S1506 intron the two available sequences of *O. clavispora* show a distance of 0.5% (2 nt and 1 gap), whereas *O. oxyspora* deviates here by 10.5–12% and *O.* aff. *clavispora* (Y.Z. bn1-14) by 19.5–20%. Other strains identified as *M. asthenopagum* belong to very different species (see p. 1607).

Map 151. Known distribution of *O. clavispora* in Europe (yellow = not included collections).

In our analyses of SSU+ITS+LSU, ITS, or LSU (Phyls 25–27, S31)*,* *O. clavispora* clustered with *O. oxyspora* and *O. dorsalis* in the strongly supported *oxyspora-clavispora* subclade. This is astonishing since its conidial morphology sharply differs from the fusiform conidia of these two species. *D. zhongdianensis* and *D. cylindrospora*, taxa with cylindric(-clavate) conidia, show a high molecular distance to *O. clavispora*, in accordance with shorter and straight ascospores in *D. zhongdianensis*. No

Plate 942. **1–2**: *Orbilia* cf. *clavispora*. – **1a**. *Fraxino-Aceretum pseudoplatani*, standing, probably dead *Ulmus* trunk with a large vertical slit in the partially detaching bark; **2a**. felled *Fagus* trunk with wounds with detaching bark; **1b–f**, **2b**. inner surface of detaching bark; **1c**, **e–f**, **2b**. rehydrated apothecia; **1d**. dry apothecia; **1g**, **2c**. marginal ectal excipulum in median section; **2d**. ascospores; **1i**. conidiophore with young conidium, **1j**. conidia (both from substrate). – Living state, except for **2c** (in KOH) and **2d** (left spore). — **1a–j**. H.B. 8207: Sweden, Skåne, on *Ulmus*; **2a–d**. H.B. 7718a: Luxembourg, on *Fagus*.

sequence of the type of *D. tenuis* was available, since a Chinese strain under that name (DQ494360, from Xinjiang) obtained by Chen et al. (2007b) clustered in phylogenetic analyses in *Drechslerella* near *O. brochopaga*, although trapping organs were not observed.

Ecology. *O. clavispora* is so far only known from atlantic to subcontinental, cold-temperate humid Europe. The type was isolated from a living *Betula* leaf in a forest on a coastal limestone hill in atlantic northern England, and the strain under the name *M. asthenopagum* from decaying wood in subatlantic Netherlands. Apothecia have been collected on rotten, mesic wood and bark of a *Betula* stump and on hygric wood of a *Tilia* branch in subcontinental southern Poland. The lectotype of *O. vestimenti* grew on a hygric rotten textile in a moist place in Czechia. Further not included collections of apothecia were from temperate subcontinental Europe on xeric bark of standing trunks of *Fagus* in Luxembourg and of *Ulmus* in central Germany and southern Sweden, those on *Ulmus* being from nutrient-rich ravine forests (*Fraxino-Aceretum pseudoplatani*).

Specimens included. **GREAT BRITAIN**: **North West England**, **Cumbria**, ~2 km NE of Grange-over-Sands, Meathop Wood, ~50 m, isolated from living leaf of *Betula*, VIII.1970, J.C. Frankland (HMAS 140510, **holotype** of *D. clavispora*, CBS 844.70, conid. isol., doc. vid., sq.: DQ494355). — **NETHERLANDS**: **Noord-Holland**, 10 km SW of Haarlem, W of Vogelenzang, Waterleidingduinen, 10 m, isolated from decaying wood, IX.1985, W. Gams (CBS 917.85, G.S. de Hoog as *D. asthenopaga*, conid. isol., non vid.; sq.: U51962). — **POLAND**: **Lower Silesia**, 9 km S of Kłodzko, 2 km S of Żelazno, Bielica Mt., 420 m, stump of *Betula*, on wood & bark, 17.XI.2006, P. Perz (P.P. 20061117-1, H.B. 8371a, anam. substr.; sq.: KT222381). – ibid., stump of *Betula*, on wood, 18.VIII.2007, P. Perz (H.B. 8606, anam. substr.). – 10 km SSE of Bystrzyca Kłodzka, 1.5 km E of Domaszków, Polna ulica, 445 m, branch of *Tilia cordata*, on wood, 6.X.2007, P. Perz (P.P. 20071006-1, anam. substr., doc. vid.).

Not included. **SWEDEN**: **Skåne**, Söderåsen, 6 km WNW of Röstånga, NNE of Kohagahus, Kvärkabäckens ravine, 135 m, trunk of *Ulmus glabra*, on bark, 3.VI.2006, H.O. Baral (H.B. 8207, anam. substr.). **—** **LUXEMBOURG**: **Gutland**, 5 km S of Luxembourg, 1 km W of Hesperange, Géisselbierg, 280 m, trunk of *Fagus sylvatica*, on bark, 10.III.2005, G. Marson (H.B. 7718a, anam. substr.). — **GERMANY**: **Hessen**, Rhön, 6.3 km NE of Gersfeld, 2.2 km SSW of Ehrenberg-Wüstensachsen, Schwarzwald, 700 m, trunk of *Ulmus*, on bark, 24.XI.2003, L.G. Krieglsteiner (H.B. 7441). — **CZECHIA**: **Central Bohemia**, ~30 km ESE of Praha, woods near Jevany, 400–500 m, on textile, 10.X.1925, J. Velenovský (PRM 151613, **lectotype** of *O. vestimenti*, H.B. 6400 ø, anam. substr.). — **SERBIA**: **Vojvodina**, Fruška Gora, 12 km S of Novi Sad, 6 km NNW of Irig, W of WWII memorial, 430 m, log of *Betula pendula*, on bark, 20.IX.2019, D. Savić (doc. vid.).

Orbilia aff. *clavispora* — Pl. 943

Description by Z.F. Yu (pers. comm., modified): — **TELEOMORPH**: **Apothecia** rehydrated 0.5–1 mm diam., 0.11 mm thick (receptacle 0.09 → 0.07 mm), light yellow-amber, translucent, ± round, scattered to gregarious; disc flat to slightly convex, margin thin, smooth, not protruding; sessile, superficial. **Asci** †22.5–36.5 × 3–3.8 µm, 8-spored, spores *2–3-seriate, lower spores inverted (± mixed); **apex** (†) strongly truncate (not indented, laterally not widened); **base** with short, flexuous stalk, h-shaped. **Ascospores** *6.5–7.3(–8) × (1.3–)1.4–1.5 µm, subcylindrical to very slightly fusoid, apex rounded, base slightly (to medium) attenuated, slightly inequilateral to slightly, rarely medium curved; **SBs** globose, 0.8–1 µm diam., total length 1.5–1.7 µm but filum and attachment invisible. **Paraphyses** apically uninflated to slightly capitate-clavate, terminal cell †14–17 × 1.7–2 µm, lower cells †~5–7 × 1.2–1.7 µm. **Medullary excipulum** 15 µm thick. **Ectal excipulum** of thin-walled to slightly gelatinized textura angularis at base and flanks, 70 µm thick near base, cells †9–14 µm diam.; 30 µm thick near margin, of t. prismatica oriented at a 20–40° angle, marginal cortical cells †~5–8 × 2–3.5 µm; **glassy processes** absent. **Anchoring hyphae** not studied. **SCBs** and **VBs** no data available. **Exudate** over paraphyses 0.3–1 µm thick, cloddy, firmly attached. **— ANAMORPH**: dactylella-like (from ascospore isolate {1}). **Conidiophores** 50–210 µm high, 3.5–4 µm wide at base, gradually tapering upward to a width of 2.5–3µm at apex, initially with a single apical conidium, later often producing a few short branches near the apex, with 2–3(–5) conidia in sympodial arrangement. **Conidia** *(20–)24–43(–47.5) × (6.5–)7.5–8.5(–9.3) µm, (cylindric-)ellipsoid-clavate, obtuse at the distal end, slightly tapered at the ± truncate base, straight, rarely curved, with (3–)4–5(–7) septa. **Trapping organs** not produced when nematodes were added.

Habitat: on rotten bark of indet. tree. **Associated**: unknown. **Desiccation tolerance**: possibly intolerant. **Altitude**: 600 m a.s.l. **Phenology**: VIII.

Taxonomic remarks. *Orbilia* aff. *clavispora* resembles *O. cardui* in the morphology of ascospores and conidia, from which it differs in the apothecial margin composed of a textura porrecta

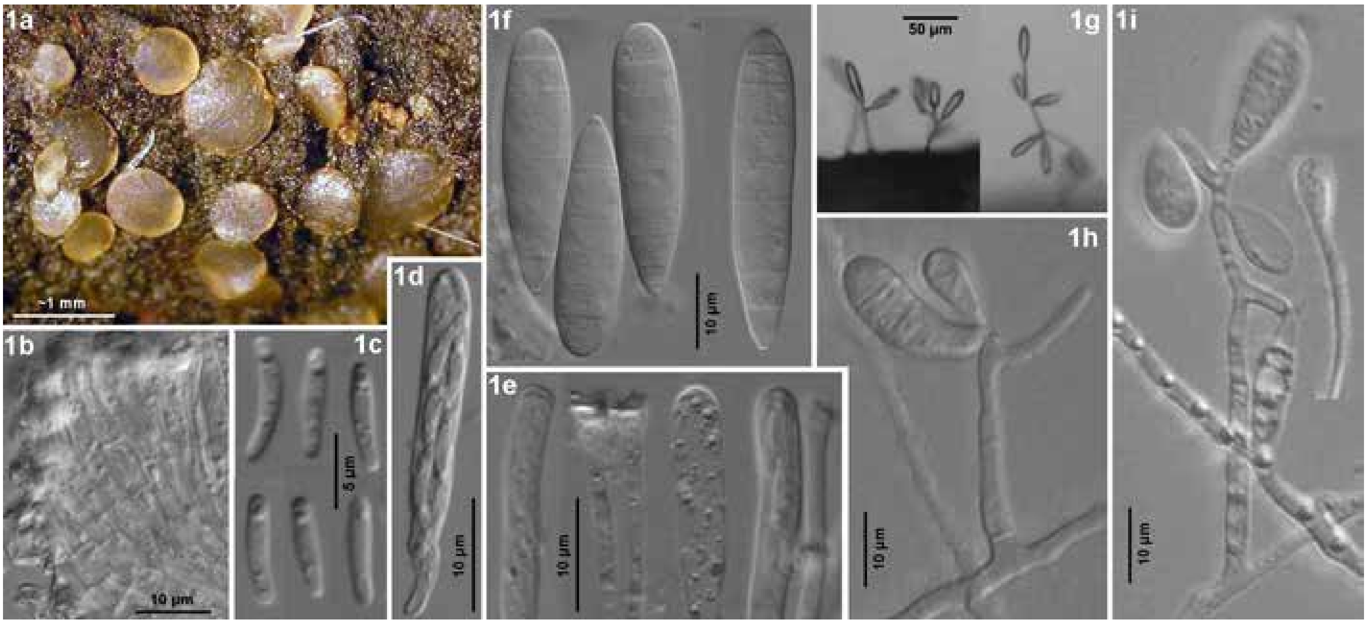


Plate 943. **1**: *Orbilia* aff. *clavispora*. – **1a**. fresh apothecia; **1b**. marginal ectal excipulum in median section; **1d–e**. asci and paraphyses; **1c**. ascospores; **1f**. conidia; **1g–i**. conidiophores with conidia. – Living state, except for **1b** (in H_2O), **1d** (ascus), **1f** (left asci and paraphyses). – phot. Z.F. Yu. — **1a–i**. Y.Z. bn1-14: China, Yunnan, on indet. tree.

oriented at a rather low angle to the surface. With this character the species resembles *O. clavispora*, which differs in always ± strongly curved and basally strongly attenuated ascospores, also in conidia with fewer septa and usually unbranched conidiophores.

Phylogeny. A sequence gained by Z.F. Yu (pers. comm.) from the ascospore isolate comprises ITS and the S1506 intron. In our analysis of the ITS region (Phyl. 26) it clustered in the medium supported *heptameres*-*qiluensis* subclade, though with a minimum distance of 6.5–7.5% to '*Dactylellina*' *varietas*, *Dactylella qiluensis*, and *D. heptameres*. When analysing the intron, it clustered in an unsupported clade with '*D.*' *varietas* (S30), with a distance of 12–14.5%.

Ecology. *Orbilia* aff. *clavispora* was collected on rotten bark, which was probably lying on the moist ground, in a tropical humid (winter-dry) rainforest in southern China.

Specimens included. **CHINA**: **Yunnan**, **Xishuangbanna**, 50 km ESE of Jinghong, 2 km SE of Menglun, Green Stone, 600 m, bark of indet. tree, 3.VIII.2005, M. Qiao & Y. Zhang (Y.Z. bn1-14, YNOA 0002, YMFT, permanent slide culture YNDA 0002, anam. cult., doc. vid.; sq.: ined.).

Orbilia desertorum Baral & Priou, **sp. nov.**, MB 813984 — Pls 944–945, Map 152

Etymology: named after the growth on xeric substrate in ± semiarid areas.

Typification: Spain, Torrevieja, leaves of *Agave americana*, 31.XII.2007, O. & J.P. Priou (ex H.B. 8737, M-0276474, holotype; sq.: KT222434).

Latin diagnosis: *Apothecia rehydratata 0.25–1.8 mm diam., dilute cremeo-(aurantio-)ochracea, sessilia, margine laevi vel minute crenulato. Ascosporae *6–11.5 × 1.1–1.6 µm, subulatae, apice rotundatae, basi attenuatae, interdum subcaudatae, modice ad valde arcuatae, corpusculum refringens (sub) globosum, ad apicem filo breve affixum continentes. Paraphyses ad apicem non vel leniter capitatae, exsudato valido luteolo tectae, cellulae vivae absque vacuolis refringentibus. Cellulae excipuli marginalis plerumque hyphas subcrassitunicatas sub angulo obliquo orientatas formantes et processis vitreis brevibus vel longis praeditae. Habitat ad folia putrida sicca* Agaves*, caules inflorescentiae* Yuccae*, ramos* Ferocacti*, plerumque in zona thermomediterranea semiarida Americae centralis, Macaronesiae et Europae meridionalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.25–)0.4–1.3(–1.8) mm diam., 0.1–0.25 mm high, pale to light carneous or cream-ochraceous(-orange) to yellow-ochre, turning light to bright reddish-brownish with age, hardly to rather strongly translucent, round, slightly lobate if large, sub- to ± densely gregarious; disc slightly concave, soon flat, margin indistinct or distinct, thin, 0–10 µm protruding, smooth to

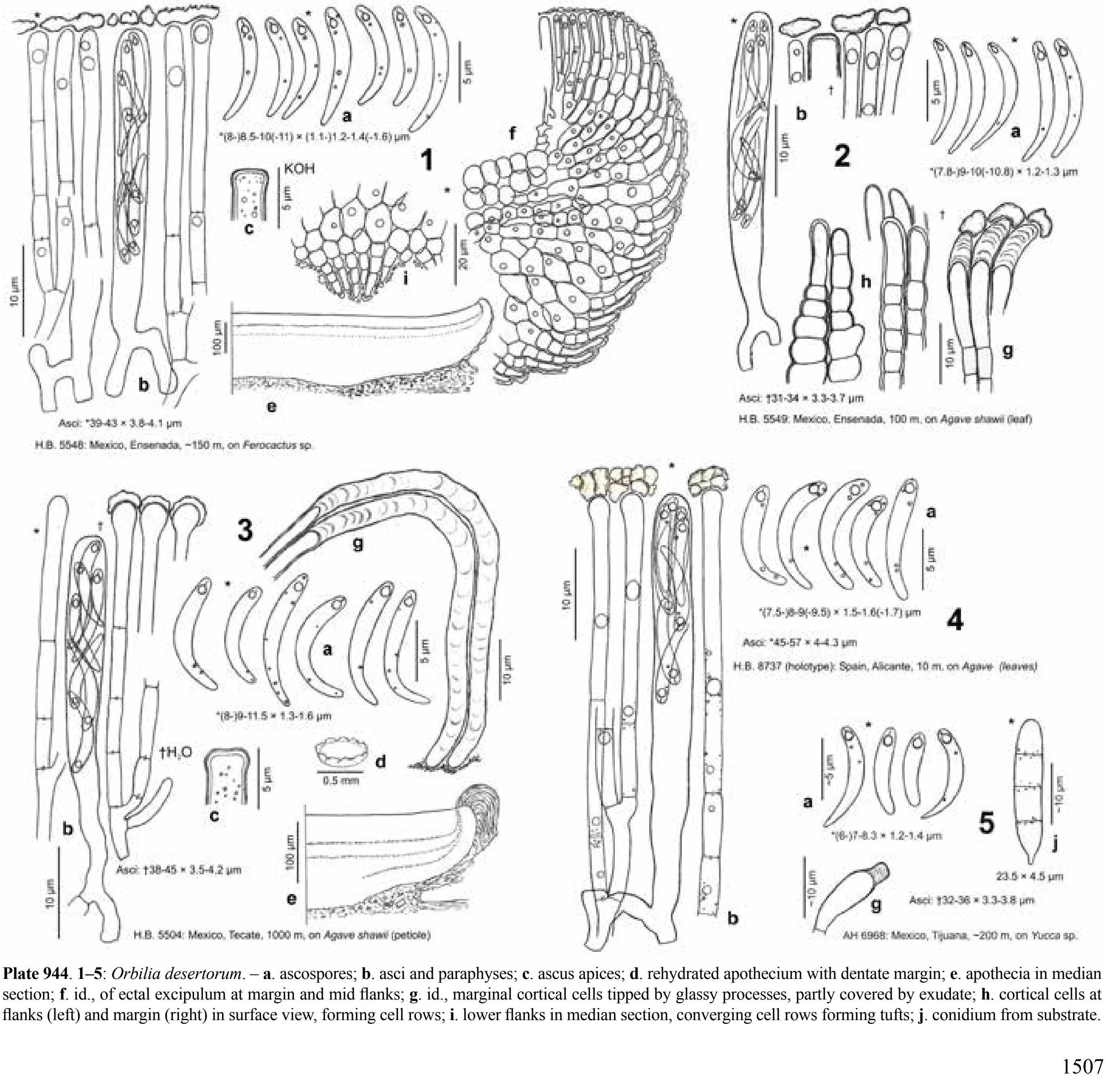


Plate 944. **1–5**: *Orbilia desertorum*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. rehydrated apothecium with dentate margin; **e**. apothecia in median section; **f**. id., of ectal excipulum at margin and mid flanks; **g**. id., marginal cortical cells tipped by glassy processes, partly covered by exudate; **h**. cortical cells at flanks (left) and margin (right) in surface view, forming cell rows; **i**. lower flanks in median section, converging cell rows forming tufts; **j**. conidium from substrate.

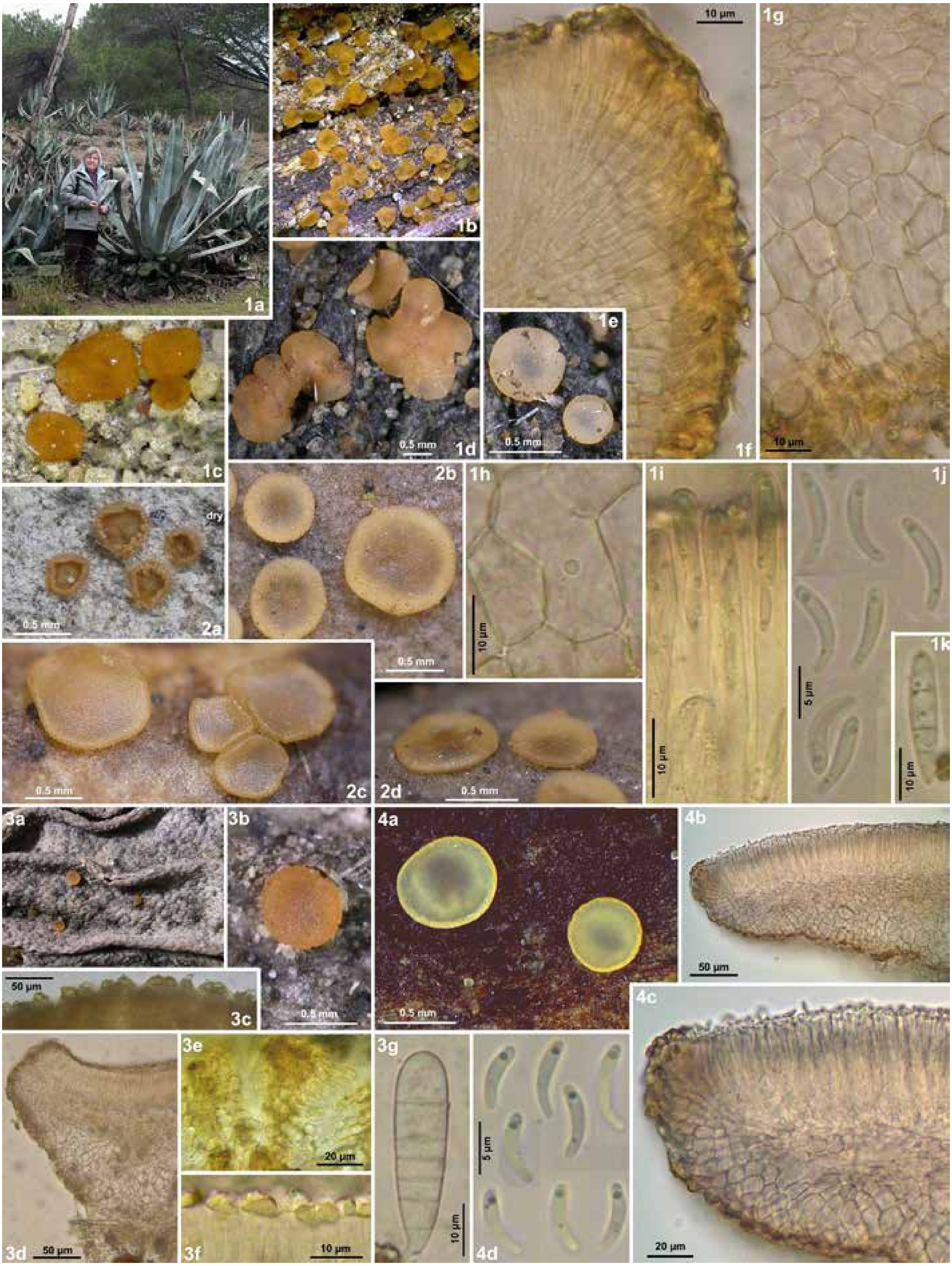


Plate 945. **1–4**: *Orbilia desertorum*. – **1a**. *Agave* population on sand dune with open pine woodland at sea shore; **1b–e**, **4a**. fresh apothecia; **2b–d**, **3a–b**. rehydrated apothecia; **2a**. dry apothecia; **3d**, **4b**. apothecia in median section; **1f**, **4c**. id., ectal excipulum at flanks and margin; **1g**. id., at lower flanks; **3c**. dentate margin; **3e**. mid flanks in external view, converging cortical cells covered by yellow exudate; **1h**. ectal excipular cells, 1 with a globose SCB; **1i**. asci; **1j**, **4d**. ascospores; **3f**. paraphysis tips covered by cloddy exudate; **1k**, **3g**. conidia (from substrate). – Living state. – **1a–c**: phot. J.P. Priou, **4a–d**: phot. L. Quijada. — **1a–g**. H.B. 8737 (holotype): Spain, Alicante, on *Agave*; **2a–d**. H.B. 5548: Mexico, Baja California, on *Ferocactus*; **3a–g**. H.B. 9448: Spain, Alicante, on *Agave*; **4a–d**. TFC Mic. 24077: Tenerife, on *Aeonium*.

finely rough or crenulate, rarely with prominent whitish teeth; (broadly) sessile, superficial; dry dirty ochraceous, with inrolled margin. **Asci** *39–43 {2} or 45–57 {1} × 3.8–4.3 µm {3}, †31–45 × (3–)3.2–3.8(–4.2) µm {5}, 8-spored, spores 3–4-seriate, (2–)3–**5**(–6) lower spores inverted {5} (not mixed), pars sporifera *(20–)23–28(–32) → 17–20 µm long; **apex** (†) medium to strongly truncate (not or slightly indented, laterally sometimes inflated); **base** with short to medium long, thick, ± flexuous stalk, Y- to h- or H-shaped. **Ascospores** *(6–)7–10.5(–11.5) × (1.1–)1.2–1.5(–1.7) µm {8} [~(7–)9–12 µm actual length], †7–10.5 × 1.2–1.4 µm {2}, (sub)cylindric-clavate (subulate), apex rounded, base slightly to strongly attenuated, sometimes with indistinct tail-like base, medium to strongly curved (falcate, in KOH slightly to medium curved); **SBs** *(1.2–)1.3–1.6(–1.8) × (0.3–)0.5–0.9 µm {6}, divided into a (sub)globose or rarely tear-shaped lower part and a short, ± indistinctly visible filum, sometimes slightly eccentrical. **Paraphyses** apically uninflated to slightly (to medium) capitate(-clavate), terminal cell *(10–)17–27(–33) × 1.8–2.5 µm {2}, †13–16 × 2.5–3 µm {1}, lower cells *(2.5–)5–11(–15) × 1.4–2.1(–2.3) µm {4}; unbranched at upper septum. **Medullary excipulum** 20–40 µm thick, of ± dense textura globulosa(-prismatica), cells ± horizontally elongated, very indistinctly to sharply delimited from ectal excipulum. **Ectal excipulum** of (†) thin-walled, vertically or indistinctly oriented t. globulosa-angularis(-prismatica) from base to mid flanks, 50–150 µm thick near base, cells *10–22(–28) × (6–)10–20(–25) µm {4}; 20–40 µm thick near margin, inner region of t. prismatica oriented at a 50–80° angle to the surface, outermost region of t. prismatica-porrecta at a 10–60° angle, cells of outer region usually forming ± distinct, free or agglutinated cell rows with yellowish, 0.2–0.3 or 0.3–0.8 µm thick lateral walls, terminal cells *(4–)6–10(–18) × (2.5–)3–5(–5.5) µm {4}; **glassy processes** absent {3} or present {5}, 1–6 {5}, 3–10 {1}, 5–20 {1}, or 50–70 {1} × (2–)3–4(–6) µm {4}, stratified, if long then curved outwards and coherent to form distinct teeth at margin and flanks. **Anchoring hyphae** ± abundant, */†2–3.5 µm wide, walls 0.2–0.5(–1) µm thick {3}, 4–5 µm wide near insertion, hyaline or pale yellowish, forming a dense t. intricata up to 50 µm thick. **SCBs** globose {5}, in paraphyses 1–2 µm diam., in ectal excipulum (at base and flanks, partly also up to margin) (1–)1.5–3(–4) µm diam.; **VBs** absent {4}, rarely present, multiguttulate {1}. **Exudate** pale to bright honey-yellow, over paraphyses cloddy, 1–3(–4.5) µm thick, loosely but also firmly attached; over margin and flanks continuous to rough-cloddy or granular, 1–5 µm thick. — **ANAMORPH**: dactylella-like (presumed, from natural substrate {3}). **Conidiophores** not seen. **Conidia** cylindric-ellipsoid, *23.5–26 × 4.5–5.3 µm, 3-sepatate {2}, or cylindric-clavate, *39 × 10.5 µm, 6-septate {1} (in each collection only 1 conidium seen).

Habitat: ± lying on sandy ground, xeric leaves, branches (2–4 cm thick) or inflorescence stems of *Aeonium pseudourbicum* {1}, *Agave americana* {4}, *A. shawii* {3}, *Ferocactus* sp. {1}, *Yucca* sp. {1}, on epidermis or epidermis-free regions, slightly to medium decayed, slightly to strongly blackened, without algae. **Associated**: *Badhamia affinis* {1}, *Didymium* sp. {1}, *Hyaloscyphaceae* sp. {1}, *Perichaena depressa* {1}. **Desiccation tolerance**: Mexican collections: fully viable for up to 5 months, ascospores, cells of ectal excipulum and some paraphyses still viable after 40 months; Spanish collections: some medullary and ectal excipular cells survived for at least 3 months, but asci and paraphyses did not survive for 3 weeks. **Altitude**: 10–18 m a.s.l. (Spain), 1050 m (Macaronesia), 100–1000 m (Mexico). **Geology**: Spain: marine sand near calcareous clay; Tenerife: tabular basaltic flow. **Phenology**: X–IV (but possibly throughout the year, long-lived).

Taxonomic remarks. *Orbilia desertorum* differs from most members of section *Arthrobotrys* in a rather high desiccation tolerance of the apothecia, also in the ability to form very long glassy processes, though this was only the case in the specimen from high altitude in Mexico. The species strongly resembles the temperate *O. oxyspora* and subtropical *O. dorsalis*, from which it differs in the globose SBs showing a more or less distinct filum, a tendency to wider spores, the occurrence on succulent desert plants in semiarid regions, apparently also in a distinctly different dactylella-like anamorph (though not proved in pure culture).

The temperate European *O. clavispora* differs from *O. desertorum* in the partial presence of ± distinct spore tails while its anamorph appears to be similar. *O. tenuissima* differs in narrower ascospores, shorter asci, and a tropical humid occurrence. *O. pseudeuphorbiae* differs in slightly spathulate-lageniform paraphyses, more geniculate instead of falcate spores, and less distinct cell rows at the margin. The Macaronesian sample on *Aeonium* was first compared with this species, but its molecular data refer it to *O. desertorum*.

O. auricolor and *O. terrestris* (series *Arthrobotrys*) differ from the former three taxa in an outer marginal excipulum of almost vertically oriented cells which do not form individual rows, and in a consistently smooth apothecial margin, *O. terrestris* also in wider spores with strongly attenuated spore bases and in more capitate paraphyses. However, a specimen reported by Liu (2006: fig. 13–14) under the name *O. auricolor* shows a marginal excipulum of textura porrecta running under a very low angle. Together with its rather short ascospores this specimen resembles *O. desertorum*, but it has a very different anamorph with 1-septate obpyriform conidia and adhesive networks which Liu identified as *Arthrobotrys javanicus* (see Pl. 959). Moreover, the habitat of this southern Chinese specimen was a subtropical semihumid montane forest.

Variation. The collections here included in *O. desertorum* show a remarkable variability in length of the glassy processes, which were very short or even absent in the samples on *Aeonium*, *Ferocactus* and *Yucca*, but strongly varied among those on *Agave* from ± absent over medium to very long. A correlation with the altitude was observed: the processes were 0–20 µm long at altitudes of 10–200 m (Spain and Mexico), but 50–70 µm at 1000 m (Mexico), but in the Macaronesian collection at 1050 m the glassy processes were absent to very short.

Further variation was noted in spore length and width, and in the paraphyses which are usually only very slightly inflated at the apex but predominantly medium capitate in the Mexican specimen with long glassy processes. In the *Aeonium* sample some paraphyses contain numerous medium-sized refractive guttules, which undoubtedly represent VBs and which were not seen in the other specimens. Apothecia in the collections from Torrevieja (Spain) showed a remarkable variation in their pigmentation, from flesh-coloured over light ochraceous or bright yellow-ochre to eventually bright reddish-brownish.

Anamorph. Only a single conidium was detected on the natural substrate in each of three collections. Based on their similarity to those of *O. clavispora*, we presume that they represent the anamorph of *O. desertorum*. However, in two of them (Pls 944: 5j; 945: 1k) the conidia were rather small and 3-septate, and resemble the type of *Dactylella tenuis*, which differs in wider conidia and in being isolated from leaf mould in deciduous woods, whereas in the third the conidium was larger and 6-septate (Pl. 944: 3g) and resembles *D. rhopalota*. The large conidium and one of the small ones occurred on the same host (*Agave*) at the same site in Spain. *D. clavispora* (= *O. clavispora*) as described by Chen et al. (2007b) has similar, (1–)3-septate conidia of *18–32.5 × 7.5–11 µm, which resemble in length and septation the small conidial type but in width the large conidial type observed in *O. desertorum*.

Phylogeny. Sequences were taken from apothecia of two samples (Com. Valenciana, on *Agave*, holotype; Tenerife, on

Map 152. Known distribution of *O. desertorum* in North America.

Aeonium), comprising the S1506 intron, ITS, and LSU, in the holotype also SSU. In the ITS region the two sequences are identical, whereas in the intron a deviation of 1 nt and 2 gaps occurs, and in the LSU (D1–D2) 1 nt deviates. In comparison, the distances among species of series *Neodactylella* lie in the range of 8–28% in the intron.

When analysing SSU+ITS+LSU or ITS (Phyls 25–27), *O. desertorum* clustered with strong support in the *oxyspora-heptameres* clade, with a minimum ITS distance of 8–9.5% to members of this clade. Also in the intron a high distance is noted among members of series *Neodactylella* (min. 12.5% to *O. clavispora*).

Ecology. *O. desertorum* grew on ± xeric, slightly to medium rotten branches, inflorescence stems, and succulent leaves of desert plants belonging to *Cactaceae* (*Caryophyllales*), *Crassulaceae* (*Saxifragales*), and *Agavaceae* (*Liliales*). The species was collected in the subtropical semiarid (summer-dry) southern mediterranean chaparral at 100–200 m a.s.l. in the Californian Coastal Sage and Chaparral and Baja California Desert and in a more warm-continental subhumid scrubland at 1000 m in the Sonoran Desert of southwestern North America. It also occurred in a thermomediterranean semiarid *Soncho-Aeonion* xerophytic scrubland with scattered *Juniperus* below the pine forest belt on a west-exposed slope of Tenerife (Macaronesia), and in thermomediterranean semiarid coastal sites with introduced *Agave* in southwestern Europe. It might well be that the fungus was introduced from North America to Spain with the *Agave* plants, but the occurrence on *Aeonium* in a natural vegetation in Tenerife might rather be native.

Specimens included. **SPAIN**: **Com**. **Valenciana**, **Alicante**, 6 km NNE of Torrevieja, E of Pinomar, Dunas de Guardamar, 10 m, leaves of *Agave americana*, 31.XII.2007, O. & J.P. Priou (ex H.B. 8737, M-0276474, **holotype**, anam. substr.; sq.: KT222434; J.P.P. 27140, **isotype**). – ibid., 4.X.2010, J.P. Priou (J.P.P. 10160 ø, H.B. 9448, anam. substr.). – ibid., 3.I.2008, J.P. Priou (J.P.P. 28001, doc. vid.). – 8.5 km NNE of Torrevieja, 18 m, leaves of *Agave americana*, 3.I.2008, J.P. Priou (J.P.P. 28002, doc. vid.). — **MACARONESIA**: **Canary Islands**, **Tenerife**, Santiago del Teide, 2 km NE of Tamaimo, 1.3 km NNE of Arguayo, SSE of Las Manchas, 1050 m, on branch of *Aeonium pseudourbicum*, 13.IV.2013, L. Quijada (TFC Mic. 24077, doc. vid.; sq.: KT222401). — **MEXICO**: **Baja California**, California Chaparral, 90 km W of Mexicali, 23 km E of Tecate, Rancho Cañada Verde, 1000 m, leaf of *Agave shawii*, 6.II.1993, R. Galán et al. (AH 7014b, H.B. 5504). – Baja California Desert, 83 km SSE of Ensenada, Ejido Eréndira, 7 km ESE of San Vicente, 100 m, leaves of *Agave shawii*, 15.II.1996, M. Lizárraga (AH 7078, H.B. 5549 ø). – 17 km SW of Ensenada, 1.3 km NE of La Bufadora, 160 m, leaves of *Agave shawii*, 12.II.1993, F. Bersan & R. Galán (AH 7080). – 116 km SSE of Ensenada, 42 km NNW of San Quintin, ?8 km N of Camalú, Arroyo de San Telmo, ~150 m, stem of *Ferocactus*, 26.II.1996, M. Lizárraga (AH 7079, H.B. 5548). – 22 km SSE of Tijuana, ~11 km SW of Abelardo Rodríguez dam, Los Alisos Ranch, ~200 m, stem of *Yucca*, on wood, 13.XI.1994, M. Lizárraga (AH 6968, H.B. 5257 ø, anam. substr.).

Orbilia tenuissima Speg., An. Soc. Cient. Argent. 26: 59 (1888) [non *O. tenuissima* Pat. & Gaillard, nom. illegit., ICN Art. 53.1, ≡ *O. gaillardii*] — Pls 946–947, Map 153

(?) = *Orbilia prasina* Massee in sched.

Etymology: named according to the thin, membranaceous apothecia.
Typification: Paraguay, Yaguaron (Guarapi), leaves of *Epipremnum pinnatum*, IX.1883, B. Balansa (LPS 24449, holotype).
Misapplied name: Korf (1992), as *O. auricolor* (?= *O. tenuissima*).

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.4–1.2 mm diam., 0.09–0.12 mm high (receptacle 0.09–0.1 → 0.07 µm), membranaceous, pale chlorinaceous or yellowish-cream-ochraceous, medium to strongly translucent, round, gregarious; disc flat to slightly convex, margin distinct, 0–10 µm protruding, very indistinctly rough to often finely to distinctly denticulate with pale yellowish teeth; broadly sessile, superficial; dry pale to light cream to chlorinaceous. **Asci** †(22–)25–32(–34.5) × 2.5–3.4 µm {5}, 8-spored, spores 4-seriate, 4 lower spores inverted {1}; **apex** (†) strongly truncate (not or slightly indented, laterally not or slightly inflated); **base** with very short to medium long, thin, ± flexuous stalk, Y- to h- or H-shaped. **Ascospores** †(7–)7.5–10.5(–11) × 0.8–1.1 µm {7} (~8.5–12 µm actual length), narrowly (subcylindric-)clavate (subulate), sometimes fusoid-clavate, apex rounded, sometimes obtuse, base ± strongly attenuated, medium (to strongly) curved (falcate); **SBs** not observed. **Paraphyses** apically slightly to strongly capitate-clavate, terminal cell †(12.5–)15–20 × (1.3–)2–3 µm {4}, lower cells †3–6.5(–9) × (1–)1.4–1.8 µm {4}; rarely branched at upper septum. **Medullary excipulum** hyaline, 10–15 µm thick, of dense textura globulosa-prismatica, medium sharply delimited from ectal excipulum. **Ectal excipulum** of (†) thin-walled, indistinctly oriented t. angularis at base and flanks, 50–70 µm thick near base, cells †10–25 × 7–18 µm {2}; towards mid flanks oriented at a 30–90° angle to the surface, 15–20 µm thick near margin, oriented at 0–45°, marginal cortical cells forming hair-like cell rows 8–35 µm long, †3.5–7.5 µm wide, (1–)3–10-celled, terminal cell †(3–)5–10(–12) × 3–4.5(–5.5) µm {5}, walls 0.2–0.5(–1) µm thick, tipped by **glassy processes** 1–10 × 3–5(–6) µm {7}, medium refractive, stratified, if cell rows long enough then ± coherent to form teeth which imbricately cover the marginal excipulum. **Anchoring hyphae** ± abundant, †1.5–3 µm wide, walls 0.2 µm thick {2}, forming a 10–20 µm thick t. porrecta-intricata. **SCBs** and **VBs** no data available. **Exudate** over paraphyses and margin 0.4–2.5(–4) µm thick, continuous to cloddy, (very) pale chlorinaceous, loosely or firmly attached; over outer excipulum granular, sparse. — **ANAMORPH**: unknown (but see below).

Habitat: lying on ground, ~2.5–30 mm thick, slightly to medium decayed stems of *Bambusa* {1}, petioles of *Cecropia* sp. {2}, *Epipremnum pinnatum* {1}, fruit pods of *Theobroma cacao* {1}, *Xylotheca kraussiana* {1}, decorticated log of indet. angiosperm {1}, corticated indet. woody plant {1}, on 1 mm deep strongly decayed wood {2}, or bark {1}, ungreyed but partly darkened, no algae. **Associated**: *Orbilia auricolor* {1}. **Desiccation tolerance**: unknown, possibly intolerant. **Altitude**: 15–500 m a.s.l. **Phenology**: XI, I, VI (tropical belt, possibly throughout the year).

Taxonomic remarks. *Orbilia tenuissima* was so far only be studied in the dead state. As in the former taxa (*O. oxyspora*, *O. dorsalis*, O. *clavispora*, *O. desertorum*), *O. tenuissima* possesses marginal cortical cells arranged in more or less free and distinct, hair-like rows oriented at a low to medium angle to the surface and tipped by short glassy processes, both causing the denticulate margin. *O. tenuissima* deviates from these four taxa in rather small asci and narrow ascospores, from *O. desertorum* also in presumably desiccation-sensitive apothecia. The rather thin apothecia of *O. tenuissima* are remarkable in usually showing a yellowish-cream to chlorinaceous colour.

O. auricolor (series *Arthrobotrys*) differs in lacking cell rows and in tending to larger asci and spores. However,

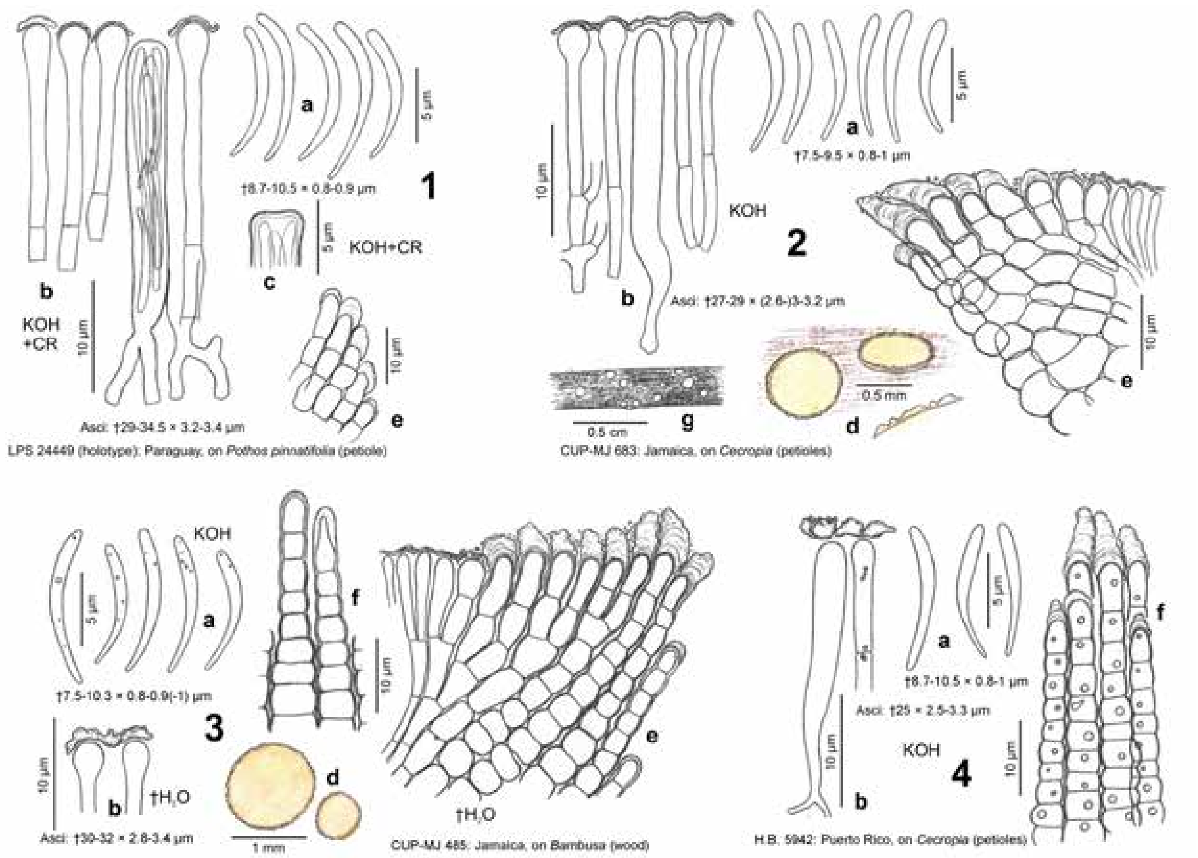


Plate 946. **1–4**: *Orbilia tenuissima*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apex; **d**. rehydrated apothecia with dentate margin (closeup in **d**); **e**. marginal ectal excipulum with cell rows in median section; **f**. cell rows in surface view; **g**. petiole with apothecia.

the presence of cell rows was verified in a species of series *Arthrobotrys*, *O. javanica*, although morphological data of the teleomorph are sparse in the description of Liu (2006: 51, as *O. auricolor*, Pl. 959). No conidia were found in the examined collections of *O. tenuissima*, but an undocumented culture obtained in that from Puerto Rico and a sequence from a somewhat insufficiently studied south Chinese sample (HMAS 139520, Liu 2006: 112, Liu et al. 2007a, no data provided on the margin except for fine teeth) suggest its relationship with series *Arthrobotrys* (see below).

Variation. *O. tenuissima* appears to be a fairly constant species. Only the length of the marginal teeth and the distinctness of the cell rows was found to vary somewhat, even within a collection, resulting in variation from an indistinctly rough to distinctly denticulate margin.

Type studies. Spegazzini (1888) described *O. tenuissima* with pale amber-coloured, very thin, smooth apothecia 0.5–1 mm diam., asci 30 × 3–4 µm, and curved, cylindric-fusoid spores 8–11 × 0.5–1 µm. The holotype bears a microscopical sketch which fits very well the protologue and the data here evaluated from the type (Pl. 946: 1). Dennis (1954: 296, fig. 6F) briefly revised this material (see Fig. 159: F). Later, Dennis (1960b: 440, 1970: 352) referred a collection on *Espeletia spicata* from Venezuela (Sierra de Santo Domingo, S of Mucubaji, Edo. Merida, 5.VII.1958) to *O. tenuissima*.

Reid et al. (1981: 856) tentatively referred to *O. tenuissima* a collection from Galapagos Islands (Santa Cruz, near *Hypoxylon* sp. on bark and wood of a trunk of *Scalesia*, *Asteraceae*, without description), which was said to differ in shorter spores (6–8 × 0.5–1 µm). The unpublished herbarium name *O. prasina* for a collection on *Cecropia peltata* from Jamaica at K was compared with *O. fimicoloides* by Webster et al. (1998) and appears to represent *O. tenuissima* (B. Spooner pers. comm.), all the more as from the same country and substrate a more recent collection was restudied here (Pl. 946: 2).

Not included collections. A specimen from Tenerife (on wood of *Laurus*) was misidentified as *O. auricolor* by Korf (1992) and also by one of us (H.B.) when restudied in 1994. It fits *O. tenuissima* in its excipular structure of the margin and its narrow ascospores [†(9–)10.5–12(–12.7) × 0.9–1 µm in situ], according to a recent reexamination by L. Quijada (Quijada et al. 2016). Yet, it differs in rather long asci [†33–40 × (2.5–)3–3.5 µm], extraordinarily long spores, and thicker apothecia (150–160 µm), therefore, is not included in the description.

Liu (2006: 112) and Liu et al. (2007a) referred to *O. tenuissima* a collection from Hainan (tropical China), which deviates in larger asci and wider paraphyses: apothecia 0.5–2 mm diam., straw-yellow, with finely denticulate margin, asci †40–42 × 3.7–4 µm [but 35–40(–46?) × 3.5–4 µm according to scale], spores *9.2–12 × 0.9–1.2 µm, with globose SBs 0.5–0.8 µm diam., paraphyses †2–2.5 µm wide, with †4–5.5 µm wide, strongly capitate apex. It is not included in the scope of *O. tenuissima* here, mainly because clear evidence about marginal cell rows is missing and its DNA data refer it to series *Arthrobotrys*.

Anamorph. In an ascospore isolate of PR 11 an arthrobotrys-like anamorph was obtained by D.H. Pfister, but details of its morphology were apparently not documented and the culture does not exist anymore (Quijada et al. 2020).

Phylogeny. In the phylogenetic analysis of the ITS region by Liu et al. (2006a) the collection from Hainan (B.L. 271),

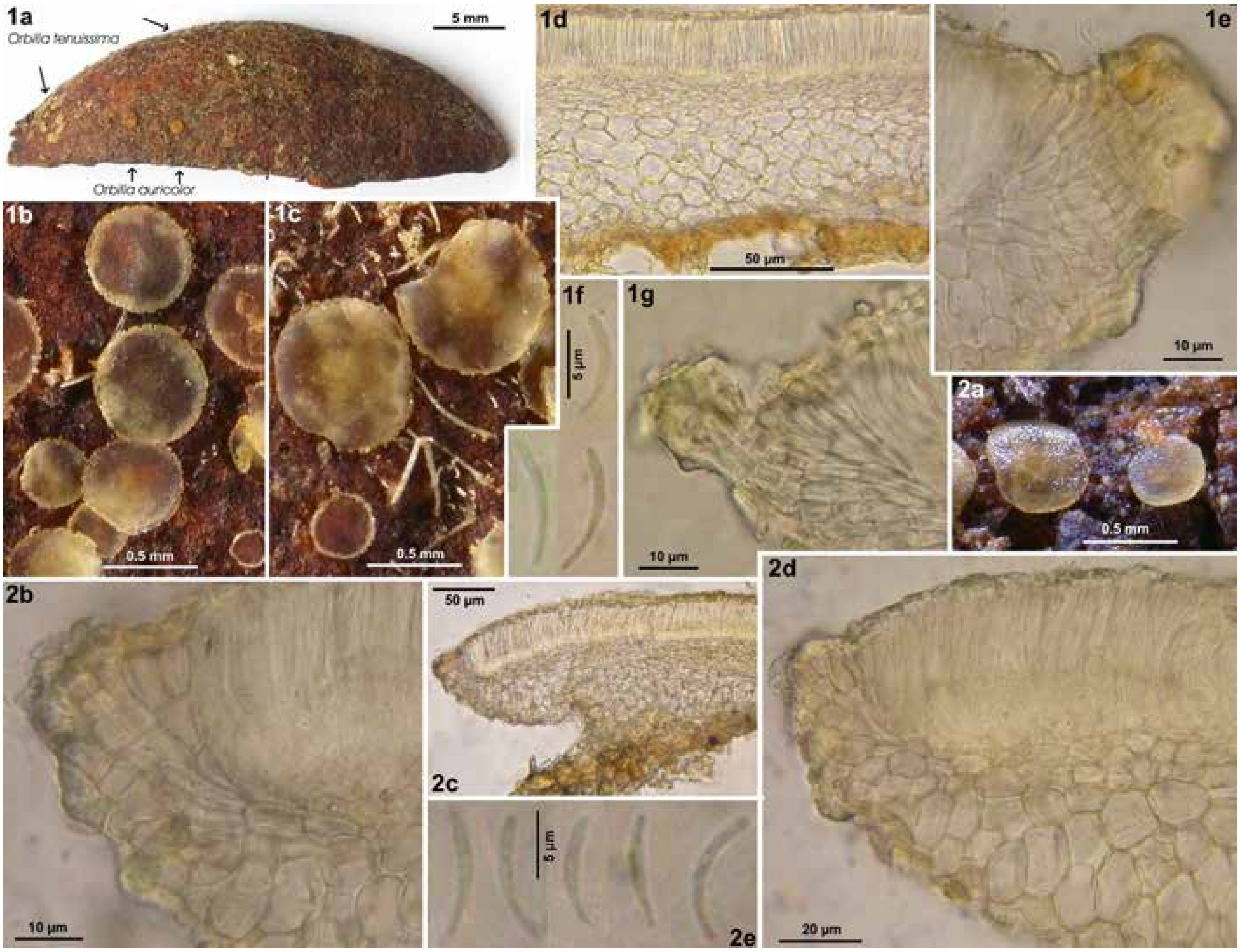


Plate 947. **1–2**. *Orbilia tenuissima*. – **1a**. outer surface of fruit pod; **1b–c**, **2a**. rehydrated apothecia (**1b–c** after 16 years, **2a** after 2 months); **2c**. apothecium in median section; **1d**. id., central part of apothecium; **1e**, **g**, **2b**, **d**. id., ectal excipulum at flanks and margin; **1f**, **2e**. ascospores. – Dead state (in KOH, except for **1d**: in H_2O). — **1a–g**. H.B. 5768b: South Africa, Durban, on *Xylotheca*; **2a–e**. H.B. 8414: Antilles, Guadeloupe, on indet. angiosperm.

from which only ITS was available (presence of S1506 intron uncertain), clustered in series *Arthrobotrys* near a strain identified by B. Liu as '*O. auricolor*' (with '*A. oligosporus*' as anamorph, B.L. 6225, Liu et al. 2006a). Also in our analysis it falls in *Arthrobotrys*, though rather unresolved and with high distance (min. 8 %) to other strains. This raises the question whether the Chinese strain actually represents *O. tenuissima*, or *O. tenuissima* as circumscribed here is better placed in series *Arthrobotrys*. Regrettably, no sequences of any of the specimens here included in *O. tenuissima* were available.

Map 153. Known distribution of *O. tenuissima* in Middle America.

An inofficial sequence from an unillustrated sample from Thailand (ITS, LSU, S1506 intron absent) formed with an ITS distance of 3.1 % a highly supported clade with B.L. 271 (Phyl. 28). It was at first confused by A.H. Ekanayaka (pers. comm.) with a documented sample of a *Hyalorbilia* (MFLU 15-0167), the trustworthy sequence of which clustered with *H. arcuata* (see there). Possibly both strains derive from the same piece of substrate and were mistaken as a single species. In our LSU analysis (Phyl. S32) the sequence of the unillustrated population clustered unsupported with *A. polycephalus*, and in the combined analysis (Phyl. S33) unsupported with *A. pyriformis*.

Ecology. *O. tenuissima* is apparently restricted to the (sub) tropical belt. Specimens are known from tropical humid rainforests in Middle America and a subtropical humid (± winter-dry) forests in South America and southeastern Africa. The not included collections were from the tropical humid (winter-dry) Hainan island in southernmost China and a mesomediterranean humid laurel forest in Tenerife (Macaronesia).

O. tenuissima is a polyphagous species that grows on hygric, slightly to medium decayed culms, leaves and fruits, but also strongly decayed wood and bark of trees. The hosts include various families of monocotyledons, such as *Poaceae* (*Bambus*) and *Araceae* (*Epipremnum*), and dicotyledons, such as *Urticaceae* (*Cecropia*), *Malvaceae* (*Theobroma*), and *Achariaceae* (*Xylotheca*).

Specimens included. **JAMAICA**: **Cornwall**, **Hanover**, ~6 km NNE of Grange Hill, Dolphin's Head, ?300 m, petioles of *Cecropia*, 22.I.1971, R.P. Korf et al. (CUP-MJ-000683, H.B. 5864 ø). – **Surrey**, **St**. **Thomas**, Morant Bay, above Bath Fountain Hotel, along Sulphur River, 170 m, stems of *Bambusa*, 14.I.1971, R.P. Korf et al. (CUP-MJ-000485; H.B. 5865 ø). — **PUERTO RICO**: 30 km ESE of St. Juan, El Yunque, Rio Grande, El Verde Field Station, 15 m, petioles of *Cecropia*, 16.I.1996, D.H. Pfister, F.A. Harrington & D.J. Lodge (D.H.P. PR 11, FH 00304902, anam. cult., H.B. 5942 ø). — **LESSER ANTILLES**: **Guadeloupe**, 3.5 km SW of Petit Bourg, Le Bois de Sergent, ~140 m, wood of indet. angiosperm, 23.XI.2006, C. Lechat (C.L.L. 6011(3), H.B. 8414). – **Dominica**, St. Paul, ~4 km NE of Roseau, Cochrane Estate, 500 m, fruit pods of *Theobroma cacao*, 28.VI.1970, R.P. Korf et al. (CUP-DO-000263). — **PARAGUAY**: **Paraguarí**, 35 km SE of Fernando de la Mora, Guarapi (today Yaguaron), leaves of *Epipremnum pinnatum* (as *Pothos pinnatifida*), on petioles, IX.1883, B. Balansa (LPS 24449, **holotype** of *O. tenuissima*; H.B. 6946 ø). — **SOUTH AFRICA**: **KwaZulu-Natal**, 20 km NW of Durban, 2.5 km E of Kloof, Kranskloof, near Molweni river, NW-exposed slope S of gorge, 400 m, fruit pods of *Xylotheca kraussiana*, 18.III.1990, D. Triebel & G. Rambold (G.R. 7216A, M-0229708, H.B. 5768b).

Not included. **CHINA**: **Hainan**, ~50 km N of Sanya, Wuzhishan, 900 m, bark of indet. tree, 14.XII.2003, B. Liu et al. (B.L. 271, HMAS 139520, doc. vid.; sq.: DQ656612). — **THAILAND**: **Northern Thailand**, **Chiang Rai**, Mae Fah Luang University, ~460 m, indet. tree, on ?bark, ?15.I.2015, A.H. Ekanayaka (unnumbered, non vid., sq.: ined.). — **MACARONESIA**: **Canary Islands**, **Tenerife**, Anaga, Monte de las Mercedes, ?800 m, on wood of *Laurus novocanariensis*, 12.IV.1972, F.E. Eckblad (CUP-MM-001132 [duplicate in O], as *O. auricolor*).

Species without known teleomorph

'Dactylellina' multiseptata (H.Y. Su & K.Q. Zhang) Z.F. Yu, in Zhang & Hyde (eds), Nematode-trapping Fungi: 155 (2014) — Pl. 9: f

'Dactylellina' varietas Yan Li, K.D. Hyde & K.Q. Zhang, in Li, Jeewon, Hyde, Mo & Zhang, Mycol. Res. 110(7): 792 (2006) — Pl. 9: a

These two species have been ascribed to the genus *Dactylellina* because upon contact with nematodes they formed stalked adhesive knobs in pure culture, '*D.*' *varietas* also non-constricting rings. However, when comparing those 3 positions in the 5.8S, ITS2, and LSU at which series *Neodactylella* and *Dactylellina* differ (Tab. 76), the two ex-type strains clearly belong to *Neodactylella*. This finding could be interpreted as a molecular exception. Yet, also in our phylogenetic analysis of the entire ITS region the two species clustered strongly supported with species of *Neodactylella*: '*D.*' *varietas* with *Dactylella qiluensis* (*heptameres-qiluensis* subclade), and '*D.*' *multiseptata* forms with *Dactylella intermedia* (Phyl. 26) another subclade of the *oxyspora-heptameres* clade. Also in the analysis of the S1506 intron (S30) '*D.*' *varietas* clustered strongly supported in this clade, and in the LSU (S31) '*D.*' *multiseptata* clustered again strongly supported with *Dactylella intermedia*. Even the only 20 nt short fragment of the intron in '*D.*' *multiseptata* permits this conclusion because it fits exactly and exclusively the intron of *O. oxyspora* of series *Neodactylella*.

Also in Li et al.'s (2006) phylogenetic analyses of ITS, LSU, or *TUBB*, the two nematode-trapping taxa clustered in the *Dactylella* clade. With their elongate-fusiform conidia without a markedly larger middle cell and their simple conidiophores these species would actually fit the various taxa of *Neodactylella* with fusiform conidia, which also *Dactylella qiluensis* and *D. intermedia* have. We suspect that the mismatch between trapping organs and phylogeny originated from some confusion in the laboratory. A Chinese strain (YMF 1.00566) misidentified as *Dactylella atractoides* (= *O. oxyspora*) belongs to '*D.*' *varietas*, differing from the type by only 2 nt and 2 gaps in the ITS and 2 nt and 1 gap (besides differences at the incomplete 5'-end) in the S1506 intron.

The conidia of ***Orbilia dehongensis*** M. Qiao & Z.F. Yu nom. prov. (Zhang et al. ined., Yunnan, Dehong, forest soil, 10.XII.2012, Y. L. Bai, YMF 1.03609), which also clusters in the *heptameres-qiluensis* subclade (Phy. 27), tend to have a distinctly larger central cell, reminiscent of species of series *Dactylellina*. No teleomorph is known in any members of the *heptameres-qiluensis* and *intermedia-multiseptata* subclades.

Series *Arthrobotrys*

Orbilia subgenus ***Orbilia*** section ***Arthrobotrys*** series ***Arthrobotrys*** – Type species: *A. superbus* Corda [= *Orbilia* ?*auricolor* (A. Bloxam) Sacc.]

= *Monacrosporium* Oudem., Ned. Kruidk. Arch., Ser. 2,4: 250 (1885) – Lectotype species: *M. elegans* Oudem. [≡ *Orbilia elegans* (Oudem.) Baral et al.], designated by Clements & Shear (1931)

= *Orbiliella* Kirschst., Ann. Mycol. 36: 374 (1938) — Type species: *Orbiliella armeniaca* Kirschst. (= *Orbilia auriolor*)

= *Didymozoophaga* Soprunov & Galiulina, Mikrobiologiya 20: 493 (1951), nom. inval., ICN Art. 39.1 (Latin diagnosis missing), nom. illegit., ICN Art. 52.1 (nomenclaturally superfluous) – Lectotype species: *Arthrobotrys oligosporus* Fresen., designated by Schenck et al. (1977)

= *Candelabrella* Rifai & R.C. Cooke, Trans. Br. Mycol. Soc. 49(1): 160 (1966) – Type species: *C. javanica* Rifai & R. C. Cooke [≡ *Arthrobotrys javanicus* (Rifai & R.C. Cooke) Jarow.]

= *Duddingtonia* R.C. Cooke, Trans. Br. Mycol. Soc. 53: 316 (1969) – Type species: *Trichothecium flagrans* Dudd. [≡ *Arthrobotrys flagrans* (Dudd.) Mekht.]

= *Geniculifera* Rifai, Mycotaxon 2: 214 (1975) – Type species: *Trichothecium cystosporium* Dudd. [≡ *Arthrobotrys cystosporius* (Dudd.) Sidorova et al.]

≡ *Genicularia* Rifai & R.C. Cooke, Trans. Br. Mycol. Soc. 49: 153 (1966), nom. illegit., ICN Art. 53.1 (non *Genicularia* Rouss. 1806)

= *Nematophagus* Mekht., Mikol. Fitopatol. 9(2): 250 (1975) – Type species: *N. azerbaijanicus* Mekht. [≡ *Arthrobotrys azerbaijanicus* (Mekht.) Van Oorschot]

= *Monacrosporiella* Subram., Kavaka 5: 94 (1978, '1977') – Type species: *Dactylella megalospora* Drechsler [≡ *Arthrobotrys megalosporus* (Drechsler) M. Scholler et al.]

= *Woroninula* Mekht., Khishchnye Nematofagovye Griby – Gifomitsety: 109 (1979) – Type species: *Dactylella polycephala* Drechsler [≡ *Arthrobotrys polycephalus* (Drechsler) Rifai]

= *Roigiella* R.F. Castañeda, Revta Jardín bot. Nac., Univ. Habana 5(1): 62 (1984) – Type species: *R. lignicola* R.F. Castañeda (= *Arthrobotrys* sp. fide Seifert et al. 2011)

Etymology: *Arthrobotrys*: after the conidia formed in clusters and the chain-like arrangement of these clusters along the proliferating conidiophore; *Candelabrella*: used for species with pronounced denticles in a candelabrum-like terminal arrangement; *Didymozoophaga*: referring to the 2-celled conidia and the ability to trap nematodes; *Duddingtonia*: named after the British mycologist C.L. Duddington; *Genicularia* and *Geniculifera*: referring to the geniculate conidiophore apex; *Monacrosporiella* and *Monacrosporium*: based on conidiophores that produce a single acrogenous conidium; *Nematophagus*: referring to the ability to trap nematodes; *Orbiliella*: diminutive of *Orbilia*; *Woroninula*: named after the Russian botanist M.S. Woronin; *Roigiella*: named after the Cuban botanist J.T. Roig Mesa.

Emended diagnosis: **TELEOMORPH**: Apothecia with smooth or finely crenulate margin, desiccation-sensitive or slightly -tolerant. Ascospores subulate, gently to strongly curved; spore bodies globose to rod-shaped, never distinctly eccentrical. — **ANAMORPH**: Conidiogenous loci singly at apex of unbranched (acrogenous) or branched conidiophores (geniculate), or on prominent denticles (candelabrelloid) or indistinct nodules (arthrobotryoid). Conidia

0–4(–13)-septate, straight, exceptionally branched, microconidia present or absent. Forming 3-dimensional adhesive networks.

Description: — **TELEOMORPH**: **Apothecia** hydrated (0.3–)0.5–2(–5.5) mm diam., whitish to pale or light cream, yellow-orange or yellow-brown, margin smooth or sometimes finely crenulate, sessile or with a short and wide stipe. **Asci** *(30–)37–60 × 3.3–4.5 µm, 8-spored, lower (2–)3–5(–6) spores inverted; **apex** (†) slightly to strongly truncate, not or sometimes slightly indented, laterally not or rarely distinctly inflated; **base** often partly H-shaped. **Ascospores** *(6–)8–13(–15) × 1–1.4(–1.5) µm, subcylindric- to fusoid-clavate (subulate), apex rounded or sometimes subacute, base attenuated or sometimes with a distinct tail, slightly to usually ± strongly curved (falcate), rarely subglobose, *2.2–2.6 × 1.8–1.9 µm; **SBs** never distinctly eccentrical, (1–)1.5–2.5(–3) × 0.2–1 µm, globose, ellipsoid, tear-shaped or subulate to rod-shaped, apically narrowed to a small point, usually with a very fine filum, apically affixed to spore wall. **Paraphyses** (not or) slightly to medium (rarely strongly) inflated at apex, capitate(-clavate), also ellipsoid or lanceolate, terminal cells 2–5(–6)× longer than lower cells, lower cells 4–9(–11) µm long. **Ectal excipulum** of (†) thin-walled to slightly (to medium) gelatinized, vertically oriented t. globulosa-angularis(-prismatica) from base to margin, cells *(10–)15–40(–50)((–85)) × (8–)12–30(–35)((–48)) µm, at margin oriented at (40–)60–90°, rarely of t. prismatica at 0° (*O. javanica*); **glassy processes** absent or 0.5–8 µm long (rarely 8–30 µm: *O.* aff. *menageshae*). **SCBs** globose; **VBs** absent or low-refractive, hyaline. **Exudate** absent or (0.1–)0.3–2(–4) µm thick, continuous-granular to cloddy or cap-like, loosely to firmly attached, hyaline or pale yellowish. **— ANAMORPH**: arthrobotrys-like. **Conidiophores** *(75–)150–400(–600) × 3.5–9 µm, apically 2.5–4.5(–6.5) µm, conidia formed singly at the unbranched tip or sympodially (geniculate, candelabrelloid, or arthrobotryoid), conidia often in ± large clusters, partly several clusters at each conidiophore, either by apical branching or through proliferation by forming up to 10 nodes in a chain at intervals. **Conidia** *(11–)16–60(–86) × (3–)5–23(–26) µm, cylindric-ellipsoid to obpyriform-obovoid or clavate, also fusoid to top-shaped, with 0–4 septa, mostly with inflated cell when 2–4-septate; rarely 4–13-septate and partly apically branched; straight, rarely slightly curved; **conidial dimorphism** sometimes present (sharply differentiated or not). **Trapping organs**: adhesive, usually 3-dimensional networks, traps mainly formed when nematodes are present.

Habitat: on hygric or sometimes semiaquatic or mesic wood and bark (rarely fruits) of angiosperms (rarely gymnosperms), herbaceous stems (rarely leaves) of mono- and dicotyledonous plants, rarely fungicolous or on dung, isolated also from rhizosphere of herbs, capturing nematodes, temperate to tropical, humid to semihumid, perhaps also semiarid (?irrigated), desiccation-sensitive or sometimes slightly desiccation-tolerant.

Recognized species: 32 (19 of them without known teleomorph), plus ~7 unnamed species ('affinis') and 1 species of uncertain affinity; for further ~27 species see Tab. S7.

Taxonomic remarks. Members of series *Arthrobotrys* can hardly be recognized by the teleomorph as belonging to this series. Characteristic features are the narrow, subulate, slightly to strongly curved (falcate), apically rounded and basally tapered ascospores with small apical SBs (the connection of a teleomorph with subglobose ascospores to *A. nonseptatus* requires confirmation), a marginal ectal excipulum made up of cells oriented at a rather high angle to the surface (exception: *O. javanica*), and a smooth apothecial margin. This combination of characters is, however, also found in some species of series *Neodactylella* and *Dactylellina*.

In the present study, anamorph-teleomorph connections are accepted for 12 species of series *Arthrobotrys* (excluding the somewhat uncertain *A. nonseptatus*). Three of them can be recognized by their teleomorph: *O. blumenaviensis* by lanceolate paraphyses, *O. javanica* by a textura porrecta at the margin, and *O. latispora* s.l. by ascospores with rather abrupt tails. The remaning species (*O. auricolor*, *O. cladodes*, *O. elegans*, *O. menageshae*, *O. multiformis*, *A. musiformis*, *O. oligospora*, *O.* aff. *oligospora*, *O. scaphoides*) hardly show any reliable characteristics in their teleomorph, according to our investigations and those of Pfister (1994), Pfister & Liftik (1995), Webster et al. (1998), Mo et al. (2005a), Liu (2006: 49), H.Y. Su (ined.), and Z.F. Yu et al. (ined.). In these species the teleomorphs currently have been identified as *O. auricolor*, with the understanding that this morph represents an aggregate of rather uniform morphology but more or less diverse anamorphs in regard to their conidiophore types and conidial shapes.

O. terrestris is the only species with a known teleomorph treated here in series *Arthrobotrys*, for which an anamorph is unknown. We assume its relationship in this series because of morphological similarities to *O. auricolor*.

Anamorph (see also p. 216–217 and Tab. S7). Members of series *Arthrobotrys* are characterized by adhesive networks with a comparatively uniform morphology (see p. 118). These trapping devices are usually only observed in pure culture, particularly in the presence of nematodes, but probably also occur on the plant substrate, although they have never been observed in vicinity of apothecia during our study. Anamorphs with adhesive networks are referred to as arthrobotrys-like here.

The conidia are often formed in fascicles (clusters) at the tip of the conidiophore or, in addition, at intercalary position by forming clusters (whorls) in a chain. In other taxa the conidia are formed singly or 2–3 at the conidiophore tip. Four different main types of conidiophores can be distinguished in regard to conidiogenesis (see also p. 110): (1) conidia are formed singly at the tip (acrogenous), (2) conidia are formed on ± long apical branches (geniculate), (3) conidia are formed on short, ± aggregated denticles (candelabrelloid), (4) conidia are formed on nodules or very short denticles on often swollen, terminal or intercalary nodes (arthrobotryoid). The first two types are often found within a single species, and also the third is not sharply separated from the second. In the species treated here these types occur as follows: *O. menageshae* (acrogenous); *O. elegans*, *O. multiformis* (acrogenous and geniculate); *O. javanica* (candelabrelloid); *O. auricolor*, *O. blumenaviensis*, *O. latispora*, *A. nonseptatus*, *O. scaphoides* (arthrobotryoid).

Various further species are only known from their anamorph. One of them, *A. flagrans*, represents an aberrant type in which the 1-septate conidia are formed in small groups on non-protruding scars at the unbranched unswollen conidiophore tip, which is why they appear as rather broadly sessile (Duddington 1950, Cooke 1969, Rubner 1996: fig. 2f; see also Fig. 103: n). Because of this peculiarity the species has been placed in a separate genus *Duddingtonia*. It is considered here as belonging to series *Arthrobotrys* because it clusters in phylogenetic analyses with high support in a clade with *O. oligospora*.

In several species two different types of conidia are formed, macro- and microconidia. Macroconidial morphology comprises a series of different, species-specific shapes: cylindric-ellipsoid, pear-shaped, fusiform, and top-shaped. Usually the macroconidia are straight and unbranched, but in some species they are slightly curved and in *O. multiformis* partly branched (trinacrium-like). The number of septa varies between 1 and 2–4, rarely 0 or up to 13. Microconidia are cylindric-ellipsoid and 0–1(–2)-septate. Sometimes, a more or less pronounced variability in conidial

Table 80. Synonymies within series *Arthrobotrys* found by rDNA sequence similarity or (in *Orbilia blumenaviensis* and *O. fici*) by morphological reexamination, with indication of the year of the basionym. ^{T} = type material or ex-type strain, ^{ET} = ex-epitype strain, ^{TT} = ex-topotype strain.

Accepted name	Synonyms
A. ellipsosporus 1984^{T}	?*A. straminicola* 1948, ?*A. stilbaceus* 1958, ?*A. anomalus* 1972, ?*Roigiella lignicola* 1984^{T}, *A. dendroides* 1985^{T}
A. janus 2003^{T}	*A. rutgeriensis* 1968$^{TT?}$ nom. inval., *A. pseudoclavatus* 2003^{T}
O. multiformis 1984^{T}	*A. iridis* 1992^{T}, *Dactylella ramiformis* 1993^{T}, *A. yunnanensis* 2005^{T}
A. oligosporus 1850^{ET}	*A. robustus* 1952^{T}
A. reticulatus 1950^{T}	*A. xiangyunensis* 2014^{T}, ?*A. megalosporus* 1954
A. thaumasius 1937^{T}	?*A. microscaphoides* 1993, *A. sinensis* 1994^{T}, ?*A. indicus* 1994, *A. multisecundarius* 2006^{T}
O. blumenaviensis 1902^{T}	*O. fici* 1958^{T}, *A. vermicola* 1966^{T}, *A. guizhouensis* 1994

size is observed within an isolate, the conidia varying gradually in size and/or shape, without a sharp limit between macro- and microconidia.

In many species only macroconidia are known, and in some others it seems that only microconidia have been observed. In one such strain which missed the characteristic macroconidia, molecular data demonstrated conspecificity with other strains which formed both conidial types: In the ex-type strains of *A. iridis*, *A. multiformis*, and *Dactylella ramiformis* large, multiseptate macroconidia and small, 0–1-septate, cylindric-clavate microconidia were reported, whereas in that of *A. yunnanensis* only small microconidia occurred. Based on identical ITS sequences in GenBank we have united all four taxa under the name *O. multiformis*, assuming that also *A. yunnanensis* is able to produce macroconidia.

Species delimitation. The morphology-based taxonomy of anamorphs within series *Arthrobotrys* is rather confusing. A vast number of species have been described in the literature, some of which are so similar that they are difficult to distinguish by their morphology, e.g., *A. superbus* and *A. cladodes*. Yu et al. (2014) listed a total of 53 accepted species. For most of them the connection to a teleomorph is as yet unknown. Species might exist that have lost the capacity to form a teleomorph, but we rather suppose that their teleomorph only awaits to be discovered. Because of the high diversity and often difficult species concepts we dispensed with a compilation of *Arthrobotrys* in the History of anamorph genera (see p. 216).

For a large number of isolates of various taxa of series *Arthrobotrys* molecular data were available in GenBank and other databases. Their analysis suggests that some of them represent synonyms and others are misidentified. Tab. 80 lists the synonymies that we observed based on sequence data originating either from the ex-type strain or from isolates being later considered to be conspecific with the type. These synonymies usually concur with a similar morphology of conidia and conidiophores, except for taxa which were described solely by their microconidial states (*A. pseudoclavatus*, *A. yunnanensis*) and were found to represent synonyms of their macroconidial states (*A. janus* and *A. multiformis*, respectively).

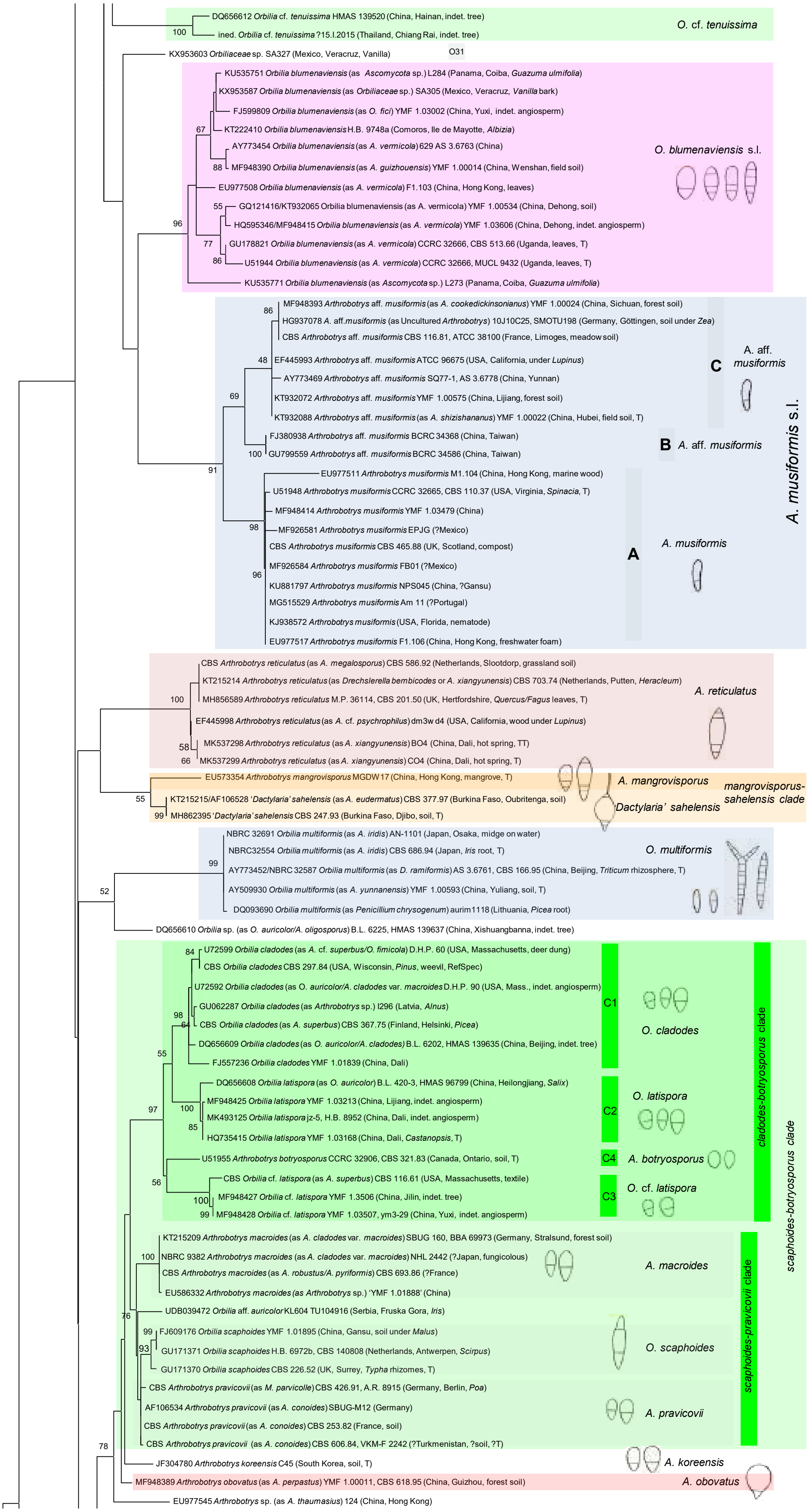
It appears that many of these synonyms are reported here for the first time, except for *A. multisecundarius* which was considered as a synonym of *A. microscaphoides* by Li et al. (2008) based on DNA data, and *Dactylella ramiformis* and *D. iridis* which were synonymised for morphological reasons under *A. multiformis* by Yu et al. (2014).

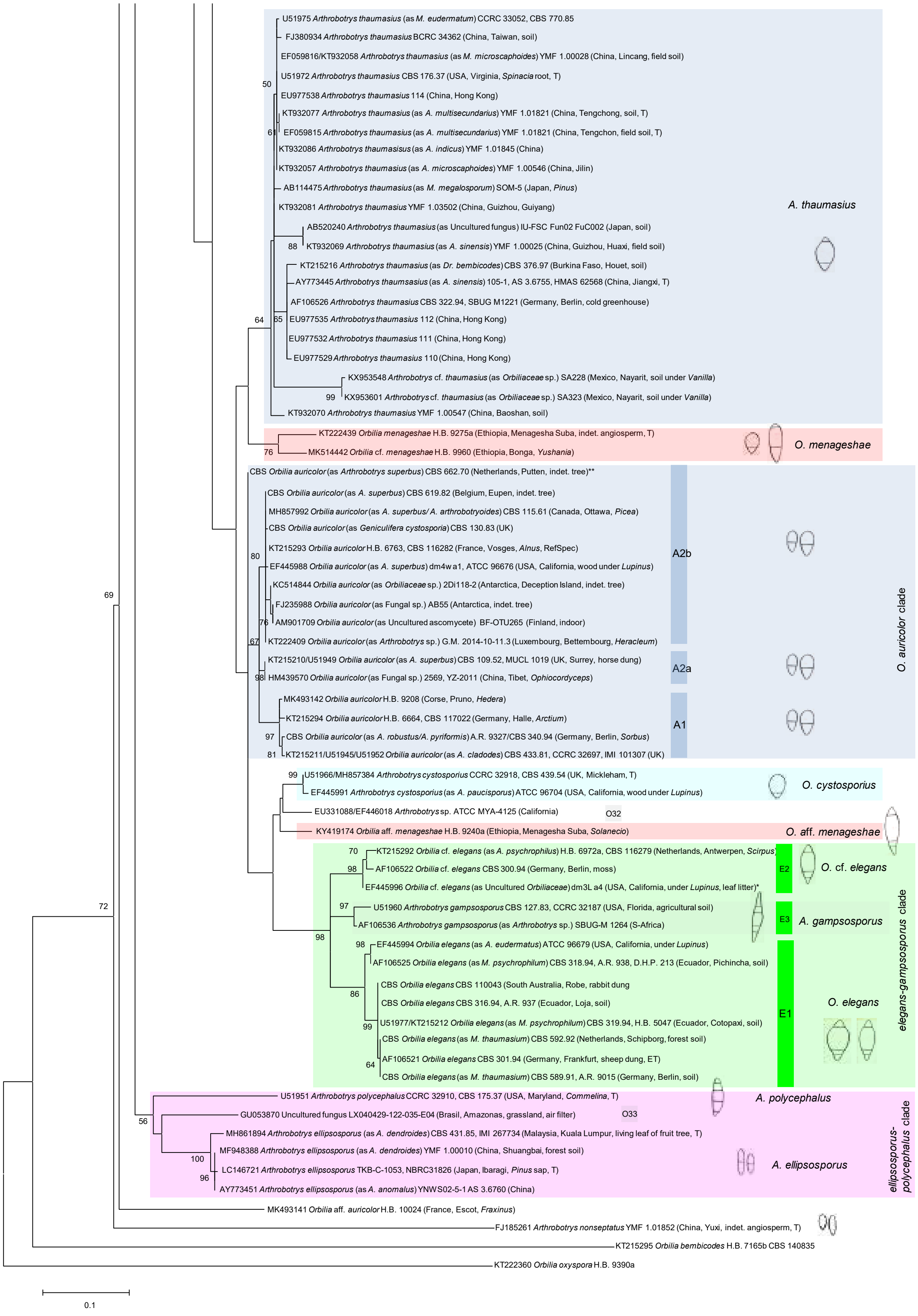
In addition to these synonymies, various misidentified strains exist in GenBank, which underline the limited taxonomic value of conidial morphology in series *Arthrobotrys*. Examples of the high confusion and doubtful identities in DNA databases are given under the respective species. On the other hand, the high molecular variation in the available ITS sequences observed at present in some species of series *Arthrobotrys* exceeds the currently accepted limits, and questions species concepts based on molecular data. For instance, *A. psychrophilus* is considered here as synonymous with *O. elegans* (≡ *A. oudemansii*) despite a 4.5% ITS distance based on the few available sequences. Likewise, the numerous sequences of *A. oligosporus* form different clades and subclades, which would permit splitting into at least three different cryptic species. From its molecular data, also *O. auricolor* exhibits a high diversity with several very distant clades, which will necessitate to split the morphologically rather homogeneous taxon into two different species. We here refrain from doing so because of the paucity of available molecular data and frequently absent data of its anamorph. Also *O. blumenaviensis*, *O. conoides*, *A. janus*, *O. latispora*, *O. menageshae*, *O. oligospora*, and *A. thaumasius* show strong molecular intraspecific variation which seems to indicate that in some of these taxa different species are involved. Other species show rather consistent ITS data (*O. multiformis*, *A. flagrans*). Irrespective of their molecular variation, the above-mentioned taxa are morphologically more or less homogeneous or show only gradual variation in conidial shape, except for *O. blumenaviensis* and *O. menageshae*, in which 1–2-septate clavate and 2–3-septate fusoid conidia occur, sometimes within a given strain.

Phylogeny. Within series *Arthrobotrys* a rather high number of clades that represent different species are observed in our ML analyses. The backbone phylogeny was generally not supported, however, and only a few clades which comprise clearly more than one species received support. In our combined analyses (Phyls 25 and S33) four groups were medium to mostly strongly supported: (1) the *scaphoides-botryosporus* clade which also includes *O. cladodes* (C1), *O. latispora* (C2+C3), *A. pravicovii*, and *A. macroides*; (2) the *mangrovisporus-sahelensis* clade; (3) the *elegans-gampsosporus* clade; (4) the *ellipsosporus-polycephalus* clade (in Phyl. 25 only weakly supported). The *oligospora-musiformis* clade with *A. amerosporus*, *A. conoides*, *A. flagrans*, *A. javanicus*, *A. musiformis*, and *O. oligospora* received medium support only in S33. In the LSU no medium or strongly supported clades with more than one species were observed, except for the *mangrovisporus-sahelensis* clade (S32).

Most of these clades were also obtained by Hagedorn & Scholler (1999: fig. 2, ITS, NJ) with high or medium support: the *elegans-gampsosporus* clade, the *scaphoides-botryosporus* clade, represented here by *A.* '*conoides*' (= *A. pravicovii*), *A. botryosporus*, and *O. cladodes* (D.H.P. 60 and 90), the *oligospora-musiformis* clade, still without *O. oligospora* since no ITS was available at that time. Their strongly supported clade with '*Monacrosporium eudermatum*' concerns the *mangrovisporus-sahelensis* clade (CBS 377.97) and *A. janus*


JX244893 Orbilia oligospora ZO 85 (?China)
EU977523 Orbilia oligospora T1.108 (China, Hong Kong, dung)
FJ557237 Orbilia oligospora YMF 1.01837 (China, Xishuangbanna)
EU977563 Orbilia oligospora 128 (China, Hong Kong)
A4
NBRC 102296 Orbilia oligospora (as A. oligosporus var. microsporus) SIS4 (Japan, grassland soil)
A2
EU977558 Orbilia oligospora (as A. superbus) T2.127 (China, Hong Kong, indet. tree)
53
AY773462 Orbilia oligospora 920 (?China)
A3
53
55
EU977505 Orbilia oligospora F1.102 (China, Hong Kong, foam)
NBRC 9436 Orbilia oligospora IFM 4471, NHL 2465 (?Japan, fungicolous)
EU977526 Orbilia oligospora 109 (China, Hong Kong)
KJ938573 Orbilia oligospora (USA, Florida)
KC663623 Orbilia oligospora CENAPA-Mendoza1 (Mexico)
EU977502 Orbilia oligospora 101 (China, Hong Kong)
A1
KC663625 Orbilia oligospora CENAPA-Mendoza3 (Mexico)
MF948413 Arthrobotrys oligosporus YMF 1.03254 (China)
KC663626 Orbilia oligospora CENAPA-Mendoza4 (Mexico)
C2
94
FJ380939 Orbilia oligospora BCRC 34377 (China, Taiwan, soil)
CBS Orbilia oligospora (as A. superbus) CBS 545.90 (Tenerife, soil under banana plantation)
99
AM412778 Orbilia oligospora (?Germany)
86
HQ649929 Orbilia oligospora r251 (Spain, Alicante Inula)
GU799560 Orbilia oligospora BCRC 34588 (China, Taiwan)
C1
O. oligospora
MH855843 Orbilia oligospora CBS 111.37 (USA)
64
MF926586 Orbilia oligospora FM02 (? Mexico)
CBS Orbilia oligospora (as A. robustus/A. pyriformis) CBS 107.51, ATCC 11856 (UK, Surrey, indet. wood, T)
B1
60
78
KY463695 Orbilia oligospora CBS 115.81 ATCC 24927 (Sweden, Skaane, soil, ET)
JQ809337 Orbilia oligospora XAo1 (China, Xinjiang)
EF445989 Arthrobotrys oligosporus ATCC 96709 (USA, California, under Lupinus)
51
AB374287 Orbilia oligospora (Japan, Hokkaido, air)
NBRC 5939 Orbilia oligospora IMI 031994
B2
KT932085 Arthrobotrys flagrans YMF 1.01471 (China)
EF445995/331087 Arthrobotrys flagrans ATCC MYA-4124 (USA, California)
KT215213/AF106520 Arthrobotrys flagrans CBS 583.91 (Germany, Berlin, Camellia greenhouse soil)
CBS Arthrobotrys flagrans CBS 561.92, ATCC 56923 (USA, ?New Jersey)
99
AY095103 Arthrobotrys flagrans NZ48C (New Zealand)
AY095102 Arthrobotrys flagrans NZ144jR (New Zealand)
A. flagrans
U51961/MH856756 Arthrobotrys flagrans CBS 565.50, CCRC 32917 (UK, London, compost, T)
U51947 Orbilia javanica CBS 534.63 (Indonesia, Java, soil, T)
100
DQ656611 Orbilia javanica (as O. auricolor) B.L. 6214, HMAS 139636 (China, Xishuangbanna, indet. tree)
53
EU977514 Orbilia javanica 105 (China, Hong Kong, soil)
99
FJ380932 Orbilia javanica BCRC 34375 (China, Taiwan, humus)
O. javanica
57
AY773455 Arthrobotrys conoides 670 AS 3.6764 (China)
89
KT932055/MF948387 Arthrobotrys conoides YMF 1.00009 (China, Guizhou, Huaxi, field soil)
CBS Arthrobotrys conoides CBS 361.94, A.R. 934 (La Palma, Chavio verde, soil under Rumex)
99
JX912941 Arthrobotrys conoides NBAII (India, soil)
95
JN191309 Arthrobotrys conoides CED (Brazil, Paraná, soil)
A. conoides
EF446014 Arthrobotrys conoides ATCC MYA-4123 (USA, California)*
EF192178 Arthrobotrys amerosporus AA1 (?England, Exeter)
CBS Arthrobotrys amerosporus CBS 435.83, IMI 232238 (Canada, Ontario, garden soil)
KT215208/AF106533 Arthrobotrys amerosporus SBUG-M1257 (Germany, Rostock, compost soil)
CBS Arthrobotrys amerosporus A.R. 9215, CBS 331.94 (Germany, Berlin, cold greenhouse soil)
MH861583 Arthrobotrys amerosporus CBS 268.83, ATCC34468 (USA, New Jersey, Paterson, pot soil, T)
99
CBS Arthrobotrys amerosporus CBS 110396, J.O. Park 4616 (Australia, Nedlands, mulch in banana plantation)
CBS Arthrobotrys amerosporus CBS 267.83, ATCC 36911 (Canada, soil)
A. amerosporus
HQ693519 Arthrobotrys amerosporus (as Uncultured fungus) S41 (Sweden, soil)
FJ380931 Arthrobotrys amerosporus BCRC 34371 (China, Taiwan, soil)
99
EU977541 Arthrobotrys pyriformis IFRD M1.123 (China, Hong Kong)
B
A. pyriformis
AY773450 Arthrobotrys pyriformis YNWS02-3-1 AS 3.6759 (China)
DQ491512 Arthrobotrys sp. (as A. psychrophilus) AFTOL-ID 906, CBS 547.63 (UK, Staffordshire, soil)
KT932056 Arthrobotrys pyriformis YMF 1.00018 (China, Hubei, forest soil)
EU586330 Arthrobotrys pyriformis YMF 1.01884 (as 1.01888) (China)
A
A. pyriformis
84
MF948391 Arthrobotrys pyriformis YMF 1.00020 (China)
AY773459 Arthrobotrys janus 85-1 HMAS 77942 (China, Shandong, T)
AY773446 Arthrobotrys janus (as A. pseudoclavatus) 1130, HMAS 84442 (China, Beijing, Camellia greenhouse soil, T)
AY773465 Arthrobotrys janus (as Monacrosporium sphaeroides) SDT24, CBS 113357 (China, Shanxi, soil)
AY773461 Arthrobotrys janus (as A. thaumasius) 917, AS 3.6769 (China, soil)
61
AF106535 Arthrobotrys janus (as Arthrobotrys sp.) SBUG 1266
O. janus
AF106530 Arthrobotrys janus (as A. rutgeriensis) CBS 769.85, SBUG M1253 (USA, ?New Jersey, ?TT)
61
51
KC663627 Arthrobotrys janus (as A. eudermatus) CENAPA-Mendoza5 (Mexico)
99
KC663624 Arthrobotrys janus (as A. eudermatus) CENAPA-Mendoza2 (Mexico)
96
KT932074 Arthrobotrys janus YMF 1.01312 (China, Shandong, Mixian, field soil)
KT932087 Arthrobotrys janus (as A. eudermatus) YMF 1.00545 (China, Lijiang, soil)
KT932068 Arthrobotrys janus YMF 1.01889 (China)
JX043192 Uncultured fungus C2 EB9 (USA, California, soil under sage scrub)
O29
HM162210 Uncultured Ascomycota 805 (USA, Texas, grass roots)
HM162163 Uncultured Ascomycota 729 (USA, Texas, grass roots)
HM161937 Uncultured Ascomycota 1045 (USA, Texas, grass roots)
O30
99
HM161956 Uncultured Ascomycota 1072 (USA, Texas, grass roots)
HM162137 Uncultured Ascomycota 689 (USA, Texas, grass roots)
HM161981 Uncultured Ascomycota 117 (USA, Texas, grass roots)


DQ656612 *Orbilia* cf. *tenuissima* HMAS 139520 (China, Hainan, indet. tree)
100
ined. *Orbilia* cf. *tenuissima* ?15.I.2015 (Thailand, Chiang Rai, indet. tree)
O. cf. *tenuissima*
KX953603 *Orbiliaceae* sp. SA327 (Mexico, Veracruz, Vanilla)
O31
KU535751 *Orbilia blumenaviensis* (as *Ascomycota* sp.) L284 (Panama, Coiba, *Guazuma ulmifolia*)
KX953587 *Orbilia blumenaviensis* (as *Orbiliaceae* sp.) SA305 (Mexico, Veracruz, *Vanilla* bark)
FJ599809 *Orbilia blumenaviensis* (as *O. fici*) YMF 1.03002 (China, Yuxi, indet. angiosperm)
67
KT222410 *Orbilia blumenaviensis* H.B. 9748a (Comoros, Ile de Mayotte, *Albizia*)
AY773454 *Orbilia blumenaviensis* (as *A. vermicola*) 629 AS 3.6763 (China)
88
MF948390 *Orbilia blumenaviensis* (as *A. guizhouensis*) YMF 1.00014 (China, Wenshan, field soil)
O. blumenaviensis s.l.
EU977508 *Orbilia blumenaviensis* (as *A. vermicola*) F1.103 (China, Hong Kong, leaves)
55
GQ121416/KT932065 Orbilia blumenaviensis (as A. vermicola) YMF 1.00534 (China, Dehong, soil)
96
HQ595346/MF948415 *Orbilia blumenaviensis* (as *A. vermicola*) YMF 1.03606 (China, Dehong, indet. angiosperm)
77
GU178821 *Orbilia blumenaviensis* (as *A. vermicola*) CCRC 32666, CBS 513.66 (Uganda, leaves, T)
86
U51944 *Orbilia blumenaviensis* (as *A. vermicola*) CCRC 32666, MUCL 9432 (Uganda, leaves, T)
KU535771 *Orbilia blumenaviensis* (as *Ascomycota* sp.) L273 (Panama, Coiba, *Guazuma ulmifolia*)
86
MF948393 *Arthrobotrys* aff. *musiformis* (as *A. cookedickinsonianus*) YMF 1.00024 (China, Sichuan, forest soil)
HG937078 *A.* aff. *musiformis* (as Uncultured *Arthrobotrys*) 10J10C25, SMOTU198 (Germany, Göttingen, soil under *Zea*)
CBS *Arthrobotrys* aff. *musiformis* CBS 116.81, ATCC 38100 (France, Limoges, meadow soil)
48
EF445993 *Arthrobotrys* aff. *musiformis* ATCC 96675 (USA, California, under *Lupinus*)
AY773469 *Arthrobotrys* aff. *musiformis* SQ77-1, AS 3.6778 (China, Yunnan)
69
KT932072 *Arthrobotrys* aff. *musiformis* YMF 1.00575 (China, Lijiang, forest soil)
KT932088 *Arthrobotrys* aff. *musiformis* (as *A. shizishananus*) YMF 1.00022 (China, Hubei, field soil, T)
C
A. aff. *musiformis*
FJ380938 *Arthrobotrys* aff. *musiformis* BCRC 34368 (China, Taiwan)
100
GU799559 *Arthrobotrys* aff. *musiformis* BCRC 34586 (China, Taiwan)
B
A. aff. *musiformis*
A. musiformis s.l.
91
EU977511 *Arthrobotrys musiformis* M1.104 (China, Hong Kong, marine wood)
U51948 *Arthrobotrys musiformis* CCRC 32665, CBS 110.37 (USA, Virginia, *Spinacia*, T)
MF948414 *Arthrobotrys musiformis* YMF 1.03479 (China)
98
MF926581 *Arthrobotrys musiformis* EPJG (?Mexico)
CBS *Arthrobotrys musiformis* CBS 465.88 (UK, Scotland, compost)
MF926584 *Arthrobotrys musiformis* FB01 (?Mexico)
96
KU881797 *Arthrobotrys musiformis* NPS045 (China, ?Gansu)
MG515529 *Arthrobotrys musiformis* Am 11 (?Portugal)
KJ938572 *Arthrobotrys musiformis* (USA, Florida, nematode)
EU977517 *Arthrobotrys musiformis* F1.106 (China, Hong Kong, freshwater foam)
A
A. musiformis
CBS *Arthrobotrys reticulatus* (as *A. megalosporus*) CBS 586.92 (Netherlands, Slootdorp, grassland soil)
KT215214 *Arthrobotrys reticulatus* (as *Drechslerella bembicodes* or *A. xiangyunensis*) CBS 703.74 (Netherlands, Putten, *Heracleum*)
100
MH856589 *Arthrobotrys reticulatus* M.P. 36114, CBS 201.50 (UK, Hertfordshire, *Quercus/Fagus* leaves, T)
A. reticulatus
EF445998 *Arthrobotrys reticulatus* (as *A.* cf. *psychrophilus*) dm3w d4 (USA, California, wood under *Lupinus*)
58
MK537298 *Arthrobotrys reticulatus* (as *A. xiangyunensis*) BO4 (China, Dali, hot spring, TT)
66
MK537299 *Arthrobotrys reticulatus* (as *A. xiangyunensis*) CO4 (China, Dali, hot spring, T)
EU573354 *Arthrobotrys mangrovisporus* MGDW17 (China, Hong Kong, mangrove, T)
A. mangrovisporus
mangrovisporus-sahelensis clade
55
KT215215/AF106528 '*Dactylaria*' *sahelensis* (as *A. eudermatus*) CBS 377.97 (Burkina Faso, Oubritenga, soil)
99
MH862395 '*Dactylaria*' *sahelensis* CBS 247.93 (Burkina Faso, Djibo, soil, T)
'*Dactylaria*' *sahelensis*
NBRC 32691 *Orbilia multiformis* (as *A. iridis*) AN-1101 (Japan, Osaka, midge on water)
NBRC32554 *Orbilia multiformis* (as *A. iridis*) CBS 686.94 (Japan, *Iris* root, T)
O. multiformis
99
AY773452/NBRC 32587 *Orbilia multiformis* (as *D. ramiformis*) AS 3.6761, CBS 166.95 (China, Beijing, *Triticum* rhizosphere, T)
52
AY509930 *Orbilia multiformis* (as *A. yunnanensis*) YMF 1.00593 (China, Yuliang, soil, T)
DQ093690 *Orbilia multiformis* (as *Penicillium chrysogenum*) aurim1118 (Lithuania, *Picea* root)
DQ656610 *Orbilia* sp. (as *O. auricolor/A. oligosporus*) B.L. 6225, HMAS 139637 (China, Xishuangbanna, indet. tree)
84
U72599 *Orbilia cladodes* (as *A.* cf. *superbus/O. fimicola*) D.H.P. 60 (USA, Massachusetts, deer dung)
CBS *Orbilia cladodes* CBS 297.84 (USA, Wisconsin, *Pinus*, weevil, RefSpec)
U72592 *Orbilia cladodes* (as O. *auricolor/A. cladodes* var. *macroides* D.H.P. 90 (USA, Mass., indet. angiosperm)
GU062287 *Orbilia cladodes* (as *Arthrobotrys* sp.) I296 (Latvia, *Alnus*)
C1
98
64
CBS *Orbilia cladodes* (as *A. superbus*) CBS 367.75 (Finland, Helsinki, *Picea*)
O. cladodes
55
DQ656609 *Orbilia cladodes* (as *O. auricolor/A. cladodes)* B.L. 6202, HMAS 139635 (China, Beijing, indet. tree)
FJ557236 *Orbilia cladodes* YMF 1.01839 (China, Dali)
DQ656608 *Orbilia latispora* (as *O. auricolor*) B.L. 420-3, HMAS 96799 (China, Heilongjiang, *Salix*)
O. latispora
97
100
MF948425 *Orbilia latispora* YMF 1.03213 (China, Lijiang, indet. angiosperm)
MK493125 *Orbilia latispora* jz-5, H.B. 8952 (China, Dali, indet. angiosperm)
C2
85
HQ735415 *Orbilia latispora* YMF 1.03168 (China, Dali, *Castanopsis*, T)
cladodes-botryosporus clade
U51955 *Arthrobotrys botryosporus* CCRC 32906, CBS 321.83 (Canada, Ontario, soil, T)
C4
A. botryosporus
CBS *Orbilia* cf. *latispora* (as *A. superbus*) CBS 116.61 (USA, Massachusetts, textile)
O. cf. *latispora*
56
100
MF948427 *Orbilia* cf. *latispora* YMF 1.3506 (China, Jilin, indet. tree)
C3
99
MF948428 *Orbilia* cf. *latispora* YMF 1.03507, ym3-29 (China, Yuxi, indet. angiosperm)
scaphoides-botryosporus clade
KT215209 *Arthrobotrys macroides* (as *A. cladodes* var. *macroides*) SBUG 160, BBA 69973 (Germany, Stralsund, forest soil)
100
NBRC 9382 *Arthrobotrys macroides* (as *A. cladodes* var. *macroides*) NHL 2442 (?Japan, fungicolous)
A. macroides
CBS *Arthrobotrys macroides* (as *A. robustus/A. pyriformis*) CBS 693.86 (?France)
EU586332 *Arthrobotrys macroides* *(as Arthrobotrys* sp.) 'YMF 1.01888' (China)
UDB039472 *Orbilia* aff. *auricolor* KL604 TU104916 (Serbia, Fruska Gora, *Iris*)
76
99
FJ609176 *Orbilia scaphoides* YMF 1.01895 (China, Gansu, soil under *Malus*)
93
GU171371 *Orbilia scaphoides* H.B. 6972b, CBS 140808 (Netherlands, Antwerpen, *Scirpus*)
O. scaphoides
scaphoides-pravicovii clade
GU171370 *Orbilia scaphoides* CBS 226.52 (UK, Surrey, *Typha* rhizomes, T)
CBS *Arthrobotrys pravicovii* (as *M. parvicolle*) CBS 426.91, A.R. 8915 (Germany, Berlin, *Poa*)
AF106534 *Arthrobotrys pravicovii* (as *A. conoides*) SBUG-M12 (Germany)
A. pravicovii
CBS *Arthrobotrys pravicovii* (as *A. conoides*) CBS 253.82 (France, soil)
78
CBS *Arthrobotrys pravicovii* (as *A. conoides*) CBS 606.84, VKM-F 2242 (?Turkmenistan, ?soil, ?T)
JF304780 *Arthrobotrys koreensis* C45 (South Korea, soil, T)
A. koreensis
MF948389 *Arthrobotrys obovatus* (as *A. perpastus*) YMF 1.00011, CBS 618.95 (China, Guizhou, forest soil)
A. obovatus
EU977545 *Arthrobotrys* sp. (as *A. thaumasius*) 124 (China, Hong Kong)



Phylogenetic analysis 28. Phylogram of series *Arthrobotrys* inferred from ML analysis of ITS1-5.8S-ITS2 rDNA dataset (225 sequences, 765 positions, aligned with MUSCLE) using the GTR+G+I model in MEGA7 (500 replicates). 22 environmental strains from GenBank are included, 10 of them representing 5 unidentified species (O29–O33). The tree is rooted with *O. oxyspora* and *D. bembicodes*. Asci 8-spored in all teleomorph taxa; T = type, ET = epitype, TT = topotype. * = without ITS1 and partial 5.8S, ** = without ITS2.

Key to species of series *Arthrobotrys* with known teleomorph

1. Spores subglobose, *2.2–2.6 × 1.8–1.9 µm; conidia non-septate, *11–16.5 × 5–6(–6.5) µm, formed in clusters (arthrobotryoid); subtropical humid southeastern Asia .... reported as teleomorph of ***Arthrobotrys nonseptatus***, p. 1551
1. Spores falcate or rarely helicoid, *6–15 × 1–1.5 µm 2

2. Spore base often or consistently narrowed to a ± abrupt tail of 1/3–1/2 × the total spore length; conidiogenesis arthrobotryoid, with unswollen nodes 3
2. Spores gradually attenuated towards base or only sometimes with a short tail; conidiogenesis arthrobotryoid or candelabrelloid 4

3. Paraphyses consistently lanceolate, non-furcate, without conspicuous exudate; conidiophores 113–500(–1500) µm long; conidia obpyriform to fusoid, *(16.5–)21–36(–40) × (10–)12.5–19(–21) µm, 1–3-septate; wood & bark of angiosperms, leaves of *Arecaceae*, thermotemperate to tropical humid America, worldwide .... ***O. blumenaviensis***, p. 1562
3. Paraphyses lageniform-mammiform, often bi- to trifurcate, with thin (sub)apical exudate that sometimes forms glassy caps on apex; conidiophores 90–200 µm long; conidia obovoid to obpyriform, *(14–)20–22(–26) × (7.5–)10–11(–13) µm, (0–)1-septate; wood of angiosperm, tropical humid Middle America .... ***O. jesu-laurae***, p. 1566

4. Spore base often or consistently narrowed to a ± abrupt tail of 1/3–1/2 × the total spore length 5
4. Spores gradually attenuated towards base or only sometimes with a short tail 7

5. Spores distinctly helicoid, †9–10 × 1.4–1.6 µm; leaves of monocots (*Arecales*), subtropical humid South America .... ***O. disseminata*** (series *Commatoideae*, section *Aurantiorubrae*), p. 818
5. Spores falcate 6

6. Spores †8–9.3 × 1.2–1.3 µm, always with abrupt, †0.15–0.2(–0.3) µm wide tails; anamorph unknown; leaves of *Elettaria* (*Zingiberales*), tropical humid Indonesia .... ***O. neglecta***, p. 1568
6. Spores *6.5–8.5(–9) × 1.3–1.5 µm, with abrupt, */†0.3–0.5 µm wide tails or sometimes tail-like or even gradually attenuated bases; conidia dimorphic, macroconidia *14.5–21.5 × 7.7–16.3 µm, (0–)1-septate, cylindric-ellipsoid to ± obpyriform, formed on ± swollen nodes in clusters (arthrobotryoid), microconidia 0-septate, ± clavate; wood & bark of angiosperms, orotemperate to subtropical humid eastern Asia .... ***O. latispora* s.l.**, p. 1569

7. Spores †9–11 × 1.4–1.7 µm, curved mainly near the strongly attenuated base, never with a distinct tail; SBs ?tear-shaped; asci †40–53 × 4.2–5.8 µm; marginal excipulum of t. prismatica oriented at a high angle; anamorph unknown; sandy soil, warm-continental semihumid mountainous Central Asia .... ***O. terrestris***, p. 1583
7. Spores *0.9–1.4(–1.5) µm wide (†0.8–1.3 µm), falcate 8

8. Macroconidia (0–)1-septate, mostly < 38 µm long, formed in groups of 3–15; microconidia unknown or rarely seen; glassy processes 0–3(–6) µm long 9
8. Macroconidia (0–)1–2(–3)- or multiseptate, mostly > 38 µm long, formed singly or in groups of 2–5 on ± distinct denticles or branches without swollen nodes (candelabrelloid or geniculate); microconidia present or absent; glassy processes 0–5(–30) µm long 12

9. Conidia formed on distinct denticles (candelabrelloid), cylindric-clavate to narrowly obpyriform, septum ± eccentrical; spores medium attenuated towards base 10
9. Conidia formed on ± swollen nodes (arthrobotryoid), obovoid, cylindric-ellipsoid, to ± obpyriform, *13–32 × 6–17 µm; spores ± strongly attenuated towards base, *(6–)7.5–12(–15) × (0.8–)1–1.3 µm; marginal excipulum oriented at a high angle 11

10. Conidia *25–42.5 × 9.5–15.5 µm, narrowly obpyriform, straight; spores *7–9 × 1.2–1.5 µm; marginal excipulum of t. prismatica oriented at a low angle; woody substrate, (sub)tropical humid (south)eastern Asia .... ***O. javanica***, p. 1550
10. Conidia *18.5–32.5 × 6–8.5 µm, cylindric-clavate, slightly curved; spores *7.7–10 × 1.1–1.2 µm; marginal excipulum of t. globulosa oriented at a high angle; woody substrate, temperate to tropical humid, worldwide .... ***A. musiformis* s.l.**, p. 1578

11. Conidia 6–13.5(–15) µm wide, cylindric-ellipsoid to ± obpyriform, septum median to slightly, exceptionally strongly eccentrical; woody substrate, herbaceous stems, dung etc., hemiboreal to tropical (semi)humid, worldwide .... ***O. auricolor***, p. 1520
11. Conidia 8.5–17 µm wide, obovoid to obpyriform, septum slightly to strongly eccentrical; woody & herbaceous, substrate, dung etc., temperate to subtropical humid to semiarid, worldwide .... ***O. oligospora***, p. 1539

12. Macroconidia narrowly fusiform, *60–198 × 7.5–21 µm, 4–13-septate, partly branched (Y-shaped); spores *8–10 × 1.3–1.4 µm, only slightly tapered towards base; isolated from monocot and conifer roots & stems, boreal to subtropical humid North America, Europe, Asia .... ***O. multiformis***, p. 1547
12. Macroconidia broadly fusiform or clavate, *32–63 × 12–26 µm, 1–3-septate; spores *(7.5–)9–13.5(–15) × (1–)1.1–1.4(–1.5) µm, ± strongly attenuated towards base 13

13. Macroconidia *33–57 × (16–)18–23(–26) µm, fusoid to top-shaped, (2–)3-septate, formed singly or 2–3 on long denticles at apex; glassy processes 2–8 µm long; spores *1–1.3 µm wide; herbaceous leaves & stems, dung, bark, cold-temperate to subtropical humid, worldwide .... ***O. elegans* s.l.**, p. 1552
13. Macroconidia *32–63 × (12–)14.5–18.3(–20.7) µm, obpyriform or fusoid, (1–)2(–3)-septate, formed singly at apex of conidiophores or on long branches; spores *1.2–1.5 µm wide; subtropical humid northeastern Africa 14

14. Paraphyses covered by firmly attached, 1–3(–4) µm thick exudate caps; glassy processes 0–5 µm long; bark of angiosperms .... ***O. menageshae***, p. 1558
14. Paraphyses covered by a thin layer of granular 0.2–0.5 µm thick exudate; glassy processes 2–30 µm long; herbaceous stems (*Solanecio*, *Euphorbia*) and bamboo .... ***O.* cf./aff. *menageshae***, p. 1558

clade (*A. eudermatus* is possibly conspecific with *A. janus*).

Morphological similarity was often not supported by molecular data: very similar taxa may cluster in very distant clades and, vice versa, morphologically different taxa may cluster in the same clade. A mismatch between phylogenetic analyses and earlier classification systems based on conidiophore and conidial morphology is often observed. For instance, the *O. auricolor* aggregate, characterized by ellipsoid-obpyriform conidia with 1 ± median septum formed on arthrobotryoid conidiophores, clustered with an ITS distance of 8–10 % in two clades, without clear morphological differences between the clades. The anamorphs of both clades can be referred to either *A. superbus* or *A. cladodes*, which are morphologically too similar and variable to enable safe distinction as two different species (see p. 1532).

However, one of these clades contains also *A. scaphoides* despite very differently shaped, fusiform, 2–4-septate conidia, whereas a species with *A. scaphoides*-like conidia, *A. gampsosporus*, clustered in a clade with *O. elegans*, which has shorter, more top-shaped conidia. The conidiophore type in the *elegans*-*gampsosporus* clade is acrogenous or candelabrelloid, suggesting that conidial types have a lower taxonomic relevance than conidiophore types. Likewise, species with 1-septate and non-septate conidia may cluster in a supported clade (*A. botryosporus* with *O. latispora*, *A. amerosporus* with *A. flagrans*). *A. amerosporus* has geniculate conidiophores, whereas *A. flagrans* lacks any nodules or denticles (similar as in *Trichothecium*), for which reason it was previously placed in a genus of its own (*Duddingtonia*). From all this follows that a subdivision of series *Arthrobotrys* into different groups based on conidiophore types turned out to be impossible.

In contrast to a high variation in the ITS region, the LSU is highly conservative and differs between closely related species often only at a few positions, resulting in a distance of often only 0.2–1 % in the D1–D2 domain. Therefore, the species are partly only indistinctly resolved in analyses of LSU.

Specific nucleotide positions. Specific nucleotide positions that characterize series *Arthrobotrys* have not been found (see Tab. 76). Position 13 in the ITS2 is CCTC**A** in series *Arthrobotrys* p.p.maj. and *Neodactylella*, and CCTC**G** in all other predacious series of section *Arthrobotrys*, but CCTC**A** also in *O. bembicodes* (series *Drechslerella*) and CCTC**G** also in *O.* aff. *auricolor* (H.B. 10024/denovo367 & G.M. 2017-09-25.1/2018-11-27.1), *A. nonseptatus*, and *A. reticulatus* (series *Arthrobotrys*). Two positions vary within series *Arthrobotrys* while being constant in the other series (Tab. 76): pos. 32 in 5.8S is mostly CCC**G**CAT as in the other series, but sometimes CCC**C**CAT (almost all strains of the *scaphoides-botryosporus* clade) and rarely CCC**A**CAT (*O. multiformis*); pos. 330 in the LSU D1 is mostly GG**C**GGG as in the other series (in series *Neodactylella* GG**C**GAG), but sometimes GG**G**GGG (all strains of the *scaphoides-botryosporus* clade) or GG**T**GGG (*O. multiformis* p.p. and a clade with *A.* '*superbus*' CBS 121.54 & 384.73 and *O.* '*auricolor*' B.L. 6225). Some further nucleotides at the few variable positions of LSU are species-specific and show interesting combinations.

Also pos. 123 of 5.8S varies between CAT**T**GGT and CAT**C**GGT, the latter being highly diagnostic for the *cladodes*-*botryosporus* clade and *A. koreensis*. This position is part of stem-loop B8 of 5.8S, in which series *Arthrobotrys* is otherwise highly conservative and concurs with two of the six variants observed in series *Neodactylella* (see Tab. 77).

Ecology. Members of series *Arthrobotrys* have predominantly desiccation-sensitive apothecia growing on a wide variety of woody and herbaceous substrates or are sometimes coprophilous or fungicolous. A certain desiccation tolerance was noted in *O. menageshae* and *O. auricolor* p.p. Species of this series occur worldwide, from boreal to tropical and from humid to semihumid regions.

Orbilia auricolor (A. Bloxam) Sacc., Syll. Fung. 8: 625 (1889) — Pls 948–954, Map 154

≡ *Peziza auricolor* A. Bloxam, in Berkeley & Broome; Ann. Mag. Nat. Hist., Ser. 3, 15: 445 (1865)
≡ *Calloria auricolor* (A. Bloxam) W. Phillips, Man. Brit. Discomyc.: 334 (1887)
≡ *Hyalinia auricolor* (A. Bloxam) Boud., Hist. Class. Discom. Eur.: 104 (1907)
?= *Peziza vinosa* Pers., Syn. Meth. Fung.: 635 (1801), non-sanctioned name [non *P. vinosa* Alb. & Schwein., ≡ *Orbilia vinosa*]
≡ *Peziza vinosa* var. *vinosella* Fr. [as 'β *P. vinosella*'], Syst. Mycol. 2(1): 141 (1822)
≡ *Orbilia vinosa* var. *vinosella* (Fr.) Sacc. [as 'β *O. vinosella*'], Syll. Fung. 8: 622 (1889)
?= *Arthrobotrys superbus* Corda [as '*superba*'], Pracht-Fl. Eur. Schimmelbild.: 43, pl. 21 (1839)
?= *Helotium karstenii* Roum., Fungi selecti Galliae exsiccati n. 65 (1879)
?= *Orbilia curvatispora* Boud., Bull. Soc. Mycol. Fr. 4: 80, pl. 16 fig. 6 (1888)
?= *Arthrobotrys superbus* var. *irregularis* Matr. [as '*superba*'], Recherches sur developp. de quelques Mucedin. (Paris): tab. 6, figs 20–23 (1892)
≡ *Arthrobotrys irregularis* (Matr.) Mekht., Dokl. Akad. Nauk Azerb. SSR 27(2): 73 (1971)
?= *Orbilia chrysocoma* var. *brassicicola* Feltgen [as '*brassicaecola*'], Rec. Mém. Trav. Soc. Bot. G.-D. Luxemb. 15: 36 (1901)
?= *Orbilia drepanispora* Lindau, Verh. Bot. Ver. Prov. Brandenburg 45: 153 (1904)
?= *Orbilia curvatispora* var. *robiniae* Velen., Monogr. Discomyc. Bohem.: 101 (1934)
?= *Orbilia curvatispora* var. *caprina* Velen., Monogr. Discomyc. Bohem.: 101 (1934)
?= *Orbilia daphnina* Velen., Monogr. Discomyc. Bohem.: 101, pl. 11 fig. 31 (1934)
?= *Orbiliella armeniaca* Kirschst., Ann. Mycol. 36: 374 (1938)
?= *Arthrobotrys kirghizicus* Soprunov [as '*kirghizica*'], Khishchnye Nematofagovye Griby - Gifomitsety: 140 (1958)
?= *Orbilia aranea* Svrček; Česká Mykol. 46: 39 (1992)

Orbilia cladodes (Drechsler) E. Weber & Baral, **comb. nov.**, MB 829070 — Pls 949

Basionym: *Arthrobotrys cladodes* Drechsler, Mycologia 29(4): 463, fig. 2 (1937)

Etymology: *aranea*: referring to the web-like subiculum; *armeniaca*, *auricolor*, *vinosa*: referring to the golden-yellow, apricot, or wine-red colour of the apothecia; *curvatispora*, *drepanispora*: according to the curved spores; *brassicicola*, *daphnina*, *robiniae*: after the host genus; *caprina*: after the host *Salix caprea*; *cladodes*: in reference to the branching of the conidiophores; *irregularis*: after the variability of the node arrangement at the conidiophore apex; *karstenii*: in honour of the Finnish mycologist P.A. Karsten; *kirghizicus*: after the geographical origin, Kyrgyzstan; *superbus*: perhaps referring to the chain-like conidial clusters.

Typification: Great Britain, Leicestershire, Gopsall, branch of ?angiosperm, III.1854, A. Bloxam (K, lectotype of ***Peziza auricolor***, designated here, MBT202391); France, Gérardmer, Lac de Longemer, branch of *Alnus*, 25.IX.2000, J. Deny (ex H.B. 6763, M-0276438, RefSpec, designated here, CBS 116282; sq.: KT215293). — unlocalized, rootstocks and stems of indet. plants, spring, collector unknown (type of ***P. vinosa*** **Pers**., not located). — Czechia, Praha, soil, winter 1935/36, A.C.J. Corda (holotype of ***Arthrobotrys superbus***, illustration in Corda 1839: pl. 21) — France, Toulouse, textile, XII.1878, collector unknown (herb. E. Mussat, PC, lectotype of ***Helotium karstenii***, designated here, MBT202393). — France, Paris, Forêt de Montmorency, bark of *Quercus*, VII.1885, É. Boudier (holotype of ***Orbilia curvatispora***, illustration in Boudier 1888: pl. 16 fig. 6, 1904–10: pl. 463). — unlocalized (?France), on indet. wood, undated (Matruchot 1892: pl. VI figs 20–23, holotype of ***A. superbus*** **var**. ***irregularis***). — Luxembourg, Mersch, stem of *Brassica oleracea*, 7.IX.1896, J. Feltgen (LUX 42535, holotype of ***O. chrysocoma*** **var**. ***brassicicola***). — Germany, Harz, Braunlage and Hohegeiß, wood and stumps of *Picea*, VIII.1903, G. Lindau (type of ***O. drepanispora***, not located). — Czechia, unlocalized, *Robinia pseudoacacia*, undated, J. Velenovský (type of ***O. curvatispora*** **var**. ***robiniae***, not located). — Czechia, Mnichovice, *Salix*

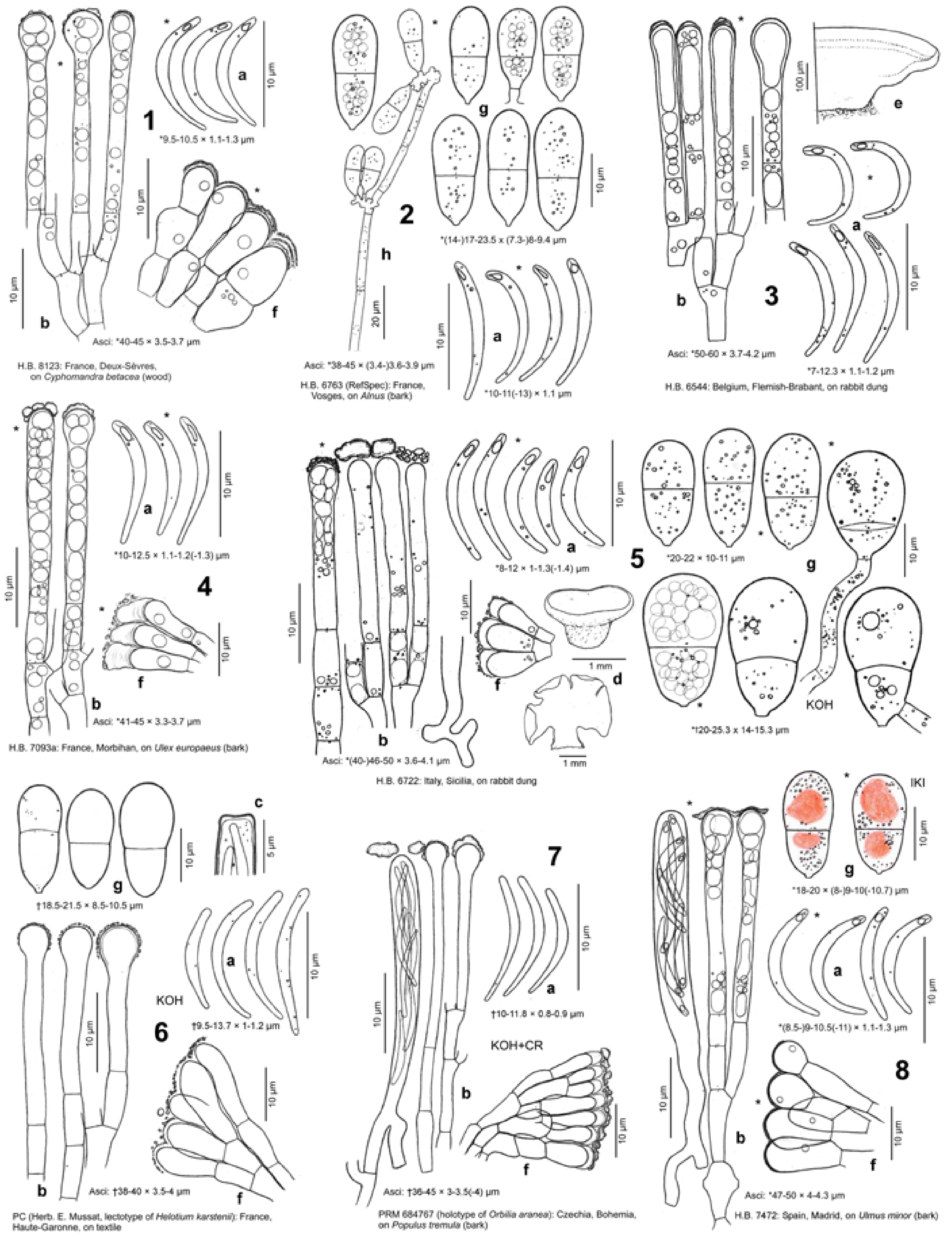


Plate 948. **1–8**: *Orbilia auricolor* s.l. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apex; **d**. rehydrated apothecia; **e**. apothecia in median section; **f**. id., ectal excipulum at margin, cortical cells with or without glassy processes; **g**. conidia; **h**. conidiophores (**2** from culture, **5–6**, **8** from substrate).

caprea, 16.X.1925, J. Velenovský (holotype of ***O. curvatispora* var. *caprina***, illustration on Velenovský's manuscript plate). — Czechia, Mnichovice, branches of *Daphne mezereum*, 1925, J. Velenovský (PRM 148299, holotype of ***O. daphnina***). — USA, Beltsville, Cumberland and Arlington, leaf mould, undated, C. Drechsler (holotype of ***A. cladodes***, illustration in Drechsler 1937a: fig. 2); USA, Wisconsin, *Pinus strobus* (CBS 297.84, CBS H-8895, RefSpec of *A. cladodes*, designated here). — Germany, Zootzen, trunk of *Quercus robur*, V.1908, W. Kirschstein (B, holotype of ***Orbiliella armeniaca***). — Czechia, Čimelice, branch of *Populus tremula*, 1.VIII.1969, M. Svrček (PRM 684767, holotype of ***Orbilia aranea***).

Misapplied names: Feltgen (1901: 36, on *Fagus*), as *O. luteorubella*, (: 37, on *Angelica*), as *O. rosella*; Fries (in sched., UPS 247614), as *O. xanthostigma*; Pfister (1994), as *O. fimicola*; Phillips (1887: 333, pl. 10 fig. 63), as *Calloria vinosa*.

Misinterpretation of *O. auricolor*: Rehm (1891: 447, fig. 10, 1891: 458, as *O. curvatispora*), = *O. xanthoguttulata*; Korf (1992), = *O. ?tenuissima*; Pfister & Liftik (1995) p.p., = *O. oligospora* (anamorph *A. oligosporus*); Baral in Rubner (1996: 92), = *O. elegans* (anamorph *A. psychrophilus*/*A. elegans*); Liu (2006: 51), = *O. javanica* (anamorph *A. javanicus*); Mo et al. (2005a), = *O. multiformis* (anamorph *A. yunnanensis*). Most authors prior to 1987 used the name *O. auricolor* in the sense of *Hyalorbilia inflatula*, e. g., Massee (1895: 148), Nannfeldt (1939: 244), Dennis (1960a, 1970: 352, 1978), Moser (1963), Bride & Caillet (1975), Ahmad (1978), Thind & Sharma (1980: 303), Chmiel (1982: 80), Ellis & Ellis (1985).

Description: — **TELEOMORPH**: **Apothecia** fresh (0.3–)0.5–1.5(–2.5)((–4)) mm diam., (0.15–)0.2–0.35(–0.4) mm high (receptacle 0.08–0.17 mm), greyish-white, also carneous, cream-rosaceous(-violaceous), or (orange-)yellowish-ochraceous-amber(-chlorinaceous), translucent, round, sometimes sinuate to lobate-crenate when large, gregarious to densely aggregated, rarely scattered; disc slightly (to medium) concave to flat, margin ± thick, 5–10 µm protruding, smooth, finally medium convex, immarginate; sessile or mostly with short and broad stipe 0.1–0.28(–0.7) × 0.25–0.8 mm, superficial (or slightly immersed); dry bright ochre, honey-yellow, yellowish-orange-apricot, or rose, in about half of the collections with a white subiculum covering ± large areas around each apothecium. **Asci** *(30–)37–51(–60) × (3.3–)3.5–4.3 µm {21}, †(26–)30–48(–55) × (2.8–)3–4(–4.5) µm {26}, 8-spored, spores 3–5-seriate, (2–)3–4(–5) lower spores inverted {18} (rarely mixed), pars sporifera *(15–)20–30(–36) µm long; **apex** (†) slightly to strongly truncate (rarely slightly indented and laterally inflated); **base** with short to medium long, thick, sometimes flexuous stalk, T-, Y-, h- or H-shaped. **Ascospores** *(6–)7.5–12(–13) × (0.8–)1–1.3 µm {38} [~(9–)10–14(–15) µm actual length], †((6–))(7.3–)8–13(–14.5) × (0.7–)0.8–1.2(–1.3) ((–1.4)) µm {40}, narrowly subcylindric-clavate (subulate) to fusoid-clavate, apex rounded, base medium to strongly attenuated, (slightly to) medium to (very) strongly curved (falcate), in dead state slightly to medium curved; **SBs** *0.5–1.3(–1.8) × (0.3–)0.5–0.7(–0.8)((–1)) µm {22}, globose to cylindric-ellipsoid or tear-shaped, sometimes rod-shaped, apically narrowed to a (very) short, fine, often invisible filum, total length (1–)1.5–2.3(–2.7) µm. **Paraphyses** apically (uninflated to) slightly to medium (to strongly) capitate(-clavate), terminal cell *14–30 × (2.5–)3–4.5(–5.5) µm {11}, †(14–)18–25(–26.5) {6} × (2–)2.5–4.5(–5) µm {8}, lower cells *4–10 × (1.7–)2–3(–3.5) µm {9}, †(3–)5–11(–13) × 1.5–2.5(–3.5) µm {4}; unbranched at upper septum. **Medullary excipulum** 20–50 µm thick, of ± loose or dense textura angularis-globulosa-intricata, sharply delimited from ectal excipulum partly only towards margin by a 10–20 µm thick layer of t. porrecta, not gelatinized but in KOH sometimes ± gelatinized. **Ectal excipulum** of (†) thin-walled to slightly gelatinized, vertically oriented t. globulosa-angularis-prismatica from base to margin, (40–)65–150(–200) µm thick near base, cells */†10–35((–45)) × 9–30 µm {12}; 40–50 µm thick at lower flanks, 20–30 µm thick at mid flanks and margin, oriented at a (50–)60–90° angle to the surface, marginal cortical cells */†(6–)8–15(–17) × (3–)4–8(–9) µm {21}, never forming individual cell rows; **glassy processes** absent {32} or more rarely present {20}, 0.5–3(–6) × 3.5–7 µm, (low to) high refractive, partly distinctly stratified, sometimes entire cortical cells thick-walled. **Anchoring hyphae** abundant, rarely sparse, */†(2–)2.5–6(–7)((–10)) µm wide, walls 0.2–0.4(–1) µm thick {31}, sometimes short-celled and moniliform, sometimes forming a loose t. (porrecta-)intricata(-angularis) 10–60(–100) µm thick, rarely gelatinized (southern Africa, H.B. 5768a). **SCBs** globose, in paraphyses 0.5–2 µm diam., in ectal excipulum 1–4.5 µm; **VBs** in paraphyses sometimes seen, several large or many small ones, globose to angular, low-refractive, hyaline {11}. **Exudate** granular to cloddy, hyaline, rarely yellowish-ochraceous, over paraphyses (0.1–)0.3–2(–3) µm thick, loosely or firmly attached, forming individual caps, at margin and flanks as a 0.3–3(–4) µm thick layer. — **ANAMORPH**: arthrobotrys-like (from ascospore isolate {6}, conidial isolate {2}, or natural substrate {23}). **Conidiophores** *~(70–)100–250(–300) µm long {8}, 4.5–7 µm wide at base, *2.5–4.5 µm wide below nodes, unbranched or sometimes branched, at nodes often (sub)apically proliferating, conidia formed on nodules or short denticles on ± inflated nodes (arthrobotryoid), occasionally on elongated denticles (sometimes with a separating cell, Pl. 951: 1h), ~5–15 conidia per node. **Conidia** varying in size and shape, also in position of septum: either *(18–)21–28(–32) × ((7–))(9–)10–12.5(–13.5) µm {4}, †18–24.5 × 9.5–15 µm {1}, obpyriform, with the upper cell usually distinctly wider and partly also longer than lower cell {3}, often with ± distinct basal protrusion, 1-septate; or *(13–)15–20(–25) × (6–)7–10(–12) µm {14}, †(15–)16–22(–25) × (7–)7.5–9.5(–11) µm {6}, cylindric-ellipsoid to slightly obpyriform, the 2 cells of ± equal size, exceptionally upper cell larger; with or without basal protrusion, 1-septate or exceptionally non-septate; sometimes mixed with non-septate **microconidia** of *11–19 × 5.3–8 µm {5} or 1-septate conidia of intermediate size. Trapping nematodes by means of 3-dimensional **adhesive networks**, forming loops with an inner diameter of (10–)12–17(–20) µm, outer diam. ~(20–)25–35(–45) µm, loop cells *(5–)5.5–7.5(–8) µm wide {1}. **Chlamydospores** not observed (but reported by Pfister & Liftik 1995).

Habitat: on moist ground or up to 1–1.5 m above the ground, mostly corticated, 3–60 mm thick **branches** and up to min. 20 cm thick **trunks or logs** of *Acacia* sp. {1}, *A. saligna* {1}, *Aesculus hippocastanum* {1}, *Alnus* sp. {1}, *A. glutinosa* {1}, *A. incana* {1}, *Baccharis halimifolia* {1}, *Bambusoideae* {1}, *Clematis vitalba* {1}, *Corylus avellana* {1}, *Cyphomandra betacea* {1}, *Daphne mezereum* {1}, *Fagus sylvatica* {8}, *Fraxinus excelsior* {1}, *Genista* sp. {1}, *Hedera helix* {2}, *Lavatera arborea* {1}, *Picea abies* {2}, *P. glauca* {1}, *Pinus pinea* {1}, *P. strobus* {1}, *P. sylvestris* {1}, *Populus* sp. {3}, *P. tremula* {4}, *Pyrus pyraster* {1}, *Quercus* sp. {1/1}, *Q. robur* {1}, *Rhus laurina* {1}, *Salix* sp. {2/2}, *S. ?alba* {1}, *S. aurita* × *caprea* {1}, *S. caprea* {1}, *Sorbus aucuparia* {1/1}, *S. torminalis* {1}, *Tilia* sp. {2}, *T. platyphyllos* {2}, *Ulex europaeus* {5}, *Ulmus* sp. {4}, *U. glabra* {1}, *U. minor* {1/1}, *Vitis vinifera* {1}, indet. climber {1}, indet. angiosperm {7/1}, on slightly to medium, also strongly decayed bark {62} (bast {20} or periderm {17}), more rarely wood {16}, exceptionally coniferous leaves {1}, often in holes in periderm caused by pyrenomycetes or anamorphic fungi, or on inner surface of bark; not greyed, no green algae; on **fruits** of *Aesculus hippocastanum* {1}, *Cocos nucifera* {3}, *Theobroma cacao* {1}, *Xylotheca kraussiana* {1}; **inflorescence stems** of *Xanthorrhoea australis* {1}; on previous year's **herbaceous stems**, **leaves**, **petioles** of *Adenostyles alliariae* {1}, *Angelica* sp. {1}, *Arctium* sp. {4}, *A. lappa* {2/1}, *Brassica oleracea* {2}, *Carex* sp. {1}, *C. vesicaria* {1}, *Digitalis purpurea* {1}, *Equisetum* sp. {1}, *Helleborus foetidus* {3}, *Heracleum sphondylium* {1}, *Humulus lupulus* {1}, *Iris foetidissima* {1}, *Lavatera* sp. {1}, *Lupinus arboreus* {2}, *Oenanthe crocata* {1}, *Oenothera biennis* {1}, *Onopordum acanthium* {1}, *Pastinaca sativa* {1}, *Petasites hybridus* {1}, *Phalaris arundinacea* {1}, *Phragmites australis* {1}, *Phoenix* (?)*canariensis* {1}, *Ranunculus repens* {1}, *Scirpoides holoschoenus* {1}, *Triticum aestivum* {1}, *Typha latifolia* {1}, *Verbascum* sp. {1}, *Yucca* sp. {2}, lying on moist ground or often at moist base when still standing, on epidermis or on epidermis-free areas; on **textile**: cloth {2}, tennis ball {1}; on **fungi**: *Bionectria ralfsii* {1}, *Diatrype stigma* {2}, ?*Cryptodiaporthe* sp. {1}, *Orbilia comma* {1, anamorph}, *Rosellinia* sp. {1}, *Thelonectria discophora* {1}, indet. crustose lichen thallus {1}; on **bone** of *Sus scrofa* {1}, **excrements** of *Capreolus capreolus* {2}, *Lepus europaeus* {1}, *Oryctolagus cuniculus* {3}. **Further associated**: *Arnium apiculatum* {1}, *Bionectria ralfsii* {1}, *Cistella grevillei* {2}, *Claussenomyces* sp. {1}, *Coprinus* sp. {1}, *Cyathicula starbaeckii* {1}, *Diaporthe arctii* {1}, *Diatrype disciformis* {1}, *Endoxyla* sp. {1}, *Graphium calicioides* {1}, *Herpotrichia macrotricha* {1}, *Holwaya mucida* {2}, *Hyalorbilia*

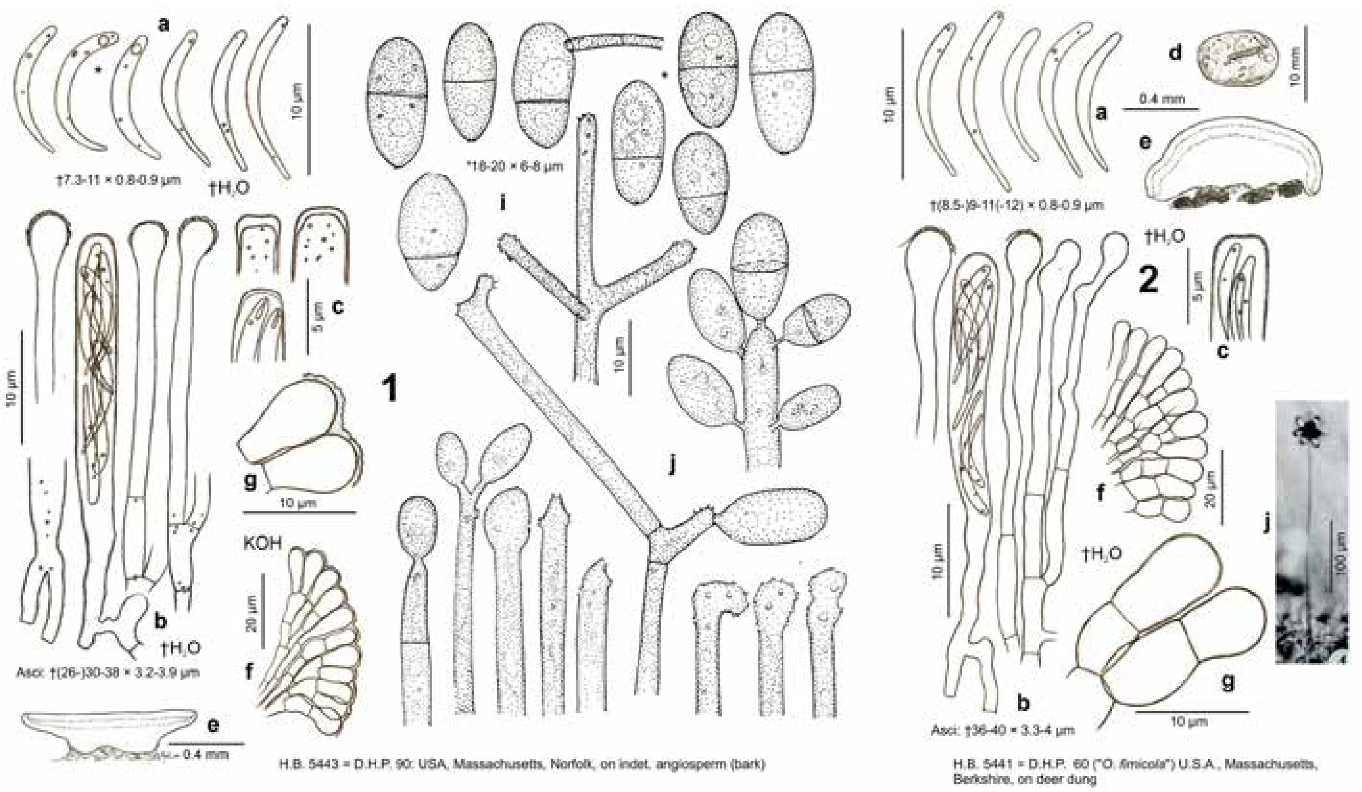


Plate 949. **1–2**: *Orbilia cladodes* from eastern North America. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. two apothecia on dung; **e**. apothecia in median section; **f**. id., marginal ectal excipulum; **g**. marginal cortical cells; **i**. conidia; **j**. conidiophores tips with conidia (from culture). – **1i–j**: from Pfister & Liftik (1995, as *A. cladodes* var. *macroides*); **2j**: from Pfister (1994, as *A. superbus*).

inflatula {1}, *H. juliae* {1}, *H. rotifera* {1}, *Karstenia rhopaloides* {1}, *Licea fimicola* {1}, *Melanomma pulvis-pyrius* {1}, *Nectria* sp. {3}, *N. pseudopeziza* {2}, *Orbilia aristata* {1}, *O. atlantis* {2}, *O. aurantiorubra* {1}, *O. caulicola* {1}, *O. comma* {1}, *O. oxyspora* {3}, *O. phragmotricha* {1}, *O. pilifera* {1}, *O. rubrovacuolata* {1}, *O. tenuissima* {1}, *O.* ?*clavispora* {1}, *Physcia* sp. {1}, *Pyrenopeziza* sp. {1}, *P. atrata* {6}, *P. caespiticia* {1}, *P. ranunculi* {1}, *Sporidesmium* sp. {1}, *Trichoderma citrinum* {1}. **Desiccation tolerance**: all asci dead after 1 hour, but sometimes some paraphyses and submature asci alive after 1 month, excipular cells still alive after 1 month, some spores viable after 21 months but in other material all spores dead after 4 months; conidia viable for at least 2 months. **Altitude**: 1–1000 m a.s.l. (temperate Europe), 20–1700 m (southern Europe), 170–500 m (Middle America), 2000–3500 m (Himalaya). **Geology**: Cambrian, Ordovician, Silurian & Carboniferous quartzitic wacke, schist, silt-, sand- & limestone, Permian (Rotliegend), Buntsandstein, Muschelkalk, Keuper (clay, marl & sandstone), Lower to Upper Jurassic limestone & shale, Cretaceous & Tertiary sand-, marl- & limestone, flysch, dolomite, Quaternary till, marl, silt & sand, peat; granite, migmatite, biotite-amphibolite & quartz diorite, mica schist, gneiss. **Phenology**: throughout the year.

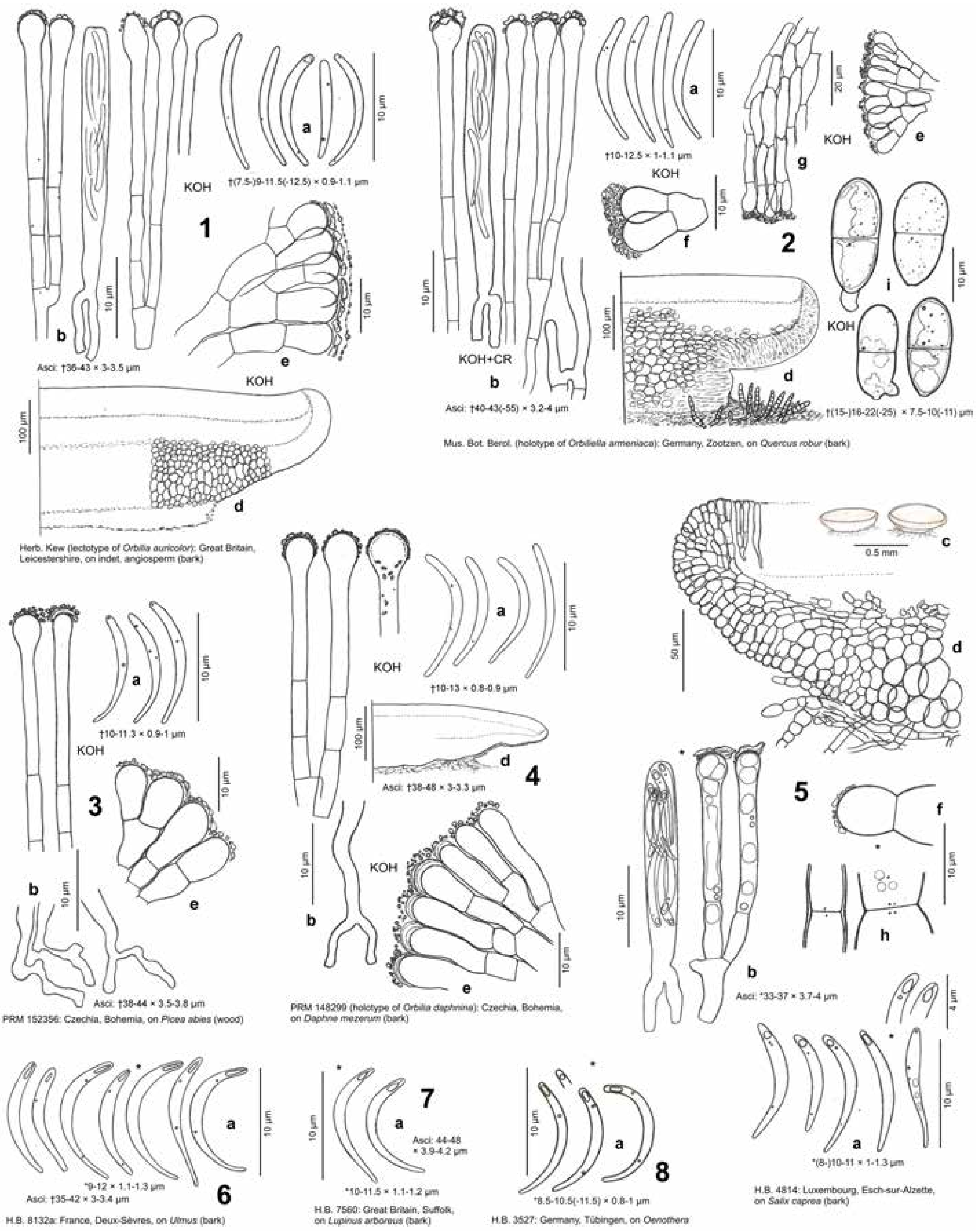
Phenology of *O. auricolor* s.l. (teleomorph, northern hemisphere, extra-tropical)											
Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
5	5	13	13	9	18	16	14	10	6	9	3

Taxonomic remarks. *Orbilia auricolor* s.l. (including *O. cladodes*) seems to be the most frequently collected species of series *Arthrobotrys* regarding the teleomorph, and also its anamorph was often isolated. In contrast, the teleomorph of the similar *O. oligospora*, of which many isolates of the anamorph exist, is known to us with certainty only from one record (Pfister & Liftik 1995).

The present concept of *Orbilia auricolor* s.l. includes specimens with the following characteristics of the teleomorph: ascospores *10–14 × 1–1.3 µm (actual length), medium to strongly falcate, distinctly tapered below, paraphyses ± capitate, marginal excipular cells oriented at a high angle to the surface, not forming distinct cell rows, glassy processes max. 3(–6) µm long, apothecial margin therefore smooth, anchoring hyphae comparatively wide (mostly 3–5 µm), conidiophores arthrobotryoid, conidia (0–)1-septate, *15–28 × 7–12.5 µm, with usually median to moderately eccentrical septum (length ratio of the upper/lower cell 1 : 1 up to 1.5 : 1, exceptionally > 2 : 1).

As a matter of fact, all taxa of series *Arthrobotrys*, for which a teleomorph is known, show more or less these characteristics in the teleomorph. Most of them can be recognized by their anamorph or by slight or clear differences in their teleomorph, while some appear to differ merely in their molecular data. Because conidia were not observed in the holotype of *O. auricolor*, the exact identity of this name remains unclear up to now. Possibly, future techniques will gain DNA from the type specimens of *O. auricolor*, *Orbiliella armeniaca*, and *Helotium karstenii*, or the authentic specimens of *O. curvatispora* and others.

For the time being, our concept of *O. auricolor* is undoubtedly heterogeneous from a molecular point of view. We here adopt the name *O. auricolor* s.str. in a restricted but still rather wide sense for the taxon being connected to an anamorph with arthrobotryoid conidiophores forming conidia that are reminiscent of *Arthrobotrys superbus*. For specimens with the very similar *A. cladodes*-like anamorph coupled with strongly deviating molecular data we use the name *O. cladodes*, and accordingly for specimens with an anamorph similar to *A. oligosporus* and corresponding molecular data we use the name *O. oligospora*. *A. macroides* appears to represent a further distinct taxon of this group, though without a known teleomorph at present (see p. 1576).



Herb. Kew (lectotype of *Orbilia auricolor*): Great Britain, Leicestershire, on indet. angiosperm (bark)

Mus. Bot. Berol. (holotype of *Orbiliella armeniaca*): Germany, Zootzen, on *Quercus robur* (bark)

PRM 152356: Czechia, Bohemia, on *Picea abies* (wood)

PRM 148299 (holotype of *Orbilia daphnina*): Czechia, Bohemia, on *Daphne mezerum* (bark)

H.B. 4814: Luxembourg, Esch-sur-Alzette, on *Salix caprea* (bark)

H.B. 8132a: France, Deux-Sèvres, on *Ulmus* (bark)

H.B. 7560: Great Britain, Suffolk, on *Lupinus arboreus* (bark)

H.B. 3527: Germany, Tübingen, on *Oenothera*

Plate 950. **1–8**: *Orbilia auricolor* s.l. – **a**. ascospores; **b**. asci and paraphyses; **c**. fresh apothecia; **d**. apothecia in median section (**2d** with *Sporidesmium*); **e–f**. id., marginal ectal excipulum, with or without thin glassy caps; **g**. id., ectal excipulum at flanks; **h**. detail of anchoring hyphae (septa with WBs); **i**. conidia from substrate.

A clarification of this complex of taxa requires epitypification of *O. auricolor* and allied taxa, including *A. superbus*, *A. cladodes*, and *A. macroides*, together with a morphological and molecular study of these epitypes. In the following we propose reference specimens for *O. auricolor* and *O. cladodes* as a first step towards an epitypification. Only for *O. oligospora* we propose an epitype and provide a separate description, being aware that some collections

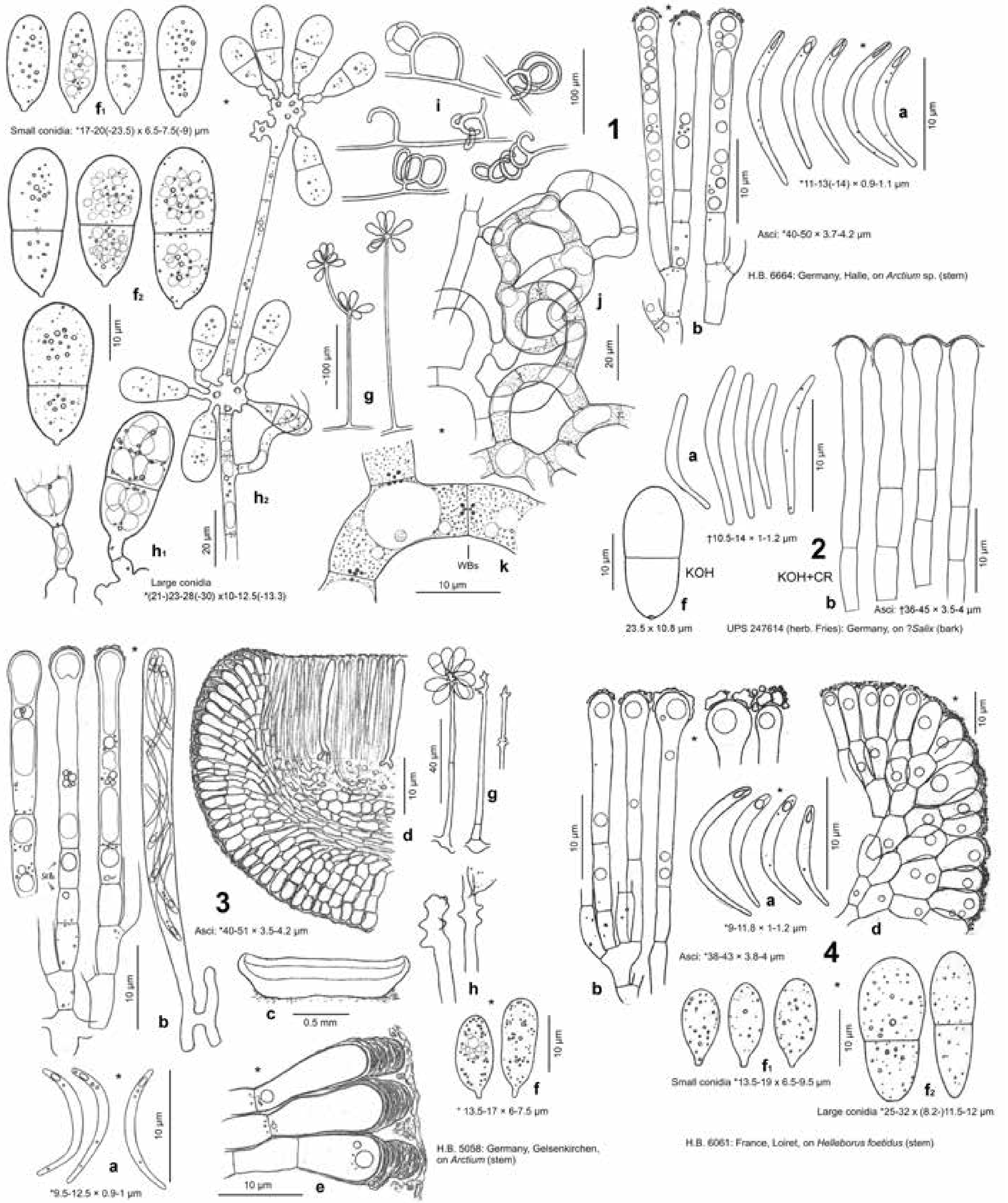


Plate 951. **1–4**: *Orbilia auricolor* s.l. – **a** ascospores; **b**. ascus and paraphyses; **c**. apothecium in median section; **d**. id., marginal region; **e**. id., marginal cortical cells with short glassy processes; **f**. conidia; **g**. conidiophores; **h**. conidiophore tips, arthrobotryoid conidiogenesis; **i–k**. adhesive networks (**k**. with WBs at septa) (**1f–k**. from culture; **3f–h**, **4f**. from substrate).

without anamorph and molecular data here included under *O. auricolor* possibly belong to *O. oligospora*.

Anamorphs within the *O. auricolor* aggregate, which corresponds more or less with the entire series *Arthrobotrys*, deviate in conidial shape and septation, type of conidiogenous loci and their aggregation at the conidiophore tip, and in branching and proliferation of conidiophores. *O. cladodes*, *O. elegans*, *O. menageshae*, and *O. oligospora* are virtually indistinguishable from *O. auricolor* as circumscribed here based on teleomorph characteristics alone, but more or less sharply differ in their anamorph. For instance, conidia of *O. oligospora* differ in having an eccentrical septum and a distinctly wider

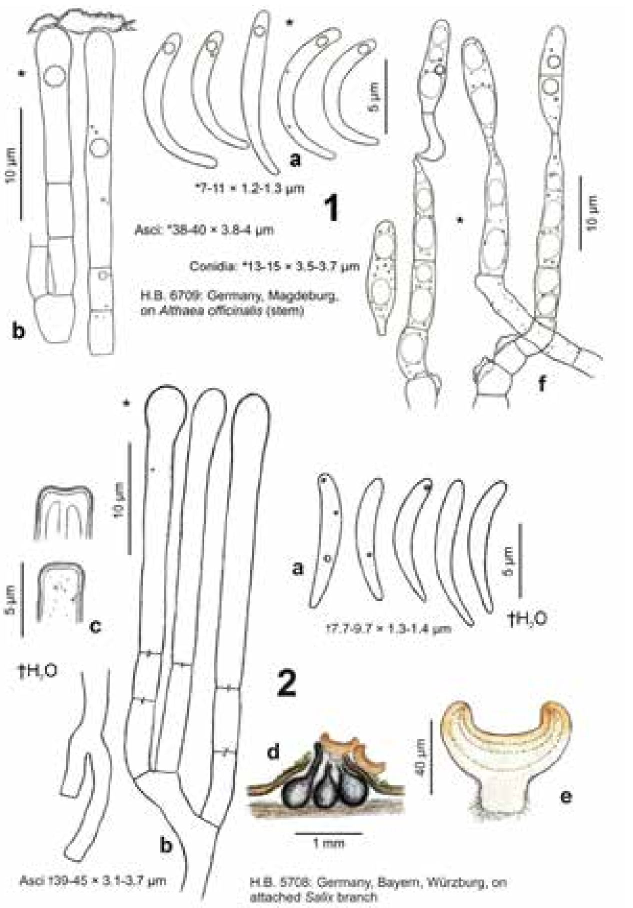


Plate 952. **1–2**: *Orbilia* cf. *auricolor*. – **a**. ascospores; **b**. paraphyses and ascus base; **c**. ascus apices; **d–e**. apothecia in median section, growing on ?*Cryptodiaporthe salicella*; **f**. conidiophores and conidia emerging from apothecia (perhaps a parasite?).

upper cell, but collections with intermediate conidia impede this distinction. *O. multiformis* differs from typical *O. auricolor* in slightly shorter, basally less tapered ascospores, but sharply differs in forming phragmo- and stauroconidia (Pl. 958). The ascospores of *O. javanica* as figured by Liu (2006) are short enough not to be confused with *O. auricolor*, also the marginal excipulum is oriented at a low angle, while the conidia are similar to *O. auricolor* but longer (Pl. 959). *O. latispora* s.l. differs in shorter and wider ascospores with basally tail-like ends and an anamorph similar to *O. cladodes* but with wider conidia (Pl. 971). *O. blumenaviensis* differs in protruding, ± lanceolate paraphyses without exudate, besides much larger, 1–3-septate conidia, and *O. terrestris* in much wider ascospores (anamorph unknown). Also for *O. scaphoides* (X.Z. Liu, BJ08-20) and *A. musiformis* (Z.F. Yu pers. comm.) a teleomorph was observed but the connection remained so far unpublished.

In a very broad sense, the *O. auricolor* aggregate comprises also taxa without an arthrobotrys-like anamorph. At least five species of series *Neodactylella*, viz. *O. oxyspora* (including *O. fimicola*), *O. dorsalis*, *O. clavispora*, *O. desertorum*, and *O. tenuissima* closely resemble *O. auricolor* in their hymenial characters. They differ in the marginal excipulum forming ± distinct cell rows oriented at a rather low angle to the surface, being often tipped by glassy processes. Their anamorphs, as far as known, are dactylella-like, i.e., without known trapping capabilities. Also two species of series *Dactylellina*, *O. rubrovacuolata* and *O. mammillata*, resemble *O. auricolor* but differ in consistently rod-shaped spore bodies without a filum, marginal cortical cells predominantly with glassy processes, and a dactylellina-like anamorph, the former also in usually bright red apothecia. Herbarium material of the teleomorph of these two species may easily be confused with *O. auricolor*. *O. leporina* and long-spored collections of *O. rectispora* or those mentioned under *O. epilobii* of series *Neodactylella* may also be confused due to their tendency to form slightly curved, basally tapered spores.

Variation in the teleomorph. The apothecial colour of *O. auricolor* s.l. is often whitish to pale cream-rosaceous but also yellow-ochraceous or even orange, especially in collections in which the apothecia are more light-exposed. Such stronger pigmented collections agree better with the species epithet '*auricolor*'. Collections with distinctly yellowish-ochraceous to apricot-orange apothecia were mainly encountered on bark (e.g., on *Ulmus* and *Tilia*), but rarely also on herbaceous stems (Pl. 953: 3) or on a bone (Pl. 953: 6, see also Fig. 116: a). Also one of the two North American samples treated by Pfister & Liftik (1995) and here referred to *O. cladodes* was described with yellow-orange apothecia (on bark, Pl. 949: 1). Svrček (1992) erected a new species *O. aranea* for samples on bark with yellowish-ochraceous apothecia and a conspicuous white subiculum. Possibly, the more yellow-orange populations tend to show a certain desiccation tolerance, but this could so far not be tested.

Sometimes, almost colourless and more intensely coloured apothecia occurred together, either in separate groups (Pl. 953: 9a–d) or intermingled (1a–b). In a specimen collected by O. Jaap (Pl. 953: 10) the pale cream apothecia had partly turned bright red due to some ageing process. Spooner observed a 'conspicuous yellowish to orange-yellow pigment' or 'yellowish sap' in many of the excipular cells in all specimens of *O. auricolor* examined, including the holotype. In the present study, however, no such intracellular pigment was ever clearly seen, neither in living nor dead material.

Although the ascospores with their subulate-falcate shape are quite characteristic, they show considerable variation in size, curvature, and strength of basal tapering. This variation is observed between populations, but generally also within an apothecium. A striking effect is that dead spores are less curved and consequently in situ slightly longer than living spores. The curvature of living spores varied in most collections between slight and very strong, therefore, the in situ length varies strongly within a collection. Nevertheless, the in situ length varied among the collections from *7–10 µm to *8.5–12 µm or rarely *10–13 µm. Spore bases varied from slightly to mostly medium to strongly attenuated, usually within a given collection.

Rather high variation was noted in the shape of the spore body, which is partly globose but often ellipsoid and sometimes tear- to rod-shaped. The attachment is generally by a short or longer, very fine or often invisible filum. The differences in SB shape possibly depend on the development stage, since globose and elongate SBs were partly observed in the same collection (e.g., Pl. 949: 1a, c).

Further variation occurs in the marginal cortical cells which are often ± short and broad and completely without glassy caps (e.g., in the types of *O. auricolor* and *Orbiliella armeniaca*, Pl. 950: 1–2, also in Pls 948: 1, 8; 949: 1–2; 940: 3, 5; 951 Fig. 4; and 953: 2). In other populations the cells are more elongate and narrow and often tipped by thinner or thicker glassy caps (e.g., in the types of *O. aranea* Pl. 948: 7 and *O. daphnina* Pl. 950: 4, also in Pl. 948: 4 and 951: 3), but sometimes they are without such caps (e.g., in the type of *Orbilia karstenii*, Pl. 948: 6). Although these glassy caps are quite conspicuous, their nature is not easy to determine because they are often covered by exudate or might consist of exudate instead.

The paraphysis apices usually vary within an apothecium from slightly to medium, sometimes strongly capitate, though in a few collections they are predominantly uninflated (e.g., Pl. 948: 3, 5). Also the exudate varies from nearly absent (e.g. Pls 948: 6; 949: 1–2; Pls 951: 2; 952: 2) to often thin-granular and firmly attached, or sometimes thick-cloddy and loosely attached (e.g., Pl. 948: 5, 7).

Misapplications. *Orbilia auricolor* belongs to the rather frequently misapplied names. The main misinterpretation lasted almost a hundred years when most authors prior to 1987 used the name *O. auricolor* in the sense of *Hyalorbilia inflatula* (see below). More recent reports concern the use of the name *O. auricolor* for teleomorphs connected with different anamorphs (see below). Misapplications of the name *O. auricolor* include also *Orbilia* spp. belonging to various other sections (*O. luteorubella*, *O. rosella*, *O. vinosa*, *O. xanthoguttulata*, *O. xanthostigma*, see under these species).

The only Macaronesian record of *O. auricolor* (Korf 1992, on ?*Laurus*) turned out to belong to a species of series *Neodactylella*, possibly *O. tenuissima*, according to a reexamination by L. Quijada (pers. comm.). No anamorph was detected, but the marginal excipulum of very distinct cell rows oriented at a very low angle clearly suggests such relationship (see Quijada et al. 2016).

Specimens treated by Pfister. Pfister (1994) and Pfister & Liftik (1995) investigated three collections from Massachusetts which they identified as two species, *O. fimicola* and *O. auricolor*, while they referred the obtained anamorphs to three different species of *Arthrobotrys*, *A.* cf. *superbus* (*O. fimicola*), *A. cladodes* var. *macroides* and *A. oligosporus* (*O. auricolor*). Reexamination of the teleomorphs of these three collections hardly revealed any differences worth mentioning (Pls 949: 1–2; 955: 1). All show the typical characters of *O. auricolor* as represented by the holotype from England (Pl. 950: 1). The latter (on a lichen, Pl. 955: 1) is treated here as *O. oligospora* according to its anamorph and DNA data, while the other two (on bark and dung) are considered to belong to *O. cladodes* based on their DNA data.

In the collection on deer dung (‘*O. fimicola*/*A.* cf. *superbus*’), the ascospores were longer and narrower (Pl. 949: 2) than can be evaluated from Pfister’s (1994) drawing: (6.4–)7.5–8.3 × (0.9–)1.1–1.2 µm (in situ), although both show about the same curvature (some of his spores might have been alive as he indicated SBs in two of them). This spore drawing would fit *O. latispora* (Pls 971–973), but our phylogenetic analysis shows *O. latispora* (clades C2/C3) to be specifically distinct from Pfister’s (clade C1), although both clustered in the *cladodes-botryosporus* clade (Phyl. 28). The paraphyses on Pfister’s drawing are abnormally inflated at the apex, quite untypical of *O. auricolor*, but they are much less inflated in the present reexamination (Pl. 949: 2b). The cells of the marginal excipulum are vertically oriented and not terminated by glassy processes (Pl. 949: 2f–g), unlike the type of *O. fimicola* (Pl. 934). Hence, Pfister’s specimen is obviously not conspecific with *O. fimicola*, which seems to belong to series *Neodactylella* close to *O. oxyspora*.

Unlike Pfister (1994), Pfister & Liftik (1995) described and illustrated the obtained anamorphs in detail, but hardly treated the microscopical features of the teleomorph, probably because of their close similarity. However, Pfister & Liftik saw slight differences in macroscopy: those apothecia growing on a lichen were fresh white to pale tan, broadly attached and broadly turbinate, whereas those on bark were fresh yellow to orange, centrally attached, lenticular. In the specimen on dung, Pfister (1994) illustrated ellipsoid SBs in two of the spores. When reexamined 21–29 months after collecting, only one of the three specimens (on bark, after 21 months) contained a few viable spores (Pl. 949: 1a, c) with partly globose, partly subulate SBs, the latter being only seen within the asci.

Nomenclature and Type studies. ***O. auricolor*** was described by A. Bloxam in a note published by Berkeley & Broome (1865), based on a single British collection on bark ‘on the underside of a fallen tree’ (in Saccardo 1889: 625 erroneously ‘on underside of fallen leaves’). The very brief protologue reads about as follows: apothecia soft, subgelatinous, orange, with a broad raised margin, springing from thin hyaline radiating filamentous layer of interwoven hairs, spores narrow. Both Nannfeldt (1939: 244) and Spooner (1987: 163) reexamined the type collection. Nannfeldt did not comment on the observed characters when he stated ‘*Orbilia inflatula* Karst.’ to be a synonym. Later (in Lundell & Nannfeldt 1946: no. 1388), he stated to have made a bad mistake when synonymising the two taxa, but did not specify the identity of *O. auricolor*. Based on Nannfeldt’s error, the epithet *auricolor* was continued to be misapplied over the next decades in the sense of *Hyalorbilia inflatula* (see also p. 342). It was only in 1987 when Spooner found that *O. auricolor* is conspecific with *O. curvatispora* based on curved spores and stipitate asci, but very different from *O. inflatula* which has straight spores and sessile asci.

The type material in K consists of six convolutes affixed to several sheets. All these convolutes bear a similar label and contain pieces of bark which undoubtedly belong to a single collection (B. Spooner pers. comm.). When ordered, one of them was received. This contained over 60 apothecia, and the present reexamination is based on this part of the collection. Spooner’s conclusion is fully confirmed. The spores were found to be wider (see Pl. 950: 1) than stated by him (10–11 × 0.5–0.8 µm), but concur with the measurements evaluated from his drawing (10–11.3 × 0.9–1.2 µm, in situ). Since only a single convolute is allowed to serve as nomenclatural type (ICN Art. 8.3, 9.1, Turland et al. 2018), we here designate specimen ‘AB [= A. Bloxam], March 1854, on the underside of a fallen tree. Gopsall Plantation’ **as lectotype** of *O. auricolor*.

Because of the molecular heterogeneity of *O. auricolor*, we here propose a European collection (H.B. 6763, CBS 116282, Pl. 948: 2), for which both a culture and sequence exists, as **Reference Specimen**, in order to give a first suggestion for the correct interpretation of the name in the future when the limits within this species complex will hopefully become clearer. This specimen was collected in a montane area of eastern France and grew like the lectotype from central England on angiosperm bark. It clustered in subclade A2 of our *O. auricolor* clade, to which also several British strains under names such as *A. superbus* and *A. pyriformis* belong (Phyl. 28).

Peziza vinosa in its original sense (non s. Albertini & Schweinitz 1805, see under *Orbilia vinosa*, p. 603) was proposed by Persoon (1801) for a caulicolous discomycete growing on 'rootstocks of larger herbs', with minute, round, sessile, subgelatinous, pale wine-coloured or rose, flat apothecia. Later, Persoon (1822: 303) changed the description by referring to a fungus on stems of *Urtica dioica*, with minute, round, subgelatinous, dull yellow-brown to flesh-coloured or rosaceous, shining, thin, flat, immarginate apothecia '½–¾ lin.' [ca. 1–1.5 mm] diam., fruiting in spring and at the end of summer, 'not to be confounded with *Tremella lacrymali*' [= *Dacrymyces sp.*].

In Persoon's herbarium in L two authentic specimens under the name *Peziza vinosa* (near Paris, VIII.1816, on herbaceous stem, 910.256–1356; on old cord, 910.261–343) exist. Both were examined in the present study and contained apothecia referable to *Orbilia auricolor* (with falcate, basally tapered spores †11–12 × 1.2–1.3 µm, IVV: H.B. 7702, 7703). From the date of the former and the substrate of the latter, both cannot be taken as lectotype material of *P. vinosa* Pers. (≡ *P. vinosa* var. *vinosella* Fr.), but it seems clear that Persoon (1822) included at least the caulicolous collection in his concept of *P. vinosa*. In the absence of older authentic material, it remains unclear whether Persoon had *O. auricolor* in hand when describing *P. vinosa* in 1801.

Fries (1822) changed the name *vinosa* to *vinosella* when treating Persoon's caulicolous taxon as a variety of Albertini & Schweinitz's lignicolous *Peziza vinosa* (see p. 604). No material under the name *Peziza vinosa* var. *vinosella* could be located in L, LG, and PC. A specimen in S labelled '?*Orbilia vinosella*' by Rehm (Italy, Südtirol, Bozen, Seis, *Aconitum napellus*, VIII.1907) was identified as *Laetinaevia carneopallida* by Hein (1976: 45). Grelet (1948a: 49) referred a collection on dead stem of *Lycopus europaeus* to *O. vinosa* var. *vinosella*. The detailed description appears to refer to *O. auricolor* or another member of section *Arthrobotrys*.

Helotium karstenii was described by Roumeguère (in sched.) to grow on rotten linen at Toulouse (France), with 1–5 mm large red apothecia with a partly undulating margin, turning light rusty-brown with age, and a 'pseudostipe' with a sparse whitish subiculum. The spores were said to be 'oblong, arcuate, ochre, 0.02 mm long, surrounded by a gelatinous substance'. Saccardo (1880: 78) examined a syntype specimen (probably from PAD) and found the spores to be 'bacilliform, 10–12 × 1 µm, slightly curved, hyaline'. He placed the taxon in synonymy with *O. luteorubella*, an opinion followed by Rehm (1882: 72, 1891: 455), Karsten (1885: 142), and Dennis (1964: 47). Dennis examined a syntype (probably from K) and described the spores as slender and rod-shaped, but appears to have seen them only within the asci, judging from his illustration.

In the two here examined syntype specimens of *H. karstenii* (from H and PC) the apothecia were rehydrated 0.5–1.5 mm diam., bright amber red-brown (PC) or pale cream (H). The microscopic features fit well *O. auricolor*: spore length is at the upper end of the range of *O. auricolor* and the marginal cortical cells of the narrow type. The original apothecial colour (concolorous red but getting paler ferruginous) suggests identity with *O. rubrovacuolata*. However, glassy processes could not be found, and the 1-septate conidia detected on the substrate fit well *O. auricolor*.

The protologue is handwritten but exists as copies (indelible autograph) in different herbaria, thus *H. karstenii* is validly published (ICN Art. 30.6, Turland et al. 2018). The specimen in PC (Pl. 948: 6) is designated here as **lectotype** of *H. karstenii.*

The holotype of ***O. curvatispora*** (Forêt de Montmorency, inner surface of *Quercus* bark, VII.1885, É. Boudier) could not be located in PC. The protologue and drawing (Boudier 1888) comprises white, hardly yellowish apothecia with smooth or scarcely subcrenulate margin, strongly capitate paraphyses, and strongly curved ('semicircular'), filiform, hardly tapering spores measuring 10 × (nearly) 1 µm but attaining 15 µm if stretched (actual length). In his Icones Fungorum Boudier (1904–10: 267, pl. 463) again illustrated the very same specimen on bark, but stated that he later found this species mainly on wood of *Quercus*. From his drawing a spore size of 8–12 × 0.9–1.1 µm (in situ) can be evaluated.

Two authentic specimens from Boudier's herbarium (PC) were examined and found to represent typical *O. auricolor*. One was collected in 1897 in Lyon, while the other is without collection data and also cannot be the holotype because the apothecia grew on the exterior of bark on detaching periderm, which does not look like *Quercus*. The very abundant apothecia are rehydrated 0.8–2 mm large (many over 1 mm, dry 0.7–1.7 mm) while in the protologue they are given as 0.6–1 mm. The spores in this undated collection have a size of 9–12 × 1 µm and are medium curved, the marginal cortical cells are clavate and without glassy caps, and do not form cell rows (IVV: H.B. 6896). A single arthrobotrys-like conidium (22 × 9.7 µm, 1-septate, cells nearly equal-sized) and some uninfected nematodes (partly still inside their eggs) were found on the subiculum of an apothecium.

In the absence of a type specimen, the illustration added to the protologue and the plate in Boudier's Icones Mycologicae must serve as holotype (Arts 8.1, 40.4 ICN). Future sequencing techniques might gain molecular data from the two authentic samples and permit selection of one as epitype of *O. curvatispora*.

For a collection from Himalaya (India) under the name *O. curvatispora*, Thind & Sharma (1980) figured straight or only slightly curved, fusoid, rather short and thick spores. Like in *H. karstenii*, the present reexamination of a duplicate in TAAM revealed typical spores of *O. auricolor* (distinctly sickle-shaped, basally tapered, †7.5–10 × 1–1.2 µm).

O. chrysocoma* var. *brassicicola from Luxembourg on stems of *Brassica oleracea* was at first invalidly described by Feltgen (1899: 55) as '?var. *brassicaecola*' under *O. chrysocoma*, with mostly curved spores of 10–15 × 1 µm. Later, Feltgen (1901) validly described this variety based on a reexamination of the same sample, with slightly curved, sometimes S-shaped spores of 8.5–10 × 0.75–1 µm. The present examination of the holotype revealed slightly to strongly falcate spores of 11–13 × 1–1.2 µm in situ (IVV: 7.IX.1896), and a marginal excipulum composed of broad cells oriented at a high angle, without glassy caps. No associated conidia could be found. The apothecia were described as 1–2 mm diam., yellowish, with undulating margin.

No type material of ***O. drepanispora*** could be located at B, H, L, and C. The taxon was described by Lindau (1904) without illustration. It was based on two collections from the Harz mountains in Germany: on naked wood of *Picea*, Kollieberg, Braunlage; on stumps of large *Picea*, Dicke Tannen, Hohegeiß. Lindau considered the taxon to be close to *O. curvatispora* (= *O. auricolor*), differing 'sharply' in the paraphyses terminated by a globose head and in the 'constantly more or less falcate spores' (7–12 × 1–1.5 µm). He compared his fungus with Rehm's description of *O. curvatispora*. Yet, Rehm (1891: 458) described the spores as worm-shaped (helicoid) and the paraphysis apices as egg-shaped inflated, with a yellowish oil drop. Rehm's interpretation clearly does not match the original concept of *O. curvatispora* but appears to refer to a specimen

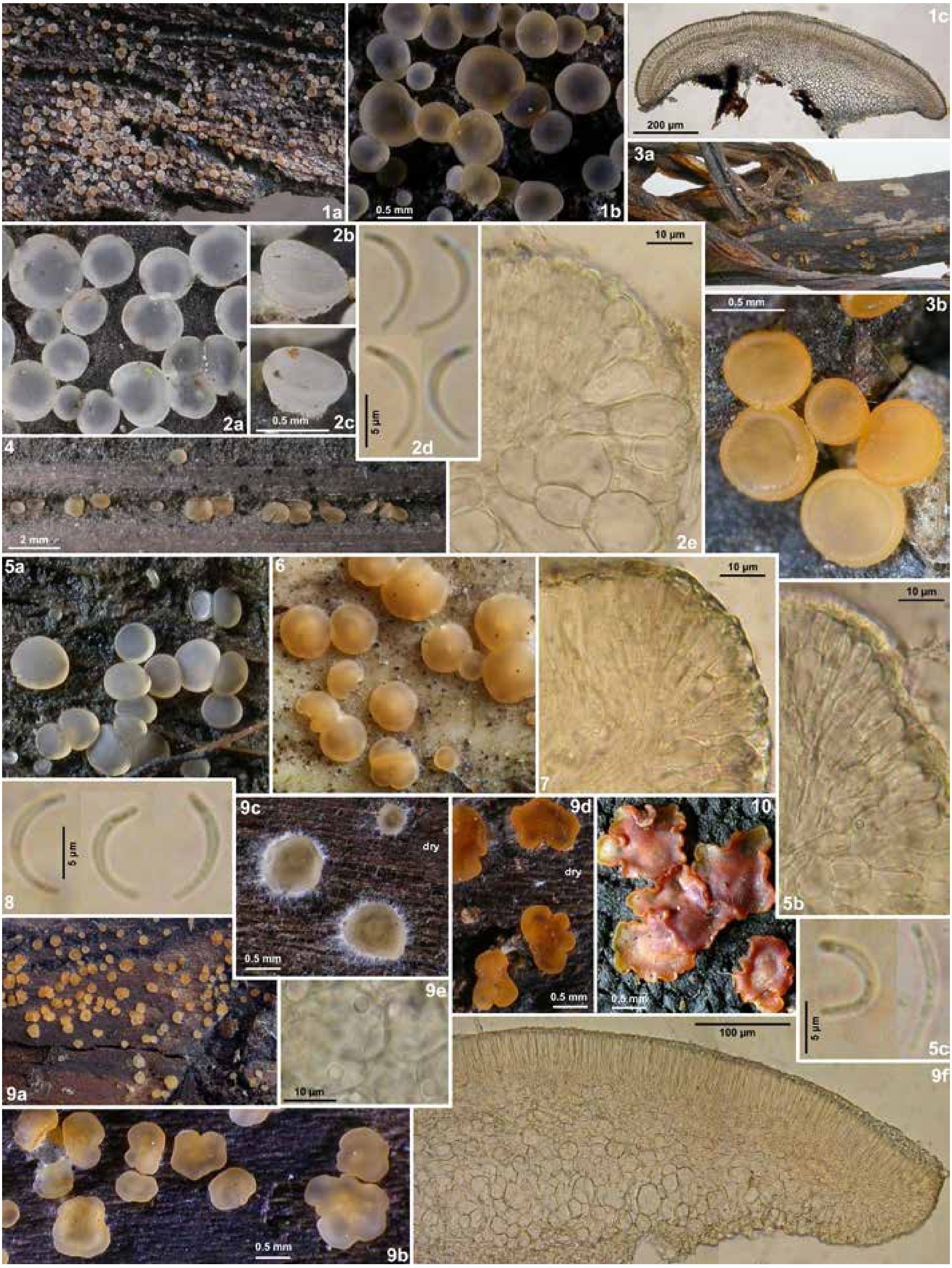


Plate 953. **1–10**: *Orbilia auricolor* s.l. – **2a–c**, **3a–b**, **5**. fresh apothecia; **1a–b**, **4**, **6**, **9a–b**, **10**. rehydrated apothecia; **9c–d**. dry apothecia; **1c**, **9f**. apothecia in median section; **2e**, **5b**, **7**. id., marginal ectal excipulum; **9e**. cells of ectal excipulum containing globose SCBs; **2d**, **5c**, **8**. ascospores. – Living state. – **6**: phot. P. Perz. — **1a–c**. H.B. 8219: France, Charente-Maritime, on *Ulmus*; **2a–e**. H.B. 8898a: Germany, Chemnitz, on (?)*Sorbus*; **3a–b**. H.B. 8826: France, Morbihan, on *Digitalis*; **4**. H.B. 7113: ibid., on *Arctium*; **5a–c**. H.B. 8161: France, Deux-Sèvres, on *Lavatera*; **6**. P.P. 20070827-1: Poland, Piątkowa, on bone of *Sus*; **7**. H.B. 8887: Germany, Chemnitz, on *Salix*; **8**. H.B. 9208: Corsica, on *Hedera*; **9a–f**. H.B. 8132a: France, Deux-Sèvres, on *Ulmus*; **10**. H.B. 7912: Germany, Prignitz, on textile.

of *O. xanthoguttulata* (see p. 851). Why Lindau asserted that Rehm reported a blue iodine reaction of the ascus tips remains mysterious. Lindau had obviously no access to Boudier (1888, 1904–10) and Saccardo (1889), where the spores of *O. curvatispora* are described as rather strongly curved (falcate) and the paraphyses distinctly capitate. These characteristics fit very well the protologue of *O. drepanispora*, which is tentatively placed here in synonymy with *O. auricolor*.

O. curvatispora* var. *robiniae was separated by Velenovský (1934) from the type variety solely by macroscopy ('apothecia 1–2 mm diam., ochraceous, scarcely lobate', no figure provided). No material exists of this taxon (Svrček 1954: 13) and no manuscript plate of Velenovský could be found (see also below under *O. aranea*). Similarly, Velenovský (l.c.) separated ***O. curvatispora* var. *caprina*** by wine-rose, not lobate apothecia of 0.5–1 mm diam. and spores of 5–8 µm, from the type variety for which he gave the spores as 8–15 µm. The spores are strongly arcuate on his manuscript plate, on which he also illustrated asci of 30–40 × 5 µm and medium clavate paraphyses. Also here no material could be found (Svrček l.c.).

O. daphnina was repeatedly collected by Velenovský on *Daphne mezereum* in his garden. Svrček (1954: 14) mentioned only one authentic collection in PRM. The rich material appears to have correctly been referred to *O. auricolor* (as *O. curvatispora*) by Svrček, according to the present reexamination (Pl. 950: 4), which revealed the apothecia to occur together with *Pyrenopeziza caespiticia*, often on old, black pycnidia erumpent beneath the periderm. The asci are larger than given by Velenovský (1934, 25–30 × 4 µm 'incl. stipe') and Svrček (35–37 × 4 µm) whereas the spores well concur with Svrček's (10–13 × 0.8–1 µm) or Velenovský's data (6–10 µm). The narrow marginal cells run under a vertical angle and are covered by very thin glassy cap. The abundant subiculum consists of comparatively broad hyphae (3.5–5 µm) with thick walls (0.3–1 µm), and covers the lower flanks as a 10–15 µm thick layer, but brown hyphae and small brown globose (?)conidia at the base of the apothecia as reported by Velenovský (1934) could not be found. The paraphyses are slightly to strongly capitate, each individual head being covered by rather small warts, in contrast to Velenovský ('slightly inflated, heavily covered by exudate').

Kirschstein (1938) described the new genus and species ***Orbiliella armeniaca*** (on bark of *Quercus*, northeastern Germany) mainly because of the whitish to very pale orange subiculum. Kirschstein seems to have overlooked the curvature of the spores which he described as filiform, 9–11 × 1 µm. The teleomorph features of the rich holotype (Pl. 950: 2), but also the associated anamorph (see below) clearly suggest conspecificity with *O. auricolor*.

Svrček (1992) described ***O. aranea*** because of the conspicuous white subiculum forming a dense mat up to 2 mm around the yellowish-ochraceous, 0.3–2 mm large apothecia, but did not discuss the differences to similar species. In addition to the holotype (on bark of fallen branches of *Populus tremula*, Czechia), Svrček identified as *O. aranea* also several samples 'on bark of accumulated branches of *Robinia*', which he earlier referred to *O. curvatispora* var. *robiniae*. The here examined holotype of *O. aranea* (Pl. 948: 7) well concurs with that of *O. auricolor*, except for the narrower marginal cortical cells (6–14 × 3–4.5 µm) which are tipped by 2–3 µm thick glassy caps. Svrček also mentioned these narrow marginal cells ('only 3–4 µm wide') but not the glassy caps. No conidia were found in association.

Svrček (1954) designated as lectotype of ***O. verrucosa*** a specimen on *Picea* from Mnichovice (PRM 152356) that represents *O. auricolor*. However, we found Svrček's selection to be against the Code, and here declare a specimen on *Pinus* from Vysoké Tatry (PRM 151737) as lectotype of *O. verrucosa* which appears to represent *O. rosea* (see p. 965).

Literature reports of anamorph-teleomorph connections. Three arthrobotrys-like anamorphs with didymosporous conidia and arthrobotryoid conidiophores have been obtained in ascospore isolates of *Orbilia auricolor* s.l. (incl. *O. cladodes*) in the here presented circumscription: Pfister (1994), as *Arthrobotrys superbus* s. Drechsler, from apothecia on dung, teleomorph misidentified as *O. fimicola* (Pl. 949: 2); Pfister & Liftik (1995), as *A. cladodes* var. *macroides*, from apothecia on bark, teleomorph as *O. auricolor* (Pl. 949: 1); Liu (2006: 52, pl. 11–12), as *A. cladodes*, from apothecia on wood, teleomorph as *O. auricolor* (IVV: HMAS 139635).

Other anamorphs reported as being connected to *O. auricolor* in a wider sense (*A. javanicus*, *A. oligosporus*, *A. psychrophilus* ?= *A. elegans*, *A. yunnanensis* = *A. multiformis*) are more easily recognizable. Three of them have acrogenous to candelabrelloid conidiophores and two have very differently shaped conidia. *A. javanicus* and *A. oligosporus* are not sharply delimited in conidial morphology from what we saw in our *O. auricolor* strains, nevertheless they strongly differ in their molecular data, the former also in candelabrelloid conidiophores.

The two anamorphs reported by Pfister (*A. superbus*) and Pfister & Liftik (*A. cladodes* var. *macroides*) resemble each other quite closely in conidial morphology when comparing Drechsler's drawings. Regrettably, Pfister did not describe *A. superbus* in detail. His photo shows a conidiophore with a single conidial cluster at the tip (Pl. 949: 1j), unlike *A. superbus* which is said to have typically a geniculate proliferation resulting in nodes in a chain (Drechsler 1937a: fig. 1). Perhaps therefore, Pfister identified the anamorph only 'tentatively' as *A. superbus*.

Two earlier observations already point to a conidial state of *O. auricolor*, though only on the natural substrate: Kirschstein (1938, on bark, type of *Orbiliella armeniaca*, Pl. 950: 2) reported 2-celled conidia of 18–20 × 8–9 µm formed on not further specified conidiophores that emerged from the subiculum. He regarded this as the anamorph and provisionally as belonging to the genus *Trichothecium*. Reexamination of the holotype suggests that these conidia might belong to *A. superbus*, but conidiophores were not observed. Velenovský described on an unpublished manuscript plate obpyriform conidia in association with '*Orbilia pyrifera*' (on stems of *Arctium*, 18.VI.1925; non *O. pyrifera* Velen. 1947 = *Hyalorbilia inflatula*). The teleomorph fits *O. auricolor*, but the 1-septate, 20–22 µm long conidia with the upper cell distinctly larger than the lower cell resemble those of *A. oligosporus* as described by Drechsler (1934a, see Pl. 955: 3), but also part of the conidia observed by us in some samples of *O. auricolor* (Pls 948: 5g; 951: 1f). Also here conidiophores were not described.

In a nematode-infested culture of *A. superbus*, Drechsler (1937a: 458, fig. 18 R) obtained apothecia of an unidentified discomycete, but he could not exclude a contamination. According to his figure showing inverse orientation of the lower spores within the asci, this fungus clearly belongs to *Orbilia*. With its short, clavate, slightly curved spores (~4.5–5.2 × 1–1.3 µm evaluated from scale) it resembles *O. flexispora* or *O. cyparissias* (incertae sedis).

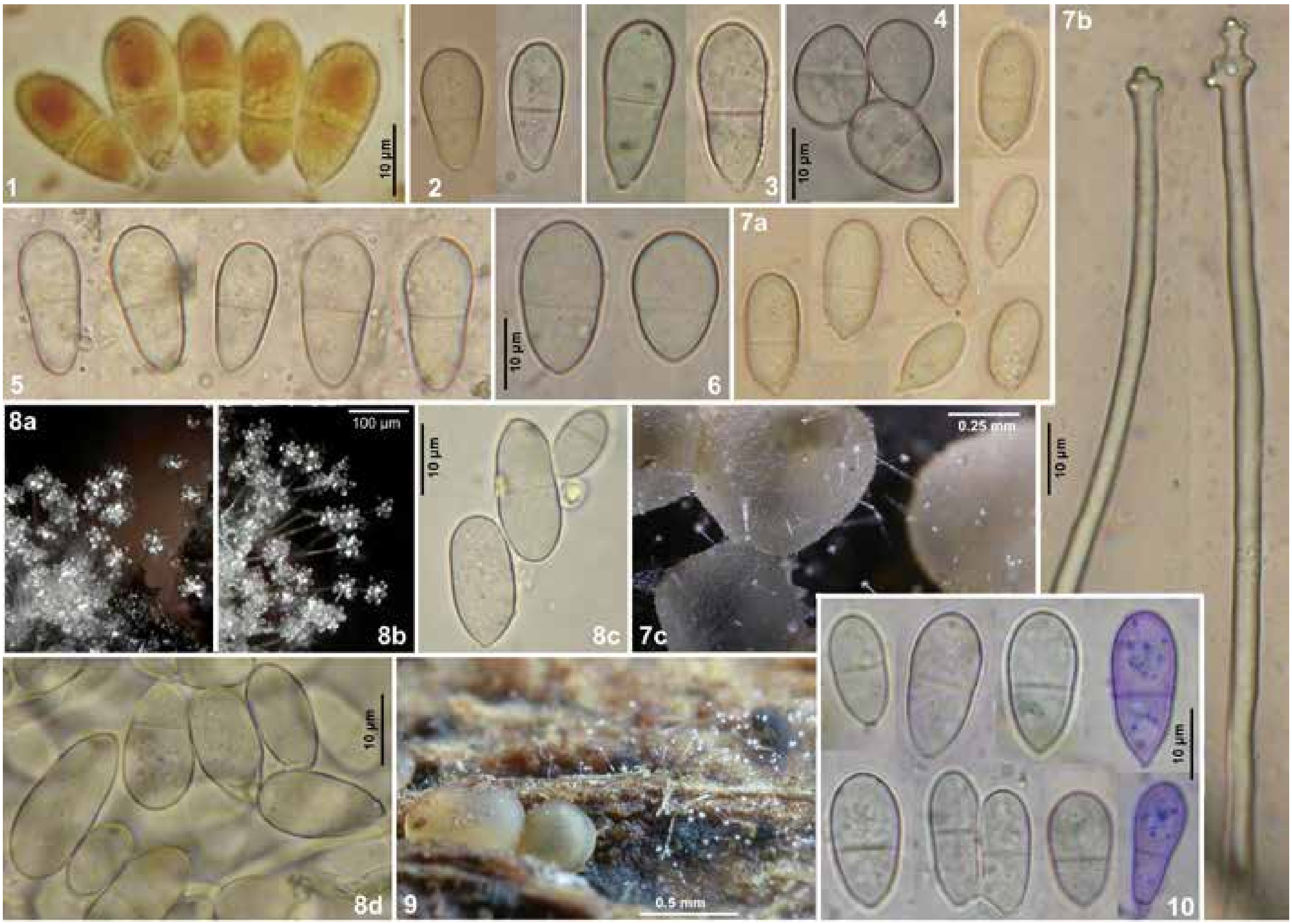


Plate 954. **1–10**: *Orbilia auricolor* s.l. – Conidia and conidiophores (**1–3**, **5–10**: from substrate, **4**: from culture, **9**: with two associated apothecia). – Living state (**10** p.p. in CRB), except for **1** (in IKI). — **1**. H.B. 7472: Spain, Guadarrama, on *Ulmus*; **2**. H.B. 8219: France, Charente-Maritime, on *Ulmus*; **3**. H.B. 8161: France, Deux-Sèvres, on *Lavatera*; **4**. H.B. 8428a: Luxembourg, Beaufort, on *Fagus*; **5**. H.B. 9003; Germany, Chemnitz, on dung of *Capreolus*; **6**. H.B. 8132a: France, Deux-Sèvres, on *Ulmus*; **7a–c**. H.B. 8898a: Germany, Chemnitz, on (?)*Sorbus*; **8a–d**. 5.XI.2010: Luxembourg, Syren, on *Fagus*; **9**. H.B. 7560: Great Britain, Suffolk, on *Lupinus*; **10**. H.B. 9553: Germany, Bayern, on *Sorbus*.

Anamorphs in present study. In 28 out of ca. 140 collections of the teleomorph here referred to *O. auricolor* s.l. an anamorph was observed, though often only some detached conidia. These anamorphs, which were either grown from ascospore isolates or mainly found on the natural substrate, varied more or less in conidial size, shape and septation among each other. Due to this variability and the ambiguous literature data, we were unable to decide to which of the described anamorph-typified taxa they can best be assigned. Our strains roughly fall into two morphological groups based mainly on conidial shape and size. Yet, no sharp border could be drawn among the two groups:

(1) three specimens with rather large, cylindric-ellipsoid to ± obpyriform conidia (Pls 948: 5; 951: 1, 4) resemble *Arthrobotrys oligosporus* var. *oligosporus*. However this taxon was described by Fresenius (1850) with much larger (up to ~36 × 18 µm), more strongly obpyriform or obovoid conidia, in which the upper cell is consistently larger than the lower cell (see p. 1540). Such conidia, albeit smaller, were only sometimes found in our specimens (e.g., Pl. 948: 5g, 4 larger conidia). The original description of *A. oligosporus* otherwise fits quite well our three specimens with rather large conidia. Based on conidial size and more equally sized cells, a further possible name for this anamorph is *A. arthrobotryoides* (Berl.) Lindau in the interpretation of Drechsler (1944a), Haard (1968), or Swe et al. (2008a), but Hoog & Van Oorschot (1985) regarded this species in the absence of type material as doubtful in its original sense.

(2) In the majority of our specimens we observed smaller, cylindric-ellipsoid or only slightly obpyriform conidia with ± equally sized cells (Pls 948: 2, 6, 8; 949: 2; 951: 3; 954: 1–3, 5, 7–10). These fit quite well *A. superbus* (but also *A. macroides*) as described by Drechsler (1937a, 1944a), Haard (1968), Jarowaja (1970), Van Oorschot (1985), or Swe et al. (2008a). Pfister & Liftik (1995) identified their collection as *A. cladodes* var. *macroides* apparently because of the presence of chlamydospores, size and predominantly median septation of conidia, and the kind of apical branching of the usually non-proliferating conidiophores. Drechsler distinguished his var. *macroides* also by conidia with a small basal protrusion, which is absent in typical *A. cladodes* but also in Pfister & Liftik's strain referred to var. *macroides*.

However, conidial size and shape varies within group (2). In some specimens the conidia were partly aseptate and comparatively small (Pls 951: 1, 3, 4; 954: 7). In such cases the conidia can usually be separated to some extent into a larger and a smaller type, the latter measuring *11–19 × 5.3–8 µm, but they are not sharply enough separated from the large ones to call them microconidia. Two types of conidia, though always 1-septate, were observed in the Italian sample on dung (Pl. 948: 5), the large ones resembling *O. oligospora*. Intermediate cases of short and wide, more obovoid conidia also occur (Pl. 954: 4, 6).

In a specimen on *Lupinus* (IVV: H.B. 7560) the aseptate conidia became larger and 1-septate after a few days in a moist chamber, whereas they remained small and non-septate under such conditions in the specimen on (?)*Sorbus* (Pl. 954: 7). Similarly, Drechsler (1937a) obtained in *A. oligosporus* only in nematode-infested cultures conidia typical of that species, whereas in cultures without nematodes smaller and less obpyriform conidia developed, comparable to ours.

Nomenclature of anamorph. The identity of the different anamorph-typified names that show morphological resemblance with the anamorphs observed within *O. auricolor* s.l. is difficult to determine. This difficulty originates from the observed morphological variability of the anamorph and the heterogeneous species concept of *O. auricolor* according to available DNA data. What makes classification within *Arthrobotrys* quite problematic is the fact that morphological data from the literature (Drechsler 1937a, 1944a, Haard 1968, Jarowaja 1970, Van Oorschot 1985) are often somewhat contradictory.

There are mainly three anamorph-typified names that come into consideration as the anamorph of *O. auricolor* s.l. as interpreted by us: ***Arthrobotrys superbus***, ***A. cladodes***, and ***A. macroides***. These are problematic in their morphological as well as molecular delimitation. Drechsler (1937a) cautiously distinguished between them, but he was aware of their close relationship.

Chain-like or geniculate proliferation and branching of conidiophores have currently been used as a key character to distinguish between ***A. superbus*** (with proliferation, unbranched) and ***A. cladodes*** or ***A. macroides*** (without proliferation, unbranched or branched), see Drechsler (1937a: figs 1–2, 1944a: fig. 1), Haard (1968), Van Oorschot (1985: figs 54, 61), and Swe et al. (2008a: figs 2, 6). Haard (1968) classified *A. superbus*, *A. oligosporus*, and *A. conoides* as unbranched. Yet, Van Oorschot found in cultures assigned to *A. superbus* that 'branching becomes increasingly evident with subculturing' compared to the natural substrate or fresh culture, and Jarowaja (1970: fig. 8) illustrated a Polish strain under the name *A. cladodes* var. *macroides* showing proliferation. Pfister (1994) and Pfister & Liftik (1995) figured only non-proliferating conidiophore tips in their strains referred to *A. superbus* and *A. cladodes* var. *macroides*, the latter with apical branches (Pl. 949: 1j, 2j). Proliferation occurred in five of the nine samples in which we observed conidiophores (see Pl. 948: 2; 951: 1g–h, 3g), but branching was generally not observed. In some other samples we only saw non-proliferating conidiophores (Pl. 954: 7b).

According to Drechsler (1937a, 1944a), Haard (1968), and Van Oorschot (1985), *A. cladodes* var. *macroides* has longer and narrower conidia with a small basal protrusion compared to *A. cladodes* var. *cladodes*, measuring *(13–)15–21(–26) × (5–)6–7(–8.2) µm vs. *(11–)13–16.5(–18) × (6.2–)7–8(–8.8) µm in var. *cladodes*, and also differs in the presence of chlamydospores. Confusion between the two taxa is exemplified by strain D.H.P. 90, which Pfister & Liftik (1995) identified as *A. cladodes* var. *macroides*, apparently because it formed chlamydospores in culture. Its sequence, however, falls in the clade of *O. cladodes* (Phyl. 28). This could mean that chlamydospores have been overestimated as a taxonomic character. Also it cannot even be excluded that Drechsler's two type strains represent a single species. Two further strains referred to *A. cladodes* var. *macroides* (CBS 120.54, 493.90) belong from their sequence data to the *O. auricolor* clade (see Phyl. S32 regarding CBS 120.54 which is the only strain studied by Van Oorschot under the name *A. cladodes* var. *macroides*).

Another taxon of relevance is *A. irregularis*, which was described by Matruchot (1892) as a variety of *A. superbus* and raised to species level by Mekhtieva. The illustrated conidiophore morphology suggests affinity with *A. conoides* and *A. macroides* rather than *A. superbus*. As conidial size he only gave a length of 25 µm and a maximum width of 12 µm for the upper cell and 8 µm for the lower cell. From the given magnification a size of ~18–31 × 8.5–11.5 µm can be evaluated, with the lower cell ~6.5–9.5 µm wide. This is larger than described in *A. conoides* and *A. macroides*.

A. superbus was described by Corda (1839) from the natural substrate with very long, unbranched conidiophores with 9–16 nodes with conidial clusters simultaneously formed at intervals along their entire length. Thereby, the conidiophore filament is apically hardly narrower than basally and seemingly unable to stay erect.

Jarowaja (1970) considered *A. superbus* as a species known only from the type collection, being non-predacious and characterized by conidia with double walls and strong constriction at the septa. However, her drawn copy of Corda's figure is rather inexact and incorrect, and the 'double wall' is merely a comparatively thick cell wall.

Van Oorschot's (1985) species concept of *A. superbus* is found to be rather heterogeneous when comparing available DNA data from 17 of a total of 18 strains studied by her. These data, which were obtained from alignment queries in the CBS database, suggest that she included in *A. superbus* mainly anamorphs referable to the *O. auricolor* clade (subclades A1–A2) and the *cladodes-botryosporus* clade (subclades C1, C3, see below and Phyl. 28), and two which are of unclear relationship (Tab. S7) Regrettably, she did not specify from which collections her drawings derive (Van Oorschot l.c.: fig. 61). Also the two strains of *A. cladodes* studied by her comprise both clades (CBS 297.84: subclade C1, CBS 433.81: subclade A1) (Phyl. 28, S32), and her single studied strain of *A. cladodes* var. *macroides* (CBS 120.54) belongs to the *O. auricolor* clade (subclade A1) (Phyl. S32, LSU). On the other hand, her concept of *A. pyriformis* also includes one species of *O. auricolor* (CBS 602.80, see Tab. 87).

A majority of Van Oorschot's *A. superbus* strains belong to subclade A2 of the *O. auricolor* clade, according to ITS data in the CBS database, but none with certainty to subclade A1, or they belong to the *cladodes-botryosporus* clade. In order to avoid more name changes than necessary, a reference specimen of *A. superbus* should be selected, perhaps among the CBS strains studied by Van Oorschot, preferably one of those European strains for which also ITS is available (Netherlands 263.83, 662.70; Belgium 507.83, 619.82). However, since we do not know any illustration that derives from one of these strains, we here refrain from proposing a reference specimen.

One of Van Oorschot's *A. cladodes* strains (CBS 297.84, USA, Wisconsin, *Pinus strobus*) belongs to the *cladodes-botryosporus* clade (subclade C1 = *O. cladodes*), and also two Chinese strains identified as *A. cladodes* are conspecific (HMAS 139635, Liu 2006: fig. 12; YMF 1.01839). The other of Van Oorschot's *A. cladodes* strains (CBS 433.81, UK) belongs in the *O. auricolor* clade (A1). Since *A. cladodes* was originally described from North America, we here designate CBS 297.84 (CBS H-8895) as **Reference Specimen** of *Arthrobotrys cladodes* (illustration: Van Oorschot 1985: fig. 54).

Not included collections. In a collection from Germany (on *Althaea*, H.B. 6709, Pl. 952: 1) the ascospores are only slightly (to medium) attenuated towards base, and an anamorph of unclear relationship was observed in association. The rather small, 0–1-septate conidia resemble microconidia and are formed singly at the tip of short conidiophores which appeared to have emerged from the marginal cortical cells. A further collection from Germany (on xeric *Salix* bark, Pl. 952: 2) and one from Algeria (on indet. bark, MPU, IVV: H.B. 5601) possess comparatively short and slightly curved ascospores (dead state) and their anamorph is unknown. A collection from Japan (on ?*Populus* bark, TNS-F-56841, IVV: H.B. 9991) is not included because of frequently slightly spathulate paraphyses.

In a collection from China, Guizhou (Z.F. Yu pers. comm., on indet. bark, IVV: gz-26) the teleomorph did not show any differences to typical *O. auricolor* (ascospores *8–11 × 1–1.2 µm, subulate, strongly tapered towards base, medium to strongly curved; marginal ectal excipulum vertically oriented, without glassy caps). In pure culture it formed 1-septate, cylindric-ellipsoid microconidia of *13.3–17.8 × 3.9–4.5 µm in brush-like arrangement on small nodules along the upper part of the microconidiophores, and 3-septate, cigar-shaped macroconidia of *23–28.5 × 4.8–5.5(–6) µm singly at the conidiophore tip. *Arthrobotrys iridis* resembles this isolate but has longer microconidia and much larger, partly branched macroconidia (see under *O. multiformis*, p. 1547).

The following three unidentified taxa lack anamorph data and are treated as ***O*. aff. *auricolor*** because their rDNA data place them very distant from *O. auricolor* and *O. cladodes*. (1) A collection from Serbia on *Iris* leaf (15.VI.2017, IVV) with whitish apothecia 0.6–1.5 mm diam. and medium curved ascospores (*9.3–10 × 1.1–1.2 µm) with tear-shaped SBs (*1.3–1.5 × 0.6 µm) clustered in vicinity of *A. pravicovii*. (2) Two collections from Luxembourg on xeric *Fagus* bark (IVV: 25.IX.2017, 27.XI.2018) have whitish apothecia 0.4–0.9 mm diam. and comparatively short, medium curved ascospores (*7–9 × 1.1–1.3 µm) with narrowly tear-shaped to almost filiform SBs (1–1.4 × 0.3–0.4 µm). They are phylogenetically related to (3) a collection from French Pyrenees on xeric *Fraxinus* bark (IVV: H.B. 10024) which has orange-ochraceous apothecia 1–2 mm diam. and comparatively short, strongly curved ascospores (7.5–8.5 × 1–1.3 µm) with ± tear-shaped SBs (~0.8 × 0.3–0.5 µm). No glassy caps occurred on the almost vertically oriented marginal excipular cells in all three taxa.

For the listed uncertain synonyms of *O. auricolor* see under Type studies and Anamorph. Their conspecificity with the here defined concept of *O. auricolor* s.str. cannot be ascertained without sequence data, but they are included in the description which comprises also *O. cladodes*.

Phylogeny. Sequences of the *O. auricolor* aggregate were available for a large number of samples (Tab. 81). Because of their high molecular and partly also morphological heterogeneity, the aggregate forms various clades across series *Arthrobotrys* (Phyl. 28). Two large clades, which are phylogenetically distant from each other, are called here *O. auricolor* clade (= *O. auricolor* s.str., with subclades A1–A2) and subclade C1 (= *O. cladodes*) of the *cladodes-botryosporus* clade. These clades include morphologically quite indistinguishable teleomorphs and anamorphs. Other clades in which *O. auricolor*-like teleomorphs occur, are the *scaphoides-pravicovii* clade, the *elegans-gampsosporus* clade, the *oligospora-musiformis* clade, *O. multiformis*, and *O. javanica*. Each of the former three clades is morphologically heterogeneous by including very different conidial types. Two unnamed clades clustered distant from the preceding: B.L. 6225 (as *O. auricolor*/*A. oligosporus*) appears to be related to two CBS strains: CBS 121.54 and 384.73 (as *A. superbus*); H.B. 10024 and G.M. 2017-09-25.1/2018-11-27.1 (all as *O. auricolor*, without anamorph data) form a supported clade.

When analysing SSU+ITS+LSU (Phyl. S33), two of the named clades received strong support (*O. auricolor*, *cladodes-botryosporus* clade) and two medium support (*oligospora-musiformis* clade, *scaphoides-pravicovii* clade). Besides *O. cladodes* (C1), the *cladodes-botryosporus* clade includes *O. latispora* s.l. (subclades C2–C3) and *A. botryosporus* (subclade C4), and the *scaphoides-pravicovii* clade includes also *A. macroides* (Phyl. 28). Characteristic nucleotides for these clades are listed in Tabs 82–83.

Table 81. Strains of *O. auricolor* s.l. (forming morphologically ± indistinguishable anamorphs and/or teleomorphs) with available rDNA data gained from apothecia (ap), ascospore isolates (ai), conidial isolates (ci). A = *O. auricolor* clade, C = *cladodes-botryosporus* clade, S = *scaphoides-pravicovii* clade, * = RefSpec of *O. auricolor*, # = teleomorph not observed. § = anamorph not observed; (+) = unavailable sequence at CBS, for H.B. 8898a only S1506 intron available. Note that present description of *O. auricolor* includes clades A1/2 and C1 because of paucity of molecular identifications.

Strain	Originally identified as	Current interpretation	Geographical origin	Substrate	S1506	isol.	rDNA	Plate	Clade
D.H.P. 90	*A. macroides*	*O. cladodes*	USA, MA, Norfolk	angiosperm bark	–?	ai	ITS	949: 1	C1
D.H.P. 60	*A. ?superbus*	*O. cladodes*	USA, MA, Berkshire	*Capreolus* dung	–	ai	SSU ITS	949: 2	C1
HMAS 96824	*O. auricolor*	*O. cladodes*	China, Tibet, Bomi	?	?	ai	LSU	–	C1
HMAS 139635	*A. cladodes*	*O. cladodes*	China, Beijing	?	–?	ai	ITS LSU	–	C1
CBS 107.81$^{\#}$	*A. superbus*	*O. cladodes*	Belgium	indet. bark	(+)	ci	SSU (ITS)	–	C1
CBS 367.75$^{\#}$	*A. superbus*	*O. cladodes*	Finland	*Picea* stump	(+)	ci	ITS LSU	–	C1
TU(M) 104916§	*O. auricolor*	*O.* aff. *auricolor*	Serbia, Novi Sad	*Iris* stem	–	ap	ITS LSU	IVV	S
H.B. 6664	*O. auricolor*	*O. auricolor*	Germany, Halle	*Arctium* stem	+	ai	SSU ITS LSU	951: 1	A1
CBS 340.94$^{\#}$	*A. robustus*	*O. auricolor*	Germany, Berlin	*Sorbus* bark	+	ci	SSU ITS LSU	–	A1
CBS 433.81$^{\#}$	*A. cladodes*	*O. auricolor*	UK	?	+	ci	SSU ITS LSU	–	A1
H.B. 9208	*O. auricolor*	*O. auricolor*	France, Corse	*Hedera* bark	–	ap	ITS LSU	953: 8	A1
H.B. 8898a	*O. auricolor*	*O. auricolor*	Germany, Chemnitz	?*Sorbus* bark/wood	+	ap	(S1506 intron)	953: 2, 954: 7	A2
ATCC 966776$^{\#}$	*A. superbus*	*O. auricolor*	USA, California	indet. wood	+	ci	ITS LSU	–	A2
H.B. 6763	*O. auricolor**	*O. auricolor*	France, Gérardmer	*Alnus* bark	+	ai	SSU ITS LSU	948: 2	A2
G.M. 2014-10-11.3$^{\#}$	*O. auricolor*	*O. auricolor*	Luxembour, Bettembourg	*Heracleum* stem	+	ci	ITS LSU	IVV	A2
H.B. 10024§	*O. auricolor*	*O.* aff. *auricolor*	France, Pyrénées, Escot	*Fraxinus* bark	–	ap	ITS LSU	IVV	basal
G.M. 2017-09-25.1§	*O. auricolor*	*O.* aff. *auricolor*	Luxembourg, Walferdange	*Fagus* bark	+	ap	SSU ITS LSU	IVV	basal
G.M. 2018-11-27.1§	*O. auricolor*	*O.* aff. *auricolor*	Luxembourg, Graulinster	*Fagus* bark	+	ap	SSU ITS LSU	IVV	basal

Also when analysing the S1506 intron, *O. auricolor* (except CBS 109.52) and *O. latispora* s.l. of the *cladodes-botryosporus* clade formed two distant, strongly supported clades (S30). Surprisingly, *A. superbus* (CBS 109.52, subclade A2) and *A. botryosporus* (subclade C4) clustered, contrary to ITS and LSU analyses, in a separate, unsupported clade together with *O.* cf. *elegans* (subclade E2) and *O. multiformis*. CBS 109.52 nested with a 2.5% distance close to *O.* cf. *elegans* while differing by ~10.5–11.5% from the *O. auricolor* clade. In comparison, the distance between the *O. auricolor* clade and the *cladodes-botryosporus* clade, or between the latter and the *elegans-gampsosporus* clade lies around 11.5–18.5%. The intron of CBS 109.52 differs from other strains also in having about double length. This intron and the ITS region were twice sequenced (U51949, Liou & Tzean 1997; KT215210, G. Hagedorn), with almost the same result (1 nt and 2 gap deviation).

Cladodes-botryosporus **clade** (with subclades C1–C4). In Pfister's (1997: fig. 12) phylogenetic analysis of the ITS region, his two North American strains (D.H.P. 60 and 90) clustered in a strongly supported clade and their close morphological similarity is supported by a 0.8% distance (4 nt, 1 gap), hence we conclude that they are conspecific. In the analysis by Hagedorn & Scholler (1999: fig. 2), Pfister's two strains clustered with *A. botryosporus* (CBS 321.83) and *A. pravicovii* (as *A. conoides*, SBUG-M12) in a clade. In our analysis of ITS (Phyl. 28), *A. botryosporus* (subclade C4) clustered in the *cladodes-botryosporus* clade, whereas *A. pravicovii* formed with *O. scaphoides* the medium supported *scaphoides-pravicovii* clade which clustered in our combined analyses with strong support sister to the *cladodes-botryosporus* clade (Phyls 25, S33), although both *A. botryosporus* and *A. pravicovii* show a similar distance of 4–5% to Pfister's strains.

A. cladodes (subclade C1) comprises at present eight strains. The ITS region was available for seven of them: Pfister's two from Massachusetts (D.H.P. 60 & 90), two from China (Beijing, HMAS 139635; Yunnan, YMF 1.01839, both as *A. cladodes*), one from Lithuania (GU062287, as *Arthrobotrys* sp.), one from Finland (CBS 367.75, as *A. superbus*), and one from Wisconsin, USA (CBS 297.84, RefSpec of *A. cladodes*), but exists also for CBS 107.81 (from Belgium, as *A. superbus*). Their variance lies in the range of 0.2–1.5%, the closest (0.2%) between D.H.P. 60 and the Wisconsin strain. For D.H.P. 60 the intron is absent whereas for CBS 367.75 and CBS 107.81 the S1506 intron exists in the CBS database (Tab. 81).

Subclades C2 and C3 include seven strains of *O. latispora* s.l. which has characteristic, shorter and wider ascospores (Pls 971–973), and subclade C4 represents the ex-type strain of *A. botryosporus* with non-septate conidia (Phyl. 28). Subclades C2–C4 show an ITS distance of 3.3–5.5% to subclade C1. The *cladodes-botryosporus* clade comprises only taxa with 0–1-septate, ellipsoid-ovoid conidia, whereas the *scaphoides-pravicovii* clade includes 1-septate, ellipsoid-ovoid conidia (*A. pravicovii*, A. *macroides* SBUG 160) as well as much larger, 2–4-septate fusiform conidia (*O. scaphoides*, Pls 974–975). *A. koreensis* with 1-septate, obovoid conidia clustered unresolved in regard to these two clades (Phyl. 28). But even *O. scaphoides* and *A. koreensis* differ from subclade C1 by only 4.5–5%.

When analysing LSU, subclades C1–C4 are not clearly resolved (S32). Eight LSU sequences belonging to clade C were available in GenBank and two unofficial ones in the CBS database. They include four Chinese strains under the names *A. cladodes* (YNUCC 3528) and *O. auricolor*/*A. cladodes* (B.L. 6141, 6202, X087; Liu 2006: figs 11–12). Also the unofficial LSU sequence of the RefSpec strain of *A. cladodes* from Wisconsin (CBS 297.84) and a strain from Finland (CBS 367.75, as *A. superbus*, MH872670, not shown), clustered, besides a strain from Oman (CBS 109508, as *A. javanicus*), an environmental strain from USA, *A. botryosporus*, and *O. cf. latispora*, in the *cladodes-botryosporus* clade. Only three of these strains possess also ITS (B.L. 6202, CBS 297.84, 367.75) and permit recognition of the subclade. When assuming that pos. 541 of LSU D2 (Tab. 83) is characteristic for subclade C1 (C**TT**, vs. C**C**T in subclades C3, C4, and environmental strain O34), then the critical B.L. X087 and CBS 109508 belong to subclade C1.

In a phylogenetic analysis of the ITS+LSU region by X.Z. Liu and X.Z. Jiang (pers. comm.) presented in Amsterdam in 2012, in which many strains comprised only ITS and some only LSU, the three Chinese HMAS strains clustered in a clade with Pfister's strains (subclade C1). The four Chinese strains with LSU deviate from each other by 1–2% in the D1–D2 domain, whereas the available LSU sequences of the *O. auricolor* clade deviate from each other by only 0–2 nt and 0–1 gaps, including an unofficial one from Texas (CBS 349.76). However, the *cladodes-botryosporus* clade differs in this region from the *O. auricolor* clade merely by 1.2–2.5% and from *A. macroides* (SBUG 160) and *O. scaphoides* by 1.3–1.7%. Specific nucleotides that separate these clades are listed in Tab. 83.

The S1506 intron was available within the *cladodes-botryosporus* clade in three sequences of the Asian *O. latispora* s.l. (C2–C3) but in none of clade C1 (*O. cladodes*). However, the intron exists for two strains in the CBS database (Tab. 81), showing distant affinities to *O. latispora* s.l., particularly to subclade C3.

O. auricolor **clade** (with subclades A1–A2). This clade differs from the *cladodes-botryosporus* clade by 8–10% in the ITS and by 1.2–2.5% in the LSU. In Hagedorn & Scholler's analysis it includes two British strains isolated and identified by Duddington as *A. cladodes* (CBS 433.81, UK, with unknown ecology) and *A. superbus* (CBS 109.52, UK, Surrey, apparently the strain from horse dung named *A. conoides* by Duddington 1951). The two strains show an ITS distance of 2.3% to each other, hence could be conspecific. Our two central European ascospore isolates (H.B. 6664, Sachsen-Anhalt; H.B. 6763, Vosges) likewise deviate from each other by 2% (10 nt and 13 gaps) and each clustered with one of Duddington's strains by forming two supported subclades, A1 and A2 (Phyl. S33, see also Phyl. 28).

Subclade A1 includes four strains: H.B. 6664 and H.B. 9208 (Corse) with a 0.2% ITS distance and a characteristic deletion of 5 nt near the 3'-end of ITS2 where most other members of series *Arthrobotrys* have CCTAC, also *A. cladodes* (CBS 433.81) and *A. pyriformis* (CBS 340.94) with a 0.4–0.6% distance from those. Subclade A2 includes H.B. 6763 (RefSpec of *O. auricolor*) and G.M. 2014-10-11.3 (Luxembourg), which fully concur in the ITS, H.B. 8898a (Sachsen), for which only the fragmentary S1506 intron was available (not shown), four partly unofficial sequences under the names *A. superbus* (ATCC 96676, California; CBS 115.61, MH857992; Québec; CBS 619.82, Belgium) and *Geniculifera cystosporia* (CBS 130.83), which differ in the ITS by 0–0.4% from the former strains, and three environmental isolates. Duddington's *A. superbus* (CBS

Table 82. Nucleotide positions in the ITS1-5.8S-ITS2 region that separate different groups within the *O. auricolor* aggregate: 26 positions differ between the *cladodes-botryosporus* clade (C1–C4) and the *O. auricolor* clade (A1–A2), additional 6 positions between C1 (*A. cladodes*) and *O. auricolor (*A1–A2), and 11 positions between A1 and A2. Note frequent identity of subclades A, E, and O32, and likewise within clade C. – A1 = subclade with H.B. 6664, A2a = CBS 109.52 and isolate 2569, A2b = remaining strains (including H.B. 6763 = RefSpec of *O. auricolor*), C2 = *O. latispora*, C3 = *O.* cf. *latispora*, C4 = *A. botryosporus*, E1 = *O. elegans*, E2 = *O.* cf. *elegans*, E3 = *A. gampsosporus*, O32 = *Arthrobotrys* sp. (ATCC MYA-4125, Houseknecht & Zhou ined., EU331088). Position numbers starting after ATCATTA by including all inserts, Str. = number of strains; C1* = B.L. 6202, C2* = B.L. 4203.

Clade	Str.	7–9	22–25	60–67	112–116	145–150	203	235	326	390–400	405–408	415–416	423–424	446–455	477–481	491–492	505–509	519–522	538–542
C1	6	A-G	ACTT	TGG--TCT	TWC-A	CCTTTA	C	C	C	CATGAACCTGCT	TG-A	AG	TC	CGTTCAGCCC	CACTG	AA	GAACA	T-GA	CTTCT
C1*	1	A-G	ACTT	TGG--TCT	TTC-A	CCTTTA	C	G	C	CATGAACCTGCT	TGAA	AG	TC	CGTTCAGCCC	CACTG	AA	GAACA	T-GA	CTTCT
C2	3	A-G	ACTT	TGG--TCT	TTG-A	CCTTTG	C	C	C	CATGAGCCTGCT	TGAA	GA	CC	CGTTCAGCCC	CACTG	AG	GGACA	T-GA	CTTCT
C2*	1	A-G	ACTC	TGG--TCT	TTG-A	CCTTTG	C	G	C	CATGAGCCTGCT	TGAA	GA	CC	CGTTCAGCCC	CACTG	AG	GAACA	T-GA	CCTCT
C3	3	A-G	ACTC	TGG--TCT	TTG-A	CCTTCA	C	C	C	CGTGAACCTGAA	T-AA	AG	TC	CGTTCAGCCC	CACTG	AG	GGAGC	T-GA	CTTCT
C4	1	A-G	ACTT	TGG--TCT	CTG-A	CCTTTA	C	C	C	CATGAACCTGAA	T-AA	AG	TC	CGTTCAGCCC	CACTG	AG	GGACA	T-GA	CCTCT
A1	4	ACG	ACTT	TGG--TTA	CTC-A	ACCAC-	T	G	T	TTTGAACCGGAA	TGTC	CA	TT	TGCTCTGCCA	AACTA	GG	AGGC-	T-GT	TTTTC
A2a	2	ACG	GCTC	CGG-TTTA	CTG-A	ACCAC-	T	G	T	TTTGAACCGGAA	TACC	CA	TT	TGCTCTGCCA	AACTA	GG	AAGC-	TGGA	TTTTC
A2b	9	ACG	GCTC	CGGTTTTA	CTG-A	ACCAC-	T	G	T	TTTGAACGGGAA	TTCA	CA	TT	TGCTCTGCCA	AACTA	GG	AAGC-	TGGA	TTTTC
E1a	2	ACG	ACTG	CAG--TCA	CTC-A	CCTTT-	T	G	T	TTTGAACCGGAA	T--A	YG	TT	TGCTCTGCCA	CACTA	AA	AAGC-	T-GA	TT-CT
E1b	6	ACG	GCTG	CAG--TCA	CTC-A	CCTTT-	T	G	T	TTTGAACCGGAA	T--A	CA	TT	TGCTCTGCCA	CCCTA	AA	AAGC-	T-GA	TTTTT
E2	2	GTC	ACTG	CAG--TCA	CTCAA	AAATC-	T	G	T	CTTGAGCCGGAG	TTAA	CG	TT	TGCTCTGCCA	CACTA	GA	AAGC-	T-GA	TTTTC
E3	2	GTC	ACTG	CAG--TCA	CTC-A	TTAYC-	T	G	T	TTTGAGCCGGAA	T--C	TA	TT	TGCTCTGCCA	CACTA	AG	AAGC-	T-GA	TC-TC
O32	1	GTC	ACTT	TGG--TTA	CTG-A	ACCAC-	T	G	T	TTTGAGCCGGAA	TACC	CA	TT	CGCTCTGCCT	CACTA	GG	AAGC-	T-GA	TT-CT

109.52) matches with only 1 gap difference an unidentified Chinese isolate from *Ophiocordyceps sinensis* (HM439570) by showing at least 1 % ITS distance to the other strains of subclade A2 (Phyl. 28). Further, apparently incomplete ITS sequences in the CBS database under the names *A. superbus* (CBS 507.83 Belgium; 662.70, Netherlands) or *A. cladodes* var. *macroides* (CBS 493.90, Tenerife) also show min. 1 % distance to the above sequences (not shown). Hence, *O. auricolor* s.str. is not restricted to the European continent, but occurs also in California, Canada, Macaronesia, and the Antarctic (all subclade A2), and similarly *O. cladodes* (subclade C1) includes strains from North America, eastern Asia, and Europe.

Two strains which were at first identified as *A. robustus* and later as *A. pyriformis* belong in the scope of the *O. auricolor* clade: CBS 340.94 (Berlin) to subclade A1 and CBS 602.80 (?UK) to subclade A2. The latter strain was said by Van Oorschot (1985) to have been isolated by Duddington (the CBS database says 'isolated by the Boots Pure Drug Co., 1963') and to belong to *A. pyriformis*, but its unofficial sequence deviates from other *A. pyriformis* strains while showing a 3.5 % ITS distance to *O. auricolor* (H.B. 6763) as closest match.

When analysing LSU, subclades A1–A2 are more or less recognizable (S32), differing by 1 nt (pos. 579: AG**T**CC vs. AG**C**CC). Within subclade A1, four strains are identical in the D1-D2, including CBS 120.54 ('*A. cladodes* var. *macroides*'), whereas CBS 340.94 deviates by 1 nt at pos. 565 (Tab. 83). Within subclade A2, 15 strains form two identical groups with 1 nt deviation at pos. 459 between them: CT**T**CC in 11 strains vs.

Table 83. Eight nucleotide positions in the LSU D1–D2 domain (16, 330, 511, 522, 567, 574, 585, 601) that separate within the *O. auricolor* aggregate the *cladodes-botryosporus* clade (C1–C4) from the *O. auricolor* clade (A1–A2), together with some other informative positions, in comparison with *O. scaphoides*, *A. pravicovii*, *A. macroides* (SBUG 160), *A. cystosporius*, *O. menageshae* s.l., the *elegans-gampsosporus* clade (E1–E3), *Arthrobotrys* sp. ATCC MYA-4125 (O32), '*A. superbus/oligosporus*' (CBS 121.54 & 384.73, B.L. 6225), *O. oligospora*, and *O.* aff. *auricolor* (G.M. 2017-09-25.1/2018-11-27.1, H.B. 10024). Note frequent identity of clades A, E, O32, and *A.* '*superbus/oligosporus*'. Pos. 522+523 characterize the *scaphoides-pravicovii* clade. – Position numbers starting with TGACCT by omitting predominant gaps in alignment of all groups of *Orbiliomycetes*. Column 'Str.' gives number of strains, whereby pos. 14–53 were not available in all strains of a clade, likewise two strains of the *elegans* clade do not cover pos. 601. * = variants of C1 occurring singly or in combination in B.L. 6262, B.L. X087, and YNUCC 3528.

Subclade	Str.	14–26	50–53	133–6	201–4	328–333	510–523	538–42	565–8	574–79	583–87	599–603
cladodes (C1)	6	GACAAGGTTACCC	GCGG	CGGC	CGTC	GGGGGG	GCGGGACAAAGGTG	CGCTT	CGCC	GCCAGC	GACTG	TCTGC
cladodes (C1)	*	GACAAGGATACCC	GCGG	TGGC	CGTC	GGCGGG	GCAGGACAAAGGTG	CGCTT	CGCC	GCCAGC	GACTG	TCTGC
CBS 109508 (C1?)	1	?????????????	????	CGGC	TGTC	GGGGGG	GTGGGACAAAGGTG	CGCTT	CGCC	GCCAGC	GACTG	TCTGC
cf. *latispora* (C3)	1	GACAAGGTTACCC	GCGG	CGGC	CGTC	GGGGGG	GCGGGACAAAGGTG	CGCCT	CGCC	GCCAGC	GACTG	TCTGC
botryosporus (C4)	1	GACAAGGTTACCC	GCGG	CGGC	TGTC	GGGGGG	GCGGGACAAAGGTG	CGCCT	CGCC	GCCAGC	GACTG	TCTGC
scaphoides	2	GACAAGGATACCT	GCAG	TGGC	CGTC	GGGGGG	GTGGGACAAAGGTA	CGCTT	CGTC	ACCAGT	GACTG	TC-GC
pravicovii	1	GACAAGG??????	GCGG	CGGC	CGTC	GGGGGG	GTGGGACAAAGGTA	CGCTT	CGTC	ACCAGT	GACTG	TC-GC
macroides	3	GACAAGGATACCC	GCGG	TGGC	TGTC	GGGGGG	GTGGGACAAAGGTA	CATCT	CGTC	ACCAGT	GATTG	TCTGC
cystosporius	2	?????????????	????	CGGC	CGTC	GGCGGG	GTGGGACAAAGGCA	CGCTT	TGTC	ACCAGC	GACTG	TC-GC
aff. *menageshae*	1	GACAAGGATACCC	GCGG	CGGC	CGTC	GGCGGG	GTGGGACAAAGGCA	CGCTT	TGTC	ACCAGC	GATTG	TC-GC
menageshae	1	GATAAGGATACCC	GCGG	TGGC	CGTC	GGCGGG	GTGGGACAAAGGCG	CGCTT	TGTC	ACCAGT	?????	?????
auricolor (A1/A2)	19	GATAAGGATACCC	GCGG	CGGC	CGTC	GGCGGG	GTGGGACAAAGGCG	CGCTT	CGTC	ACCAGY	GATTG	TC-GC
CBS 340.94 (A1)	1	GATAAGGATACCC	GCGG	CGGC	CGTC	GGCGGG	GTGGGACAAAGGCG	CGCTT	TGTC	ACCAGT	GATTG	TC-GC
elegans (E1–2)	8	GATAAGGATACCC	GCGG	CGGC	CGTC	GGCGGG	GTGGGACAAAGGCG	CGCTT	TGTC	ACCAGY	GACTG	TC-GC
gampsosporus (E3)	1	GATAAGGATACCC	????	CGGC	CGTC	GGCGGG	GTGGGACAAAGGCA	CGCTT	TGTC	ACCAGT	GACTG	TC-GC
MYA-4125 (O32)	1	GATAAGGATACCC	GCGG	CGGC	CGTC	GGCGGG	GTGGGACAAAGGCG	CGCTT	????	??????	?????	?????
'*superbus/oligosp.*'	3	GACAAGGATACCC	GCGG	CGGC	CGTC	GGTGGG	GTGGGACAAAGGCG	CGCTT	TGTC	ACCAGC	GACTG	TC-GC
oligospora	13	GACAAGGATACCC	GCGG	CGGC	CGTC	GGCGGG	GCGGGACAAAGGCG	CGTTT	TGTC	GCCAGC	GACTG	TC-GC
oligosp. CBS 107.51	1	GACAAGGATACCC	GCGG	CGGC	CGTC	GGCGGG	GCGGGACAAAGGCA	CGTTT	TGTC	GCCAGT	GACTG	TC-GC
aff. *auricolor* (G.M.)	1	GACAAGGATACCC	GCGG	TGGC	CGTC	GGCGGG	GCGGGACAAAGGCG	CACCT	TGCC	GCCAGC	GATTG	TC-GC
aff. *auricolor* (H.B.)	1	GACAAGGATACCC	GCGG	TGGC	CGTC	GGCGGG	GCAGGACAAAGGTG	CACCT	TGCC	GCCAGC	GATTG	TC-GC

CT**C**CC in four strains (including H.B. 6763). The heterogeneity of the 11 strains in S32 is mainly due to incompleteness of some sequences.

The S1506 intron was available in two North American and six European strains. Two strains of subclade A1 and two of A2 each show full identity, while CBS 115.61 (not shown) and ATCC 96676 fall in subclade A1 with a 0.3 % and 2 % distance, respectively, and CBS 340.94 falls in subclade A2 with 0.8–1.1 % distance. The distance between subclades A1 and A2 lies at 4–6 %. A very fragmentary, unpublished sequence which only includes the fragmentary intron (H.B. 8898a) falls in subclade A1.

***O.* aff. auricolor**. A sequence from the Serbian collection on *Iris* (TU(M) 104916, ITS+LSU, presence of S1506 intron uncertain) clustered in the *scaphoides-pravicovii* clade (Phyl. 28) by showing an ITS distance of 1.9–2.3 % to *A. pravicovii* and 3.1 % to *O. scaphoides*. In the LSU it differs from *A. macroides* (SBUG 160) merely by 1 nt, although the ITS distance is 3.5 % here. We assume that it represents a species of its own related to monocotyledonous substrates, from which also *A. pravicovii* was once isolated (see p. 1577).

Sequences of the two mentioned samples from Luxembourg (on *Fagus* bark, G.M. 2017-09-25.1/2018-11-27.1) comprise SSU+ITS+LSU and possess the S1506 intron. They merely differ by 1 nt in the ITS and formed a strongly supported clade with the sample from French Pyrenees (on *Fraxinus* bark, H.B. 10024, S1506 intron absent), with an ITS distance of 7 % (1 % in LSU D1–D2). This clade clustered unsupported near *A. nonseptatus*, *A. polycephalus*/*A. ellipsosporus*, or *A. reticulatus* (Phyl. 25, 28, *Fagus* strains not shown), all representing basal species with unknown relationship within series *Arthrobotrys*, or even unsupported with *O. quercus* of series *Dactylellina* (S33).

It seems well possible that some other collections with yellow to orange apothecia and a more or less xeric habitat here accepted in *O. auricolor*, including the types of *O. aranea* and perhaps even *O. auricolor*, belong to H.B. 10024. Since variation from whitish to yellow-orange was observed within populations here referred to *O. auricolor* s.l. (e. g., Pl. 953: 9), macroscopic recognition of different genotypes appears to be impossible. A molecular extract (ITS2) from a *Picea* log in northwestern Russia (Karelia) matches H.B. 10024 except for 5 nt and 2 gaps (denovo367, Kazartsev et al. 2018). Almost identical with the two samples from Luxembourg in the ITS and fully so in the LSU is a strain in CBS which is visible only as a restricted item in the database, and which represents an isolate of W. Gams under the name *Arthrobotrys entomopagus* (G. Verkley pers. comm.).

Specific nucleotide positions. Characteristic motifs in the alignment of ITS1-5.8S-ITS2 distinguish the *O. auricolor* clade (A1–A2), the *cladodes-botryosporus* clade (C1–C4) and the *elegans-gampsosporus* clade (E1–E3) and their subclades (Tab. 82). *A. cladodes* (subclade C1, 7 strains) differs from the *O. auricolor* clade (14 strains) at 32 positions, 24 of them being consistent within the entire *cladodes-botryosporus* clade. One of these positions (326) belongs to 5.8S. The *elegans-gampsosporus* clade shares at these positions either the character of the *cladodes-botryosporus* clade (pos. 66, 477, partly also 145, 491–92, 542) or mainly that of the *O. auricolor* clade (16 positions) whose two subclades, represented by H.B. 6664 (A1, 4 strains) and H.B. 6763 (A2, 11 strains), are separated by 9 consistent nt in the ITS region. At six of them (22, 25, 60, 64, 114, 406) subclades A1 and C1 concur, and at two of them (506, 522) subclades A2 and C1 concur.

Characteristic positions in the LSU (D1–D2) that separate the *O. auricolor* clade from the *cladodes-botryosporus* clade are listed in Tab. 83. Also here the *elegans-gampsosporus* clade shares positions of one of the two clades, mainly those of the *O. auricolor* clade.

The two aberrant genotypes on *Fagus* and *Fraxinus* bark show at pos. 13–15 of ITS2 the exceptional motif CCTC**GGC** which otherwise occurred only in *A. reticulatus* (6 strains), *Dactylellina* aff. *phymatopaga* (3 strains), and Chinese *O. orientalis* (4 strains). The majority of series *Arthrobotrys* have here CCTC**AGC**, and members of *Dactylellina* (including *O. quercus*) CCTC**GGT** (see Tab. 77).

Conclusions. The above analyses of the ITS and LSU region and that of the S1506 intron suggest that our here presented narrow concept of *O. auricolor* is heterogeneous and comprises at least two phylogenetically different species, *O. auricolor* s.str. and *O. cladodes*, despite a very high morphological similarity in both anamorph and teleomorph. Difficult to understand is the fact that species with morphologically very different conidia (*O. scaphoides*, *O. elegans*/*A. gampsosporus*) cluster near members of these two clades and share their characteristic nucleotides. Remarkable is also the deviating result from the intron region in regard to *A. botryosporus* and the *A. superbus* strain CBS 109.52.

From all this we conclude that anamorphs of *Arthrobotrys* cannot safely be identified with existing morphological keys. Our analysis of the two investigated European ascospore isolates (H.B. 6763, H.B. 6664) indicate that differences in conidial size seem to be of subordinate value, although an ITS distance of 2 % and the formation of two rather well-defined subclades within *O. auricolor* s.str. seems remarkable. A more comprehensive morphological and molecular study on further collections of the *O. auricolor* aggregate is required, also an rDNA extraction of the type material of *O. auricolor* and its here suggested synonyms might question the here proposed reference specimens.

Ecology. *O. auricolor* s.l. is a plurivorous species which is obviously able to grow on all kinds of organic substrates, including bark and wood of twigs, branches, and trunks of angiosperm, rarely gymnosperm trees, shrubs and climbers, also coniferous leaves, fruits, herbaceous stems of various, predominantly dicotyledonous plants, sometimes also fungi such as stromata of pyrenomycetes or lichen thalli. Even dung, bones, and textile are colonized. two records were on a fern (*Angiopteris*, Wu et al. 1998) and a horsetail (*Equisetum*, E. Rubio pers. comm.), but the former was reported as *O.* cf. *auricolor* and inadequately described, and the latter remained undocumented and unpreserved. The strength of decomposition of the substrate also varies considerably. Regarding availability of moisture, *O. auricolor* is usually found on hygric substrate in close contact to the ground, but some collections were on mesic or xeric substrate.

O. auricolor s.l. occurs worldwide. The here examined collections are from various regions of Europe and northern Africa with an atlantic to continental, thermo- to hemiboreal or oro- to thermotemperate humid, but also suprasub- to mesosub- and supra- to inframediterranean semihumid climate, from planar to montane altitudes. Included extra-European collections are from hemiboreal warm-temperate and mild-maritime humid or subtropical subhumid Northern America, subtropical semiarid to tropical humid (partly winter-dry) Middle and South America, subtropical humid (winter-dry) southeastern Africa, cold-continental to warm-temperate humid (winter-dry) central and eastern Asia, and oceanic, warm-temperate humid southeastern Australia. The few unquestionable European and North American records of *O. cladodes* are all from supratemperate humid sites, whereas those from Asia include also a subtropical monsoon and cold-continental climate.

The high substrate diversity comes along with a high variety of plant associations in which *O. auricolor* was found. In addition to various *Querco-Fagetea* communities, it occurred in floodplain forests with *Alnus*, *Salix*, *Ulmus* etc., open wetlands (*Cirsio-Filipenduletum*, *Oenotheretum*, *Caricetea*), tall forb communities, dry grassland (*Gentiano-Koelerietum*), atlantic *Ulex* shrubs, mediterranean shrub- and woodland, and even halophytic vegetation at the sea shore.

European reports of *O. auricolor* s.l. (under the name *O. curvatispora*) are, e.g., those of Boudier (1904–10: 267), Velenovský (1934: 100), Grelet (1948a: 51), Dennis (1978: 188), Breitenbach & Kränzlin (1981: 210), Ginko (1988), and Pop (1994: 65, pl. 1 fig. 5). Extra-European reports (some as *O. curvatispora*) include Binyamini (1991: 367, Israel, *Eucalyptus* branch), Ahmad (1978: 210, Pakistan), Thind & Sharma (1980, India), Raitviir (1991: 360, eastern Russia), Zhuang & Korf (1989: 306, China), Liu (2006, HMAS 96824 Tibet, HMAS 139635 Beijing); Wu (1998, Taiwan, *Angiopteris lygodiifolia* petiole), Spooner (1987, southeastern Australia), and Seaver (1951: 155, northeastern America).

Two GenBank sequences gained from culture isolates from rotten timber in the maritime antarctic (subarctic) tundra region (Arenz & Blanchette 2009, Held & Blanchette 2013) belong to European *O. auricolor* (clade A). These wood isolates were taken from old British and Chilean research station buildings at Deception and Stonington Island, and the fungus could well have been introduced to this remote region.

Map 154. Known distribution of *O. auricolor* s.l. in Europe and northern Africa (yellow = not included collections).

Specimens included [A = *O. auricolor* s.str., C1 = *O. cladodes*]: **EUROPE**: unlocalized, on a rope, undated, collector unknown (herb. Persoon, L 910.261–343, as *Peziza vinosa*, H.B. 7702 ø). — **GREAT BRITAIN**: unlocalized, substrate unknown, 1963, C.L. Duddington (CBS 130.83, as *Geniculifera cystosporia*, conid. isol., non vid.; sq.: CBS ined. [A2]). – **East Midlands**, **Leicestershire**, 7 km NW of Market Bosworth, 2 km NNE of Twycross, Gopsall plantation, 100 m, branch of ?angiosperm, on bark, III.1854, A. Bloxam (K, **lectotype** of *O. auricolor*, H.B. 5348 ø). – **East England**, **Suffolk**, 5 km SW of Southwold, 1.8 km of Dunwich, Dunwich Forest, 15 m, stem of *Lupinus arboreus*, 7.III.2003, E. Batten & S.M. Francis (E.B. 4397, H.B. 7309). – 4 km ESE of Halesworth, NNE of Wenhaston, Blyford Lane, Hill Cottage, 12 m, branch of *Lupinus arboreus*, on bark, 13.VII.2004, E. Batten (E.B. 4539, K(M) 227390, H.B. 7560 ø, anam. substr.). – **South East England**, **London**, ~18 km SW of London, Kingston-upon-Thames, ~10 m, horse dung delivered as garden manure, XI.1949, C.L. Duddington (MUCL 1019, CBS 109.52, CCRC 32698, as *A. conoides* or *A. superbus*, conid. isol., doc. vid.; sq.: KT215210, U51949 [A2]; non AJ001983 = *O. oligospora* ?CBS 115.81). – unlocalized, substrate unknown, 1963, C.L. Duddington (IMI 101307, CBS 433.81, CCRC 32697, as *A. cladodes*, conid. isol., non vid.; sq.: U51945, U51952, KT215211 [A1]). — **SWEDEN**: **Uppsala**, 40 km NNE of Uppsala, 1.5 km W of Österbybruk, Sandgropen, 42 m, stem base of *Arctium*, 17.VII.1936, S. Lundell (Holm & Nannfeldt F. exs. Suec. 3450, as *O.* cf. *epipora*, UPS F-005012, H.B. 7330 ø). – **Blekinge**, 12 km E of Karlshamn, Åryd, Tjärö, 10 m, dung of *Oryctolagus cuniculus*, 11.VI.1962, I. Nordin, vid. I. Olariaga (UPS F-705224, as *Orbilia* sp., doc. vid.). — **DENMARK**: **Sjælland**, Falster, 11 km WNW of Nørre Alslev, Resle Skov, 2 m, branch of *Corylus avellana*, on wood, 10.VII.2006, J.G.B. Nielsen (J.N. 06–114). — **FINLAND**: **Kanta-Häme**, ~1 km N of Tammela, Mustiala, ~110 m, branch of *Salix*, on bark, IX.?1869, P.A. Karsten (FFE 834, H 6051957, in envelope of '*O. rubella*' = *O. phragmotricha*). – **Uusimaa**, Helsinki, unlocalized, ~10 m, stump of *Picea abies*, A.M. Hallakselä (CBS 367.75, as *A. superbus*, conid. isol., non vid.; sq.: CBS ined., MH872670 [A1]). – ibid., from house dust (M. Pitkaranta et al., BF-OTU265, mol. extr.; sq.: AM901709 [A2]). — **ESTONIA**: **Tartumaa**, 44 km NNW of Tartu, Jõgevamaa Sport Center, culms of *Phalaris arundinacea*, 80 m, 20.X.1982, K. Allik (TAAM, H.B. 8714 ø). — **RUSSIA (West)**: **Stavropol**, **Predgorny**, Caucasus region, ~3 km SSE of Zheleznovodsk, Beshtau Mt., ~1000 m, stump of indet. angiosperm, on wood, 29.VIII.1925, A.I. Lobik, vid. E.S. Popov (LE 142161, doc. vid.). — **POLAND**: **Lesser Poland**, 6 km E of Nowy Sącz, 1.8 km E of Piątkowa, NW of Paszyn, 380 m, bone of *Sus scrofa*, 27.VIII.2007, S. Pintscher (P.P. 20070827-1, anam. substr., doc. vid.). — **CZECHIA**: **Central Bohemia**, Praha, unlocalized, soil, winter 1835/36, A.C.J. Corda (**holotype** of *Arthrobotrys superbus*, anam. only, doc. vid.). – 27 km SE of Praha, Mnichovice, 350–400 m, trunk of *Picea abies*, on wood, VII.1926, J. Velenovský (as *O. verrucosa*, PRM 152356; H.B. 6416 ø). – Mnichovice, in Velenovský's garden, ~350 m, branches of *Daphne mezereum*, on bark and black pycnidia, 1925, J. Velenovský (PRM 148299, **holotype** of *O. daphnina*; H.B. 6130 ø). – **South Bohemia**, Boudy, near Čimelice, mons Hrad, 570 m, branch of *Populus tremula*, on bark, 1.VIII.1969, M. Svrček (PRM 684767, **holotype** of *O. aranea*, H.B. 6940 ø). — **SERBIA**, **Vojvodina**: 10 km SSW of Novi Sad, 5 km SW of Beočin, Fruška Gora, Racovac, 190 m, stem of ?*Arctium lappa*, 26.V.2016, D. Savić (FG-304, doc. vid.). – 13 km SSW of Novi Sad, 1 km E of Brankovac, stem of *Arctium lappa*, 10.VII.2019, D. Savić (doc. vid.). – 12 km SE of Novi Sad, 2.8 km SE of Bukovac, NNE of Stražilovo, 225 m, petiole of *Petasites hybridus*, 1.VI.2016, D. Savić (FG-431, doc. vid.). – 8 km WSW of Sremska Mitrovica, 2 km E of Zasavica, 76 m, leaf of *Phragmites australis*, 29.VI.2017, D. Savić (doc. vid.). — **CROATIA**: **Zagreb**, 7.5 km ESE of Jastrebarsko, 3 km W of Dona Zdenčina, Gajne forest, 118 m, leaves of *Carex*, 6.VIII.1998, N. Matočec (CNF 2/3903, doc. vid.). – **Split-Dalmatia**, 124 km SSW of Split, Palagruža island, ENE of tower, 27 m, branch of *Lavatera arborea*, 29.III.1999, N. Matočec (CNF 2/4197, doc. vid.). — **MONTENEGRO**: 2.7 km NW of Herceg Novi, SSE of Ratiševina, 93 m, branch of *Bambusoideae*, 20.VI.2019, D. Savić (FG-1087, doc. vid.). — **ITALY**: **Sicilia**, around Siracusa, ~30 m, dung of *Oryctolagus cuniculus*, 30.VI.2000 (dung collected 30.VI.1998), E. Feuillard (H.B. 6722, anam. substr.). — **AUSTRIA**: **Niederösterreich**, 17.5 NW of Wien, NW of Hainbuch, 330 m, branch of ?*Fagus sylvatica*, on *Diatrype stigma*, 5.IX.1992, W. Jaklitsch (WU 13304). – 21 km SW of Wien, Gaaden, Sittendorferstraße, 320 m, *Pyrus pyraster*, on bark, 9.II.2018 (7.IV.2018 in moist box), M. Mann (anam. substr., doc. vid.). – **Salzburg**, 7.5 km WSW of Salzburg, 1 km SW of Wals, Saalach-Altarm, east riverbank, 445 m, branch of *Alnus incana*, on bark, 28.VIII.1990, W. Dämon (W.D. 71/90). — **SWITZERLAND**: **Jura**, 4.5 km NE of Tramelan, 1.6 km WNW of Les Genevez, Les Embreux, log of *Fagus sylvatica*, on bark, 15.VI.2018, H.O. Baral (H.B. 10150). – **Luzern**, 10 km NNW of Luzern, 3 km S of Hochdorf, Wasewald, 524 m, cupules of *Aesculus hippocastanum*, 11.VIII.2013, U. Graf (ø). – 6 km W of Luzern, 2.5 km W of Littau, Littauer Schachen 470 m, branch of ?*Quercus*, on bark, 7.XI.1977, J. Breitenbach (NMLU 0711–77 BR2). — **GERMANY**: unlocalized, branch of ?*Salix*, on bark, undated, A.E. Sauter (herb. E. Fries, UPS 247614 F-015650, as *Peziza xanthostigma*, H.B. 7327 ø, anam. substr.). – **Schleswig-Holstein**, Helgoland, Oberland, ornithological station, 50 m, branch of *Populus*, on bark, 24.IV.1986, T.R. Lohmeyer (T.R.L. 86/52). – **Mecklenburg-Vorpommern**, Nordwestmecklenburg, 7 km NW of Rehna, W of Roduchelstorf, 33 m, leaves and stems of *Typha latifolia*, 22.VI.2019, T. Richter, vid. M. Reul (M.R. 6879, doc. vid.). – 5 km N of Rehna, NNE of Törber, Ackersoll, 18 m, stem of *Arctium lappa*, 7.VII.2007, T. Richter (H.B. 8571a ø). – **Brandenburg**, Prignitz, 8 km NW of Pritzwalk, Triglitz, 60 m, on cloth, 25.VIII.1905, O. Jaap (herb. Jaap, H, as *Orbilia pannorum*, H.B. 7912 ø). – Westhavelland, ~5 km NE of Friesack, Zootzen, 30 m, trunk of *Quercus robur*, on bark, V.1908, W. Kirschstein (B, **holotype** of *Orbiliella armeniaca*, H.B. 6176 ø, anam. substr.). – **Berlin**, Berlin-

Dahlem, Botanical Garden, 50 m, bark of *Sorbus torminalis*, VIII.1993, A. Rubner (A.R. 9327, CBS 340.94, as *A. robustus* or *A. pyriformis*, conid. isol., non vid.; sq.: AJ001988, CBS ined., AY261131 [A1]). – **Sachsen-Anhalt**, 6.5 km SW of Halle, 1.6 km SE of Holleben, Sackwiesen, 80 m, stem of *Arctium*, 30.IV.2000, Y. Ostermann (H.B. 6664, CBS 117022, anam. cult.; sq.: KT215294 [A1]). – **Sachsen**, 6 km NN of Chemnitz, Glösa, Kinderwaldstätte near railway, 330 m, branch of *Salix* ?*alba*, on wood, 5.VII.2008, B. Mühler (H.B. 8887 ø). – 5 km E of Chemnitz, 2 km WSW of Euba, Eubaer Straße, Um den Eibsee, 410 m, dung of *Capreolus capreolus*, 7.II.2009, P. Welt (grown in moist box, H.B. 9003 ø, anam. substr.). – 13 km S of Chemnitz, 3 km S of Burkhardtsdorf, Abtwald, NW of Buschmühlenteich, 525 m, branch of ?*Sorbus aucuparia*, on wood & bark, 16.VII.2008, B. Mühler (H.B. 8898a, anam. substr.; sq.: only partial S1506 intron. ined. [A2]). – 7.5 km NE of Chemnitz, N of Niederwiesa, Auen- & Zapfenbachtal, 280 m, branch of (?)*Salix*, on bark, 8.II.2008, B. Mühler (ø). – **Thüringen**, 4.7 km S of Sonneberg, 1.7 km ENE of Heubisch, Rohof, Rohgraben, 350 m, branch of *Alnus glutinosa*, on bark, 29.VII.2014, I. Wagner (I.W. 140729, doc. vid., anam. substr.). – **Nordrhein-Westfalen**, Recklinghausen, 8 km NNE of Gelsenkirchen, 1.8 km S of Herten, Schlosspark, 60 m, stem of *Arctium*, ~17. IV.1994, F. Kasparek (H.B. 5058, anam. substr.). – **Rheinland-Pfalz**, Neustadt a. d. Weinstraße, ~200 m, branch of *Vitis vinifera*, on wood, 31.VIII.1973, R. Thate (H.B. 632 ø). – **Hessen**, Biedenkopf, Schlossberg, 350 m, trunk of *Ulmus*, on bark, 30.IV.2000, L.G. Krieglsteiner & H.O. Baral (H.B. 6626b). – 2.7 km NW of Rüsselsheim, 2 km WSW of Flörsheim, 105 m, dung of *Lepus europaeus*, 2.III.2013, K. Hoffmann (non vid., anam. substr.). – **Baden-Württemberg**, 5 km SSE of Aalen, 1 km NE of Oberkochen, Tierstein, 630 m, trunk of *Populus*, on bark, 13.VI.1994, K. Neff (H.B. 5135). – 6 km N of Schwäbisch Gmünd, Durlangen, 490 m, on rootlets in a flowerpot, 25.VIII.1983, L.G. Krieglsteiner (ø). – 5.5 km SE of Nürtingen, 3.5 km WNW of Owen, Tiefenbachtal, 350 m, petioles of *Ranunculus repens*, 28.IX.1990, H.O. Baral (ø). – 5 km NE of Tübingen, S of Pfrondorf, Obere Mähder, 395 m, stem of *Oenothera biennis*, 21.VIII.1988, H.O. Baral (H.B. 3527). – 1.5 km SW of Pfrondorf, quarry near Bitzle, 425 m, stem of *Pastinaca sativa*, 23.VI.1991, H.O. Baral (ø). – 1.9 km WNW of Pfrondorf, Hägnach, 420 m, trunk of *Tilia platyphyllos*, on bark, 6.X.2002, H.O. Baral & E. Weber (ø). – 1.7 km WNW of Weil der Stadt, Schützenhaus, 510 m, branch of *T. platyphyllos*, on bark, 20.V.1993, A. Gminder (H.B. 5029). – **Bayern**, **Unterfranken**, 14 m NW of Würzburg, SE of Retzbach, Tiertalberg, 230 m, culms of *Triticum aestivum*, 7.VI.1994, L.G. Krieglsteiner (H.B. 5094 ø, anam. substr.). – **Oberpfalz**, 14 km NE of Amberg, 1.8 km NNW of Hirschau, Hintere Peneslohe, 460 m, leaves of *Carex vesicaria*, 13.VII.1991, H.O. Baral & E. Weber (ø). – **Oberbayern**, Weilheim-Schongau, Fünfseenland, 8 km NW of Tutzing, 3.5 km S of Andechs, Goaslweide, 720 m, branch of *Fagus sylvatica*, on bark, 9.V.2001, P. Karasch (P.K. G/26-01). – ?near Ingolstadt, stem of *Humulus lupulus*, 26.VII.1989, H.O. Baral (ø). – Starnberger See, unlocalized, 600 m, branch of *Tilia*, on bark, 30.IV.1978, R. Agerer (H.B. 2304). –7.5 km SE of Waging am See, Petting-Reuten, 510 m, log of *Sorbus aucuparia*, on bark, 9.VI.2011, T.R. Lohmeyer (H.B. 9553, anam. substr.). — **NETHERLANDS**: **Gelderland**, 31 km SSE of Utrecht, 1 km E of Waardenburg, 8 m, on old tennis ball, 22.IX.2002, L. Rommelaars (L.R. 02-206, as *O. vinosa*). – ~2 km SE of Putten, Schovenhorst, 35 m, on indet. wood, undated, J.A. Stalpers (CBS 662.70, as *A. superbus*, conid. isol., non vid.; sq.: CBS ined. [near clade A]). — **BELGIUM**: **Vlaanderen**, **Vlaams-Brabant**, 14 km WNW of Brussels, Asse (road to Aalst), border of village, 85 m, dung of *Oryctolagus cuniculus*, 3.X.1999, J. De Sloover (J.S. 99C119, H.B. 6544). – **Oost-Vlaanderen**, 16 km E of Gent, Overmere, ~5 m, branch of *Fraxinus excelsior*, on bark, 15.VI.1913, M.H. Rousseau (BR 5020090690924, H.B. 8856 ø). – **Wallonie**, **Liège**, La Gileppe, ~350 m, indet. bark, 17.IX.1981, W. Gams (CBS 107.81, isol. C.S. Huang, as *A. superbus*, conid. isol., non vid.; sq.: AJ001989, CBS ined. [C]). – ibid., indet. bark, 17.IX.1981, W. Gams (CBS 507.83, isol. W. Gams, as *A. superbus*, conid. isol., non vid.; sq.: CBS ined. [A2]) – Eupen, ~300 m, indet. twig, X.1982, W. Gams (CBS 619.82, as *A. superbus*, conid. isol., non vid.; sq.: CBS ined. [A2]). — **LUXEMBOURG**: **Gutland**, **Mersch**, garden Cornette, ?240 m, stem of *Brassica oleracea*, 7.IX.1896, J. Feltgen (LUX 42535, **holotype** of *O. chrysocoma* var. *brassicicola*). – **Echternach**, 10 km WNW of Echternach, 1.2 km SW of Beaufort, Längt, 340 m, trunk of *Fagus sylvatica*, on bark, 3.II.2007, G. Marson (H.B. 8428a, anam. cult.). – **Capellen**, 3 km ENE of Arlon, Gaichel, Sägemühle, 290 m, stem of *Angelica*, 25.VIII.1899, J. Feltgen (LUX 42440, as *O. rosella*). – **Luxembourg**, 6 km NNE of Luxembourg, 2.3 km E of Walferdange, Croix de la Femme Morte, 410 m, trunk of *Fagus sylvatica*, on bark, 25.XI.2004 (H.B. 7627d, anam. only). – ?7 km NE of Luxembourg, Gréngewald, 340 m, wood of *F. sylvatica*, V.1899, V. Noppeney (LUX 42444, J. Feltgen as *O. luteorubella*). – 5 km S of Luxembourg, 1 km W of Hesperange, Géisselbierg, 280 m, trunk of *F. sylvatica*, on bark, 7.IV.2005, G. Marson (H.B. 7718c ø, anam. substr.). – 3 km ESE of Luxembourg, Verlorenkost, Durensbësch (39, rue Jacquemart), 287 m, branch of *Ulmus glabra*, on bark, 23.VIII.1993, G. Marson (H.B. 4936a). – 11.5 km S of Luxembourg, 1 km S of Bettembourg, Zillerei, 280 m, stem of *Heracleum sphondylium*, 11.X.2014, G. Marson (G.M. 2014-10-11.3, anam. only, conid. isol.; sq.: KT222409 [A2]). – **Esch-sur-Alzette**, 5 km SSW of Luxembourg, N of Kockelscheier, Haus vun der Natur, 305 m, branch of *Salix* × *capreola*, on bark, 10.XI.2000, G. Marson (H.B. 6832). – 2.2 km S of Esch-sur-Alzette, 1.5 km ENE of Audun-le-Tiche, Ellergronn, 350 m, branch of *Salix caprea*, on bark, 10.XII.1992, G. Marson (H.B. 4814, G.M. 4908). – **Remich**, 10.5 km SE of Luxembourg, 2 km E of Syren, Buchholz, 350 m, trunks of *Fagus sylvatica*, on bark, 5.XI.2010, G. Marson (ø, conid. isol.). – 1 km W of Greiveldange, Fanken, 230 m, trunk of *F. sylvatica*, on bark, 8.I.2011, G. Marson (ø). — **FRANCE**: unlocalized, branch of indet. angiosperm, on bark, undated, collector unknown (herb. Boudier, as *O. curvatispora*, PC, H.B. 6896 ø, anam. substr.). – **Nord-Pas-de-Calais**, **Pas-de-Calais**, 17 km WSW of Calais, 1.4 km SSW of Wissant, la Motte du Bourg, 10 m, branch of *Ulex europaeus*, on bark, 29.X.2016, J.P. Priou (J.P.P. 16279, doc. vid.). – **Haute-Normandie**, **Eure**, 17 km S of Rouen, 1 km SSE of Martot, Les Fiefs Mancels, 25 m, branch of *Ulex europaeus*, on bark, 22.XI.2009, A. Delannoy, vid. J.P. Priou (J.P.P. 29233, non vid.). – **Bretagne**, **Morbihan**, 0.3 km NW of La Gacilly, Les Bresles, 13 m, stem of *Arctium*, 2.IV.2002, J.P. Priou (J.P.P. 22086, H.B. 7113a). – 12 km S of Auray, 1.6 km SW of Locmariaquer, Breneguy, 1 m, branch of *Baccharis halimifolia*, on bark, 5.XI.2006, J.P. Priou (J.P.P. 26173, doc. vid.). – 2.5 km SSE of La Gacilly, 2 km NNE of Glénac, Pré Naval, 8 m, branch of *Ulex europaeus*, on bark, 24.I.2002, J.P. Priou (H.B. 7093a ø). – 1.9 km SW of La Gacilly, 3 km NNW of Glénac, La Forêt Neuve, 54 m, stem of *Digitalis purpurea*, 10.IV.2008, J.P. Priou (H.B. 8826 ø). – Île de Groix, 2 km WSW of Le Bourg, WNW of Quéhello, Port St.-Nicolas, 17 m, stem of *Oenanthe crocata*, 6.VI.2015, J.P. Priou (J.P.P. 15139, doc. vid.). – **Ille-et-Vilaine**, 15 km NE of Redon, 1 km W of St.-Just, Moulin de Cojoux, 70 m, branch of *Ulex europaeus*, on bark, 9.VI.2003, J.P. Priou (J.P.P. 23066, non vid.). – 1 km ENE of La Gacilly, 3 km WSW of Sixt sur Aff, Trégaret, 32 m, needles of *Pinus pinea*, 25.III.2005, J.P. Priou (J.P.P. 25066, doc. vid.). – **Côtes-d'Armor**, 7 km NW of St.-Brieuc, Pordic, 100 m, branch of *Ulmus*, on bark, 16.III.2002, H. Dupuy (H.B. 7118). – **Pays-de-la-Loire**, **Loire-Atlantique**, 2.3 km NE of Mesquer, l'Île de Rostu, 2 m, branch of *Ulex europaeus*, on bark, 23.III.2002, J.P. Priou (H.B. 7114). – **Île-de-France**, near Paris, unlocalized, herbaceous stem of indet. angiosperm, VIII.1816, collector unknown (herb. Persoon, L 910.256–1356, as *Peziza vinosa*, H.B. 7703 ø). – **Val d'Oise**, ~20 km N of Paris, Forêt de Montmorency, ~100–150 m, bark of *Quercus*, VII.1885, É. Boudier (**holotype** of *O. curvatispora* [illustration], doc. vid.) – **Seine-et-Marne**, 50 km S of Paris, Forêt de Fontainebleau, 82 m, branch of indet. climber, on bark, 19.VII.1987, A. Reynaud, vid. L. Gauthier (L.G. 834, H.B. 6233). – **Centre**, **Loiret**, 10 km N of Montargis, 4 km NNE of Cepoy, E of les Ricordelles, Loing river, 75 m, stem of *Helleborus foetidus*, 28.II.1998, A. Reynaud (H.B. 6061, anam. substr.). – ibid., 23.III.1998, L. Gauthier (H.B. 6076). – ibid., 4.II.1999, L. Gauthier (H.B. 6311). – **Lorraine**, **Vosges**, 5.5 km E of Gérardmer, 1.5 km SE of Xonrupt-Longemer, Lac de Longemer, 740 m, branch of *Alnus*, on bark, 25. IX.2000, J. Deny (ex H.B. 6763, M-0276438, **RefSpec** of *O. auricolor*, CBS 116282, anam. cult.; sq.: KT215293 [A2]). – **Franche-Comté**, **Doubs**, 17 km SSE of Besançon, 2.8 km ENE of Cléron, Ravine de Valbois, 360 m, trunk of *Populus*, on bark, 20.VI.2016, G. Moyne (doc. vid.). – **Poitou-Charentes**, **Deux-Sèvres**, 7 km ESE of Beauvoir-sur-Niort, E of Villiers-en-Bois, Virollet, 81 m, trunk of *Cyphomandra betacea*, indet wood, 23.IV.2006, C. Lechat & H.O. Baral (H.B. 8123). – 14 km SSE of Niort, Poivendre de Marigny, 50 m, stem of *Lavatera*, 8.V.2006, M. Hairaud (H.B. 8161, anam. substr.). – 12.5 km WSW of Niort, ENE of Le Vanneau, Marais Poitevin, 3 m, branch of *Ulmus*, on bark, 25.IV.2006, B. Coué (H.B. 8132a, anam. substr.). – **Charente-Maritime**, 8.7 km N of St.-Jean-d'Angély, 2.3 km SSE of Lozay, Bois des Essouverts, 90 m, trunk of *Ulmus*, on bark, 2.XII.2012, P. Tanchaud (doc. vid.). – 16.5 km SSW of Saintes, 1.1 km NE of Cravans, Chatenet, 45 m, trunk of *Ulmus*, on bark, 4. VI.2006, B. Coué (H.B. 8219, anam. substr.). – Île de Ré, 1.5 km WNW of Ars-en-Ré, 1.8 km SSE of St.-Clément-des-Baleines, Forêt de la Combe à l'Eau, 8 m, leaf of *Iris foetidissima*, B. Capoen (H.B. 9492b ø). – **Midi-Pyrénées**, **Haute-Garonne**, Toulouse, ~150 m, on textile, XII.1878, collector unknown (herb. E. Mussat, PC, **lectotype** of *Helotium karstenii*, H.B. 6892 ø, anam. substr., isolectotype in H). – **Rhône-Alpes**, **Rhône**, Lyon, ~250 m, branch of indet. angiosperm, on bark, V.1897, D. Biel (PC, herb. Boudier, as *O. curvatispora*). – **Provence-Alpes-Côte d'Azur**, **Alpes Maritimes**, 8 km SW of Cannes, 1 km ESE of Théoule-sur-Mer, Boulevard des Alpes, 145 m, branch of *Acacia*, among *Rosellinia*, 27.IV.2013, M. Gaignon, vid. N. Van Vooren (N.V. 2013.04.24, doc. vid.). – **Corse**, **Haute-Corse**, 1.5 km NNE of Pruno, ENE of Campu Pianu, 152 m, branch of *Hedera helix*, on bark, 11.X.2009, P. Collombon (H.B. 9208; sq.: MK493142 [A1]). — **SPAIN**: **Asturias**, 3.7 km ESE of Gijón, Jardín Botánico Atlántico, 27 m, ?log of *Populus*, on bark, 28.III.2017, M. González (E.R.D. 6998, doc. vid.). – 2.2 km S of Villaviciosa, ESE of Valbúcar, 55 m, stems of *Equisetum*, 12.VI.2005, E. Rubio (ø, non vid.). – 4.5 km E of Pola de Somiedo, Villarín, 850 m, branch of *Pinus sylvestris*, on bark, 1.III.2008, E. Rubio (E.R.D. 4388, doc. vid.). – 7 km S of Pola de Somiedo, 1.9 km W of Santa Maria del Puerto, 1538 m, twigs of *Genista* ?*florida*, on bark, 5.VI.2017, J. Bometón (J.B. 686/17, anam. substr., doc. vid.). – 10 km NW of Villablino, SW of Puerto de

Leitariegos, laguna del Puerto, 1700 m, stem of *Verbascum*, 29.IX.2017, J. Linde, vid. E. Rubio (E.R.D. 7343, doc. vid.). – 6.3 km W of Pola de Lena, Alto de La Cobertoria, 1330 m, stem of *Adenostyles alliariae*, 26.IX.2019, E. Rubio (E.R.D. 8072, doc. vid.). – **Navarra**, 29 km N of Pamplona, 2.3 km SSW of Almandoz, Mendiola, 555 m, branch of *Clematis vitalba*, on wood, 20.X.2017, F.J. Balda (doc. vid.). – 13 km WSW of Pamplona, 1 km SW of Etxauri, 378 m, branch of ?*Crataegus*, on bark, 26.V.2014, F.J. Balda (F.J.B. 26514, doc. vid.). – 23.5 km SSW of Pamplona, 3.7 km NE of Artajona, 472 m, culm of *Scirpoides holoschoenus*, 7.III.2014, F.J. Balda (F.J.B. 7314, doc. vid.). – **La Rioja**, 2.2 km SW of San Román de Cameros, S of Jalón de Cameros, 860 m, stem of *Onopordum acanthium*, 17.IX.2016, R. Martínez Gil (R.M. 1349). – **Cataluña**, **Girona**, 5.5 km ENE of Camprodon, 1.5 km NE of Font-Rubí, 1092 m, branch of *Populus tremula*, on bark, 27.XI.2014, M. Hairaud (J.B. 558/14). – **Barcelona**, 27 km NW of Barcelona, 3 km NW of Terrassa, Torrent de Gaià, 330 m, petiole of *Phoenix* (?)*canariensis*, 1.VI.2014, J. Bometón (J.B. 0492/14, doc. vid.). – 4 km NE of Mataró, 1 km SW of Sant Andreu de Llavaneres, 155 m, on leaves of *Yucca*, 10.I.2015, J. Bometón (J.B. 0579/14, doc. vid.). **– Madrid**, 5.7 km ENE of Guadarrama, 1.5 km SSE of Collado Mediano, Las Canalejas, 1005 m, trunk of *Ulmus minor*, on bark, 25.I.2004, F. Prieto (AH 7587, H.B. 7472, anam. substr.). – 10 km SSW of Alcalá de Henares, Finca Cervantes, 600 m, bark of *Yucca*, 17.III.1991, C. Illana (AH 6800). – **Castilla y León**, **Salamanca**, near Candelario, 1500 m, branch of *Hedera helix*, on bark, 1.XI.1989, A. Acha (AH 6512). — **MACARONESIA**: **Canary Islands**, **Tenerife**, Puerto de la Cruz, 1.5 km SE of Puerto de la Cruz, El Durazno, ~180 m, soil of banana plantation, undated, G. Lysek (CBS 493.90, as *A. cladodes* var. *macroides*, conid. isol., non vid.; sq.: CBS ined. [A2]). — **MOROCCO**: **Laâyoune-Boujdour-Sakia El Hamra**, 100 km WSW of Casablanca, El Jadida, ~20 m, log of *Acacia saligna* (as *A. cyanophylla*), on bark, ?9.III.1963, G. Malençon (MPU, as *O. inflatula*, H.B. 5599 ø). — **SOUTH AFRICA**: **KwaZulu-Natal**, Kranskloof, 20 km NW of Durban, 2.5 km E of Kloof, near Molweni river, NW-exposed slope south of gorge, 400 m, fruits of *Xylotheca kraussiana*, 18.III.1990, D. Triebel & G. Rambold (G.R. 7216B, M-0229709, H.B. 5768a). — **CANADA**: **Québec**, Gatineau, St.-Cécile-de-Masham, ~170 m, bark of *Picea glauca*, undated, G.L. Hennebert (CBS 115.61, as *A. superbus*, conid. isol., non vid.; sq.: MH857992, CBS ined. [A2]). — **USA**: **Massachusetts**, Berkshire, unlocalized, ?400 m, dung of *Capreolus capreolus*, 3.VII.1993, E.J. Kneiper (FH, D.H.P. 60, anam. cult., as *O. fimicola*, anamorph as *A. superbus*, H.B. 5441 ø; sq.: U72599, AF006307 [C1]). – **Norfolk**, 17 km SW of Boston, 3 km NE of Westwood, Purgatory Tract Area, 60 m, trunk of indet. angiosperm, on bark, 14.VII.1994, D.H. Pfister (D.H.P. 90, FH 00304901, anam. cult., anamorph as *A. cladodes* var. *macroides*; sq.: U72592; H.B. 5443 ø [C1]). – **Maryland** (Beltsville and Cumberland) and **Virginia** (Arlington), leaf mould, undated, C. Drechsler (**holotype** of *Arthrobotrys cladodes* [illustration], conid. isol., doc. vid.). – **Wisconsin**, unlocalized, from *Pissodes strobi* (white pine weevil) on *Pinus strobus*, undated, collector unknown (CBS 297.84, as *A. cladodes* var. *cladodes*, conid. isol., non vid.; sq.: CBS ined. [C1]). – **California**, ~30 km WSW of Santa Rosa, Bodega Bay, from wood (Smith & Jaffee 2009, dm4w_a1, ATCC 96676, as *A. superbus*, conid. isol., non vid.; sq.: EF445988 [A2]). – **Texas**, Austin, undated (CBS 349.76, as *A. superbus*, conid. isol., non vid.; sq.: CBS ined. [A]). — **MEXICO**: **Baja California**, Baja California Desert, 35 km SSE of Ensenada, 6 km WNW of Santo Thomás, Cañón de Las Animas, Rancho las Jacarandas, 200 m, branch of *Rhus laurina*, on bark, 7.II.1993, R. Galán, C. Illana & J. Delgadillo (AH 7081). — **JAMAICA**: **Surrey**, **Saint Thomas**, 46 km E of Kingston, 10 km NNE of Morant Bay, above Bath Fountain Hotel, along Sulphur River, 170 m, fruit pods of *Theobroma cacao*, 14.I.1971, R.P. Korf, J.B. Dixon, K.P. Dumont et al. (CUP-MJ-000472). – **Saint Andrew**, 11 km ESE of Kingston, 3 km NE of Seven Mile, Cane River, slope of Good Hope Mt., ~180 m, fruits of *Cocos nucifera*, 12.I.1971, R.P. Korf et al. (CUP-MJ-000404, 000419, 000420). — **PUERTO RICO**: 9.5 km SW of Luquillo, El Yunque, near km 10.4 on Rte. 191, 500 m, fruits of *C. nucifera*, 6.VI.1970, R.P. Korf et al. (CUP-PR-003862). — **LESSER ANTILLES**: **Dominica**, St. Paul, between Springfield Estate and Corona Estate, along road, ~450 m, fruits of *C. nucifera*, 23.VI.1970, R.P. Korf et al. (CUP-DO-000149). — **ECUADOR**: **Tungurahua**, 27 km SE of Ambato, Baños, ~1800 m, soil from lemon orchard, III.1993, A. Rubner (A.R. 9311, CBS 341.94, as *A. superbus*, conid. isol., non vid.; sq.: CBS ined. [A2]). — **INDIA**: **Himachal Pradesh**, 13 km WSW of Chamba Dalhousie, Panjpulla, ~2000 m, herbaceous stem of indet. dicot, 21.VII.1973, M.P. Sharma (Sharma 3915, TAAM). — **CHINA**: **Beijing**, 12 km NW of Beijing, university campus, Weiming Lake, 50 m, indet. wood, 29.IX.2002, B. Liu (B.L. 6202, HMAS 139635, anam. cult., as *O. auricolor*/*A. cladodes*, non vid.; sq.: DQ656609, DQ656664 [C1]). – **Anhui**, **Huangshan**, Kowloon waterfall, 800 m, indet. wood, 14.VI.2002, B. Liu (B.L. 6141, HMAS 96810, non vid.; sq.: B.L. ined., DQ656663 [C1]). – **Tibet**, **Bomi**, ~90 km W of Bomê (Bomi), Lulangzhen, 3500 m, indet. wood, 18.VI.2004, B. Liu & X.Z. Liu (B.L. X087, HMAS 96824, doc. vid.; sq.: DQ656662 [C1]). – Tibetan Plateau, unlocalized, culture from *Ophiocordyceps sinensis*, undated, Y.J. Zhang (isolate 2569 YZ-2011; sq.: HM439570 [A2]). – **Yunnan**, **Dali**, Jizushan, Guo et al. 2009 (YMF 1.01839, sq.: FJ557236 [C1]). – For further 10 samples from China (including Heilongjiang, Fujian, Hunan, and Qinghai) see Liu (2006). — **JAPAN**: **Honshu**, **Nagano**, Chiisagata-gun, 16.5 km NE of Ueda, 1 km SE of Sugadaira, Sugadaira Montane Research Center, Arboretum, 1325 m, branch of indet. angiosperm, on bark, 21.VIII.1997, T. Hosoya (H.B. 5901). — **AUSTRALIA**: **Victoria**, Naracoorte Coastal Plain, 67 km NW of Portland, 27 km SE of Mt. Gambier, McEachern's Cave area, 25 m, flower spikes of *Xanthorrhoea australis*, 21.VIII.1964, K. Beaton (G. Beaton 250, Spooner 1987: 164, fig. 19A–D, doc. vid.). — **ANTARCTICA**: **South Shetland Islands**, Deception Island, Pendulum Cove, Chilean Station, 7 m, undated, isolate from ?gymnosperm wood (timber from buildings) (Held & Blanchette 2013, strain 2Di118-2, KC514844 [A2]). – **Antarctic Peninsula**, Stonington Island, Base E, 1 m, I.2007, isolate from wood (timber from buildings), I.2007 (Arenz & Blanchette 2009, strain AB55, FJ235988 [A2]).

Not included. **LUXEMBOURG**: 18.5 km NE of Luxembourg, 1 km NW of Graulinster, Marscherwald, Rippeger Deel, 400 m, branches of *Fagus sylvatica*, on bark, 27.XI.2018 (G.M. 2018-11-27.1; sq.: MK473421). – 6 km NNE of Luxembourg, 2.5 km E of Walferdange, Gréngewald, Stafelter, branches of *F. sylvatica*, on bark, 25.IX.2017, G. Marson (G.M. 2017-09-25.1; sq.: MK473422). — **GERMANY**: **Sachsen-Anhalt**, Börde, 13 km SW of Magdeburg, 2.5 km E of Wanzleben, Fauler See, 100 m, stem of *Althaea officinalis*, 18.VI.2000, U. Richter (H.B. 6709 ø). – **Bayern**, **Unterfranken**, ~11 km N of Kitzingen, between Sommerach and Nordheim, Mainufer, 200 m, branch of *Salix*, on bark and old ?*Cryptodiaporthe salicella*, 12.III.1996, L.G. Krieglsteiner (H.B. 5708). — **SERBIA**: **Vojvodina**, 10 km WSW of Novi Sad, N of Beočin, 74 m, stem of *Iris pseudacorus*, 15.VI.2017, D. Savić (TU(M) 104916, sq.: UDB039472). — **FRANCE**: **Aquitaine**, **Pyrénées Atlantiques**, 11 km WSW of Arudy, 3.8 km E of Escot, 545 m, branch of *Fraxinus excelsior*, on bark, 8.X.2016, R. Tena & H.O. Baral (H.B. 10024; sq.: MK493141). — **ALGERIA**: **Algiers** ~16 km WSW of Algiers, SE of Koléa, forêt d'Oum-el-Hallouf, ~10 m, indet. woody plant, on bark, 8.III.1915, M. Maire (Maire 3267, as *O. rubella*, MPU, H.B. 5601). — **RUSSIA (West)**: **Karelia**, 59 km NNW of Petrosavodsk, 1 km NNW of Kivach, 48 m, *Picea* log (denovo367, Kazartsev et al. 2018, m.e.). — **CHINA**: **Guizhou**, **Zunyi**, Suiyang, ~62 km NNE of Zunyi, ~38 km ENE of Tongzi, Kuankuoshui, 1420 m, branch of indet. tree, on bark, 10.IX.2007, S.F. Li & J.W. Guo (J.W.G. gz-26, YMFT). — **JAPAN**: **Honshu**, **Iwate**, W of Morioka, Shizukuishi, branch of ?*Populus*, on bark, 15.V.1995, T. Hosoya (TRL 1151, TNS-F-56841, H.B. 9991 ø).

Orbilia oligospora (Fresen.) Baral & E. Weber, **comb. nov.**, MB 813985 — Pls 955–957, Map 155

Basionym: *Arthrobotrys oligosporus* Fresen. [as '*oligospora*'], Beitr. Mykol. 1: 18, pl. 3 figs 1–8 (1850)
≡ *Arthrobotrys superbus* var. *oligosporus* (Fresen.) Coem., [as '*superba* var. *oligospora*'] Bull. Soc. R. Bot. Belg. 2: 14 (1863)
≡ *Didymozoophaga oligospora* (Fresen.) Soprunov & Galiulina, Mikrobiologiya 20: 493 (1951)
= *Arthrobotrys roseus* Massee [as '*rosea*'], J. Roy. Microscop. Soc., Ser. 2, 5: 758 (1885)
= *Arthrobotrys robustus* Dudd. [as '*robusta*'], Trans. Br. Mycol. Soc. 34(4): 598, pl. 13 figs 6, 6a, 7 (1952) [1951]
= *Trichothecium globosporum* Soprunov, Khishchnye Griby-Gifom.: 120, fig. 10 (1958)
≡ *Didymozoophaga globospora* Soprunov & Galiulina, Mikrobiologiya 20: 495 (1951), nom. inval., ICN Art. 39.1 (Latin diagnosis missing)
≡ *Arthrobotrys globosporus* (Soprunov) Mekht. [as '*globospora*'], Dokl. Akad. Nauk Azerb. SSR 20(6): 70 (1964)
[≡ *Arthrobotrys globosporus* (Soprunov) Sidorova, Gorlenko & Nalepina [as '*globosporum*'], Bot. Zh. SSSR 49: 1598 (1964), nom. inval., ICN Art. 41.1]
?= *Trichothecium globosporum* var. *microsporum* Soprunov, Khishchnye Nematofagovye Griby - Gifomitsety: 122 (1958)
≡ *Didymozoophaga globospora* var. *microspora* Soprunov & Galiulina, Mikrobiologiya 20: 496 (1951), nom. inval., ICN Art. 39.1
≡ *Arthrobotrys globosporus* var. *microsporus* (Soprunov) Mekht. [as '*globosporum* var. *microsporum*'], Dokl. Akad. Nauk Azerb. SSR 20(6): 70 (1964)
≡ *Arthrobotrys microsporus* (Soprunov) Mekht. [as '*microspora*'], Dokl. Akad. Nauk Azerb. SSR 27(2): 73 (1971), nom. inval., ICN Art. 35.2
≡ *Arthrobotrys oligosporus* var. *microsporus* (Soprunov) Oorschot [as '*oligospora* var. *microspora*'], Stud. Mycol. 26: 84 (1985)
= *Trichothecium globosporum* var. *roseum* Soprunov, Khishchnye Griby-Gifom.: 123 (1958)

≡ *Didymozoophaga globospora* var. *rosea* Soprunov & Galiulina, Mikrobiologiya 20: 496 (1951), nom. inval., ICN Art. 39.1
≡ *Arthrobotrys globosporus* var. *roseus* (Soprunov) Mekht. [as '*globosporum* var. *roseum*'], Dokl. Akad. Nauk Azerb. SSR 20(6): 77 (1964)
?= *Arthrobotrys globosporus* var. *sarmaticus* Jarow. [as '*globospora* var. *sarmatica*'], Acta Mycologica, Warszawa 6(2): 371, fig. 12 (1970)
≡ *Arthrobotrys oligosporus* var. *sarmaticus* (Jarow.) Oorschot [as '*oligospora* var. *sarmatica*'], Stud. Mycol. 26: 84 (1985)
?= *Arthrobotrys oviformis* Soprunov, Khishchnye Griby-Gifom.: 136, fig. 19 (1958)
≡ *Didymozoophaga oviformis* Soprunov & Galiulina, Mikrobiologiya 20: 496 (1951), nom. inval., ICN Art. 39.1 (Latin diagnosis missing)
≡ *Nematophagus oviformis* (Soprunov) Mekht., *Khishchnye Nematofagovye Griby - Gifomitsety* (Baku): 106 (1979)
= *Arthrobotrys compactus* Mekht. [as '*compacta*'], Nov. sist. Niz. Rast. 10: 176 (1973)

Etymology: *compactus*: probably after the dense arrangement of the conidial clusters; *globosporus*: apparently after the rather broad, almost globose upper cells of the conidia; *microsporus*: named after the smaller conidia compared to these of *A. oligosporus*; *oligospora*/*us*: named after the formation of fewer conidia on each conidiophore in comparison to *A. superbus*; *oviformis*: referring to the conidial shape; *robustus*: referring to its vigorous habit of growth; *roseus*: after the colony colour on the natural substrate (Massee) or in pure culture (Soprunov); *sarmaticus*: referring to the geographical origin (Poland), though this term is ambiguously used.

Typification: Germany, Frankfurt/Main, wood of *Fagus sylvatica* and soil, undated, G. Fresenius (holotype of ***Arthrobotrys oligosporus***, illustration in Fresenius 1850: pl. 3 figs 1–8); Sweden, Malmö, soil, undated, M. Paasuke (CBS 115.81, in metabolically inactive state, epitype of *A. oligosporus* designated here, MBT382131; sq.: KY463695). — Great Britain, Scarborough, branches of indet. plant, undated, G. Massee (holotype of ***A. roseus***, illustration in Massee 1885: pl. 13 figs 6, 6a, 7). — Great Britain, Surrey, Mickleham, rotten wood in beech forest, X.1948, C.L. Duddington (type of ***A. robustus***, CBS 107.51; sq.: MH868284). — Turkmenistan, Aşgabat, soil, VII.1949, F.F. Soprunov (holotype of ***Trichothecium globosporum***, illustration in Soprunov & Galiulina 1951: pl. 5. VII, Soprunov 1958: fig. 10). — Turkmenistan, Mary, soil, II.1949, F.F. Soprunov (holotype of ***T. globosporum* var. *roseum***, unillustrated). — Turkmenistan, Aşgabat, soil, XII.1949, ?F.F. Soprunov (holotype of ***T. oligosporum* var. *microsporum***, illustration in Soprunov & Galiulina 1951: pl. 5.V) — Poland, Kopice, soil, 22.V.1966, N. Jarowaja (holotype of ***A. globosporus* var. *sarmaticus***, illustration in Jarowaja 1970: fig. 12). — Turkmenistan, Aşgabat, soil, V.1950, ?F.F. Soprunov (holotype of ***A. oviformis***, illustrations in Soprunov & Galiulina 1951: fig. 5 II and Soprunov 1958: fig. 19). — Azerbaijan, Shamakhi, rotten leaves in soil, (?)2.VI.1962, N.A. Mekhtieva (holotype of ***A. compactus***, illustration in Mekhtieva 1979: fig. 19). – Most synonyms following Van Oorschot (1985), based mainly on illustrations because no original material is known to have been preserved.

Misapplied name: Pfister & Liftik (1995, teleomorph), as *O. auricolor*.
Misinterpretation of anamorph: Loew (1867), = ?*A. cladodes*; Liu (2006: fig. 15, B.L. 6225), = *Arthrobotrys* sp.; den Belder (1994) (CBS 289.82), ?= *Arthrobotrys pravicovii*.

Description: — **TELEOMORPH** (from D.H.P. 45/55): **Apothecia** dry 0.4–1.6 mm diam., rehydrated 0.25–0.28 mm thick, white to pale brownish (tan); disc flat, margin smooth, not protruding; sessile on a very broad and short stipe; dry deep yellowish-ochre, with a white, radiating subiculum. **Asci** †40–44 × 3.2–4 µm, 8-spored, spores †~4-seriate, lower spores inverted, pars sporifera †20 µm long; **apex** (†) strongly truncate (slightly indented, laterally distinctly widened); **base** with medium thin stalk, h-shaped. **Ascospores** †8–12.5(–14.5) × 0.9–1.1 µm [~10–14(–16) µm actual length], narrowly subcylindric-clavate, apex rounded, base strongly attenuated into a thin or thick tail, medium to strongly curved (falcate); **SBs** no data available. **Paraphyses** apically medium clavate-capitate, terminal cell †19 × 2.7–3.7 µm, lower cells †6.5–8 × 1.4–2 µm, branched below. **Medullary excipulum** 20–50 µm thick, of small-celled textura angularis. **Ectal excipulum** of (†) thin-walled t. angularis at base and flanks, 150–200 µm thick at base, large-celled, marginal cortical cells oriented at a high angle, †9–12 × 3–6 µm; **glassy processes** forming refractive caps of 0.8–1.2 µm thickness. **Anchoring hyphae** very abundant, †3–5(–6.5) µm, wall 0.3–0.5 µm thick. **SCBs** and **VBs** no data available. **Exudate** over paraphyses 0.2–1 µm thick, granular to cloddy, firmly attached. — **ANAMORPH**: arthrobotrys-like (from ascospore isolate {1}; description compiled from Fresenius 1850, Drechsler 1937a, Duddington 1952, Soprunov 1958, Haard 1968, Jarowaja 1970, Mekhtieva 1979, Van Oorschot 1985, Pfister & Liftik 1995, and Swe et al. 2008a): **Conidiophores** erect, 180–800 µm long, 5–8.5 µm wide at base, 2–4(–5) µm wide below nodes, often proliferating repeatedly to form several nodes in a chain, unbranched or rarely branched, conidia formed on nodules or short denticles on ± 4–6 µm wide, swollen nodes (arthrobotryoid), ~5–20 conidia per node. **Conidia** ((12–))(16–)20–27(–30)((–36)) × ((6–))(8–)10–15(–17)((–20)) µm, consistently 1-septate (exceptionally 2-septate), often constricted at septum, obovoid to obpyriform, upper cell usually distinctly wider and mostly also longer than lower cell. Trapping nematodes by means of 3-dimensional **adhesive networks** with outer diameter of ~25–45 µm, loops 5–7 µm thick. **Chlamydospores** present, intercalary, usually singly, 8–30 µm diam.

Habitat: branch of *Fagus sylvatica* {1}, indet. trees {2}, on wood {3}, thallus of indet. *Lecanorales* {1}, dung of *Capreolus capreolus* {1} and *Equus caballus* {1}, various isolates from soil, fresh water, and mangroves. **Associated**: none reported. **Desiccation tolerance**: not tested, ?slightly tolerant. **Altitude**: 10–390 m a.s.l. (temperate Europe), 1–3000 m (northern China), 1–550 m (southern Asia). **Phenology**: IV (teleomorph).

Taxonomic remarks. *Orbilia oligospora* appears to be indistinguishable from *O. auricolor* when considering teleomorph morphology alone, for which reason Pfister & Liftik (1995) applied the name *O. auricolor* in a wide sense. Identification of *O. oligospora* by its anamorph is complicated by strains with variable, intermediate conidial characters. The main argument for its independency is supplied by molecular data, by which it sharply differs from closely related taxa. *C*onsequently, collections of *O. oligospora* without anamorph and without molecular data are easily misidentified as *O. auricolor*. Since many of our records of *O. auricolor* are without such data, some of them might in fact belong to *O. oligospora*. Some other species possess an anamorph reminiscent of *O. oligospora*, but differ in teleomorph characteristics: *O. latispora* s.l. has shorter and wider ascospores, and *O. blumenaviensis* lanceolate paraphyses.

Anamorph. The connection of *A. oligosporus* var. *oligosporus* to the teleomorph *O. auricolor* was reported by Pfister & Liftik (1995, D.H.P. 45/55) and Liu (2006: fig. 15, B.L. 6225, but see under Misinterpretation). Pfister & Liftik's anamorph was isolated from apothecia that were obtained during storage in a moist chamber, growing on a crustose lichen which was collected on a rock in a temperate area in Massachusetts (Pl. 955: 1), whereas Liu's (2006) apothecia grew on branches of an undetermined tree in a tropical botanical garden in Yunnan (for a spore photo see Pl. 957: 1). In the teleomorph both authors saw no difference to *O. auricolor*.

O. oligospora differs from *O. auricolor* in conidia with more or less obovoid to obpyriform shape and consistently more or less eccentrical septum. As a consequence, the upper cell is mostly distinctly larger than the lower cell [Pl. 955], 957). Conidial size is somewhat beyond that of *O. auricolor*, but varies strongly. Conidial length as given by Fresenius is at the upper range of *O. oligospora* and far beyond that of *O. auricolor*, but such a length never occurred in the here available documentations of *O. oligospora*.

Identification of *O. oligospora* is complicated by populations here referred to *O. auricolor*, in which the conidia tend to be asymmetrically septate (see, e.g., Pls 948: 5g; 949: 1i; 954: 6). The anamorph of *O. oligospora* may also be confused with

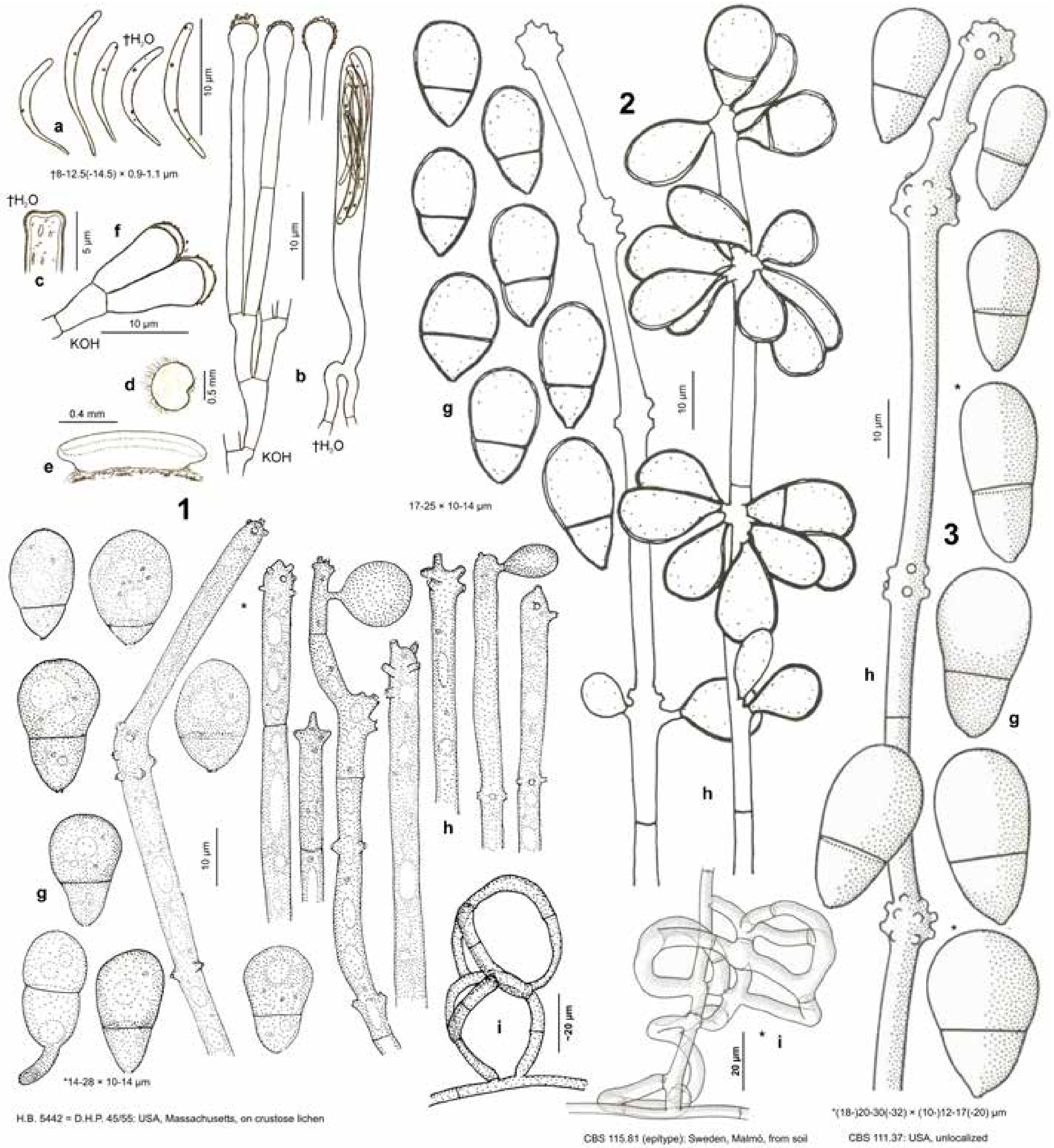


Plate 955. **1–3**: *Orbilia oligospora* (clade B). – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apex; **d**. fresh apothecium with subiculum; **e**. apothecium in median section; **f**. id., marginal cortical cells with thin glassy caps; **g–i**. anamorph (from culture); **g**. conidia; h. upper parts of conidiophores; **i**. adhesive networks. – **1a–f**. H.B. 5442 = D.H.P. 45/55; **1g–i**. D.H.P. 45 (from Pfister & Liftik 1995, as *A. oligosporus* var. *oligosporus*, scale for **1i** corrected, in Pfister & Liftik given as 16 instead of ~32 µm); **2**. CBS 115.81 (from Van Oorschot 1985, as *A. oligosporus* var. *oligosporus*, epitype, scale corrected [20 µm, as '10 µm']); **3**. CBS 111.37 (from Drechsler 1937a, as *A. oligosporus*).

that of *O. latispora* s.l. (= *Arthrobotrys latisporus*), in which the conidia are partly eccentrically septate, though often also more centrally (Pl. 973). A similar situation of partly eccentrical septation is observed in *O. blumenaviensis* (= *A. vermicola*), which differs from *O. oligospora* in larger conidia and in the simultaneous formation of fusoid, 2–3-septate conidia, though in a strongly varying frequency. *A. conoides* differs from *O. oligospora* in more elongate conidia, i. e., with a higher l:w ratio. *A. koreensis* Wu et al., *A. paucisporus* (R.C. Cooke) Jarow., *A. cystosporius* (Dudd.) Sidorova et al., and *A. perpastus* (R.C. Cooke) Jarow. have similar conidia, but rather sharply differ in the candelabrelloid or geniculate type of conidiogenesis (longer denticles, lack of swollen nodes) and in producing less conidia per conidiophore.

Arthrobotrys oligosporus was frequently investigated because of various peculiarities, such as the ability to effectively capture four different plant-parasitic nematode species (den Belder 1994: 27), the formation of simple adhesive rings directly on

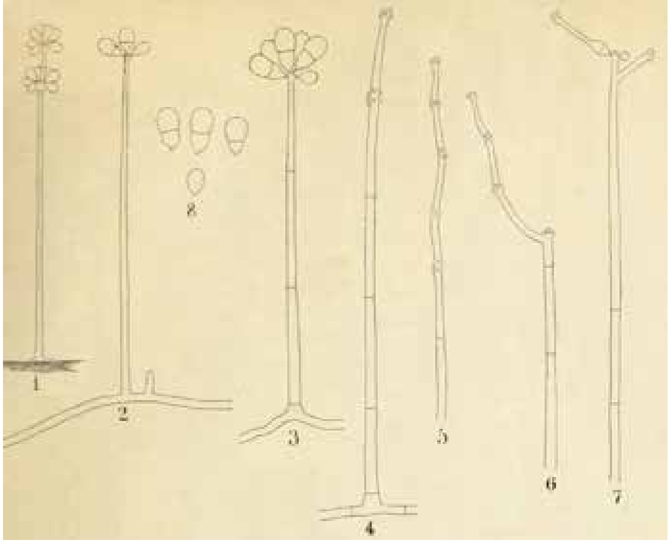


Plate 956. Type of *A. oligosporus*, original drawing by Fresenius (1850, published without scale).

the conidia ('conidial traps'), and mycoparasitism (formation of hyphal coils around hyphae of *Rhizoctonia*, Nordbring-Hertz 2004) Molecular studies involve the detection of active chemical compounds (e.g., Zhao et al. 2004), and the evaluation of population genetics (Zhang et al. 2011b).

Type studies. In the original description of *A*. ***oligosporus*** (Pl. 956), Fresenius (1850) described the conidia as pear-shaped, 1/28 mm long (= 35.7 µm, 18 µm wide when taking the longest conidium as 36 µm), with the septum somewhat below the centre, and the conidia less constricted at the septa compared to *A. superbus*. In the discussion, however, he emphasized that the septum occurs 'more in the lower third of the spore than in the middle'. His illustration (Pl. 956) shows both unequally and almost equally septate conidia, with the upper cell always distinctly wider than the lower cell, reminiscent of some collections here referred to *O. auricolor*. About 12 conidia as a maximum are said to be formed in a terminal cluster, more rarely also two conidial clusters or exceptionally up to 5 clusters in a row.

Since a pure culture of the type of *A. oligosporus* is lacking, an **epitype** (Sweden, Malmö, CBS 115.81) is designated here, which is well-documented (Pl. 955: 2), and for which sequences of different gene regions are available.

Massee (1885) was obviously unaware of *Arthrobotrys oligosporus* when he described *A*. ***roseus***. He did not give a conidial size, but from his drawing a size of ~21–27 × 14–17.5 µm can be evaluated. From *A. roseus* he distinguished *A. superbus* by equally septate conidia and pure white colonies. Duddington (1952) compared his *A*. ***robustus*** with *A. superbus* and *A. cladodes* s.l. regarding differences in conidiophore morphology, conidial size, and chlamydospores, but mentioned *A. oligosporus* only for its similar trapping organs. He described the spores with a nearly median septum, which appears to have mislead Van Oorschot (1985) and the CBS database to consider *A. robustus* to be a synonym of *A. pyriformis* or to compare it with *A. cladodes* var. *macroides*. However, Duddington's figure shows also conidia with the septum almost in the lower third and with always broader upper cell, reminiscent of *O. oligospora*. Conidial size is given as 18–27 × 8–12 µm, hence conidial width is at the lower range of *O. oligospora*. Molecular data from the ex-type strain (CBS 107.51), which was said by Van Oorschot to be now sterile, confirm synonymy with *O. oligospora* (see below).

A. ***globosporus*** **var**. ***globosporus*** was proposed by Soprunov (1958) and separated from *A. oligosporus* based on a denser arrangement of the clusters, with a maximum distance of 20–30 µm between the nodes, the terminal clusters being gradually more closely arranged and, therefore, confluent to form a single elongate cluster (in *A. oligosporus* all clusters separate at a distance of ~25–50 µm). Judging from the illustration we see no clear differences between the two taxa. Although Soprunov stated the colony colour to be light pink in his var. *globospora*, he separated *A*. ***globosporus*** **var**. ***roseus*** from the type variety merely by the intense rose-red colony colour. Mekhtieva (1979) compared *A*. ***compactus*** with *A. oligosporus*, from which she distinguished it, e.g., in larger conidial clusters, but her description and illustration concurs well with typical *A. oligosporus*. According to Van Oorschot (1985), *A*. ***globosporus*** **var**. ***microsporus*** has distinctly smaller conidia (Soprunov 1958: 15.2–19.6 × 6–11 µm) than *A. oligosporus*. A sequence from Japan under the name *A. oligosporus* var. *microsporus* falls in subclade A of the *O. oligospora* clade.

The descriptions and illustrations of ***Arthrobotrys oviformis*** in Soprunov & Galiulina (1951) and Soprunov (1958), a species accepted by Scholler et al. (1999), present obovoidal to pyriform conidia of 22.5–32.5 × 10–15.5 µm, with a strongly eccentrical septum, reminiscent of *A. oligosporus*, except that almost 1/4 of the conidia are 2-septate and of ellipsoid shape (note that in Soprunov & Galiulina l.c. the legends to Fig. 5 II and VI are confused). Van Oorschot (1985) and Yu et al. (2014) accepted *A. oviformis* as distinct from *A. oligosporus* based on branching of conidiophores and occasionally 2-septate conidia in *A. oviformis* as opposed to consistently unbranched conidiophores and consistently 1-septate conidia in *A. oligosporus*.

Only one of the six included Chinese samples bears a culture number (YMF 1.00121), and Yu et al. (l.c. fig. 3.34) illustrate the morphology of this strain. Its conidia measure from the scale 19–32 × 11–13.7 µm, which concurs with Soprunov (1958) but is about the double size of what their description tells (7.5–22.5 × 5–10 µm, note that the scales for conidiophores and conidia have the same length, although the former are reproduced at a smaller magnification). A sequence of YMF 1.00121 was uploaded in GenBank under the name *A. oligosporus* (MH179701). It belongs to clade A1 of *O. oligospora*, where it is fully identical in the ITS with, e.g., an *A. oligosporus* strain from Florida (KJ938573). This questions the taxonomic value of branching and additional spore septum in *A. oviformis*.

Jarowaja (1970) distinguished her *A*. ***oligosporus*** **var**. ***sarmaticus*** from *A. globosporus* var. *globosporus* by shorter conidiophores with only one or rarely two nodes at intervals, longer conidia of 20–34(–40) × 10–19 µm, and adhesive nets with thicker loop hyphae.

Variation in the anamorph. In Pfister & Liftik's strain the nodules at the conidiophore tips are uninflated (Pl. 955: 1h), whereas in Drechsler's strain they are distinctly inflated (3h). The position of the conidial septum and the volume relation between the two cells vary among conidia of a population, also the total size of conidia may vary considerably. This is particularly seen in Drechsler's (1937a: fig. 3) strain, in which, conidia on nematode-infested plates were distinctly larger than on non-infested ones.

Misinterpretation of ***A*. *oligosporus***. A few literature reports under the name *A. oligosporus* represent different species. Loew (1867) illustrated samples on rotten stems of *Apiaceae* and

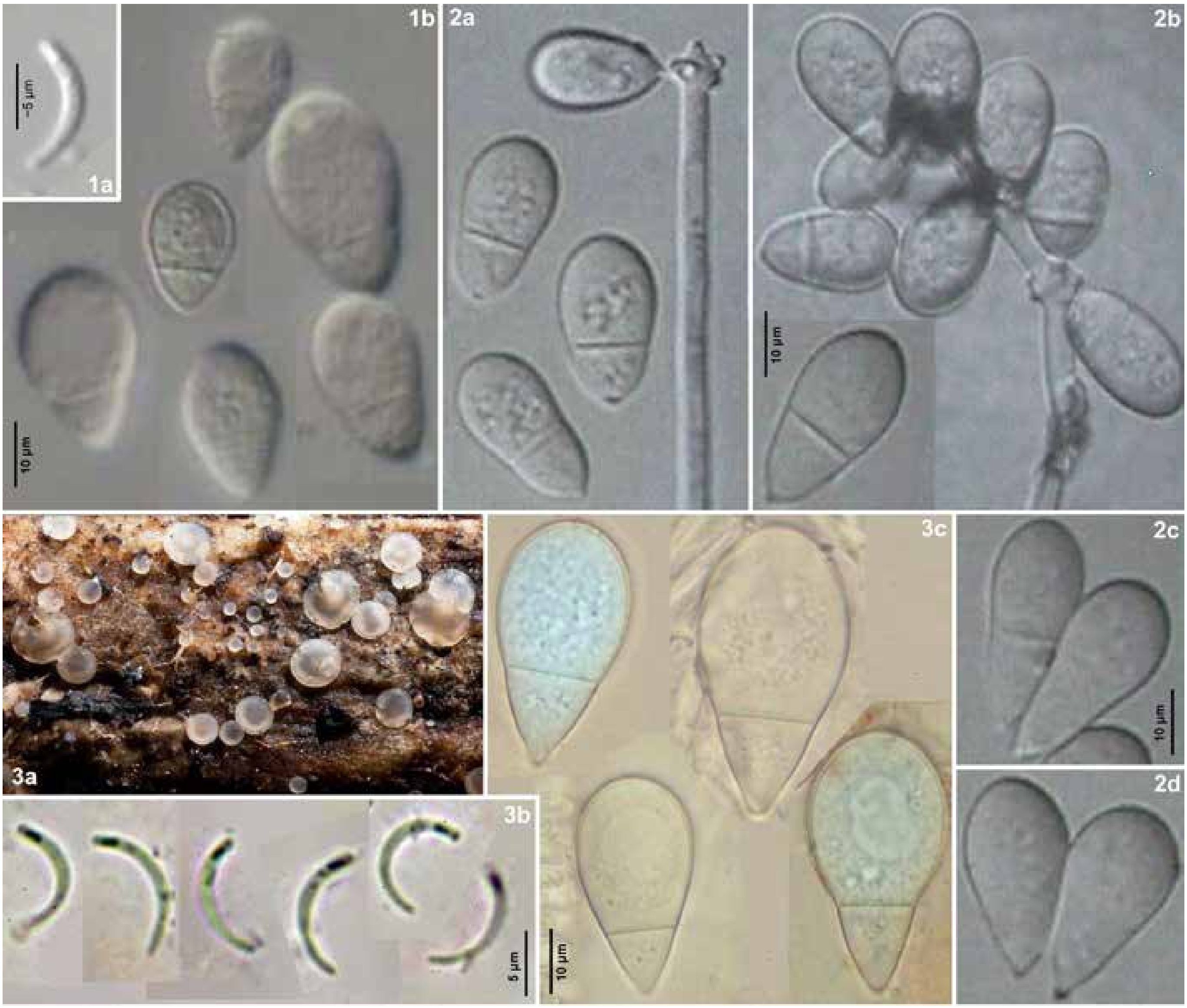


Plate 957. **2**: *Orbilia oligospora*; **1**, **3**: *O.* aff./cf. *oligospora*. – **3a**. fresh apothecia of assumed teleomorph; **1a**, **3b**. ascospores; **1b**, **2a–d**, **3c**. conidia and conidiophores (**1b**, **2a–d** from culture, **3c** from natural substrate). – Living state. – **1**: from Liu (2006), **2**: from Swe et al. (2008a), **3**: phot. E. Rubio. **— 1a–b**. B.L. 6225: China, Yunnan, on indet. tree (Liu 1006); **2a–d**. unspecified: China, Hong Kong; **3a–c**. E.R.D. 5918: Spain, Asturias, on *Brassica*.

Brassicaceae, which he assigned to *A. oligosporus* only with hesitation because of much smaller (9–14 × 5–7 µm) conidia with mostly ± median septum formed on branched or unbranched instead of proliferating conidiophores that lack nodules and inflated nodes. The conidiogenesis resembles that of *A. flagrans*, but the small conidia arranged in clusters of ca. 12 at each node of the branched conidiophores point to *A. cladodes*. Liu's (2006) ascospore isolate (B.L. 6225) was identified as *A. oligosporus* because of obpyriform conidia (17.5–35 × 10–17.5 µm) with a strongly eccentrical septum (Pl. 957: 1b), but its sequences cluster distantly from the *O. oligospora* clade. Likewise, an unillustrated strain under the name *A. oligosporus* (CBS 289.82), which was comprehensively studied for nematode-trapping by den Belder (1994) and characterized by attaching to nematodes through hyphae without prior formation of complex networks, is phylogenetically distant from *A. oligosporus*.

Not included collections. For the not included *A. globosporus* var. *microsporus* and var. *sarmaticus*, and *A. oviformis* see under Nomenclature and type studies. In a Spanish collection on *Brassica*, conidia with an even larger size and a similar shape as in *A. globosporus* var. *sarmaticus* occurred (*30–45 × 17–24 µm, E. Rubio pers. comm., Pl. 957: 3a–c), which resemble those of typical *O. oligospora* except for their large size. Regrettably, no conidiophores were seen. Apothecia occurred in close vicinity, which did not differ in any respect from those of *O. auricolor* or *O. oligospora*. However, their connection to the conidia is uncertain. For the not included sample from China (B.L. 6225) see under Misinterpretation.

Phylogeny. In the maximum parsimony analysis of the ITS region by Zhang et al. (2010), *A. oligosporus* formed a strongly supported clade of its own by forming with rather high support a sister group to the remaining taxa of *Arthrobotrys*. A similar position was obtained in the NJ analysis of ITS by Qiao et al. (2012), in which *A. oligosporus*, formed with *A. flagrans*, *A. amerosporus*, and *A. musiformis*, species not included by Zhang et al., as an unresolved paraphyletic sister group to the remaining species. This is in contrast to Yang et al.'s (2007: fig. 2A/B) ML analyses of ITS or *TUBB*+*RPB2*+*TEF1*, in which *A. oligosporus* (strain 920) clustered with *A. conoides*, *A. pseudoclavatus* (= *A. janus*), *A. musiformis*, and *A. vermicola* in a terminal clade which received strong support in the combined analysis.

Table 84. Diagnostic positions in the ITS region which separate three clades and two subclades within the *Orbilia oligospora* aggregate. * = strain FM01 (Mexico) has ‘`CTGT`’, # = two strains from Mexico have ‘`---TAACCGGGGGAA`’. Position numbers starting after ATCATTA by including all inserts.

Clade	31–35	48–51	71–74	163–170	177–180	238–242	454–459	464–478	521–525	543–546	564–567	584–590
A1	GCTTG	G-TT	AAGC	CCCCGTTT	CCGT*	CAAAA	GTG-C	---TAACC-GGGGAA#	-CCCC	AC-A	AAGC	CTGAACA
A2	GCTTG	G-TT	AAGC	CCCCGTTT	CCGT	CAAAA	GTG-C	---TAACC-GGGGAA	-CCCC	AT-A	AAGC	CTGAACA
A3	GCTTG	G-TT	AAGC	CCCCGTCT	CCGT	CAAAA	GTT-C	---TAACC-GGGGAA	-CCCC	AT-A	AAGC	CTGAACA
A4	GCTTG	G-TT	AAGC	CCCCGTCT	CCGT	CAAAA	GTG-C	---TAACC-GGGGAA	-CCCC	AT-A	AAGC	CTGAACA
B1	GTTCG	GTTT	AAGC	CCCCTTCT	CCGT	CAAAA	GTTTC	---CAACA-GGGGAT	CCTCC	AC-A	AAGC	CTGGAAA
B2	GTTCG	GTTT	AAGC	CCCCTTCT	CTGT	CAAAA	GTTTC	---TAATA-GGGGAT	CCTCC	AC-A	AAGC	CTGGAAA
C1	GCTCG	G-TT	GAGC	TCCCGCTC	CTGT	C-AAA	GTA-C	CTTTAACCGGGGGAA	--CCC	ACTA	AAGT	CTGAACA
C2	GCTCG	G-TT	GAGC	TCCCGCTC	CCGT	C-AAA	GTA-C	CTTTAACCGGGGGAA	--CCC	ACTA	AAGT	CTGAACA

In our combined analysis of SSU+ITS+LSU (Phyl. S33) *O. oligospora* clustered medium supported with *A. amerosporus*, *A. conoides*, *A. flagrans*, *A. musiformis*, and *O. javanica* (here called *oligospora-musiformis* clade). This clade is likewise obtained with medium support when analysing SSU (Phyl. S29). Also when analysing ITS (Phyl. 28) and LSU (S32) the clade is formed but received no support, and *A. musiformis* (in the LSU tree also *O. javanica*) clustered outside the clade. In the combined ML analysis in Baral et al. (2017b), *A. oligosporus* formed with *A. flagrans* a strongly supported clade, but this analysis comprised only six members of series *Arthrobotrys*. With our results concurs a combined analysis of ITS+LSU by X.Z. Liu & X.Z. Jiang (pers. comm., presented in Amsterdam in 2012), where *A. oligosporus* clustered in a medium supported clade with *A. amerosporus*, *A. javanicus*, and *A. musiformis* (*A. flagrans* was not included). A close association between *A. oligosporus* and *A. flagrans* was also noted by Ahrén et al. 2004).

About 30 more or less complete **ITS** sequences correctly identified as *Arthrobotrys oligosporus* were available in GenBank (accessed Oct. 2018) and three in NBRC. Although *O. oligospora* formed in our analysis a strongly supported clade (Phyl. 28), the available sequences exhibit considerable variation by forming three different subclades (A–C) that differ by 1.3–3 % (Phyl. 29, Tab. 84). The sharp separation of *O. oligospora* from other species of series *Arthrobotrys* confirms earlier, morphology-based species concepts. The clade includes the here designated epitype (CBS 115.81).

Despite this rather clear situation, strains exist that fit the morphology of *O. oligospora* but strongly deviate by molecular data: Liu’s (2006: fig. 15) ascospore isolate B.L. 6225 clustered distant from the *O. oligospora* clade, either unresolved near *O. multiformis* (ITS, Phyl. 28) or near two strains of unclear identity under the name *A. superbus* (LSU, S32) for which no ITS was available. Likewise, den Belder’s (1994, CBS 289.82) unillustrated strain differs from genuine *O. oligospora* by 3 nt in the V8 and 9 nt in the V9 loop of SSU (S29) but concurs in the V8–V9 region with *A. pravicovii* and *O. scaphoides* (*scaphoides-pravicovii* clade). Unofficial ITS data of den Belder’s strain in the CBS database confirm a close relationship particularly to *A. pravicovii* (2 % distance).

In their molecular study on three gene regions (ITS, *TUBB*, *RPB2*), Zhang et al. (2011b) investigated 97 *A. oligosporus* strains from various regions of China, which have been isolated mainly from agricultural and forest soils but also from water (Map. 155). In their combined tree but also in supplementary analyses of single regions, the authors detected the above-mentioned three lineages, which they classified as clades A–C and assumed to represent cryptic species. But they also observed significant variation within each clade. No morphological data were documented for any of these strains although conidia were available (Z.F. Yu pers. comm.). It is, therefore, impossible to hypothesize which of the morphology-based varieties of *A. oligosporus* might be represented by clades A–C. Also no efforts were undertaken to identify GenBank sequences regarding the three cryptic species.

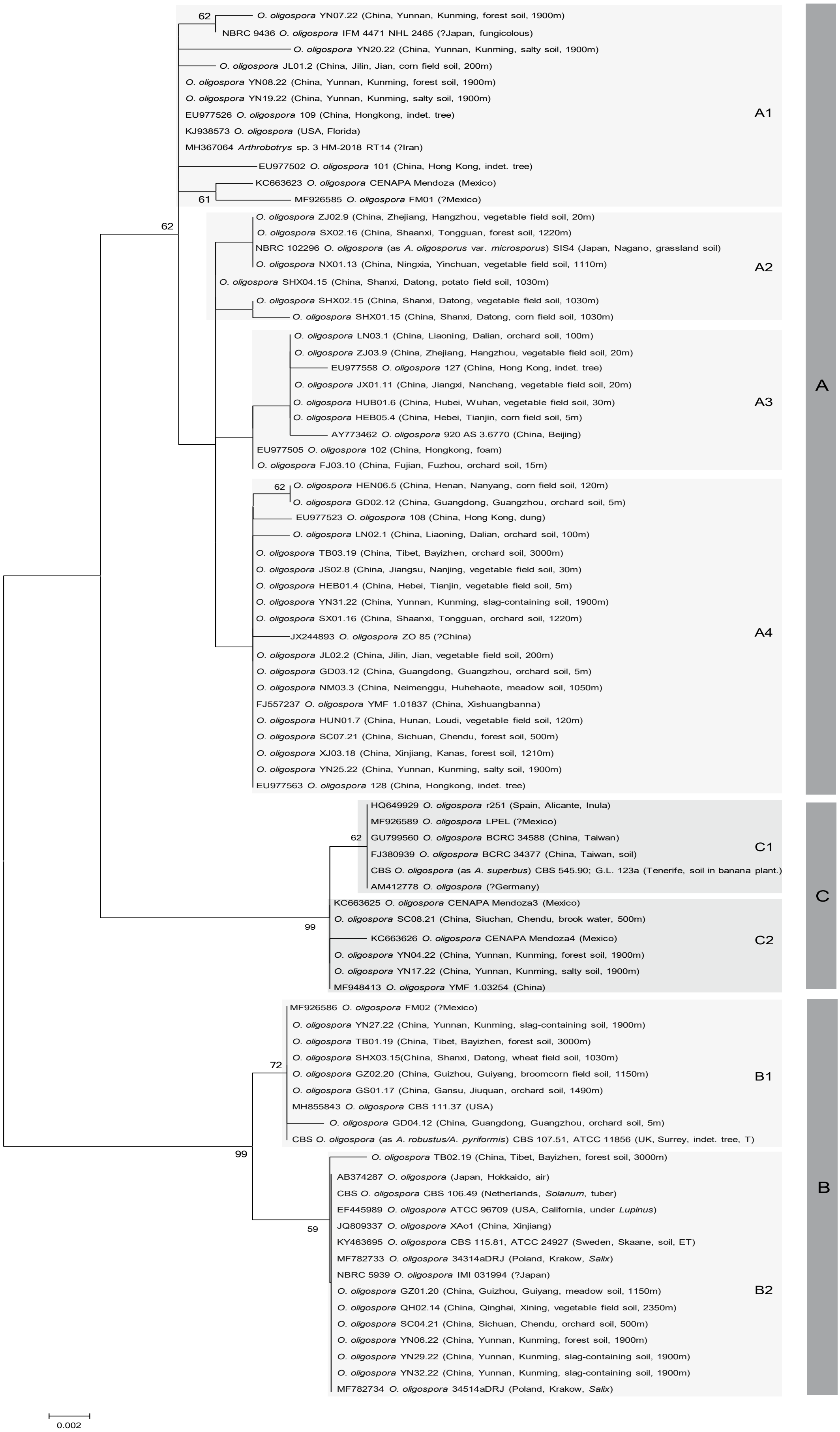
None of the sequences treated by Zhang et al. (2011b) were uploaded in an online database, but Z.F. Yu generously supplied us all ITS and *TUBB* data. An ITS tree is presented (Phyl. 29) which includes a selection of their 97 strains. We included also strains from official repositories and herewith identified their relationship with three lineages of Zhang et al. For instance, the Chinese strain 920 treated by Yang et al. (2007) clustered in clade A, whereas the Swedish epitype strain of *O. oligospora* (CBS 115.81) treated by Ahrén et al. (2004) clustered in clade B.

The distances between the three clades lie at 1.4–3 % (A–B), 1.3-2 % (A–C), and 2.3–2.9 % (B–C), and the observed variation within each clade at 0–1 % (A), 0–0.7 % (B), and 0–0.3 % (C). Each clade is characterized by a varying number of unequivocal nucleotides and indels Tab. 84: clade A by 1 nt, clade B by 7 nt and 2 inserts, and clade C by 6 nt, 5 inserts, and 2 deletions. Also within each clade a few nt correlate with the subclades obtained by ML analysis: 3 nt between A1–A4, 3 nt between B1 and B2, 1 nt between C1 and C2.

When analysing ***TUBB*** in GenBank (Phyl. S34), 20 strains, mostly identified as *A. oligosporus*, clustered in two associated clades, one clade comprising only strains from China (mainly Hong Kong) and the other only strains from Europe, India, and America. Because Zhang et al. (2011b) sequenced another region of *TUBB* (primer pair Bt1a-Bt1b) than Ahrén et al. (2004) and Yang et al. (2007) (‘tubA’, primer pair Bt2a-Bt2b), their isolates cannot be compared. However, strains which include also ITS permit to recognize in S34 the Chinese strains as clade A and the others as clade B (no sequences for Bt2a-Bt2b appear to exist for clade C). For Bt1a-Bt1b only the here designated epitype strain of *O. oligospora* exists in GenBank (ATCC 24927 = CBS 115.81, XM_011123192), and for this strain also Bt2a-Bt2b is available (AY444611).

Also Zhang et al. (2011b) found some geographical correlations in their analysis: clade A comprised almost all tested localities across China’s north, south, and west (0–3000 m a.s.l.), but clades B and C mainly sites in western China (500–3000 m a.s.l.). However, three exceptions question this correlation: their strain from Guangdong (5 m) clusters in clade B, and two GenBank strains from Taiwan in clade C. The fact that the large clade A comprises mainly Chinese strains, besides some from Japan, USA, and Mexico, might be simply due to the rich sequence data in Zhang et al.’s study.

Only **SSU** (V1–V9) was available for Pfister & Liftik’s strain from Massachusetts (D.H.P. 45/55, H.B. 5442). This shows over a length of 1687 nucleotides a distance of only 0.1–



Phylogenetic analysis 29. Phylogram of *Orbilia oligospora* s.l. inferred from ML analysis of ITS1-5.8S-ITS2 rDNA sequences from GenBank and NBRC (83 sequences, 627 positions, aligned with MUSCLE) using the K2+G model in MEGA6 (500 replicates), in comparison with a majority of Chinese strains (without repository number) treated in Zhang et al. (2011b), with indication of their geographical origin (province) and altitude. Clades A–C appear to represent 3 cryptic species, whereas subclades B1/B2 and C1/C2 merely differ by a few characteristic positions (Tab. 84). Note that all recognized subclades contain strains from different continents.

0.2 % to three further strains under the name *A. oligosporus* in GenBank. Hence, D.H.P. 45/55 obviously belongs in the scope of *O. oligospora* s.l. (see Phyl. S1). two of them (XAo1, from Xinjiang; CBS 115.81, from Sweden) comprise also ITS and belong in subclade B2 of *O. oligospora*. In the V8–V9 region of SSU they are identical with D.H.P. 45/55 (apart from 4 'N' in D.H.P. 45/55). No SSU sequence of other *O. oligospora* clades were available. Because SSU is highly conservative, it seems improbable that SSU permits to distinguish among the three clades of *O. oligospora*.

A third SSU sequence ('CBS 109.52', AJ001983, Ahrén et al. 1998) was named *A. conoides* and fully concurs in the V1–V9 with CBS 115.81 except for 3 gaps. It is in confusion, because three further sequences without SSU (U51949, Liou & Tzean 1997; KT215210; CBS ined.), taken from CBS 109.52, belong in the ITS or LSU to *A. superbus* (*O. auricolor* clade). This explains why in the phylogenetic analysis of SSU by Hagedorn & Scholler (1999: fig. 4) strain D.H.P. 45/55 clustered in a clade with '*A. superbus* CBS 109.52' (AJ001983) and *A. oligosporus* CBS 115.81 (KY463695).

The above-mentioned CBS 289.82, studied by den Belder (1994) and misidentified as *A. oligosporus*, differs in the entire SSU from the above four reliable strains of *O. oligospora* by 1.1–1.2 %, and *A. superbus* (CBS 107.81) differs from them by 2 %, therefore, these two strains clustered in Ahrén et al.'s (1998) analysis in a clade distant from genuine *A. oligosporus* [note that Ahrén et al.'s '*O. auricolor*' refers to D.H.P. 45/55, see Ahrén et al. 2004: 1210].

An unofficial ITS sequence at CBS (www.cbs-knaw/collections) of the type of ***A. robustus*** (CBS 107.51) and a GenBank sequence of *O. oligospora* (CBS 111.37, MH855843), apparently the one figured in Drechsler (1937a: fig. 3), are fully identical and cluster in clade B1 (Phyl. 29). They show a 0.6 % distance (3 nt) to the epitype strain from Sweden (CBS 115.81, clade B2). Another strain under the name *A. robustus* (CBS 602.80, unlocalized) was referred by Van Oorschot (1985) to *A. pyriformis* but its sequence belongs to *O. auricolor* (see p. 1535).

Since ITS is generally rather variable within *Orbilia*, we are reluctant in splitting *O. oligospora* into three species (clades A–C) based on distances of only 1.5–3 %, particularly since no morphological data were available to support the taxonomic value of the three genotypes.

A characteristic insert of ~55 (or sometimes only 19) nucleotides occurs at the 5'-end of ITS1 in almost every sequence of *O. oligospora*. This insert is absent in any other sequences of section *Arthrobotrys*, or rarely present but much shorter. The S1506 intron at the 3'-end of SSU is consistently absent in the six available sequences of *O. oligospora* that cover this region.

Ecology. *O. oligospora* seems to be among the most common predacious species by showing a worldwide distribution, judging from the many existing isolates. Drechsler (1937a) even wrote: 'Of all predacious fungi *Arthrobotrys oligospora* is undoubtedly by far the most widely known among mycologists'. Zhang et al. (2011b) found the species in 97 out of 400 soil or water samples from various regions of China. Among the taxa with adhesive nets it is by far the most often isolated species, therefore, it is used as a model organism to study the relationship between nematode-trapping fungi and their nematode host (Niu & Zhang 2011). Nevertheless, we did not come across an unequivocal collection of either the anamorph or teleomorph of *O. oligospora* for personal study, except for the sample from Massachusetts.

Map 155. Distribution of *O. oligospora* based on isolates investigated by Zhang et al. (2011b, China), Swe et al. (2008a, Hongkong), Kuo et al. (2008 ined., Taiwan), Tokumasu (ined., Japan); clades: cyan = A, yellow = B, red = C, green = A + B, magenta = A + B + C. Coordinates in Zhang et al. corrected according to their map, altitudes taken herefrom.

The few at present known records of both morphs on the natural substrate do not permit to circumscribe the ecological preferences of the fungus. The isolation sources of the reported cultures are very diverse and include, besides soil, gymno- and angiosperm wood and bark, decaying herbaceous plants, and dung. The climate includes cold-temperate to subtropical humid (partly winter-dry) and warm- to cold-continental semiarid regions.

Specimens included. **USA**: unlocalized, 1937, C. Drechsler (CBS 111.37, conid. isol., doc. vid.; sq.: MH855843, MH867347, AY444619 etc. [B1]). – **Massachusetts**, Middlesex, 28.5 km NW of Boston, 4.3 km N of Concord, Estabrook Woods, 65 m, on black crustose thallus of indet. *Lecanorales* covering a rock, IV.1994, D.H. Pfister (isolates D.H.P. 45 & 55, anam. cult., FH 304900, sq.: U72598; H.B. 5442 ø). – **Michigan & Missouri**, several collections from soil or rotten wood, K. & R. Haard (conid. isol., doc. vid., Haard 1968). — **SWEDEN**: **Skåne**, 7.5 km NE of Malmö, ~2 km SE of Lomma, Alnarp, ~10 m, from soil, undated, M. Paasuke, depos. I.1981 by B. Nordbring-Hertz (CBS 115.81 epitype, ATCC 24927, BBA 69390, conid. isol., doc. vid.; sq.: AJ001986, KU729032, KY463695, AY444611, XM_011123192 [B2]). — **GREAT BRITAIN**: **Yorkshire**, **North Yorkshire**, Scarborough, unlocalized, ?100 m, on indet. branches, undated, G. Massee (holotype of *A. roseus* [illustration], anam. only, doc. vid.) – **South East England**, **Surrey**, Mickleham, ?60 m, on indet. wood, X.1948, C.L. Duddington (type of *A. robustus*, CBS 107.51, as *A. pyriformis*, conid. isol., doc. vid.; sq.: CBS ined., MH868284 [B1]). — **GERMANY**: **Hessen**, Frankfurt, unlocalized, ~100 m, on wood of *Fagus sylvatica*, rotten fruit and soil, undated, G. Fresenius (holotype of *A. oligosporus* [illustration], anam. only, doc. vid.). – 7.5 km NNE of Wiesbaden, 2 km NW of Naurod, Trockenborn, 390 m, droppings of *Capreolus capreolus*, 2.V.2012, H. Lotz-Winter (FR-0219169, anam. only, doc. vid.). – ibid., 27.II.2013 (T1387, FR-0219186, anam. only, non vid.). — **TURKMENISTAN**: Aşgabat (Ashkhabad), ~250 m, soil isolate, VII.1949, F.F. Soprunov (holotype of *A. globosporus* [illustration], conid. isol., doc. vid.). – Mary, 220 m, soil isolate, II.1949, F.F. Soprunov (holotype of *A. globosporus* var. *roseus*, conid. isol., non vid.). — **AZERBAIJAN**: **Shamakhi**, rotten leaves in soil, (?)2.VI.1962, N.A. Mekhtieva (holotype of *A. compactus* [illustration], conid. isol., doc. vid.). — **CHINA**: northeastern provinces (**Liaoning**, **Jilin**, **Neimenggu**, **Hebei**, **Henan**, **Shanxi**), southeastern provinces (**Hubei**, **Hunan**, **Jiangsu**, **Zhejiang**, **Fujian**, **Jiangxi**, **Guangdong**), northwestern provinces (**Ningxia**, **Qinghai**, **Gansu**, **Xinjiang**), and southwestern provinces (**Tibet**, **Guizhou**, **Sichuan**, **Yunnan**), various soil and water isolates (Zhang et al. 2011b, conid. isol., non vid.). – **Xinjiang**, unlocalized (strain XAo1, conid. isol., non vid.; sq.: JQ809337 [B2]). **– Hong Kong**, New Territories, Mai Po, mangrove region, 1 m; Hoi Ha Wan, Sai Kung, mangrove region, 1 m; Tai Lam Chung Reservoir, from freshwater, 55 m; Tai Po Kau, from soil, ?100 m; Lantau, Lantau North Country Park, Mui Wo, from freshwater; ibid., from soil; from mangroves (M1.101, sq.: EU977502 [A1]; M2.109, sq.: EU977526 [A1]; M3.128, EU977563 [A4]), freshwater (F1.102, sq.: EU977505 [A3]), dung (T1.108; sq.: EU977523 [A4]), indet. wood (T2.127; sq.: EU977561, EU977558 [A3], EU977559 etc.) (Swe et al. 2008a, conid. isol., doc. vid.). – **Taiwan**, unlocalized (BCRC 34377, sq.: FJ380939 [C1]; BCRC 34588, sq.: GU799560 [C1]). — **JAPAN**: unlocalized, 1.I.1954 (IMI 031994; sq.: NBRC 5939 [B2]). – unlocalized, isolated from mushroom, 5.VI.1971 (IFM 4471, NHL 2465, sq.: NBRC 9436 [A1]). – **Honshu**, **Nagano**, Chiisagata-gun, ~16 km NE of Ueda, Sugadaira, ~1300 m, grassland soil, S. Tokumasu (SIS4, as *A. oligosporus* var. *microsporus*, conid. isol., non vid.; sq.: NBRC 102296 [A2]).

Not included. **POLAND**: **Podlaskie**, 58 km NW of Białystok, ~7 km NW of Goniądz, Leśnictwo Kapice, ~110 m, from soil, 22.V.1966, S. Szymański (holotype of *A. oligosporus* var. *sarmaticus* [illustration] conid. isol., doc. vid.). — **TURKMENISTAN**: Aşgabat (Ashkhabad), ~250 m, soil isolate, VII.1949, ?F.F. Soprunov (holotype of *A. globosporus* var. *microsporus* [illustration], conid. isol., doc. vid.). – ibid., V.1950, ?F.F. Soprunov (holotype of *A. oviformis*, [illustrations], conid. isol., doc. vid.). — **FRANCE**: unlocalized (CBS 289.82, investigated by den Belder 1994, conid. isol., non vid.; sq.: AJ001987). — **SPAIN**: **Asturias**, 8,5 km WNW of Tineo, NW of Sabadel de Troncedo, 555 m, stem of *Brassica oleracea*, 28.VI.2013, E. Rubio (E.R.D. 5918, anam. substr., doc. vid.). — **CHINA**: **Yunnan**, **Xishuangbanna**, 47 km ESE of Jinghong, 1 km S of Menglun, Tropical Botanical Garden, 550 m, indet. tree, on wood, 11.XI.2002, B. Liu, Y. Yang & B. Wang (B.L. 6225, HMAS 139637, anam. cult., doc. vid.; sq.: DQ656610).

Orbilia multiformis (Dowsett, J. Reid & Kalkat) E. Weber & Baral, **comb. nov.**, MB 813986 — Pl. 958

Basionym: *Dactylella multiformis* Dowsett, J. Reid & Kalkat, Mycologia 76(3): 563 (1984)
≡ *Monacrosporium multiforme* (Dowsett, J. Reid & Kalkat) A. Rubner, Stud. Mycol. 39: 84 (1996)
≡ *Arthrobotrys multiformis* (Dowsett, J. Reid & Kalkat) M. Scholler, Hagedorn & A. Rubner, Sydowia 51(1): 103 (1999)
= *Trinacrium iridis* Ts. Watan., Mycologia 84: 794 (1992)
≡ *Dactylella iridis* (Ts. Watan.) K.Q. Zhang, Xing Z. Liu & L. Cao [as '*irida*'], Mycosystema 7: 112 (1995, '1994')
≡ *Monacrosporium iridis* (Ts. Watan.) A. Rubner & W. Gams, Stud. Mycol. 39: 77 (1996)
≡ *Arthrobotrys iridis* (Ts. Watan.) M. Scholler, Hagedorn & A. Rubner, Sydowia 51: 102 (1999)
= *Dactylella ramiformis* Xing Z. Liu & W.F. Qiu, Mycol. Res. 97: 359 (1993)
= *Arthrobotrys yunnanensis* M.H. Mo & K.Q. Zhang, in Mo et al., Fungal Diversity 1: 109 (2005)

Etymology: *iridis*: after the host; *multiformis*: referring to the different conidial types (unbranched macroconidia, 1-septate microconidia, non-septate secondary microconidia); *ramiformis*: referring to the partly branched macroconidia; *yunnanensis*: after the geographical origin.

Typification: Canada, Lake Manitoba, marsh soil, undated, J. Reid (ATCC, CBS 773.84, CMI, living ex-type culture, syntypes of ***Dactylella multiformis***; sq.: MH861834, AY261171). — Japan, Wakayama, *Iris ensata* var. *hortensis* roots, 27.IX.1982, T. Watanabe (FFPRI TW 82-567, holotype of ***Trinacrium iridis***; ex-type culture: CBS 686.94 = IFO 32554, sq.: EU107316, NBRC 32554). — China, Beijing, *Triticum aestivum* rhizosphere, IV.1989, X.Z. Liu (HMAS 62571, holotype of ***Dactylella ramiformis***; ex-type culture: CBS 166.95 = IFO 32587; sq.: AY773452). — China, Yunnan, Xiaobailong Mt., from wet soil, 15.VIII.2003, M.H. Mo et al. (HT 1.00593, holotype of ***Arthrobotrys yunnanensis***; ex-type culture: YMF 1.00593; sq.: AY509930).

Misapplied name: Mo et al. (2005a, teleomorph), as *O. auricolor*.

Description: — **TELEOMORPH** (after Mo et al. 2005a, values partly modified according to scale): **Apothecia** fresh 0.3–0.8 mm diam. (on CMA), white, finally pale yellowish-cream; disc flat, margin smooth; sessile. **Asci** *53 × 4.1 µm, †49–51 × 3.5–3.8 µm, 8-spored, spores *2–4-seriate, lower spores inverted, pars sporifera *21 µm long (†35 µm); **apex** (†) medium truncate (not indented, laterally not widened); **base** with short, thin stalk, h- to H-shaped. **Ascospores** *8–10 × 1.3–1.4 µm (~9–11 µm actual length), narrowly subcylindric-clavate, apex rounded, base slightly attenuated, medium to strongly curved (falcate); **SBs** *~1.5–2 × 0.6 µm, elongate tear-shaped, filum ?invisible. **Paraphyses** apically slightly clavate, also spathulate-lageniform, terminal cell *18–20 × 3–4(–4.5) µm, lower cells *5–7 × 2.5–3 µm, unbranched at upper septum. **Medullary excipulum** ~20 µm thick, small-celled, medium sharply delimited. **Ectal excipulum** of (†) thin-walled t. globulosa from base to margin, cells *10–20 × 8–18 µm; **glassy processes** not seen. **Anchoring hyphae** not examined. **SCBs** and **VBs** absent. **Exudate** over paraphyses absent. — **ANAMORPH** (after Dowsett et al. 1984, Watanabe 1992, Liu & Qiu 1993, Nakagiri & Ito 1996, Rubner 1996, and Mo et al. 2005a, values partly modified according to scale): arthrobotrys-like (from ascospore isolate {1} or isolated from culms, roots, or soil {4}). **Macroconidiophores** (10–)30–150(–210) µm long, 2.5–6 µm wide at base, ~2–3 µm at apex, conidia usually formed singly at apex; **macroconidia unbranched**, elongate fusoid to fusiform, */†(60–)80–150(–210) × (7.5–)10–16(–21) µm, (4–)5–10(–13)-septate {4}, or apically **branched** (Y-shaped, sometimes 3-armed), (75–)90–125 × 35–85 µm, stipe (45–)55–95 µm long, cylindrical or mostly fusoid, (2–)4–6(–8)-septate, arms (11–)20–75(–98) × (4–)5–8(–12) µm, ± gradually tapered, (0–)2–3(–5)-septate {3}. **Microconidiophores** emerging from hyphae or from macroconidia, (28–)50–150(–225) µm long, 3–6 µm wide at base, 1.5–2.5 µm at apex, 1–5(–12) conidia formed on denticles 2–6 × 1–1.2 µm near the tip, sometimes also further down; **microconidia** */†(15–)18–30(–36) × (3–)4–5(–6.2) µm {5}, cylindrical to ellipsoid-fusoid, sometimes lageniform, strongly tapered at the truncate base, non-septate or occasionally with 1(–2) septa. 3-dimensional **adhesive networks** formed when challenged by nematodes, loops with an inner diameter of †(11–)13–20(–25) µm and an outer diam. of (15–)20–40 µm, loop cells †(2–)3–5(–6) µm wide {3}; **chlamydospores** globose to ellipsoid, intercalary.

Habitat: on rotten stems or roots of *Iris ensata* var. *hortensis* {1}, *Oryza sativa* {1}, *Triticum aestivum* {1}, unspecified soil isolate {2}. **Associated**: none reported. **Desiccation tolerance**: probably intolerant. **Altitude**: ~10 m a.s.l. (Japan), 1900 m (southern China), 250 m (Canada). **Phenology**: unknown (teleomorph).

Taxonomic remarks (teleomorph). *Orbilia multiformis* is only known from a few isolates of the anamorph, except for the type of *A. yunnanensis* in which primarily the teleomorph was obtained in culture (Mo et al. 2005a), which was identified as *Orbilia auricolor* because of a very similar micromorphology. Mo et al. spread a wet soil sample from Yunnan (China) on agar (CMA), and on the soil granules and surrounding agar the apothecia developed within 20 days. In the rather short and wide ascospores which are medium to strongly curved and only slightly attenuated towards base, the teleomorph resembles also *O. desertorum* (series *Neodactylella*). That species differs in a marginal excipulum composed of rows of rectangular cells lying at an oblique angle, whereas Mo et al.'s fungus was described with a marginal excipulum of globose cells.

Anamorph. Ascospore isolates obtained by Mo et al. (2005a) formed an anamorph in pure culture, which the authors described as a new species, *Arthrobotrys yunnanensis*. It was characterized by small, narrowly cylindric-ellipsoid or somewhat lageniform, 0(–1)-septate conidia formed in small groups on conidiophores of the candelabrelloid type (Pl. 958: 1g–h). Since the isolate strongly deviated from the currently known anamorphs of *O. auricolor*, the authors described it as a new species. Based on a comparison of their rDNA data (see below), we here conclude that the conidia of *A. yunnanensis* are microconidia and the species is conspecific with *Dactylella multiformis*, *Trinacrium iridis*, and *D. ramiformis*.

The holotype strain of *T. iridis* from *Iris* roots in Wakayama, Japan (Watanabe 1992) formed three types of conidia: 0–1-septate microconidia similar to *A. yunnanensis*, and two types of macroconidia: unbranched, 4–10-septate (phragmosporous) and branched (Y-shaped, rarely 3-armed). The branched conidia fit the generic concept of *Trinacrium*, in which genus Watanabe placed the species. Almost

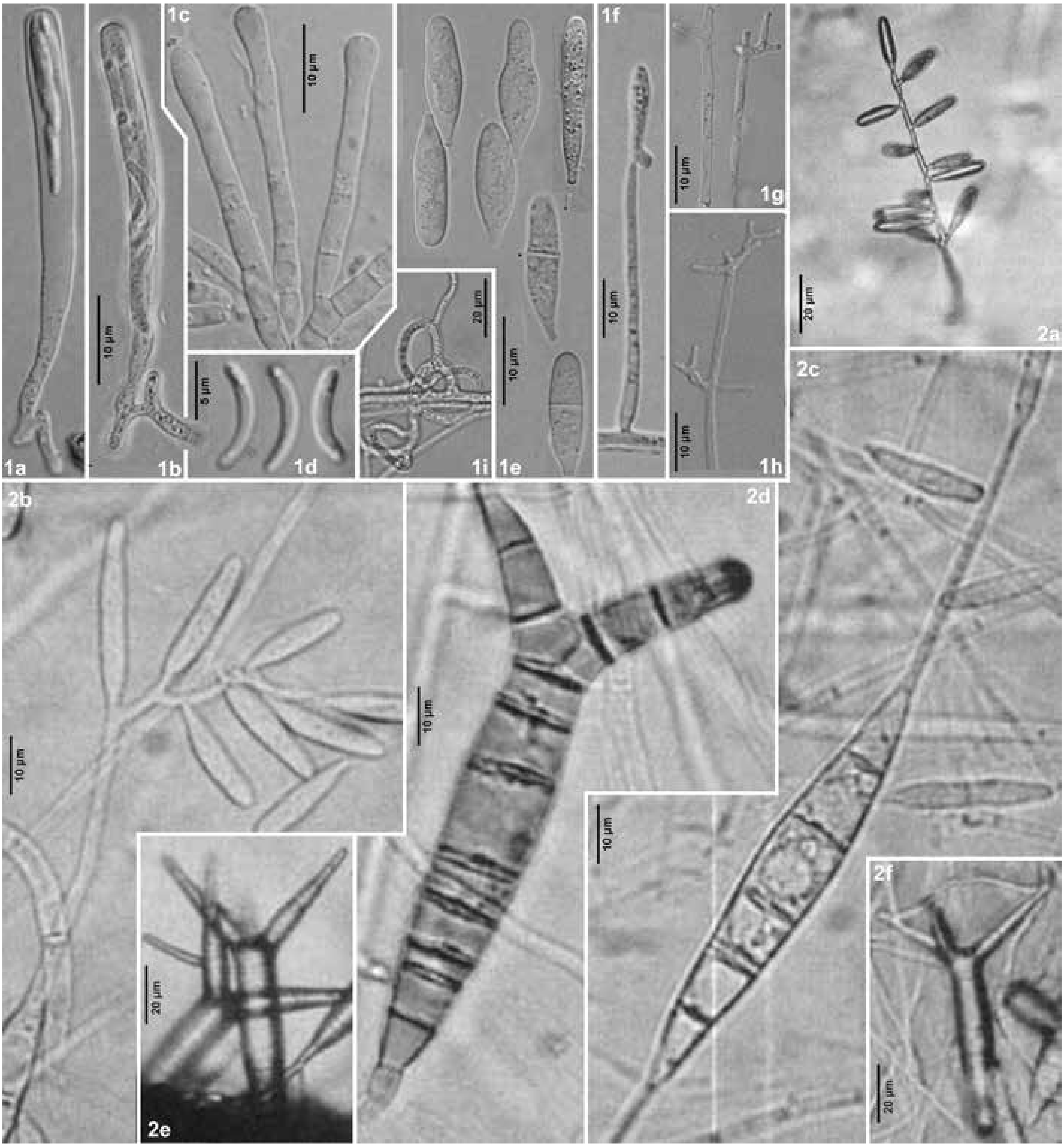


Plate 958. **1–2**: *Orbilia multiformis*. – **1a–b**. asci; **1c**. paraphyses; **1d**. ascospores; **1e**, **2a–b**. microconidia; **2c–f**. macroconidia; **1f–h**. conidiophores of microconidia; **1i**. adhesive network (**1e–i** from ascospore isolate, **2a–f** from environmental isolate). – Living state (**1a** fully turgescent), except for **1b** (ascus), **1e** (3 conidia right and below), **1f–i**, **2d**. – **1a–i**: from Mo et al. (2005a), **2a–f**: from Watanabe (1992). — **1a–i**. YMF 1.00593 (holotype of *A. yunnanensis*): China, Yunnan, from soil; **2a–f**. TW 82-567 (FFPRI, holotype of *T. iridis*): Japan, Wakayama, on *Iris*.

simultaneously, the same polymorphous anamorph was described under the name *Dactylella ramiformis* by Liu & Qiu (1993) from *Triticum* roots in Beijing (China), with non-septate microconidia and unbranched (4–12-septate) or partly branched macroconidia. About 8 years earlier, Dowsett et al. (1984) published *Dactylella multiformis* isolated from marsh soil in Manitoba (Canada) with 0–1-septate micro- and 4–12-septate, always unbranched macroconidia. One of its ex-type strains (CBS 773.84) was restudied and illustrated by Rubner (1996).

Nakagiri & Ito (1996) reexamined the types of *T. iridis* and *D. ramiformis* and studied also a personal isolate from Osaka (Japan), thereby accepting placement in *Dactylella* (as *D. iridis*). Zhang et al. (1995) believed that *D. ramiformis* and *D. iridis* were different species, mainly because of the absence of chlamydospores in the former and occasionally 3-armed conidia in the latter (see Pl. 958: 2f), whereas Nakagiri & Ito regarded the two taxa as synonymous. Except for their large width, the conidia of *A. yunnanensis* fit quite well the microconidia in the other three strains. Based on our molecular comparison, we assume that Mo et al.'s strain failed to produce macroconidia, though possibly being able to do so, and likewise Dowsett et al.'s strain might produce branched macroconidia on suitable media. In her key, Rubner (1996: 43, 86) argued with the much larger middle cells in the macroconidia of *Monacrosporium multiforme* (due to conspicuously inequidistant septation) compared to *M. iridis* (= *D. ramiformis*). However, large middle cells are also seen in the photos and drawings of *D. ramiformis* (Liu & Qiu 1993) and *T. iridis* (Pl. 958: 2d).

Adhesive networks were reported by Mo et al., Dowsett et al., and Liu & Qiu, while Watanabe merely assumed that his strain was nematophagous. Nakagiri & Ito tested Watanabe's, Liu & Qiu's and their own strain with nematodes and obtained adhesive networks in all of them. They also observed a filiform hyphal 'appendage' emerging from the subbasal cell of branched conidia in all three strains, but also at the tip of the arms or stipes (Nakagiri & Ito l.c., fig. 1, 9; see also Pl. 958: 2c). These 'appendages' finally produced microconidia at the apex and may thus be considered as microconidiophores. Such terminal 'appendages' at the macroconidia were also drawn and photographed by Liu & Qiu. According to Nakagiri & Ito, the macroconidia are hydrophobous and float on the water surface, the 'appendages' thereby extending into the air.

Nomenclature. Cultures gained from the single isolate of *Dactylella multiformis* were deposited by Dowsett et al. (1984) in three different culture collections (ATCC, CBS, CMI). *D. multiformis* should be considered as validly published, because of the retroactive acceptance of metabolically inactive cultures as types (Art. 8.4 ICN), and because before 1990 there was no requirement for specifying a single institution where the type is deposited (Art. 40.7 ICN) (P. Kirk pers. comm.). We here adopt *Arthrobotrys multiformis* as the correct name for this species but transfer it to *Orbilia* following our broad generic concept. Also Yu et al. (2014) adopted *A. multiformis* and suggested *D. iridis* and *D. ramiformis* as synonyms because they 'share most morphological characteristics'.

Variation and measurement errors: In Watanabe's (1992) strain of *T. iridis* the macroconidiophores are distinctly shorter than in Liu & Qiu's (1993) strain of *D. ramiformis*, and only Watanabe occasionally observed 3-armed macroconidia. Liu & Qiu found 16% of the macroconidia to be branched (grown on CMA), whereas Watanabe stated that macroconidia were rarely branched when growing on V-8 juice agar or PDA, but predominantly branched when growing on oatmeal agar (OA). Dowsett et al. used potato-carrot agar (PCA) as culture medium and Rubner (1996) CMA:2, CMA:10, and WA plus nematodes, and both did not observe branched macroconidia in *D. multiformis*.

Measurements are partly severely erroneous in these papers, and Nakagiri & Ito (1996) and Rubner (1996) presented corrections of conidial size, according to their reexaminations. Dowsett et al.'s measurement of macroconidia [35–90.5(–116) × 4–7.5 µm] is in conflict with the given magnification of the plates which yields values of 125–210 × 11–17 µm (macroconidiophore 210 × 4 µm), but their measurements of secondary microconidia (15–17 × 5 µm) better fit those evaluated from the photos (16–22 × 5 µm). Rubner found the macroconidia in the ex-type culture at CBS particularly wider: 38–80–116(–145) × 7.5–14 µm (95–115 × 10–14 µm when evaluated from her drawing).

Liu & Qiu (l.c.) gave a width of 0.9–3.6 µm for the macroconidial arms, although their illustrations yield a width of 4–7 µm which seems more trustworthy, since Nakagiri & Ito found in this strain a width of 6–8 µm. A very wide range (13.7–98 µm) is given for the arm length by Watanabe (l.c.) and Nakagiri & Ito (l.c.), which is probably due to emerging microconidiophores at the arm tips. Watanabe gave a very high range in microconidial length (20–47.5 × 3–5.3 µm) which was corrected to 19–25 × 4–5 µm by Nakagiri & Ito. Likewise, Mo et al. (l.c.) gave a rather high range in width (17.5–32.5 × 2.75–7.5 µm), while their figure yields values of only 21–25(–31) × (4.5–)5.7–6.2 µm.

Measurements given for the asci (30–45 × 3.5–5 µm) by Mo et al. (2005a) indicate that both living and dead asci were included, based on the wide range in width. Indeed, on their figs 13–14 the authors show a dead and a living, fully turgescent ascus, the latter also after spore ejection. According to the scale the size of 1 ascus is †49 × 3.5 (fig. 13) and the other *53 × 4.1 and †51 × 3.8 µm (fig.14). We conclude that the length values in the description are erroneous or exclude the ascus stalk. We further suspect that the scales in their figs 15–16 should be 10 µm, not 7 µm; this would result in wider paraphyses and excipular cells than indicated in their description, but the paraphyses then better concur in length with the asci (see our Pl. 958: 1c the scale is changed accordingly), and the excipular cells fit better those in their fig. 11. The scale bar in their fig. 7 is assumed to have a length of 20 µm instead of 10 µm, considering the given width of 2–4 µm for the mycelial hyphae and the fact that loops with an outer diameter of 10–13 µm are unknown in *Arthrobotrys*.

Phylogeny. Sequences of five strains exist in GenBank: the Canadian type of *A. multiformis* (ITS, LSU), the Japanese type of *T. iridis* (LSU), the northern Chinese type of *D. ramiformis* (ITS, *TUBB*, *RPB2*, *TEF1*), and the southern Chinese type of *A. yunnanensis* (ITS). Three further sequences in the NBRC database under the name *A. iridis* comprise ITS and LSU: two of them refer to the types of *T. iridis* and *D. ramiformis*, and one to the isolate of Nakagiri & Ito. The ITS sequences of the types of *A. yunnanensis* and *A. multiformis* include the S1506 intron, while the other sequences are unclear in this respect.

In the ITS region, the types of *T. iridis*, *D. ramiformis* and *A. yunnanensis* show a 100% similarity (without gaps, see also the analysis by Qiao et al. 2012), which permits to conclude that the three are conspecific. The type of *A. multiformis* differs from them in the ITS by 0.7% (3 nt), though also in the LSU (D1–D2) by 0.5–0.7% (3–4 nt, thereby pos. 330 concurring with the type of *T. iridis*). The S1506 intron in the type of *A. yunnanensis* differs by only 1% (4 nt) from the type of *A. multiformis*. We may therefore conclude that also *A. multiformis* is conspecific with *A. iridis*. An ITS sequence under the name *Penicillium chrysogenum* in GenBank (DQ093690), isolated from decayed *Picea* root in Lithuania by Menkis et al. (2006), matches the above *O. multiformis* strains with a 0.4–0.8% distance. Perhaps it got contaminated when it was sent to CBS for identification (A. Menkis pers. comm.).

In phylogenetic analyses of the ITS region by Yang & Liu (2006) and Yang et al. (2007), *A. iridis* is found with high support in a sister position to all remaining strains of series *Arthrobotrys*, whereas in a combined analysis of ITS, *TUBB*, *RPB2*, and *TEF1* it clustered in a well-supported clade with *A. anomalus* and *A. sinensis* which are, however, morphologically very different among another and show in the ITS region a distance of 7.5–10.5%. In our combined analysis (Phyl. 25) or that of ITS (Phyl. 28), LSU (S32), or S1506 intron (S30), *O. multiformis* clustered unresolved by showing a high distance to other strains.

Ecology. The Japanese strains of *O. multiformis* were from subtropical humid lowlands around Osaka, being isolated from stems and roots of rice or Japanese iris incubated under water. The Chinese isolates were from roots of a continental, temperate humid (winter-dry) wheat field near Beijing and from unspecified soil in the subtropical humid (winter-dry) highland near Kunming. The Canadian site was a boreal humid, continental marshland at a large lake, and the European isolate from conifer roots in a hemiboreal humid forest plantation.

Specimens included. **CANADA**: **Manitoba**, Lake Manitoba, Delta Marsh, University Field Station, 250 m, marsh soil, undated, J. Reid (ATCC, CBS 773.84, CMI, **ex-type cultures** of *D. multiformis*, conid. isol., doc. vid.; sq.: MH861834, AY261171). — **JAPAN**: **Honshu**, **Wakayama**, ~60 km SW of Osaka, ?10 m, *Iris ensata* var. *hortensis* roots, 27.IX.1982, T. Watanabe (FFPRI TW 82-567, **holotype** of *T. iridis*, doc. vid.; CBS 686.94, IFO 32554, ex-type culture, conid. isol., doc. vid.; sq.: EU107316, NBRC 32554). – **Osaka**, Mishima, 25 km NE of Osaka, Shimamoto, ?10 m, *Chironomus* in water, 18.I.1990, A. Nakagiri (AN-1101, IFO 32691; conid. isol., doc. vid.; sq.: NBRC 32691). — **CHINA**: **Beijing**, unlocalized, *Triticum aestivum* rhizosphere, IV.1989, X.Z. Liu (HMAS 62571, **holotype** of *D. ramiformis*; strain 521 = 89019-1, CGMCC 3.6761, CBS 166.95, IFO 32587, conid. isol., doc. vid.; sq.: NBRC 32587, AY773452, AY773364, AY773423, AY773394). – **Yunnan**, **Kunming**, ~35 km W of Kunming, ~8 km WNW of Yiliang, Xiaobailong Mt., ~1900 m, soil isolate, 15.VIII. 2003, M.H. Mo et al. (M.H.M. 002, HT 1.00593, **holotype** of *A. yunnanensis*; YMF 1.00593, ex-type culture, apoth. & anam. cult., doc. vid.; sq.: AY509930). — **LITHUANIA**: **Kaunas**, 19 km WNW of Kaunas, 7.5 km N of Kulautuva, 70 m, forest nursery, on roots of *Picea abies*, VII.2003, Menkis et al. (2006, aurim1118, mol. extr., as *Penicillium chrysogenum*; sq.: DQ093690).

Orbilia javanica (Rifai & R.C. Cooke) Bin Liu, Baral & E. Weber, **comb. nov.**, MB 813987 — Pl. 959

Basionym: *Candelabrella javanica* Rifai & R.C. Cooke, Trans. Br. Mycol. Soc. 49(1): 162 (1966)

≡ *Arthrobotrys javanicus* (Rifai & R.C. Cooke) Jarow. [as ‘*javanica*’], Acta Mycol. 6(2): 373 (1970)

Etymology: after the geographical origin, Java.

Typification: Indonesia, Java, Bogor Botanical Gardens, soil, XI.1963, N. Wariwan (IMI 108725, holotype, doc. vid.).

Misapplied name: Liu (2006: 51, teleomorph), as *O. auricolor*.

Description: — **TELEOMORPH**: **Apothecia** with ~10 µm protruding ?smooth margin. **Asci** †4 µm wide, apex strongly truncate (not indented, not inflated), thin-walled, lower spores inverted. **Ascospores** *~7–9 × 1.2–1.5 µm (in situ), medium attenuated towards base, slightly to medium curved; **SBs** subglobose/tear-shaped, ~1.5 × 0.8 µm. **Paraphyses** apically hardly inflated, covered by exudate. **Ectal excipulum** at base and flanks of textura angularis, ~20 µm thick at margin, forming a t. prismatica oriented at a 0° angle to the surface; **glassy processes** absent. **— ANAMORPH** (after Rifai & Cooke 1966 and Liu 2006): arthrobotrys-like (from ascospore {1} and soil isolate {1}). **Conidiophores** erect, 275–480 µm long, 8–12 µm wide at base, 2.5–3.5 µm at apex, branched only at the very apex, 3–15 conidia formed on distinct denticles (~3–9 × 2–3 µm) at apex (candelabrelloid). **Conidia** *(25–)28–34(–42.5) × (7.5–)10–12(–15.5) µm {2}, narrowly obpyriform (clavate), 1-septate, septum slightly eccentrical or almost at lower third of conidia, slightly constricted. Trapping nematodes by 3-dimensional **adhesive network** with loops with ~30–35 µm outer diameter, loop cells 3.5–4.5 µm wide.

Habitat: on twig of indet. woody plant on moist ground {1}. **Desiccation tolerance**: unknown (possibly intolerant). **Altitude**: 260–1000 m a.s.l. **Geology**: Jurassic sedimentary rock. **Phenology**: XI (teleomorph).

Taxonomic remarks. Liu (2006: 51) identified a collection from subtropical southern China (Pl. 959: 1) as *Orbilia auricolor*, but with ascospores shorter than in typical collections. No description of the teleomorph was provided. The marginal ectal excipulum is composed of elongated, narrow cells oriented at a very low angle, which recalls the broader cell rows running under a low angle typical of some species of series *Neodactylella*, such as *O. oxyspora* or *O. desertorum*. Yet, these species are connected

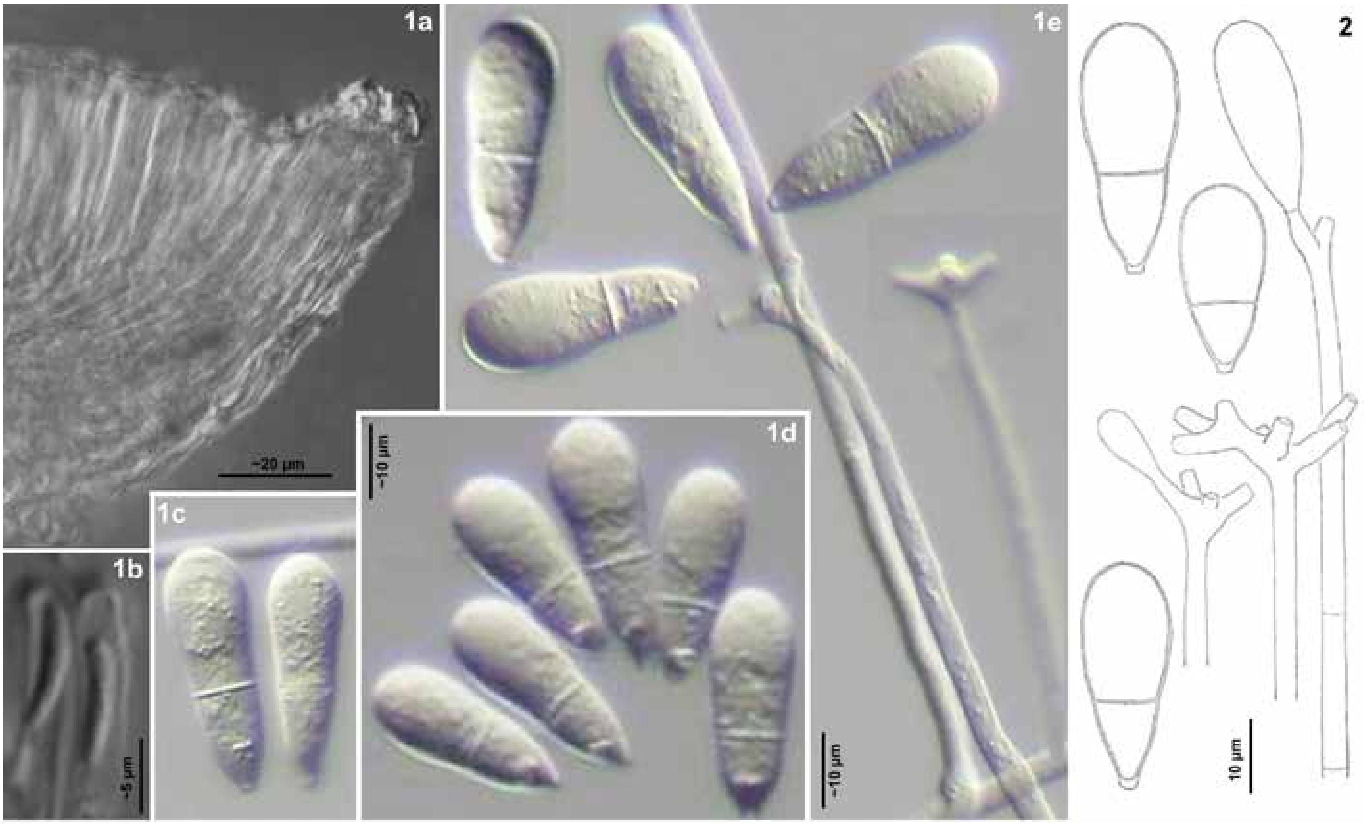


Plate 959. **1–2**: *Orbilia javanica*. – **1a**. marginal ectal excipulum in median section; **1b**. ascospores; **1c–e**, **2**. conidia and conidiophores (from culture). – Living state, except for **1a–b**, ?**2**. – **1a–e**: from Liu (2006); **2**: from Rifai & Cooke (1970). — **1a–e**. HMAS 139636: China, Yunnan, on indet. woody plant; **2**. IMI 108725 (holotype): Java, from soil.

to non-predacious dactylella-like anamorphs with multiseptate conidia, whereas Liu's collection formed adhesive networks in pure culture that refer the fungus to series *Arthrobotrys*. Z.F. Yu et al. (pers. comm., see IVV) obtained *Arthrobotrys musiformis*, an anamorph morphologically very similar to *O. javanica*, in pure culture from apothecia, which differed in longer and narrower spores and a marginal excipulum of broad, roundish cells.

Anamorph. Liu (2006) identified the anamorph of his collection as *Arthrobotrys javanicus*. The narrowly obpyriform conidia developed on candelabrelloid conidiophores (Pl. 959: 1e). The type of *A. javanicus* was isolated from soil in Java. It differs from Liu's strain in somewhat wider conidia produced on conidiophore tips with partly more branches forming a typical candelaber-like structure (Pl. 959: 2). *A. javanicus* is the type species of the genus *Candelabrella* Rifai & R.C. Cooke.

A. javanicus closely resembles *A. musiformis* in having the same type of conidiophores and similar-sized conidia, which differ merely in lacking a constriction at the septum and in being sometimes slightly curved (19–42.5 × 7–14 µm, Van Oorschot 1985). *A. conoides* has similarly shaped but longer conidia and an arthrobotryoid conidiogenesis. Elshafie et al. (2003, fig. 8) described a soil isolate from a *Citrus* plantation in Nizwa, Oman (CBS 109508) and noted a high variability of the species; however, this isolate belongs to *A. cladodes* (see below).

Phylogeny. Sequences exist for the type of *O. javanica* (ITS, LSU), Liu's ascospore isolate from Yunnan (ITS, LSU), two soil isolates (Hong Kong, Swe et al. ined., ITS; Taiwan, Kuo et al. 2008, ITS), and an isolate of unclear origin (YNUCC 6907, Li et al. ined., LSU). In the ex-type strain and that from Yunnan the S1506 intron is absent, while this is unclear for the other two ITS sequences.

In the phylogenetic analysis by Liu et al. (2006a), Liu's isolate from Yunnan clustered close to the ex-type strain by showing a much higher distance to *O. auricolor* s.l. In the ITS region, the four sequences show a distance of 1–2% among each other by forming a strongly supported clade (Phyl. 28). In our combined analysis (S33), *O. javanica* clustered in the medium supported *oligospora-musiformis* clade, which received no support in the ITS tree. *A. musiformis* shows a high distance of 8–9% to *O. javanica* and also differs by various characteristic gaps. In the LSU (D1–D2), however, *O. javanica* is very close to *A. musiformis* (0.7–1.5%), differing only at pos. 539 (C vs. T) and 546 (G vs. T), respectively. *O. javanica* forms a monophyletic clade also here by forming an unsupported clade with *A. musiformis* outside the *oligospora-musiformis* clade (S32).

According to molecular data (ITS, LSU) in the CBS database, Elshafie et al.'s soil isolate of *A. javanicus* (CBS 109508) was misidentified. In concordance with its more arthrobotryoid conidiophores it belongs to the *cladodes-botryosporus* clade (see LSU analysis S32), with *A. botryosporus* (C4) as closest taxon when comparing the low distance of ITS (2.7%) or LSU (0.6%) together with a characteristic position in the LSU D1 (pos. 201, Tab. 83), although its 1-septate conidia and pos. 541 in LSU D2 (Tab. 83) point to *A. cladodes*.

Ecology. *O. javanica* is mainly known from anamorphic soil isolates, and only once from the teleomorph collected on an unidentified twig. The type strain from Indonesia was from a tropical humid rainforest, an area with the highest precipitation recorded in Java. The other samples are from monsoon-dominated, winter-dry regions: a subtropical humid (winter-dry) montane forest in Yunnan and subtropical mountainous and tropical low-land areas in Taiwan.

Specimens included. **CHINA**, **Yunnan**, **Xishuangbanna**, Jinghong, 1000 m, twig of indet. tree, 9.XI.2002, B. Liu et al. (B.L. 6214, HMAS 139636, anam. cult., doc. vid.; sq.: DQ656611, DQ656666). – **Hong Kong**, unlocalized, soil isolate, Swe et al. (strain 105, conid. isol., doc. vid.; sq.: EU977514). – **Taiwan**, **Yilan**, Songluo, from humus, 16.VIII.2007, K.T. Chen (SL11; ?BRC 34375, conid. isol., [doc. vid.]; sq.: FJ380932). – **Kaohsiung**, Maolin, from humus, 8.II.2007, K.T. Chen (ML13, conid. isol., [doc. vid.]). — **INDONESIA**: **Java**, **West Java**, 43 km S of Jakarta, Bogor Botanical Gardens, 260 m, soil isolate, XI.1963, N. Wariwan (IMI 108725, **holotype** of *Arthrobotrys javanicus*, CBS 534.63, conid. isol., doc. vid.; sq.: U51947, AB161069, AY261136, MH858347). – **Unlocalized** (YNUCC 6907, non vid.; sq.: AY261150).

Arthrobotrys nonseptatus [as '*nonseptata*'] Z.F. Yu, S.F. Li & K.Q. Zhang, in Li et al., Mycotaxon 109: 249 (2009) — Pl. 960

Etymology: after the non-septate conidia.
Typification: China, Yunnan, Yuxi, bark of indet. angiosperm tree, 18.VIII.2006, Y. Zhang (YMF 1.01852, holotype, doc. vid.).

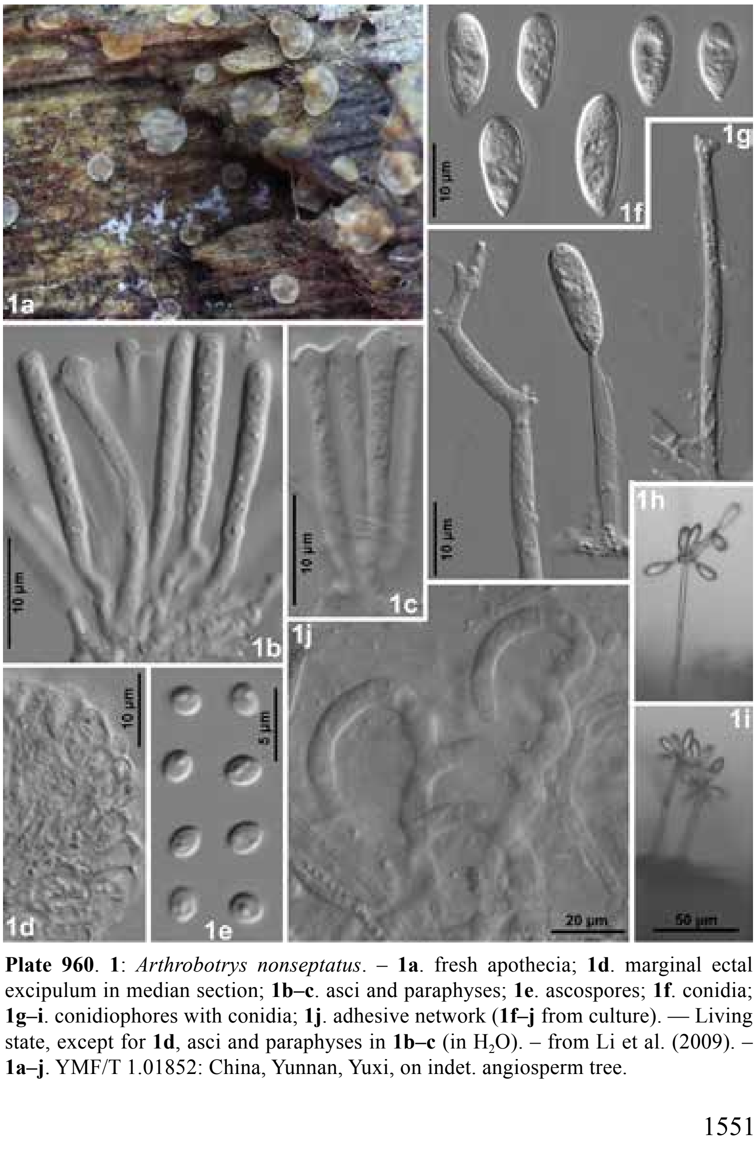


Plate 960. **1**: *Arthrobotrys nonseptatus*. – **1a**. fresh apothecia; **1d**. marginal ectal excipulum in median section; **1b–c**. asci and paraphyses; **1e**. ascospores; **1f**. conidia; **1g–i**. conidiophores with conidia; **1j**. adhesive network (**1f–j** from culture). — Living state, except for **1d**, asci and paraphyses in **1b–c** (in H_2O). – from Li et al. (2009). – **1a–j**. YMF/T 1.01852: China, Yunnan, Yuxi, on indet. angiosperm tree.

Description: — Anamorph (after Li et al. 2009): arthrobotrys-like (from ascospore-isolate {1}). **Conidiophores** erect, septate, unbranched, 40–120 µm high, 2–4 µm wide in the lower part, 1.5–2 µm at apex, producing 3–10 conidia from retrogressive conidiogenous loci on nodules or short denticles (1–1.3 × 1.2–1.3 µm) on indistinctly swollen nodes at the apex (arthrobotryoid), sometimes two in a row. **Conidia** *11–16.8 × 5–6.6 µm, (cylindric-)ellipsoid, narrowed at base to form a small truncate protuberance, non-septate. Trapping nematodes by means of 3-dimensional **adhesive networks**, loops with a *30–35 µm outer diam. and 18–25 µm inner diam., loop cells *5.5–7.5 µm wide.

Habitat: on rotten bark of indet. angiosperm tree. **Altitude**: 1750 m a.s.l. **Geology**: metamorphic rock. **Phenology**: VIII.

Taxonomic remarks. Li et al. (2009) described *A. nonseptatus* based on the anamorph. It was gained from an ascospore isolate, reportedly from a species with subglobose ascospores. In ascospore shape this teleomorph resembles taxa of series *Drechslerella* (*O. tonghaiensis*) or series *Orbilia* (e. g., *O. cejpii* and *O. fissilis*), but not a member of series *Arthrobotrys*. Particularly O. *tonghaiensis* (Pls 1027, 1028: 1) resembles *A. nonseptatus* in the teleomorph and even in the microconidial anamorph, but forms constricting rings.

Due to the unexpected anamorph, Li et al. (2009) hesitated in validly describing a new species for the teleomorph, but hoped for further isolates to clarify the observed connection to the anamorph. The authors did not provide a description of the teleomorph, only the spore length was said to be ~2.5–3 µm. According to the scale the figured spores measure *2.2–2.6 × 1.8–1.9 µm. Because of the unusual spore shape we here refrained from giving a description of the teleomorph.

Phylogeny. A sequence of the ex-type strain comprises S1506 intron and ITS. In our ITS analysis (Phyl. 28) and that by Li et al. (2009), *A. nonseptatus* clustered unresolved within series *Arthrobotrys*, with a high distance (~10%) to other species. It clustered in an unsupported clade with *A. reticulatus* and *A. polycephalus* when analysing the intron (S30). Possibly the authors had a culture containing a mixture of two different species, *O. tonghaiensis* and an unknown *Arthrobotrys*. The observed conidiophores and conidia would then belong to *O. tonghaiensis*, and only the figured adhesive network and the sequence would derive from the *Arthrobotrys* species. In this case, lectotypification would be necessary to fix the name *A. nonseptatus* on one of the two species included in the protologue.

Ecology. *A. nonseptatus* was collected on rotten bark of an unidentified angiosperm tree in a montane mixed forest with *Quercus schottkyana* and *Pinus armandii* in subtropical humid (winter-dry) southeastern Asia.

Specimens included. **CHINA**, **Yunnan**, **Yuxi**, Yimen, 54 km NW of Yuxi, 3 km NW of Fangtunxiang, Dalongkou, ~1750 m, on bark of indet. angiosperm tree, 18.VIII.2006, Y. Zhang (Y.Z. ym-28, YMF/T 1.01852, **holotype**, anam. cult., doc. vid.; sq.: FJ185261).

Orbilia elegans (Oudem.) Baral, A. Rubner, E. Weber & Van Ryck., **comb. nov.**, MB 813988 — Pls 961–962

Basionym: *Monacrosporium elegans* Oudem., Ned. Kruidk. Arch., series 2, 4: 250, pl. 5 fig. 9 (1885)

≡ *Golovinia elegans* (Oudem.) Mekht., Khishchnye Nematofagovye Griby - Gifomitsety (Baku): 142 (1979)

≡ *Arthrobotrys elegans* (Oudem.) M. Scholler, G. Hagedorn & A. Rubner, Sydowia 51(1): 102 (1999), nom. illegit., ICN Art. 53.1 [non *A. elegans* (Subram. & Chandrash.) Seifert & W.B. Kendrick, = *A. amerosporus*]

≡ *Arthrobotrys oudemansii* M. Scholler, Hagedorn & A. Rubner, Sydowia 52(1): 60 (2000)

(?)= *Arthrobotrys psychrophilus* (Drechsler) M. Scholler, G. Hagedorn & A. Rubner [as '*psychrophila*'], Sydowia 51(1): 104 (1999)

≡ *Dactylaria psychrophila* Drechsler, Mycologia 36(2): 161, figs 4C–F, 5 (1944)

≡ *Monacrosporium psychrophilum* (Drechsler) R.C. Cooke & C.H. Dickinson, Trans. Br. Mycol. Soc. 48: 622 (1965)

≡ *Genicularia psychrophila* (Drechsler) Rifai, Reinwardtia 7(4): 367(1968)

≡ *Geniculifera psychrophila* (Drechsler) Rifai, Mycotaxon 2: 216 (1975)

≡ *Golovinia psychrophila* (Drechsler) Mekht., Khishchnye Nematofagovye Griby - Gifomitsety (Baku): 151 (1979)

Etymology: *elegans*: after the elegant shape of the conidia; *oudemansii*: named after the botanist and mycologist C.A.J.A. Oudemans; *psychrophilus*: referring to the anamorph which preferably grows at low temperatures.

Typification: Netherlands, Amsterdam, dung of *Oryctolagus cuniculus*, 1883, C.A.J.A. Oudemans (L 9096, holotype of ***Monacrosporium elegans***); Germany, Frankfurt/Oder, Lebus, from dung of *Ovis*, 10.X.1993, A. Rubner (A.R. 9338, dried culture preserved in CBS, epitype, designated by Rubner 1996: 60, ex-epitype culture: CBS 301.94; sq.: AF106521). — USA, Maine, near Presque Isle, leaves & stems of *Solanum tuberosum*, undated, C. Drechsler (holotype of ***Dactylaria psychrophila***, illustration in Drechsler 1944a: figs 4C–F, 5); Germany, Kiel-Kitzeberg, wheat field soil, undated, W. Gams (CBS 548.63, dried culture preserved in herb. CBS, epitype, designated by Rubner 1996: 92).

Misapplied name: Baral (in Rubner 1996: 92, teleomorph), as *O. auricolor*.

Description: — **TELEOMORPH**: **Apothecia** fresh 0.5–1.6 mm diam., 0.18–0.24 mm high (receptacle 0.14–0.17 mm), watery white {*Scirpus*} or light orange-ochraceous {H.B. 5047}, round, ± scattered; disc flat to slightly convex (strongly convex in pure culture), margin distinct, not protruding, ± smooth; broadly sessile to subsessile, superficial. **Asci** *41–52(–58) × 3.5–4.2 µm {2}, †(30–)35–39 × 3.5–3.8 µm {1}, 8-spored, spores 4-seriate, (2–)3–4(–5) lower spores inverted {2} (not mixed), pars sporifera *22–30 µm long; **apex** (†) slightly to strongly truncate (not indented, laterally not widened); **base** with short to long, thin, flexuous stalk, L-, h- to H-shaped. **Ascospores** *(7.5–)9–13(–15) × (1–)1.1–1.3 µm {2} (~11–17 µm actual length), †11–12.3 × 1–1.2 µm {1}, narrowly subcylindric-clavate (subulate) to fusoid-clavate, apex rounded, base ± strongly attenuated, medium to very strongly curved (falcate), only slightly curved in KOH; **SBs** *1.5–2.2 × 0.5–1 µm {2}, divided into a globose to mostly cylindric-ellipsoid or tear-shaped, 0.8–1.2(–1.4) µm long lower part and a fine, hardly visible filum. **Paraphyses** apically uninflated or slightly to medium clavate-capitate, terminal cell *(21–)25–30 × (2.6–)3.5–4 µm {2}, lower cells *6–9 × 2.4–2.8 µm {1}, unbranched at upper septum. **Medullary excipulum** hyaline, 30–40 µm thick, of dense, non-gelatinized textura angularis-intricata, medium sharply delimited from ectal excipulum, at mid flanks with a thin, parallel layer of t. prismatica-porrecta. **Ectal excipulum** of thin-walled, indistinctly oriented t. globulosa-angularis from base to margin (or vertically at flanks), 70–150 µm thick near base, cells */†(15–)20–25(–30) × 11–20(–25) µm {2}; 25–35 µm thick near margin, oriented at a 40–70° angle to the surface, cells not forming distinct rows, marginal cortical cells *7–15 × 4–11 µm {1}; **glassy processes** 2–8 × 4–8 µm {2}, cap-like, refractive, stratified, hyaline to pale chlorinaceous. **Anchoring hyphae** abundant, *(3–)4–4.5(–5.5) µm wide, at insertion 6–7 µm wide, walls 0.2(–0.3) µm thick {1}, projecting. **SCBs** in paraphyses globose, 1–2 µm diam.; **VBs** absent. **Exudate** over paraphyses 0.2–1(–2) µm thick, granular, loosely attached; over margin and flanks granular to cloddy, 0.3–1.5 µm thick. — **ANAMORPH**: arthrobotrys-like (from ascospore isolate {1}, from soil isolate where both anamorph and teleomorph were formed {1}). **Macroconidiophores** 150–600 µm long, 5–9 µm wide at base, 2.5–4.5 µm at tip, conidia formed singly at apex or on short branches in clusters of 2–3 {including Drechsler 1944a}. **Macroconidia** *(33–)42–52(–57) × (16–)18–23(–26) µm {2}, *46–71 × 21–29 µm {Drechsler 1944a}, (35–)40–62(–68) × (16–)17–22(–23) µm {Rubner 1996}, fusiform to top-shaped, with the middle cell much larger than the remaining cells, (2–)3((–4))-septate {2}. **Microconidiophores** 50–90 µm long, 4–5 µm wide at base, 1.5–2.5 µm at tip, candelabrelloid, with 2–4 terminal conidia {Drechsler 1944a}. **Microconidia** ellipsoid-clavate, 0(–1)-septate *13–24.3 × 5.5–7 µm, {CBS 319.94}, *16–27 × 5.4–7.2 µm {Drechsler 1944a}, 13–16.5 × 5–6 µm {Rubner 1996}. Trapping nematodes by means of 3-dimensional

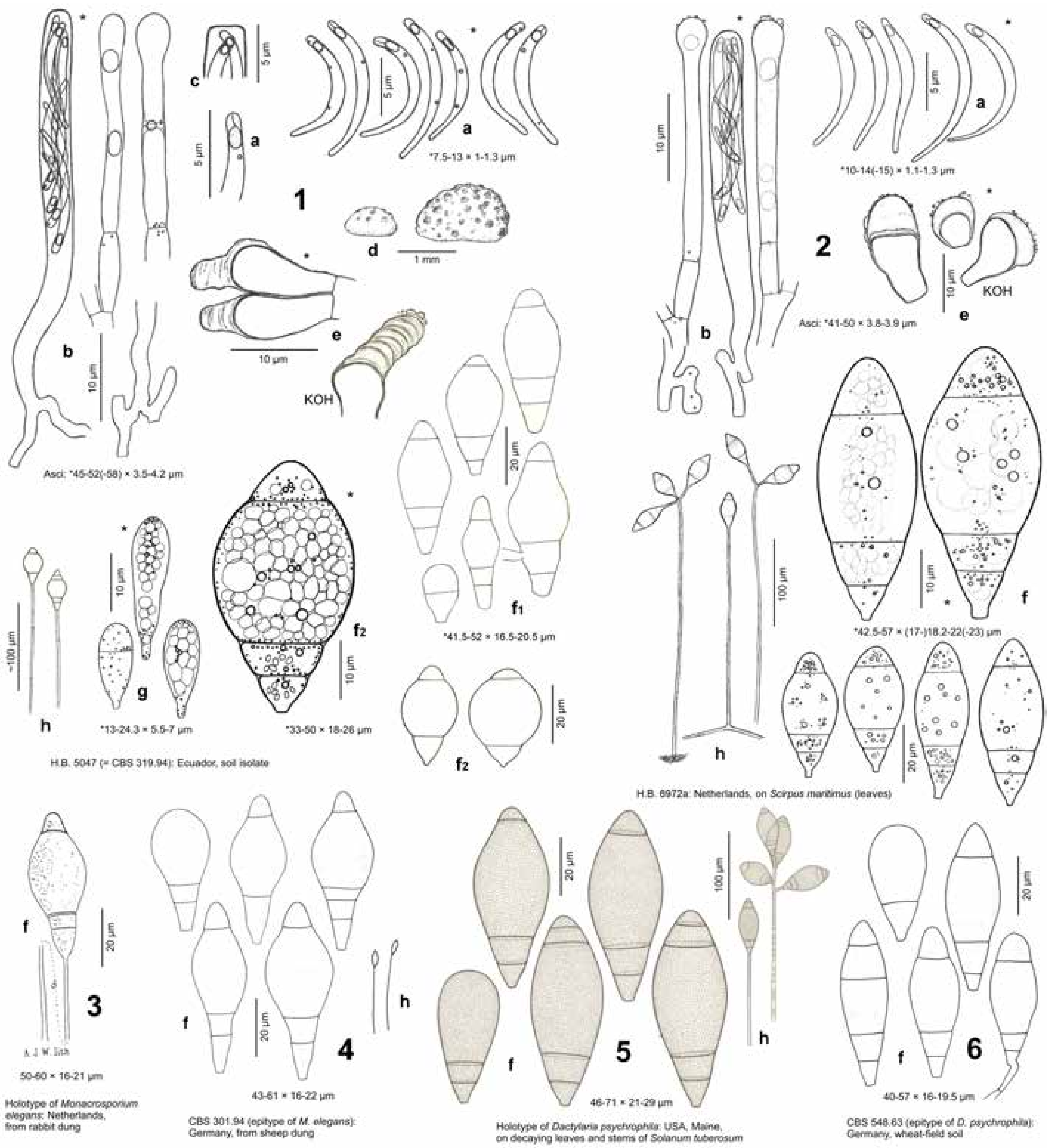


Plate 961. **1–4**: *Orbilia elegans*; **5–6**: *O.* cf. *elegans*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apex; **d**. apothecia (with convex warted hymenium, formed in pure culture); **e**. marginal cortical cells with glassy processes; **f**. macroconidia; **g**. microconidia; **h**. conidiophores with macroconidia (**f–h**. from culture). – **1f**$_1$: del. A. Rubner, **4**, **6**: from Rubner (1996: figs 26c, 47a), **3**: from Oudemans (1885), **5**: from Drechsler (1944a). – Subclade E1: **1**, **4**; subclade E2: **2**.

adhesive networks, forming loops with an inner diam. of (6–)10–20 µm and outer diam. 14–28 µm, loop cells *(3.5–)4–6(–6.5) µm wide (taken from drawings by Drechsler 1944a and Duddington 1951). **Chlamydospores** not observed.

Habitat: on previous year's leaves of *Scirpus maritimus* {1}, medium decayed, without algae; dung of *Oryctolagus cuniculus* {1}, *Ovis* {1}; isolated from soil {6}. **Associated**: *Orbilia scaphoides* {1}. **Desiccation tolerance**: unknown (probably intolerant). **Altitude**: 1–60 m a.s.l. (temperate Europe), 3010 m (Ecuador). **Phenology**: unknown (teleomorph).

Taxonomic remarks. *Orbilia elegans* is very similar to *O. auricolor* in the teleomorph, which explains Rubner's (1996) identification of this morph as *O. auricolor*, although the two species sharply differ in their anamorph (see below). Asci, ascospores, and terminal cells of paraphyses in *O. elegans* show virtually the same width as in *O. auricolor*, and also their length is only very slightly higher. The presence of short glassy processes could perhaps be diagnostic, though such are sometimes also present in *O. auricolor*. Despite the absence of distinctive characteristics of the teleomorph, *O. elegans* is recognized here as a species of its own based on the deviating anamorph and the deviating molecular data. Some of those specimens without a known anamorph, assigned to *O. auricolor* in the present study, could as well belong to *O. elegans*. Such confusion is not unlikely: e. g., the Chinese specimen on bark (Pl. 962: 2), here tentatively assigned to *O. elegans*, hardly differs in the teleomorph from the predominantly bark-inhabiting *O. auricolor*.

Anamorph. Rubner (1996) established for the first time the connection between anamorph (as *Monacrosporium psychrophilum*) and teleomorph (as *O. auricolor*) based on both being formed in pure culture of an Ecuadorian soil isolate (CBS 319.94). The anamorph sharply deviates from taxa previously reported for *O. auricolor* (*Arthrobotrys cladodes* and *A. oligosporus*) by its much larger, (2–)3(–4)-septate, fusiform to top-shaped conidia with a strongly enlarged, ventricose middle cell, formed singly or in groups of 2–3 at the conidiophore tip. Cylindric-clavate, 0(–1)-septate microconidia were occasionally observed in this strain together with the macroconidia.

Species concepts in this group are difficult, however (see Rubner 1996). Based on molecular data we here consider the two Ecuadorian strains identified by Rubner as *M. psychrophilum* (CBS 318.94, Rubner 1996: fig. 47b; CBS 319.94, Pl. 961: 1) as conspecific with *M. elegans* as circumscribed by Rubner. The two Ecuadorian strains differ from the type of *M. psychrophilum* (Pl. 961: 5) in slightly smaller, especially shorter conidia which are partly more distinctly top-shaped, with a strongly ventricose middle cell, but possibly these differences do not warrant separation between *M. psychrophilum* and *M. elegans*. The conidia of *Arthrobotrys thaumasius* (Drechsler) S. Schenck et al. are also similar to *M. elegans* in shape but are again slightly shorter and often formed in clusters of 2–4(–10). *A. reticulatus* is a further taxon to be confused with *M. elegans*, with (3–)4(–5)-septate conidia with a less swollen middle cell (see Rubner 1996). Also *A. eudermatus* and *A. megalosporus* are very similar to *M. elegans* (see Rubner 1996).

Variation in anamorph. In her concept of *Monacrosporium psychrophilum*, Rubner (1996) observed some variation in the morphology of conidia and conidiophores. She united under this name several European and Ecuadorian isolates, which varied somewhat in conidial size, shape, and number of septa, and in branching of conidiophores, though sometimes within a collection. In a German strain from wheat field soil (Rubner l.c., fig. 47a, CBS 548.63, epitype, Pl. 961: 6) she figured mainly fusiform conidia, whereas her drawings of the two Ecuadorian isolates (fig. 47b, CBS 318.94; Pl. 961: 1f$_1$) show a tendency to top-shaped conidia, and one from Sweden (fig. 47c, L.P. 9203) again more fusiform conidia. In all these strains occurred also smaller, strongly clavate conidia with only 1–2 septa. The large conidia are mainly figured with 3 septa, but Drechsler (1944a) observed also often 2- and 4-, rarely 5-septate conidia (Pl. 961: 5). In the three strains figured by Rubner under the name *M. elegans* from Sweden (CBS 397.93) and Germany (CBS 300.94; 301.94, epitype, Pl. 961: 4) the conidia were consistently top-shaped and generally 3-septate, but the conidiophores also varied between apically unbranched and branched.

In the two isolates examined by us (Pls 961: 1–2; 962: 1) we saw mainly 3-septate conidia, but also some with 2 septa, and exceptionally one with 4. Conidial shape and size was rather different between the two strains: top-shaped in the soil isolate from Ecuador but more fusiform in that on *Scirpus*. However, the conidia in Rubner's unpublished drawing of the Ecuadorian strain (Pl. 961: 1f$_1$) considerably deviate in size from those observed by us in the same culture. The conidia from the *Scirpus* strain and those drawn by Rubner better fit the holotype or epitype of *M. psychrophilum*, but those in 1f$_2$ better fit the epitype of *M. elegans* or *A. thaumasius*.

Based on the morphological similarity of these anamorphs and on molecular data (see below), we conclude that the two Ecuadorian strains are conspecific with Rubner's three figured *M. elegans* strains. The variable features within this group were also stressed by Rubner (1996: 63) regarding the identification of the two Ecuadorian strains which she left in *M. psychrophilum* although the conidia were morphologically closer to *M. elegans*. Conidial shape in this group appears to be subjected to a certain degree of variability between fusiform and top-shaped, even within a strain, rather than representing a valuable species marker.

The holotype material of *M. psychrophilum* from North America now appears to be empty (Rubner 1996), and no sequence was available for the German epitype. In conidial shape the epitype fits quite well the holotype of *M. psychrophilum*, but its conidia are distinctly smaller when evaluated from the scale in Rubner's drawing than those of Drechsler (see Pl. 961: 5–6).

Not included collections. Two not included Chinese samples comprising teleomorph and anamorph differ rather severely from each other in conidial size and shape, including their microconidia. They were studied by H.Y. Su who kindly provided her data. One of them (Pl. 962: 3) closely matches the original description of *M. cystosporum* R.C. Cooke & C.H. Dickinson (1965, = *A. thaumasius* fide Rubner 1996) though the conidia are shorter [*(28.5–)30–37(–42) × (15–)16.5–19.5(–22) µm, 2–3-septate; microconidia *17–22(–26.5) × 4.3–6.2 µm, 1-septate]. From this strain the other (Pl. 962: 2) differs in longer macro- and microconidia (*46.5–69 × 16–23 µm, 3–4-septate; *21–32 × 4.7–6 µm, 0–3-septate). It was compared by H.Y. Su with *A. longiphorus*, a species with rather narrow, fusiform conidia (Liu & Lu 1993), but we believe that it also fits quite well in the scope of *M. elegans*. Actually, its macroconidia hardly differ in size and shape from the epitype of *M. elegans*, except for being frequently 4-septate. Its microconidia are also distinctly longer than in Rubner's Ecuadorian isolate (Pl. 961: 1g) and differ in being partly 3-septate. Drechsler (1944a) observed in an aberrant culture of *Dactylaria psychrophila* rather large, 0–1-septate microconidia of 14–35 × 4.8–7.5 µm, and Rubner (1996) in *M. elegans* non-septate microconidia of 13–16.5 × 5–6 µm.

A more striking difference appears to lie in the trapping organs of the two Chinese collections. Their loops have a distinctly larger diameter compared to illustrations by Drechsler (1944a) and Duddington (1951), although their cells show a similar width, resulting in more gracile networks (but note that Duddington's measurements do not match his scale and appear to be too large). In Pl. 962: 3l the loops measure 40–55 µm outer diam. (28–45 µm inner diam.) according to the scale and their cells are 3.5–7 µm thick. Also *A. thaumasius* shows larger, more gracile networks when screening the literature. Therefore, and because of the mentioned deviations in the macroconidia, this strain might indeed belong to *A. thaumasius*. Regrettably, molecular data were not available for the two Chinese strains.

For the not included *A. psychrophilus* (*O.* cf. *elegans*) see under Anamorph.

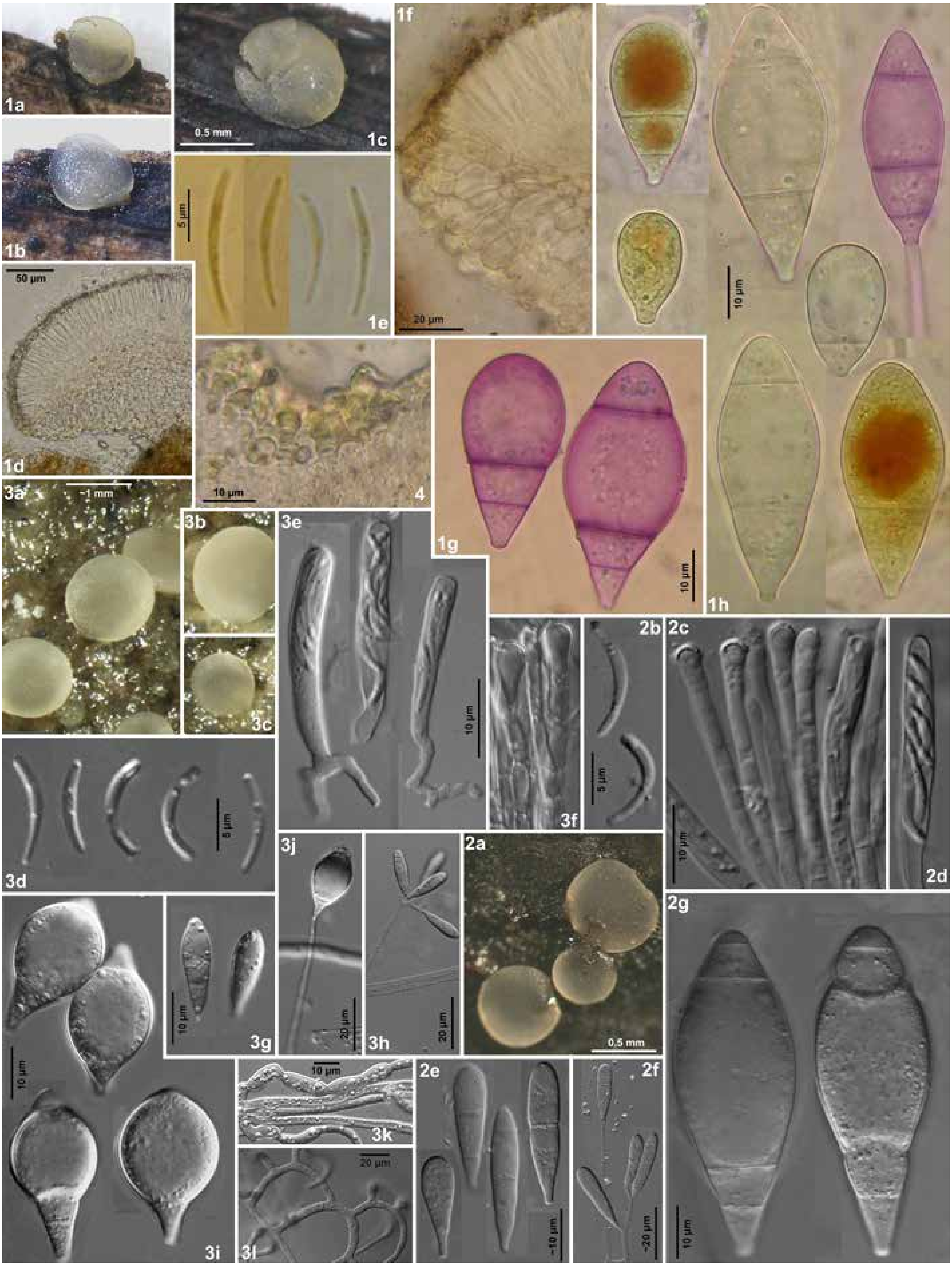


Plate 962. **1**, **4**: *Orbilia elegans*; **2–3**: *O.* cf. *elegans*/*A.* cf. *thaumasius*. – **2a**, **3a–c**. fresh apothecia; **1a–c**. rehydrated apothecia; **1d**. apothecium in median section; **1f**. id., marginal ectal excipulum; **4**. marginal cortical cells with short glassy processes (external view); **2d**, **3e**. asci; **2c**, **3f**. paraphyses; **1e**, **2b**, **3d**. ascospores; **1g–h**, **2g**, **3i–j**. macroconidia; **2e–f**, **3g–h**. microconidia; **3k**. chlamydospores; **3l**. adhesive network (**1g–h**, **2e–g**, **3g–l** from culture). – Living state (**1g–h** partly stained in CRB or IKI), except for **1d–f**, **4** (in KOH), **3d** p.p. & 2 right asci in **3e** (in H_2O). – **2a–g**. **3a–l**: phot. H.Y. Su (DIC). — **1a–h**. H.B. 6972a: Netherlands, Zeeland, on *Scirpus*; **2a–g**. H.Y.S. blq-3: China, Yunnan, Dali, on bark; **3a–l**. H.Y.S. dn-1: China, Yunnan, Binchuan, soil isolate; **4**. H.B. 5047 = CBS 319.94: Ecuador, soil isolate. Subclade E1: **4**; subclade E2: **1**.

Table 85. 26 nucleotide positions in the ITS1 and ITS2 region separate subclade E1 (*O. elegans* s.str.) from subclade E2 (*O.* cf. *elegans*, ?*A. psychrophilus*, one strain lacking ITS1), in comparison with subclade E3 (*A. gampsosporus*), O32 (Houseknecht & Zhou ined., ATCC MYA-4125, EU331088), *O. auricolor* (subclades A1–A2) and the *cladodes-botryosporus* clade (C1–C4). Note concordance of either E1 or E2 with other clades and subclades. Alignment and position numbers are the same as in Tab. 82, with indication of number of strains.

Clade	Strains	7–9	26	38	57	122	145–149	165	381	388	393	399–401	415	405–406	410	412	486–489	540
C1	7	A–G	T	C	G	T	CCTTT CATTT	–	–	C	A	TCC	G	G– GA	A	C	–––A	T
C2–C3	6	A–G	T	C	G	T C	CCTTY	–	–	C	A G	WCS	A G	G– –A GA	A C	C	–––A	T
C4	1	A–G	T	C	G	T C	CCTTT	–	–	C	A	ACG	G	––	A	C	–––A	T
A1–A2	12	ACG	T	C	G	T C	ACCAC	–	–	T	A	ACG	A	NC NT	C	C	–––A	C
E1	8	ACG	T	T	A	T	CCTTT	A	–	T	A	ACG	A G	––	T	C	CAAA CA–A	T
E2	2	GTC	C	C	G	C	AAATC	–	C T	C	G	GCA	G	TA –A	C A	T	–––G	C
E3	3	GTC	C	C	G	T C	TTAYC	–	–	T	G	ACG	A	––	T	C	–––A	C
O32	1	–TG	T	T	G	T	ACCAC	–	–	T	G	ACG	A	AC	C	C	–––G	T

Phylogeny. Sequences of *O. elegans* s.l. (in the following called *elegans-gampsosporus* clade) were available in GenBank and the CBS database for a total of 12 isolates: three from soil, moss, or sheep dung in Germany, three from soil in Ecuador, one from soil in Sweden, one from soil and one from apothecia on *Scirpus* in the Netherlands, two from nematodes or litter in California, and one from dung in Australia. Seven of them were identified as *M. elegans* (or *A. oudemansii*, a nomen novum, including the epitype), two as *M. psychrophilum*, two as *M. thaumasium*, and one as *M. eudermatum*. In addition to ITS some of these strains comprise also SSU and LSU. The S1506 intron is present in the *Scirpus* strain and perhaps in the one from Sweden, but absent in the other six strains that cover this region.

The two Ecuadorian soil isolates referred by Rubner (1996: 92) to *M. psychrophilum* (CBS 318.94, 319.94) show to the morphologically very similar *Scirpus* isolate (H.B. 6972a) a 4.1–4.6 % ITS distance (13 nt in ITS1 and 13 nt in ITS2, 12–14 gaps). Yet, also between the two Ecuadorian isolates 7 nt (1.3 %) and 4 gaps differ. When including all available ITS sequences, high distances are also observed between strains from the same continent, and very low distances also occur between strains from different continents.

Two main groups can be distinguished within *O. elegans* s.l., subclade E1 (*O. elegans* s.str.) and subclade E2, which differ by 4.1–5 % and a characteristic pattern of more than 10 gaps (Phyl. 30). Two subclades can be distinguished within clade E1 (a/b) which differ by 1.3–1.7 % (7 consistent and 2 variable nt, 4 gaps). Likewise, two subclades can be distinguished within clade E2 (a/b), which differ by 1.3 % (7 nt, 0 gaps). Variation in subclade E1a at 1 position in the ITS1 (C in E1a-1, G in E1a-2) is so far correlated with the geographical origin. Subclade E1a-1 includes three strains from central Europe: the epitype of *M. elegans* on dung and two isolates under the name *M. thaumasium*. Subclade E1a-2 includes two Ecuadorian soil isolates (as *M. elegans* and *M. psychrophilum*) and the Australian *M. elegans* from dung. Subclade E1b varies by 1 nt in the ITS2: C in E1b-1 (another Ecuadorian *M. psychrophilum*), T in E1b-2 (the Californian nematode isolate under the name *A. eudermatus*).

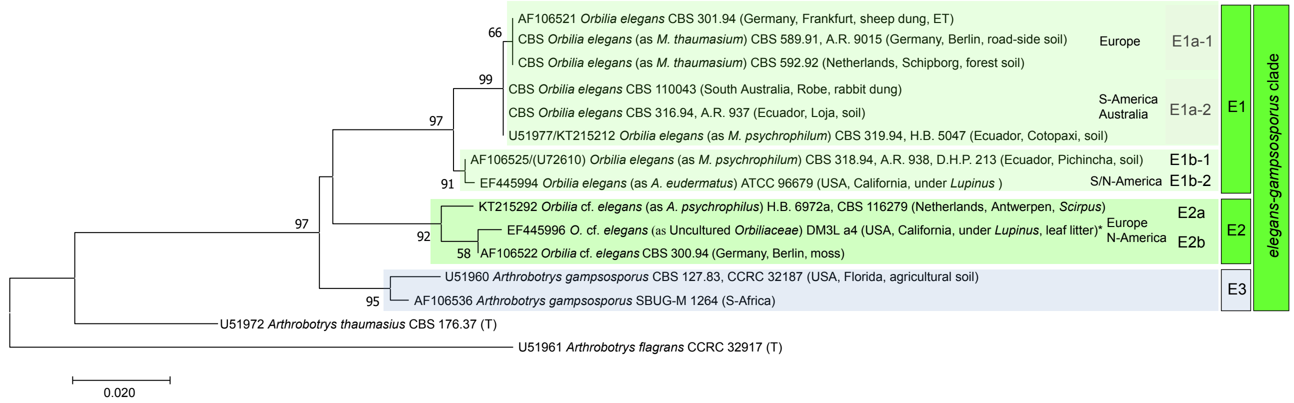
To clade E2 belongs our *Scirpus* strain from the Netherlands (E2a) and one of the German isolates referred by Rubner (1996: 60) to *M. elegans* (E2b). The Californian leaf litter isolate, which comprises only ITS2 (and LSU), fully matches subclade E2b in the available ITS2 region (except for 1 gap), where this subclade deviates by 3 nt from subclade E2a.

All differences in the ITS region in total include 26 nucleotides or gaps that separate between clades E1 and E2 (Tab. 85). Two aberrant deviations were neglected in the above discussion: a rare deviation in the 5.8S region in the *Scirpus* strain, and an unusual repeat (GAAGAA) in the ITS2 of the Californian strain ATCC 96679.

The observed ITS distance of 4.1–5 % between clade E1 and E2 suggests that two different species are involved, particularly when considering that *A. gampsosporus* shows a comparable distance of 4.5–5.5 % to *O. elegans* s.l. (see also p. 1582). However, in the LSU D1–D2 domain the two genotypes (E1/E2) cannot be differentiated because the 3 deviating nucleotides are not correlated with them, and the single sequence of the morphologically different *A. gampsosporus* deviates from all of them only at 1 position in the D2. Since morphological differences could not be found between clades E1 and E2, we refrain here from splitting *O. elegans* into two species. We did not include holo- and epitype of *A. psychrophila* in the description of *O. elegans* because of lacking molecular data.

Table 86. 14 nucleotide positions in the ITS1 region that separate *O. elegans* s.l. from *O. auricolor* and *O. cladodes*, in comparison with *A. gampsosporus*, *O. latispora* s.l., *A. botryosporus*, and the unidentified strain ATCC MYA-4125 (Houseknecht & Zhou ined.). No positions were found in the ITS2 region that separate *O. elegans* s.l. from *O. auricolor* and *O. cladodes*. – Alignment and position numbers are the same as in Tab. 82, Str. = number of strains.

Species	Str.	17	25	30	38	52	59	61	89	91	101	107	133	135	141
O. auricolor, *O. cladodes* (**A**, **C1**)	16	A	T/C	A	C	T	C	G	C	T	G	T/(C)	C	C	C
O. latispora s.l. & *A. botryosporus* (**C2–C4**)	7	A	T/C	A	C	T	C	G	C	T/G	G	T	C	C/T	C
O. elegans (**E1–E2**)	10	C	G	G	T	C	T	A	A	C	T	G	G/(A)	T	T
A. gampsosporus (**E3**)	2	C	G	G	C	C	T	A	A	C	T	T	G	T	T
ATCC MYA-4125 (**O32**)	1	A	T	A	T	C	C	G	C	T	G	T	C	C	C



Phylogenetic analysis 30. NJ analysis of ITS1-5.8S-ITS2 rDNA dataset (15 sequences, 595 positions, aligned with MUSCLE, 500 replicates), showing relationship within the *elegans-gampsosporus* clade. U72610 deviates from AF106525 and the CBS database at pos. 34 of 5.8S (T vs. A) which is probably erroneous. The tree is rooted with *A. flagrans* and *A. thaumasius*. Asci 8-spored in all teleomorph taxa; T = type, ET = epitype, * = without ITS1 and partial 5.8S.

Also in the phylogenetic analysis of the ITS region by Hagedorn & Scholler (1999: fig. 2), two German isolates of *O. elegans* (as *M. elegans*, CBS 300.94, 301.94) clustered with two from Ecuador (as *M. psychrophilum*, CBS 318.94, 319.94) in a clade that included also a sequence of *M. gampsosporum* (CBS 127.83). Three isolates of *A. thaumasius* (including an ex-syntype strain) formed in Hagedorn & Scholler's and our analyses (Phyls 28, S32) a separate clade very distant from the *elegans-gampsosporus* clade. Therefore, *A. thaumasius* (see p. 1582) can be excluded from synonymy with *O. elegans*. Also *A. eudermatus*, *A. mangrovisporus*, and *A. janus* clustered distantly (see there).

Between *O. elegans* and *O. auricolor* s.l. a distance of ~7–11 % in the ITS region is observed, which is slightly higher to the *cladodes-botryosporus* clade in comparison to the *O. auricolor* clade. 14 characteristic nucleotides in the ITS1 region but none in the ITS2 distinguish *O. elegans* from *O. auricolor* (Tab. 86, see also Tabs 82–83).

Ecology. The strains here included in *O. elegans* were isolated from a variety of substrates (soil, dung, moss, decaying herbaceous plants) in Europe, North and South America. Literature reports of *M. elegans* or *M. psychrophilum* include various European countries (Great Britain, Ireland, Sweden, Denmark, Netherlands, Germany), but also Macaronesia, Turkmenistan, Arabian Peninsula, eastern USA, and Antarctica (Drechsler 1944a, Duddington 1951a, Elshafie et al. 2003, Gray 1985, Oudemans 1885, Rubner 1994, 1996, Shepherd 1956, Soprunov 1958).

The apothecia of the collection on *Scirpus maritimus* (≡ *Bolboschoenus maritimus*) from northwestern Europe were obtained during storage of dead leaves for about 2 months in a moist chamber. They were collected in a nearly dominant stand of *Scirpus maritimus* in a subatlantic coastal brackish marsh influenced by the tides (G. Van Ryckegem pers. comm.). Rubner's (1996) soil isolates, in which partly apothecia developed on agar, were from ruderal places between path and a meadow in a subtropical humid highland climate of Ecuador (with a dry season during 3 months). The German and Swedish isolates from dung, moss, or soil are from subcontinental, cold-temperate humid areas, and the western North American isolate from a nematode originates from a mild-maritime humid (summer-dry) coastal region. Further samples, particularly of the teleomorph, are needed to explore the substrate preferences of *O. elegans*.

Not included collections were from a wheat field in cold-temperate humid, subcontinental-maritime northern Germany (epitype of *M. psychrophilum*) and from remnants of potato under a similar climate in northeastern North America (holotype of *M. psychrophilum*). Those from southern China were from lake water mud and from bark in montane evergreen forests in subtropical humid (winter-dry) eastern Asia (at the eastern end of Himalaya).

Specimens included (subclades: E1a-1 = includes epitype, E1a-2 = 1 nt deviation from epitype, E1a-3 = 2 nt deviation from epitype, E1b = 7–8 nt and 4 gaps deviation from epitype, E2 = 4.4–4.8 % and 12–13 gaps deviation from E1): **SWEDEN**: **Skåne**, Bjärröd (near Gyllsjö?), loamy soil under *Salix*, 9.V.1989 L. Persmark (as *A. elegans*, CBS 397.93, conid. isol., non vid.; sq.: FJ176810, FJ176864 [E1a-1]). — **NETHERLANDS**: **Noord-Holland**, Amsterdam, ~1 m, dung of *Oryctolagus cuniculus*, 1883, C.A.J.A. Oudemans (L 9096, **holotype** of *M. elegans*, conid. isol., doc. vid.). – **Drenthe**, Schipborg, forest soil, 1992, H. Velvis (CBS 592.92, as *M. thaumasium*, conid. isol., non vid.; sq.: CBS ined. [E1a-1]). – **Zeeland**, 18 km NW of Antwerpen, old harbour facing the Hertogin Hedwighe Polder, most eastern part of Verdronken Land van Saeftinghe, 3 m, on previous year's leaves of *Scirpus maritimus*, 23.III.2001, G. Van Ryckegem (H.B. 6972a, CBS 116279, as *M. elegans*, anam. cult.; sq.: KT215292 [E2a]). — **GERMANY**: **Brandenburg**, ~9 km N of Frankfurt, Lebus, ~50 m, dung of *Ovis*, 10.X.1993, A. Rubner (A.R. 9338, **epitype** of *M. elegans*, CBS 301.94, conid. isol., doc. vid.; sq.: AF106521 [E1a-1]). — **Berlin**, Dahlem, 60 m, from moss cushion, 1992, S. Behnke (A.R. 9232, CBS 300.94, as *A. elegans*, conid. isol., non vid.; sq.: AF106522 [E2b]). – ibid., soil at roadside, 23.III.1990, A. Rubner (A.R. 9015, CBS 589.91, as *M. thaumasium*, conid. isol., non vid.; sq.: CBS ined. [E1a-1]). — **ECUADOR**: **Cotopaxi**, 70 km SSW of Quito, 18 km N of Latacunga, 3.5 km NE of Tanicuchi, Hacienda La Cienega, 3010 m (Rubner 1994 as 2500 m), from ruderal soil, 16.III.1993, A. Rubner (A.R. 9312, H.B. 5047, CBS H-5669, CBS 319.94, apoth. & anam. cult.; sq.: U51977, as *M. psychrophilum*, KT215212, as *A. elegans* [E1a-2]). – **Pichincha**, 45 km N of Quito, ~2500 m, from ruderal soil, 6.III.1993, A. Rubner (A.R. 938, D.H.P. 213, CBS 318.94, SBUG M1228, as *A. psychrophilus*, conid. isol., doc. vid.; sq.: U72610 [in Pfister 1997 erron. as U72609], AF106525 [E1b-1]). – **Loja**, Olmedo, from soil, 13.III.1993, A. Rubner (A.R. 937, CBS 316.94, as *M. elegans*, conid. isol., non vid.; sq.: CBS ined. [E1a-2]). — **USA**: **California**, ~30 km WSW of Santa Rosa, Bodega Bay, ~30 m, *Lupinus arboreus* soil, from nematode (Smith & Jaffee 2009, ATCC 96679, as *A. eudermatus*, conid. isol., non vid.; sq.: EF445994 [E1b-2]). – ibid., *Lupinus arboreus* soil, from leaf litter (Smith & Jaffee 2009, dm3l_a4, uncultured, as *A.* cf. *elegans*, mol. extr., non vid.; sq.: EF445996 [E2b]). — **AUSTRALIA**: **South Australia**, 277 km SSE of Adelaide, Robe, XI.2001, D.P. Mahoney, dung of *Oryctolagus cuniculus* (CBS 110043, as *A. elegans*, conid. isol., non vid.; sq.: CBS ined. [E1a-2]).

Not included. **USA**: **Maine**, near Presque Isle, ~150 m, leaves and stems of *Solanum tuberosum*, undated, C. Drechsler (**holotype** of *Dactylaria psychrophila* [illustration], conid. isol., doc. vid.). — **GERMANY**: **Schleswig-Holstein**, ~5 km NE of Kiel, Kitzeberg, from wheat field soil (*Triticum*), undated, W. Gams (**epitype** of *D. psychrophila*, CBS 548.63, conid. isol., doc. vid.). — **CHINA**: **Yunnan**, **Dali**, Dali, 5 km WNW of Dali, Cangshan, Baolinqing stream, 2430 m, indet. tree, on bark, 24.X.2009, X.J. Su & Y.H. Liao (H.Y.S. blq3, CBCD, anam. cult., doc. vid.). – Binchuan, Xiamo, 3 km N of Dali (Xiaguan), 1.5 km NE of Dazhantun, 1970 m, Erhai lake, mud from bottom of lake, 21.III.2008, H.Y. Su (H.Y.S. dn-1, CBCD, apoth. cult., doc. vid.).

Orbilia menageshae Baral & U. Lindem., **sp. nov.**, MB 813989 — Pls 963–965

Etymology: named after the type locality, Menagesha Suba State Forest.

Typification: Ethiopia, Addis Ababa, Menagesha Suba, branch of indet. angiosperm, 26.III.2010, Dawit Abate & U. Lindemann (ex H.B. 9275a, M-0276510, holotype; sq.: KT222439).

Latin diagnosis: *Apothecia rehydratata 0.8–5.5 mm diam., dilute cremea vel intense ochracea, disco conspicue concavo vel plano, margine laevi. Asci 8-spori. Ascosporae *9.5–14 × 1.2–1.5 µm, subulatae, apice rotundati. basi attenuatae, interdum subcaudatae, modice ad valde arcuatae, corpusculum refringens subulatum vel cylindricum, ad apicem filo indistincto affixum continentes. Paraphyses ad apicem leniter vel modice inflatae, saepe ellipsoideae, exsudato calyptriforme tectae, cellulae vivae absque vacuolis refringentibus. Cellulae excipuli marginalis sub angulo alto orientatas formantes, processis vitreis brevibus vel carentibus. Habitat ad corticem putridum angiospermarum, in zona temperata humida afromontana Africae septentrio-orientalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.8–)1–2.5(–5.5) mm diam., 0.27–0.4 mm high (receptacle 0.19–0.28 → 0.11–0.15 mm), pale greyish-cream to light or bright ochraceous(-orange), slightly translucent, round, somewhat undulating when large, slightly gelatinous, scattered to gregarious in small groups; disc medium concave, finally flat, margin distinct, thin or thick, not protruding, smooth; sessile on a broad base, superficial; dry ± cupulate, pale to bright yellowish-cream to greyish-ochraceous. **Asci** *55–60 × 3.6–4.5 µm {2}, †45–53 × 3.2–3.8 µm {T}, 8-spored, spores indistinctly 4-seriate, 4–5 lower spores inverted {2} (sometimes mixed); **apex** (†) medium to strongly truncate (not indented, laterally sometimes slightly inflated); **base** with short to medium long, thin or thick, ± flexuous stalk, Y- or h-shaped. **Ascospores** *(9.5–)10–13(–14) × (1.2–)1.3–1.4(–1.5) µm {2} (~12–15 µm actual length), †12–14.5(–15.5) × 1–1.3 µm {T}, narrowly fusoid, apex rounded, base gradually attenuated or with a ± distinct tail, medium to (very) strongly curved (falcate), (†) slightly to medium curved; **SBs** *2–3 × 0.2–0.4 µm {2}, subulate or often divided into a narrowly cylindrical, 1.5–2 µm long lower part and a ± invisible filum. **Paraphyses** apically slightly to medium capitate-clavate or often ellipsoid, terminal cell *26–33 {1} or 35–40 {T} × (2.8–)3–4(–4.3) µm {2}, †25–33 × (2–)3–4.5 µm {T}, lower cells *6–9 × 2–2.5 µm {2}, †5–7 × 1.5–2 µm {T}, branched only near base, partly pale ochraceous below. **Medullary excipulum** hyaline, 80–170 µm thick in centre, of (†) not or slightly gelatinized textura angularis-globulosa (upper 30–40 µm small-celled), very indistinctly delimited from ectal excipulum, more clearly so at flanks by a 10–20 µm thick layer of t. porrecta. **Ectal excipulum** hyaline to pale ochraceous near surface, of vertically oriented textura angularis(-globulosa) from base to mid flanks, ~50–250 µm thick near base, cells */†(20–)27–55(–85) × (15–)20–30(–48) µm {3}, (†) (not or) slightly (to medium) gelatinized (outer wall of cortical cells up to 1.5–2.5 µm thick); 20–25 µm thick at margin, oriented at a 60–80° angle to the surface, marginal cortical cells */†11–15(–17) ×(3–)3.5–4.5 µm {2}; **glassy processes** 2–4 × 4–5(–5.5) µm {T}, refractive. **Anchoring hyphae** ± sparse, †(3.5–)4–5.5(–6) µm wide, walls 0.3–0.6(–1.2) µm thick {2}. **SCBs** globose, in paraphyses ~0.8–1.8 µm diam., in medullary excipulum at flanks 1.8–2.7 µm; **VBs** absent. **Exudate** over paraphyses 1–3(–4) µm thick {2}, cap-like, hyaline to pale yellowish, firmly attached, over margin and flanks hyaline to light golden(-ochraceous). — **ANAMORPH**: arthrobotrys-like (from ascospore isolate {T}). **Mycelial hyphae** *(2.5–)3–5(–8) µm wide, covered by a 0.8–2.5 µm thick gel sheath, with scattered LBs, cells ~4-nucleate. **Conidiophores** *(75–)140–270(–600) µm long, *(3.5–)5–7.5(–9) µm wide at base, 3.5–4.3 µm at apex, near base up to middle part (0–)2–3(–7)-septate, sometimes branched in lower or upper half, conidia formed terminally, singly. **Large conidia** *(32–)40–50(–63) × (12–)14.5–18.3(–20.7) µm, (1–)2(–3)-septate {T}, obpyriform or more often fusoid to fusoid-clavate, with a large central cell if 3-septate; containing some small LBs. **Small conidia** *21–26.5 × (9–)10.5–13.3(–15.5) µm, (0–)1-septate {T}, obpyriform, not sharply differentiated from large conidia. **Adhesive networks** not formed in the presence of a nematode and springtails (but a few loops formed in the not included strain on *Solanecio*). **Chlamydospores** not observed.

Habitat: close to the ground, corticated, 11–22(?–30) mm thick branches of indet. angiosperms {2}, on slightly to strongly decayed bark {2} (periderm and bast), often on small cracks in periderm, ± darkened, green algae absent or very sparse. **Associated**: *Cosmospora* sp. {1}, *Lanatonectria flocculenta* {1} (apothecia partly very close to or even on perithecia). **Desiccation tolerance**: many cells of ectal and medullary excipulum, some paraphyses and mature asci and many ascospores still viable after 2 months, conidia formed in culture did not survive 2 days. **Altitude**: 2500 m a.s.l. **Phenology**: III.

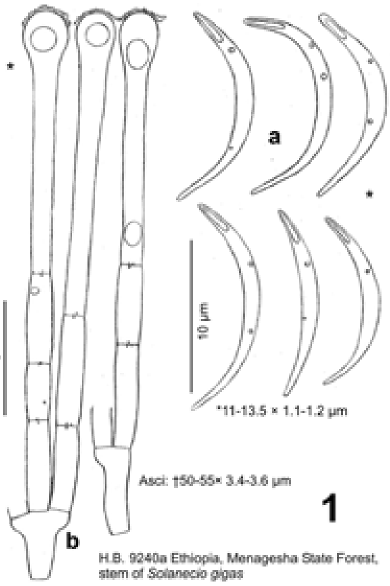


Plate 963. **1a–b**: *Orbilia* aff. *menageshae*. – **a**. ascospores; **b**. paraphyses.

Taxonomic remarks. *Orbilia menageshae* resembles *O. auricolor* or *O. elegans* in the ascospores. It differs in the paraphyses that tend to ellipsoid tips and to being covered by conspicuous, 1–3 µm thick, firmly attached caps of exudates (but not so on *Solanecio*), in the frequent presence of glassy processes, also in comparatively long spores and in rather large and thick apothecia. Yet, the main characteristic of *O. menageshae* is the deviating anamorph.

Variation. At the type locality, four samples were collected on bark of apparently two different angiosperms. The apothecia concurred very well in their microscopic features, but differed by colour: bright ochraceous in two (Pl. 964: 1a–d, holo- & isotype), pale greyish-cream in the other two (2a–c). Also the apothecial diameter varied between 0.8–1.7 (holo/isotype) and (1–)2.5–4.5(–5.5) mm (paratype).

Not included collections. In addition to these corticolous collections, two further samples were taken at the type locality which were on herbaceous stems of *Solanecio gigas* (Pls 963, 964: 3). These differ in some details from the corticolous ones: (1) the exudate over the paraphyses does not form caps but instead a thin (0.2–0.5 µm) continuous to granular layer, (2) the glassy processes are longer (2–15 µm up to 8–30 µm, 4–6 µm wide), therefore, the margin is finely crenulate, (3) the heads of the paraphyses are never ellipsoid, and (4) the spore apices are usually more subacute and the SBs more subulate and visibly attached (Pl. 963: 1a). In the dead state, however, the shape of the spores is very similar (Pl. 964: 1j, 2e, 3g), and their length [†(10–)12–15.5(–16)((–18)) × (0.9–)1–1.3(–1.4) µm] only slightly exceeds spore length of the corticolous specimens. One of the *Solanecio* specimens (H.B. 9309b) deviates in further points: the apothecia are up to 0.8 mm thick due to an apparently 600 µm thick basal ectal excipulum (however, the delimitation from the similarly large-celled medullary excipulum is quite obscure), and the marginal cortical cells are distinctly larger (†15–28 × 4–6 µm). These

Plate 964. **1–2**: *Orbilia menageshae*; **3**. *O.* aff. *menageshae*. – **3a**. *Solanecio gigas* in Menagesha Suba State Forest; **1a–d**, **2a–b**, **3b–d**. rehydrated apothecia; **1e**, **3e**. apothecia in median section; **1g–h**, **3h**. id., marginal ectal excipulum; **1f**. id., basal ectal excipulum; **1i**, **2f–g**, **3f**. paraphyses; **1j–k**, **2d–e**, **3g**. ascospores. – Living state (**1f**, **1k**, **2d**) or mainly dead state: **1g–h** (some cells alive), **1j**, **2e–g**, **3f–h** (in H_2O), **1i** (in KOH+CR). – **3a**: phot. U. Lindemann. — **1a–k**. H.B. 9275a (holotype, but **1b**, **e**, **h**, **1k** the rightmost spore from isotype in H.B.): Ethiopia, Menagesha, on indet. woody angiosperm; **2a–f**. H.B. 9310a: ibid., on indet. angiosperm; **3a–h**. H.B. 9240a: ibid., on *Solanecio*.

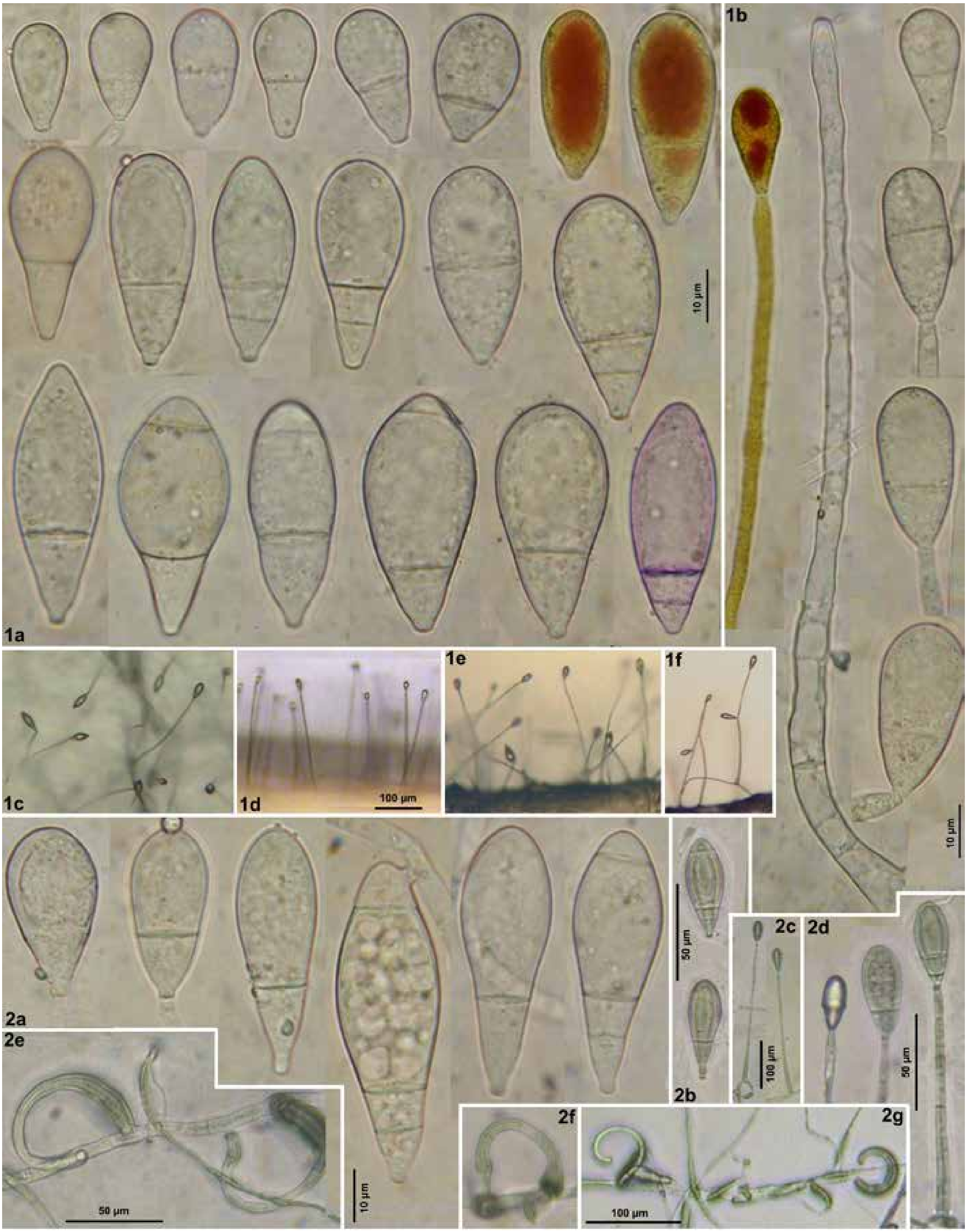


Plate 965. **1**: *Orbilia menageshae*; **2**: *O.* aff. *menageshae*. – **1a**, **2a–b**. conidia; **1b–f**, **2c–d**. conidiophores with conidia; **2e–g**. adhesive loops (all from culture). – Living state (partly stained by IKI or CRB). — **1a–f**. H.B. 9275a (holotype): Ethiopia, Menagesha, on indet. woody angiosperm; **2a–g**. H.B. 9309b: ibid., on *Solanecio*.

herbicolous specimens are not included in the description of *O. menageshae* because of deviating DNA data, although the anamorph obtained in pure culture closely concurs with that of the ex-type strain (see below).

Two samples from places other than the type locality are also not included. One on bamboo (*Yushania*, IVV: H.B. 9960) from southwestern Ethiopia has rather small and thin, flat, light cream-amber apothecia. It lacks caps on the paraphyses and has rather short and wide marginal cortical cells with thin glassy caps (1–2 µm) and comparatively long spores (†11–17 × 1.1–1.2 µm); also its DNA deviates from the type, therefore, it is referred to as *O.* cf. *menageshae* here. A collection on a herbaceous stem of *Euphorbia* from Kenya was studied by I. Olariaga (IVV; 29.XII.1968) when revising an associated *Hydropisphaera*. It concurs quite well with those on *Solanecio*, showing rather long and narrow spores (†11–17.5 × 0.8–1.2 µm), thin exudate over the paraphyses, and 25–60 µm long glassy processes at the margin.

Anamorph. Within the *O. auricolor* aggregate, the anamorph of *O. menageshae* is characterized by conidiophores being unbranched in the apex region where only 1 terminal conidium is formed, also in the conidia having often 2 septa. The species herein resembles *O. elegans*, which differs in wider, more regularly top-shaped, often 3-septate conidia and a tendency to apically branched conidiophores bearing 2–3 conidia. Unlike *O. elegans*, the conidia of *O. menageshae* show a rather high variability in size and shape. The predominant type is obpyriform, but fusoid (to fusiform) conidia are also frequent. There are usually (1–)2 septa near the base, but sometimes a further septum near the apex. Distinctly smaller, 0–1-septate obpyriform conidia are partly abundant but are not sharply separable from the large ones. Trapping organs could not be observed in the ex-type culture.

In the ascospore isolate from the not included sample on *Solanecio* (Pl. 965: 2) the large conidia were quite similar in size and shape to those in the holotype (965: 1): *(32–)42–59 × (13.5–)15.5–18.5 µm, 1–3-septate. Small obpyriform conidia were not seen in culture, but 1 such conidium was found on the natural substrate. The conidiophores had a similar length (120–350 µm) as in the ex-type strain and were never branched towards the apex. Only in this isolate a few adhesive networks were spontaneously formed (without presence of nematodes). They consisted of 1–2 loops with an outer diameter of 45–55 µm, their cells being *4.5–6 µm wide (near the attachment *7–9 µm).

The anamorph of *O. menageshae* somewhat resembles *A. fusiformis* R.C. Cooke & C.H. Dickinson (1965), isolated from soil in Shropshire in England, which differs in consistently fusiform conidia. The same applies to the type of *Arthrobotrys vermicola* (= *O. blumenaviensis*), but here the conidiophores are of the arthrobotryoid type. *A. mangrovisporus* Swe et al. (2008b) very closely matches the anamorph of *O. menageshae* in conidial characters, including the high variability in shape and septation. The species differs in mostly branched conidiophore tips bearing 1–6 conidia, also in the habitat (submerged wood in a mangrove swamp in southeastern Asia).

Phylogeny. Sequences were gained from an ascospore isolate of the holotype of *O. menageshae* (SSU with S1506 intron, ITS, LSU), also from apothecia of one of the *Solanecio* samples from the type locality (H.B. 9240a; S1506 intron, ITS, LSU) and of the *Yushania* sample (H.B. 9960; ITS). In the ITS region the three strains differ by 3.1–3.9% (3.9% between type and *Solanecio*, 3.3% between type and *Yushania*, 3.1% between *Solanecio* and *Yushania*). In comparison, *A. cystosporius* differs from them by 3–4.5%. In the LSU D1–D2 domain the distance is 0.9% between the *O. menageshae* type and the *Solanecio* sample, although both differ by only 0.3–0.6% from *A. paucisporus* and 0.5–0.7% from *A. superbus* (ATCC 96676).

In our ITS analysis (Phyl. 30), the type of *O. menageshae* clustered with the *Yushania* sample in a medium supported clade with unresolved position, whilst the *Solanecio* sample clustered unsupported with *A. cystosporius* in a similarly unresolved position. In phylogenetic analyses of SSU+ITS+LSU (Phyl. 25, S33), *O. menageshae* s.l. clustered unsupported with the *O. auricolor* clade and the *elegans-gampsosporus* clade. Also when analysing SSU (V8–V9), *O. menageshae* clustered with low distance (0.2–0.3%) with the *O. auricolor* clade and *elegans-gampsosporus* clade (S29).

In contrast, *A. mangrovisporus* differs from *O. menageshae* s.l. by 6.7–8.5% in the ITS and by 2.9–3.2% in the LSU. In the available SSU (V1–V5), *A. mangrovisporus* differs by 1.5–3.5% from other sequences. In our combined analyses (Phyls 25, S33), *A. mangrovisporus* clustered strongly supported with '*Dactylaria*' *sahelensis*. In the ITS analysis of Zhang et al. (2010), *A. mangrovisporus* is found near the base of *Arthrobotrys*, with only *A. oligosporus* situated more basally.

In the S1506 intron, the type of *O. menageshae* differs from the *Solanecio* sample by 7%. The intron occurs also in the *A. mangrovisporus* sequence and shows a high distance of 17% to *O. menageshae* s.l. When analysing this region, *A. mangrovisporus* clustered unresolved whereas *O. menageshae* s.l. is found in a strongly supported clade with *A. gampsosporus* and *A. cystosporius* (S30). The *Yushania* sample apparently lacks the intron, according to the used ITS1F primer.

Ecology. *O. menageshae* was collected on ± rotten bark of corticated mesic branches of apparently two different angiosperms in a subtropical humid (winterdry), evergreen, predominantly broad-leaved afromontane forest, with the large herbs *Lobelia giberroa* and *Solanecio gigas*, at the western slope of an old volcano in the central plateau of the Ethiopian highlands. The intimate growth with two species of *Hypocreales* might indicate a fungicolous habitat.

The not included collections do not seem to be closely associated with pyrenomycetes. The one at the type locality was on a mesic herbaceous stem of *Solanecio gigas*. The sample on bamboo (*Yushania alpina*) in southwestern Ethiopia was collected in an afromontane bamboo forest with a climate comparable to the type locality. Here populations of apothecia grew on fallen bamboo stems on the upper and lateral side. Also the collection on a herbaceous stem of *Euphorbia* in Kenya was from a similar subtropical highland climate.

Specimens included. **ETHIOPIA**: **Oromia**, 22 km WSW of Addis Ababa, 10 km NW of Sebeta, southern part of Menagesha Suba State Forest, 2500 m, branch of indet. angiosperm, on bark, 26.III.2010, Dawit Abate & U. Lindemann (M-0276510, **holotype**; anam. cult.; sq.: KT222439; **isotypes** in H.B. 9275a & U.L. 0310-6). – ibid., branch of indet. angiosperm, on bark, 26.III.2010, U. Lindemann (U.L. 0310-41, H.B. 9310a).

Not included. **ETHIOPIA**: **Oromia**, 22 km WSW of Addis Ababa, 10 km NW of Sebeta, southern part of Menagesha Suba State Forest, 2520 m, stem of *Solanecio gigas*, 22.XII.2009, U. Lindemann (U.L. 1209-7, H.B. 9240a; sq.: KY419174). – ibid., stem of *S. gigas*, 26.III.2010, U. Lindemann (U.L. 0310-40, H.B. 9309b, anam. cult.). – **Menjiwo**, 62 km SW of Jimma, 23 km E of Bonga, 4 km E of Boka, 2.5 km S of Kaka, Boka forest, bamboo forest, 2650 m, stem of *Yushania alpina*, 4.XII.2014, A. Gminder (A.G. eth-032, H.B. 9960; sq.: MK514442). — **KENYA**: **Kiambu**, 32 km NNW of Nairobi, ~2 km E of Uplands (railway station), Uplands Forest at southern end of Gatamaiyo Forest, 2360 m, on branch of *Euphorbia*, 29.XII.1968, O.E. Eriksson, vid. I. Olariaga (UPS F-639415, doc. vid.).

Orbilia blumenaviensis (Henn.) Baral & E. Weber, in Qiao et al., Mycol. Progr. 11: 257 (2012) — Pls 966–968, Map 156

Basionym: *Helotium blumenaviense* Henn., Hedwigia 41: 24 (1902)
= *Orbilia fici* E.K. Cash & Corner, Trans. Br. Mycol. Soc. 41: 280 (1958)
= *Arthrobotrys vermicola* (R.C. Cooke & Satchuth.) Rifai, Reinwardtia 7: 371 (1968)
≡ *Dactylaria vermicola* R.C. Cooke & Satchuth., Trans. Br. Mycol. Soc. 49(1): 27 (1966)
= *Arthrobotrys guizhouensis* K.Q. Zhang, in Zhang, Zhou, He & Huang, Acta Mycol. Sin. 13(2): 101 (1994), [non *A. guizhouensis* (K.Q. Zhang, Xing Z. Liu & L. Cao) M. Scholler, Hagedorn & A. Rubner, Sydowia 51(1): 102 (1999), nom. illegit., ICN Art. 53.1 (≡ *A. huaxiensis*)]

Etymology: *blumenaviensis*: referring to the type locality, Blumenau (Brazil); *fici*: according to the substrate of the type, *Ficus irregularis*; *guizhouensis*: named after the province Guizhou in China; *vermicola*: after the ability to prey on nematodes.

Typification: Brazil, Blumenau, (?)leaves of indet. *Arecales*, 17.I.1892, A. Möller (S, lectotype of ***Helotium blumenaviense***, designated here, MBT202394). — Singapore, branch of *Ficus irregularis*, IV.1935, E.J.H. Corner (BPI, holotype of ***Orbilia fici***). — Uganda, Mpanga forest, leaves of indet. plant, undated, R.C. Cooke (IMI 113071, holotype of ***Dactylaria vermicola***; ex-type culture: CBS 513.66; sq.: U51944, GU178821). — China, Guizhou, rotten debris, IX.1987, K.Q. Zhang (nr. 8736, type of ***Arthrobotrys guizhouensis***).

Description: — **TELEOMORPH**: **Apothecia** fresh or rehydrated (0.7–)1–3.5(–4) mm diam., 0.3–0.4 mm up to 0.6–0.8 mm high (receptacle 0.11–0.19 up to 0.4–0.6 mm), at first greyish-white, then pale to light greyish- to chlorinaceous-yellowish-cream to (honey-)yellow-ochre or amber-brown to orange-reddish-brown, slightly to medium translucent, somewhat gelatinous, round, slightly undulating or with small lobes when large, scattered to gregarious in small groups; disc young strongly, later slightly concave to flat, margin distinct, 0–15 µm protruding, more or less inrolled, smooth, even; sessile on a narrowed base or sometimes with a very broad, obconical or abrupt stipe 0.15–0.25 × 0.9–1.2 mm, superficial, dry honey-brown, ± strongly deformed. **Asci** *36–42 × 3.7–4 µm {1}, †(26–)28–42(–53) × (2.8–)3–3.8(–4) µm {6}, 8-spored, spores 4-seriate, lower 3–4 spores inverted {3}; **apex** (†) slightly to strongly truncate (not indented, laterally not or scarcely widened); **base** with short to medium long, flexuous stalk, h- to H-shaped. **Ascospores** *(8.8–)10–12(–14) × (1–)1.1–1.2(–1.3) µm {3} (~11–17 µm actual length), †(9–)9.5–13(–14.5) × (0.8–)0.9–1.2 µm {7}, narrowly subcylindric-clavate (subulate) to often fusoid-clavate, apex rounded, base ± strongly attenuated, rarely with a distinct tail, slightly to strongly curved (falcate, a little less curved in dead state); **SBs** 1.5–2.2(–2.5) {3, incl. invisible part} × (0.3–)0.4–0.6(–0.7) {2} or 0.7–0.8 µm {1}, rod-shaped to elongate ellipsoid or subglobose, with a (very) short invisible filum. **Paraphyses** apically narrowly to broadly lanceolate {6}, apex obtuse to acuminate, terminal cell *(9–)12–27(–29.5) × (2.7–)3–4 µm {1}, †12.5–29 × (1.5–)2–3(–3.5) µm {6}, exceeding the dead asci by (2–)3–6(–8) µm {7}, lower cells *5–14 × 2.7–3.5(–4.5) µm {1}, †4–9(–11) × 1.5–2.5(–3) µm {5}; unbranched at upper septum. **Medullary excipulum** subhyaline to yellowish, 15–40 µm thick, of dense textura intricata-porrecta-angularis, not or often medium (to strongly) gelatinized, horizontally oriented, overall very sharply delimited from ectal excipulum. **Ectal excipulum** of (†) thin- to firm-walled, hyaline, indistinctly vertically oriented t. globulosa-angularis(-prismatica) from base to margin, 220–600 µm thick near base, cells */†(18–)25–50(–80) × (12–)15–35(–40) µm {5}, at base and near medullary excipulum smaller; cortical cells from lower to mid flanks externally with 1–2(–3) µm thick pale yellowish-chlorinaceous walls {5}, in external view forming strongly transversely oriented rows of cells with 1–4 thin longitudinal septa; 20–30 µm thick near margin, oriented at an 80–90° angle to the surface, marginal cortical cells */†6–11(–14) × (3–)5–7.5(–9.5) µm {6}, uppermost cells with slightly conical apex, firm-walled; **glassy processes** 0.4–1(–3) × 3–5 µm {7}, high-refractive, partly stratified. **Anchoring hyphae** either only present among but not above host cells, medium abundant, †3–7 µm wide, wall 0.2–1 µm thick {2}, or forming a 30–200 µm thick, compact t. prismatica-angularis with cells of †7–12(–18) × (3–)4–6(–8) µm with gelatinized walls (common walls 1–1.5 µm) {2}. **SCBs** in paraphyses globose, medium refractive, 1.5–2.2 µm diam., 1((–2)) per cell, sometimes also with elongate, strongly refractive **VBs**; in marginal excipulum no cell contents seen. **Exudate** absent {8}. — **ANAMORPH**: arthrobotrys-like (from ascospore isolate {2} or natural substrate {2}; isolated from soil, water, leaves, or unidentified litter {4}) (including data of Cooke & Satchuthananthavale 1966, Van Oorschot 1985, Zhang et al. 1994, Swe et al. 2008a, and Qiao et al. 2012). **Conidiophores** 113–500(–1500) µm long, 4–9 µm wide at base, 3.5–6.5 µm below nodes, unbranched or branched below or above, at nodes not or often recommencing growth to form up to 3–4(–7) clusters of conidia in a row, conidia formed on conical nodules on indistinctly swollen nodes (arthrobotryoid), 1–8 conidia per node. **Conidia** variously shaped, of 3 main types: (a) obpyriform to obovoid, 1-septate, the upper cell often or always distinctly larger than the lower, (b) elongate cylindric-clavate, 1–2(–4)-septate, (c) elongate ellipsoid-fusoid, 2–3-septate, *(16.5–)21–38(–48.5) × ((8.5–))(10–)12.5–19(–22.5) µm {9}. Forming **adhesive networks** after adding nematodes, loops *33–43 µm outer diam., *21–33 µm inner diam., loop cells *(3.8–)5–7(–8.5) µm wide {3}. **Chlamydospores** present {2}, yellowish; or absent {2}.

Habitat: lying on ground, decorticated or corticated, ~2–20 cm thick branches and trunks of *Albizia lebbeck* {1}, *Ficus irregularis* {1}, *Phoenix canariensis* {1}, *Tabebuia rigida* {1}, indet. angiosperm trees {6}, 0.1–0.3 mm deep medium to strongly decayed wood {6} or bark {6} (periderm, rarely bast), (?)petiole of indet. *Arecaceae* {1}, textile (tentage). **Associated**: *Diplodia* sp. {1}, *Hyalorbilia ?juliae* {1}, ?*Nectria* sp. {1}, *Nectriopsis* sp. {1/1}. **Desiccation tolerance**: intolerant, a few spores and many conidia still viable after 1 month. **Altitude**: 5–385 m a.s.l. (Middle & South America), 1200 m (central Africa), 1–1850 m (southeastern Asia), 8 m (southeastern Europe). **Geology**: Devonian-Carboniferous & Jurassic sedimentary rock; felsic plutonic & metamorphic rock. **Phenology**: VII–VIII, X (teleomorph, northern hemisphere), XI–I, VI (teleomorph, tropical belt and southern hemisphere).

Taxonomic remarks. *Orbilia blumenaviensis* is well characterized by lanceolate paraphyses with obtuse to ± acute tips which distinctly protrude beyond the asci, the absence of exudate on them, also by the thick-walled, pale yellowish cortical cells of the ectal excipulum which form transversely oriented cell rows (Pl. 968: 1d, h–i), and by rather large, fleshy, ± gelatinous apothecia that turn honey-yellow or amber-brown with age and lack a visible subiculum. In other features the teleomorph hardly differs from *O. auricolor*. A SEM micrograph of a collection from Puerto Rico (D.H.P. PR 116, as *Orbilia* sp.) showing obtusely lanceolate paraphyses is given by Pfister (1997: fig. 2, bottom row, hymenium in top view).

Variation. The species shows some variation in several features. Spore length varies from *9–12 µm up to sometimes *11–14 µm (in situ). A thick compact texture of gelatinized cells at the base of the apothecia, representing the anchoring hyphae, was only seen in the type of *O. blumenaviensis*, whereas a comparable layer in a sample from Guadeloupe (H.B. 8413a) was almost non-gelatinized. In contrast to the American specimens studied, a medium strong gelatinization of the medullary excipulum was noted in the southeastern Asian holotype of *O. fici* and in the specimen from the Comoros. The glassy caps on the marginal cortical cells are usually only present as moderate wall thickenings (Pl. 966: 1f, 2f), but attain a thickness of 1–3 µm in two of the samples from Puerto Rico (Pl. 966: 4f and D.H.P. PR 116). Finally, the apothecia may strongly vary in size, ranging usually around 1–3 mm in diam. but sometimes only 0.7–1.5 or rarely 1.5–6 mm (see Qiao et al. 2012). Apothecial thickness was often around 0.3–0.4 mm, but showed extraordinarily high values (0.6–0.8 mm) in the lectotype of *O. blumenaviensis* and in the specimen from the Comoros. A distinct stipe was only sometimes present (Pls

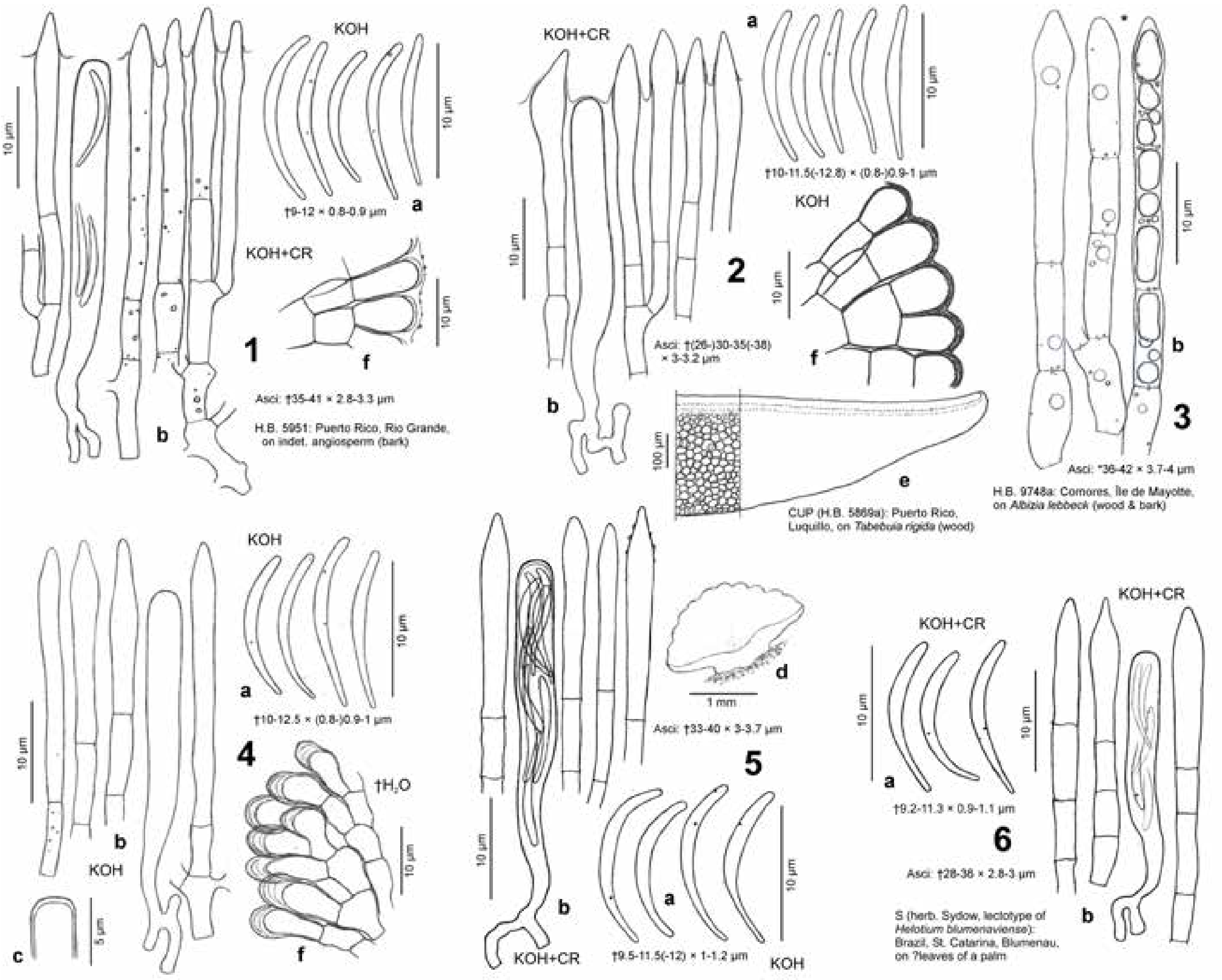


Plate 966. **1–9**: *Orbilia blumenaviensis*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apex; **d**. rehydrated apothecium; **e**. apothecium in median section; **f**. id., ectal excipulum at margin; **g**. conidia and conidiophores (**7** from substrate, **8–9** from culture). Scale in **9** adjusted to given conidial size (Van Oorschot's scale is ca. 2.5 × too long).

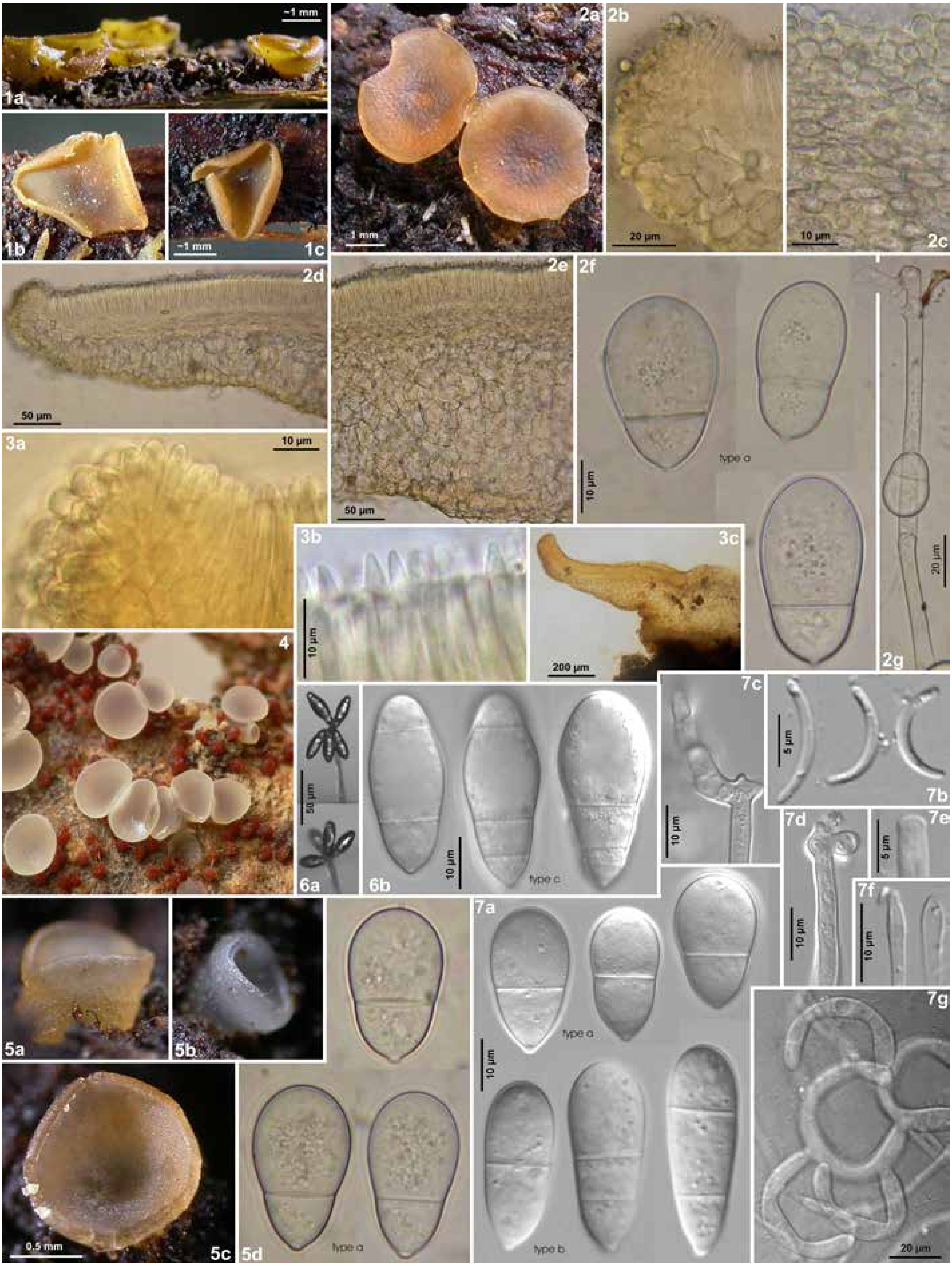


Plate 967. **1–7**: *Orbilia blumenaviensis*. – **1a–c**, **2a**, **5a–c**. rehydrated apothecia, **4**. fresh apothecia; **2d–e**, **3c**. apothecia in median section; **2b**, **3a**. id., marginal excipulum; **2c**. id., external view; **7b**. ascospores; **7e**. ascus apex; **3b**, **7f**. paraphyses; **2f**, **5d**, **6a–b**, **7a**. conidia; **2g**, **7c–d**. conidiophores; **7g**. adhesive network (**6a–c**, **7a**, **c–d**, **g**. from culture; **2f–g**, **5d**. from substrate). – Anamorph in living state; **2b–e**, **3a–c** in KOH, **7e–f** in H_2O. – **4**: phot. M. Wilhelm, **6a–b**, **7a–g**: from Qiao et al. (2012). — **1a–c**. S (herb. Sydow): Brazil, on indet. *Arecales* (lectotype of *H. blumenaviense*); **2a–g**. H.B. 8029: Martinique, on indet. angiosperm; **3a–b**. H.B. 7597: Singapore, on *Ficus*; **4**. 15.I.2008: Switzerland (tropic house), on *Pandanus*; **5a–d**. H.B. 8413a: Guadeloupe, on indet. angiosperm; **6**. YMF 1.03606: China, Yunnan, Lianghe, on indet. angiosperm; **7a–g**. YMF 1.03002: ibid., Tonghai, on indet. angiosperm.

966: 5d; 967: 3c). Whitish apothecia were only seen in the two European samples (Pl. 967: 4), but this may be so because they are the only ones which were photographed in the fresh state.

Type studies. ***Helotium blumenaviense*** was examined from the 'holotype' in S by Dumont (1981: 323) who found it to represent an *Orbilia*. Dumont was unable to see the paraphyses and ascospores 'owing to the poor preservation', therefore, he did not compare the species with other taxa. The apparently same specimen, though labelled 'ISOTYPUS' by the museum, was reexamined here and found to contain 8 extraordinarily thick (0.7–0.8 mm), honey-yellow apothecia (cream-hazel in protologue) which are in quite good shape (Pl. 967: 1). The protruding lanceolate paraphyses are clearly visible, but free spores very rare (Pl. 966: 6). The anchoring hyphae form a compact stromatic texture, a character not observed in most of the other collections referred here. The protologue is rather inaccurate in describing the paraphyses as narrowly filiform (0.5–0.8 µm wide) and in neglecting the curvature of the spores which were described as acicular, acute at both ends, biguttulate, 9–11 × 1.5–2 µm. The specimen in S (herb. Sydow) examined in this study is designated here as **lectotype** of *Helotium blumenaviense* (ICN Art. 9.11, Turland et al. 2018); a duplicate in B was destroyed during the Second World War.

The holotype of ***Orbilia fici*** (Pl. 966: 5) contains abundant apothecia which were described as drab or greyish olive in the protologue, but now showed a dirty ochre-orange colour (rehydrated). Although the authors reported the paraphyses as 'apically sublanceolate', they stressed only the hymenial colour as diagnostic against *O. curvatispora* (= *O. auricolor*). The spores were described as straight or curved, filiform, 10–11 × 0.5 µm. A blue iodine reaction of the ascus pore is an error in the protologue.

Anamorph. Two Chinese ascospore isolates of *O. blumenaviensis* from Tonghai and Lianghe in Yunnan formed an anamorph (Pl. 967: 6–7; Qiao et al. 2012). At first glance, the two differ in shape of the predominant type of conidia (clavate vs. fusoid), which seem to point to a species aggregate. However, both isolates show a distinct conidial polymorphism. In fact, three types of conidia can be observed. In the isolate from Tonghai only heteropolar conidia occurred, being either obpyriform to obovoid, 1-septate, *(16.5–)20.5–28 × (10–)13.5–15.5(–19) µm (type a, Pl. 967: 7a upper row), but sometimes also more elongate cylindric-clavate, with often 2 septa and a size of *(21.5–)30–34.5(–39) × 12.7–14 µm (type b, 7a lower row). In the isolate from Lianghe predominantly homopolar (ellipsoid-fusoid), 2–3-septate, *33–35(–40) × (10.5–)13–16(–17) µm large conidia where found (type c, Pl. 967: 6a–b), but also a few of types a and b. No difference in the teleomorph was noted (see also Qiao et al. 2012). A soil isolate from Dehong without teleomorph formed mainly fusoid conidia (type c, see Qiao et al. l.c.: fig. 3).

Additionally, in two Caribbean apothecial samples a few conidia were found on the natural substrate, which all belonged to type a (1-septate, obpyriform to obovoid, Pls 966: 7g; 967: 2f, 5d), but differ from those of the Tonghai isolate in their larger size. However, also here the conidia differ somewhat in size (H.B. 8029: *32–36 × 17–21 µm, H.B. 8413a: *29–31 × 17–18 µm). In an unlocalized isolate from the Panama Canal Zone (CBS 119.54) the conidia measured only 22–25 × 13–15 µm (?dead state, G. Verkley pers. comm.) and were undoubtedly 1-septate, which explains the misidentification as *A. arthrobotryoides*.

The Lianghe isolate concurs quite well with the protologue of ***Arthrobotrys vermicola*** concerning conidial size, shape, and septation. *A. vermicola* was described by Cooke & Satchuthananthavale (1966, as *Dactylaria*) from Uganda, with ellipsoid-fusoid, (1–)2(–3–4)-septate conidia measuring 27.5–47.5 × 13.5–20 µm (Pl. 966: 8). However, when van 0orschot (1985) redescribed the type strain, she found besides ellipsoid-fusoid to cymbiform, (1–)2–3-septate conidia also some 1-septate ones with an obovoid shape (size of both types 28.5–48.5 × 17–22.5 µm, Pl. 966: 9). In her drawing the conidia partly emerge from distinct denticles suggestive of the candelabrelloid type, but in the protologue drawing the conidiogenesis is clearly arthrobotryoid. Swe et al. (2008a) reported *A. vermicola* isolates from three mangrove habitats in southeastern Asia, which well correspond to the type as redescribed by Van Oorschot 1985 (erroneously as CBS 513.60 in the legend). Also here some elongate obpyriform (0–)1(–2)-septate conidia occurred along with fusoid (1–)2–3-septate ones (size of both *24–40 × 13–20 µm).

The obpyriform 1-septate conidia of *A. vermicola* (type a) resemble those of *A. oligosporus* in shape and eccentrical septation, but those of *A. oligosporus* are distinctly smaller, and isolates of that species cluster in a separate clade (Qiao et al. 2012, fig. 2a). In conidial morphology *A. perpastus* and *A. cystosporius* resemble *A. vermicola* in size and shape, but sharply differ in geniculate conidiophores, also in the conidial septum being more eccentrical.

A. guizhouensis K.Q. Zhang was described in Zhang et al. (1994) from an isolate from rotten debris in Guiyang, Guizhou, Sept. 1987 (date fide Yu et al. 2014). Although Yu et al. considered this species as distinct from *A. vermicola* based on branched conidiophores and mainly 1-septate conidia, we see a close morphological resemblance to the type of *A. vermicola*, and molecular data of a strain referred by Yu et al. to *A. guizhouensis* (YMF 1.00014) confirms synonymy with *A. vermicola*. The type was deposited as a living culture ('cultura viva 8736') in Coll. Agr. Guizhou, Guiyang (China), which was later retroactively permitted by the Code (Art. 8.4 ICN) if preserved in a metabolically inactive state. The illegitimate homonym *A. guizhouensis* (K.Q. Zhang et al.) M. Scholler et al. is a different species of series *Arthrobotrys* having much larger, partly fusiform conidia formed acrogenously on the conidiophores.

According to Zhang et al. (1994), *A. guizhouensis* K.Q. Zhang differs from *A. vermicola* by 1-, rarely 2–3-septate conidia and by branched conidiophores. Yu et al. (2014) examined the type culture and included three soil isolates from Guizhou and Yunnan. One of them (YMF 1.00014) was gained by Z.W. Zhao in 2002 from field soil at Wenshan, Yunnan, and is shown on their fig. 3.19, but erroneously under the name '*A. huaxiensis*', while fig. 3.18, which is labelled '*A. guizhouensis*', represents *A. huaxiensis*. Note further, that the scale bars in fig. 3.19 yield much smaller conidia than given in Yu et al.'s description of *A. guizhouensis* K.Q. Zhang. In fact the bars should be reduced by ~72% to achieve a correct conidial size. According to Zhang et al. (1994), *A guizhouensis* has partly rather small conidia down to 19 × 8.4 µm, which Yu et al. named microconidia, but which are not sharply separated from the normal ones. The presence of yellowish chlamydospores in culture was reported by Zhang et al. (1994) for the type of *A guizhouensis* and its absence by Swe et al. (2008b) for *A. vermicola*.

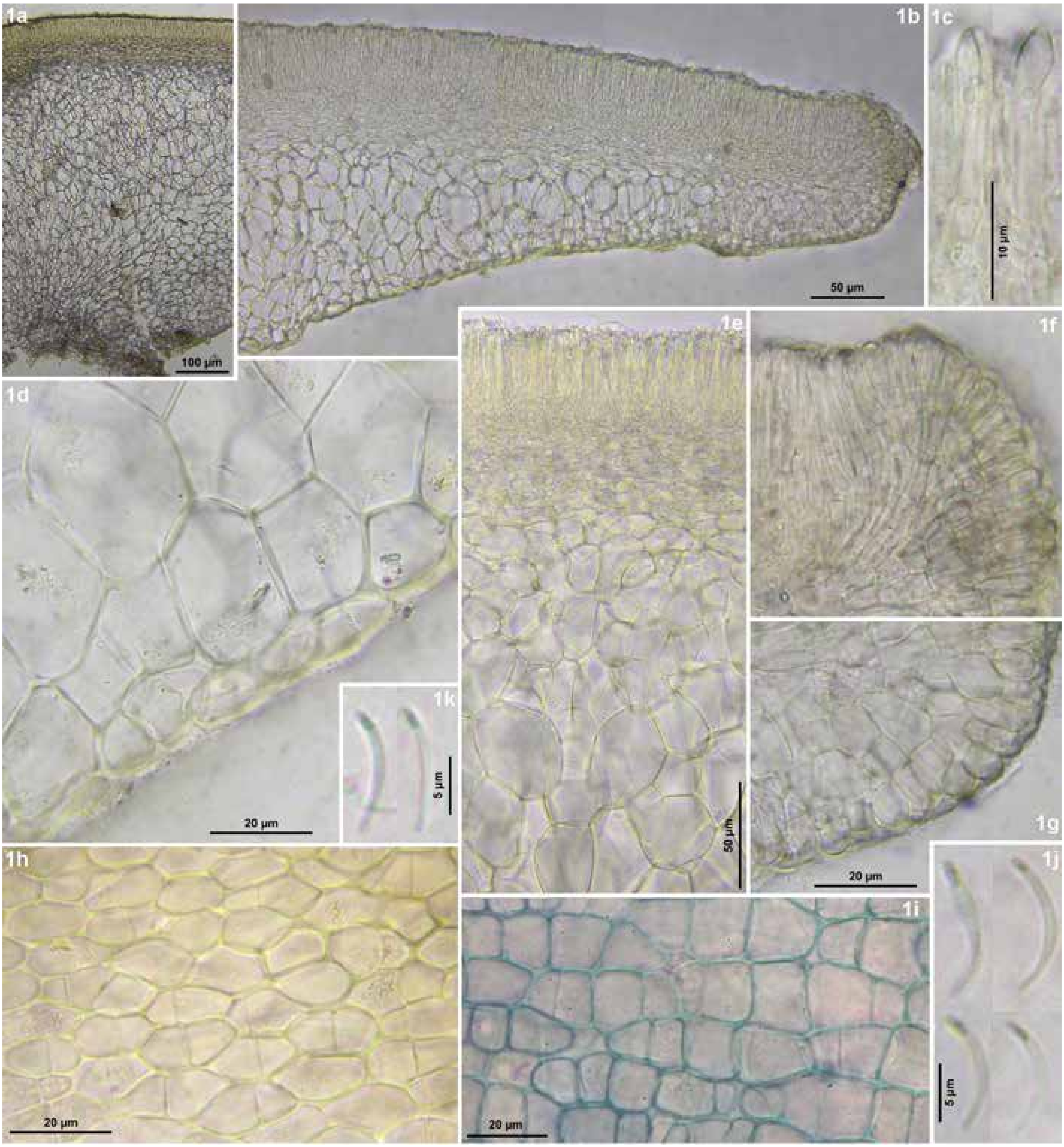


Plate 968. **1a–k**. *Orbilia blumenaviensis*. – **1a**. median section of apothecium in central part; **1b**. id., in receptacle; **1c**. paraphyses with SCBs; **1d**. median section of ectal excipulum at lower flanks (outer region); **1e**. id., inner region incl. medullary excipulum and hymenium; **1f**. id., at margin; **1g**. id., at mid flanks; **1h–i**. external view on cortex of ectal excipulum at lower flanks, showing transversely orientated, 1–4-septate cell rows; **1j–k**. ascospores. – Living state (**1i** in CRB). – **1i**, **k**: phot. J.P. Priou. – **1a–k**. H.B. 9748a: Comoros, Mayotte, on *Albizia*.

Not included collection. Based on a recent collection from Puerto Rico, the new species ***Orbilia jesu-laurae*** Quijada, Beltrán-Tejera, Pfister & Baral was described (Quijada et al. 2020). It differs from *O. blumenaviensis* in paraphyses with lageniform-mammiform apices with one or often several terminal or lateral abrupt beaks that are covered by exudate, and in thinner apothecia (0.1–0.2 mm vs. 0.3–0.8 mm) though of a similar size (1–2 mm). In the anamorph obtained in pure culture the species differs in shorter and narrower conidiophores and consistently (0–)1-septate, never fusoid conidia of a smaller size (see key p. 1519), being reminiscent of those of *O. auricolor* (*A. superbus*) or *O. oligospora*. For its phylogenetic position see below.

Phylogeny. A sequence was taken from apothecia of a specimen from Mayotte (Comoros, H.B. 9748), comprising ITS and LSU (the S1506 intron is absent). Further sequences of *O. blumenaviensis* as circumscribed in Qiao et al. (2012) were available for the ITS region from six eastern Asian strains (deposited in GenBank as *O. fici*, *A. guizhouensis*, or mainly *A. vermicola*, two of them from ascospore isolates), and the ex-type strain of *A. vermicola* from Uganda. LSU sequences exist in GenBank for two eastern Asian strains (125, 126, Swe et al. 2008a), for which the ITS region comprised only ITS1, and two under the name *A. guizhouensis* (YMF 1.00014, YNUCC 0076) from an unpublished study by W.P. Li et al., one of them being from Guizhou (YNUCC 0076). Further sequences concern samples from Mexico (SA305, ITS) and Panama (CBS 199.54, as *A. arthrobotryoides*, ITS+LSU). The S1506 intron is present in five strains (YMF 1.03002, Tonghai; YMF 1.00014, Wenshan; strain 629, unlocalized; strains 125, 126, Hong Kong), but absent in the ex-type strain of *A. vermicola* and H.B. 9748, whereas the other sequences are unclear in this respect. For YMF 1.00014 also SSU V1–V3, mtLSU, *RPB2, TEF1,* and *TUBB* exist.

In analyses of the ITS region by Qiao et al. (2012) and in the present study (Phyl. 28), *O. blumenaviensis* including the ex-type strain of *A. vermicola* clustered with high support in a clade, though with a comparatively high variation which lies in the range of 0.2–3 %, whereas, e.g., the type of *A. menageshae* shows a distance of 6.5–7.5 % and *A. musiformis* 7–9 %. Qiao et al. concluded that all *O. blumenaviensis* and *A. vermicola* strains belong to a single variable species. Due to the variation, different clades can be recognized within the species, and the observed conidial types show a certain correlation with the clades: strains with ± fusoid conidia (from Dehong and type of *A. vermicola* from Uganda) clustered with a 0.8–1.1 % distance in a clade. The Wenshan isolate (as *A. guizhouensis*) with mainly obpyriform conidia clustered with 0.6 % distance in a clade with strain 629 (without data). The remaining two strains with anamorph data have mainly obpyriform conidia (YMF 1.03002) or partly also fusoid conidia (isolate 103, in Swe et al. 2008a). However, these authors did not specify to which isolate their illustration (fig. 8) belongs. For strain 103 they gave the conidia as 2–3-septate but did not indicate the shape. Because of the repeatedly observed mixture of different conidial types within a single strain, we agree that a separation of *O. blumenaviensis* into different taxa is impossible.

For *O. jesu-laurae* sequences of ITS and LSU D1–D4 exist in GenBank. In the ITS region the species differs from *O. blumenaviensis* by 7–8 %, but in the LSU D1–D2 by only 0.2–0.6 %. Higher ITS distances are observed to *O. elegans* and *O. musiformis* s.l. (ITS 9–11 %, LSU 0.4–0.6 %), whereas the closest ITS sequences were '*A. musiformis*' (EVLL02, EVLL-2) with 3.6 % distance, and '*O. auricolor*/*A. oligosporus*' (B.L. 6225) with 3.7 % distance (but in LSU 0.7–0.9 %). In Quijada's analysis of ITS+LSU, *O. jesu-laurae* clustered supported with '*A. musiformis*' (see also p. 1578).

The type strain of *A. vermicola* from Uganda was sequenced for the ITS by Liou & Tzean (1997, U51944) and resequenced by Qiao et al. (2012, GU178821 = NR_144911). The two sequences differ by 6 nt and 1 gap, but in comparison to other sequences of this and related species it seems that all deviations in U51944 are based on sequencing errors. This is confirmed by a sequence in the CBS database (with the wrong name *Arachniotus hebridensis* and the possibly wrong number CBS 360.66) which matches perfectly GU178821 in the ITS region and should instead derive from CBS 513.66. In Qiao et al. (2012) Liou & Tzean's sequence is erroneously said to originate from a strain from Taiwan, and also Yang et al.'s (2007) strain was assumed to originate from Beijing although in fact no information is available about it.

In Hagedorn & Scholler's (1999: fig. 2) neighbour joining analysis of ITS, Liou & Tzean's sequence of *A. vermicola* clustered in a medium supported clade with *A. musiformis*, a species with candelabrelloid conidiophores and cylindric-clavate, 1-septate conidia, positioned with medium support sister to a clade with *A. amerosporus*, *A. flagrans*, and *A. javanicus*. The entire clade corresponds to the *oligospora-musiformis* clade, in which, however, *O. blumenaviensis* did not cluster in our combined analyses (Phyls 25, S33), whereas an unsupported association with *A. musiformis* is also seen in our ITS analysis (Phyl. 28). In Qiao et al.'s (2012) neighbour joining analysis of ITS, the *O. blumenaviensis* clade clustered with medium support as a sister group to the major clade of *Arthrobotrys* species, but with *A. amerosporus*, *A. flagrans*, *A. musiformis*, and *A. oligosporus* more basally positioned. In the two parsimony analyses by Yang et al. (2007), *A. vermicola* clustered with *A. musiformis*, *A. oligosporus*, and *A. conoides*, either with ITS alone (unsupported) or in combination with *TUBB*, *RPB2* and *TEF1* (here with strong support and only here including *A. pseudoclavatus*).

In the LSU D1–D2 the five available sequences of *O. blumenaviensis* vary by a few nt in the D1 (pos. 99, 107, 126, 128) and by 1–2 nt in the D2 (pos. 523, 545). Yet, also *A. musiformis* and some other species deviate from *O. blumenaviensis* in the D1–D2 domain by only 1–2 nt, and *O. elegans* by only 0–1 nt. Therefore, it is impossible to differentiate among species with LSU alone (see Phyl. S32), and analyses of ITS+LSU lead to virtually the same result as with ITS. At 1 position in LSU D2 (516) *A. musiformis* and *O. javanica* differ by GGGA**T**AAA compared to GGGA**C**AAA in *O. blumenaviensis* and various other species. Based on this position, a strain under the name *A. vermicola* in GenBank (AY261143, YNUCC 2428) belongs to *A. musiformis* s.l.

When analysing the S1506 intron (~400 nt), three strains are very close (125, 126, 629, 0.3–0.5 % distance) but differ from the two YMF strains by 3.2–5.7 %, and the YMF strains even by 8.8 %. Nevertheless, the five sequences clustered in a strongly supported clade (S30, strains 125 and 126 not shown). This result and BLAST similarities of the ITS1 confirm that strains 125 and 126 clearly belong to *O. blumenaviensis*.

Ecology. Apothecia of *O. blumenaviensis* occur on rotten wood and bark of hygric branches and trunks of angiosperms including palms. The species shows a pantropical distribution, being so far mainly recorded from tropical humid maritime Middle America (Caribbean belt) and southeastern Africa (Comoros) and tropical humid central Africa (Uganda), as well as subtropical humid eastern South America (type of *O. blumenaviensis*), and subtropical humid (winter-dry) to tropical humid (type of *O. fici*) southeastern Asia. *O. blumenaviensis* was also once collected in thermotemperate humid atlantic southeastern Europe (Galicia). A further European record was made by M. Wilhelm (pers. comm.) in the Masoala tropic house at the Zoo in Zürich, which represents the tropical rainforest flora and fauna of the Masoala peninsula in northeastern Madagascar.

Specimens included. **MEXICO**: **Veracruz**, 170 km NW of Veracruz, 18 km SSE of Papantla de Olarte Ocampo, 166 m, *Vanilla planifolia*, on bark, 2013, M.C.A. González Chávez & R. Carrillo (SA305, as *Orbiliaceae* sp., mol. extr., non vid.; sq.: KX953587). — **PANAMA**: **Canal Zone**, unlocalized, on textile (tentage), undated, isol. E.S. Barghoorn, No. B-63A, 1944, depos. by E.g. Simmons IX.1954 (CBS 119.54, as *A. arthrobotryoides*, conid. isol., non vid.; sq.: MH857262, MH868798). – **Coiba Island**, undated, branch of *Guazuma ulmifolia*, submerged wood, Brown et al. (2016, L284, L273, as *Ascomycota* sp., mol. extr., non vid., sq.: KU535751, KU535771). — **PUERTO RICO**: ~5 km S of Luquillo, El Yunque, along streamlet at km 3.1 of Rte. 988, 150 m,

Map 156. Known distribution of *O. blumenaviensis* in Middle America and southeastern Asia (cyan = *O. jesu-laurae*).

log of *Tabebuia rigida*, on wood, 6.VI.1970, R.P. Korf et al. (CUP-PR-003885, H.B. 5869a ø; CUP-PR-003878, H.B. 5869b ø). – 10.5 km SE of Isabela, 1.7 km S of Pueblito de Ponce, Reserva Forestal Guajataca, 200 m, branch of indet. angiosperm, on bark, 23.I.1996, D.H. Pfister et al. (D.H.P. PR 116, FH 00458349, 00458350). – 6.3 km SSE of Rio Grande, El Yunque, El Verde, forest entrance trail before Oxcart Trail, 385 m, branch of indet. angiosperm, on bark, 24.I.1996, F.A. Harrington & M. Liftik (D.H.P. PR 137, FH 00458345, H.B. 5951 ø). — **LESSER ANTILLES**: **Martinique**, 5.5 km WSW of Les-Troits-Îlets, L'Anse Noire, 5 m, branch of indet. angiosperm, on bark, 10.XII.2005, C. Lechat (C.L.L. 5645, H.B. 8029, anam. substr.). – **Guadeloupe**, ~1.7 km NE of Vieux Fort, Ravine Blondeau, 280 m, branch of indet. angiosperm, on bark, 22.XI.2006, C. Lechat (C.L.L. 6016, H.B. 8413a, anam. substr.). — **BRAZIL**: **Santa Catarina**, 90 km NW of Florianopolis, Blumenau, ~100 m, (?)petioles of indet. *Arecales*, 17.I.1892, A. Möller (S, herb. Sydow, **lectotype** of *Helotium blumenaviense*, H.B. 7679 ø). — **UGANDA**: 34 km WSW of Kampala, 26 km NW of Entebbe (N of Lake Victoria), Mpanga forest, ~1200 m, rotten leaves, undated, R.C. Cooke (IMI 113071, **holotype** of *A. vermicola*, CBS 513.66, CCRC 32666, MUCL 9432, conid. isol., doc. vid.; sq.: U51944, GU178821). — **COMOROS**: **Mayotte**, 11.5 km WSW of Mamoudzou, 2.2 km NE of Chiconi, Lycée Agricole, 125 m, log of *Albizia lebbeck*, on wood & bark, 11.XII.2012, M. Pélissier (J.P.P. 13001, H.B. 9748a; sq.: KT222410). — **CHINA**: unlocalized, Yang et al. (2007, 629, CGMCC (AS) 3.6763, non vid., as *A. vermicola*; sq.: AY773454). – **Guizhou**, **Guiyang**, rotten debris, IX.1987, K.Q. Zhang ('Z ool' or 'Z001', living culture nr. 8736, **type** of *Arthrobotrys guizhouensis*). – Guizhou, unlocalized (YNUCC 0076, as *A. guizhouensis*; sq.: AY056598). – **Yunnan**, **Dehong**, unlocalized, from soil, VII.2003, H. Luo, isol. by L. Cao (YMF 1.00534, as *A. vermicola*, conid. isol., doc. vid.; sq.: GQ121416). – ibid., Lianghe, 47 km WNW of Dehong, 5.5 km SW of Wenleng, 1230 m, log of indet. angiosperm, VIII.2010, Z.F. Yu & M. Qiao (YMF 1.03606, anam. cult., doc. vid., as *A. vermicola*; sq.: HQ595346). – **Yuxi**, Tonghai, ~35 km SE of Yuxi, ~3.5 km S of Tonghai, eastern part of Xiushan, 1800–1850 m, wood of indet. angiosperm, VII.2007, J.W. Guo & S.F. Li (YMF 1.03002, anam. cult., doc. vid., as *O. fici*; sq.: FJ599809, MH179764). – **Wenshan**, unlocalized, field soil, IV.2002, Z.W. Zhao (YMF 1.00014, as *A. guizhouensis*, doc. vid.; sq.: MF948506, MF948390, etc.). – **Hong Kong**, New Territories (doc. vid., not stated from which collection), 15 km NW of Kowloon, 7.5 km E of Tuen Mun, Tai Lam chung, 80 m, freshwater, undated, Swe et al. (2008a, F1.103, conid. isol., doc. vid.; sq.: EU977508). – 22 km NW of Kowloon, Mai Po, 1 m, mangrove, Swe et al. (2008a, M1.125, conid. isol., doc. vid., as *A. vermicola*; sq.: EU977549). – 10 km NE of Kowloon, 2 km SW of Sai Kung, Pak Sha Wan, 10 m, mangrove, Swe et al. (2008a, M2.126, conid. isol., doc. vid., as *A. vermicola*; sq.: EU977554).— **SINGAPORE**, unlocalized, ?50 m, branch of *Ficus irregularis*, on bark, IV.1935, E.J.H. Corner 1249 (BPI, **holotype** of *O. fici*, H.B. 7597 ø). — **SPAIN**: **Galicia**, **Pontevedra**, 21 km WNW of Pontevedra, 1.3 km W of O Grove, N of O Con, 8 m, log of *Phoenix canariensis* cut into pieces, 20.X.2015, M.A. Delgado, vid. J. Castillo (J.Ca., doc. vid.). — **SWITZERLAND**: **Zürich**, Zoo Zürich, Masoala Rainforest tropic house (Madagascar), on *Pandanus* (172) and indet. wood (174), 15.I.2008, M. Wilhelm (M.Wi. 172, 174).

Orbilia jesu-laurae: **PUERTO RICO**: **Bayamón**, Parque Nacional Julio Enrique Monagas, 15 m, branch of indet. angiosperm, on wood, 15.VII.2018, L Quijada (L.Q. H-59; FH, **holotype**; CUP, isotype; anam. cult., doc. vid.; sq. from culture: MN816816, MN816819, MN816817, MN816820, from apothecia: MN816818, MN816821).

Orbilia neglecta Penz. & Sacc., Malpighia 15(7–9): 219 (1902) — Pls 969–970

Etymology: meaning 'overlooked'.

Typification: Indonesia, Java, Cibodas, leaves of *Elettaria*, 6.II.1897, A.J.O. Penzig (PAD, nr. 442 ex parte, lectotype, designated here, MBT202392)

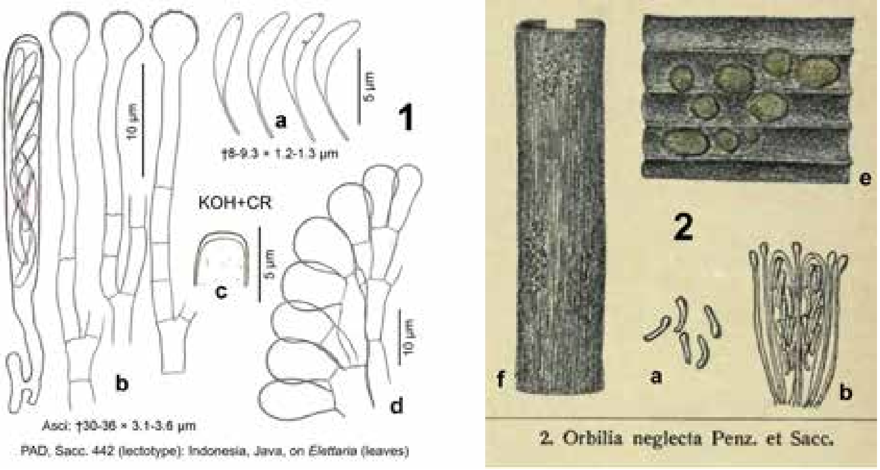


Plate 969. **1–2**: *Orbilia neglecta*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apex; **d**. median section of ectal excipulum at margin; **e**. apothecia; **f**. *Elettaria* leaf. – **2**: uncalibrated original drawing in Penzig & Saccardo (1904: pl. 57 fig. 2).

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.3–0.7 mm diam., 0.14 mm high, now pale cream (light honey-yellow in the protologue), translucent, round, gregarious over large areas; disc flat, margin distinct, not protruding, smooth; broadly sessile, superficial; dry light amber, with white subiculum around each apothecium. **Asci** †30–36 × 3.1–3.6 µm, 8-spored, spores (†) obliquely 2-seriate, 3–5 lower spores inverted (not mixed); **apex** (†) medium to strongly truncate (not indented, laterally not widened); **base** with medium long, thin, flexuous stalk, h- to H-shaped. **Ascospores** †8–9.3 × 1.2–1.3 µm (~9–10 µm actual length), divided into a narrowly ellipsoid-fusoid upper part and an abrupt, very thin tail of 2.5–3 × 0.1–0.2 µm (about ⅓ of spore length), apex obtuse, medium

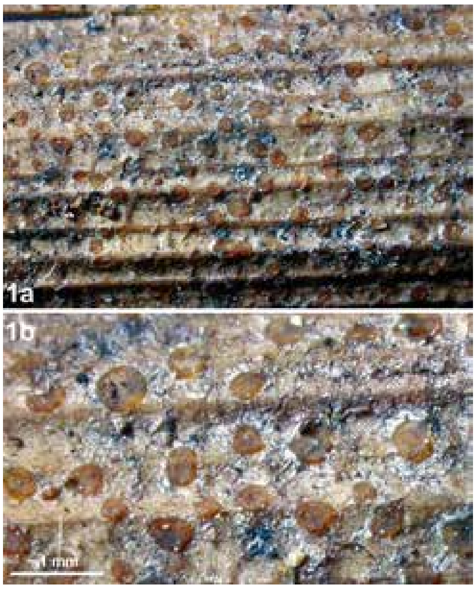


Plate 970. **1**: *Orbilia neglecta*. – Dry apothecia. — **1a–b**. PAD, nr. 442 (lectotype): Indonesia, Java, on *Elettaria*.

to strongly curved; **SBs** not seen. **Paraphyses** apically strongly (to very strongly) capitate, terminal cell †15.5–23 × 3–4.5 µm, lower cells †3–7.5 × 1.7–2.3 µm; unbranched at upper septum. **Medullary excipulum** 10–15 µm thick, of dense, horizontal textura prismatica-porrecta. **Ectal excipulum** of thin-walled to slightly gelatinized, indistinctly oriented t. angularis-globulosa from base to margin, 90–100 µm thick near base, cells †15–40 × 15–30 µm; 15 µm thick near margin, oriented at a high angle to the surface, marginal cortical cells †10–16 × 6–12 µm, thin-walled; **glassy processes** absent. **Anchoring hyphae** very abundant, †3–4.5 µm wide (near insertion up to 6.5 µm), walls (0.2–)0.3–0.8 µm thick. **SCBs** and **VBs** no data available. **Exudate** over paraphyses 0.2–0.4 µm thick, finely rough, firmly attached, over margin and flanks absent. **— ANAMORPH**: unknown.

Habitat: on upper side of dead leaves of *Elettaria* sp. **Associated**: hyphomycete with dark brown setae. **Desiccation tolerance**: unknown (possibly intolerant). **Altitude**: 1350 m a.s.l. **Phenology**: II (tropical belt).

Taxonomic remarks. *Orbilia neglecta* is easily recognized by its curved, narrowly ellipsoid-fusoid ascospores being abruptly attenuated in a very thin tail. *O. neglecta* and *O. latispora* s.l. (see below) are the only known members of section *Arthrobotrys* with a distinct basal spore tail, though similar tails were found in some spores of *O. clavispora*. *O. disseminata* somewhat resembles *O. neglecta* in the spores, but it deviates in a helicoid spore shape and is assumed here to belong to the vicinity of *O. comma* (section *Aurantiorubrae*).

Penzig & Saccardo (1902) compared *Orbilia neglecta* with *O. luteorubella*, from which they separated it by smaller asci and spores. One member of section *Helicoon*, *O. falciformis*, indeed resembles *O. neglecta* in the curved spores which are, however, attenuated at the base instead of tailed. *Orbilia carpathica* Velen. was figured with spores very similar to *O. neglecta*, but they were said to have the double length (20 µm, see p. 1664).

Because of a strong similarity with Chinese lignicolous collections here reported as *O. latispora* s.l. and belonging to series *Arthrobotrys*, *O. neglecta* is assumed to be also a member of that series.

Type studies. In the protologue the spores are described as ‘cylindrical, often clavate, mostly curved, 6–7 × 0.7 µm (mature?)’ and the asci as ‘27–30 × 4.5–5 µm, subsessile’ (see also Penzig & Saccardo 1904: 85, pl. 57 fig. 2, Pl. 969: 2). The paraphyses are figured with a distinctly inflated, clavate apex. A microscopic sketch matching the original description (including a spores size of ‘6–7 × 0.7’ and an ascus size of ‘27–30 × 5’) is found on the here examined authentic specimen. Although the rich material appears to be fully mature, according to the many asci that contain spores, only a few free spores could be observed (Pl. 969: 1a), and only after strong pressure. Based on observations on other species, their fine tail has probably been wider in the living state. Penzig & Saccardo’s rough microscopic sketch shows much thicker spore tails and herein fits well the spore shape in the Chinese collections of *O. latispora* s.l. on woody substrate. However, in the latter taxon (Pls 971: 1a; 972: 1f, 2f) little difference in tail width is seen between living and dead spores.

The present examination of *O. neglecta* (Pls 969: 1; 970) is based on ‘nr. 442 ex parte’ (herb. Saccardo, PAD). The specimen contains several fragments of leaves with abundant apothecia (the protologue gives both leaves and stems as substrate). Another specimen, labelled ‘*Orbilia neglecta*?, Java, t. 406’ (herb. Saccardo, PAD), contains a single leaf fragment which might also belong to *Elettaria*, but on which no apothecia could be found. Further specimens are mentioned in the protologue: nrs 41 & 449 (on *Zalacca*), nr. 33 (on bark). These were stated to be immature and were not received from PAD. Collection ‘442 e.p.’ (PAD) is designated here as **lectotype** of *O. neglecta*. A further number cited in the protologue and in Penzig & Saccardo (1904), nr. 38 (on *Elettaria*), appears to represent an isolectotype.

Ecology. *O. neglecta* was collected on dead herbaceous leaves and stems of *Elettaria* (Cardamom, *Zingiberales*) in a tropical humid rainforest area at the foothill of Mt. Gede volcano in western Java. In the examined lectotype the apothecia grew gregariously and exclusively on the upper side of the leaf blades.

Specimens included. **INDONESIA**: **Java**, **West Java**, 60 km SSE of Jakarta, 30 km SE of Bogor, Cibodas (‘Tjibodas’), ~1350 m, leaves of *Elettaria*, 6.II.1897, A.J.O. Penzig (PAD, nr. 442 ex parte, **lectotype** of *O. neglecta*, H.B. 7342 ø).

Orbilia latispora (H.Y. Su & X.Y. Yang) Baral, Ying Zhang & E. Weber, **comb. nov.**, MB 830234 — Pls 971–973

Basionym: *Arthrobotrys latisporus* H.Y. Su & X.Y. Yang [as ‘*latispora*’], Mycotaxon 117: 32 (2011)

Etymology: *latispora*: according to the broad conidia.

Typification: China, Yunnan, Jinguangsi, branch of *Castanopsis orthacantha*, VIII.2008, X.J. Su, Z.L. Luo & H.Y. Su (YMF 1.03168, holotype; sq.: HQ735415).

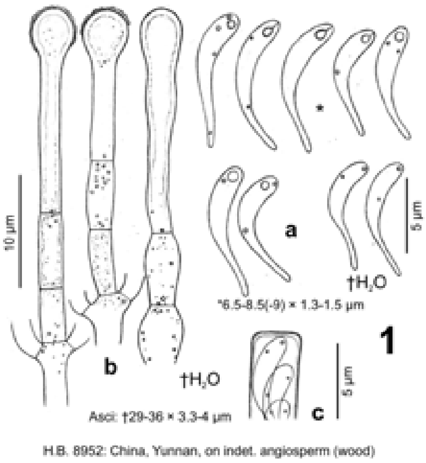


Plate 971. **1**: *Orbilia latispora*. – **a**. ascospores; **b**. paraphyses; **c**. ascus apex.

Description: — **TELEOMORPH**: **Apothecia** fresh (0.3–)0.5–1.8 mm diam., 0.2–0.28 mm high (receptacle 0.09–0.11 mm), whitish or yellowish to pale orange, rehydrated pale to bright cream-brown, somewhat translucent, round to irregular or slightly lobed, ± gregarious, partly in groups; disc flat to slightly convex, margin ± indistinct, not protruding, smooth; with a ± distinct stipe 0.08–0.12 × 0.45–1 mm, superficial. **Asci** ~*35–41 × 3.6–4.2 µm {2}, †29–36 × 3.3–4 µm {1}, 8-spored, spores *4(–8)-seriate, 3(–4) lower spores inverted {2} (rarely mixed), pars sporifera *(9–)11–17 µm long (†17–21.5 µm); **apex** (†) strongly truncate (not indented, laterally not or hardly inflated); **base** without or with short to medium long, ± thick, flexuous stalk, Y-, h- to H-shaped. **Ascospores** *6.5–8.5(–9) × (1.1–)1.3–1.5 µm {3} (~7–10 µm actual length), †6–8.5(–9.5) × (1.1–)1.3–1.5 µm {2}, strongly clavate, apex rounded to obtuse, strongly attenuated into a tail-like base or often distinct tail */†2–3 × 0.3–0.5 µm, medium to strongly curved in middle or upper part (falcate, not helicoid); **SBs** *1–1.2 × 0.5–0.8 µm {3}, (sub)globose, with a very short, fine filum, partly somewhat eccentrical. **Paraphyses** apically slightly to strongly clavate-capitate, terminal cell *20–24 × 2.6–3.6 µm {2}, †13.5–32 × (2.5–)3–4 µm {1}, lower cells *3.5–5(–7.5) × 2.2–2.7 µm {2}, †5–7 × 2–2.5(–3.3) µm {1}; never branched at upper septum. **Medullary excipulum** pale cream-ochraceous, 40–50 µm thick, of dense textura intricata with many inflated cells, medium sharply delimited from ectal excipulum. **Ectal excipulum** hyaline, of (†) thin-walled to slightly gelatinized, vertically oriented t. globulosa-angularis from base to margin, 100–170 µm thick near base, cells †25–50 × 20–35 µm {1}; 20–30 µm thick near margin, oriented at a 70–90° angle to the surface, marginal cortical cells †8–13 × 5–8 µm {1}; **glassy processes** absent. **Anchoring hyphae** abundant, †2.5–3.5(–5) µm wide, walls 0.2–0.3 µm thick {1}, forming a medium dense, hyaline t. intricata ~20–80 µm thick. **SCBs** not observed; **VBs** in terminal cells (sub)globose to very elongate, medium refractive. **Exudate** over paraphyses absent or usually 0.1–0.2 µm thick, finely rough, firmly attached, over margin and flanks 0.1–0.2 or 0.2–1(–1.5) µm thick, continuous, ± smooth. **— ANAMORPH** (from Su et al. 2011b and Y. Zhang pers. comm.): arthrobotrys-like (from ascospore isolate {2}). **Conidiophores** erect, septate, 60–210 µm long, 4.5–7.5 µm wide at base, slightly tapering to 2–6 µm near tip, with 4–8(–12) conidia in a loose capitate arrangement, formed on short denticles on ± swollen nodes (arthrobotryoid), unbranched, not proliferating. **Macroconidia** *16.5–18.5 × 7.7–11.7 µm {1} or *14.8–21.5 × 10–16.3 µm {type of *A. latisporus*}, obovoid-pyriform to subcylindrical, (0–)1-septate, septum median or eccentrical. **Microconidia** much more abundant than macroconidia, non-septate, ± cylindric-clavate, rounded at apex, tapered towards the ± beaked base, *11–17 × 4.5–6(–8.5) µm {1}. **Adhesive networks** formed when nematodes were added, outer diameter of loops ~35–40 µm, cells 4–7 µm wide, at insertion 7–8 µm {1}. **Chlamydospores** not observed.

Habitat: collected on moist ground, decorticated, ~4 cm thick branches of *Castanopsis orthacantha* {1}, *Salix* {1}, indet. angiosperm trees {3}, on 0.1 mm deep medium decayed wood {1} or bark {3} (?periderm), partly on thin black stroma of old pyrenomycete, no algae. **Associated**: ?*Bisporella* sp. {1}, *Nectria* sp. {1}, *Orbilia nemaspora* {1}. **Desiccation tolerance**: intolerant, many spores and a few cells of medullary excipulum still viable after 3 weeks. **Altitude**: 400 m a.s.l. (northern China), 2700–2730 m (southern China). **Geology**: Paleozoic, Jurassic & Tertiary sedimentary rock; mafic volcanic, felsic plutonic & metamorphic rock. **Phenology**: VIII–X (teleomorph).

Taxonomic remarks. *Orbilia latispora* differs from the type of *O. neglecta* in ascospores with wider tails or only tail-like or gradually attenuated bases, and in larger and thicker apothecia growing on wood and bark of angiosperms instead of monocot leaves. A similar spore shape as in *O. latispora* is also found in *O. clavispora* (series *Neodactylella*), but that species deviates in the marginal excipulum composed of distinct cell rows oriented at a rather low angle, and in lacking nematode-induced trapping organs. *O. latispora* is also similar to *O. terrestris*, a species which differs in distinctly larger asci and spores, the latter being only basally curved and without tails, possibly also in larger, tear-shaped SBs.

Because of the unclear relationship to the type of *O. neglecta*, for which molecular data were not available, and because of the molecular heterogeneity of *O. latispora* s.l., we here refrain from adopting the name *O. neglecta* for the here included collections.

Variation in teleomorph. The first two collections of *Orbilia latispora* s.l. have been made in 2004. One was reported by Zhang et al. (2009b: 152, fig. 8) under the name *O.* cf. *neglecta* (Pl. 972: 2), while Liu (2006) included a sample from Heilongjiang (northern China) in *O. auricolor* (IVV: HMAS 96799), although it shows the characteristic spores of *O. latispora*. Photos of three further records were forwarded to us by Z.F. Yu (pers. comm., Pl. 973: 2–4), and a duplicate of a sixth sample was sent to us by H.Y. Su (Pls 971: 1; 972: 1). All these specimens closely concur in their microscopic characteristics of the teleomorph, without any variation worth mentioning. An unillustrated report by Zhuang & Wang (1998: 28) on bark from Hainan under the name *O.* cf. *fimicola* might refer to the same species, but was not examined by us. The type of *O. latispora*, which is the dried agar plate of the anamorph, was gained from an ascospore isolate from an ‘unidentified *Orbilia* sp.’, but no illustration or description was provided by Su et al. (2011b).

Anamorph. In three of the six Chinese samples of *O. latispora* s.l. conidia were gained from ascospore isolates (Pl. 973: 2–4). In two of them (2, 4) smaller conidia resembling microconidia were also produced. The macroconidia showed a certain degree of variation, some resemble those of *Arthrobotrys oligosporus*, others *A. superbus* or *A. cladodes*. Chlamydospores were not formed. The type of *A. latisporus* (Pl. 973: 1) differs in slightly longer and distinctly wider conidia. Conidiophores are often branched. Moreover, chlamydospores were present, and conidial dimorphism was not observed. *A. latisporus* was described by Su et al. (2011b) from an ascospore isolate of an unidentified *Orbilia* (jgs-31) which we here refer to *O. hoana* of section *Helicoon*, according to an unpublished photo plate (IVV: YMF 1.03168). The authors hesitated to publish this teleomorph because we had expressed our doubts about *O. hoana* being connected to an arthrobotrys-like anamorph. In Yu et al. (2014: 78) *A. latisporus* was erroneously said to have been isolated from soil.

A strain described by Drechsler (1944a) under the name *A. arthrobotryoides* resembles *A. latisporus* but differs in longer conidia reaching a length of 28(–30) µm. The conidia of *A. botryosporus* show a size similar as *A. latisporus* but are consistently non-septate. Drechsler 1937a (p. 458, fig. 18 R) mentioned apothecia with tear-shaped ascospores of ~4.5–5.2 × 1–1.3 µm, growing in a non-sterile, nematode-infested culture of *A. superbus*. The hymenial characters recall *O. latispora*, but Drechsler (l.c.: fig. 1) did not mention or illustrate small non-septate conidia for his cultures of *A. superbus*, and the large 1-septate conidia are distinctly narrower than in *O. latispora*.

Phylogeny. Sequences from seven Chinese strains (mainly ascospore isolates) and one from North America, were available: S1506 intron and ITS in four strains from Yunnan and two without collection data (YMF 1.03242, 1.03243), and ITS in two strains from northern China (Jilin, Heilongjiang). Whether or not the latter two possess the intron is unclear, but it is absent in the anamorphic strain from Massachusetts under the name *A.*

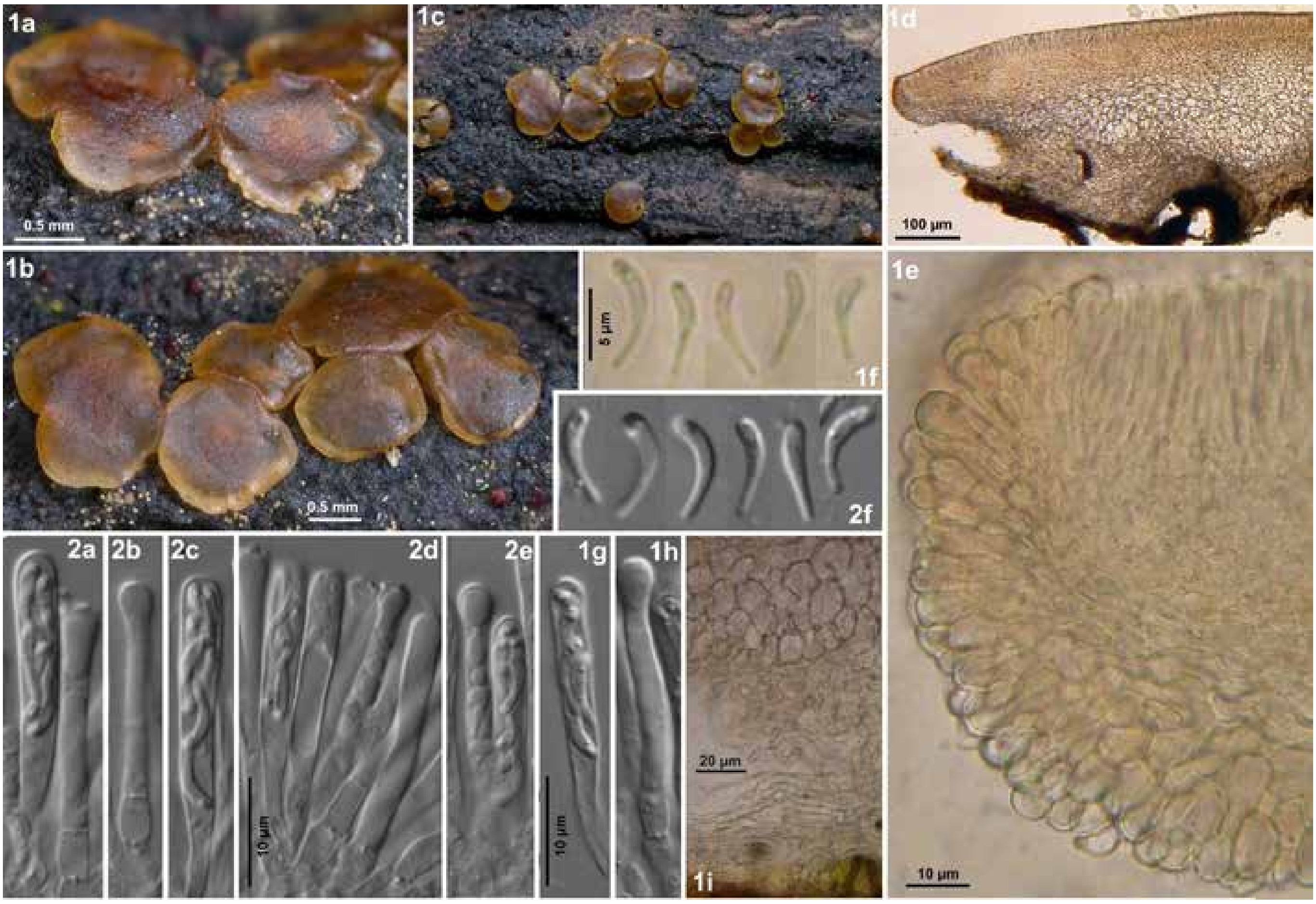


Plate 972. **1–2**: *Orbilia latispora*. – **1a–c**. rehydrated apothecia; **1d**. apothecium in median section; **1e**. id., at margin; **1i** id., ectal excipulum and anchoring hyphae at base; **1g–h**, **2a–e**. asci and paraphyses; **1f**, **2f**. ascospores. – Living state, except for 4 right spores in **1f**, 1 left and 3 right spores in **2f**, asci in **1g** & **2c** (all in H_2O); apothecial sections in **1d–e**, **i** (?in KOH). – **2a–f**: from Zhang et al. (2009b, DIC), **1g–h**: phot. H.Y. Su (DIC). — **1a–i**. H.B. 8952: China, Yunnan, Dali, Jizushan, on indet. angiosperm; **2a–f**. Y.Z. jz-30: ibid., on indet. angiosperm.

superbus (CBS 116.61, on textile), for which an unofficial ITS sequences exists in the CBS database.

When analysing the ITS region, *O. latispora* surprisingly formed with a 5 % distance two separate subclades (C2 & C3), which clustered with *O. cladodes* (subclade C1) and *A. botryosporus* (C4) in the strongly supported *cladodes-botryosporus* clade (see Phyl. 28). The 5 % distance suggests that two different species are involved. Subclade C2 includes four very similar sequences from Yunnan, including the type of *A. latisporus* (YMF 1.03168). Two of them (YMF 1.03213, YMF 1.03242) deviate by 1 nt from another and from the other two (YMF 1.03168, H.B. 8952) which are identical in the ITS. With strong support and a 1.2–1.3 % distance clustered the strain from Heilongjiang (HMAS 96799) in this subclade. Subclade C3 comprises the strains from Jilin (YMF 1.03506), Yuxi (YMF 1.03507), and YMF 1.03243, which are identical in the ITS though coming from very remote provinces of China, and the strain from Massachusetts (CBS 116.61) which shows a 1.2 % distance to them. Strains YMF 1.03242 and YMF 1.03243 are not shown in Phyls 28, S30 as we obtained them very late.

This result is surprising, because the morphology of the teleomorph is the same in the two subclades and the observed differences in the anamorph do not correlate with them. Because of the 5 % distance, we refer to subclade C3 as *O.* cf. *latispora*. The ex-type strain of *A. botryosporus* (subclade C4) also nests in the *cladodes-botryosporus* clade by showing a 4.5–5.5 % distance to the two subclades of *O. latispora* s.l. and 4.5–5 % to Pfister's two American *O. auricolor* strains (D.H.P. 60 and 90, subclade C1, *O. cladodes*), the latter two strains differing by 3.3–5.5 % to *O. latispora* l.s.

Analysing the S1506 intron (Phyl. S30) confirms the above result: within subclade C2 strains YMF 1.03213, YMF 1.03242, and H.B. 8952 (the 2 latter not shown) are identical in the overlapping 359 nt (except for 1 gap in YMF 1.03213), and YMF 1.03168 differs by 1 nt. Subclade C3 includes YMF 1.03507 and YMF 1.03243 (the latter not shown), which differ by 1 nt in the overlapping 391 nt. Subclade C3 differs from subclade C2 by 10–10.5 %, and *A. botryosporus* by 13–16 % from both. Also *A. pravicovii* (SBUG M12) and *A. obovatus* clustered strongly supported with *O. latispora* s.l., whereas *A. botryosporus* clustered in another clade. In contrast to this, in the ITS analysis *A. pravicovii* and *A. obovatus* did not cluster in the *cladodes-botryosporus* clade, but the former in the *scaphoides-pravicovii* clade and the latter unresolved.

LSU was only available for *O.* cf. *latispora* (CBS 116.61, subclade C3), which clustered in the analyses of LSU (Phyl. S32) or SSU+ITS+LSU (S33) with subclades C1 and C4.

Ecology. *O. latispora* s.l. grew on ± decayed wood and bark of hygric branches of angiosperms in oro- to cold-temperate humid (winter-dry) continental colline to montane deciduous forests of northern China and subtropical humid (winter-dry) montane evergreen forests in southern China. The CBS isolate is from cold-temperate humid northeastern North America.

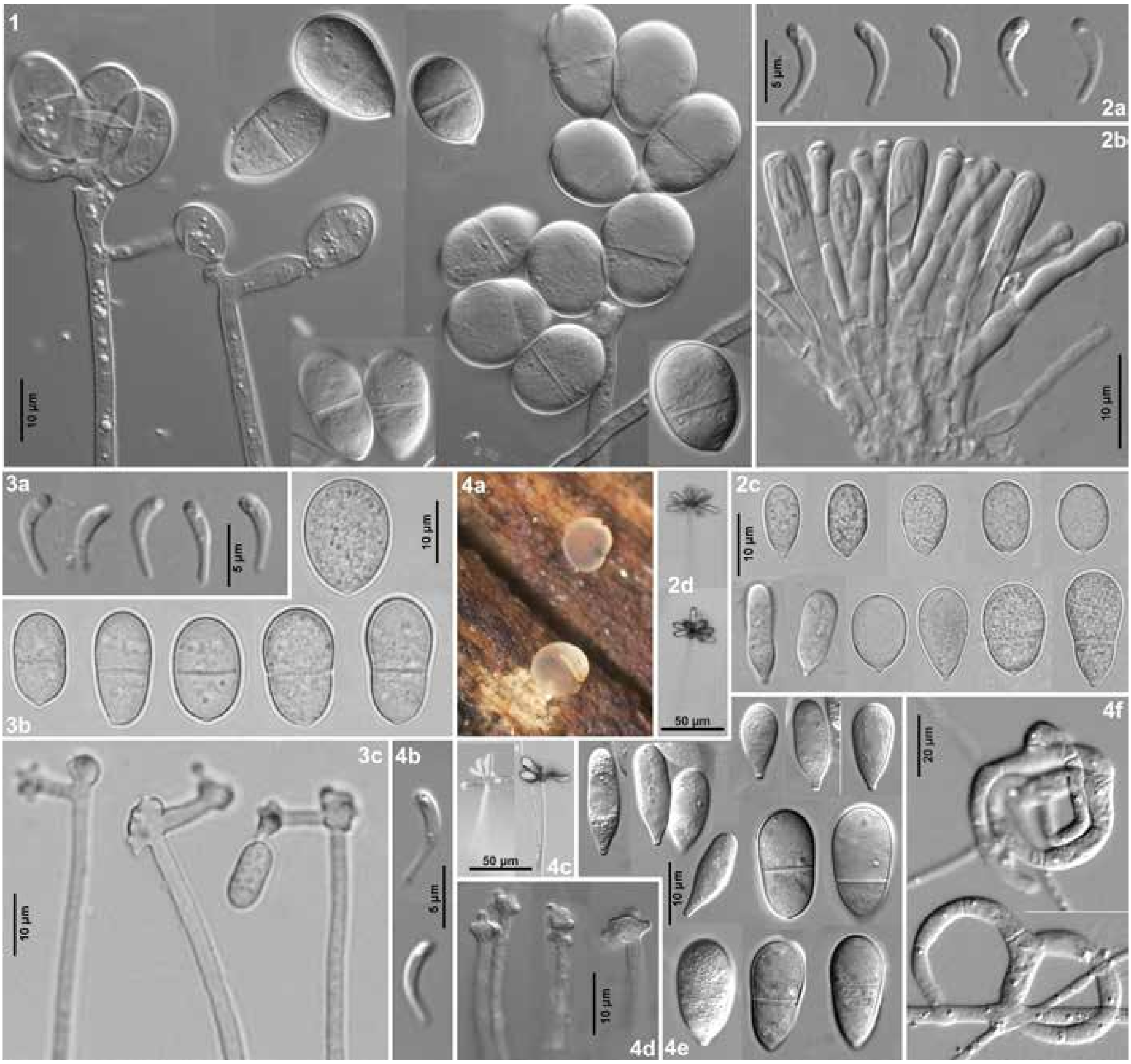


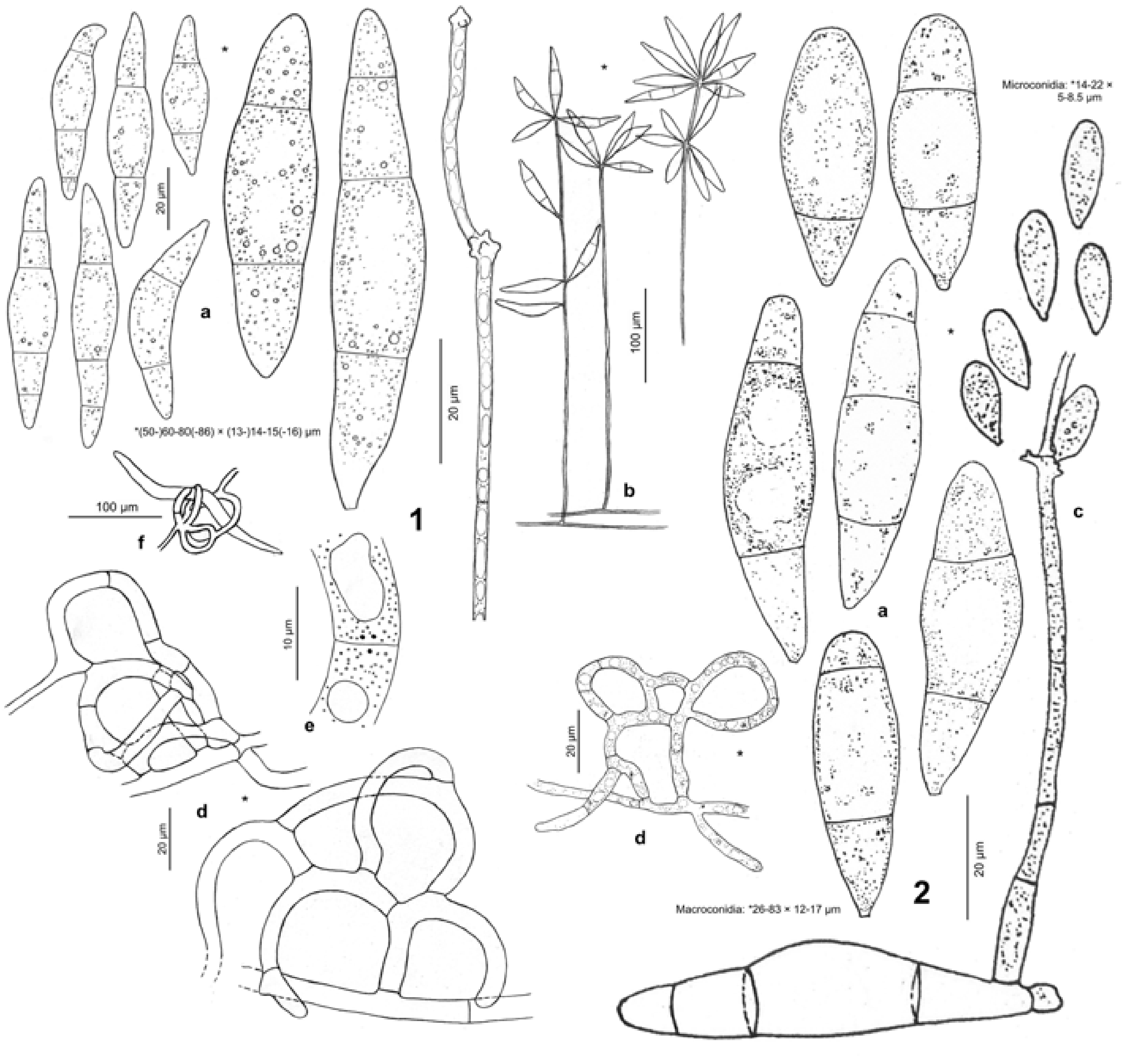
Plate 973. **1–2**: *Orbilia latispora* (subclade A2); **3–4**: *O.* cf. *latispora* (subclade A3). – **4a**. fresh apothecia; **2b**. asci and paraphyses; **2a**, **3a**, **4b**. ascospores; **1**, **2c**, **3b**, **4e**. conidia (**4e**. micro- and macroconidia); **1**, **2d**, **3c**, **4c–d**. conidiophores; **4f**. adhesive networks (**2–4** from ascospore isolate). – Living state. – **1**: from Su et al. (2011b), **2–4**: phot. Z.F. Yu. – **1**. YMF 1.03168 (holotype of *Arthrobotrys latisporus*): China, Yunnan, Dali, Yongping, on *Castanopsis*; **2a–d**. YMF 1.03213: ibid., Lijiang, on indet. angiosperm; **3a–c**. YMF 1.03506: China, Jilin, on indet. tree; **4a–f**. YMF 1.03507: China: Yunnan, Yuxi, Yimen, on indet. angiosperm.

Specimens included (subclade A2): **CHINA**: **Heilongjiang**, **Yichun**, ~60 km S of Yichun, Liangshui, 400 m, branch of *Salix*, 14.IX.2004, B. Liu (as indet. wood, B.L. 420-3, HMAS 96799, erron. as 96796 in Liu 2006, as *O. auricolor*, doc. vid.; sq.: DQ656608). **– Yunnan**, **Kunming**, 21 km NE of Kunming, E of Xiaohe, 1965 m, from soil, 20.IV.2008, Y. Zhang (YMF 1.03241, 1.03242, 1.03243, non vid., sq.: MH179775, MH179776, MH179777, as *A. cladodes*). – **Dali**, Binchuan, 42 km NNE of Dali, Jizushan, 2700 m, branch of indet. angiosperm, on wood, 20.X.2008, X.M. Gao, H.Y. & X.J. Su (H.Y.S. jz-5, CBCD, H.B. 8952; sq.: MK493125). – ibid., on bark of indet. angiosperm, (?VIII.)2004 (Zhang et al. 2009b erron. as 1.IX.2005), Y. Zhang & M. Qiao (Y.Z. jz-30, YMFT, doc. vid.). – Yongping, 35 km ENE of Baoshan, Jinguangsi virgin forest, ~2500 m (as 2820 m), branch of *Castanopsis orthacantha*, on bark, VIII.2008 (erroneously as 20.IX.2008 in Su et al. 2011b and as X.2009 in Yu et al. 2014), X.J. Su, Z.L. Luo & H.Y. Su (H.Y.S. jgs-31, YMF 1.03168, **holotype** of *O. latispora*, anam. cult., doc. vid [H.B. 8984b ø]; sq.: HQ735415). – Lijiang, 59 km WSW of Lijiang, 1 km NW of Jinmugu, Laojunshan, 2700 m, branch of indet. angiosperm, on bark, VIII.2008, S.F. Li and J.W. Guo (J.W.G. lj-14, YMF 1.03213 [permanent slide], CGMCC 3.18837, anam. cult., doc. vid.; sq.: MF948425).

Not included (subclade A3): **CHINA**: **Jilin**, 179 km S of Dunhua, 30 km S of Changbaishan, 1300 m, wood of indet. tree, VIII.2008, Y. Zhang (Y.Z. db-15, YMF 1.03506, CGMCC 3.18839, anam. cult., doc. vid.; sq.: MF948427). – **Yunnan**, **Yuxi**, Yimen, Dalongkou, 1800 m, branch of indet. angiosperm, on bark, 8.VIII.2008, S.F. Li & J.W. Guo (J.W.G. ym3-29, YMF 1.03507, anam. cult., doc. vid.; sq.: MF948428). — **USA**: **Massachusetts**, Natick, textile on exposure test, V.1961 (CBS 116.61, QM 7365, as *A. superbus*, conid. isol., non vid.; sq.: ITS CBS ined., LSU MH869548).

Orbilia scaphoides (Peach) E. Weber & Baral, **comb. nov.**, MB 813991 — Pls 974–975

Basionym: *Dactylaria scaphoides* Peach, Trans. Br. Mycol. Soc. 35: 19 (1952)
≡ *Woroninula scaphoides* (Peach) Mekht., Khishchnye nematofagovye Griby – Gifomitsety: 113 (1979)
≡ *Monacrosporium scaphoides* (Peach) Xing Z. Liu & K.Q. Zhang, Mycol. Res. 98: 865 (1994)
≡ *Arthrobotrys scaphoides* (Peach) S. Schenck, W.B. Kendr. & Pramer, Can. J. Bot. 55: 984 (1977)



H.B. 6972b: Netherlands, Zeeland, on *Scirpus maritimus* (leaves)

CBS 226.52 (ex holotype culture): UK, Surrey, Wisley Pool, on *Typha latifolia* (leaves & rhizomes)

Plate 974. **1–2**: *Orbilia scaphoides*. – **a**. macroconidia; **b**. macroconidiophores; **c**. microconidia and microconidiophore; **d**. adhesive networks; **e**. id., detail of loop; **f**. captured nematode (all from culture); (**1** also in Zhang et al. 2010, **2** from Peach 1952).

?= *Arthrobotrys nematopagus* (Mekht. & Faizieva) A. Rubner [as '*nematopaga*'], Stud. Mycol. 39: 114 (1996)

≡ *Dactylaria nematopaga* Mekht. & Faizieva, Khishchnye Nematofagovye Griby - Gifomitsety (Baku): 130 (1979)

Etymology: according to the boat-like shape of the conidia.

Typification: Great Britain, London, leaves and rhizomes of *Typha latifolia*, IX.1950, isolated by M.P. Peach (K(M), type; CBS 226.52, ex-type culture of ***Dactylaria scaphoides***; sq.: GU171370). – Azerbaijan, Baku, from plant remnants, IX.1977 (BAK, holotype of ***Dactylaria nematopaga***).

Description: — **TELEOMORPH**: unknown (but see below). — **ANAMORPH**: arthrobotrys-like (conidial or soil isolates {3}), including data of Peach (1952) and Zhang et al. (2010). **Conidiophores** arthrobotryoid, unbranched, with 1 node or by proliferation 2–4 nodes, very sparsely septate, 80–200 µm up to 365–430(–690) µm long, 4.5–5.5 µm wide below, 3–5 µm wide above, conidia formed singly or usually in clusters of 4–8(–12) at each node. **Macroconidia** fusiform, sometimes ± curved, *((26–))(37–)50–80(–86) × (11–)13–15(–17.5) µm {3}, ((1–))2(–3–4)((–6))- {2} or (1–)2(–3)-septate {T}. **Microconidiophores** 50–160 µm long, conidia formed on nodes in groups of ~6 {T}. **Microconidia** 14–22 × 5–8.5 µm {T}, ellipsoid, non-septate. **Adhesive networks** formed in the presence of nematodes, loops with ~35–50 µm outer diameter {1}, (15–)25–30(–45) µm {T} (inner diam. 14–18 µm), cells 4–7 µm wide {2}. **Chlamydospores** not observed.

Habitat: previous year's leaves & rhizomes of *Scirpus maritimus* {1}, *Typha latifolia* {1}. **Associated**: *Orbilia elegans* {1}. **Desiccation tolerance**: not tested (probably intolerant). **Altitude**: 3–20 m a.s.l. (northwestern Europe), 1450 m (northern China).

Taxonomic remarks. *Orbilia scaphoides* was reported by Zhang et al. (2010) based on a Chinese soil isolate and a European strain, the latter grew in an ascospore isolate of the morphologically very different *O. elegans* (H.B. 6972a) as a mixture. From the same collection G. Van Ryckegem (pers. comm.) obtained in his ascospore isolate solely the *A.*

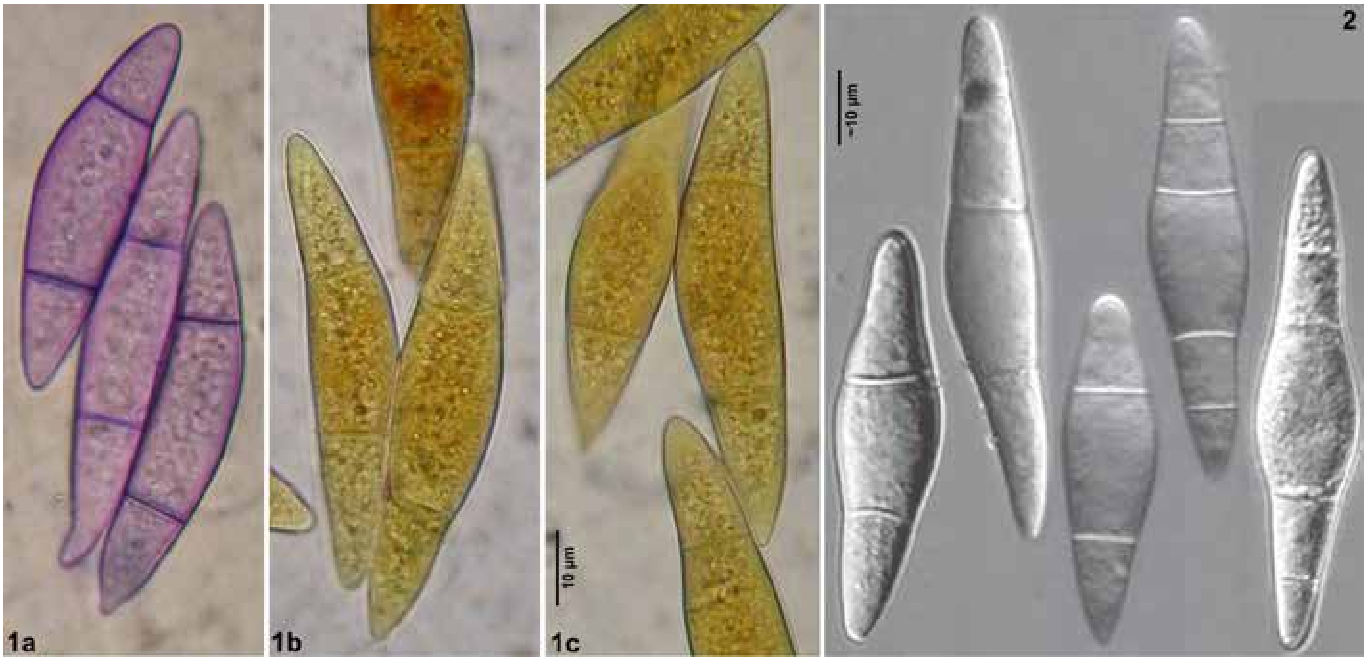


Plate 975. **1–2**: *Orbilia scaphoides*. – **1a–c**, **2**. macroconidia from culture. – Living state (**1a** in CRB, **1b–c** in IKI). – **2**: from Zhang et al. (2010) **— 1a–c**. H.B. 6972b: Netherlands, on *Scirpus*; **2**. YMF 1.01895: China, Gansu, from soil (here scale adjusted to description in Zhang et al. 2010).

oudemansii anamorph, hence we conclude that *A. scaphoides* was a contamination in our culture.

Peach (1952) obtained the anamorph in a culture taken from remnants of *Typha latifolia* in the mud of a lake in England (Pl. 974: 2). Its macroconidia match well the Dutch and Chinese ones in size, but were only up to 3-septate. Peach also observed microconidia formed on germinated macroconidia (2c), which were not observed in the other two strains.

Arthrobotrys nematopagus closely resembles *O. scaphoides* in its conidia (35–90 × 10.7–14.8 µm), conidiophores, and trapping organs, and might be a synonym. It merely differs in mainly 4-septate conidia, with only 1–4 conidia at the conidiophore tip (but a conidiophore is figured with min. 6 nodules). The similar *A. gampsosporus* differs in having mostly 4-septate, slightly narrower, partly more distinctly curved conidia and in forming chlamydospores (Drechsler 1962, Rubner 1996). Likewise, *A. polycephalus* has smaller, mostly 4-septate conidia. *A. microscaphoides* differs in shorter, top-shaped conidia, and also *A. mangrovisporus* has somewhat shorter and wider, partly top-shaped conidia; in both taxa chlamydospores were formed. Also *Dactylellina copepodii* (Barron) Scholler et al. has conidia very similar to *A. scaphoides*, though mainly 4-septate, but here only 1 conidium is formed at the conidiophore apex and the prey (copepods) is captured by adhesive knobs (Barron 1990).

In a presentation held in Amsterdam in 2012, X.Z. Liu reported an ascospore isolate (BJ08-20) under the name '*Orbilia auricolor*' being conspecific with *O. scaphoides*, but we did not see a documentation of this collection.

Phylogeny. Sequences of *O. scaphoides* were taken from three strains: two comprise SSU, ITS, and LSU (England: CBS 226.52, Netherlands: H.B. 6972b) and one only ITS (China: YMF 1.01895). The distance between them is 0–0.8 % in the ITS region, thereby the ex-type strain differs by 4 nt and 1–2 gaps from the other two, which differ only by 1 gap. Distances to morphologically similar species lie in the range of 5–7.5 % to *A. thaumasius*, and 9.5–10 % to *A. gampsosporus* (CBS 127.83), whereas *A. pravicovii* (SBUG M12) and *A. macroides* (SBUG 160), characterized by 1-septate conidia, show only 1.2 % and 2.1–2.3 % distance, respectively. Zhang et al. (2010) gave much higher distances which are obviously due to inclusion of false nucleotides in the adjacent SSU and LSU in strain YMF 1.01895.

In the LSU (D1–D2), H.B. 6972b differs from the type of *O. scaphoides* by 1 nt, whereas the deviation to sequences of other species is min. 5–8 nt in this region. In the SSU (V8–V9) the two *O. scaphoides* sequences are identical, but also *A. pravicovii* (SBUG M12) fully concurs here.

In the ITS analysis by Zhang et al. (2010) *O. scaphoides* clustered with *A. pravicovii* (as *A. conoides*) in a weakly supported clade that formed with the *cladodes-botryosporus* clade a strongly supported clade of species with arthrobotryoid conidiophores. In our analyses of SSU+ITS+LSU or ITS (Phyls 25, 28, S33) it formed a medium supported clade with *A. pravicovii* and *A. macroides*, here called *scaphoides-pravicovii* clade, which formed in the combined trees with strong support a sister clade to the *cladodes-botryosporus* clade whereas in the analysis of ITS this association remained unsupported. According to their ITS sequences, *A. microscaphoides* is a synonym of *A. thaumasius*, and also *A. gampsosporus*, *A. mangrovisporus*, and *A. polycephalus* clustered very distant from *O. scaphoides*.

Ecology. Both the type and the specimen from the Netherlands grew on decayed remnants of monocots in aquatic habitats at planar altitude in subatlantic to atlantic, temperate humid northwestern Europe. The Asian record was a soil isolate under probably irrigated *Malus asiatica* in a suburban plantation, located in a cold-continental arid high plateau in northern China between Qilian Shan mountain range and Gobi Desert, and the type of *A. nematopagus* was from a temperate semiarid lowland in Azerbaijan.

Specimens included. **GREAT BRITAIN**, **South East England**, **Surrey**, 33 km SW of London, Wisley Pool, 20 m, leaves & rhizomes of *Typha latifolia*, IX.1950, isolated by M.P. Peach (K(M), **type**, CBS 226.52, MUCL 9430, IMI 050675, conid. isol., doc. vid.; sq.: GU171370). — **NETHERLANDS**: **Zeeland**, 18 km NW of Antwerpen, old harbour facing the Hertogin Hedwighe Polder, easternmost part of Verdronken Land van Saeftinghe, 3 m, leaves of *Scirpus maritimus*, 23.III.2001, G. Van Ryckegem (H.B. 6972b dried culture, CBS 140808, conid. isol.; sq.: GU171371). — **CHINA**: **Gansu**, **Jiuquan**, 1450 m (2450 m in Zhang et al. 2010 is incorrect), from soil under *Malus asiatica*, VIII.2006, Y. Zhang et al. (Y.Z. zn-1, YMF 1.01895, conid. isol., doc. vid.; sq.: FJ609176).

Not included. **AZERBAIJAN**: **Baku**, ~50 m, isolated from plant remnants, IX.1977 (**holotype** of *Dactylaria nematopaga*, conid. isol., doc. vid.).

Comments on the nomenclature and molecular identity of selected species without known teleomorph

Conidiophores arthrobotryoid

Arthrobotrys amerosporus S. Schenck, W.B. Kendr. & Pramer [as '*amerospora*'], Can. J. Bot. 55(8): 979 (1977) [1976]

= *Arthrobotrys elegans* (Subram. & Chandrash.) Seifert & W.B. Kendrick, in Seifert, Kendrick & Murase, Univ. Waterloo Biol. Ser. 27: 21 (1983)
  ≡ *Candelabrella elegans* Subram. & Chandrash., Kavaka 6: 47 (1979) [1978]

Five strains in GenBank (CBS 268.83 USA, type; SBUG M1257, Germany; AA1, ?England; S41, Sweden; BCRC 34371, Taiwan) and four in CBS (331.94, Germany; 267.83, 435.83, Canada; 110396, Australia) are fully identical in the ITS region, except that CBS 435.83 deviates by 2 adjacent nt in the ITS2, and both Canadian strains include some inserts (?sequencing errors) (Phyl. 28). All strains carry the name *A. amerosporus*, except for that from Sweden which is an environmental isolate. In the LSU D1–D2 (4 strains), CBS 435.83 differs from SBUG M1257, CBS 331.94, and CBS 267.83 by 3 nt in the D1 domain. *A. amerosporus* clustered in our combined analyses with medium support in the *oligospora-musiformis* clade (Phyl. S33) where it formed a strongly supported subclade with *A. flagrans*. The S1506 intron is absent (SBUG M1257).

Another species with consistently non-septate conidia, *A. botryosporus*, differs in often strongly branched conidiophores and shorter conidia arising in denser clusters, and nested in the *cladodes-botryosporus* clade.

Arthrobotrys conoides Drechsler, Mycologia 29(4): 476 (1937)

?= *Arthrobotrys tortor* Jarow., Acta Mycologica, Warszawa 4: 241 (1968)
?= *Arthrobotrys doliiformis* Soprunov [as '*dolioformis*'], Khishchnye Nematofagovye Griby - Gifomitsety (Baku): 138 (1958)
  ≡ *Didymozoophaga dolioformis* Soprunov & Galiulina, Microbiol., Reading 20: 497 (1951), nom. inval., ICN Art. 39.1 (Latin diagnosis missing)

Arthrobotrys conoides was originally described from two sites in North America (Arlington in Virginia, Beltsville in Maryland, Drechsler 1937a). Sequences of the partly incomplete ITS region of five strains under the name *A. conoides* in GenBank (including YMF 1.00009 and strain 670) clustered with a 0–1.5 % distance in a strongly supported clade (Phyl. 28), in which also three unofficial ITS sequences under this name in the CBS database (CBS 265.83, 575.91, 361.94) belong, as they differ by only 0–3.3 % from those. In this clade clusters also Drechsler's ex-syntype strain (CBS 108.37, not shown), a recently released sequence (MH855840) which differs by 2–3 % from *A. conoides* in GenBank and up to 5 % in CBS (CBS 265.83). In our combined analyses (Phyls 25, S33) *A. conoides* clustered in the *oligospora-musiformis* clade, and also in our ITS tree it nested in that clade.

However, there are sequences of three further strains under the name *A. conoides* (SBUG-M12 in GenBank, CBS 253.82 and CBS 606.84 in CBS) which show a 0–0.2 % ITS distance among another but differ from the true *A. conoides* by ~ 10.5 %. This aberrant *A. conoides*, which clustered in the *scaphoides-pravicovii* clade, is reidentified here as *A. pravicovii* (see below), a species with conidia resembling *A. superbus* rather than *A. conoides*.

LSU (D1–D2) exists in GenBank for three strains of the true *A. conoides* (1 as *A. oviformis*, YNUCC 2628) and in CBS for six unofficial sequences (two as *A. oviformis*). They all formed with low support a distinct clade (see S32) with a variation of 1 nt in the D1 and 3 adjacent nt at the 3'-end of D2, whereas *A. pravicovii* clustered with *O. scaphoides*. No illustrations were available for these '*A. oviformis*' strains, and it is assumed that they resemble in their conidia *A. conoides* more than *A. oviformis*. Also *A. pyriformis* was confused with *A. conoides*, according to an Ecuadorian strain under this name (CBS 339.94) which shows a min. 2 % distance to the true *A. conoides*.

Zhang et al. (2014) reported different isolates under the name *A. oviformis*, but apparently without providing sequences for them. In conidial size and shape *A. oviformis* resembles *O. oligospora* but deviates in a tendency to branched conidiophores and sometimes 2-septate conidia, judging from theses isolates and the protologue (Soprunov 1958). It must be noted here that Soprunov & Galiulina (1951) erroneously interchanged their figs II (*oviformis*, as *dolioformis*) and VI (*dolioformis*, as *oviformis*) on pl. 5 when invalidly describing *A. oviformis* under the name *Didymozoophaga oviformis*. A strain which belongs from its ITS data to *O. oligospora* was at first misidentified as *A. oviformis* (CBS 251.82, see CBS database), which illustrates the difficulty to distinguish these two species.

When analysing *RPB2*, *A. conoides* (YMF 1.00009) fully concurs with *A. conoides* (strain 670) and clustered with *O. oligospora* (YMF 1.03254) and *A. pseudoclavatus* (type strain 1130) in a medium supported clade (not shown), although the latter is a member of the *A. janus* clade.

Arthrobotrys doliiformis and *A. tortor* are currently treated as synonyms of *A. conoides*, based on their very similar morphology (Van Oorschot 1985, Scholler et al. 1999), but no sequences were available. Interestingly, Jarowaja (1970) observed in the ex-type strain of *A. tortor* three types of conidiophores (candelabrelloid, geniculate, and arthrobotryoid), although *A. conoides* is typically of the arthrobotryoid type.

An anamorph referable to *A. conoides* with narrowly obpyriform-clavate conidia of *30–36 × (11–)12–13.5(–15) µm, very similar to *A. javanicus* but with arthrobotryoid conidiogenesis, was observed on the natural substrate in a collection from Luxembourg (on inner surface of *Fagus* bark, IVV: H.B. 8428c). It grew in association with apothecia of *O. auricolor* (H.B. 8428a) and *O. oxyspora* (H.B. 8428b), but for these two populations very different anamorphs were noted: *A.* cf. *superbus* in pure culture for the former (Pl. 954: 4) and *D. oxyspora* from the natural substrate for the latter species (Pl. 933: 1f).

Specimens included. **LUXEMBOURG**: **Gutland**, 10 km WNW of Echternach, 1.2 km SW of Beaufort, Längt, 340 m, trunk of *Fagus sylvatica*, on bark, 3.II.2007, G. Marson (H.B. 8428c, anam. only).

Arthrobotrys ellipsosporus Tubaki & K. Yamanaka [as '*ellipsospora*'], Trans. Mycol. Soc. Japan 25(4): 350 (1984)

= *Arthrobotrys dendroides* Kuthub., Muid & J. Webster, Trans. Br. mycol. Soc. 84(3): 564 (1985)
?= *Arthrobotrys straminicola* Pidopl., Mikrobiol. Zh. 9(2-3): 55 (1948)
?= *Arthrobotrys stilbaceus* J.A. Mey. [as '*stilbacea*'], Bull. trimest. Soc. mycol. Fr. 74(3): 246 (1958)

?= *Arthrobotrys anomalus* G.L. Barron & J.G.N. Davidson [as '*anomala*'], Can. J. Bot. 50(8): 1773 (1972)

?= *Roigiella lignicola* R.F. Castañeda, Revta Jardín bot. Nac., Univ. Habana 5(1): 64 (1984)

Based on similarities of conidiophores and conidia, the inconsistent formation of synnemata, and available sequence data (ITS/LSU D1–D2) of the type strains, we conclude that *A. dendroides* with synnemata is a later synonym of *A. ellipsosporus* with solitary conidiophores (distance 1.2/0.2%). Also the synnemata forming *Roigiella lignicola* is possibly conspecific (distance 3.4/0.9% to *A. dendroides*, 3.2/0.7% to *A. ellipsosporus*). No sequences were available for the type strains of *A. anomalus* and *A. straminicola* (solitary), and *A. stilbaceus* (synnematous), therefore, their exact identity remained unclear. The oldest name, *A. straminicola*, was considered by Van Oorschot (1985) as a probable earlier synonym of *A. ellipsosporus*. Because of the high molecular variance within this complex, we adopt here for the time being the name *A. ellipsosporus* as the oldest name for which DNA data were available.

The ex-type strain of *A. ellipsosporus* from Japan (Ibaraki, Tsukuba, Sakura-mura, from sap of *Pinus densiflora*, IV.1979, NBRC 31826, TKB-F-5089, TKB-C-1053; Tubaki & Yamanaka 1984), for which ITS and LSU exist, fully concurs with a Chinese strain under the name *A. anomalus* in Yang et al. (2007, YNWS02-5-1, as *Arthrobotrys* sp. in GenBank), for which only ITS was available. The type of *A. anomalus* was isolated as a contaminant from soil in Canada (unlocalized, OAC 100761, dried culture; Barron & Davidson 1972). In fact, the protologues of the two species and a report of *A. ellipsosporus* by Matsushima (1995: nr. 0785) appear to represent a single species. In their survey on nematophagous taxa, Scholler et al. (1999) and Yu et al. (2014) treated *A. anomalus* but did not mention *A. ellipsosporus*.

A. anomalus, *A. ellipsosporus*, and *A. straminicola* were described with solitary conidiophores, but otherwise closely resemble three taxa with synnematous conidiomata in having ± cylindrical, basally acute, 1-septate, microconidia-like conidia formed on arthrobotryoid conidiophores: *A. stilbaceus* (Kongo, Yangambi, on rachis of palm leaves), *A. dendroides* (CBS 431.85, Malaysia, Kuala Lumpur, living leaves of fruit trees), and *R. lignicola* (CBS 222.85, Cuba, Havana, *Cecropia peltata* dead branch). Morphologically, all these taxa are similar, except for slight differences in conidial size, *R. lignicola* and *A. stilbaceus* having the smallest conidia and *A. anomalus* and *A. dendroides* the largest. In addition, the synnemata of *R. lignicola* are with 0.25–0.57 mm much shorter than those of *A. dendroides* (1.2–1.75 mm) and *A. stilbaceus* (2–3 mm) (Castañeda Ruíz 1984, Kuthubutheen et al. 1985, Meyer 1984). However, the synnemata figured by Kuthubutheen and Meyer appear to measure also only ca. 0.5 mm in height.

A collection on palm petioles from Peru was referred by Matsushima (1995: nr. 0787) to *A. stilbaceus* but would fit as well *A. dendroides* in conidial size and synnemata height (0.3–1 mm). A Chinese strain referred to *A. dendroides* (YMF 1.00010) fully matches in the ITS region the Chinese *A. anomalus* (YNWS02-5-1). This strain formed besides synnemata ('1 cm tall', probably an error for 1 mm) sometimes also solitary conidiophores (Yu et al. 2014: fig. 3.12). Also in the protologue of *A. dendroides* conidiophores were solitary or synnematous, though mainly synnematous on natural substrata (Kuthubutheen et al. 1985).

The type of *A. anomalus* combines both adhesive networks and adhesive columns ('hyphal branches'), but the columns were not considered as homologous to those of *Gamsylella* (Scholler et al. 1999: 94). Adhesive networks were also reported in *A. dendroides*, but not in the other two synnemata-forming taxa *A. stilbaceus* and *R. lignicola*, probably because no nematodes were added to the cultures.

The S1506 intron is absent in the type strains of *A. ellipsosporus* and *A. dendroides*, while in the other sequences this region is not covered. For strain YMF 1.00010 sequences of six different gene regions exist in GenBank. *A. ellipsosporus* (= *A. dendroides*) clustered medium or weakly supported with *A. polycephalus* in our analyses of SSU+ITS+LSU or ITS (Phyls 25, 28, S33), while in the LSU it clustered unresolved (S32). *R. lignicola* clustered likewise with medium support with the *ellipsosporus-polycephalus* clade (not shown), whereas in our analysis of LSU (S32) it clustered instead unsupported with *A. pyriformis* (EU586333) or (NJ, not shown) unsupported with *A. polycephalus* and *A. ellipsosporus*.

Arthrobotrys macroides (Drechsler) Mekht., Khishchnye Nematofagovye Griby – Gifomitsety: 89 (1979)

≡ *Arthrobotrys cladodes* var. *macroides* Drechsler, Mycologia 36(2): 144, fig. 1 (1944)

Arthrobotrys macroides was erected as a variety of *A. cladodes* by Drechsler (1944a: fig. 1), based on a strain isolated from roots of *Viola tricolor* and leaf mould in Beltsville, Maryland, USA, X.1936, C. Drechsler. The name *macroides* appears to refer to the more elongated conidia which are in both species cylindric-ellipsoid with a ± median septum.

No sequence of the type strain was available, but two strains under this name (SBUG 160: Germany, Stralsund, forest soil; NHL 2442: ?Japan, on decaying higher fungi) and two further strains (CBS 693.86: ?France, as *A. robustus*, later changed to *A. pyriformis*; 'YMF 1.01884/1.01888': China, as *Arthrobotrys* sp.) have identical sequences of ITS and LSU (see Phyl. 28, S33), except for a few inserts in both regions in CBS 693.86. We here tentatively consider these sequences to represent *A. macroides*. However, illustrations of any of them were not available to us. Moreover, the morphological distinction between *A. cladodes* and *A. macroides* is problematic (see under *O. auricolor*, p. 1531).

Arthrobotrys mangrovisporus Swe, Jeewon, Pointing & K.D. Hyde [as '*mangrovispora*'], Bot. Mar. 51(4): 332 (2008)

The ex-type strain (culture accession no. IFED2016) was isolated in 2005 from decaying submerged wood from Mai Po mangrove in Hong Kong (Swe et al. 2008b). The two available sequences (ITS, LSU) were uploaded in III.2008 under the title of the original publication and the strain number MGDW17 (decaying mangrove wood). Therefore, it can be assumed that they refer to a topotype, if not the holotype. *A. mangrovisporus* shows in the ITS a distance of 3% to the unofficial sequence of the ex-epitype strain of *A. eudermatus* from La Palma (CBS 305.94) and 3.7% to '*Dactylaria*' *sahelensis*, which formed with *A. mangrovisporus* a strongly supported clade (Phyls 25, S33), but a much higher distance to any other strain in GenBank or CBS.

Arthrobotrys pravicovii (Soprunov) Mekht. [as '*pravicovi*'], Dokl. Akad. Nauk Azerb. SSR 20(6): 71 (1964)

≡ *Didymozoophaga pravicovii* Soprunov & Galiulina [as '*pravicovia*'], Microbiol. 20: 496 (1951), nom. inval., ICN Art. 39.1 (Latin diagnosis missing)

≡ *Trichothecium pravicovii* Soprunov [as '*Pravicovi*'], Khishchnye Nematofagovye Griby - Gifomitsety: 117 (1958)
≡ *Arthrobotrys pravicovii* (Soprunov) Sidorova, Gorlenko & Nalepina [as '*pravicovi*'], Bot. Zh. SSSR 49: 1598 (1964), nom. inval., ICN Art. 41.1

A. pravicovii was isolated from soil near Mary (Merv), Turkmenistan (Soprunov 1958). Based on a 'possibly authentic' strain from (?)Turkmenistan in BAKU (VKM-F 2242) and CBS 606.84, the species (as '*A. pravicovia*') has been considered as a synonym of *A. conoides* by Van Oorschot (1985: 74) and Hoog & Van Oorschot (1985: 117). Regrettably, the authors did not describe or illustrate this strain by neglecting the quite different conidial shape and size in the protologues of the two species: ellipsoid in *A. pravicovii* similar as in *A. superbus*, much longer and conical in *A. conoides*.

The unofficial ITS sequence of this strain shows a 10.5 % distance to Drechsler's North American type strain of *A. conoides* (CBS 108.37, see above), but it clustered with a 0–0.2 % distance in a clade with two further strains that were misidentified as *A. conoides* (SBUG-M12 from Germany, in GenBank; CBS 253.82 from France, in CBS database). Also LSU (D1–D2) exists for CBS 606.84, in which *A. pravicovii* deviates from *A. scaphoides* by only 1–2 nt, although the conidia strongly differ in size and shape. In our analyses of ITS and SSU+ITS+LSU (Phyls 28, S33), *A. pravicovii* clustered in the medium supported *scaphoides-pravicovii* clade (see also Hagedorn & Scholler 1999: fig. 3, SBUG-M12).

A strain under the name *D. parvicollis* (CBS 426.91, Berlin-Dahlem, from dead *Poa nemoralis*, A.R. 8915, in Rubner 1996 erroneously as CBS 429.91) differs in the ITS region from SBUG-M12 by only 0.4 % and thus represents *A. pravicovii*. A strain under the name *A. pyriformis* (CBS 577.91, Québec, from soil) clustered near *A. pravicovii* when drawing an ITS tree in the CBS database, but with a 4 % distance.

Arthrobotrys pyriformis (Juniper) Schenk, W.B. Kendr. & Pramer, Can. J. Bot. 55(8): 984 (1977)

≡ *Dactylaria pyriformis* Juniper, Trans. Br. mycol. Soc. 37(4): 437 (1954)
≡ *Dactylariopsis pyriformis* (Juniper) Mekht., Khishchnye Nematofagovye Griby - Gifomitsety (Baku): 119 (1979)

A. pyriformis was described by Juniper (1954) from England (Lincolnshire, Nocton Fen, dung, V.1953, K and CMI), with elongated-obovoidal, (1–)2–3-septate conidia of 26–41 × 9–14 µm. Van Oorschot (1985) studied the 'type culture' (CBS 221.54, IMI 56803, UK, Essex, Langdon Hills, cow dung, undated, A.J. Juniper) and two further strains accepted by her as belonging to this species (CBS 602.80 = IMI 101310, ?UK, C.L. Duddington; CBS 221.82, Netherlands, W. Gams).

In her discussion of *A. pyriformis* Van Oorschot did not mention the strong mismatch in the geographical data of the ex-type collection (CBS 221.54), nor did she explain why she used another number (CBS 204.83) when stating that the ex-type strain has changed in comparison to the protologue, e. g., by having now smaller (15–25 × 5–8 µm), 1-septate conidia. In fact, CBS 221.54 and CBS 204.83 are listed in the CABRI HyperCatalogue (http://frc.cabri.org/HyperCat/fun/cabi403238.htm) as representing the same strain, to which also IMI 56803 and MUCL 9431 belong.

Also Rubner (1996: tab. 1) examined CBS 221.54 regarding the formation of trapping organs and conidia, but without providing morphological data. However, the numbers 221.54 and 204.83 cannot now be found in the CBS database. According to G. Verkley (pers. comm.), the number 204.83 was removed and only that of the first deposit was kept. But also CBS 221.54 was withdrawn following communication by A. Rubner in 1992, as it did not match the original description 'by the production of adhesive hyphal branches instead of a network and by the length and the number of septa of the conidia'. The original entry of CBS 221.54 was 'England, Lincolnshire, Nocton Fen, dung of cow, A.J. Juniper, No. 37, May 1953; other strain numbers: CBS 204.83; IMI 056803; MUCL 9431' (G. Verkley pers. comm.).

An LSU sequence of CBS 221.54 was recently uploaded in GenBank (MH868833) as 'authentic' and is annotated with these latter data. This sequence fully concurs with CBS 221.82 and obviously belongs to *A. musiformis* (Phyl. S32), a species with consistently 1-septate conidia. Unofficial ITS of CBS 221.54 does not exist in the CBS database, but exists for CBS 221.82. This shows a rather high similarity with clade B strains of *A. pyriformis* (Tab. 87), but not with *A. musiformis*, suggesting some confusion.

Table 87. Strains in the CBS database and GenBank to which the name *A. pyriformis* has been applied, but which belong according to their DNA data to at least eight species in five different clades. The two available SSU sequences include the V1–V4 region (in 340.94 V1–V9), and those of nuclear LSU the D1–D2 or sometimes D3 domain. CBS 107.51^{T}: ex-type strain of *A. robustus*, later synonymised with *A. pyriformis* but here with *O. oligospora*; CBS 221.54^{T}: authentic strain of *A. pyriformis* but apparently confused; CBS 221.82§: ?chimere (LSU apparently not conspecific with ITS); YMF 1.01884*: LSU erroneously as YMF 1.01888 (EU586333) but uncertain whether it belongs to 1.01884.

Strain	Locality	rDNA	Protein-coding genes	Identity	Main clade	Repository
CBS 340.94	Germany, Berlin	SSU ITS LSU		*O. auricolor* (A1)	*O. auricolor*	GB, CBS
CBS 602.80	?UK	ITS LSU		*O. auricolor* (A2)		CBS
CBS 578.91	Germany, Berlin	LSU		*O. auricolor* (A2)		CBS
CBS 577.91	Canada, Québec	ITS		*A.* aff. *pravicovii*	*scaphoides-pravicovii*	CBS
CBS 693.86	?France	ITS LSU		*A. macroides*		CBS
CBS 107.51^{T}	UK, Surrey	ITS LSU		*O. oligospora*	*oligospora-musiformis*	GB, CBS
CBS 339.94	Ecuador	ITS		*A. conoides*		CBS
CBS 221.54^{T}	UK	LSU		*A. musiformis*	*oligospora-musiformis*	GB
CBS 221.82§	Netherlands	LSU		*A. musiformis*		CBS
YMF 1.00018	China, Hubei	ITS	*MAD1*	*A. pyriformis* (A)	*A. pyriformis*	GB
YMF 1.00020	China	SSU ITS mtLSU	*TUBB*, *RPB2*, *TEF1*	*A. pyriformis* (A)		GB
YMF 1.01884*	China	ITS LSU		*A. pyriformis* (A)		GB
IFRD M1.123	Hong Kong	SSU ITS	*TUBB*, *RPB2*	*A. pyriformis* (B)		GB
YNWS02-3-1	China	ITS	*TUBB*, *RPB2*, *TEF1*	*A. pyriformis* (B)		GB
CBS 221.82§	Netherlands	ITS		*A. pyriformis* (B)		CBS

Since the available LSU sequence of CBS 221.54 belongs to *A. musiformis*, and this authentic strain differs morphologically from the protologue, the correct identity of *A. pyriformis* cannot now be clarified with certainty, because the name *A. pyriformis* was very differently used. Based on a similar conidial morphology, we consider two subclades of an unsupported clade as presumed candidates for the true *A. pyriformis* (Tab. 87, Phyl. 28). The reason why the name *A. pyriformis* was applied in very different ways is possibly due to divergences in conidial shape and septation between the protologue and strain CBS 204.83 as observed by Van Oorschot (1985).

Six strains under the name *A. pyriformis* exist at present in GenBank, and two further ones (YNWS02-3-1, YMF 1.01884, erroneously as 1.01888) were uploaded as *Arthrobotrys* sp. but fit strains under that name (the former has been renamed to *A. pyriformis* by Yang et al. 2007). At least eight strains exist in CBS under the name *A. pyriformis*, all with unofficial sequences, and only three of them exist in GenBank (see Tab. 87). 12 of these 14 strains include ITS and 9 LSU. They derive from different regions in Europe, North and South America, and eastern Asia. According to their molecular data these 14 strains fall in five different main clades (Tab. 87) and belong to eight different species.

Two strains are members of the ***scaphoides-pravicovii* clade**: CBS 577.91 (Québec) clustered in vicinity of *A. pravicovii*, and CBS 693.86 (?France) belongs to *A. macroides* (SBUG 160). Three strains clustered in the ***O. auricolor* clade**: CBS 340.94 (Berlin) closely concurs with members of genotype A1, CBS 602.80 (?UK, as *A. robustus*, reidentified by Van Oorschot 1985 as *A. pyriformis*) is distantly related to members of genotype A2, and the LSU of CBS 578.91 (Berlin) concurs with *A. superbus* (CBS 115.61), a member of genotype A2 (Phyl. 28). Two strains are members of the ***oligospora-musiformis* clade**: CBS 339.94 (Ecuador) clustered close to *A. conoides* with which it seems to be conspecific; CBS 107.51 (UK), the ex-type strain of *A. robustus* was reidentified as *A. pyriformis* in CBS, but belongs to *O. oligospora* (for details see also p. 1542). Three Chinese strains form the ***A. pyriformis* subclade A** and vary by only 0–0.2% in the ITS. Two further Chinese strains vary by 3% in the ITS and form the strongly supported ***A. pyriformis* subclade B** (Phyl. 28).

The two subclades of *A. pyriformis* (A and B) clustered in our analysis of ITS in an unsupported clade (Phyl. 28), with a distance of 8–8.5% (the Hubei strain is incomplete in the ITS1). In this clade clustered also a European strain under the name *A. psychrophilus*/*O. auricolor* (Staffordshire, UK, CBS 547.63), which fully concurs in the ITS with an unpublished Chinese strain under the name *A. microscaphoides* (YMF 1.01453, Y. Zhang pers. comm.). These two unclarified strains with apparently top-shaped conidia shows an ITS distance of 2.7–2.8% to subclade A and 7–7.2% to subclade B. An unofficial sequence of the *A. pyriformis* strain from the Netherlands (CBS 221.82) clustered in the CBS database with YNWS02-3-1 (subclade B) with a 3.3% ITS distance, but not with IFRD_M1.123, to which it surprisingly differs by ~9%, perhaps because of various gaps.

In the LSU D1–D2, CBS 221.82 fully concurs with CBS 221.54 = CBS 204.83 (MH868833), and in our analysis (Phyl. S32) this genotype clustered with the low distance of 0.2–0.4% with 14 strains of *A. musiformis* s.l. However, in the ITS no close relationship between CBS 221.82 and *A. musiformis* can be seen in the CBS database, while no ITS appears to exist for CBS 221.54 or 204.83. It seems, therefore, impossible at present to clarify the identity of the authentic strain.

There is some confusion with the YMF numbers and sequences. Four sequences with two strain numbers were uploaded under the name *Arthrobotrys* sp.: YMF 1.01884 (EU586330 ITS, EU586331 LSU) and YMF 1.01888 (EU586332 ITS, EU586333, LSU). According to Y. Zhang (pers. comm.) the two ITS sequence were confused. In fact, EU586331 and EU586332 are conspecific with *A. macroides* (SBUG 160, NBRC 9382, CBS 693.86), whereas EU586330 concurs with *A. pyriformis* (YMF 1.00018, KT932056) and EU586333 clustered unsupported with *Roigiella lignicola* (Phyl. 28, S32). Since there was no other strain of *A. pyriformis* with both ITS and LSU, we could not clarify whether EU586330 and EU586333 belong to the same species. The unpublished plate of YMF 1.01884 (IVV) shows elongated cylindric-pyriform, mainly 2–3-septate conidia typical of *A. pyriformis*, therefore, we conclude that this confusion rather concerns LSU than ITS. However, the unpublished plate of YMF 1.01888 (IVV) shows elongated ellipsoid-fusoid, 3-septate conidia and represents *A. polycephalus*, which is confirmed by another ITS sequence with the number YMF 1.01888 in GenBank (MH179760). Therefore, the ITS and LSU sequences of *A. macroides* cannot be linked to either YMF 1.01884 or YMF 1.01888.

Further microphotographs which fit *A. pyriformis* were available for YMF 1.00018 (Yu et al. 2014) and IFRD_M1.123 (Swe et al. 2008a). Swe et al. stated that their strain differs from the type in longer and slightly wider conidia (*38–52 × 10–16 µm) compared to 26–41 × 9–14 µm in the protologue and 15–25 × 5–8 µm in the 1-septate conidia observed by Van Oorschot (1985) in the ex-type strain. In contrast to this, strain YMF 1.01884 (*27–37.5 × 10–13.5 µm) is pretty close to the protologue and also YMF 1.00018 concurs rather well (*24–38 × 8–11 µm).

CBS 693.86 was later renamed to *A. pyriformis*, but its original name was *A. robustus* (= *A. oligosporus*), which would explain confusion with *A. macroides*. Actually, Van Oorschot (1985) considered the protologue of *A. robustus* in Duddington (1952) as strongly reminiscent of *A. cladodes* var. *macroides*. On the other hand, she believed that CBS 602.80, a strain which Duddington referred to *A. robustus*, belonged to *A. pyriformis*, while DNA data suggest this to belong to *O. auricolor* genotype A2. Hagedorn & Scholler (1999: tab. 1) synonymised *A. robustus* with *A. pyriformis* regarding strain CBS 340.94 (= *O. auricolor* genotype A1 in present study), while Scholler et al. (1999) listed both *Arthrobotrys* species as distinct.

Conidiophores candelabrelloid or of *Duddingtonia* type

Arthrobotrys musiformis Drechsler, Mycologia 29(4): 481 (1937)

≡ *Candelabrella musiformis* (Drechsler) Rifai & R.C. Cooke, Trans. Br. mycol. Soc. 49(1): 163 (1966)

≡ *Dactylella musiformis* (Drechsler) Matsush., Microfungi of the Solomon Islands and Papua-New Guinea (Osaka): 22 (1971)

Numerous sequences exist under the name *A. musiformis* in GenBank and the CBS database. Judging from the ITS region they appear to belong to three distinct and rather homogeneous, closely related taxa (Phyl. 28): the largest clade (A) includes the type (CBS 110.37), while no names are available for the other two clades (B & C), both of which we here call *A.* aff.

musiformis. When comparing complete ITS sequences (in YMF 1.00575 almost 100 nt are missing), the distance between *A. musiformis* (10 strains) and *A.* aff. *musiformis* (B & C, 8 strains) lies in the range of 4.8–6.5 %, and between B and C at 3.6–4.2 %. In relation to this, the variation within each clade was in *A. musiformis* 0–1.5 % and in *A.* aff. *musiformis* 0–1.3 %. *A. musiformis* s.l. differs from *O. blumenaviensis* by 7–9 % and from *O. javanica* by 7.5–9 %. A fourth very distant group under the name *A. musiformis* is represented by two sequences (EVLL02, MF926582; EVLL-2, MF926583, not shown in phylotrees) which clustered in the ITS+LSU analysis of Quijada et al. (2020) supported with *O. jesu-laurae*.

In the LSU D1–D2 domain the available sequences (8 strains in clade A, 3 strains in clade C, none in clade B) are fully identical, except for a few singular deviations in some of them (0–0.2 % distance). In this region *A. musiformis* s.l. differs from *O. blumenaviensis* by 0.2–0.6 % and from *O. javanica* by 0.7–1.5 %, but also, e. g., *O. elegans* differs from *A. musiformis* s.l. by only 0.2–0.9 %. In the D3 domain, however, a single position (728) distinguishes seven strains of clade A (AGTC**T**TCGG) from three strains of clade C (AGTC**C**TCGG). The identity of the two groups could be ascertained for five strains, because they include both ITS and LSU D1–D3: 3 of *A. musiformis* (CBS 117.81, 465.88, 743.95) and two of *A.* aff. *musiformis* (CBS 437.83, ATCC 96675). Two uncultured clones of *A. musiformis* s.l. from Australia could not be identified because they lack both ITS and D3 domain. Based upon pos. 728, a strain under the name *A. vermicola* in GenBank (AY261143, YNUCC 2428) belongs to *A.* aff. *musiformis*.

Because several ITS sequences from CBS were not or only incompletely available, they could not be included in the analysis. Also not included are nine unpublished Chinese isolates received from Y. Zhang (pers. comm.). Eight fall in clade A, one in clade C (YMF 1.00122), and three formed a further clade situated close to clade A (YMF 1.01891, 1.01892, 1.01893). Two sequences in GenBank which fall in clade C appear to be confused (YMF 1.00022, 1.00024, see under *A. shizishananus* and *A. cookedickinsonianus*).

Z.F. Yu (pers. comm.) obtained morphologically typical *A. musiformis* anamorphs in ascospore isolates from apothecia of various Chinese collections. A photo plate of one of their teleomorphs shows features reminiscent of *O. auricolor*, except that the ascospores (*7.7–10 × 1.1–1.2 µm in situ) are less curved (see IVV). Sequences gained from these ascospore isolates and also from Chinese conidial isolates clustered in the two here observed clades of *A. musiformis* s.l. (Z.F. Yu pers. comm.). Also D.H. Pfister obtained an *A. musiformis* anamorph in an ascospore isolate from Puerto Rico (Quijada et al. 2020, PR 98-20).

Arthrobotrys shizishananus (X.F. Liu & K.Q. Zhang) J. Chen, L.L. Xu, B. Liu & Xing Z. Liu [as '*shizishanna*'], Fungal Diversity 26(1): 124 (2007)

≡ *Dactylella shizishanana* X.F. Liu & K.Q. Zhang [as '*shizishanna*'], Fungal Diversity 14: 104 (2003)

Dactylella shizishanana was described by Liu & Zhang (2003) from a soil sample taken on 8.XI.2001 in Shizishan, Wuhan, Hubei, China (YMF W7244021). Sequences of ITS, mtLSU, *TEF1*, *RPB2*, *MAD1*, *TUBB*, and cuticle-degrading serine protease gene exist in GenBank for an authentic strain (YMF 1.00022) under this name which is possibly taken from the original culture, judging from Yu et al.'s (2014) statement 'isolated from field soil in Shizishan, Hubei in February 2001 by Xuefeng Liu'.

A. shizishananus was originally placed in *Dactylella* because of its cylindric-clavate phragmoconidia formed singly at the conidiophore tip, but its adhesive networks refer it to series *Arthrobotrys* and also its molecular data place it there. However, this authentic strain must be confused, because it shows a strong similarity in many of the mentioned gene regions to the morphologically very different *A. musiformis* s.l., which has 1-septate, ellipsoid-clavate conidia, whereas *A. shizishananus* has 2–9-septate, cylindric-fusoid conidia (see Yu et al. 2014).

In the ITS region *A. shizishananus* belongs to clade C of *A. musiformis* s.l., showing an ITS distance of 0–1.3 % to YMF 1.00024 (*A. cookedickinsonianus*) and two strains under the name *A. musiformis* (YMF 1.00575, SQ77-1). Perhaps the *A. shizishananus* strain YMF 1.00022 is confused with SQ77-1. Clade C clustered with genuine *A. musiformis* with an ITS distance of 5–6.5 % in a supported clade which contains some other sequences uploaded under this name (Phyl. 28, see also under *A. musiformis*, p. 1578).

A. shizishananus matches *A. musiformis* s.l. also regarding the *MAD1* gene uploaded by Li et al. (2016) without specification of the culture number. In the *TEF1* gene the two species clustered in a clade though with a moderate distance, whereas *RPB2* places it in clade C of *A. musiformis*.

Arthrobotrys flagrans (Dudd.) Mekht., Dokl. Akad. Nauk Azerb. SSR 20(6): 70 (1964)

≡ *Trichothecium flagrans* Dudd., Trans. Br. mycol. Soc. 32(3-4): 287 (1950)
≡ *Arthrobotrys flagrans* (Dudd.) Sidorova, Gorlenko & Nalepina, Bot. Zh. SSSR: 1598 (1964), nom. inval., ICN Art. 41.1
≡ *Duddingtonia flagrans* (Dudd.) R.C. Cooke, Trans. Br. mycol. Soc. 53(2): 316 (1969)

Arthrobotrys flagrans forms a rather homogeneous and distant clade in analyses of ITS (Phyl. 28). In our combined analysis (Phyl. S33) it formed with *A. amerosporus* a strongly supported subclade as a part of the medium supported *oligospora-musiformis* clade. Numerous sequences of different protein-coding regions and also D6, D7, and D9 of LSU exist in GenBank under the name *Duddingtonia flagrans*. An authentic strain (CBS 565.50, ITS, *TUBB*) confirms the identity of the clade. A *TUBB* sequence of *Arthrobotrys pseudoclavatus* (1130, AY773359) appears to be confused since it fully matches several strains of *A. flagrans*, whereas the ITS of it belongs to the *A. janus* clade.

Conidiophores acrogenous

Arthrobotrys cookedickinsonianus Z.F. Yu [as '*cookedickinson*'], in Yu et al., Fungal Diversity Res. Ser. 23: 61 (2014), non *A. cystosporius* (Dudd.) Sidorova et al.

≡ *Monacrosporium cystosporum* R.C. Cooke & C.H. Dickinson, Trans. Br. mycol. Soc. 48(4): 623 (1965)
≡ *Golovinia cystospora* (R.C. Cooke & C.H. Dickinson) Mekht., Khishchnye Nematofagovye Griby - Gifomitsety (Baku): 146 (1979)

Monacrosporium cystosporum was isolated from soil in Bogor, Java (Indonesia, Cooke & Dickinson 1965) and has obovoid to turbinate, 2–3-septate, acrogenously formed conidia with one very strongly inflated cell. Rubner (1996) synonymised it with *Arthrobotrys thaumasius*, but Yu et al. (2014) considered it to be different and renamed it to *A. cookedickinsonianus* in order to avoid confusion with *A. cystosporius* with broadly obovoid, 1-septate conidia. The authors compared *A. cookedickinsonianus* with *A. eudermatus* and *A. sphaeroides* and referred strains from different provinces of China to it.

Sequences exist for two of these strains: YMF 1.00024 (ITS, as *A. cookedickinsonianus*) and YNUCC 2128 (LSU D1–D3, as *M. cystosporum*). An illustration was available for YMF 1.00024 (Yu et al. 2014: fig. 3.11) which matches well the protologue of *M. cystosporum*. This strain fully concurs with *A. thaumasius* CBS 322.94 in the ITS, supporting Rubner's synonymisation, but only when using the unpublished sequence from the chromatogram of YMF 1.00024 (Y. Zhang pers. comm.), not the uploaded sequence (MF948393) which belongs to *A.* aff. *musiformis* (clade C).

M. cystosporum (YNUCC 2128) fully concurs with *A. salinus* (YNUCC 2328) and *A. eudermatus* (YNUCC 2228) in the LSU. They formed with the close *A.* cf. *thaumasius* (CBS 591.91) a strongly supported clade which nested near the *A. thaumasius* clade (Phyl. S32). Since no ITS was available for any of these four strains, their identity remains unsettled; perhaps they represent *A. janus* for which no LSU was available. Also the identity of the unsequenced type of *A. cookedickinsonianus* (≡ *M. cystosporum*) is uncertain. Rubner (1996) synonymised *M. cystosporum* with *A. thaumasius*, apparently based on the protologue, but she did not discuss her opinion. Placement of *A. cookedickinsonianus* near *A. thaumasius* is supported by the fact that other gene regions of YMF 1.00024 (RPB2, TEF1, TUB) cluster in the clade of *A. thaumasius*.

Arthrobotrys salinus (R.C. Cooke & C.H. Dickinson) M. Scholler, Hagedorn & A. Rubner [as '*salina*'], Sydowia 51(1): 104 (1999)

≡ *Monacrosporium salinum* R.C. Cooke & C.H. Dickinson, Trans. Br. mycol. Soc. 48(4): 626 (1965)
≡ *Golovinia salina* (R.C. Cooke & C.H. Dickinson) Mekht., Khishchnye Nematofagovye Griby - Gifomitsety (Baku): 145 (1979)

Under the name *M. salinum* a sequence of LSU (D1–D3) of a strain from Yunnan, China (YNUCC 2328) exists in GenBank. It fully concurs with two other strains from Yunnan under the names *M. cystosporum* and *A. eudermatus* (see under *A. cookedickinsonianus*, p. 1579).

Arthrobotrys cystosporius (Dudd.) Mekht. [as '*cystosporium*'], Dokl. Akad. Nauk Azerb. SSR 20(6): 70 (1964)

≡ *Trichothecium cystosporium* Dudd., Trans. Br. mycol. Soc. 34(4): 600 (1952) [1951]
≡ *Arthrobotrys cystosporius* (Dudd.) Sidorova, Gorlenko & Nalepina [as '*cystosporia*'], Bot. Zh. SSSR 49: 1598 (1964), nom. inval., ICN Art. 41.5
≡ *Genicularia cystosporia* (Dudd.) Rifai & R.C. Cooke, Trans. Br. mycol. Soc. 49(1): 154 (1966)
≡ *Geniculifera cystosporia* (Dudd.) Rifai, Mycotaxon 2(2): 215 (1975)
?= *Arthrobotrys paucisporus* (R.C. Cooke) Jarow. [as '*paucispora*'], Acta Mycologica, Warszawa 6(2): 381 (1970)
≡ *Genicularia paucispora* R.C. Cooke, in Rifai & Cooke, Trans. Br. mycol. Soc. 49(1): 157 (1966)
≡ *Geniculifera paucispora* (R.C. Cooke) Rifai, Mycotaxon 2(2): 215 (1975)

The types of *A. cystosporius* (UK, Surrey, Mickleham, rotten wood) and *A. paucisporus* (UK, Derbyshire, Cressbrook Dale, *Briza* roots) are morphologically similar in their obovoid to obpyriform conidia with eccentrical septum. *A. paucisporus* differs in narrower conidia, and different authors, including Van Oorschot (1985), segregated the two taxa even in different genera (*Arthrobotrys* and *Geniculifera*) based on a deviating conidiogenesis: proliferation at the conidiophore apex (candelabrelloid) in *A. cystosporius*, subapical proliferation (geniculate) in *A. paucisporus*.

Two Californian strains under the names *A. paucisporus* (ATCC 96704) or *Geniculifera paucispora* (CBS 495.92) fully concur in the LSU D1–D3. The ATCC strain comprises also S1506 intron and ITS and shows a high similarity with two strains under the name *A. cystosporius* (CBS 439.54, UK; CBS 591.92, Netherlands), with distances in the intron/ITS/LSU D1–D2 of 1.8/0.4/0.3 % (UK) and ~3/~0.4/0.3 % (NL). This result suggests that the four strains are conspecific.

CBS 439.54 is the ex-type strain of *A. cystosporius* fide Van Oorschot (1985: 92), with ATCC 13418 and IMI 101313 (Van Oorschot l.c.), CCRC 32918 (Hagedorn et al. 1999), and CBS 130.83 (CBS database) representing the same strain. In the CBS database originally only Duddington's number C.L.D. 143 and ATCC 13418 was mentioned under CBS 439.54, and only IMI 101313 under CBS 130.83. According to the Latin diagnosis in Duddington (1952) the type locality is Mickleham, with the collection date X.1948 (no herbarium number indicated), but Duddington mentions in the discussion two further collections. Whether illustrations of the other three strains exist is unknown to us. *O. blumenaviensis* (H.B. 9748a) and *A. gampsosporus* (CBS 127.83) are very close to *A. cystosporius* in the LSU (Phyl. S32) but cluster very distantly in the ITS (Phyl. 28).

Arthrobotrys eudermatus (Drechsler) M. Scholler, Hagedorn & A. Rubner [as '*eudermata*'], Sydowia 51(1): 102 (1999)

≡ *Dactylaria eudermata* Drechsler, Mycologia 42(1): 40 (1950)
≡ *Monacrosporium eudermatum* (Drechsler) Subram., J. Indian bot. Soc. 42: 293 (1964) [1963]
≡ *Genicularia eudermata* (Drechsler) Rifai, Reinwardtia 7(4): 367 (1968)
≡ *Golovinia eudermata* (Drechsler) Mekht., Dokl. Akad. Nauk Azerb. SSR 27(2): 73 (1971)
≡ *Geniculifera eudermata* (Drechsler) Rifai, Mycotaxon 2(2): 216 (1975)
≡ *Dactylella eudermata* (Drechsler) Seifert & W.B. Kendr., in Seifert, Kendrick & Murase, Univ. Waterloo Biol. Ser. 27: 30 (1983)

Arthrobotrys eudermatus is a frequently confused species. Based on rDNA data, strains identified so turned out to belong to very different clades (*A. janus*, *O. elegans*, *mangrovisporus-sahelensis* clade, *A. thaumasius*). No type culture appears to exist. Rubner (1996) designated a strain from La Palma, Macaronesia (CBS 305.94) as epitype of this North American species. The strain represents a further distinct taxon based on its unofficial ITS sequence in CBS which shows a 6.5–10 % distance to the above taxa and also min. 7 % to *O. elegans* s.l., but only 3 % to the type strains of *A. mangrovisporus* and '*Dactylaria*' *sahelensis*.

Also Rubner's concept of *A. eudermatus* was too wide, which is obvious from the three existing ITS sequences of isolates referred by her to this species, which show a high distance among each other. Only one of them is in GenBank (CBS 769.85, unlocalized, as *A. rutgeriensis*) and falls in the *A. janus* clade (Phyl. 28). The other two sequences appear to have no further matches: CBS 305.94 (epitype) is close to *A. mangrovisporus* (3 %), and CBS 584.91 (Germany, Berlin) is distant from all tested sequences (minimum 6 % to *O. blumenaviensis* H.B. 9748a). Whether Rubner's epitype choice was justified remains to be clarified by rDNA data from North America. In the LSU no comparison of CBS 305.94, recently available in GenBank

(MH874116), to *A. janus* is possible because the whole clade lacks this gene region.

Two isolates from Burkina Faso (CBS 377.97, as *A. eudermatus*; CBS 247.93, type of '*Dactylaria*' *sahelensis*) are identical in the ITS and differ by 1 nt in the LSU. In our combined analyses, they clustered with a 3.7 % ITS and 3 % LSU distance with the type of *A. mangrovisporus* in the strongly supported *mangrovisporus-sahelensis* clade (Phyls 25, S33), which nested unresolved in series *Arthrobotrys* and show, e. g., a 6–7.5 % ITS distance to the *A. janus* clade. The epitype of *A. eudermatus* shows a 3 % ITS distance to *A. mangrovisporus* (0.7 % in LSU), but 9.8 % to '*Dactylaria*' *sahelensis* (3 % in LSU).

Arthrobotrys huaxiensis Z.F. Yu, in Zhang & Hyde (eds), Nematode-trapping Fungi: 72 (2014)

≡ *Arthrobotrys guizhouensis* (K.Q. Zhang, Xing Z. Liu & L. Cao) M. Scholler, Hagedorn & A. Rubner, Sydowia 51(1): 102 (1999), nom. illegit., ICN Art. 53.1, non *Arthrobotrys guizhouensis* K.Q. Zhang (1994) (?= *O. blumenaviensis*)

≡ *Monacrosporium guizhouense* K.Q. Zhang, Xing Z. Liu & L. Cao, Mycol. Res. 100(3): 275 (1996)

Arthrobotrys huaxiensis was described as *M. guizhouense* by Zhang et al. (1966). It sharply differs from the earlier described *A. guizhouensis* (Zhang 1994, = *O. blumenaviensis*), in acrogenous conidiophores and much larger, 1–4-septate conidia that vary between obpyriform and fusiform (see also Yu et al. 2014: fig. 3.18, redrawn and modified, legend with the wrong name *A. guizhouensis* [K.Q. Zhang]). No sequence was available, since the type culture of *A. huaxiensis* (CBS 616.95, under the illegitimate name *A. guizhouensis* as combined by Scholler et al. 1999, KT215198) seems to be confused: when querying the CBS database, CBS 616.95 fully concurs in the ITS region with the ex-type strain of *Dactylellina yunnanensis* (CBS 615.95), a species closely related to *D. haptotyla* (see p. 1607). A possible confusion in the trapping organs of *A. huaxiensis* seems to be excluded by the much narrower conidia of *D. haptotyla* s.l., although conidial shape and septation is similar in these two species.

Arthrobotrys janus (S.D. Li & Xing Z. Liu) Z.F. Yu, in Yu et al., Fungal Diversity Res. Ser. 23: 75 (2014) (erroneously MB number of *A. cookedickinsonianus* cited)

≡ *Monacrosporium janus* S.D. Li & X.Z. Liu, in Li, Miao, Zhang & Liu, Mycol. Res. 107(7): 890 (2003)

= *Arthrobotrys rutgeriensis* (R.C. Cooke & Pramer) Z.F. Yu [as '*rutgeriense*'], in Zhang & Hyde (eds), Nematode-trapping Fungi: 108 (2014)

≡ *Monacrosporium rutgeriense* R.C. Cooke & Pramer [as '*rutgeriensis*'], Phytopathology 58: 544 (1968), nom. inval., ICN Art. 40 (type material not indicated)

= *Arthrobotrys pseudoclavatus* (Z.Q. Miao & Xing Z. Liu) J. Chen, L.L. Xu, B. Liu & Xing Z. Liu [as '*pseudoclavata*'], Fungal Diversity 26(1): 123 (2007)

≡ *Dactylella pseudoclavata* Z.Q. Miao & X.Z. Liu, in Miao, Liu, Li & He, Can. J. Bot. 81(5): 453 (2003)

Three strains under the name *Arthrobotrys eudermatus* (from Mexico and China) form in our ITS analysis with six Chinese strains under the names *A. janus* (3 strains including ex-type), *A. pseudoclavatus* (type), *A. sphaeroides*, and *A. thaumasius*, and one from North America (*A. rutgeriensis*, ?topotype), a strongly supported clade (Phyl. 28). The comparatively low distance (0–2.3 %) among the strains of this clade suggests that all belong to a single species. This clade is referred to as *A. janus* here, because the unofficial sequence of the epitype of *A. eudermatus* (CBS 305.94) differs by 7–8 % from members of this clade. LSU was not available for members of *A. janus*, but perhaps the clade of the four LSU sequences without ITS (including *A. cookedickinsonianus* YNUCC 2128) represents *A. janus*.

The type of *A*. ***rutgeriensis*** was isolated from soil at the Rutgers University in New Brunswick, New Jersey, USA (undated, Cooke & Pramer 1968). The taxon is invalid because no type specimen was cited (Rubner 1996). An isolate by W.D. Rosenzweig of unknown date and origin (CBS 769.85) possibly represents a topotype, since Rosenzweig worked at this university during the 1980s. *A. rutgeriensis* was synonymised with *M. eudermatum* by Rubner (1996), but was considered as distinct from both, *A. eudermatus* and *A. janus*, by Yu et al. (2014). The sequence in GenBank comprises SSU and ITS. Rubner's concept of *A. eudermatus* includes this strain, but it differs by 8 % from the La Palma epitype and by 13 % from *A. eudermatus* CBS 584.91. Actually, it clustered in the *A. janus* clade with a distance of 1.3 % to the types of *A. janus* and *A. pseudoclavatus*.

The type of *A*. ***janus*** was isolated in IX.2000 from soybean field soil in Gaomi, Shandong, China (85-1, HMAS 77942, ex-type culture CGMCC (AS) 3.6626). It comprises ITS, *TUBB*, *RPB2*, and *TEF1*, and shows a 1.3 % ITS distance to *A. rutgeriensis* and 7 % to the epitype of *A. eudermatus*. Two further strains under the name *A. janus* (YMF 1.01312, from Mixian, Shandong, Yu et al. 2014; unlocalized, YMF 1.01889, Li et al. 2016) differ in the ITS by 0 % and 1.4 %, respectively.

The type strain of *A*. ***pseudoclavatus*** was isolated in II.1998 from field soil in Haiding, Beijing, China (HMAS 84442). Sequences (ITS, *TEF1*, *RPB2*, *TUBB* etc.) exist in GenBank for 'strain 1130', which represents the ex-type strain (X.Z. Liu, pers. comm.). In the ITS this strain is fully identical with a strain of *A. sphaeroides* (SDT24) and the type of *A. janus*, except for one doubtful insert in the motif AAAAAAA in ITS1. When analysing *RPB2* or *TEF1* (not shown), however, it clustered distantly with *A. conoides* and *O. oligospora* in a supported clade, whereas the identical sequences of *A. sphaeroides* and *A. janus* clustered in another clade. The *TUBB* sequence of *A. pseudoclavatus* fully matches *A. flagrans* (strain R4). All these results suggest some confusion of sequences.

A. pseudoclavatus was solely described from its microconidial state, which was also reported in *A. eudermatus* by Drechsler (1950a), but not in *A. rutgeriensis*, *A. janus*, and *A. sphaeroides*. Because of its small conidia *A. pseudoclavatus* was thought to represent a distinct species.

No type culture of *A*. ***sphaeroides*** is available (Rubner, 1996). A Chinese strain under this name in GenBank (SDT24) comprises ITS (AY773465), *RPB2*, and *TEF1* and might be misidentified (X.Z. Liu, pers. comm.). Another *A. sphaeroides* strain (YNUCC 0077, unlocalized) has only LSU (AY268930) and *TUBB*. Strain SDT24 is identical in the ITS and *RPB2* with the type of *A. janus*, hence must be conspecific. YNUCC 0077 (LSU) appears to be conspecific with four YNUCC strains under the names *M. globosporum*, *M. rutgeriense*, *A. superbus*, and *A. sinensis*: in the D1–D2 domain, three of them are identical, from which *A. sphaeroides* differs by 2 nt (1 in D1, 1 in D2) and 6 inserts, and *A. sinensis* by 3 nt in the D2 (no inserts). Between *A. sinensis* and *A. sphaeroides* 5 nt differ (1 in D1, 4 in D2). Also two CBS strains which belong from their ITS to *A. thaumasius* fall in this clade. Possibly the associated clade with *A. cookedickinsonianus* (Phyl. S32) represents *A. janus*, but no sequence with both ITS and LSU was available for that species.

Arthrobotrys gampsosporus (Drechsler) S. Schenck, W.B. Kendr. & Pramer [as '*gampsospora*'], Can. J. Bot. 55(8): 982 (1977)

≡ *Dactylaria gampsospora* Drechsler, Sydowia 15(1-6): 9 (1962) [1961]
≡ *Woroninula gampsospora* (Drechsler) Mekht., Khishchnye Nematofagovye Griby - Gifomitsety (Baku): 112 (1979)
≡ *Dactylella gampsospora* (Drechsler) de Hoog & Oorschot, Stud. Mycol. 26: 110 (1985)
≡ *Monacrosporium gampsosporum* (Drechsler) Xing Z. Liu & K.Q. Zhang, Mycol. Res. 98(8): 865 (1994)

A strain isolated by G. Barron from soil in Florida (from where also the holotype derives) and identified as *Arthrobotrys gampsosporus* (CBS 127.83) comprises S1506 intron, ITS, and LSU D1–D3. In our analyses of ITS or SSU+ITS+LSU (Phyls 28, S33), this strain clustered in the strongly supported *elegans-gampsosporus* clade, with an ITS distance of 4.5–5.5% to *O. elegans* s.l. We did not see a photo of Barron's isolate, but Drechsler's (1962) original illustration and the drawing of the type by Rubner (1996: fig. 30) shows conidia reminiscent of *A. scaphoides*, very different from *O. elegans*. A strain under the name *Arthrobotrys* sp. from southern Africa (SBUG-M 1264) comprises SSU and ITS. It clustered with Barron's isolate with a 1.2% ITS distance and thus seems to be conspecific with it, but it differs in lacking the S1506 intron.

In the LSU the differences to other species are too sparse to enable identification. Barron's strain clustered here in an unsupported clade with some of the strains of *A. cystoporius*, *O. blumenaviensis*, and *O. menageshae* s.l. (Phyl. S32) When analysing the S1506 intron, *O. elegans* clustered with *O. auricolor* (as *A. superbus*, CBS 109.52, clade A2 of *O. auricolor*, see p. 1534), whereas *A. gampsosporus* is found in a strongly supported clade with *O. menageshae* s.l. and *A. cystosporius* (S30). This is similarly astonishing because *A. cystosporius* has 1-septate conidia and only *O. menageshae* tends to fusiform conidia with 2–3 septa.

Arthrobotrys reticulatus (Peach) M. Scholler, Hagedorn & A. Rubner [as '*reticulata*'], Sydowia 51(1): 104 (1999)

≡ *Dactylella reticulata* Peach, Trans. Br. mycol. Soc. 33(1-2): 148 (1950)
≡ *Golovinia reticulata* (Peach) Mekht., Khishchnye Nematofagovye Griby - Gifomitsety (Baku): 143 (1979)
≡ *Monacrosporium reticulatum* (Peach) R.C. Cooke & C.H. Dickinson, Trans. Br. mycol. Soc. 48(4): 622 (1965)
= *Arthrobotrys xiangyunensis* S.R. Liu, H.Y. Su, X.J. Su, F. Zhang, G.H. Liao & X.Y. Yang, Phytotaxa 174(2): 90 (2014)
?= *Arthrobotrys megalosporus* (Drechsler) M. Scholler, Hagedorn & A. Rubner [as '*megalospora*'], Sydowia 51(1): 103 (1999)
≡ *Dactylella megalospora* Drechsler, Mycologia 46(6): 769 (1954)
≡ *Golovinia megalospora* (Drechsler) Mekht., Khishchnye Nematofagovye Griby - Gifomitsety (Baku): 155 (1979)
≡ *Monacrosporiella megalospora* (Drechsler) Subram., Kavaka 5: 94 (1978) [1977]
≡ *Monacrosporium megalosporum* (Drechsler) Subram., J. Indian bot. Soc. 42: 293 (1964) [1963]

ITS Sequences of CBS 703.74 (Netherlands, as *Drechslerella bembicodes*, GenBank), CBS 586.92 (Netherlands, as *Arthrobotrys megalosporus*, CBS), and *A.* cf. *psychrophilus* (dm3w d4, California) clustered in a strongly supported clade with the ex-type strains of *A. reticulatus* (CBS 201.50, England) and *A. xiangyunensis* (B04, C04, China) (Phyl. 28). The five taxa have similar conidia which are acrogenously formed on unbranched conidiophores. The six sequences differ from each other by only 0–1.2% (0% between the two ex-type strains), therefore, they can be considered as conspecific, and *A. xiangyunensis* becomes a synonym of *A. reticulatus.* Also in the LSU D1–D2 the ex-type strains of *A. reticulatus* and *A. xiangyunensis* and the strain from California are fully identical, while a Chinese strain (YNUCC 3228) differs by 5 nt in the D2.

When Liu et al. (2014) described *A. xiangyunensis*, they provided a morphological comparison with other *Arthrobotrys* species, but not with *A. reticulatus* or the also similar *A. megalosporus*. An ITS sequence under the name *M. megalosporum* (SOM-5, Japan, AB114475) fits the syntype of *A. thaumasius* by a 0.2% distance. However, since the size of the predominantly 4-septate conidia in the unsequenced type of *A. megalosporus* fits more *A. reticulatus*, we placed it as a doubtful synonym here. In case of synonymy, *A. megalosporus* would provide an earlier name for *A. reticulatus*.

'Dactylaria' sahelensis Sawadogo & Cayrol, Riviéra Scientifique: 27 (1990), nom. inval., ICN Art. 39.1 (without Latin diagnosis)

One of the many isolates under the name *Arthrobotrys eudermatus* derives from marshy soil in Oubritenga in the centre of Burkina Faso (CBS 377.97, J.L. Devineau, AF106528, KT215215). This strain fully concurs in the ITS and with 0.2% distance in the LSU (D1–D2) with the ex-type strain of the invalidly described '*Dactylaria*' *sahelensis* (CBS 247.93, MH862395, MH874055), which was isolated by A. Sawadogo & J.C. Cayrol from agricultural soil near Djibo in the north of Burkina Faso. The species was described with very large conidia with a long flagellum-like apical appendage (Sawadogo & Cayrol 1990), but otherwise resembles species such as *A. eudermatus* or *A. thaumasius*. Thus, strain CBS 377.97 is better identified as '*Dactylaria*' *sahelensis*, since it shows a 9.8% distance to the epitype of *A. eudermatus* and 6% to the syntype of *A. thaumasius*. The species formed with *A. mangrovisporus* the strongly supported *mangrovisporus-sahelensis* clade in our combined analyses (Phyls 25, S33), with an ITS distance of 3.7%, but also the ex-epitype of *A. eudermatus* (see p. 1580) appears to belong in this clade, showing a 3% distance to those.

Arthrobotrys thaumasius (Drechsler) S. Schenck, W.B. Kendr. & Pramer [as '*thaumasia*'], Can. J. Bot. 55(8): 984 (1977)

≡ *Dactylaria thaumasia* Drechsler, Mycologia 29(4): 522 (1937)
≡ *Golovinia thaumasia* (Drechsler) Mekht., Mikol. Fitopatol. 1: 276 (1967)
≡ *Candelabrella thaumasia* (Drechsler) Rifai, Reinwardtia 7(4): 369 (1968)
≡ *Monacrosporium thaumasium* (Drechsler) de Hoog & Oorschot [as '*thaumasia*'], Stud. Mycol. 26: 120 (1985)
?= *Arthrobotrys indicus* (Chowdhry & Bahl) M. Scholler, Hagedorn & A. Rubner [as '*indica*'], Sydowia 51(1): 102 (1999)
≡ *Monacrosporiella indica* Chowdhry & Bahl [as '*indicum*'], Curr. Sci. 51(18): 895 (1982)
≡ *Monacrosporium indicum* (Chowdhry & Bahl) Xing Z. Liu & K.Q. Zhang, Mycol. Res. 98(8): 865 (1994)
?= *Arthrobotrys microscaphoides* (Xing Z. Liu & B.S. Lu) M. Scholler, Hagedorn & A. Rubner, Sydowia 51(1): 103 (1999)
≡ *Monacrosporium microscaphoides* Xing Z. Liu & B.S. Lu, Mycosystema 6: 68 (1993)
= *Arthrobotrys sinensis* (Xing Z. Liu & K.Q. Zhang) M. Scholler, Hagedorn & A. Rubner, Sydowia 51(1): 104 (1999)
≡ *Monacrosporium sinense* Xing Z. Liu & K.Q. Zhang, Mycol. Res. 98(8): 863 (1994)
= *Arthrobotrys microscaphoides* var. *multisecundarius* (W.F. Hu & K.Q. Zhang) Juan Li, J.K. Yang, L.M. Liang & K.Q. Zhang [as '*multisecundaria*'], Journal of Microbiology 46(5): 517 (2008)
≡ *Arthrobotrys multisecundarius* W.F. Hu & K.Q. Zhang [as '*multisecundaria*'], in Hu, Li, Mo & Zhang, Mycotaxon 95: 182 (2006)

The *Arthrobotrys thaumasius* clade includes numerous strains that show an ITS distance of 0–1.7% to each other (Phyl. 28), which suggests conspecificity of all these strains. Based on an ITS sequence of the ex-syntype strain from Virginia (CBS 176.37), the name ***A. thaumasius*** was correctly applied to four strains from Hong Kong, one from Taiwan, one from Guizhou, and one from Germany. The remaining strains of this large clade carry various other, partly wrong names: *M. megalosporum* (from Japan), *Drechslerella bembicodes* (from Burkina Faso), *A. indicus* (from China), and *M. eudermatum* (unlocalized). Also Chinese strains of *A. microscaphoides*, *A. multisecundarius* (ex-type), and *A. sinensis* (ex-type) clustered in this clade, the latter two consequently representing synonyms of *A. thaumasius*. Only for two of the above strains also LSU was available (CBS 322.94, Germany; CBS 376.97, Burkina Faso). When analysing the D1–D2 domain, further strains appear to belong to *A. thaumasius*: *A. rutgeriensis* (YNUCC 1828), *M. globosporum* (YNUCC 1928), and *A. sphaeroides* (YNUCC 0077) (Phyl. S32). However, since ITS was not available for them, their closeness to *A. thaumasius* remains uncertain.

The type of ***A. indicus*** was isolated from horse dung used for mushroom cultivation in New Dehli, India (ITCC 3081, HCIO 33760, Chowdhry & Bahl 1982), and no sequence appears to exist. A Chinese sequence under the name *A. indicus* (YMF 1.01845) exists in GenBank which might correspond to the first of two isolates reported by Yu et al. (2014) under this name (Sjz3.11.1). The other isolate (XZM-7) was provided with an illustration which fits the type of *A. indicus* and indeed resembles taxa here included in *A. thaumasius*, but also taxa here referred to *A. janus*.

The type of ***A. sinensis*** was isolated in IV.1990 in Nanchang, JiangXi, China, apparently from plant remnants in soil. The holotype was deposited in HMAS 62568 and the ex-type culture as AS 3.6755, from which sequences of ITS, *RPB2*, *TEF1*, *TUBB*, and *MAD1* under the number 105-1 in GenBank derive (X.Z. Liu pers. comm.). In the ITS the strain differs from *A. microscaphoides* and the syntype of *A. thaumasius* by 0.6% and from the two YNUCC strains of *A. microscaphoides* by only 0.2%. Rubner (1996) already treated *M. sinense* as a possible synonym of *M. thaumasium*.

The type of ***A. microscaphoides*** was isolated in 22.III.1992 from the rhizosphere of *Cocos nucifera* near Sanya, Hainan, China. The holotype was deposited as HMAS 66381, but no culture and sequence appear to exist. Sequences of ITS, *TUBB*, and *MAD1* exist in GenBank for two Chinese isolates treated by Yu et al. (2014: 85): a field soil sample from Lincang, Yunnan, isolated in 1999 (YMF 1.00028) and uploaded by Li et al. (2008), and a forest soil isolate from Changbaishan, Jilin, isolated in X.2002 (YMF 1.00546) and uploaded by Li et al. (2016).

The type of ***A. multisecundarius*** was isolated in 2005 from soil in Tengchong, Yunnan (Hu et al. 2006). Li et al. (2008) observed a 0.2% ITS distance and 0.5% in *TUBB* between the type culture (YMF 1.01821) and *M. microscaphoides* (YMF 1.00028), therefore, they reduced *A. multisecundarius* to a variety of *A. microscaphoides* by considering it as a spontaneous mutant.

Two unsequenced Chinese ascospore isolates are mentioned under *O. elegans* (Pl. 962: 2–3) but could as well belong to *A. thaumasius* and would then represent the first report of the teleomorph state of *A. thaumasius*.

Incertae sedis (?series *Arthrobotrys*)

Orbilia terrestris Raitv. & Faizova, Nov. Sist. Niz. Rast. 20: 106 (1983) — Pl. 976

Etymology: referring to the soil habitat.

Typification: Tajikistan, Dushanbe, Varzob river, soil, 15.VI.1978, A. Raitviir (TAAM 64761, holotype).

Description: — **TELEOMORPH**: **Apothecia** fresh 1–2 mm diam. (dry 0.45–1.1 mm), 0.22–0.25 mm high, pale ochraceous (fresh orange-red), ± round, ?scattered, sometimes two apothecia clustered; disc flat to slightly convex, margin smooth, not protruding; sessile but with a very broad stalk-like base; dry apothecia yellow-ochraceous. **Asci** †40–53 × (4.2–)4.8–5.4(–5.8) µm, 8-spored, ~4–6 lower spores inverted, pars sporifera †18–24 µm long; **apex** (†) strongly truncate, hemispherical in profile view (not or very slightly indented), thin-walled; **base** with medium long, slightly flexuous stalk, h-shaped. **Ascospores** †9–11 × 1.4–1.7 µm (~9.5–12 µm actual length), clavate to fusoid-clavate, apex rounded to obtuse, rarely subacute, base strongly attenuated (often tail-like), medium to strongly curved below; **SBs** visible as a transparent, tear-shaped region of 1.5–1.7(–2) × 0.7–1.2 µm. **Paraphyses** apically medium to strongly clavate-capitate, terminal cell †17–22 × 2.8–4.2(–4.8) µm, lower cells †6–13 × 1.5–2.5 µm, unbranched at upper septum. **Medullary excipulum** hyaline, 50–70 µm thick, of dense, horizontal textura prismatica-angularis, cells †10–22 × 9–16 µm, distinctly delimited from ectal excipulum only towards margin by a parallel, 10–15 µm thick layer of t. porrecta. **Ectal excipulum** of thin-walled, vertically oriented t. angularis(-prismatica) from base to margin, 80 µm thick near base, cells †20–40 × 15–25 µm; 30 µm thick at lower flanks, 25 µm thick at mid flanks and margin, oriented at a 90° angle, marginal cortical cells †10–19 × 5–8 µm; **glassy processes** absent. **Anchoring hyphae** very sparse, †2.5–4 µm wide, walls 0.2 µm thick. **SCBs** in apices of dead terminal cells of paraphyses (SCBs or VBs?) globose, medium-refractive, KOH-soluble, 1–3 per cell, 1.2–2.3 µm diam; **LBs** in paraphysis cells at level of ascus base, very pale yellowish. **Exudate** over paraphyses, margin and flanks granular, partially detaching. **— ANAMORPH**: unknown.

Habitat: on fine sandy to clayey ground of light grey-brown colour, with a few organic particles (?bark), a few green algae among anchoring hyphae. **Desiccation tolerance**: unknown (possibly intolerant). **Altitude**: 1450–1750 m a.s.l. **Geology**: granite. **Phenology**: VI.

Taxonomic remarks. *Orbilia terrestris* was characterized in the protologue (Raitviir & Faizova 1983) mainly by the terrestrial habitat and the orange-red apothecia of 1–2 mm diam. which superficially resemble the operculate discomycete *Pulvinula constellatio*, also by fusoid-clavate spores with a strongly tapered, medium curved base. *O. terrestris* might be closely related to *O. auricolor*, from which it differs in distinctly wider ascospores and asci and a more clavate spore shape. *O. neglecta* differs from *O. terrestris* in smaller asci and spores, the latter with distinct narrow tails. Particularly *O. latispora* s.l. quite closely resembles *O. terrestris*. Due to this similarity in the teleomorph, *O. terrestris* might belong to series *Arthrobotrys*, although the anamorph and the type of trapping organ are unknown.

Type studies. The protologue of *O. terrestris* concurs rather well with the here reexamined holotype which contains ~10 apothecia. The present spore measurements well correspond to those evaluated from the protologue illustration (9–10 × 1.4–1.6 µm), whereas the protologue gives longer spores (10–12 µm), perhaps because referring to the actual length, and an inaccurate width of 1–2 µm. No spore contents were reported in the protologue, although the present study revealed a faintly visible, medium-sized, apparently closely attached, tear-shaped spore body without a filiform upper part.

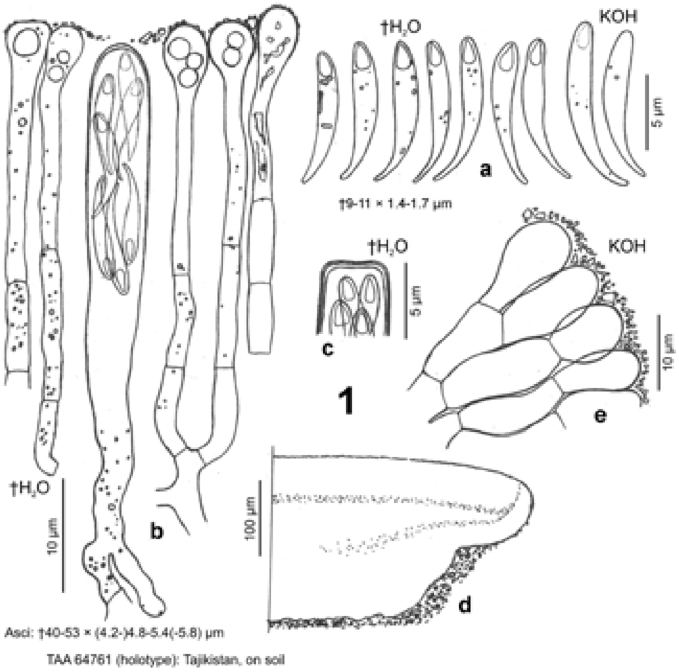


Plate 976. **1**: *Orbilia terrestris*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apex; **d**. apothecium in median section; **e**. ectal excipulum (margin, median section).

Ecology. The type of *O. terrestris* grew on acidic clayey-sandy (granitic) soil with a few organic particles, which might be remnants of bark, in a streambed of a gorge and valley in the warm-continental semihumid (mediterranean) Hissar Range in the western part of the Pamir-Alay mountain range at the northwestern end of Himalaya (central Asia).

Specimens included. **TAJIKISTAN**: Pamir-Alay Mts., Hissar Range, 35 km NNE of Dushanbe, ~5 km E of Varzob river, base of Tagob (Takob) gorge, near Tagob, ~1450 m, on clayey-sandy ground, 15.VI.1978, A. Raitviir (TAAM 64761, **holotype** of *O. terrestris*, H.B. 5206 ø). – ibid., southern slope of Hissar Range, side gorge of Tagob gorge, 1730–1800 m, 5.VI.1980, K. Kalamees & S. Faizova (TAAM, paratype, non vid.).

Series *Dactylellina*

Orbilia subgenus ***Orbilia*** section ***Arthrobotrys*** series ***Dactylellina*** (M. Morelet) Baral & E. Weber, **comb. et stat. nov.**, MB 814994 – Type species: *Dactylella leptospora* Drechsler [≡ *Dactylellina leptospora* (Drechsler) M. Morelet]

Basionym: *Dactylellina* M. Morelet, Bull. Soc. Sci. Nat. Archéol. Toulon et du Var 178: 6 (1968)

?= *Dactylium* Nees, Syst. Pilze: 58 (1816) [1816–1817]; – Fr., Syst. Mycol. 3: 382, 412 (1832), nom. utique rej., ICN Art. 56.1 – Type species: *D. candidum* Nees [?non *Dactylaria candida* (Nees) Sacc. s. Drechsler (1937a: 523), = *D. haptotyla* (Drechsler) M. Scholler et al.]

= *Anulosporium* Sherb., Mycologia 25: 262 (1933) – Type species: *A. nematogenum* Sherb. (nom. dub., identity unclear at the species level)

≡ *Dactylosporium* Mekht. (1967), Mikol. Fitopatol. 1: 278 (1967), nom. illegit., ICN Art. 53.1 [non *Dactylosporium* Harz 1871] – Type species: *Dactylella leptospora* Drechsler

= *Laridospora* Nawawi, Trans. Br. Mycol. Soc. 66: 344 (1976) – Type species: *Dactylella appendiculata* Anastasiou [≡ *D. appendiculata* (Anastasiou) M. Scholler et al.]

= *Kafiaddinia* Mekht. Mikol. Fitopatol. 12: 8 (1978) – Type species: *K. fusariispora* Mekht. (= *D. leptospora* fide Rubner 1996)

Etymology: *Anulosporium*: referring to the non-constricting rings (misinterpreted by Sherbakoff as ring-like conidia); *Dactylellina*, *Dactylium* and *Dactylosporium*: modifications of *Dactylella*; *Kafiaddinia*: named after the Azerbaijanian poet Kafiaddin Omar; *Laridospora*: referring to the characteristic conidial shape and semiaquatic habitat reminiscent of seagulls (*Laridae*).

Emended diagnosis: **Teleomorph**: Apothecia with smooth or finely crenulate margin, desiccation-sensitive. Ascospores subcylindrical to subulate, straight to strongly curved; spore bodies rod- to tear-shaped, rarely (sub)globose, central or sometimes eccentrical. — **Anamorph**: Conidiogenous loci singly or on prominent denticles. Conidia fusiform to cylindrical or clavate, 0–15-septate, straight, microconidia rare. Forming adhesive knobs, partly also non-constricting rings.

Description: — **TELEOMORPH**: **Apothecia** hydrated (0.2–)0.3–1.5(–6) mm diam., whitish or pale to bright yellowish-orange or rose- to blood-red, margin smooth or finely crenulate, sessile or with ill-defined stipe. **Asci** *(24–)27–47(–51) × 3–5.5 µm, 8-spored, (1–)3–4(–5) lower or sometimes upper spores inverted; **apex** (†) medium to strongly truncate, not or rarely ± indented, not or slightly laterally inflated; **base** generally partly H-shaped. **Ascospores** *4.5–13 × 0.8–1.4 µm, narrowly subcylindrical to fusoid-clavate (subulate), apex rounded to obtuse, sometimes with a more or less distinct tail, straight to strongly curved (falcate); **SBs** central or sometimes eccentrical, (0.8–)1–1.8(–2.2) × 0.2–0.7 µm, rod- to tear-shaped, rarely (sub) globose, apically narrowed to a minute to wide point, or attachment invisible. **Paraphyses** uninflated or mostly slightly to medium (rarely strongly) capitate(clavate) at apex, also spathulate to lanceolate-lageniform, terminal cells (1.2–)2–4(–6)× longer than lower cells. **Ectal excipulum** of (†) thin-walled to slightly, rarely medium gelatinized (common walls 0.3–0.5 µm or rarely up to 1–2 µm thick), vertically oriented t. globulosa-angularis(-prismatica) from base to mid flanks, cells near base *(7–)10–30(–39) × (5–)8–25(–30) µm, margin of t. (globulosa-)prismatica oriented at (10–)30–90°; **glassy processes** near margin absent or up to 5–10(–20) µm long. **SCBs** globose or absent; **VBs** low-refractive, hyaline to yellowish or reddish, also absent. **Exudate** (0.1–)0.2–1.5 µm thick, continuous to granular-cloddy, loosely or often firmly attached, hyaline or yellowish to reddish, also absent. — **ANAMORPH**: dactylellina-like. **Conidiophores** 32–220 µm long, apically ± unbranched, with single terminal conidium, or geniculate to candelabrelloid. **Conidia** (13–)17–70(–132) × (4–)6–16(–18) µm, fusiform to elongate top-shaped, or cylindric-ellipsoid to -clavate, 1–7(–9–15)-septate, with or without oversized cell; **conidial dimorphism**: microconidia only observed in *D. leptospora* and *O. biforma*, sharply differentiated or not. **Trapping organs**: short- to long-stalked adhesive knobs with globose, ± detachable heads, some species additionally with detachable non-constricting rings, traps spontaneously formed in culture.

Habitat: on hygric wood and bark (rarely leaves) of both gymno- and angiosperms, also herbaceous stems and leaves of monocots, isolated also from rhizosphere of trees, capturing nematodes, rarely copepods, temperate to tropical, humid, ± desiccation-sensitive.

Recognized species: 16 (9 of them without teleomorph), plus 4 unnamed species (‘affinis’); for further 7 species see Tabs 46 and S9.

Taxonomic remarks. The morphology of the teleomorph hardly permits recognition of series *Dactylellina*. Somewhat diagnostic are the rod-shaped SBs in the ascospores of *Orbilia rubrovacuolata* and *O. mammillata*, being centrally attached in the spore apex and often lacking a filiform upper part. Yet, also *O. blumenaviensis*, *O. menageshae* and sometimes *O. auricolor* (series *Arthrobotrys*) possess, besides series *Gamsylella* and *Drechslerella*, rod-shaped SBs, though often with a short, usually invisible filum. In *O. mammillata* p.p. and the Chinese *O. quercus* the SBs are instead ± globose.

Anamorph (see also p. 224–228 and Tab. S9). Members of series *Dactylellina* are characterized by forming stalked adhesive knobs with globose heads more or less spontaneously in pure culture. In addition to adhesive knobs, several species form non-constricting rings. All anamorphs with these characteristics are referred to as dactylellina-like here. However, delimitation against series *Gamsylella* is problematic, and the original concept of that genus had to be revised based on available molecular data (see p. 235). For instance, *Dactylellina phymatopaga* forms both stalked and sessile adhesive knobs together with adhesive columns that may grow out to form rings (see Pl. 8: i). This species and its synonym *D. parvicollis* were transferred to *Gamsylella* when that genus was erected, but the available molecular data better fit *Dactylellina* (see below).

The conidia of dactylellina-like anamorphs are usually fusiform, comparatively long, and often with inflated central cell, (2–)3–4(–6)-septate. In '*Arthrobotrys*' *paucus* and *Dactylellina hertziana*, however, they are small to medium-sized, cylindric-ellipsoid, 1–3-septate, and in *D. asthenopaga* clavate. Long and narrow, fusoid, multiseptate conidia occur in *D. leptospora*. Clear cases of microconidia have rarely been reported in species of *Dactylellina*, but smaller, not sharply delimited conidia with fewer septa are often seen. The conidiophores are usually very long, and the conidia are often formed singly at the tip (acrogenous) or on a few apical branches (geniculate). In some species a tendency to candelabrelloid is observed (e. g., *D. haptotyla*).

Species delimitation. In our analyses of the ITS region (Phyl 36), various well-defined clades were obtained within series *Dactylellina*. However, applying names to these clades proved difficult, since a large number of strains were misidentified. For instance, the four available sequences of *O. lysipaga* clustered at four different positions. Confusion appears to have happened even regarding the correct affiliation to a series. The ex-type strains of *D. multiseptata* and *D. varietas*, two species being described in *Dactylellina* because of their adhesive knobs, surprisingly clustered in series *Neodactylella* (Phyl 26, see also phylogram in Li et al. 2005), the former with *D. intermedia* and the latter with *D. qiluensis*.

Yu et al. (2014) listed a total of 28 accepted species treated by us in series *Dactylellina* and *Gamsylella*, and for many of them the connection to a teleomorph is as yet unknown. Many species of series *Dactylellina* are difficult to distinguish by morphological characteristics of both their teleomorph and anamorph (for the latter see Pls 7–9), also the morphological variability of the two morphs is little explored. During our study only *O. rubrovacuolata* was examined from a large number of collections of the teleomorph, and also the conidia of its anamorph were seen in five of them. This species appears to be easily recognizable by its bright red apothecia caused by pigmented vacuolar bodies. However, a few collections completely lack the pigment, although fully concurring in their rDNA. Likewise, species delimitation in anamorph-typified taxa is often rather complicated (see under the species). *O. quercus* and *O. lysipaga* are morphologically hardly separable if no trapping organs of the anamorph are observed.

Phylogeny. In the neighbour joining analysis of LSU by Liu et al. (2006a), series *Dactylellina* (represented by *O. quercus*, *O. quercus* var. *hainanensis* and var. *hunanensis*, and *D. leptospora*) formed a paraphyletic sister group to the monophyletic series *Arthrobotrys*, whereas in Liu et al.'s parsimonious ITS analysis it formed together with two species from GenBank with medium support a monophyletic sister group to *Arthrobotrys*. Also in the analysis of ITS by Hagedorn & Scholler (1999: fig. 1) and in combined analyses of ITS, *TUBB*, *RPB2* and *TEF1* by Yang & Liu (2006: fig. 1B) and of SSU+ITS+LSU in Baral et al. (2017b), *Dactylellina* formed with *Gamsylella* a moderate (Yang & Liu) or unsupported monophyletic sister clade to *Arthrobotrys*. In the present analyses of SSU+ITS+LSU (Phyls 7, 25) no such monophyly was obtained but the three series clustered unresolved in a supported clade that represents all taxa with adhesive traps. In Li et al.'s (2005) combined analysis of 5.8S+LSU+*TUBB*, *Dactylellina* clustered as a distant sister group of *Drechslerella* and *Dactylella*, with *Gamsylella* and *Arthrobotrys* diverging earlier, but all main branches did not receive support.

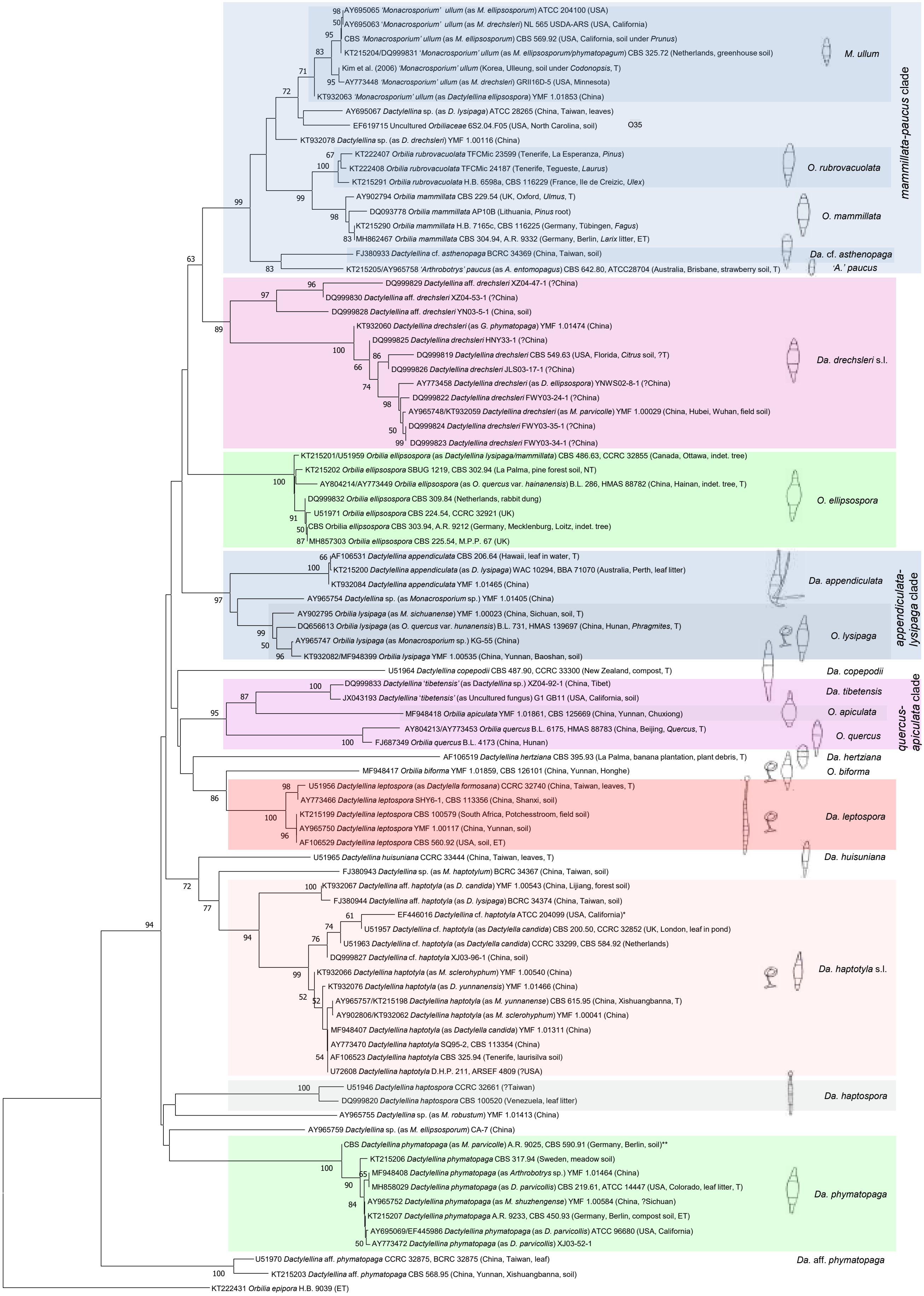
The phylogenetic relationship within series *Dactylellina* was mostly unresolved when analysing the ITS region, and only some species showed supported associations with other taxa (Phyl. 31, NJ), but also in the combined analyses many taxa clustered unresolved (Phyl. 25, S35, ML). One such clade is that around *O. mammillata* and *O. rubrovacuolata*, to which also '*Monacrosporium*' *ullum* and '*Arthrobotrys*' *paucus* belong (here called *mammillata-paucus* clade), and which received strong support in Phyls 31, S35. Another clade concerns *D. appendiculata* and *O. lysipaga* (type of *D. sichuanensis*) which clustered with medium (S35) or strong support (Phyls 32, 33) in the *appendiculata-lysipaga* clade. All the other species clustered in a more or less unresolved position, but for some only ITS was available. The identity of almost all these taxa are affirmed by type sequences in GenBank or CBS. Some of the clades remained unnamed as they included only incorrectly identified strains.

In analyses of Yang & Liu (2006, ITS+LSU) and Yang et al. (2007, ITS and ITS+LSU), *D. leptospora* clustered with *D. haptotyla*, whereas in the ITS phylogram of Yang & Liu (2006) it clustered with *D. appendiculata* (= *M. tentaculatum*). However, in Hagedorn & Scholler's (1999) and our ITS and LSU analyses (Phyl. 31, 32) but also in the combined trees (Phyls 25, S35), *D. leptospora*, *D. haptotyla*, and *D. appendiculata* clustered quite distantly and unresolved, although the strains in any of these analyses do not appear to be misidentified.

A certain correlation was noted in our analyses with regard to the two types of trapping organs: non-constricting rings occur in four species (*O. biforma*, *D. haptotyla*, *D. leptospora*, *O. lysipaga*, see Phyl. 31), whereas the entire *mammillata-paucus* clade, but also *O. ellipsospora*, *D. copepodii*, *D. hertziana*, and some other, unresolved clades are devoid of them. Only in the *appendiculata-lysipaga* clade taxa with and without non-constricting rings occur. Yang et al.'s (2007) analysis, however, suggests occurrence of non-constricting rings in a single clade which contains *D. leptospora* and *D. haptotyla*.

Specific nucleotide positions. Series *Dactylellina* as circumscribed here shows at pos. 13–15 of the ITS2 region a characteristic motif (TC**GGT**), by which it consistently differs from series *Gamsylella* and *Drechslerella* that have TC**GAC**, and from series *Arthrobotrys* and *Neodactylella* that have TC**AGC** (Tab. 76). Two strains under the name *M. phymatopagum* in GenBank (CCRC 32875, CBS 568.95), here called *D.* aff. *phymatopaga*, clustered outside the *Dactylellina* clade but also without clear association to other series. Their intermediate position is supported by the deviating motif TC**GGC**, which otherwise occurs only in Chinese *O.* cf. *orientalis* (series *Drechslerella*), but when studying other diagnostic motifs in Tab. 76 series *Drechslerella* can be excluded.

In the 5.8S region, species here accepted in series *Dactylellina* are identical, except for *D. haptotyla*, *D.* aff. *haptotyla*, *D. haptospora*, and *D.* aff. *phymatopaga*, which



Phylogenetic analysis 31. NJ analysis of series *Dactylellina* based on ITS1-5.8S-ITS2 rDNA dataset (90 sequences, 621 positions, aligned with MUSCLE) using MEGA7 (500 replicates). The tree is rooted with *O. epipora*. Asci 8-spored in all teleomorph taxa; T = type, ET = epitype, NT = neotype, * = without ITS1 and partial 5.8S, ** = without ITS2. NJ was chosen because ML gave a similar tree topology with much less bootstrap support.

Phylogenetic analysis 32. Phylogram of series *Dactylellina* inferred from ML analysis of LSU (D1–D2) rDNA dataset (55 sequences, 575 positions, aligned with MUSCLE) using the K2+G+I model in MEGA7 (500 replicates). The tree is rooted *with Lilapila oculispora* and *O. patellarioides*. Asci 8-spored in all teleomorph taxa; T = type, ET = epitype, NT = neotype.

deviate in stem-loop B8 at 4 symmetric positions (pos. 122–123 & 132–133), *D. haptotyla* also at pos. 119 & 136 and at pos. 147 (Tab. 77). The character C at position 147 is otherwise found within *Orbiliomycetes* at present only in *Orbilia multicurvula*, *Amphosoma resinicola*, and the four species of *Lecophagus*.

Ecology. Members of series *Dactylellina* have more or less desiccation-sensitive apothecia that grow on a wide variety of woody and herbaceous substrates. They occur worldwide in temperate to tropical humid to subhumid regions.

Orbilia rubrovacuolata Baral, Priou & E. Weber, **sp. nov.**, MB 814376 — Pls 977–980, Map 157

Etymology: referring to the paraphyses and excipular cells containing large rose-red vacuoles.

Typification: France, La Gacilly, branch of *Ulex europaeus*, 25.II.2000, J.P. Priou (ex H.B. 6588, M-0276580, holotype).

Misapplied name: H. & P. Crouan (in sched., as *Helotium coccinellum* and *Peziza infixa*).

Latin diagnosis: *Similis* Orbiliae auricolori *sed apothecia dilute ad intense salmoneo-roseo-rubra, raro pallide chlorinacea, margine saepe minutissime crenulato, ascosporae vivae corpusculum refringens bacilliformem, ad apicem late vel anguste affixum continentes, paraphyses in statu vivo vacuolas dilute purpureo-roseo-rubras continentes, cellulae excipuli marginalis processis vitreis brevibus praeditae. Habitat ad corticem vel lignum putridum ramorum uvidorum fruticum vel arborum angiospermarum, raro coniferarum, ad caules Rubi, in zona atlantica temperata ad mesomediterranea (semi)humida Europae occidentalis et Macaronesiae.*

Description: — **TELEOMORPH**: **Apothecia** fresh (0.2–)0.3–1.3(–2) mm diam., 0.15–0.25 mm high (receptacle 0.12–0.16 mm), pale to mostly light to bright (pinkish- or lilac-)salmon-rose-red (or carmine-rose), also orange- or blood-red, rarely whitish-greyish-yellowish(-chlorinaceous), slightly to strongly translucent, round, slightly lobate when large, subscattered to subgregarious; disc saucer-shaped to flat, finally slightly convex, margin distinct, thin, scarcely protruding, smooth to often (very) finely crenulate, rarely toothed; broadly sessile, sometimes with a small stipe-like base 30 × 90 µm, superficial; dry bright to deep carmine-lilac to orange-red or carmine, with a more thick and raised margin. **Asci** *(32–)35–47(–51) × (3.3–)3.5–4.5(–5.2) µm {8}, †30–43 × 3.3–4 µm {3}, 8-spored, spores 4-seriate, (2–)3–4 lower spores inverted (not mixed) {12}, pars sporifera *18–24 → 14 µm long; **apex** (†) (slightly to) medium (to strongly) truncate (not indented, laterally sometimes slightly inflated); **base** with a short to medium long, flexuous stalk, T-, h- or H-shaped. **Ascospores** *(8.5–)9–12(–13) × (0.8–)0.9–1.2(–1.3) µm {11} (~9.5–14 µm actual length), †9–13(–14) × (0.9–)1(–1.2) µm {3}, narrowly subcylindric- to fusoid-clavate, apex rounded, base slightly or often medium to strongly attenuated, often with a more or less distinct tail; medium to strongly

Key to species of series *Dactylellina* with known teleomorph

1. Spores slightly to strongly curved, length/width ratio ~8–12 based on actual length (i.e., < 1.3 µm wide if actual length = 10 µm 2
1. Spores straight to medium curved, length/width ratio < 7(–8).. 4

2. Spores *(8.5–)9–12(–13) × (0.8–)0.9–1.2(–1.3) µm (in situ); SBs consistently rod-shaped, 0.2–0.4(–0.5) µm wide, apical attachment broad or only slightly narrowed; apothecia pale to bright red (pigmented VBs in paraphyses), rarely whitish; conidia fusiform, (2–)3–4(–6)-septate; bark & wood of angio- & gymnosperms, *Rubus* stems, polypores, cold- or warm-temperate humid to mesomediterranean semihumid, (sub)atlantic western Europe, Macaronesia .... ***O*. *rubrovacuolata***, p. 1587
2. Spores *8–10(–11.5) µm long, slightly to medium curved; SBs globose to rod-shaped, 0.3–0.6 µm wide; apothecia whitish, sometimes pale rosaceous or light yellow-orange, without reddish vacuoles 3

3. Spores *(6.5–)8–10(–11.5) × 1–1.3(–1.4) µm; marginal excipulum oriented at a 50–80° angle, cortical cells *8–16 × 4–6 µm; conidia fusiform, (2–)3–4-septate; wood & bark of angio- & gymnosperms, hemiboreal to cold-temperate humid Europe ***O*. *mammillata***, p. 1594
3. Spores *8–10 × 1–1.1 µm; marginal excipulum oriented at 10–40°, cortical cells †6–11 × 3–3.5 µm; anamorph unknown; leaf of *Quercus*, cold-temperate humid atlantic Europe .... ***O*. cf. *mammillata***, p. 1596

4. Spores slightly to medium curved (allantoid), *4–6 × 1–1.2 µm; indet. bark, subtropical humid eastern Asia ....***O*. *biforma***, p. 1605
4. Spores ± straight 5

5. Paraphyses at least partly distinctly spathulate or lanceolate-lageniform; anchoring hyphae 3–6 µm wide; heads of adhesive knobs ellipsoid to lageniform, covered by strongly swellable gel; SBs often distinctly eccentrical, subglobose to rod-shaped; marginal cortical cells without glassy processes ....**series *Gamsylella***, p. 1610
5. Paraphyses uninflated or slightly to medium capitate, never apically attenuated; anchoring hyphae 1.5–4 µm wide; heads of adhesive knobs ± globose, without conspicuous gel 6

6. Marginal cortical cells without glassy processes; spores *3.5–6.8 × 1–1.4 µm........................7
If spores longer and/or wider, SBs 1.5–2.5 × 0.3–0.6 µm, with a short filum, compare *O. yuanensis* (section *Helicoon*).
6. Marginal cortical cells with very short to long glassy processes........................11

7. Asci †20–32 µm long; apothecia 0.2–0.55 mm diam., whitish to pale yellowish........................8
7. Asci †(30–)33–40(–43) µm long; apothecia 0.3–1.2 mm diam........................10
Compare also *O.* aff. *polybrocha* (series *Drechslerella*, Pl. 1007) and *O. cyparissias* on *Euphorbia* (p. 1659).

8. Conidia 3(–5)-septate, *25–40(–50) × 8–12 µm, middle cell only somewhat larger than adjacent cells; wood of *Quercus*, cold-temperate to cold-continental humid eastern & central Asia........................ ***O*. *quercus***, p. 1597
8. Conidia (2–)4-septate, *(34–)40–50(–57) × (8.5–)10–17(–18.5) µm, middle cell mostly much larger than adjacent cells........................9

9. Conidia not or only slightly attenuated above; adhesive knobs long-stalked; wood & dung, boreal to subtropical (semi)humid, worldwide ....***O*. *ellipsospora***, p. 1603
9. Conidia slightly to strongly attenuated above; adhesive knobs subsessile; indet. wood, subtropical humid eastern Asia...***O*. *apiculata***, p. 1605
Compare also *O. acuum* on needles & bark of *Pinus* in temperate humid Europe (p. 1658).

10. Apothecia light cream-rose; anamorph unknown; stem of *Bambusa*, subtropical humid eastern Asia ....***Orbilia* sp. H.B. 8963**, p. 1654
10. Apothecia whitish; conidia 3-septate, *38–42.5 × 16–22 µm; dung of *Ovis*, orotemperate humid central Europe .... ***Orbilia* sp. H.B. 8749**, p. 1655

11. Spores *6.5–11.5 µm long, slightly to medium curved; asci †3.4–4.3 µm wide ....see under 3 (*O. mammillata*)
11. Spores *4.5–6.8(–7.5) µm long, ± straight; asci †3–3.7 µm wide 12

12. Glassy processes 10–20 µm long, curved downwards; spores ellipsoid-fusoid, *4.5–5.5 × 1.3–1.5 µm; wood of indet. angiosperm, subtropical humid eastern Asia........................***O*. aff. *quercus***, p. 1599
12. Glassy processes 1–4 µm long 13

13. Spores fusoid-clavate, with obtuse to subacute apex, *(4.5–)5–6.8(–7.5) × 1–1.2(–1.3) µm; anamorph unknown; stem of *Bambusa*, leaf of *Cocos*, tropical humid northeastern Australia ....***O*. *bambusina***, p. 1656
13. Spores cylindric-clavate, with rounded to obtuse apex, */†5–6 × 1–1.3 µm; conidia fusiform, 2–4-septate, adhesive knobs long-stalked; culms of *Phragmites* and other litter, warm-temperate to subtropical humid North America, Macaronesia, eastern Asia ***O*. *lysipaga***, p. 1600

curved (falcate, rarely helicoid), less curved in the dead state; **SBs** *(1.3–)1.5–1.8(–2.2) × 0.2–0.4(–0.5) µm {6}, rod-shaped to subulate, apically narrowed to a wide or narrow point, sometimes with very short invisible attachment. **Paraphyses** apically slightly to medium clavate-capitate, terminal cell *(8–)15–27(–32) {7} × (2–)2.5–3.2 {2} or 3.5–5.3 µm {5}, unbranched at upper septum, lower cells *5–13 × 1.8–3.2 µm {5}; hymenium pale to light pinkish-red. **Medullary excipulum** hyaline, 30–70 µm thick, of a dense, ± horizontally oriented textura globulosa-prismatica-intricata, intermingled with a few narrow hyphae, medium to very sharply delimited from ectal excipulum. **Ectal excipulum** hyaline near base, pale to bright rose-red at flanks and margin, of thin-walled, vertically oriented t. angularis(-prismatica) from base to mid flanks, 45–100 µm thick near base, cells *(9–)15–31(–39) × (8–)10–25(–30) µm {7}; 20–30 µm thick near margin, of t. prismatica oriented at 10–45 to often 80–90°, marginal cortical cells */†7–15(–20) × 3–6 µm {6}; **glassy processes** at margin and flanks absent {4} or present, (1–)2–15(–20) × 3–5 µm {14}, rarely 30–40 µm long {1}, slightly refractive, distinctly stratified, pale yellowish, distinctly curved outwards when long enough, ± conglutinate to form small crenulae or teeth at the margin. **Anchoring hyphae** sparse to abundant, forming a loose texture of parallel hyphae *1.8–3.5 µm wide (4–7 µm near insertion), walls 0.2 µm thick {4}. **SCBs** globose, hyaline, medium-refractive, in paraphyses 1(–3) per cell, 1–2.5 µm diam.; in marginal cortical cells 1 per cell, 1.5–2 µm diam.; **VBs** abundant in paraphyses and marginal cortical cells, low-

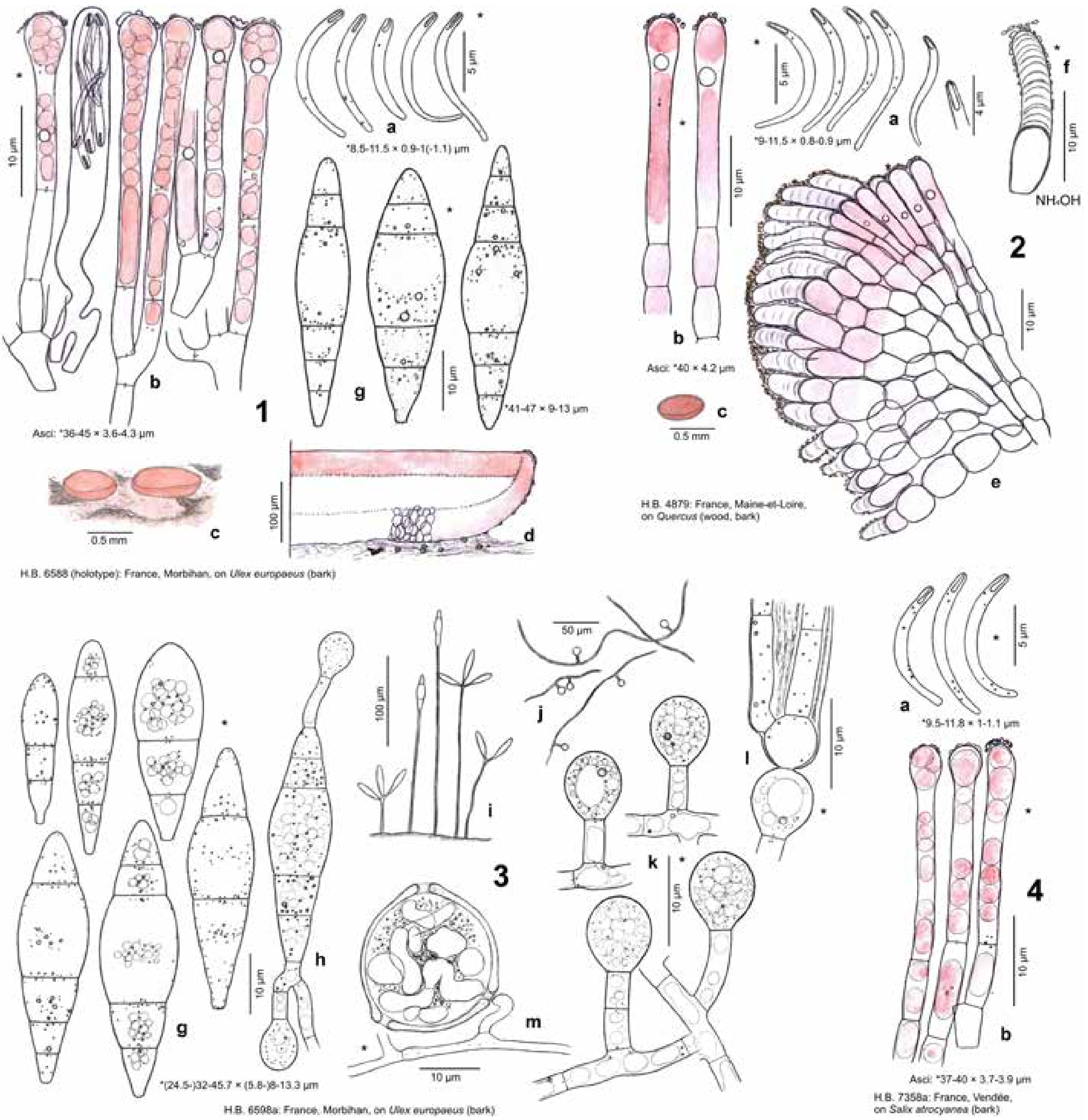


Plate 977. **1–4**: *Orbilia rubrovacuolata*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. fresh apothecia; **d**. apothecium in median section; **e**. id., ectal excipulum at margin; **f**. marginal cortical cell with glassy process; **g**. conidia; h. germinated conidium with adhesive knobs; **i**. conidiophores; **j**. mycelial hyphae with adhesive knobs; **k**. adhesive knobs; **l**. adhesive knob forming a haustorial cell and assimilative hyphae inside the end of a nematode; **m**. *Corylus* pollen infected by assimilative hyphae (**1g** from substrate, **3g–m** from culture).

refractive, pale to light purplish rose-red {20}, rarely hyaline to pale yellowish {2}. **Exudate** over paraphyses, margin and flanks granular to cloddy, pale yellowish-chlorinaceous, 0.2–0.5(–1.5) µm thick, ± firmly attached, sometimes forming caps on the paraphyses. — **ANAMORPH**: dactylellina-like (from ascospore isolate {2} and natural substrate {3}). **Conidiophores** 85–220 µm long, erect, ± straight, conidia formed singly or 2–3 in a cluster on short apical branches. **Conidia** *(25–)40–47 × (6–)9–13.3 µm {2}, (2–)3–4(–6)-septate {2}, fusiform, middle cell much larger than terminal cells when 3–4-septate. **Adhesive knobs** formed abundantly within ~10 days after nematodes were added, head subglobose, *7.3–8.8 × 6.2–7.5 µm, stalk *5–10(–18) × 2.3–2.8 µm, 0(–1)-septate {1}, also seen on the natural substrate {1}. **Non-constricting rings** not observed.

Habitat: mostly lying on moist ground {> 25}, more or less hidden under vegetation or litter, rarely still standing and 0.2–1 m above the ground {2}, on corticated, rarely decorticated, 10–70 mm thick branches of *Abies ?nordmanniana* {1}, *Castanea sativa* {1}, *Corylus avellana* {1}, *Eucalyptus* sp. {2}, *Fraxinus* sp. {1}, *F. excelsior* {1/1}, *Ilex aquifolium* {1}, *Laurus novocanariensis* {1}, *Picea abies* {1}, *Pinus* sp. {2}, *P. canariensis* {1}, *P. sylvestris* {1}, *Pseudotsuga menziesii* {1}, *Quercus* sp. {1}, *Q. robur* {3}, *Salix* sp. {10}, *S. alba* {1}, *S. atrocinerea* {1/2}, *Ulex europaeus* {10}; stems of *Rubus fruticosus* agg. {13}, *R. idaeus* {1}, *R. ulmifolius* {1}; basidiomata of *Fomitopsis betulina* {2}; on lower or nearly lateral side of branches, on medium to often strongly decayed wood {24} or loosely attached bark {24}, often on periderm but also on bast (on periderm-free areas or on inner

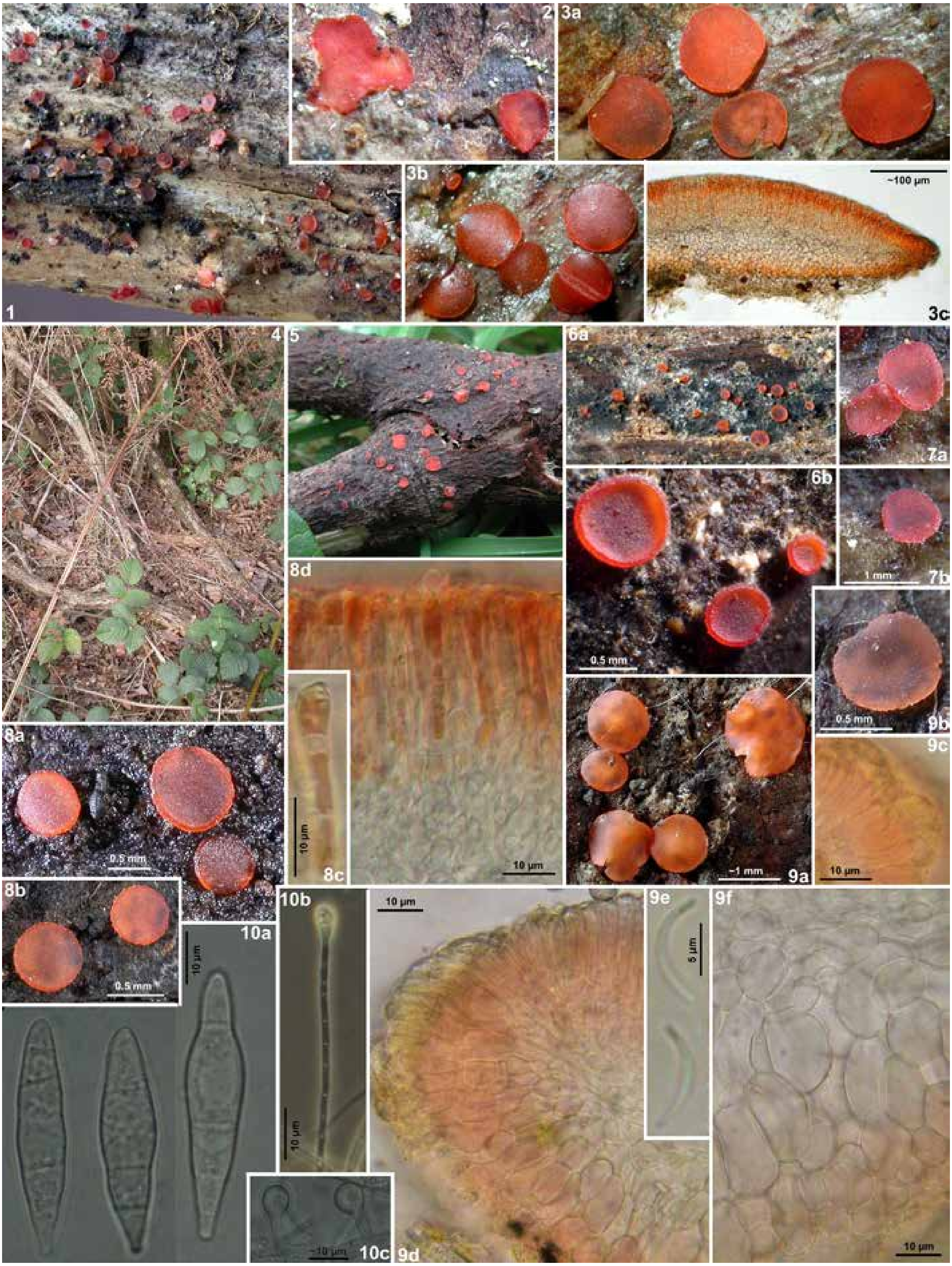


Plate 978. **1–10**: *Orbilia rubrovacuolata*. – **4**. atlantic *Ulex europaeus* shrub with *Rubus fruticosus* agg. and *Pteridium aquilinum* near pine-oak forest (holotype locality); **1**, **3a–b**, **5**, **6a–b**, **7a–b**, **8a–b**, **9a–b**. fresh or rehydrated apothecia, **2**. dry apothecia; **3c**. apothecium in median section; **9c–d**. median section of ectal excipulum at margin (with glassy processes); **9f**. id., at flanks; **8c–d**. paraphyses; 9e. ascospores; **10a**. conidia; **10b**. conidiophore with young conidium; **10c**. adhesive knobs (**10a–c**. from culture). – Living state. – **3a–c**, **4**, **5**: phot. J.P. Priou, **6a–b**: D. Mitchell, **7a–b**: M. Hairaud, **9a**: E. Rubio, **10a–c**: M. Scholler. — **1**. H.B. 7443: Netherlands, on *Rubus*; **2**. H.B. 7358a: France, Vendée, on *Salix*; **3a–c**. J.P.P. 27041: France, Morbihan, La Gacilly, on *Rubus*; **4**. phot. 18.X.2010: ibid., Glénac, Pré Naval, on *Ulex*; **5**. H.B. 7109: France, Finistère, on *Salix*; **6a–b**. H.B. 8511: Great Britain, Kent, on *Corylus*; **7a–b**. H.B. 8688: France, Côtes-d'Armor, on *Salix*; **8**. H.B. 7719a: Netherlands, Noord-Brabant, on *Picea*; **9a–f**. H.B. 8492a: Spain, Asturias, on *Salix*; **10a–c**. H.B. 7093b: France, Morbihan, La Gacilly, on *Ulex*.

surface of bark), sometimes among and on *Thelonectria discophora* or indet. old pyrenomycetes, also on old dark brown *Corticiaceae*; with very few green algae and brown hyphae. **Associated**: *Brachysporiella gayana* {1}, *Brachysporium bloxamii* {1}, *Calycina* sp. {1}, *Chaetosphaerella phaeostroma* {1}, *Chalara* sp. {1}, ?*Cosmospora* sp. {1}, *Endophragmiella boothii* {3}, *Hamatocanthoscypha laricionis* {1/1}, *Herpotrichia macrotricha* {1}, *Hyaloscypha ?vitreola* {1}, *Lachnum ?subvirgineum* {1}, *Mollisia* sp. {3}, *M. fusca* {1}, *M. ulicis* {1}, *Nemania serpens* {1}, *Orbilia auricolor* {2}, *O. eucalypti* {1}, *O. fabacearum* {1}, *O. leucostigma* {1}, *O. luteorubella* {1}, *O. rosea* {1}, *O. sarraziniana* {1}, *Pezicula rubi* {1}, *Pleurothecium recurvatum* {1}, *Pseudorbilia bipolaris* {1}, *Thelonectria discophora* {2}, *Trichoderma aureoviride* {1}, sometimes with bryophytes (*Lophocolea bidentata*, pleurocarpous mosses). **Desiccation tolerance**: Asci, terminal cells of paraphyses, and marginal excipular cells dead already after half a day in the herbarium; lower cells of paraphyses viable up to 3 weeks, some basal excipular cells and ascospores after 5 weeks, and some medullary excipular cells after 8 weeks. **Altitude**: 2–268 m a.s.l. (western Europe), 7–512 m (Spain), 825–1203 m (Tenerife). **Geology**: Cambrian siltstone & quartzitic wacke, Ordovician, Silurian & Carboniferous mud-, silt- & sandstone and coal, quartzite, Keuper (marl- & sandstone), Upper Jurassic limestone, Cretaceous & Tertiary marl-, sand- & mudstone, Quaternary sand, gravel & clay, marsh over Middle Jurassic limestone; granite, granodiorite, andesite, quartz diorite & biotite-amphibole, gabbro, mica schist, gneiss; Tenerife: basaltic flows and pyroclasts. **Phenology**: throughout the year.

Phenology of *O. rubrovacuolata*											
Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
4	7	13	5	10	3	4	3	5	4	3	0

Taxonomic remarks. *Orbilia rubrovacuolata* is easily recognized in the field by its conspicuously red (mostly carmine-rose) colour due to a vacuolar pigment in the living cells of both paraphyses and marginal ectal excipulum. Further characteristics separating the species from the microscopically similar *O. auricolor* are consistently rod-shaped spore bodies being attached at the ascospore apex without a filum, narrower anchoring hyphae, and usually present glassy processes at the margin which vary in length between 2–4 and 8–20(–40) µm, whereas in *O. auricolor* they were only sometimes present and then max. 6 µm long. The main difference to *O. auricolor* is the dactylellina-like anamorph with large, fusiform, mostly 4–5 septate conidia and stalked adhesive knobs. The other here reported *Orbilia* spp. with a dactylellina-like anamorph differ in whitish apothecia and in shorter and less curved ascospores.

The taxonomic value of the red vacuolar pigment of *O. rubrovacuolata*, which has never been seen in *O. auricolor*, is affirmed by the deviating anamorph and molecular data. Although the dried apothecia show an intensified bright red colour, there is no red pigment or only some remnants visible inside the rehydrated dead cells so that the tissue appears ± hyaline under the microscope. Adding alkali or acids instantly removes the pigment in fresh specimens, without extruding in the medium. The apothecia get discoloured in the herbarium by becoming very pale cream-rosaceous, sometimes already after 1–2 years, or only after a much longer period of time. As a consequence of this colour loss, the species can hardly be separated from *O. auricolor* on the basis of herbarium material, if notes on the fresh colour were not made and if the characteristic anamorph is not found on the substrate.

Variation. A certain variation was noted in the length of the glassy processes and in the width and attachment of the SBs. Also the red pigment, which was present in 59 out of 62 collections, varied somewhat in the intensity and shade. The pigment was entirely absent in the not included sample from Luxembourg (H.B. 5274, on *Quercus*, see Pls 979, 980: 3), and in two from Macaronesia (Tenerife, on *Laurus* and *Pinus*), according to photos made by L. Quijada (Pl. 980: 1–2). From both Luxembourg and Macaronesia no records of *O. rubrovacuolata* with red apothecia are so far known (see Map 157). In the Macaronesian specimens the paraphyses were narrower and often individually tipped by exudate caps, and the apothecia distinctly toothed at the margin.

We have included the Macaronesian specimens in the description because their sequence data unexpectedly indicated conspecificity with *O. rubrovacuolata* (no data were available for that from Luxembourg). From *O. auricolor* they differ by narrow marginal cortical cells tipped by rather long glassy processes (Luxembourg: 6–30 µm, Tenerife: 12–40 µm). The lack of pigment in Macaronesian *O. rubrovacuolata* does not seem to originate from a hidden growth protected from light, because also strongly pigmented populations frequently occurred on the underside of branches or were covered by litter.

Type studies. According to a reexamination by J.P. Priou (pers. comm.), three specimens in H. & P. Crouan's herbarium (CO) under the names *Peziza infixa* Wallr. (on bark of *Salix* branches, 26.IX.1863, on stems of *Rubus fruticosus* agg., VIII.1865) and '*Helotium coccinellum* (Sommerf.) Crouan' in sched. (on stems of *R. fruticosus* agg., 12.VIII.1867), which represent the first known records of *O. rubrovacuolata*. For both substrates the collectors noted the apothecia to be 'carmine-red in the living state'. In this material, even today the red colour is still present to a certain degree. Despite the characteristic falcate ascospores, this fungus was obviously included in the concept of *Peziza infixa* by Crouan & Crouan (1867: 49), a name which the authors mainly used in the sense of *O. eucalypti* (see p. 1675).

Not included collections. Because of lacking DNA data, the sample with whitish apothecia from Luxembourg (H.B. 5274, on *Quercus*, see Pls 979, 980: 3) in not included in the description. Also a specimen from Czechia (on *Populus*, IVV: H.B. 6422) with 5–12 µm long glassy processes is unclear. It might either belong to *O. rubrovacuolata* or to *O. mammillata*. The apothecia are now bright ochraceous with orange centre. On his manuscript plate, Velenovský described them as pale amber, but this plate shows a species with ellipsoid spores, suggesting a mixture or confusion. The specimen was believed by Svrček (1954) to represent *O. auricolor* (as *O. curvatispora*) and was designated by him as lectotype of *Orbilia tremulae* Velen., but this lectotypification is against the Code (see p. 1375).

Anamorph. Among the known anamorph-typified taxa with adhesive knobs, four resemble the anamorph of *O. rubrovacuolata* regarding conidial morphology: (1) *Dactylellina haptotyla* is excluded by having clusters of 3–10 conidia at the candelabrelloid conidiophore tip, stalks of adhesive knobs < 2 µm thick, and forming of non-constricting rings; (2) *D. ellipsospora* differs in wider conidia (40–50 × 12–16 µm) formed always singly at the unbranched conidiophore tip; (3) *D. drechsleri* and (4) *D. mammillata* are morphologically hardly separable from *O. rubrovacuolata*. Available molecular data of isolates under these names, including the types of *D. mammillata* and *D. drechsleri* and the neo- and epitypes designated by Rubner (1996), suggest that all of them are not conspecific with *O. rubrovacuolata*. The most closely related species is *O. mammillata*, which is shown here to be connected to a different teleomorph (see p. 1596). Since no molecular data exist in GenBank and CBS that fit

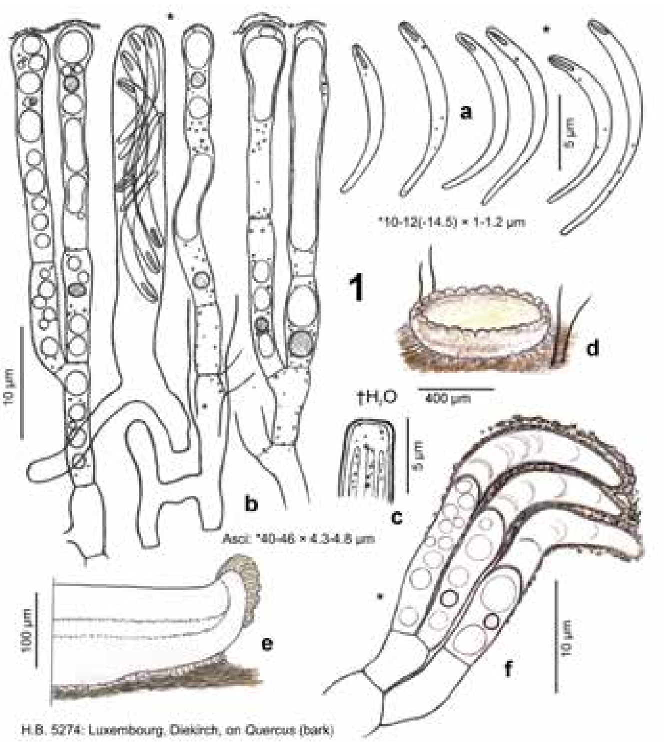


Plate 979. **1**: *Orbilia* cf. *rubrovacuolata*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apex; **d**. fresh apothecium; **e**. apothecium in median section; **f**. marginal cortical cells with glassy processes, in median section.

O. rubrovacuolata, we assume that its anamorph has not been isolated previously.

Phylogeny. A sequence from our ascospore isolate (Morbihan, H.B. 6598a) comprises SSU, ITS, and LSU. Sequences were also gained from the two Macaronesian samples with whitish apothecia, comprising ITS and LSU. In all of them the S1506 intron is absent. A distance of only 0.6–1 % is observed in the ITS region between the French and the two Macaronesian samples which differ by 0.6 %. 1 of the 3 deviating nt between the Macaronesian strains lies in the 5.8S at pos. 84 (C vs. T), the T representing a very rare exception (verified from chromatogram, see Tab. 18). In the LSU (D1–D2), the two samples from Macaronesia are identical and differ from the French ones by 2 nt (0.3 %).

When analysing the ITS region (Phyl. 31), *O. rubrovacuolata* clustered with *O. mammillata* in a strongly supported clade which, however, received only medium support in our combined analysis (Phyl. S35) and included '*M.*' *ullum* when analysing LSU (Phyl. 32). Together with *D.* cf. *asthenopaga* and '*A.*' *paucus* these taxa form the strongly supported *mammillata-paucus* clade (Phyl. 31, S35). The distance between *O. rubrovacuolata* and *O. mammillata* is 2.5–3.8 % in the ITS (2.5–3 % regarding the ex-type strain of *O. mammillata*, for the characteristic nucleotides see Tab. 88), and 0.7–0.9 % in the LSU. *O. rubrovacuolata* shows a 4.5–5 % ITS distance to '*M.*' *ullum* and 5.7–6 % to '*A.*' *paucus*.

Much more distant are the other three species with similar conidia, which clustered in separate clades: the neotype of *D. ellipsospora* (CBS 302.94) shows a 10 % ITS distance to *O. rubrovacuolata*, *D. haptotyla* (CBS 325.94) 10.5 %, and the presumed ex-type strain of *D. drechsleri* (CBS 549.63) 12.5 %.

Ecology. Populations of *O. rubrovacuolata* with red apothecia have so far only been observed in the atlantic to subatlantic, supra- to thermotemperate humid and mesosubmediterranean semihumid western Europe, partly only a few kilometres from the sea shore. The species occurs on ± rotten bark and wood of hygric branches of various angiosperm but also gymnosperm trees and shrubs, rarely large fruitbodies of polypores. Preferred hosts were *Rubus* {15}, *Salix* {14}, *Ulex* {10}, and gymnosperms {7}. The vegetation includes atlantic woodlands with *Ulex* and *Pteridium aquilinum*, also floodplain forests with *Salix*, *Fraxinus*, *Corylus*, *Tilia*, *Oenanthe crocata*, *Arum maculatum*, *Hedera helix* etc.

O. rubrovacuolata is obviously a common species in the atlantic belt. For instance, in Asturias it is said to be very frequent, especially on stems of *Rubus fruticosus* agg., therefore, collection data have often not been noted and specimens not preserved (E. Rubio pers. comm.). The first German record was presented by Lindemann & Wieschollek (2010). The apparent rareness or absence of the species in the regions of Poitou-Charentes, Aquitaine, and Cantabria is difficult to explain and might be due to a preference of *O. rubrovacuolata* for acidic soil, although occurrence on calcareous soil is ascertained.

Populations with whitish-chlorinaceous apothecia are known from subcontinental cold-temperate humid Luxembourg on bark of *Quercus* in a dense deciduous forest over Middle Keuper, and from lower mesomediterranean (semi)humid Macaronesia (Tenerife) on bark of *Laurus* in the laurel evergreen cloud forest (*Lauro novocanariensis-Perseetum indicae*) and on wood of *Pinus* in the Canarian pine forest (*Sideritido solutae-Pinetum canariensis ericetosum arboreae*) on volcanic soil (L. Quijada pers. comm.).

Specimens included. **IRELAND**: **Clare**, 8 km WNW of Ballyvaughan, Black Head Bay, 29 m, stems of *Rubus fruticosus*, on bark, 30.V.2016, J.P. Priou (J.P.P. 16112, doc. vid.). – **Kildare**, 2.5 km S of Newbridge, 1 km WNW of Curragh Edge, 105 m, branch of *Ulex europaeus*, on bark, 6.V.2016 J.P. Priou (J.P.P. 16133, doc. vid.). – **Cork**, 12.5 km WSW of Glengariff, 1.5 km N of Adrigole, 65 m, branch of *U. europaeus*, on bark, 7.V.2016, J.P. Priou (J.P.P. 16150, doc. vid.). — **GREAT BRITAIN**: **Yorkshire**, **West Yorkshire**, 8.5 km SSE of Halifax, 1.8 km NW of Huddersfield, Edgerton Park, 145 m, stem of *Rubus fruticosus*, 9.X.2015, C. Yeates (C.Y. F/2654, doc. vid.). – ibid., stem of *R. idaeus*, 1.II.2016, C. Yeates (C.Y. F/2687, doc. vid.). – ibid., stem of *R. fruticosus*, 11.III.2018 (C.Y. F/2758, doc. vid.). – 9.5 km WSW of Huddersfield, 1.5 km NNE of Marsden, 230 m, stem of *R. fruticosus*, 15.XI.2014, C. Yeates (C.Y. F/2552, anam. substr., doc. vid.). – **West Midlands**, 17 km NW of Birmingham, 4 km E of Wolverhampton, NW of Willenhall, Waddens Brook, 135 m, branch of *Salix*, on wood, 28.I.2018, P. Thompson (ø, doc. vid.). – 16 km NNW of Birmingham, 4 km NW of Walsall, Rough Wood, 150 m, branch of *Quercus robur*, on wood, 29.VIII.2016, P. Thompson (doc. vid.). – 4 km SE of Walsall,

Table 88. Eleven characteristic nucleotides in the ITS region that separate *O. rubrovacuolata* from *O. mammillata*, in comparison with *M. ullum*, remaining members of the *mammillata-paucus* clade (*A. paucus*, *D.* cf. *asthenopaga*, 3 unnamed strains), and *O. ellipsospora* s.str. Position numbers starting after ATCATTA by omitting rare inserts; number of strains indicated. 140: G* = Macaronesian *O. rubrovacuolata*, 381: T* = *A. paucus*, 382: G* = *D.* cf. *asthenopaga* (BCRC 34369).

Species	Strains	17	20	92	116	117	125	140	182	381	382	423
O. mammillata	3	A	T	A	G	C	T	A	T	C	A	C
O. rubrovacuolata	4	G	C	G	C	T	A	T G*	C	T	C	T
Monacrosp. ullum	7	A	C	A	G	T	A	A	C	C	C	C
A. paucus etc.	5	G	C	A	G	T	A	A	C	C T*	C G*	C
O. ellipsospora s.str.	5	G	C	A	T	T	A	A	C	T	C	C

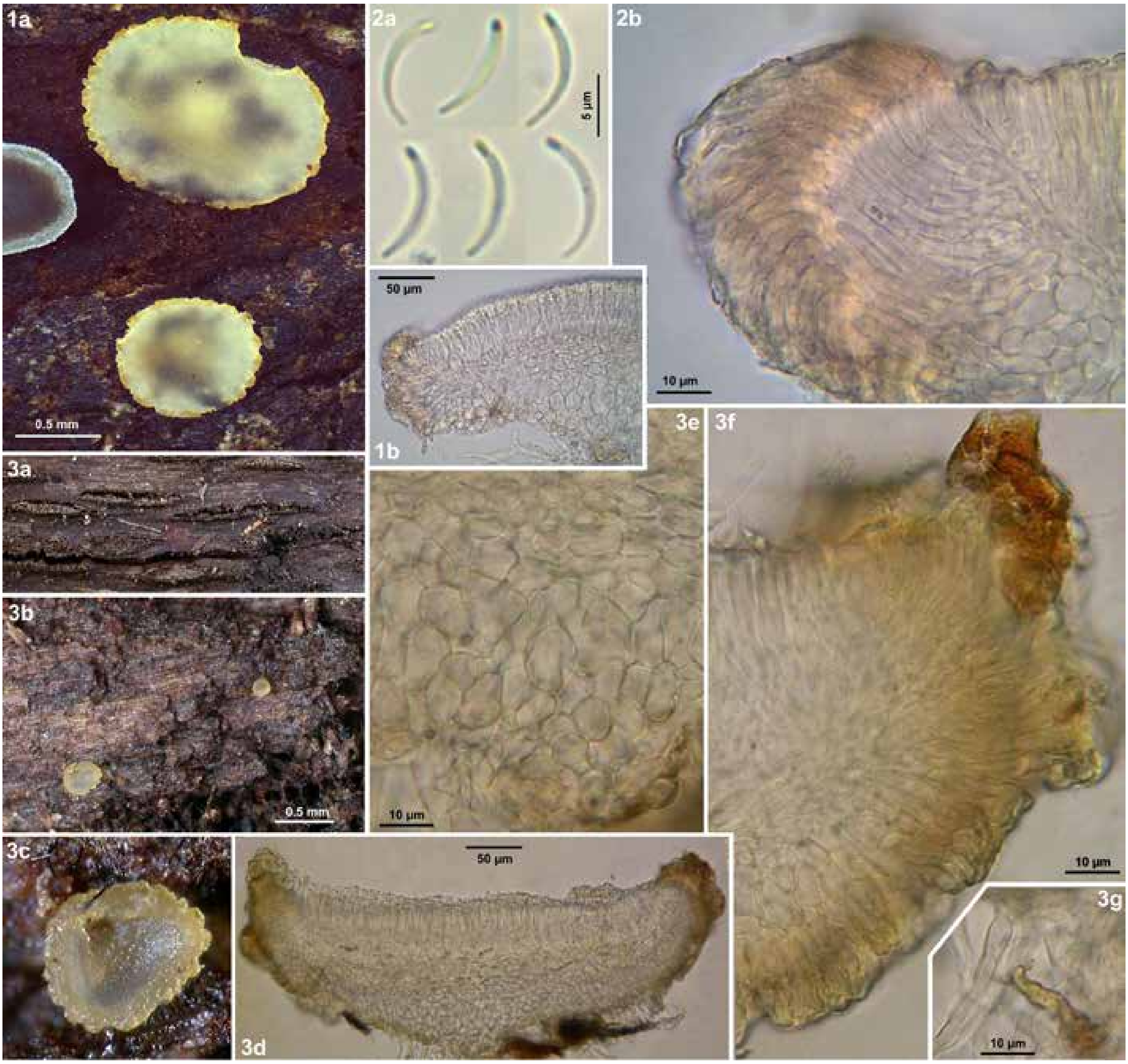
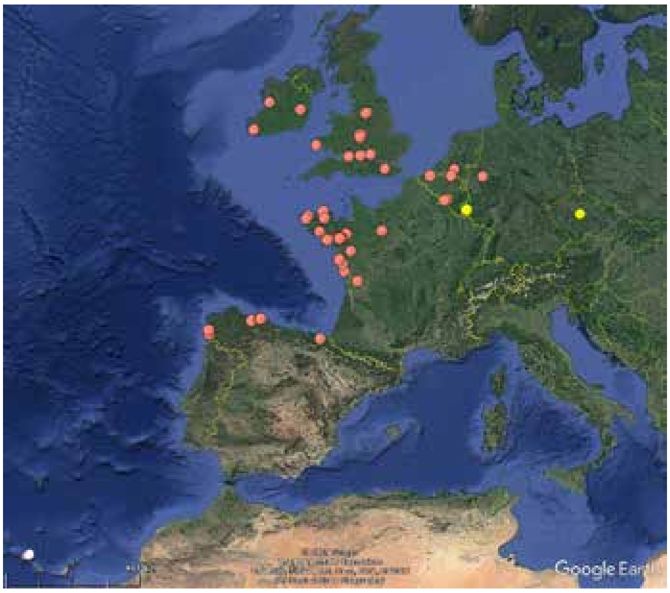


Plate 980. **1–2**: *Orbilia rubrovacuolata*; **3**: *O.* cf. *rubrovacuolata*. – **3a**. inner surface of bark; **1a**, fresh apothecia; **3b–c**. rehydrated apothecia; **1b**, **3d**. apothecium in median section; **3e**. id., ectal excipulum at base; **2b**, **3f**. id., at margin; **3g**. anchoring hyphae; **2a**. ascospores. – Living state, except for **3d–g** (in KOH). – **1a–b**, **2a–b**: phot. L. Quijada. — **1a–b**. TFC Mic. 24187: Tenerife, Tegueste, on *Laurus*; **2a–b**. TFC Mic. 23599: Tenerife, La Esperanza, on *Pinus*; **3a–g**. H.B. 5274: Luxembourg, Diekirch, on *Quercus*.

Merrions Wood, 157 m, branch of *Ilex aquifolium*, on wood, 23.VIII.2017, P. Thompson (doc. vid.). – 10 km WSW of Birmingham, E of Halesowen, Leasowes Park, 135 m, twig of *Quercus robur*, on wood, 1.IX.2018, P. Thompson (P.T. 1/9/18-8, doc. vid.). – **Wales**, **Pembrokeshire**, 7 km WNW of Pembroke, 3.7 km SSW of Waterston, Pwllcrochan Marsh, 13 m, stem of *R. fruticosus*, 8.VI.2013, P. Thompson (H.B. 9826). – **South West England**, **Bristol**, 2 km E of Bristol, Redfield, N of Netham Park, 28 m, log of *Pinus*, on wood, 10.VII.2012, J. Smith (doc. vid.). – **Wiltshire**, 5.2 km NNE of Swindon, 1 km SSW of Stanton Fitzwarren, Great Wood, 117 m, log of *Betula pendula*, on *Fomitopsis betulina*, 16.IV.2016, G. Connor, vid. Jason Doe, mis. P. Thompson (doc. vid.). – **South East England**, **Oxfordshire**, 5.5 km WSW of Thame, 1.2 km SE of Tiddington, Fernhill Wood, 80 m, stem of *Rubus fruticosus*, 28.VII.2018, P. Thompson (doc. vid.). – **Kent**, 10 km SSW of Sevenoaks, 10 km W of Tonbridge, Clinton Wood, 45 m, branch of *Corylus avellana*, on wood, 7.IV.2007, D.W. Mitchell, vid. P.W. Wilberforce (K(M) 147787, as *Hyalinia rubella*; H.B. 8511 ø). — **NETHERLANDS**: **Noord-Brabant**, 7 km NE of Tilburg, 1 km N of Udenhout, Nieuwe Tiend, 10 m, branch of *Picea abies*, on bark, 28.III.2005, L. Rommelaars (H.B. 7719a). – ibid., stem of *Rubus fruticosus*, 15.XI.2003, L. Rommelaars (L.R. 03-279, H.B. 7443). — **GERMANY**: **Nordrhein-Westfalen**, 6.5 km E of Bochum, 1 km SE of Kirchharpen, Harpener Teiche, 95 m, stem of *Rubus fruticosus*, 13.IX.2009, D. Wieschollek (doc. vid.). — **BELGIUM**: **Vlaanderen**, **Oost-Vlaanderen**, 4 km SW of Maldegem, 5 km ENE of Oedelem, Burkelbos, 19 m, trunk of *Quercus robur*, on wood, 25.VII.2007, B. Declercq (B.D. 07/064, GENT, doc. vid.). – **Antwerpen**, 3 km SSW of Turnhout, WNW of Verloren Kost, Frans Segers, 21 m, stem of *Rubus fruticosus*, 15.II.2016, F. Bartholomeeusen (F.B. 20160215FS01, doc. vid.). – **Wallonie**, **Namur**, 3 km NW of Hastière, SW of Maurenne, Bois Royal de Lens, 213 m, branch *Salix*, on bark & old pyrenomycete, 26.IX.2007, B. Declercq (B.D. 07/104, GENT, non vid.). – 6.5 km SE of Philippeville, 1.6 km WSW of Sart-en-Fagne, 179 m, branch of *Salix alba*, on wood, 4.III.2014, B. Clesse (B.C. 20140304A, doc. vid.). – **FRANCE**: **Bretagne**, **Morbihan**, 2.5 km SSE of La Gacilly, 2 km NNE of Glénac, Pré Naval, 8 m, branch of *Ulex europaeus*, on bark, 25.II.2000, J.P. Priou (ex H.B. 6588, M-0276580, **holotype**; **isotype** in J.P.P. 20066, anam. substr.); – ibid., 24.I.2002, J.P. Priou, vid. M. Scholler (J.P.P. 22005, H.B. 7093b ø, anam. substr., anam. cult., PUL F1645). – 2.5 km SE of Larmor Baden, Île de Creïzic, 14 m, branch of *U. europaeus*, on bark, 11.III.2000, J.P. Priou (J.P.P. 20088, H.B. 6598a, anam. cult., CBS 116229; sq.: KT215291). – 4.5 km WNW of La Gacilly, 1 km NW of St.-André, 93 m, branch of *U. europaeus*, on bark, 21.III.2000, J.P. Priou (J.P.P. 20093, non vid.). – 1 km WNW of La Gacilly, rue de Picardie, 30 m, stem of *Rubus fruticosus*, 3.III.2007, J.P. Priou (J.P.P. 27041, doc. vid.). – 0.3 km NW of La Gacilly, Les Bresles, 13 m, branch of *Salix*, on bark, 1.X.2006, J.P. Priou (J.P.P. 26154, non vid.). – 4.5 km SE of La Gacilly, 2.6



Map 157. Known distribution of *O. rubrovacuolata* in Europe and Macaronesia (salmon-rose = typical red form, white = genetically verified white form, yellow = not included samples with whitish-yellowish apothecia).

km E of Cournon, Pinguily, 24 m, branch of *Ulex europaeus*, on bark, 19.III.2008, J.P. Priou (J.P.P. 28039, doc. vid.). – 1.2 km WSW of La Gacilly, E of Mabio, La Naveterie, 30 m, branch of *Pinus sylvestris*, on wood, 27.X.2010, A. Gardiennet (J.P.P. 10179, doc. vid.). – 2 km SW of Locmariaquer, Breneguy, 2 m, branch of *U. europaeus*, on bark, 31.III.2000, J.P. Priou (J.P.P. 20114, doc. vid.). – 5 km SW of Auray, 0.5 km NW of Crach, Mangoero, 22 m, branch of *U. europaeus*, on bark, 19.IV.2000, J.P. Priou (J.P.P. 20130, doc. vid.). – 13 km WNW of La Gacilly, 1.3 km E of St.-Laurent sur Oust, Petit trio, 40 m, branch of *U. europaeus*, on bark, 30.I.2001, J.P. Priou (J.P.P. 21024, non vid.). – **Ille-et-Vilaine**, 10 km SW of Rennes, 2.4 km NW of Bruz, Bois de Cicé, 28 m, branch of *Salix*, on wood, 23.III.2007, A. Poncelet (J.P.P. 27064, non vid.). – 15 km SSW of Rennes, 4 km NE of Guichen, NE of Le Boel, 50 m, stem of *Rubus fruticosus*, 11.I.2007, J.P. Priou & A. Poncelet (J.P.P. 26023, doc. vid.). – 14.5 km NE of Redon, 1.6 km WSW of St.-Just, Ruisseau de Cojoux, 35 m, branch of *Salix*, on wood, 22.II.2007, A. Poncelet & J.P. Priou (J.P.P. 27063, non vid.). – **Finistère**, unlocalized, stems of *R. fruticosus* agg., VIII.1865, H. & P. Crouan, vid. J.P. Priou (CO, Crouan as *Peziza infixa*, non vid.). – unlocalized, stems of *Rubus fruticosus* agg., 12.VIII.1867, H. & P. Crouan, vid. J.P. Priou (CO, Crouan as *Helotium coccinellum*, doc. vid.). – 9 km NW of Crozon, 1 km W of Roscanvel, Men Caër, 50 m, branches of *S. atrocinerea*, on bark & *Corticiaceae*, rarely wood, 8.III.02, J.P. Priou (J.P.P. 22050, H.B. 7109a). – 3.3 km ENE of Quimperlé, 4 km N of Rédené, Rosgrand, 79 m, branch of *Pinus*, on wood, 15.VII.2012, P.Y. Courio, vid. J.P. Priou (J.P.P. 12081, doc. vid.). – 8 km N of Brest, NW of Gouesnou, marais de Kergontès, 80 m, branches of *Salix*, on bark, 26.IX.1863, H. & P. Crouan, vid. J.P. Priou (CO, Crouan as *Peziza infixa*, doc. vid.). – **Côtes-d'Armor**, 2 km NNW of Pleumeur-Bodou, Impasse de Crec'h Labo, 40 m, branch of *Salix*, on wood, 22.XI.2007, M. Hairaud (H.B. 8688). – 17 km WSW of Guingamp, 3 km E of Loc Envel, forêt de Coat An Noz, log of *Pseudotsuga menziesii*, on bark 6.III.2016, M. Hairaud & B. Capoen (M.H. 10316, doc. vid.). – **Basse-Normandie**, **Orne**, 3 km NNW of Bellême, La Herse, 190 m, branch of *Salix*, on wood, 23.IX.2005, J.P. Priou (J.P.P. 25135, doc. vid.). – **Pays-de-la-Loire**, **Maine-et-Loire**: 23 km ENE of Nantes, ~0.7 km WNW of St.-Sauveur-de-Landemont, affluent of Divatte, ~50 m, branch of *Quercus*, on wood & bark, 16.V.1993, T.R. Lohmeyer & J. Mornand (H.B. 4879). – **Vendée**, 33 km NW of La Rochelle, 1.5 km NW of La Tranche sur Mer, 2 m, branch of *Salix ~atrocinerea*, on bark, 2.VI.2003, C. Lechat (H.B. 7358a). – ibid., branch of *Fraxinus excelsior*, on wood, 2.VI.2003, R. Pacaud (H.B. 7358b). – 1.3 km NW of St.-Georges-de-Pointindoux, WNW of Les Moulières, 55 m, branch of *Salix*, on bark, 18.III.2011, R. Pacaud (R.P., as *O.* ?*coccinella*, H.B. 9497 ø). – **Poitou-Charentes**, **Charente Maritime**, 9.3 km N of St.-Jean-d'Angély, 2.7 km ESE of Lozay, Bois des Essouverts, 87 m, log of *Abies* ?*nordmanniana*, on wood, 18.II.2019, P. Tanchaud (doc. vid.). — **SPAIN**: **País Vasco**, **Gipuzkoa**, 5 km SSW of Zarautz, 2.5 km W of Aia, 480 m, on *Fomitopsis betulina*, 25.IV.2015, J. Martin (ARAN-F 01254, doc. vid.). – **Asturias**, Castrillón, 0.8 km S of Salinas, 7 m, stem of *Rubus fruticosus*, 15.V.2010, E. Rubio (ø, non vid.). – near Llodares, La Lloba, inside village, 50 m, branch of *Salix*, on bark, 4.V.2007, E. Rubio (E.R.D. 4102, H.B. 8492a). – ibid., stem of *Rubus ulmifolius*, 4.V.2007, E. Rubio (E.R.D. 4103, non vid.). – 7 km NW of Tineo, SSE of Bustellán, Valle de Tablado, 512 m, on wood of ?*Fraxinus* (or ?*Corylus*), 8.IV.2007, J. Linde (doc. vid.). – **Galicia**, **Pontevedra**, 21 km WNW of Pontevedra, 1.3 km W of O Grove, N of O Con, 8 m, branches of *Eucalyptus*, on wood, 13.V.2015, M.A. Delgado, vid. J. Castillo & R. Blasco (R.B. 13-05-15-817-GA, doc. vid.). – 16 km SW of Pontevedra, Bueu, E of Alfonso Rodríguez Castelao Rd, 10 m, board of *Eucalyptus*, on wood, 13.II.2019, S. Corral, vid. E. Rubio (E.R.D. 7845, doc. vid.). — **MACARONESIA**: **Canary Islands**, **Tenerife**, El Rosario, 13.5 km WSW of Santa Cruz, 3 km SW of La Esperanza, Montaña Grande, 1203 m, branch of *Pinus canariensis*, on wood, 3.X.2012, L. & C. Quijada (TFC Mic. 23599, doc. vid.; sq.: KT222407). – Tegueste, 5 km NNW of San Cristóbal de La Laguna, 4 km ENE of Tegueste, Hoya Zapata, 825 m, branch of *Laurus novocanariensis*, on bark, 8.V.2013, L. & C. Quijada (TFC Mic. 24187, doc. vid.; sq.: KT222408).

Not included. **LUXEMBOURG**: **Gutland**, **Diekirch**, 5 km SE of Diekirch, 1.5 km WSW of Ermsdorf, Kieselshéicht, 300 m, trunk of *Quercus*, on bark, 28.IV.1995, A. Lauron (H.B. 5274). — **CZECHIA**: **Central Bohemia**, 3 km SE of Mnichovice, Hrusice, 360 m, branch of *Populus tremula*, on bark, 13.VI.1923, J. Velenovský (PRM 149390, as *O. tremulae*, H.B. 6422 ø).

Orbilia mammillata (S.M. Dixon) Baral & E. Weber, **comb. nov.**, MB 813997 — Pls 981–982

Basionym: *Dactylella mammillata* S.M. Dixon, Trans. Br. Mycol. Soc. 35: 144 (1952)

≡ *Monacrosporium mammillatum* (S.M. Dixon) R.C. Cooke & C.H. Dickinson, Trans. Br. Mycol. Soc. 48: 622 (1965)

≡ *Golovinia mammillata* (S.M. Dixon) Mekht., Khishchnye Nematofagovye Griby – Gifomitsety (Baku): 159 (1979)

≡ *Dactylellina mammillata* (S.M. Dixon) M. Scholler, Hagedorn & A. Rubner, Sydowia 51(1): 111 (1999)

Etymology: named according to the blunt (obtuse) upper end of the conidium. **Typification**: Great Britain, Oxford, wood of *Ulmus*, IX.1950, S.M. Dixon (K, holotype; ex-type culture: CBS 229.54, not sporulating fide Rubner 1996; sq.: AY902794, AY902802, MH868837); Germany, Berlin, leaf litter of *Larix decidua*, 22.VIII.1993, A. Rubner (A.R. 9332, CBS H-5694, epitype, designated by Rubner 1996; ex-epitype culture: CBS 304.94, sq.: MH862467, MH874115). **Misinterpretation**: Rubner (1996: 83, CBS 486.63), = *O. ellipsospora*.

Description: — **TELEOMORPH**: **Apothecia** fresh (0.3–)0.5–1.1 mm diam., 0.1–0.22 mm high, pale to light (whitish-)cream-greyish(-yellowish), turning bright dirty amber with age, translucent, round to very slightly undulating, ± gregarious; disc flat to slightly convex, margin 0–15 µm protruding, smooth to very finely rough; broadly sessile, superficial, dry pale cream(-ochraceous). **Asci** *(24–)27–35(–40) × 4.3–5.5 µm {2}, †25–36 × 3.4–4.3 µm {2}, 8-spored, spores *4–8-seriate, 3–4(–5) lower spores inverted {1} (sometimes mixed), pars sporifera *10–14.5(–18.5) µm long; **apex** (†) medium to strongly truncate (rarely very slightly indented, laterally often slightly inflated); **base** with short to medium long, thin or thick, flexuous stalk, Y- to h- or H-shaped. **Ascospores** *(6.5–)8–10(–11.5) × 1–1.3(–1.4) µm {2} (~8–12 µm actual length), †(6–)7–10(–11.3) × 1–1.1 µm {2}, narrowly subcylindrical to mostly cylindric- to fusoid-clavate, apex rounded, sometimes obtuse, base slightly to medium (to strongly) attenuated, slightly (to medium) curved (falcate), rarely straight; **SBs** *(0.8–)1–1.5(–2) × 0.3–0.5(–0.6) µm {3}, rod-shaped (to subulate), apically narrowed to a minute or wide point, also tear-shaped to subglobose with often invisible attachment (?overmature). **Paraphyses** apically (not or) slightly to medium capitate(-clavate), terminal cell *(12–)15–22(–25) × (2.2–)3–4(–4.5) µm {2}, lower cells *4–8(–9) × 2.2–3(–4.5) µm {2}; rarely branched at upper septum, hymenium hyaline to pale yellowish. **Medullary excipulum** hyaline, 40–50(–70) µm thick, of dense textura intricata with many inflated cells, sharply delimited from ectal excipulum, especially at flanks. **Ectal excipulum** hyaline, of thin-walled, vertically oriented t. globulosa(-angularis) from base to mid flanks, 40–60(–110) µm thick near base, cells *10–30 × 9–24 µm {1}; 25–30 µm thick near margin, of t. prismatica oriented at a 50–80° angle to the surface, marginal cortical cells *(6–)8–16 × 4–6 µm {2}; **glassy processes** (0–)2–9 × 4–5.5(–6.5) µm {3}, low-refractive, stratified. **Anchoring hyphae** abundant, */†(2–)2.5–3.5(–5) µm wide, walls 0.2 µm thick {2}. **SCBs** not seen; **VBs** in paraphyses very low- to low-refractive, (very) pale chlorinaceous-yellow, globose to strongly elongate {T}. **Exudate** over paraphyses and marginal excipulum

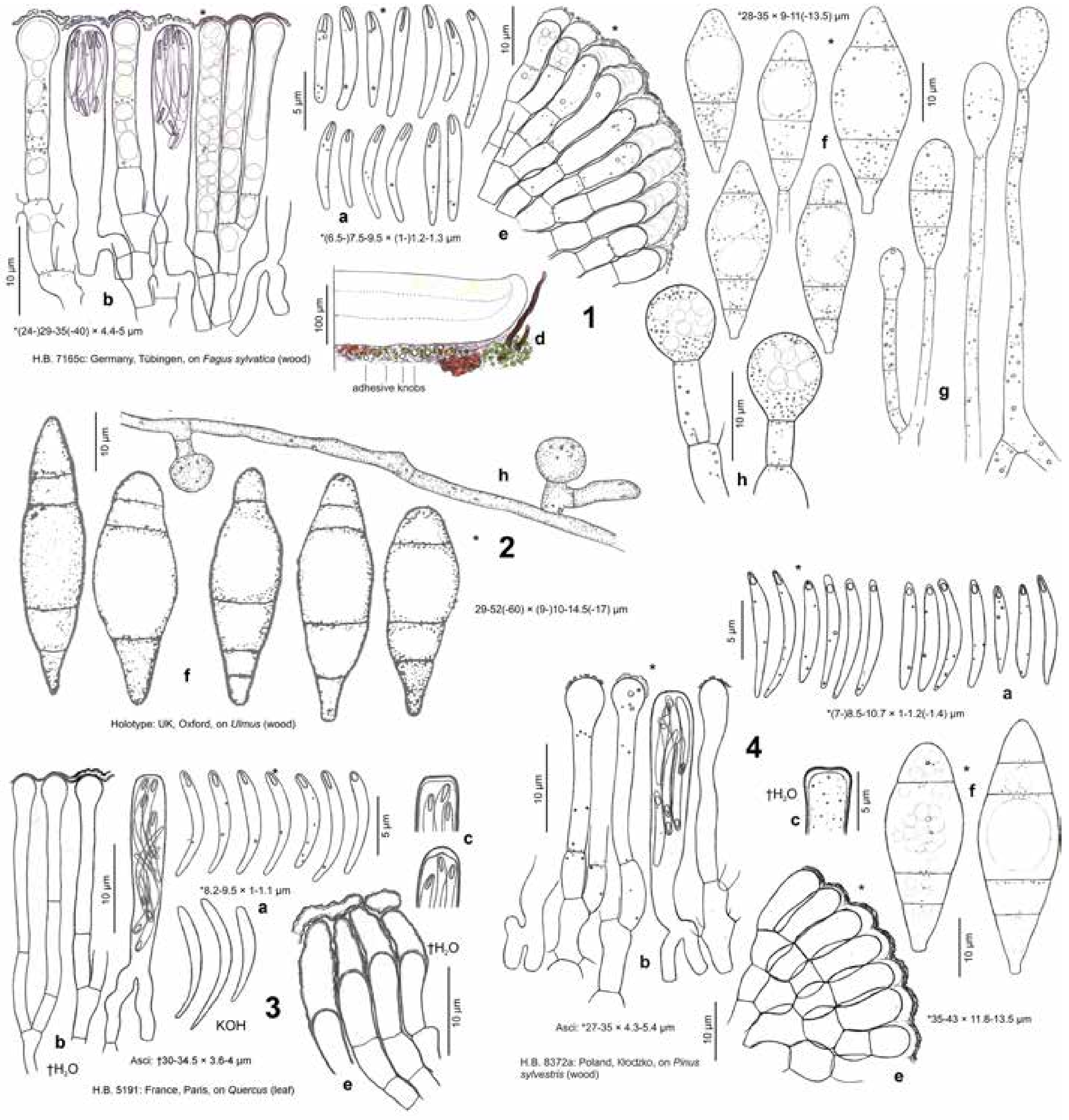


Plate 981. **1–2**, **4**: *Orbilia mammillata*; **3**. *O.* cf. *mammillata*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. apothecium in median section (with adhesive knobs below); **e**. marginal ectal excipulum in median section, cortical cells with or without glassy processes; **f**. conidia; **g**. conidiophores; **h**. adhesive knobs (**1f–g**, **2f**, **h**, **4f** from culture, **1h** from substrate). – **2**: from Dixon (1952).

0.2–0.5(–1) µm thick, granular-cloddy, loosely attached, hyaline to pale chlorinaceous-yellow or sometimes pale (olivaceous-)brown. — **ANAMORPH**: dactylellina-like (from ascospore isolate {2} and natural substrate {3}). **Conidiophores** 32–60 µm long, ~3–3.5 µm wide at base, 1.8–2.2 µm wide at apex, unbranched {1}, 0–1-septate, with a single conidium at apex. **Conidia** fusiform (to fusiform-clavate), with obtuse apex, *(27.5–)30–43(–47.3) × (9–)10–13.5(–14.5) µm {4}, 29–52(–60) × (9–)10–14.5(–17) µm {T}, (2–)3–4-septate, middle cell always distinctly larger than other cells {3}. **Chlamydospores** not observed. **Adhesive knobs** short-stalked, heads *7.5–10.2 × 7–8.2 µm, stalks 5–9 × 2–3 µm, arising either from excipular cells and anchoring hyphae, or from mycelium in pure culture. **Non-constricting rings** absent.

Habitat: 0–50 cm above the ground, partially to entirely decorticated, 45–70 mm thick branches or ~30–40 cm thick cut stumps of *Fagus sylvatica* {2}, *Picea abies* {1}, *Pinus sylvestris* {2}, ?*Populus* sp. {1}, *Ulmus* sp. {1}, on underside or laterally, or on cut surface, on 2–3 mm or deeper strongly decayed wood {5}, sometimes on old pyrenomycete, no algae. **Associated**: *Brachysporium nigrum* {1}, *Cacumisporium capitulatum* {1}, *Chaetosphaeria* sp. {1/1}, *C. myriocarpa* {1}, *Claussenomyces prasinulus* {1}, *Dematioscypha delicata* {1}, *Lentomitella cirrhosa* {1}, *Leptodontidium trabinellum* {1}, *Metatrichia vesparium* {1}, *Mollisia* sp. {1}, *M.* ?*oblonga* {1}, *Orbilia bembicodes* {1}, *O. dryadum* {1}, *O. xanthostigma* {1}, *Rhizodiscina lignyota* {1}, *Tubeufia cerea* {1}. **Desiccation tolerance**: apparently intolerant, but a few inflated cells of the medullary excipulum still viable after 2 months. **Altitude**: 62–430 m a.s.l. **Geology**: Keuper (Stubensandstein), Pleistocene sand & gravel, mica schist & gneiss. **Phenology**: VII, X–XI (teleomorph).

Taxonomic remarks. *Orbilia mammillata* is characterized by slightly curved (falcate), only partly distinctly heteropolar ascospores, with ± rod-shaped but also subglobose spore bodies, short-stalked, rather thick asci, and short glassy processes at the margin. The closest relative *O. rubrovacuolata* has longer and narrower, more curved spores, and *O. quercus* has shorter, almost straight spores with tear- to broadly rod-shaped SBs. The more distant *O. rectispora* and *O. cardui* (series *Neodactylella*) differ in less curved, partly shorter spores with globose to tear-shaped SBs, and longer and narrower asci, and also the type of *O. vestimenti* (= *O.* cf. *clavispora*) resembles *O. mammillata* but differs in a tendency to tailed spore bases and in slightly narrower asci with rather long and thin stalks (Pl. 938: 3).

Variation. The specimens from Poland (on *Pinus* and ?*Populus*) differ from the collection from southern Germany (on *Fagus*) in often subglobose SBs and very short glassy caps, the *Pinus* specimen also in more fusoid spores and the absence of VBs in the paraphyses (these features are possibly due to a slight senescence of the apothecia).

Misapplication. According to available molecular data, some of the strains assigned by Rubner (1996) to *M. mammillatum* belong instead to *O. ellipsospora*.

Not included collection. A sparse sample on a fallen leaf of *Quercus* (Pl. 981: 3) is very similar to *O. mammillata*. It differs in more curved spores and a marginal excipulum of distinctly smaller cortical cells (†6–11 × 3–3.5 µm) oriented at a lower angle (10–40°). Conidia could not be observed here, but placement in series *Neodactylella* seems less probable, as members of that series with similar spores differ in globose SBs and distinct marginal cell rows.

Anamorph. The anamorph of the present species fits well *Dactylellina mammillata* as described by Dixon (1952, Pl. 981: 2) and Rubner (1996, fig. 39a). Yet, in the closely related *O. rubrovacuolata* we also obtained an anamorph very similar to that of *O. mammillata*, and delimitation from *D. ellipsospora* and *D. drechsleri* is also problematic (see p. 1591). The conidia of *O. mammillata* are slightly shorter and wider than those of *O. rubrovacuolata*, and the conidiophores always formed only a single conidium. However, conidial dimensions strongly overlap. Moreover, some variation was noted within the strains here included in *O. mammillata*: in that from *Pinus* the conidia were partly 4-septate and larger (Pls 981: 4f; 982: 1j) compared to that from *Fagus* in which 4-septate conidia were not seen (Pl. 981: 1f). However, in another sample on a *Fagus* branch, collected not far from the locality of the latter one, the conidia were larger and 3–4-septate (Pl. 982: 4).

Dactylellina quercus, described by Liu et al. (2005a) as anamorph of *O. quercus*, is morphologically also very similar to *O. mammillata*. It has conidia of the same size and shape, but the middle cell is not so much enlarged, also the stalks of the adhesive knobs are shorter or even absent (0–5.5 µm).

When adding nematodes to our cultures, many of them adhered to the adhesive knobs. Where nematodes were captured, the mycelium produced many adhesive knobs in direct vicinity. A lot of adhesive knobs were also found on the natural substrate in two collections (Pls 981: 1d, h; 982: 3c). They occurred at the apothecial base and lower flanks, where they clearly emerged from the excipular cells, or from anchoring hyphae attached to excipular cells.

Typification of anamorph. Rubner could not redescribe Dixon's living ex-type culture of *D. mammillata* because it did no longer sporulate. In the dried specimen she found much smaller conidia of another shape (15–23 × 6–9 µm, ellipsoid-clavate, 3-septate) than given in the protologue (30–60 × 9–17 µm, fusiform, mostly 4-septate, also 2–3-septate). Because of this divergence, Rubner designated an epitype. She selected a collection with mostly 3-septate, apically rounded conidia (CBS 304.94, Berlin-Dahlem), because in her studied strains this type of conidia strongly prevailed, and also Dixon emphasized conidia with more rounded apices as typical. Yet, our strains of *O. mammillata* and *O. rubrovacuolata* had predominantly conidia with attenuated apices, in the latter species sometimes with up to 5–6-septa.

Phylogeny. A sequence from our ascospore isolate of *O. mammillata* (Tübingen, H.B. 7165c) comprises SSU (without S1506 intron), ITS, and LSU. In the ITS region it shows a distance of 0.4% (2 nt, 0 gaps) to the ex-type culture of *D. mammillata* (Oxford, CBS 229.54, ITS+LSU) and no difference at all to the sequence of the ex-epitype culture (Berlin, CBS 304.94, ITS+LSU) (see Phyl. 31). An environmental sequence uploaded as *D. mammillata* (Lithuania, AP10B, ITS) differs by 3 nt from H.B. 7165c and by 5 nt from the holotype. In the LSU (D1–D2) H.B. 7165c fully concurs with the ex-type and epitype of *D. mammillata* (Phyl. 31, epitype not shown). A molecular extract (ITS2) from a *Picea* log in northwestern Russia (Karelia) matches the holotype except for a few gaps (denovo110, Kazartsev et al. 2018).

O. rubrovacuolata differs from *O. mammillata* in the ITS region by ~12–20 nucleotides and some gaps (2.5–3.8%), and in the LSU D1–D2 by 4–5 nt (0.7–0.9%), but no difference was noted in the D3. We conclude that the ex-type strain of *D. mammillata* is conspecific with our ascospore isolate, consequently we name the here described holomorph *O. mammillata*. A strain from Ontario under the name *D. mammillata* (CBS 486.63) shows a 7% distance in the ITS to the type strain and belongs to *O. ellipsospora*. The distance between *O. mammillata* and *O. quercus* ranges at 14–15.5%.

Ecology. *O. mammillata* was found on rotten wood of hygric or mesic branches and stumps of *Fagus*, *Pinus*, ?*Populus* and *Ulmus* in atlantic to subcontinental, hemiboreal to cold-temperate humid Europe. The type grew on rotten elm wood in a ditch in southern England, and the epitype was isolated from *Larix* litter in northeastern Germany. The vegetation at the two sites in southern Germany was a *Fagetum* on Stubensandstein at a south-exposed slope and a periodically flooded place along a rivulet in a shady valley nearby. In Poland it was a rich mixed forest on calcareous soil, in Lower Silesia Ordovician marble and in Lublin upper Cretaceous limestone.

Specimens included. **GREAT BRITAIN**: **South East England**, **Oxfordshire**, 9 km WNW of Oxford, near Eynsham, 65 m, on wood of *Ulmus*, IX.1950, S.M. Dixon (K, **holotype**, CBS 229.54, conid. isol., doc. vid.; sq.: AY902794, AY902802, MH868837). — **GERMANY**: **Berlin**, 10 km SW of Berlin, Dahlem, Botanical Garden, *Larix decidua* leaf litter, 22.VIII.1993, A. Rubner (A.R. 9332, CBS H-5694, **epitype**, CBS 304.94, conid. isol., non vid.; sq.: MH862467, MH874115). – **Baden-Württemberg**, 5 km ENE of Tübingen, S of Pfrondorf, Bitzle, 350 m, branch of *Fagus sylvatica*, on wood, 12.VII.2002, E. Weber (H.B. 7165c, CBS 116225, anam. substr. & anam. cult.; sq.: KT215290). – 5.5 km ENE of Tübingen, 1.4 km SE of Pfrondorf, Poppelesloch, 320 m, branch of *F. sylvatica*, on wood, 30.X.2005, E. Weber (H.B. 7954c ø, anam. substr.). — **POLAND**: **Lower Silesia**, 9 km S of Kłodzko, 2 km S of Żelazno, Bielica Mt., 430 m, stump of *Pinus sylvestris*, on wood, 21.XI.2006, P. Perz (P.P. 20061121-1, H.B. 8372a, anam. cult.). – **Lublin**, 24 km ENE of Lublin, 3.7 km N of Łęczna, 183 m, stump of ?*Populus*, on wood, 26.VII.2007, J. Węcławski (J.W. 001-33/110281, anam. substr., doc. vid.). — **LITHUANIA**: **Alytus**, 14 km ESE of Alytus, 1.5 km SW of Pocelonys, 160 m, pine plantation, on roots of *Pinus sylvestris*, VII.2003, Menkis et al. (2006, AP10B, mol. extr.; sq.: DQ093778). —

Plate 982. **1–4**: *Orbilia mammillata*. – **1a**. *Pinus* stump in calcareous mixed forest; **1b–f**, **3a**. fresh apothecia; **2a**. rehydrated apothecia; **2b**. apothecium in median section; **1g**. id., marginal ectal excipulum; **1h**. paraphyses; **1i**. asci; **1l**, **3b**. ascospores; **1j**, **4**. conidia; **1k**, **3c**. adhesive knobs (**1j–k**, **3c**, **4** from substrate). – Living state. – **1a–d**, **h–i**, **l**, **3b–c**: phot. P. Perz, **3a**: phot. J. Węcławski. — **1a–l**. H.B. 8372a: Poland, Kłodzko, on *Pinus*; **2a–b**. H.B. 7165c: Germany, Tübingen, on *Fagus*; **3a–c**. 26.VII.2007: Poland, Lublin, on ?*Populus*; **4**. H.B. 7954c: Tübingen, on *Fagus*.

RUSSIA (West): **Karelia**, 59 km NNW of Petrosavodsk, 1 km NW of Kivach, 62 m, *Picea* log (denovo110, Kazartsev et al. 2018, m.e.).

Not included. **FRANCE**: **Île-de-France**, **Essonne**, 17 km SW of Paris, Palaiseau, Parc d'Ardenay, 130 m, leaf of *Quercus*, 25.XI.1994, J. Deny (H.B. 5191).

Orbilia quercus Bin Liu, Xing Z. Liu & W.Y. Zhuang [as '*querci*'], FEMS Microbiol. Lett. 245: [99] (2005) — Pls 983–984

= *Dactylellina quercus* Bin Liu, Xing Z. Liu & W.Y. Zhuang [as '*querci*'], FEMS Microbiol. Lett. 245: [99] (2005)

Etymology: referring to the substrate, wood of *Quercus*.

Typification: China, Beijing, Huairou, trunk of *Quercus*, 10.VII.2002, B. Liu (HMAS 88781, holotype of teleomorph; HMAS 88783, permanent slide culture, holotype of anamorph; sq.: AY804213, AY773453).

Misapplied names: *O. cunninghamii* with anamorph *M. parvicolle* (Liu et al. 2002).

Description: — **TELEOMORPH**: **Apothecia** fresh 0.2–0.35 mm diam., 0.09 mm high (receptacle 0.07 → 0.045 mm), whitish to pale yellowish when fresh, translucent, round, subgregarious; disc slightly concave to flat, margin distinct, thin, not protruding, smooth; broadly sessile, superficial; dry brownish-yellowish. **Asci** †20–30 × 3.2–3.7 µm, 8-spored, spores †2–3-seriate, ~2–4 lower spores inverted (probably often mixed); **apex** (†) medium to strongly truncate (indistinctly indented, laterally not inflated); **base** unstalked or with short, ± thin stalk, Y- to h- or often H-shaped. **Ascospores** *5–6 × (0.8–)1–1.2 µm, †(4.5–)5–6.5 × 0.9–1.1 µm {T}, subcylindrical to narrowly fusoid-clavate, apex obtuse, base not or only slightly attenuated (slightly to medium attenuated in dead state), straight to ± inequilateral; **SBs** ~1–1.5 × 0.6–0.7 µm {1}, tear- to broadly rod-shaped, attached to the less attenuated spore end, ± centrally oriented. **Paraphyses** apically slightly to medium (clavate-)capitate, terminal cell †(11–)15–18 × (2–)2.5–3 µm {1}, lower cells †2.7–5.5 × 1.5–2 µm {1}; sometimes branched at upper septum. **Medullary excipulum** 20–30 µm thick, of dense textura intricata with some inflated cells, sharply delimited from ectal excipulum. **Ectal excipulum** of (†) slightly gelatinized, vertically oriented t. angularis from base to mid flanks, 30 µm thick near base, cells †9–13 × 4–9 µm {1}; 10 µm thick at margin, of t. globulosa to t. prismatica oriented at a 30–70° angle to the surface, marginal cortical cells †6–8 × 3.5–5 µm {1}; **glassy processes** absent. **Anchoring hyphae** sparse, †2–3 µm wide, walls 0.2 µm thick {1}. **SCBs** and **VBs** no data available. **Exudate** over paraphyses 0.2–0.5(–1.3) µm thick, continuous, finely rough, firmly attached, over margin and flanks 0.3–1 µm thick, granular. **— ANAMORPH**: dactylellina-like (from ascospore isolate {1}, Liu et al. 2005a). **Conidiophores** mostly 130–180 µm high, 5–6.5 µm wide at base, 1.5–2.5 µm at apex, sometime branched near the apex, tips with a single conidium. **Conidia** mostly fusiform, apically rounded to obtuse, truncate at base, *25–40(–50) × 8–12 µm, with 3(–5) septa, middle cell not much larger than the others. **Chlamydospores** not observed. Trapping nematodes by means of ± stalked **adhesive knobs**, stalk ~1–5.5 × 2.8–3.2 µm wide, heads spherical to subspherical, 8–12 × 7.5–10 µm, produced frequently on the nutritional agar plates even without presence of nematodes; **non-constricting rings** absent.

Habitat: on trunk of *Quercus* ?*mongolica* {1} lying on the moist ground, on medium decayed wood {1}, on dark layer of *Tomentella* sp., no algae. Further **associated**: none observed. **Desiccation tolerance**: unknown (probably intolerant). **Altitude**: 850–~3500 m a.s.l. Felsic **Geology**: Beijing: felsic plutonic rock. **Phenology**: VII, X.

Taxonomic remarks. *Orbilia quercus* is characterized by rather small, ± straight, subcylindrical (in the dead state narrowly fusoid-clavate) ascospores containing ± tear-shaped spore bodies, in combination with a dactylellina-like anamorph with fusoid to fusiform conidia. *O. bambusina* (incertae sedis, without known anamorph, Pls 1025–1026) appears to be very closely related, differing mainly in the presence of short glassy caps on the margin and (in the holotype collection) also on the paraphysis tips, spores with partly subacute apices, and in growing on monocots. The European *O. mammillata* differs from *O. quercus* in longer and more curved spores and in the presence of glassy processes, but in the anamorph it is very similar.

Two Chinese collections, from Hunan (on *Phragmites*) and Hainan (on indet. wood), were separated from *O. quercus* at the variety level by Liu (2006: 96, 99), based mainly on a deviating anamorph which was identified as *Dactylellina lysipaga* and *D. ellipsospora*, respectively, but also for molecular reasons. In the teleomorph the two varieties appear to be hardly distinguishable from the type of *O. quercus*. The differences lie in the conidia and the stalk length of the adhesive knobs. In the present work they are recognized at the species level as *O. lysipaga* and *O. ellipsospora*. For the questionable *O.* aff. *quercus* without anamorph see below.

O. rectispora deviates in longer spores with globose SBs with a ± invisible filum, and a dactylella-like anamorph with cylindric-fusoid conidia. Also *O. polybrocha* resembles *O. quercus* in the spores, but differs in ± eccentrical SBs, long glassy processes, an often pigmented exudate, and a drechslerella-like anamorph.

Variation. The collection from Tibet on wood of *Pinus* (without description) was said to deviate from the type merely by larger apothecia (Liu et al. 2006b: 115).

Nomenclature and type studies. Apothecial size was given in the protologue as 0.2–0.5 mm, and in the present reexamination of an isotype it was rehydrated 0.2–0.35 mm. Liu et al. (2005a) described the asci distinctly narrower (18–30 × 2.5–3 µm) than here found, but from his photograph a size of 26–31 × 3.2–3.7 µm can be evaluated. The height of the ectal excipulum in the protologue (78–96 µm) is in conflict with Liu's plate (fig. 1B), where a height of 30 µm can be measured, which is in concordance with the examined isotype. The spores are distinctly tapered at the base in the dead state, whereas on Liu's photos the living spores are cylindrical or hardly narrowed below. The SBs are given as 1.1–1.8 × 0.7–1 µm in the protologue, but they are somewhat smaller, especially narrower when evaluated from the scale.

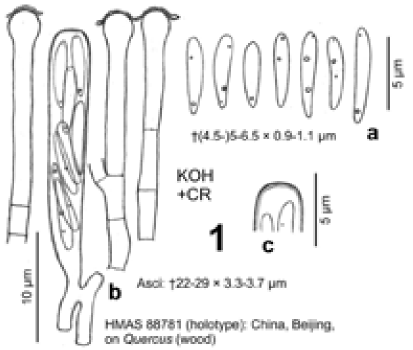


Plate 983. **1**: *Orbilia quercus*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apex.

The orignal specific epithet '*querci*' is improper because both nominative and genitive are '*Quercus*' (Latin 4th declension).

Anamorph. According to Liu et al. (2005a), *Dactylellina quercus* resembles *D. haptotyla*, *D. ellipsospora*, and *D. drechsleri*. Especially the latter two differ in their conidia having a distinctly larger middle cell. The same is true for the also similar *O. mammillata*. Apart from *D. haptotyla*, the conidia of these species are wider than in *D. quercus*. *D. haptotyla* differs in adhesive knobs with much longer stalks and in 3–10 conidia at the candelabrelloid conidiophore tip. Yang et al. (2012a) classified the partly very short-stalked adhesive knobs of *O. quercus* as sessile and suggested, also based on their multigene analysis, a transfer to the genus *Gamsylella*. The phylogenetically close *D. leptospora* differs in much longer and narrower conidia with more septa.

Phylogeny. Besides the type sequence gained by Liu et al. (2005a) from the ascospore isolate (S1506 intron, ITS, LSU), two further ITS sequences were available in GenBank: AY773453 was used by Yang et al. (2007) but is exactly a copy of AY804213, whereas FJ687349 refers to a collection from Hunan (B.L. 4173) used by Yang et al. (2012a), being incomplete in the ITS1 and showing 0.4 % distance (2 nt) to the type sequence.

In Liu et al.'s (2005a) analysis of the ITS region, *O. quercus* clustered with weak support in a clade with two strains of *D. leptospora* (CBS 560.92, epitype; SHY6-1). In our analysis we could not confirm this association, instead, *O. quercus* formed a strongly supported clade with *O. apiculata* and *D. tibetensis* nom. nud. in our NJ analysis of the ITS region (Phyl. 31, medium supported under ML), here called *quercus-apiculata* clade, with a distance of 7.7–8 % to *D. tibetensis* and 11–13 % to *D. apiculata*, *D. leptospora*, and *D. phymatopaga*. When analysing the intron, which is absent in *O. apiculata* and *D. tibetensis*, *O. quercus* clustered in a weakly supported clade with *D. leptospora*, but with a very high distance (S30). In the LSU D1–D2, *O. quercus* differs from *D. tibetensis* by 1.7 % (no LSU available for *D. apiculata*), and both clustered with *D. phymatopaga* (2.2–2.3 % distance) in a weakly supported clade Phyl. 31). This clade received medium support in our combined analysis of SSU+ITS+LSU (S35, *D. tibetensis* not shown).

Also Liu et al. (2005a) observed a high molecular distance between *O. quercus* and the previously mentioned,

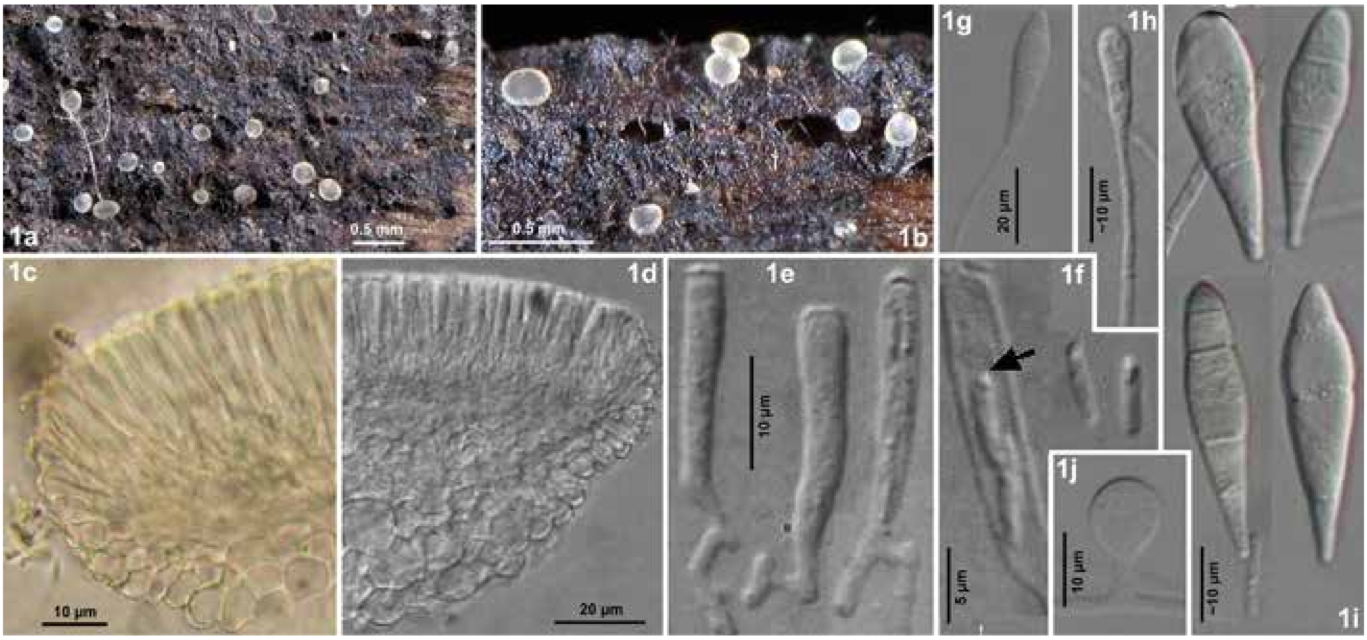


Plate 984. **1**. *Orbilia quercus*. – **1a–b**. rehydrated apothecia (after 3 years); **1c–d**. median section of ectal excipulum at flanks and margin; **1e**. asci; **1f**. ascospores; **1g–h**. conidiophores; **1i**. conidia; **1j**. adhesive knob (**1g–j** from culture). – Living state, except for **1c** (in KOH), **1e**, **h**, ascus in **1f**. – **1d–j**: from Liu et al. (2005a). — **1a–f**. HMAS 88781 (holotype of *O. quercus*); **1g–f**. HMAS 88783 (holotype of *D. quercus*): China, Beijing, on *Quercus*.

morphologically similar species *D. haptotyla*, *D. ellipsospora*, and *D. drechsleri* (11–16.5% in our evaluation). In Yang et al.'s (2012a) multigene analysis, *D. quercus* clustered strongly supported with *Gamsylella cionopaga* in a clade, and with *G. robusta* and *G. parvicollis* (= *D. phymatopaga*) forming a paraphyletic sister clade to them within the strongly supported *Gamsylella* clade. Therefore, the authors used the name '*Gamsylella querci*', but did not propose a valid combination for it. In any case, *O. quercus*, *O. apiculata*, and *D. tibetensis* concur at 2 positions of the ITS2 region (pos. 14–15) with all other sequences of series *Dactylellina* (TCG**GT**), whereas all members of series *Gamsylella* have the motif TCG**AC** (Tab. 76).

Ecology. Apothecia of *O. quercus* s.str. were so far only found in central and eastern Asia, on rotten wood of hygric logs of both gymno- and angiosperms. The type was in an orotemperate humid (winter-dry) deciduous *Quercus* ?*mongolica* forest with *Betula platyphylla* and other species in the mountain range north of Beijing (northeastern China). Another sequenced strain was reported by Liu (in GenBank) from a probably subtropical humid (winter-dry) area in Hunan (southeastern China). The collection on wood of *Pinus* was from a continental humid, subalpine site in Tibet (eastern Himalaya).

Specimens included. **CHINA**: **Beijing**, **Huairou**, 115 km N of Beijing, ~11 km WNW of Labagoumenxiang, Sunzhazi, 850 m, log of *Quercus* ?*mongolica*, on wood, 10.VII.2002, B. Liu (B.L. 6175, HMAS 88781, **holotype** of *O. quercus*, **isotype** in H.B. 7810; HMAS 88783, permanent slide from culture, **holotype** of *D. quercus*, CGMCC (AS) 3.6762 culture, anam. cult., doc. vid.; sq.: AY804213=AY773453, DQ656669). – **Hunan**, unlocalized, X.2002, B. Liu (B.L. 4173, non vid.; sq.: FJ687349). – **Tibet**, **Nyingchi**, Gongbujiangda, ?3500 m, on wood of *Pinus*, 21.VII.2004, B. Liu (HMAS 138526, non vid.).

Orbilia aff. *quercus* 8986 Pls 985–986

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.5–0.6 mm diam., 0.28 mm thick (receptacle 0.11 → 0.08 mm), pale cream, non-translucent, ± round, scattered; disc flat to medium convex, margin finely crenulate; with abrupt stalk 0.1 × 0.3 mm. **Asci** †28–32(–40) × 3.3–3.7 µm, 8-spored, orientation unknown; **apex** (†) medium truncate; **base** with short to long, thin, slightly flexuous stalk, H-shaped. **Ascospores** *4.6–5.2 × 1.3–1.5 µm, †(3.5–)4–5(–5.5) × (1–)1.2–1.3(–1.4) µm, narrowly ellipsoid to slightly fusoid, apex obtuse (to subacute), base obtuse to sometimes medium attenuated, straight, rarely slightly curved; **SBs** 1.5–1.7 × 0.25–0.3 µm, rod-shaped to subulate, narrowed to a wide or small point, ± centrally oriented. **Paraphyses** apically slightly to medium clavate-capitate, terminal cell †12–15.5 × 2.5–3.5 µm, lower cells †4–6 × 1.7–2.5 µm; unbranched at upper septum. **Medullary excipulum** 20 µm thick, of dense textura angularis(-intricata), indistinctly delimited from ectal excipulum. **Ectal excipulum** of (†) not or slight to medium gelatinized, of t. globulosa-angularis from base to margin, 230 µm thick near base, cells †(12–)15–30 × 10–20 µm, common walls up to 1–2 µm thick; 25 µm thick at margin, of t. prismatica oriented at an 80° angle to the surface, marginal cortical cells †(6–)8–11(–14) × 4–6 µm; **glassy processes** 10–20 × 3–4 µm, outwards curved, refractive, slightly stratified. **Anchoring hyphae** medium abundant, †3–4.5 µm wide, walls (0.2–)0.3–0.5(–0.8) µm thick. **SCBs** and **VBs** no data available. **Exudate** over paraphyses 0.2–0.3 µm thick, finely rough, firmly attached. **— ANAMORPH**: unknown.

Habitat: on decorticated, ?5 cm thick branch of indet. angiosperm lying on moist ground, on medium decayed wood. **Associated**: *Brachysporium* sp. **Desiccation tolerance**: unknown (probably intolerant), very few spores alive when studied after 6 weeks. **Altitude**: 1845 m a.s.l. **Phenology**: VIII.

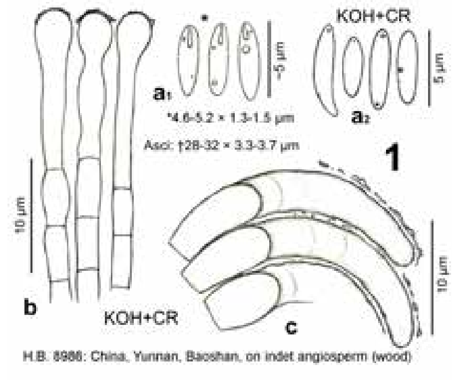


Plate 985. **1**: *Orbilia* aff. *quercus*. – **a**. ascospores; **b**. paraphyses; **c**. marginal cortical cells with glassy processes.

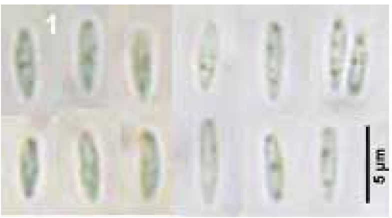


Plate 986. **1**: *Orbilia* aff. *quercus*. – Ascospores (dead state, left **6** spores in H_2O, right in KOH). – H.B. 8986: Yunnan, Baoshan, on indet. angiosperm.

Taxonomic remarks. The present sample resembles *Orbilia quercus* in the spores, which are slightly shorter and especially wider, and more fusoid. The spores contain narrowly rod-shaped to subulate SBs which are not distinctly eccentrical, an unusual feature in series *Gamsylella* and *Drechslerella* to which the species might instead belong. A certain gelatinization of the ectal excipulum and particularly the presence of short glassy processes further separate this taxon from *O. quercus*.

Ecology. The very sparse apothecia were found on rotten hygric wood of an unidentified angiosperm in a subtropical humid (winter-dry) montane evergreen broad-leaved forest in southern China.

Specimens included. **CHINA**: **Yunnan**, **Baoshan**, Tengchong, 52 km SW of Baoshan, 31 km SE of Tengchong, Gaoligongshan, 1845 m, branch of indet. angiosperm, on wood, 4.VIII.2008, X.J. Su, H.Y. Su & X.N. Zhao (H.B. 8986).

Orbilia lysipaga (Drechsler) Bin Liu, Baral & E. Weber, **comb. nov.**, MB 831501 — Pls 987–988

Basionym: *Dactylella lysipaga* Drechsler, Mycologia 29: 503, fig. 10 (1937)
≡ *Monacrosporium lysipagum* (Drechsler) Subram., J. Indian. bot. Soc. 42: 293 (1963)
≡ *Golovinia lysipaga* (Drechsler) Mekht., Mikol. Fitopatol. 1: 277 (1967)
≡ *Dactylellina lysipaga* (Drechsler) M. Scholler, Hagedorn & A. Rubner, Sydowia 51: 111 (1999)
= *Dactylellina sichuanensis* Yan Li, K.D. Hyde & K.Q. Zhang, in Li et al., Mycol. Res. 110(7): 792 (2006)
= *O. quercus* var. *hunanensis* Bin Liu, Xing Z. Liu & W.Y. Zhuang [as '*querci*'], in Liu (2006: 96), nom. inval., ICN Art. 29
?= *Dactylellina illaqueata* D.S. Yang & M.H. Mo, in Yang et al., Mycotaxon 94: 215 (2006, '2005')

Etymology: *lysipaga*: named after the non-constricting rings that get broken from their attachment by the trapped nematode; *sichuanensis* & *hunanensis*: named after the Chinese provinces Sichuan and Hunan; *illaqueata*: referring to the capturing of nematodes by trapping devices.

Typification: USA, Maryland & Virginia, leaf mould, undated, C. Drechsler (holotype of ***Dactylella lysipaga***, illustration in Drechsler 1937a: fig. 10); Azores, Faial, *Sphagnum*, V.1988, A.R. Bernitzky (CBS 581.91, RefSpec, designated here; sq.: AY261165). — China, Sichuan, Emei Shan, soil, 7.VIII.2002, L. Cao (YMF 1.000234, holotype of ***Dactylellina sichuanensis***). — China, Yunnan, Simao, soil, X.2005, D.S. Yang (YMF 1.01846, holotype of ***D. illaqueata***).

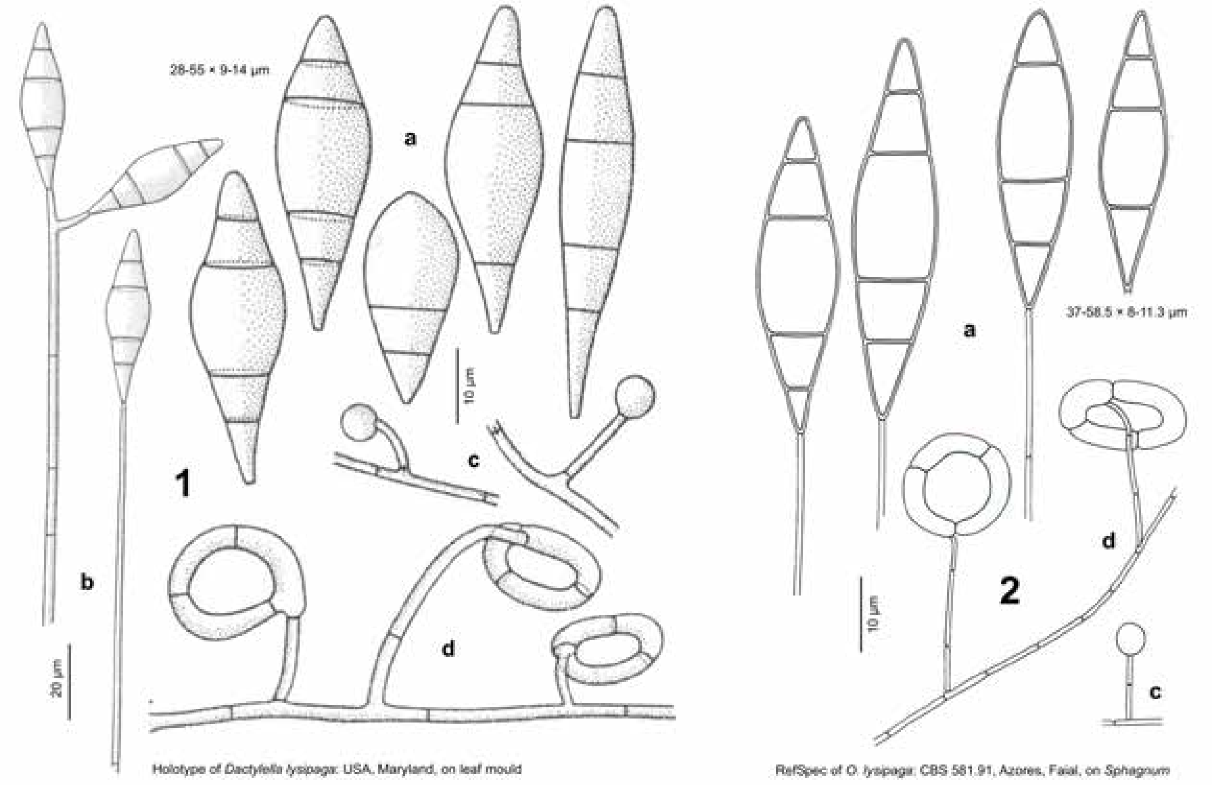
Description: — **TELEOMORPH**: **Apothecia** fresh 0.26–0.8 mm diam., white, translucent, round, scattered; disc flat, margin smooth, not protruding; sessile. **Asci** †23–32 × 3–3.4(–3.8) µm, 8-spored, 4 lower spores inversely oriented; **apex** truncate or hemispherical, thin-walled; **base** without or with medium long stalk, L-, h- or H-shaped. **Ascospores** *5–6 × 1–1.2 µm, †4.5–6 × 1.1–1.3 µm, cylindric-clavate, apex rounded to obtuse, base medium attenuated, ± acute, straight, rarely slightly curved; **SBs** ovoid to short cylindrical, ~1.4–1.6 × 0.5–0.7 µm, ± central, attachment not clearly seen. **Paraphyses** apically not or slightly, rarely medium capitate. **Medullary excipulum** not examined. **Ectal excipulum** 30 µm thick near base, of (†) thin-walled t. prismatica-angularis, cells 6.2–11 × 4–6 µm, 15 µm thick at margin, of t. prismatica oriented at 40–70°, marginal cortical cells †9–10.5 × 3–3.5 µm; terminated by short, refractive **glassy processes** 2–3 × 3.5–4 µm. **Anchoring hyphae** not examined. **VBs** no data available. **Exudate** over paraphyses and margin 0.3–1.5 µm thick, granular-cloddy, firmly attached. **— ANAMORPH** (from Drechsler 1937a, Fritsch & Lysek 1992, Liu 2006, Li et al. 2006): dactylellina-like (from ascospore isolate {1}): **Conidiophores** 85–250 µm long, unbranched, 3–5 µm wide at base, 1.1–2.2 µm at apex, conidia formed singly, exceptionally on a short apical side branch. **Conidia** *(28–)35–70(–80)((–117)) × (7.5–)9–14(–17.5) µm {4}, fusiform (partly resembling a distaff), rarely clavate, (2–)4(–6)-septate, with a large middle cell, straight, rarely curved below; exceptionally forming conidiophores with secondary conidia. **Adhesive knobs** with subglobose to obovoid heads of *(5–)6–8(–9) × (4.5–)5–7(–7.5) µm, stalks *(5–)10–60(–146) × 1.2–1.7 µm {3}. **Non-constricting rings** *(13–)15–20(–24) µm outer diam., (8.5–)10–13(–16) µm inner diam., composed of (2–)3(–4) ring cells *2.5–4 µm wide, stalks *9–20(–35) × 1.5–2 µm {3}.

Habitat: on culms of *Phragmites australis* {1}. **Desiccation tolerance**: probably intolerant. **Altitude**: ?100 m a.s.l. (USA), 575 m (Azores), 600–?2000 m a.s.l. (China). **Phenology**: IX (teleomorph).

Taxonomic remarks. Apothecia of *Orbilia lysipaga* are only known from a Chinese record on *Phragmites* (Liu 2006), which are described above as a compilation of Liu's data and the present reexamination. The teleomorph coincides to a certain degree with *O. bambusina* (incertae sedis), especially with the paratype collection on *Cocos*, though the spores of *O. lysipaga* are apically more rounded. Regrettably, the shape of the SBs is not clearly recognizable on the spore photos of Liu's collection (Pl. 988: 1f), who called it '*O. querci* var. *hunanensis*'. The present reexamination (Pl. 988: 1a–e) seems to indicate that differences to *O. quercus* merely exist in slightly wider spores, larger apothecia, and a caulicolous habitat. A similar collection on leaves of *Bambusa* is treated as *Orbilia* sp. 8963 (incertae sedis, Pls 1021–1022), and the lignicolous *O. quercus* var. *hainanensis* under *O. ellipsospora*.

Anamorph. In an ascospore isolate of the *Phragmites* collection, Liu (2006) obtained an anamorph which he identified as *Dactylellina lysipaga*. It formed adhesive knobs with partly very long stalks, also non-constricting rings (Pl. 988: 1g–i). Similar as in *O. ellipsospora*, the middle cell of the fusiform conidia is much larger than the adjacent cells. Drechsler's drawing and description of the type of *D. lysipaga* (Pl. 987: 1) fits very well this isolate, though here the conidiophores sometimes produced an additional conidium on a short branch below the tip. Fritsch & Lysek (1992) described a collection from Azores under the name *Monacrosporium lysipagum*, which is said to have rather long and narrow conidia (47–58.5 × 8–11.3 µm, Pl. 987: 2). When evaluating their size from the scale bar, however, they are of the typical size of that species (37–51 × 9–11.3 µm). In all these strains the conidia have never more than 4 septa.

D. sichuanensis as described by Li et al. (2006) differs from the above strains in larger, especially longer conidia of 35–82.5 × 7.5–17.5 µm [mean value 53.5 × 13 µm, *(47–)50–70(–74) × 12.5–15.5 µm when evaluated from the scale], with sometimes up to 5(–6) septa. Phylogenetically, however, this taxon is conspecific with Liu's *D. lysipaga* (see below). The higher number of septa considered by Li et al. as diagnostic ('usually characterized by more than 4 septa') might correspond to the larger conidia, but the authors noted that, in fact, only 9% of the conidia had 5 septa, and only 1% 6 septa. Despite their molecular conformity, the difference in size between the illustrated conidia of *D. sichuanensis* (Li et al. 2006) and *D. lysipaga* (Liu 2006) is very striking (Pl. 988: 1a vs. 2a). Although Li et al. gave a mean value of 53.5 × 13 µm, they figured mainly conidia at the upper size range. Another possibility is that their scale bar is incorrect.



Holotype of *Dactylella lysipaga*: USA, Maryland, on leaf mould

RefSpec of *O. lysipaga*: CBS 581.91, Azores, Faial, on *Sphagnum*

Plate 987. **1–2**: *Orbilia lysipaga*. – **a**. conidia; **b**. conidiophores with conidia; **c**. adhesive knobs; **d**. non-constricting rings (from culture). – **1**: from Drechsler (1937a: fig. 10); **2**: from Fritsch & Lysek (1992).

D. illaqueata as described by Yang & Mo (2006) closely resembles *D. sichuanensis* and might be conspecific, but molecular data are wanting. Here the number of septa is predominantly 5 and sometimes up to 8. The conidia are given as 25.5–117.5 × 5.5–15.2 µm, therefore, the scale bar of 10 µm appears to be erroneous as it would lead to 18–22 µm wide conidia. With an assumed 5 µm bar, the figured mature conidia would have a size of 37–50 × 9–11 µm.

In all these strains the conidia are usually straight, except that in *D. sichuanensis* they sometimes show a strongly curved base. Conidia curved in this way occurred also in *D. appendiculata* (≡ *Monacrosporium tentaculatum*), a species isolated from leaves in a stream in Hawaii and deviating by its molecular data from the above strains (see below). *D. appendiculata* deviates also in lacking non-constricting rings and in very long and thin, arm-like hyphae arising always from the second cell of the main axis (see Rubner 1996: 98). However, such arm-like hyphae formed at the second cell were also drawn by Drechsler (1937a: fig. 10 W) in *D. lysipaga*, though here they appear to be conidiophores on which further conidia are formed (fig. 10 X).

The adhesive knobs in the protologue of *D. lysipaga* are slightly smaller (5–8 × 4.5–6 µm) compared to those of *D. sichuanensis* (7.5 × 7 µm) or Liu's strain (~6.5–9 × 5.5–7.5 µm). On the drawing of the strain from Azores the scale bar for the trapping organs seems to be incorrect, because the knobs would show a width of only 3.3–3.7 µm and the stalks 0.6–0.7 µm, also the relation in cell width between ring and stalk appears to be erroneous.

In order to settle the confusion about the name *D. lysipaga*, we here designate a **reference specimen**: PAO4728s, the strain from Azores described by Fritsch & Lysek (1992). It concurs morphologically rather well with Drechsler's protologue (Tab. 89) and its sequence fits Liu's (2006) concept of *D. lysipaga*. There is, however, confusion about its CBS number. GenBank has this strain as CBS 581.91 (PAO4728s, AY261165), but under the same CBS number also *Arthrobotrys polycephalus* (PAO5428s, AY261172). The CBS database lists under CBS 581.91 *D. lysipaga* from Azores, with reference to both LSU sequences which cluster in different series of section *Arthrobotrys*. An LSU sequence alignment with *A. polycephalus* (EU107317) in CBS shows under 581.91 *A. polycephalus*, but when inserting the type strain of *D. sichuanensis* (AY902795) no dactylellina-like strain with the number 581.91 appears, indicating that a culture of the *D. lysipaga* strain from Azores might not exist at CBS.

O. lysipaga (Pl. 8: c) matches *D. haptotyla* in conidial morphology but its conidiophores bear 1(–2) conidia at the tip in contrast to 1–5 conidia in *D. haptotyla*. In the trapping organs *O. lysipaga* matches *D. candida* s. Drechsler, the latter differing in 3–10 narrower conidia at the conidiophore tip. *O. lysipaga* differs from *O. quercus* and *O. ellipsospora* in conidial characters, but especially in the adhesive knobs having distinctly thinner and partly much longer stalks, and in the presence of non-constricting rings.

Phylogeny. Sequences (ITS+LSU) of strains here referred to *O. lysipaga* were available for the types of *O. quercus* var. *hunanensis* and *D. sichuanensis* (here also SSU V1–V5) and for an unlocalized strain under the name *Monacrosporium* sp. (KG-55). Only LSU exists for the here designated reference specimen of *D. lysipaga* and an unlocalized strain under that name (YNUCC 3251), and only ITS for a Chinese strain under the name *D. lysipaga* (YMF 1.00535). The *D. sichuanensis* type includes the S1506 intron, which is absent in *O. quercus* var. *hunanensis*. Regrettably, no sequence of *D. illaqueata* and no ITS of the reference specimen were available.

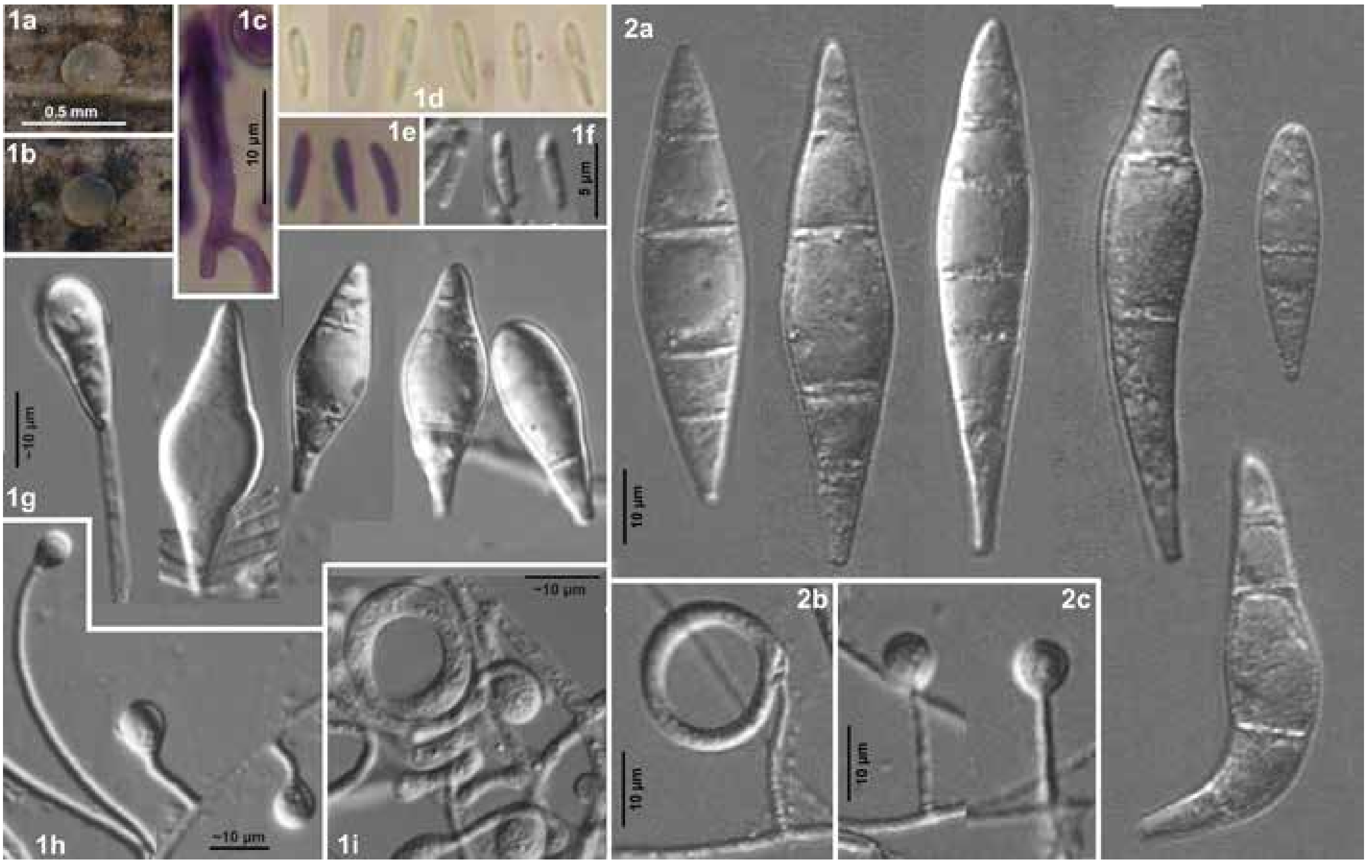


Plate 988. **1–2**: *Orbilia lysipaga*. – **1a–b**. rehydrated apothecia; **1c**. ascus; **1d–f**. ascospores; **1g**, **2a**. conidia; **1h**, **2c**. adhesive knobs; **1i**, **2b**. non-constricting rings (**1g–i**, **2a–c**. from culture). – Living state, except for **1d** (in H_2O), **1c**, **e** (in KOH+CB). – **1f–i**: from Liu (2006, figs 36–37), **2**: from Li et al. (2006). – **1a–i**. HMAS 1399697, H.B. 9202: China, Hunan, on *Phragmites*; **2a–c**. YMFT 1.000234 (holotype of *D. sichuanensis*): China, Sichuan, from soil.

The four strains with ITS vary by 0.5–1.8 %, the highest distance occurring between the types of *O. quercus* var. *hunanensis* and *D. sichuanensis*. The five strains with LSU are fully identical in the D1–D3 domain, except that KG-55 deviates by 1 nt in the D3 (pos. 919, GA**T**CC vs. **A**) and the reference specimen by 1 nt in the D2 (pos. 511, GG**T**GG vs. **C**) and 1 nt in the D3 (pos. 701, CG**G**AA vs. **A**). The deviating T in the D2 occurs in about 1/3 of the strains of series *Dactylellina*, therefore, it appears to be a trustable deviation, also G at pos. 701 is not unusual. T at pos. 919 is a rare exception in *Orbiliomycetes*, therefore, it could be erroneous. All these results permit to conclude that the four strains with ITS are conspecific, despite the absence/presence of the S1506 intron. Also the reference specimen might be conspecific, but it would be desirable to affirm this by an ITS sequence which does not exist in the CBS database. For the time being, we consider all these strains as belonging to *O. lysipaga*. The S1506 intron, which was only available for the type of *D. sichuanensis* (Tab. 89), shows a very high distance to any other strain which has this intron.

The similar *D. appendiculata* clustered strongly supported with *O. lysipaga*, but with a 6–6.5/1.7–1.9 % distance in the ITS/LSU (D1–D2) (Phyls 31, 32). An unlocalized strain under the name *Monacrosporium* sp. (YMF 1.01405, ITS+LSU) is somewhat intermediate, differing from *O. lysipaga* by 4–5/1.5 % and from *D. appendiculata* by 5.7/0.7 %.

The epithet *lysipaga* has very inconsistently been applied according to available molecular data. Besides YMF 1.00535 (China, *O. lysipaga* s.str.), ITS sequences of four further strains under the name *D. lysipaga* exist in GenBank. They appear very scattered in our phylogenetic analysis (Phyl. 31) and show distances of 10–13 % among each other, which permits to conclude that they belong to five different species: one from Australia (WAC 10294, ITS+LSU) fully concurs with the type of *D. appendiculata* (see p. 1606), one from Ottawa (CBS 486.63, Liou & Tzean 1997, SSU+ITS+LSU) fits the epitype of *D. ellipsospora*, one from Taiwan (ATCC 28265, Meyer et al. 2005, ITS) clustered in the *mammillata-paucus* clade near '*Monacrosporium*' *ullum,* and one from ?Taiwan (BCRC 34374, C.C. Kuo et al. ined., ITS) clustered near *D. haptotyla*. Regrettably, no morphological data from all these strains were available to us.

In Liu et al.'s (2006a) phylogenetic analysis of the ITS region, *O. quercus* var. *hunanensis* (= *O. lysipaga*) clustered in a clade with *O. quercus* var. *hainanensis* (= *O. ellipsospora*) and *M. ullum* (as *D. drechsleri* (GRII16D-5), but they show a rather high distance of 9–10.5 % to each other. *O. quercus* s.str. is situated with even higher distance (13–15 %) sister to this clade, which supports its separation at the species level. Also in the LSU the three varieties of *O. quercus* distinctly deviate from each other (3.5–5.3 %, see also Liu et al. l.c.).

In the *TUBB* gene region a Chinese strain under the name *D. lysipaga* (YMF 1.00535) fully matches one under the name *M. phymatopagum* (CBS 325.72), and both differ from KG-55 and the ex-type strain of *D. sichuanensis* by only ~1–2 %, while other species of *Dactylellina* differ by ~5–10 %. According to ITS analyses, however, CBS 325.72 belongs to *M. ullum*.

Ecology. *O. lysipaga* was originally isolated from leaf mould at two sites around Washington D.C. (Beltsville and Arlington) in warm-temperate humid eastern North America. The reference specimen of *O. lysipaga* is from a *Sphagnum* peat bog in a subtropical humid (somewhat summer-dry, mediterranean)

Table 89. Comparison of conidial and trapping features of the *O. lysipaga* type and reference strains and synonymous taxa (upper block). *D. appendiculata* (lower block) deviates phylogenetically from the here listed sequenced strains and probably represents a species of its own. Conidial size given according to the author's description, Curvat. = basal curvature of conidia, Tent. = basally inserted tentacles, Rings = non-constricting, S1506 = intron at 3'-end of SSU.

Species/strain	Conidia (µm)	Septa	Curvat.	Tent.	Rings	S1506	ITS	LSU
quercus var. *hunanensis* (type)	*30.4–40.2 × 10.6–13.2	2–**4**	–	–	+	–	DQ656613	DQ656704
lysipaga (type)	*28–55 × 9–14	2–**4**	–	–	+	?	-	-
lysipaga (RefSpec)	37–58.5 × 8–11.3	3–4	–	–	+	?	-	AY261165
sichuanensis (type)	*35–82.5 × 7.5–17.5	3–**4**–6	–/+	–	+	+	AY902795	AY902803
illaqueata (type)	*25.5–117.5 × 5.5–15.2	3–**5**–8	–	–	+	?	-	-
appendiculata (type)	57–108 × 9.3–14.5	**4–5**–7	–/+	+	–	–	AF106531	AY902792
'*lysipaga*' (WAC 10294)	?	?	?	?	?	–	KT215200	KT215200

volcano caldera in the Azores archipelago. The Asian records were from subtropical humid (winter-dry) forests, on *Phragmites* culms in the Suoxi Valley in the montane rocky (calcarean) Zhangjiajie Forest Park in southern China and from soil of the Emei Shan Permian volcano in southeastern China.

Specimens included. **USA**: **Maryland**, Beltsville, ?50–100 m, and **Virginia**, Arlington, ?0–100 m, leaf mould, undated, C. Drechsler (**type** of *O. lysipaga* [illustration], conid. isol., doc. vid.). — **MACARONESIA**: **Azores**, **Faial**, caldera of central volcano, 575 m, *Sphagnum* peat, V.1988, A.R. Bernitzky (**RefSpec** of *O. lysipaga*, strain PAO4728s [CBS 581.91], conid. isol., doc. vid.; sq.: AY261165). — **CHINA**: **Hunan**, **Zhangjiajie**, ~27 km N of Zhangjiajie, Suoxiyu river, 600 m, culms of *Phragmites australis*, 14.IX.2005, B. Liu & X.Z. Liu (B.L. 731, HMAS 139697, H.B. 9202, type of *O. quercus* var. *hunanensis*, anam. cult.; sq.: DQ656613, DQ656704, as *O.* cf. *quercus*). – **Sichuan**, Emei Shan, ?2000 m, from soil, 7.VIII.2002, L. Cao (YMFT 1.000234 **holotype** of *D. sichuanensis*; YMF 1.00023 ex-type culture, conid. isol., doc. vid.; sq.: AY902795, AY902803). — **UNLOCALIZED**: KG-55 (Li et al. 2006, as *Monacrosporium* sp., sq.: AY965747, AY965760). – YMF 1.01405 (Li et al. 2006, as *Monacrosporium* sp., AY965754, AY965768). – PAO4628s (YNUCC 3251, Li et al. ined., as *D. lysipaga*, sq.: AY261164).

Not included. **CHINA**: **Yunnan**, **Pu'er**, Simao, ?1300 m, soil, X.2005, D.S. Yang (YMF 1.01846, **holotype** of *D. illaqueata*).

Orbilia ellipsospora (Preuss) Bin Liu, E. Weber & Baral, **comb. nov.**, MB 813999 — Pls 989–990

Basionym: *Menispora ellipsospora* Preuss, in J.W. Sturm, Deutschl. Fl. Abt. 3, 6(29/30): 93, pl. 47 (1851)
≡ *Dactylella ellipsospora* (Preuss) Grove, J. Bot. (London) 24: 200 (1886)
≡ *Monacrosporium ellipsosporum* (Preuss) R.C. Cooke & C.H. Dickinson, Trans. Br. Mycol. Soc. 48: 622 (1965)
≡ *Dactylellina ellipsospora* (Preuss) M. Scholler, Hagedorn & A. Rubner, Sydowia 51: 110 (1999)
= *O. quercus* var. *hainanensis* Bin Liu, Xing Z. Liu & W.Y. Zhuang [as '*querci*'], in Liu (2006: 99, nom. inval., ICN Art. 29

Etymology: *ellipsospora*: after the ellipsoid conidia (though having a limoniform shape, with pointed ends); *hainanensis*: after the Chinese province Hainan.
Typification: Germany, Hoyerswerda, needles of *Pinus sylvestris*, undated, C.G.T. Preuss (holotype, illustration in Preuss 1851b: pl. 47); La Palma, Virgen del Pino, soil under *Pinus canariensis*, X.1992, G. Lysek (CBS H-5682, dried culture of CBS 302.94, neotype, designated by Rubner 1996; sq.: KT215202).
Misapplied name: Rubner (1996: 83, p.p.), as *Monacrosporium mammillatum*.

Description: — **TELEOMORPH** (after Liu 2006: 99): **Apothecia** fresh 0.3–0.8 mm diam., white, translucent, round, subgregarious; disc flat, margin smooth, not protruding; sessile. **Asci** †25–30 × 2.5–3 µm, 8-spored, spores †2–3-seriate, inversion unknown; **apex** medium truncate or hemispherical, thin-walled; **base** partly bifurcate. **Ascospores** *4.5–7 × 1–1.2 µm, subcylindrical to subfusoid, homopolar, apex obtuse, base only slightly attenuated, straight, rarely slightly inequilateral; **SB** 1 × 0.5 µm, ovoid, central, apically attached. **Paraphyses** apically hardly inflated. **Medullary excipulum** not examined. **Ectal excipulum** 25 µm thick near base, of textura angularis, cells 6–8 µm diam., 15 µm thick at margin, of t. prismatica oriented at 60–70°, marginal cortical cells without **glassy processes**. **Anchoring hyphae** not examined. **VBs** no data available. **Exudate** over paraphyses ?0.5–1 µm thick, cloddy, ± firmly attached. — **ANAMORPH** (after Drechsler 1937a, Rubner 1996 and Liu 2006): dactylellina-like (from ascospore isolate {1}): **Conidiophores** 50–300 µm long, unbranched, 3–4 µm wide at base, 1.5–2.5 µm at apex, conidia formed singly. **Conidia** *40–53(–57) × (8.5–)10–16.5(–18.5) µm, fusiform with both ends strongly attenuated, occasionally clavate with obtuse apex, (2–)4-septate, with a large swollen middle cell. **Adhesive knobs** with globose, 6–10 µm wide heads, stalks 5–23 × 2.2–4 µm. **Non-constricting rings** not formed.

Habitat: on rotten wood of unidentified trees {2}, *Picea abies* {1}, dung of *Oryctolagus cuniculus* (rabbit) {1}, or soil isolate {1}. **Desiccation tolerance**: probably intolerant. **Altitude**: 10–120 m a.s.l. (Europe), 1050 m (Macaronesia), 900 m (southern China). **Geology**: Tenerife: tephritic and phonolitic mafic flow. **Phenology**: XII (teleomorph, tropical belt).

Taxonomic remarks. No specimen of *Orbilia ellipsospora* was examined in the present study. The above description is taken from Liu (2006), who examined a sample from Hainan which he named '*O. querci* var. *hainanensis*'. According to his observations, the teleomorph hardly differs from that of *O. quercus* var. *hunanensis* (= *O. lysipaga*) and *O. quercus* s.str.

Anamorph. In the ascospore isolate of the collection from Hainan a dactylellina-like anamorph was obtained, which Liu (2006) identified as *Dactylellina ellipsospora* (Pl. 990). It is characterized by fusiform conidia with a strongly inflated middle cell, very similar in shape to the anamorph of *O. lysipaga* but very different from that of *O. quercus*. In conidial size *O. ellipsospora* distinctly overtops the other two species. Differences to *O. lysipaga* exist also in the trapping organs (see there).

Type studies. The original diagnosis by Preuss (1851a, 1851b, on *Pinus* needles) features ellipsoid conidia with pointed ends (limoniform), and ignores the septa. Grove (1886: 200, tab. 266 fig. 9) gave an emended description based on a personal sample, with fusiform conidia with 2 septa near each end very similar to those reported by Liu (2006). The 'central guttule' in the middle cell as reported by Grove and also mentioned by Preuss refers to glycogen, not to a lipid body. Also the description by Drechsler (1937a: fig. 8, Pl. 989: 2), who named the species '*Dactylella ellipsospora* Grove', fits well Liu's isolate.

According to Rubner (1996: 64), 'authentic material of *Menispora ellipsospora* is not preserved in B and could not be found in Klotzsch Herbarium vivum mycol. (in B)'. In the absence of type material and because the original description is insufficient, Rubner designated a neotype (from Tenerife, as *Monacrosporium ellipsosporum*, Pl. 989: 1, the here given conidial size was evaluated from the scale). This specimen could alternatively be considered as epitype because Preuss' illustration represents the holotype (Arts 9.9, 40.5 ICN).

Misapplication. According to available molecular data, some of the strains assigned by Rubner (1996) to *M. mammillatum* belong instead to *O. ellipsospora*.

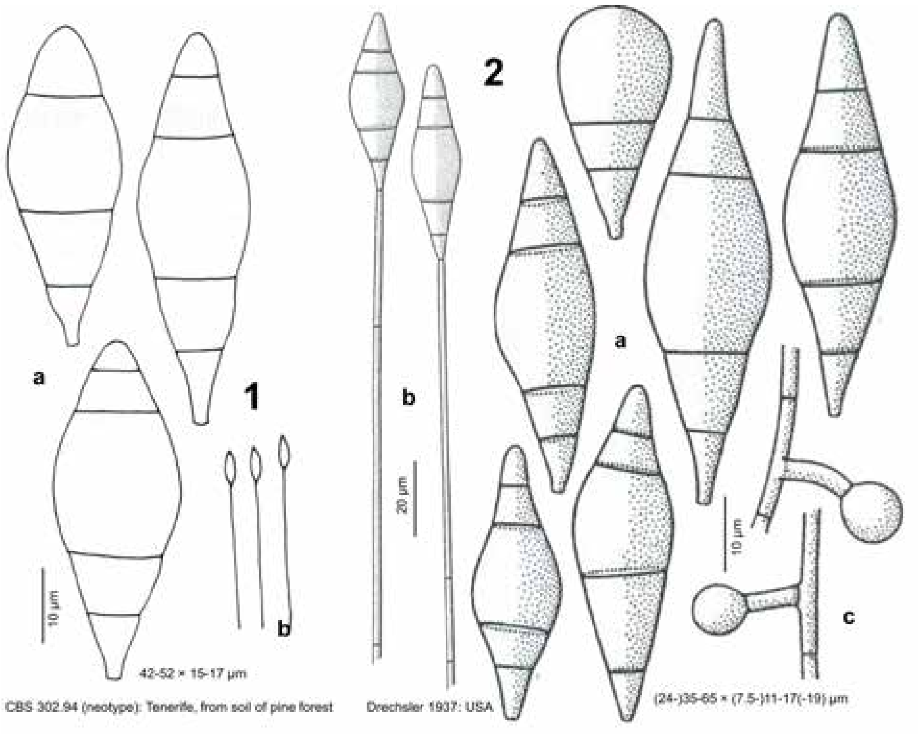


Plate 989. **1–2**: *Orbilia ellipsospora*. – **a**. conidia; **b**. conidiophores; **c**. adhesive knobs (from culture). – **1**: from Rubner (1996: 64), **2**: from Drechsler (1937a: 493).

Phylogeny. Sequences of seven strains that cluster in the *O. ellipsospora* clade were available, six in GenBank and one only in the CBS database. They comprise mainly ITS, also LSU (La Palma, Ottawa, Hainan, UK), and SSU (La Palma, Ottawa). The S1506 intron is absent, according to three strains that cover this region. In the ITS region *O. ellipsospora* shows a variation of 0–1.5 %. The strain from Ottawa was deposited as *D. lysipaga* in GenBank and reidentified as *D. mammillata* by Rubner (1996), but the other strains bear the name *M. ellipsosporum* or *D. ellipsospora*. With the here provided rDNA data of the ex-neotype strain (CBS 302.94) the molecular identity of *D. ellipsospora* could be settled. A molecular extract (ITS2) from a *Picea* log in northwestern Russia (Karelia) matches *O. ellipsospora* except for min. 2 nt and 1 gap (denovo140, Kazartsev et al. 2018).

Some other strains under the name *D. ellipsospora* exist in GenBank (e. g., Netherlands, CBS 325.72; USA, ATCC 204100), but they clustered in a different clade which includes also *D. 'drechsleri'* (GRII16D-5). Because also the ex-type strain of '*Monacrosporium*' *ullum* falls with high similarity in this clade, we here refer to this species as *M. ullum*. The presence of *D. ellipsospora* in two distant clades illustrates the confusing situation around this taxon, which was also stressed by Meyer et al. (2005). Another '*D. ellipsospora*' strain (YNWS02-8-1) belongs to *D. drechsleri*.

The type of *O. mammillata* clustered with *O. rubrovacuolata* and *M. ullum* in the strongly supported *mammillata-paucus* clade, which is phylogenetically distant from *O. ellipsospora* (Phyl. 31). The high molecular distance in the ITS (11–13 %) between *O. quercus* and *O. ellipsospora* supports separation of *O. quercus* var. *hainanensis* (= *O. ellipsospora*) at the species level. *O. lysipaga* and *D. leptospora* showed the lowest observed distance to *O. ellipsospora* (8–11.5 %). In the LSU *O. ellipsospora* varies by 1–2 nt.

When analysing LSU (Phyl. 32), *O. ellipsospora* formed with *D. drechsleri* a medium supported clade, but in the other analyses *D. drechsleri* clustered unresolved.

Ecology. The strains here included in *O. ellipsospora* have been collected on or isolated from hygric wood, leaf litter, dung, or soil. They derive from a tropical humid (winter-dry) rainforest in Hainan at the very south of China, a mesomediterranean semihumid Canary pine forest (*Sideritido solutae-Pinetum canariensis*) in Macaronesia, subcontinental cold-temperate humid areas in northwestern and central Europe, a boreal humid forest in eastern Canada, and a warm-temperate humid climate in eastern USA. The British Fungal Database lists four records from Yorkshire and Surrey between 1885 and 1948.

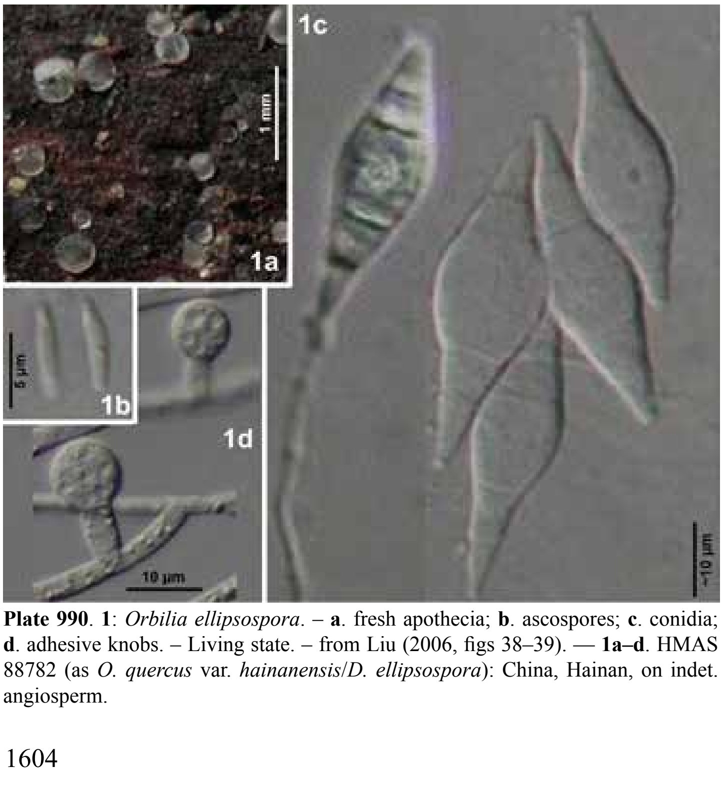


Plate 990. **1**: *Orbilia ellipsospora*. – **a**. fresh apothecia; **b**. ascospores; **c**. conidia; **d**. adhesive knobs. – Living state. – from Liu (2006, figs 38–39). — **1a–d**. HMAS 88782 (as *O. quercus* var. *hainanensis*/*D. ellipsospora*): China, Hainan, on indet. angiosperm.

Specimens included. **GREAT BRITAIN**: unlocalized, isolated by S.M. Dixon (S.M.D. 39, CBS 224.54, CCRC32921, conid. isol., non vid.; sq.: U51971). – unlocalized, isolated by M.P. Peach (M.P.P. 67, CBS 225.54, conid. isol., non vid.; sq.: AJ001995, MH857303). — **NETHERLANDS**: **Utrecht**, ~2.5 km WNW of Baarn, Groeneveld, ~10 m, dung of *Oryctolagus cuniculus*, II.1989, K.A. Seifert (CBS 309.84, conid. isol., non vid.; sq.: DQ999832). — **GERMANY**: **Mecklenburg**, Loitz, Kronwald, ~15 m, dead wood, 18.V.1992, A. Rubner (A.R. 9212, CBS 303.94, conid. isol., non vid.; sq.: CBS ined.). – **Sachsen**, Hoyerswerda, ~120 m, needles of *Pinus sylvestris*, undated, C.G.T. Preuss (**holotype** of *Menispora ellipsospora* [illustration], anam. only, doc. vid.). — **MACARONESIA**: **Canary Islands**, **La Palma**, ~5 km ENE of El Paso, NE of Ermita de la Virgen del Pino, soil of *Pinus canariensis* forest, ~1050 m, X.1992, G. Lysek, vid. A. Rubner (A.R. 931 [Rubner 1996 erron. as Tenerife], CBS H-5682, **neotype**, CBS 302.94, SBUG 1219, BBA 69970, conid. isol., doc. vid.; sq.: KT215202). — **RUSSIA (West)**: **Karelia**, 59 km NNW of Petrosavodsk, 1 km NNW of Kivach, 47 m, *Picea* log (denovo140, Kazartsev et al. 2018, m.e.). — **CHINA**: **Hainan**, ~50 km N of Sanya, Wuzhishan, 900 m, on indet. wood, 14.XII.2003, B. Liu, X.Z. Liu & M.H. Sun (B.L. 286, HMAS 88782, CGMCC (AS) 3.6758, **type** of *O. quercus*

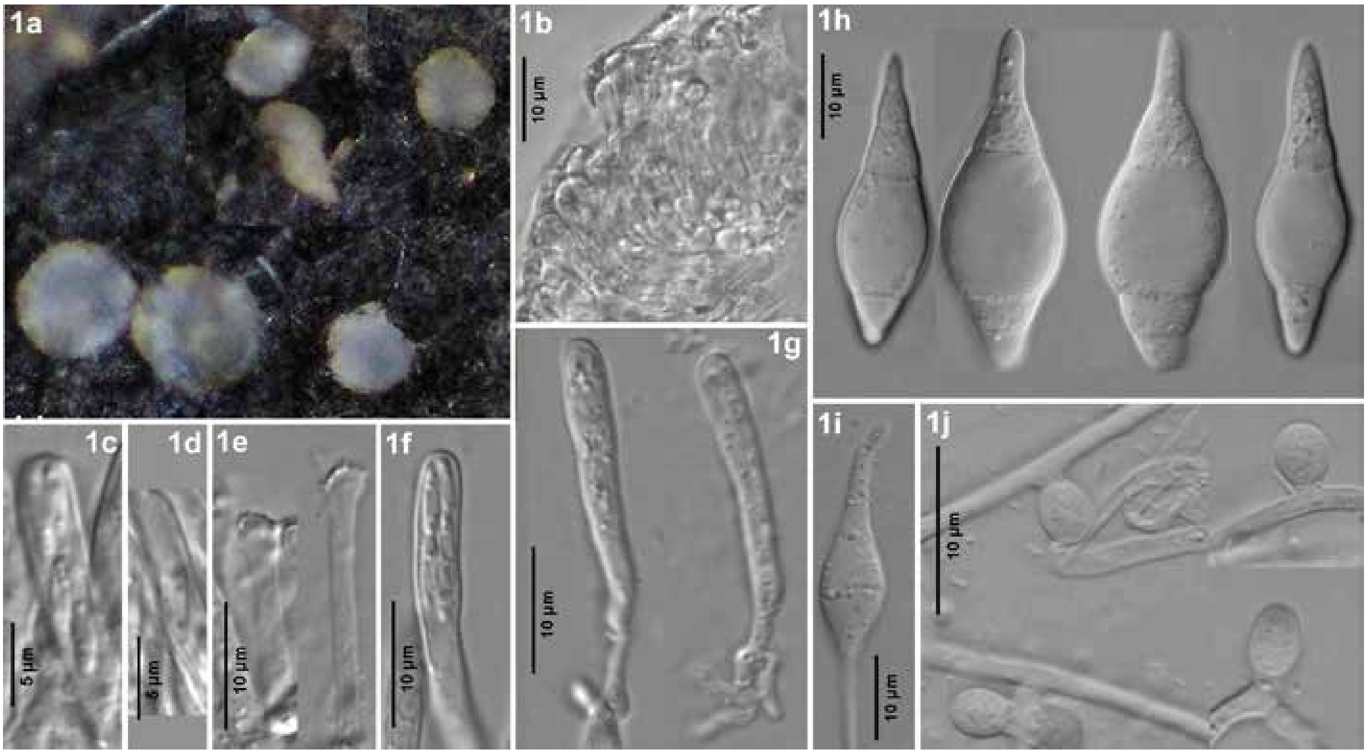


Plate 991. **1**: *Orbilia apiculata* (holotype). – **1a**. rehydrated apothecia; **1b**. marginal excipulum; **1c–d**, **f**. ascospores within asci; **1e**. paraphyses; **1f–g**. asci; **1h**. conidia; **1i**. conidium on conidiophore; **1j**. adhesive knobs (**1h–j**. from culture). – Living state, except for **1b**, **e**, **g**, **i** (in H_2O). – from Zhang et al. (in prep.). – **1a–i**. YMF1.01861: China, Yunnan, on indet. wood.

var. *hainanensis*, anam. cult., doc. vid.; sq.: AY773449=AY804214, DQ656668). — **CANADA**: **Ontario**, Ottawa River, Ridrella Island (unlocalized), on wood, G.L. Hennebert, 30.X.1960 (as *M. mammillatum* or *D. lysipaga*, CBS 486.63, CCRC 32855, DAOM 74596, MUCL 1657, conid. isol., non vid.; sq.: U51959, KT215201). — **USA**: unlocalized (probably region of Maryland), Drechsler (1937a, conid. isol., doc. vid.).

Orbilia apiculata Z.F. Yu & M. Qiao, in Zhang et al. (in prep.) — Pl. 991

Etymology: referring to the tail-like upper end of conidia.

Typification: China, Yunnan, Chuxiong, on indet. wood, 10.X.2006, Z.F. Yu & M. Qiao (YMF1.01861, holotype; ex-type culture: CBS 125669; CGMCC 3.18830).

Description (from Zhang et al. in prep.): — **TELEOMORPH**: **Apothecia** gregarious, 0.2–0.5 mm diam., pale yellow with white centre when fresh, margin indistinctly finely crenulate; sessile, superficial. **Asci** *30–33 × 3.5–3.6 µm wide, †26.5–32 × 3.2–3.6 µm, 8-spored, lower ~3 spores inverted, pars sporifera *13.5–16.5 µm long; **apex** truncate; **base** with short to medium long stalk, h-shaped. **Ascospores** *4–6 × 1–1.2 µm, subcylindrical to slightly fusoid, straight, apex rounded to obtuse, slightly attenuated towards base. **SBs** ~1–1.5 × 0.3–0.5 µm, rod- (to tear-)shaped, slightly eccentrical, apically attached, with 2–3 LBs ~0.2–0.4 µm diam. **Paraphyses** slightly capitate, terminal cell †20 × 2.3–2.6 µm, lower cells 4.5 × 1.8 µm. **Ectal excipulum** of textura globulosa-angularis, upper margin of hyphoid cells oriented at a ~40–50° angle to the surface, cortical cells inflated, balloon-like, †6–8 × 3.5–5 µm. **SCBs** and **VBs** no data available. **Exudate** 0.2–0.5 µm thick, granular, firmly attached. **ANAMORPH**: dactylellina-like (from ascospore isolate). **Conidiophores** 50–160 µm high, unbranched, 2–2.5 µm wide at base, gradually tapering to a width of 1.5 µm at the apex, bearing a single conidium. **Conidia** *(34–)40–48.5(–51) × (9.3–)12–17(–18.5) µm, (3–)4(–5)-septate, fusiform (top-shaped), strongly tapered towards both ends, upper part tail-like, always longer than basal part, apex subacute, base subtruncate, middle cell much larger than other cells. **Adhesive knobs** subsessile, head subglobose to broadly ellipsoid, *3.2–4.2 × 2.9–3.3 µm, stipe-like base very short and broad, 0.3–0.5 × 1.5–2 µm. **Chlamydospores** not observed in culture.

Habitat: on indet. rotten wood lying on moist ground. **Desiccation tolerance**: probably intolerant. **Altitude**: ~1870 m a.s.l. **Geology**: Proterozoic metamorphic rock. **Phenology**: X.

Taxonomic remarks. *O. apiculata* resembles *O. quercus* which appears to differ merely in slightly longer ascospores (*5–6.5 µm).

Anamorph. In contrast to *O. quercus*, *O. apiculata* has larger, fusiform conidia with strongly attenuated ends, the upper end being elongated like a tail, and with predominantly 4 septa, also in almost sessile and much smaller adhesive knobs (*3.5–4.2 × 3.2–3.6 vs. *8–12 × 7.5–10 µm). Among species without known teleomorph, *D. phymatopga* (= *D. parvicollis*) has comparable though larger subsessile to sessile adhesive knobs.

Phylogeny. In our NJ analysis of the ITS region (Phyl. 31), *O. apiculata* clustered with an 8.5–13% distance with *D. tibetensis* nom. nud. and *O. quercus* in a strongly supported clade (*quercus-apiculata* clade).

Ecology. *O. apiculata* derives from a subtropical humid (winter-dry) highland evergreen forest in southern China.

Specimens included. **CHINA**: **Yunnan**, **Chuxiong**, Lufeng, 53 km NW of Kunming, ~2 km S of Bichengzhen, Yulong Temple, N of Shengli, ~1870 m, on indet. wood, 10.X.2006, Z.F. Yu & M. Qiao (YMF 1.01861, **holotype**, CBS 125669, CGMCC 3.18830; sq.: MF948418).

Orbilia biforma Z.F. Yu & M. Qiao, in Zhang et al. (in prep.) — Pl. 992

Etymology: referring to the formation of 2 types of conidia.

Typification: China, Yunnan, Honghe, Pingbian, on indet. bark, 16.VIII.2006, Z.F. Yu, M. Qiao & Y. Zhang (YMF/T 1.01859, holotype; further ex-type cultures: CBS 126101, CGMCC3.18829).

Description (from Zhang et al. in prep.): — **TELEOMORPH**: **Apothecia** fresh 0.2–0.5 mm diam., gregarious, sessile, superficial; disc pale yellow, margin ?smooth. **Asci** †24.5–27 × 2.8–3.2 µm, 8-spored, spores †1–2-seriate, orientation unknown, pars sporifera

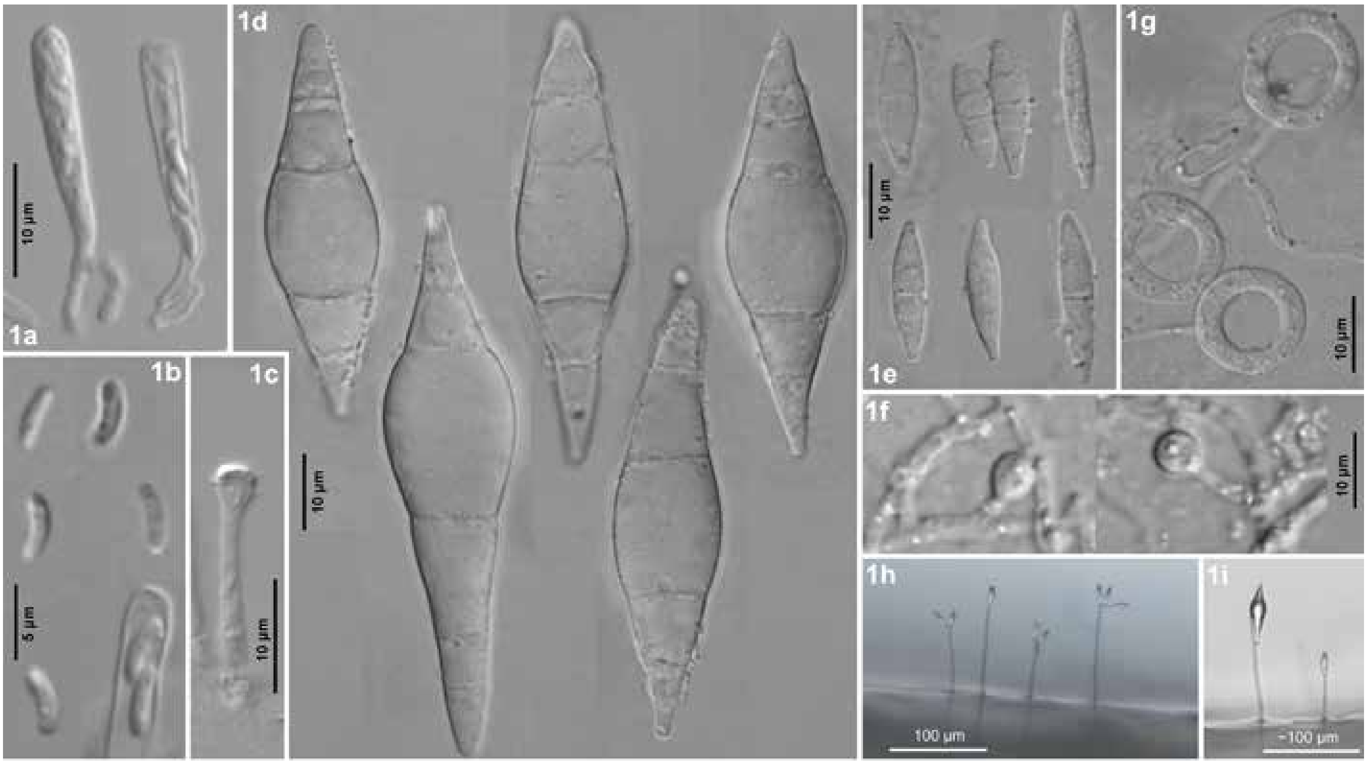


Plate 992. **1**: *Orbilia biforma* (holotype). – **1a**. asci; **1b**. ascospores; **1c**. paraphysis; **1d**. macroconidia; **1e**. microconidia; **1f**. adhesive stalked knobs; **1g**. non-constricting rings; **1h**. microconidiophores with microconidia; **1i**. macro- (left) and microconidiophore (right). – Living state, except for asci, paraphyses, and spores inside asci (in H_2O), **1d–i** from culture. – from Zhang et al. (in prep.). – **1a–i**. YMF1.01859 (holotype): China, Yunnan, on indet. woody plant.

†~16–19 µm long; **apex** truncate, hemispherical in profile view, thin-walled; **base** usually with short stalk, h- to L/H-shaped. **Ascospores** *4.2–4.7 × 1–1.2 µm, cylindrical, with rounded ends, slightly to mostly medium curved (allantoid). **SBs** 1–1.2 × 0.5 µm, rod- to tear-shaped, apically attached, partly eccentrical, with 1–2 small LBs. **Paraphyses** slightly to medium capitate, terminal cells †13–14 × 2.5–3.5 µm, lower cells †3.5–4.5 × 2.3–2.5 µm. **Ectal excipulum** not studied. **SCBs** and **VBs** no data available. **Exudate** 0.2–0.5 µm thick, ± granular, firmly attached. — **ANAMORPH**: dactylellina-like (from ascospore isolate). **Macroconidiophores** 96–182 µm high, unbranched, 2–2.5 µm wide at base, gradually tapering upwards to a width of 0.5–1 µm, bearing 1 single conidium. **Macroconidia** *42–72.5 × 12–17 µm, ((3–))4(–5)-septate, fusiform, strongly narrowed towards both ends, truncate at base, rounded at apex, middle cell much larger than other cells. **Microconidiophores** 47–90 µm high, unbranched or with short apically branches, bearing 1–3 conidia. **Microconidia** *14–24 × 3.7–5 µm, 1(–3)-septate, narrowly subcylindrical to fusoid to fusiform, with or without basal protrusion. **Adhesive knobs** stalked, with subglobose head of *6–7 × 4.5–5.5 µm and long stalk of *5.5–11 × 2 µm. **Non-constricting rings** with an outer diameter of *13–17 µm and an inner diameter of 7–10 µm, 3-celled, ring cells *3–3.5 µm wide, slightly constricted at septa, stalk ~12–15 × 1.5 µm. **Chlamydospores** not observed in culture.

Habitat: on indet. rotten bark lying on moist ground. **Desiccation tolerance**: probably intolerant. **Altitude**: 1320–1400 m a.s.l. **Geology**: Proterozoic metamorphic rock. **Phenology**: VIII.

Taxonomic remarks. In the ascospores *O. biforma* and *O. umbilicata* (treated under series *Orbilia*) are very similar, but *O. umbilicata* sharply differs in having globose SBs, lanceolate paraphyses, and larger apothecia.

Anamorph. *Orbilia biforma* differs from most other species of series *Dactylellina* in forming both macro- and microconidia. Microconidia were otherwise only described in *D. leptospora* (Tab. 15) which has much narrower macroconidia without a larger middle cell. In its fusiform macroconidia *O. biforma* resembles the anamorphs of *O. ellipsospora* and *O. lysipaga*, but differs in smaller non-constricting rings with equally broad ring cells, consequently a distinctly narrower inner diameter.

Phylogeny. In our NJ analysis of the ITS region (Phyl. 31), *O. biforma* clustered with medium support and a 5.8–6.5% distance sister to *D. leptospora*, suggesting taxonomic relevance for the presence of microconidia.

Ecology. *O. biforma* was collected in a subtropical humid (winter-dry) montane evergreen forest in southern China.

Specimens included. **CHINA**: **Yunnan**, **Honghe**, Pingbian, 1.5 km SW of Yuping, Aoga, 1320–1400 m, on bark of indet. tree, 16.VIII.2006, Z.F. Yu, M. Qiao & Y. Zhang (YMF/T1.01859, **holotype**, further ex-type cultures in CBS 126101, CGMCC 3.18829; sq.: MF948417, MF948531, MF948457, MF948601).

Species without known teleomorph

Dactylellina appendiculata (Anastasiou) M. Scholler, Hagedorn & A. Rubner, Sydowia 51(1): 110 (1999) — Pl. 9: c

≡ *Dactylella appendiculata* Anastasiou, Pacific Sci. 18: 202 (1964)
≡ *Laridospora appendiculata* (Anastasiou) Nawawi, Trans. Br. mycol. Soc. 66(2): 344 (1976)
≡ *Monacrosporium tentaculatum* A. Rubner & W. Gams, Stud. Mycol. 39: 97 (1996) [non *Monacrosporium appendiculatum* (Mekht.) Xing Z. Liu & K.Q. Zhang]

The ex-type strain of *D. appendiculata* from Hawaii (CBS 206.64) and a strain under the name *D. lysipaga* from Australia (WAC 10294) are fully identical in the overlapping SSU (V8–V9), ITS, and LSU (D1–D2), except for a possibly erroneous deviation at the 3'-end of the D2 domain. In both strains the S1506 intron is absent. *D. appendiculata* differs from *O. lysipaga* in lacking non-constricting rings (Tab. 89), but it forms a medium to strongly supported clade with this species in the here proposed sense, with a 6–6.5/1.7–1.9 % distance in the ITS/LSU (D1–D2) (Phyls 31–32, S35).

Dactylellina asthenopaga (Drechsler) M. Scholler, Hagedorn & A. Rubner, Sydowia 51(1): 110 (1999) — Pl. 7: d

≡ *Dactylariopsis asthenopaga* (Drechsler) Mekht., Mikol. Fitopatol. 1: 279 (1967)
≡ *Dactylella asthenopaga* Drechsler, Mycologia 29(4): 498 (1937)
≡ *Monacrosporium asthenopagum* (Drechsler) A. Rubner, Stud. Mycol. 39: 50 (1996)

Although *D. asthenopaga* was described with stalked adhesive knobs, two strains identified so belong to series *Neodactylella*. One from the Netherlands (**CBS 917.85**, U51962, on decaying wood) clustered in Li et al.'s (2006) phylogenetic analyses of ITS, LSU, or *TUBB*, and in Hagedorn et al.'s (1999: 34) ITS analysis in a clade which corresponds to series *Neodactylella*. This strain did not form trapping organs when studied by Rubner (1996: 52), hence it seems to be misidentified. In conidial morphology it resembles *Dactylella clavispora*, and actually it fully concurs in the ITS with the type (CBS 844.70), except for 2 gaps, and in the LSU D1–D2 it differs by 2 nt from H.B. 8371a (see Phyls 26–27, S31). Another strain (**CBS 262.83**, Australia, Queensland, from soil), for which only LSU exists in GenBank (AY965770), fully concurs in the D1–D2 domain (and almost so in D3) with one under the name *D. implexa* (AY261175, unlocalized) when comparing the unofficial LSU sequence in CBS, hence appears to be conspecific (see S31). Also an ITS sequence exists in the CBS database for CBS 262.83, which shows a ~15–17 % distance to *D. clavata*, *D. ramosa*, and *D. xinjiangensis* (no ITS of *D. implexa* exists in GenBank).

Three further strains under the name *Dactylellina asthenopaga* or *Monacrosporium asthenopagum* belong in series *Dactylellina*: a British strain (**CBS 222.54**, S.M.D. 47, unlocalized) shows a 5.5–6.5 % ITS distance in the CBS database to three Chinese strains of *D.* aff. *drechsleri* (DQ999828, DQ999829, DQ999830) as closest taxon, which form a distinct subclade within the *O. drechsleri* s.l. clade and differ by 1–4 % from each other. In the LSU D2–D3 (MH868834) it clustered with *D.* aff. *drechsleri* YMF 1.00573 (not shown, 5 nt difference, all in D2). Another British strain (**CBS 227.52**, S.M.D. 33, Wimbledon Common, wood of *Quercus petraea*) fully matches in the LSU (D1–D3) *D. phymatopaga* (CBS 325.72), which in turn belongs to *M. ullum* according to its ITS sequence. Thus, CBS 227.52, for which no ITS sequence appears to exist, is *M. ullum*. A strain from Taiwan (FJ380933, **BCRC 34369**) reported by Kuo et al. (2008) shows a 4.7 % ITS distance to *A. paucus*, 5.5–6 % to *M. ullum*, and 9 % to CBS 222.54.

No authentic sequence or ex-type culture appears to exist for *D. asthenopaga*, which was described by Drechsler (1937a) from humus and especially seeds of *Quercus prinus* in Maryland and Virginia (USA). Its stalked adhesive knobs prompted Scholler et al. (1999) to transfer it to *Dactylellina*. Rubner (1996) examined the four CBS strains and could not observe trapping organs in any of them, including those belonging to series *Dactylellina*, although Duddington (1951) reported them in strain CBS 227.52. For the Taiwan strain, Kuo et al. (2008) illustrated stalked adhesive knobs and fusoid-clavate conidia on unbranched conidiophores which closely resemble Drechsler's *D. asthenopaga* except for slightly wider, more fusoid conidia with longer terminal cells when 2-septate.

Dactylellina haptotyla (Drechsler) M. Scholler, Hagedorn & A. Rubner, Sydowia 51(1): 110 (1999) — Pl. 8: b (**non-constricting rings absent**, **adhesive knobs large**)

≡ *Dactylaria haptotyla* Drechsler, Mycologia 42(1): 48 (1950)
≡ *Golovinia haptotyla* (Drechsler) Mekht., Mikol. Fitopatol. 1: 277 (1967)
≡ *Candelabrella haptotyla* (Drechsler) Rifai, Reinwardtia 7(4): 369 (1968)
≡ *Arthrobotrys haptotylus* (Drechsler) S. Schenck, W.B. Kendr. & Pramer [as '*haptotyla*'], Can. J. Bot. 55(8): 983 (1977)
≡ *Dactylella haptotyla* (Drechsler) de Hoog & Oorschot, Stud. Mycol. 26: 111 (1985)
≡ *Monacrosporium haptotylum* (Drechsler) Xing Z. Liu & K.Q. Zhang, Mycol. Res. 98(8): 865 (1994)
= *Arthrobotrys sclerohyphus* (Drechsler) S. Schenck, W.B. Kendr. & Pramer [as '*sclerohypha*'], Can. J. Bot. 55(8): 984 (1977) (fide Rubner 1996)
≡ *Dactylaria sclerohypha* Drechsler, Mycologia 42(1): 57 (1950)
≡ *Monacrosporium sclerohyphum* (Drechsler) Xing Z. Liu & K.Q. Zhang, Mycol. Res. 98(8): 865 (1994)

Dactylellina yunnanensis (K.Q. Zhang, Xing Z. Liu & L. Cao) M. Scholler, Hagedorn & A. Rubner, Sydowia 51(1): 111 (1999) (**non-constricting rings present**, **adhesive knobs small**)

≡ *Monacrosporium yunnanense* K.Q. Zhang, Xing Z. Liu & L. Cao, Mycol. Res. 100(3): 275 (1996)
= *Dactylaria candida* s. Drechsler (1937a), Peach (1950) and others

Dactylaria candida s. Drechsler (1937a, see Pl. 8: h) was synonymised with *Monacrosporium haptotylum* (Pl. 8: b) by Rubner (1996: 72), although Drechsler (1950a) distinguished the former by producing non-constricting rings and much smaller adhesive knobs (*4–7 × 3.8–6 vs. *7–10 × 6–8.5 µm diam.). Rubner (1996: 120) further assumed that *Monacrosporium yunnanense* (erroneously cited as *Dactylella yunnanensis*), a taxon which likewise formed non-constricting rings and small knobs of 5–7.5 × 4.5–6 µm (Zhang et al. 1996, see Pl. 8: f), is conspecific with *M. haptotylum*, based on personal study of the type culture (CBS 615.95) but without seeing the protologue which presents distinctly longer conidia than described by Drechsler. Also *Dactylaria sclerohypha* (Drechsler 1950a) was included in synonymy by Rubner, because it differs from the protologue of *M. haptotylum* merely in producing chain-like chlamydospores, a feature found to be variable and therefore unreliable (see Cooke & Satchuthananthavale 1966). Yu et al. (2014) accepted Rubner's concept but adopted instead the name *Dactylellina candida* instead of *D. haptotyla*.

Available molecular data suggest that three different, though closely related species are involved in the current concept of *D. haptotyla*/*D. candida*, which form three distinct clades (A–C) when analysing ITS (Phyl. 33): clade A comprises nine strains, including the Chinese isotype of *D. yunnanensis* (CBS 615.95), clade B comprises five strains, including the German epitype of *D. haptotyla* (CBS 326.94, Berlin, with non-constricting rings, knobs not figured), and clade C includes two strains with unavailable morphology (one identified as *D. candida*). To clade B belongs also the Californian strain ATCC 204099 (EF446016) for which only ITS2 was available (not shown).

Each clade is genetically highly homogeneous: 1 nt varies in the ITS1 of clade A (4 strains have C, 5 strains T), and 1–2 gaps occur in the ITS2 of two strains of clade B. Rare deviations in the 5.8S in clades A (pos. 51, YMF 1.01466) and B (pos. 32, CBS 200.50) are accidental mutants or sequencing errors (the deviation at pos. 32 is absent in the sequence of the CBS database). Clades A and B differ by 1.4–1.5 %, whereas clade C deviates by 3.7–5 % from clade B and 4.5–5.7 % from clade A.

Three other names were previously in use for strains of *D. haptotyla* s.l.: (1) *M. sclerohyphum* for two strains of clade A, (2) *D./D. candida/M. candidum* for two strains of clade A, 4 of clade B, and one of clade C, and (3) *D. lysipaga* for one species of clade C. For two strains of clade B the presence of non-constricting rings was documented (CBS 200.50, Peach 1950: fig. 8; CBS 326.94, Rubner 1996: fig. 32a), and for one of clade A the absence of non-constricting rings and broader conidia (CBS 325.94, Rubner 1996: fig. 32b). This suggests that clade A represents *D. haptotyla* and clade B *D. yunnanensis*. However, the type of *D. yunnanensis* (CBS 615.95), which forms non-constricting rings, clustered in clade A, which supports Rubner's opinion that non-constricting rings are of doubtful value and dimensions of conidia and adhesive knobs variable.

Irrespective of this problem, we suspect a confusion regarding CBS 616.95, the type culture of the adhesive net forming *Arthrobotrys guizhouensis* nom. inval. (≡ *A. huaxiensis*, see p. 1581), described in the same paper as *M. yunnanense* (CBS 615.95), because ITS and LSU sequences in the CBS database fully concur with those of CBS 615.95. Also G. Hagedorn's SSU+ITS+LSU sequence of CBS 616.95 (KT215198) fully concurs herewith and with GenBank ITS sequences of CBS 615.95 (AY965757, MH862541), therefore, when uploading Hagedorn's data we changed the CBS number to 615.95. Resequencing of CBS 616.95 or reexamination of the culture for conidial and trap organ morphology could clarify this confusing case.

When analysing LSU D1–D2 (Phyl. 32), 2 nt (pos. 133/561) differ among the available strains of *D. haptotyla* s.l. and sharply separate clade A (2 strains, A/A) from clade B (5 strains, G/G) (no LSU sequence was available for clade C). In our analysis of SSU+ITS+LSU, only one species of *D. haptotyla* s.l. (CBS 615.95, clade A) was included in Phyls 25, S35 where it clustered unresolved in series *Dactylellina*.

Based on the available data we may conclude that Drechsler was right in separating different species. However, whether one of them (his *Dactylaria candida*) can be distinguished based on smaller adhesive knobs, narrower conidia, and non-constricting rings remains unclear. Because of the possible taxonomic value of non-constricting rings, Rubner's epitypification of *D. haptotyla* on CBS 326.94 (from Berlin, clade B) seems unacceptable. Better would have been to propose CBS 325.94 (from Tenerife, clade A) as epitype, which seems to be in closer concordance with Drechsler's protologue of *D. haptotyla*.

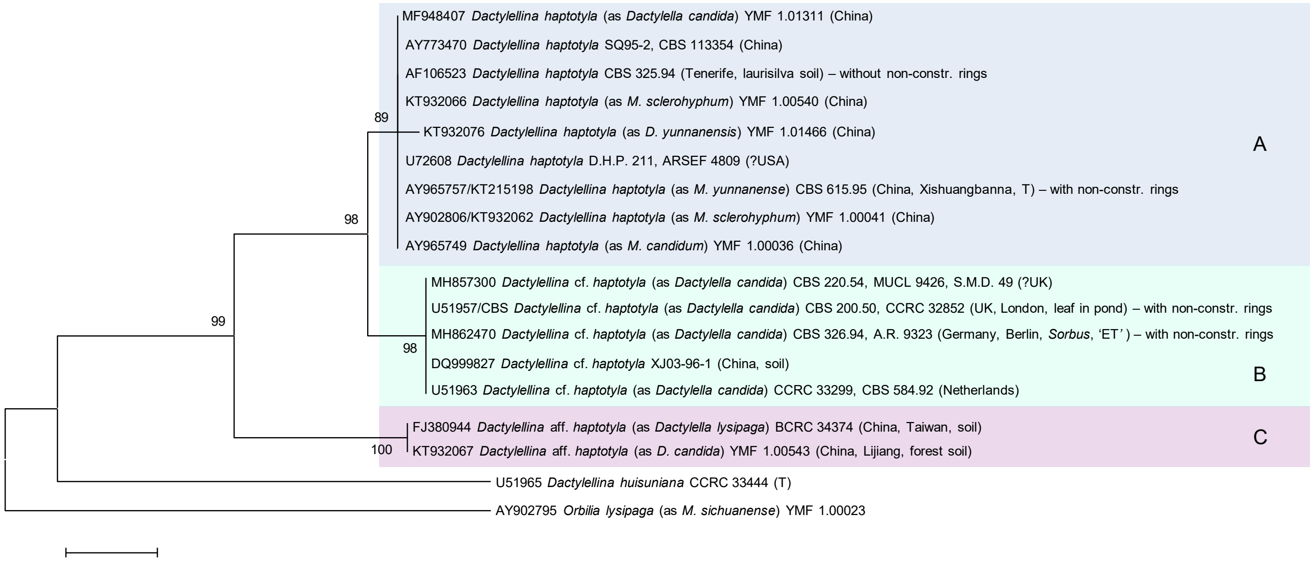
The original identity of *Dactylium candidum* Nees, the type species of *Dactylium* Nees, is dubious. Both genus and species are treated as nomina utique rejicienda (ICN appendix V) following a proposal by Gams & Rubner (1997), who argued that *Dactylium* would replace the widely used *Monacrosporium* if *Dactylium candidum* would be neotypified in the sense of *M. haptotylum*. In the new classification (Scholler et al. 1999) *Dactylium* would likewise replace the established generic name *Dactylellina*.

Monacrosporium chiuanum Xing Z. Liu & K.Q. Zhang was tentatively synonymised with *M. haptotylum* by Rubner (1996) and Yu et al. (2014). Since the taxon was described by Liu & Zhang (1994) without trapping organs and no sequence was available, its relationship remains obscure.

Dactylellina leptospora (Drechsler) M. Morelet, Bull. Soc. Sci. nat. Arch. Toulon et du Var 178: 6 (1968) — Pl. 7: k

≡ *Dactylella leptospora* Drechsler, Mycologia 29(4): 507 (1937)
≡ *Dactylosporium leptosporum* (Drechsler) Mekht., Mikol. Fitopatol. 1: 277 (1967)
≡ *Monacrosporium leptosporum* (Drechsler) A. Rubner, Stud. Mycol. 39: 79 (1996)
= *Dactylaria dasguptae* S.K. Shome & U. Shome [as '*dasguptaii*'], Mycopath. Mycol. appl. 30: 216 (1966), nom. inval., ICN Art. 40 (type material not indicated)
≡ *Arthrobotrys dasguptae* (S.K. Shome & U. Shome) S. Schenck, W.B. Kendr. & Pramer, Can. J. Bot. 55(8): 982 (1977)
≡ *Dactylella dasguptae* (S.K. Shome & U. Shome) de Hoog & Oorschot [as '*dasguptaii*'], Stud. Mycol. 26: 105 (1985)
= *Dactylellina formosana* (J.Y. Liou, G.Y. Liou & Tzean) M. Scholler, Hagedorn & A. Rubner, Sydowia 51(1): 110 (1999)

Rubner (1996) incorrectly stated a North American strain (ATCC 36915 = CBS 560.92), which was deposited under the name *Dactylaria dasguptae*, to be the type of *D. dasguptae*, which was actually collected in West Bengalen, India (Shome & Shome 1966). Simultaneously, Rubner proposed this North American strain as epitype of *Dactylellina leptospora*. *Dactylaria dasguptae* she considered as a synonym of *D. leptospora*, because differences in apical branching of conidiophores



Phylogenetic analysis 33. Phylogram of *Dactylellina haptotyla* s.l. complex inferred from ML analysis of ITS1-5.8S-ITS2 rDNA dataset (18 sequences, 544 positions, aligned with MUSCLE) using the JC+I model in MEGA6 (500 replicates). The tree is rooted with *O. lysipaga* and *D. huisuniana*. T = type, ET = epitype.

seemed not convincing, and the absence of adhesive knobs on hyphae (but not on conidia) in Drechsler's material remained the only distinguishing character.

This epitype strain clustered in a clade with the type strain of *D. formosana* (Taiwan, CCRC 32740) and three further strains from China and South Africa identified as *D. leptospora* (Phyl. 31). The species formed with *O. biforma*, for which only ITS was available, a medium supported clade with a distance of 5.8–6.5%. The high ITS similarity among the strains (0–1% distance, 1% between the two types) suggests conspecificity. Also in the LSU (D1–D2) only 0.2% differ among the three available sequences of *D. leptospora* (Phyl. 32). *D. leptospora* clustered unresolved in series *Dactylellina* in our combined analyses (Phyls 25, S35).

Hagedorn & Scholler (1999: 36), however, doubted Rubner's concept and assumed that the ex-epitype strain might not belong to *D. leptospora* in a narrow sense, because it formed solely adhesive knobs on conidia and hyphae but no non-constricting rings. Also *D. formosana* was described with adhesive knobs only, and for the three further strains no information was available in respect to trapping organs. Since *D. leptospora* and also *D. dasguptae* were originally described with both adhesive knobs and non-constricting rings, it appears possible that the true *D. leptospora* is still without a sequence.

The description of *D. dasguptae* is invalid because two collection sites were mentioned in the Latin protologue (gardens of two different towns, Kalyani and Haringhata) and no holotype was designated, although description and plates solely derive from the Haringhata sample.

Dactylellina multiseptata (H.Y. Su & K.Q. Zhang) Z.F. Yu, in Zhang & Hyde (eds), Nematode-trapping Fungi: 155 (2014) — Pl. 9: f

≡ *Monacrosporium multiseptatum* Hong Y. Su & K.Q. Zhang, Mycotaxon 92: 194 (2005)

See under series *Neodactylella* (p. 1513).

'Arthrobotrys' paucus J.S. McCulloch [as '*pauca*'], Trans. Br. mycol. Soc. 68(2): 176 (1977)

The ex-holotype strain of *Arthrobotrys paucus* (Australia, Queensland, Woodridge, soil around strawberry, I.1969, A. Shewchenko, isolated by J. McCulloch, Pl. 7: a) is found in different culture collections (CBS 642.80, ATCC28704, IMI 143686, BRIP 11223) and in GenBank under the name *A. entomopagus* (AY965758, ITS), because it was synonymised herewith by Roxon & Jong (1975) followed by Van Oorschot (1985: 78), based on similar adhesive knobs and 1-septate conidia. Roxon & Jong studied the ex-type strain before it was given the name *A. paucus* by McCulloch (1977), and declared it as neotype of *A. entomopagus*.

Roxon & Jong described the adhesive knobs of the later *A. paucus* type strain with globose upper cells, but they did not provide an illustration. According to the protologues in Drechsler (1944b) and McCulloch (1977), and a LM/TEM study of *A. entomopagus* by Saikawa et al. (2010), *A. entomopagus* differs from *A. paucus* by adhesive knobs with ellipsoid head with a very thick mucilage that capture springtails, also by conidiophores with longer denticles and slightly longer and narrower conidia (Pl. 14: b). *A. paucus* is sufficiently different in having adhesive knobs with (sub)globose head covered by very thin mucilage.

No sequence of the ex-type strain of *A. entomopagus* was available. Because of the special trapping organs adapted to arthropods we suppose that *A. entomopagus* belongs in close relationship of *Orbilia alba*, a member of series *Gamsylella*, in contrast to the opinion of Scholler et al. (1999) who placed *A. entomopagus* in *Dactylellina* because of having adhesive knobs. Our sequence of the ex-type strain of *A. paucus* (KT215205, SSU, ITS, LSU) concurs with AY965758 in the ITS and clustered in series *Dactylellina* in the strongly supported *mammillata-paucus* clade (Phyl. S35). Also *RPB2*, *TEF1, MAD1,* and *TUBB* of *A. paucus* exist in GenBank under the wrong name *Arthrobotrys entomopagus*.

Dactylellina phymatopaga (Drechsler) Yan Li, in Li, Hyde, Jeewon, Cai, Vijaykrishna & Zhang, Mycologia 97(5): 1042 (2006) [2005] — Pl. 8: d, i

≡ *Dactylella phymatopaga* Drechsler, Mycologia 46(6): 775 (1954)
≡ *Monacrosporium phymatopagum* (Drechsler) Subram. [as '*phymatophagum*'], J. Indian bot. Soc. 42: 293 (1964) [1963]
≡ *Golovinia phymatopaga* (Drechsler) Mekht., Khishchnye Nematofagovye Griby - Gifomitsety (Baku): 165 (1979)
≡ *Gamsylella phymatopaga* (Drechsler) M. Scholler, Hagedorn & A. Rubner [as '*phymatophaga*'], Sydowia 51(1): 109 (1999)
= *Dactylellina parvicollis* (Drechsler) Yan Li, in Li, Hyde, Jeewon, Cai, Vijaykrishna & Zhang, Mycologia 97(5): 1042 (2005) [2006]
≡ *Dactylella parvicollis* Drechsler, Sydowia 15(1-6): 13 (1962) [1961]
≡ *Monacrosporium parvicolle* (Drechsler) R.C. Cooke & C.H. Dickinson, Trans. Br. mycol. Soc. 48(4): 622 (1965)
≡ *Golovinia parvicollis* (Drechsler) Mekht., Khishchnye Nematofagovye Griby - Gifomitsety (Baku): 162 (1979)
≡ *Gamsylella parvicollis* (Drechsler) M. Scholler, Hagedorn & A. Rubner, Sydowia 51(1): 109 (1999)
= *Monacrosporium shuzhengense* X.F. Liu & K.Q. Zhang nom. nud. (in Li et al. 2005)

Dactylellina parvicollis was thought by Rubner (1996) and Scholler et al. (1999) to be a species distinct from *D. phymatopaga* because of slightly smaller conidia and the frequent presence of superimposed knobs that form rings on their tip. Yet, molecular data show that the ex-syntype strain of *D. parvicollis* from Colorado (CBS 219.61) is conspecific with the German ex-epitype strain of *D. phymatopaga* (CBS 450.93, KT215207), showing an ITS distance of only 0.2% (1 nt). Liu et al.'s (2002) report of *M. parvicolle* as anamorph of *O. cunninghamii* refers to *O. quercus*/*D. quercus* (see p. 1597).

Various European and Asian strains belong to this species based on available ITS and LSU data (Phyls 31–32), including *Monacrosporium shuzhengense* (discussed in Li et al. 2005 but not validly published). They differ by 0–0.6% in the ITS, though sequences in the CBS database differ up to 1.2% (CBS 590.91), and show full identity in the LSU (D1–D2). Two misidentified strains are referred to as *D.* aff. *phymatopaga* here, as they clustered outside of series *Dactylellina* (see under Specific nucleotide positions in series *Dactylellina*, p. 1585).

Dactylellina tibetensis nom. nud. (mentioned in Yang et al. 2007: 8380, 8382)

This undescribed Chinese taxon clustered with an ITS distance of 0.6% (3 nt) with an obviously conspecific environmental strain from grassland soil in California. Both formed a strongly supported clade with *O. apiculata* and *O. quercus*, with a distance of 7.7–10% to them (Phyl. 31). Also LSU D1–D2 exists for the Californian strain, differing from *O. quercus* by 1.7%. In our combined analysis (S35), *O. quercus* and *D. tibetensis* (not shown) formed with *D. phymatopaga* a medium supported clade, with an ITS/LSU distance of 9.5–10.5/2.2–2.3 % between *D. tibetensis* and *D. phymatopaga*.

CHINA: **Tibet**, collection data unavailable (XZ04-92-1, sq.: DQ999833). — **USA**: **California**, 70 km WNW of Los Angeles, 5 km SW of Newbury Park, Rancho Sierra Vista, grassland soil, 275 m, 30.V.2008 (G1_GB11, mol. extr., JX043462, JX043463).

'Monacrosporium' ullum D.G. Kim, Ryu & H.G. Hwang, Pl. Path. J. 22(2): 174 (2006), nom. inval., ICN Art. 40 (type material not indicated)

= *Dactylellina drechsleri* s. Meyer et al. (2005)

When describing *M. ullum*, Kim et al. (2006) provided an ITS sequence of the ex-type strain isolated from soil around *Codonopsis lanceolata* in Ulleung island (east of South Korea). The authors published this sequence in their article but did not upload it in an official database repository. Except for one insert in the ITS1 (GGCG**C**CTTAA), it fully coincides with one of the three sequences of *D. drechsleri* s. Meyer et al. (2005: AY773448, from Minnesota, USA), whereas Meyer et al.'s other two sequences (AY695063, AY695065), which are identical (a repeat of TAACATT in the ITS1 might be an error), deviate by 3 nt (always C instead of T). Some further strains from China, USA, and the Netherlands under the names *M. ellipsosporum*, *M. phymatopagum*, and *D. asthenopaga* (erron. as *asterospermum*) are undoubtedly conspecific according to molecular data of either ITS or LSU (see Phyls 31–32), including an uncultured North American clone for which only ITS1 is available (FJ778149). In the ITS a variation of 0–1 % is observed, and in the LSU 0–0.2 %. Accordingly, *M. ullum* was isolated from rotten plant material or soil in Europe, North America, and Asia.

Morphologically, Kim et al. (2006) characterized *M. ullum* by the absence of non-constricting rings in contrast to *M. candidum*. They also stressed the smaller, mainly 2-septate conidia in comparison to *M. ellipsosporum*, *M. drechsleri* and others. In Kim et al.'s phylogenetic analysis, '*M. ellipsosporum*' and '*M. drechsleri*' (s. Meyer et al.) belong with *M. ullum* to a single species, while their '*M. lysipagum*' (s. Meyer et al., ATCC 28265) represents a close, possibly distinct taxon showing a 2.5 % distance to them.

In our combined analysis (Phyl. S35), the only *M. ullum* strain with both ITS and LSU (CBS 325.72) clustered within series *Dactylellina* in the strongly supported *mammillata-paucus* clade.

Dactylellina varietas Yan Li, K.D. Hyde & K.Q. Zhang, in Li, Jeewon, Hyde, Mo & Zhang, Mycol. Res. 110(7): 792 (2006) — Pl. 9: a

See under series *Neodactylella*, p. 1513.

Series *Gamsylella*

Orbilia subgenus ***Orbilia*** section ***Arthrobotrys*** series ***Gamsylella*** (M. Scholler, Hagedorn & A. Rubner) Baral & E. Weber, **comb. & stat. nov.**, MB 814995 – Type species: *Dactylella arcuata* Scheuer & J. Webster

Basionym: *Gamsylella* M. Scholler, Hagedorn & A. Rubner, Sydowia 51(1): 108 (1999)

Etymology: in honour of the Austrian mycologist Walter Gams and in reference to the genus *Dactylella*, to which most of the included anamorphic species formerly belonged.

Emended diagnosis: **TELEOMORPH**: Apothecia with smooth margin, desiccation-sensitive or -tolerant. Ascospores subulate, straight to slightly curved; spore bodies subglobose to rod-shaped, ± eccentrical. — **ANAMORPH**: Conidiogenous loci singly or on prominent denticles. Conidia mainly 1–4-septate, straight, cylindrical to fusiform, microconidia present or absent. Forming sessile or stalked adhesive knobs, columns, arches and bridges.

Description: — **TELEOMORPH**: **Apothecia** hydrated (0.4–)1–5(–7.5) mm diam., white or pale isabelline to bright yellowish-orange, margin smooth, sessile. **Asci** *26–40 × 3–4 µm, 8-spored, (1–)3–5 lower or upper spores inverted; **apex** (†) slightly to strongly truncate, not or somewhat indented and slightly laterally inflated; **base** partly H-shaped. **Ascospores** *(3.6–)4–7.5(–8.5) × 0.8–1.3 µm, subcylindric- to fusoid-clavate (subulate), apex rounded to obtuse, base ± tapered, straight to slightly curved; **SBs** mostly distinctly eccentrical, 0.8–1.6 × 0.2–0.4(–0.6) µm (total length), subglobose to often rod-shaped, attachment invisible. **Paraphyses** uninflated or usually lanceolate (to lageniform), rarely capitate-clavate, terminal cells 2–4 × longer than lower cells. **Ectal excipulum** (†) thin-walled to slightly gelatinized, vertically or irregularly oriented textura (globulosa-)angularis(-prismatica), cells near base *(8–)12–40(–55) × (6–)10–25(–44) µm, margin or t. (angularis-)prismatica oriented at 10–80°; **glassy processes** absent. **SCBs** globose or absent; **VBs** absent. **Exudate** absent or 0.1–3 µm thick, continuous, finely rough, firmly attached, hyaline. — **ANAMORPH**: gamsylella-like. **Conidiophores** 50–500 µm long, conidiogenesis acrogenous (unbranched) or geniculate to candelabrelloid. **Conidia** (15–)18–68(–85) × 4.5–21(–30) µm, cylindric(-clavate) to fusoid or fusiform, 1–4(–6)-septate, with or without much larger central cell; **conidial dimorphism** only reported for *G. gephyropaga*, microconidia sharply separated. **Trapping organs**: sessile adhesive knobs, adhesive columns, arches and bridges, also long-stalked, large adhesive knobs with ellipsoid to lageniform, non-detachable heads covered by thick mucilage; traps spontaneously formed in culture.

Habitat: on hygric (also xeric) bark and wood of angiosperms, also herbaceous stems and leaves of monocots, capturing nematodes, rotifers, rhizopods, and arthropods, temperate to tropical, humid to semihumid, desiccation-sensitive or sometimes -tolerant.

Recognized species: 5 (3 of them without known teleomorph), plus 1 unnamed species ('affinis'); for further 2 species see Tabs 50 and S11.

Taxonomic remarks. Two species with a known teleomorph are assigned here to series *Gamsylella*, *Orbilia alba* and *O. anigozanthi*. Both have exceptionally large apothecia which are desiccation-sensitive in the former and highly desiccation-tolerant in the latter species. Without their anamorph or DNA data they can hardly be distinguished from other groups, particularly from series *Dactylellina* and *Drechslerella*. The ascospores contain subglobose to ± rod-shaped, distinctly eccentrical SBs without a visible attachment, a feature characteristic also of series *Drechslerella*. The two species are somewhat exceptional within section *Arthrobotrys* by their (sub)lanceolate paraphyses and wide anchoring hyphae, *O. anigozanthi* also by inversely oriented upper spores.

Anamorph (see also p. 235–236 and Tab. S11). The genus *Gamsylella* was erected for its more or less unique type of trapping organs, comprising sessile adhesive knobs and/or adhesive columns, arches and bridges. However, delimitation from *Dactylellina* is problematic. We here maintain *Gamsylella* at the series level in a modified sense, with *D. phymatopaga* (= *D. parvicollis*) remaining in *Dactylellina*, and with *D. alba* (= *O. alba*), *D. entomopaga*, and *D. ferox* tentatively transferred to *Gamsylella*. This concept is predominantly based on molecular data, with the exception of *D. entomopaga* and *D. ferox*, for which such data were not available (a sequence under the name *D. entomopaga* in GenBank refers to the type of *Arthrobotrys paucus*, a member of series *Dactylellina*, see p. 1609). Our emended concept extends the morphological diversity of *Gamsylella* by including robust stalked adhesive knobs covered by thick mucilage. *D. ferox* is not included in the above description because it is the only species of this group with arthrobotryoid conidiophores.

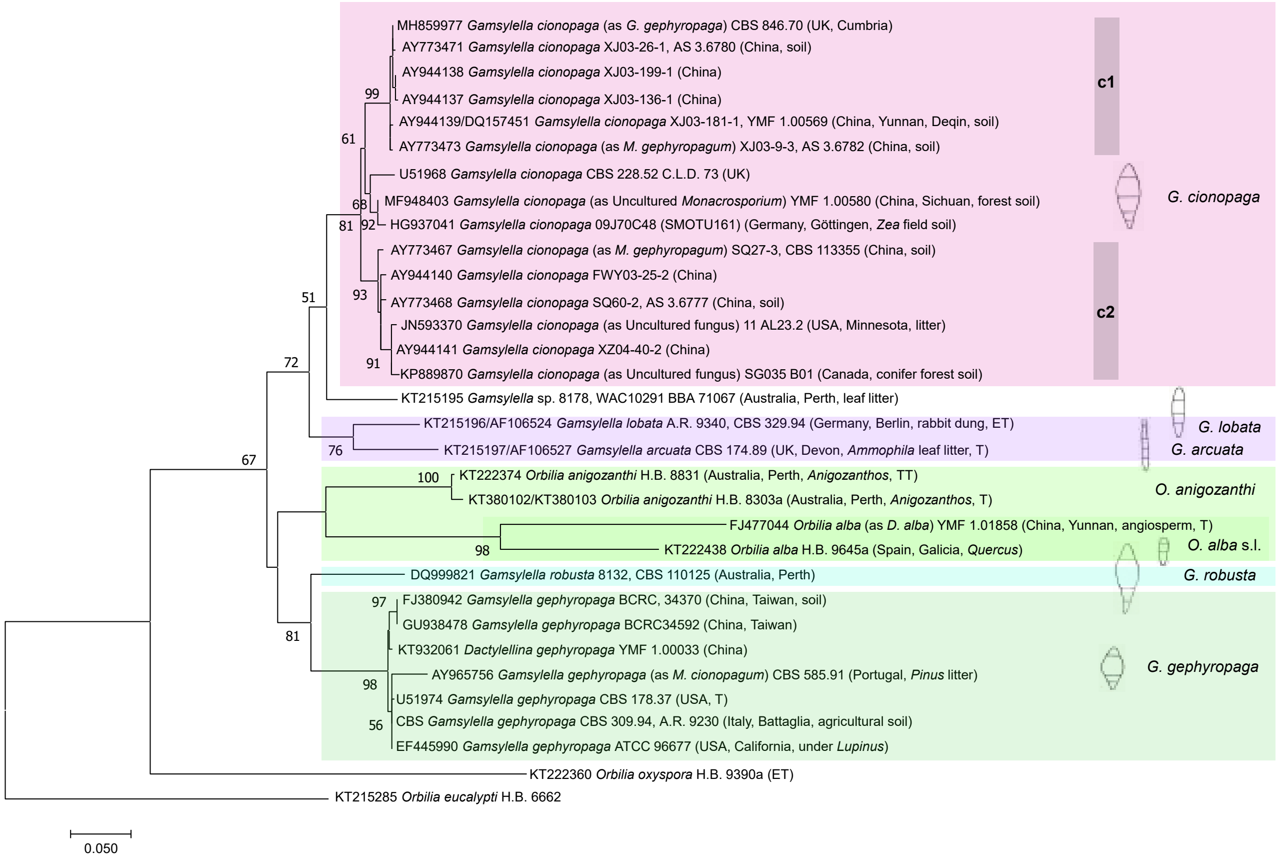
We consider *D. ferox* and *D. entomopaga* as possibly related to *Gamsylella* because the two available sequences of *O. alba* fall in the *Gamsylella* clade (no anamorph is known in *O. anigozanthi*) and the three species are quite similar in their trapping organs, having large, distinctly stalked adhesive knobs with either globose, ellipsoid, or lageniform heads (respectively) covered by thick mucilage. Due to the size of the knobs and the thick mucilage, all three species are able to capture arthropods (springtails, flies, mites etc.).

The conidiophore diversity observed in series *Gamsylella* includes most of the different types of conidiogenesis known from other series of section *Arthrobotrys* (acrogenous, candelabrelloid, arthrobotryoid). The conidia vary from short, cylindric-clavate, 1-septate (*O. alba*, *D. entomopaga* and *D. ferox*) to long, narrowly to broadly fusoid or fusiform, 3–4-septate (*G. arcuata*, *G. lobata*, *G. robusta*, *G. cionopaga*, *G. gephyropaga*).

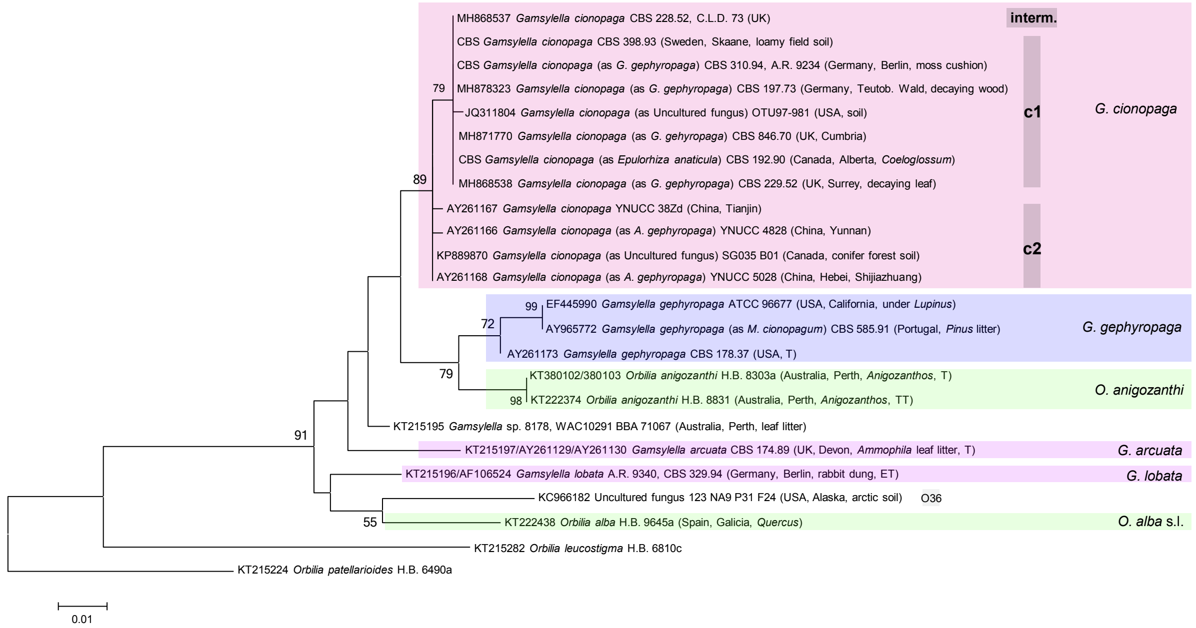
Species delimitation. *O. alba* might be a collective species, with different taxa occurring on different continents. This can be concluded from slight morphological and strong molecular differences. *G. cionopaga* was synonymised with *G. gephyropaga* by Rubner (1996) and Scholler et al. (1999), but deserves recognition at the species level based on strong molecular differences.

Previous phylogenetic concepts. Hagedorn & Scholler's (1999: fig. 1) and Scholler et al.'s (1999: fig. 2) phylogenetic analysis of the ITS region included four species: *G. arcuata*, *G. lobata*, *G. gephyropaga* (s.l.), and *G. phymatopaga*. The former three formed with high bootstrap support a sister clade to *Dactylellina*, while *G. phymatopaga* was situated unresolved between both. In another molecular phylogenetic study based on 5.8S+LSU and *TUBB*, Li et al. (2005) could not find support to accept *Gamsylella* as a separate genus, because the included species are found in different clades in their phylogenetic trees of rDNA as well as *TUBB*: the three species *G. arcuata*, *G. gephyropaga*, and '*M. cionopagum*' (*G. gephyropaga* according to ITS sequence) clustered in their analysis of 5.8S+LSU with *Arthrobotrys thaumasius* as sister taxon, the only included typical species of *Arthrobotrys*, whereas *G. parvicollis*, *G. phymatopaga*, and *G. robusta* clustered with species of *Dactylellina*. As a consequence, they provided the necessary new combinations, although their ß-tubulin and combined analyses gave partly quite different results.

In their multigene analysis (ITS, *RPB2*, *TEF1*, *TUBB*), Yang & Liu (2006) likewise found that *G. parvicollis* clustered together with species of *Dactylellina* (particularly in their ITS tree), whereas *D. cionopaga* formed a clade of its own, though situated closer to *Dactylellina* than *Arthrobotrys* when using a combined dataset (no further species of *Gamsylella* was included in this study). Therefore, Yang & Liu combined *D. cionopaga*, but also the not analysed *G. arcuata* and *G. gephyropaga*, into *Dactylellina*, and *Gamsylella* was consequently synonymised with *Dactylellina*. In a similar analysis by Yang et al. (2007)



Phylogenetic analysis 34. Phylogram of series *Gamsylella* inferred from ML analysis of ITS1-5.8S-ITS2 rDNA dataset (32 sequences, 605 positions, aligned with MUSCLE) using the K2+G model in MEGA7 (500 replicates). The tree is rooted with *O. eucalypti* and *O. oxyspora*. Asci 8-spored in all teleomorph taxa; T = type, ET = epitype.



Phylogenetic analysis 35. Phylogram of series *Gamsylella* inferred from ML analysis of LSU (D1–D2) rDNA dataset (24 sequences, 506 positions, aligned with MUSCLE) using the K2+G model in MEGA6 (500 replicates). Three environmental strains from GenBank are included, one of them representing an unidentified species (O36). The tree is rooted with *O. patellarioides* and *O. leucostigma*. Asci 8-spored in all teleomorph taxa; T = type, ET = epitype.

based on more species of *Gamsylella*, *G. parvicollis* and *G. phymatopaga* clustered with typical species of *Dactylellina* in a monophyletic group, whereas *G. robusta*, *G. arcuata*, *D. cionopaga* and *G. gephyropaga* formed a monophyletic sister group. The latter three species are very similar in having adhesive columns, arches or bridges, while *G. robusta* has sessile, peg-like adhesive knobs. Both groups together formed a monophyletic sister group to *Arthrobotrys*.

The four Chinese strains of *D. cionopaga* analysed by Yang et al. (2007) show a remarkable distance to the strains of *G. gephyropaga*, indicating that two distinct species are involved. Further Chinese sequences in GenBank support this distinction, though being partly labelled with the opposite name. When applying a narrow species concept, Abiko et al.'s (2005) apparently unsequenced four strains of '*D. gephyropaga*' are more likely *G. cionopaga* because of their high conidial length (40–64 µm) with up to 5 septa. On the other hand, adhesive branches with scalariform bridges were frequent in these strains, but are more rare in *G. cionopaga*, according to Drechsler (1950).

Yang et al. (2012a) conducted phylogenetic analyses of 5 protein-coding genes and found the genus *Gamsylella* to be well founded. However, among the accepted species only *G. cionopaga* is morphologically typical of that genus, showing adhesive columns and scalariform bridges, while *G. robusta* forms only peg-like adhesive knobs, and *G. parvicollis* and the also included *Orbilia quercus* (as '*G. querci*') mainly form globose adhesive knobs. Li et al. (2016) analysed the *MAD1* gene of nematode-trapping fungi and retrieved *Gamsylella* (*Ga. gephyropaga*, *G. cionopaga*, *G. robusta*) as a paraphyletic sister group of *Arthrobotrys*.

Present phylogenetic concept. When analysing SSU+ITS+LSU, five species of series *Gamsylella* for which sequences were available formed a weakly supported monophyletic clade positioned without support sister to series *Dactylellina* (Baral et al. 2017b) or unresolved (Phyls 7, 25). Within series *Gamsylella*, analyses of ITS and LSU, or SSU+ITS+LSU produced different phylogenies (Phyls 34–35, S35), particularly regarding *O. anigozanthi* which clustered in the LSU and the combined tree medium supported with *G. gephyropaga*, but in the ITS tree without support in a clade with *G. gephyropaga*, *G. robusta*, and *O. alba*. In the ITS or combined analyses, *G. arcuata* and *G. lobata* clustered in a medium (Phyl. 34) or strongly (S35) supported clade which formed with medium support a sister clade to *G. cionopaga*. A rather high distance is observed between all seven species for which DNA data were available. Even the currently synonymised *G. gephyropaga* and *G. cionopaga* are very different and clustered with other species in separate clades.

Specific nucleotide positions. Position 98 of the 5.8S region is informative in regard to subgroups within series *Gamsylella*. It is consistently CATCGA**A** in *G. cionopaga*, *G. arcuata*, *G. lobata*, and *Gamsylella* sp. (WAC10291), but CATCGA**G** in *G. gephyropaga*, *G. robusta*, *O. alba*, and *O. anigozanthi*. The former motif occurs also in members of *Mycoceros*, *Lilapila*, *Amphosoma*, *Microdochiella*, *Vermispora*, *Lecophagus*, *Hyalorbilia erythrostigma*, *H. orbiliicola*, *H. latispora*, and in a few taxa of *Orbilia* (*O. patellarioides*, *O. ovalis*, *O. comma*, and series *Piliferae*), and it is widespread in other groups of *Ascomycota*. All remaining members of *Orbilia* and *Hyalorbilia* possess the latter motif. Also the 3'-end of ITS1 (left of AAAACTTT) is informative, being C in *G. gephyropaga* and *G. robusta* but T in all other *Gamsylella* species.

A motif in the ITS2 region (pos. 14–15) permits to distinguish between series *Gamsylella* (TCG**AC**) and *Dactylellina* (TCG**GT**, Tab. 76). This motif supports placement of *D. robusta* (type), *O. alba*, and *O. anigozanthi* in series *Gamsylella*, and *M. robustum* (YMF 1.01413) and *O. quercus* in series *Dactylellina*. Also in stem-loop B8 of 5.8S (pos. 119–126) series *Gamsylella* differs from series *Dactylellina* in the combination of 4 symmetric nucleotides, except for *Gamsylella* sp. 8178 which concurs with series *Dactylellina* p.p.maj. (Tab. 77).

At pos. 243–245 of the LSU D1 domain, *G. gephyropaga* and *O. anigozanthi* differ by C**GAT**CATG from any other

Key to species of series *Gamsylella* with known teleomorph

1. Apothecia whitish, 0.4–7.5 mm diam.; spores *(3.6–)4–6.5(–7) × 0.8–1.2 µm, lower spores predominantly inverted within asci; conidia 1(–2) septate; hygric to mesic bark & wood of *Aroideae*, *Eucalyptus*, *Quercus*, thermotemperate to tropical humid southern Europe, eastern Asia, South America .... ***O. alba***, p. 1613

1. Apothecia pale to bright isabelline-orange, 0.7–2.2 mm diam.; spores *(5.3–)6–7.5(–8.5) × (1–)1.1–1.3 µm, upper spores predominantly inverted within asci; anamorph unknown; xeric stems, leaves & fruits of *Anigozanthos*, subtropical semihumid Australia ....***O. anigozanthi***, p. 1619

If spore bodies eccentrical and trapping organs unknown, see also series *Drechslerella* (p. 1623).

Orbiliomycetes which usually have C**TTC**CA or C**TTC**TA, supporting their close relationship. At pos. 399 of the D2 domain, *G. cionopaga* and the syntype of *G. gephyropaga* (CBS 178.37) deviate by CAG**C**ACG from any other *Orbiliomycetes* which have CAG**T**ACG, except for *Amphosoma resinicola* and *Dactylellina* aff. *phymatopaga* CBS 568.95 which also have CAG**C**ACG.

Ecology. Members of series *Gamsylella* have desiccation-sensitive apothecia, except for *O. anigozanthi* which shows a high tolerance to drought. Apothecia, which are only known in the two marginal members *O. alba* and *O. anigozanthi,* were found on woody angiosperms and herbaceous monocots. Records are known from boreal to tropical, humid to semihumid regions of Europe, Asia, Australia, and America.

Orbilia alba Dennis; Kew Bull. 9: 295 (1954) — Pls 993–996

= *Dactylella alba* Z.F. Yu & K.Q. Zhang, in Yu et al., J. Microbiol. 47: 266 (2009), nom. illegit., ICN Art. 53.1 [non *Dactylella alba* (Preuss) Sacc., Syll. fung. 4: 194 (1886)]

Etymology: teleomorph: referring to the colourless apothecia; anamorph: in reference to the associated teleomorph.

Typification: Trinidad, Arima, twigs of *Aroideae*, 23.X.1949, R.W.G. Dennis (K(M) 36045, holotype of ***Orbilia alba***). — China, Yunnan, Wenshan, branch of indet. angiosperm, 30.VI.2006, Z.F. Yu (YMF 1.01858, holotype of ***Dactylella alba***; sq.: FJ477044, MH179758).

Description: — **TELEOMORPH**: **Apothecia** fresh (0.4–)1–1.8(–2.3) {Spain} or 2.5–7.5 mm diam. {China}, rehydrated 3.5–5 mm diam. {T}, 0.08–0.12 {China} or 0.13–0.2 mm high {Spain} (receptacle 0.08–0.14 → 0.045–0.08 mm), (greyish–)white, pale cream to chlorinaceous when rehydrated, round to slightly undulating, slightly to strongly translucent, non- or slightly gelatinous, gregarious in smaller or larger groups; disc young strongly concave, soon flat or remaining medium concave, margin 0–10 µm protruding, externally smooth or sometimes finely pubescent ± up to margin; sessile on a narrow or very broad base, superficial; dry with slightly inrolled margin, whitish to cream. **Asci** *(26–)28–35(–39) × 3.2–3.8(–4) µm {2, Spain}; †(22–)24–30(–33) × (2.5–)2.7–3.3 µm {4}, 8-spored, spores */†2–4-seriate, (2–)3–5 of lower spores inverted (slightly to strongly mixed) {4}, pars sporifera */†(11–)14–16(–20) µm long; **apex** (†) slightly (to medium) truncate (never indented nor inflated); **base** with short to long, ± thin, flexuous stalk, Y- to T- or h- to H-shaped. **Ascospores** *(3.6–)4–5(–6.5) × 0.8–1.1 µm {China} or *(5–)5.5–7 × (1–)1.1–1.2(–1.3) µm {2, Spain}, †(4–)4.5–6(–6.5) × (0.7–)0.8–1.1 µm {3}, narrowly cylindrical to often subcylindric-clavate-fusoid, apex rounded to obtuse (sometimes subacute), base slightly to strongly attenuated, straight or slightly curved; **SBs** subglobose to rod-shaped, often distinctly eccentrical, 0.5–0.8 × (0.2–)0.3–0.4(–0.6) µm {2, Spain}, 0.3–0.6 µm away from apex (total length 1–1.4 µm), attachment invisible. **Paraphyses** apically uninflated to slightly (rarely medium to strongly) inflated, very slightly or sometimes distinctly obtusely lanceolate (to spathulate), rarely capitate-clavate {2}, terminal cell *(10–)12–19(–21) × 2.5–3(–4) µm {2, Spain}, †(7–)12–21 × 1.5–3(–6) µm {China & T}, exceeding the dead asci by 1–3.5 µm, lower cells *(4–)5–8(–9) × 2–3(–3.8) µm {2}, †3.5–7(–8) × 1.4–2.7 µm {1}. **Medullary excipulum** 20–70 µm thick, of loose, non-gelatinized textura intricata {3} with or without inflated cells, or of dense, strongly gelatinized horizontal t. prismatica {China}, mostly (very) sharply delimited from ectal excipulum. **Ectal excipulum** of (†) thin-walled to slightly gelatinized, irregularly to distinctly vertically oriented t. (globulosa-)angularis(-prismatica) from base to margin, 30–70 µm thick near base, cells *(12–)20–40(–45) × (8–)15–27(–32) µm {2, Spain}, †(7–)10–24(–30) × (5–)8–19 µm {China & T} (Dennis: up to 40 × 20 µm); 20–30 µm thick at lower flanks, 15–20 µm at margin, of t. globulosa-angularis-prismatica oriented at a 10–50° angle, marginal cortical cells */†(5–)6–13(–15) × (3.5–)5–7(–9) µm {3}; **glassy processes** absent. **SCBs** low-refractive, globose to elongate, present in some paraphyses {2}; **VBs** absent; **LBs** in paraphyses absent or sparse and minute, but in excipular cells of senescent apothecia with some peripheral LBs 1–2(–2.5) µm diam. **Exudate** absent or as very sparse minute granules, tips of paraphyses and asci and also marginal cortical cells somewhat immersed in gel. **Anchoring hyphae** medium to very abundant, */†(3–)4–6(–8) µm wide, walls 0.2–0.7(–1.2) µm thick {4}, singly projecting or forming a very loose t. intricata up to 40 µm thick. — **ANAMORPH**: gamsylella-like (from ascospore isolate {2} and natural substrate [trapping organs only] {2}). **Conidiophores** erect, *50–80 µm {China} or *(30–)90–175 µm long {Galicia}, 3–3.5 µm wide at base {China}, ~2–2.5 {China} or 2.7–3.2 µm {Galicia} at apex, here ± strongly branched (candelabrelloid), ~3–11 denticles of *3.5–10 × 1.5–2.5 µm {China}, or 1–9 denticles of 2–6.5 × 1.5–3.5 µm {Galicia}. **Conidia** *(18–)19–26(–32) × (5–)5.5–7.5(–8) µm {China, modified according to scale} or *18–26(–34) × 5–6 µm {Galicia}, cylindric-ellipsoid to cylindric-clavate, with {China} or without {Galicia} prominent basal protrusion, 1(–2)((–3))-septate, containing a few small LBs at septa or lateral wall. **Adhesive knobs** abundant, gregarious, erect, (35–)65–130 µm long {2}; **stalks** 0–1-septate, *35–90 × 4.5–5.5 µm [†~28–35 × 2–2.5 µm {China}], at base *5.5–7(–8) µm wide, apically *3–4.7 µm, emerging from basal hyphae or often by repeated branching of the stalks (stalks then also only 8–35 µm long); **heads** on natural substrate {Spain}: *26–36 × 8.5–11(–12) {2}, †26–34 × 7–10.5 µm {1}, spathulate to lageniform, apically narrowed to a width of *5.5–6 µm; in pure culture: *14–20(–27) × 8.7–10 µm {China}, *22–29 × (9–)10–12.5 µm {Galicia}, ellipsoid to narrowly obovoid; cytoplasm mainly vacuolated, with some small LBs, apical wall delicate, lateral wall often more firm, entire heads embedded in a globose adhesive mucilage of (25–)30–40(–45) µm total diam. when soaked with water, under normal condition strongly dehydrated and mucilage then only 10–20 µm total diam. and with strongly wrinkled, rough surface, mucilage staining bright lilac in CRB; **overmature heads** *30–40(–48) × 9.5–12(–13) µm {2}, renewed formation of trapping organs by proliferation at base, tip, or lateral part of heads; **infection bulb** *7 µm diam., globose, **assimilative hyphae** *4–6(–7) µm wide, entirely colonizing the interior of the animal; very distinct globose **WBs** on both sides of septa in assimilative hyphae, aerial mycelium, and anchoring hyphae *0.3–0.4 µm diam., in stalks of adhesive knobs *(0.3–)0.4–0.5(–0.7) µm diam. (†0.4–0.8 µm diam); otherwise without visible cell contents. **Non-constricting rings** absent.

Habitat: lying on ground; 0.7 mm thick, living corticated stem of *Aroideae* {T}; corticated, 2 cm thick branches of *Quercus robur* {1}, indet. angiosperm tree {1}; detached bark of trunk of *Eucalyptus globulus* {1}; on slightly to strongly rotten bark {3} (periderm and bast), also on 0.5–1.5 mm deeply very rotten wood {1}, on upper- and underside. **Associated**: *Acrodictys* sp. {1}, *Gamsylella cionopaga* {1}, *Heteroconium tetracoilum* {1}, *Orbilia* ?*bembicodes* {1}, *O.* ?*cotoneastri*

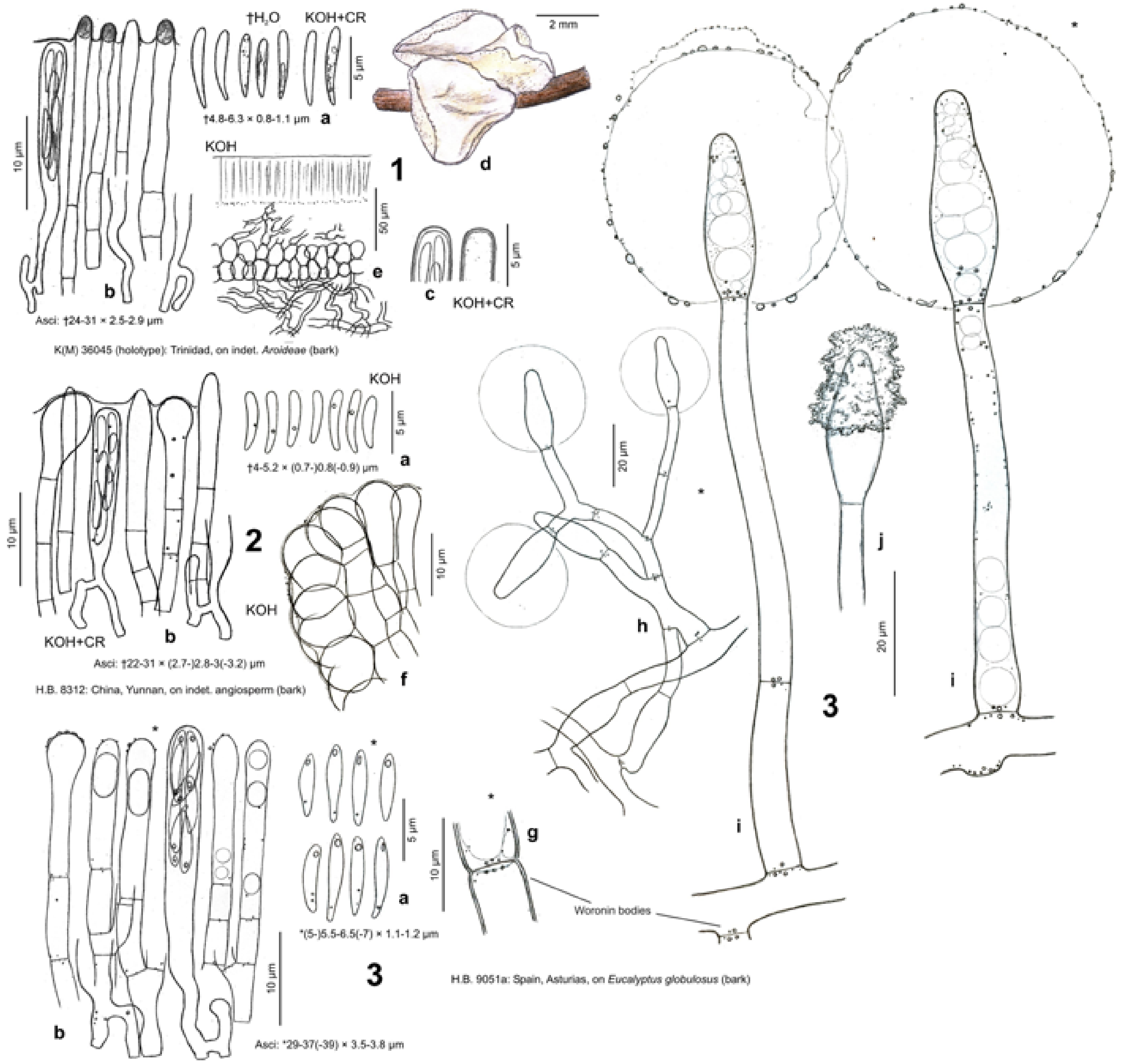


Plate 993. **1–3**: *Orbilia alba*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. rehydrated apothecia; **e**. median section of apothecial receptacle at lower flanks, showing hymenium, medulla, ectal excipulum, and anchoring hyphae; **f**. id., marginal ectal excipulum; **g**. detail of anchoring hypha; **h–j**. adhesive knobs (from substrate; **h–i**: hydrated, **j**: dehydrated in ethanol).

{2}, *Pleurothecium recurvatum* {1}. **Desiccation tolerance**: mature asci still viable after 12 hours, but dead in all parts after a few days, except for the ascospores which were dead when reexamined 3 months later (H.B. 9051a). **Altitude**: 40–80 m a.s.l. (southwestern Europe), 850 m (tropical America), 1272 m (southern China). **Geology**: China: Devonian sedimentary rock; Spain: Silurian-Devonian red sandstone, shale, dolomite; granite, amphibolite, serpentinite. **Phenology**: IV, VI, XII (northern hemisphere, extra-tropical), X (tropical belt).

Taxonomic remarks. *Orbilia alba* is characterized by comparatively large and thin, whitish, sessile apothecia, a thin, sharply delimited ectal excipulum of large excipular cells, extraordinarily wide anchoring hyphae, predominantly non-capitate to obtusely sublanceolate paraphyses, and by small and narrow, basally ± attenuated, straight or slightly curved ascospores. *O. alba* resembles *O. anigozanthi* in the teleomorph (for the differences see p. 1620), and our molecular data confirm a close relationship. *O. quercus* differs, e. g., in much smaller apothecia and consistently slightly capitate paraphyses, in addition to a very different anamorph.

Variation. The Chinese specimen reported by Yu et al. (2009a) differs in several details from the Southern American holotype and the collections from Spain. The ascospores are a bit smaller and their ends almost untapered. However, this difference in shape is only obvious when comparing spores in the living state (Spain: Pls 993: 3a; 994: 1l; 995: 1e; China: Pl. 996: 1h). In the dead state the spores of the Chinese specimen are also distinctly tapered and their shape hardly differs from the holotype (Pl. 993: 1a, 2a). The paraphyses are more distinctly lanceolate in the Chinese specimen, but capitate-clavate paraphyses with distinctly shorter and wider terminal cells frequently likewise occurred (Pl. 993: 2b), at least in some of the apothecia examined. Yet, such inflated paraphyses were also seen in one of the specimens from Spain (3b, left paraphysis). The medullary excipulum is rather strongly gelatinized in the Chinese specimen by a refractive intercellular gel (faintly visible in Pl. 996: 1d–e), whereas no such gel could be observed in the other three specimens.

The rehydrated apothecia of the Chinese specimen have a diameter of 2.5–7.5 mm (Pl. 996: 1a–b), and those of the holotype 3.5–5 mm. In contrast, the fresh ones in the Spanish specimens measured only 0.4–2.3 mm. Despite their large size, the apothecia in the Chinese specimen were thinner than in the Spanish ones. In the holotype they are affixed to the thin twig by a rather narrow base and have a deeply concave disc. The apothecia in the other samples grew on much larger pieces of substrate; apparently therefore, they are attached to the substrate by a ± broad base and soon have a more or less flat disc. In the holotype the paraphysis apices contained a large, slightly refractive inclusion (in H_2O as well as KOH, Pl. 993: 1b) which might correspond to the faint SCBs seen in some paraphyses of the two Spanish collections (3b). No such structure was seen in the Chinese specimen in either the living or dead state.

Anamorph (see also p. 235). In their ascospore isolate of a southern Chinese collection, Yu et al. (2009a) obtained an anamorph which they named *Dactylella alba* (Pl. 996: 1i–k). It is characterized by long, candelabrelloid conidiophores with loose terminal clusters of small-sized, mainly 1-septate conidia (the statement 'mainly 2-septate' in the English description is an error, correct is: '30 % 2-septate, 70 % 1-septate', Z.F. Yu pers. comm.). As an exception, a 3-septate conidium occurred (1i upper right). It must be mentioned that the stated conidial size does not well correspond to the scale bar: either the bar is ~ 8 % too long or the measurements ~ 8 % too large. A photo of further, unpublished conidia kindly sent by Z.F. Yu shows distinctly longer and narrower conidia, which led us to believe more in the published scale bar; therefore, we slightly diminished the conidial measurements in the protologue. In pure culture of the specimen from Galicia (Spain) a very similar anamorph developed (Pl. 995: t–w), with slightly narrower conidia with indistinct instead of prominent basal protrusion. Also here 70–80 % of the conidia were 1-septate, the remaining 2-septate.

Dactylellina entomopaga has very similar conidiophores and conidia, except that the conidia are often formed in whorls at intervals (Pl. 14: b). Also the trapping organs are distinctly smaller. Molecular data were not available since the only sequence in GenBank under this name refers to '*Arthrobotrys*' *paucus*, a member of series *Dactylellina* (see p. 228 and Pl. 7: a). *Dactylella vermiformis*, the anamorph of *Orbilia vermiformis*, resembles *D. alba* in conidial morphology. It differs in conidiophores with single conidia at the tip (sometimes subapically branched but not candelabrelloid), and in lacking trapping organs. With its candelabrelloid conidiophores, *Dactylella alba* was compared by Yu et al. with *D. pulchra*, which has much larger multiseptate conidia and also lacks trapping organs.

Adhesive knobs. *O. alba* captures small invertebrates by means of comparatively large, long-stalked adhesive knobs with elongate, flask-like (lageniform) heads surrounded by thick mucilage (Pl. 993: 3h–j). In the hydrated state the mucilage attains the shape of small balls whereas under normal atmospheric conditions it is strongly dehydrated and shows a wrinkled surface. This rather unusual type of trapping organ, which is already macroscopically visible (Pl. 994–995), strongly recalls the short-stalked and distinctly smaller adhesive knobs of *Dactylellina entomopaga* with ellipsoid heads or *D. ferox* with globose heads, which are similarly surrounded by thick mucilage (Pl. 14: b, c).

Particularly *D. entomopaga* appears to be very closely related to *O. alba*, including its ability to trap collembola. It differs in the smaller size of the trapping organ (data after Drechsler 1944b and Saikawa et al. 2010): the ellipsoid heads measure *8–13 × (4.5–)6–7.5(–8) µm [in *O. alba* *(14–)20–30(–36) × 8.5–11(–12) µm] and the total width of the swollen mucilage 15–21 µm [in *O. alba* (25–)30–40(–45) µm]; also the mostly non-septate stalks are with *7–18 × (2–)3–4.5(–5) µm much shorter than the often 1-septate, 28–90 × 2–5.5 µm large stalks of *O. alba*. This indicates that *O. alba* is able to trap also larger invertebrates in comparison to *D. entomopaga*. A further difference might be in the mucilage which attains in *D. entomopaga* a lobed surface when dehydrated (Drechsler 1944b: fig. 5, see Fig. 106: d, e; Saikawa et al. 2010, fig. 3), whereas that in *O. alba* becomes strongly wrinkled but not clearly lobed (Pls 993: 3j; 1002: 1w).

Yu et al. observed in their *D. alba* 'a new type of spores similar to chlamydospores' (Pl. 996: 1j), being formed 'terminal to intercalary, solitary' from aerial mycelium. The authors believed that trapping organs were not formed and, therefore, placed this anamorph in *Dactylella*, despite the fact that it clustered in their phylogenetic analysis near *Dactylellina quercus*. That these 'chlamydospores' are, in fact, adhesive knobs is supported by the observation of some slime around them (Z.F. Yu pers. comm.).

In the two Spanish specimens the trapping organs occurred in high frequence around the apothecia, while in that from China no such organs could be found. The adhesive knobs possess rather thick stalks with conspicuous Woronin bodies (WBs) at the septa (Pls 993: 3i; 994: 1s; 995: 1n–o). WBs are also found in the wide hyphae from which the stalks emerge. These hyphae and their WBs closely correspond in size to the anchoring hyphae of the associated apothecia of *O. alba* (Pl. 993: 3g). Moreover, in the specimen from Galicia a direct connection between the hyphal system of the trapping organs to that of an apothecium could unequivocally be demonstrated on the natural substrate. In an ascospore isolate from this specimen the same type of trapping organs were formed without the presence of prey (Pl. 995: 1k–m, o–s).

The trapping organs of *O. alba* grow gregariously in great number by covering several square millimetres of substrate. They are able to capture arthropods at their legs or antennae. Several dead individuals of mites (*Acari*), flies (*Diptera*), and springtails (*Collembola*) occurred on the bark in close proximity to the apothecia when the two Spanish specimens were collected and studied. These were infected and overgrown by mycelium and surrounded by many adhesive knobs.

The adhesive mucilage is virtually invisible in water mounts (even under phase contrast), because it is instantly soaked to maximum hydration when placed in water. It becomes more visible when adding a drop of 96 % alcohol which dehydrates the mucilage (Pl. 994: 1v, x), or by adding CRB which stains the mucilage bright lilac (Pl. 995: 1p–q, see also Fig. 107 on p. 118). Under natural condition, even under a high air humidity, the mucilage is rather strongly dehydrated (Pls 994: 1m–n; 995: 1h–i) and has a very rough, wrinkled surface. Direct placement in 96 % alcohol allows to study this situation under the microscope (Pls 993: 3j; 994: 1w). In this state the mucilage covers mainly the narrower upper part of the head. When spraying water over

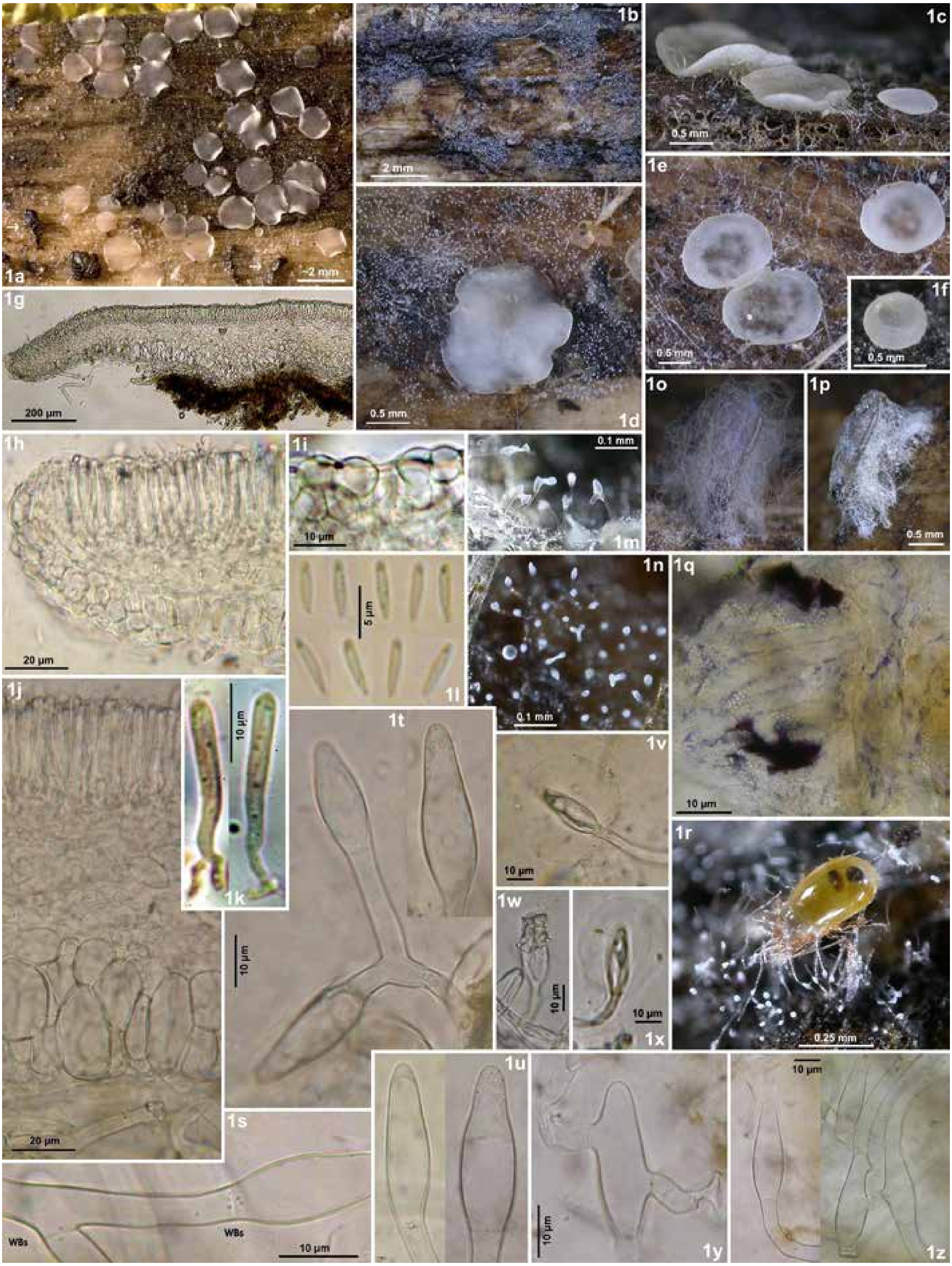


Plate 994. **1**: *Orbilia alba*. – **1a–f**. fresh apothecia (**1a**. arrows: 2 trapped dipterans, **1b**, **d**. with numerous adhesive knobs); **1g**. apothecium in median section; **1h**. id., ectal excipulum at flanks and margin; **1j**. id., near base; **1i**. marginal cortical cells in top view; **1k**. asci; **1l**. ascospores; **1m–n**. adhesive knobs; **1o–p**. trapped fly overgrown by mycelium (**1p** after spraying with water); **1q**. head of trapped springtail (with 2 dark eyes), colonized by assimilative hyphae; **1r**. trapped juvenile mite, hyphae starting to overgrow the prey; **1s–z**. adhesive knobs [**1y–z**: proliferating terminally or laterally; mucilage only visible in **1v**, **x** (soaked) and **1w** (dehydrated)] (**1m–z** on natural substrate). – Living state (in water, but **1v** & **x** in water to which ethanol was added, **1w** directly in ethanol 96 %), except for asci in **1k** (in CR). – **1a**, **k**: phot. E. Rubio. — **1a–z**. H.B. 9051a: Spain, Asturias, on *Eucalyptus*.

the substrate, or under natural conditions during rainfalls, the mucilage swells to a spherical shape in the same way as in a water mount. The mucilage then entirely encompasses the flask-shaped terminal cell. A few knobs in Pl. 994: 1n and Pl. 995: 1i show the hydrated state.

Adhesive knobs grown in pure culture differed somewhat from those on the natural substrate in their heads being distinctly shorter and more ellipsoid to obpyriform instead of lageniform, by lacking the neck-like apex, also in having distinctly thickened lateral walls (Pl. 995: 1o–s; 996: 1j). In the specimen from Galicia the heads are slightly larger than in that from China. The mucilage showed a fibrous microstructure when stained in CRB (Pl. 995: 1p–q), but in those heads with pronounced wall thickenings (1o, r–s) no mucilage could be demonstrated. In the dead state the lateral wall is considerably more thick-walled (1s right), but abruptly thin at the apex. Whether outer parts of the thick wall get disintegrated to produce the mucilage is unclear.

In the Galician specimen, apothecia developed in some agar plates which partly contained wood fragments, but these remained rather small and immature. Although the apothecia in the collection from Asturias got senescent on the natural substrate during some weeks in the moist chamber, the trapping organs strongly increased in number. Repeated photographic documentation showed that these traps are rather quickly formed: a large group of fully-developed traps was detected at a spot where almost no traps were present about 2 days before. Tests with small invertebrates (spiders, mites, springtails) proved that these animals immediately get stuck with their legs or antennae to the mucilage of the large adhesive knobs of *O. alba* (see also Fig. 107: k–m). Attraction oft the animal by the knobs could not be observed, instead, the trapping occurred accidentally. Larger invertebrates (spider, adult mite) which were tested escaped from the knobs within some minutes, but none of the springtails and young mites succeeded to get free.

The process of adhesion of the animal to the adhesive knob does not require strong hydration of the mucilage. Instead, the knobs are highly sticky also when the mucilage is comparatively dehydrated. Often several adjacent knobs get attached to 1 leg and also among one another. Then the animal needs two- to three-fold force to escape.

The trapped animals try to escape the traps over a period of about 5–10 minutes. When an hour or more has passed and they are still affixed to the knobs, movements get slower or are hardly visible anymore. But even after about 10–12 hours, when the mycelium starts to overgrow the animal body, legs or antennae still show distinct occasional movement. The aerial mycelium soon completely covers and masks the animal, perhaps in order to avoid capture by other predators (Pl. 994: 1o–p). Death and collapsing of the animal was noted 2 days after capture. Probably rather quickly after capture a globose infection bulb is formed inside the animal, and from this emerge assimilative hyphae which finally colonize the entire interior (Pl. 994: 1q).

Variation is also noted in the anamorph. The conidia in the two strains closely correspond in shape and septation, also in length, but in that from Galicia they tend to be narrower (*5–6 μm, China: *5–8 μm). The heads of the adhesive knobs were slightly larger in the Spanish collections when compared in pure culture to that from China, and particularly their stalks were distinctly larger (*35–90 × 4.5–5.5 μm, China: †~28–35 × 2–2.5 μm).

Type studies. The present reexamination of the holotype well corresponds to the protologue, except for the paraphyses which Dennis (1954) illustrated as capitate and not protruding. The pubescent exterior of the apothecia is due to the anchoring hyphae forming a loose texture that extends over the flanks. This appears to be what Dennis described as a 10 μm thick gelatinous covering layer containing a few slender hyphae, although no gel matrix between the hyphae could be observed in the present study.

Other conidial states observed in association. Three orbiliaceous anamorphs grew in association on the natural substrate in the collection from Asturias: *Dactylella* sp., *Gamsylella cionopaga*, and *Drechslerella* cf. *bembicodes*, the latter two also with their trapping organs. All of them are obviously not connected to *O. alba*. In fact, apothecia of *O.* cf. *cotoneastri*, to which the dactylella-like anamorph obviously belongs, appeared during incubation of the substrate in a moist box (Pl. 909: 2), partly very close to the trap areas of *O. alba*. A similar dactylella-like anamorph was abundantly present in the specimen from Galicia, where it occurred in close connection to the apothecia and adhesive knobs of *O. alba*. Also here, a single apothecium reminiscent of *O. cotoneastri* appeared during incubation in a moist box. This undoubtedly represents the teleomorph of the dactylella-like anamorph which, unlike the above, resembles *Dactylella rhopalota* (Pl. 909: 4). Conidiophores and conidia of *O. alba* have so far not been observed on the natural substrate.

Phylogeny. Molecular data of *O. alba* were available from the ascospore isolate from China (ITS) and from apothecia of the specimen from Galicia (SSU+ITS+LSU). In both the S1506 intron is absent. In the ITS region the two sequences show a high distance of 13% to each other, compared to their distance to *O. anigozanthi* which lies around 16.5% for both strains. In combination with slight morphological differences between European and Chinese specimens this indicates that two different species are involved. Since no molecular data were available for the holotype, the identity of the three recent records remains unsettled.

Our combined analyses of SSU+ITS+LSU (Baral et al. 2017b, Phyl. S35) placed *O. alba* and *O. anigozanthi* with strong or medium support in a clade with *G. gephyropaga*, though with a high distance. This placement suggests that the two species belong to series *Gamsylella* inspite of the different trapping organs in *O. alba* and *G. gephyropaga*. Further research is necessary to settle the taxonomy in this interesting group, including its relationship to *Dactylellina entomopaga* and *D. ferox*.

Ecology. The holotype of *O. alba* grew on the epidermis of very thin, living stems of a terrestrial aroid (*Aroideae*, *Araceae*) in a tropical humid rainforest in the Northern Range of Trinidad (southeastern Caribbean Sea). The Chinese collection was on rotten bark of a mesic branch of an unidentified angiosperm tree lying on calcareous soil in a subtropical humid (winter-dry) montane evergreen forest. The specimens from northern Spain grew in a cantabroatlantic, thermotemperate humid (somewhat summer-dry) climate: that from Asturias was in a *Eucalyptus* plantation on the underside of detached rotten bark of *Eucalyptus* fallen to the ground, and that from Galicia in a forest with *Laurus nobilis* and *Castanea sativa* on a fallen, partially corticated branch of *Quercus robur*.

Specimens included. **Trinidad**, 30 km ENE of Port-of-Spain, ~10 km NNE of Arima, El Cerro del Aripo Mt., ~850 m, near cave, stems of *Aroideae*, on bark, 23.X.1949, R.W.G. Dennis (Dennis 483, K(M) 36045, **holotype** of *O.*

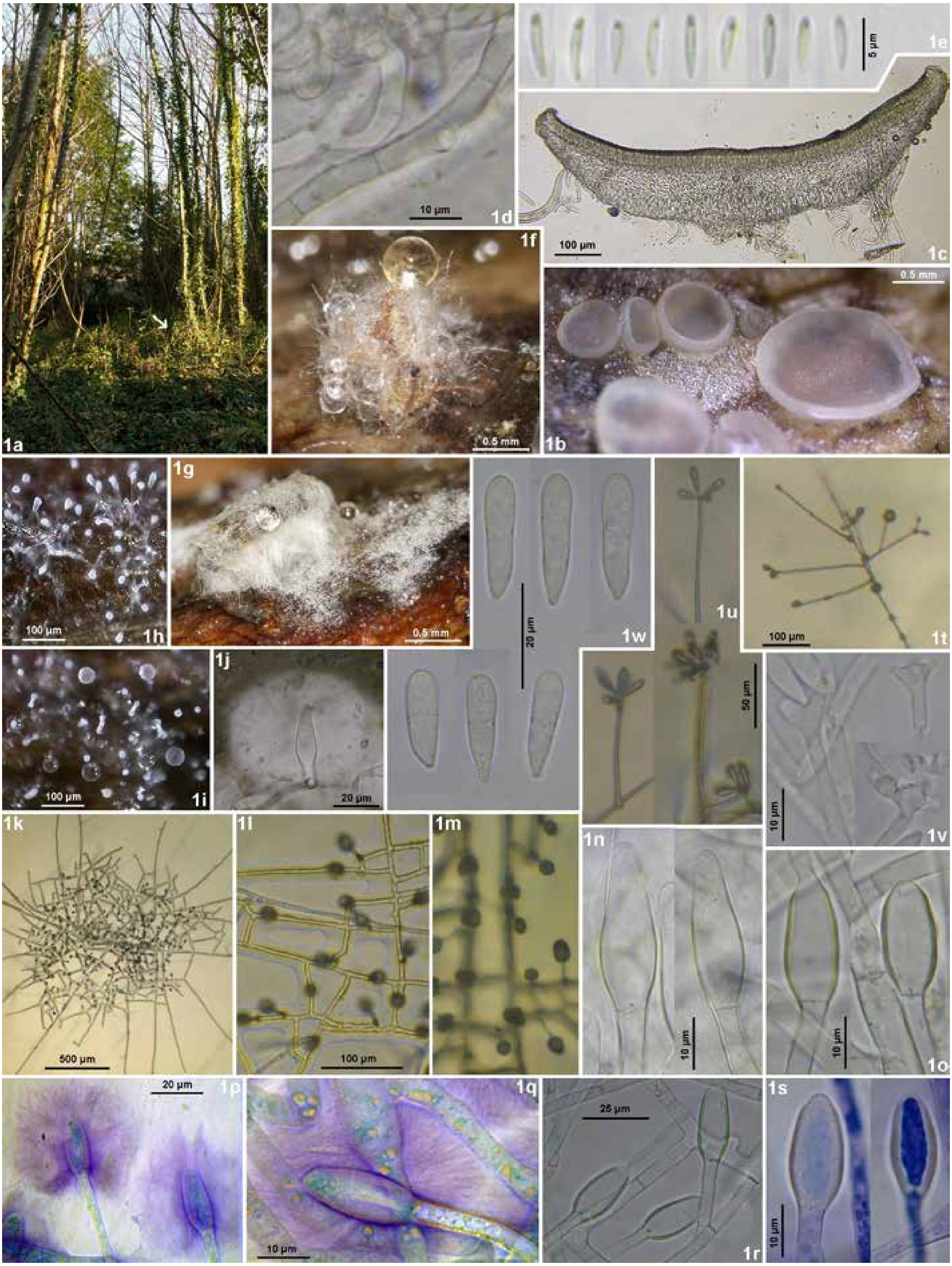


Plate 995. **1**: *Orbilia alba*. – **1a**. atlantic forest with *Castanea sativa*, *Laurus nobilis*, *Quercus robur*, arrow indicating place of collection; **1b**. fresh apothecia; **1c**. median section of apothecium; **1d**. anchoring hyphae; **1e**. ascospores; **1f–g**. trapped invertebrates (**f**: springtail, **g**: dipteran), overgrown by hyphae (**1g**: surrounded by numerous adhesive knobs); **1h–i**. adhesive knobs (**1i**: mucilage of some heads soaked with water); **1j**, **p–q**. adhesive knob with visible swollen mucilage; **1k–m**. mycelium with adhesive knobs on agar; **1n–o**, **r–s**. adhesive knobs (mucilage invisible); **1t–u**. conidiophores with conidia; **1v**. conidiophore apices with denticles; **1w**. conidia (**1f–j**, n on natural substrate, **1k–m**, **o–w** from culture). – Living state (in water, **1j** in Indian ink, **1s** left in CRB), except for **1p–q** (in Methyl green in ammonium hydroxide, to which CRB was added), **1s** right (in CRB). – **1a–b**, **f–g**: phot. B. Amarante Rodríguez. — **1a–w**. H.B. 9645a: Spain, Galicia, on *Quercus robur*.

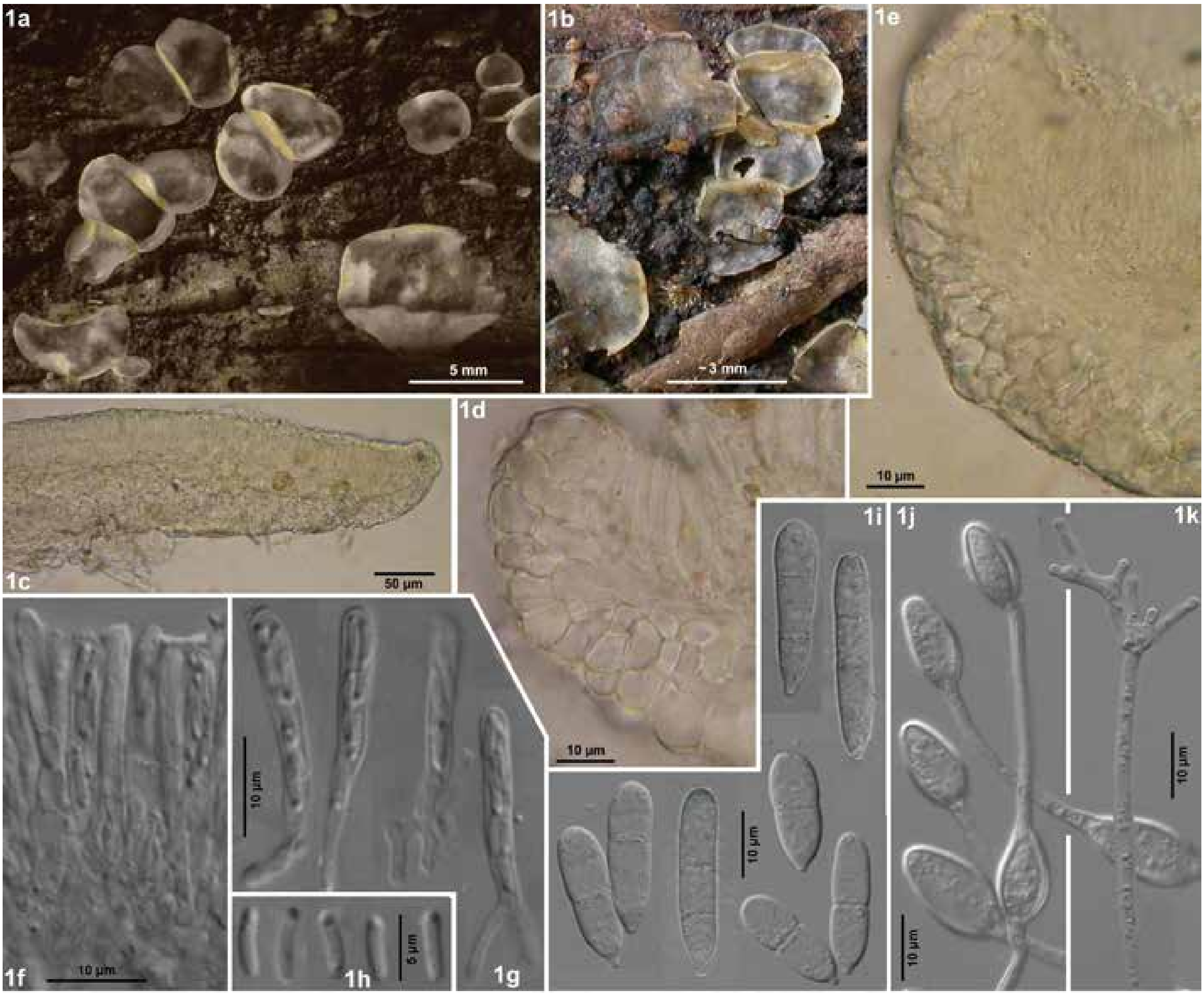


Plate 996. **1**: *Orbilia alba*. – **1a**. fresh apothecia; **1b**. rehydrated apothecia; **1c**. apothecium in median section; **1d–e**. id., ectal excipulum at flanks and margin; **1f–g**. asci (and paraphyses); **1h**. ascospores; **1i**. conidia; **1j**. adhesive knobs; **1k**. conidiophore (**1i–k**. from culture). – Living state, except for asci in **1g**, adhesive knobs in **1j** (p.p.). – **1a**, **f–k**: phot. Yu.et al. (2009b). — **1a–k**. YMF/T 1.01858, H.B. 8312: China, Yunnan, on indet. angiosperm.

alba, H.B. 5450 ø). — **SPAIN**: **Asturias**, 5 km WSW of Avilés, 2 km SSW of Piedras Blancas, Las Bárzanas, 80 m, branch of *Eucalyptus globulus*, on bark, 25.IV.2009, E. Rubio & A. Suárez (E.R.D. 4772, H.B. 9051a, anam. substr.); – **Galicia**, **La Coruña**, 18 km SE of La Coruña, SE of Betanzos, N of Calle de Concepción Arenal, 40 m, branch of *Quercus robur*, on wood & bark, 31.XII.2011, B. Amarante Rodríguez (H.B. 9645a, anam. substr., anam. cult.; sq.: KT222438). — **CHINA**: **Yunnan**, **Wenshan**, 1272 m, branch of indet. angiosperm, on bark, 30.VI.2006, Z.F. Yu (YMF/T 1.01858, **holotype** of *D. alba*, anam. cult., H.B. 8312; sq.: FJ477044, MH179758).

Orbilia anigozanthi Baral & G. Marson, **sp. nov.**, MB 813993 — Pls 997–998

Etymology: named after the host plant, *Anigozanthos*.

Typification: Western Australia, Perth, stems and leaves of *Anigozanthos manglesii*, 7.IX.2006, G. Marson (ex H.B. 8303a, MEL 2389239, holotype; sq.: KT380102).

Latin diagnosis: *Apothecia rehydratata 0.7–2.2 mm diam., pallide isabellino-cremea vel intense luteo-aurantiaca, sessilia, margine prominuli, laevi. Ascosporae *5.3–8.5 × 1–1.3 µm, (clavato-)fusoideae, apice rotundatae vel obtusae, subrectae, corpusculum refringens minutum, plerumque bacilliformem, iuxta apicem plus minusve excentricum continentes, saepe superiores inverse orientates. Paraphyses ad apicem saepe obtuse lanceolatae ad lageniformes, exsudato tenuissimo tectae. Excipulum basale cellulis magnis, tenuitunicatis, marginale absque processis vitreis, exsudato valido tectum. Hyphae basales abundantes, latae. Cellulae vivae excipuli et paraphysium corpuscula globosa continentes. Habitat ad culmos putridos siccos, etiam ad folia et capsulas* Anigozanthi *in zona subtropica semihumida Australiae meridio-occidentalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated (0.7–)1–1.5(–2.2) mm diam., 0.11–0.28(–0.35) mm high (receptacle 0.09–0.2 → 0.06–0.09 mm), very pale to light isabelline-cream or light to bright yellow-orange-apricot, slightly to strongly translucent, round to very slightly undulating, slightly gelatinous, subgregarious; disc flat, margin slightly to strongly inrolled, 0–35 µm protruding, smooth; broadly sessile, superficial; dry pale to deep cream or yellow-orange-apricot. **Asci** *34–40 × 3–3.3 µm {1}, †28–39 × 2.5–2.8 µm {1}, 8-spored, spores *2–3-seriate, (1–)3–4 upper spores inverted {2} (often mixed, sometimes lower spores inverted), pars sporifera *23–25 µm long; **apex** (†) strongly truncate (very slightly to distinctly indented, laterally sometimes inflated); **base** without or with short, thick stalk, h- or sometimes H-shaped. **Ascospores** *(5.3–)6–7.5(–8.5) × (1–)1.1–1.3 µm {2}, †5.3–7 × 1–1.1 µm {1}, subcylindrical to mostly fusoid, sometimes slightly clavate to fusoid-clavate, apex rounded to obtuse, base slightly to medium tapered, straight to slightly inequilateral; **SBs** *0.5–1 × 0.2–0.3 µm {1, visible part, total length 0.8–1.6 µm}, consistently ± eccentrical (close to lateral wall) near spore apex, subglobose to mostly rod-shaped, attachment invisible. **Paraphyses** apically uninflated to often obtusely lanceolate to lageniform, terminal cell *(14–)17–24 × 2.5–3.5(–4)((–4.5)) µm {2}, exceeding the dead asci by 3–5 µm (the living asci by 2–3 µm),

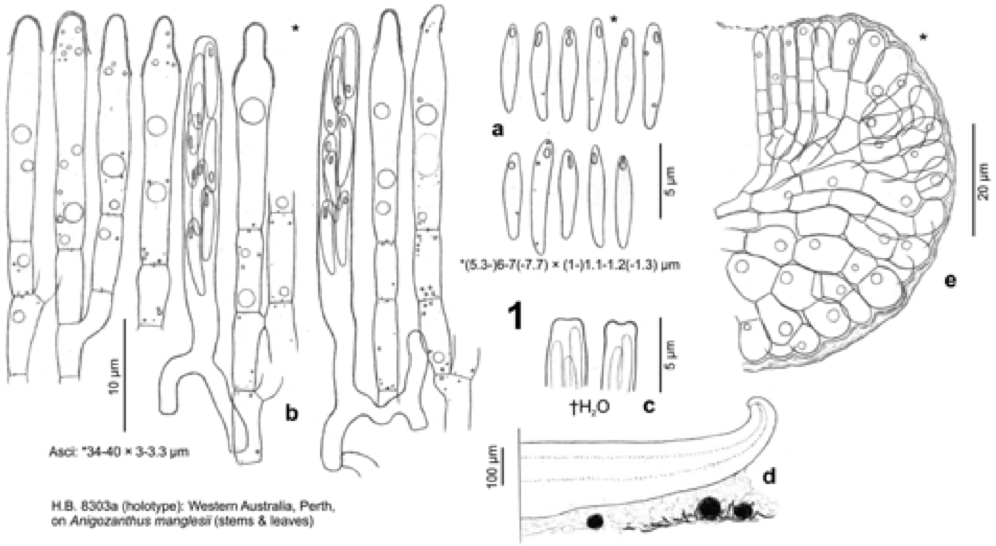


Plate 997. **1**: *Orbilia anigozanthi*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. apothecium in median section; **e**. id., ectal excipulum at margin.

lower cells *4.5–8 × 2–3.2 µm {1}; never branched at upper septum, hymenium pale rose-orange. **Medullary excipulum** hyaline to very pale rose-orange, 40–120 µm thick, of loose to ± dense, non-gelatinous textura intricata-prismatica, mainly composed of rather large cells (*5–15 µm wide), somewhat horizontally oriented, sharply delimited from ectal excipulum. **Ectal excipulum** hyaline to very pale rose-orange, of thin-walled, vertically oriented t. globulosa-angularis-prismatica from base to mid flanks or margin, (30–)70–120(–200) µm thick near base, cells *(12–)20–48(–55) × (10–)16–23(–44) µm {2}; 40–80 µm thick at flanks, 15–25 µm at margin, of short-celled t. prismatica oriented at a 50–80° angle to the surface, marginal cortical cells *5–9 × 4–7.5 µm {2}, at upper margin often oriented at 10–20°, partly of t. prismatica(-porrecta) with cortical cells †/*9–15(–20) × 4–6 µm; **glassy processes** absent. **Anchoring hyphae** very abundant, *2.7–6(–8) µm wide, walls 0.15–0.3(–0.6) µm thick {2}, with 1–2 µm thick indistinct gel sheath, forming a medium to very loose hyaline, t. intricata ~40–100 µm thick. **SCBs** globose, in paraphyses (1–)1.5–2.5(–3) µm diam., in ectal excipulum 1.5–3.7(–4.5) µm; **VBs** absent. **Exudate** over paraphyses 0.1–0.2 µm thick, finely rough, mostly reaching down to the widest part of terminal cell, firmly attached; over margin and flanks 1–3 µm thick, continuous, hyaline. **— ANAMORPH**: unknown.

Habitat: lying ± close to dry sandy soil or sticking in soil by 1 end, 2.5–8 mm thick, previous year's stems (partly on leaf sheaths), also leaves and empty capsules of *Anigozanthos manglesii* {2}, medium to strongly decayed and greyed, partly on blackened areas, algae very sparse. **Associated**: *Orbilia kingsiana* {1} (on separate stems), *O.* cf. *nothoaprilis* {1}, dematiaceous hyphomycete. **Desiccation tolerance**: a few mature asci still viable after 6 months, many paraphyses after 13.5 months, many excipular cells and ascospores even after 2.5 years. **Altitude**: 48–58 m a.s.l. **Geology**: Cenozoic regolith (whitish sandy soil). **Phenology**: long-lived.

Taxonomic remarks. *Orbilia anigozanthi* is easily recognized in the field by its large, dry pale to mostly bright yellow-orange apothecia. The straight, fusoid ascospores with eccentrical, rod-shaped SBs strongly resemble those of *O. polybrocha*. *O. anigozanthi* is extraordinary within series *Gamsylella* and also *Dactylellina* because of its desiccation-tolerant apothecia. *O. pilosa* resembles *O. anigozanthi* in paraphysis shape but differs, e.g., in white, ± desiccation-sensitive apothecia with thick-walled hairs at the margin, and much shorter spores with globose SBs. *O. alba* resembles *O. anigozanthi* in the large apothecia, large excipular cells, wide anchoring hyphae, sublanceolate paraphyses, and ± eccentrical SBs, but differs in smaller spores and white apothecia growing on hygric woody substrate.

Phylogeny. Sequences were gained from apothecia, two from the holo- and one from the paratype, comprising ITS and LSU. Those from the holotype include a small part of SSU, in which the S1506 intron is absent. Among these three sequences interesting variation occurs at 3 positions of the ITS region, which is clearly not the result of a sequencing error, according to the consensus analysis of two different runs for pos. 85 and 3 for pos. 359 and 461 (Tab. 90). These positions are otherwise consistent among members of series *Gamsylella* and *Dactylellina*, except for a few deviations: *D.* aff. *phymatopaga* CBS 568.95 deviates at pos. 85 by A and *D. haptotyla* in this region by 13 gaps from other *Dactylellina* and *Gamsylella* species which have G, and *D. haptospora* differs at pos. 461 by a gap from the typical situation (T).

The three sequences of *O. anigozanthi* were gained from a few small fragments of detached apothecia found in the envelope. Therefore, each sequence could derive from one or several apothecia, and it remains unclear whether the observed variation is due to multinucleate cells, or the genome deviates among apothecia of a population.

The morphological similarity between *O. alba* and *O. anigozanthi* in the teleomorph is supported by our combined phylogenetic analyses (Baral et al. 2017b, Phyl. 25) in which they form with *G. gephyropaga* a strongly or medium supported clade. However, a distance of 16.5% in the ITS region and 4% in the LSU D1–D2 is found between the two species. When analysing LSU or SSU+ITS+LSU (Phyls 35, S35), *O. anigozanthi* clustered with medium support with *G. gephyropaga*, whereas in the ITS alone this association remained unsupported (Phyl. 34). Actually, the distance between *O. anigozanthi* and *G. gephyropaga* is only 11–13.5/1.9–2.1%, compared to 14–19.5/3.8–4.3% between *O. alba* and *G. gephyropaga*.

Ecology. *O. anigozanthi* was found on decayed, xeric herbaceous stems, leaves, and fruits of *Anigozanthos* (*Commelinales*), an attractive Australian plant genus known as Kangaroo Paw. The substrate was lying on the dry ground in a subtropical semihumid banksia-eucalypt woodland in southwestern Australia. The paratype collection was gathered only 430 m away from the holotype locality. Apothecia have been collected during the dry season, though the first record was made shortly after the humid wintertime. Despite its conspicuous apothecia the species was only observed in the Kings Park in Perth.

Specimens included. **AUSTRALIA**: **Western Australia**, **Swan Coastal Plain**, 3 km SW of Perth, Kings Park, NE of Matilda Bay, non-cultivated part, 48 m, stems & leaves of *Anigozanthos manglesii*, 7.IX.2006, G. Marson (MEL 2389239, holotype; isotype in H.B. 8303a; sq.: KT380102, KT380103). – ibid., 430 m NE of type locality, 58 m, stems, leaves & fruits of *A. manglesii*, 14.XI.2007, G. Marson (H.B. 8831; sq.: KT222374).

Plate 998. **1–2**: *Orbilia anigozanthi*. – **1a**. banksia-eucalypt woodland with *Anigozanthos manglesii*, dead parts lying on dry ground; **1b–e**, **2c**. rehydrated apothecia; **1f**, **2a–b**. dry apothecia; **1g**. apothecium in median section; **1h**. id., ectal excipulum at margin; **1j**. id., ectal and medullary excipulum at lower flanks; **1i**. id., ectal excipulum; **1k**. id., near base, with anchoring hyphae; **2d**. globose SCBs in cells of ectal excipulum near margin, **1l**. ascus apices; **1m**, **2e**. ascospores; **1n–o**. apices of paraphyses. – Living state. — **1a–o**. H.B. 8303a (holotype): Western Australia, Perth, on *Anigozanthos*; **2a–e**. H.B. 8831: ibid.

Table 90. Variation among the three available sequences of *O. anigozanthi* (all from Kings Park) at three positions in the ITS rDNA (pos. 85 of ITS1, pos. 359 & 461 of ITS2), in comparison with available sequences of *O. alba*, *Gamsylella* spp., and *Dactylellina* spp. Position numbers according to a sole alignment of *O. anigozanthi*, starting after ATCATTA.

Species	GPS nr.	Herbarium	Collection year	pos. 82–88	pos. 356–362	pos. 458–64
O. anigozanthi	#957-1	H.B. 8303a	2006 (type)	`AGCAGTC`	`TCGGCAC`	`TACTTGT`
O. anigozanthi	#957-2	H.B. 8303a	2006 (type)	`AGCAGTC`	`TCGACAC`	`TACGTGT`
O. anigozanthi	#1105	H.B. 8831	2007 (paratype)	`AGCGGTC`	`TCGACAC`	`TACTTGT`
O. alba (s.l.)				`-YKGKCC`	`TCGACMC`	`TACTTGT`
Gamsylella (remaining)				`-SSGGYY`	`TCGACAC`	`TACTTGT`
Dactylellina				`-YNGGYY`	`TCGGYHM`	`YRCTTGY`

Species without known teleomorph

Gamsylella gephyropaga (Drechsler) M. Scholler, Hagedorn & A. Rubner, Sydowia 51(1): 108 (1999) — Pl. 14: f

≡ *Arthrobotrys gephyropagus* (Drechsler) Yan Li [as '*gephyropaga*'], in Li, Hyde, Jeewon, Cai, Vijaykrishna & Zhang, Mycologia 97(5): 1042 (2006) [2005]
≡ *Dactylella gephyropaga* Drechsler, Mycologia 29(4): 512 (1937)
≡ *Monacrosporium gephyropagum* (Drechsler) Subram. [as '*gephyrophagum*'], J. Indian bot. Soc. 42: 293 (1964) [1963]
≡ *Golovinia gephyropaga* (Drechsler) Mekht., Mikol. Fitopatol. 1: 276 (1967)
≡ *Dactylellina gephyropaga* (Drechsler) Ying Yang & Xing Z. Liu, Mycotaxon 97: 158 (2006)

Gamsylella cionopaga (Drechsler) E.C. Yang, L.L. Xu, Ying Yang, Xin Yu Zhang, M.C. Xiang, C.S. Wang, Z.Q. An & Xing Z. Liu, Proc. natn Acad. Sci. U.S.A. 109(27): 10964 (2012), nom. inval., ICN Art. 39.1, 41.1 — Pl. 14: g

≡ *Dactylella cionopaga* Drechsler, Mycologia 42(1): 30 (1950)
≡ *Monacrosporium cionopagum* (Drechsler) Subram., J. Indian bot. Soc. 42: 293 (1964) [1963]
≡ *Golovinia cionopaga* (Drechsler) Mekht., Khishchnye Nematofagovye Griby - Gifomitsety (Baku): 166 (1979)
≡ *Dactylellina cionopaga* (Drechsler) Ying Yang & Xing Z. Liu, Mycotaxon 97: 158 (2006)

Gamsylella cionopaga was synonymised with *G. gephyropaga* by Rubner (1996) and Scholler et al. (1999). Drechsler (1950a) distinguished it because of adhesive branches that seldom fuse to a scalariform network, noticeably longer conidia with a more variable pattern of septation. Yet, Rubner could not draw a line between the many studied strains which included both species according to two unpublished sequences in CBS.

In fact, strong molecular differences are observed among strains under these two names. These resulted in two very distant main clades (Phyls 34–35, S35) which show an ITS distance of 11–14.5 % and an LSU (D1–D2) distance of 2.5–3.7 %. However, the two names occur mixed within both clades, but also a rather high infraspecific variation in the ITS/LSU (D1–D2) is obvious within the two clades: 0–3.6/0–0.7 % in *G. gephyropaga* and 0.2–4.2/0–0.7 % in *G. cionopaga* in the here applied sense. Syntype sequences (ITS and LSU) were only available for *G. gephyropaga* (CBS 178.37), whereas *G. cionopaga* requires epitypification. Due to their very similar morphology, the correct nomenclature of the two main clades is not fully assured, particularly since morphological documentations were not available regarding sequences in GenBank.

We assume that the larger clade of the ITS tree, in which 10 of 15 strains originally carried the name *G. cionopaga* and two *G. gephyropaga*, represents *G. cionopaga*. If this is true, five strains bear the wrong, opposite name in GenBank: CBS 585.91 (ITS) is in fact *G. gephyropaga*, whereas SQ27-3 & XJ03-9-3 (both ITS) and YNUCC 4828 & 5028 (both LSU) belong to *G. cionopaga*. Three uncultured strains turned out to belong to *G. cionopaga*. One of them (from Canada) represents the only strain of this species in GenBank that includes both ITS and LSU, and it was this strain which enabled us, together with some unofficial sequences in CBS, to identify the *G. cionopaga* clade for the LSU (Phyl. 35). The *G. gephyropaga* clade in the LSU tree was identified by two sequences (including the syntype) which comprise both ITS and LSU.

Some mostly unofficial ITS and LSU sequences in the CBS database under the names *G. gephyropaga* can herewith be assigned to the two species: *G. gephyropaga*: CBS 309.94 (ITS), CBS 109507 (ITS+LSU); *G. cionopaga*: CBS 229.52 (LSU), CBS 310.94 (ITS+LSU), CBS 311.94 (ITS+LSU), CBS 398.93 (LSU), CBS 846.70 (ITS+LSU). The predominant use of the name *G. gephyropaga* is mainly a result of a broad species concept: some of the strains previously carried the name *G. cionopaga* but were later renamed to *G. gephyropaga* at CBS (228.52, 398.93, 846.70). Two further sequences under the name *G. gephyropaga* (308.94, 587.91; unofficial) could not be clarified because of a ca. 7–9 % ITS distance to *G. gephyropaga* and ca. 14–24 % to *G. cionopaga*. The drawings supplied by Rubner (1996) refer to *G. cionopaga* as here defined regarding figs 31b (CBS 310.94, trapping organs,) and 31d–e (CBS 311.94, 398.93, conidiophores and conidia), while for the other two illustrated strains no sequence data could be detected. CBS 109507 from Oman (Elshafie et al. 2003: fig. 3) belongs in the relationship of *G. gephyropaga* but differs from it by 4.5 % in the ITS and 0.7 % in the LSU.

G. cionopaga appears to include two different cryptic taxa (c1/c2), because most of the available sequences cluster unequivocally in two distinct clades, with 19 consistently deviating positions: 10 nt and 5 gaps in the ITS1, 5 nt in the ITS2, and 2 nt at the 3'-end of the D2 domain of LSU (Tab. 91). However, four strains clustered in an intermediate position by sharing the character of either c1 or c2 (the unofficial CBS 310.94 was not available).

According to the available collection data, *G. cionopaga* and *G. gephyropaga* prefer different climatic zones. *G. cionopaga* is so far known from temperate to boreal regions of Asia, Europe, and North America, whereas *G. gephyropaga* occurs more in subtropical regions of the same continents.

Gamsylella robusta (J.S. McCulloch) M. Scholler, Hagedorn & A. Rubner, Sydowia 51(1): 109 (1999) — Pl. 14: h

≡ *Dactylellina robusta* (J.S. McCulloch) Yan Li, in Li et al., Mycologia 97(5): 1043 (2006) [2005]
≡ *Monacrosporium robustum* J.S. McCulloch, Trans. Br. mycol. Soc. 68(2): 177 (1977)

Table 91. Comparison of informative positions in the ITS1 and ITS2 (pos. 15 to 476), and LSU (pos. 523 & 562) between the three subclades of *G. cionopaga* in relation to *G. gephyropaga*. Position numbers starting after ATCATTA (ITS) or with TGACCT (LSU) by omitting rare inserts; right column: number of strains. Y = C or T; * = rarely `GAA` (FWY03-25-2), # = rarely `GTTAT` (CBS 585.91), + = rarely `GAAC` (SQ27-3).

Gamsylella	14–18	31–33	88–95	103–106	126–129	149–152	159–61	356–8	364–6	375–377	383–385	423–5	474–7	522–4	561–3	ITS/LSU
cionopaga C1	GCCCG	TGG	AGAGA--T	GCTT	AACA	ATTA	ATA	CTG	TCT	AAC	AAC	GCT	GAAC	CAG	GTT	6/7
intermediate	GTCTG	T-G	GCTAACCC	GTGT	A--A	ATTA	ATA	CAG	TCT	GAT	AAC	GCT	GAAC	CAG	GTT	3/1
cionopaga C2	GTCTG	T-G	GYYAACCC	GCTT	A--A	AACA	ACA	CAG	TAT	AAC	CAA*	GAT	GACC+	CGG	GCT	6/4
gephyropaga	GTCGG#	T-G	AGGATTCT	GCGT	ATTT	AYTA	ATA	CTG	TAT	CCT	GAA	GCT	GGGC	CGG	GCT	7/3

An ITS sequence of the Australian ex-type strain of *G. robusta* (CBS 110125, DQ999821) clustered unequivocally in series *Gamsylella* (in a medium supported clade with *G. gephyropaga*, Phyl. 34), in which relationship it was placed by Scholler et al. (1999) based on morphological reasons, when the sequence was not yet available. In the ITS2 the characteristic motif TCGAC confirms this placement (see Tab. 76). A misidentified Chinese strain under the name *M. robustum* (YMF 1.01413, ITS+LSU) clustered in series *Dactylellina* (Phyls 25, S35) and has the characteristic motif of that series (TCGGT).

Series *Drechslerella*

Orbilia subgenus ***Orbilia*** section ***Arthrobotrys*** series ***Drechslerella*** (Subram.) Baral & E. Weber, **comb. & stat. nov.**, MB 814996 – Type species: *Dactylella acrochaeta* Drechsler

Basionym: *Drechslerella* Subram., J. Indian Bot. Soc. 42: 299 (1964) [‘1963’]
= *Orbiliaster* Dennis, Kew Bull. 9: 294 (1954) — Type species: *Orbiliaster pilosus* Dennis [≡ *Orbilia pilosa* (Dennis) Baral]
= *Golovinia* Mekht., Mikol. Fitopatol. 1: 275 (1967) – Type species: *Dactylella bembicodes* Drechsler [≡ *Orbilia bembicodes* (Drechsler) E. Weber & Baral]
= *Dactylariopsis* Mekht., Mikol. Fitopatol. 1: 278 (1967) – Type species: *Dactylella brochopaga* Drechsler [≡ *Orbilia brochopaga* (Drechsler) E. Weber & Baral]

Etymology: *Dactylariopsis*: referring to the similarity with *Dactylaria*; *Drechslerella*: named after the North American mycologist C. Drechsler; *Golovinia*: named after the Russian mycologist P.N. Golovin; *Orbiliaster*: an *Orbilia* with long hairs at the apothecial margin appearing star-like.

Emended diagnosis: **TELEOMORPH**: Apothecia with smooth or crenulate to hairy margin, desiccation-sensitive or slightly -tolerant. Ascospores rod-shaped to ellipsoid, straight; spore bodies subglobose to rod-shaped, ± eccentrical. — **ANAMORPH**: Conidiogenous loci singly or on prominent denticles. Conidia 1–4((–5))-septate, straight or curved, microconidia often present. Forming constricting rings.

Description: — **TELEOMORPH**: **Apothecia** hydrated 0.2–1.5(–3) mm diam., white, pale to light cream-chlorinaceous or sulphur-yellow, or bright vinaceous to greyish-brown, margin smooth to distinctly crenulate, sessile or often with a prominent obconical to cylindrical stipe. **Asci** *(20–)23–42(–47) × (3.2–)3.5–4.5(–5.2) µm, 8-spored, lower (2–)3–5(–6) spores inverted; **apex** (†) medium to strongly truncate, not to distinctly indented and laterally inflated; **base** always partly H-shaped. **Ascospores** *(2.7–)3.5–8(–9) × 1–1.4(–1.9) µm, subcylindrical or (narrowly) cylindric-ellipsoid to fusoid-clavate or ellipsoid-obovoid, apex rounded to obtuse (rarely subacute), base exceptionally tail-like, straight or rarely slightly curved below, **SBs** slightly to strongly eccentrical (close to lateral wall below spore apex), rarely central, 0.4–1.7(–2) × 0.15–0.5 µm, rod- to tear-shaped or subglobose (often mixed in an apothecium), with a fine, very short, often hardly visible (or invisible) filum. **Paraphyses** slightly to strongly capitate(-clavate) at apex, also spathulate to lanceolate, terminal cells (1.5–)2.5–5 × longer than lower cells. **Ectal excipulum** of (†) thin-walled to medium gelatinized textura globulosa-angularis(-prismatica) [common walls †0.3–1(–2) µm], cells near base *(7–)10–40(–58) × (5–)9–30(–42) µm, margin of t. globulosa-prismatica or t. prismatica-porrecta oriented at (30–)50–90°; **glassy processes** near margin absent or up to 10–60 µm long, sometimes with septate, 12–110 µm long **hairs**. **SCBs** absent, rarely globose; **VBs** absent or often low- to medium refractive, hyaline to light yellow. **Exudate** absent or usually or 0.2–1.5(–8) µm thick, granular to cloddy, loosely or firmly attached, hyaline to pale yellowish or olivaceous-brown. **— ANAMORPH**: drechslerella-like. **Conidiophores** (40–)90–500 µm long, 3–8 µm wide at base, 2–4.5 µm at apex, unbranched, with a single terminal conidium, rarely apically branched, also with a few to many denticles or nodules at or near tip. **Macroconidia** *25–65 × 5–9.5 or 10.5–26.5 µm, fusiform to top-shaped, fusoid, ellipsoid, obovoid, clavate, or cylindrical, 1–4((–5))-septate, with or without inflated cell, straight or curved; **conidial dimorphism** often present, sharply differentiated. **Trapping organs**: spontaneously forming constricting rings in culture, with 1-septate stalk of *7–19 × 3.5–6 µm; rings *18–40 µm outer diam. (9.5–27 µm inner diam.), 3-celled, inner wall with triangular wall thickenings at the 3 septa (in optical cross section), cells strongly expanding inwards when nematodes enter the ring, smaller rings of *(8–)15–22 µm outer diam. formed directly on macroconidia, giant rings of *80–130 µm outer diam. (60–110 µm inner diam.) formed together with normal ones in some species.

Habitat: hygric or mesic wood and bark of angiosperms, also isolated from rhizosphere of trees (including conifers) and mono- or dicot herbs, capturing nematodes (occasionally rotifers), altimontane to tropical, humid, desiccation-sensitive or slightly -tolerant.

Recognized species: 10 (1 of them without known teleomorph), plus 3 unnamed species (‘affinis’); for further 11 species see Tabs 48 and S10.

Taxonomic remarks. Like in most other series of section *Arthrobotrys*, species cannot with certainty be assigned to series *Drechslerella* based on the teleomorph alone, i.e., without cultivation of the anamorph or without molecular data. Species recognition is likewise quite problematic without such data.

Up to now, only straight or slightly curved ascospores are known within series *Drechslerella*. Similar as in series *Gamsylella*, the spores contain slightly to strongly eccentrical, often rod-shaped but also more or less globose SBs attached by a fine filum. However, some unidentified taxa with predominantly roundish SBs (as incertae sedis) also tend to an eccentrical orientation (Pls 1021–1024).

Apothecia of series *Drechslerella* tend to be stipitate and may resemble members of *Helotiales* by external appearance. *O. pilosa* is exceptional in having broad, septate, thick-walled marginal hairs and a gelatinized excipulum. Marginal glassy processes are typical of *O. orientalis*, *O. polybrocha* and some other taxa. Species of series *Drechslerella* have comparatively wide anchoring hyphae of usually (3–)4–6(–8) µm.

Anamorph (see also p. 231–232 and Tab. S10). Members of series *Drechslerella* are charaterized by constricting rings formed ± spontaneously in pure culture, i.e., without presence of nematodes (see p. 119–121). Anamorphs that form such trapping organs are named drechslerella-like here. The macroconidia are medium- to large-sized and very different in shape (see Pl. 12, Phyl. 36): (1) ± cylindrical, often slightly curved (musiform), 3-septate, the individual cells having ± equal width (e.g., *O. brochopaga*); (2) cylindric-clavate to broadly obovoid, with 1 median or strongly eccentrical septum (e.g., *Drechslerella dactyloides*, *O. polybrocha*); (3) (cylindric-)ellipsoid, with 2 terminal septa and an inflated middle cell (*D. stenobrocha*, *D. heterospora*); (4) fusiform to top-shaped, with 2–4 septa and strongly inflated middle cell (e.g., *O. bembicodes*). *D. dactyloides* and *D. effusa* are intermediate in forming typically 1-septate cylindric-clavate conidia but also 2-septate cylindric-clavate, ellipsoid to fusiform conidia.

Microconidia are frequently formed (see Tab. 15). They differ from macroconidia in being much smaller, usually 1-septate, and always cylindric(-clavate). In some isolates only microconidia were observed. For instance, *D. yunnanensis* was described with small, 1-septate conidia, but another strain with identical ITS sequence formed besides microconidia also 3-septate macroconidia.

Fusiform macroconidia as in *O. bembicodes* are formed singly at the tip of long unbranched conidiophores (acrogenous), rarely from conidiophores with 2 apical branches (*D. effusa*, geniculate). Cylindric-allantoid 3-septate macroconidia as in *O. brochopaga*, or cylindric-clavate 1-septate ones as in *D. dactyloides* and *D. anchonia* differ in conidiophore tips with aggregated denticles or nodules on which the conidia are formed in a loose, capitate arrangement (candelabrelloid to almost arthrobotryoid).

Trapping organs of series *Drechslerella* are quite uniform in shape (see p. 119), consisting of a 2-celled stalk and a 3-celled ring. They vary considerably in size among the species and may serve as species marker. Sharply separated giant ring traps of a much larger size may occur in association with the normal traps and were so far recorded in *O. brochopaga*, *O. dactyloides*, and *O.* cf. *tonghaiensis*. In all cases where constricting rings where studied under oil immersion, triangular to lens-shaped wall thickenings occurred at all 3 ring septa. Bulge-like projections of the three cells at the inner part of the unexpanded ring are typical of three species (*Drechslerella acrochaeta*, *D. doedycoides*, *D. heterospora*).

Species delimitation. Morphological variation in the teleomorph is observed in species with a known teleomorph treated here, which obscures the limits between closely related taxa. *O. naumburgensis* and *O. flavovacuolata* resemble *O. polybrocha* in the ascospores, but sharply differ in apothecial colour and conidial morphology (the latter unknown in *O. flavovacuolata*). However, these species have been collected only rarely, hence their variation is little explored.

Yu et al. (2014) listed a total of 14 accepted species, but a teleomorph is as yet unknown in most of them. A morphological group of species with very uniform, cylindrical, often ± curved conidia includes *O. brochopaga*, *O. naumburgensis*, *O. orientalis*, *O. tonghaiensis*, and *O. yunnanensis*. Their members are also similar in the teleomorph, therefore, they can safely be distinguished only by molecular data.

Drechslerella anchonia and *D. dactyloides* are treated at present as synonyms in Species Fungorum and MycoBank, although Van Oorschot 1985 and Scholler et al. (1999) accepted them as two distinct species. In fact, their cylindric-clavate, 1-septate conidia are quite different in size, those of *D. anchonia* being much wider. However, *D. dactyloides* may also form much wider conidia which are usually more fusiform and 2-septate and sometimes just like in *D. anchonia* (Drechsler 1937a: 484, fig. 18K; Pl. 12: c right conidium), which obscures the difference.

Molecular species concept. High molecular distances are observed within the morphologically defined *O. brochopaga* group, despite a rather uniform conidial morphology. This indicates that several more or less cryptic species exist which at least do not markedly differ in their anamorph, and prompted us to consider *O. brochopaga* and *O. orientalis* as distinct species.

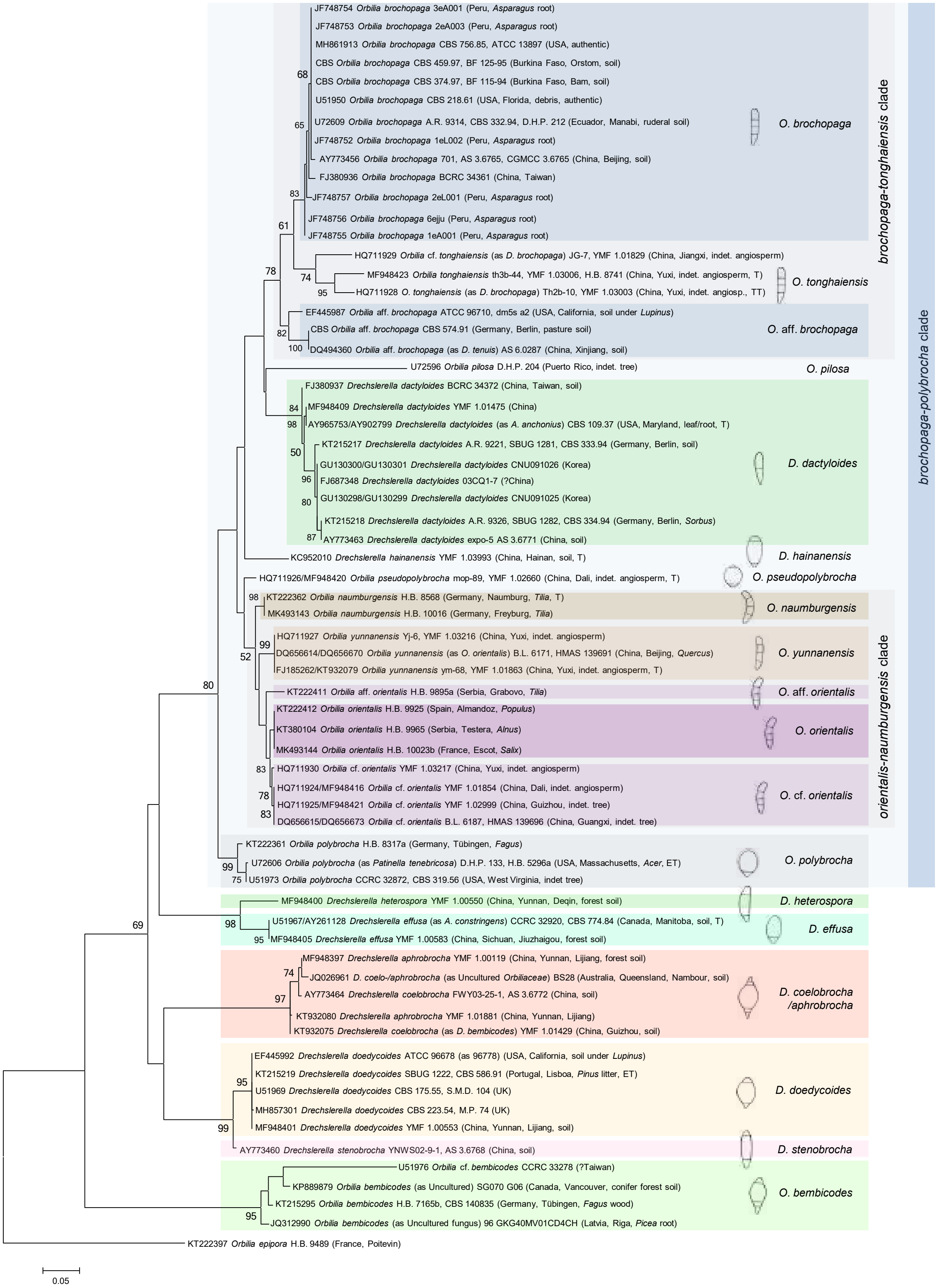
Molecular data under the name *Arthrobotrys anchonius* (CBS 109.37) in GenBank misleadingly support synonymisation of *D. anchonia* and *D. dactyloides*, based on ITS which fits various strains under the name *D. dactyloides*: However, CBS 109.37 in fact represents the ex-syntype strain of *D. dactyloides*, whereas no type culture of *D. anchonia* appears to exist (Van Oorschot 1985). Why Li et al. (2005) named this strain *A. anchonius* is unclear, particularly since the name is younger than the basionym of *D. dactyloides*.

Phylogeny. In our phylogenetic analysis of the ITS region, *Drechslerella bembicodes*, *D. coelobrocha*, *D. doedycoides*, *D. effusa*, *D. heterospora*, and *D. stenobrocha*, formed a paraphyletic basal group, whereas the remaining taxa clustered with medium support in a monophyletic group (Phyl. 36), which received strong support in our combined analysis (S37) and is called *brochopaga-polybrocha* clade here. Within the paraphyletic basal group, *D. doedycoides* and *D. stenobrocha* clustered in a clade, which received strong support in all three analyses (including LSU, S36), and also *D. effusa* and *D. heterospora* clustered in a strongly supported clade (Phyl. 36).

Our analysis suggests that fusiform (top-shaped) macroconidia characteristic of *D. bembicodes* represent the plesiomorphic character within series *Drechslerella*. Although cylindrical conidia can be considered as more primitive in shape, they seem to have evolved within this series by retrogression from conidia with a swollen middle cell. In *D. dactyloides*, in which both conidial types occur, this retrogression appears to be incomplete.

The *brochopaga-polybrocha* clade comprises two monophyletic subclades which both contain species with cylindrical, mainly 3-septate conidia: (1) the medium (ITS, LSU) supported *brochopaga-tonghaiensis* clade, and (2) the weakly (ITS) or strongly (LSU) supported *orientalis-naumburgensis* clade (Phyls 36, S36). The *brochopaga-polybrocha* clade includes also *D. dactyloides*, *D. hainanensis*, *O. pilosa*, *O. polybrocha*, and *D. pseudopolybrocha* which clustered unresolved within this clade. Four of them possess top-shaped conidia, and *D. dactyloides* cylindrical 1-septate or rarely top-shaped conidia. The very similar conidial morphology in the *brochopaga-tonghaiensis* clade and the *orientalis-naumburgensis* clade suggests a common ancestor with cylindrical 3-septate conidia, although this is not supported by phylogenetic analysis. More probable seems that *O. polybrocha*, *O. pseudopolybrocha*, and *D. hainanensis* retained the plesiomorphy of the strongly inflated conidial cells, but these taxa are missing in the combined analysis (S37) because they lack LSU.

Specific nucleotide positions. In the SSU V8–V9 region, series *Drechslerella* is unique at pos. 70 (AGG**C**TTG, rarely AGG**C**CTG), whereas other members of section *Arthrobotrys* have mostly AGG**T**TTG but never **C** which is generally rare in the *Orbiliomycetes*. Pos. 109 and 126 differ from other



Phylogenetic analysis 36. Phylogram of series *Drechslerella* inferred from ML analysis of ITS1-5.8S-ITS2 rDNA dataset (66 sequences, 551 positions, aligned with MUSCLE) using the K2+G model in MEGA6 (500 replicates). The tree is rooted with *O. epipora*. Asci 8-spored in all teleomorph taxa; T = type, ET = epitype, NT = neotype, TT = topotype.

predacious members of section *Arthrobotrys* by concurring with series *Neodactylella* (Tab. 76) and all other members of *Orbilia* outside that section. However, SSU was only available for four taxa of series *Drechslerella* (Phyl. S29). In the LSU D1–D2 domain, series *Drechslerella* has at pos. 502 AG**C**TGG unlike any other member of *Orbiliomycetes* which have AG**T**TGG, GG**T**TGG, GG**T**TGA etc. but only very rarely **C**. Three further positions (182: CC**C**AA, 511: GG**T**GG, 574: CC**A**CC) are consistent within series *Drechslerella* but the remaining series of section *Arthrobotrys* differ only partly herein.

The *brochopaga-polybrocha* clade, but also *D. effusa* and *O. pilosa* which clustered near to it, show full identity in the 5.8S region (a deviation at pos. 102 in U51973, G vs. T, is erroneous according to a sequence at CBS). A single nucleotide position in the 5.8S (pos. 111, GCA**T**ATT) distinguishes this clade (including *D. effusa* and *O. pilosa*) from the five more

Key to species of series *Drechslerella* with known teleomorph

(for a key based on anamorphs see Zhang et al. 2020)

1. Paraphyses predominantly obtusely lanceolate to spathulate or lageniform; apothecia smooth or with thick-walled septate hairs with a wide central lumen 2
1. Paraphyses predominantly capitate-clavate; apothecia smooth or with solid glassy processes 3

2. Apothecial margin with 12–45 µm up to 70–100 µm long, 5–9 µm wide, septate, thick-walled hairs; spores *3.5–5 × 1–1.4 µm, cylindrical, straight to very slightly curved; SBs globose; conidia broadly fusoid, with large middle cell; wood of angiosperms, warm-temperate to tropical humid oceanic Europe & Middle America .... ***O. pilosa***, p. 1629
2. Apothecial margin hairless; SBs subglobose to rod-shaped, often eccentrical; conidia ± cylindrical, with 1 median septum .... see **series *Gamsylella***, p. 1610

3. Apothecia 0.2–0.25 mm diam., pale yellow, margin smooth; paraphyses and marginal cells containing yellow VBs; spores *4.8–8(–9) × (1–)1.2–1.3(–1.4) µm; SBs predominantly roundish; wood of *Fagus*, cold-temperate humid central Europe .... ***O. flavovacuolata***, p. 1639
3. Apothecia whitish to vinaceous-brown, if yellowish then spores shorter and margin crenulate; VBs hyaline or absent 4

4. Macroconidia ellipsoid to obovoid or subglobose, *26–39 × 16–26 µm, with 1 strongly inflated cell and 1–3 much smaller terminal cells, formed singly at the conidiophore tip; apothecia whitish to vinaceous-brown 5
4. Macroconidia cylindrical, straight to ± allantoid, *28–45 × 5.3–9 µm, with (1–)3 equidistant or centrally aggregated septa, formed in clusters on denticles at the conidiophore tip; apothecia whitish or cream 7

5. Macroconidia broadly obovoid, with 1 subbasal septum; conidiophore tips not swollen; apothecia typically dull vinaceous-brown, 0.3–1.8 mm diam., with a denticulate margin due to glassy processes; spores *(4.2–)5–6.5(–7.5) × (1–)1.1–1.3(–1.4) µm; SBs usually rod-shaped; wood of angiosperms, orotemperate to subtropical humid Europe & North America .... ***O. polybrocha***, p. 1631
5. Macroconidia broadly ellipsoid to fusiform, with mainly 2–3 terminal septa and a strongly swollen middle cell 6

6. Spores *5–6.8 × 1.2–1.4 µm; SBs subglobose to tear-shaped, 0.5–0.8 µm wide; macroconidia (presumed) 3-septate, fusiform, *38–42.5 × 16–22 µm, conidiophores and trapping organs not observed; apothecia whitish, with smooth margin; dung, orotemperate humid central Europe .... ***Orbilia* sp. H.B. 8749**, p. 1655
Compare also *O. lysipaga* (Pls 987–988) and *Orbilia* sp. H.B. 8963 (Pls 1021–1022).
6. Spores 2.8–5.5 × 1.2–1.5 µm; SBs rod-shaped, 0.3–0.4 µm wide; macroconidia 2-septate, broadly ellipsoid to fusoid, *26–32.5(–39) × (15.5–)17–21(–24) µm, formed on ± swollen conidiophore tips; apothecia yellowish-cream, margin finely denticulate; angiosperm bark, subtropical humid eastern Asia .... ***O. pseudopolybrocha***, p. 1637
7. Spores *3.5–5(–5.7) × 1.3–1.7 µm, ellipsoid-fusoid, slightly to strongly attenuated below; wood of *Tilia*, cold-temperate humid (almost subhumid) central Europe .... ***O. naumburgensis***, p. 1640
7. Spores *(2.7–)3–4.3 µm long, cylindric-ellipsoid to ellipsoid, not or slightly attenuated below; wood & bark of various angiosperms, rarely gymnosperms 8

8. Spores *2.1–2.8(–3.5) × (1.4–)1.6–2(–2.2) µm; SBs tear-shaped, slightly eccentrical; glassy processes absent; apothecia substipitate; wood of indet. angiosperms, subtropical humid eastern Asia .... ***O. tonghaiensis***, p. 1653
8. Spores *(2.6–)3–4.5 µm long; glassy processes present or absent 9

9. SBs globose, central; apothecia smooth, ± sessile; woody ?& herbaceous plants, cold-temperate to tropical, humid to semiarid, worldwide .... ***O. brochopaga* s.l.**, p. 1649
9. SBs rod-shaped or sometimes almost globose, ± strongly eccentrical; apothecia smooth or often with crenulate margin, stipitate 10

10. Outer diameter of constricting rings *35–39 µm; glassy processes mostly present, 20–60 µm long, forming a crenulate margin; spores *(1.2–)1.3–1.7(–1.9) µm wide, SBs tear- to rod-shaped, eccentrical; apothecia (0.3–)0.5–1.5(–3) mm diam., with a distinct stalk up to 0.5 × 0.6 mm; angiosperm (& gymnosperm) wood, cold- to warm-temperate humid Europe .... ***O. orientalis***, p. 1644
10. Outer diameter of constricting rings *19–27 µm (rarely giant rings in addition); glassy processes absent or present; humid eastern Asia 11

11. Spores *1.2–1.5 µm wide; apothecia 0.4–0.6 mm diam.; subtropical .... ***O.* cf. *orientalis***, p. 1645
11. Spores *1.6–2 µm wide; apothecia 0.3–2 mm diam.; cold-temperate to subtropical .... ***O. yunnanensis***, p. 1642

basal *Drechslerella* species and all other members of section *Arthrobotrys*, which have instead the motif GCA**C**ATT.

In stem-loop B8 of the 5.8S region (Tab. 77), series *Drechslerella* concurs with a majority of series *Dactylellina* and some species of series *Neodactylella* (*rhamni-fraxini* clade) in having **TT**GGTATTCC**AT** at the 2 symmetric positions 122–123/132–133, except for *D. bembicodes* which has **TC**GGTATTCC**GA** (CCRC 33278) or **TT**GGTATTCC**GA** (H.B. 7165b). The latter motif occurs also in *D.* aff. *phymatopaga*, *Arthrobotrys nonseptatus*, and *A. polycephalus*, and many non-predacious *Orbilia* spp.

Ecology. Members of series *Drechslerella* form apothecia on wood and bark of angiosperms. Species were recorded on most continents from boreal (altimontane) to tropical, but always humid regions (records from arid areas concern irrigated agricultural fields).

Orbilia bembicodes (Drechsler) E. Weber & Baral, **comb. nov.**, MB 814000 — Pls 999–1000

Basionym: *Dactylella bembicodes* Drechsler, Mycologia 29(4): 491, fig. 7 (1937)
≡ *Monacrosporium bembicodes* (Drechsler) Subram., J. Indian Bot. Soc. 42: 293 (1964, '1963')
≡ *Golovinia bembicodes* (Drechsler) Mekht., Mikol. Fitopatol. 1: 275 (1967)
≡ *Drechslerella bembicodes* (Drechsler) M. Scholler, Hagedorn & A. Rubner, Sydowia 51(1): 99 (1999)

Etymology: named according to the top-shaped (turbinate) conidia.

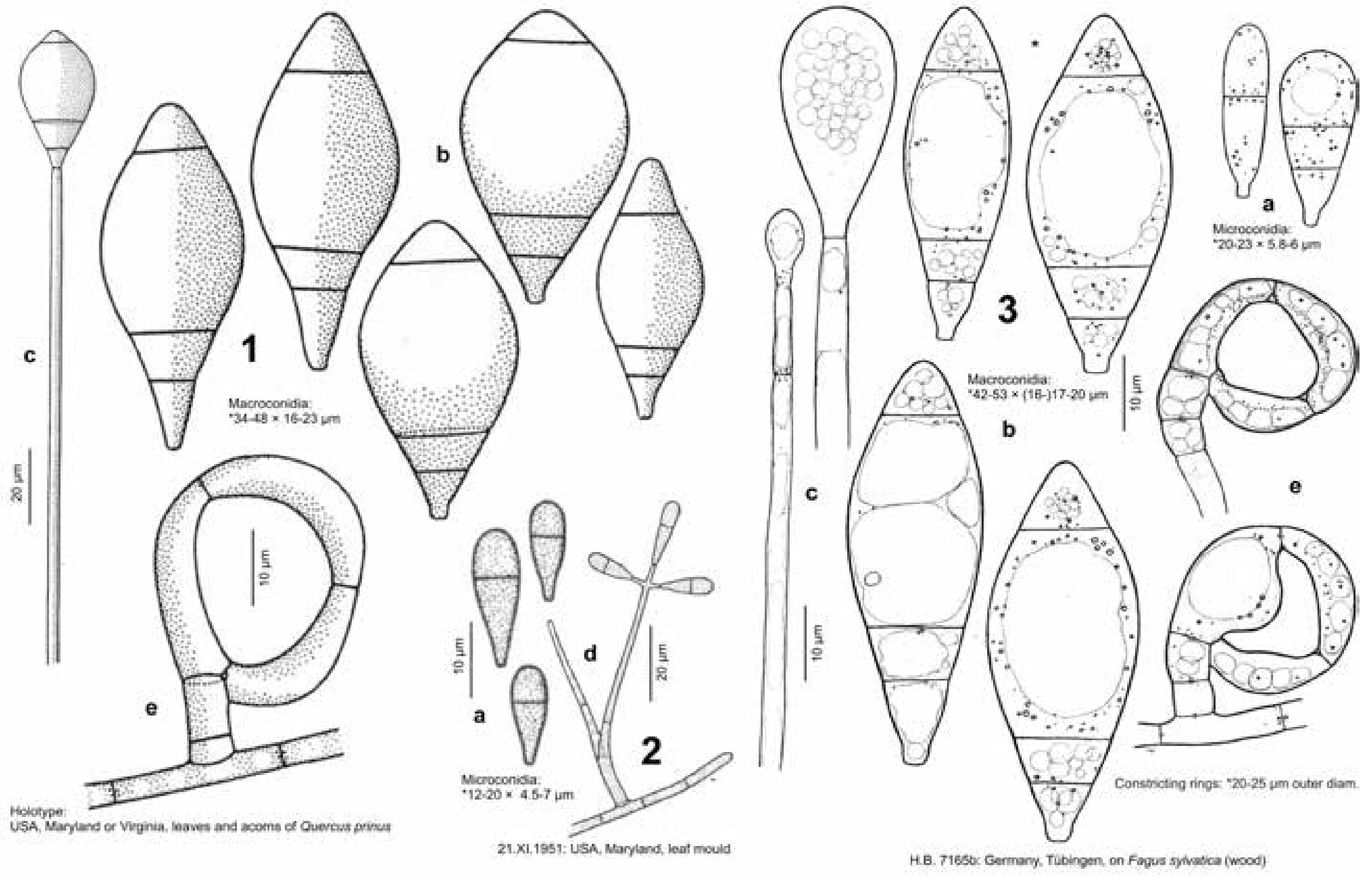


Plate 999. **1–3**: *Orbilia bembicodes*. – **a**. microconidia; **b**. macroconidia; **c**. macroconidiophores; **d**. microconidiophore; **e**. constricting rings, 1 ring cell in **2d** expanded (from soil or conidial isolate); **1**: from Drechsler 1937a, **2**: from Drechsler 1962.

Typification: USA, Maryland & Virginia, leaves and acorns of *Quercus prinus*, undated, C. Drechsler (holotype, illustration in Drechsler 1937a: 491 [ex-type culture in CBS 177.37 is a contaminant]).

Description: — **TELEOMORPH**: unknown. **— ANAMORPH**: drechslerella-like (isolated from mould {T & Drechsler 1962} or from conidia on wood {1}). **Macroconidiophores** *250 {1} or (250–)300–450(–500) {T} µm long, *3–4 µm {1} or 5–7.5 {T} µm wide at base, *2–3.2 µm at apex, very sparsely septate, with a single conidium at apex. **Macroconidia** fusiform, *34–48 × 16–23 µm {T}, *42–53 × (13.7–)16–20 µm {1}, 3-septate, consistently with 2 septa near base and 1 near apex, middle cell very large, containing a large vacuole. **Microconidiophores** *55 µm long, 3.5 µm wide at base, 1.2 µm at tip, forming 4–8 conidia on 2.5–4 µm long denticles {1962}. **Microconidia** *12–20 × 4.5–7 µm {1962}, *20–23 × 5.8–6 µm {1}, clavate to cylindric-ellipsoid, 1-septate, septum slightly above middle; also intermediate conidia of *23 × 10 µm, clavate, 2-septate {1}. **Chlamydospores** not observed. **Constricting rings** with 1-septate stalk of *7–14 × 4.5–6 {T} or *11 × 6–6.5 µm {1}; ring unexpanded *22–37 µm {T} or *20–23 × 22–25 µm {1}, 3-celled, ring cells *4.5–7 µm wide {2} (up to *12.5 µm when expanded), with small triangular wall thickenings at the 2 distal septa {1}, capturing nematodes (but also rotifers, Drechsler 1937a: fig. 18).

Habitat of German collection: lying on ground, decorticated, 45 mm thick branch of *Fagus sylvatica* {1}, on lateral upperside, on 2–3 mm deep strongly decayed wood {1}, no algae. **Associated**: *Cacumisporium capitulatum* {1}, *Chaetosphaeria myriocarpa* {1}, *Claussenomyces prasinulus* {1}, *Dematioscypha delicata* {1}, *Mollisia* ?*oblonga* {1}, *Orbilia mammillata* {1}, *O. xanthostigma* {1}, *Rhizodiscina lignyota* {1}, *Tubeufia cerea* {1}. **Desiccation tolerance**: apparently intolerant. **Altitude**: 15–350 m a.s.l. (Europe), ~10–100 m (USA). **Geology**: Tübingen: Keuper (Stubensandstein).

Taxonomic remarks. *Orbilia bembicodes* is characterized by broadly fusiform (top-shaped), consistently 3-septate conidia, with 2 septa always in the basal part and a very large middle cell, in combination with constricting rings. Because of differences in molecular data (see below), the taxon seems to comprise a species aggregate, but no morphological data were available for the isolate of Liou & Tzean. *Drechslerella doedycoides* and *O. pseudopolybrocha* deviate in conidia with only 1 basal septum and in apically swollen conidiophore tips (Pls 12: l; 1009).

The teleomorph of *O. bembicodes* is unknown. In the two records here identified as *D. bembicodes* s.l. (Pls 999: 2; 1000), two different teleomorphs grew in association (*O. mammillata*, *O. alba*). It could be shown, however, that these are not connected to *D. bembicodes* but to two very different anamorphs. Conidia comparable to *O. bembicodes* occurred associated with apothecia on dung in Austria (Pls 1023–1024), but here no trapping organs were found. Another possible teleomorph is *O. flavovacuolata* (see p. 1639).

In the collection on *Fagus* (Pl. 999: 2), the associated apothecia of *O. mammillata* and its anamorph occurred at a distance of ~10 cm. Problematic was the fact that the conidia of both species are very similar, those of *O. mammillata* being only slightly smaller. Yet, adhesive knobs were associated on the natural substrate with both the conidiophores and apothecia of *O. mammillata*, and constricting rings with the conidiophores of *O. bembicodes*. Conidiophores and trapping devices of these two anamorphs developed also in pure culture of the two conidial isolates from this mixed collection when nematodes were added.

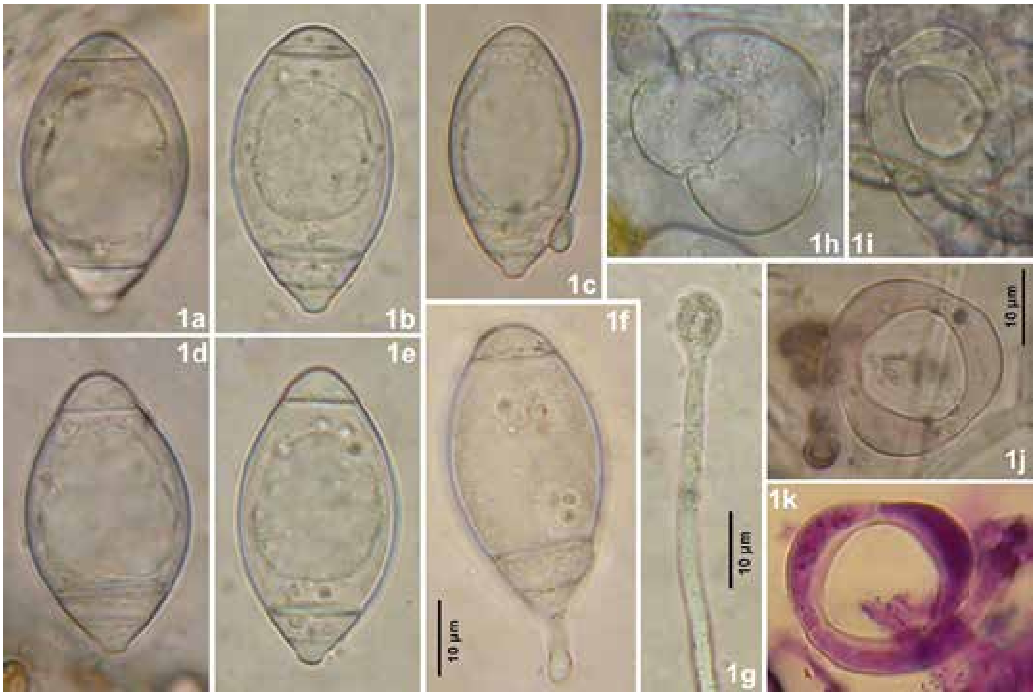


Plate 1000. **1**: *Orbilia* cf. *bembicodes* (on natural substrate). – **1a–f**. macroconidia; **1g**. macroconidiophore, **1h–k**. constricting rings (**1h** expanded) (all from substrate). – Living state, except for **1g** (in H_2O), **1j** (in KOH), **1k** (in KOH+CRB). — **1a–k**. H.B. 9051g: Spain, Asturias, on *Eucalyptus*.

Drechsler's (1937a) type illustration of *Dactylella bembicodes* (from leaves and acorns of *Quercus prinus*, Pl. 999: 1) shows top-shaped, slightly shorter and wider conidia and somewhat larger constricting rings compared to the strain on *Fagus*, but in conidial shape the two fit quite well. Couch (1937) described a North-American collection on pine wood, probably from North Carolina, with 400–1500 µm long conidiophores, conidia of ca. 47.5–49.5 × 21–23 µm, and constricting rings of 24–31 µm outer diam. Conidial size was not indicated in the text, however, and a wrong magnification of ×110 was given for figs 2–4 that show the conidia. The above size was evaluated with an assumed magnification of ×525, which is indicated for figs 6–11 that show constricting rings.

Not included collection. In association with *O. alba* (on *Eucalyptus* bark) we observed several anamorphs which are obviously not connected to each other. One (Pl. 1000) resembles *D. bembicodes* but differs in more ellipsoid-fusoid macroconidia with rather short terminal cells and a size comparable to the type [*(33–)36–39 × (17.5–)19.5–22 µm, †34–37(–39) × 18.5–21.3 µm], with conidiophores of †340 × 6 µm. The unexpanded constricting rings measured *20–26 µm outer diam. The large vacuole in the central conidial cell is surrounded by a few refractive, KOH-soluble guttules of 0.4–0.7 µm diam. (?SCBs). In conidial size and shape this specimen matches very well '*Dactylella*' *megalobrocha* Glockling (in Glockling & Dick 1994), described on rabbit dung from Great Britain with conidia of 36–40 × 20–22 µm. This taxon was perhaps incorrectly treated as a synonym of *D. bembicodes* by Rubner (1996), as its constricting rings are reported with an outer diameter of 40–48(–56) µm, which is twice as large as in the specimens on *Fagus* and *Eucalyptus*.

Phylogeny. A sequence was gained from our isolate from *Fagus*, comprising SSU (with S1506 intron), ITS, and LSU. It differs from a sequence of unknown origin in GenBank (?Taiwan) uploaded under the name *M. bembicodes* by Liou & Tzean (1997; S1506 intron, ITS) by 11% in the ITS region and 12.5% in the intron, which suggests heterogeneity of *O. bembicodes*. Two unidentified uncultured soil isolates from conifer forests in GenBank are obviously conspecific with *O. bembicodes* from *Fagus*. One is from northern Europe (Latvia) and comprises parts of 5.8S and ITS2, differing from our strain by only 1.9% in the ITS2. Another isolate is from Canada (SG070_G06) and comprises ITS and LSU (S1506 intron absent in the partial SSU), differing from the *Fagus* strain by 2.7% in the ITS (1.1% in LSU D1–D2) and from Liou & Tzean's strain by 11.5% in the ITS. We here refer to the three similar strains as *O. bembicodes* s.str. Regrettably, molecular data of the ex-type (CBS 177.37) was not available, since this culture turned out to be a contaminant: a sequence gained by G. Hagedorn belongs to *Peniophora pini*, and the same result was obtained at CBS (see CBS database).

Especially the ITS2 of *O. bembicodes* s.l. is very different from other strains of *Orbiliomycetes* and does not align in a GenBank BLAST. Even within *O. bembicodes* s.l. the ITS2 varies in the range of 1.9–21.5% among the four strains: 1.9% within *O. bembicodes* from Europe, 3.2% to the Canadian strain, 21.5% for the Taiwanese strain. A misidentified Chinese strain (YMF 1.01429) appears to belong to *D. coelobrocha*, together with another identified as *D. aphrobrocha* (YMF 1.01881), see Phyl. 36

In our phylogenetic analysis of the ITS region, *O. bembicodes* s.l. formed a strongly supported clade situated at the very base of series *Drechslerella*, with a high distance to all other species of this series (Phyl. 36). Also when analysing LSU, *O. bembicodes* s.str. formed a basal sister clade to the rest of the series (Phyl. S36). In the intron analysis, *O. bembicodes* surprisingly clustered in a weakly supported clade with *O. tonghaiensis* s.l. from Jiangxi and Tonghai which is associated unsupported with taxa with adhesive traps, whereas the remaining members of series *Drechslerella* (including *O. brochopaga* and *O. orientalis*) clustered with 100% bootstrap support in a distant clade (S30).

Two CBS cultures under the name *D. bembicodes* were sequenced by G. Hagedorn (SSU, ITS, LSU), but turned out to belong to series *Arthrobotrys*. One (CBS 703.74, Netherlands) coincides with the ex-type strains of *A. xiangyunensis* and *A. reticulatus*, and the other (CBS 376.97, Burkina Faso) belongs to *A. thaumasius*.

Ecology. Drechsler's isolates were from two sites around Washington D.C. (Beltsville and Arlington) in warm-temperate humid eastern North America. Our collection from southern Germany was made on the lateral upperside of a decorticated *Fagus* log in a *Fagetum* at a south-exposed slope in subcontinental, cold-temperate humid central Europe. The strain from northeastern Europe (Latvia) was isolated from soil of the *Picea* rhizosphere of a hemiboreal humid spruce forest (Menkis et al. 2012), and that from Canada was a soil isolate in a boreal conifer forest (unpublished). The not included Spanish collection was on the hygric underside of detached rotten bark of *Eucalyptus* in an atlantic, thermotemperate humid (somewhat summer-dry) eucalypt plantation. Two Scottish collections under the name *Monacrosporium bembicodes* are listed in the British database (FRDBI): from Arran (on *Ilex perneyi* leaf, IX.1980, P.M. Kirk) and Perthshire (from soil, 1985, G.C. Ainsworth).

Specimens included. **GERMANY**: **Baden-Württemberg**, 5 km ENE of Tübingen, 1 km S of Pfrondorf, Bitzle, 350 m, branch of *Fagus sylvatica*, on wood, 12.VII.2002, E. Weber (H.B. 7165b, conid. isol., CBS 140835; sq.: KT215295). — **LATVIA**: 30 km SW of Riga, 16.5 km N of Jelgava, 5.5 km E of Kalnciems, 15 m, *Picea abies* forest soil, VI.2009, Menkis et al. (2012, 96_GKG40MV01CD4CH, mol. extr.; sq.: JQ312990). — **CANADA**: **?British Columbia**, unlocalized, conifer forest soil, undated (S.H.A. Guichon & S.W. Simard, SG070_G06, mol. extr.; sq.: KP889879). — **USA**: **Maryland**, Beltsville, ~50–100 m, and **Virginia**, Arlington, ~0–100 m, leaf mould and acorns of *Quercus michauxii* (as *Q. prinus*), undated, C. Drechsler (**type** of *O. bembicodes* [illustration], conid. isol., doc. vid.). – **Maryland**, near Salisbury, ~10 m, leaf mould, 21.XI.1951, C. Drechsler (1962, conid. isol., doc. vid.).

Not included. **SPAIN**: **Asturias**, 5 km WSW of Avilés, 2 km SSW of Piedras Blancas, Las Bárzanas, 80 m, detached bark of trunk of *Eucalyptus globulus*, 25.IV.2009, E. Rubio & A. Suárez (H.B. 9051g ø, anam. only). — ?**CHINA**: **Taiwan**, unlocalized (CCRC 33278, Liou & Tzean 1997, sq.: U51976).

Orbilia pilosa (Dennis) Baral, Syst. Ascom. 13: 120 (1994) — Pls 1001–1002.

≡ *Orbiliaster pilosus* Dennis, Kew Bull. 9: 294 (1954) [as '*pilosa*', ICN Art. 62.1]

Etymology: named after the long hairs on the apothecial margin.
Typification: Trinidad, Diego Martin, trunk of indet. angiosperm, 22.IX.1949, R.W.G. Dennis (K(M) 36046, holotype).

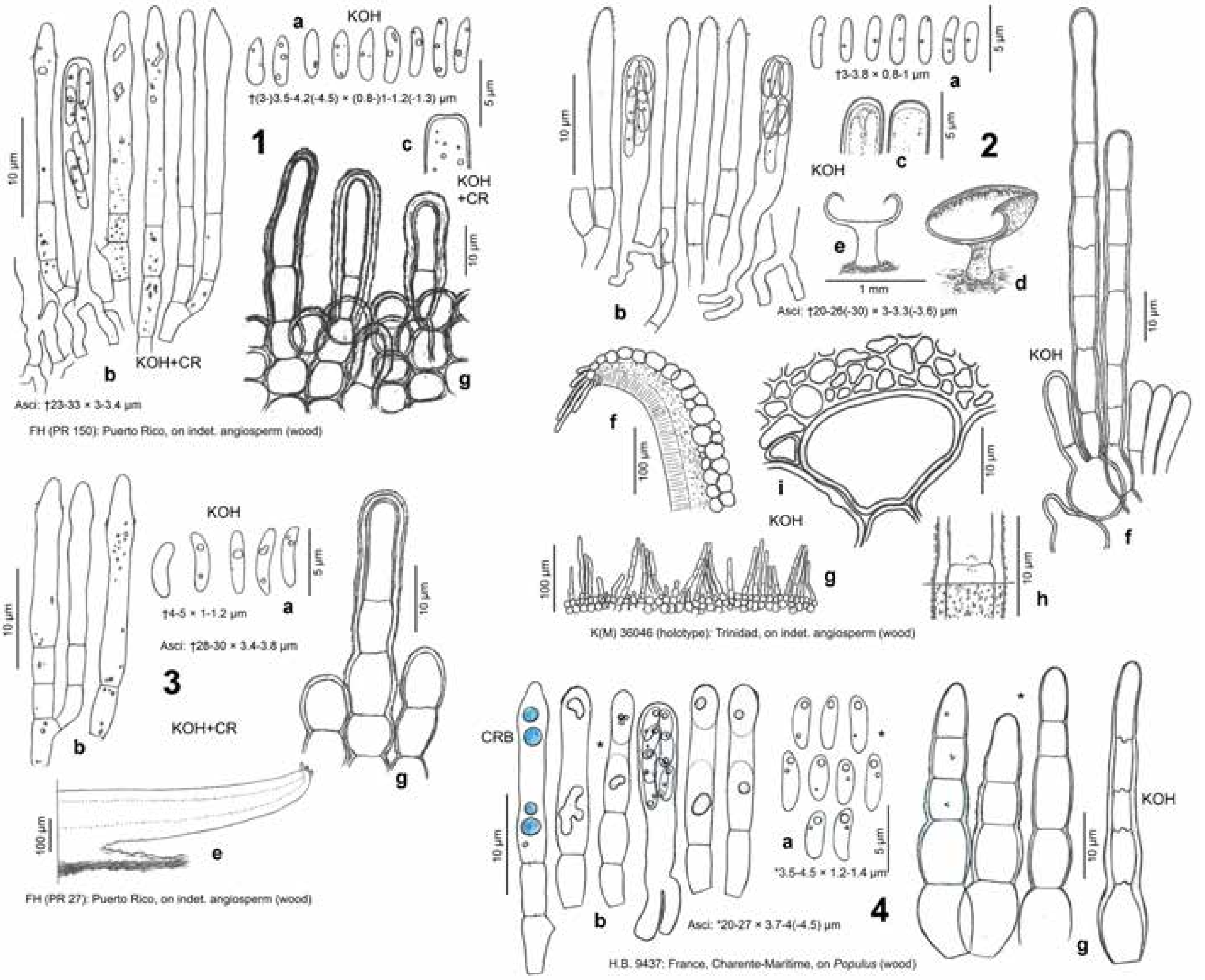
Description: — **TELEOMORPH** (values in [...] from 2 Puerto-Rican collections): **Apothecia** rehydrated 0.5–1.5(–1.8) mm diam., 0.5–0.7 {T} or 0.2–0.45 mm tall (receptacle 0.08–0.17 → 0.06–0.08 mm), white {1} or light fawn {T} [cream-yellowish-ochre], round, ± gelatinous, scattered to medium gregarious; disc deeply cupulate, sometimes with inrolled margin {T} [slightly cupulate to flat], with prominent hairs exclusively at the margin, these either free {3} or loosely agglutinated to form distinct teeth {T}; exterior glabrous, white to cream, subsessile or mostly with an obconical to cylindrical, white to cream stipe 0.05–0.3 × 0.15–0.25 {3} or 0.2–0.4 × 0.2–0.3 mm {T}, superficial; dry with strongly inrolled margin with the teeth directed downwards to the hymenium {T}. **Asci** *20–27 × 3.7–4(–4.5) µm {1}, †20–25(–30) × 3–3.4(–3.7) {2}, [†23–33 × 3–3.8 {2}], 8-spored, spores 2–3-seriate, basal ~4 spores inverted {1}, pars sporifera *10.5 µm long, †8–11.5 µm; **apex** (†) hemispherical to slightly [medium to strongly] truncate (not or rarely slightly indented, laterally not inflated), thin-walled; **base** without or with short to medium long, flexuous stalk, h- to H-shaped. **Ascospores** *3.5–4.5 × 1.2–1.4 µm, †(3–)3.2–3.8 {2} × 0.8–1 {T} or 1.1–1.2 {1} µm, [†3–5 × (0.8–)1–1.2(–1.3) µm {2}], (sub)cylindrical with rounded ends, also narrowly ellipsoid, straight to (very) slightly curved [sometimes 1 end subacute]; **SBs** 0.5–0.7 µm diam., globose, central or eccentrical, filum invisible (total length 0.8–1.3 µm) {1}. **Paraphyses** apically uninflated or often slightly to medium spathulate or lanceolate, with ± obtuse tips, terminal cell *10.5–18 × (2.2–)2.5–3.3 µm {1}, †15–20 × 1.5–2.3(–2.5) µm {T}, [†15–23 × 1.8–2.8(–3) µm {2}], exceeding the asci by *2–3 or †3–5 [2–5] µm, lower cells *(3–)4–6(–7) × 2.2–3 µm {1}, †3.5–6.5 × 1.3–2(–2.5) µm {T}, [†3–7 × 1.5–2.3 µm {2}]; unbranched at upper septum, not immersed in gel. **Medullary excipulum** 20–100 µm thick, of horizontal textura prismatica-porrecta, t. globulosa-intricata, or t. intricata, cells †9–13 × 2–6 µm, slightly to strongly gelatinized, common walls 0.5–1(–1.5) µm thick {T}, very sharply delimited from ectal excipulum {T} or only at flanks. **Ectal excipulum** of (†) thick-walled t. globulosa-angularis from base to margin, 40–70 µm thick at lower flanks, cells *(10–)20–50 × (10–)20–35 µm {1}, †(10–)20–37 µm diam. {T}, [†15–30(–45) µm diam. {2}], single walls †0.8–1.5 µm thick {T} [common walls †0.8–2 µm]; 15–20 µm thick near margin, marginal cortical cells *8–14 × 6–9.5 µm {1}, oriented at 80–90°; **hairs** †(20–)70–100(–110) × (5–)6–7.5(–9.5) µm {T}, †23–38(–45) × 6.5–8 µm {1}, [†12–35 × 5–9 µm {2}], hyaline {3} or pale yellowish-ochraceous {T}, thick-walled (walls near base 1–1.5 µm, in long hairs at middle part 0.7–1.2 µm, near apex 0.3–1 µm), 3–6- {T} or (0–)1–3(–4)-septate {3}, septa very delicate, smooth or very finely warted {4}, **glassy processes** absent. **Anchoring hyphae** forming a 30–50 µm thick, dense layer at base of stipe, *(2.7–)3–5 µm wide, wall 0.2 µm thick {1}, towards excipulum forming globose cells *8–15 µm diam.; [abundant, strongly gelatinized, forming an up to 60 µm thick layer of narrow hyphae]. **SCBs** absent; **VBs** in paraphyses strongly refractive, globose to irregularly shaped, inside large non-refractive vacuole {1}, in hairs forming a few minute droplets. **Exudate** over paraphyses absent or very thin, rough to minutely granular; also over ectal excipulum and hairs often finely warted. — **ANAMORPH**: [drechslerella-like (from ascospore isolate {1})]. **Conidiophores** and **conidia** not documented, identified by Pfister (1997) as *Monacrosporium* ?*doedycoides*.

Habitat: lying on ground, decorticated, 30–50 cm thick logs of *Populus* sp. {1}, indet. angiosperm trees {3}, on 0.5 mm or very deeply medium to strongly decayed wood {4}. **Associated**: *Orbilia* ?*eucalypti*, ?*Rhizodiscina lignyota*, remotely with indet. pyrenomycetes {2}. **Desiccation tolerance**: probably intolerant. **Altitude**: 20–250 m a.s.l. (tropical America), 26 m (western Europe). **Geology**: France: Upper Cretaceous lime- & sandstone. **Phenology**: IX, I (tropical belt), IX (Europe).

Taxonomic remarks. The stipitate, ± cupulate, pubescent to hairy, whitish, rather large apothecia of *Orbilia pilosa* resemble under a hand lens a helotialean discomycete (*Lachnum* or *Cistella*). The species is characterized by short to long, septate, thick-walled hairs restricted to the margin, obtusely lanceolate paraphyses, small, cylindrical, straight to slightly curved ascospores, and an ectal excipulum of large, globose, thick-walled cells which is often very sharply delimited from the gelatinized medullary excipulum.

Without vital characters and without information about its anamorph, *O. pilosa* could be taken for a member of section *Orbilia*. For instance, *O. umbilicata* resembles *O. pilosa* in some points. It differs in strongly curved ascospores, smaller, thin-walled excipular cells, and in lacking hairs. *O. alba* (series *Gamsylella*) resembles *O. pilosa* in its apothecia with a finely pubescent exterior and large excipular cells, but differs in sessile apothecia, a non-gelatinized medullary and a thin-walled ectal excipulum, the absence of thick-walled hairs, and spores with distinctly tapered bases.

Variation. In the holotype the rehydrated apothecia have a concave disc, with the margin ± inrolled, the hairs being agglutinated as teeth pointing inwards (Pl. 1001: 2). When dry the margin is even more inrolled, whereas upon rehydration the apothecia open within some seconds, obviously due to the thin receptacle composed of two very differently constructed layers. In the fresh state the long marginal hairs have probably been oriented more upwards. The two samples from Puerto Rico (Pl. 1001: 1, 3) concur quite well with the specimen from France (Pls 1001: 4; 1002) in having much shorter hairs with fewer septa, less cupulate apothecia with shorter stipes, slightly longer and wider spores, and a less sharply differentiated border between ectal and medullary excipulum. Whether these differences are the result of variation or due to different taxa should be investigated by molecular methods.



FH (PR 150): Puerto Rico, on indet. angiosperm (wood)

K(M) 36046 (holotype): Trinidad, on indet. angiosperm (wood)

FH (PR 27): Puerto Rico, on indet. angiosperm (wood)

H.B. 9437: France, Charente-Maritime, on *Populus* (wood)

Plate 1001. **1–4**: *Orbilia pilosa*. – **a**. ascospores; **b**. asci and paraphyses (in **4b** containing VBs); **c**. ascus apices; **d**. apothecium (sectioned); **e**. apothecia in median section; **f–g**. marginal hairs emerging from ectal excipulum (**f**: median section, **g**: external view); **h**. detail of a hair; **i**. border between small-celled medullary and large-celled ectal excipulum.

Type studies. Because of the presence of septate hairs, Dennis (1954) and Huhtinen (1992) separated *Orbiliaster pilosus* from *Orbilia* at the generic level. In their examination of the holotype, the authors described the paraphyses as filiform and the apothecia as sessile (Dennis) or sessile to clearly stipitate (Huhtinen). Dennis reported the spores as bacilliform, straight, 5 × 0.5 µm, whereas from Huhtinen's drawing a spore size of 3–4 × (0.9–)1.1(–1.3) µm can be evaluated in accordance with the present result (Pl. 1001: 2a).

Anamorph. In one of the two collections from Puerto Rico here included in *O. pilosa* (D.H.P. 204, Pl. 1001: 1), Pfister (1997: 16, tab. 1, fig. 12) obtained a drechslerella-like anamorph which he named '*Monacrosporium* ?*doedycoides*' (teleomorph as *Orbilia* sp.). Regrettably, he did not describe and illustrate this isolate but he reported to have seen both macro- and microconidia.

Phylogeny. From one of the two collections from Puerto Rico (D.H.P. 204) an ITS sequence was available (the presence of the S1506 intron is unclear because the ITS1 primer was used). This clustered with high distance and unresolved inside the medium supported *brochopaga-polybrocha* clade (Phyl. 36). To *D. doedycoides* it shows a 20 % distance, which provides evidence that two distinct species are involved. *D. doedycoides* exists in GenBank and CBS with four strains which comprise ITS and LSU, one also SSU (ATCC 96778, CBS 175.55, 223.54, 586.91), the latter being the epitype. They coincide in the ITS region by a 0–1 nt difference. Also other species of *Drechslerella* show a rather high distance of min. 15 % (*O. brochopaga*) to D.H.P. 204.

Ecology. *O. pilosa* was collected on ± rotten wood of hygric logs of angiosperm trees in tropical humid rainforests of Lesser Antilles in the eastern part of the Caribbean region, and in a cavity of an entirely very rotten, decorticated *Populus* log in a mesosubmediterranean humid riverbank forest with *Ruscus aculeatus* in atlantic western France.

Specimens included. **Trinidad**, 3 km NNW of Diego Martin, River Estate, 45 m, trunk of indet. angiosperm, on wood, 22.IX.1949, R.W.G. Dennis (Dennis 30, K(M) 36046, **holotype**, H.B. 5533 ø). — **PUERTO RICO**: 2.5 km SSW of Luquillo, near Rio Sabana, hill above chicken farm, 20 m, trunk of indet. angiosperm, on wood, 17.I.1996, D.H. Pfister, F.A. Harrington, D.J. Lodge & S.M. Hundorf (D.H.P. PR 27, FH 00304895, H.B. 5948 ø). – 8 km SW of Luquillo, 3.5 km WSW of Sabana, El Yunque, El Verde, Bisley watershed #3, 250 m, stump of indet. angiosperm, on wood, 27.I.1996, F.A. Harrington & M. Liftik (as *Orbilia* sp./*M.*?*doedycoides*, D.H.P. 204, PR 150, FH 00304818, anam. cult., H.B. 5955 ø; sq.: U72596). — **FRANCE**: **Poitou-Charentes**, **Charente-Maritime**, 3.5 km NE of Saintes, 1.4 km W of Foncouverte, NE of Chaumet, near river Escambouille, 26 m, log of *Populus*, on wood, 18.IX.2010, S. Buissonnet, vid. M. Hairaud (H.B. 9437).

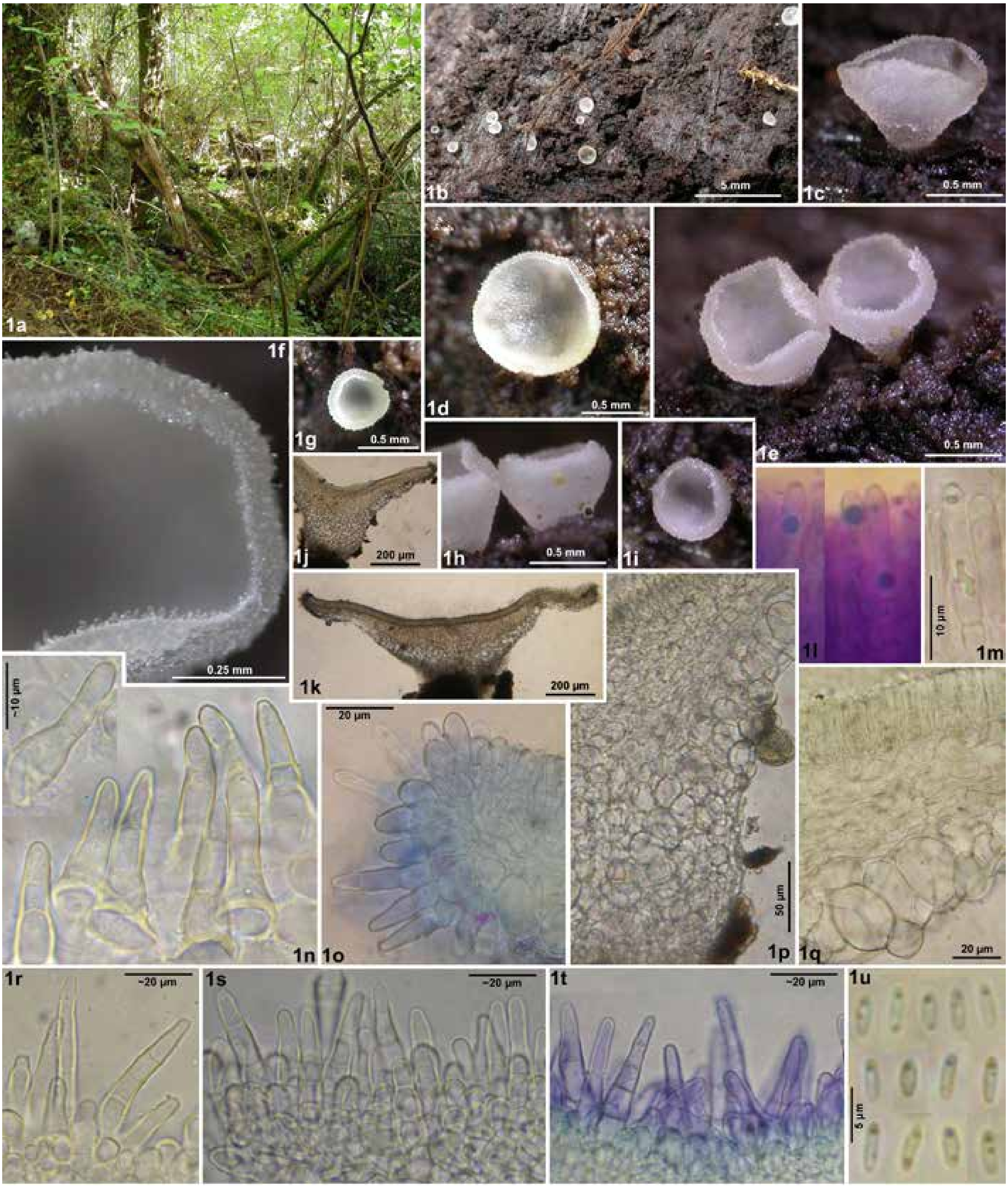


Plate 1002. **1**: *Orbilia pilosa*. – **1a**. submediterranean riverbank forest with *Populus* and *Ruscus*; **1b–i**. fresh apothecia; **1j–k**. apothecia in median section; **1p**. id., ectal excipulum in stipe; **1q**. id., at flanks; **1n–o**, **r–t**. marginal hairs; **1l–m**. paraphyses; **1u**. ascospores. – Living state (**1l**, **o**, **t**: stained with CRB), but terminal cells of hairs partly dead. – **1a–b**, **d**, **n**, **r–t**: phot. M. Hairaud. — **1a–u**. H.B. 9437: France, Charente-Maritime, on *Populus*.

Orbilia polybrocha (Drechsler) Baral, E. Weber & Pfister, **comb. nov.**, MB 814001 — Pls 1003–1006

Basionym: *Trichothecium polybrochum* Drechsler, Mycologia 29(4): 536, fig. 18A–E (1937)

≡ *Dactylella polybrocha* (Drechsler) Mekht. [as '*polybrochum*'], Dokl. Akad. Nauk Azerb. SSR 20(6): 70 (1964)

≡ *Monacrosporium polybrochum* (Drechsler) Subram., Kavaka 5: 96 (1978, '1977')

≡ *Golovinia polybrocha* (Drechsler) Mekht., Khishchnye Nematofagovye Griby – Gifomitsety: 137 (1979)

≡ *Drechslerella polybrocha* (Drechsler) M. Scholler, Hagedorn & A. Rubner, Sydowia 51(1): 100 (1999)

= *Orbilia tenebricosa* (Svrček) Baral, in Yu et al., Mycotaxon 96: 167 (2006)

≡ *Patinella tenebricosa* Svrček, Česká Mykol. 31: 135 (1977)

Etymology: *polybrocha*: with many lassos (bróchos = noose, meaning the constricting rings); *tenebricosa*: referring to the dark pigmentation of the apothecia.

Typification: USA, Virginia, Norfolk, decaying rootlets of *Spinacia oleracea* undated, C. Drechsler (holotype of ***Trichothecium polybrochum***, illustration in Drechsler 1937a: fig. 18A–E); USA, Massachusetts, Concord, trunk of *Acer*, 20.VI.1995, D.H. Pfister (ex H.B. 5296a, M-0276567, epitype, designated here, MBT202637; ex D.H.P. 133, FH 00458180, FH 00458181, isoepitypes; sq.: U72606). — Czechia, Písek, Otava valley, trunk of *Tilia cordata*, 3.IX.1972, M. Svrček (PRM 804304, holotype of ***Patinella tenebricosa***).

Description: — **TELEOMORPH**: **Apothecia** fresh (0.3–)0.5–1.3(–1.8) mm diam., 0.22–0.35(–0.4) mm high, receptacle (0.1–)0.12–0.18(–0.2) → 0.07–0.1(–0.14) mm, typically light (greyish-) or (reddish- or purplish-)umbra-brown, also pale cream-rosaceous(-amber), translucent if pale-coloured, round, slightly undulating when large, ± scattered or in small groups; disc flat, sometimes slightly (to medium) convex, margin subhyaline or bright greyish- to blackish-brown, finely to distinctly crenulate, teeth protruding for 10–30 µm; (sub)stipitate, stipe 0.05–0.2 × 0.2–0.55 mm (partly composed of anchoring tissue), superficial; dry dark olivaceous- to black-brown **Asci** *(28–)32–42(–47) × (3.5–)4–4.5(–5) µm {3}, †(28–)32–40(–42) × 3.2–4 µm {3}, 8-spored, spores 3–4-seriate, 2–5 lower spores inverted {3} (often mixed), pars sporifera *12–17 → 10–13 µm long; **apex** (†) strongly truncate (not or sometimes very slightly indented, laterally usually not inflated); **base** with short to long, thin or thick, flexuous stalk, Y- to h- or mostly H-shaped. **Ascospores** *(4.2–)5–6.5(–7.5) × (1–)1.1–1.3(–1.4)((–1.6)) µm {4}, †5–6.8 × (0.9–)1–1.1 µm {3}, subcylindrical to narrowly cylindric-ellipsoid or fusoid(-clavate), apex rounded to obtuse, base slightly to medium attenuated (rarely not or strongly so), straight, rarely slightly curved below; **SBs** *0.8–1.5 × 0.2–0.5 µm {3}, slightly to strongly eccentrical, usually rod- but also tear-shaped to subglobose, attachment mostly invisible, rarely narrowed to a small point; with small or sometimes rather large LBs up to 0.5–0.7 µm. **Paraphyses** apically (uninflated to) slightly to medium, rarely strongly capitate(-clavate), terminal cell *(14–)16–24(–26) × (2–)2.5–4(–4.7) µm {3}, †15–21 × 2.5–3.7(–5.5) µm {2}, lower cells *(4–)5–7.5(–9) × 1.8–2.8(–3.3) µm {3}, †4–8.5 × 1.3–2.3 µm {2}; never branched at upper septum. **Medullary excipulum** hyaline, 60–100(–170) µm thick, of ± dense textura globulosa-intricata with large globose cells in lower part, distinctly delimited from ectal excipulum only towards margin by a parallel, 10–20 µm thick layer of t. prismatica, here sometimes pale to bright brown. **Ectal excipulum** hyaline, of thin-walled († very slightly gelatinized), vertically oriented t. globulosa-angularis-prismatica from base to mid flanks, 100–180 µm thick at base, cells *(15–)20–40 × (12–)18–25 µm {3}, †20–35 × 13–20 µm {1}; 30–60 µm thick at lower flanks, 25–35 µm at mid flanks, cells *10–17 × 6–12 µm; 20–35 µm thick near margin, of t. prismatica-porrecta oriented at a (45–)70–90° angle to the surface, marginal cortical cells *(10–)12–17(–20) × (2.5–)3–4(–6) µm {3}, submarginal cells partly shorter and thicker; **glassy processes** abundant at mid flanks and margin, (5–)10–40(–50) × (2.5–)3–5(–7) µm {5}, medium to strongly curved outwards {6}, low- to mostly highly-refractive, stratified or not, coherent to form ± distinct small teeth. **SCBs** absent in both paraphyses and excipulum {3}, but ring-shaped SCBs seen in cells of medullary excipulum after rehydrating a section {1}; **VBs** ± globose, low to medium refractive, hyaline, present in a few or most paraphyses, nearly completely filling the terminal cell. **Exudate** over paraphyses 0.5–1.5 µm thick, granular-cloddy, hyaline or typically very pale to light chlorinaceous-olivaceous to brass-brown, firmly attached but absent on some apices, unchanged in KOH; glassy processes covered by a thin or 1–3(–8) µm thick layer of granular-cloddy or homogeneous, hyaline to often pale brass-olivaceous-brown exudate, in perihymenial part of medulla sometimes with pale to bright grey-brown-olivaceous, granular intercellular exudate. **Anchoring hyphae** abundant at base of stipe, *(3–)4–6(–7) µm up to *5–10 µm wide, walls 0.2 µm thick {2}, forming a loose or dense, hyaline, 50–150 µm thick t. globulosa-angularis-intricata. — **ANAMORPH**: drechslerella-like (from ascospore isolate {2}). **Macroconidiophores** 275–400 µm long, unbranched, 7–8 µm wide at base, 3–4.5 µm above, with a single conidium at apex {T}. **Macroconidia** broadly obovoid, *33.5–36 × 23.5–25 µm {T}, *27–29.5 × 16–18 µm {ET}, *32–37 × 23.5–26.5 µm {Germany}, 37–41 × 20–21 µm {West Virginia}, 1-septate, septum very close to base, covered by a 2–3 µm thick surrounding gel sheath {T, Germany} or an 8–12 µm thick lateral gel cap {ET, West Virginia}. **Microconidiophores** ~30–60 µm long, forming 1–4 conidia on denticles near the conidiophore tip {ET}. **Microconidia** *16–23 × 3.7–5.5 µm {ET}, *19 × 5.5 µm {Germany}, cylindric-ellipsoid-clavate, 1–2-septate. **Constricting rings** with 1-septate stalk of *10–12.5 × 4–4.8 µm {T} or *11–19 × 4.5–5.5 µm {Germany}; ring unexpanded *22–30 µm outer diam. {T}, *31.5–36.5 × 32.5–34.5 µm {Germany}, *12.5–15 µm inner diam. {T}, *16–22 {Germany}, 3-celled, with triangular wall thickenings especially at the 2 distal septa.

Habitat: on partly water-soaked old, decorticated branches or logs lying on the ground, also on the bank close to a stream or rivulet, on lower, sometimes upper side, 50–300 mm thick, of *Acer* sp. {1}, *Corylus avellana* {2}, *Fagus sylvatica* {2}, *Fraxinus excelsior* {1}, *Tilia cordata* {1}, on partly eroded, deeply medium to strongly decayed wood {7} (brown- or white-rot), sometimes in old beetle galleries, without or with minute green algae. **Associated**: *Ascocoryne ?cylichnium* {1}, *A. inflata* {1}, *Brachysporium ?nigrum* {1}, *Hyalorbilia tortuosa* {1}, *Hypnum cupressiforme* {1}, *Lasiosphaeria hirsuta* {1}, *Leptodontidium trabinellum* {1}, *Mollisia ?oblonga* {1}, *Orbilia ?cejpii* {1}, *O. dryadum* {1}, *O. leucostigma* {2}. **Desiccation tolerance**: mature asci survive for a few hours on the dry slide, only spores viable after 2 days. **Altitude**: 335–485 m a.s.l. (central Europe), ~1200 m (eastern Europe), 5–280 m (eastern USA). **Geology**: Germany: Keuper (Knollenmergel), Lower Jurassic limestone (Arietenkalk), Tertiary molasse, syenogranite, amphibole-biotite; USA: Carboniferous (Pennsylvanian) sedimentary rock, Quaternary sediment, granite. **Phenology**: VI, VIII–X (teleomorph).

Taxonomic remarks. *Orbilia polybrocha* is characterized by usually light umbra-brown, comparatively large apothecia when fresh, with a crenulate margin of glassy processes, cylindric-fusoid ascospores with ± eccentrical, rod-shaped to subglobose SBs, and by a drechslerella-like anamorph with obovoid, balloon-shaped macroconidia with a single subbasal septum and a gel sheath. *O. orientalis* s.l. differs in usually distinctly shorter and wider, ellipsoid spores, whitish to cream apothecia, and in very different cylindrical, 3-septate macroconidia. However, in *O. naumburgensis* (Pls 1012–1013) the spores hardly differ from those of *O. polybrocha*, but the macroconidia closely resemble those of *O. orientalis* or *O. brochopaga*.

O. flavovacuolata, but also *O. anigozanthi* and *O. alba* of series *Gamsylella*, have ascospores very similar to *O. polybrocha*, but they differ, e. g., in the absence of glassy processes, the latter two species also in lanceolate-lageniform paraphyses, the former in minute apothecia with yellow vacuoles.

O. aff. *polybrocha* from Taiwan (Pls 1007–1008) differs from *O. polybrocha* in whitish apothecia with a smooth margin (see p. 1636). Some members of series *Dactylellina* (*O. mammillata*, *O. quercus*) and series *Neodactylella* (*O. cardui*, *O. zhongdianensis*) have also ascospores with a similar shape, but deviate in more centrally positioned, usually globose SBs.

Variation. The colour of mature apothecia varies in *O. polybrocha* to a high extent. In a majority of collections, including the type of *P. tenebricosa*, a light (reddish-)umbra-brown exudate, which turns bright olive in KOH, occurs on the tips of paraphyses, on the cortical excipular cells and glassy processes, and to a varying extent also among the marginal cells between medullary and ectal excipulum (Pls 1003: 1e–f; 1006: 1). Pfister's North American collection fits herein very well the European samples. In typical collections the fresh apothecia were light umbra-brown (Pls 1003: 1d; 1005: 1b–g; 1006: 3a–b), whereas the rehydrated herbarium specimens showed a darker brown pigmentation, with the margin almost blackish (Pls 1003:

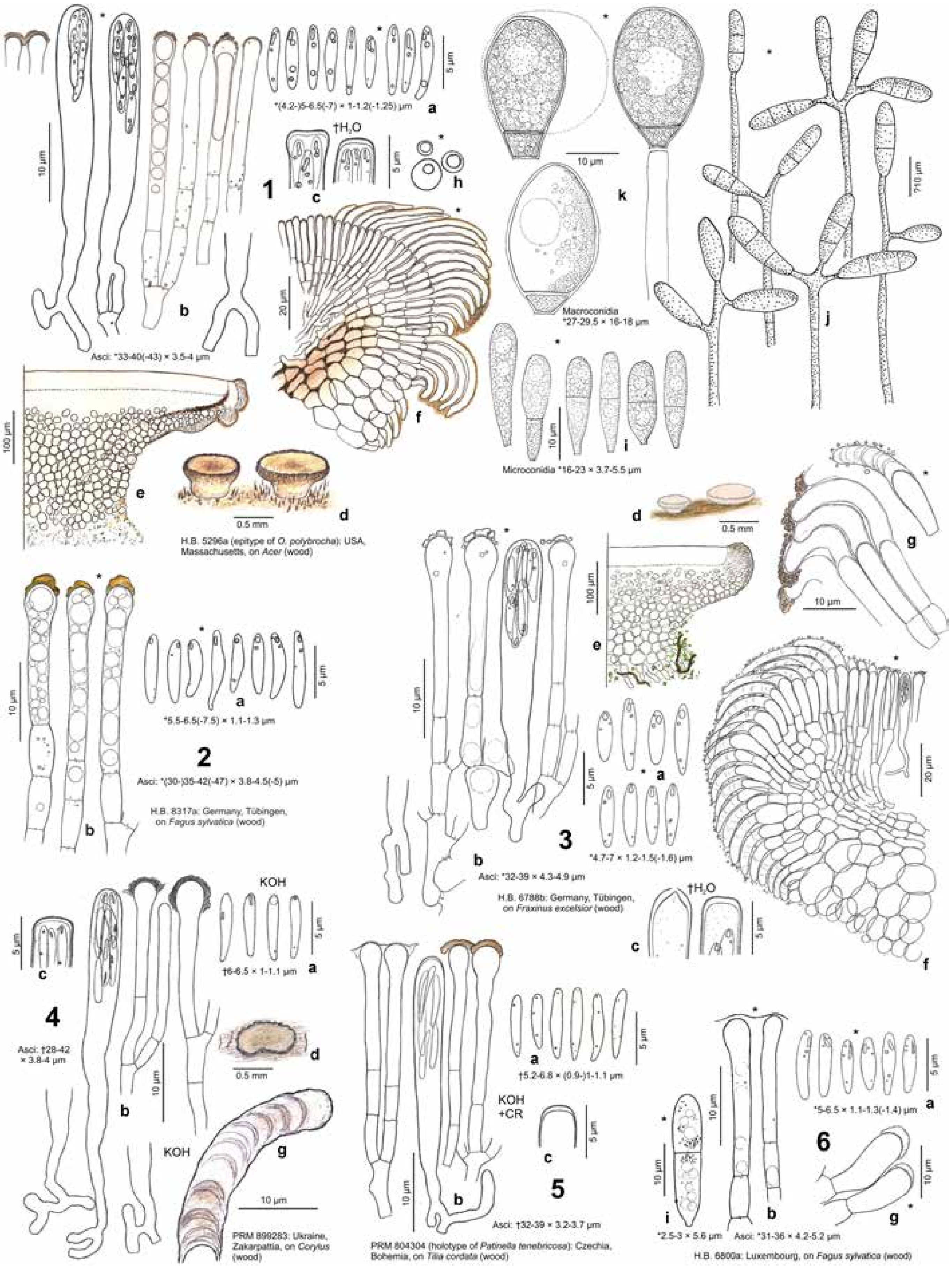


Plate 1003. **1–5**: *Orbilia polybrocha*; **6**: *O.* cf. *polybrocha*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. fresh or rehydrated apothecia; **e**. apothecium in median section; **f**. id., marginal ectal excipulum; **g**. id., marginal cortical cells tipped by curved glassy processes; **h**. SCBs in medullary excipulum (after rehydration); **i–j**. microconidia and microconidiophores; **k**. macroconidia (**1i–k**. from culture, **6i**. from substrate). – **1i–k**: from Pfister (1997).

4d; 1006: 2b–e). Yet, in one collection the fresh apothecia were pale cream-rosaceous with a pale chlorinaceous-olivaceous exudate over the margin (Pl. 1003: 3).

Type studies. Drechsler (1937a, Pl. 1004) described *Trichothecium polybrochum* from decaying rootlets of *Spinacia oleracea* from Norfolk (Virginia, USA). Neither a type culture nor a dried specimen appear to exist (see Rubner 1996: 91). We here designate Pfister's North American isolate (Massachusetts, Concord, on *Acer*, ex H.B. 5296a, M-0276567), from which a sequence was gained by Pfister (1997), as **epitype** of *T. polybrochum*.

Svrček (1977b) described the apothecia of the holotype of *Patinella tenebricosa* as 1–3 mm diam., deep violaceous, dry blackish-brown, with a brown, denticulate margin, and the marginal teeth composed of 40–60 × 4–5 µm large clavate hyphae. With the latter statement he obviously neglected the solid nature of the processes. In the present reexamination of the holotype the apothecia were rehydrated 0.6–1 mm diam. and dark (purplish-)brown. The somewhat stratified, solid downwards curved processes of the marginal teeth measured 30–40 × 3.5–5 µm. Although the spore size in the protologue (5–6.5 × 0.8–1 µm, with partly 1 small guttule at each end) quite well corresponds to the present reexamination (Pl. 1003: 5), Svrček's drawing shows too narrow and too cylindrical spores. A clear reference to the spore body is not found in Svrček's description which apparently shows all elements in the dead state.

A completely hyaline, marginally associated single apothecium occurs in the holotype which is microscopically very similar, including the marginal teeth, but differs in cylindric-ellipsoid ascospores †4–4.5 × 1.2–1.4 µm. Whether this is an albinotic form of *P. tenebricosa* or more probably belongs to *O. orientalis* could not be clarified.

Because of the light brown excipular cells, Svrček placed his collection in *Patinella*, a genus which was considered to be orbiliaceous by Nannfeldt (1932). Due to Svrček's misleading description of the marginal hairs, Spooner (1987: 158) and Huhtinen (1992) discussed a possible placement in *Orbiliaster*, a genus which has been characterized by septate hairs without glassy processes.

Not included collections. A specimen from Luxembourg (Pl. 1003: 6) is not included because of whitish apothecia with a smooth margin with only 1–2 µm thick glassy caps. Here a single microconidium was found on the substrate.

Two Chinese samples of unclear identity were reported under the name *O. tenebricosa* although having yellowish apothecia. No anamorph was observed, and the asci are with †22–30 µm a bit too short to be included in *O. polybrocha*. Liu's (2006: 110, pl. 44) sample from Guangxi has 15–50 × 4–5 µm large glassy processes, whereas Guo et al.'s (2014b) sample from Yunnan is without them and herein resembles *O.* aff. *polybrocha* illustrated in Pl. 1007. *O. pseudopolybrocha* deviates from both in shorter and wider spores.

Anamorph. Pfister (1997) obtained *Drechslerella polybrocha* (as *Monacrosporium polybrochum*) in pure culture of a North American collection identified as *Patinella tenebricosa*, which formed macro- and microconidia (Pl. 1003: 1i–k) and constricting rings. In a German sample we obtained distinctly larger conidia (Pl. 1005: 1o), which fit well in size Drechsler's (1937a) holotype ('ca. 35 × 24 µm' in protologue, Pl. 1004). In a strain of *D. polybrocha* from West Virginia examined by Rubner (1999, fig. 46, CBS 319.56) the macroconidia were longer though narrower than in the holotype.

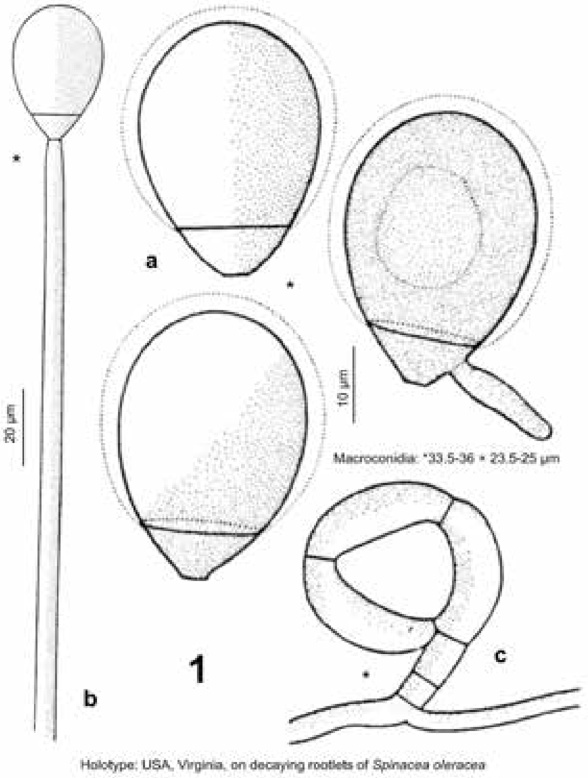


Plate 1004. **1**: *Orbilia polybrocha*. – **a**. conidia; **b**. conidiophore; **c**. constricting ring (from culture). – from Drechsler (1937a).

Much smaller, cylindric-ellipsoid, 2-septate microconidia were reported by Pfister (1999) in pure culture, formed in abundance on apically branched microconidiophores (Pl. 1003: 1i–j). Those drawn by him on the conidiophores (Pfister 1999, fig. 11 F–H) appear to have an erroneous scale (Pfister pers. comm.) which is tentatively reduced here by 75 % of the original length (1j). Similar but only single microconidia were observed on the natural substrate near apothecia in the German collection (Pl. 1005: 1p) and that from Luxembourg (Pl. 1003: 6i).

The constricting rings are distinctly smaller in the holotype (Pl. 1004: 1c) compared to the sample from Germany (Pl. 1005: 1q). No measurements of trapping organs were available for the epitype.

Phylogeny. Sequences of three strains of *O. polybrocha* were available, one (?) conidial and two ascospore isolates. They comprise the ITS region, one also the S1506 intron: Pfister's strain (D.H.P. 133, from Massachusetts) lacks any parts of SSU; the other two (CBS 319.56, from West Virginia; H.B. 8317a, from Tübingen) encompass a small part of the SSU, and here the S1506 intron occurs only in the strain from West Virginia.

Pfister's strain differs in the ITS region only by 2 nt (0.4 %) from the strain from West Virginia (1 nt lies in the 5.8S and is possibly a sequencing error, the other is in the ITS2), whereas the European sample shows a 3 % distance to those (15 nt). In our ITS analysis (Phyl. 36), *O. polybrocha* nested unresolved in the medium supported *brochopaga-polybrocha* clade by showing a high distance of 7–8 % to *O. pseudopolybrocha*, 9–9.5 % to *O. naumburgensis*, and 9.5–11 % to *O. orientalis* and *O. yunnanensis*. When analysing the intron, *O. polybrocha* clustered with medium support with these species (S30, *O. orientalis* is without intron).

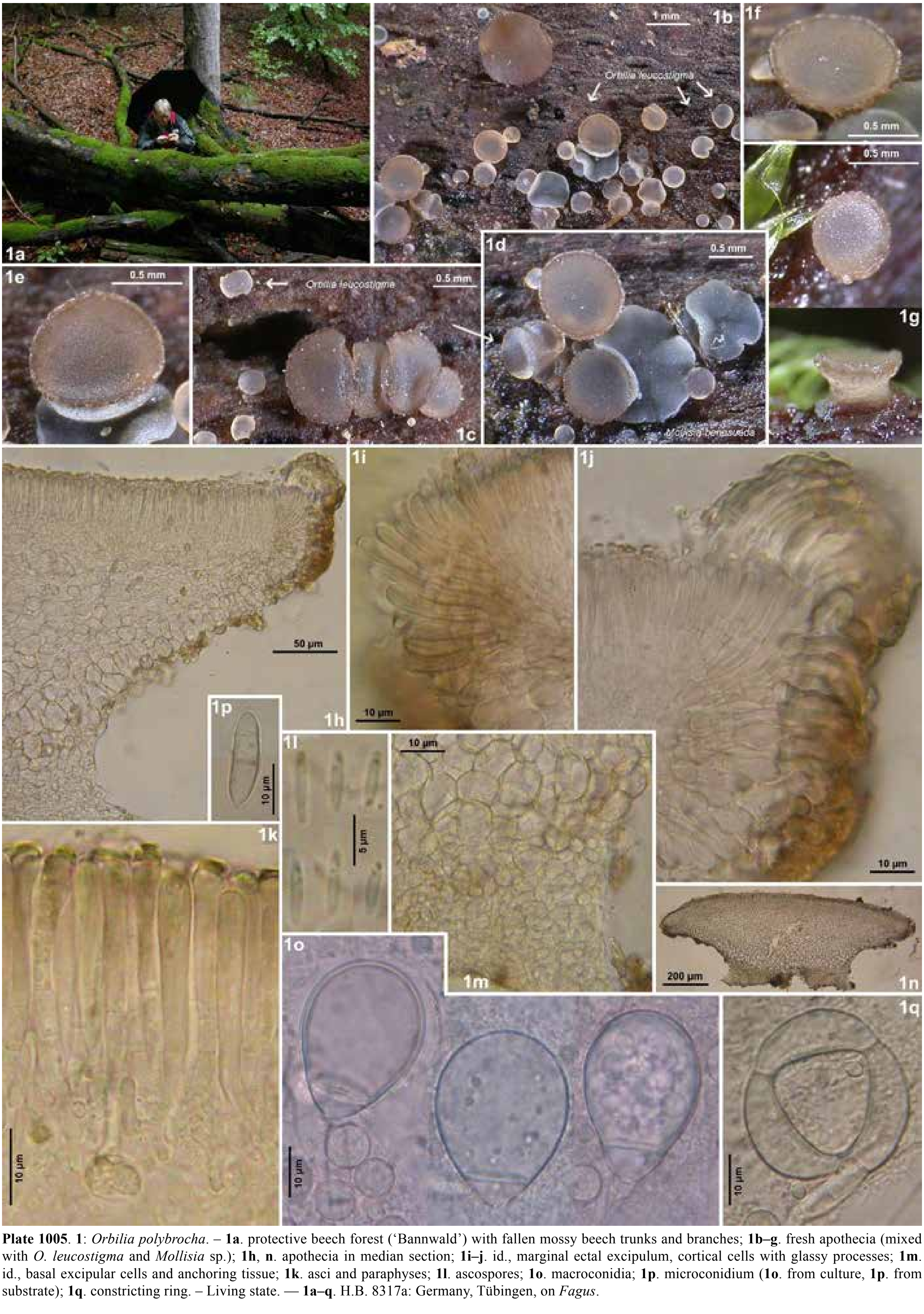


Plate 1005. **1**: *Orbilia polybrocha*. – **1a**. protective beech forest ('Bannwald') with fallen mossy beech trunks and branches; **1b–g**. fresh apothecia (mixed with *O. leucostigma* and *Mollisia* sp.); **1h**, **n**. apothecia in median section; **1i–j**. id., marginal ectal excipulum, cortical cells with glassy processes; **1m**. id., basal excipular cells and anchoring tissue; **1k**. asci and paraphyses; **1l**. ascospores; **1o**. macroconidia; **1p**. microconidium (**1o**. from culture, **1p**. from substrate); **1q**. constricting ring. – Living state. — **1a–q**. H.B. 8317a: Germany, Tübingen, on *Fagus*.

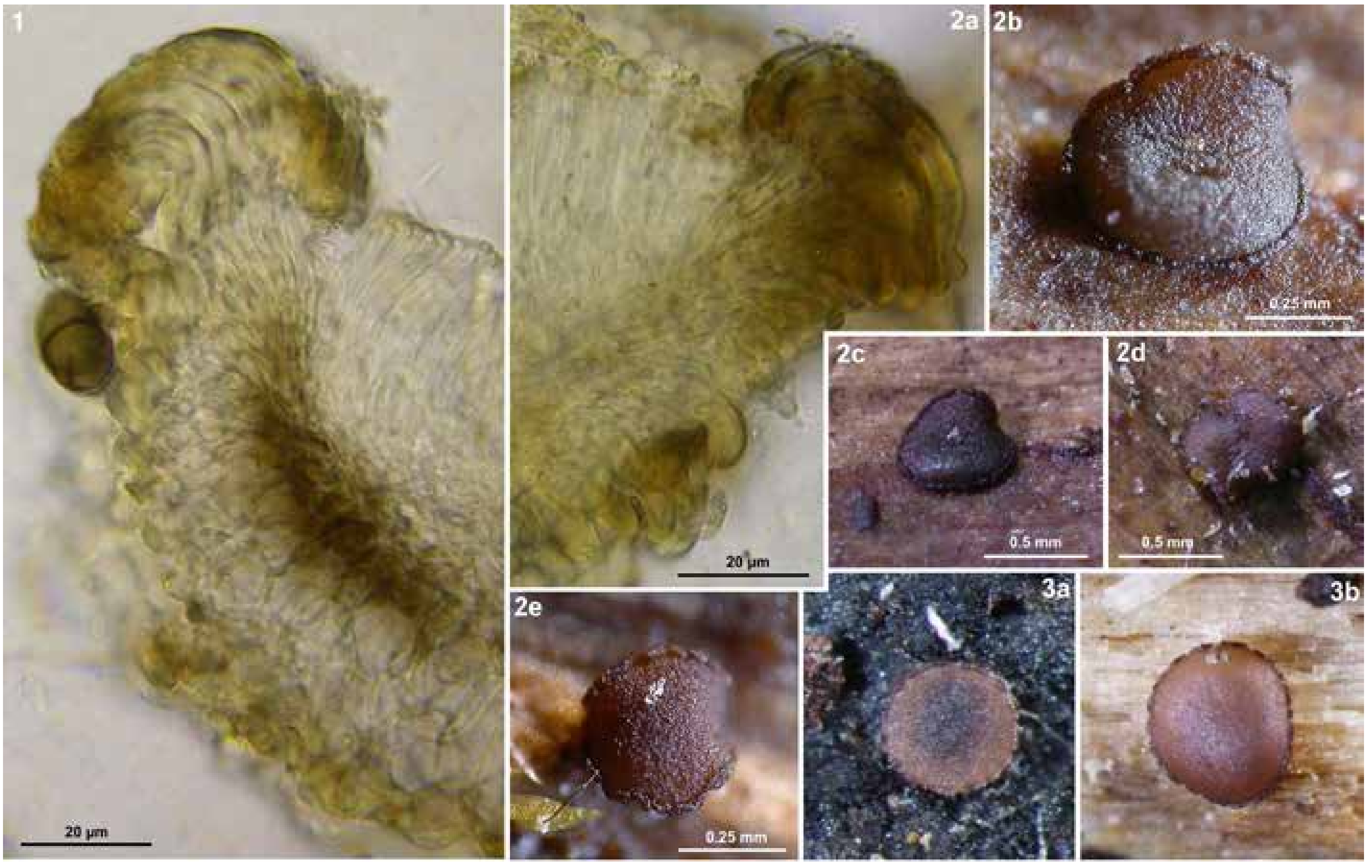


Plate 1006. **1–3**: *Orbilia polybrocha*. – **1**, **2a**. marginal receptacle in median section, cortical cells with curved glassy processes; **3a–b**. fresh apothecia; **2b–e**. rehydrated apothecia. – Dead state (in KOH). — **1**. H.B. 5296a (epitype): USA, Massachusetts, on *Acer*; **2a–e**. PRM 899283: Ukraine, Zakarpattia, on *Corylus*; **3a–b**. G.F. 20150048: Austria, Steiermark, on *Corylus*.

Ecology. *O. polybrocha* was found on ± rotten wood of hygric branches and logs of various angiosperm trees, in subcontinental to continental cold- to orotemperate humid central and eastern Europe, but also in cold- to warm-temperate or warm-continental humid northeastern and eastern North America. Our collections were on a log of *Fagus* in a shady protective forest (*Fagetum*), and on a log of *Fraxinus* lying on the bank of a rivulet in a shady and moist ravine (*Aceri-Fraxinetum*). The type strain was isolated from *Spinacia* in a warm-temperate coastal region of Virginia. The two deviating collections were made on a *Fagus* log in a somewhat thermophilous mixed *Querco-Fagetum* with *Pinus* in cold-temperate humid Luxembourg, and on bark and wood in a subtropical humid rainforest in the Shiwan Dashan mountain range in the southernmost part of mainland China.

Specimens included. **CZECHIA**: **South Bohemia**, ~8 km N of Písek, ~1 km E of Vráž, Otava valley, Žlíbky, ?400 m, trunk of *Tilia cordata*, on wood, 3.IX.1972, M. Svrček (PRM 804304, **holotype** of *Patinella tenebricosa*, H.B. 7099 ø). — **GERMANY**: **Baden-Württemberg**, 8 km NE of Tübingen, 4 km N of Pfrondorf, Eisenbachhain, 485 m, branch of *Fagus sylvatica*, on wood, 3.X.2006, H.O. Baral (H.B. 8317a, anam. cult.; sq.: KT222361). – E of Pfrondorf, Tiefenbach, 385 m, branch of *Fraxinus excelsior*, on wood, 15.X.2000, H.O. Baral & E. Weber (H.B. 6788b). — **AUSTRIA**: **Steiermark**, 6 km WNW of Feldbach, ENE of Rohr a. d. Raab, 335 m, log of *Corylus avellana*, on wood, 20.VIII.2015, A. Gallé, vid. G. Friebes (G.F. 20150048, doc. vid.). — **UKRAINE**: **Zakarpattia**, Ukrainian Carpathians, unlocalized, ?1200 m, log of *Corylus* [*avellana*], on wood, VIII.1929, A. Pilát (PRM 899283, H.B. 6183b ø, mixture with *O. ?leucostigma*). — **USA**: **Massachusetts**, Middlesex, 2.8 km NNE of Concord, Punkatasset Hill, Hutchins Pond, 40 m, trunk of *Acer*, on wood, 20.VI.1995, D.H. Pfister (ex H.B. 5296a, M-0276567, **epitype**; D.H.P. 133 [0.117], FH 00458180, 00458181, **isoepitypes** of *Trichothecium polybrochum*, anam. cult., sq.: U72606). – **Virginia**, Norfolk (Portsmouth), ~5 m, decaying rootlets of *Spinacia oleracea*, undated, C. Drechsler (**holotype** of *Trichothecium polybrochum* [illustration], conid. isol., doc. vid.). – **West Virginia**, Morgantown, West Virginia University, 280 m, wood isolate, undated, H.L. Barnett, vid. A. Rubner (CBS 319.56, CCRC 32872, conid. isol., doc. vid., sq.: U51973).

Not included. **LUXEMBOURG**: **Gutland**, **Luxembourg**, 10.5 km NE of Luxembourg, 1.2 km W of Ernster, Wuurzelwis, 350 m, log of *Fagus sylvatica*, on wood, 22.X.2000, G. Marson (H.B. 6800a ø, anam. substr.). — **CHINA**: **Guangxi**, **Fangchenggang**, Shangsi, Shiwan Dashan, 800 m, on angiosperm wood, 20.VI.2003, B. Liu (HMAS 138520, doc. vid.). – **Yunnan**, **Kunming**, Xishan, ~2000 m, branch of indet angiosperm, 16.V.2007, J.W. Guo & S.F. Li (J.W.G. xs-6).

Orbilia aff. *polybrocha* — Pls 1007–1008

Description: — **TELEOMORPH**: **Apothecia** fresh 0.15–0.6 mm diam., 0.1 mm high (receptacle 0.07 mm), translucent white, round, subgregarious; disc flat, margin distinct, thin, not protruding, smooth; broadly sessile, superficial. **Asci** †25–32 × 3.3–3.7 µm, 8-spored, spores †2–3-seriate, ~3–5 lower spores inverted (± mixed); **apex** (†) medium (to strongly) truncate (not indented, laterally not or very slightly inflated); **base** with short stalk, h- to H-shaped. **Ascospores** *4.2–5.7(–6) × 1–1.3(–1.4) µm, †4.4–6(–7.3) × 0.8–1(–1.2) µm, cylindrical, sometimes fusoid(-clavate), apex rounded to obtuse, rarely subacute, base not or only slightly, rarely medium attenuated, straight to slightly inequilateral; **SBs** 1–1.7 × (0.2–)0.3–0.4(–0.5) µm, rod-shaped, sometimes ellipsoid or tear-shaped, with a very short, mostly invisible filum, ± centrally or often very eccentrically oriented. **Paraphyses** apically uninflated or slightly (to medium) (clavate-)capitate, terminal cell †14–20 × 1.6–3.2 µm, lower cells †4.5–6 × 1.4–2.2(–3) µm; unbranched or branched at upper septum. **Medullary excipulum** 20–35 µm thick, of dense textura intricata-angularis, medium sharply delimited. **Ectal excipulum** of (†) ± thin-walled t. globulosa-angularis from base to margin, 30–40 µm thick near base, cells †~6–10 × 5–7 µm; 15 µm thick at margin, of t. globulosa-prismatica oriented at an 80° angle to the surface, marginal cortical cells †6–8 × 3–4(–5) µm; **glassy processes** absent. **Anchoring hyphae** abundant, †1.5–4.5 µm wide, walls 0.2–0.25 µm thick. **SCBs**

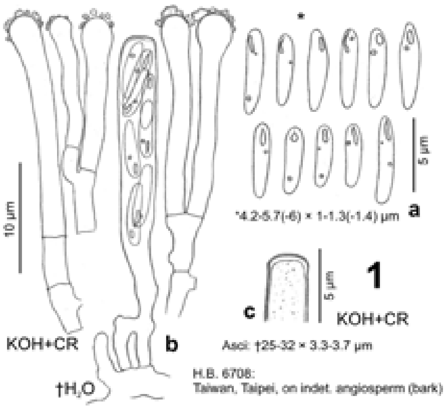


Plate 1007. **1**: *Orbilia* aff. *polybrocha*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apex.

and **VBs** no data available. **Exudate** over paraphyses 0.3–1 µm thick, granular-cloddy, firmly attached, over margin and flanks sparse, 0.2–0.3 µm thick, rough. **— ANAMORPH**: unknown.

Habitat: on ~4 cm thick branch of indet. angiosperm lying on the ground, on very decayed bark (periderm and bast), on blackened areas, no algae. **Associated**: none observed. **Desiccation tolerance**: intolerant, but many spores still alive after 5 weeks. **Altitude**: 1000 m a.s.l. **Phenology**: V.

Taxonomic remarks. This specimen from Taiwan resembles *Orbilia polybrocha* in ascospore size and shape and in the SBs being predominantly narrowly rod-shaped, strongly eccentrical, and always very narrowly attached. However, it has a textura globulosa-angularis up to the margin, with short marginal cortical cells, whereas in *O. polybrocha* the marginal cells consistently showed a length of *12–18 µm. *O. naumburgensis* has slightly wider, more fusoid ascospores, and apothecia with a crenulate margin. Since neither an anamorph nor molecular data are known, a relationship to other series of section *Arthrobotrys*, especially to *Gamsylella* (*O. alba*, *O. anigozanthi*), is possible.

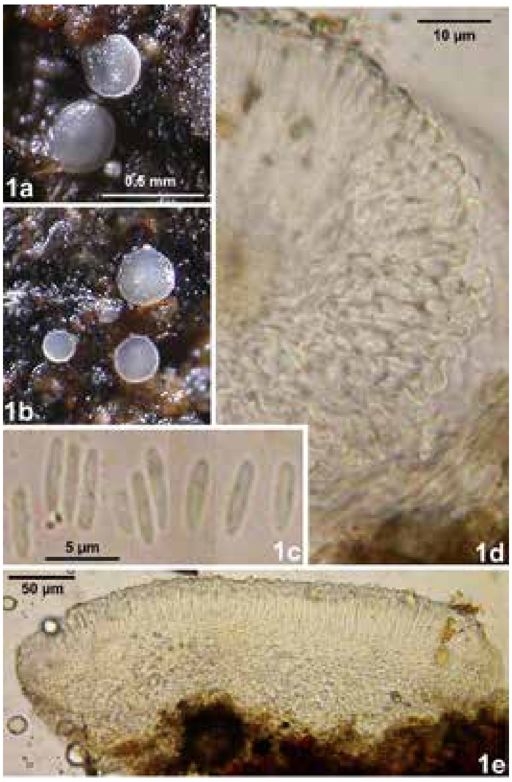


Plate 1008. **1**: *Orbilia* aff. *polybrocha*. – **1a–b**. rehydrated apothecia; **1e**. apothecium in median section; **1d**. id., marginal ectal excipulum; **1c**. ascospores. – Dead state (in KOH). — **1a–e**. H.B. 6708: Taiwan, Taipei, on indet. angiosperm bark.

Ecology. *O.* aff. *polybrocha* was found on rotten hygric bark of an unidentified angiosperm in a montane subtropical humid (winter-dry) evergreen broad-leaved forest at the northern end of Taiwan in southeastern Asia.

Specimens included. **CHINA**: **Taiwan**, **Taipei**, 14.5 km N of Taipei, Yangmingshan, Tatun Shan, ~1000 m, branch of indet. angiosperm, on bark, 17.V.2000, R. Kirschner (H.B. 6708).

Orbilia pseudopolybrocha Z.F. Yu & M. Qiao, in Zhang et al., Int. J. Syst. Evol. Microbiol. 70: 2666 (2020) — Pl. 1009

Etymology: referring to the morphological similarity with *O. polybrocha*.
Typification: China, Yunnan, Yuxi, Xinping, Mopanshan, indet. angiosperm bark, 8.IX.2008, S.F. Li (YMFT 1.02660 holotype, CGMCC 3.18832).

Description: — **TELEOMORPH**: **Apothecia** fresh 0.3–0.6 mm diam., up to 0.26 mm high (receptacle 0.11 mm thick), whitish to pale cream-chlorinaceous, slightly translucent, round, scattered to gregarious; disc flat, margin thin, not protruding, smooth to finely crenulate by minute blunt teeth; with a hidden stipe 0.12 mm tall, superficial, dry light yellow-chlorinaceous or pale pink. **Asci** *23–33 × 3.2–3.8 µm {2}, 8-spored, spores *2–3-seriate, lower spores inverted, pars sporifera *11–15.5 µm long; **apex** (†) slightly truncate (not indented, laterally not inflated); **base** without or with short stalk, h-shaped. **Ascospores** *2.8–4 or 4.5–5.5 × 1.2–1.5 µm {2}, cylindrical to slightly fusoid-clavate, both ends obtuse, slightly tapered towards base, straight; **SBs** *~0.8–1.2 × 0.3–0.4 µm, rod-shaped, eccentrical. **Paraphyses** apically slightly to medium capitate, terminal cell *13.5–17 × 2.2–3.7 µm {2}, lower cells *3–5.5 × 1.8–2.5 µm {2}; unbranched at upper septum. **Medullary excipulum** ~15 µm thick, indistinctly delimited from ectal excipulum. **Ectal excipulum** hyaline, of thin-walled, indistinctly oriented textura globulosa at base and flanks, 180 µm thick at base, 60 µm at lower flanks, cells †10–16(–26)((–32)) × 8–13(–20)((–28)) µm {2}; margin of t. globulosa (orientation not noted); **glassy processes** possibly sometimes present (not examined). **Anchoring hyphae** not examined. **SCBs** absent; **VBs** in paraphyses hyaline, elongate-cylindrical, low to medium refractive. **Exudate** over paraphyses scattered, granular, 0.2–0.5 µm thick. **— ANAMORPH**: drechslerella-like (from ascospore isolate {3}, data from Zhang et al. 2020a and H.Y. Su pers. comm.). **Mycelium** on CMA scanty, hyaline, hyphae 2.5–4 µm wide. **Macroconidiophores** erect, unbranched, 3–5-septate, 80–250 µm high, 4–7 µm wide at base, 2.5–3.5 µm at apex, here abruptly swollen to 3.5–4.5 µm {2}, with 1 terminal conidium. **Macroconidia** *26–33(–39) × (15.5–)17–21(–24) µm {2}, broadly ellipsoid to subglobose or fusoid, with short and broad basal protrusion, 2-septate, with 1 septum at each end and a very large middle cell, less often (0–)1-septate, often with 2–4.5 µm thick lateral mucus. **Microconidiophores** short, simple or branched, with 3–4 apical denticles. **Microconidia** *(15–)16.5–24 × (3.3–)4–6 µm {2}, 1-septate, with distinct basal protrusion. **Chlamydospores** present. **Constricting rings** abundantly obtained in the presence of nematodes, with 1-septate stalk of *12–20 × 5–5.5 µm; ring *23–24 {T} or 29–33 µm {1} outer diam., *15 {T} or 19–22 µm {1} inner diam., with triangular wall thickenings at the septa.
Habitat: lying on moist ground, on thick, corticated branch of unidentified angiosperms {3}, on medium rotten bark (periderm) {3}, no algae seen. **Associated**: black setae of hyphomycete. **Desiccation tolerance**: unknown, possibly intolerant. **Altitude**: 1800–2730 m a.s.l. **Geology**: Proterozoic metamorphic & Jurassic sedimentary rock. **Phenology**: VIII–IX.

Taxonomic remarks. *Orbilia pseudopolybrocha* was investigated by H.Y. Su (pers. comm.) and two years later by Z.F. Yu (pers. comm.), based on totally three collections of the teleomorph from which the anamorph was obtained in pure culture. In the teleomorph the species differs from

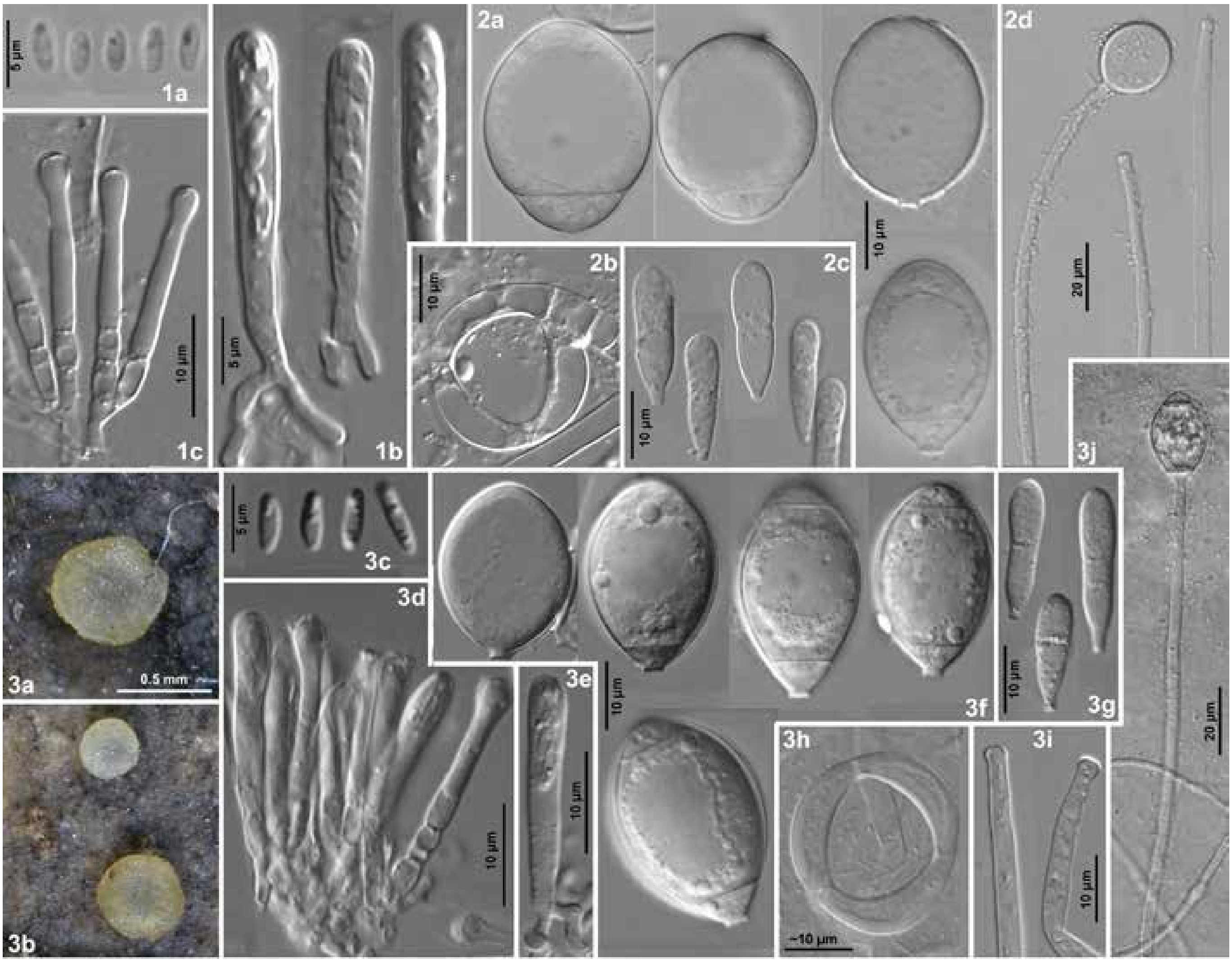


Plate 1009. **1–3**: *Orbilia pseudopolybrocha*. – **3a–b**. rehydrated apothecia; **1b–c**, **3d–e**. asci and paraphyses; **1a–b**, **3c**. ascospores; **2d**, **3i–j**. conidiophores with macroconidia; **2c**, **3g**. microconidia; **2a**, **3f**. macroconidia; **2b**, **3h**. unexpanded constricting rings (**2a–d**, **3f–j**. from culture). – Living state, except for **3i**. – **1a–c**, **2a–d**: from Zhang et al. (2020), **3a–j**: phot. H.Y. Su. — **1a–c**. Z.F.Y. jgs-63: China, Yunnan, Dali; **2a–d**. YMF 1.02660 (holotype): Yunnan, Yuxi, on indet. angiosperm; **3a–j**. H.B. 8929: Yunnan, Baoshan, on indet. angiosperm bark.

O. polybrocha in apothecial colour and shorter, more blunt marginal teeth, also in shorter asci and slightly shorter ascospores. Based on the teleomorph alone the species can hardly be segregated from *O. orientalis* s.l.

Variation. The sample from Gaoligongshan has longer ascospores (*4.5–5.5 × 1.3 µm) than that from Jinguangsi (spores *2.8–4 × 1.2–1.4 µm), also it has partly longer conidia which are more frequently 2-septate than in the other two strains. Regrettably, features of the teleomorph have not been documented in the holotype, and the apothecial margin was not studied in detail in the other two samples. The margin in the Gaoligongshan sample is finely crenulate whereas that from Jinguangsi was said to have an even margin.

Anamorph. *O. pseudopolybrocha* differs from *O. polybrocha* in macroconidia with mostly 2 septa, one close to each end, also in apically swollen conidiophores. These characteristics are reminiscent of *Drechslerella doedycoides* as described by Drechsler (1940). *O. pseudopolybrocha* differs in macroconidia with smaller terminal cells, microconidia with distinct apiculi, and in lacking inner bulge-like projections of the unexpanded constricting rings. In the sample from Jinguangsi the conidia were similar to those from Yuxi (Z.F. Yu pers. comm.), but photographs were not available to us.

Phylogeny. A sequence was obtained by Z.F. Yu (pers. comm.) from the ascospore isolate from the ex-type culture from Yuxi, comprising S1506 intron and ITS. *O. pseudopolybrocha* clustered unresolved in the *brochopaga-polybrocha* clade when analysing either ITS (Phyl. 36) or the intron (S30). The distance in the ITS region is 4.5 % to *O. naumburgensis*, 7–8 % to *O. polybrocha* (11 % in the intron), and 17 % to the epitype of *D. doedycoides*.

Ecology. *O. pseudopolybrocha* is known from three collections on bark of hygric branches of unidentified angiosperms in subtropical humid (winter-dry) evergreen broad-leaved mountain forests at the southeastern extension of Himalaya in southern China.

Specimens included. **CHINA**: **Yunnan**, **Baoshan**, Tengchong, 52 km SW of Baoshan, 31 km SE of Tengchong, Gaoligongshan, 1845 m, branch of indet. angiosperm, on bark, 4.VIII.2008, X.J. Su, H.Y. Su & X.N. Zhao (H.Y.S. glgs-3, CBCD, anam. cult., H.B. 8929 ø). – **Yuxi**, Xinping, 75 km SW of Yuxi, ~18 km S of Xinping, Mopanshan, ~1850 m, branch of indet. angiosperm, on bark, 8.IX.2008, S.F. Li (Z.F.Y. mop-89, YMF/T 1.02660, **holotype**, CGMCC 3.18832, anam. cult., doc. vid., sq.: HQ711926, MF948420). – **Dali**, Yongping, ~35 km ENE of Baoshan, Jinguangsi, ~2550 m, on bark of indet. angiosperm, 18.VII.2010, Z.F. Yu (Z.F.Y. jgs-63, YMFT 1.03549, anam. cult., doc. vid.).

Orbilia flavovacuolata Baral & E. Weber, **sp. nov.**, MB 814002 — Pls 1010–1011

Etymology: named after the pale yellow vacuoles in the exposed peripheral parts of the apothecia.

Typification: Germany, Tübingen, branch of *Fagus sylvatica*, 22.X.2005, E. Weber (ex H.B. 7943a, M-0276481, holotype).

Latin diagnosis*: Similis* Orbiliae tenebricosae *sed apothecia minora, dilute sulphureo-lutea, margine laevi, ascosporae paulo longiores, apice partim subacutae, paraphyses vivae vacuolas dilute luteo-chlorinas continentes, absque exsudato, excipulum cellulis marginalibus latioribus, absque processis vitreis. Habitat ad lignum putridum trunci uvidi* Fagi sylvaticae *in zona temperata humida subcontinentali Europae centralis.*

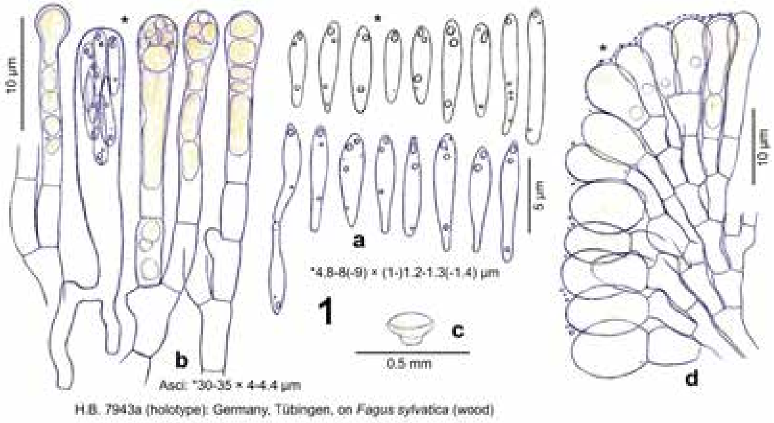


Plate 1010. **1**: *Orbilia flavovacuolata*. – **a**. ascospores; **b**. asci and paraphyses; **c**. fresh apothecium; **d**. ectal excipulum (margin, median section).

Description: — **TELEOMORPH**: **Apothecia** fresh 0.2–0.25 mm diam., 0.13 mm high (receptacle 0.09 mm), pale to light sulphur-yellow, medium translucent, round, very scattered; disc flat, margin thin, not protruding, smooth; with a distinct stipe 0.04 × 0.09–0.1 mm, superficial. **Asci** *30–35 × 4–4.4 µm, †25–30 × 3.4–3.7 µm, 8-spored, spores *3–4-seriate, ~4 lower spores inverted (not always all 8 spores developed), pars sporifera *10.5–12 µm long; **apex** (†) strongly truncate (not indented, laterally not inflated); **base** with short stalk, h- to H-shaped. **Ascospores** *4.8–8(–9) × (1–)1.2–1.3(–1.4)((–1.6)) µm, narrowly cylindric-ellipsoid to fusoid-clavate, exceptionally cylindrical, apex obtuse to subacute, base not or often medium to strongly attenuated, sometimes with a tail-like end, straight, rarely slightly curved below; **SBs** *0.4–0.8 × 0.3–0.5 µm, often eccentrical, close to spore apex, subglobose to tear- or short rod-shaped, attachment invisible. **Paraphyses** apically slightly (to medium) clavate-capitate, terminal cell *15–18 × 2.8–3.5(–4) µm, lower cells *5.5–7.5 × 1.8–2.5(–2.8) µm; unbranched at upper septum. **Medullary excipulum** hyaline, 30 µm thick, of ± dense textura angularis-prismatica-intricata, quite sharply delimited from ectal excipulum. **Ectal excipulum** hyaline, of thin-walled, vertically oriented t. globulosa(-prismatica) from base to margin, 60 µm thick near base, cells *10–17(–30) × (5–)9–13(–15) µm; 15 µm thick near margin, oriented at a (50–)70–90° angle to the surface, marginal cortical cells *(6–)8–13 × 4–8 µm; **glassy processes** absent. **Anchoring hyphae** fairly abundant, *3–4 µm wide, walls 0.2–0.4 µm thick. **SCBs** in paraphyses and ectal excipulum (at margin) globose, 1–1.5 µm diam., hyaline; **VBs** in paraphyses and marginal cortical cells light yellowish-chlorinaceous, globose to elongate-cylindrical, medium refractive. **Exudate** over paraphyses absent; over margin and flanks absent or as 0.2–1 µm thick sparse granules. — **Macroconidia** unknown. **Microconidia** cylindric-clavate, *26 × 5.5 µm, 1-septate. **Trapping organs** unknown. **— ANAMORPH**: unkonwn (but see below).

Habitat: lying on moist ground, decorticated, ~10 cm thick log of *Fagus sylvatica*, on entirely strongly decayed wood, blackened, green algae sparse. **Associated**: *Ascocoryne inflata*, *Brachysporium* sp., *Hyalorbilia polypori*, *Mollisia ?oblonga*, *Orbilia dryadum*, *O. ?xanthostigma*, *Psilocistella quercina.* **Desiccation tolerance**:

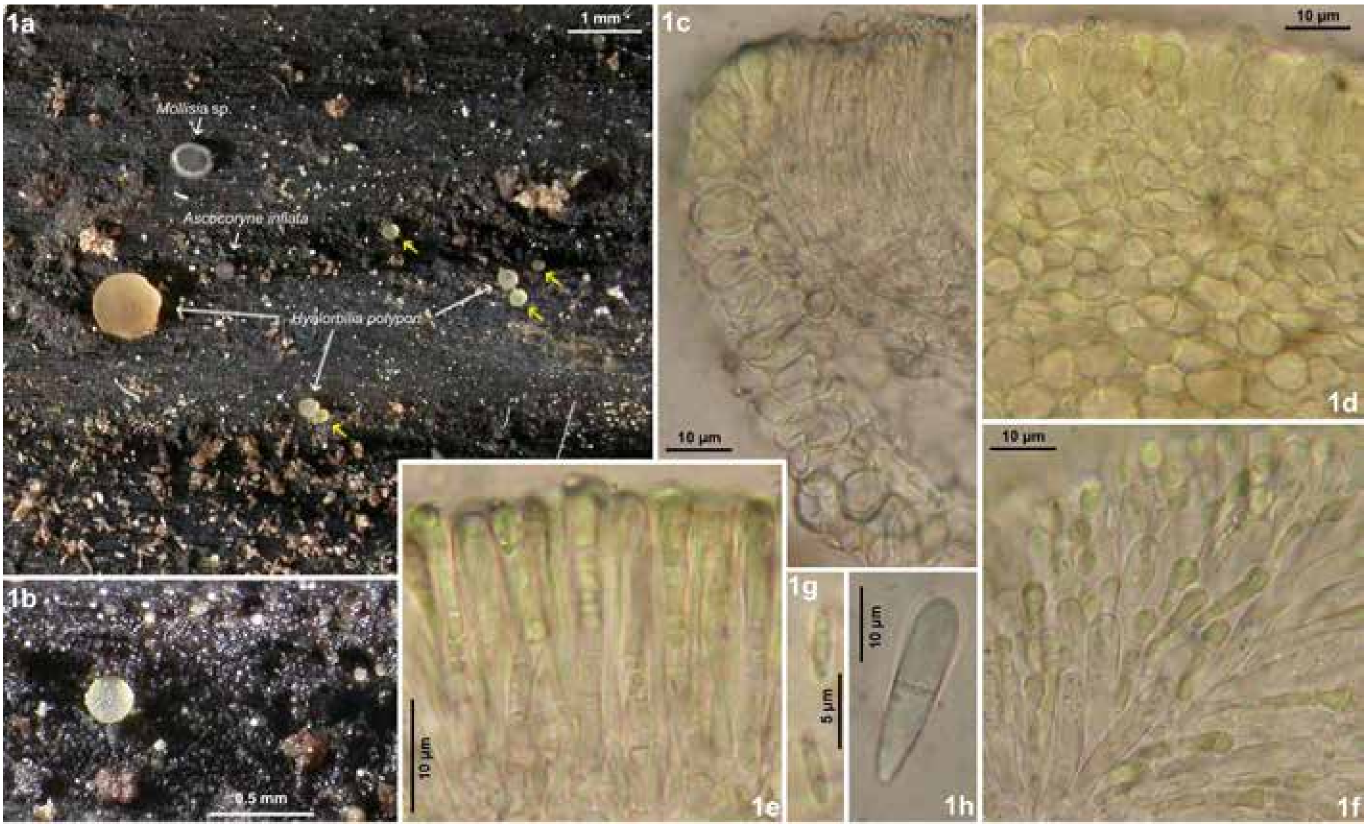


Plate 1011. **1**: *Orbilia flavovacuolata*. – **1a–b**. fresh apothecia (pale yellow in contrast to associated whitish to ochraceous *Hyalorbilia polypori*); **1c**. median section of ectal excipulum at flanks and margin; **1d**. id., external view; **1e–f**. asci and paraphyses (containing pale yellow VBs); **1g**. ascospores; **1h**. microconidium from substrate. – Living state, except for some cells in **1c**. — **1a–h**. H.B. 7943a (holotype): Germany, Tübingen, on *Fagus*.

many mature asci still viable after 12 h dry on slide. **Altitude**: 410 m a.s.l. **Geology**: Keuper (Rhätsandstein over Knollenmergel). **Phenology**: X.

Taxonomic remarks. *Orbilia flavovacuolata* resembles *O. polybrocha* in its hymenial characters, especially in the ascospores and their SBs and LBs. It differs in smaller apothecia with a smooth margin and a light yellow colour due to yellowish-chlorinaceous vacuoles (VBs) in paraphyses and marginal cortical cells, also in lacking exudate over the paraphyses, furthermore in the inflated marginal cortical cells lacking glassy processes, and in slightly longer spores. *O. flavovacuolata* resembles *O. mammillata* (series *Dactylellina*) in the rather short and wide asci, but differs from that species in shorter, straight spores with often eccentrical SBs, also in the marginal excipulum. From *O. atlantis* (series *Neodactylella*) it differs in a tendency to distinctly larger spores with a tail-like base and smaller, much more eccentrical SBs.

Anamorph. Only two microconidia could be found on the substrate. A possibility would be that the anamorph of *O. flavovacuolata* is *D. bembicodes*, a species which we have collected on the same substrate under similar conditions about 1 km away from the type locality. Judging from the SBs in the ascospores, *O. flavovacuolata* might be connected either to a drechslerella- or a gamsylella-like anamorph. Because microconidia rarely occur in series *Dactylellina* (*D. leptospora*, *O. biforma*) and *Gamsylella* (*G. gephyropaga*) but frequently in series *Drechslerella*, *O. flavovacuolata* is tentatively placed here in series *Drechslerella*. Another possibility would be that *O. flavovacuolata* lacks conidial dimorphism comparable to *O. alba* and '*Dactylellina*' *entomopaga*, the conidia of which resemble microconidia.

Ecology. *O. flavovacuolata* was found on rotten wood of a decorticated hygric log of *Fagus* lying on wet soil very close to a small pond in a rather shady *Fagetum* on upper Keuper (Rhätsandstein) in the southern part of Schönbuch in subcontinental cold-temperate humid southern Germany (central Europe).

Specimens included. **GERMANY**: **Baden-Württemberg**, 6 km ENE of Tübingen, 1 km ESE of Pfrondorf, Hinterpfand, 410 m, branch of *Fagus sylvatica*, on wood, 22.X.2005, E. Weber (ex H.B. 7943a, M-0276481, **holotype**).

Orbilia naumburgensis Baral & E. Weber, **sp. nov.**, MB 814003 — Pl. 1012–1013

Etymology: from the geographical origin, Naumburg in Sachsen-Anhalt (Germany).

Typification: Germany, Naumburg, log of *Tilia cordata*, 30.VI.2007, W. Huth (ex H.B. 8568, M-0276536, holotype; sq.: KT222362).

Latin diagnosis: *Similis* Orbiliae orientali *sed ascosporae longiores, subtus partim valde attenuatae, conidia magis curvatae. Habitat ad lignum rami et trunci uvidi* Tiliae *in zona temperata humida subcontinentali Europae centralis.*

Description: — **TELEOMORPH**: **Apothecia** moist/rehydrated (0.6–)1–2 mm diam., 0.25–0.5 mm high (receptacle 0.16–0.2 → 0.08–0.1 mm), whitish-cream-greyish, slightly translucent, round or slightly undulating when large, subgregarious; disc slightly to strongly concave, finally flat with a central depression, margin finely rough to crenulate {1} or with distinct minute teeth {T}, teeth 20–35 µm protruding and ~50–120 µm wide; exterior rough, whitish; with a cylindrical stipe 0.13–0.3 × 0.35–0.8 mm, superficial or ± immersed in small clefts. **Asci** *(29–)32–37(–40) × 3.4–4.2 µm {2}, †31–39 × 3–3.5 µm {1}, 8-spored, spores *~3-seriate, lower spores inverted (± strongly mixed), pars sporifera *13–15 → 9 µm long; **apex** (†) medium truncate (not indented, laterally not widened); **base** with short, thick stalk, h- (to H-)shaped. **Ascospores** *3.5–5(–5.7) × (1.3–)1.4–1.5(–1.7) µm {2}, narrowly cylindric-ellipsoid or mainly fusoid to fusoid(-clavate), apex obtuse (to subacute), base slightly to strongly attenuated, rarely tail-like, straight to distinctly inequilateral, also slightly to medium curved; **SBs** visible part *0.8–1.8 × 0.1–0.3 µm {2}, consistently eccentrical, filiform, filum hardly visible [total length (1–)1.2–1.8 µm]. **Paraphyses** apically slightly to medium capitate, terminal cell *18–28 × (2–)2.5–3.8 µm {3}, lower cells *4–7(–8) × 2–2.5 µm {2}; unbranched at upper septum. **Medullary excipulum** hyaline, at flanks of dense textura intricata-porrecta, sharply delimited. **Ectal excipulum** hyaline, near base of (†) slightly gelatinized t. globulosa-angularis, cells *13–30(–42) × 8–28(–40) µm {1}, †14–28 × 10–12 µm {T}; 25 µm thick at margin, of t. porrecta oriented at a 30–80° angle, marginal cortical cells hyphoid, †~2–2.5 µm wide {T}; **glassy processes** 20–30 {T} or 50–80{1} × 2.8–4 µm {2}, only outer layer refractive, internally not stratified, strongly downwards curved, ± granular by exudate, coherent to form or a crenulate or toothed margin. **Anchoring hyphae** sparse, †2.5–5 µm wide, wall 0.2–0.4 µm thick {1}. **SCBs** absent, **VBs** absent, vacuoles in paraphyses non-refractive {2}. **Exudate** hyaline to pale yellowish, over paraphyses 0.2–0.7 µm thick, granular(-cloddy), firmly attached, hyaline; over marginal processes abundant, granular. — **ANAMORPH**: drechslerella-like (from apothecium at lid of Petri dish {1}). **Conidiophores** not observed. **Macroconidia** cylindrical, rounded above, shortly tapered-truncate below, medium to strongly curved (entirely or especially towards upper end), *33–38 × 7–8 µm, 3-septate {T}, terminal cells not or distinctly longer (up to 2×) than middle cells, with small LBs at the septa but also forming roundish aggregations, lipid content low to medium. **Microconidia** not observed. **Constricting rings** not observed.

Habitat: lying on moist ground, partially to entirely decorticated, 5–10 cm thick branches and logs of *Tilia* sp. {1}, *T. cordata* {4}, on underside on 0.1–1 mm deep slightly to strongly decayed wood {5}, sometimes on insect excrements or old *Lasiosphaeria hirsuta*, ungreyed but sometimes blackened, without algae. **Associated** (on same or different *Tilia* branches and logs, W. Huth, T. Richter & M. Reul pers. comm.): *Basidiopycnides* sp. {1}, *Ceratostomella cirrhosa* {2}, *Chaetosphaerella fusca* {1}, *Hyalorbilia inflatula* {4}, *Lasiosphaeria ovina* {1}, *Mollisia cinerea* {2}, *Orbilia crenatomarginata* {1}, *O. leucostigma* {2}, *O. tremulae* {1}, *O. xanthostigma* {1}, *Protounguicularia transiens* {1}, *Rhizodiscina lignyota* {1}, *Tulasnella cystidiophora* {1}, brown hyphomycetes. **Desiccation tolerance**: only ascospores and some inflated cells of medullary excipulum alive after 8 days. **Altitude**: 85–215 m a.s.l. **Geology**: Muschelkalk, Pleistocene sand & loess over Upper Buntsandstein. **Phenology**: VI–XI.

Taxonomic remarks. *Orbilia naumburgensis* is morphologically very close to *O. orientalis*, *O. yunnanensis*, and *O. tonghaiensis*, especially in the conidia. It differs in longer ascospores that are sometimes apically subacute and basally strongly attenuated. *O. polybrocha* resembles *O. naumburgensis* in spore size and shape, but has very different conidia and usually light reddish-brown apothecia.

Variation. One of the paratypes differs in more cupulate apothecia with only finely crenulate margin, although much longer glassy processes were observed (Pl. 1013:

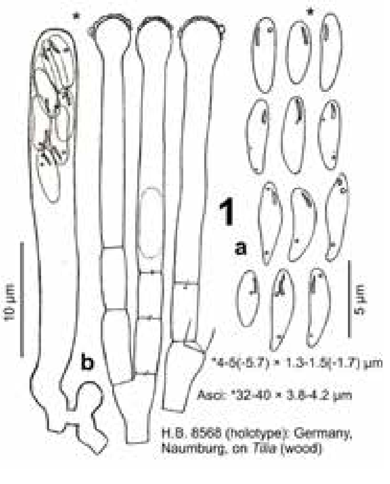


Plate 1012. **1**: *Orbilia naumburgensis*. – **a**. ascospores; **b**. ascus and paraphyses.

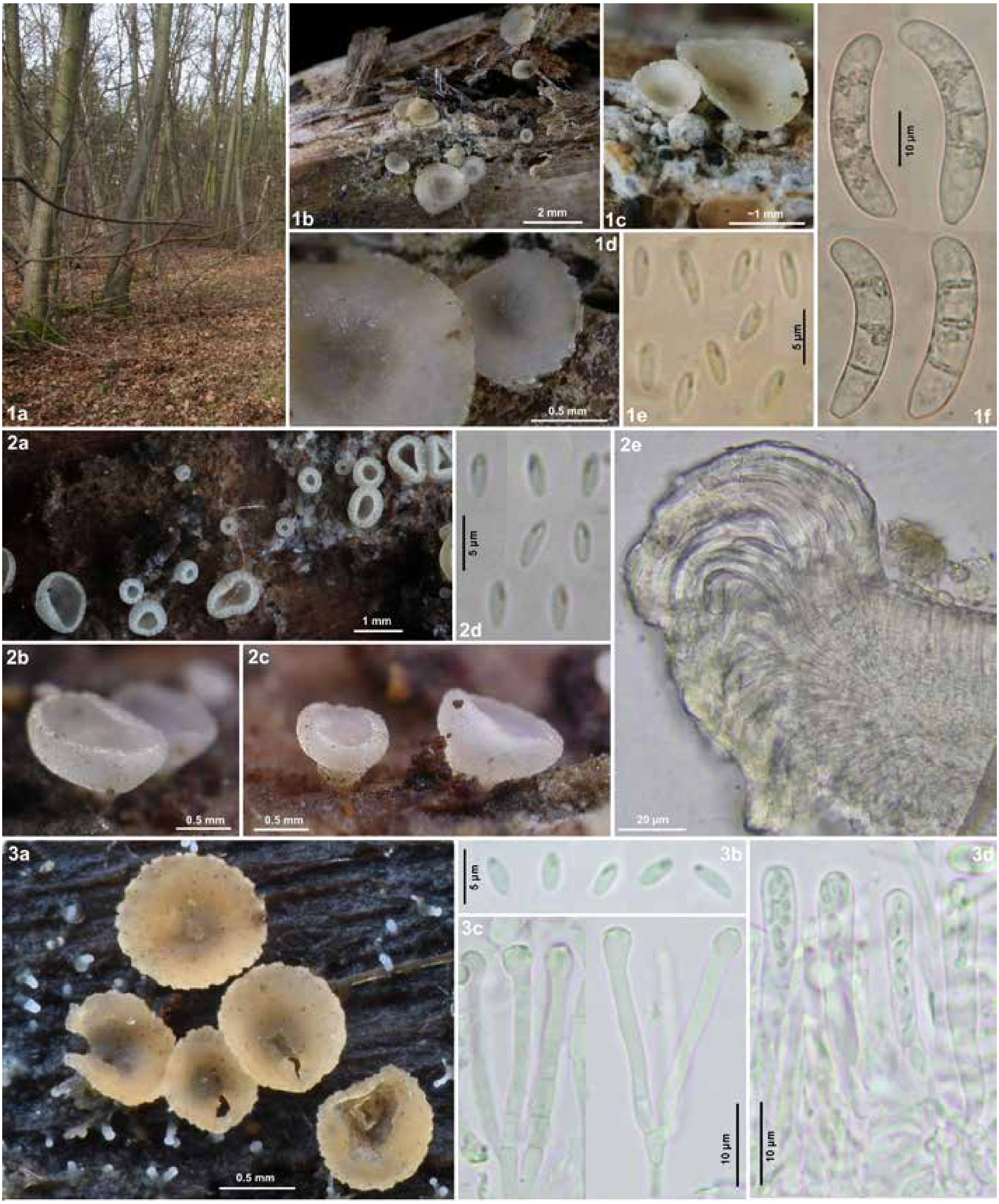


Plate 1013. **1–3**: *Orbilia naumburgensis*. – **1a**. thermophilous *Tilia cordata* forest in wine-growing region; **1b–d**, **2a–c**, **3a**. fresh apothecia (**3a** with *Basidiopycnides* sp.); **2e**. marginal part of apothecium in median section; **3c**. paraphyses; **3d**. asci; **1e**, **2d**, **3b**. ascospores; **1f**. conidia (from culture). – Living state, except for 1 ascus in **3d**. – **1a–b**, **2a**: phot. W. Huth, **3a**: phot. T. Richter, **3b–d**: phot. M. Reul. — **1a–f**. H.B. 8568 (holotype): Germany, Naumburg, on *Tilia*; **2a–e**. H.B. 10016: ibid., on *Tilia*; **3a–d**. M.R. 6432: Colbitz, on *Tilia*.

2). The spores were here slightly shorter and never strongly tapered below (Pl. 1013: 2d).

Anamorph. Conidia similar to *O. orientalis* and allied taxa, but more strongly curved, were formed from mycelium growing out of an apothecium in a Petri dish. A pure culture was not obtained.

Phylogeny. Sequences were gained from apothecia of the holotype from Keilholz and a paratype from Alte Göhle, which both comprise S1506 intron and ITS, the latter also LSU D1–D2. In the overlapping parts the two sequences are completely identical.

O. naumburgensis clustered in our LSU (Phyl. S36) or combined analysis (S37) with *O. orientalis* and *O. yunnanensis* in a strongly supported clade, here called *orientalis-naumburgensis* clade. When analysing the ITS region it clustered weakly supported in this clade (Phyl. 36). The distance in the ITS is 4.5% to *O. pseudopolybrocha*, 4.6–4.8% to *O. orientalis*, 7% to *O. yunnanensis*, and 9–9.5% to *O. polybrocha*, in the LSU 0.5–0.8% to *O. yunnanensis* and 1.3–1.6% to *O. orientalis* s.l., but 3.8–4.2% to *O. brochopaga*. When analysing the intron (S30), *O. naumburgensis* clustered medium supported with *O. yunnanensis* (6% distance), and more distant from *O. pseudopolybrocha* (8%), *O. polybrocha* (12%), and *O. brochopaga* (14%).

Ecology. *O. naumburgensis* was found on the underside of fallen, ± decayed branches and logs of *Tilia*. The thermophilous, almost pure *Tilia cordata* forest at the type locality is situated close to a vineyard, on a very slightly inclined southeastern-exposed slope. The site near Almrich is a *Fagus* forest with *Acer pseudoplatanus* and a few *Tilia cordata*, that near Freyburg (5 km from the type locality) a *Querco-Carpinetum* with *Tilia cordata* and *T. platyphyllos*, and that from Colbitz (130 km N of Naumburg) a *Tilia* forest. Naumburg belongs to an area with a relatively warm climate and low annual precipitation (W. Huth pers. comm.) in the otherwise subcontinental cold-temperate humid central Europe. Also Magdeburg receives a low annual precipitation (below 500 mm), but is in the temperature in the nationwide average of Germany.

Specimens included. **GERMANY**: **Sachsen-Anhalt**, 24 km NNW of Magdeburg, 3.5 km WNW of Colbitz, Colbitzer Heide, 85 m, log of *Tilia*, on wood, 1.XI.2018, T. Richter, vid. M. Reul (M.R. 6432, doc. vid.). – 8 km N of Naumburg, 2.3 km ENE of Freyburg, Alte Göhle, 215 m, branch of *Tilia cordata*, on wood, 1.VIII.2016, W. Huth (W.H., H.B. 10016; sq.: MK493143). – ibid., 27.IX. & 2.X.2016 (W.H., doc. vid.). – 3 km NNE of Naumburg, NW of Hotel Henne, Keilholz, 160 m, log of *T. cordata*, on wood, 30.VI.2007, W. Huth (ex H.B. 8568, M-0276536, **holotype**, anam. apoth.; sq.: KT222362). – 2.7 km WSW of Naumburg, S of Almrich, Sperlingsholz, 195 m, branches of *Tilia cordata*, on wood, 12. & 13.VIII.2019, W. Huth (W.H., doc. vid.).

Orbilia yunnanensis (Z.F. Yu & K.Q. Zhang) Bin Liu, E. Weber & Baral, **comb. nov.**, MB 814004 — Pl. 1014

Basionym: *Drechslerella yunnanensis* Z.F. Yu & K.Q. Zhang, in Yu et al., Mycotaxon 110: 254 (2009)

Etymology: named after Yunnan province in China.
Typification: China, Yunnan, Fangtunxiang, branch of indet. angiosperm, VIII.2008, Z.F. Yu (YMF 1.01863, holotype; sq.: FJ185262, MH179759).
Misapplied name: Liu (2006: 88 p.p.), as *O. orientalis*.

Description: — **TELEOMORPH**: **Apothecia** fresh 0.3–2 mm diam., white to yellow, round, translucent, scattered or in groups; disc flat or slightly concave, margin almost smooth or distinctly dentate (teeth 25–40 × 35–70 µm), stipe 0.2–0.8 × 0.8–0.9 mm, dry pale yellow to light brown. **Asci** *31–41 × 3.8 µm {1}, †25–40 × (3–)3.2–3.5(–3.7) µm {3}, 8-spored, spores *~2-seriate, 3–5(–7) lower or upper spores inverted (sometimes strongly mixed), pars sporifera *12 µm long; **apex** (†) truncate, thin-walled; **base** unstalked or with short to medium long stalk, L-, Y-, h- or H-shaped. **Ascospores** *3–4.3 × 1.6–2 µm {2}, †2.6–3.5 × 1.2–1.8 µm {2}, (cylindric-)ellipsoid, straight to slightly inequilateral; **SBs** *~1.2–1.5 × 0.3–0.4(–0.8) µm (visible part 0.9–1.1 µm long) {2}, rod-shaped, rarely almost globose, very eccentrical. **Paraphyses** apically slightly to medium capitate(-clavate) {3}, terminal cell *19–24 × 2.2–3 µm {1}, †12–19 {1} × 2–3 µm {2}, lower cells */†4–7.5 × 1.5–2.3 µm {2}; unbranched at upper septum. **Medullary excipulum** not examined. **Ectal excipulum** of thin- or somewhat thick-walled t. globulosa-angularis, 20–40 µm thick, cells 7–16 × 6.5–11 µm, margin not examined; **glassy processes** almost absent {1} or 14–22 × 3.5–4.5 µm {1}, refractive. **Anchoring hyphae** not examined. **SCBs** and **VBs** absent. **Exudate** over paraphyses 0.2–0.5 µm thick, granular, firmly attached.
— **ANAMORPH**: drechslerella-like (from ascospore isolate {3}, according to Yu et al. 2009b, Z.F. Yu pers. comm., Liu 2006). **Macro- & microconidiophores** usually unbranched, erect, *(40–)60–100(–200) µm high, 2.5–4.2 µm wide at base, 1.5–2 µm at apex, with 2–7(–10) denticles of 2.3–5 × 1.5–1.8 µm at not or indistinctly swollen nodes, sometimes proliferating to form nodes in a row. **Macroconidia** cylindrical to subclavate, straight to slightly curved, *(16–)20–32 × 5.0–6.5 µm {1}, (1–)3-septate, ± equidistantly septate. **Microconidia** cylindric-ellipsoid-clavate, below with a short truncate protuberance, straight, *(8–)10–14(–17.5) × 3.3–4.5(–5.5) µm, (0–)1-septate {2} (values of Yu et al. modified according to scale). **Constricting rings** with short and thick stalk (not clearly seen on photos); ring unexpanded *18–25(–28) µm outer diam., 12–15(–17.5) µm inner diam. {2}, 3-celled, with triangular wall thickenings at the septa.

Habitat: lying on moist ground, on branches of *Quercus* {2}, indet. angiosperm {2}, indet. tree {1}, on rotten wood {3} or bark {1}. **Desiccation tolerance**: unknown, possibly intolerant. **Altitude**: 850 m a.s.l. (northern China)), 500–1750 m (southern China). **Geology**: felsic plutonic and metamorphic rock. **Phenology**: VII–VIII.

Taxonomic remarks. Yu et al. (2009b) described *Drechslerella yunnanensis* for an anamorph obtained in an ascospore isolate from Yimen county (Yunnan, Pl. 1014: 1e–h). In the teleomorph the species fits *Orbilia orientalis* in most respects, apart from the absence of distinct glassy processes at the minutely crenulate margin. A collection from Yuanjiang county (Yunnan) was not mentioned by Yu et al. and was not documented for the margin, but phylogenetically concurs with the type. However, three collections which apparently possessed medium long glassy processes, all from a single locality near Beijing (HMAS 139691–139693) and included by Liu (2006) in his concept of *O. orientalis*, are transferred here to *O. yunnanensis* because of their molecular data.

A specimen from southern China (Guangxi, on wood, HMAS 139696), identified as *O. orientalis* by Liu (2006), deviates from those from Beijing (see below) in much longer glassy processes and concurs with other Chinese strains of *O. orientalis*.

Yu et al. (2009b) named the teleomorph of *Drechslerella yunnanensis* '*O.* cf. *orientalis*' because of differences in anamorph and DNA data to a strain from Jiangxi province, which Yu et al. (2006) named *D. brochopaga* and believed to be the anamorph of *O. orientalis*, but which is shown here to be closely related to *O. tonghaiensis*.

Not included collections. Among the seven collections reported by Liu (2006) under the name *O. orientalis*, three from Beijing and Guangxi were without sequence data. Since Liu described *O. orientalis* with distinct marginal teeth composed of glassy processes, it can be assumed that the three also possessed them. Liu's concept of *O. orientalis* includes both *O.* cf. *orientalis* (1 ×) and *O. yunnanensis* (3 ×) based on available DNA data, whereas the three unsequenced samples remain of unclear identity.

Anamorph. Yu et al. (2009b) characterized *Drechslerella yunnanensis* by small, (0–)1-septate conidia (see Pl. 1014: 1e) very different from the much larger 3-septate conidia of *D. brochopaga*. Since the latter and its possible synonym *Dactylaria gracilis* were described by Drechsler (1937a) and Duddington (1951) without microconidia, Yu et al. took the small conidia as homologous to the large conidia of *D. brochopaga*, but did not consider that *D. yunnanensis* might

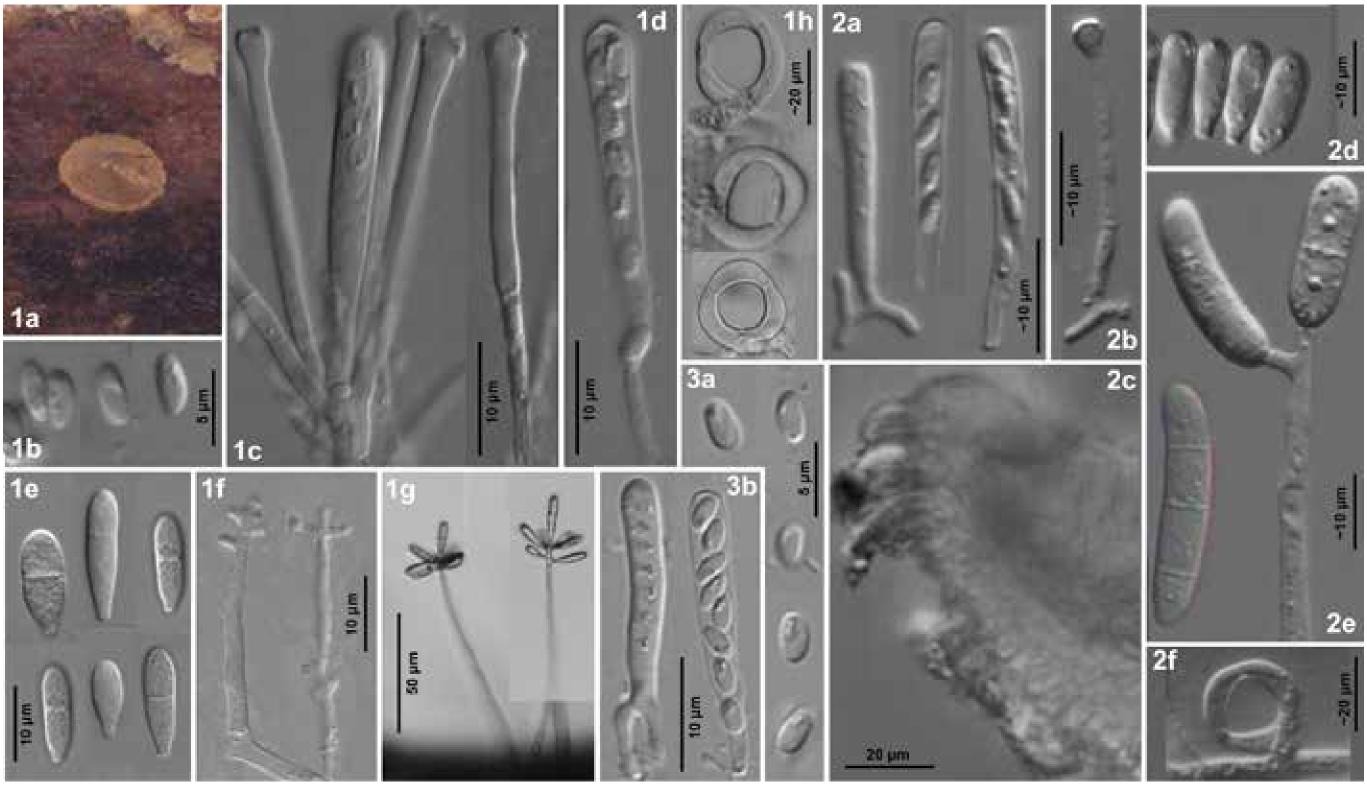


Plate 1014. **1–3**: *Orbilia yunnanensis*. – **1a**. fresh apothecium; **2c**. marginal ectal excipulum in median section; **1c–d**, **2a–b**, **3b**. asci and paraphyses; **1b**, **3a**. ascospores; **1f–g**, **2e**. conidiophores; **1e**, **2d**. microconidia; **2e**. macroconidia; **1h**, **2f**. constricting rings (anamorph from culture). – Living state, except for **1d**, **2a**, **3b** (asci) and **2b**. – **1**: from Yu et al. (2009b), **2**: from Liu (2006, figs 32–33). — **1a–h**. YMF 1.01863 (holotype): China, Yunnan, Yimen, on indet. angiosperm (Yu et al. 2009b); **2a–f**. HMAS 139691: Beijing, on *Quercus* (Liu 2006); **3a–b**. Z.F.Y. yj-6: Yunnan, Yuanjiang, on indet. angiosperm.

also form macroconidia. Not only the ex-type strain (YMF 1.01863) but also the isolate from Yuanjiang (YMF 1.03216) produced only small conidia (Z.F. Yu pers. comm.). However, two unpublished macrophotos made under the microscope show an apothecium of the holotype growing on agar and surrounded by mycelium with conidiophores and conidia, the latter being distinctly curved and rather long for their width, suggesting that they were macroconidia. The photos are uncalibrated, therefore it is impossible to tell the size of these conidia.

At least 1 of Liu's (2006) three ascospore isolates from Beijing (HMAS 139691), which belong phylogenetically to *O. yunnanensis*, formed both micro- and macroconidia (Pl. 1014: 2). From the anamorph of *O. orientalis* these macroconidia differ only gradually in being less curved. From all this we conclude that *D. yunnanensis* was misleadingly characterized by small, 1-septate conidia. Yu et al. (2009b) compared *D. yunnanensis* with *D. dactyloides*, which represents the only hitherto known species of series *Drechslerella* with similar 1-septate though distinctly larger conidia.

Phylogeny. Sequences were gained by Yu et al. (2009b) from two Chinese strains from Yimen (type) and Yuanjiang, comprising S1506 intron and ITS. The two strains fully concur in the ITS except for 1 gap, and in the intron except for 1 nt and 1 gap in the overlapping 350 nt. Liu et al. (2006a) gained LSU D1–D2 sequences from three strains from Beijing under the name *O. orientalis* (HMAS 139691–139693), and ITS from one of them (139691). The ITS sequence fully concurs with the type of *O. yunnanensis*, but it is too short to see whether it possesses the intron. Also the three LSU sequences from Beijing differ by only 0–1 nt. Another identical ITS sequence from China was given by Li et al. (2016) the provisional name *D. longkoensis*.

O. yunnanensis shows an ITS distance of 7–9% to *O. orientalis* and *O. naumburgensis*, and ~7–13% to *O. brochopaga* and *O. tonghaiensis*. The LSU D1–D2 distance is 1–1.5% to *O. orientalis*/*O. naumburgensis* and 3.5% to *O. brochopaga*. In a NJ analysis of the ITS region by Yu et al. (2009b), *D. yunnanensis* clustered in an unsupported clade with *D. polybrocha* distant from *D. brochopaga*. In our analyses, *O. yunnanensis* clustered with weak (ITS, Phyl. 36) or strong support (LSU and SSU+ITS+LSU, S36–37) in the *orientalis-naumburgensis* clade.

Ecology. The type of *O. yunnanensis* was found on decayed bark of an unidentified angiosperm tree in a subtropical humid (winter-dry) mixed evergreen mountain forest dominated by *Quercus schottkyana* and *Pinus armandii* in southern China. Records from northern China (near Beijing) were on wood of *Quercus*, *Betula* etc. in continental cold-temperate humid (winter-dry) forests.

Specimens included. **CHINA**: **Beijing**, **Huairou**, 115 km N of Beijing, ~11 km WNW of Labagoumenxiang, Sunzhazi, 850 m, wood of *Quercus*, 10.VII.2002, B. Liu (B.L. 6171, HMAS 139691, anam. cult., doc. vid.; sq.: DQ656614, DQ656670). – ibid., wood of *Quercus* (B.L. 6174, HMAS 139692, doc. vid.; sq.: DQ656671). – ibid., wood of indet. tree (B.L. 6180, HMAS 139693, non vid.; sq.: DQ656672). – **Yunnan**, **Yuxi**, Yimen, 54 km NW of Yuxi, 3 km NW of Fangtunxiang, Dalongkou, ~1750 m (Yu et al. 2009b as 1580 m, with erroneous coordinates), branch of indet. angiosperm, on bark, VIII.2006, Z.F. Yu (Z.F.Y. ym-68, YMF 1.01863, **holotype** of *D. yunnanensis*, anam. cult., doc. vid.; sq.: FJ185262, MH179759). – Yuanjiang, ~500 m, branch of indet. angiosperm, VIII.2008, S.F. Li (Z.F.Y. yj-6, YMF 1.03216, anam. cult., doc. vid.; sq.: HQ711927). – ?**Shandong**, Longkou (KQZ-2016a, YMF 1.01863, as *D. longkoensis* or *D.* sp.; sq.: KT932079).

Not included (without sequence data). **CHINA**: **Beijing**, **Yanqing**, Matsuyama, 750 m, *Betula*, on wood, 31.VIII.2003, B. Liu (HMAS 139694). – **Mentougou** East Mountain, 800 m, on indet. wood, 15.IX.2003, B. Liu & X.Z. Liu (HMAS 139695, non vid.). – **Guangxi**, **Fangchenggang**, Shangsi, Great Mountain, 800 m, on indet. bark, 20.VI.2003, B. Liu (HMAS 138522, non vid.).

Orbilia orientalis (Raitv.) Baral, in Krieglsteiner, Regensb. Mykol. Schriften 9: 271 (1999) — Pls 1015–1017, Map 158

≡ *Hyalinia orientalis* Raitv., in Azbukina, Plantae non vasculares, Fungi et Bryopsida Orientis extremis Sovietici, Fungi, Tom. 2, Ascomycetes: 362, fig. 252 (1991)

Etymology: from the geographical origin, the Far East of Russia (*orientalis* = eastern).

Typification: Russian Far East, Petrova island, branch of *Tilia amurensis*, 2.IX.1961, A. Raitviir (TAAM 42475, holotype).

Misinterpretation of *O. orientalis*: Liu (2006: 88 p.p.), = *O. yunnanensis*; Yu et al. (2006), ?= *O. tonghaiensis*.

Description: — **TELEOMORPH**: **Apothecia** moist/rehydrated (0.3–)0.5–1.5(–3) mm diam., 0.21–1 mm high (receptacle 0.1–0.23 mm), fresh whitish to pale flesh-cream-chlorinaceous or ochraceous, slightly to medium translucent, round, sometimes ± undulating when large, scattered or subgregarious; disc medium to strongly concave (cup-shaped), flat to slightly convex with age, margin slightly curved upwards or not, distinctly crenulate to denticulate by minute teeth of 20–35 × 50–100 or up to 60 × 150–180 µm; externally ± rough or nearly smooth, concolorous; (sub)sessile or mostly with prominent cylindrical stipe 0.15–0.5 × 0.2–0.6 mm, superficial (or erumpent below periderm); dry light honey-yellow-ochraceous-amber, margin strongly inrolled. **Asci** *29.5–41(–44) × (3.2–)3.5–4.3(–4.7) µm {4}, †26–40 × 3–4 µm {5}, 8-spored, spores *2–4-seriate, (2–)3–5(–6) lower spores inverted {4} (sometimes strongly mixed), pars sporifera *10–13(–15) → 8–11 µm long, †12–15 µm; **apex** (†) medium to strongly truncate (rarely very slightly indented, laterally not widened); **base** with short to medium long, flexuous stalk, L- or mainly Y-, h- to H-shaped. **Ascospores** *(2.6–)3–4 × (1.2–)1.3–1.7(–1.9) µm {12}, †2.7–3.8 × (1.1–)1.2–1.5(–1.8) µm {3}, cylindrical to cylindric-ellipsoid, also ellipsoid(-clavate), sometimes ovoid, rarely slightly tapered at base, ends rounded to obtuse, straight, sometimes slightly inequilateral or curved; **SBs** *0.8–1.7 × 0.15–0.4 µm {3}, consistently eccentric, divided into a small tear- to rod-shaped lower part and a fine, somewhat shorter, often invisible, apically attached filum. **Paraphyses** apically mostly slightly to rather strongly capitate(-clavate), terminal cell *15–22.5 × (2–)3–4(–5) µm {4}, †20–25 {1} × 1.8–4 µm {2}, lower cells *3–7(–9) × 1.7–3 µm {4}, †5–7.5 × 1–1.8 µm {1}; unbranched at upper septum. **Medullary excipulum** hyaline, 50–200 µm thick in centre, 2-layered: lower part up to 100–120 µm thick, of ± loose to dense textura intricata-globulosa with inflated moniliform cells of */†13–30 × 6–17 µm, upper part 60 µm thick, of dense t. intricata with scattered inflated cells of smaller size, towards margin of irregular t. prismatica-porrecta with inflated cells of *20–35 × 8–14 µm, only here sharply delimited. **Ectal excipulum** hyaline, of thin-walled, indistinctly vertically oriented t. globulosa-angularis(-prismatica) from base to flanks, 170–300 µm thick near base, cells *18–58 × 12–42 µm {3}, †20–40 × 15–32 µm {2}; 30–40 µm thick at lower flanks, cells */†10–30 × 8–23 µm {3}, 20–30 µm thick at mid flanks, of vertical t. globulosa or t. prismatica, cells */†6–16 × 4–8 µm; 15–20 µm at margin, of t. prismatica-porrecta oriented at a 70–90° angle, marginal cortical cells *(6–)9–16(–19) {3} or 16–22 {1} × (2.7–)3–5(–6) µm {5}, †7–10 {T} or 12–15 {1} × 3–5 µm {2}; **glassy processes** (10–)20–50(–60) × (2.5–)3–4(–5) µm {12}, rarely only 3–7 µm long {1}, low- (to high-)refractive, partly stratified, strongly curved downwards {7}, covered by finely granular exudate, coherent to form teeth. **Anchoring hyphae** sparse to very abundant, */†(2.5–)3–5(–6) µm wide, walls †0.2–0.3(–0.5) µm thick {4}, forming a dense, thick, hyaline t. intricata. **VBs** in paraphyses long-cylindrical or large-guttulate, low-refractive {2}, 12–16 µm from tip, or vacuoles nearly non-refractive {3}; in ectal excipulum absent; **SCBs** absent. **Exudate** hyaline to pale yellowish, over paraphyses 0.3–1(–1.4) µm thick, granular-cloddy, ± loosely or firmly attached, hyaline; over margin and flanks sparse or abundant, granular. **— ANAMORPH**: drechslerella-like (from ascospore isolate {1} or from apothecia on lid of Petri dish {1}). **Conidiophores** unbranched below, erect, *90–150 µm high {1}, *4.2–5 µm wide at base {1}, *2.5–3.5 µm at apex {2}, here with 2–10 denticles. **Macroconidia** cylindrical (to cylindric-ellipsoidal), rounded above, shortly tapered-truncate below, slightly to medium curved (especially towards upper end), *(27.5–)30–39(–45) × 6.5–7.5(–9) µm, (1–)3-septate {2}, terminal cells often slightly longer (up to 1.7×) than middle cells, strongly varying in lipid content among strains. **Microconidia** not observed. **Constricting rings** with 1-septate stalk of *11–19 × 5.2–5.5 µm {1}; ring unexpanded *35–39 µm outer diam. (expanded 30–37 µm), *22–26 µm inner diam. {1}, 3-celled, with triangular wall thickenings at the septa.

Habitat: collected usually on the moist or wet ground (sometimes half submerged) but also in 1–2.5 m above the ground, corticated to decorticated, 15–150 mm thick branches and logs of *Alnus glutinosa* {1}, *Carpinus betulus* {1}, *Corylus avellana* {1}, *Fagus sylvatica* {3}, *Pinus nigra* {1}, *Populus nigra* {1}, *P. tremula* {1}, *Prunus avium* {1}, *Quercus* sp. {1}, *Q. ilex* {1}, *Salix* sp. {2}, *Rosaceae* sp. {1}, *Tilia amurensis* {1}, *T. cordata* {1}, *T. platyphyllos* {1}, on usually deeply strongly decayed wood {15}, sometimes splitted, also on decayed bark (periderm and bast) {3}, in cracks or holes of periderm, on underside if lying on ground, medium to strongly greyed or blackened, with a few or many green algae. **Associated**: *Annulusmagnus* sp. {1}, *Calycina claroflava* {1}, *Chaetosphaeria* sp. {1}, *Corticiaceae* {1}, *Cryptodiscus foveolaris* {1}, *Dematioscypha olivacea* {2}, *Flagelloscypha* sp. {1}, *Hyalorbilia juliae* {1}, *H. tortuosa* {1}, *Hypoxylon fuscum* {1}, *Melanomma* sp. {1}, *Mollisia* sp. {3}, *Orbilia cejpii* {4}, *O. clavispora* {1}, *O. crenatomarginata* {1}, *O. eucalypti* {2}, *O. xanthostigma* {1}, *Parmelia* sp. {1}, *Pleurothecium recurvatum* {1}, *Rhizodiscina lignyota* {1}, *Stilbella* sp. {1}. **Desiccation tolerance**: a few mature asci still viable after 3 days. **Altitude**: 13–650 m a.s.l. (Europe), 50–400 m (Far East of Russia, Japan). **Geology**: Buntsandstein, Muschelkalk, Keuper (Lettenkohle), Middle & Upper Jurassic limestone, Upper Cretaceous calcareous clay- & marlstone, flysch, Tertiary limestone & molasse; andesite, ophite. **Phenology**: III–IV, VI–X.

Taxonomic remarks. *Orbilia orientalis* is characterized by small, (cylindric-)ellipsoid ascospores with a small, rod-shaped, eccentrical spore body, and rather prominent glassy processes that are agglutinated to form a crenulate margin. The cupulate, usually stipitate, whitish apothecia resemble somewhat a helotialean discomycete, e.g., a *Hymenoscyphus*, *Cyathicula*, or *Calycina*. Since cultural or molecular data are unavailable in the type of *O. orientalis*, conspecificity with the here included European specimens is only assumed, because very similar Chinese collections (Pl. 1017) might as well fall in the narrow scope of this taxon. Even *O. brochopaga* and *O. yunnanensis* cannot be excluded with certainty from being conspecific with the type of *O. orientalis*.

The Chinese *O. yunnanensis* (Pl. 1014) differs from *O. orientalis* as interpreted here in a tendency to shorter glassy processes, shorter, less curved macroconidia, and in the formation of microconidia. It is separated at the species level mainly for molecular reasons. *O. naumburgensis* (Pls 1012–1013) and *O. polybrocha* differ from *O. orientalis* particularly in distinctly longer and partly narrower ascospores with a more tapered base, *O. naumburgensis* also in the marginal excipulum oriented at a rather low angle (30–40°), *O. polybrocha* also in usually having a (purplish-)brown pigment and, above all, in very differently shaped macroconidia. Both species differ also strongly in their molecular data. Difficult to distinguish are also *O. tonghaiensis* (Pl. 1019–1020, p. 1653) and *O. brochopaga* (Pl. 1018: 1), at least based on their anamorph. *O. dryadum* (section *Orbilia*) might be confused with *O. orientalis* and related species due to similar hymenial characters; it differs in usually narrower spores which contain in the living state a globose, central spore body, and in a non-predacious dactylella-like anamorph.

Variation. Within Europe the teleomorph exhibits some variation between the collections. The ascospores vary

H.B. 5382a: Germany, Schweinfurt, on *Populus tremula* (wood)

TAA 42475 (holotype): Russia, Primorje, on *Tilia amurensis* (bark)

H.B. 7379: France, Vendée, on *Corylus avellana* (bark)

H.B. 8146a: France, Charente-Maritime, on *Carpinus betulus* (wood)

Plate 1015. **1–4**: *Orbilia orientalis*. – **a**. ascospores; **b**. asci and paraphyses; **c**. ascus apices; **d**. fresh or rehydrated apothecia; **e**. apothecia in median section; **f**. id., marginal ectal excipulum; **g**. marginal cortical cells with glassy processes; **h**. anchoring hypha; **i**. conidia; **j**. conidiophore (both from culture). – The long, filiform, refractive, serpentinoid inclusions in the dead spores of **2a** & **c** are artifacts caused by coagulation of cytoplasm.

somewhat in size and shape. The SBs are usually thin (rod-shaped) and strongly eccentrical (Pls 1015: 3a, 4a; 1016: 2g, 3e), but in one collection they were predominantly central and more tear-shaped (Pl. 1015: 1a). In the dead spores, long, filiform, refractive, serpentinoid inclusions were frequently seen in water mounts, especially when still within the asci (Pl.1015: 2a). These are artifacts which are caused by the coagulation of cytoplasm, but can easily be mistaken for spore bodies.

Type studies of teleomorph. Some differences between the protologue of ***Hyalinia orientalis*** and the present reexamination of the holotype need to be mentioned (see Pl. 12: b and Pl. 1015: 2). Raitviir (1991) described the paraphyses with only slightly inflated ('apically subclavate', here ± strongly clavate-capitate) tips, and the spores as broadly ellipsoid-fusoid with pointed ends (here ellipsoid to slightly ovoid). The given spore size (3–4 × 1.5–2 µm) is confirmed here. The apothecia were described as sessile, but are found here to be partly stipitate (the stipe is hidden in holes of the periderm). Raitviir placed the species in *Hyalinia* because of 40–60 µm long 'solid glassy hairs' at the margin (present study: 15–40 µm).

Not included collections. A sample from Serbia (Pl. 1016: 7) fits morphologically *O. orientalis* quite well [spores *(3–)3.2–

Plate 1016. **1–6**: *Orbilia orientalis*; **7**: *O.* aff. *orientalis*. – **2a**. branches of *Tilia* on a heap in small *Quercus robur* forest; **1a–f**, **2b–c**, **3a–b**, **4a–b**, **5a**, **7a**. fresh apothecia; **1g**. apothecium in median section; **1h–i**. id., ectal excipulum at flanks and margin; **3f**. id., medullary excipulum; **1j**. id., ectal excipular cells with MCs; **3c**. apothecium in external view (squash mount); **1k**, **2d–e**, **3d**. asci and paraphyses; **2f**. ascus apex; **2g**, **3e**, **5b**, **6**, **7b**. ascospores; **1l**, **7c**. conidiophore tips; **1m**, **7d**. macroconidia (from culture). – Living state (**1j–k** in Neutral Red, **2d**. VBs stained in CRB), except for ascus in **2f**. Phot: **2a–g**. P. Perz; **4a–b**, **5a**. F.J. Balda; **6**, **7a**. D. Savić. — **1a–m**. H.B. 8146a: France, Charente-Maritime, on *Carpinus*; **2a–g**. P.P. 20071006-2: Poland, Kłodzko, on *Tilia*; **3a–f**. H.B. 8939a: France, Deux-Sèvres, on *Salix*; **4a–b**. F.J.B. 061113: Spain, Navarra, on *Populus*; **5a–b**. H.B. 9925: Spain, Navarra, on *Populus*; **6**. 5.IX.2014: Serbia, Testera, on *Alnus*; **7a–d**. H.B. 9895a: Serbia, Grabovo, on *Tilia*.

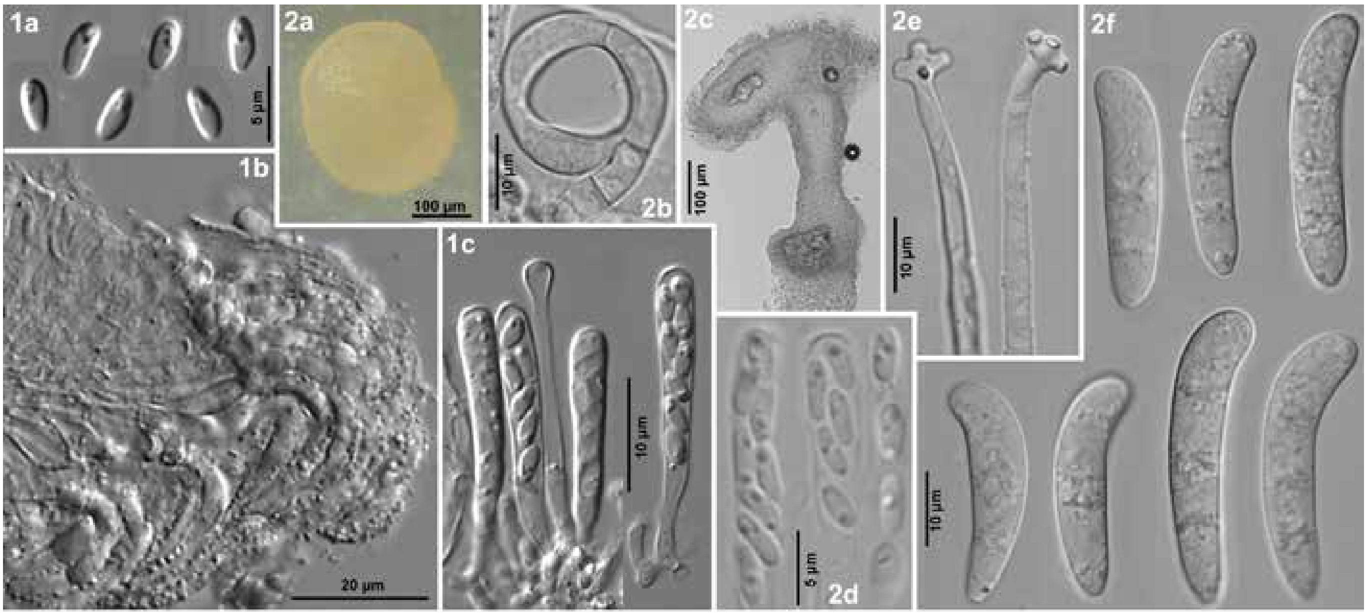


Plate 1017. **1–2**: *Orbilia* cf. *orientalis*. – **2a**. fresh apothecium grown on agar; **2b**. id., in vertical section; **1b**. marginal ectal excipulum in median section, with glassy processes covered by granular exudate; **1c**. asci and paraphysis; **1a**, **2d**. ascospores; **2e**. conidiophores; **2f**. conidia; **2b**. constricting ring (all from culture). – Living state. – **1**: phot. Z.F. Yu/S.F. Li **2**: from Zhang et al. (2020, p.p.). **— 1a–c**. YMF 1.02999 (J.W.G. gz-7): China, Guizhou, on indet. angiosperm; **2a–f**. YMF 1.01854: China, Yunnan, Dali, Yongping, on indet. angiosperm.

3.5(–4) × (1.3–)1.4–1.6 µm, conidia *(20–)22–39 × (5.7–)6–6.6(–7) µm]. It is not included in the description because it deviates for > 3 % in the ITS region (see below).

Three Chinese records from Guizhou and Yunnan (Yongping and Yuxi) studied by Z.F. Yu et al. (pers. comm., Pl. 1017: 1–2) and one from Guangxi reported by Liu (2006) fit *O. orientalis* in most respects (3 further strains of B. Liu under the name *O. orientalis* from Beijing belong phylogenetically to *O. yunnanensis*). They cluster very close to European *O. orientalis*, but are tentatively kept apart here mainly due to their geographical origin and because they form a clade of their own (see below). For one of them (Guizhou) no anamorph was obtained in culture. Rather long glassy processes of 20–40 × 2.5–3.5 µm reminiscent of *O. orientalis* were observed here (1b, Z.F. Yu pers. comm.) and in the strain from Guangxi (HMAS 139696, B. Liu pers. comm.). Glassy processes were possibly absent in the strain from Yongping (IVV: YMF 1.01854). Ascospore size was with *3.3–4.2(–4.5) × 1.2–1.6(–2.2) µm in the range of European *O. orientalis*. For the isolate from Yuxi no documentation was available. A description is given in Zhang et al. (2020a).

Anamorph. The macroconidia of *O. orientalis* as figured in Pls 1015–1016 (2 strains from France) tend to be apically curved. This is also the case in the not included strains from Serbia (Pl. 1016: 7) and China (Pl. 1017: 2), but also in *O. naumburgensis* (Pl. 1013: 1e). Microconidia were not observed in either of these strains.

Measurements of Chinese strains were available for the two isolates from Yunnan, which closely resemble those of European *O. orientalis* (data from Z.F. Yu pers. comm., partly modified): conidiophores erect, 58–166 µm high, 3.2–5 µm wide at the base, 3 µm at apex, bearing 3–9 denticles 2–3 × 2 µm in a capitate arrangement. Macroconidia cylindrical to very slightly clavate, shortly attenuated below, with a truncate hilum, slightly to medium curved near distal end, *28–39 × 6–8 µm, 3-septate but often also 1–2-septate. Constricting rings unexpanded *21–22 diam., inner diameter 12–13.5 µm, 3-celled, with triangular wall thickenings at the septa.

O. brochopaga and *O. yunnanensis* differ from *O. orientalis* in their macroconidia which tend to be more straight, *O. brochopaga* also in having the septa distinctly centrally aggregated, *O. yunnanensis* in a smaller conidial size and the presence of microconidia (Tab. 95).

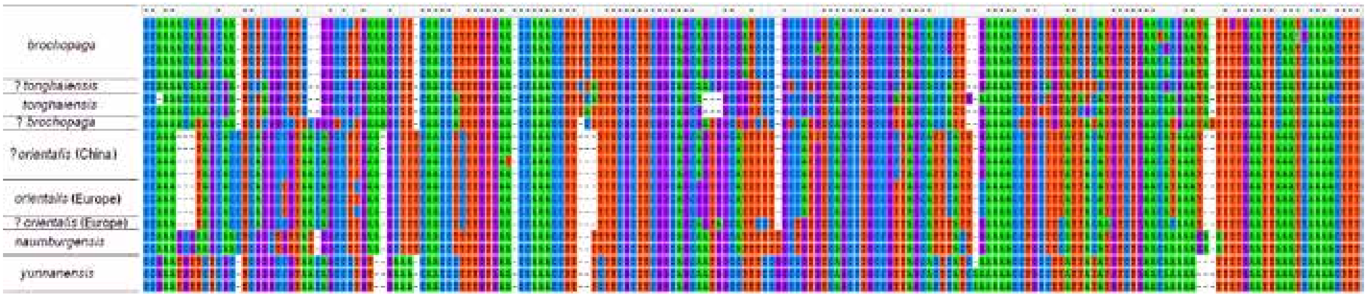
Phylogeny. Sequences of *O. orientalis* s.l. were gained from apothecia of three European samples (Pyrénées Atlantiques, Navarra, Serbia H.B. 9965; ITS+LSU) and from four Chinese ascospore isolates (*O.* cf. *orientalis*), three from Yunnan (ITS) by Zhang et al. (2020a), and one from Guangxi (HMAS 139696, ITS+LSU) by Liu et al. (2006a, as *O. orientalis*/*D.* cf. *brochopaga*). A further sequence of *O. orientalis* s.l. was gained from an ascospore isolate of the not included *O.* aff. *orientalis* from Serbia (H.B. 9895a, ITS+LSU). The S1506 intron is absent in the four European samples, and also the three Chinese strains which cover this region do not have it. All these sequences clustered in a medium (ITS, Phyl. 37) or strongly (LSU, SSU+ITS+LSU, S36–S37) supported clade.

In the phylogenetic analyses of the ITS and LSU region by Liu et al. (2006a), the Guangxi strain clustered distant from their '*O. orientalis*' strains which are reidentified here as *O. yunnanensis*, and also distant from authentic *D. brochopaga*. Also in the analyses of Zhang et al. (2020a), *O. yunnanensis* formed a clade distinct from the four Chinese and three European strains.

Two subclades are recognized within *O. orientalis* s.l. (see Phyl. 36, 37). Three of the four European strains differ by only 0–1 nt in the ITS region and fully concur in the LSU. The four Chinese strains vary in the ITS by 0–0.4 %, thereby the strains from Guangxi (Guilin), Guizhou (Suiyang), and Yunnan (Dali, Yongping) fully concur. Between both subclades a distance of 1.2–2.5 % is observed. Based on the 7 positions at which the two subclades consistently differ, the Chinese and European specimens are possibly not conspecific (Tab. 94).

One of the two strains from Serbia (H.B. 9895a) deviates from the three European *O. orientalis* strains by 3.3–3.5 % in the ITS and 0.5 % in the LSU D1–D3 (4 nt in D1). Also from the four Chinese strains this sample deviates by 3–4 % in the ITS

Table 92. Alignment of ITS1 region for all known members of the *O. brochopaga* aggregate (with very similar ana- and teleomorph). Three blocks can be recognized: (1) *brochopaga-tonghaiensis*, (2) *orientalis-naumburgensis*, and (3) *yunnanensis*. Incomplete sequences are omitted.



region. This strain shares many nucleotides with the other seven strains of *O. orientalis* s.l., at which *O. naumburgensis* deviates (Tab. 93), or only those of Chinese *O.* cf. *orientalis* (Tab. 94), but also 3 positions that are characteristic of *O. naumburgensis* (Tab. 94). Therefore, we did not include it in our description of European *O. orientalis*. To *O. naumburgensis* this aberrant strain shows an ITS distance of 4.8 %.

When viewing the alignment of the ITS1 region (Tab. 92), the eight available sequences of *O. orientalis* s.l. form a rather distinctive block with characteristic gaps, whereas *O. naumburgensis* clearly deviates. A higher distance is observed between these taxa and the morphologically very similar *O. yunnanensis*, *O. brochopaga*, and *O. tonghaiensis* (~6–13 %), which are also more clearly set apart in the appearance of the ITS1 alignment.

More sequences are needed in order to clarify how many different species are involved. Extraction of DNA from the holotype of *O. orientalis* is recommended to clarify the identity of this name.

Ecology. *O. orientalis* was found on ± rotten wood or more rarely bark of hygric to mesic branches and logs of various angio-, rarely gymnosperms. In two collections the apothecia grew at a height of 1–2.5 m above the ground. Yet, even after some dry days the deeply rotten wood of the rather thick branches still retard some moisture. A slight desiccation tolerance was noted in one of these collections. This may also be true for the holotype for which the protologue says 'on dry bark'.

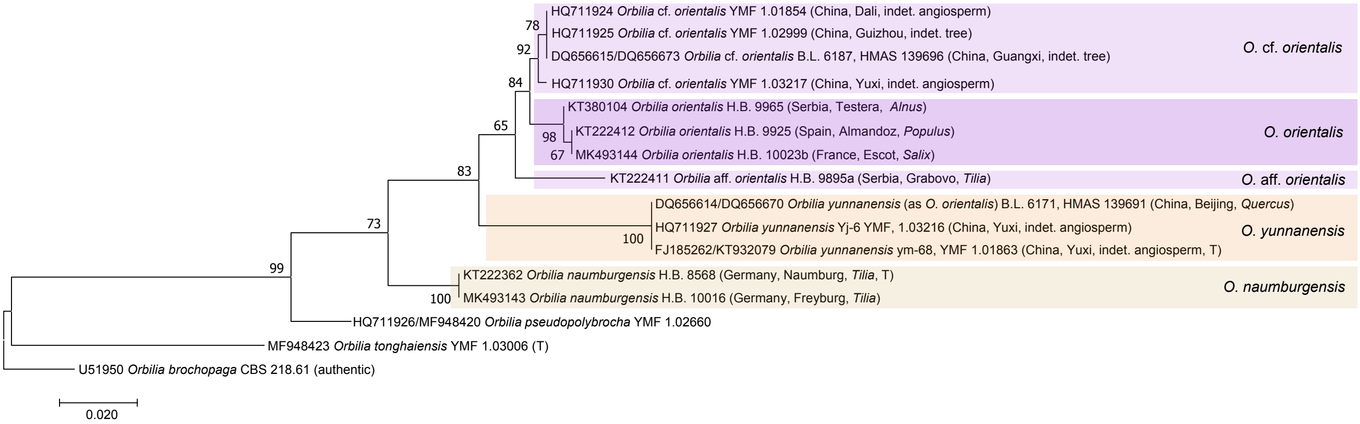
O. orientalis was infrequently collected in western and central Europe in atlantic to subcontinental, cold- to warm-temperate, usually shady deciduous forests. The vegetation includes rich *Quercus*-mixed forests, thermophilous *Quercetea pubescentis*, also acidic forests. The type was collected in a mixed deciduous forest with *Tilia amurensis* and *Pinus* on a small island in the region of Wladiwostok in the Far East of Russia. Despite the coastal situation the climate is continental, cold-temperate humid (winter-dry), with average temperatures of -8 to -15 °C in January. The collection from Japan is from a similar but warm-temperate climate.

The not included Serbian sample on *Tilia* wood was on serpentinite at the northern foothill of western Fruška Gora mountains, whereas typical *O. orientalis* in the same mountain range grew on *Alnus* bark over Cretaceous & Tertiary sediments. Collections from southeastern Asia were on hygric rotten bark and wood of unidentified angiosperm trees in subtropical humid (winter-dry) evergreen forests mountain forest of southern China (1420–2400 m a.s.l.).

Specimens included. **BELGIUM**: **Vlaanderen**, **Oost-Vlaanderen**, 4 km SW of Gent, Sterre, Maaltepark, 13 m, log of *Fagus sylvatica*, on wood, 16.XI.2013, B. Declercq (B.D. 13/105, doc. vid.). — **GERMANY**: **Baden-Württemberg**, 7 km E of Heidelberg, 2.5 km ESE of Ziegelhausen, Bärenbach, 165 m, branch of indet. *Rosaceae*, on wood, 10.VII.2010, M. Bemmann (H.B. 9359). – ibid., 175 m, branch of *Fagus sylvatica*, on wood, 31.VII.2010, M. Bemmann (doc. vid.). – **Bayern**, **Unterfranken**, Rhön, 3.3 km SW of Bad Kissingen, 1 km SW of Heiligenhof, Batzenleite, 305 m, branch of *Tilia platyphyllos*, on wood, 13.VIII.2015, A. Gminder (doc. vid.). – 15 km SE of Schweinfurt, 1 km S of Alitzheim, Hörnauwald, 220 m, branch of *Populus tremula*, on wood, 12.XI.1995, H.O. Baral (H.B. 5382a). — **POLAND**: **Lower Silesia**, Kłodzko, 10 km SSE of Bystrzyca Kłodzka, 1.5 km E of Domaszków, Polna ulica, 445 m, branch of *Tilia cordata*, on wood, 6.X.2007, P. Perz (P.P. 20071006-2, doc. vid.). – **AUSTRIA**: **Steiermark**, 10 km WNW of Graz, 2 km ENE of St. Oswald, Jägerberg, 650 m, log of *Fagus sylvatica*, on wood, 23.VII.2015, I. Wendelin, vid. G. Friebes (GJO 77054, doc. vid.). — **SERBIA**: **Vojvodina**, Fruška Gora, 17 km SW of Novi Sad, 6.5 km WSW of Beočin, Testera, 165 m, branch of *Alnus glutinosa*, on bark, 5. & 8.IX.2014, D. Savić (FG-211, doc. vid., H.B. 9965; sq.: KT380104). – 13 km S of Novi Sad, 6 km NNW of Irig, Iriški venac, WSW of WWII memorial, 460 m, log of *Pinus nigra*, on wood, 8.VII.2019, D. Savić (FG-1102, doc. vid.). — **FRANCE**: **Pays-de-la-Loire**, **Vendée**, 4 km NE of Luçon, 1 km W of Ste.-Gemme-la-Plaine, Forêt de Ste.-Gemme-la-Plaine, 30 m, branch of *Corylus avellana*, on bark, 6.VI.2003, J.L. Surault (H.B. 7379, anam. apoth.). – **Poitou-Charentes**, **Deux-Sèvres**, 17 km E of Melle, 0.8 km WSW of Le Breuillac, Bois de Fontadam, 150 m, log of *Salix*, on wood, 7.X.2008, B. Coué (H.B. 8939a). – 22 km WSW of Melle, 1.3 km SSE of Villiers-en-Bois, Forêt de Chizé, 77 m, log of *Prunus avium*, on wood,

Table 93. Nucleotide positions in the ITS1 and ITS2 region which differ between *O. brochopaga* and *O. orientalis*, in comparison with *O. tonghaiensis*, *O.* aff. *brochopaga* (upper = ATCC 96710, lower = AS 6.0287 & CBS 574.91), *O. naumburgensis*, and *O. yunnanensis*. Position numbers starting after ATCATTA (including rare inserts). Str. = number of strains; small letters = exceptions.

Species	Str.	6–18	25–28	35–42	48–50	91–101	121–124	133	139	173	353	360	389–392	408	418–421	448	450	451	473	482
O. brochopaga	10	ACAGAGCAA-TCT	T-CG	AAAGCTT-	TTT	GATCCC-GCCG	CCVT	T	G	C	G	A	GGCC	G	TCTG	C	G	A	C	T
O. cf. *tonghai.*	1	ACAAAGCGA-TCC	T-CG	AAAGCTT-	TTT	GGTTCC-GTCG	CCAT	T	G	C	G	A	GGTC	G	ACCT	T	-	A	T	T
O. tonghaiens	2	ACAAAGCGA-TCT	T-CG	AAAGCTT-	ATT	GGTTCC-GCCG	CCAT	T/C	G	C	G	T	RGCC	G	ACTG	C	A/-	A	T/C	T
O. aff. *brochop.*	1	ACATAGCAA-TCT	TCGG	AAAGCTTC	ATT	TGTCTC-GTCA	CCAT	T	G	C	G	A	AGCC	G	ACTG	T	A	A	T	G
O. aff. *brochop.*	2	??????????TCT	CCGG	AAAGCTT-	TTT	GACCTC-GTCA	CCAT	T	G	C	G	A	AGCT	G	ACTG	T	A	A	T	G
O. orientalis	7	---TAGCACCTCA	AACA	AA-GCTTT	TCT	ATTTTT-GCCA	TTCA	C	T	A	T	T	AGCT	A	ACCA	T	C/t	G/t	T	G
O. aff. *orientalis*	1	---TAGCACCTCA	AACA	AA-GCTTT	TCT	ATTCCT-GCTG	TTTA	C	T	A	T	T	AGCT	A	ACCA	T	C	G	T	G
O. naumburg.	2	GCGAAGCAACTCC	TATG	AA-GCTTT	TTT	ATTTTTTGCTG	TTTA	C	T	A	T	T	AGCC	A	ACCA	T	C	G	T	G
O. yunnanensis	4	TGTTCTCGC-TCG	AACA	T--GAAA-	CTT	CTTTTCGGCCG	CTCA	C	T	A	T	T	AGCC	A	ACCA	T	C	G	T	G



Phylogenetic analysis 37. Phylogram of *orientalis-naumburgensis* clade inferred from ML analysis of ITS1-5.8S-ITS2 rDNA dataset (16 sequences, 505 positions, aligned with MUSCLE) using the K2+G model in MEGA7 (500 replicates). The tree is rooted with *O. brochopaga*. Asci 8-spored in all teleomorph taxa; T = type.

27.IV.2011, E. Camporesi (ø). – **Charente-Maritime**, 25 km SSE of Niort, 2.5 km ESE of la Villedieu, Forêt d'Aulnay, 115 m, branch of *Carpinus betulus*, on wood, 28.IV.2006, P. Tanchaud (H.B. 8146a, anam. cult.). – **Aquitaine**, **Pyrénées Atlantiques**, 11 km WSW of Arudy, 3.8 km E of Escot, 545 m, branch of *Salix*, on wood, 8.X.2016, H.O. Baral (H.B. 10023b; sq.: MK493144). — **SPAIN**: **País Vasco**, **Gipuzkoa**, 6.5 km WNW of Zarautz, 1 km ESE of Zumaia, NW of Artadi, 55 m, branch of *Quercus ilex*, on wood, 19.III.2016, J. Martin (ARAN-F 03410, doc. vid.). – **Navarra**, 31 km N of Pamplona, 1 km E of Almandoz, 350 m, branch of *Populus nigra*, on wood, 6.XI.2013, F.J. Balda (F.J.B. 061113, doc. vid.). – ibid., 28.VIII.2014 (H.B. 9925; sq.: KT222412). – ibid., 2.XII.2015 (ø, doc. vid.). – 1 km NE of Almandoz, 300 m, branch of *Quercus robur*, on wood, 8.IX.2014, F.J. Balda (F.J.B. 80914, doc. vid.). — **RUSSIA (East)**: **Primorje**, 155 km ESE of Wladiwostok, 8.5 km WSW of Preobrazheniye, Lazo, Petrova island, ~50 m, branch of *Tilia amurensis*, on bark, 2.IX.1961, A. Raitviir (TAAM 42475, **holotype** of *Hyalinia orientalis*, H.B. 5207 ø). — **JAPAN**: **Honshu**, **Fukushima**, ~6 km NNE of Ishikawa, NE of Bobata, Bobata lake, ~380 m, branch of *Quercus*, on wood, 30.VII.1991, T. Hosoya (TRL 387, TNS-F-56085, H.B. 9990 ø).

Map 158. Known distribution of *O. orientalis* in Europe (cyan = genetically distant collection).

Not included. **SERBIA**. **Vojvodina**, Fruška Gora, 22.5 km WSW of Novi Sad, 2.3 km SW of Grabovo, Ravne, 200 m, log of *Tilia platyphyllos*, on wood and *Nemania serpens*, 28.V.2014, D. Savić (H.B. 9895a ø, anam. cult.; sq.: KT222411). – ibid., 5.VI.2014 (ø, doc. vid.). — **CHINA**: **Yunnan**, **Dali**, Yongping, ~38 km ENE of Baoshan, Jinguangsi, 2550 m, branch of indet. angiosperm, on bark, 14.VII.2006, Y. Zhang (Y.Z. yp-1, YMF 1.01854, CGMCC 3.18828, anam. cult., doc. vid.; sq.: HQ711924). – **Yuxi**, Yimen, Dalongkou, 2000 m, substrate unknown, 8.VIII.2008, S.F. Li (Z.F.Y. ym4-7, YMF 1.03217, CGMCC 3.18838, anam. cult., non vid.; sq.: HQ711930). – **Guizhou**, **Zunyi**, Suiyang, ~62 km NNE of Zunyi, ~38 km ENE of Tongzi, Kuankuoshui, 1420 m, branch of indet. tree, 10.IX.2007, S.F. Li & J.W. Guo (J.W.G. gz-7, YMF 1.02999, CGMCC 3.18833, anam. cult., doc. vid.; sq.: HQ711925). – **Guangxi**, **Guilin**, Xing'an, ~65 km NNE of Guilin, ~30 km NW of Xing'an, Mao'er Shan, 1500 m, branch of indet. tree, on wood, 26.VII.2002, B. Liu (B.L. 6187, HMAS 139696, doc. vid.; sq.: DQ656615, DQ656673).

Orbilia brochopaga (Drechsler) Baral, E. Weber, Bin Liu & Z.F. Yu, **comb. nov.**, MB 814005 — Pl. 1018

Basionym: *Dactylella brochopaga* Drechsler, Mycologia 29: 517, fig. 13 (1937)
≡ *Dactylaria brochopaga* (Drechsler) Drechsler, Mycologia 32: 467 (1940)
≡ *Dactylariopsis brochopaga* (Drechsler) Mekht., Mikol. Fitopatol. 1: 278 (1967)
≡ *Arthrobotrys brochopagus* (Drechsler) S. Schenck, W.B. Kendr. & Pramer [as '*brochopaga*'], Can. J. Bot. 55: 982 (1977)
≡ *Candelabrella brochopaga* (Drechsler) Subram., Kavaka 5: 95 (1978, '1977')
≡ *Drechslerella brochopaga* (Drechsler) M. Scholler, Hagedorn & A. Rubner, Sydowia 51: 99 (1999)
?= *Dactylaria gracilis* Dudd., Trans. Br. Mycol. Soc. 34: 194 (1951)
≡ *Arthrobotrys gracilis* (Dudd.) S. Schenck, W.B. Kendr. & Pramer, Can. J. Bot. 55: 983 (1977)
≡ *Dactylariopsis gracilis* (Dudd.) Mekht., Khishchnye Nematofagovye Griby - Gifomitsety (Baku): 117 (1979)

Table 94. Chinese *O.* cf. *orientalis* differs from European *O. orientalis* at seven nucleotide positions in the ITS1 and ITS2 region (22, 85, 115, 128, 348, 403, 435). *O.* aff. *orientalis* (H.B. 9895a) concurs with *O. naumburgensis* at three positions (pos. 100, 123, 140) by differing from all other taxa listed. Alignment and position numbers as in Tab. 93.

Species	Str.	22	85	100	114	123	128	140	348	403	434–436
O. brochopaga	11	C	A	C	C	A/C/G	G	T	A	T	AAA
O. tonghaiensis s.l.	3	C	A/G	C	A/C/T	A	G	T	A	T	AGA
O. aff. brochopaga	3	C	A/G	C	C/T	A	G	T	A	T	AAA
O. cf. orientalis (China)	4	C	A	C	C	C	G	T	G/(A)	T	A–A
O. orientalis (Europe)	3	T	G	C	T	C	C	T	A	C	AAA
O. aff. *orientalis*	1	C	A	T	T	T	G	C	A	T	AAA
O. naumburgensis	2	T	A	T	T	T	G	C	A	T	AAA
O. yunnanensis	4	C	A	C	T	C	G	T	A	T	AAA

Etymology: *brochopaga*: trapping nematodes by lassos (bróchos = noose, pagída = snare, trap); *gracilis*: 'on account of the long, slender conidia'.

Typification: USA, Maryland & Virginia, from leaf mould in deciduous woods, undated, C. Drechsler (holotype of ***Dactylella brochopaga***, illustration in Drechsler 1937a: fig. 13). — Great Britain, Devon, Marlborough, in various bryophytes, IX.1948, C.L. Duddington (K, holotype of ***Dactylaria gracilis***).

Misapplied name: Ren et al. (2014a), as *O. orientalis*.
Misinterpretation of *O. brochopaga*: Yu et al. (2006), ?= *O. tonghaiensis*, Liu (2006: 88), = *O. yunnanensis*.

Description: — **TELEOMORPH** (from Ren et al. 2014a, data partly obtained from scale): **Apothecia** 0.3–1.1 mm diam., pale yellow, translucent, ± round, ± sessile, dry orange. **Asci** ?*36 × 4.4 µm, †~30 × 2.8–3.2 µm, cylindrical, 8-spored, spores biseriate above, obliquely uniseriate below; **apex** slightly truncate, thin-walled; **stipe** medium to very long, flexuous, sometimes L-shaped. **Ascospores** *3.1–4.3 × (1.2–)1.4–1.5 µm, subcylindrical, rounded to obtuse at both ends, straight to very slightly inequilateral; **SBs** ~1–1.2 × 0.8–1.1 µm, ± globose, centrally situated a short distance below apex, attachment not seen. **Paraphyses** slightly to medium capitate-clavate, terminal cells *11.5–13 × 2.1–2.8 µm, lower cells *3–4 × 1.5–1.8 µm, branched below. **SCBs** in terminal cells of paraphyses globose, 1–1.2 µm diam. **Medullary and ectal excipulum** without data. **Exudate** absent. **— ANAMORPH**: drechslerella-like (from ascospore isolate {1}), description from Drechsler 1937a {T} and Turnbull & Zachariah 1978): drechslerella-like (from leaf mould isolates) – **Conidiophores** unbranched, erect, (40–)200–325(–400) µm, 4–7 µm wide near base, 2.4–3.5 µm at apex, with (2–)3–8(–12) ((–15)) short denticles {T}. **Macroconidia** straight or slightly curved, cylindrical (to cylindric-ellipsoid), rounded above, shortly tapered-truncate below, *26–46 × (5–)6–7(–9) µm, ((1–))(2–)3((–4))-septate, terminal cells often slightly longer (up to 1.7×) than middle cells {T}. **Microconidiophores** absent {T} or present, 80–140(–220) × 2–2.8 or 4–5 µm {2}, 2 µm wide above, apically slightly swollen, with 2–5 denticles of 2.8–4.5 × 1.6–1.9 µm. **Microconidia** (13–)14–17(–21) × (4–)4.5–5(–6.2) µm {2}, cylindrical to elongate-ellipsoid, with basal protrusion, 1-septate or rarely 2–3-septate. **Constricting rings** formed on mycelium, with 1-septate stalk of *7–13 × 3.5–5(–6) µm {T}; ring unexpanded *20–35 {T} or 25–40 µm {ATCC 13897} outer diam., *16–22 {T} or 20–27 µm inner diam. {ATCC 13897}, 3-celled, with triangular wall thickenings at the septa; smaller rings formed directly on conidia, *19–22 µm outer diam., *12–14 µm inner diam. {T}; giant traps of 105–130 µm outer diam., 70–110 µm inner diam., sometimes formed together with normal rings {ATCC 13897}.

Habitat: fallen branch of indet tree, on wood {1, apothecia}, isolated from leaf mould in deciduous forests {T}, ruderal and agricultural soil. **Altitude**: ~50–200 m a.s.l. (eastern North America), ~30–100 m (Peru), ~350 m (subtropical Africa). **Drought tolerance**: unknown (probably intolerant). **Phenology**: VIII (teleomorph).

Taxonomic remarks. The *Orbilia brochopaga* aggregate comprises a group of species with very similar conidia, though being phylogenetically rather diverse, including *O. orientalis*, *O. naumburgensis*, *O. orientalis*, *O. tonghaiensis*, and some unnamed clades, all being characterized by cylindrical, 3-septate, ± allantoid macroconidia (see Phyl. 38). *O. brochopaga* s.str. is almost exclusively known from its anamorph, which was originally isolated by Drechsler (1937a) from leaf mould in deciduous woods in Maryland and Virginia. The present species concept is based on molecular data gained from two authentic strains from USA isolated by Drechsler, and from strains from Ecuador, Peru, Beijing, Guangxi, and Taiwan. For all of them no illustrations or descriptions were available, except for the ascospore isolate from Guangxi which provides data from both morphs (Ren et al. 2014a).

Anamorph. Morphological differences in the anamorph within the *O. brochopaga* aggregate are shown in Tab. 95. They include curvature of conidia, arrangement of septa, and presence vs. absence of microconidia, but also conidial and constricting ring size (see also under *O. orientalis*, p. 1647). For instance, the closely related Chinese *O. tonghaiensis* differs from *O. brochopaga* in smaller traps.

The outer diameter of the unexpanded rings seems to be correlated with macroconidial size (Tab. 95): *O. yunnanensis* and *O. tonghaiensis* with rather small macroconidia have comparatively small rings of 18–25 µm diam. (Pl. 1014: 1h, 2f), whereas *O. brochopaga* and *O. orientalis* with distinctly larger macroconidia have rings of 20–39 µm diam. (including the type of *Dactylaria gracilis*). Also *O.* cf. *tonghaiensis* (from Jiangxi) with conidia more of the smaller size have rather small rings. Yet, in *O.* cf. *orientalis* the conidia are more of the larger size though the rings are small (Pl. 1017: 2b, 2f). The given ring diameters refer to rings formed from mycelium, not directly from conidia, from which considerably smaller rings emerge.

Together with the normal ring traps, much larger 'giant ring traps' were formed in some strains. *O.* cf. *tonghaiensis* was associated with giant traps of 80–85 µm diam. (Z.F. Yu pers. comm.). Giant ring traps among the normal ones have also been reported by Turnbull & Zachariah (1978) for a mutant of the unlocalized authentic strain of *Drechslerella brochopaga* (ATCC 13897) which was unexplainably renamed to *D. bembicodes* in Zachariah & Insell (1979). Also in *D. dactyloides* a mutant with such giant traps was observed (Fig. 110: t–u).

Microconidia are known from the similar *O. yunnanensis* (Pl. 1014: 1–2) and *O. tonghaiensis* (Pl. 1020: 1–2). Because *D. brochopaga* was described without microconidia and with larger macroconidia, also with more abundant denticles at the conidiophore tip, Liu (2006) hesitated to assign the anamorph of his strain to *D. brochopaga*. However, Barron (1979a) observed microconidia in a strain of *D. brochopaga* from Ontario (Canada). The only figured, equidistantly 3-septate macroconidium in his fig. 11 has a rather small in size of ~30 × 6.5 µm (estimated from the given size of microconidia).

Ren et al. (2014a) reported an anamorph (as *D.* cf. *brochopaga*) which developed in an ascospore isolate of a collection from Guangxi (China, as *O. orientalis*), with 1–3-septate straight conidia of 14.3–21 × 4.5–6.2 µm. Only 1(–2)-septate conidia of about that size were illustrated, however, which must be microconidia, judging from their small size. Perhaps macroconidiophores did not develop because it seems that no nematodes were added to the culture.

Based on the reported molecular analysis (see below), we conclude that Ren et al.'s sample represents *O. brochopaga* and the first report of a teleomorph of this species. Ren et al. doubted identity with *D. brochopaga* because of smaller conidia with basal nodule and often fewer septa, also because of a certain distance in the ITS rDNA, which however seems to lie, in our opinion, in the range of infraspecific variation.

Type studies. In the protologue of ***Dactylella brochopaga*** (Drechsler 1937a, Pl. 1018: 1) the depicted conidia are mainly 6–7 µm wide). Duddington (1951a, Pl. 1018: 3) reported in the protologue of ***Dactylaria gracilis*** 3(–4)-septate macroconidia of *46–66 × 8–11 µm, i.e., distinctly larger than Drechsler's. This larger conidial size might suggest that *Dactylaria gracilis* is a species distinct from *D. brochopaga*. The conidia were obtained in a non-sterile culture from bryophyte material with soil and nematodes. However, in pure culture (maize-meal agar) the conidia measured only 36–53 × 6–11 µm. Duddington emphasized that the distal and partly also the proximal cell of the conidia was often about twice as long as the middle cells, but also Drechsler stressed shorter middle cells in his description. Also in *O. tonghaiensis* (Pl. 1020: 1g, 2c) the terminal cells tend to be much longer than the middle cells, whereas this is much

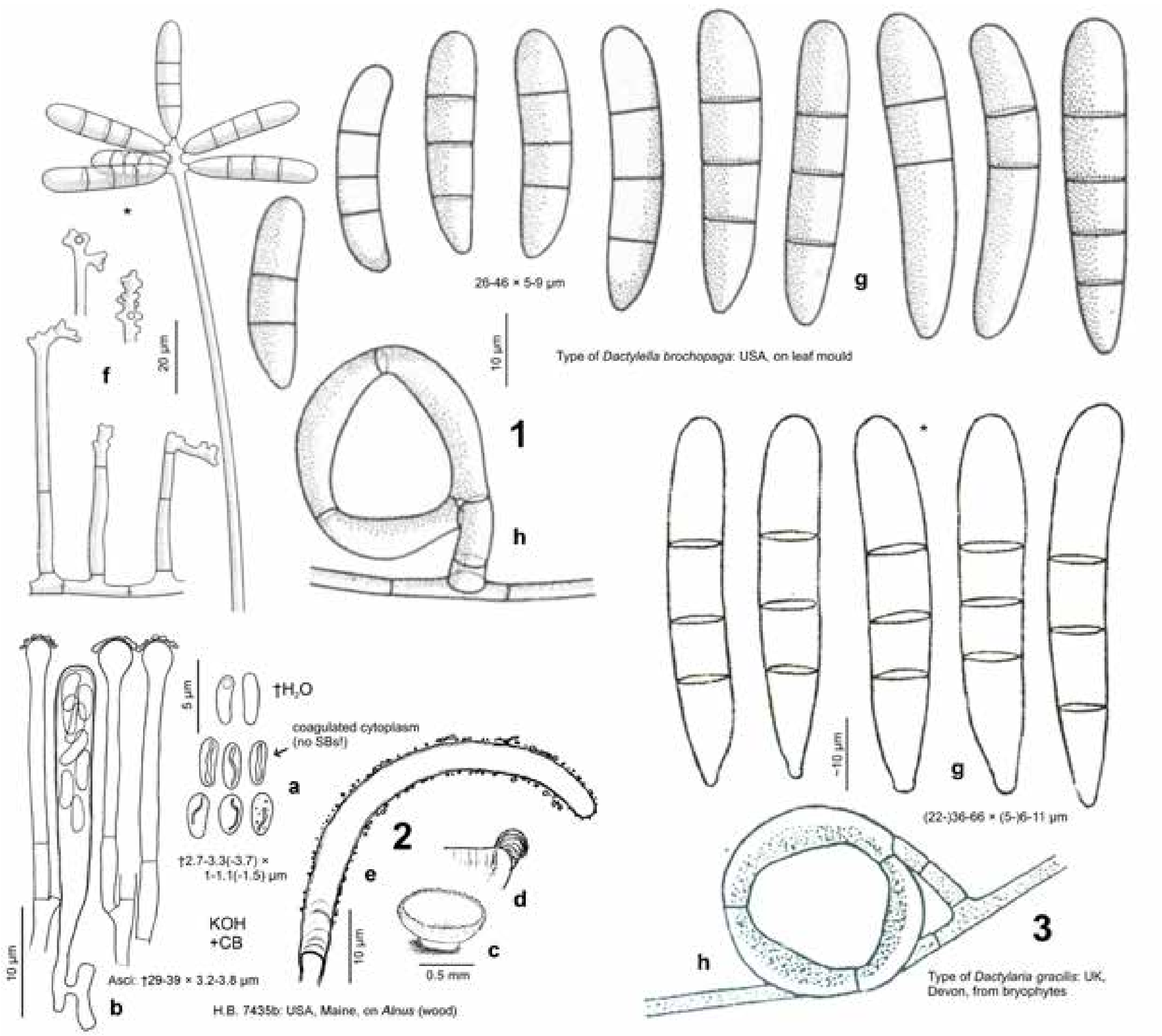


Plate 1018. **1**: *Orbilia brochopaga*; **2–3**: *O.* cf. *brochopaga*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. rehydrated apothecium; **d**. marginal region in median section with agglutinated glassy processes; **e**. closeup of glassy process; **f**. conidiophores; **g**. conidia; **h**. constricting ring (anamorph from soil isolates). – **1**: from Drechsler (1937a), **3**: from Duddington (1951, scale adjusted). – The long filiform, refractive, serpentinoid inclusion in dead spores of **2a** is an artifact caused by coagulation of cytoplasm.

less the case in European (Pls 1015: 3i, 4i; 1016: 1m, 7d) or Chinese strains (Pl. 1017: 2f) of *O. orientalis* s.l. In correlation with this almost equidistant septation, the macroconidia of *O. orientalis* s.l. tend to be apically curved, unlike those of *D. brochopaga* or *Dactylaria gracilis*.

Neither Drechsler nor Duddington observed microconidia in their cultures. A few conidia with shorter terminal cells, which Duddington considered as apparently imperfectly developed, he reported with only 22–31 × 5–9 µm. On Duddington's drawing the conidia measure 39–43 × 6.2–7 µm when evaluated from the scale. Since also the outer diameter of the constricting ring, for which he gave a size of 24–33 µm, measures only 22 µm on his drawing, we assume that his scale was wrong, and we adjusted it in the present reproduction according to his measurements.

Misinterpretations. The following reports do not represent genuine *D. brochopaga* but phylogenetically distinct though morphologically very similar species. Yu et al. (2006) reported *Drechslerella brochopaga* as anamorph of *O. orientalis*, gained from ascospore isolates of two collections, one from China (Jiangxi, treated here as *O.* cf. *tonghaiensis*, Pl. 1020: 3) and one from Europe (here referred to *O. orientalis*, Pls 1015: 4; 1016: 1). Simultaneously, Liu (2006: 88, as *D.* cf. *brochopaga*/*O. orientalis*) reported a similar anamorph-teleomorph connection based on an ascospore isolate of a Chinese collection (here referred to *O. yunnanensis*, Pl. 1014: 2). In a further European specimen (W-France, Pl. 1015: 3i–j) the anamorph was formed on mycelium growing out of the fruitbody at the lid of a Petri dish.

Not included collections. A single apothecium growing in a collection of *O. dryadum* from Maine (Pl. 1018: 2) fits quite well the type of *O. orientalis* but is named here *O.* cf. *brochopaga* because of its northeastern North American origin. Two similar samples from tropical Middle America (Puerto Rico, IVV: H.B. 5952; Martinique, Pl. 450: 1a–b) entirely lack glassy processes and their paraphyses are apically not inflated; whether they belong in series *Drechslerella* or instead in series *Orbilia* is uncertain. For the not included anamorph-typified *Dactylaria gracilis* see under Anamorph, and for other anamorphic isolates see under Phylogeny.

Phylogeny. ITS sequences of 13 strains in GenBank and/or CBS, all under the name *Drechslerella* (or *Arthrobotrys*) *brochopaga*, form a rather homogeneous, medium supported clade (Phyl. 36). This clade includes two authentic strains of Drechsler (from Florida and unlocalized) sequenced by Liou & Tzean (1997) and CBS, a strain from Ecuador isolated by A. Rubner and sequenced by Pfister (1997), strains from Beijing (Yang et al. 2007), Taiwan (Kuo et al. 2008), and Burkina

Faso (CBS, isolated by J.L. Devineau), and seven strains from Peru (Murga-Gutierrez et al. 2012). The Peru sequences are incomplete in the ITS1, once in the ITS2 (JF748757), and once entirely lacking ITS2 (JF748758).

The distance among these sequences lies in the range of 0–1.6 % in the ITS region. This variation occurs especially among the strains from Peru. On the other hand, one species from Africa shows full identity with some from North and South America. A distance of 0.4 % (2 nt) is observed between the two authentic North American strains, but one of these nucleotides (pos. 157 in ITS1) seems to be incorrect in GenBank (CBS 218.61, ‘G’), as it is T in the CBS sequence in agreement with other strains. An incomplete sequence of a Peruvian isolate (JF748758, lacking ITS2) shows various sequencing errors in the 5.8S but matches others in the ITS1. Because this clade includes Drechsler’s authentic strains, it is considered here to represent the genuine *O. brochopaga*.

A sequence obtained by Ren et al. (2014a) remained unpublished and was not available to us. It clustered in their neighbour joining tree of ITS with a low distance (~ 1–2 %) with strains of *O. brochopaga* from Peru (JF748752, JF748753) and Taiwan (FJ380936), whereas its distance to *O. yunnanensis* and *O. orientalis* is expected to lie above 10 %.

In our analysis of the ITS region, two further taxa need to be separated from genuine *O. brochopaga*. *O. tonghaiensis* comprises three somewhat heterogeneous ascospore isolates from Yunnan, and *O.* aff. *brochopaga* contains an obviously misidentified soil isolate from Xinjiang (Chen et al. 2007b, as *Dactylella tenuis*, AS 6.0287) and a nematode isolate from California (Smith & Jaffee 2009, as *D. brochopaga*, dm5s_a2), with a distance of 4.5 % to each other. Two further ITS sequences under the name *A. brochopagus* in the CBS database (CBS 574.91, Germany; CBS 597.92, Netherlands, not shown) are associated with this clade, the former differing from *D. tenuis* only by 3 indels, and the latter from both by 4 %. The distance between this and *O. tonghaiensis* lies at 8–10 %, and the distance of both to *O. brochopaga* at 6.5–9.5 %. The morphologically similar *O. yunnanensis*, *O. naumburgensis*, and *O. orientalis* cluster in distant clades and differ from the above by ~ 9–12 %.

For the strain from Ecuador and one from Oman also LSU (D1–D3) was available. The two strains are identical in this region, although a 13 % distance in the ITS between them is observed in the CBS database. Here *O. brochopaga* differs from European *O. orientalis* by 3 %, and from *D.* aff. *brochopaga* from California (dm5s_a2) by 1.2–1.3 % (3–3.5 % between *O. orientalis* and *D.* aff. *brochopaga*).

Two of the *O. brochopaga* s.str. strains include a short part of SSU (Florida and Taiwan), and both possess the S1506 intron in which they differ by 1.5 % (in accordance with a 1.4 % distance in the ITS), whereas the distance to other taxa with similar conidia lies at ~ 10–18 %. When analysing this gene region, *O. brochopaga* clustered with strong support sister to the rest of the *brochopaga-polybrocha* clade, except that *O. tonghaiensis* clustered with *O. bembicodes* distant from those (S30).

Ecology. *O. brochopaga* is mainly known from its anamorph which was isolated from soil or plant material (herbaceous roots, leaf mould). The species is verified from eastern North America with a warm-continental (Maryland) to warm-temperate (Virginia) humid, or a subtropical subhumid climate (Florida). The South American isolates were from ruderal soil in a tropical subhumid coastal forest of Ecuador (A. Rubner 1994) and from irrigated *Asparagus* cultivations on sandy alluvial soil in coastal tropical hyperarid northern Peru (Murga-Gutierrez et al. 2012). The African isolate is from the subtropical semiarid savannah in the Sahel belt of the southern Sahara, and the Chinese ones from continental temperate to subtropical humid, monsoon-influenced climates.

Records under the name *Drechslerella brochopaga* actually show a worldwide distribution, which is exemplified here by two reports without molecular data, originating from nematode-infested soil of *Citrus* plants in the hyperarid subtropical eastern part of the Arabian peninsula (Nizwa, Oman, Elshafie et al. 2003) and from nematode-infested roots of *Oryza* in subtropical humid (winter-dry) rice fields in southern Asia (Benares, northern India, Singh et al. 2007).

Among the not included collections, the four strains with sequence data include temperate humid Europe, mild-maritime humid coastal California, and cool-continental ?semiarid northwestern China, and the two without molecular data are from cold-temperate humid coastal northeastern North America and from atlantic mesotemperate humid coastal southwestern England (holotype of *Dactylaria gracilis*).

Specimens included. **CANADA**: **Ontario**, unlocalized (Barron 1979a). — **USA**: **Maryland**, near Cumberland, and **Virginia**, Arlington, leaf mould in deciduous forest, ?100–300 m, undated, C. Drechsler (**type** [illustration], conid. isol., doc. vid.). – **Florida**, ~23 km ENE of Lakeland, Lake Alfred, 50 m, plant debris, 18.IV.1959, C. Drechsler (authentic mycelial isolate, CBS 218.61, ATCC 14451, CCRC 32702 etc., conid. isol., non vid.; sq.: U51950, AY965823, AY965794). – **USA**: unlocalized, undated, C. Drechsler (authentic isolate, Turnbull & Zachariah 1978, Zachariah & Insell 1978, mg-20, CBS 756.85, ATCC 13897, conid. isol., doc. vid.; sq.: MH861913, MH873602). — **ECUADOR**: **Manabí**, 8.5 km WNW of Jipijapa, 9 km E of Puerto Cayo, ~600 m, ruderal soil isolate, III.1993, A. Rubner (A.R. 9314, PAO5828s, CBS 332.94, ARSEF 4815, D.H.P. 212, conid. isol., non vid.; sq.: U72609 [in Pfister 1997 erron. as U72608], AY261176). — **PERU**: **La Libertad**, Virú, Pur Pur, ~50 m (conid. isol., non vid.; sq.: JF748752, JF748757, JF748758). – Virú, Río Seco, ~30 m (mol. extr., non vid.; sq.: JF748753, JF748754, JF748755). – **Chao**, San Carlos Alto, ?100 m (mol. extr., non vid.; sq.: JF748756) – (all isolated from nematode-infested rhizosphere of *Asparagus officinalis*, Murga-Gutierrez et

Table 95. Comparison of characters of the anamorph in species of series *Drechslerella* with cylindrical, 3-septate conidia. Constricting ring outer diameters refer to unexpanded rings formed from mycelium, not directly from conidia. All measurements in living state. * = microconidia present in sample of Ren et al. (2014a).

Taxon	Macroonidia [µm]	Septation	curvature	Microconidia	Outer diam. of ring [µm]
Orbilia brochopaga (type)	26–46 × (5–)6–7(–9)	centrally aggregated	± straight	–*	20–40 & 105–130
Dactylaria gracilis (type)	(22–)36–66 × (5–)6–11	centrally aggregated	± straight	–	24–33
O. tonghaiensis (Yunnan)	(27–)29–37(–39) × 5–6.5(–7.5)	centrally aggregated	± straight	+	26–28.5
O. cf. *tonghaiensis* (Jiangxi)	20–36 × 5–7.5	intermediate	± straight	–	25–27 & 80–85
O. yunnanensis	16.2–30.5 × 5–6.5	± equidistant?	intermediate	+	18–25
O. orientalis (Europe)	(27.5–)30–39(–45) × 6.5–7.5(–9)	± equidistant	± curved	–	35–39
O. cf. *orientalis* (China)	28–39.5 × 6–8	± equidistant	± curved	–	21–22
O. aff. *orientalis* (Serbia)	(20–)22–39 × (5.7–)6–6.6(–7.1)	intermediate	± curved	–	?
O. naumburgensis	33–38 × 7–8	± equidistant	± curved	?	?

al. 2012). — **CHINA**: **Beijing**, soil isolate (strain 701, CGMCC (AS) 3.6765, conid. isol., non vid.; sq.: AY773456). – **Guangxi**, **Nanning**, Wuming, N of Nanning, NE of Wuming, Damingshan, [300–1500 m], branch of indet. tree, on wood, 3.VIII.2012, collector not stated (Ren et al. 2014a, Guangxi University, anam. cult., doc. vid. sq.: ined.). – **Taiwan**, unlocalized (BCRC 34361, conid. isol., non vid.; sq.: FJ380936). — **BURKINA FASO**: Bam, 300–400 m, soil isolate, undated, J.L. Devineau (BF 115-94, CBS 374.97, conid. isol., non vid.; sq.: CBS ined.). – ibid., unlocalized (BF 125-95, CBS 459.97, conid. isol., non vid.; sq.: CBS ined.).

Not included. **USA**: **Maine**, 25 km E of Brunswick, 9 km NNW of Boothbay Harbor, Oven's Mouth Preserve, 10 m, trunk of *Alnus*, on wood, 30.VII.1994, D.H. Pfister (D.H.P. 107 [0.103] [soc. *O. dryadum*], FH 00458098, H.B. 7435b ø). – **California**, ~30 km WSW of Santa Rosa, Bodega Bay, soil under *Lupinus arboreus* (Smith & Jaffee 2009, dm5s_a2, ATCC 96710, conid. isol., non vid.; sq.: EF445987). — **PUERTO RICO**: 6.3 km SSE of Rio Grande, El Yunque, El Verde, forest entrance trail before Oxcart Trail, 385 m, branch of indet. angiosperm, on wood, 24.I.1996, F.A. Harrington & M. Liftik (D.H.P. PR 133, FH, H.B. 5952 ø). — **LESSER ANTILLES**: **Martinique**, 4.5 km NNW of Case-Pilote, 4 km SE of Le Carbet, Bois La Roche, ~300 m, branch of indet. angiosperm, on wood, 27.VIII.2005, C. Lechat & R. Courtecuisse (H.B. 8034b, C.L.L. 5132). — **GREAT BRITAIN**: **South West England**, **Devon**, 27 km SE of Plymouth, Marlborough, ~100 m, from moss, undated, C.L. Duddington (holotype of *Dactylaria gracilis*, K, conid. isol., doc. vid.). — **NETHERLANDS**: **Drenthe**, Tynaarlo, grassland soil, 1992, H. Velvis (NTF 24, CBS 597.92, as *Arthrobotrys brochopagus*, conid. isol., non vid.; sq.: CBS ined.). — **GERMANY**: **Berlin**, pasture soil, ?1988, G. Jancke and M. Schmecktal (CBS 574.91, as *A. brochopagus*, conid. isol., non vid.; sq.: CBS ined.). — **CHINA**: **Xinjiang**, unlocalized, soil, 2003, X.Z. Liu (AS 6.0287, as *Dactylella tenuis*, conid. isol., non vid.; sq.: DQ494360).

Orbilia tonghaiensis Z.F. Yu, Baral & E. Weber, in Zhang et al., Int. J. Syst. Evol. Microbiol. 70: 2669 (2020) — Pls 1019–1020

Etymology: from the geographical origin, Tonghai, a county in Yunnan province. **Typification**: China, Yunnan, Tonghai, Xiushan, branch of indet. angiosperm, IX.2007, J.W. Guo & S.F. Li (Z.F.Y. th3b-44, YMFT 1.03006, holotype; sq.: MF948423).

Latin diagnosis: *Similis* Orbiliae orientali *sed ascosporae breviores et latiores, conidia leniter curvatae, cellulae terminales conidiarum longiores, laquei constringentes minores. Habitat ad lignum ramuli uvidi angiospermarum in zona subtropica humida Asiae meridio-orientalis.*

Description: — **TELEOMORPH** (from type): **Apothecia** rehydrated 0.5 mm diam., 0.18–0.2 mm high (receptacle 0.11→ 0.06 mm), whitish to light orange; disc flat, margin smooth; substipitate, stipe 0.09 × 0.3 mm; dry pale yellowish-cream. **Asci** *30–33 × 4.3–4.8 µm {YMF 1.03006}, †23–30 × 3–3.3 µm {H.B. 8741}, 8-spored, spores *biseriate, †uniseriate, ~2–4 lower spores inverted (sometimes strongly mixed), pars sporifera *12.5–15 µm long, †11–16(–19) µm; **apex** (†) medium to strongly truncate (not indented, laterally not widened); **base** with short to long, thick or thin, flexuous stalk, T-, Y-, h- or H-shaped. **Ascospores** *2.1–2.5 × 1.4–1.7 µm {H.B. 8741} or *2.5–2.8(–3.5) × 1.8–2(–2.2) µm {YMF 1.03006}, subcylindric-ellipsoid to ovoid, ends rounded, sometimes slightly inequilateral; **SBs** *0.8–1.2 × 0.3–0.4 µm, not or slightly eccentrical, divided into a small tear-shaped to ovoid lower part and a fine, short, apically attached filum. **Paraphyses** apically slightly to (very) strongly capitate-clavate(-spathulate), terminal cell *12–16 × 3–4 µm, †(7.5–)11–15 × 2–3.5(–4) µm, lower cells *3–6 × 1.7–2.3 µm, †4–7 × 1.3–1.7 µm; unbranched at upper septum. **Medullary excipulum** 20–50 µm thick, of dense textura globulosa-intricata, sharply delimited. **Ectal excipulum** of (†) slightly gelatinized, t. globulosa-angularis at base and flanks, 100–150 µm thick near base, cells †16–38 × 10–30 µm, common walls 0.5–1(–1.5) µm thick; 15 µm at margin, of t. globulosa(-prismatica) oriented at a 60–80° angle, marginal cortical cells †6–10(–13) × 4–8 µm; **glassy processes** absent. **Anchoring hyphae** not examined. **SCBs** and **VBs** apparently absent. **Exudate** over paraphyses 0.2–0.3 µm thick, ± continuous. — **ANAMORPH**: drechslerella-like (from ascospore isolate {2}). **Macroconidiophores** unbranched below, erect, *150–190 µm high, ~2–2.5 µm wide at base, *1.7–2 µm at apex, here with 5–10 denticles, sometimes proliferating. **Macroconidia** cylindrical, rounded above, shortly tapered-truncate below, straight to very slightly curved, *(27–)29–37(–39) × 5–6.5(–7.5) µm {2}, (1–)3-septate, terminal cells partly much longer (up to 3.5×) than middle cells, lipid content low. **Microconidiophores** similar to macroconidiophores but more tiny. **Microconidia** *10–14(–16.5) × 3.5–4(–4.5) µm {2}, cylindrical with tapered base, 1-septate. **Constricting rings** with 1-septate stalk of *12–14 × 4–4.6 µm; ring unexpanded *26–28.5 µm outer diam., *18.5–20 µm inner diam., 3-celled, ring cells *5.5–6 µm wide, at septa apparently with internal triangular wall thickenings.

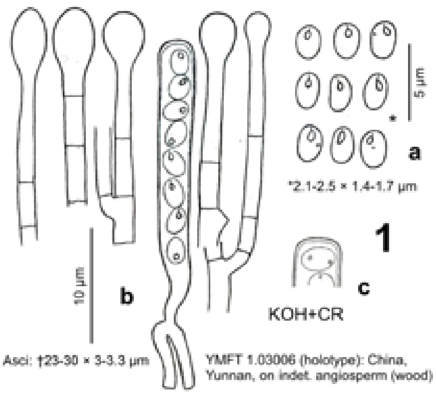


Plate 1019. **1**: *Orbilia tonghaiensis*. – **1a**. ascospores; **1b**. ascus and paraphyses; **1c**. ascus apex.

Habitat: collected on the moist ground on decorticated, thin branch of indet. angiosperm trees {2}, on strongly decayed wood {1}. **Associated**: none observed. **Desiccation tolerance**: intolerant, except for the ascospores which abundantly survived after 6 months in the herbarium. **Altitude**: ~1850 m a.s.l. **Geology**: Devonian to Carboniferous sedimentary rock. **Phenology**: VII, IX.

Taxonomic remarks. *Orbilia tonghaiensis* differs from *O. orientalis* and *O. yunnanensis* in shorter ascospores, shorter terminal cells of paraphyses, and in lacking glassy processes, perhaps also in the SBs being tear-shaped and only slightly eccentrical. In the anamorph it differs from *O. orientalis* in forming microconidia, less curved macroconidia with the septa more accumulated in the middle, and smaller constricting rings. Also from *O. brochopaga* it seems to differ in smaller constricting rings.

The drawing of the teleomorph of *O. tonghaiensis* (Pl. 1019) originates from a single apothecium of the holotype which was received in the dry state. The original photo plate (Pl. 1020: 1) was based on another apothecium and yields distinctly larger measurements of asci, spores, and paraphyses when evaluated from the scale in Zhang et al. (2020a), given that this scale is correct. The topotype collection (Pl. 1020: 2) is without data of the teleomorph which was not retained in a herbarium (Z.F. Yu pers. comm.).

Not included collections. A sample from Dali (IVV: H.B. 8932) without molecular or cultural data has smooth apothecia and an ascospore size (*2.7–3 × 1.7–1.8 µm) very similar to *O. tonghaiensis*, but the SBs are partly rod-shaped and very eccentrical, therefore, this could instead be a short-spored form of *O. orientalis*. Also not included is the collection from Ji'an, Jiangxi, which was reported by Yu et al. (2006, YMFT 1.01829, partly erroneously as 1.01892) under the names *O. orientalis*/*D. brochopaga* (Pl. 1020: 3), with longer ascospores of *3.1–3.9 × 1.6–1.8 µm which contain hardly eccentrical tear-shaped SBs as in *O. tonghaiensis* (for differences in the anamorph see below). The apothecial margin was reported with very short or perhaps even absent glassy processes (Yu et al. 2006).

Anamorph. Ascospore isolates were gained from the holo- and topotype of *O. tonghaiensis*. In both the formation of macro- and microconidia was observed, and in the holotype also constricting rings occurred. The conidia match typical *O. orientalis* in size except that they are less curved. The not included collection from Jiangxi (Tab. 95, IVV: YMFT

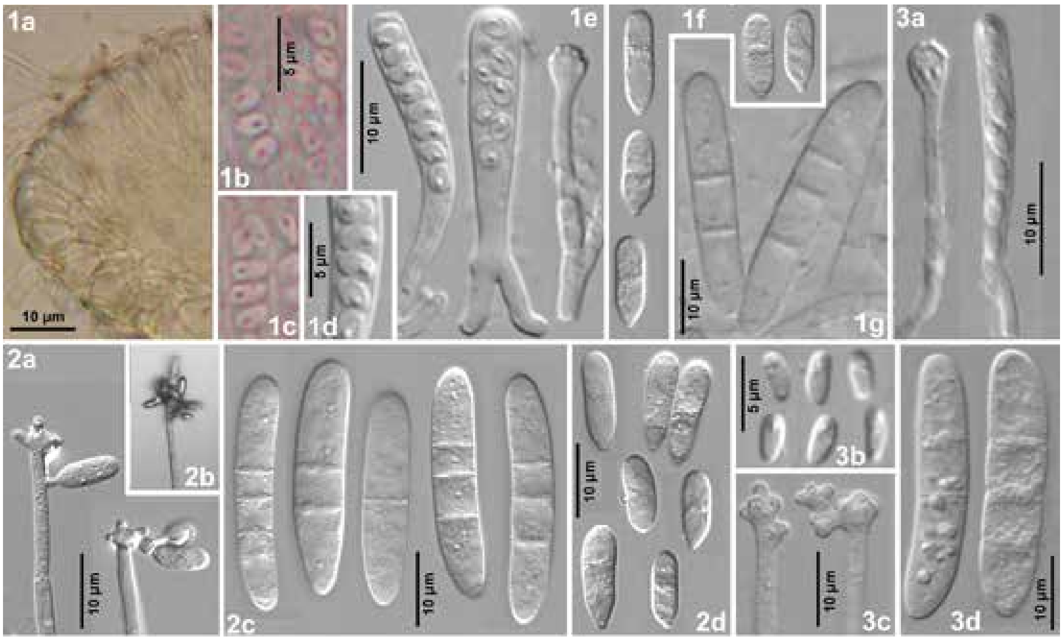


Plate 1020. **1–2**: *Orbilia tonghaiensis*; **3**: *O.* cf. *tonghaiensis*. – **1a**. marginal ectal excipulum in median section, lacking glassy processes; **1e**, **3a**. asci and paraphyses; **1b–d**, **3b**. ascospores; **3c**. macroconidiophores; **1g**, **2c**, **3d**. macroconidia; **2a–b**, microconidiophores; **1f**, **2d**. microconidia (anamorph from pure culture). – Living state, except for **1a** (in KOH), left ascus in **1e**, ascus and paraphysis in **3a**. – **1d–g** & **2a–d**: phot. Z.F. Yu, **3a–d**: from Yu et al. (2006). — **1a–g**. YMFT 1.03006 (holotype): China, Yunnan, Yuxi, Tonghai, on indet. angiosperm; **2a–d**. YMFT 1.03003: ibid.; **3a–d**. YMF 1.01829: China, Jiangxi, Ji'an, on indet. angiosperm.

1.01829) appears to differ from *O. tonghaiensis* in not forming microconidia. Both the constricting rings and macroconidia have a comparable size. Yet, a discrepancy in measurements occurs in Yu et al. (2006) who gave macroconidia of *20–36 × 5–7.5 µm, in correspondence to their fig. 2 G–J (without oil immersion) with *24–29 × 5–6 µm according to scale, whereas their Fig. K–L (with oil immersion) yields a possibly wrong size of 35–36 × 6.5–8 µm. The constricting rings occurred in two very different sizes: besides the normal ones of 25–27 µm diam. were also giant ring traps with an outer diameter of 80–85 µm (60–65 µm inner diam.) frequently present 1–2 days after the normal ones were formed (Z.F. Yu pers. comm.). The statement of 30–40 µm large rings in Yu et al. (2006) refers to *O. orientalis* from France (H.B. 7379).

Phylogeny. Sequences of the ITS region were available for the holo- and topotype from Tonghai and for *O.* cf. *tonghaiensis* from Jiangxi. The holotype and the Jiangxi strain cover also the 3'-end region of SSU and include the S1506 intron. Holo- and topotype clustered in a strongly supported clade (Phyl. 36), though with a 5 % distance in the ITS region. The Jiangxi strain (YMF 1.01829) clustered with medium support and a 7.3–7.7 % distance sister to *O. tonghaiensis* s.str. In fact, the Jiangxi strain shares some nucleotides with the holo- and some with the topotype, therefore, the three strains might well be conspecific. The three strains require exclusion from *O. brochopaga*, to which they clustered weakly supported as a sister clade, with a distance of 7.5–9.5 % (8.5–10 % to *O.* aff. *brochopaga*).

In the S1506 intron the holotype of *O. tonghaiensis* differs by 11 % from the Jiangxi strain. When analysing this gene region, the two strains clustered unexpectedly in a weakly supported clade with *O. bembicodes*, very distant from the rest of the *brochopaga-polybrocha* clade (S30).

Ecology. *O. tonghaiensis* s.l. was collected on rotten wood (type) and bark (not included samples) of hygric branches of unidentified angiosperms in the subtropical humid (winter-dry) evergreen broad-leaved montain forests in southern (Yunnan) and southeastern China (Jiangxi).

Specimens included. **CHINA**: **Yunnan**, **Yuxi**, Tonghai, ~35 km SE of Yuxi, ~3.5 km S of Tonghai, eastern part of Xiushan, ~1850 m, branch of indet. angiosperm, on wood, IX.2007, J.W. Guo & S.F. Li (Z.F.Y. th3b-44, YMFT 1.03006, **holotype**; ex-type culture CGMCC 3.18835, anam. cult.; sq.: MF948423, MF948496, H.B. 8741 ø). – ibid., branch of indet. angiosperm, on wood, VII.2007, J.W. Guo & S.F. Li (Z.F.Y. th2b-10, YMF/T 1.03003, CGMCC 3.18836, anam. cult., doc. vid.; sq.: HQ711928/ MF948422, MF948495).

Not included. **CHINA**: **Jiangxi**, **Ji'an**, ~13 km SW of Ji'an, Jinggangshan, 848 m, bark of indet. angiosperm, 1.X.2005, Y. Zhang (Y.Z. jg-7, YMFT 1.01829, anam. cult., doc. vid.; sq.: HQ711929, as *D. brochopaga*). – **Yunnan**, **Dali**, Yongping, 35 km ENE of Baoshan, virgin forest around Golden Light temple (Jinguangsi), 2730 m, branch of indet. angiosperm, on bark, 25.X.2008, H.Y. Su et al. (H.Y.S. jgs-24, H.B. 8932).

Incertae sedis

Five species without known anamorph are treated as 'incertae sedis' within section *Arthrobotrys*. They show similarities to species in series *Neodactylella*, *Dactylellina*, *Gamsylella*, and *Drechslerella*. *O. cyparissias* and *O. acuum* are only known from the old holotype specimens, therefore no information about SBs and VBs were available and a relation to members of series *Orbilia* (section *Orbilia*) cannot be excluded.

Orbilia sp. H.B. 8963 — Pls 1021–1022

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.3–1.2 mm diam., 0.12–0.13 mm high (receptacle 0.09–0.11 mm), light cream-rose, translucent, ± round, subgregarious; disc flat, margin ± thick, not protruding, smooth; broadly sessile, superficial; dry light to bright cream-orange, with sunken disc and protruding margin. **Asci** †34–40 × 3–3.8 µm, 8-spored, spores †1–2-seriate, 3–5 lower spores inverted (± mixed); **apex** (†) medium truncate (not indented, laterally not inflated); **base** without or with short to medium long, ± thin, flexuous stalk, h-shaped. **Ascospores** *5.3–6.8 × 1–1.2 µm, †5–6.3 × 1–1.2 µm, cylindrical to fusoid, homopolar, apex rounded to obtuse, base not or slightly attenuated, straight to slightly inequilateral; **SBs** 1–1.5 × 0.4–0.6 µm, subglobose to ellipsoid, rarely tear-shaped, ± eccentrical, filum not seen, attachment mostly invisible. **Paraphyses** apically slightly to strongly (clavate-)capitate, terminal cell †17–20 × 2.5–3.8 µm, lower cells †6–7 × 1.5–1.8 µm; unbranched at upper septum. **Medullary excipulum** 15–20 µm thick, of dense textura porrecta(-intricata), horizontally oriented, slightly gelatinized, with many small inflated cells, sharply delimited. **Ectal excipulum** of (†) thin-walled, vertically oriented t. prismatica-angularis from base to margin, 50–80 µm thick near base, cells */†12–28 × 10–18 µm; 20 µm thick at

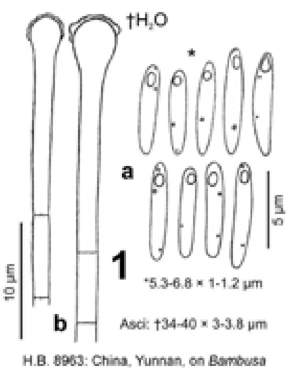


Plate 1021. **1**. *Orbilia* sp. H.B. 8963. – **a**. ascospores; **b**. paraphyses.

margin, oriented at a 80–90° angle to the surface, marginal cortical cells †6–11 × 2.5–5 µm; **glassy processes** absent. **Anchoring hyphae** medium abundant, †2–3 µm wide, walls 0.2 µm thick. **VBs** present at least in lower cells, elongate, medium refractive. **Exudate** over paraphyses 0.2–0.5 µm thick, firmly attached, ± rough, over margin 0.5–1.5 µm thick, cloddy to cap-like, very pale yellowish. — **ANAMORPH**: unknown.

Habitat: at tip of dead rotten stems of *Bambusa* sp. {1}, on leaf sheaths, ± blackened, no algae. **Associated**: black setae of hyphomycete. **Desiccation tolerance**: many basal excipular cells and ascospores viable after ~6 weeks. **Altitude**: 2700 m a.s.l. **Phenology**: X.

Taxonomic remarks. The present taxon differs from *Orbilia quercus*, *O. lysipaga* (series *Dactylellina*), and *O. bambusina* in longer asci and larger basal excipular cells, from the latter two also in the complete absence of glassy processes at the margin which are, however, very short in the above two taxa. A further difference is seen in the morphology of the spore bodies, which are ± eccentrical and apically apparently not visibly connected. In ascospore and SB morphology the specimen strongly resembles also a coprophilous Austrian sample (Pls 1023–1024, see below).

Ecology. *Orbilia* sp. H.B. 8963 grew on rotten leaf sheaths of bamboo stems in an altimontane subtropical humid (winter-dry) broad-leaved evergreen forest at the eastern end of Himalaya in southern China.

Specimens included. **CHINA**: **Yunnan**, **Dali**, 42 km NNE of Dali, Jizushan, 2700 m, on leaf sheaths of stems of *Bambusa*, 20.X.2008, X.M. Gao et al. (H.B. 8963).

Orbilia sp. H.B. 8749 — Pls 1023–1024

Description: — **TELEOMORPH**: **Apothecia** fresh 0.5–1 mm diam., 0.2–0.23 mm high, whitish(-cream), slightly translucent, ± round; disc slightly to strongly convex, margin indistinct, not protruding, smooth; broadly sessile, superficial. **Asci** *(30–)33–36(–43) × 3.9–4.2 µm, †28–33 × 3.4–4.2 µm, 8-spored, spores *4-seriate, 4–5 lower spores inverted (often mixed), pars sporifera *12–14 → 10 µm long; **apex** (†) strongly truncate (not or slightly indented and laterally inflated); **base** with short to medium long, ± thin, flexuous stalk, Y-, h- or H-shaped. **Ascospores** *5–6.8 × 1.2–1.4 µm, cylindric(-ellipsoid) to very slightly fusoid-clavate, apex rounded to obtuse, base not or slightly attenuated, straight to slightly curved below; **SBs** *1.4–1.7 × 0.5–0.8 µm, ± eccentrical, subglobose to tear-shaped, narrowed to a fine, very short, mostly invisible filum. **Paraphyses** apically slightly to strongly clavate-capitate, terminal cell *15–25 × (3–)4–5.5 µm, lower cells *4–10 × 2.3–3.3 µm; unbranched at upper septum. **Medullary excipulum** ~60 µm thick, of dense textura globulosa(-intricata), very indistinctly delimited from ectal excipulum. **Ectal excipulum** of thin-walled t. globulosa from base to margin, 70–100 µm thick near base, cells *9–25 × 7–20 µm; 30 µm thick near margin, oriented at an 80–90° angle to the surface, marginal cortical cells *10–20 × 8–12 µm, firm-walled; **glassy processes** absent. **Anchoring hyphae** sparse, *3–5 µm wide, walls 0.1–0.2 µm thick. **SCBs** and **VBs** absent. **Exudate** over paraphyses and ectal excipulum 0.1–0.3 µm, firmly attached, smooth to finely rough. — **ANAMORPH**: (presumed, from natural substrate). **Conidiophores** ~120–180 µm long, conidia formed singly at apex. **Conidia** *38–42.5 × 16–22 µm, fusiform, with 2 septa near the base and 1 near the apex. **Trapping organs** unknown.

Habitat: on dung of *Ovis*. **Associated**: none observed. **Desiccation tolerance**: unknown, possibly intolerant. **Altitude**: 1500 m a.s.l. **Phenology**: unknown.

Taxonomic remarks. This collection resembles *Orbilia polybrocha* (series *Drechslerella*) in ascospore characters, but differs in hyaline apothecia, absence of glassy processes, much wider marginal cortical cells, wider SBs, and in the presumed

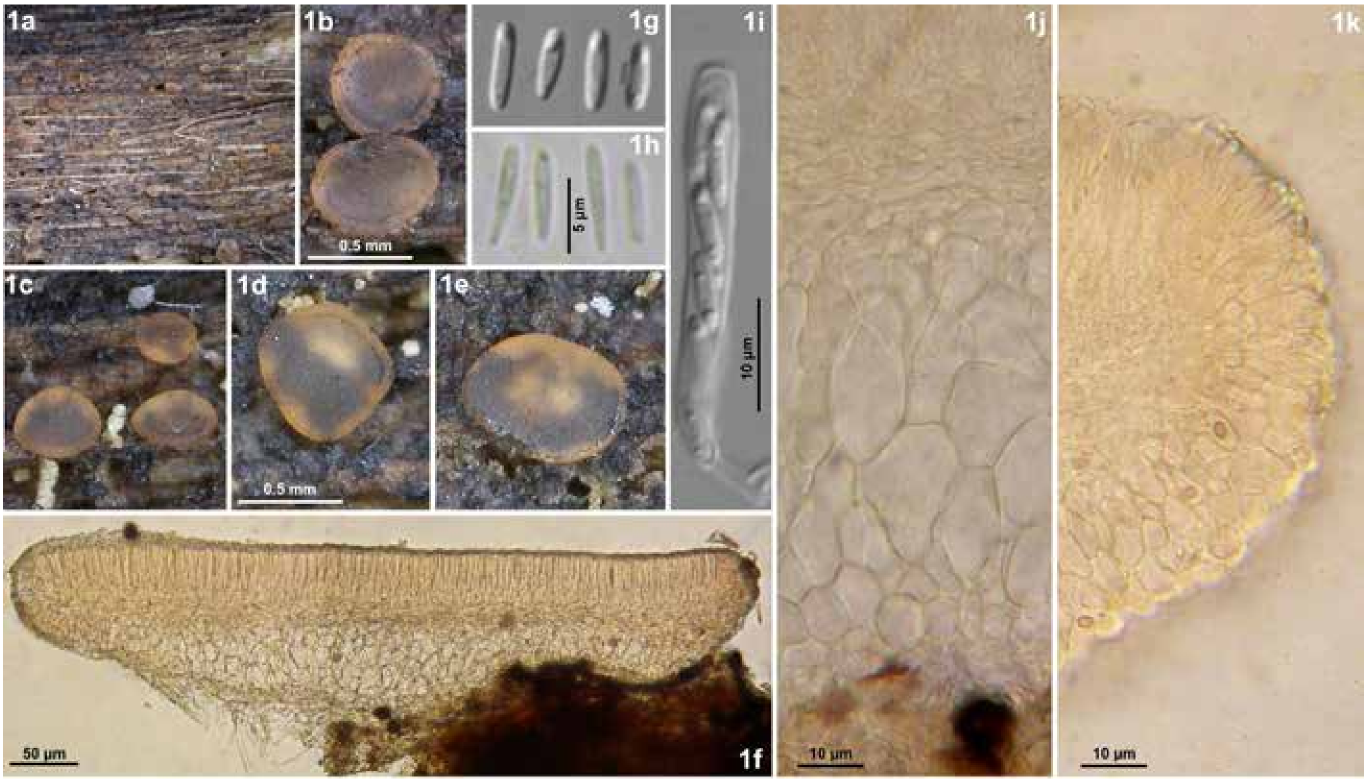


Plate 1022. **1**: *Orbilia* sp. H.B. 8963. – **1a–e**. rehydrated apothecia; **1f**. apothecium in median section; **1j**. id., central part; **1k**. id., marginal region; **1i**. ascus; **1g–h**. ascospores. – Living state (spores in **1g** & **1i**), except for **1f** (in H_2O), **1h**, **k** (in KOH), ascus in **1i**. – **1g**, **i**: phot. H.Y. Su. – **1a–k**. H.B. 8963: China, Yunnan, Dali, on *Bambusa*.

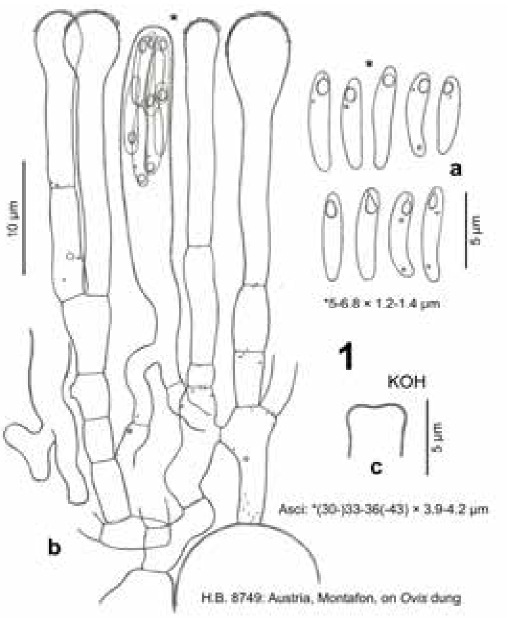


Plate 1023. **1**: *Orbilia* sp. H.B. 8749. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apex.

anamorph (fusiform conidia with 3 septa). In the ascospores and SBs this specimen resembles the Chinese collection of *O. alba* (series *Gamsylella*), but it lacks sublanceolate paraphyses, also the conidia are different. A subtropical Chinese collection on leaves (husks) of *Bambusa* (Pl. 1021–1022) strongly resembles the Austrian collection in spore and SB morphology, with the SBs also somewhat eccentrical and not visibly connected to the spore apex. Also a specimen mentioned under *O. cardui* (series *Neodactylella*, Pls 906: 7; 907: 4) is similar but deviates in wider ascospores with consistently globose SBs.

Anamorph. The conidia of *Drechslerella bembicodes* (≡ *O. bembicodes*) strongly resemble the present anamorph, especially when comparing the Drechsler's (1937a) type description. Since no trapping organs could be observed, its relationship remains uncertain.

Ecology. *Orbilia* sp. H.B. 8749 was collected on droppings of sheep in a pasture near a subalpine *Picea* forest in the orotemperate humid central northern part of the calcarean Alps.

Specimens included. **AUSTRIA**: **Vorarlberg**, Montafon, 12 km S of Schruns, W of Gargellen, ~1500 m, dung of *Ovis*, 12.VIII.07 W. & H. Friese, 26.I.2008 grown in moist box, P. Welt pers. comm. (H.B. 8749, anam. substr.).

Orbilia bambusina Baral, **sp. nov**., MB 813998 — Pls 1025–1026

Etymology: named after the substrate of the type, *Bambusa*.

Typification: Australia, Queensland, Cape Tribulation, stem of *Bambusa*, 30.VIII.2006, G. Marson (ex H.B. 8497b, BRI AQ799193, holotype).

Latin diagnosis: *Similis* Orbiliae quercus *sed ascosporae apice partim subacutae, corpuscula refringentes angustiora, excipulum marginale processis vitreis brevissimis praeditum. Habitat ad culmos vel folia putrida sicca* Bambusae *et* Cocois *in zona tropica humida Australiae septentrio-orientalis.*

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.28–0.34 {1} or 0.4–0.8 mm diam. {T}, 0.08–0.12 mm high (receptacle 0.07–0.09 → 0.5–0.7 mm), pale greyish-cream, somewhat translucent, round, scattered to subgregarious; disc flat, margin distinct, 5–10 µm protruding, very finely crenulate; broadly sessile, superficial. **Asci** †22–33 × 3–3.5 µm {2}, 8-spored, spores †2–3-seriate, 4 lower spores inverted {1} (often mixed), pars sporifera †13–20 µm long; **apex** (†) medium to strongly truncate (not indented, laterally not or very slightly inflated); **base** without or with short to medium long, ± thin, flexuous stalk, Y- or h-, rarely H-shaped. **Ascospores** *(4.5–)5–6.8(–7.5) × (1–)1.1–1.2(–1.3) µm {2}, †5–6 × 1–1.1 µm {1}, fusoid to often fusoid-clavate, apex obtuse to subacute, base medium to strongly attenuated, straight to inequilateral or slightly curved; **SBs** 0.9–1.7 × 0.3–0.6 µm {2}, tear- to rod-shaped or slightly ampulliform, narrowed to a wide or small point. **Paraphyses** apically slightly to strongly (clavate-)capitate, terminal cell †(11–)13–18(–22) × 2.5–4(–5) µm {2}, lower cells †(3–)5–7 × 1.2–2.5 µm {2}; unbranched at upper septum. **Medullary excipulum** 15–20 µm thick, of dense textura intricata, horizontally oriented, with many inflated cells, indistinctly to ± sharply delimited from ectal excipulum. **Ectal excipulum** of (†) thin-walled, indistinctly vertically oriented t. angularis-globulosa from base to mid flanks or margin, 20–60 µm thick near base, cells †8–16 × 6–11 µm {2}; 15–20 µm thick near margin, of t. prismatica-angularis oriented at a 70–80° angle to the surface, partly forming distinct cell rows, marginal cortical cells †4.5–13 × 3–5.5 µm {2}; **glassy processes** (0–)1–4 × 3–5 µm {2}, low-refractive, not or indistinctly stratified. **Anchoring hyphae** medium abundant, †1.5–3 µm wide, walls 0.1–0.2 µm thick {2}. **SCBs** and **VBs** no data available. **Exudate** over paraphyses forming 0.1–0.5 {1} or 1–2(–3) µm {T} thick, firmly attached glassy caps, over margin and flanks 0.3–2 µm thick, (rough-)cloddy to granular. **— ANAMORPH**: unknown.

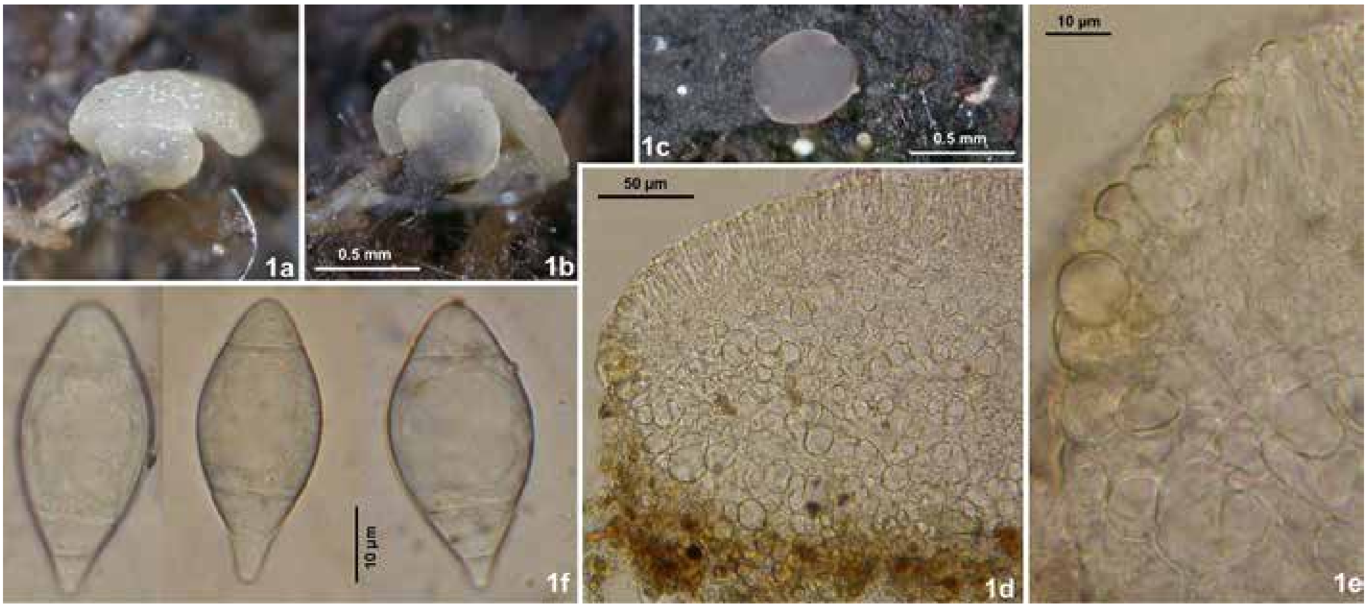


Plate 1024. **1**: *Orbilia* sp. H.B. 8749. – **1a–c**. fresh apothecia (surrounded by conidiophores); **1d**. apothecium in median section; **1e**. id., marginal ectal excipulum; **1f**. conidia from substrate. – All in living state. — **1a–e**. H.B. 8749: Austria, Montafon, on *Ovis* dung.

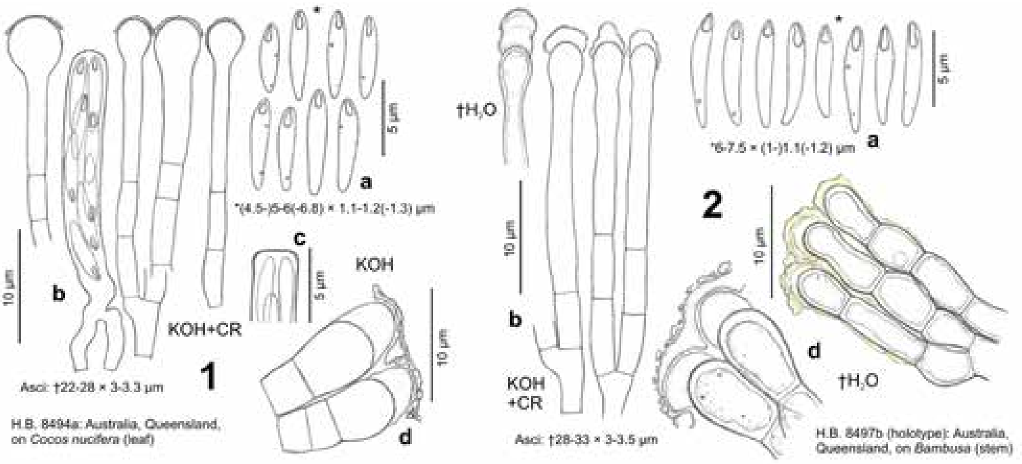


Plate 1025. **1–2**: *Orbilia bambusina*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apex; **d**. marginal cortical cells with glassy caps.

Habitat: collected 0.5–3 m above the ground, on 14 mm thick standing dead rotten stem of *Bambusa* sp. {1}, rotten leaf of *Cocos nucifera* {1}, strongly greyed, no algae. **Associated**: *Hyalorbilia citrina* {1}, *Orbilia cejpii* {1}, *O.* ?*tremulae* {1}. **Desiccation tolerance**: probably slightly tolerant, but only the ascospores viable when examined after 8.5 months. **Altitude**: 14 m a.s.l. **Geology**: Devonian sedimentary rock. **Phenology**: VIII (southern hemisphere).

Taxonomic remarks. *Orbilia bambusina* is characterized by rather small, fusoid ascospores containing tear- to rod-shaped SBs, and by a marginal ectal excipulum of textura prismatica terminated by short glassy caps.

O. bambusina is similar to the teleomorphs of *O. quercus* and *O. lysipaga* (series *Dactylellina*, for the differences see under these species). It might instead be close to *O. cardui* and *O. cocois* (series *Neodactylella*) which differ in more globose SBs, longer asci, and distinctly thicker apothecia. The partial distinctness of marginal cell rows in *O. bambusina*, though running under a high angle, actually suggest a connection with

Plate 1026. **1–2**: *Orbilia bambusina*. – **1a–b**. tropical rainforest with *Bambusa* stand (holotype locality); **1c–i**, **2a–c**. rehydrated apothecia; **1j**, **2d**. marginal ectal excipulum in median section. – Dead state (in KOH). — **1a–j**. H.B. 8497b (holotype): Australia, Queensland, Cape Tribulation, on *Bambusa*; **2a–d**. H.B. 8494a: ibid., on *Cocos*.

a dactylella-like anamorph. Species of series *Regales* (section *Aurantiorubrae*) with non-spathulate paraphyses (*O. aradi*, *O. puyae*) differ from *O. bambusina* in thicker, yellow to orange apothecia, longer and/or wider, more curved spores, and in wider SBs with a more globose lower part. Other species with similar spores (e. g., *O. cylindrospora* of section *Orbilia* or *O. atlantis* of series *Neodactylella*) differ from *O. bambusina* mainly in globose SBs and the absence of caps of exudate on the paraphyses.

Variation. The very sparse collection on *Cocos* (Pl. 1025: 1) differs from the holotype in smaller apothecia, slightly shorter and wider ascospores, smaller SBs, shorter asci, and paraphyses with distinctly more inflated apices lacking glassy caps. Until the variability of the species is further explored, the two specimens are considered as conspecific. In the type collection (Pl. 1025: 2) the exudate caps over paraphyses and glassy caps stained bright reddish-brown in IKI.

Ecology. *O. bambusina* was found on xeric stems and leaves of large monocotyledons (*Bambusa*, *Cocos*) in a tropical humid (dry in the less warm winter) rainforest area in northeastern Australia.

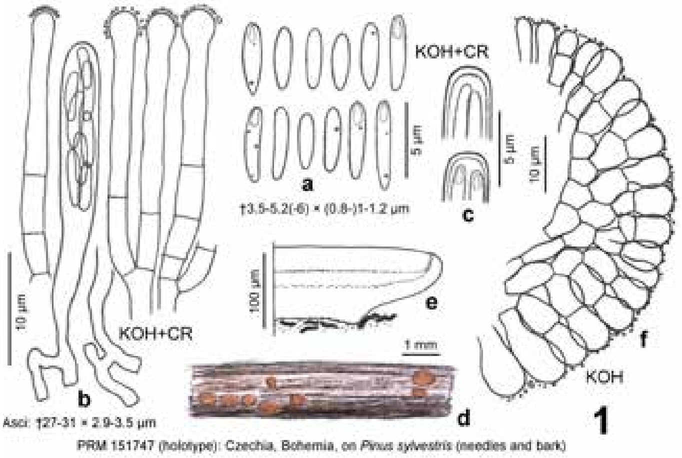
Specimens included. **AUSTRALIA**: **Queensland**, Wet Tropics, border of Daintree forest, 43 km N of Port Douglas, Cape Tribulation, 14 m, leaf of *Cocos nucifera*, 30.VIII.2006, G. Marson (H.B. 8494a). – ibid., stem of *Bambusa*, 30.VIII.2006, G. Marson (ex H.B. 8497b, BRI AQ799193, **holotype**).

Orbilia acuum Velen., Monogr. Discom. Bohem.: 94, pl. 11 fig. 22 (1934) — Pl. 1027

Etymology: according to the substrate in the type, needles of *Pinus*.
Typification: Czechia, Lysá nad Labem, needles and branch of *Pinus sylvestris*, VI.1927, J. Velenovský (PRM 151747, holotype).
Misinterpretation of *O. acuum*: Spooner (in Kirk & Spooner 1984: 573, fig. 9B, erroneously as 'A' on the plate), = *O. dryadum*.

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.25–0.55 mm diam., 0.11 mm high (receptacle 0.08 mm), pale cream-orange (fresh whitish, glassy-translucent), round, gregarious in small groups; disc flat, margin distinct, not protruding, smooth; broadly sessile, superficial; dry bright brick-red-orange. **Asci** †27–31 × 2.9–3.5 µm, 8-spored, spores †2–3-seriate, basal spores inverted, pars sporifera 14.5 µm long; **apex** (†) slightly, rarely medium to strongly truncate (not indented, laterally not inflated); **base** with medium long, thin, slightly flexuous stalk, h- to H-shaped. **Ascospores** †3.5–5.2(–6) × (0.8–)1–1.2 µm, subcylindrical (rarely narrowly ellipsoid-fusoid), apex rounded to obtuse, base not or slightly attenuated, rarely acute, straight to slightly inequilateral; **SBs** †1.2–1.4 × 0.5 µm, partly visible as a transparent, narrowly tear-shaped region. **Paraphyses** apically uninflated or slightly, rarely medium capitate, terminal cells †12–18 × 1.8–3 µm (× 3–4 µm fide Svrček), lower cells †(2–)4–5(–7) × 1.8–2.6 µm; unbranched at upper septum. **Medullary excipulum** 20 µm thick. **Ectal excipulum** of thin-walled, vertically oriented textura globulosa-angularis from base to margin, 40 µm thick near base, cells †14–18 (–23 fide Svrček) × 10–12 µm; 20 µm thick near margin, oriented at a 90° angle to the surface, marginal cortical cells almost globose, †6–10 × 5–8 µm; **glassy processes** absent. **Anchoring hyphae** †2.5–4 µm wide, thin-walled (fide Svrček). **SCBs** no data available. **Exudate** over paraphyses, margin and flanks 0.2–0.4 µm thick, granular, ± firmly attached. **— ANAMORPH**: unknown.

Habitat: on a corticated, ~15 mm thick branch of *Pinus sylvestris*, on medium decayed bark (periderm) and needles, strongly greyed or blackened, no algae seen. **Associated**: none observed. **Desiccation tolerance**: unknown (possibly slightly desiccation-tolerant). **Altitude**: 200 m a.s.l. **Geology**: Upper Cretaceous calcareous clay- & marlstone. **Phenology**: VI.



PRM 151747 (holotype): Czechia, Bohemia, on *Pinus sylvestris* (needles and bark)

Plate 1027. **1**: *Orbilia acuum*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apices; **d**. pine needle with rehydrated apothecia; **e**. apothecium in median section; **f**. id., ectal excipulum at margin. – Most elements originate from an apothecium on a needle, but those in which a spore body was seen derive from bark.

Taxonomic remarks. In concordance with Svrček (1954: 8), *Orbilia acuum* is tentatively accepted here as a distinct species which is only known from the features of the dead type specimen (Velenovský's illustration does not show cell contents). Its characteristics are the small, subcylindrical, ± straight ascospores with apparently narrowly tear-shaped SBs, paraphyses which are only slightly capitate, and large, globose marginal cortical cells being externally covered by a thin granular exudate.

The species might be close to *O. epipora* (series *Neodactylella*) with which it was compared by Spooner (in Kirk & Spooner 1984: 573). However, the spores in *O. acuum* are longer, not shorter than in *O. epipora* as was thought by Spooner who did not examine type material of the two species. Actually, the collection which he identified as *O.* cf. *acuum* (on decorticated wood, Scotland) seems to be *O. dryadum* (section *Orbilia*). *O. acuum* appears to differ from *O. epipora*, *O. dryadum*, and also *O. atlantis* (series *Neodactylella*) in the shape of the spore body which could be discerned as an elongate tear-shaped transparent region in the more blunt end of the spore, whereas the mentioned species have globose SBs. The affinities of *O. acuum* might also be with *O. cyparissias*, a species with a much thicker, cloddy exudate (see p. 1659), or with species around *O. rectispora* (series *Neodactylella*) which have longer spores. It is also similar to members of series *Dactylellina*, e. g. *O. quercus*, *O. acuum*.

Type studies. The holotype of *O. acuum* contains ~15 apothecia on rotten needles (covered by thin blackish mycelium), and a further ~50 on bark. Bark was not mentioned by Velenovský in the protologue, but the apothecia on it were found to be conspecific by Svrček (1954) and in the present study, and showed more free spores. Only in the examined apothecium from bark the spore body could be seen in the present study (Pl. 1027: 1a, c).

Velenovský reported the apothecia as '0.5–1 mm, sessile, glassy translucent, whitish', but they were here found to be rehydrated distinctly smaller (0.25–0.55 mm) and are now pale cream-orange. Also Svrček reported them as 'dry pale yellowish-amber or straw-coloured yellow, 0.1–0.3 mm diam.'. He found the spores slightly smaller than evaluated here (3–4 × 0.8–1 µm, Velenovský: 2–3 µm), but the paraphyses apically clavate, 3–4 µm wide. Although the protologue says 'without epithecium', Velenovský's manuscript plate shows granular exudate over 1 paraphysis. This granular exudate was also observed by Svrček (especially in apothecia on bark) and in the present study. The asci are reported by both (Svrček as 20–24 × 3–3.5 µm, including stipe, Velenovský 20–24 × 3 µm), but on bark Svrček observed them often to be up to 30 µm long. The dark brown basal hyphae mentioned by Velenovský as 'hypothallus' belong to a different fungus.

Not included collection. Also an Australian sample on unidentified monocot (IVV: H.B. 8995b) was only studied in the dead state. It differs in smaller asci (†23–26 × 2.7–3 µm) and spores (†3.3–4 × 0.8–0.9 µm), a thicker exudate (0.5–1 µm) over the paraphyses, a marginal excipulum of elongated cells oriented at an oblique angle, and smaller apothecia (0.15–0.22 mm).

Ecology. *O. acuum* is only known from the holotype, which grew on rotten bark of a branch and on needles of *Pinus sylvestris* in subcontinental, cold-temperate humid central Europe. The monocot sample is from subtropical semihumid banksia-eucalypt woodland in southwestern Australia.

Specimens included. **CZECHIA**: **Central Bohemia**, ~30 km ENE of Praha, Lysá nad Labem, ~200 m, branch of *Pinus sylvestris*, on bark, also on needles, 11.VI.1927, J. Velenovský (PRM 151747, **holotype**, H.B. 6063 ø).

Not included. **AUSTRALIA**: **Western Australia**, Swan Coastal Plain, Perth, Kings Park, 48 m, culms of (?)*Liliidae*, 14.XI.2007, G. Marson (H.B. 8995b).

Orbilia cyparissias Velen., Monogr. Discom. Bohem.: 101 (1934) — Pl. 1028

Etymology: referring to the host plant, *Euphorbia cyparissias*.

Typification: Czechia, Mnichovice, stem of *Euphorbia cyparissias*, IX.1933, J. Velenovský (PRM 721481, holotype).

Description: — **TELEOMORPH**: **Apothecia** rehydrated 0.3–0.7 mm diam., 0.12 mm high, light yellowish-cream, fresh pale vinaceous fide Velenovský, round, scattered or in small groups; disc flat to slightly convex, margin indistinct, not protruding, smooth; sessile, superficial. **Asci** †30–40 × 2.8–3.5 µm, 8-spored, spores biseriate, 5 lower spores inverted (strongly mixed); **apex** (†) slightly to medium truncate (not indented, laterally not widened), hemispherical in profile view, ± thin-walled; **base** with short to medium long, thin, flexuous stalk, L- or H-shaped. **Ascospores** †(3–)3.5–4.5(–5.2) × 0.8–1.2 µm, subcylindric-clavate to clavate, apex rounded (to obtuse), base mostly slightly to medium attenuated, mostly slightly curved (comma-shaped); **SBs** visible as a transparent region †1.3–1.8 µm long, possibly tear-shaped. **Paraphyses** apically uninflated to slightly capitate-clavate, terminal cell †14–18 × 2–3 µm, lower cells †(3–)5–6 × 1.5–2.5 µm. **Medullary excipulum** 45 µm thick, of ± loose textura intricata, medium sharply delimited from ectal excipulum. **Ectal excipulum** of thin-walled, vertically oriented t. angularis from base to mid flanks, 50 µm thick near base, cells †7–12 × 6–8 µm; 20 µm thick near margin, marginal cortical cells vertically oriented, †6.5–11 × 2.5–3.5 µm, cylindric-clavate, thin-walled, without **glassy processes**. **Anchoring hyphae** medium abundant, †1.7–2.2 µm wide, walls 0.2 µm thick. **SCBs** and **VBs** no data available. **Exudate** over paraphyses 0.5–2 µm thick, cloddy, hyaline, ± firmly attached; at margin and flanks thin, ± granular. **— ANAMORPH**: unknown.

Habitat: 3.5 mm thick stem of *Euphorbia cyparissias*, slightly decayed. **Associated**: black, small, hysterioid, very senescent fungus (apothecia partly growing on it). **Desiccation tolerance**: unknown, probably slightly tolerant. **Altitude**: 400 m a.s.l. **Geology**: biotite-amphibolite & quartz diorite. **Phenology**: IX.

Taxonomic remarks. *Orbilia cyparissias* is characterized by small, slightly curved ascospores being mostly ± tapered at the base, with a probably tear-shaped SB in the apex, also by hardly inflated paraphysis apices covered by thick exudate. The species might be related to *O. cardui* (series *Neodactylella*), from which it differs in distinctly shorter, more curved spores and the absence of glassy processes. *O. acuum* has similar spores and apparently also similar SBs, but the spores are more straight and less attenuated at the base, the exudate over the paraphyses much thinner, and the marginal cortical cells much wider. *O. epipora* (series *Neodactylella*) differs in lacking exudate over the paraphyses and in straight spores with globose SBs. *O. alba* (series *Gamsylella*) and *O. quercus* (series *Dactylellina*) resemble *O. cyparissias*, but differ in a thinner exudate over the paraphyses, wider marginal cortical cells, and smaller SBs, the latter also in more straight, slightly longer spores, the former in larger apothecia and longer and narrower spores. Another possible relation might be with *O. caulicola* (section *Aurantiorubrae*), which differs in larger spores with globose SBs. However, in section *Aurantiorubrae* H-shaped ascus bases were generally not observed.

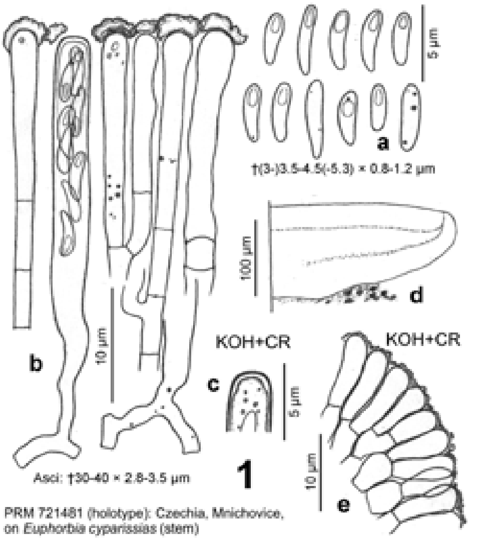


Plate 1028. **1**: *Orbilia cyparissias*. – **a**. ascospores; **b**. ascus and paraphyses; **c**. ascus apex; **d**. apothecium in median section; **e**. id., ectal excipulum at margin.

Type studies. Velenovský (1934) described the apothecia as 0.5–1 mm diam., pale vinaceous, the spores as 2–3 µm long, arcuate, and the paraphyses covered by a strong 'epithecium'. The unpublished manuscript plate shows strongly allantoid, narrow, homopolar spores without contents. When considering a calibration error of ~50 %, these spores might have an actual size of ~5–6 × 0.8–1 µm in situ. Svrček (1954) found the spores 4–5 × 0.8 µm, slightly curved, rarely almost straight, the exudate over the paraphyses 3–4 µm thick, and compared the species with *O. minutispora* (section *Orbilia*, see p. 1385).

Ecology. *O. cyparissias* was collected on blackened, dead, possibly xeric stems of *Euphorbia cyparissias* in subcontinental, cold-temperate humid central Europe. The altitude is colline and the site a hill with probably thermophilous vegetation.

Specimens included. **CZECHIA**: **Central Bohemia**, ~27 km SE of Praha, Mnichovice, hill above, ~400 m, stem of *Euphorbia cyparissias*, IX.1933, J. Velenovský (PRM 721481, **holotype** of *O. cyparissias*, H.B. 6129 ø).

List of excluded, doubtful, or little-known taxa

Included in this list are all those taxa which have ever been combined in the orbiliaceous genera *Cheilodonta*, *Habrostictis*, *Hyalinia*, *Orbilia*, *Orbiliaster*, and *Orbiliella*. Only a small number of the many taxa ever combined in the genus *Patinella* have been examined in the present study and are mentioned below, since *Patinella* comprises only a few truly orbiliaceous members. Some taxa combined in genera other than those mentioned above have erroneously been assumed by previous workers to belong to *Orbilia*. They are also treated here, as well as two with the epithet '*orbilioides*' which have never been combined in orbiliaceous genera. The taxa are arranged according to their specific or infraspecific epithet.

Patinella abietina (Cooke) Sacc., Syll. Fung. 8: 771 (1889)

≡ *Patellaria abietina* Cooke, Grevillea 7: 4 (1878)
= *Patinella atroviridis* Rehm, Rabenh. Krypt.-Fl., 1.3: 312 (1889)

In the holotype material (USA, California, on '*Abies douglasii*' [= *Pseudotsuga menziesii*], undated, W.H. Harkness 763, K(M) 36005, IVV: H.B. 5529) the wall surface of the entire asci and the ascogenous hyphae stains distinctly blue in IKI (with or without KOH-pretreatment). The dark olivaceous-brown pigment in the excipulum dissolves in KOH and gives a strong honey-yellow stain to the medium (ionomidotic). The asci are thin-walled including the apex, arise from croziers, and contain 8 slightly heteropolar spores (6–8.2 × 1.8–2 µm) which include some minute LBs. *Patinella atroviridis* Rehm is a later synonym (see p. 1662).

Also two recent collections of this species (USA, Arizona, Flagstaff, Grand Canyon, on wood of *Pinus ponderosa*, G. Marson, IVV: H.B. 5776a; ibid., on wood of *Pinus edulis*, IVV: H.B. 5227d) were studied. A pure culture of H.B. 5776a produced a striking yellow-olivaceous mycelium and small conidia formed in phialides. The living ascospores did not contain refractive, KOH-sensitive contents.

The peculiar amyloid iodine reaction that gives a blue stain to the entire hymenium suggests a relationship with lichenized discomycetes, but any association with algae could not be observed. A very similar, unidentified species on decorticated xeric *Olea* branches in Spain with a similar yellow-orange KOH reaction of the excipulum deviates by larger ascospores (S. Tello, IVV: 26.VI.2015). Its ITS+LSU rDNA (KY462809) suggests a relationship with *Lecanoromycetes* (Phyl. 1).

Orbilia agyrioides (Desm.) Quél., Enchir. Fung.: 298 (1886)

≡ *Peziza agyrioides* Desm., Ann. Sci. Nat., Bot., sér. 2, 8: 9, pl. 2 fig. 5 (1837)
≡ *Hyalinia agyrioides* (Desm.) Boud., Hist. Class. Discom. Eur.: 104 (1907)
(?)= ***Iodophanus carneus*** (Pers.) Korf, in Kimbrough & Korf, Am. J. Bot. 54: 19 (1967)

The holotype (France, Haute-Vienne, date and collector not indicated, on dry plant stems, Desmazières Pl. Crypt. N. France no. 1803; PC 1054) was studied and found to be a species of *Iodophanus* Korf, probably *Iodophanus carneus* (Pers.) Korf. The asci measure 220 × 25 µm and react diffusely pale blue in KOH+IKI (not restricted to apex), and the spores are ellipsoid, smooth, 16–22 × 10–13 µm, without LBs.

For the very different *Helotium agyrioides* P. & H. Crouan see under *Hyalinia crouanorum*, p. 1668.

Hyalinia albella – see *H. albida*

Hyalinia albida (With.) Boud. [as '*H. albella*'], Hist. Class. Discom. Eur.: 103 (1907)

≡ *Peziza albida* With., Bot. Arr. Brit. Pl., ed. 2, 3: 440 (1792) [non *P. albida* (All.) Lam. 1804; nec *P. albida* Sowerby 1799; nec *P. albida* Roberge in Desm. 1850, ≡ *Hymenoscyphus albidus* (Gillet) W. Phillips]
≡ *Helotium albidum* (With.) P. Karst. [as '*H. albellum*'], Bidr. Känn. Finl. Nat. Folk 19: 116 (1871), nom. illegit., ICN Art. 53.1 [non *Helotium albidum* P. & H. Crouan 1867, ≡ *Mniaecia albida*, see below; nec *Helotium albidum* (Gillet) Pat. 1885, nom. illegit, ICN Art. 53.1, ≡ *Hymenoscyphus albidus*]
≡ *Pezizella albida* (With.) Sacc. [as '*P. albella*'], Syll. Fung. 8: 280 (1889)
≡ *Pseudopeziza albida* (With.) Massee [as '*P. albella*'], Brit. Fung.-Fl. 4: 202 (1895)

Peziza albida With. was first published by Withering in 1792 (see Ramsbottom & Balfour-Browne 1951, B. Spooner pers. comm.), but authors (e. g., Fries 1822: 146) have more frequently cited Withering (1796: ed. 3, vol. 4: 350) as basionym, which provides the same description. According to Nannfeldt (1939: 244), Withering's original description refers to a fungus which 'seems to be identical with, or closely allied to *Peziza adae* Sadl.' (= *P. domiciliana* Cooke, *Pezizales*). *Peziza albida* was described as growing on a cellar floor in joints of the bricks, with pinky white apothecia 1/4–3/4 of an inch (~7–20 mm) diam. If type material would be found, *P. albida* might provide an older name for *P. domiciliana*. However, nothing of Withering's taxa seems to have been preserved (B. Spooner pers. comm.).

Fries (l.c.) reduced *Peziza albida* (as '*albella*') to synonymy or infraspecific level of his new species *P. vulgaris* Fr. [≡ *Calycina vulgaris* (Fr.) Baral], a helotialean fungus described from bark of *Corylus*, with much smaller (max. ~2 mm), whitish apothecia. Phillips (1890, see also Rehm 1892: 710) pointed out the strange discrepancy in ecology and macroscopy of these two very distant taxa. Fries actually identified a collection on *Rubus*, with incarnate, later pale rose apothecia, as '*P. albella* With. arr. IV, p. 350'. Saccardo (1889: 281) interpreted this as the erection of a new variety, *Pezizella vulgaris* var. *incarnata* Fr. Fries (1822: 146) changed Withering's epithet *albida* to *albella*, a procedure considered as incorrect by Phillips (l.c.), Rehm (l.c.), and Nannfeldt (l.c.). Nevertheless, many authors have followed Fries's name change. Perhaps Fries did this in order to avoid confusion with homonyms. In any case, he wrote in the index to his volume the correct name '*Peziza albida*' (Fries 1832: 126), as already mentioned by Nannfeldt.

When interpreting *P. albida* With., later authors obviously relied on Fries's misinterpretation of Withering's taxon. For example, Saccardo (1889: 278, 280), followed by Boudier (1907), stated '*P. albella*' to be a synonym of *Peziza vulgaris*. Nevertheless, both authors published a new combination for the taxon (in *Pezizella* and *Hyalinia*, respectively), obviously because of priority of *P. albida* over *P. vulgaris*. Nannfeldt apparently reexamined Karsten's and Massee's specimens of *Helotium albellum* and *Pseudopeziza albella*, respectively, and stated that both belonged to *Allophylaria vulgaris* (Fr.) Nannf. (≡ *Calycina vulgaris*).

Orbilia albida (P. & H. Crouan) Quél., Enchir. Fung.: 299 (1886)

≡ ***Mniaecia albida*** (P. & H. Crouan) Priou & Baral, **comb. nov.** — MB 814586

Basionym: *Helotium albidum* P. & H. Crouan, Florule Finistère: 47 (1867) [non *Helotium albidum* (With.) P. Karst. 1871, see under *Hyalinia albida*]

≡ *Calycina albida* (P. & H. Crouan) Kuntze, Revis. Gen. Pl. 3: 448 (1898)
≡ *Ombrophila albida* (P. & H. Crouan) Boud., Hist. Class. Discom. Eur.: 93 (1907)
= *Epiglia gloeocapsae* Boud., Bull. Soc. Mycol. Fr. 1: 113 (1885)
≡ *Mniaecia gloeocapsae* (Boud.) Van Vooren, Bull. Mens. Soc. Linn. Lyon 74 (spéc.): 19 (2005)

The protologue of *Helotium albidum* (Crouan & Crouan 1867) and an unpublished original illustration preserved at CO refer to a terricolous fungus with sessile, whitish, smooth, hemispherical apothecia, clavate asci with ellipsoid-oblong, multiguttulate spores, and apically hooked paraphyses. Le Gal (1953: 108) redescribed the type material ('sur la terre, 22.X.1866') and referred the fungus to the *Hyaloscyphaceae*, close to *Cistella*, mainly because of small, smooth, unicellular hairs near the margin.

However, judging from Crouan's illustration which was not at Le Gal's disposition, the species is more reminiscent of a white member of *Mniaecia* Boud. Actually, reexamination of the type material by J.P. Priou (IVV: 22.X.1866) revealed it to be an earlier synonym of *Mniaecia gloeocapsae* (Boud.) Van Vooren as described and figured by Boudier (1904–10: 262, pl. 454). Le Gal found the rehydrated apothecia to measure 0.5–0.6 mm diam., not 2–3 mm as stated by Crouan & Crouan (1867), and to grow in groups in connection with small mosses. The dead spores are now filled with large and small oil drops as a result of fusion of the originally numerous small LBs (OCI 5). Typical of the genus *Mniaecia* are the inamyloid asci (in IKI, KOH-pretreated), a feature not tested by Le Gal and Boudier.

J.P. Priou found the spores in the type non-septate, 6–9 × 3–4 µm, whereas Le Gal reported them (8–)10–12 × (3–)4 µm, finally 1–3-septate, apparently because she examined a more senescent apothecium. In the protologue of *Epiglia gloeocapsae* the spores are *13–16 × 5–6 µm, but evaluating Boudier's spore drawing leads to a size of *10–13(–15) × 4–5.2(–5.7) µm. A few recent collections from Bretagne on loamy or sandy ground among *Jungermanniales* very well match this species (IVV: e. g. H.B. 7324, 21.III.2015). Here a spore size of *(8–)9.5–12 × 4.5–5(–6) µm was noted.

As a curiosity, the very same words ('parmi les Jungermannes/ jongermannes et les petites mousses') were used when authors reported the ecology of *Helotium albidum* and *Epiglia gloeocapsae* (*albidum*: Le Gal 1953 regarding Crouan's label of a non-type collection made in 15.III.1868; *gloeocapsae*: Grelet 1948b: 114). Since Crouan's taxon has priority over Boudier's, we here propose a new combination.

Orbilia albomarginata Rehm, Österr. Bot. Z. 56: 344 (1906), nom. nud.
?= ***Calycina discreta*** (P. Karst.) Kuntze, Revis. gen. pl. (Leipzig) 3(3): 448 (1898)

Reexamination of the material on which this taxon was based (Austria, Tirol, Schrofenpass above Warth, ?1650 m, stems of *Aconitum*, IX.1905, H. Rehm, S-F9994, IVV: H.B. 6427) revealed short stipitate, whitish-ochraceous apothecia 1.5–2.5(–4) mm diam. when dry, asci with croziers, with an IKI deep blue apical ring (BB, *Calycina*-type), and ascospores of 8–10.5 × 2–2.3 µm, with a few minute LBs. The collection clearly belongs to *Calycina* Nees ex Gray and is obviously closely related to *C. discreta*. It represents the more rare form with asci arising from croziers, slightly larger spores, and apothecia that tend to be larger. Rehm provided a handwritten Latin diagnosis attached to the specimen. Specimen and diagnosis do not seem to have any duplicates in other public herbaria, therefore, the taxon has no valid status. Saccardo & Trotter (1913: 725) listed the taxon as a 'nomen nudum' with only substrate and geographical data.

Hyalinia alboviridis (Saut.) Boud., Hist. Class. Discom. Eur.: 104 (1907)
≡ *Peziza alboviridis* Saut., Flora (Regensburg) 20: 314 (1841) [non *Peziza alboviridis* Cooke 1878, ≡ *Proliferodiscus alboviridis* (Sacc.) Spooner]
≡ *Pezizella alboviridis* (Saut.) Sacc., Syll. Fung. 8: 278 (1889)
≡ *Hymenoscyphus alboviridis* (Saut.) Kuntze, Revis. Gen. Pl. 3: 485 (1898)
?= ***Calycellina chlorinella*** (Ces.) Dennis, Kew Bull. 30: 350 (1975)

The type material (Austria, Salzburg, Pinzgau, Mittersill, rotten stems of *Rubus idaeus*, 31.X.1838, A. Sauter) was found to be immature by Keißler (1917: 86). The taxon was believed to be close to *Orbilia xanthostigma* (Saccardo 1889, as *Peziza xanthostigma*). Yet, Winter (1881: 132) considered synonymy with *Peziza dilutella* Fr. which is possibly a member of *Pyrenopeziza* Fuckel (see p. 1670). Saccardo treated the species shortly before *Pezizella chlorinella* (= *Calycellina chlorinella*, see under *Hyalinia chlorinella*, p. 1665), probably because of the greenish disc. *P. alboviridis* might, in fact, be a synonym of that species. Despite Keißler's report no material could be found in BREG, LI, SZB, and W. Saccardo gave the apothecial size as ½ cm by error (Sauter wrote '½ Linie'; in Austria this corresponds to ~1 mm).

Orbilia algiseda Velen., Novit. Mycol.: 177 (1940)

No type material exists of this taxon (Svrček 1954), which was said to grow on a layer of *Gloeocapsa* on a trunk of *Alnus*. The small, yellow to orange apothecia and the small, ellipsoid, biguttulate spores suggest identity with *O. eucalypti* or more probably *O. xanthostigma*.

Hyalinia alnicola (Feltgen) Boud., Hist. Class. Discom. Eur.: 104 (1907)
≡ *Cenangella alnicola* Feltgen, Rec. Mém. Trav. Soc. Bot. G.-D. Luxemb. 16: 89 (1903) [non *Cenangella alnicola* Rehm 1905]
= ***Phaeohelotium imberbe*** (Bull.) Svrček, Sb. nár. Mus. Praze 40B(3-4): 152 (1985) [1984]

The study of the holotype (Luxembourg, Grünew[ald]-Helms[ingen], corticated twig of *Alnus glutinosa*, J. Feltgen, LUX 43451, IVV: H.B. 6300) suggests that it is a synonym of *Phaeohelotium imberbe* (see also under *O. flexuosa*, p. 1672). The asci arise from croziers and the euamyloid apical ring is of the *Hymenoscyphus*-type.

Habrostictis diaphana var. **alpigena** (Rehm) Rehm, Ber. naturhist. Ver. Augsburg 26: 32 (1881)
≡ *Calloria fusarioides* var. *alpigena* Rehm, Ascomyc. 118 (1872)
≡ *Unguicularia alpigena* (Rehm) Höhn., Sitzungsber. Kaiserl. Akad. Wiss. Wien, Math.-Naturwiss. Kl., Abt. I, 127: 378 (1918)
= ***Laetinaevia diaphana*** (Rehm) Baral (see below)

This variety was placed in synonymy with *Naevia diaphana* (Rehm) Rehm already by Rehm (1888: 140), which is confirmed here: in two authentic specimens (both Austria, Tirol, on *Cirsium spinosissimum*: Stubai, Alpeiner Gletscher, ~2100 m, VIII.1872, H. Rehm Ascomyc. 118, M (syntype); Pitztal, ~1850 m, VIII.1875, H. Rehm, Thümen Mycoth. univ. 719, M) no differences to '*Naevia*' *diaphana* could be found (see under *Habrostictis diaphana*, p. 1669).

Pteromyces ambiguus – see p. 209

Patinella antarctica Speg., Bol. Acad. Nac. Cienc. 11 (1): 57 (1887)

≡ *Ascophanus antarcticus* (Speg.) Speg., in Saccardo, Syll. Fung. 8: 532 (1889)

Only a single, strongly overmature apothecium (rehydrated redb-rown, 0.4 mm diam.) was found in the holotype (Argentina, Santa Cruz, on dung of *Rhea darwinii* [≡ *R. pennata*], VIII.1882, C.L. Spegazzini, Fungi Patagonici 162, LPS 4861). No hymenial or excipular elements could be observed, except for abundant ellipsoid, firm-walled, smooth, eguttulate, hyaline ascospores measuring 14–18 × 10–11 µm in H_2O and 15–19.5 × 12–14.5 µm in KOH. A large, globose, non-refractive, subeccentric region (?nucleus) is very clear in H_2O but has only weak contrast in KOH. Spores and spore content closely fit Spegazzini's drawing on the convolute, except for their size (Spegazzini: 10–11 × 5–6½ µm). The observed spores appear to belong to a member of the ***Pezizales***.

Orbilia antenorea (Sacc.) Sacc., Syll. Fung. 8: 627 (1889)

≡ *Calloria antenorea* Sacc., Michelia 1(1): 64 (1877)
≡ *Hyalinia antenorea* (Sacc.) Boud., Hist. Class. Discom. Eur.: 104 (1907)

No specimens could be found in PAD, PAL, TO, and W. The taxon (Italy, Padova, on wood or bark of *Prunus laurocerasus*, III.1877, G. Bizzozero) was compared with *Calloria chrysostigma* (Fr.) W. Phillips [≡ *Psilachnum chrysostigma* (Fr.) Raitv.] and *Peziza xanthostigma* by Saccardo. From the diagnosis its generic position remains obscure. The asci (50–60 × 8 µm) were said to have a rounded apex, and the cylindrical spores (10–11 × 2–3 µm) to be somewhat curved.

Orbilia arctica Allesch., in Allescher & Hennings, Biblioth. Bot. 42: 44 (1897)

≡ ***Naeviopsis arctica*** (Allesch.) B. Hein, Willdenowia, Beih. 9: 69 (1976)

According to Hein (1976) this species grows on stems and leaves of arctic-alpine *Rosaceae* (*Alchemilla*, *Geum*, *Potentilla*). It has inamyloid asci and ascospores of 11–18 × 5–6 µm. *N. arctica* is said to be very close to the type species of *Naeviopsis* B. Hein (*Calloriaceae*, *Helotiales*), *N. epilobii* (P. Karst.) B. Hein, which has an amyloid apical ring of the *Pezicula*-type ('T-shaped').

Orbilia assimilis (Cooke & Peck) Sacc., Syll. Fung. 8: 629 (1889)

≡ *Peziza assimilis* Cooke & Peck, in Cooke, Grevillea 1: 6, pl. 1 fig. 6 (1872)
≡ ***Calloria assimilis*** (Cooke & Peck) B. Hein, Willdenowia, Beih. 9: 59 (1976)

According to Hein (1976) this is a good taxon very close to the type species of *Calloria* Fr., *C. neglecta* (Lib.) B. Hein (*Calloriaceae*). In the lectotype (USA, [New York,] West Albany, V. [no year], stems of *Aster puniceus*, M.C. Cooke & C. Peck 278, K, IVV: H.B. 5350) the asci arise from croziers and their conical apices have a slight, inamyloid apical thickening. Only 5–6 spores were seen within them, which contain a few minute LBs and measure (9–)10–11 × (3–)3.5–4 µm [Hein: 9–11(–13) × 3–4 µm]. With their medium (capitate-)clavate apices the paraphyses resemble indeed those of *Orbilia*. Another specimen under the name *O. assimilis* (USA, Virginia, Shenandoah Nat. Park, below Horver Camp, Rapidan River, VI.1935, stems of *Impatiens*, C.L. Shear, herb. Petrak, M) deviates merely in narrower spores (7–11 × 2.4–2.7 µm).

C. assimilis resembles *Duebenia compta* in its elongate, erumpent apothecia and a reduced number of spores within the asci. *D. compta* deviates in an excipulum with a yellowish-ochraceous granular exudate and in more or less lanceolate paraphyses. Whether these differences justify separation at the generic level seems questionable.

Orbilia atropurpurea Clem., Bot. Surv. Nebraska 4: 16 (1896)

Seaver (1951: 236) considered this taxon as a possible synonym of *Ascocoryne sarcoides* (Jacq.) J.W. Groves & D.E. Wilson. Upon type material request, no response was received from NY. The original description (USA, Nebraska, Brown County, Hazel Creek Canyon, on dead wood) could also fit *Coryne inflata* Wilson (nom. inval.) because of the rather small apothecia (2–5 mm) and long spores (20–25 × 5–6 µm). The paraphyses are described as 'above broadened into a minute clavula', which is perhaps not as pronounced as in *C. inflata* but might have been the reason for Clements to place the fungus in *Orbilia*.

Patinella atroviridis Rehm, Rabenh. Krypt.-Fl., 1.3: 312 (1889)

= ***Patinella abietina*** (Cooke) Sacc., Syll. Fung. 8: 771 (1889)

This species was described from Italy (Tirol, Ortler above Sulden) on decorticated trunk of *Pinus cembra*. Two North American collections on *Pinus* were referred by Sydow & Petrak (1922: 198) to this species. One of them (USA, Idaho, St. Joe National Forest, Ward's Peak, 1220 m, on decorticated branches of *Pinus albicaulis*, VI.1920 [8.VII.1920 in Sydow & Petrak], A.S. Rhoads, herb. Petrak, M) was examined and fits the protologue: the 8-spored asci arise from croziers, the wall surface of the entire asci stains pale blue (euamyloid) in IKI, the spores are cylindric-clavate, 7–9.5 × 2–2.2 µm, eguttulate, some of the lower spores are often inversely oriented inside the asci, the whole excipulum contains a blackish-brown exudate which completely dissolves in KOH and gives an ochraceous-olive stain to the medium (ionomidotic). The iodine reaction of the entire ascus wall is also mentioned by Rehm (1889) and Sydow & Petrak (l.c.). Rehm's observation is confirmed that no trace of a thallus or algae could be found. *Patinella abietina* (see p. 1660) is obviously an earlier synonym, as already suggested by Sydow & Petrak.

Habrostictis aurantiaca Rehm, Ber. naturhist. Ver. Augsburg 26: 67 (1881)

≡ *Ocellaria aurantiaca* (Rehm) Rehm, Rabenh. Krypt.-Fl., 1.3: 135 (1888)
≡ ***Pezicula aurantiaca*** (Rehm) Rehm, Ber. Bayer. Bot. Ges. 13: 198 (1912)

In a syntype (Austria, Tirol, Oetz, Kühtai, Längenthal, dry corticated branch of *Alnus alnobetula* (as *A. viridis*), VIII.1874, H. Rehm, Ascomyc. 226, M) the now orange-brown apothecia are seated on a common stroma. The asci arise from croziers and vary in the ascus apex: the apical thickening is often nearly absent and entirely inamyloid (IKI), or an apical ring of the *Pezicula*-type is present which is, however, partly reactive only in the lower part of the dome (now euamyloid). Large druses of octahedral crystals are found in the (in KOH) deep yellow stroma. Verkley (1999: 49) accepted the taxon as a distinct species of *Pezicula* Tul. & C. Tul., but neither did he report the partly iodine-positive ascus apex, nor the presence of crystals, also he found the apothecia mostly solitary without a stroma.

Orbilia betulina (Alb. & Schwein.) Höhn., Sitzungsber. Kaiserl. Akad. Wiss. Wien, Math.-Naturwiss. Kl., Abt. I, 127: 336 (1918)

≡ *Peziza betulina* Alb. & Schwein., Conspect. Fung. Lusat.: 339 (1805)
≡ *Sclerotium betulinum* (Alb. & Schwein.) Fr., Syst. Mycol. 2(1): 262 (1822)
≡ *Mollisia betulina* (Alb. & Schwein.) Rehm, Ber. Bayer. Bot. Ges. 14: 96 (1914) [non *Mollisia betulina* Velen. 1934]
≡ ***Pyrenopeziza betulina*** (Alb. & Schwein.) Rauschert, Haussknechtia 4: 54 (1988)
= *Calloria winteri* J. Kunze, Fungi Sel. Exs. no. 283 (1880), nom. nud.
= *Pyrenopeziza betulicola* Fuckel, Jahrb. Nassau. Ver. Naturkd. 23 & 24: 294 (1870)
≡ *Mollisia betulicola* (Fuckel) Rehm, Rabenh. Krypt.-Fl., 1.3: 538 (1891)
≡ *Merostictis betulicola* (Fuckel) Svrček, Česká Mykol. 39(4): 207 (1985)

Hein (1976: 108) listed *Orbilia betulina* and *Calloria winteri* as synonyms of *Pyrenopeziza betulicola*, following Rehm (1891: 538, 1914: 96) and Höhnel (1918: 336), a *Dermateaceae* with uncertain generic affiliation, possibly related to *Orbilia mollisioides* Höhn. (Nannfeldt 1932: 188). Syntypes of *Calloria winteri* (Germany, Sachsen, Eisleben, Wolferode, Holzmarken, on rotten leaves of *Betula alba*, VI.1879, J. Kunze Fungi Sel. 283) were examined in the present study (Rabenh. Fungi Eur. Exs. 3570, M) and by Hein (1976, UPS). The reddish apothecia (rehydrated, ~0.25 mm diam.) grow on the underside of the leaves. The 8-spored asci (38–44 × 7 µm) arise from croziers and have a strongly conical apex reacting deep blue (euamyloid) in IKI, the cylindrical ascospores measured around 10 × 2 µm and contained a few small LBs. The hyaline ectal excipulum is a gelatinized textura globulosa with scattered light brown patches of cloddy exudate on its surface. According to Rehm (1914: 96), *Pyrenopeziza betulina* represents an earlier synonym of *P. betulicola*. See also under *Hyalinia tumidula*, p. 1688.

Some recent collections which include vital characters appear to belong here (IVV: e.g. H.B. 9308b, 20.V.2009, 13.IV.2017) and confirm a relationship with *Pyrenopeziza* and particularly *P. fuckelii* Nannf. (= *Microscypha monticola* Svrček) on *Salix* leaves.

Orbilia boydii A.L. Sm. & Ramsb., Trans. Br. Mycol. Soc. 4: 168 (1913)

= ***Pezicula myrtillina*** (P. Karst.) P. Karst., Bidr. Känn. Finl. Nat. Folk 19: 165 (1871)

Authentic specimens on twigs of *Vaccinium myrtillus* were reexamined by Nannfeldt (1936: 199) and found to be conspecific with *Pezicula myrtillina* (see also Verkley 1999: 100), a species which possesses hemiamyloid apical rings of the *Pezicula*-type, according to personal studies of recent collections.

Orbilia caesia Rick, Brotéria, sér. Cienc. Nat. 1: 44 (1932)

The description of this taxon (Brazil, Rio Grande, on bark) is too brief to recognize its identity (apothecia 0.5 mm diam., violet-hyaline, spores ovate to cylindrical, 5–12 × 3–4 µm, paraphyses apically globose). The 'sessile' asci appear to exclude an *Orbilia*. No material under this name could be found in GH, IACM, and W.

Orbilia calamaria (Ces.) Sacc., Syll. Fung. 8: 632 (1889)

≡ *Peziza calamaria* Ces., in Rabenh., Klotzschii Herb. Viv. Mycol., Cent. 20: no. 1926, 1855 [and Bot. Zeitung 13: 283 (1855), Flora 38: 267 (1855)]
= *Hydropisphaera arenula* (Berk. & Broome 1852) Rossman & Samuels, Stud. Mycol. 42: 30 (1999)

Syntype material of *Peziza calamaria* (Italy, Piemonte, Biella, on dry leaves and culms of *Festuca* or *Calamagrostis*, aut[umn]o [1]850, V. de Cesati, Rabenh. Klotzschii Herb. Viv. Mycol. Ed. 2, no. 18 [1855]) was seen from M and HBG. In one of the two convolutes from HBG that contained fragments of a *Poaceae*, several ascocarps could be found that fit the protologue ('carneous to saturn-red, cupulate, with obtuse margin'). These are collapsed perithecia of a *Bionectriaceae*, 0.25–0.35 mm diam., bright orange-brown, asci ~50–60 × 8–11 µm, ascospores 17–19 × 4.2–4.8 µm, 1-septate, hyaline, apparently smooth. Even after rehydration the perithecia retained their collapsed shape. The species was referred to synonymy with *Hydropisphaera arenula* by Lechat & Baral (2008), a taxon which is said to have usually longitudinally striate spores.

In the syntype in M no fruitbodies could be found. The convolute contains six fragments of substrate, four of which belong to a *Poaceae* but the remaining two are stems of a dicotyledonous plant. A duplicate in RO is devoid of any plant remains (A. Millozza pers. comm.). The short protologue printed on the label and in Saccardo (1889: 632) does not give any information on the microscopic features of the taxon. The herbarium label was reproduced by Braun (2018) who considered it as validly published.

Habrostictis callorioides Sacc. & Briard, in Briard, Rev. Mycol. (Toulouse) 7: 210 (1885)

≡ *Naevia callorioides* (Sacc. & Briard) Sacc. & Briard., in Saccardo, Syll. Fung. 8: 658 (1889)

The lectotype (France, *Chaerophyllum temulum*) was restudied by Hein (1976: 113), who found the asci to have an apical ring reacting blue in IKI and saw a similarity to *Merostictis* Clem. (= *Diplonaevia* Sacc.), except that the characteristic margin was missing in *N. callorioides*.

Orbilia calochroa Syd. & P. Syd., Bot. Jahrb. Syst. Pflanzengesch. Pflanzengeogr. 54: 258 (1917)

≡ ***Dicephalospora calochroa*** (Syd. & P. Syd.) Spooner, Bibl. Mycol. 116: 269 (1987)

Spooner (1987) erected a new genus *Dicephalospora* Spooner, with *Orbilia calochroa* as the type species (holotype: Papua New Guinea, on rotten bark), and *D. rufocornea* (Berk. & Broome) Spooner. His redescription of the holotype (Spooner 1987: fig. 43) shows apical rings of the *Hymenoscyphus*-type and ascospores with polar mucilaginous caps in both species. The genus was assigned to the *Sclerotiniaceae* on account of a slight blackening of the substrate. The microscopic characters, however, indicate relationship to *Hymenoscyphus* Gray (Baral, in Eriksson et al. 2001: note 3258), and molecular data confirm its placement near *Hymenotorrendiella* P.R. Johnst. et al. (Johnston et al. 2014a).

Naevia canadica Rehm, Ann. Myc. 11: 154 (1913)

Hein (1976: 33) considered the type material of *Naevia canadica* to be an *Orbilia*. However, he did not mention in which herbarium the examined specimen is deposited. No specimen under this name could be located in B, PAD, and S. The species was collected on dead stems of *Impatiens fulva* in Ontario (Canada). The minute apothecia are described as erumpent, yellowish-white, the inamyloid asci up to 45 × 4–5 µm, 8-spored, the spores 5 × 1.5–2 µm, and the paraphyses as filiform. Except for the uninflated paraphyses, a relationship to *Orbilia cookei* Baral (≡ *Peziza exigua* Cooke) would be possible.

Orbilia curvatispora var. ***caprina*** Velen., Monogr. Discom. Bohem.: 101 (1934)

No material is found in PRM (Svrček 1954). The extremely brief diagnosis gives as difference to *O. curvatispora* wine-rose ('vinoso-rosea') apothecia 0.5–1 mm diam. and only 5–8 µm long spores (for *O. curvatispora* Velenovský gave 8–15 µm). The collection was on *Salix caprea* from Mnichovice (Bohemia). In his manuscript notes the apothecia were described as yellow-rose ('luteo-rosella') and the spores illustrated as semicircular. This taxon appears to be a synonym of *O. auricolor* or a related taxon, assuming the possibility that the spore measurements are erroneous.

Habrostictis carneopallida P. Karst., Hedwigia 23: 40 (1884)

= *Ocellaria carneopallida* (P. Karst.) Sacc., Syll. Fung. 8: 658 (1889)

According to Verkley (1999: 142) no type specimen can be found. Karsten described this species (on bark of *Alnus incana*, Finland) with ascospores 27–34 × 14–15 µm, inequilateral, ellipsoid, eguttulate, with thick epispore, and compared it with *Habrostictis aurantiaca* Rehm (≡ *Pezicula aurantiaca* (Rehm) Rehm). The description could well refer to a *Pezicula*. However, Verkley (l.c.) stated that it might represent a lichenized discomycete. *Naeviopsis carneopallida* (Roberge ex Desm.) B. Hein is a different foliicolous fungus.

Calycina carneorosea (Cooke & Harkn.) Baral, **comb. nov.** — MB 814587

Basionym: *Peziza carneorosea* Cooke & Harkn., Grevillea 9: 130 (1881)
≡ *Pezizella carneorosea* (Cooke & Harkn.) Sacc., Syll. Fung. 8: 284 (1889)
≡ *Hymenoscyphus carneoroseus* (Cooke & Harkn.) Kuntze, Revis. Gen. Pl. 3: 485 (1898)

This species appears to be only known from the type material which was redescribed by Dennis (1964: 38). It was assumed to be an *Orbilia* by Seaver (1951: 161). According to the holotype material in K (USA, California, on periderm of 3 mm thick, corticated twig of *Eucalyptus*, undated, Harkness 2164, K(M) 36002, IVV: H.B. 5526), the apothecia are dry 0.3–0.4 mm diam., yellowish-ochraceous, pubescent, without a brown basal ring, the asci measure 40–55 × 5.6–6(–6.5) µm, arise from croziers, and have a conical apex and an apical ring reacting strongly blue (BB) in IKI (*Calycina*-type). The ascospores (5–6.8 × 2.4–3 µm) are broadly ellipsoid-fusiform and contain a few minute LBs at each end. The ectal excipulum is composed of a thin-walled textura angularis-prismatica, the exterior of which is pubescent by thin-walled, smooth, ± cylindrical to moniliform, 1-septate hairs (15–25 × 3–3.5 µm). Dennis considered a relationship to *Cistella trabinella* (P. Karst.) Nannf. [≡ *Leptodontidium trabinellum* (P. Karst.) Baral, Platas & R. Galán]. However, species of *Leptodontidium* have much larger LBs in the spores, basally more densely septate paraphyses, and a marginal excipulum without hairs (see under *Orbilia diaphanula*, p. 1669). *Calycina carneorosea* should be studied from a fresh sample in order to clarify the presence of VBs in the paraphyses.

Orbilia carpathica Velen., Monogr. Discom. Bohem.: 103, pl. 11 fig. 6 (1934)

O. carpathica was based on a single specimen from the Carpathian Mountains (Ukraine), on wood of *Quercus*, VIII.1930, A. Pilát (PRM 151703). The protologue points to a desiccation-tolerant species of subgenus *Hemiorbilia*, according to the reported apothecial colour ('igneo-sanguinea') and the figured exudate over the paraphyses. The rather accurately described and illustrated spores with elongate heads and long and thin tails suggest identity with *O. flagellispora*, apart from the lack of a basal inflation of the tails. Velenovský based his new species on a peculiarity of the spore tails which he figured strongly geniculate in their upper part, a feature only rarely observed by us in a few spores of a few collections of *O. flagellispora*. The paraphyses are figured as apically medium clavate. Another possibility would be to compare *O. carpathica* with members of section *Arthrobotrys*. For example, the spores of *O. clavispora* (H.B. 8371a) have a thicker upper and a tail-like lower part. Especially the spores in the holotype of the Indonesian *O. neglecta* strongly resemble Velenovský's drawing of *O. carpathica*, but all these members of section *Arthrobotrys* have much smaller spores.

Svrček expressed doubts about the size (20 µm) and shape of the spores as indicated by Velenovský, which does not concur with the stated ascus size (25 × 4 µm, excluding stipe). Yet, when assuming an inverse orientation of some of the spores, the tails scarcely need any space within the asci and the spore heads of ~10 µm length could well have been arranged in a 4-seriate bundle within the asci.

The holotype of *O. carpathica* contains a microscopically entirely different fungus (IVV: H.B. 6054). The apothecia are ± gregarious, abundant (roughly 200), macroscopically uniform, with smooth margins. Some features in the protologue (gregarious growth, apothecial size, clavate apices of paraphyses) actually appear to fit this probably desiccation-sensitive species. Spore orientation was clearly seen in various asci, with the upper spores pointing with their acute end always downwards, and the lower spores always upwards. This fungus undoubtedly belongs to ***O. sarraziniana***, a semiaquatic species with ascospores without a tail. Svrček (1954: 12) identified this material as *O. luteorubella* f. *pellucida*, a taxon which is, however, treated as a synonym of *O. cardui* in the present study. He found the spores 6–9 × 0.8–1 µm, which is in discordance with the present measurement (7.3–8.7 × 1.4–1.7 µm in KOH). Unexplainably, Svrček stated that the type contains only a few apothecia.

The ring-pored woody fragments taken from a decorticated log clearly belong to *Quercus*, not *Fagus* as stated in the protologue. This discrepancy in substrate, together with the severe inconsistency in micromorphology might be due to some confusion of the material.

Orbilia caulophylli Ellis & Everh., Proc. Acad. Nat. Sci. Philadelphia 45: 145 (1893)

≡ *Laetinaevia caulophylli* (Ellis & Everh.) Korf, Phytologia 21: 204 (1971)
≡ ***Diplonaevia caulophylli*** (Ellis & Everh.) B. Hein, Sydowia 36: 99 (1983)

According to Hein (1983) the species is confined to herbaceous stems of *Caulophyllum thalictroides* in North America and has asci with an amyloid apical ring.

Orbilia chlorina Rick, Brotéria, sér. Cienc. Nat. 1(1): 46 (1932)

No material could be found in GH, IACM, and W. The description of this taxon (Brazil, Rio Grande, on wood) is too brief to recognize its identity (apothecia 1–2 mm diam., sessile, greenish-chlorinaceous, asci 25–40 × 3–4 µm, sessile, polysporous, spores small, not further described, paraphyses yellowish, apically globose).

Hyalinia chlorinella (Ces.) Boud., Hist. Class. Discom. Eur.: 104 (1907)

≡ *Peziza chlorinella* Ces., Bot. Ztg. 12: 186 (1854) [also in Flora (Regensburg) 37: 203 (1854)]
≡ *Pezizella chlorinella* (Ces.) Sacc., Syll. Fung. 8: 278 (1889)
≡ *Hymenoscyphus chlorinellus* (Ces.) Kuntze, Revis. Gen. Pl. 3: 485 (1898)
≡ ***Calycellina chlorinella*** (Ces.) Dennis, Kew Bull. 30: 350 (1975)
≡ *Mollisiella chlorinella* (Ces.) Svrček, Česká Mykol. 31: 13 (1977)

The type material was reexamined by Lowen & Dumont (1984) who accepted Dennis's placement in the genus *Calycellina* Höhn. The species is very common in central Europe on blackened areas of herbaceous stems. The asci have an amyloid apical ring and arise from croziers, the latter character being not examined by Lowen & Dumont.

Orbilia chrysocoma (Bull.) Sacc., Syll. Fung. 8: 624 (1889)

≡ *Peziza chrysocoma* Bull., Herb. France 8: tab. 376, fig. 2 (1788); – Fr., Syst. Mycol. 2(1): 140 (1822), nom. sanct.
≡ *Hymenoscyphus chrysocomus* (Bull.) Gray, Nat. Arr. Brit. Pl. 1: 674 (1821)
≡ *Bulgaria chrysocoma* (Bull.) Sommerf., Suppl. Fl. Lapp.: 299 (1826)
≡ *Calloria chrysocoma* (Bull.) Fr., Summa Veg. Scand.: 359 (1849)
≡ ***Dacrymyces chrysocomus*** (Bull.) Tul., Ann. Sci. Nat., Bot., sér. 3, 19: 211 (1853)
≡ *Mollisia chrysocoma* (Bull.) Gillet [as '*Mollicia*'], Champ. Fr., Discomyc.: 212 (1887)
≡ *Guepiniopsis chrysocoma* (Bull.) Brasf., Am. Midl. Nat. 20: 226 (1938)

No authentic material of *Peziza chrysocoma* could be traced in E and PC (see also McNabb 1973: 501). The taxon was interpreted by later authors in very different ways, applied for fungi belonging to basidiomycetes (*Dacrymycetales*) as well as ascomycetes (*Orbiliomycetes*), e. g., by Saccardo (1878: 429), see also Donk (1964: 97). Today the taxon is accepted in the *Dacrymycetales*.

Bulliard's (1788) protologue, published also in Bulliard (1791: 254), describes the fungus as ~ 2–3 mm diam., more or less dark golden yellow, young like a small hollow bell, more or less flattened with age, on rotten wood. Donk (l.c.) believed that 'these characters would tend to exclude some of the minute discomycetes of which one is reminded when glancing superficially at Bulliard's plate'. In the absence of authentic material, Donk followed Fries's (1822: 140) interpretation of *P. chrysocoma*, material of which has been preserved (e. g., Scleromyc. Suec. 331, UPS). Donk referred to this material as *Dacrymyces chrysocomus*, and considered it to be a basidiomycete not uncommon in Europe, whereas Dennis (1954: 297) identified it as *D. stillatus* Fr. Donk also identified a specimen in Persoon's herbarium under the name '*Peziza chrysocoma* Fries / *P. aurea* ? Pers.' as *D. chrysocomus* (L 910.261–259). Similar as Donk, McNabb (1973: 501) argued that 'there are no major discrepancies between the two descriptions' of Bulliard and Fries, and that 'it seems reasonable to assume that Bulliard's name was not misapplied by Fries'. Nevertheless, neither Donk nor McNabb selected a neotype for *Peziza chrysocoma*.

Fuckel (1870: 283) considered a possible synonymy between *Calloria chrysocoma* and *C. deliquescens* (Bull.) Fr. [≡ *Dacrymyces deliquescens* (Bull.) Duby], and his concept of *Calloria* comprised, like that of Fries (1849), both ascomycetes and basidiomycetes today assigned to *Dacrymyces* Nees, as he believed that those without asci were anamorphs of discomycetes. Reexamination of Fuckel's *C. chrysocoma* (Fungi Rhen. Exs. 1130) in the present study revealed identity with *Orbilia xanthostigma*. Several later authors interpreted *P. chrysocoma* as a basidiomycete. Under the name *Dacryomyces chrysocomus*, Saccardo (1888: 798) described the basidiospores as 20–28 × 9–11 µm, multiseptate. Under the same name Brefeld (1888: 156, pl. 10 fig. 12–17) treated a fungus which McNabb (1973: 501) believed to be probably *Dacrymyces estonicus* Raitv. When Brasfield (1938, see Donk 1964) transferred the taxon to *Guepiniopsis* Pat., he applied it for a North American basidiomycete 'very different from Fries's' and, according to McNabb (l.c.), most probably belonging to *Heterotextus* Lloyd. McNabb accepted *P. chrysocomus* as a species of *Dacrymyces*, based on the study of specimens collected on coniferous wood by E.M. Fries, whereas Jülich (1984: 442) accepted placement in *Guepiniopsis*. Today the species is generally accepted as belonging to *Dacrymyces*.

In our opinion, Bulliard's brief diagnosis does not for sure exclude a discomycete. The consistency of the fruitbodies is not mentioned, and a bell-like shape occurs, e. g., also in young *Hyalorbilia inflatula*. Likewise, Dennis (1954: 297) stated that 'Bulliard's figure does indeed resemble an *Orbilia* but it is impossible to say which species he had'. However, since Fries's interpretation concerns a *Dacrymyces*, Dennis concluded that 'It is, therefore, unwise to attempt to attach the epithet *chrysocoma* Bull. ex Fr. to a species of *Orbilia*'.

In fact, many authors applied the name to a discomycete. In Persoon's herbarium at least two specimens under the name *P. chrysocoma* are ascomycetous (Sowerby, L 910.261–250, identified by Donk as *Orbilia* sp., not examined in present study; Junghuhn, L 910.261-249, identified in present study as *O. xanthostigma*, IVV: H.B. 7709). Moreover, Persoon (1801, 1822) hesitated regarding distinction between *P. chrysocoma* and his *P. aurea*, which was listed as a synonym of *P. chrysocoma* by Fries (1822: 140, 1874: 699) and also by some later authors. Specimens under the name *P. aurea* (without question mark) in Persoon's herbarium are found in the present study to comprise *Orbilia comma* and *O. xanthostigma*.

Saccardo (1878: 429, 1889: 624) appears to be the first to describe asci in *Calloria* or *Orbilia chrysocoma*; yet, he (1888: 798) also referred to Tulasne's and Fries's interpretation as a basidiomycete under the name *Dacryomyces chrysocomus*. Saccardo (1889) cited various hosts and countries for *O. chrysocoma* and compared it with *O. luteorubella*, whereas his diagnosis (1878, 1889) refers to a collection from Italy ([Venice, Treviso,] Conegliano, corticated branches of *Morus alba*, autumn 1877, C.L. Spegazzini), with subgelatinous, golden yellow apothecia scarcely 0.5 mm diam., asci subsessile, 40–45 × 5 µm, apex obtuse, spores 14–15 × 0.75–1 µm, bacilliform, slightly curved, paraphyses apically clavate. This diagnosis could represent *Hyalorbilia berberidis* if the asci are correctly described, or to *O. auricolor* if the spore data refer to the actual spore length. Rehm's (1891: 457), Grelet's (1948a: 50) and Seaver's (1951: 153) diagnoses of *O. chrysocoma* are merely copies of Saccardo's (1889). Also the description to an illustration in Cooke's (1892: 220, pl. 20 fig. 161) Handbook of Australian Fungi under the name *O. chrysocoma* exactly repeats Saccardo's measurements, although the collection data read 'on wood, Victoria'. Perhaps this refers to a specimen in K (*Mollisia chrysocoma*, near Melbourne, 12.VII.1886) which was found by B. Spooner (pers. comm.) to be a *Bisporella*.

Saccardo (1889, as *O. chrysocoma*) and Donk (1964: 98, as *D. chrysocomus*) mentioned Patouillard (1886: 130, fig. 293, as *C. chrysocoma*) who illustrated a fungus completely different from Saccardo's interpretation, with ellipsoid-fusoid, straight spores with a large central oil drop. This could be *Agyrium rufum*, except for the longer spores (18–20 × 7.2–8.6 µm, evaluated from Patouillard's scale). Gillet (1887) described as *M. chrysocoma* a yellowish-orange discomycete 2–3 mm diam. on conifer wood, with short clavate asci and globose ascospores with a strong 'sporule' (lipid or spore body?). Schröter (1893: 121) referred to *O. chrysocoma* a number of collections with golden yellow apothecia on various woody substrates. These could belong to *O. xanthostigma*, if the spores had not been described as cylindrical, mostly slightly curved, 4.5–5 × 1 µm. Feltgen (1899: 55, 1901: 36) referred to *O. chrysocoma* several collections on ligneous substrate. Two of them were found in his herbarium: one (Grünewald-Walferdingen, *Quercus*, LUX 42533) is identified here as *O. vinosa*, another (Ettelbruck, *Fagus*, LUX 42534) as *O. sarraziniana*. He further described *O. chrysocoma* var. *brassicicola* Feltgen on *Brassica oleracea* with spores of 10–15 × 1 µm, which is treated here as a synonym of *O. auricolor*. Benny et al. (1978) applied the name *O. chrysocoma* to a briefly mentioned specimen of *Orbilia* sp. in which a spore body was seen with the TEM.

Orbilia circinella (Pat.) Sacc. 1889, Syll. Fung. 8: 628 (1889)

≡ *Calloria circinella* Pat., Rev. Mycol. (Toulouse) 8: 179, pl. 59 fig. 1 (1886)

The holotype (China, Yunnan Province, stem of *Cypripedium*, undated, Abbé Delavay, herb. Patouillard, IVV: H.B. 5454) is not lost as suspected by Hein (1976), but exists at FH and contains numerous apothecia in good shape. The gelatinized hyaline ectal excipulum of textura angularis and the erumpent ochraceous apothecia seem to indicate a relationship to the genus *Naeviopsis* as circumscribed by Hein (1976). However, the asci sharply differ in having an apical ring of the *Calycina*-type which reacts deep blue (euamyloid) in IKI, whereas in *Naeviopsis* they are much broader and of the *Allophylaria*- or *Pezicula*-type and react red (hemiamyloid) or sometimes euamyloid. The whole ectal excipulum stains distinctly pale blue in IKI, a character not known in the genus *Naeviopsis*. In addition, typical members of *Naeviopsis* are characterized by an ectal excipulum that initially covers the hymenium and lacerates at maturity into star-like lobes (Hein 1976: 61, fig. 17), a feature not observed in *C. circinella*. A further characteristic of *C. circinella* are the apically enlarged, strongly hooked to circinate paraphyses. The short ascus stalks probably arise from croziers although they mostly appeared simple-septate.

A very similar species in which the excipulum likewise reacts euamyloid is *Pezizella orbilioides* Feltgen (see p. 1681). The two taxa might belong in the genus *Loricella* Velen., which was established by Velenovský (1934) for two species, *L. juncina* Velen. and *L. loricata* Velen. Later, he added four further species (Velenovský 1939, 1947). Based on the description, *Loricella* is probably heterogeneous: *L. juncina* has the characteristic hooked paraphyses, whereas *L. loricata* is a later synonym of '*Mollisia*' *spectabilis* Kirschst., a species that appears to belong in *Helotiaceae* based on the *Hymenoscyphus*-type of apical ring. Reexamination of the types of *L. juncina* und *L. loricata* is required and a lectotypification of *Loricella* necessary before this name can be used.

Hyalinia cisti Maire, Treb. Mus. Ci. Nat. Barcelona, Ser. Bot. 15(2): 15 (1933)

Material could neither be found in BC and MPU (R. Galán pers. comm.), nor in NCY and PC. The drawing and description of the protologue (on rotten leaves of *Cistus laurifolius*, in the mountains over Prades, Catalonia, Spain) refers to a species of *Helotiales* rather than *Orbiliomycetes*. The species appears to resemble *Orbilia rubicunda* (see below) in both macro- and microscopy, but is said to have a gelatinized excipulum without hairs, and inamyloid asci (in MLZ without KOH). Maire compared it with *Helotium microspis* (P. Karst.) Boud. [≡ *Calycellina microspis* (P. Karst.) Dennis].

Peziza citrinella Schwein., Trans. Am. Philos. Soc. II, 4: 177 (1832)

≡ *Pezizella citrinella* (Schwein.) Sacc., Syll. Fung. 8: 287 (1889)
≡ *Hymenoscyphus citrinellus* (Schwein.) Kuntze, Revis. Gen. Pl. 3: 485 (1898)

No apothecia could be found in the holotype specimen in PH (USA, Pennsylvania, Bethlehem, very rotten wood of *Salix*). Schweinitz compared *P. citrinella* with *P. chrysocoma*. Therefore, Saccardo who treated the latter as *Calloria chrysocoma*, noted that *P. citrinella* could be a *Calloria*. Seaver (1951: 161) stated that *P. citrinella* is 'probably an *Orbilia*'. The brief protologue of *P. citrinella* includes: apothecia sessile, with an always distinct, obtusely thick margin, ± flexuous, uniformly lemon-yellow, 1 line (~2 mm) diam. The identity of *P. citrinella* remains obscure.

Stictis coccinea Fr., Elenchus Fung. 2: 24 (1828)

≡ *Ocellaria coccinea* (Fr.) Rehm, Rabenh. Krypt.-Fl., 1.3: 136 (1888)
≡ *Propolis coccinea* (Fr.) Sacc., Syll. Fung. 15: 306 (1900)

Without seeing type material, Höhnel (1917: 333) assumed that this taxon (VI. [no year], on dead branches of *Morus alba*, [J.F. de] Chaillet) is very probably closely related to *Habrostictis rubra*. Sherwood (1977: 167, see also Verkley 1999: 144) found the holotype to be 'immature Hypocrealean stroma' and stated that Nannfeldt (1929) suggested this to be ***Nectria verrucosa*** (Schwein.) Sacc.

Helotium coccinellum (Fr.) Boud., Hist. Class. Discom. Eur.: 112 (1907)

≡ *Peziza coccinella* Fr., Syst. Mycol. 2(1): 125 (1822), nom. sanct. [non *P. coccinella* Sommerf. 1828, ≡ *Orbilia coccinella* Fr.]
≡ *Phialea coccinella* (Fr.) Gillet, Champ. Fr., Discomyc.: 211 (1887)

Fries (1822) described *Peziza coccinella* based on Micheli (1729: 205, pl. 86 fig. 12, as '11. Fungoides ...'). Judging from Micheli's and Fries's brief diagnoses (see also Saccardo 1892: 10) and Micheli's illustration, the taxon obviously refers to a cyphelloid basidiomycete. The minute fungus is described with thin and rather long stipes, and deeply urceolate cups. The fruitbodies are strongly geniculate at the connection between stipe and receptacle, with the cups pointing downwards. It appears that the existence of *Peziza coccinella* Fr. and its competition with the homonym *P. coccinella* Sommerf. has been neglected in the literature since Boudier (1907). Fries (l.c.) cited *P. nutans* Batsch and *P. cernua* Pers. as synonyms, which likewise seem to represent cyphelloid fungi (both names mean nodding). It remains mysterious why Fries introduced the epithet *coccinella* despite the existence of *P. nutans* and *P. cernua*.

The collections which Gillet (1887) reported under the name *Phialea coccinella* concern 'sessile or stipitate' fruitbodies. The microscopic features appear to refer to an *Orbilia*, perhaps *O. eucalypti* (asci cylindric-subclavate, spores ovoid, paraphyses with globose apical inflation).

Orbilia coccostigma (Wallr.) Sacc., Syll. Fung. 8: 631 (1889)

≡ *Peziza coccostigma* Wallr., Fl. Crypt. Germ.: 466 (1833)

No type material of this species (Germany, Harz mountains, on decorticated wood of *Abies*) could be found in PRM and STR. The fruitbodies were described as scarlet-red ('rubrococcinea') but their size was not stated and no information on the hymenial elements was given, therefore, *P. coccostigma* is considered as a nomen dubium. An old collection under that name in PRM (727318, without collection data except for 'Neuhof') was examined which contains abundant perithecia of an orange *Nectria* (?*peziza*) fruiting on decorticated wood of a ?*Rosaceae*.

Orbilia coleosporioides Sacc. & D. Sacc., Syll. Fung. 18: 139 (1906)

≡ *Orbiliopsis coleosporioides* (Sacc.) Syd., Ann. Mycol. 22: 308 (1924)

This is the type species of *Orbiliopsis* (Sacc.) Syd., a small group of fungi parasitic on living leaves. Following Nannfeldt (1932) the group could be of the ascolocular type (see also p. 207). No material of this species could be found in PAD.

Peziza conchella Schwein., Trans. Am. Philos. Soc. II, 4: 177 (1832)

≡ *Pezizella conchella* (Schwein.) Sacc., Syll. Fung. 8: 284 (1889)
≡ *Hymenoscyphus conchellus* (Schwein.) Kuntze, Revis. Gen. Pl. 3: 485 (1898)

Without type study, Massee (1894b: 99) mentioned this species as a possible synonym of *Peziza cruenta* Schwein. The holotype specimen in PH (USA, Pennsylvania, Bethlehem, Syn. #942) was examined. It merely contains sporodochia of a hyphomycete growing erumpent through the periderm of a 6 mm thick woody branch of an unidentified angiosperm, with very sparsely occurring cylindric(-ellipsoid) conidia of 5.8–6.5 × 1.7–2.7 µm (conidiophores not seen). The tissue is composed of a light orange, medium gelatinized textura angularis. W.-R. Arendholz (in sched.) referred to this specimen as 'sporodochia of a *Tuberculariaceae*'.

Calloria coccinella f. **condensata** W. Phillips, Man. Brit. Discomyc.: 329 (1887)

No material has been studied of this taxon, which was considered to be a form of *Calloria coccinella* (Sommerf.) W. Phillips (≡ *Orbilia coccinella* Fr.). It was characterized by the words 'Forming condensed fasciculate heaps, Forres, N.B. [Scotland], in Herb. Currey'.

Orbilia corticalis Velen., Monogr. Discom. Bohem.: 101, pl. 11 fig. 25 (1934).

No material exists of this taxon (on *Picea* bark) following Svrček (1954), who concluded from the protologue that it is a synonym of *Orbilia berberidis* Velen. (≡ *Hyalorbilia berberidis*). The ascus bases, however, are figured with flexuous stalks which suggest identity with *O. auricolor*, if there were not the minute apothecia of '< 0.1 mm' diam. No manuscript notes were found for this taxon.

Patinella crandallii Sacc., Syll. Fung. 11: 434 (1895)

≡ *Patinella macrospora* Ellis & Everh., Proc. Acad. Nat. Sci. Philadelphia 46: 354 (1894) [non *P. macrospora* Massee 1893]

Ellis & Everhart described this taxon on dead stems of *Geum rossii* from Southern Rocky Mountains (USA, Colorado, above Cameron Pass, 3660 m, VII.1894, C.S. Crandall), with olive-black apothecia 3/4 mm diam., capitate olivaceous paraphyses, and hyaline ellipsoid spores 20 × 10 µm. A specimen under the name *P. crandallii* (USA, Colorado, Bottomless Pitt, 3600 m, on stems of *Sieversia turbinata* ≡ *Geum rossii* var. *turbinata*, VII.1906, F.E. & E.g. Clements, herb. Petrak, M) fits well the protologue. It has ellipsoid smooth spores 18.5–22 × 9.5–10.5 µm with 2 large LBs 5–7 µm diam. The ascus apex is broadly conical and has a strongly reactive (IKI blue, type BB), 1.5–2.2 µm high and 5–6 µm wide apical ring similar as in *Drepanopeziza* (Kleb.) Höhn. The asci arise from croziers and measure 105–120 × 18–22 µm. The brownish paraphyses have a ± globose apical cell 7–9 µm wide and are covered by dark brown exudate. The ectal excipulum is a blackish-brown textura angularis, and the black apothecia (dry 0.3–0.6 mm diam.) are subepidermally erumpent. The species shows some similarity with the genus *Drepanopeziza*, especially regarding its apical apparatus. Ellis & Everhart compared it with *P. hyalophaea*, the type species of *Patinella*.

Orbilia crocina (Mont. & Fr.) Sacc., Syll. Fung. 8: 632 (1889)

≡ *Peziza crocina* Mont. & Fr., in Montagne, Ann. Sci. Nat., Bot., sér. 2, 5: 289 (1836) [non *Peziza crocina* Berk. & Curt. 1868, ≡ *Calycella crocina* (Berk. & Curt.) Dennis]
= ***Dendrodochium citrinum*** Grove, J. Bot. 24: 206, pl. 287 fig. 8 (1886)
(?)= *Lemalis aurea* (Lév.) Sacc., Syll. fung. (Abellini) 3: 672 (1884)
≡ *Catinula aurea* Lév., Annls Sci. Nat., Bot., sér. 3, 9: 248 (1848)

Peziza crocina was described from decorticated unidentified branches (France, Ardennes, Sedan, Bois de Marfée, undated, J.P.F.C. Montagne) for sessile, gelatinous, saffron-yellow apothecioid fructifications up to 1 mm diam., which form at first purplish dots and stain the wood yellow around them (Montagne 1836). The hymenium was said to be composed of 'hyaline linear asci' from which 'numerous spheric sporidia' easily detach. The authors were, however, unsure whether the spores are formed inside these linear elements or only at their tips, and compared the fungus with the genus *Dacrymyces*, but also with *Peziza chrysocoma* Bull. and *P. coccinella* Fr. When Saccardo (1889) combined *P. crocina* in *Orbilia*, he referred to it another collection (on wood chips, Singapore, Malacca, [O.] Beccari).

A syntype in herb. Desmazières (IVV: Pl. Crypt. N. France, Ed. 1 1863 N° 8) was received from PC. The label bears handwritten notes which closely correspond to the protologue. The fungus is mitosporic and has a gelatinized excipulum, narrow phialides in a palisade, and subglobose conidia measuring †1.8–2.2 × 1.5–1.9 µm. Possibly it is the anamorph of a helotialean genus (*Calycina*?). When the specimen was studied, the wood anatomy was possibly examined but no notes were now found.

Conspecific or closely related recent collections were studied by us and by P. Perz (pers. comm.), forming white or yellow cupulate to disc-shaped conidiomata on coniferous substrate. The phialides and conidia of *P. crocina* closely resemble those of *Sarea resinae* (Fr.) Kuntze [= *Pycnidiella resinae* (Ehrenb.) Höhn.] (*Lecanorales*) as described in Hawksworth & Sherwood (1981) and frequently found by us on resinous wounds of conifers. Yet, the anamorph of *S. resinae* differs in having pycnidia with a defined ostiolum.

Grove (1886) described *Dendrodochium citrinum* on rotten wood of *Pinus sylvestris* from Barnt Green, Worcestershire, UK, including yellow sporodochia of 0.5 mm diam., verticillate, filiform 'basidia', and globose, smooth, yellowish, guttulate conidia of 1.75 µm diam. formed acrogenously. Based on the brief description and illustration, it is regarded here to be a synonym of *Peziza crocina*. No molecular data of this taxon appear to exist. In a strict sense, *Dendrodochium* Bonord. is probably a synonym of *Clonostachys* Corda (*Bionectriaceae*) (see Seifert et al. 2011).

Lemalis aurea, on rotten trunks of conifers in France, is a probable further synonym of *P. crocina*, being described with yellow sporodochia of pinhead size, conidiophores in parallel palisades, and globose, minute, smooth, concolorous conidia (no size given). The genus *Lemalis* Fr. is based on another species of unclear relationship.

Hyalinia crouanorum Boud., Hist. Class. Discom. Eur.: 104 (1907) [non *Hyalinia agyrioides* (Desm.) Boud.]

≡ *Helotium agyrioides* P. & H. Crouan, Florule Finistère: 47 (1867)
≡ *Calycina agyrioides* (P. H. Crouan) Kuntze [as '*agyriodes*'], Revis. Gen. Pl. 3: 448 (1898)
?= ***Agyrium rufum*** (Pers.) Fr., Syst. mycol. (Lundae) 2(1): 232 (1822)

An authentic specimen (on rotten wood of *Quercus*) was redescribed by Le Gal (1953: 122), who considered it to represent a pale form of *Agyrium rufum*. Le Gal found the lecanoralean-like asci to stain 'blue in iodine'.

Orbilia cruenta (Schwein.) Morgan, J. Mycol. 8: 182 (1902)

≡ *Peziza cruenta* Schwein., Trans. Am. Philos. Soc. ser. II, 4: 177 (1832) [non *P. cruenta* Wallr. 1833, see Saccardo (1889: 428, as *Trichopeziza cruenta*); nec *P. cruenta* Bong. 1836, see Saccardo (1889: 339, as *Mollisia cruenta*)]
≡ *Pezizella cruenta* (Schwein.) Sacc., Syll. Fung. 8: 284 (1889)
≡ *Hymenoscyphus cruentus* (Schwein.) Kuntze, Revis. Gen. Pl. 3: 485 (1898)
≡ *Tubercularia cruenta* (Schwein.) Höhnel, Mitt. bot. Inst. tech. Hochsch. Wien 3: 69 (1926)

The type specimen (USA, Pennsylvania, Bethlehem, on bark of unidentified branches) could not be located in BPI, K, and PH. The translated protologue reads about as follows: 'small, sparse, sessile, flattened, blood-red ('cruenta'), subtranslucent, with a raised margin being whitish crenulate or sprinkled by pruina, disc concave, circular, hardly exceeding ½ line [~1 mm]'. Nannfeldt (1932: 252) tentatively placed *Orbilia cruenta* in synonymy with *O. rubella* (as *Hyalinia rubella*), yet without studying the type. As long as no type material can be located and the microscopic features determined, *O. cruenta* must be treated as a nomen dubium.

Massee (1894b: 99) redescribed *O. cruenta* under the name *Peziza cruenta* and considered *P. fibriseda* Berk. & Curt., *P. regalis* Cooke & Ellis, *P. rufula* Schwein., and *P. saccharifera* Berk. as synonyms. He mentioned to have examined 'specimens from Schweinitz, also Berkeley's type specimens', as well as Ellis & Everhart (N. Amer. Fungi II 2326) and Ellis (N. Amer. Fungi 438), probably all from K. Collection data are given for two specimens, according to which it can be seen that M.J. Berkeley 3311 was the type of *P. fibriseda* and M.J. Berkeley 5208 that of *P. saccharifera*. Although existing at K, Massee did not mention the type of *P. regalis* [M.C. Cooke 2778, U.S.A., New Jersey, Newfield, on bark of *Malus*, undated, J.B. Ellis, K(M) 35323], but only N. Amer. Fungi 438 (publ. 1880, Newfield, on bark of *Malus*, undated, J.B. Ellis, K(M) 180561), which possibly represents a duplicate exsiccata hereof. Since Massee wrote that he saw specimens from Schweinitz, it can be assumed that he examined the types of both *O. cruenta* and *P. rufula*. However, it is not clear then why the type of *O. cruenta* cannot now be found at K.

Massee (l.c.) described *Peziza cruenta* with paraphyses having clavate to lanceolate apices, small asci [size not given] with long, slender, crooked stalk, spores 4–5 × 1.5 µm, cylindric-oblong, ends obtuse, and apothecial margins with tufts of hairs 25–35 × 5–6 µm, agglutinated by honey-coloured amorphous lumps. It is not clear from which of the specimens this description was gained, also the identity of the described fungus cannot be stated in the absence of any illustration. Massee's synonymisation was followed by Morgan (1902: 182) and Seaver (1951: 158), and Seaver included also *O. occulta* in this synonymy.

In the present monograph, all these taxa (except for *P. cruenta*) were studied from the type material and found to belong to five different species of *Orbilia*. Apart from *P. rufula* (Pl. 875: 1), which has a smooth margin and belongs in the scope of *O. xanthostigma* (section *Orbilia*), they fit in their macroscopy the original description of *P. cruenta* in having a raised, whitish crenulate or pruinose margin. *Peziza fibriseda* (Pl. 572: 2) has rather large asci and spores and is considered here to be conspecific with *O. carpoboloides* (section *Habrostictis*). *O. occulta* (N. Amer. Fungi 438, Pl. 353: 3) has spores with a thin tail and asci with a rounded, thick-walled apex and is closely related to *O. aristata* (section *Hemiorbilia*); an immature population associated with the type of *O. regalis* in M.C. Cooke 2778 appears to belong to this species. The types of *P. saccharifera* (Pl. 426) and *P. regalis* (Pl. 389) correspond to Massee's description in their small asci and spores, but have differently shaped spores and belong in the vicinity of *Orbilia rubella* and *O. aradi*, respectively (section *Aurantiorubrae*).

N. Amer. Fungi II 2326 is a rich specimen issued under the name *Peziza cruenta* [USA, Delaware, Wilmington, bark of *Morus*, IX.1889, A. Commons, K(M) 48760]. It was also examined in the present study and found to belong to *O. carpoboloides*, particularly to the here synonymised *O. piloboloides* because of its short spores (Pl. 571: 2). A photocopy of an undated specimen (USA, Ohio, Preston, bark of *Gleditsia*, A.P. Morgan, herb. G. Massee) under the name *Pezizella cruenta* in K shows a sketch by Massee with much smaller spores of 5–7 × 1.5 µm, asci of 60 × 5 µm, and apically clavate paraphyses, which better corresponds to Massee's (1894b) description, but it might have been collected later as he did not mention *Gleditsia* there.

Höhnel (1926a: 69) found a specimen of *P. cruenta* (Ellis & Everhart, Fungi Columb. 1553) to be a mitosporic fungus, *Dendrodochium hymenuloides* Sacc. [= *Tubercularia hymenuloides* (Sacc.) Höhnel]. He concluded that *P. cruenta* must be combined as *Tubercularia cruenta* in the case this material is conspecific with Schweinitz's fungus.

Orbilia crystallina Rodway [as '*crystalina*'], Pap. Proc. Roy. Soc. Tasm.: 114 (1920) [non *Orbilia crystallina* (Quél.) Baral 1994, nom. illegit., ICN Art. 53.1, = *O. crenatomarginata* (Höhn.) Sacc. & Trotter]

The type (Tasmania, on soil) was not ordered. The habitat, the large ascospores (18 × 7 µm, ellipsoid with acute ends) and the large excipular cells suggest a member of *Pezizales*. The apothecia are described as 1–2 mm diam., orange, the hymenium at first covered by a crystalline membrane that bursts to form a toothed margin (see also Saccardo et al. 1928: 1239).

Orbilia cucurbitae (W.R. Gerard) Seaver, North American Cup-fungi (Inoperculates): 155 (1951)

≡ *Peziza cucurbitae* W.R. Gerard, Bull. Torrey Bot. Club 5: 26 (1874)
≡ *Pezizella cucurbitae* (W.R. Gerard) Sacc., Syll. Fung. 8: 285 (1889)
≡ *Hymenoscyphus cucurbitae* (W.R. Gerard) Kuntze, Revis. Gen. Pl. 3: 485 (1898)
?= *Pseudombrophila deerrata* (P. Karst.) Seaver, North American Cup-fungi, (Operculates) (New York): 141 (1928)

Authentic material, on dried rinds of squash (*Cucurbita*) was restudied by Dennis (1964: 40) who found this to be a synonym of *Pseudombrophila deerrata* or a closely allied fungus.

***Orbilia diaphana* –** see *Hyalinia subdiaphana*, p. 1686

Habrostictis diaphana Rehm, Ber. naturhist. Augsburg 26: 32 (1881)

≡ ***Laetinaevia diaphana*** (Rehm) Baral, **comb. nov.** — MB 826710
Basionym: *Naevia diaphana* (Rehm) Rehm, Rabenh. Krypt.-Fl., 1.3: 140 (1888)
≡ *Calloria diaphana* Rehm, Ascomyc. 210 (1874), nom. inval., ICN Art. 38.1 [non *Calloria diaphana* (Fr.) W. Phillips, see under *Hyalinia subdiaphana*]
≡ *Unguicularia diaphana* (Rehm) Nannf., Nova Acta Regiae Soc. Sci. Upsal., ser. 4, 8: 278 (1932)

Orbilia diaphanula (Cooke) Seaver, North American Cup-fungi (Inoperculates): 153 (1951)

≡ ***Leptodontidium diaphanulum*** (Cooke) Baral, **comb. nov.** — MB 814588
Basionym: *Peziza diaphanula* Cooke, Bull. Buffalo Soc. Nat. Sci. 2: 295 (1875) [also in Hedwigia 14: 84 1875]
≡ *Pezizella diaphanula* (Cooke) Sacc., Syll. Fung. 8: 279 (1889)
≡ *Hymenoscyphus diaphanulus* (Cooke) Kuntze, Revis. Gen. Pl. 3: 485 (1898)
≡ *Hyalinia diaphanula* (Cooke) Boud., Hist. Class. Discom. Eur.: 104 (1907)

Type material of *Habrostictis diaphana* (Romania, Siebenbürgen, Hunyad, at Zenoga lake below Retyezát, stems of *Angelica* ?*sylvestris*, VIII.1873, H. Lojka, Rehm, Ascomyc. 210, M, IVV: H.B. 4673) and several fresh collections referred to this species have been studied (IVV: e.g. H.B. 3798a, 9177b). The apothecia have sparse to abundant, broad, gradually tapering glassy hairs with an inflated base to which the lumen is restricted. A fine channel extends to the very tip but is nearly invisible in the middle part of the hair. The glassy matrix is inamyloid and loses refractiveness in 5 % KOH, at least when heated. The asci arise from croziers and have a rather strongly hemiamyloid (type RR) apical ring of the *Pezicula*-type, except that the upper part of the ring is less reactive. The species appears to be not uncommon on various large perennial herbs in subalpine to alpine but also colline regions of Europe.

Very similar is *Hyalopeziza raripila*, which occurs on a wide range of herbaceous stems in colline to altimontane habitats. It differs mainly in faintly hemiamyloid or often inamyloid ascus apices, a glassy hair matrix not dissolving in 5–10 % KOH (even when heated) and usually staining pale bluish-violet in IKI towards the hair base, and a tendency to form longer or narrower ascospores. In both species the hairs may be abundant or sparse, the abundance varying even within a population. In one collection of *H. raripila* (Luxembourg, Wiltz, Doncols, *Althaea rosea*, M.T. Tholl, H.B. 6936) the hairs were completely absent in most apothecia, with a single hair detected only on one of them.

Both taxa have apically flexuous to bent paraphyses and possibly belong to the *Calloriaceae* rather than the *Hyaloscyphaceae*. This view is supported by the presence of a mucilaginous sheath around the spores, being characteristic of both species as well as, e.g., *Laetinaevia adonis* (Fuckel) Hein. They appear to differ from typical members of *Laetinaevia* Nannf. merely in the presence of glassy hairs. Because of the inconsistent presence of these hairs they might well represent good members of *Laetinaevia*. Macroscopically both species can easily be mistaken in the field for an *Orbilia*, a fact also stated by Höhnel (1917: 330) for *Hyalopeziza raripila* (as *Unguicularia raripila*). Hein (1976: 59) tentatively placed *Naevia diaphana* close to *Chaetonaevia nannfeldtii* Arx, the type species of the monotypic genus *Chaetonaevia* Arx. The hairs of *C. nannfeldtii* as figured by Arx (1951) are actually very similar in shape, but with a broad lumen extending to the very apex, the walls being ~1 µm thick from base to tip. A further synonym of *Laetinaevia* appears to be the genus *Iridinea* Velen. (see also under *Calloria gentianae*, p. 1672).

Hyalopeziza latispora Raitv. and its synonyms *H. schachdarica* Raitv. and *H. archangelica* Olsen & Sivertsen appear to be synonymous with *Naevia diaphana*, judging from the description in Raitviir & Huhtinen (1997: 454), although the hair walls were stated not losing refractiveness in KOH. That the asci are described as inamyloid could be due to the use of MLZ without KOH-pretreatment. Yet, according to Huhtinen (pers. comm.) the paratype of *H. archangelica* from Greenland is inamyloid also after treatment with KOH, whereas a specimen from France (Val d'Isere, on *Cirsium spinosissimum*, 31.VIII.1992, TUR 105053), assigned to *H. latispora* by Raitviir & Huhtinen (l.c.), reacts deep blue in both MLZ and IKI (type BB) without KOH. This particular specimen, with the narrowest spores amongst the treated material, is a misidentification and represents another, unnamed species (Huhtinen pers. comm.). Though believed to be a synonym of *H. latispora*, *H. schachdarica* differs in the hair lumen extending to the very apex (Raitviir & Huhtinen l.c., fig. 7b) similar as in *C. nannfeldtii*.

Conclusions about the possible existence of different species in this group must await reexamination of the types concerning ascus amyloidity, and also need vital study of fresh collections. Molecular studies would be appreciated in order to clarify the relationship of this group within the *Helotiales*. An unpublished ITS sequence of *Hyalopeziza raripila* (S. Helleman pers. comm.) shows a high similarity (0.2–0.4 %) with various species of the anamorph genus *Tetracladium* de Wild. and 3 % with *Laetinaevia carneoflavida* (Rehm) Nannf. ex B. Hein. This result confirms a close relationship of *H. raripila* with *Laetinaevia* in the current circumscription of this genus and indicates an interesting, previously unknown connection to a genus of anamorphs.

Although no sequence was available of the type species *L. lapponica* (Nannf.) Nannf. [= *L. adonis* fide Hein 1976], its morphological similarity with *L. carneoflavida* suggests congenericity, according to recent studies of these two species in the living state (IVV: e. g. H.B. 2889, 6371, 9055b). Because the number of species accepted in *Laetinaevia* distinctly exceeds that in *Tetracladium*, we here propose to **protect** the younger name *Laetinaevia* over *Tetracladium*. As a consequence of this, new combinations in *Laetinaevia* are here proposed for the three involved teleomorph-typified species.

Laetinaevia raripila (Höhn.) Baral & Helleman, **comb. nov.** — MB 826712

Basionym: *Unguicularia raripila* Höhn., Ber. dt. bot. Ges. 35(3): 248 (1917)
≡ *Hyalopeziza raripila* (Höhn.) Huhtinen, Karstenia 27(1): 12 (1988) [1987]
(?)= *Iridinea anserina* Velen., Monogr. Discom. Bohemiae: 299, fig.a 61 (1934)

The type in K ([New Jersey,] VII.1874, on rotten, stromatized wood of a 30 mm thick decorticated branch of apparently *Magnolia*, according to wood anatomy, herb. Cooke, Ellis & Everh. N. Amer. Fungi 2161, K(M) 48782, IVV: H.B. 5755) consists of about a hundred subsessile apothecia (rehydrated 0.13–0.25 mm) in good shape. The species fits *Calycellina* in having an ectal excipulum of horizontal, gelatinized textura porrecta, and a grey-brown basal ring. The ascospores measure 10–12.8 × 3–4 µm and have a high lipid content (OCI 4, ?multiguttulate). A few obviously overmature spores are 1-septate and without lipid. The apical ring of the asci resembles the *Ploettnera*-type in having a small, strongly euamyloid lower part and a faintly reactive and slightly laterally extending middle part, whereas the upper part is inamyloid.

Peziza diaphanula appears to be closely related to *Leptodontidium trabinellum*, particularly because of the basally densely septate paraphyses. *L. trabinellum* markedly differs in a thin-walled textura globulosa(-prismatica) oriented under a high angle, and an apical ring of the *Calycina*-(or *Allophylaria*-)type. The protologue of *P. diaphanula* gives smaller apothecia (0.1 mm) and much larger spores (17–20 × 8 µm). Since the population in the type looks uniform, there seems to be no doubt that Cooke was dealing with this fungus. Probably Cooke's measurements are erroneous. Surprisingly, a note on the label indicates that R.W.G. Dennis could not find any apothecia.

Another specimen in K (USA, Newfield [New Jersey], VI.1887, branch of *Magnolia* lying on the ground in swampy woods, Ellis & Everh. N. Amer. Fungi II 2046, K(M) 36001, erroneously as 'type', IVV: H.B. 5528) differs from the type merely in growing on bark, and appears to be conspecific (ascospores 10–10.5 × 3–3.5 µm, multiguttulate). Unlike the type, a distinct blue IKI-reaction of the ectal excipulum was here observed, especially near the base, a feature also often seen in *L. trabinellum*. According to Seaver (1951: 153), the species was only known from the type locality, on bark and wood of decaying *Magnolia*.

For *Leptodontidium* de Hoog [type species *L. elatius* (F. Mangenot) de Hoog, anamorph of *L. trabinellum*], a new family *Leptodontidiaceae* was proposed (Hernández-Restrepo et al. 2017).

Hyalinia dilutella (Fr.) Boud., Hist. Class. Discom. Eur.: 104 (1907)

≡ *Peziza dilutella* Fr., Syst. Mycol. 2(1): 147 (1822)
≡ *Pezizella dilutella* (Fr.) Fuckel, Jahrb. Nassau. Ver. Naturkd. 23–24: 300 (1870)
≡ *Mollisia dilutella* (Fr.) Gillet, Champ. Fr., Discomyc.: 131 (1882)
≡ *Niptera dilutella* (Fr.) Rehm, Rabenh. Krypt.-Fl., 1.3: 556 (1896)
≡ *Hymenoscyphus dilutellus* (Fr.) Kuntze, Revis. Gen. Pl. 3: 485 (1898)
≡ *Pyrenopeziza dilutella* (Fr.) Gminder, Index Fungorum 302: 1 (2016)

The taxon was described by Fries (1822) on dry stems of *Epilobium angustifolium*, with sessile, glabrous, whitish-grey apothecia with a white margin. No type material could be found in UPS. A specimen in the herbarium E. Fries (UPS), collected by M.R. Roberge in Caen and identified by him as *Peziza dilutella* Fr., contains a black fungus growing on stems of *Cerastium*. It resembles a *Spilopodia* but was not examined with the microscope during a short stay at UPS and remained therefore unclarified (for macrophotos see IVV). Recent collections on *Rubus* stems tentatively identified as *Niptera dilutella* by Baral (in Weber 1992: 34) are shown here to be conspecific with the type of *Orbilia rubicola* (Cooke & Phill.) Sacc. (see p. 1684). In the absence of a type specimen, *P. dilutella* could be considered as a nomen dubium, if not Roberge's specimen as accepted by Fries is designated as epitype.

Orbilia divisa Velen., Monogr. Discom. Bohem.: 96, pl. 11 fig. 36 (1934)

No material under this name exists following Svrček (1954). The diagnosis (on bark of *Populus*) and the manuscript plate suggest a possible identity with *O. cardui* or *O. cotoneastri* (hardly inflated paraphyses, narrowly ellipsoid, 5–6 µm long spores).

Patinella dryadea Velen., Monogr. Discomyc. Bohem.: 75 (1934)

During a revision of the Slovakian type material (Tatra Mts, on stems of *Dryas octopetala*) and a French collection (Pyrenees) identified so by Chlebicki (1995: 396), the author found this taxon to be a species of *Lecanorales* and possibly a representative of the lichen genus *Lecidella* Körb. The spores, which were described as 10–12 µm long, ovoid-ellipsoid, hyaline, could not be found in the type. Ascus apical structure and iodine reaction were not reported by Velenovský and Chlebicki. Reexamination of the French collection revealed a deep blue IKI-reaction of the entire ascus (A. Chlebicki pers. comm.).

Hyalinia elaeina (Pass. & Beltr.) Boud., Hist. Class. Discom. Eur.: 104 (1907)

≡ *Niptera elaeina* Pass. & Beltr., *Atti R. Acad. Lincei*, Trans., sér. 3 **7**: 37 (1882) [also in Hedwigia 22: 121 (1883)]
≡ *Pezizella elaeina* (Pass. & Beltr.) Sacc., Syll. Fung. 8: 283 (1889)

When requesting type material, no response was received from PI and PARMA. The species was described from decorticated wood of *Olea europaea*, Monostalla, Sicilia (Italy). The apothecia were described as pale saturn-red ('miniata', no size stated), with in dry state undulating smooth margin, the asci as short-cylindrical, 27–30 µm long, 8-spored, inamyloid, the spores as narrow, rod-shaped, 12 × 4 µm. The indicated spore width could be erroneous, considering the given spore shape and ascus length. Until type material becomes available, the species is considered as a nomen dubium.

Habrostictis elegans Rabenh., Hedwigia 13: 184 (1874)

The brief, unillustrated diagnosis of this species (on wet wood near Salem, southern Germany, Rabenhorst Fungi Eur. Exs. XIX) is only microscopical and does not give any measurements: asci linear-sublanceolate, 8-spored, inamyloid, soon evanescent, ascospores uniseriate (straight or oblique), ovate-ellipsoid or subpyriform, hyaline, pseudoseptate (with divided cytoplasm), paraphyses filiform. Placement in *Habrostictis* Fuckel and comparison with *Stictis ocellat*a (= *Pezicula ocellata*) suggests that the apothecia resembled a *Pezicula* with a fringed margin. However, the habitat and the inamyloid, evanescent asci are in conflict with that genus. No reexamination of this exsiccata came to our notice.

Orbilia epiblastematica (Wallr.) Fr., Summa Veg. Scand.: 357 (1849)

≡ *Peziza epiblastematica* Wallr., Fl. cryptog. Germ. 2: 464, no. 2480 (1833)
≡ *Patellaria epiblastematica* (Wallr.) Sacc., Syll. Fung. 8: 788 (1889)
≡ ***Scutula epiblastematica*** (Wallr.) Rehm, Rabenh. Krypt.-Fl., 1.3: 294 (1890)
≡ *Biatorina epiblastematica* (Wallr.) A.L. Smith, Monogr. Brit. Lich. 2: 132 (1911)
≡ *Spilodium epiblastematicum* (Wallr.) Nieuwl., Am. Midl. Nat. 4: 385 (1916)
≡ *Catillaria epiblastematica* (Wallr.) Vain., Lichenogr. Fenn. 4: 448 (1934)

Scutula epiblastematica is a lichenicolous species that exclusively grows on thalli of *Peltigera* (Triebel et al. 1997). *Scutula* Tul. is a member of *Lecanorales*, but placement in a family seems not yet settled (P. Diederich pers. comm.). Lumbsch & Huhndorf (2010) placed it in *Pilocarpaceae*, but in Jaklitsch et al. (2016) it is in *Ramalinaceae*. See also under *Orbilia peltigerae*, p. 1681.

Orbilia erythrostigma (Mont.) Quél., Enchir. Fung.: 298 (1886) [non *Orbilia erythrostigma* (W. Phillips) Matočec et al. 2005, as '(Berk. & Broome) Boud.', nom.inval., Art. 41.5 ICN, ≡ *Hyalorbilia erythrostigma*]

≡ *Peziza erythrostigma* Mont., Ann. Sci. Nat., Bot., sér. 2, 18: 246, no 47 (1842) [non *Peziza erythrostigma* Berk. & Broome 1866, nom. illegit., ICN Art. 53.1, ≡ *Hyalorbilia erythrostigma*]
≡ *Nectria erythrostigma* (Mont.) Tul. & C. Tul., Select. fung. carpol. 3: 196 (1865)
≡ *Nectriella erythrostigma* (Mont.) Sacc., Syll. Fung. 9: 942 (1891)
≡ ***Octosporella erythrostigma*** (Mont.) Döbbeler, Feddes Repert. 115: 6 (2004)

This bryophilous species was recently (Döbbeler 2004) found to be an earlier synonym of *Octosporella urosperma* Döbbeler (*Pezizales*). The very small, perithecioid ascocarps appear to be confined to *Frullania dilatata*. Montagne (1842) placed the species in vicinity of *Peziza xanthostigma* and *P. leucostigma* and, perhaps therefore, Quélet made the combination in *Orbilia*, followed by Saccardo (1889: 632).

Hyalinia excavata (Saut.) Boud., Hist. Class. Discom. Eur.: 104 (1907)

≡ *Peziza excavata* Saut., Flora (Regensburg) 24: 314 (1841)
≡ *Pezizella excavata* (Saut.) Sacc., Syll. Fung. 8: 287 (1889)
≡ *Hymenoscyphus excavatus* (Saut.) Kuntze, Revis. Gen. Pl. 3: 485 (1898)

No material was found in BREG, LI, SZB, and W. Also Winter (1881: 132) and Keißler (1917: 109) were unable to locate a specimen. The taxon (Austria, Salzburg, Pinzgau, Mittersill, on rotten wood, 24.XI.1838, A. Sauter) was compared with *Mollisia leucostigma* [(Fr.) Gillet, ≡ *Orbilia leucostigma*] (see Saccardo 1889). The description (yellow, submembranaceous, smooth, concave, with undulating margin, ½ Linie [~1 mm] diam.) might refer to *Hyalorbilia inflatula* or *Orbilia xanthostigma*.

Orbilia fairmanii (Rehm) Seaver [as '*fairmani*'], North American Cup-fungi (Inoperculates): 154 (1951)

≡ *Pezizella fairmanii* Rehm [as '*fairmani*'], Ann. Mycol. 5: 519 (1907)

The asci of the holotype (USA, New York, Lyndonville, decorticated branch of *Tsuga canadensis*, IV.1906, C.E. Fairman, S-F9713, IVV: H.B. 6425) arise from croziers and have strongly euamyloid apical rings (*Calycina*-type), although Rehm (1907) stated 'I-'. The ascospores measure 4.5–7 × 2–2.4(–2.7) µm and contain some small LBs. The species strongly resembles *Orbilia hyalinula* (see p. 1674), which differs in distinctly smaller amyloid rings and in occurring on bark of ?*Acer*. Both taxa might belong in the genus ***Calycina***, but the excipular structure could not clearly be seen in *O. fairmanii*.

Orbilia flavoviridis (P. & H. Crouan) Quél., Enchir. Fung.: 298 (1886)

≡ *Helotium flavoviride* P. & H. Crouan [as '*flavoviridis*'], Florule Finistère: 47 (1867)
≡ *Calycina flavoviridis* (P. & H. Crouan) Kuntze, Revis. Gen. Pl. 3: 448 (1898)
≡ *Corynella flavoviridis* (P. & H. Crouan) Boud., Hist. Class. Discom. Eur.: 99 (1907)

According to a reexamination by J.P. Priou (pers. comm.), 2 packets bearing the name '*Helotium flavoviridis*' can be found at CO. One (Kergontès [part of Gouesnou, north of Brest], on rotten wood of a *Pinus* trunk, IVV: III.1866) represents ***Claussenomyces atrovirens*** (Pers.) Korf & Abawi or a very closely related species. The ~7-septate ascospores measure 21–22 × 3 µm and produce small cylindric-ellipsoid ascoconidia that fill the complete ascus. On the contrary, Crouan described the spores in the protologue as 'thick, ovoid, granular'. Broadly ellipsoid-ovoid spores with a granular content are actually figured on their herbarium label and also on a watercolour sketch which was undoubtedly made from this material. This conflict is easily explained by the fact that, in living asci, the conidia form 8 broadly ellipsoid 'balls' around the ascospores. Hence, the Crouan brothers misinterpreted balls of conidial masses as ascospores, a frequent mistake when studying living specimens of *Claussenomyces*. As a further error, Crouan gave the apothecia as 1–2 mm diam., whereas they are found here to measure rehydrated 0.3 mm at most.

The second packet (Penfeld [part of Brest], on rotten ?wood of a *Pinus* trunk, II.1866) contains a fungus showing a strongly blue IKI reaction of the outer ascus wall. The few apothecia are dark brown and measure 0.15 mm diam., with an ectal excipulum of brown textura globulosa. The spores have a size of 10–11 × 4–5 µm and contained, according to Crouan's sketch, several differently sized oil drops in the living state. This is a member of *Placynthiella* Elenkin, possibly *P. uliginosa* (Schrader) Coppins & P. James, a lichenized species of *Agyriales*.

Since the former collection fits much better the protologue, the collection from Kergontès is designated here as **lectotype** of *Helotium flavoviride* (MBT382123).

Orbilia flexuosa Crossl. in Massee, Grevillea 22: 44 (1894, '1893')

≡ *Phaeohelotium flexuosum* (Crossl.) Dennis, Kew Bull. 25: 354 (1971)

This species was transferred by Dennis to *Phaeohelotium* Kanouse. Reexamination of the holotype (Great Britain, Yorkshire, Lightcliffe, Halifax, 'on bark' [decorticated branch of *Alnus*], 6.VI.1893, C. Crossland, K(M) 32262, IVV: H.B. 5445) revealed that it is obviously a synonym of ***Phaeohelotium imberbe*** in the sense as reported in Baral & Krieglsteiner (1985), a species very common in central Europe on rotten wood and bark of both gymno- and angiosperms lying in wet habitats. In this species the asci arise from croziers and have a euamyloid apical ring of the *Hymenoscyphus*-type. The base of the ectal excipulum often shows an external faintly blue stain in IKI also in the holotype of *O. flexuosa*.

Orbilia fugax Sacc., E. Bommer & M. Rousseau, in Bommer & Rousseau, Bull. Soc. R. Bot. Belg. 29: 228 (1890)

≡ *Hyalinia fugax* (Sacc., E. Bommer & M. Rousseau) Boud., Hist. Class. Discom. Eur.: 104 (1907)

No material of this taxon was found in BR. The description (in Bommer & Rousseau 1890: 228, on leaves of *Calamagrostis sylvatica*, V.1890, Poix[-St.-Hubert, dépt. Luxembourg], Belgium) does not allow us to conclude whether it is orbiliaceous or not. The apothecia are described as very small ('36–45 mill.' diam.; 36–45 µm fide Saccardo 1892: 40), semitranslucent, white, the asci as 18–21 × 5–6 µm, sessile, the paraphyses as filiform, and the spores as 4–5 × 0.7–1 µm, oblong. Saccardo cited the authors differently as 'Bomm. Rouss. Sacc.'.

Orbilia fuscopallida Henn., Hedwigia 42, Beibl.: (85) (1903)

Reexamination of a syntype in S (herb. Sydow, Australia, southern Queensland, Eumundi, on petiole of *Lauraceae*, V.1902, Pritzel. no. 27, IVV: H.B. 7687) revealed that this taxon is a later synonym of *Orbilia myristicae* (see p. 1679).

Orbilia gelatinosa Sacc., Syll. Fung. 8: 624 (1889)

≡ *Peziza gelatinosa* Ellis & G. Martin, Amer. Nat. 17(12): 1283 (1883), nom. illegit., ICN Art. 53.1 [non *Peziza gelatinosa* Haller 1768, nom. inval., ICN Art. 32.1(c); nec *Peziza gelatinosa* Bull. 1790, = *Exidia recisa* (Ditmar) Fr.]
≡ *Coryne gelatinosa* (Sacc.) Rehm, Ann. Mycol. 5: 518 (1907)
≡ *Calloriopsis gelatinosa* (Sacc.) Syd. & P. Syd., Ann. Mycol. 15: 254 (1917)
= *Calloriopsis herpotricha* (Berk.) R. Sant., Svensk bot. Tidskr. 45(1): 300 (1951)
≡ *Peziza herpotricha* Berk., Hooker's J. Bot. Kew Gard. Misc. 3: 16 (1851)
≡ *Tapesia herpotricha* (Berk.) Sacc., Syll. fung. (Abellini) 8: 381 (1889)
≡ *Helotiella herpotricha* (Berk.) Sacc., Syll. fung. (Abellini) 8: 477 (1889)
= *Calloria meliolicola* Henn., Bot. Jb. 25: 509 (1898)
≡ *Coryne meliolicola* (Henn.) Höhn., Sber. Akad. Wiss. Wien, Math.-Naturw. Kl., Abt. 1 118: 106 (1909)
= *Diplothrix mirabilis* Vain., Ann. Acad. Sci. fenn., Ser. A 15(6): 154 (1921)

The above synonymy was established by Santesson (1951) and Pfister (1976), although Santesson did not mention *C. meliolicola* and Pfister overlooked that *P. herpotricha* has priority. *P. gelatinosa* is the type species of *Calloriopsis* Syd. & P. Syd. and *D. mirabilis* that of *Diplothrix* Vain., and further specific epithets have apparently not been combined in these two genera. Pfister erected for *Calloriopsis* the tribe *Calloriopsideae* which he referred to the *Leotiaceae* (see also Nannfeldt 1932: 254), whereas Baral (in Jaklitsch et al. 2016) considered it to belong to the new family *Helicogoniaceae*. For a description see Pfister (l.c.) and Baral & Marson (2001).

Calloria gentianae Grelet & Crozals, Bull. Trimest. Soc. Mycol. Fr. 44: 336, pl. 21 figs 1–4 (1928)

(?)= *Iridinea iridina* Velen., Monogr. Discom. Bohemiae: 299, figs 59–60 (1934)
(?)= *Unguicularia iridis* Svrček, Ceská Mykol. 42(3): 146 (1988)

Hein (1976: 34) stated that *Calloria gentianae* belongs to *Hyalinia*. However, in the type envelope (France, Haute-Savoie, La Clusaz, on stems of *Gentiana lutea*, VII.1927, A. de Crozals, PC), he noted that the species belongs in the relationship of *Unguicularia*. Two specimens bearing the same collection data were received from PC. One of them was examined (PC 0001045, IVV: H.B. 7759) and found to be a probable earlier synonym *Iridinea iridina* and *Unguicularia iridis*. The species possesses glassy hairs similar as in *Habrostictis diaphana* treated above, though without a lumen in their upper part, and also resembles this species in its hymenial characteristics. Documentations of several fresh collection of this species were available (IVV: H.B. 2897, E.R.D. 4495 etc.). A paper on this species, the relationship of which appears to be within the *Calloriaceae*, is in preparation. In this paper the genera *Chaetonaevia* (see under *Naevia diaphana*, p. 1669), *Hyalacrotes* (Korf & L.M. Kohn) Raitv., and *Iridinea* (see under *Habrostictis diaphana*, p. 1669) are discussed regarding their possible synonymy with *Laetinaevia*.

Orbilia geralensis (Henn.) Rick, Brotéria, sér. Cienc. Nat. 1(1): 46 (1932)

≡ *Ombrophila geralensis* Henn., Hedwigia 38, Beibl.: (65) (1899)
≡ ***Coenogonium geralense*** (Henn.) Lücking, Fl. Neotrop. Monogr. 103: 579 (2008)

A syntype specimen in S (Brazil, Santa Catarina, Serra Geral, on unidentified tree bark, E. Ule, herb. Sydow, IVV: IV.1891) was examined and found to be a representative of the genus *Dimerella* Trevis, a genus which is now considered as a synonym of *Coenogonium* Ehrenb. (*Coenogoniaceae*, *Gyalectales*, see Jaklitsch et al. 2016). In the protologue Hennings reported the bark to be covered by lichens, but obviously he overlooked the inconspicuous thallus of this lichenized discomycete. The apothecia are rehydrated 0.6–1 mm diam., bright yellow. The whole ascus wall reacts hemiamyloid (first blue then dirty olive-brown in IKI), the ascospores are 1-septate, 6.5–10 × 2.4–2.7 µm (Hennings: 9–11 × 3 µm, 'non-septate'), guttulate, the paraphyses densely septate, with inflated apical cell of 4–5 × 2.5–3.5 µm (Hennings: apically clavate, 3.5 µm wide). Based on the present reexamination, Lücking (2008: 579) made the combination in *Coenogonium* as *C. geralense* (Henn.) Lücking, which he considered to provide an earlier synonym of *C. flavicans* (Vězda & Farkas) Kalb & Lücking (but also of *Belonidium collemoides* Rehm and *Gyalecta marginalis* Vaino), for which he gave a spore size of 6–9 × 1.8–2.5 µm. In the substrate the type of *C. geralense* differs from the various pantropical collections reported by Lücking (l.c.) which were on living leaves. Yet, some species of *Coenogonium* are found to be both lignicolous and foliicolous (Lücking pers. comm.).

Orbilia glabrovirens (Boud.) Boud., Bull. Soc. Mycol. Fr. 1: 114 (1885)

≡ *Helotium glabrovirens* Boud., Bull. Soc. Bot. Fr. 28: 95, pl. III fig. VIII (1881)
≡ *Belonidium glabrovirens* (Boud.) Sacc., Syll. Fung. 8: 498 (1889)
≡ *Corynella glabrovirens* (Boud.) Boud., Icon. Mycol., liste prélim.: 4 (1904)

= ***Claussenomyces prasinulus*** (P. Karst.) Korf & Abawi, Can. J. Bot. 49: 1882 (1971)

When Boudier (1885: 114) assigned two species to his new genus *Corynella* Boud., *Coryne atrovirens* Pers. and *Helotium glabrovirens* Boud., he erroneously wrote for the latter basionym '*Orb. glabrovirens* Boud.'. According to ICN Art. 35.2 (Turland et al. 2018), the two intended combinations in *Corynella* were not realized because genus and species epithet were not definitely associated. They became valid only in 1907 and 1904, respectively. Van Vooren (2011) drew attention to the fact that most of the names newly included in genera by Boudier (1885) cannot be considered as valid combinations. However, the obviously unintended combination '*Orb. glabrovirens* Boud.' is valid. The Code allows abbreviations when they clearly refer to a name; the generic name *Orbilia* appears also unabbreviated on the same page, and the phrase '*glabrovirens* Boud.' can be interpreted as cryptic reference to *Helotium glabrovirens* (ICN Art. 41.3). It can hardly be argued that '*Orb.*' is a typographical error for '*Cor.*' (Art. 60.1 ICN), but it cannot be excluded that the error was made by the printer. *Helotium glabrovirens* is currently placed in synonymy with *Claussenomyces prasinulus*.

Orbilia glacialis Rehm, Rabenh. Krypt.-Fl., 1.3: 461 (1891)

No type material (Austria, Tirol, Pitztal, Taschach-Gletscher, on dry stems of inflorescence of *Petrocallis pyrenaica*) was found in M, PAD, S (see also Hein 1976: 34). Rehm described the apothecia as pale yellowish, 0.2–0.3 mm diam., asci sessile, with a hemispherical, strongly thickened apical wall (no iodine reaction stated), 30–36 × 12–14 µm, 8-spored, spores 5–7 × 3 µm. An authentic later collection studied by Hein (1976: 59, on *Apiaceae*, IX.09, Rehm as '*Orbilia ?glacialis*', S) showed hairs similar as in *Chaetonaevia* (*Calloriaceae*).

Patinella gnaphaliana (Cooke & Ellis) Sacc., Syll. Fung. 8: 771 (1889)

≡ *Patellaria gnaphaliana* Cooke & Ellis, Grevillea 6: 91 (1878)
≡ *Pyrenopeziza gnaphaliana* (Cooke & Ellis) Rehm, Ann. Mycol. 2: 354 (1904)

The type material (stems of *Gnaphalium decurrens*, New Jersey, USA, no. 2665) was not ordered, but a collection under the name *Patellaria gnaphaliana* was examined (unlocalized, herbaceous stems of *Gnaphalium polycephalum*, V.1879, Ellis N. Amer. Fungi 398, M). It has longer spores (12.5–14 × 5–5.4 µm) and smaller apothecia (0.2–0.35 mm when dry) compared to the protologue (spores ovoid, 8 × 5 µm, apothecia 0.5–1 mm). The collection studied has ascus apical rings of the *Ploettnera*-type (only the lower part of the apical thickening turns blue in IKI). Its position might be close to *Ploettnera* Henn. (*Calloriaceae*).

Orbilia griseocarnea Henn., Hedwigia 41: 19 (1902)

Type material (Brazil, Santa Catarina, Caetébach, on rotten trunks, 24.VII.1891, A. Möller no. 135) could not be located in B, GH, HBG, K, IAC, and S. The apothecia are described as 3–6 mm diam., the spores as broadly ellipsoid-ovoid, 4–5 × 3.5 µm. Whether or not this is an orbiliaceous fungus remains unclear.

Orbilia sericea f. ***grisea*** Girz., Bull. Jard. Bot. Kieff 10: 59 (1929)

The type specimen (dry branches of *Ribes nigrum*, 2.X.1927, in a garden in Kyiv, Ukraine) was not ordered, and no microscopic features are mentioned in the protologue. The 'small fungus' is said to differ from *O. sericea* merely in its light grey colour (no further macroscopic features are described). The occurrence on a dry substrate together with the given colour is quite unexpected within the *Orbiliomycetes* and seems to fit better a member of the *Helotiales*. Actually, a topotype specimen in LE turned out to represent a member of *Mollisia* (Fr.) P. Karst. when examined by E.S. Popov (pers. comm.).

Hyalinia gyalectoides (Saut.) Boud., Hist. Class. Discom. Eur.: 104 (1907)

≡ *Peziza gyalectoides* Saut., Hedwigia 15: 151 (1876) [also in Mitt. Ges. Salzb. Landesk. 18: 112 (1878)]
≡ *Helotium gyalectoides* (Saut.) Sacc., Syll. Fung. 8: 240 (1889)
≡ *Calycina gyalectoides* (Saut.) Kuntze [as '*gyalectodes*'], Revis. Gen. Pl. 3: 448 (1898)

Type material could not be located in BREG, LI, SZB, and W. However, Keißler (1917: 94) was able to examine Sauter's type specimen (Austria, Salzburg, on rotten leaves of *Salix*, X.1869). He found a prosenchymatic ectal excipulum and thus confirmed Saccardo's placement in *Helotium*. Without describing further features, he believed the taxon to be identical with *Helotium epiphyllum* (Pers.) Fr. [≡ *Phaeohelotium epiphyllum* (Pers.) Hengstm]. According to Winter's (1881: 133) revision of Sauter's type, the asci measured 50–60 × 7 µm and the spores 8–10 × 2 µm, which clearly excludes *P. epiphyllum*. Keißler's reference to the protologue ('Flora, Bd. 24 (1841), p. 151') is erroneous, correct is Hedwigia 15: 151 (1876). Also Saccardo's reference ('Pilz. Salzb., p. 14') is a mystery.

Orbilia haematites (Wallr.) Sacc., Syll. Fung. 8: 632 (1889)

≡ *Peziza haematites* Wallr., Fl. Crypt. Germ.: 472 (1833)

No type specimen was found in PR and STR. The protologue (Germany, Thüringen, on dry stems of *Rubus idaeus*) is without microscopic features. Wallroth described the apothecia as obconical, smooth, deep blood-red, resembling *Sphaeria episphaeria* (≡ *Cosmospora episphaeria*) at first glance.

Rodwayella haematoidea (Cooke & W. Phillips) Baral & Quijada, **comb. nov.** — MB 826713

Basionym: *Peziza haematoidea* Cooke & W. Phillips, in Cooke, Grevillea 8: 62 (1879)
≡ *Pezizella haematoidea* (Cooke & W. Phillips) Sacc., Syll. Fung. 8: 284 (1889)
≡ *Hymenoscyphus haematoideus* (Cooke & W. Phillips) Kuntze, Revis. Gen. Pl. 3: 485 (1898)
≡ *Pseudohelotium haematoideum* (Cooke & W. Phillips) Dennis, Kew Bull. 15(2): 315 (1961)
?= *Remleria piceicola* Raitv., Scripta Mycol., Tartu 20: 110 (2004)

The species was compared with *Peziza rubella* Pers. (≡ *Orbilia rubella*) by Cooke & Phillips (in Cooke 1879). Therefore, the holotype material (New Zealand, Waitaki, [on wood and bark of unidentified angiosperm], undated, M.C. Cooke 1885, K(M) 36003, IVV: H.B. 5527) was examined. It contains a few dirty red-brown apothecia 0.4–1 mm diam. (in dry state) in a rather decayed stage (originally described as blood-red, 1–1.5 mm diam.). The asci (90–105 × 7–9 µm) have a slightly conical apex with an apical ring of the *Calycina*-type (deep blue in IKI after KOH-treatment). The ascus base was not clearly seen. The ascospores (13–21 × 2.5–3.7 µm) are at first non-septate but all 8 spores inside the asci later become 3-septate. The non-septate spores contain many small LBs in each half, the 3-septate ones fewer in each cell. The ectal excipulum is a thin-walled, yellow-orange, horizontal textura prismatica (more t. angularis towards the base).

The species belongs in the *Pezizellaceae*, judging from very similar, possibly conspecific recent European collections on *Rubus* (UK, IVV: H.B. 9851) and *Picea* (Spain, IVV: TFC Mic. 140830). Their 3-septate spores are found inside the living asci and are surrounded by an inconspicuous sheath that does not stain in CRB. The white, subsessile apothecia, which partly turn red-brown with age, are reminiscent of *Calycina* spp. with 2-septate spores but also resemble species of *Rodwayella* Spooner. Based on the protologue, *Remleria piceicola* could be conspecific.

ITS and LSU rDNA sequences gained by L. Quijada (pers. comm.) from the Spanish sample placed the species in a medium supported clade with *Rodwayella sessilis* (Rodway) Spooner (TFC Mic. 24329), the type of *Rodwayella*, but more distant from *Calycellina* and particularly *Calycina*.

Hyalinia helleboricola Ade, Hedwigia 64: 318 (1923)

(?)= ***Psilachnum rubicundum*** (Sacc. & Speg.) Baral

No type material (Germany, Untere Schrainbachalpe S of Königssee, on leaves of *Helleborus niger*, 19.VI.1921, A. Ade) could be located in B, M, and S. The species was described with asci stained blue in iodine and ascospores of 4–5 × 2–2.5 µm. *Hyalinia helleboricola* is probably a later synonym of *Psilachnum rubicundum* (see below).

Hyalinia hungarica (Rehm) Boud., Hist. Class. Discom. Eur.: 104 (1907)

≡ *Pezizella hungarica* Rehm, in Winter, Flora N.S. 30: 526 (1872)
≡ *Hymenoscyphus hungaricus* (Rehm) Kuntze, Revis. Gen. Pl. 3: 485 (1898)
≡ *Hyaloscypha hungarica* (Rehm) Velen., Monogr. Discom. Bohem.: 274 (1934)
≡ *Clavidisculum hungaricum* (Rehm) Raitv., Scripta Mycol. 1: 77 (1970)
≡ *Cistella hungarica* (Rehm) Raitv., Scripta Mycol. 8: 151 (1978)

According to Dennis (1964: 47) and Raschle (1978), *Pezizella hungarica* is a synonym of *Dasyscyphus grevillei* (Berk.) Massee (≡ ***Cistella grevillei*** (Berk.) Raschle), but Raitviir (1970, 1978, 2004) considered it to be specifically distinct on account of shorter ascospores.

Orbilia hyalinula (Nyl.) P. Karst., Bidr. Känn. Finl. Nat. Folk 19: 99 (1871)

≡ *Peziza hyalinula* Nyl., Not. Sällsk. Fauna Fl. Fenn. Förh. 10: 57 (1869)
≡ *Hyalinia hyalinula* (Nyl.) Boud., Hist. Class. Discom. Eur.: 104 (1907)

The holotype (Finland, Nylandia, Helsinki, in horto botanico, inner surface of bark of ?*Acer*, 6.II.1863, W. Nylander, H, IVV: H.B. 5250) belongs in the *Hyaloscyphaceae*. The most characteristic feature is the reduced apical dome (only subapically thickened) with an IKI pale blue apical ring (after KOH-treatment) visible as 2 minute apical dots. The ascospores measure 5–7.6(–8.2) × (1.8–)2–2.4 µm and contain several small LBs. The generic position of this species is unclear because vital characters, particularly the paraphysis contents, are unknown. *P. hyalinula* could belong to ***Calycina***, from which it differs in a reduced *Calycina*-type of apical ring. The clavate, smooth, hair-like cortical cells might instead indicate a relationship to *Cistella* Quél. Closely related is *Orbilia fairmanii* (p. 1671), which differs in a strongly euamyloid apical ring of the *Calycina*-type.

Patinella hyalophaea Sacc. – see p. 208, under *Patinella*.

Naevia rosella f. ***impatientis*** Höhn., in Strasser, Verh. Zool.-Bot. Ges. Wien 69: 366 (1919)

No type material of this taxon (Austria, [Niederösterreich, Amstetten,] Sonntagberg, rotten stems of *Impatiens noli-tangere*, VI.1917) could be located in PAD and S. Hein (1976: 34) apparently studied the type when stating that it is an *Orbilia*. The protologue gives asci of 40–48 × 8–12 µm (including the long and thick stipe), spores ovoid-oblong, 8–10 × 3 µm, paraphyses apically slightly enlarged. Hein further believed that a collection on *Impatiens* from Michigan (USA), identified by Kanouse (1936: 100) as *Laetinaevia rosella* (Rehm) Nannf. (≡ *Orbilia rosella*), was probably the same *Orbilia*. However, this assumption appears to be based only on the substrate, since Kanouse gives no microscopic characters. *Naevia rosella* (Rehm) Rehm (≡ *Pseudopeziza rosella* Rehm, non *Orbilia rosella*) was compared with *Naevia diaphana* by Rehm (1888: 146) and is probably a member of *Calloriaceae*.

Hyalinia incarnata (Cooke) Boud., Hist. Class. Discom. Eur.: 103 (1907)

≡ *Peziza incarnata* Cooke, Grevillea 1: 131 (1873)
≡ *Mollisia incarnata* (Cooke) W. Phillips, Man. Brit. Discomyc.: 191 (1887)
≡ *Pezizella incarnata* (Cooke) Sacc., Syll. Fung. 8: 285 (1889)
≡ *Hymenoscyphus incarnatus* (Cooke) Kuntze, Revis. Gen. Pl. 3: 485 (1898)
= ***Pseudohelotium pineti*** (Batsch) Fuckel, Jb. Nassau. Ver. Naturk. 23-24: 298 (1870) [1869-70]

According to Nannfeldt (1936: 195) and Dennis (1964: 47), the type material (on needles of *Pinus sylvestris*) is a synonym of *Pseudohelotium pineti*.

Orbilia inconspicua Nograsek & Matzer, Nova Hedwigia 53: 460 (1991), nom. inval. (Art. 36.1(a), 39.1 ICN)

Orbilia inconspicua, proposed by Nograsek & Matzer (1991) as a nomen provisorium (with only German diagnosis) for samples on leaves and stems of *Dryas octopetala* from alpine eastern Austria and arctic Lapland (Sweden), resembles *O. vitalbae* and *O. caulicola* based on the authors' description and a reexamination of two authentic collections, GZU 60-92 (Austria) and GZU 64-92 (Sweden), judging from spore size and shape, and the partly capitate-clavate paraphyses. Spore bodies were not described and could also not be discerned in the dead spores. Two other specimens from Austria cited by the authors contained a very different *Orbilia* with thick-walled ascus apices and spores with short basal tails (see under *O. angustoaristata*, p. 700). A type was not designated by the authors.

Mollisia incrustata (Ellis) Seaver, North American Cup-fungi (Inoperculates): 215 (1951)

≡ *Peziza incrustata* Ellis, Amer. Nat. 17: 192 (1883)
≡ *Pseudohelotium incrustatum* (Ellis) Sacc., Syll. Fung. 8: 301 (1889)
≡ *Cistella incrustata* (Ellis) Dennis, Res. Norweg. Sci. Exped. Tristan da Cunha 36: 2 (1955)
≡ ***Hyphodiscus incrustatus*** (Ellis) Raitv., Scripta Mycol. 20: 74 (2004)
= *Mollisia trametis* Ellis & Everh., Proc. Acad. Nat. Sci. Philadelphia 45: 147 (1893)

Peziza incrustata was described growing on the pores of perennial basidiomycetes in North America. Seaver (1951: 215), who placed it in *Mollisia* and cited *M. trametis* as synonym, saw a similarity in apothecial colour with *Helotium* and *Orbilia*. Dennis (1955) transferred the taxon to *Cistella* and compared it with *C. stereicola* (Cooke) Dennis and *Peziza hymeniophila* P. Karst. (≡ *Hyphodiscus hymeniophilus* (P. Karst.) Baral). Type material of *Mollisia trametis* (USA, New Jersey, Newfield, on *Trametes stevensii*, Dec. 1888, J.B. Ellis, FH) was reexamined and found to be very close to European *H. hymeniophilus*. However, the *Phialophora* anamorph found in the type of *M. trametis* differs from that of *H. hymeniophilus*, *Phialophora rhodogena* (Mangenot) W. Gams, in lacking a red colour, as already stated by Raitviir (2004). The phialoconidia in the two taxa are about the same size [*M. trametis*: 3.3–4.5 × 1.3–1.6 µm; *H. hymeniophilus*: two personal collections *2.8–4.5(–7) × 1.3–1.8 µm, wood of *Fagus*, 21.II.1990, 4.X.1994 (H.B. 5161); Helfer 1991: 3–5 × 1.5–2.5 µm]. Further investigations are necessary to clarify whether *H. incrustatus* is distinct from *H. hymeniophilus* at the species level.

Orbilia infixa (Wallr.) Quél., Enchir. Fung.: 299 (1886)

≡ *Peziza infixa* Wallr., Fl. Crypt. Germ.: no. 2504 (1833)
≡ *Pezizella infixa* (Wallr.) Sacc., Syll. Fung. 8: 287 (1889)
≡ *Hymenoscyphus infixus* (Wallr.) Kuntze, Revis. Gen. Pl. 3: 485 (1898)
≡ *Mollisiella infixa* (Wallr.) Boud., Hist. Class. Discom. Eur.: 142 (1907)

Type material of this taxon (Germany, Thüringen, on rotten wood of *Salix*) has not been ordered but is unlikely to exist. The apothecia are described as pale wax-coloured, dry orange-yellow (no size stated), scattered, first urceolate, later with a raised smooth margin. No information on the hymenial elements is given. In the case that no type material has survived, *Peziza infixa* must be considered as a nomen dubium.

Crouan & Crouan (1867: 49) reported under the name *P. infixa* collections from NW-France on various woody and herbaceous substrates, with ovoid spores and the apothecial colour varying from white over amber-yellow to red. The authors cited '*Peziza tenacella* Wallr. in sched.' and *P. coccinella* Sommerf. as synonyms. Eight specimens labelled *Peziza infixa* exist in Crouan's herbarium (CO) and were revised by J.P. Priou (pers. comm.). Three or four of them represent *O. eucalypti* (on *Carpinus*, *Pinus*, *Quercus* and *Ulex*), two *O. auricolor* (on *Fraxinus* and *Ulmus*), one perhaps *O. cardui* (on *Angelica*), and one *O. rubrovacuolata* (on *Salix*). Two further collections with red apothecia (on *Rubus*) labelled '*Helotium coccinellum* (Sommerf.) Crouan' (in sched., with *Peziza infixa* as a possible synonym) also represent *O. rubrovacuolata* (J.P. Priou pers. comm.).

Belonopsis ingae Seaver, in Chardon & Toro, J. Dept. Agric. Porto Rico 14, 4: 226 (1930)

Seaver described this taxon (Colombia, Cordillera Occidental, El Valle, Hacienda Bitaco, on dead pod of *Inga*, 11.VI.1929, no. 506) very briefly, with gregarious, pale yellow, semitranslucent apothecia up to 0.5 mm diam., asci clavate, short, 18–20 × 4–5 µm (as '48–20'), spores straight or slightly curved, 8–10 µm long, paraphyses very slender with globose, 3 µm wide apices. Dennis (1970: 352, 354) noted that the description sounds like an *Orbilia*. No material could be located in NY.

Patinella inquinans Sacc., Syll. Fung. 8: 770 (1889)

≡ *Peziza inquinans* Cooke, Hedwigia 14: 84 (1875), nom. illegit., ICN Art. 53.1 [non *Peziza inquinans* Pers. ≡ *Bulgaria inquinans* (Pers.) Fr.]
?= ***Durella macrospora*** Fuckel, Jb. Nassau. Ver. Naturk. 23-24: 281 (1870) [1869-70]

No type material has been studied. A collection under this name (USA, Alabama, Lee County, Auburn, decorticated twig of unidentified angiosperm, V.1896, F.S. Earle & L.M. Underwood, herb. Petrak, M) fits the protologue. This specimen has 3-septate, multiguttulate ascospores 20–25 × 4 µm, asci 60–67 × 9–10 µm, with hemispherical, thin-walled, inamyloid apex (IKI), arising from croziers, paraphyses apically covered by dark brown granular exudate, ectal excipulum of horizontal textura porrecta, with a KOH-inert dark pigment. This is a *Durella* and probably not different from *Durella macrospora*.

Orbilia lacustris (Fr.) Quél., Enchir. Fung.: 299 (1886)

≡ *Peziza lacustris* Fr., Syst. Mycol. 2(1): 143 (1822)
≡ ***Niptera lacustris*** (Fr.) Fr., Summa Veg. Scand.: 359 (1849)
≡ *Belonidium lacustre* (Fr.) W. Phillips, Man. Brit. Discomyc.: 149 (1887)
≡ *Belonopsis lacustris* (Fr.) Höhn., Mitt. bot. Inst. tech. Hochsch. Wien 4(2): 40 (1923)
≡ *Mollisia lacustris* (Fr.) Gillet, Champ. Fr., Discomyc.: 130 (1882)

When Fries (1849) erected the genus *Niptera* Fr., he designated *P. lacustris* as type species. The confusing interpretation of this species as pointed out by Höhnel (1927) was settled by Dennis (1972) who reexamined the type material. *Niptera* is accepted as a genus close to *Mollisia* (*Mollisiaceae*, *Helotiales*, see Dennis l.c., Baral 1994: 116).

Orbilia leightonii (W. Phillips) Sacc. [as '*Leightoni*'], Syll. Fung. 8: 631 (1889)

≡ *Calloria leightonii* W. Phillips [as '*Leightoni*'], Man. Brit. Discomyc.: 329 (1887)
≡ *Hyalinia leightonii* (W. Phillips) Boud. [as '*Leightoni*'], Hist. Class. Discom. Eur.: 104 (1907)
?= ***Hyaloscypha quercicola*** (Velen.) Huhtinen, Karstenia 29(2): 163 (1990) [1989]

The presumed holotype ([Great Britain, Shropshire, near Shrewsbury], on the pores of a brownish resupinate *Polyporaceae*, undated, W.A. Leighton, K(M) 36054, IVV: H.B. 5449) appears to be a species of *Hyaloscypha* Boud., although hairs could not be found. The asci arise from simple septa, the apex is distinctly conical and IKI-, and the nearly eguttulate ascospores measure 6–8.5(–9.5) × 2.3–2.5(–3) µm. These characters would fit *H. quercicola*, but in the absence of hairs this synonymy remains questionable. The genus *Parorbiliopsis* Spooner & Dennis was established to accomodate two such hairless species. Based on personal studies of type material in K and H (IVV: H.B. 5753), the type species *P. minuta* Spooner & Dennis [≡ *Hyaloscypha minuta* (Spooner & Dennis) Baral] is doubtfully distinct from *Hyaloscypha intacta* Svrček, although pointed hairs are almost absent in *P. minuta*. In fact, *Parorbiliopsis* is hardly separable from *Hyaloscypha* at the generic level (see also Phyl. 1). The other species originally included in *Parorbiliopsis*, *P. extumescens* (P. Karst.) Spooner & Dennis, is probably a synonym of *H. albohyalina* (P. Karst.) Boud. In its holotype (P. Karsten 3593, H, IVV: H.B. 5249) some of the apothecia possess hairs typical of *Hyaloscypha*, but the hymenial elements were too overmature in order to study the ascus base.

Orbilia lenticularis (Bull.) Riel, nom. inval. (P. Riel, unpublished colour drawing no. 2228)

≡ *Peziza lenticularis* Bull., Herb. France pl. 300 (1787) [also in Hist. Champ. France 1: 248 (1791)]
≡ *Peziza citrina* subsp. *lenticularis* (Bull.) Pers., Mycol. Eur. 1: 293 (1822)
≡ *Helotium lenticulare* (Bull.) Fr., Summa Veg. Scand.: 356 (1849)
≡ *Calycina lenticularis* (Bull.) Kuntze, Revis. Gen. Pl. 3: 448 (1898)
≡ *Calycella lenticularis* (Bull.) Boud., Hist. Class. Discom. Eur.: 95 (1907)

No type material was ordered. According to Bulliard's (1787) original plate, which shows two cut trunks of an unidentified tree with two populations that inhabit the wood surface, the fungus is obviously a mixture of two species, a sessile ?*Orbilia* (pl. 300 A, '*Peziza lenticularis sessilis*') and a stipitate ?*Bisporella* (pl. 300 B, '*P. lenticularis pediculata*', perhaps *B. subpallida* (Rehm) Dennis or *B. pallescens* (Pers.) S.E. Carp. & Korf). Besides this heterogeneity of *P. lenticularis*, Bulliard (1791) reported also the colour to vary from whitish to yellow-orange or brownish.

N. Van Vooren (pers. comm.) drew our attention to the unpublished colour drawings of Philibert Riel, a contemporary of Émile Boudier, preserved in the Herbarium of the Société linnéenne de Lyon. According to a handwritten note, Riel was in contact with Boudier concerning *P. lenticularis*, and Boudier appears to have used Bulliard's taxon at that time for a fungus 'frequent on rotten trunks of various trees, especially *Quercus*' (Boudier in litt. to Riel, 22.VIII.1897). Riel's plate 2228 (Rhône, Poule, 18.VIII.1897, Bracq & Renard) bears the name *Orbilia lenticularis*, an unpublished combination that was apparently suggested by Boudier who seems to have determined several dozens of Riel's plates (Van Vooren pers. comm.). This plate clearly represents *Orbilia eucalypti*. Riel also stated that Boudier (1907: 95) followed a different interpretation of *P. lenticularis* when proposing the combination in *Calycella* by referring more to the stipitate form of *Peziza lenticularis*.

Hyalinia leucostigma (Fuckel) Boud., Hist. Class. Discom. Eur.: 104 (1907)

≡ ***Hyaloscypha leucostigma*** (Fuckel) Baral, **comb. nov.** — MB 814681

Basionym: *Niptera leucostigma* Fuckel [as '(Fr.?) Fuckel'], Jahrb. Nassau. Ver. Naturkd. 27–28: 59 (1874 [1873–74])

≡ *Pezizella leucostigma* (Fuckel) Sacc., Syll. Fung. 8: 279 (1889)

≡ *Mollisia leucostigma* (Fuckel) Rehm, Rabenh. Krypt.-Fl., 1.3: 516 (1891), nom. illegit., ICN Art. 53.1 [non *Mollisia leucostigma* (Fr.) Gillet 1882, ≡ *Orbilia leucostigma* (Fr.) Fr.]

≡ *Hymenoscyphus leucostigma* (Fuckel) Kuntze, Revis. Gen. Pl. 3: 485 (1898)

= *Hyaloscypha spiralis* (Velen.) J.G. Han, Hosoya & H.D. Shin, Fungal Biol. 118: 161 (2014)

≡ *Chrysothallus spiralis* Velen., Monogr. Discom. Bohem. (Prague): 269 (1934)

≡ *Hyaloscypha albohyalina* var. *spiralis* (Velen.) Huhtinen, Karstenia 29(2): 99 (1990)

= *Truncicola parasitica* Velen., Monogr. Discom. Bohem. (Prague): 289 (1934)

= *Hyaloscypha lignicola* Abdullah & J. Webster, Trans. Br. mycol. Soc. 80(2): 253 (1983)

When Fuckel (1874) described a collection 'on rotten stumps of *Fagus* (or *Betula*)' (Germany, Rheingau, [Mainz,] Hallgarten, Fuckel Fungi Rhen. Exs. 2572), he referred it to '*Peziza leucostigma* Fr.' or '*Orbilia leucostigma* Fr.', though with hesitation under the new name '*Niptera leucostigma* (Fr.?) Fckl. F. rh. ed. I. 2572 & ed. II.'. His major doubts he expressed by adding 2 question marks after the two mentioned names, According to Art. 52 Note 1 (ICN), the citation of a name with a question mark does not make the name of a new taxon nomenclaturally superfluous.

Although the new name *Niptera leucostigma* appears to have been intended merely as a new combination, it was taken up by later authors as the erection of a new species. Saccardo (1889: 279) and Rehm (1891: 516) shared Fuckel's doubts about the identity of his fungus with that of Fries, and proposed the combinations *Pezizella leucostigma* and *Mollisia leucostigma*. They gave as basionym '*Niptera leucostigma* Fuckel', thus explicitly excluding Fries's fungus, which they treated elsewhere (Saccardo 1889: 629, Rehm 1891: 454). Also Kuntze's (1898: 485) and Boudier's (1907: 104) combinations give Fuckel as the author of the species. As a consequence, all these combinations may not be connected to *Peziza leucostigma* Fr. (≡ *Orbilia leucostigma* (Fr.) Fr.), but refer to Fuckel's *Niptera leucostigma*, which represents a valid description of a new taxon (S.R. Pennycook pers. comm.).

Rehm did not find any apothecia when studying a syntype of Fuckel Fungi Rhen. Exs. 2572 (on wood of *Fagus*), neither did Arendholz in a syntype from G. When the latter specimen was examined in the present study (IVV: H.B. 7798), a small group of apothecia was discovered. These well correspond to Fuckel's diagnosis and belong to a member of *Hyaloscypha*. The microscopic features (asci with amyloid ring, without croziers, spores 7–10.5 × 2.5–3.2 µm, with some small oil drops in each half, OCI 1–2) refer this taxon to *Hyaloscypha albohyalina* var. *spiralis* as circumscribed by Huhtinen (1990a), who considered *H. lignicola* and *Truncicola parasitica* as synonymous. Fuckel's specimen deviates from typical populations of this taxon only in very short hairs which are, however, similarly depicted in one of the collections included by Huhtinen (l.c.: fig. 50).

H. albohyalina differs from *H. leucostigma* not only in the presence of croziers as stated by Huhtinen (l.c.), who separated the two taxa merely at the variety level, but also in having refractive SCBs in the living paraphyses (Baral 1992: 368). Obviously, the two taxa merit distinction at the species level. This was supported by a multigene analysis of two eastern Asian specimens by Han et al. (2014), which revealed a rather high molecular distance between the two taxa.

An exsiccata distributed by E.C. Bommer & M.H. Rousseau under the name *Mollisia leucostigma* (Fuckel) Rehm (Belgium, Champlon, on inner surface of undecayed bark of *Carpinus*, X.1909, M.H. Rousseau, BR 073559,33, IVV: H.B. 7645) contains a small *Mollisia*, which could not be identified at the species level. The paraphyses show a strong yellow KOH-reaction and the ascospores measure 10–13 × 2.8–3.5 µm and have a medium high lipid content (OCI 3, multiguttulate).

Hyalinia leucostigmoides (Sacc.) Boud., Hist. Class. Discom. Eur.: 104 (1907)

≡ *Calloria leucostigmoides* Sacc., Michelia 1(1): 63 (1877) [also in Michelia 2(6): 77 (1880)]

≡ *Mollisia leucostigmoides* (Sacc.) Gillet, Champ. Fr., Discomyc.: 131 (1882)

≡ *Pezizella leucostigmoides* (Sacc.) Sacc., Syll. Fung. 8: 277 (1889)

= ***Calycellina chlorinella*** (Ces.) Dennis, Kew Bull. 30: 350 (1975)

Two specimens in PAD labelled *Pezizella leucostigmoides* were examined (Italy, [Piemonte,] Valsesia, Riva Valdobbia, *Rumex scutatus*, 9.III.1891, A. Carestia; Czechia, Mährisch-Weißkirchen, *Galium sylvaticum*, VIII.1913, F. Petrak). Both showed euamyloid apical rings of the *Calycina*-type and refractive contents of paraphyses and clavate hairs, and clearly represent *Calycellina chlorinella* (see also under *Hyalinia chlorinella*, p. 1665). As a typical character of this species, the apothecia grew on black stromatic stripes that are acervuli of a coelomycete which might be the anamorph of this *Calycellina.*

Rehm (1891: 524) placed *P. leucostigmoides* in synonymy with *Mollisia teucrii* (Fuckel) Rehm, which in turn was suggested as a synonym of *C. chlorinella* by Svrček (1977a: 13). Höhnel (1926a: 67) studied *M. teucrii* (as *Pezizella teucrii* (Fuckel) Rehm) from the type and concluded that it is intermediate between *Helotium* and *Orbilia*. This taxon is included as *Mollisia teucrii* (Fuckel) Rehm in the British checklist. According to W.D. Graddon (in litt., Cannon et al. 1985: 150), its type belongs to *Calycellina* and a specimen under this name collected by M.C. Clark is *C. chlorinella*.

Orbilia limpida Kobayasi, Bot. Mag., Tokyo 53: 159 (1939)

?= ***Ombrophila violacea*** Fr., Summa veg. Scand., Sectio Post. (Stockholm): 357 (1849)

According to Korf (1958: 31) the type specimen cannot be located. Korf considered *O. limpida* as a possible pallid sessile form of *Ombrophila violacea*.

Hyalinia leightonii var. ***lignicola*** Bayl. Ell. [as '*Leightoni*'], Trans. Br. Mycol. Soc. 6: 266, pl. VI figs 1–2 (1920)

No material could be located in K. The parenchymatous, fuscous excipulum was emphasized by Bayliss Elliott (1920) as distinctive in contrast to the type variety of *Hyalinia leightonii* (see p. 1675) with a hyaline excipulum. Judging from the description, *H. leightonii* var. *lignicola* seems to be a *Mollisia*.

Orbilia loci-simiarum Henn., Hedwigia 41: 19 (1902)

?= ***Ombrophila violacea*** Fr., Summa veg. Scand., Sectio Post. (Stockholm): 357 (1849)

A syntype in S (Brazil, Santa Catarina, Blumenau, 'Affenwinkel', on rotten bark of a palm, 26.VII.1892, A. Möller no. 347, herb. Sydow, S, IVV: H.B. 7680) contains 3 overmature apothecia measuring (rehydrated) 2.5–8 mm diam. The asci are rather disintegrated, some showing a minute amyloid apical ring at the inner part of the dome. The 8 ellipsoid(-fusoid) ascospores (4.7–6.5 × 2.8–3.5 µm) contain two transparent areas (vacuoles?) but no LBs. The ectal excipulum is of a horizontal hyaline textura prismatica of large, thin-walled cells (25–50 × 17–27 µm), and the medullary excipulum of very thin hyphae immersed in abundant gel. This taxon appears to be close to or even conspecific with *Ombrophila violacea*. Typical of *O. violacea* are 2 medium-sized LBs in the spores which were also mentioned in the protologue of *Orbilia loci-simiarum*. Their absence in the present material is obviously due to senescence of the spores.

Under the name *O. loci-simiarum* Chardon & Toro (1930) reported a collection from Colombia on leaf sheaths of *Guadua latifolia*.

Orbilia luteola (Roum.) McPartl., in McPartland & Cubeta, Mycol. Res. 101(7): 854 (1997)

≡ *Calloria luteola* Roum., Rev. Mycol. (Toulouse) 3(12): 7 (1881)
(?)= ***Calycellina chlorinella*** (Ces.) Dennis, Kew Bull. 30: 350 (1975)

McPartland & Cubeta (1997) reexamined an authentic specimen which they named 'holotype' (France, Haute Garonne, Villermusi, undated, stems of *Cannabis sativa,* Roumeguère, Fungi Sel. Gall. Exs. 27, no.1671, BR), and 2 'isotypes' (BPI no. 802622A, CUP), but their brief description lacks important characters, such as ascus iodine reaction and type of ascus base ('Asci small, cylindrical, 8-spored, 26 × 4.5 µm, ... Ascospores hyaline, single-celled, fusiform, indistinctly guttulate, 6.5 × 1.5 µm'). No microscopic features are illustrated but only a macrophoto is provided. The species does not appear to have been restudied before, and McPartland & Cubeta's statement must be taken as a lectotypification.

The present reexamination of the lectotype in BR revealed a discomycete which fully matches *Calycellina chlorinella*, except for a single character: in contrast to all previously studied collections in which the iodine reaction was tested, the asci did not show a positive IKI reaction (with or without KOH-pretreatment). In deviation from McPartland & Cubeta's description, the cells of the ectal excipulum are distinctly thick-walled, and the spores cylindrical instead of fusiform, often slightly allantoid, 6.3–8.5(–9.5) × 1.3–1.5 µm, with 1–3 minute LBs near each end. The asci measured 32–44 × 3.5–4.2 µm, with the inamyloid apical wall only 0.2–0.5 µm thick, and arise from croziers. The paraphyses are densely filled with large, rectangular refractive bodies (VBs) when mounted in water, an important character of *Calycellina* which is sometimes still visible in herbarium material (in KOH the VBs disappear). The apothecia often grew on a black, stripe-like coelomycete with rod-shaped conidia 4–4.5 × 0.8 µm. Typical *C. chlorinella* with euamyloid asci is likewise regularly associated with this coelomycete, which might be the anamorph of the discomycete (see also under *Hyalinia leucostigmoides*, p. 1676).

The question remains open whether the observed difference in iodine reaction supports separation of two taxa. See also under the similar *Orbilia veratri* (p. 1689).

Orbilia macrospora Penz. & Sacc., Malpighia 15: 220 (1902)

Type material [Java, Cibodas ('Tjibodas'), on rotten wood] could not be located in PAD, PAL, and W. The species is described with fusoid, nearly unstalked asci (112–130 × 8–8.5 µm) with a conical apex, thin uninflated paraphyses, and fusoid, often very slightly curved, eguttulate spores of 28–30 × 4 µm (see also Penzig & Saccardo 1904: 86, pl. 57 fig. 4). The red semitranslucent apothecia (0.5–0.7 mm) appear to refer to an *Orbilia*, but the large asci and spores were mentioned by the authors as strange for that genus.

Patinella macrospora Ell. & Everh. – see under *Patinella crandallii* (p. 1667).

Orbilia marina Boyd, in Smith, Trans. Br. Mycol. Soc. 3: 113 (1909)

≡ *Laetinaevia marina* (Boyd) Spooner, in Kirk & Spooner, Kew Bull. 38: 568 (1984)
≡ ***Calycina marina*** (Boyd) Rämä & Baral, in Baral & Rämä, Bot. Mar. 58: 527 (2015)

Spooner (in Kirk & Spooner 1984) redescribed this algicolous species, which he tentatively transferred to *Laetinaevia* and for which he proposed a lectotype. Baral & Rämä (2015) provided a redescription based on fresh specimens and a molecular analysis of rDNA. *O. marina* nested with high support in the genus *Calycina* (*Pezizellaceae*), although its macro- and microscopic features only partly support such placement.

The apothecia are pulvinate and erumpent, the asci arise from simple septa (not bifurcate) and have a conical apex with a hemiamyloid (type RB) apical ring similar as in *Calycina*. The ring much resembles that of *Cyathicula cyathoidea* (*Conchatium*-type, Triebel & Baral 1996, fig. 5), whereas typical *Laetinaevia* species have a 'T-shaped' ring of the *Pezicula*-type. The living ascospores contain a few small LBs. The paraphyses are medium clavate at the apex and covered by a thick hyaline gel. The apical cell of each paraphysis contains a few large, globose, faintly refractive VBs which stain pale turquoise in

CRB but strongly blackish red-brown in IKI, a feature so far not seen in personal studies of typical *Laetinaevia* species. Both the gel and the total ascus wall stain lilac in CRB. Apart from the CRB-positive ascus wall, nothing points to a relationship to the *Orbiliomycetes*.

Orbilia medicaginis (Fautrey & Roum.) Sacc., Syll. Fung. 11: 426 (1895)

≡ *Calloria medicaginis* Fautrey & Roum., in Roumeguère, Rev. Mycol. (Toulouse) 14: 3 (1892)
= ***Duebenia compta*** (Sacc.) Nannf. ex B. Hein, Beih. Willdenowia 9: 105 (1976)

According to Nannfeldt (1929: 319, as *Duebenia purpurascens* (Rehm) Nannf.) and Hein (1976: 105), this is a synonym of *Duebenia compta*, a species currently placed in *Calloriaceae* (*Helotiales*). This species is confined to herbaceous stems of *Fabaceae* and has orange, elongate apothecia with a darker margin. The ascus iodine reaction is variable in Hein's concept of the species, being either amyloid or inamyloid.

Hyalinia microspis (P. Karst.) Boud., Hist. Class. Discom. Eur.: 104 (1907)

≡ *Peziza microspis* P. Karst., Not. Sällsk. Fauna Fl. Fenn. Förh. 10: 178 (1869)
≡ *Helotium microspis* (P. Karst.) P. Karst., Bidr. Känn. Finl. Nat. Folk 19: 152 (1871)
≡ *Pezizella microspis* (P. Karst.) Sacc., Syll. Fung. 8: 281 (1889)
≡ *Hymenoscyphus microspis* (P. Karst.) Kuntze, Revis. Gen. Pl. 3: 485 (1898)
≡ *Hyaloscypha microspis* (P. Karst.) Velen., Monogr. Discom. Bohemiae: 280 (1934)
≡ *Calycellina microspis* (P. Karst.) Dennis, Trans. Bot. Soc. Edinb., 150th anniv. suppl. 45(3): 213 (1989) [also in Kew Bull. 45(2): 293 (1990)]

No type material could be located in H, although Dennis (1956: 181) has examined the type (Finland, Runsala, rotting leaves of *Phragmites*, 1.IX.1868). Dennis wrote that *Helotium microspis* can scarcely be separated from the genus *Mollisina* (*Helotiales*). However, he could not find the typical processes on the cortical cells of the ectal excipulum. The minute amyloid apical ring excludes *H. microspis* from the *Orbiliomycetes*. Recent collections assignable to *H. microspis* show globose refractive vacuoles (VBs) in the paraphyses and marginal cells reminiscent of the genus *Calycellina* (IVV: H.B. 9551b, 9957 etc.). However, similar collections without VBs likewise resemble Dennis' type description (IVV: H.B. 8471b etc.). *Hyalinia turgidella* (p. 1688) and *Orbilia succinella* (p. 1687) might be synonymous.

Orbilia oculifuga var. ***microspora*** Sacc., Syll. Fung. 8: 627 (1889)

≡ *Hyalinia oculifuga* var. *microspora* (Sacc.) Boud., Hist Class. Discomyc.: 104 (1907)
?= ***Calycina cruentata*** (P. Karst.) Kuntze, Revis. gen. pl. (Leipzig) 3(3): 448 (1898)

Le Breton & Malbranche (1884: 129) described from Forêt de Roumare, Mare de l'Epinay, 8.V.1884 (France, Haute-Normandie, Seine-Maritime, W of Rouen) a collection on culms of *Juncus communis* and leaves of *Eriophorum angustifolium*, which they referred with some doubts to *Orbilia oculifuga* Quél. By referring to this description, Saccardo (1889) erected the new variety *microspora*, and also Grelet (1948b: 108) only repeated Le Breton & Malbranche's brief description by accepting Boudier's (1907) placement in *Hyalinia*. Saccardo, Boudier, and Grelet refer to 'p. 15' in Le Breton & Malbranche (1884), probably by using a reprint with different page numbers.

There exist two sketches at the herbarium of Rouen labelled '*O. oculifuga* Quel.?' (I. Gaspérini pers. comm.). One of them shows a fungus on *Juncus* from Mare de l'Epinay (IVV: Le Breton, undated) with apparently sessile, short-haired apothecia, but the microscopic data are not the same as in the protologue, and a date is not indicated. The other shows short-stipitate and short-haired apothecia, but no collection data and no substrate are given. Since the herbarium does not send specimens on loan, this material could not be studied.

When asking for the type of *O. oculifuga* at PC, another specimen was received, identified by Le Breton & Malbranche as '*Orbilia oculifuga*?', collected in Forêt de Pont-de-l'Arche [Haute-Normandie, Eure, SSE of Rouen] on *Carex riparia*, undated, E. Niel & A. Le Breton (PC 0088500, IVV: H.B. 7749). This is identified here as *Calycina cruentata*, a taxon that fits quite well the characteristics reported by Le Breton & Malbranche (1884), e. g., faintly amyloid ascus tips and slightly allantoid spores.

Le Breton & Malbranche did not describe the apothecia of their *O. oculifuga* var. *microspora*, therefore, it remains unclear whether the protologue originates from sessile or short-stipitate apothecia, or perhaps from both. In PC 0088500 the apothecia had a very short stalk.

Orbilia miniata (Batsch) Sacc., Syll. Fung. 8: 632 (1889)

≡ *Peziza miniata* Batsch, Elenchus fung. II: 207, pl. 27 fig. 144 (1786)
≡ *Calloria miniata* (Batsch) Sacc., Michelia 1: 63 (1877)

No type material ([Germany, Weimar,] Webicht, on wood and rotten leaves, beginning of Sept. 1785) was found in JE, LE, PAD, PAL, and W. The description refers to a saturn-red (= miniate), short stipitate discomycete. Saccardo (1877, 1889) transferred the taxon with hesitation to *Calloria* and later to *Orbilia*, and considered a possible relationship to *Peziza haematites* (see p. 1673). Without studying the type he referred two Italian collections (on wood of *Fagus*) to this taxon. Based on the lignicolous vs. foliicolous habitat, it can be assumed that the original description includes two different fungi.

Orbilia minutissima (Rostr.) Sacc., Syll. Fung. 8: 629 (1889)

≡ *Calloria minutissima* Rostr., Medd. Grønl. 3: 537 (1888)
≡ ***Laetinaevia minutissima*** (Rostr.) Nannf. ex B. Hein, Willdenowia, Beih. 9: 50 (1976)

Hein (1976: 50) examined the holotype in C (Greenland, Kobbefjord, on *Angelica archangelica*, 28.VI.1884). The many included specimens from various parts of Europe inhabit herbaceous stems of a wide range of dicotyledonous plants and appear to show an arctic-alpine distribution. The species is said to differ from the very similar *L. adonis* (Fuckel) Nannf. ex B. Hein mainly in the absence of an amyloid apical ring.

A specimen under the name *O. minutissima* which is not listed by Hein in his examined specimens (Sweden, Torne Lappmark, Jukkarjärvi, Murlja, on stems of *Angelica archangelica*, VIII.1928, J.A. Nannfeldt, herb. Petrak, M) was studied and found to have long, acute, glassy hairs at the margin (30–40 × 3.3–3.8 µm), with an acute-conical lumen near the base. The asci arise from croziers and have hemiamyloid (type RR) apical rings, and the spores measured 12–14 × 4.2–4.7 µm. This appears to be conspecific with the type material of *Naevia diaphana* Rehm [≡ *Unguicularia diaphana* (Rehm) Nannf.], although the glassy substance did not dissolve in 5% KOH. These glassy-haired taxa perhaps belong to the genus *Iridinea* Velen. (see under *Habrostictis diaphana*, p. 1669).

Orbilia mitracea Velen., Monogr. Discom. Bohem.: 98, pl. 11 fig. 42 (1934)

No type material exists of this taxon (Svrček 1954) which was collected in June 1925 near Mnichovice (Bohemia). The stated ecology (humid trunk of *Picea*, shady forest) and the colourless apothecia of 0.5–1 mm diam. suggest a desiccation-sensitive taxon, but the small excipular cells of 12–15 µm diam. and the uninflated paraphyses covered by thick exudate might point to a desiccation-tolerant species, perhaps *O. vinosa*. The acicular, 10–12 µm long spores are also reminiscent of *Hyalorbilia juliae* or a member of section *Helicoon*. The mitra-like glassy processes on the marginal cortical cells, from which the name of the taxon is derived, and particularly the thin flexuous stalk of the rather short asci (25 × 3–4 µm incl. stalk), depicted on his manuscript plate, exclude the genus *Hyalorbilia.*

Laricina mollis Velen., Monogr. Discom. Bohem.: 104 (1934)

= ***Ascocorticium anomalum*** (Ellis & Harkn.) J. Schröt., in Engler & Prantl, Nat. Pflanzenfam., Teil. I (Leipzig) 1(1): 161 (1897)

The monotypic genus *Laricina* Velen. was compared by Velenovský (1934) with *Orbilia*. A recent unpublished revision of the type species *L. mollis* (on brachyblasts of twigs of *Larix*) by M. Svrček (I.2004, in sched., PRM 149442) revealed this to be a synonym of *Ascocorticium anomalum* (M. Šandová pers. comm.).

Orbilia mollisioides Höhn., Sitzungsber. Kaiserl. Akad. Wiss. Wien, Math.-Naturwiss. Kl., Abt. I, 118: 1521 (1909)

≡ ***Micropeziza mollisioides*** (Höhn.) Baral, Helleman & U. Lindemann, in Helleman et al., Ascomycete.org 5(4): 134 (2013)
= *Crustomollisia roburnea* (Velen.) Svrček, Sydowia 39: 219 (1987) [1986]
≡ *Pezizella roburnea* Velen., Monogr. Discom. Bohem. (Prague): 161 (1934)

Höhnel placed this foliicolous species in *Orbilia* on account of its clavate-capitate apices of paraphyses embedded in gel, and the yellowish clods of exudate on the marginal excipulum. According to a study of the holotype (Germany, Sachsen, Schandau, Kurpark, leaves of *Quercus rubra*, X.1900, W. Krieger [FH], IVV: H.B. 6293), this is an earlier synonym of *Crustomollisia roburnea*, the type of the genus *Crustomollisia* Svrček, and a very close relative of the North American *Micropeziza castanea* (Sacc. & Ellis) Baral & Guy Garcia (≡ *Calycellina castanea* (Sacc. & Ell.) Dennis, see Helleman et al. 2013). The species was also studied from fresh collections and seems confined to leaves of *Quercus*. The asci have a conical ascus apex with an amyloid ring of the *Calycina*-type. The genus *Micropeziza* Fuckel as redefined by Helleman et al. is considered to be closely related to *Calycellina*, differing in abundant brown clods of exudate on the excipulum, a gelatinized, slightly protruding margin, and swollen paraphysis apices containing in the living state a strongly refractive, hyaline to yellow-green vacuolar body (VB). See also under *Orbilia myristicae*.

Orbilia myriospora (W. Phillips & Harkn.) Sacc., Syll. Fung. 8: 631 (1889)

≡ *Calloria myriospora* W. Phillips & Harkn., Bull. Calif. Acad. Sci. 1: 23 (1884)
≡ *Myridium myriosporum* (W. Phillips & Harkn.) Clem., Gen. Fungi: 174 (1909)
≡ ***Laetinaevia myriospora*** (W. Phillips & Harkn.) Nannf. ex B. Hein, Willdenowia, Beih. 9: 51 (1976)

The type material (USA, California, herbaceous stems of *Psoralea macrostachya*, undated [1882 according to Hein 1976], W.H. Harkness 2779, K(M) 36056, IVV: H.B. 5544) contains numerous apothecia which are, however, immature as already stated by Hein (1976), who found the asci up to 10 µm wide and the 'apex (still?) without a wall thickening or iodine reaction'. A single, 14 µm wide ascus was found in the present study, which showed a distinct amyloid apical ring (blue in KOH+IKI), with the lower part most reactive (*Ploettnera*-type). The species was described in the protologue as having multispored asci ('sporidia excessively minute, innumerable'), but the authors noted on the label that 'The contents of the asci resemble granular plasma such as is often seen in *Peziza* in an immature shape of growth'. Both Hein's and the present examination confirm that these minute 'sporidia' are lipid bodies which fill the cytoplasm of immature asci. Presumably, the species is not more than 8-spored at maturity, since polyspored taxa are so far unknown in the *Naevioideae*. The asci appear to arise from croziers, and the species seems well-placed in *Laetinaevia* in concordance with Hein (l.c.). *Calloria myriospora* is the type species of *Myridium* Clem., hence this genus is a tentative synonym of *Laetinaevia*. *Myridium* was declared as a nomen rejiciendum in order to conserve *Laetinaevia* over *Myridium* (Korf 1988). The present material bears the original handwritten diagnosis. Hein (l.c.), who studied a duplicate deposited in PAD, named that specimen 'lectotype'.

Orbilia myristicae Henn., Hedwigia 41: 144 (1902)

The species and *Orbilia coleosporioides* Sacc. were placed by Saccardo & Saccardo (1906: 139) in an unranked subgroup of *Orbilia*, *Orbiliopsis* Sacc., to comprise fungi parasitic on living leaves. Sydow (1924) designated the latter as type species, raised the group to generic level, and added a further species, but did not mention *O. myristicae* at all (see also p. 207). In fact, *O. myristicae* shows little resemblance to the two species included by Sydow.

Reexamination of a syntype of *O. myristicae* [Java, Bogor ('Buitenzorg'), on living leaves of *Myristica fragrans*, undated, A.W.P. Zimmermann, herb. Sydow, S-F9972, IVV: H.B. 7686] revealed asci with conical apex and a slightly refractive apical ring that does not stain in IKI, with or without KOH-pretreatment). The ectal excipulum is of a rather pale brown textura angularis. The fungus is found here to be conspecific with *Orbilia fuscopallida* (p. 1672), and shows similarities to the genus *Micropeziza* (see also under *Orbilia mollisioides*, p. 1679), but differs in lacking both gel and brown clods, and in having short hair-like protrusions.

Orbilia nivea (P. & H. Crouan) Quél., Enchir. Fung.: 299 (1886)

≡ *Helotium niveum* P. & H. Crouan, Florule Finistère: 47 (1867) [non *Helotium niveum* Kirschst. 1907; nec. *Helotium niveum* Velen. 1947 = *Hymenoscyphus vernus* (Boud.) Dennis]
≡ *Calycina nivea* (P. & H. Crouan) Kuntze, Revis. Gen. Pl. 3: 448 (1898)
≡ ***Mniaecia nivea*** (P. & H. Crouan) Boud., Hist. Class. Discom. Eur. (Paris): 99 (1907)

Helotium niveum was described by Crouan & Crouan (1886) for white, sessile apothecia of 1/5 mm diam. growing on the stem base of living *Diplophyllum albicans* (as *Jungermannia albicans*), probably near Brest (Bretagne, Finistère). The unpublished watercolour sketch preserved at CO (J.P. Priou pers. comm.) shows distinctly larger apothecia in relation to the leaves of the host. The large asci are 8-spored, the ellipsoid spores multiguttulate (no size given), and the filiform, straight paraphyses eguttulate.

Le Gal (1953: 122) redescribed the original collection (30.I.1864), with asci of 160–240 × 22–30 µm and spores of 18–28 × 10–17 µm, but did not mention the apothecial size. J.P. Priou (pers. comm.) wanted to examine the holotype but found the cardboard inside the envelope empty. A recent collection on *Jungermannia gracillima* (E. Rubio, IVV: E.R.D. 6643) showed similarly large spores of *22–27 × 12.7–14.5 µm and apothecia of 0.17–0.35 mm diam., but curved paraphyses. Boudier (1904–10, 1909: 263, pl. 456) described under the name *Mniaecia nivea* a collection on an unidentified member of *Jungermanniales* from Jura, with slightly smaller spores [*17–25 × 10–12 µm, but 16–19.5(–25) × 8.2–10.3(–11) µm when evaluated from scale] and apothecia of 0.5–1 mm diam. (0.53–0.6 mm from scale). See also under *Orbilia albida* (p. 1660).

Hyalinia nostra Rehm, Ann. Myc. 6: 117 (1908)

≡ *Orbilia nostra* (Rehm) Sacc. & Trotter, Syll. Fung. 22: 724 (1913)
= ***Sarcotrochila alpina*** (Fuckel) Höhn., Sber. Akad. Wiss. Wien, Math.-Naturw. Kl., Abt. 1 126(4-5): 310 (1917)

This taxon is a later synonym of *Sarcotrochila alpina*, following reexamination of two syntype specimens (Germany, München, Park Neufriedenheim, leaves of *Larix japonica*, IV.1908, H. Rehm, Ascomyc. 1754, M, MPU, IVV: H.B. 5050). The apothecia open by a lateral ellipsoid lid of host epidermis, the short-stalked asci arise from croziers and have a strongly papillate apex with a small, IKI deep blue (euamyloid) apical ring. The multiguttulate ascospores (10.5–13 × 3.5–4 µm) have a median constriction and large, polar gelatinous caps. A yellowish refractive substance (remnants of VBs) is observed in the long, cylindrical terminal cells of the paraphyses. Various recent collections showed large, elongated, hyaline to chlorinaceous VBs (IVV: H.B. 6109, 9544 etc.). *Orbilia retrusa* is a further synonym (see p. 1683). The genus *Sarcotrochila* Höhn. is related to *Trochila* Fr. which has the same type of paraphyses that contain VBs. These refractive vacuolar contents were shown to be characteristic of the family *Cenangiaceae* (= *Hemiphacidiaceae*), to which the two genera belong (see Pärtel et al. 2016).

Orbilia obscura T. Ghosh, N. Mukherji & Basak, Jute Bull. 27: 135 (1964)

≡ ***Peziza multiguttulata*** A. K. Kar & K. P. Pal, Mycologia 60: 964 (1968) [non *Peziza obscura* Cooke (1878)]

Based on the examination of the type and further specimens from India, Kar & Pal (1968) reported this species to have operculate amyloid asci, and recognized it as a member of the genus *Peziza*.

Habrostictis ocellata (Pers.) Fuckel, Jahrb. Nassau. Ver. Naturkd. 25–26: 326 (1871)

≡ *Peziza ocellata* Pers., Syn. Meth. Fung. 2: 667 (1801)
≡ *Stictis ocellata* (Pers.) Fr., Syst. Mycol. 2(1): 193 (1822), nom. sanct.
≡ *Propolis ocellata* (Pers.) Sacc., Michelia 2: 333 (1881)
≡ *Ocellaria ocellata* (Pers.) J. Schröt., in Cohn, Krypt.-Fl. Schlesien 3.2: 150 (1893)
≡ ***Pezicula ocellata*** (Pers.) Seaver, North American Cup-fungi (Inoperculates): 345 (1951)

Pezicula ocellata has some macroscopic resemblance to *Orbilia carpoboloides* (P. & H. Crouan) Baral (= *Habrostictis rubra* Fuckel). Both species have therefore been treated by Fuckel in the same genus. The asci of *P. ocellata* have a large hemiamyloid (type RR) apical ring of the *Pezicula*-type, and the ascospores a very high lipid content (OCI 5, multiguttulate). Both features are typical of the genus *Pezicula* to which Verkley (1999) assigned the species that was earlier known under the name *Ocellaria ocellata*.

Orbilia oculifuga Quél., Compt. Rend. Associated Franç. Avancem. Sci. 9: 674, pl. IX fig. 16 (1881)

≡ *Hyalinia oculifuga* (Quél.) Boud., Hist. Class. Discom. Eur.: 104 (1907)
?= ***Calycina cruentata*** (P. Karst.) Kuntze, Revis. gen. pl. (Leipzig) 3(3): 448 (1898)

Type material (Normandie, on culms of *Glyceria*, spring, A. Le Breton) could not be located at PC, but a specimen exists at the herbarium of Rouen (I. Gaspérini pers. comm.) which seems to be part of the type. Because this herbarium does not send any material on loan, J.P. Priou (pers. comm.) visited it and examined that specimen but found only immature apothecia, therefore, he could not resolve the identity of this obviously helotialean discomycete. The label bears the data '1876, on *Glyceria*, Béch, Rouen' (France, Normandie, Seine-Maritime, IVV: 1876), and a diagnosis and sketch which exactly agree with Quélet's (1881) protologue. Obviously this is the handwriting of Le Breton, who was given as the finder of *O. oculifuga* by Quélet and who later added Quélet's diagnosis by referring to Quélet's publication. J.P. Priou reviewed another specimen at the herbarium of Rouen under the name *Orbilia oculifuga* (on leaves of *Cyperaceae*, Ferrières, A. Malbranche, IVV: VIII.1885), which had sessile, hairy apothecia, and identified it as *Calycina cruentata*.

In April 1879 Le Breton collected a similar fungus, on culms of *Glyceria aquatica*, prairies du Grand-Quevilly in Rouen (Le Breton & Malbranche 1884). Despite the same host genus, he doubted identity with *O. oculifuga* but considered this specimen to be conspecific with another sample collected in 1884, which became the type of Saccardo's *O. oculifuga* var. *microspora* (see above). Also a third specimen was doubted by Le Breton to be genuine *Orbilia oculifuga*, which was reexamined in the present study and found to belong as well to *Calycina cruentata* (see under *O. oculifuga* var. *microspora*, p. 1678). It has a very short stipe, whereas Quélet (1881) described the apothecia of *O. oculifuga* as sessile.

Belonium orbilioides Rehm, Rabenh. Krypt.-Fl., 1.3: 1232 (1896)

= ***Micropeziza umbrinella*** (Desm.) Baral, Helleman & U. Lindem., in Helleman, Lindemann, Baral & Yeates, Ascomycete.org 5(4): 134 (2013)

The holotype (Switzerland, Berner Oberland, Wengern-Alpe behind Jungfrau, on stems of *Apiaceae*, IX.1893, H. Rehm, S-F12076, IVV: H.B. 6429) was examined and found to be a later synonym of *Micropeziza umbrinella*. The species was also studied from Desmazière's type of *Peziza umbrinella* (IVV: H.B. 4674), which is the type of the genus *Calloriella* Höhn., as well as from fresh specimens. According to the original description, *Allophylaria soederholmii* Svrček is a further synonym. The species is characterized by its inamyloid, conical ascus apices, large fusoid ascospores containing two large and many small LBs, and paraphyses with strongly capitate-clavate apices (possibly, therefore, the name '*orbilioides*') containing VBs in the living state. The subsessile, yellowish-brownish apothecia have a distinctly gelatinized ectal excipulum, especially at the slightly protruding margin, which is covered by brown exudate. See also under *Orbilia mollisioides*, p. 1679.

Hyalinia orbilioides (Feltgen) Boud., Hist. Class. Discom. Eur.: 104 (1907)

≡ *Pezizella orbilioides* Feltgen, Rec. Mém. Trav. Soc. Bot. G.-D. Luxemb. 16: 53 (1903)
≡ *Ombrophila orbilioides* (Feltgen) Höhn., Sitzungsber. Kaiserl. Akad. Wiss. Wien, Math.-Naturwiss. Kl., Abt. I 115: 1282 (1906)

Höhnel (1906) examined two authentic specimens of *Pezizella orbilioides* and found them to belong to two different taxa. Without specifying the envelopes, he referred one of them (with abundant apothecia) to Feltgen's taxon and combined it in *Ombrophila*. He did not supply a diagnosis of that fungus, which he found to be mostly immature. In the other envelope, Höhnel observed apothecia with a dentate margin, which he considered to belong to *Cistella ciliata* (Crouan) Höhn. However, he reported its spores as 6–12 × 1.4–1.8 µm, with obtuse ends, which would match those in the protologue of *P. orbilioides* (8–9.5 × 1.25–2 µm), whereas *Helotium ciliatum* P. & H. Crouan was described with certainly much longer, fusiform to falcate spores with acute ends (Crouan & Crouan 1867 and unpublished watercolour sketch, spore size not indicated).

Three authentic specimens exist at LUX. Though bearing slightly deviating data, they all appear to be part of the single collection mentioned in the protologue (Luxembourg, Kockelscheier, on petioles of *Petasites hybridus*, 8.IV.1902, J. Feltgen). In one (LUX 42513, undated) no apothecia could be found. Apothecia were abundantly seen in the other two: LUX 42512 (8.IV.1902) contains the original diagnosis together with a sketch of the apothecia and microscopy, but the examined apothecium was apparently not mature; in LUX 42532 (IV.1902, IVV: H.B. 9570) mature asci were found, and this specimen was thoroughly investigated. LUX 42512 and LUX 42532 undoubtedly contain the same species which fits well Feltgen's description and original sketch, particularly in the characteristic, apically mostly hooked paraphyses. We here designate LUX 42532 as **lectotype** of *Pezizella orbilioides* (MBT382125).

A specimen from France (Pay-de-Dôme, Mont. Dore, on stem of *Heracleum sphondylium*, 7.V.1993, R. Péan 9338A, IVV: H.B. 5183) was also examined only in the dead state. It appears to be conspecific with the lectotype and suggests a wider host spectrum. An unusual feature of this species is the slightly gelatinized ectal excipulum of textura angularis which stains distinctly blue in IKI in this as well as the two type specimens. There is also a yellow pigment in the paraphyses when mounted in KOH, which Feltgen mentions as 'reddish-yellow mass'. *P. orbilioides* appears to be congeneric with *Orbilia circinella* (see p. 1666). The two taxa might belong in the *Calloriaceae*, but their generic affiliation is unknown at present.

Tapesia orbilioides (Rehm) Sacc., Syll. Fung. 11: 410 (1895)

≡ *Eriopezia orbilioides* Rehm, Rabenh. Krypt.-Fl., 1.3: 695 (1889)
= ***Ascobolus foliicola*** Berk. & Broome, J. Linn. Soc., Bot. 14(no. 74): 109 (1873) [1875]

This species is listed in Aebi (1972: 69) as a synonym of *Ascobolus crouanii* Boud. (≡ *A. foliicola*).

Habrostictis pallida (Fuckel) Clem., Gen. Fungi: 174 (1901)

≡ *Pseudopeziza pallida* Fuckel, Jahrb. Nassau. Ver. Naturkd. 23–24: 291 (1870)
≡ *Naevia pallida* (Fuckel) Rehm, Rabenh. Krypt.-Fl., 1.3: 138 (1888)

The original description of *Pseudopeziza pallida* in Fuckel (1870, copied by Rehm 1888) refers to a discomycete with asci of 56 × 6 µm and ascospores of 10 × 2 µm, growing on the underside of leaves of *Buxus sempervirens*. Rehm placed the species in *Naevia* Fr., but he stated that its relationship was dubious because of the insufficient description and the lacking data on the iodine reaction. Hein (1976: 34) listed *P. pallida* as a mitosporic fungus. Yet, this opinion can hardly be accepted, as it does not match the original description of a fungus with a teleomorph. *P. pallida* is the type species of *Habrostictis* Clem. (non Fuckel, see p. 206).

Orbilia pannorum J. Schröt., in Cohn, Krypt.-Fl. Schlesien 3.2: 121 (1893)

No type material (Poland, Wrocław, botanical garden, on rotten [stems of] *Arctium*, July) could be located in M, W, WRSL, and Z. Apothecia were described as 0.5–1.5 mm diam., light carneous to almost rosaceous, at the base with white, delicate hyphae, and the spores as 'filiform, 9–11 × 0.5–1 µm', without any further details. The original description suggests identity with *O. auricolor*, but it remains unclear why Schröter did not mention curvature of the spores.

A specimen identified by Jaap (1922: 15) as *O. pannorum* (Germany, Prignitz, Triglitz, on rotten cloth in pine forest, 25.VIII.1905, O. Jaap, IVV: H.B. 7912) was reexamined from HBG. It contains abundant, often large and strongly undulating apothecia (Fig. 116e, Pl. 953: 10) referable to *O. auricolor*, with comparatively long spores (10–14 × 1 µm).

Orbilia parietina (Schrad.) S. Hughes

This is a misspelling for ***Orbicula parietina*** (Schrad.) S. Hughes (*Pyronemataceae*, *Pezizales*).

Orbilia peltigerae (Fuckel) Sacc., Syll. Fung. 8: 631 (1889)

≡ *Calloria peltigerae* Fuckel, Jahrb. Nassau. Ver. Naturkd. 23–24: 283 (1870)
≡ *Hyalinia peltigerae* (Fuckel) Boud., Hist. Class. Discom. Eur.: 104 (1907)
= ***Scutula epiblastematica*** (Wallr.) Rehm, Rabenh. Krypt.-Fl., 1.3: 294 (1890)

According to Keißler (1930: 151) and Nannfeldt (1932: 254) this is a synonym of *Scutula epiblastematica* (*Lecanorales*), see under *O. epiblastematica* (p. 1671).

Hyalinia perexigua (J. Schröt.) Boud., Hist. Class. Discom. Eur.: 104 (1907)

≡ *Hymenoscyphus perexiguus* J. Schröt. [as '*Hymenoscypha perexigua*'], in Cohn, Krypt.-Fl. Schlesien 3.2: 71 (1893)
≡ *Pezizella perexigua* (J. Schröt.) Sacc., Syll. Fung. 11: 405 (1895)

Type material ([Poland,] Breslau [Wrocław], Bischofswalde, on rotten leaves of *Carex* in swamps, October) could not be located in M, W, and WRSL. From ZT a specimen under the name *Pezizella perexigua* (Schröter) Sacc. was received (Austria, Sonntagberg, on leaves of *Carex glauca*, X.1905, P. Strasser, Rehm, Ascomyc. 1652). This is *Mollisia caricina* Fautrey 1891, with asci of 20–25 × 3.5–4 µm, with euamyloid apical ring, allantoid ascospores of 4.5–6 × 0.8–1 µm, and an only basally pigmented ectal excipulum of light olive-brown textura angularis. Also Höhnel (1926a: 71) identified Rehm Ascomyc. 1652 as *Mollisia caricina*. The protologue of *H. perexigua* differs in much wider asci (22–25 × 7–9 µm) and spores (5–6 × 2.5–3 µm). Since the apothecia were described as 'white, translucent', *H. perexigua* might represent a *Calycina* rather than a *Mollisia*.

Habrostictis persoonii (Moug.) Rehm in Hedwigia 21: 70 (1882)

≡ *Peziza persoonii* Moug., in Persoon, Mycol. Eur. 1: 288 (1822, tab. 12 figs 1–3); –Fr., Syst. Mycol. 2(1): 121 (1822), nom. sanct.
≡ ***Stamnaria persoonii*** (Moug.) Fuckel, Jahrb. Nassau. Ver. Naturkd. 23–24: 309 (1870)
≡ *Phialea persoonii* (Moug.) Gillet, Champ. Fr., Discomyc.: 106 (1881)
≡ *Calycella persoonii* (Moug.) Quél., Enchir. Fung.: 305 (1886)

Dennis (1956: 64) described British material of this species and mentioned Mougeot's 'excellent original figure'. The genus was previously placed in the *Helotiaceae* (see Künkele et al. 2005) but might belong to a family of its own (as *Stamnaria* lineage in Jaklitsch et al. 2016).

Orbilia phymatodes (W. Phillips) Seaver, North American Cup-fungi (Inoperculates): 156 (1951)

≡ *Peziza phymatodes* W. Phillips, Grevillea 5: 117 (1877)
≡ *Pezizella phymatodes* (W. Phillips) Sacc., Syll. Fung. 8: 285 (1889)
≡ *Hymenoscyphus phymatodes* (W. Phillips) Kuntze, Revis. Gen. Pl. 3: 485 (1898)
≡ ***Psilachnum phymatodes*** (W. Phillips) Declercq, Sterbeeckia 25: 24 (2005)

Dennis (1964: 60) redescribed the type of this badly known species (California, Sierra Nevada, Blue Canyon, on some soft swamp grass). He reported asci with small amyloid apical rings and cylindrical paraphyses, and tentatively kept the species in *Pezizella* Fuckel (= *Calycina*). Recent European collections (IVV: H.B. 3809, 8835, E.R.D. 7062 etc.) appear to match Dennis' description quite well. The species is probably better placed in *Psilachnum* instead of *Calycina*, e. g., because of the striking large guttule below the spores inside the living ascus. Originally restricted to taxa with lanceolate paraphyses, the concept of *Psilachnum* was widened to include also those with narrowly lanceolate to cylindrical paraphyses (Baral, in Baral & Krieglsteiner 1985: 86).

Orbilia picea Velen., Monogr. Discom. Bohem.: 98 (1934)

No material exists of this taxon (Svrček 1954), which was said to grow on a xeric branch of *Picea* near Mnichovice (Bohemia). The large, carneous apothecia of 1 mm diam., the stalked, bifurcate asci, the scarcely inflated paraphyses covered by exudate, and the very narrow, straight spores suggest *Orbilia cardui* or *O. atlantis*, except that the 8–10 µm long spores.

Orbilia primulae (Rehm) Sacc., Syll. Fung. 8: 630 (1889)

≡ *Calloria primulae* Rehm, Ber. naturhist. Ver. Augsburg 26: 66 (1881)
≡ *Naevia primulae* (Rehm) Rehm, Ber. Bayer. Bot. Ges. 13: 142 (1912)
≡ ***Naeviopsis primulae*** (Rehm) B. Hein, Willdenowia, Beih. 9: 74 (1976)

Hein (1976) studied the type material (Austria, Tirol, on *Primula glutinosa*) of this alpine species, and found inamyloid asci with very large (25–32 × 5–6 µm), finally asymmetrically 1-septate ascospores. The species is said to be close to another alpine species, *Naeviopsis salicis* B. Hein, that has asci with apical rings reacting faintly blue in IKI.

Patinella punctiformis Rehm, Rabenh. Krypt.-Fl., 1.3: 311 (1889)

The type (Germany, Bayern, Neustadt a. d. Aisch, Sugenheim, on bark of *Picea*, H. Rehm, S, IVV, H.B. 7716) was examined. It has large, ellipsoid-oblong, multiguttulate spores of 12.5–19.5 × 6.5–7.6 µm, inamyloid asci with obtuse, thin-walled apex, and a blackish-olivaceous-brown ectal excipulum of isodiametric cells running under a high angle to the surface, the pigment of which not dissolving in KOH. *P. punctiformis* was also recorded from a sun-exposed root of *Pinus* (Velenovský 1934: 75), whereas Saccardo (1892: 52) erroneously translated 'Auf Fichtenrinde' to 'ad corticem *Pinus*'. The relationship of this fungus is unclear.

Orbilia pulviscula (Cooke) Seaver, North American Cup-fungi (Inoperculates): 160 (1951)

≡ *Peziza pulviscula* Cooke, Bull. Buffalo. Soc. Nat. Sci. 2: 297 (1875) [also in Hedwigia 14: 84 (1875)]
≡ *Pezizella pulviscula* (Cooke) Sacc., Syll. Fung. 8: 278 (1889)
≡ *Hymenoscyphus pulvisculus* (Cooke) Kuntze, Revis. Gen. Pl. 3: 485 (1898)
≡ ***Calycellina pulviscula*** (Cooke) Dennis, Persoonia 3: 61 (1964)

Dennis (1964) redescribed the type (USA, New York, Poughkeepsie, on stems of *Phytolacca*) as having asci with a conical apex with a 'very small pore probably blued by Melzer's reagent'. The conical ascus tips, cylindrical paraphyses, and excipulum anatomy (with a basal brown-walled layer) led Dennis to place the taxon in '*Calycellina* rather than *Hyalinia*'.

Orbilia pusilla (Speg.) Sacc., Syll. Fung. 8: 630 (1889)

≡ *Calloria pusilla* Speg., Michelia 1(5): 473 (1879)
≡ *Hyalinia pusilla* (Speg.) Boud., Hist. Class. Discom. Eur.: 104 (1907)
≡ ***Naeviopsis pusilla*** (Speg.) B. Hein, Willdenowia, Beih. 9: 81 (1976)

The holotype (Italy, [Venice, Treviso,] Conegliano, leaves of *Cornus sanguinea*, 8.IV.1879, C.L. Spegazzini, LPS 28072, IVV: H.B. 6952) was examined. The taxon is characterized by asci arising from croziers, with a conical apex reacting deep blue (euamyloid) in IKI (*Pezicula*-type), ascospores ellipsoid-oblong, 9–13.5 × 4.3–4.5 µm, with a few minute LBs, and apically uncinate paraphyses. The minute apothecia grow on the under side of fallen leaves below the epidermis, which they split in 4 hyaline lobes.

Hyalinia querceti (Sacc.) Boud., Hist. Class. Discom. Eur.: 104 (1907)

≡ *Helotium querceti* Sacc., Michelia 1(1): 68 (1877)
≡ *Calycina querceti* (Sacc.) Kuntze, Revis. Gen. Pl. 3 (2): 449 (1898)
= ***Calycellina punctata*** (Fr.) Lowen & Dumont, Mycologia 76(6): 1006 (1984)

This is a synonym of *Calycellina punctata* according to a type study by Dennis (1956: 174, fig. 152 A), a species with euamyloid apical rings and yellow, elongate VBs in the living paraphyses and hairs.

Habrostictis quercicola Hazsl., Verh. K. K. Zool.-Bot. Ges. Wien 37: 151 (1887)

≡ *Ocellaria quercicola* (Hazsl.) Sacc., Syll. Fung. 8: 657 (1889)

The original description (Hungary, Eperies, on branches of *Quercus*) suggests a *Pezicula* (asci 4–8-spored, spores 20–26 × 8–12 µm, eventually 1–3-septate). However, Verkley (1999: 150), who did not study the type, doubted such a relation, because Hazslinsky reported numerous conidia within the asci ('filled with spermatia'), which are not known to occur in such high number in asci of *Pezicula*.

Algincola quercina Velen., Novit. Mycol.: 177 (1940)

No specimen under this name could be found in PRM. *A. quercina* was found in a layer of *Pleurococcus* on a rotten trunk of *Quercus* near Mnichovice (Bohemia). The honey-yellowish apothecia of 1 mm diam. contain small inamyloid asci with broadly ellipsoid, biguttulate, 2.5–3.5 µm long spores. The monotypic genus *Algincola* Velen. was thought by Velenovský (1940) to be related to *Agyrium* Fr. and *Orbilia*.

Orbilia racheophila (Sacc. & Speg.) Sacc., Syll. Fung. 8: 626 (1889)

= *Calloria succinella* subsp. *racheophila* Sacc. & Speg., Michelia 1(4): 430 (1878)

No material was received from PAD, PAL, and W. The authors compared the taxon (Italy, [Venice, Treviso,] Conegliano, main axis of rotten spike of *Zea mays*, spring 1878) with *Calloria succinella* Sacc. and *Orbilia luteorubella*. The description is too incomplete to recognize a genus or family: apothecia rose-red, scarcely 0.5 mm diam., flat, smooth, ectal excipulum rose, of a thin, parenchymatous texture, asci 45–50 × 5–5.5 µm, short-stalked, with rounded apex, paraphyses slightly clavate, spores 10–12 × 1.75–2 µm, cylindrical, straight to slightly curved.

Orbilia retrusa (W. Phillips & Plowr.) Sacc., Syll. Fung. 8: 630 (1889)

≡ *Peziza retrusa* W. Phillips & Plowr., in Phillips, Grevillea 4: 122 (1876)
≡ *Calloria retrusa* (W. Phillips & Plowr.) W. Phillips, Man. Brit. Discomyc.: 407 (1887)
≡ *Pseudopeziza retrusa* (W. Phillips & Plowr.) Massee, Brit. Fung.-Fl. 4: 294 (1895)
= ***Sarcotrochila alpina*** (Fuckel) Höhn., Sber. Akad. Wiss. Wien, Math.-Naturw. Kl., Abt. 1 126(4-5): 310 (1917)

The studied specimen (Great Britain, North Wales, leaves of *Larix*, date and collector not indicated, W. Phillips 126, M, IVV: H.B. 5052) appears to be part of the type material. *Orbilia retrusa* is conspecific with *Sarcotrochila alpina*. The apothecia open by a lateral lid of host epidermis, the ascus apex is strongly papillate, with a small, IKI deep blue (euamyloid) apical ring, the multiguttulate spores are slightly constricted, have polar sheaths, and measure 9–12 × 3–3.2 µm, the long terminal cells of paraphyses have deep yellowish-ochraceous contents. *Hyalinia nostra* is a further synonym (see p. 1680).

Habrostictis roseoflavida (Rehm) Höhn., Mitt. bot. Inst. tech. Hochsch. Wien 3: 95 (1926)

≡ *Pezizella roseoflavida* Rehm, Ann. Mycol. 11: 167 (1913)

The reddish colour of the apothecia seems to have prompted Höhnel (1926b) to believe that this taxon is 'very probably' conspecific with *Orbilia lasia* s. Schröter (1893) and very close to but different from the type of *Habrostictis lasia* (Berk. & Broome) Boud.

A syntype specimen was examined (Germany, Bayern, Burgkunstadt, on wood of *Tilia*, A. Ade, Rehm Ascomyc. 2029, PAD, IVV: H.B. 7320). *H. roseoflavida* hereafter clearly represents a member of the genus *Cistella*, with short uninflated hairs with distinct, partly rod-shaped warts restricted to the apex. It is further characterized by asci with croziers and hemiamyloid apical rings, spores of †5–7.3(–8) × 2–2.5 µm with several small LBs in each half, and an inamyloid medullary excipulum. *Cistella granulosella* (P. Karst.) Nannf., *C. xylita* (P. Karst.) Nannf., and *C. geelmuydenii* Nannf. are possible synonyms. Type material of these taxa should carefully be compared in order to clarify their identity (see also Raitviir 2004: 32). The substrate is *Tilia* as indicated in the protologue, not *Salix* as printed on the label.

Hyalinia roseola (Fr.) Boud. [as '*rosella* Quél.'], Icon. Mycol., liste prélim.: 4 (1904) [non *Orbilia rosella* (Rehm) Sacc.]

≡ *Peziza roseola* Fr., Syst. Mycol. 2(1): 101 (1822)
≡ *Lachnea roseola* (Fr.) Gillet, Champ. Fr., Discomyc.: 86 (1881)
≡ *Mollisia roseola* (Fr.) Quél., Compt. Rend. Associated Franç. Avancem. Sci. 11: 412 (1883) [1882]
≡ *Trichopeziza roseola* (Fr.) Sacc., Syll. Fung. 8: 429 (1889)

No authentic material of this taxon (Sweden, on bark of fallen branches of *Juglans* etc., autumn) could be located in UPS. Fries characterized it by a flexuous, non-dentate, whitish-puberulent margin and a concave, carneous-rose disc. Saccardo (1889) merely repeated Fries's description, whereas Quélet (1873: 403; 1883: pl. XII fig. 9) and Gillet (1881) added personal collections from France (Quélet: on fallen branches of *Juglans*, Gillet: on wood, coniferous branches, herbaceous stems). Quélet's (1883) combination *Mollisia roseola* in the legend (p. 412) to his pl. XII is nothing but the binomen without author citation, but with a reference to his previous treatment (Quélet 1873) by erroneously citing p. 398 instead of 403.

Boudier (1909: 269, pl. 465, as '*Hyalinia rosella*') interpreted Fries's taxon as a fungus with a 'regularly dentate' margin. This is in conflict with Fries's statement of a non-dentate but puberulent margin. Boudier's fungus grew on bark of *Tilia* and is referred here to *Orbilia crenatomarginata*.

Although very brief, the descriptions of Fries and Quélet appear to fit *O. phragmotricha* or *O. rubella* rather than *O. crenatomarginata*. The spores were figured as narrow and medium allantoid by Quélet (1883), but Gillet described them as 'ovoid, difficult to observe'. In the absence of microscopic characters in the protologue, Fries's taxon remains a nomen dubium.

Orbilia roseorubra (P. & H. Crouan) Quél., Enchir. Fung.: 298 (1886)

≡ *Helotium roseorubrum* P. & H. Crouan, Florule Finistère: 48 (1867)

Crouan & Crouan (1867) described this taxon from Bretagne (France), on a heap of muddy soil, with sessile, hemispherical or turbinate, rose-red apothecia 1–3 mm diam., 8-spored, subcylindrical asci, ovoid spores with a single large drop ('sporidiole'), and apically a little inflated, curved paraphyses. Together with the habitat this might refer to an *Octospora* (*Pezizales*), but no microscopic measurements are given. According to J.P. Priou (pers. comm.), material of *H. roseorubrum* exists at CO.

Orbilia rozei (Quél.) Quél., Compt. Rend. Associated Franç. Avancem. Sci. 9: 674, pl. IX fig. 15 (1881)

≡ *Peziza rozei* Quél., Grevillea 8: 38 (1879)
≡ *Pezizella rozei* (Quél.) Sacc., Syll. Fung. 8: 283 (1889) [also on p. 623, as *Orbilia*]
≡ *Hymenoscyphus rozei* (Quél.) Kuntze, Revis. Gen. Pl. 3: 486 (1898)
(?)= ***Psilachnum rubicundum*** (Sacc. & Speg.) Baral

Nannfeldt (1932: 253) excluded this species from *Orbiliaceae*. Two non-authentic collections (France, Presles, Forêt de Carnelle, on underside of dead leaves of *Helleborus foetidus*, 22.X.1924, R. Maire, as *Orbilia rozei*, MPU, IVV: H.B. 5460; Luxembourg, Kockelscheier, on petioles of *Helleborus viridis*, 10.III.1903, J. Feltgen, as *Orbilia*, LUX 42458, IVV: H.B. 7134) were studied and found to be conspecific with *Psilachnum rubicundum* (see below). Probably, the type of *O. rozei* (France, Jura, on dead stems of *Helleborus foetidus*) is the same species and hence a later synonym of *O. rubicunda*, and also *Hyalinia helleboricola* is probably a synonym (see under these epithets).

Orbilia rubens (Sacc. & Roum.) Boud., Hist. Class. Discom. Eur.: 193 (1907)

≡ *Helotium rubens* Sacc. & Roum., Rev. Mycol. (Toulouse) 6: 28 (1884)
≡ *Calycina rubens* (Sacc. & Roum.) Kuntze, Revis. Gen. Pl. 3: 449 (1898)
≡ *Pezicula rubens* (Sacc. & Roum.) Rehm, Ber. Bayer. Bot. Ges. 13: 200 (1912)
= *Mollisia ramealis* (P. Karst.) P. Karst., Bidr. Känn. Finl. Nat. Folk 19: 187 (1871)

The microscopic sketch on the label of the holotype (Reliquiae Libert. IV, no. 224, PAD) shows fusiform ascospores ranging from 18–20 × 2 up to 25–28 × 3.5 µm, and asci 80–100 × 8 µm. The protologue gives the spore size as 18–22 × 2–3 µm and the ascus size as 85–100 × 8 µm, with the following data: [Belgium,] Ardennes, on bark of *Rhamnus* (Saccardo 1889: 239, as 'Reliq. Libert. IV, no. 40'; Grelet 1948a: 55, as 'Reliq. Libert. IV, no. 10'). A hymenial fragment of no. 224 was examined. It showed IKI deep blue apical rings of the *Calycina*-type, but no spores. This is clearly *Mollisia ramealis*. as was also assumed by Verkley (1999: 151), a species which already Saccardo considered to be related ('subaffinis') to *Helotium rubens*.

Mollisia ramealis is misplaced in *Mollisia* (*Mollisiaceae*) but belongs in *Cenangiaceae* with unclear generic affiliation, according to unpublished molecular data by A. Gminder and K. Pärtel (pers. comm.). Dennis (1964: 62) found in the specimen under the name *Helotium rubens* at K a *Mollisia* (as *Tapesia*) with much shorter spores of 8–12 × 2 µm.

Orbilia rubicola (Cooke & W. Phillips) Sacc., Syll. Fung. 8: 622 (1889)

≡ ***Pyrenopeziza cookei*** Baral, **nom. nov.** — MB 831503
[non *Pyrenopeziza rubicola* Losa, An. Jard. bot. Madr. 8: 330 (1947, '1948']
Replaced synonym: *Calloria rubicola* Cooke & W. Phillips, in Phillips, Man. Brit. Discomyc.: 331 (1887)
≡ *Hyalinia rubicola* (Cooke & W. Phillips) Boud., Hist. Class. Discom. Eur.: 104 (1907)

Cooke & Phillips considered *Calloria rubicola* to be very similar to *C. vinosa* in their interpretation, which seems to concern a taxon around *Orbilia auricolor*. Originally the authors planned to describe it as a variety of *C. vinosa*, as can be seen from the handwriting on the label ('*Peziza vinosa* var. *rubicola*'). In the protologue the apothecia are described as 0.5–1.5 mm diam., reddish flesh-coloured, with smooth margin, and the spores as 9–11 × 1 µm in size.

The type material of *C. rubicola* (Great Britain, [Northamptonshire], King's Cliffe, on stems of *Rubus caesius*, undated, [M.J. Berkeley], herb. M.C. Cooke, K, IVV: H.B. 5351) contains a pale ochraceous, sessile discomycete 0.6–1.2 mm diam. when rehydrated, with a hairy margin. The asci arise from croziers and have a conical apex with an IKI deep blue (euamyloid) apical ring of *Calycina*-type, and the spores are multiguttulate (in KOH, OCI 3) and measure 10–12 × 2–2.4 µm. The ectal excipulum is a hyaline textura angularis with a thin, yellow-ochre intercellular gel, externally bearing 50–60 × 3–5 µm large, cylindric-moniliform, 4–5-septate, thin-walled, hyaline, smooth hairs.

C. rubicola fits a number of studied fresh collections from stems of *Rubus* spp. (e.g., H.B. 6367) in which the paraphyses and hairs are filled with many globose, medium refractive SCBs, and the spores measure *(7.5–)9–14(–16) × (2–)2.2–2.5(–2.8) µm and contain a varying number of small LBs at each end (OCI 1–3). It was referred with some hesitation to *Niptera dilutella* by Baral (in Weber 1992), which is considered here as a nomen dubium (see under *Hyalinia dilutella*, p. 1670). Although devoid of a brown excipulum, the remaining characters of *C. rubicola* strongly recall the genus *Pyrenopeziza* (*Ploettnerulaceae*) and suggest a close vicinity to *P. rubi* (Fr.) Rehm and *P. escharodes* (Berk. & Broome) Rehm. In fact, the combination *Pyrenopeziza dilutella* (Fr.) Gminder relates to these considerations.

Because of the dubious identity of *N. dilutella* it seems appropriate to adopt Cooke & W. Phillips's epithet. However, because of *Pyrenopeziza rubicola* Losa which was described on stems of *Rubus* sp. with spores of 5–6 × 2–3 µm, a new name, *P. cookei*, had to be chosen for Cooke & W. Phillips's fungus. The similar *P. rubi* (especially on *Rubus* spp.) and *P. escharodes* (especially on *Rubus fruticosus*, *R. saxatilis*) differ from *P. cookei* by shorter, ± clavate spores of ~6–9.5 × 1.5–3 µm (e.g., Rehm 1892, Gremmen 1954, Hütter 1958).

Orbilia rubicunda (Sacc. & Speg.) Sacc., Syll. Fung. 8: 622 (1889)
= ***Psilachnum rubicundum*** (Sacc. & Speg.) Baral, **comb. nov.** — MB 814590
Basionym: *Calloria rubicunda* Sacc. & Speg., Michelia 1(4): 429 (1878)

Nannfeldt (1932: 253) excluded this species from the *Orbiliaceae*, and Hein (1976: 34) suggested that it is similar to *Orbilia rozei* Quél. A topotype in RO (Italy, [Venice, Treviso,] Conegliano, on underside of dead leaves of *Helleborus viridis*, IV.1879, C.L. Spegazzini, IVV: H.B 7794) was studied. It bears abundant subsessile, light yellowish-amber apothecia (rehydrated 0.15–0.3 mm diam.). The asci arise from croziers and have a characteristic apical ring, of which only the inner part, which slightly protrudes in the ascoplasm, is reactive and stains distinctly blue in IKI. Very short, cylindrical, smooth hairs occur near the margin. An illustration is found in Saccardo (1883: fig. 1292).

A recent, undoubtedly conspecific Spanish collection on leaves of *Helleborus foetidus* studied in the living state (IVV: H.B. 7268) showed a distinct hair vesture at the apothecial margin and refractive globose to elongate VBs in both paraphyses and hairs. The species appears to fit the genus *Psilachnum* in many respects. See also under *O. rozei* and *O. helleboricola*.

Orbilia cardui var. ***rutae*** Velen., Monogr. Discom. Bohem.: 401 (1934)

According to Svrček (1954), only a bad microscopic preparation has been preserved of this taxon which grew on stems of *Ruta graveolens*. The inflated paraphyses and short (3–5 µm), narrowly subcylindrical spores appear to exclude synonymy with *O. cardui*. However, Velenovský's spore measurements are not trustworthy, as he described the spores of, e.g., *O. pellucida* (= *O. cardui*) with the same length of 3–5 µm, although in the lectotype a length of 5–7 × 1–1.2 µm was found in the present study (see Tab. 38).

Peziza vulgaris var. ***sanguinella*** Berk. & Curtis, in Berkeley, Grevillea 3: 159 (1875)

This taxon was based on three collections (USA, South Carolina, on *Liquidambar*, no. 2180; New England, C.J. Sprague, nos 5372, 5380). Dennis (1964: 70, fig. 54 right) reexamined no. 2180 (probably in K) and found it to belong to *Orbilia*. No specimen was examined in the present study. Dennis's figure shows asci with truncate apices and thin stalks with a furcate base, hence the taxon clearly belongs to *Orbilia*. The spores 'were not well seen but appear to be fasciculate and about 8 × 0.5 µm'. The name refers to the pale orange disc.

Patinella sanguineoatra (Rehm) Sacc., Syll. Fung. 8: 773 (1889)
≡ *Patellaria sanguineoatra* Rehm, in Britzelmayr & Rehm, Ber. Naturhist. Ver. Augsburg 24: 63 (1877)

An authentic specimen (Czechia, Böhmisches Erzgebirge, V.1912, on decorticated branch of *Fagus sylvatica*, vid. Rehm, herb. Kupka, M) was studied. This appears to agree with Rehm's

(1889: 311) description of the type (Germany, Augsburg, dry branch of *Fagus*). It is conspecific with some recent collections from Germany and Luxembourg (IVV: H.B. 3349, 3727, 6589). The size of the non-septate ascospores is in the protologue 15 × 5 µm, in Rehm (1889: 311) 15–17 × 5–6 µm, in Kupka's specimen 12–19 × 3.5–4.3 µm, and in our specimens *11–21.3 × 3.5–5.5 µm. They have 2 large ellipsoid glycogen regions that stain red-brown in IKI, each being densely surrounded by small LBs. The asci have a thin-walled, subconical, inamyloid apex (IKI), and arise from croziers. The ectal excipulum of a vertically oriented textura prismatica-globulosa is rich in red-brown exudate, which is partly dissolved in KOH by staining the medium deep red-brown. Based on its strong ionomidotic reaction, a relationship with the lichenicolous genus *Skyttea* Sherwood, D. Hawksw. & Coppins (*Cordieritidaceae*) seems possible.

Calloria scolicospora Rehm, Ascomyceten, fasc. 10: no. 461 (1878), nom. inval., Art. 38.1(a) ICN

The name was published by Rehm (1878 in sched.) on the printed label of Ascomyceten no. 461, as *Calloria scolicospora* Rehm f. *minor* (≡ *Orbilia rehmii*, see p. 904). No diagnosis was supplied, and also no later publication of this name could be detected, so it appears that it has never been validly published and must be regarded as a nomen nudum.

Hyalinia dilutella var. ***smyrnii*** (W. Phillips & Plowr.) Boud., Hist. Class. Discom. Eur.: 104 (1907)

≡ *Mollisia dilutella* var. *smyrnii* W. Phillips & Plowr., in Phillips, Man. Brit. Discomyc.: 192 (1887)
≡ *Pezizella dilutella* var. *smyrnii* (W. Phillips & Plowr.) Sacc., Syll. Fung. 8: 277 (1889)
≡ *Mollisia digitalina* var. *smyrnii* (W. Phillips & Plowr.) Massee, Brit. Fung.-Fl. 4: 212 (1895)

No type material of this taxon was ordered. Described on stems of *Smyrnium*, it is said by the original authors to 'differ only very little' from *Mollisia dilutella*, a species which was interpreted by Baral (in Weber 1992) as belonging to *Pyrenopeziza* (see under *Hyalinia dilutella*, p. 1670). *Mollisia digitalina* W. Phillips is likewise today treated as a *Pyrenopeziza*, *P. digitalina* (W. Phillips) Sacc.

Patinella stenotheca (P. Karst.) Sacc., Syll. Fung. 11: 434 (1895)

≡ *Patinellaria stenotheca* P. Karst., Hedwigia 31: 132 (1892)
≡ *Durella stenotheca* (P. Karst.) Nannf., Acta Soc. Sci. Upsal., ser. 4, 8: 293 (1932)
= ***Durella commutata*** Fuckel, Jb. Nassau. Ver. Naturk. 23-24: 281 (1870) [1869-70]

Two syntype specimens in Karsten's herbarium were studied. One (Fennia, Tammela, Mustiala, 2.X.1869, wood of *Betula*, herb. P. Karsten 3426, IVV: H.B. 7621) fits *Durella commutata* Fuckel in the non-septate ascospores (6–8.2 × 1.7–2.1 µm), inamyloid asci, and paraphyses which contain a single yellow vacuolar body (VB) in the apex. The other (ibid., 31.III.1870, wood of *Betula*, herb. P. Karsten 3427) contained both *D. commutata* (IVV: H.B. 7622a, asci inamyloid, spores 6–8 × 2.2–2.4 µm) and *D. macrospora* Fuckel (IVV: H.B. 7622b, asci with amyloid apical rings, spores 17–22 × 3.2–4.3 µm). The large, 3-septate ascospores of *D. macrospora* exclude this species from the protologue of *Patinellaria stenotheca*, which reads 'Sporae ... continuae, ... 6–10 × 2 µm'. *P. stenotheca* is, therefore, a later synonym of *Durella commutata*. Since the original diagnosis was clearly based on the specimen from 1869, judging from the microscopic measurements noted by Karsten on the label, Karsten 3426 (H) is designated here as **lectotype** of *P. stenotheca* (MBT382128).

Orbilia stipitata Ekanayaka & K.D. Hyde, in Ekanayaka et al., Mycosphere 9(1): 160 (2018)

Ekanayaka et al. (2018: 160, fig. 2) described *Orbilia stipitata* based on a collection on unidentified wood at the Kun Korn waterfall in Chiang Rai (Northern Thailand). The entire presentation is full of errors and it is impossible to clarify the taxon without a thorough restudy of the holotype. Undoubtedly, the description and illustration includes a mixture of two species. For instance, the capitate paraphyses are described as 'swollen at the apices, terminal cell 1–1.5 µm width'. This width is very unlikely to be correct, and the given scale bar of '10 µm' should better be 20 µm in order to fit the 15 µm scale bars of the asci.

The strongly falcate spores of †8–11 × 0.8–1.3 µm, with obtuse apex and tapered base, are reminiscent of *O. auricolor* agg. However, it is not fully clear which is the upper spore end. Although the authors studied the holotype in the dead state and did not mention spore bodies, the spores in their fig. 2j–k could be alive as they appear to show a vermiform spore body in the narrowed end. If this is true, the upper spores point with their apex downwards. The authors compared *O. stipitata* with *O. arcospora* and *O. vermiformis* and distinguished it based on shorter asci, although the main difference seems to lie in the spore shape: tapered towards both ends in *O. arcospora* and helicoid in *O. vermiformis*.

Moreover, straight spores of ~7 × 1 µm were observed and considered as immature spores of *O. stipitata* (fig. 2i, l–o). Since young and immature spores generally do not markedly differ in curvature from mature spores, these elements very probably derive from another apothecium which belonged to a different species, perhaps *Hyalorbilia inflatula*.

The sequence gained from *Orbilia stipitata* (ITS+LSU, MG599272/MG599275, identical sequences are NR_156687/NG_059860) clustered with *O. nemaspora* (Ekanayaka et al. 2018: fig. 1), with a 4 nt deviation in the ITS and 3 nt in the LSU. This surprising result points to a confusion since *O. nemaspora* has narrower and distinctly helicoid spores. We assume that the sequence of *O. stipitata* could well belong within the natural variation of *O. nemaspora*. A lectotype should be chosen which coincides to a major extent with the protologue, and it seems that the provided sequence does not belong to this lectotype.

The apothecia are figured with a size of 0.4–0.55 mm diam. but described as 0.4–2 mm diam., which might be due to a mixture of different species. The specific epithet suggests stipitate apothecia, although these are reported as 'subsessile to shortly stipitate'. The given etymology ('refers to the ascospore shape') should be an error as it seems to refer to another previously applied epithet.

Hyalinia strobincola Rehm, in Ade, Hedwigia 64: 316 (1923)

No material of this taxon (Germany, Bayern, Weismain, Islingerberg, blackened scales of dry *Pinus* cones, V.1909) could be found in PAD and S. The description (apothecia reddish-yellow, 0.2–0.35 mm diam., asci 33–42 × 4.5–7.5 µm, with rounded inamyloid apex, spores 8.5–13 × 1.5 µm, narrowly fusiform, paraphyses scarcely enlarged above, excipulum parenchymatous) could fit *Orbilia vinosa*, but since no mention is made of the ascus base or the presence of exudate, the taxon could also belong to the *Helotiales*.

Hyalinia subaurantiaca (Feltgen) Boud., Hist. Class. Discom. Eur.: 104 (1907)

≡ *Pezizella subaurantiaca* Feltgen, Rec. Mém. Trav. Soc. Bot. G.-D. Luxemb. 16: 48 (1903)

No material of this taxon (Luxembourg, Grünewald-Helmsingen, at border of a pond, on rotten *Quercus* board, IX.1902) could be located in LUX. Feltgen compared it with *Pezizella bresadolae* Rehm, a species that seems to fit *Phaeohelotium imberbe*, according to the illustration in Bresadola (1928: pl. 1236). Höhnel (1906: 1277) examined the type of *P. subaurantiaca* and found it to be very poorly developed and possibly belonging to *Helotium citrinum* [≡ *Calycina citrina* (Hedw.) Gray], perhaps also to *Helotium trabinellum* (= *Leptodontidium trabinellum*). Feltgen's description may indeed refer to a pale form of *C. citrina*. The 'prosenchymatic' excipulum excludes identity with *P. imberbe*.

Hyalinia subcarnea (Schumach.) Boud., Hist. Class. Discom. Eur.: 104 (1907)

≡ *Peziza subcarnea* Schumach., Enum. pl. (Kjbenhavn) 2: 427 (1803) [also in Hornemann, Flora danica 12, pl. 2084 fig. 1 (1832)] [non *Peziza subcarnea* Cooke & Peck 1875, nom. illegit., ICN Art. 53.1, ≡ *Roseodiscus subcarneus* (Sacc.) Baral]
≡ *Helotium subcarneum* (Schumach.) Sacc., Michelia 2(7): 260 (1881) [non s. Sacc.]
≡ *Pezizella subcarnea* (Schumach.) Rehm, Rabenh. Krypt.-Fl., 1.3: 657 (1892)
≡ *Hymenoscyphus subcarneus* (Schumach.) J. Schröt. [as '*Hymenoscypha subcarnea*'], in Cohn, Krypt.-Fl. Schlesien 3.2: 69 (1893) [non *Hymenoscyphus subcarneus* (Sacc.) Kuntze 1898, nom. illegit., ICN Art. 53.1, ≡ *Roseodiscus subcarneus*]
≡ *Calycina subcarnea* (Schumach.) Kuntze, Revis. Gen. Pl. 3 (3): 449 (1898)
≡ *Orbiliopsis subcarnea* (Schumach.) Höhn., Mitt. bot. Inst. tech. Hochsch. Wien 3(3): 102 (1926)
≡ *Belonium subcarneum* (Schumach.) Velen., Monogr. Discom. Bohem.: 177 (1934)
≡ *Phaeohelotium subcarneum* (Schumach.) Dennis [as '(Schum. ex Sacc.)'], Kew Bull. 25 (2): 355 (1971)
= *Phaeohelotium carneum* (Fr.) Hengstm., Mycotaxon 107: 272 (2009)
≡ *Peziza carnea* Fr., Syst. mycol. (Lundae) 2(1): 135 (1822), nom. sanct.

No authentic material of *Peziza subcarnea* Schumach. could be located in C, H, L, and PAD, and none appears to have ever been redescribed (see also Hengstmengel 2009). Höhnel (1926b: 97) studied Saccardo's specimen (Italy, Padova, on fallen fragments of wood and cones of *Pinus*, XII.1880, G. Bizzozero) and considered it distinct from the description of *Peziza carnea* Fr. by Fries (1822: 135), who assessed Schumacher's diagnosis of *P. subcarnea* as seemingly conspecific. Höhnel, therefore, erected for Saccardo's collection a new species, *Eubelonis albosanguinea* Höhn. (probably a *Calycina*, judging from the description).

Höhnel (l.c.: 99) also studied a collection of Jaap (Brandenburg, Prignitz, Triglitz, on wood of *Betula*) which he believed to be undoubtedly the genuine *Peziza subcarnea* Schumach. In his diagnosis of this collection, the ectal excipulum of isodiametrical cells, the rather large asci with an amyloid (blue) pore, and the non-septate spores containing 2–4 large plasma portions (oil drops?) are worth mentioning. Höhnel considered this material to be related to *Calloria austriaca* Höhn., which he both placed in his new genus *Orbiliopsis* Höhn. (see p. 207). *C. austriaca* (IVV: H.B. 6290) is a synonym of *Leptodontidium trabinellum* (IVV: H.B. 4847), according to a restudy of type material, and *Peziza subcarnea* in the sense of Höhnel's diagnosis of Jaap's material seems also conspecific with that species (for the genus *Leptodontidium* see also under *Orbilia diaphanula*, p. 1669).

The original identity of *Peziza subcarnea* Schumach. remains unclear, however. Hengstmengel (2009, pers. comm.) relied on the study of eight recent specimens identified by the collectors as *Phaeohelotium subcarneum* (from the Netherlands, Belgium and France, all on bark or wood of deciduous or unidentified trees). However, he hardly provided any diagnostic microscopical characters which allow recognition of this species. For a further collection, Verkley (1993: figs 59–61) illustrated an ascus apex of the *Hymenoscyphus* type (France, Côte d'Or, Forêt de St.-Léger, on unidentified wood, 10.X.1990, J. van Brummelen 7963). According to a microscopic analysis by J. Hengstmengel (pers. comm., J.H. 474 = L 979.198-854), his concept of *Phaeohelotium carneum* might correspond to the concept of *Phaeohelotium imberbe* in Baral & Krieglsteiner (1985, as *Hymenoscyphus imberbis*). However, Hengstmengel (2009) considered the two taxa as distinct because *P. imberbe* lacks the uniformly pink colour of *P. carneum*.

Hengstmengel considered *Peziza carnea* Fr. as a heterotypic synonym of *Peziza subcarnea* Schumach., following authors of the 19th century, and he pointed out that the former epithet has priority over the latter. However, he admitted that the opinion of synonymy is solely based on macroscopical and ecological similarities, because 'there is no type material preserved for microscopical comparison'. *P. carnea* was described by Fries (1822) on 'wood of *Fagus*, *Carpinus* etc.', and *P. subcarnea* by Schumacher (1803) on wood of *Betula*. Because of the starting point of 1821 which was valid until 1981, Dennis (1971) stated that *P. subcarnea* Schumach. was illegitimate and, therefore, considered Saccardo (1881) as the validating author of the taxon. However, Dennis overlooked that *P. subcarnea* became valid already in 1832 (Hengstmengel pers. comm.). Therefore, Baral (1986: 17, Baral & Krieglsteiner 2006) erroneously considered Saccardo's specimen on *Pinus* as type and referred to *Phaeohelotium subcarneum* a collection on rotten coniferous wood (IVV: H.B. 1104) with hemiamyloid apical rings of the *Calycina*-type, and greyish-white apothecia which turn rose-carneous when dried. Because of the apical ring type, this collection is certainly not congeneric with the specimen investigated by Verkley.

Hyalinia subdiaphana (Sowerby) Boud., Hist. Class. Discom. Eur.: 104 (1907)

≡ *Peziza subdiaphana* Sowerby, Col. Fig. Engl. Fung. Mushr., vol. 1: 654, pl. 389 fig. 7 (1789–1791)
≡ *Peziza vulgaris* var. *diaphana* Fr., Syst. Mycol. 2(1): 147 (1822)
≡ *Mollisia diaphana* (Fr.) Gillet [as '*M. diaphana* (Sow.)'], Champ. Fr., Discomyc.: 132 (1882)
≡ *Calloria diaphana* (Fr.) W. Phillips [as '*C. diaphana* (Sow.)'], Man. Brit. Discomyc.: 335 (1887) [non *Calloria diaphana* Rehm 1874, nom. inval., see *Habrostictis diaphana*]
≡ *Orbilia diaphana* (Fr.) Sacc. [as '*O. diaphana* (Sow.) Sacc.'], Syll. Fung. 8: 633 (1889) *Peziza diaphana* (Fr.) Mussat, in Saccardo, Syll. fung. (Abellini) 15: 252 (1901)

The original diagnosis of *Peziza subdiaphana* reads: 'Of a semitransparent waxy appearance; not uncommon on the under sides of rotting wood in somewhat close places, and may be a variety of *P. cinerea*, t. 64, dried before perfected.' The illustration shows cupulate to saucer-shaped, ochraceous apothecia which are reminiscent of *Hyalorbilia inflatula*. No authentic specimen could be found in BM, E, and K. According to B. Spooner (pers. comm.), most Sowerby types were destroyed or not preserved, whereas later collections under '*Orbilia diaphana* Sowerby' from W. Phillips's herbarium in K have been reexamined by Spooner and redisposed under *Cistella* sp. and *H. inflatula* (as *Orbilia inflatula*). What Gillet referred to this taxon, on rotten cardboard, remains unclear but could likewise concern *H. inflatula*. In the absence of a type specimen *P. subdiaphana* remains a nomen dubium.

Fries (1822) did not comment on why he changed the epithet to *diaphana*, and he did not even mention Sowerby's epithet *subdiaphana* at all, but he clearly referred to Sowerby's plate 389 fig. 7. His description reads: 'sparse, first urceolate then flattened, whitish hyaline'. He considered the species to be intermediate between *Calycina vulgaris* and *Mollisia cinerea* (Batsch) P. Karst. (both as *Peziza*), but much thinner and subdiaphanous. Like Fries, also Gillet, Phillips, and Saccardo referred to Sowerby's plate but adopted Fries's epithet *diaphana* without mentioning Sowerby's epithet *subdiaphana*, and Mussat's combination in *Peziza* was likewise merely an erroneous citation of Sowerby's basionym.

Orbilia succinea (Fr.) Quél., Enchir. Fung.: 298 (1886) [non *Orbilia succinea* Velen. 1947, = *O. eucalypti*]

≡ *Calloria succinea* Fr., Summa Veg. Scand.: 359 (1849)
≡ *Mollisia succinea* (Fr.) Gillet, Champ. Fr., Discomyc.: 132 (1882), nom. illegit., ICN Art. 53.1 [non *Mollisia succinea* (Quél.) Quél. 1881, (?)= *Hyalorbilia inflatula*]
≡ *Hyalinia succinea* (Fr.) Boud., Hist. Class. Discom. Eur.: 104 (1907)
≡ *Siroscyphella succinea* (Fr.) Höhn., Sitzungsber. Kaiserl. Akad. Wiss. Wien, Math.-Naturwiss. Kl., Abt. I 127: 374 (1918)
≡ *Dacrymyces succineus* (Fr.) Fr., Hymenomyc. eur. (Upsaliae): 699 (1874), nom. illegit., ICN Art. 53.1 [non *Dacrymyces succineus* Sprée]
?= *Pseudocenangium succineum* (Sprée) Dyko & Sutton, Can. J. Bot. 57: 372 (1979)
≡ *Dacrymyces succineus* Sprée, in Rabenhorst, Fungi Eur. Exs. no. 680 (1864) [also in Bot. Ztg. (Berlin) 22: 175 (1864)]

Calloria succinea was described by Fries for a minute sessile fungus with immarginate, amber-coloured disc on needles of *Pinus* (without collection data). Fuckel (1870: 282) reported under that name a mitosporic fungus associated with fruitbodies which he interpreted as immature apothecia of the teleomorph. Fuckel's collection (Germany, [Mainz,] Budenheim, needles of *Pinus sylvestris*, spring, L. Fuckel, Fungi Rhen. Exs. 1600, MPU, IVV: H.B. 5600) was reexamined. Mainly the conidial stage was found, with short-stalked, light yellow apothecioid fruitbodies ~0.4 mm diam. (rehydrated), with a receptacle of strongly gelatinized textura oblita. The conidia are 1-septate, cylindrical to dumbbell-shaped, 14–15 × 2.3–2.5 µm.

According to Höhnel (1918), Fuckel's specimen is very probably conspecific with that of Fries, judging from Fries's description. Based on the studies of the anamorphs by Cooke & Ellis (1878: 91, *Hymenula fumosa* Cooke & Ellis) and Starbäck (1895: 34, *H. fumosellina* Starbäck), Höhnel (1918) concluded that *Peziza fumosella* Cooke & Ellis (ascospores 10 µm long) is conspecific with *Phialea fumosellina* Starbäck (ascospores 16–20 × 2 µm), and represents the teleomorph of *Calloria succinea*. For the anamorph he erected the genus *Siroscyphella* Höhn. Höhnel did not accept Phillips's (1880) opinion who believed that *Peziza electrina* W. Phillips & Plowr. (ascospores 5 × 1 µm) was the teleomorph of *Calloria succinea*.

Dyko & Sutton (1979) were unable to locate type material of *Calloria succinea*. According to McNabb (1973: 510), Sprée (1864) cited Fries' taxon as a questionable synonym when proposing the combination '*Dacrymyces succineus* Sprée', therefore, Donk (1966, fide McNabb) attributed this binomial solely to Sprée. This view was accepted by Dyko & Sutton who transferred the taxon to *Pseudocenangium* P. Karst. and listed *Phialea fumosella* (Cooke & Ellis) Sacc. as teleomorph.

Peziza fumosella is treated in *Phialea* (Pers.) Gillet by Dennis (1956) and Dyko & Sutton (1979), whereas Carpenter (1981: 215) believed that its type material shared several features with members of *Chloroscypha* Seaver. Several fresh collections on needles of *Pinus* were studied which appear to belong to *P. fumosella* (IVV: H.B. 3927, 8321a, 9914 etc.). This fungus has rather long, 1–3-septate spores (*23.5–26.5 × 2.3–2.6 µm) and is not a *Cyathicula* (= *Phialea*) but more probably a representative of *Allophylaria*, *A. fumosella* (Cooke & Ellis) Nannf., or *Calycellina*, e.g., because of the *Calycina*-type of apical ring and the elongate vacuolar bodies (VBs). The apothecia in H.B. 8321a grew intermingled with *Xiambola mirabilis* Minter & Hol.-Jech., a mitosporic fungus with toothed sporodochia and with a very similar grey colour and excipular texture. This similarity suggests that *X. mirabilis* is the anamorph of *Allophylaria fumosella*. Apart from its teeth, however, *X. mirabilis* resembles *Pseudocenangium succineum* quite well; moreover, the teeth are not always present in this sample of *X. mirabilis* as well as in a collection on *Picea* cone from Poland (P. Perz pers. comm.). Hence, *X. mirabilis* and *P. succineum* could well be synonyms.

Peziza electrina was placed in synonymy with *Orbilia succinea* by Saccardo (1889: 625) and Rehm (1891: 460), who used Fries' taxon as a teleomorph name. Rehm reexamined Phillips's type material and completed the diagnosis of *P. electrina*. A syntype was examined in the present study (Great Britain, Scotland, Morayshire, Forres, needles of *Pinus*, undated, C. B. Plowright, herb. W. Phillips no. 187, M). Judging from external appearance, *P. electrina* is the same species which Svrček (1978: 87) named *Pezizella pulchella* Fuckel [= *Antinoa proximella* (P. Karst.) Velen. fide Svrček]. This species has stalked apothecia with a yellow-ochre exterior and a blackish base, and very small, non-septate spores, and is obviously very close to *Antinoa acuum* Velen., the type species of *Antinoa* Velen. (see Baral & Krieglsteiner 1985: 46, IVV: H.B. 1010, 3129 etc.).

Orbilia succinella (Sacc.) Sacc., Syll. Fung. 8: 625 (1889)

≡ *Hyalinia succinella* (Sacc.) Boud., Hist. Class. Discom. Eur.: 104 (1907)
≡ *Calloria succinella* Sacc., Michelia 1(1): 62 (1877)

No apothecia could be found in the holotype (Italy, [Veneto,] Pianzano, on rotten culm of *Zea mays*, [XII.1876, C.L. Spegazzini], PAD). The original sketch on the label (see also the colour drawing in Saccardo 1877: fig. 1293) shows cylindric-subclavate ascospores of 6 × 2 µm, with a rather small drop at each end, and two asci with subconical apices and unstalked, crozier-like inflated bases. The apothecia were described as 1/6–1/8 mm diam., hyaline, then faintly amber, flat, nearly immarginate. The taxon could perhaps be conspecific with *Calycellina microspis* (P. Karst.) Dennis as redescribed by Dennis (1956: 181, as *Helotium microspis*; see also under *Hyalinia microspis*, p. 1678).

Habrostictis tithymalina (J. Kunze) Rehm, Ber. naturhist. Ver. Augsburg 26: 78 (1881)

≡ *Calloria tithymalina* J. Kunze, Hedwigia 15: 105 (1876)
≡ *Naevia tithymalina* (J. Kunze) Rehm, Rabenh. Krypt.-Fl., 1.3: 139 (1888)
≡ *Laetinaevia tithymalina* (J. Kunze) Petr., Ann. Mycol. 38: 153 (1940)
≡ ***Naeviopsis tithymalina*** (J. Kunze) B. Hein, Willdenowia, Beih. 9: 64 (1976)

This species is mainly found on herbaceous stems of *Euphorbia* (Hein 1976). A fresh collection (Germany, Schwäbisch Gmünd, Hornberg, Furtlochereck, on *E. cyparissias*, 8.V.1999, L. Krieglsteiner, H.B. 6368) showed asci arising from croziers, with a hemiamyloid apical ring of the *Pezicula*-type. The living ascospores measured 12.5–16.3 × 6.8–7.7 µm and contained some small LBs. The pale ochraceous apothecia open by large, light-coloured lobes.

Orbilia tricellularia Matsush., Matsush. Mycol. Mem. 10: 198 (2003, '2001')

The species is named after the anamorph, *Tricellula inaequalis* Beverw., which was reported from freshwater (see, e. g., Nilsson 1964, Czeczuga & Orlowska 2001). Matsushima's strain was isolated from leaves of an unidentified broad-leaved tree on forest soil (Mt. Rokko, Kobe, Japan, III.1999). Both the anamorph and teleomorph developed in pure culture. The abundant apothecia are described as 0.06–0.2 mm diam., cushion-shaped, sessile, white, with smooth margins. The ectal excipulum is of textura angularis, and the hymenial elements are not covered by gel or exudate. The asci are described as thick-walled without further specification; yet, on the photos they are overall thin-walled, though at an immature stage apically slightly thick-walled (Matsushima 2003: figs 1744–1745). The conical apices of the cylindric-fusiform asci are without apical rings, and the thick stalks appear to arise from croziers. The iodine reaction seems not to have been tested. The 8 spores are hardly visible on the photos, and are described as oblong to bean-shaped, 7–9 × 2.5–3.5 µm (no contents mentioned). The filiform paraphyses are not or slightly inflated at the apex and 1–1.5 µm wide. All elements are figured in the dead state. For the anamorph see Baral et al. (2017b).

Matsushima (2003) placed the species in *Orbilia* subgenus *Hemiorbilia*, obviously because of the thickened ascus wall. However, the conical shape of ascus apex and the presence of croziers excludes *Orbilia*, also a relationship to *Hyalorbilia* does not seem very probable. Possibly *O. tricellularia* belongs in the *Helotiales* rather than the *Orbiliomycetes*. A more detailed morphological documentation and a molecular study on this species should be carried out to find out its phylogenetic place.

Hyalinia tumidula (Roberge in Desm.) Boud., Hist. Class. Discom. Eur.: 104 (1907)

≡ *Peziza tumidula* Roberge in Desm., Pl. Crypt. Nord France, Edn 1: no. 2100 (1850) [also in Ann. Sci Nat., Bot. 16: 325 (1851)]
≡ *Pezizella tumidula* (Roberge in Desm.) Sacc., Syll. Fung. 8: 276 (1889)
≡ *Hymenoscyphus tumidulus* (Roberge in Desm.) Kuntze, Revis. Gen. Pl. 3 (2): 486 (1898)
≡ *Helotium tumidulum* (Roberge in Desm.) Massee, Fungus Fl. Yorkshire: 285 (1905)
≡ *Mollisia tumidula* (Roberge in Desm.) Höhn., Sitzungsber. Akad. Wiss. Wien, Math.-Naturwiss. Kl. 1, 115: 1284 (1906)
≡ *Discorehmia tumidula* (Roberge in Desm.) Kirschst., Ann. Mycol. 34: 204 (1936)
≡ *Hyaloscypha tumidula* (Roberge in Desm.) Grelet, Rev. Mycol. 16: 95 (1951)

Based on a restudy of the type material (France, Caen, leaves of *Betula*, M. Roberge), Arendholz (1979: 97) considered the species to be closely related to *Pyrenopeziza betulicola* Fuckel (see under *Orbilia betulina*, p. 1663) if not identical. He further argued that the species would fit in *Pyrenopeziza* because of its ectal excipulum of textura globulosa-angularis, except for the hyaline, somewhat glassy cell walls. So he retained it as *Mollisia tumidula*. Also White (1943: 165) studied the type material of *Peziza tumidula* and presented a very precise figure of the hymenial elements, but he omitted the excipular characters. Both authors reported the ascus apex as amyloid. The available data do not allow us to conclude with certainty whether *P. tumidula* should be placed in *Pyrenopeziza* or *Mollisia*, or perhaps even in *Calycellina*, a genus for which, in our opinion, an ectal excipulum with or without gelatinized cell walls should be accepted. For *Calycellina* the raised apothecial margin that covers the hymenium in the dry state does not fit.

According to White (l.c.), *H. tumidulum* is only known with certainty from the type collection, whereas most if not all of the material referred to this taxon by later authors has been wrongly identified. For example, when describing a British collection as '*Phialea* sp. I', Dennis (1956: 35) noted that this seems to be *Pezizella tumidula* s. Rehm (1892: 666) but clearly not s. Roberge. Dennis referred the British specimen to *Phialea* based on the thick-walled prosenchymatic ectal excipulum. However, judging from Dennis's description, this fungus is referable to *Calycellina* rather than *Phialea* (= *Cyathicula*).

Hyalinia turgidella (P. Karst.) Boud., Hist. Class. Discom. Eur.: 104 (1907)

≡ *Peziza turgidella* P. Karst., Not. Sällsk. Fauna Fl. Fenn. Förh. 10: 179 (1869)
≡ *Helotium turgidellum* (P. Karst.) P. Karst., Not. Sällsk. Fauna Fl. Fenn. Förh.11: 240 (1870)
≡ *Pezizella turgidella* (P. Karst.) Sacc., Syll. Fung. 8: 281 (1889)
≡ *Hymenoscyphus turgidellus* (P. Karst.) Kuntze, Revis. Gen. Pl. 3: 486 (1898)
≡ *Calycina turgidella* (P. Karst.) Van Vooren, in Ayel & Van Vooren, Bull. Mens. Soc. Linn. Lyon 74, num. spec.: 8 (2005)

Dennis (1956: 180) redescribed the lectotype (Finland, Mustiala, on culm of *Poaceae*, 2.X.1868, herb. P. Karsten 2195, H) and found the ascus apex to stain deep blue in MLZ. The present reexamination of the lectotype (IVV: H.B. 7624) revealed a possible relationship to *Calycellina microspis*, a species with a difficult taxonomy (see under *Hyalinia microspis*, p. 1678).

Hyalinia tyrolensis (Rehm) Boud., Hist. Class. Discom. Eur.: 104 (1907)

≡ *Pezizella tyrolensis* Rehm, Ber. naturh. Vereins Augsburg 26: 31 (1881)
≡ *Hymenoscyphus tyrolensis* (Rehm) Kuntze, Revis. Gen. Pl. 3: 486 (1898)

Three authentic specimens from PAD (Austria, Tirol, Pitztal, Taschach-Gletscher, on stems of *Cirsium spinosissimum*, summer 1875) were received. Two (Rehm Ascomyc. 116, Rabenhorst Fungi Eur. Exs. 2475) were found to be empty, but one (Thümen Mycoth. Univ. 516), which is the only number cited in the protologue, contained a fungus which appears to belong to *Calycina*, possibly close to *C. discreta* (P. Karst.) Kuntze, but differing from the majority of recent collections of that species in asci arising from croziers. The asci measured 45–51 × 4.5–5.2 µm (Rehm 1883: 40–60 × 6–8 µm) and the spores 6.5–9.3 × 2–2.4 µm (Rehm 1881, 1883: 6–9 × 2.5 µm). The apical rings react strongly euamyloid and is of the *Calycina*-type. Höhnel (1926a) concluded that *Pezizella tyrolensis* is a synonym of *Peziza micacea* Pers. (≡ *Psilachnum micaceum* (Pers.) Dennis). Dennis (1964: 69, fig. 52), who examined Rehm Ascomyc. 116 with the date Aug. 1872, also measured narrower asci of 40 × 5 µm, but saw the paraphyses varying from cylindrical to lanceolate, which would exclude the genus *Calycina*.

Orbilia ulcerata (W. Phillips & Plowr.) Sacc., Syll. Fung. 8: 630 (1889)

≡ *Peziza ulcerata* W. Phillips & Plowr., Grevillea 4: 122 (1876)
≡ *Calloria ulcerata* (W. Phillips & Plowr.) W. Phillips, Man. Brit. Discomyc.: 330 (1887)

≡ *Hyalinia ulcerata* (W. Phillips & Plowr.) Boud., Hist. Class. Discom. Eur.: 104 (1907)
≡ *Phacidium ulceratum* (W. Phillips & Plowr.) Höhn., Sitzungsber. Kaiserl. Akad. Wiss. Wien, Math.-Naturwiss. Kl., Abt. I, 126: 322 (1917)
= ***Ploettnera solidaginis*** (Ces.) B. Hein, Willdenowia, Beih. 9: 96 (1976)

According to Hein (1976: 96) this is a synonym of *Ploettnera solidaginis*, a species growing on herbaceous stems of mainly *Asteraceae*, characterized by 4-spored asci and apically flexuous paraphyses. The ascus apex is variable in Hein's concept of the species: in some of the material it is thick-walled and contains a strongly blue (euamyloid) apical ring of the *Ploettnera*-type, whereas other specimens are devoid of apical thickenings and amyloid rings. Inamyloid asci were also found in a recent collection (Germany, Merseburg-Querfurt, Bündorf, Buna-Halde, on *Aster tripolium*, 28.VIII.2000, U. Richter, IVV: H.B. 6751). Here the ascospores measured *13–19.5 × 7–9.3 µm and contained many small and a few larger LBs, and apparently 2 nuclei. The asci arise from croziers. The partly strongly elongate apothecia with dark lobes at the margin resemble those of *Duebenia compta*.

Hyalinia uvidula (P. Karst.) Boud., Hist. Class. Discom. Eur.: 104 (1907)

≡ *Helotium uvidulum* P. Karst., Bidr. Känn. Finl. Nat. Folk 19: 127 (1871)
≡ *Pezizella uvidula* (P. Karst.) Sacc., Syll. Fung. 8: 279 (1889)
≡ *Hymenoscyphus uvidulus* (P. Karst.) Kuntze, Revis. Gen. Pl. 3 (2): 486 (1898)

Based on a study of the lectotype (Fennia, Tammela, Mustiala, Haarankorpi, 4.IX.1870, on rotten wood of *Betula*, herb. P. Karsten 2805, H), Dennis (1956: 195) found the taxon to be lichenized and concluded that it is conspecific or very close to *Epiglia gloeocapsae* Boud. (= *Mniaecia albida*, see under *Hyalinia albida*, p. 1660), a species growing on *Gloeocapsa* on the thallus of *Jungermanniales*.

Reexamination of the lectotype by S. Huhtinen (pers. comm.) and in the present study (IVV: H.B. 7625) revealed conspecificity with various recent collections from both temperate and mediterranean Europe. Although the type was said to grow on wet wood ('in ligno udo', the Latin *uvidus* means moist or wet), the species is desiccation-tolerant and was found by us in 1–4 m above the ground on xeric, decorticated, rotten branches of a great variety of mainly angiosperm trees and shrubs. Possibly the branch of Karsten's specimen has fallen to the ground shortly before he collected it. This hypothesis is supported by some black apothecia of a lichen growing in association in the lectotype.

The very small, cushion-shaped apothecia of this discomycete attain a size of rehydrated 0.08–0.35(–0.5) mm diam. (0.2 mm in lectotype). Due to their pale cream to rose colour they are easily confounded with desiccation-tolerant species of *Orbilia* which often grew in association. Among the anchoring hyphae are often many algal cells, but there was never a clear connection between hyphae and algae, consequently we do not believe in a lichenization in this fungus but in an optional coexistence with algae similar as often observed in *Orbilia*. The hyaline excipulum is very thin and composed of a textura porrecta, which is immersed in some inconspicuous gel like the paraphyses. The ellipsoid spores [10–12.8 × (5.5–)6–7 µm in the lectotype] are indeed reminiscent of a *Mniaecia*.

Our guess was to place the species in *Laetinaevia* or perhaps in *Gelatinopsis*. A sequence of *H. uvidulum* from a recent collection (KY462819) clustered unresolved in the *Helotiales* (Phyl. 1) and did not confirm a relationship with *Laetinaevia*. However, sequence data were unavailable for most of the *Calloriaceae*.

Orbilia veratri Velen., Monogr. Discom. Bohem.: 99, pl. 11 fig. 34 (1934)

The holotype (Czechia, Bohemia, Bilichov, on stems of *Veratrum nigrum*, 23.VII.1925, PRM 148759: IVV: H.B. 6399), probably belongs to *Calycellina*, especially on account of its gelatinized (refractive) ectal excipulum of angular to prismatic cells. The taxon is similar to the common *Calycellina chlorinella*, but differs, e.g., in the shorter, IKI-negative asci (27–30 × 3.8–4 µm) with an apical dome (immature 1.5–2 µm thick), also in the very short, clavate hairs (9–13 × 3.5–9 µm) being covered by a light ochraceous cloddy exudate. The somewhat fusiform, straight ascospores measure 4.8–6(–8) × 1.1–1.3 µm and contain several minute LBs. *Orbilia luteola* (see p. 1677) represents a similar inamyloid variant of *C. chlorinella*, but differs from *O. veratri* in a much thinner apical ascus wall. *Calycellina chlorinella* differs from *O. veratri* also in cylindrical, allantoid spores.

Orbilia vinosula (Rehm) Quél., Enchir. Fung.: 298 (1886)

≡ *Calloria vinosula* Rehm, Ascomyc. Lojk. no. 50 (1883)
≡ *Phragmonaevia vinosula* (Rehm) Höhnel, Sitzungsber. Kaiserl. Akad. Wiss. Wien, Math.-Naturwiss. Kl., Abt. I, 127: 339 (1918)

Höhnel (1918) reexamined the type specimen and found the asci to have an amyloid apical ring which excludes the taxon from the *Orbiliomycetes*. The spores are described as over 10 × 2 µm, with large oil drops, finally 1–3-septate, and the minute, pale rose apothecia (0.2 mm) as possessing hardly any excipulum. Höhnel referred *Phragmonaevia ebulicola* Höhn. to synonymy with *P. vinosula*. According to Rehm (in Saccardo 1889: 639) the paraphyses are apically branched and ellipsoid-clavate. The apothecia grew on stems of *Sambucus ebulus* and *Datura stramonium* in Kaposvar (Hungary).

Hyalinia vulgaris (Fr.) Boud., Hist. Class. Discom. Eur.: 103 (1907)

≡ *Peziza vulgaris* Fr., Syst. Mycol. 2(1): 146 (1822)
≡ *Mollisia vulgaris* (Fr.) Gillet, Champ. Fr., Discomyc. 119 (1882)
≡ *Pezizella vulgaris* (Fr.) Sacc., Syll. Fung. 8: 278 (1889)
≡ *Phialea vulgaris* (Fr.) Rehm, Rabenh. Krypt.-Fl., 1.3: 709 (1892)
≡ *Allophylaria vulgaris* (Fr.) Nannf., Nova Acta Regiae Soc. Sci. Upsal., ser. 4, 8: 291 (1932)
≡ *Hymenoscyphus vulgaris* (Fr.) Raschle & E. Müll., in Müller, Beitr. Krypt.-flora Schweiz 15: 49 (1977)
≡ ***Calycina vulgaris*** (Fr.) Baral, in Baral & Krieglsteiner, Beitr. Kenntn. Pilze Mitteleuropas 5: 227 (1989)

No authentic material of Fries's taxon seems to have been preserved following Arendholz (1989). According to Dennis (1964: 70), the current interpretation of *Peziza vulgaris* follows Rehm (1892: 709) and Höhnel (1926a: 56), who interpreted Fries's species for a fungus with inamyloid asci and aseptate, cylindrical, slightly curved spores. The species was correctly assigned to *Pezizella* by Saccardo (1889), a genus which was later recognized as a later synonym of *Calycina* (Baral in Baral & Krieglsteiner 1985). According to Dennis (1954: 297, 1964: 70) and present study, Berkeley (1875) interpreted *Peziza vulgaris* as an orbiliaceous taxon when he described the two taxa *P. vulgaris* var. *myceticola* Berk. & Curtis (= *Hyalorbilia* ?*inflatula*, see p. 345) and *P. vulgaris* var. *sanguinella* Berk. & Curtis (= *Orbilia* sp., see p. 1684). Also Boudier transferred *P. vulgaris* to the orbiliaceous genus *Hyalinia*.

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Appendix 1. List of hosts on which *Orbiliomycetes* were recorded

Only orbiliaceous species are included for which a description is given in the present monograph. Plant nomenclature mainly follows the systematics of Angiosperm Phylogeny Group IV[1], for gymnosperms see Chase & Reveal (2009)[2], and for fungi mainly Species Fungorum. The number of records is given in parenthesis, numbers after the slash stand for *Orbiliomycetes* with uncertain identity (uncertain hosts are counted as if certain). When growing on leaves or fruits of woody plants this is indicated. Under 'soil' only those are listed that formed apothecia on soil. Cultural or molecular isolates from soil around the rhizosphere of plants (indicated as 'roots') are only included when their association is explicitly mentioned. Substrates that were solely recorded from a molecular extract are marked by 'mol. extr.'. Reports from the literature for which no illustration was available are generally omitted.

[1] AGP IV 2016, https://en.wikipedia.org/wiki/APG_IV_system

[2] Chase, M.W.; Reveal, J.L. (2009). A phylogenetic classification of the land plants to accompany APG III. – Botanical Journal of the Linnean Society. 161: 122–127.

Fungi (140/200)

ASCOMYCOTA
DOTHIDEOMYCETES (2/2)
PLEOSPORALES
- *Karstenula rhodostoma*
Orbilia aurantiorubra (1)
- *Cyclothyriella rubronotata*
Orbilia carpoboloides (1)

LECANOROMYCETES (1/1)
- indet. black crustose lichen
Orbilia oligospora (1)

LEOTIOMYCETES (2/4)
RHYTISMATALES
- *Colpoma quercinum*
Orbilia eucalypti (3)
Orbilia tremulae (1)

ORBILIOMYCETES (14/41)
- *Orbilia acaciae*
Hyalorbilia aff. *orbiliicola* (1)
- *Orbilia aristata*
Hyalorbilia orbiliicola (4)
- *Orbilia aurantiorubra*
Hyalorbilia orbiliicola (14)
- *Orbilia eucalypti*
Hyalorbilia orbiliicola (7)
- *Orbilia flagellispora*
Hyalorbilia orbiliicola (1)
- *Orbilia mali*
Hyalorbilia orbiliicola (1)
- *Orbilia ?myriella*
Hyalorbilia ?orbiliicola (1)
- *Orbilia neocomma*
Hyalorbilia ?orbiliicola (1)
- *Orbilia octoserpentina*
Hyalorbilia ?orbiliicola (1)
- *Orbilia pleioserpens*
Hyalorbilia aff. *orbiliicola* (2)
- *Orbilia subaristata*
Hyalorbilia orbiliicola (1)
- *Orbilia ?subvinosa*
Hyalorbilia ?hergiswiliana (1)
- *Orbilia ?tremulae*
Hyalorbilia orbiliicola (1)
- *Orbilia vinosa*
Hyalorbilia hergiswiliana (1/3)
Hyalorbilia orbiliicola (2)

SORDARIOMYCETES (50/70)
CHAETOSPHAERIALES
- *Menispora glauca*
[= *Zignoella ovoidea*]
Hyalorbilia inflatula (1)

CORONOPHORALES
- *Bertia moriformis*
Hyalorbilia juliae (1)
- *Chaetosphaerella phaeostroma*
Hyalorbilia erythrostigma (1)
Hyalorbilia ulicicola (2)
- *Nitschkia acanthostroma*
Hyalorbilia ?erythrostigma (2)
- *Nitschkia grevillii*
Hyalorbilia multiguttulata (1)

DIAPORTHALES
- *Diaporthe* sp.
Hyalorbilia juliae (1)

HYPOCREALES
- *Bionectria ralfsii*
Hyalorbilia erythrostigma (1)
- *Cosmospora* sp.
Hyalorbilia erythrostigma (2)
- *Nectria* sp.
Orbilia sarraziniana (1)
- *Ophiocordyceps sinensis*
Orbilia auricolor s.l. (1)
- *Thyronectria cucurbitula*
Orbilia eucalypti (1)

XYLARIALES
- *Annulohypoxylon* sp.
Hyalorbilia ?erythrostigma (1)
- *Daldinia* sp.
Hyalorbilia inflatula (1)
- indet. Diatrypaceae
Hyalorbilia ?inflatula (1)
Hyalorbilia erythrostigma (2)
- *Diatrype* sp.
Hyalorbilia erythrostigma (2)
Hyalorbilia multiguttulata (1)
- *Diatrype bullata*
Hyalorbilia erythrostigma (3)
Orbilia aurantiorubra (1)
Orbilia eucalypti (1)
Orbilia xanthoguttulata (1)
- *Diatrype stigma*
Hyalorbilia erythrostigma (2)
Hyalorbilia inflatula (2)
Hyalorbilia subfusispora (2)
Orbilia aurantiorubra
Orbilia auricolor s.l. (1)
Orbilia carpoboloides (1)
- *Diatrype ?stigma*
Hyalorbilia inflatula (3)
Orbilia aristata (1)
- *Diatrypella* sp.
Hyalorbilia erythrostigma (1)
- *Diatrypella quercina*
Hyalorbilia berberidis (1)
Hyalorbilia erythrostigma (3)
Hyalorbilia inflatula (1)
- *Eutypa* sp.
Hyalorbilia erythrostigma (1)
- *Eutypa maura*
Hyalorbilia polypori (1)
- *Eutypa spinosa*
Hyalorbilia subfusispora (1)
- ***Eutypa tetragona***
Hyalorbilia erythrostigma (2)
- *Eutypella caricae*
Hyalorbilia erythrostigma (1)
- *Eutypella leprosa*
Hyalorbilia erythrostigma (1)
- *Eutypella sorbi*
Orbilia phragmotricha (1)
- *Hypoxylon fragiforme*
Hyalorbilia inflatula (5)
Hyalorbilia juliae (1)
- *Jackrogersella minutella*
Hyalorbilia erythrostigma (1)
- *Jackrogersella multiformis*
Hyalorbilia fagi (1)
- *Peroneutypa scoparia*
Hyalorbilia erythrostigma (2)

- indet. pyrenomycetes
Hyalorbilia brevistipitata (1)
Hyalorbilia erythrostigma (1)
Hyalorbilia subfusispora (1)
Orbilia aurantiorubra (1)
Orbilia crenatomarginata (1)

BASIDIOMYCOTA (67/78)
- indet. aphyllophoralean basidiomycetes
Hyalorbilia berberidis (1)
Hyalorbilia inflatula (1)
Orbilia epipora (1)
Orbilia sarraziniana (1)

CORTICIALES
- *Vuilleminia* sp.
Orbilia ?delphinus (1)
Orbilia eucalypti (1)
Orbilia obtusispora (1)
- *Vuilleminia comedens*
Orbilia euonymi (1)

HYMENOCHAETALES
- *Fomitiporia hippophaeicola*
Hyalorbilia juliae (1)
- *Fomitiporia punctata*
Hyalorbilia berberidis (2)
Orbilia epipora (1)
- *Fuscoporia ferreus*
Hyalorbilia ulicicola (1)
Orbilia xanthostigma (1)
- *Fuscoporia ?ferruginosus*
Hyalorbilia tortuosa (1)
- *Hymenochaete rubiginosa*
Hyalorbilia fomentarii (1)
- *Hymenochaetopsis tabacina*
Hyalorbilia juliae (1)
Hyalorbilia subfusispora (1)
Orbilia cejpii (1)
- *Inonotus* sp.
Hyalorbilia ulicicola (1)
- *Phellinus* sp.
Hyalorbilia citrina (1)
Hyalorbilia ?fomentarii
Hyalorbilia polypori (1)
Hyalorbilia ?ulicicola (1)
Orbilia cunninghamii (1)
- *Phellinus igniarius*
Orbilia epipora (1)
- *Phellinus laevigatus*
Hyalorbilia tortuosa (1)
- *Phylloporia ribis*
Hyalorbilia ulicicola (1)
Hyalorbilia berberidis (1)
- *Schizopora paradoxa*
Hyalorbilia berberidis (1)
Hyalorbilia inflatula (1)
Orbilia eucalypti (1)
Orbilia tremulae (1)
- *Xanthoporia nodulosa*
Orbilia eucalypti (1)
- *Xanthoporia radiata*
Hyalorbilia juliae (1)

POLYPORALES
- *Cellulariella warnieri*
Hyalorbilia ulicicola (1)
- *Cerioporus mollis*
Hyalorbilia inflatula (1)
- *Cerrena unicolor*
Hyalorbilia subfusispora (1)
- *Fomes fomentarius*
Hyalorbilia berberidis (1)
Hyalorbilia fomentarii (2)
Hyalorbilia inflatula (3)
Hyalorbilia multiguttulata (1)
Hyalorbilia polypori (1)
- *Fomitopsis betulina*
Orbilia cardui (1)
Orbilia eucalypti (1)
Orbilia ?frangulae (1)
Orbilia rubrovacuolata (2)
- *Fomitopsis pinicola*
Hyalorbilia berberidis (1)
- *Ganoderma* sp.
Hyalorbilia citrina (1)
- *Ganoderma applanatum*
Hyalorbilia berberidis (2)
Hyalorbilia inflatula (3)
Hyalorbilia ulicicola (1)
- *Ganoderma australe*
Hyalorbilia ulicicola (3)
- *Ganoderma lucidum*
Hyalorbilia polypori (1)
- *Ischnoderma benzoinum*
Hyalorbilia fagi (1)
Hyalorbilia polypori (1)
- *Polyporus* sp.
Hyalorbilia ?inflatula (1)
- *Trametes gibbosa*
Hyalorbilia tortuosa (1)
- *Trametes hirsuta*
Hyalorbilia inflatula (1)
Hyalorbilia juliae (1)
Hyalorbilia subfusispora (1)
- *Trametes hydnoides*
Hyalorbilia citrina (1)
- *Trametes versicolor*
Hyalorbilia inflatula (1)

RUSSULALES
- *Peniophora* sp.
Orbilia euonymi (1)
- *Peniophora quercina*
Orbilia eucalypti (1)
- *Stereum rugosum*
Hyalorbilia berberidis (1)

AGARICOMYCETES
AGARICALES
- *Cyathus striatus*
Hyalorbilia inflatula (1)

AURICULARIALES
- *Exidia recisa*

Hyalorbilia erythrostigma (1)

TREMELLALES
- *?Tremellales* spp.
Hyalorbilia erythrostigma (2)

OOMYCOTA (4/4)
PERONOSPORALES
- *Pythium* spp. (oospores)
?*Orbilia epipora* (*Dactylella polyctona*) (1)
Hyalorbilia ?*inflatula* (*Dactylella passalopaga*) (1)
Tridentaria tylota (1)
Hyalorbilia spermatophaga (1)
and others

Bryophytes (5/5)

BRYOPHYTA
- *Ceratodon purpureus*
Bryorbilia arenicola (1)
- *?Hypnum cupressiforme*
Pseudorbilia bipolaris (1)

MARCHANTIOPHYTA
- *Frullania dilatata*
Orbilia frullaniae (1)
Hyalorbilia fusispora (1)
- *Radula complanata*
Orbilia mali (1)

Pteridophytes

MARATTIIDAE
- *Angiopteris lygodiifolia*
Orbilia auricolor s.l. (1)

EQUISETIDAE
- *Equisetum* sp.
Orbilia auricolor s.l. (1)

Spermatophytes

Gymnosperms

- indet. conifers
Hyalorbilia ?*arcuata* (1)
Hyalorbilia polypori (2)
Orbilia auricolor s.l. (1)
Orbilia cucumispora (1)
Orbilia eucalypti (2)
Orbilia leucostigma (4)
Orbilia rosea (2)
Orbilia sarraziniana (1)
Orbilia xanthostigma (12)
Pseudorbilia bipolaris (1)

PINALES
• Pinaceae
Abietoideae
- *Abies* sp.
Hyalorbilia ?*subfusispora* (1)
Orbilia ?*cejpii* (1)
Orbilia aff. *clavipisca* (1)
Orbilia magnifica (1)
Orbilia sinensis (1)
Orbilia xanthostigma (1)
- *Abies alba*
Amphosoma resinicola (1)
Hyalorbilia inflatula (2)
Hyalorbilia ?*polypori* (1)
Orbilia aristata (3)
Orbilia eucalypti (1/1)
Orbilia subvinosa (1)
Orbilia tremulae (1)
Orbilia xanthoguttulata (1)
Orbilia xanthostigma (4)
- *Abies balsamea*.
Orbilia euonymi (1)
Orbilia vinosa (1)
- *Abies concolor*
Orbilia clavipisca (2)
Orbilia concoloris (1)
Orbilia coniferarum (2)
Orbilia delphinus (2)
Orbilia maeandrina (1)
Orbilia ophiosoma (3)
Orbilia phanosoma (1)
Orbilia pileosoma (1)
- *Abies lasiocarpa*
Orbilia lentiformis (1)
Orbilia magnifica (1)
- *Abies nordmanniana*
Hyalorbilia inflatula (1)
Hyalorbilia polypori (1)
Orbilia rubrovacuolata (1)
- *Abies pinsapo*
Orbilia ?*subvinosa* (4)
- *Abies sibirica*
Orbilia ?*xanthostigma* (1)
- *Cedrus* sp.
Orbilia euonymi (1)
- *Cedrus atlantica*
Hyalorbilia orbiliicola (1)
Orbilia flagellispora (1)
Orbilia ovoidea (1)
Orbilia spermoides (1)
Orbilia subclavuliformis (1)
- *Tsuga canadensis*
Orbilia euonymi (1)
Orbilia vinosa (1)

Laricoideae
- *Larix* sp.
Amphosoma atroolivaceum (1)
Hyalorbilia resinae (3)
Hyalorbilia sibirica (1)
Orbilia crenatomarginata (1)
Orbilia cylindrospora (1)
Orbilia dryadum (1)
Orbilia eucalypti (1)
Orbilia flagellispora (1)
Orbilia pleioeuonymi (1)
- *Larix decidua*
Amphosoma atroolivaceum (5)
Hyalorbilia juliae (1)
Hyalorbilia orbiliicola (1)
Orbilia aristata (1)
Orbilia cylindrospora (1)
Orbilia eucalypti (1)
Orbilia euonymi (2)
Orbilia mammillata (1 leaves)
Orbilia patellarioides (1)
Orbilia vinosa (1)
- *Larix sibirica*
Orbilia delphinus (1)
- *Pseudotsuga menziesii*
Amphosoma resinicola (1)
Hyalorbilia berberidis (1)
Hyalorbilia polypori (1)
Orbilia aprilis (1)
Orbilia ?*carpoboloides* (1)
Orbilia coniferarum (1)
Orbilia eucalypti (1)
Orbilia euonymi (7)
Orbilia lentiformis (1)
Orbilia macrodelphinus (2)
Orbilia magnifica (1/1)
Orbilia rubrovacuolata (1)
Orbilia spermoides (2)

Piceoideae
- *Picea* sp.
Amphosoma resinicola (1)
Orbilia aristata (1)
Orbilia flagellispora (1)
Orbilia maeandrina (1)
Orbilia magnifica (1)
Orbilia xanthostigma (1)
- *Picea abies*
Amphosoma atroolivaceum (14/1)
Amphosoma resinicola (6)
Hyalorbilia berberidis (1)
Hyalorbilia fagi (2)
Hyalorbilia inflatula (1)
Hyalorbilia polypori (2)
Hyalorbilia resinae (1)
Hyalorbilia subfusispora (1)
Lilapila gallica (5)
Lilapila jurana (17)
Lilapila oculispora (13)
Lilapila oculisporella (8)
Orbilia alpigena (15)
Orbilia aprilis (9)
Orbilia aristata (5)
Orbilia auricolor s.l. (3)
Orbilia clavuliformis (2)
Orbilia aff. *concoloris* (1)
Orbilia crenatovinosa (1)
Orbilia cylindrospora (8)
Orbilia ellipsospora (1)
Orbilia eucalypti (5)
Orbilia euonymi (17)
Orbilia flagellispora (6)
Orbilia lentiformis (1)
Orbilia leucostigma (1)
Orbilia luteorubella (1)
Orbilia mammillata (1)
Orbilia multiformis (1 roots, mol. extr.)
Orbilia pleioeuonymi (1)
Orbilia quaestiformis (1)
Orbilia rosea (2/1)
Orbilia rubrovacuolata (1)
Orbilia sarraziniana (2)
Orbilia sphaerospora (2)
Orbilia aff. *subulivinosa* (1)
Orbilia tremulae (2)
Orbilia vibrioides (6)
Orbilia vinosa (11)
Orbilia xanthoguttulata (4)
Orbilia xanthostigma (10)
- *Picea glauca*
Hyalorbilia orbiliicola (1)
Orbilia auricolor s.l. (1)
Orbilia vinosa (1)
- *Picea obovata*
Orbilia aff. *coniferarum* (1)
- *Picea orientalis*
Orbilia aprilis (1)
- *Picea sitchensis*
Amphosoma atroolivaceum (1)
Orbilia coniferarum (1)
Orbilia macrodelphinus (1)
Orbilia maeandrina (1)
Orbilia magnifica (1)

Pinoideae
- *Pinus* sp.
Hyalorbilia arcuata (1)
Hyalorbilia inflatula (1)
Hyalorbilia japonica (1)
Hyalorbilia juliae (1)
Hyalorbilia lignatilis (1)
Hyalorbilia oreadum (1)
Hyalorbilia ulicicola (1)
Orbilia aristata (2)
Orbilia cylindrospora (1)
Orbilia eucalypti (3)
Orbilia euonymi (2)
Orbilia fusiformis (1)
Orbilia jinguangsiensis (1)
Orbilia juruensis (1)
Orbilia leucostigma (2)
Orbilia limoniformis (1)
Orbilia myriophanosoma (1)
Orbilia olivacea (1)
Orbilia patellarioides (4)
Orbilia polyspora (1)
Orbilia quercus (1)
Orbilia rhopalota (1 leaves)
Orbilia rubrovacuolata (2)
Orbilia sarraziniana (2/1)
Orbilia subclavuliformis (1)
Orbilia subvinosa (3)
Orbilia vinosa (6)
Orbilia xanthostigma (10)
- *Pinus brutia*
Orbilia euonymi (4)
Orbilia pleiomicrosoma (1)
Orbilia subaristata (3)
Orbilia subvinosa (1)
Orbilia vinosa (1)
- *Pinus canariensis*
Orbilia dryadum (1)
Orbilia ellipsospora (1)
Orbilia liliputiana (2)
Orbilia patellarioides (1)
Orbilia rubrovacuolata (1)
Orbilia vinosa (1)
- *Pinus contorta*
Orbilia atrolentiformis (1)
Orbilia flagellispora (1)
Orbilia pileosoma (1)
Orbilia subclavuliformis (1)
Orbilia vinosa (1)
- *Pinus densiflora*
Retiarius aff. *bovicornutus* (1)
- *Pinus edulis*
Amphosoma macrosporum (1)
Orbilia clavipisca (1)
Orbilia ?*clavuliformis* (1)
Orbilia edulis (1)
Orbilia macroasca (2)
Orbilia multitrapezoidea (1)
Orbilia phanosoma (2)
Orbilia spermoides (3)
- *Pinus halepensis*
Orbilia coniferarum (1)
Orbilia hesperidea (3)
Orbilia microlentiformis (1)
Orbilia microserpens (1)
Orbilia octocorculispora (1)
Orbilia pleiomicrosoma (2)
Orbilia subaristata (1)
Orbilia vibrioides (1)
Orbilia vinosa (4)
- *Pinus mugo*
Orbilia ?*rosea* (1)
- *Pinus nigra*
Amphosoma atroolivaceum (1)
Hyalorbilia subfusispora (1)
Orbilia breviaristata (1)
Orbilia ?*cardui* (1)
Orbilia cejpii (1)
Orbilia eucalypti (1)
Orbilia orientalis (1)
Orbilia xanthostigma (2)
- *Pinus pinea*
Orbilia auricolor s.l. (1 leaves)
Orbilia pleioungulata (1)
- *Pinus pinaster*
Orbilia aprilis (1)
Orbilia euonymi (1)
Orbilia fabacearum (1)
Orbilia quaestiformis (1)
- *Pinus ponderosa*
Orbilia cucumispora (1)

Orbilia ?microsoma (1)
Orbilia multimacroasca (1)
Orbilia aff. *pleioalbidorosea* (1)
Orbilia ponderosae (1)
Orbilia spermoides (2)
Orbilia vinosa (2)
- Pinus radiata
Orbilia aprilis (1)
Orbilia euonymi (1)
- Pinus strobus
Orbilia ?aprilis (1)
Orbilia auricolor [*O. cladodes*] (1)
Orbilia euonymi (1)
Orbilia leucostigma (1)
Orbilia ?vinosa (2)
- Pinus sylvestris
Amphosoma atroolivaceum (18)
Amphosoma resinicola (1)
Amphosoma aff. *resinicola* (1)
Hyalorbilia berberidis (1)
Hyalorbilia inflatula (2)
Hyalorbilia polypori (1)
Lecophagus pini (2)
Liladisca acicola (1 leaves)
Lilapila ?oculispora (2)
Lilapila oculisporella (7)
Orbilia acuum (1)
Orbilia alpigena (1)
Orbilia aprilis (6)
Orbilia aristata (6)
Orbilia auricolor s.l. (1)
Orbilia battenii (1)
Orbilia clavuliformis (2)
Orbilia coniferarum (1)
Orbilia crenatovinosa (4)
Orbilia cylindrospora (4)
Orbilia delphinus (1)
Orbilia ellipsospora (1 leaves)
Orbilia eucalypti (7)
Orbilia euonymi (5)
Orbilia flagellispora (2)
Orbilia gambelii (1)
Orbilia ?graminis (2)
Orbilia leucostigma (2)
Orbilia mammillata (2)
Orbilia olivacea (2)
Orbilia ovoidea (1)
Orbilia patellarioides (11)
Orbilia rhopalota (2 [1 × leaves])
Orbilia rosea (1)
Orbilia rubrovacuolata (1)
Orbilia sphaerospora (8)
Orbilia subclavuliformis (2/1)
Orbilia subcylindrospora (1)
Orbilia subtrapeziformis (1)
Orbilia subvinosa (19)
Orbilia trapeziformis (1)
Orbilia tremulae (1)
Orbilia vinosa (6/1)
Orbilia xanthostigma (5)
Retiarius ?bovicornutus (2)
- Pinus thunbergii
Orbilia ?cejpii (1)
- Pinus uncinata
Orbilia sarraziniana (1)
Orbilia vinosa (1)

• Cupressaceae
Cupressoideae
***- Cupressus* sp.**
Orbilia aff. *subdelphinus* (1)
Orbilia sarraziniana (1)
- Cupressus macrocarpa
Orbilia cupressi (1)
Orbilia obtusispora (1)
Orbilia subdelphinus (2)
- Cupressus sempervirens
Orbilia atlantis (1 fruits)
Orbilia subocellata (1)
***- Juniperus* sp.**
Hyalorbilia fusispora (1)
Orbilia euonymi (1)
Orbilia gambelii (1)
- Juniperus chinensis
Orbilia euonymi (1)
- Juniperus communis
Orbilia cardui (1)
Orbilia cylindrospora (1)
Orbilia euonymi (1)
Orbilia filiformis (2)
Orbilia flagellispora (3)
Orbilia leucostigma (1)
Orbilia ovalis (1)
Orbilia rhopalota (1 leaves)
Orbilia ?rosea (1)
Orbilia sphaerospora (1)
Orbilia subaristata (1)
Orbilia subcylindrospora (1)
Orbilia ?subvinosa (2)
Orbilia vinosa (2)
- Juniperus communis* var. *saxatilis
Orbilia ?subvinosa (1)
- Juniperus macrocarpa
Orbilia dalmatica (1)
- Juniperus occidentalis
Orbilia coniferarum (1)
Orbilia aff. *gregorii* (1)
- Juniperus osteosperma
Orbilia arizonensis (1)
Orbilia calyptrata (2)
Orbilia clavipisca (1)
Orbilia cucumispora (3)
Orbilia flexisoma (2)
Orbilia macrodelphinus (1)
Orbilia multidelphinus (1)
Orbilia multihamulata (2)
Orbilia multitrapezoidea (1)
Orbilia navajoana (2)
Orbilia octosporoides (1)
Orbilia ophiosoma (3)
Orbilia osteospermae (1)
Orbilia pisciculus (1)
- Juniperus oxycedrus
Orbilia trapeziformis (1)
Orbilia vinosa (1)
- Juniperus phoenicea
Orbilia hesperidea (1)
Orbilia aff. *paravitalbae* (1)
- Juniperus sabina
Orbilia subsphaerospora (1)
- Juniperus thurifera
Orbilia euonymi (1)
Orbilia gambelii (1)
Orbilia trapeziformis (2)
- Juniperus phoenicea* var. *turbinata
Orbilia pleioungulata (1)
Orbilia subaristata (1)
- Thuja occidentalis
Orbilia aprilis (1)
Orbilia euonymi (1)
- Thuja plicata
Lecophagus vermicola (1)
Orbilia aprilis (1)
Orbilia aristata (1)
Orbilia euonymi (1)

Sequoioideae
- Sequoiadendron giganteum
Orbilia aprilis (1)
Orbilia euonymi (1)
Taxodioideae
- Taxodium distichum
Orbilia euonymi (1)
- Cryptomeria japonica
Hyalorbilia subfusispora (1)
Orbilia ?aristata (1)
Orbilia euonymi (1)

• Taxaceae
- Taxus baccata
Lecophagus vermicola (1)
Mycoceros antennatissimus (2)
Orbilia aprilis (1)
Orbilia aristata (1)
Orbilia euonymi (1)
Orbilia vibrioides (1)
Retiarius revayae (1)

ARAUCARIALES
• Araucariaceae
- Araucaria cunninghamii
Orbilia ?oxyspora (1)

• Podocarpaceae
Orbilia ?xanthostigma (1)

CYCADIDAE
• Zamiaceae
- Macrozamia riedlei
Orbilia eucalypti (1 leaves)
Orbilia myrioobliqua (1 leaves)
Orbilia nothovinosa (1 leaves)

GINKGOIDAE
- Ginkgo biloba
Orbilia euonymi (1)

GNETIDAE
• Ephedraceae
- Ephedra gerardiana
Orbilia flavidorosella (1)
- Ephedra viridis
Orbilia calyptrata (1)
Orbilia lacrimispora (1)
Orbilia macrohesperidea (1)
Orbilia maeandrina (1)
Orbilia multiserpens (1)
Orbilia sonorensis (1)

Angiosperms

Monocotyledons

ALISMATALES
• Hydrocharitaceae
- Elodea canadensis
Lecophagus muscicola (1)

• Araceae
- Epipremnum pinnatum
Orbilia tenuissima (1)
- indet. *Aroideae*
Orbilia alba (1)

ASPARAGALES
• Asparagaceae
Agavoideae
- Agave americana
Orbilia bicknellensis (1)
Orbilia desertorum (4 leaves)
Orbilia flavida (1)
Orbilia serpentina (1)
- Agave shawii
Orbilia desertorum (4 leaves)
***- Yucca* sp.**
Orbilia auricolor s.l. (2 leaves)
Orbilia caulicola (2)
Orbilia desertorum (1)
Orbilia flavida (3)
Orbilia ocellata (2)
Orbilia quaestiformis (4)
- Yucca elata
Orbilia bicknellensis (2)
Orbilia denticulata (1)
Orbilia lentiformis (1)
Orbilia macrotrapeziformis (1)
Orbilia multigambelii (1)
Orbilia paradoxoides (1)
Orbilia pleiolentiformis (1)
Orbilia serpentina (1)
Orbilia yuccae (1)
- Yucca gloriosa
Orbilia flavida (1)
Orbilia lentiformis (1)
- Yucca schidigera
Orbilia denticulata (1 leaves)

Asparagoideae
***- Asparagus* sp.**
Orbilia pleioungulata (1)
- Asparagus officinalis
Orbilia multiformis (1)

• Asphodelaceae
- Xanthorrhoea australis
Orbilia auricolor s.l. (1)
- Xanthorrhoea preissii
Orbilia astrovinosa (1)
Orbilia ?tremulae (1 fruits)

• Iridaceae
- Iris ensata* var. *hortensis
Orbilia multiformis (1 roots)
- Iris foetidissima
Orbilia atlantis (1)
Orbilia auricolor s.l. (1)
- Iris pseudacorus
Orbilia atlantis (1)
Orbilia aff. *auricolor* (1)
Orbilia rectispora (2)

• Orchidaceae
- Vanilla planifolia
Orbilia blumenaviensis (1 mol. extr.)

PANDANALES
• Pandanaceae
- Pandanus tectorius
Orbilia aff. *rectispora* (1 leaves)

Commelinids
ARECALES
indet. palm
Hyalorbilia aff. *erythrostigma* (2 leaves)
Orbilia blumenaviensis (1 leaves)
Orbilia disseminata (1 leaves)
Orbilia flavida (1 leaves)
Orbilia milinana (1)
- Calamus quiquesetinervius
Orbilia aff. *dorsalis* (1)
- Cocos nucifera
Orbilia auricolor s.l. (3 fruits)
Orbilia bambusina (1 leaves)
Orbilia cejpii (1 leaves)
Orbilia cocois (1 leaves)
- Licuala ramsayi
Hyalorbilia inflatula (1 leaves)
- Livistona nitida
Orbilia acaciae (1 leaves)
Orbilia aff. *australiensis* (1 leaves)
Orbilia ?commarosa (1 leaves)
Orbilia coronohesperidea (1 leaves)
Orbilia ?dixienis (1 leaves)
Orbilia livistonae (1 leaves)
Orbilia multiserpens (1 leaves)
Orbilia myrioeuonymi (1 leaves)
Orbilia palmicola (1 leaves)
Orbilia parviclava (1 leaves)

Orbilia pleiohesperidea (1 leaves)
- ***Oenocarpus* sp.**
Hyalorbilia citrina (1 leaves)
- ***Phoenix canariensis***
Orbilia auricolor s.l. (1 leaves)
Orbilia blumenaviensis (1)

COMMELINALES
• **Haemodoraceae**
- ***Anigozanthos manglesii***
Orbilia anigozanthi (2)
Orbilia kingsiana (1)
Orbilia aff. *nothoaprilis* (1)

POALES
• **Bromeliaceae**
- ***Puya raimondii***
Orbilia puyae (1)

• **Juncaceae**
- ***Juncus acutus***
Orbilia subvitalbae (1)
- ***Juncus roemerianus***
Orbilia junci (6)
- ***Luzula pilosa***
Orbilia cardui (1)
- ***Luzula sylvatica***
Orbilia ?cardui (1)

• **Cyperaceae**
- ***Carex* sp.**
Orbilia auricolor s.l. (1)
Orbilia ?epilobii (1)
Orbilia ?flagellispora (1)
- ***Carex vesicaria***
Orbilia auricolor s.l. (1)
- ***Scirpoides holoschoenus***
Orbilia auricolor s.l. (1)
Orbilia caulicola (1)
- ***Scirpus maritimus***
Orbilia elegans (1)
Orbilia scaphoides (1)
- ***Scirpus silvaticus***
Orbilia rectispora (3)

• **Poaceae**
Bambusoideae
- **indet. *Bambusoideae***
Hyalorbilia brevistipitata (1)
Hyalorbilia japonica (1)
Orbilia auricolor s.l. (1)
Orbilia sp. H.B. 8963 (1)
- ***Bambusa* sp.**
Hyalorbilia citrina (1)
Hyalorbilia tortuosa (1)
Orbilia bambusina (1)
Orbilia aff. *nothoaprilis* (1)
Orbilia tenuissima (1)
Orbilia ?tremulae (1)
Orbilia ?xanthostigma (1)
- ***Chusquea* sp.**
Hyalorbilia andina (1)
- ***Dendrocalamus giganteus***
Orbilia nemaspora (1)
- ***Phyllostachys* sp.**
Orbilia caulicola (1)
Orbilia sarraziniana (1)
- ***Yushania alpina***
Orbilia ?menageshae (1)

Oryzoideae
- ***Oryza sativa***
Orbilia iridis (2)

Pooideae
Orbilia ?atlantis (1)
Orbilia quaestiformis (3)
- ***Ammophila arenaria***
Orbilia graminis (1)
Orbilia quaestiformis (3)
- ***Dactylis glomerata***
Orbilia caulicola (1)
- ***Hordeum vulgare***
Orbilia elegans (2)
Orbilia ellipsospora (1)
Orbilia oxyspora (1 roots)
- ***Phalaris arundinacea***
Orbilia auricolor s.l. (1)
- ***Phleum pratense***
Hyalorbilia herbicola (1)
Hyalorbilia ?juliae (1)
- ***Triticum* sp.**
Orbilia elegans (1)
- ***Triticum aestivum***
Orbilia auricolor s.l. (1)
Orbilia multiformis (1 roots)

Arundinoideae
- ***Arundo donax***
Orbilia subvitalbae (1)
- ***Phragmites australis***
Orbilia ?atlantis (1)
Orbilia auricolor s.l. (1)
Orbilia ?breviaristata (1)
Orbilia ?clavuliaristata (1)
Orbilia cylindrosoma (1)
Orbilia graminis (8)
Orbilia lysipaga (1)
Orbilia phragmitis (1)
Orbilia ?puyae (1)
Orbilia quaestiformis (1)
Orbilia rectispora (1)
Orbilia septispora (27)
Orbilia stilbospora (1)
Orbilia vitalbae (2)

Panicoideae
- ***Zea mays***
Hyalorbilia fusarioides (1 roots)
Orbilia ?atlantis (1)
Orbilia aff. *cocois* (1)

• **Typhaceae**
- ***Sparganium erectum***
Orbilia rectispora (1)
- ***Typha* sp.**
Orbilia quaestiformis (3)
Orbilia rectispora (7)
Orbilia septispora (1)
Orbilia vitalbae (2)
- ***Typha angustifolia***
Orbilia rectispora (1)
- ***Typha angustifolia***
Orbilia rectispora (1)
- ***Typha latifolia***
Orbilia auricolor s.l. (1)
Orbilia caulicola (1)
Orbilia quaestiformis (1)
Orbilia rectispora (6)
Orbilia scaphoides (1)
Orbilia vitalbae (1)

ZINGIBERALES
• **Zingiberaceae**
- ***Elettaria* sp.**
Orbilia neglecta (1)

Dicotyledons

LAURALES
• **Lauraceae**
- ***Apollonias barbujana***
Orbilia xanthostigma (1)
- ***Beilschmiedia tawa***
Orbilia cunninghamii (2)
- ***Laurus* sp.**
Orbilia xanthostigma (1)
- ***Laurus novocanariensis***
Hyalorbilia lunata (1)
Hyalorbilia polypori (2)
Orbilia rubrovacuolata (1)
Orbilia ?tenuissima (1)
Orbilia vibrioides (1)
Orbilia xanthostigma (13)
- ***Ocotea foetens***
Hyalorbilia brevistipitata (1)
Hyalorbilia inflatula (1)
Hyalorbilia lunata (3)
Hyalorbilia polypori (2)
Orbilia dryadum (1)
Orbilia leucostigma (1)
Orbilia xanthostigma (6)

MAGNOLIALES
• **Magnoliaceae**
- ***Liriodendron tulipifera***
Orbilia eucalypti (1)
Orbilia xanthoguttulata (2)
- ***Magnolia* sp.**
Orbilia eucalypti (1)
Orbilia ficicola (1)
- ***Magnolia denudata***
Orbilia corculispora (1)

Eudicots

- **indet. climber**
Hyalorbilia ?erythrostigma (1)
Hyalorbilia aff. *erythrostigma* (1)
Hyalorbilia ?orbiliicola (1)
Orbilia auricolor s.l. (1)
Orbilia brachychitonis (1)
Orbilia mammifera (2)
Orbilia neocomma (3)
Orbilia paracaudata (1)
Orbilia scandens (2)
Orbilia subfabacearum (1)

BUXALES
• **Buxaceae**
- ***Buxus sempervirens***
Orbilia aprilis (2)
Orbilia euonymi (3)
Orbilia vibrioides (1)
Orbilia vinosa (2)
Orbilia vitalbae (1)

PROTEALES
• **Proteaceae**
- ***Adenanthos sericeus***
Orbilia astrovinosa (1)
Orbilia austrocylindrica (1)
Orbilia eucalypti (2)
Orbilia plurililacina (1)
- ***Banksia cuneata***
Orbilia australiensis (1)
Orbilia eucalypti (1)
Orbilia ?nothovinosa (1)
- ***Banksia grandis***
Orbilia astrovinosa (1)
Orbilia australiensis (1)
Orbilia aviceps (3)
Orbilia curvatinavajoana (1)
Orbilia eucalypti (1)
Orbilia microserpens (1)
- ***Banksia menziesii***
Orbilia amberina (1)
Orbilia austrocylindrica (1)
Orbilia aviceps (2)
Orbilia curvatinavajoana (1)
Orbilia eucalypti (2)
Orbilia ?pleioserpens (1)
- ***Banksia sessilis***
Orbilia ?arachnopus (1)
- ***Brabejum stellatifolium***
Retiarius bovicornutus (1 leaves)
- ***Hakea* sp.**
Orbilia australiensis (1)
Orbilia myriobliqua (1 incl. fruits)

• **Platanaceae**
- ***Platanus* sp.**
Orbilia ?rosea (1)
Orbilia xanthostigma (1)
- ***Platanus orientalis***
Hyalorbilia caucasica (1)
Orbilia eucalypti (1)
Orbilia vinosa (1)
- ***Platanus* × *acerifolia***
Hyalorbilia juliae (3)
Lecophagus ellipsoideus (3)
Lecophagus vermicola (3)
Mycoceros antennatissimus (3)
Retiarius goenczoelii (1)

RANUNCULALES
• **Berberidaceae**
- ***Berberis hispanica***
Orbilia pleiogambelii (1)
Orbilia pleistosphaera (1)
- ***Berberis vulgaris***
Hyalorbilia berberidis (2)
Orbilia ?dixiensis (1)
Orbilia eucalypti (1)
Orbilia euonymi (2)
Orbilia filiformis (1)
Orbilia jacaensis (1)
Orbilia subtrapeziformis (1)
Orbilia vitalbae (2)
- ***Mahonia dictyota***
Orbilia flavida (1)
Orbilia vibrioides (1)
- ***Mahonia fremontii***
Orbilia lentiformis (1)
Orbilia ?macrotrapeziformis (1)

• **Ranunculaceae**
- ***Clematis flammula***
Orbilia subclavuliformis (1)
- ***Clematis vitalba***
Hyalorbilia erythrostigma (3)
Hyalorbilia juliae (3)
Hyalorbilia latispora (2)
Hyalorbilia multiguttulata (1)
Hyalorbilia subfusispora (8)
Hyalorbilia ulicicola (1)
Lecophagus ellipsoideus (2)
Orbilia aprilis (6)
Orbilia arachnovinosa (1)
Orbilia auricolor s.l. (1)
Orbilia cejpii (1)
Orbilia euonymi (5)
Orbilia fabacearum (1)
Orbilia filiformis (5)
Orbilia flavida (1)
Orbilia gambelii (2)
Orbilia jacaensis (1)
Orbilia obtusispora (1/1)
Orbilia pleioeuonymi (3)
Orbilia quaestiformis (1)
Orbilia ?trapeziformis (1)
Orbilia ungulata (3)
Orbilia vitalbae (10)
Retiarius ?bovicornutus (1)
- ***Helleborus foetidus***
Orbilia auricolor s.l. (3)
Orbilia paravitalbae (1)
- ***Helleborus niger***
Orbilia atlantis (1)
Orbilia rubicunda (1)
- ***Ranunculus aconitifolius***
Orbilia ?epilobii (1)

- Ranunculus repens
Orbilia auricolor s.l. (1)
- Thalictrum flavum
Orbilia cardui (1)

DILLENIALES
• Dilleniaceae
- Hibbertia aurea
Orbilia multicurvula (1)

Superrosids
SAXIFRAGALES
• Altingiaceae
- Liquidambar styraciflua
Orbilia saccharifera (1)
- Liquidambar formosana
Hyalorbilia ?polypori (1)

• Crassulaceae
- Aeonium arboreum
Orbilia subaristata (1)
Orbilia flavida (1)
- Aeonium lindleyi
Orbilia pleioungulata (1)
- Aeonium pseudourbicum
Orbilia desertorum (1)

• Grossulariaceae
- Ribes cereum
Orbilia delphinus (1)
Orbilia euonymi (1)
Orbilia idahoensis (1)
Orbilia lentiformis (1)
Orbilia maeandrina (1)
Orbilia pubescens (1)
- Ribes petraeum
Orbilia subtrapeziformis (3)
- Ribes rubrum
Orbilia sarraziniana (1)

Rosidae
VITALES
- Parthenocissus quinquefolia
Orbilia flavida (1)
***- Vitis* sp.**
Hyalorbilia subfusispora (1)
Orbilia hesperidea (1)
Orbilia ?pleioungulata (1)
- Vitis vinifera
Orbilia aristata (2)
Orbilia auricolor s.l. (1)
Orbilia clavuliformis (3)
Orbilia occulta (1)
Orbilia subaristata (1)
Orbilia subclavuliformis (1)

Fabids
CELASTRALES
- Canotia holacantha
Orbilia arizonensis (1)
Orbilia bicknellensis (1)
Orbilia calyptrata (2)
Orbilia lacrimispora (1)
Orbilia macrodelphinus (1)
- Euonymus europaeus
Hyalorbilia fusispora (1)
Hyalorbilia inflatula (1)
Hyalorbilia juliae (1)
Orbilia clavuliformis (1)
Orbilia euonymi (1)
Orbilia ficicola (1)
Orbilia gambelii (4)
Orbilia paracylindrospora (1)
Orbilia subclavuliformis (1)
Orbilia trapeziformis (1)

FABALES (Fabaceae)
Orbilia jugulospora (0/1)
Orbilia polyspora (1)
Orbilia vinosa (1)

• Caesalpinioideae
- Ceratonia siliqua
Hyalorbilia ulicicola (1)
Orbilia aprilis (1)
Orbilia microserpens (1)
Orbilia subaristata (1)
Orbilia vinosa (1)
- Gleditsia sinensis
Orbilia filiformis (1)
- Gleditsia triacanthos
Orbilia carpoboloides (1)
Orbilia octocorculispora (1)
Orbilia vinosa (1)
- Gymnocladus dioicus
Lecophagus vermicola (1)
- Parkinsonia florida
Orbilia ?vermiculati (1)
- Parkinsonia microphylla
Orbilia calyptrata (1)
Orbilia hesperidea (1)
Orbilia maeandrina (2)
Orbilia aff. *megahesperidea* (1)
Orbilia multicercocarpi (1)
Orbilia paloverdensis (1)
Orbilia aff. *pleiomesaverdiana* (1)
Orbilia pleionavajoana (1)
Orbilia pleioserpens (1)
Orbilia pluristomachia (1)
Orbilia sedonensis (1)

• Cercidoideae
- Cercis siliquastrum
Haptocara aff. *latirostrum* (1)
Hyalorbilia orbiliicola (1)
Lecophagus vermicola (2)
Orbilia aurantiorubra (2)
Orbilia carpoboloides (4)
Orbilia cercidicola (3)
Orbilia flagellispora (1)
Orbilia gambelii (1)
Orbilia myriolentiformis (1)
Orbilia myriosphaera (6)
Orbilia pleiogambelii (2)
Orbilia polyspora (4)
Orbilia subaristata (5)
Orbilia subclavuliformis (3)
Orbilia subocellata (1)
Orbilia trapeziformis (3)
Orbilia xanthoguttulata (1)

• Detarioideae
- Hymenaea sp.
Hyalorbilia citrina (3)

• Mimosoideae
- Acacia sp.
Hyalorbilia inflatula (1)
Hyalorbilia aff. *orbiliicola* (3)
Orbilia albidorosea (1)
Orbilia amberina (1)
Orbilia anguliobliqua (3)
Orbilia angustoobliqua (1)
Orbilia ?atriplicis (1)
Orbilia auricolor s.l. (1)
Orbilia australiensis (8)
Orbilia austroobtusispora (1)
Orbilia austroocculta (1)
Orbilia austroregalis (1)
Orbilia aviceps (1)
Orbilia aviflagellata (1)
Orbilia barrowensis (1)
Orbilia commarosa (6)
Orbilia corculispora (2)
Orbilia coronohesperidea (3)
Orbilia curvatimyriella (1)
Orbilia curvatiobliqua (1)
Orbilia eucalypti (5)
Orbilia helicoobliqua (2)
Orbilia helicovinosa (1)
Orbilia hesperidea (4/1)
Orbilia macrocarpa (2)
Orbilia aff. *macrocarpa* (1)
Orbilia macrotrapeziformis (1)
Orbilia maeandrina (1)
Orbilia microserpens (5)
Orbilia mirabilis (2/1)
Orbilia multigambelii (1)
Orbilia multiserpens (1/2)
Orbilia aff. *multitrapezoidea* (1)
Orbilia ?multivirgula (1)
Orbilia aff. *multivirgula* (1)
Orbilia myriella (3)
Orbilia myrioauris (2)
Orbilia myrioaustraliensis (3)
Orbilia myriofusiclava (6)
Orbilia myriofusoidea (1)
Orbilia myriohesperidea (1)
Orbilia myriolilacina (2)
Orbilia myriomuscula (5)
Orbilia myrionamibica (1/1)
Orbilia myrionanosoma (3)
Orbilia myrioobliqua (7)
Orbilia myriopseudoregalis (1)
Orbilia ?navajoana (1)
Orbilia nothoaprilis (1)
Orbilia nothovinosa (2/1)
Orbilia octocercocarpi (1)
Orbilia octoserpentina (1)
Orbilia paraobliqua (2)
Orbilia phanosoma (3)
Orbilia pleioaustraliensis (4)
Orbilia pleioaustrocylindrica (1)
Orbilia pleiocoronohesperidea (2)
Orbilia pleiocrescens (1)
Orbilia ?pleiohesperidea (1)
Orbilia pleioquaestiformis (1)
Orbilia pleioserpens (4/3)
Orbilia pleiostomachia (1)
Orbilia pleioungulata (3)
Orbilia pleistoobliqua (1)
Orbilia pluristomachia (2)
Orbilia ?pseudeuphorbiae (1)
Orbilia quaestiformis (1)
Orbilia ?saguarina (2)
Orbilia serpentina (1/1)
Orbilia wannerooensis (1)
- Acacia aneura
Orbilia australiensis (1)
Orbilia commarosa (1)
Orbilia euphorbiae (1)
Orbilia ?multiaustraliensis (1)
Orbilia ?multiserpens (1)
Orbilia phanosoma (1)
Orbilia pluristomachia (1)
Orbilia serpentina (1)
- Acacia cheelii
Orbilia austropleiomicrosoma (1)
- Acacia coriacea
Orbilia aff. *livistonae* (1)
Orbilia pleioungulata (1)
- Acacia cyperophylla
Orbilia allantoobliqua (1)
Orbilia australiensis (1)
Orbilia multiaustraliensis (1)
Orbilia pleioaustraliensis (1)
Orbilia aff. *pleiocoronohesperidea* (1)
Orbilia pleiovinosa (1)
Orbilia aff. *sarothamni* (8-sp.) (1)
- Acacia erioloba
Orbilia acaciae (1)
- Acacia estrophiolata
Hyalorbilia aff. *orbiliicola* (1)
Orbilia pleioaustraliensis (1)
- Acacia georginae
Orbilia acaciae (1)
Orbilia albidorosea (1)
- Acacia heterophylla
Orbilia ?aristata (1)
Orbilia eucalypti (1)
Orbilia vinosa (1)
- Acacia jennerae
Orbilia angustoaristata (1)
Orbilia austropleiomicrosoma (1)
Orbilia coronohesperidea (1)
Orbilia multiaustraliensis (1)
Orbilia multiserpens (1)
Orbilia myriella (1)
Orbilia myrionamibica (1)
Orbilia pleioaustraliensis (1)
Orbilia pleiocoronohesperidea (1)
- Acacia mollissima
Orbilia eucalypti (1)
- Acacia saligna
Orbilia auricolor s.l. (1)
Orbilia serpentina (1)
- Albizia julibrissin
Orbilia carpoboloides (1)
- Albizia lebbeck
Hyalorbilia ?juliae (1)
Orbilia blumenaviensis (1)
- Inga laurina
Hyalorbilia citrina (2)
- Prosopis velutina
Orbilia ?carpoboloides (1)
***- Vachellia* sp.**
Orbilia caudimaeandrina (1)
Orbilia corculispora (1)
Orbilia ?filiformis (1)
Orbilia maeandrina (1)
Orbilia myrioflexa (1)
Orbilia namibica (1)
Orbilia pluristomachia (1)
Retiarius ?revayae (1)
- Vachellia farnesiana
Hyalorbilia ?orbiliicola (1)
Orbilia corculispora (2)
Orbilia farnesianae (2)
Orbilia aff. *myriella* (1)
Orbilia octocercocarpi (1)
Orbilia pleioaustraliensis (1)

Faboideae

Dalbergieae
- Dalbergia szemaoensis
Hyalorbilia multiguttulata (1)
***- ?Pterocarpus* sp.**
Amphosoma natalense (1)
Retiarius ?revayae (1)
- Tipuana tipu
Orbilia corculispora (1)

Galegeae
- Astragalus lusitanicus
(= *Erophaca baetica*)
Orbilia eucalypti (1)
- Colutea arborescens
Orbilia carpoboloides (1)

Genisteae
- Adenocarpus foliolosus
Orbilia cejpii (1)
Orbilia dryadum (3)
- Adenocarpus viscosus
Orbilia adenocarpi (10)
Orbilia eucalypti (1)
Orbilia euonymi (1)
Orbilia gambelii (1)
Orbilia microsoma (1)
Orbilia pleiogambelii (1)
- Calicotome villosa
Orbilia aprilis (1)

Orbilia carpoboloides (1)
Orbilia gambelii (1)
Orbilia hesperidea (1)
Orbilia pleiogambelii (1)
Orbilia vinosa (1)
- *Chamaecytisus proliferus*
Orbilia aurantiorubra (1)
Orbilia corculispora (2)
Orbilia dryadum (1)
Orbilia gambelii (1)
Orbilia ?succulenticola (1)
Orbilia vinosa (1)
- *Cytisus* sp.
Orbilia ?flavidorosella (1)
- *Cytisus alpinus*
Orbilia euonymi (1)
- *Cytisus scoparius*
Hyalorbilia berberidis (1)
Hyalorbilia ?biguttulata (1)
Hyalorbilia erythrostigma (3)
Hyalorbilia inflatula (1)
Hyalorbilia ulicicola (2)
Orbilia aristata (1)
Orbilia aurantiorubra (14)
Orbilia breviaristata (2)
Orbilia carpoboloides (3)
Orbilia clavuliformis (1)
Orbilia corculispora (4)
Orbilia eucalypti (3)
Orbilia euonymi (1)
Orbilia flavida (1)
Orbilia flavidorosella (1)
Orbilia gambelii (1)
Orbilia ?obtusispora (1)
Orbilia pleiogambelii (1)
Orbilia polyspora (3)
Orbilia quaestiformis (3)
Orbilia sarothamni (1)
Orbilia subclavuliformis (6)
Orbilia subovoidea (1)
Orbilia subtrapeziformis (2)
Orbilia trapeziformis (1)
Orbilia vinosa (5)
Retiarius aff. *revayae* (1)
- *Cytisus supranubius*
Orbilia euonymi (1)
Orbilia flavidorosella (2)
Orbilia macrodelphinus (1)
Orbilia subtrapeziformis (1)
- *Erinacea anthyllis*
Orbilia sarothamni (1)
- *Genista florida*
Orbilia aurantiorubra (2)
Orbilia auricolor s.l. (1)
Orbilia xanthoguttulata (1)
- *Genista scorpius*
Orbilia euonymi (2)
Orbilia gambelii (2)
Orbilia microserpens (1)
Orbilia polyspora (1)
Orbilia subovoidea (1)
- *Laburnum alpinum*
Orbilia aristata (1)
Orbilia fabacearum (1)
Orbilia subtrapeziformis (1)
- *Laburnum anagyroides*
Orbilia aprilis (1)
Orbilia corculispora (1)
Orbilia microsoma (1)
Orbilia montigena (1)
Orbilia obtusispora (1)
Orbilia pleiomicrosoma (1)
- *Lupinus arboreus*
Orbilia aurantiorubra (2)
Orbilia auricolor s.l. (2)
Orbilia carpoboloides (1)
Orbilia fabacearum (1)
- *Lupinus polyphyllus*
Orbilia ?oxyspora (1)
- *Petteria ramentacea*
Orbilia gambelii (1)
Orbilia polyspora (1)
Orbilia subclavuliformis (1)
Orbilia subovoidea (1)
Orbilia ?ungulata (1)
Orbilia vinosa (1)
- *Spartium junceum*
Hyalorbilia ?hergiswiliana (1)
Hyalorbilia orbiliicola (1)
Orbilia aprilis (1)
Orbilia aurantiorubra (1)
Orbilia ?cejpii (1)
Orbilia corculispora (6)
Orbilia eucalypti (2)
Orbilia gambelii (1)
Orbilia hesperidea (1)
Orbilia pleiogambelii (2)
Orbilia pleiomicrosoma (1)
Orbilia polyspora (5)
Orbilia subaristata (1)
Orbilia ?tremulae (1)
Orbilia vinosa (6)
- *Ulex* sp.
Hyalorbilia juliae (1)
Orbilia microserpens (1)
Orbilia octocorculispora (1)
- *Ulex europaeus*
Hyalorbilia berberidis (7)
Hyalorbilia erythrostigma (1)
Hyalorbilia inflatula (5)
Hyalorbilia juliae (3)
Hyalorbilia rotifera (1)
Hyalorbilia subfusispora (2)
Hyalorbilia ulicicola (21)
Orbilia aprilis (3)
Orbilia aurantiorubra (3)
Orbilia auricolor s.l. (5)
Orbilia breviaristata (4)
Orbilia carpoboloides (2)
Orbilia caulicola (1)
Orbilia cejpii (2)
Orbilia clavuliformis (1)
Orbilia corculispora (24)
Orbilia cotoneastri (1)
Orbilia aff. *dryadum* (4)
Orbilia eucalypti (11)
Orbilia euonymi (1)
Orbilia fabacearum (3)
Orbilia gambelii (1)
Orbilia pleioeuonymi (1/1)
Orbilia rubrovacuolata (10)
Orbilia subclavuliformis (8)
Orbilia tremulae (1)
Orbilia vibrioides (3)
Orbilia vinosa (4)
Pseudorbilia bipolaris (1)
- *Ulex minor*
Orbilia aprilis (1)
Orbilia corculispora (1)
Orbilia xanthostigma (1)
- *Ulex parviflorus*
Hyalorbilia subfusispora (1)
Orbilia corculispora (1)
Orbilia gambelii (1)
Orbilia microserpens (1)
Orbilia montigena (2)
Orbilia ?pleioserpens (2)
Orbilia polyspora (1)
Orbilia serpentina (1)
Orbilia vinosa (1)

Millettieae
- *Wisteria* sp.
Orbilia comma (1)

Mirbelioids
- *Jacksonia* sp.
Orbilia albidorosea (1)
Orbilia australiensis (2)
Orbilia curvativitalbae (2)
Orbilia eucalypti (2)
Orbilia kingsiana (1)
Orbilia macrotrapeziformis (1)
Orbilia microserpens (1)
Orbilia myrioeuonymi (1)
Orbilia myriofusiclava (2)
Orbilia myrioobliqua (2)
Orbilia nothovinosa (1)

Ormosieae
- *Ormosia krugii*
Hyalorbilia citrina (2)

Robinieae
- *Olneya tesota*
Orbilia ?barrowensis (1)
Orbilia maeandrina (2)
Orbilia multicreosoteris (1)
Orbilia multigambelii (2)
Orbilia myrioolneyae (2)
Orbilia myriourosperma (2)
- *Robinia pseudoacacia*
Hyalorbilia erythrostigma (3)
Hyalorbilia fagi (2)
Hyalorbilia fusispora (1)
Hyalorbilia juliae (2)
Hyalorbilia subfusispora (1/1)
Hyalorbilia ulicicola (2)
Orbilia aprilis (10)
Orbilia aristata (1)
Orbilia bicknellensis (1)
Orbilia carpoboloides (1)
Orbilia ?cejpii (1)
Orbilia comma (1)
Orbilia cylindrosoma (1)
Orbilia euonymi (5)
Orbilia filiformis (1)
Orbilia montigena (2)
Orbilia pleioeuonymi (1)
Orbilia pleiomicrosoma (1)
Orbilia pleistoeuonymi (1)
Orbilia quaestiformis (2)
Orbilia subtrapeziformis (1)
Orbilia trapeziformis (1)
Orbilia vinosa (1)
Orbilia vitalbae (1)
Orbilia xanthostigma (1)
Retiarius aff. *bovicornutus* (1)

Sophoreae
- *Anagyris foetida*
Orbilia corculispora (1)
Orbilia gambelii (1)
Orbilia subclavuliformis (1)
- *Sophora microphylla*
Hyalorbilia erythrostigma (1)

Trifolieae
- *Melilotus* sp.
Orbilia carpoboloides (2)
Orbilia caulicola (2)
Orbilia flavida (4)
Orbilia flavidorosella (6)
Orbilia quaestiformis (7)
Orbilia subclavuliformis (1)
Orbilia ?vinosa (1)
- *Melilotus albus*
Orbilia caulicola (1)
Orbilia flavida (2)
Orbilia flavidorosella (1)
Orbilia quaestiformis (3)
Orbilia septispora (1)
- *Ononis spinosa*
Orbilia caulicola (1)
Orbilia ?oxyspora (1)

FAGALES
• *Betulaceae*
- *Alnus* sp.
Hyalorbilia ?erythrostigma (1 roots, mol. extr.)
Hyalorbilia inflatula (3)
Hyalorbilia japonica (3)
Hyalorbilia tortuosa (1)
Orbilia auricolor (1)
Orbilia ?brochopaga (1)
Orbilia canadensis (1)
Orbilia carpoboloides (1)
Orbilia dryadum (2)
Orbilia eucalypti (2)
Orbilia leucostigma (1)
Orbilia luteorubella (2)
Orbilia rosea (7)
Orbilia sarraziniana (3/2)
Orbilia tremulae (1/1)
Orbilia vinosa (1)
Orbilia xanthostigma (10)
- *Alnus alnobetula*
Hyalorbilia ?anonyma (1)
Hyalorbilia inflatula (1)
Hyalorbilia juliae (1)
Hyalorbilia polypori (1)
Orbilia aristata (4)
Orbilia eucalypti (2)
Orbilia flagellispora (5)
Orbilia leucostigma (2)
Orbilia rosea (2/2)
Orbilia subtrapeziformis (6)
Orbilia tremulae (5/1)
Orbilia vinosa (2)
- *Alnus alnobetula* subsp. *fruticosa*
Hyalorbilia ?fagi (1)
Orbilia tremulae (1)
- *Alnus cordata*
Orbilia xanthostigma (1)
- *Alnus glutinosa*
Hyalorbilia berberidis (1)
Hyalorbilia inflatula (5)
Hyalorbilia multiguttulata (1)
Hyalorbilia ulicicola (1)
Orbilia aprilis (3)
Orbilia auricolor s.l. (1)
Orbilia dryadum (2)
Orbilia eucalypti (2)
Orbilia leucostigma (1)
Orbilia luteorubella (1)
Orbilia nemaspora (1)
Orbilia orientalis (1)
Orbilia rosea (4/1)
Orbilia sarraziniana (8/4)
Orbilia vinosa (2)
Orbilia xanthostigma (6)
- *Alnus incana*
Hyalorbilia fagi (1)
Hyalorbilia juliae (1)
Hyalorbilia polypori (1)
Orbilia auricolor s.l. (1)
Orbilia rosea (1)
Orbilia ?tremulae (1)
Orbilia xanthostigma (5)
- *Betula* sp.
Hyalorbilia berberidis (2)
Hyalorbilia ?erythrostigma (1 roots, m.e)
Hyalorbilia fagi (1)
Hyalorbilia fomentarii (1)
Hyalorbilia fusispora (1)
Hyalorbilia inflatula (10)
Orbilia aprilis (1)

Orbilia canadensis (1)
Orbilia clavispora (3 [1× leaves])
Orbilia coccinella (1)
Orbilia crenatomarginata (2)
Orbilia dryadum (1)
Orbilia eucalypti (1)
Orbilia leucostigma (2)
Orbilia luteorubella (1/1)
Orbilia ovalis (1)
Orbilia rosea (1)
Orbilia sarraziniana (3)
Orbilia tremulae (2 [1× leaves])
Orbilia vinosa (3)
Orbilia xanthostigma (13)
- Betula fusca
Orbilia delphinus (1)
- Betula obscura
Orbilia epipora (1)
- Betula pendula
Hyalorbilia ?japonica (1)
Hyalorbilia subfusispora (1)
Lecophagus ellipsoideus (1)
Orbilia aristata (1)
Orbilia ?clavispora (1)
Orbilia eucalypti (1)
Orbilia luteorubella (1)
Orbilia nemaspora (1)
Orbilia rubrovacuolata (1)
Orbilia sarraziniana (1)
Orbilia vinosa (2)
Orbilia xanthostigma (5)
- Betula pubescens
Hyalorbilia fagi (1)
Hyalorbilia inflatula (2)
Hyalorbilia polypori (1)
Orbilia aprilis (1)
Orbilia arachnovinosa (4)
Orbilia eucalypti (2)
Orbilia leucostigma (1)
Orbilia rosea (2)
Orbilia subtrapeziformis (1)
Orbilia tremulae (1)
Orbilia vinosa (1)
Orbilia xanthostigma (4)
- Carpinus **sp.**
Hyalorbilia fagi (1)
Orbilia eucalypti (1)
Orbilia ?rosea (1)
Orbilia subaristata (1)
Orbilia xanthostigma (1)
- Carpinus betulus
Hyalorbilia inflatula (2)
Hyalorbilia juliae (2)
Hyalorbilia multiguttulata (1)
Hyalorbilia subfusispora (1)
Hyalorbilia tortuosa (1)
Orbilia aprilis (4)
Orbilia cejpii (1)
Orbilia crenatomarginata (8)
Orbilia eucalypti (1)
Orbilia epipora (1)
Orbilia dryadum (3)
Orbilia eucalypti (20)
Orbilia euonymi (2)
Orbilia filiformis (1)
Orbilia gambelii (1)
Orbilia leucostigma (5)
Orbilia montigena (1)
Orbilia ocellata (1)
Orbilia orientalis (1)
Orbilia phragmotricha (1)
Orbilia pleistoeuonymi (1)
Orbilia rosea (1/1)
Orbilia sarraziniana (5)
Orbilia subaristata (1)
Orbilia trapeziformis (3)
Orbilia tremulae (7/6)
Orbilia vinosa (8)
Orbilia ?vitalbae (1)
Orbilia xanthoguttulata (1)
Orbilia xanthostigma (10)
- Corylus **sp.**
Hyalorbilia berberidis (1)
Orbilia polybrocha (1)
Orbilia sarraziniana (1)
- Corylus avellana
Hyalorbilia berberidis (1)
Hyalorbilia erythrostigma (2)
Hyalorbilia fusispora (2)
Hyalorbilia helicospora (2)
Hyalorbilia ?hergiswiliana (1)
Hyalorbilia inflatula (6)
Hyalorbilia polypori (0/1)
Hyalorbilia subfusispora (2)
Orbilia angiosubvinosa (2)
Orbilia aprilis (10)
Orbilia auricolor s.l. (1)
Orbilia crenatomarginata (2)
Orbilia dryadum (1)
Orbilia eucalypti (18)
Orbilia filiformis (4)
Orbilia jacaensis (1)
Orbilia leucostigma (4)
Orbilia mali (1)
Orbilia montigena (1)
Orbilia obtusispora (1)
Orbilia orientalis (1)
Orbilia oxyspora (1)
Orbilia phragmotricha (1)
Orbilia polybrocha (1)
Orbilia rosea (2)
Orbilia rubrovacuolata (1)
Orbilia subsphaerospora (1)
Orbilia trapeziformis (3)
Orbilia tremulae (4)
Orbilia vibrioides (1)
Orbilia vinosa (15)
Orbilia xanthostigma (4)
- Corylus ?colurna
Hyalorbilia rotifera (1)
- Corylus cornuta
Hyalorbilia juliae (1)
Orbilia aristata (1)
Orbilia delphinus (1)
Orbilia eucalypti (1)
Orbilia euonymi (1)

Casuarinaceae
- Allocasuarina campestris
Orbilia microserpens (1)
Orbilia multiserpens (1)
Orbilia pleioserpens (1)
- Allocasuarina decaisneana
Orbilia macrotrapeziformis (1)
Orbilia multivinosa (1)
Orbilia phanosoma (1)
Orbilia pleiolentiformis (1)
Orbilia pleioobtusispora (1)
Orbilia pleiovitalbae (1)
Orbilia pluristomachia (1)
Orbilia serpentina (1)
- Casuarina cunninghamiana
Orbilia aff. *australiensis* (1)
Orbilia livistonae (1)
Orbilia multiserpens (1)
Orbilia ?saguarina (1)
Orbilia wannerooensis (1)

• Fagaceae
- Castanopsis **sp.**
Orbilia eucalypti (1)
- Castanopsis orthacantha
Orbilia hoana (1)
Orbilia latispora (1)
- Castanea sativa
Hyalorbilia inflatula (2)
Hyalorbilia tortuosa (1)
Orbilia aprilis (10)
Orbilia eucalypti (4)
Orbilia obtusispora (2)
Orbilia ?quercus-ilicis (1)
Orbilia rubrovacuolata (1)
Orbilia subcylindrospora (1)
Orbilia trapeziformis (1)
Orbilia ?tremulae (1)
Orbilia vinosa (4)
Orbilia xanthoguttulata (1)
Orbilia xanthostigma (1)
- Fagus **sp.**
Hyalorbilia ?fagi (1)
Orbilia laevimarginata (1)
Orbilia leucostigma (1)
Orbilia ?umbilicata (1)
Orbilia xanthostigma (1)
- Fagus crenata
Hyalorbilia japonica (1)
Orbilia sarraziniana (1)
- Fagus orientalis
Hyalorbilia inflatula (1)
Hyalorbilia polypori (1)
Orbilia aprilis (1)
- Fagus sylvatica
Arthrobotrys conoides (1)
Haptocara aff. *latirostrum* (1)
Hyalorbilia berberidis (1)
Hyalorbilia erythrostigma (1)
Hyalorbilia fagi (9)
Hyalorbilia helicospora (1)
Hyalorbilia ?hergiswiliana (1)
Hyalorbilia inflatula (27)
Hyalorbilia juliae (10)
Hyalorbilia latispora (1)
Hyalorbilia polypori (6)
Hyalorbilia rotifera (5)
Hyalorbilia subfusispora (10)
Hyalorbilia tortuosa (2)
Hyalorbilia ulicicola (1)
Lecophagus sp. (1)
Lecophagus vermicola (1)
Orbilia aprilis (8)
Orbilia arachnovinosa (3)
Orbilia aradi (18)
Orbilia aristata (14)
Orbilia auricolor s.l. (9/2)
Orbilia aff. *auricolor* (2)
Orbilia bembicodes (1)
Orbilia cejpii (5)
Orbilia ?clavispora (1)
Orbilia crenatomarginata (4)
Orbilia dryadum (8)
Orbilia epipora (8)
Orbilia eucalypti (14)
Orbilia euonymi (1)
Orbilia filiformis (2)
Orbilia ?fissilis (2)
Orbilia flavovacuolata (1)
Orbilia leucostigma (24)
Orbilia luteorubella (8/1)
Orbilia mammillata (2)
Orbilia montigena (1)
Orbilia ?obtusispora (1)
Orbilia ocellata (1)
Orbilia oligospora (1)
Orbilia orientalis (3)
Orbilia oxyspora (2)
Orbilia phragmotricha (1)
Orbilia pleioeuonymi (2)
Orbilia polybrocha (2)
Orbilia rosea (10)
Orbilia sarraziniana (24/2)
Orbilia sinensis (1/1)
Orbilia somedana (1)
Orbilia subsphaerospora (3)
Orbilia subtrapeziformis (1)
Orbilia trapeziformis (3)
Orbilia tremulae (4/3)
Orbilia vinosa (25)
Orbilia xanthoguttulata (3)
Orbilia xanthostigma (31)
- Fagus sylvatica **subsp.** ***moesiaca***
Hyalorbilia inflatula (1)
Orbilia vinosa (1)
- Quercus **sp.**
Hyalorbilia berberidis (2)
Hyalorbilia erythrostigma (5)
Hyalorbilia fusispora (1)
Hyalorbilia helicospora (11)
Hyalorbilia inflatula (14)
Hyalorbilia aff. *inflatula* (1)
Hyalorbilia japonica (1)
Hyalorbilia juliae (1/1)
Hyalorbilia lunata (1)
Hyalorbilia oreadum (1)
Hyalorbilia polypori (1)
Hyalorbilia subfusispora (4)
Hyalorbilia tortuosa (3)
Hyalorbilia ulicicola (1)
Orbilia aprilis (24)
Orbilia ?arachnovinosa (1)
Orbilia aurantiorubra (1)
Orbilia auricolor s.l. (3)
Orbilia ?cejpii (2)
Orbilia claviliformis (2)
Orbilia crenatomarginata (2)
Orbilia eucalypti (40)
Orbilia euonymi (2)
Orbilia fabacearum (1)
Orbilia fissilis (1)
Orbilia ?frangulae (1)
Orbilia georgiana (2)
Orbilia laevimarginata (3/1)
Orbilia leucostigma (12)
Orbilia luteorubella (1)
Orbilia aff. *mammillata* (1 leaves)
Orbilia montigena (1)
Orbilia obtusispora (10)
Orbilia ocellata (2)
Orbilia orientalis (1)
Orbilia pleistoeuonymi (3)
Orbilia quercus (1)
Orbilia renispora (4)
Orbilia rosea (1/1)
Orbilia rubrovacuolata (1/1)
Orbilia sarraziniana (5/1)
Orbilia scolecospora (1)
Orbilia subaristata (1)
Orbilia ?subdelphinus (1)
Orbilia tenuispora (1)
Orbilia tianmushanensis (1)
Orbilia trapeziformis (7)
Orbilia tremulae (5/3)
Orbilia vinosa (35)
Orbilia vitalbae (1)
Orbilia ?xanthoflexa (1)
Orbilia xanthoguttulata (7)
Orbilia xanthostigma (30)
Orbilia yuanensis (1)
Orbilia yunnanensis (1)
- Quercus agrifolia
Orbilia eucalypti (1)
- Quercus alba
Orbilia xanthostigma (1)
- Quercus aucheri
Orbilia bicknellensis (1)
- Quercus cerris

Hyalorbilia fagi (1)
Hyalorbilia inflatula (1)
Orbilia aprilis (1)
Orbilia ?*cejpii* (1)
Orbilia eucalypti (2)
Orbilia trapeziformis (2)
Orbilia xanthostigma (1)
- *Quercus coccifera*
Orbilia gambelii (4)
Orbilia hesperidea (1)
Orbilia myriosphaera (1)
Orbilia ?*obtusispora* (1)
Orbilia pleiogambelii (1)
Orbilia subaristata (1)
- *Quercus deserticola*
Orbilia ?*filiformis* (1 mol. extr.)
- *Quercus gambelii*
Orbilia curvatitrapeziformis (1)
Orbilia delphinus (2)
Orbilia flexisoma (2)
Orbilia gambelii (3)
Orbilia multiphanosoma (1)
Orbilia myriophanosoma (2)
Orbilia ocellata (1)
Orbilia sedonensis (1)
- *Quercus ilex*
Hyalorbilia inflatula (3)
Hyalorbilia juliae (1)
Orbilia eucalypti (4)
Orbilia foliicola (1 leaves)
Orbilia gambelii (2)
Orbilia hesperidea (1)
Orbilia myriosphaera (1)
Orbilia obtusispora (2)
Orbilia orientalis (1)
Orbilia pleiomicrosoma (1)
Orbilia polyspora (2)
Orbilia quercus-ilicis (1 leaves)
Orbilia subaristata (2)
Orbilia subclavuliformis (4)
Orbilia subovoidea (2)
Orbilia subsphaerospora (1)
Orbilia trapeziformis (1)
Orbilia vibrioides (1)
Orbilia vinosa (7)
- *Quercus michauxii*
Orbilia bembicodes (1 leaves & fruits)
- *Quercus mongolica*
Orbilia cejpii (1)
- *Quercus myrsinifolia*
Orbilia fissilis (1 leaves)
- *Quercus petraea*
Orbilia aprilis (2)
Orbilia crenatomarginata (1)
Orbilia eucalypti (2)
Orbilia montigena (1)
Orbilia rosea (1)
Orbilia vinosa (4)
Orbilia xanthoguttulata (1)
- *Quercus pubescens*
Hyalorbilia fusispora (2)
Orbilia aprilis (1)
Orbilia beatricis (1)
Orbilia eucalypti (2)
Orbilia hesperidea (1)
Orbilia pleistoeuonymi (1)
Orbilia subsphaerospora (1)
Orbilia trapeziformis (3)
Orbilia ungulata (1)
Orbilia vinosa (1)
- *Quercus pyrenaica*
Orbilia eucalypti (1)
Orbilia subaristata (1)
Orbilia vinosa (1)
Orbilia xanthostigma (1)
- *Quercus robur*
Hyalorbilia berberidis (1)
Hyalorbilia inflatula (2/1)
Orbilia alba (1)
Orbilia aprilis (26)
Orbilia auricolor s.l. (1)
Orbilia ?*cotoneastri* (1)
Orbilia crenatomarginata (1)
Orbilia ?*cylindrospora* (1)
Orbilia eucalypti (14)
Orbilia euonymi (1)
Orbilia lentiformis (1)
Orbilia montigena (1)
Orbilia obtusispora (5)
Orbilia octoserpentina (1)
Orbilia orientalis (1)
Orbilia pleistoeuonymi (4)
Orbilia quaestiformis (1)
Orbilia rubrovacuolata (3)
Orbilia subsphaerospora (1)
Orbilia trapeziformis (4)
Orbilia tremulae (1/2)
Orbilia vinosa (21)
Orbilia xanthoguttulata (1)
Orbilia xanthostigma (4)
- *Quercus rotundifolia*
Hyalorbilia erythrostigma (1)
Orbilia eucalypti (1)
Orbilia filiformis (1)
Orbilia foliicola (1 leaves)
Orbilia gambelii (2)
Orbilia microserpens (2)
Orbilia ocellata (1)
Orbilia pleiomicrosoma (1)
Orbilia polyspora (2)
Orbilia quercus-ilicis (1 leaves)
Orbilia subaristata (1)
Orbilia ?*subocellata* (1)
Orbilia subovoidea (2)
Orbilia subsphaerospora (1)
Orbilia vinosa (5)
Orbilia xanthostigma (1)
- *Quercus rubra*
Hyalorbilia erythrostigma (1)
Hyalorbilia subfusispora (1)
Orbilia aprilis (1)
Orbilia aristata (2)
Orbilia eucalypti (1)
Orbilia euonymi (1)
Orbilia vinosa (1)
- *Quercus suber*
Orbilia subclavuliformis (1)
Orbilia suberis (1)
Orbilia trapeziformis (1)
Orbilia vinosa (1)
- *Quercus virginiana*
Orbilia ?*aprilis* (1)

Juglandaceae
- *Carya* sp.
Orbilia ?*eremaeae* (1)
- *Juglans major*
Orbilia ocellata (1)
Orbilia serpentina (1)
Orbilia ?*sonorensis* (1)
- *Juglans nigra*
Orbilia trapeziformis (1)
- *Juglans regia*
Hyalorbilia inflatula (1)
Hyalorbilia juliae (1)
Orbilia aprilis (1)
Orbilia ?*cejpii* (1)
Orbilia ?*cisti* (1)
Orbilia cylindrosoma (1)
Orbilia eucalypti (2)
Orbilia euonymi (1)
Orbilia ficicola (2/2)
Orbilia filiformis (2)
Orbilia gambelii (2)
Orbilia milinana (1)
Orbilia ovoidea (2)
Orbilia septispora (1)
Orbilia trapeziformis (10)
Orbilia ungulata (1)
Orbilia vitalbae (1)

• **Myricaceae**
- *Myrica faya*
Hyalorbilia lunata (2)
Hyalorbilia polypori (1)
Hyalorbilia tortuosa (2)
Orbilia dryadum (1)
Orbilia xanthostigma (8)

• **Nothofagaceae**
- *Nothofagus* sp.
Orbilia xanthostigma (3)
- *Nothofagus cunninghamii*
Orbilia xanthostigma (1)
- *Nothofagus fusca*
Orbilia ?*xanthostigma* (1)

MALPIGHIALES
• **Achariaceae**
- *Xylotheca kraussiana*
Orbilia auricolor s.l. (1 fruits)
Orbilia tenuissima (1 fruits)

• **Euphorbiaceae**
- *Euphorbia* sp.
Orbilia eucalypti (2)
Orbilia euphorbiae (1)
Orbilia ?*menageshae* (1)
- *Euphorbia atropurpurea*
Orbilia pisciformis (1)
Orbilia pleiomicrosoma (1)
Orbilia succulenticola (1)
- *Euphorbia balsamifera*
Orbilia ?*bicknellensis* (1)
Orbilia clavuliaristata (1)
Orbilia curvatitrapeziformis (1)
Orbilia eucalypti (1)
Orbilia obtusispora (1)
Orbilia pisciformis (1)
Orbilia pleioungulata (2)
Orbilia pseudeuphorbiae (14)
Orbilia succulenticola (2)
- *Euphorbia berthelotii*
Orbilia eucalypti (1)
- *Euphorbia canariensis*
Orbilia acaciae (5)
Orbilia amarilla (1)
Orbilia asomatica (6)
Orbilia beltraniae (8)
Orbilia milinana (1)
Orbilia obtusispora (1)
Orbilia pisciformis (10)
Orbilia pseudeuphorbiae (8)
Orbilia scolecospora (4)
Orbilia succulenticola (5)
- *Euphorbia characias*
Orbilia aurantiorubra (1)
Orbilia breviaristata (1)
Orbilia eucalypti (2)
- *Euphorbia cyparissias*
Orbilia cylindrosoma (1)
Orbilia cyparissias (1)
- *Euphorbia lamarckii*
Orbilia asomatica (1)
Orbilia ?*bicknellensis* (1)
Orbilia pisciformis (1)
Orbilia pleiomicrosoma (1)
Orbilia pseudeuphorbiae (1)
Orbilia succulenticola (2)
- *Euphorbia palustris*
Orbilia eucalypti (1)
- *Euphorbia polyacantha*
Orbilia euphorbiae (1)
- *Euphorbia wulfenii*
Orbilia flavida (1)
- *Hevea brasiliensis*
Orbilia dorsalis (1)

• **Passifloraceae**
- *Passiflora caerulea*
Orbilia carpoboloides (1)
Orbilia gambelii (3)

• **Salicaceae**
- *Populus* sp.
Hyalorbilia fagi (1)
Hyalorbilia inflatula (4)
Hyalorbilia juliae (1)
Hyalorbilia multiguttulata (1)
Hyalorbilia polypori (1)
Orbilia auricolor s.l. (4/1)
Orbilia clavuliformis (1)
Orbilia crenatomarginata (3)
Orbilia dryadum (1)
Orbilia epipora (6)
Orbilia eucalypti (2)
Orbilia ficicola (2)
Orbilia luteorubella (1)
Orbilia mammillata (1)
Orbilia obtusispora (3)
Orbilia phragmotricha (1)
Orbilia pilosa (1)
Orbilia ?*rosea* (1)
Orbilia sarraziniana (2)
Orbilia sinensis (1)
Orbilia xanthoguttulata (2)
Orbilia xanthostigma (7)
- *Populus alba*
Hyalorbilia inflatula (1)
Orbilia canadensis (1)
Orbilia crenatomarginata (1)
Orbilia ficicola (2)
Orbilia ?*fraxini* (1)
Orbilia montigena (1)
Orbilia siculispora (1)
- *Populus* ?*balsamifera*
Lecophagus vermicola (1)
- *Populus* × *canadensis*
Hyalorbilia inflatula (1)
Hyalorbilia juliae (1)
Orbilia bicknellensis (1)
Orbilia filiformis (1)
Orbilia gambelii (1)
Orbilia siculispora (2)
Orbilia trapeziformis (1)
- *Populus nigra*
Orbilia crenatofalcata (2)
Orbilia crenatomarginata (1)
Orbilia eucalypti (2)
Orbilia orientalis (3)
Orbilia phragmotricha (2)
Orbilia vinosa (1)
Orbilia xanthostigma (1)
- *Populus nigra* ‘*italica*’
Hyalorbilia ?*ulicicola* (1)
- *Populus tremula*
Hyalorbilia ?*hergiswiliana* (1)
Hyalorbilia inflatula (1)
Hyalorbilia juliae (2)
Hyalorbilia subfusispora (1)
Orbilia aprilis (1)
Orbilia ?*aristata* (1)
Orbilia auricolor s.l. (3)
Orbilia crenatomarginata (1)
Orbilia epipora (1)
Orbilia eucalypti (7)

Orbilia filiformis (2)
Orbilia ?fraxini (1)
Orbilia leucostigma (1)
Orbilia montigena (1)
Orbilia ?obtusispora (1)
Orbilia orientalis (1)
Orbilia phragmotricha (2)
Orbilia plurivacuolata (1)
Orbilia quaestiformis (1)
Orbilia rosea (1)
Orbilia ?rubrovacuolata (1)
Orbilia subsphaerospora (1)
Orbilia subtrapeziformis (1)
Orbilia vinosa (6)
Orbilia xanthoguttulata (4)
Orbilia xanthostigma (1)
Orbilia zhongdianensis (1)
- *Populus tremuloides*
Orbilia crenatomarginata (1)
Orbilia delphinus (5)
Orbilia gambelii (2)
Orbilia maeandrina (3)
Orbilia microsoma (1)
Orbilia multimaeandrina (1)
Orbilia navajoana (1)
Orbilia ?ophiosoma (1)
Orbilia pleiolentiformis (1)
Orbilia spathulata (1)
Orbilia tremuloidis (1)
- *Populus trichocarpa*
Orbilia brettii (1)
- *Salix* sp.
Hyalorbilia berberidis (1)
Hyalorbilia erythrostigma (2)
Hyalorbilia fusispora (9)
Hyalorbilia inflatula (9)
Hyalorbilia juliae (7)
Hyalorbilia lunata (1)
Hyalorbilia orbiliicola (8)
Hyalorbilia polypori (1)
Hyalorbilia rotifera (1)
Hyalorbilia subfusispora (1)
Hyalorbilia orbiliicola (4)
Hyalorbilia erythrostigma (1)
Hyalorbilia subfusispora (7)
Hyalorbilia tortuosa (1)
Lecophagus ellipsoideus (1)
Lecophagus vermicola (2)
Orbilia angiosubvinosa (2)
Orbilia aprilis (8)
Orbilia arachnovinosa (1)
Orbilia aristata (23)
Orbilia aurantiorubra (33)
Orbilia auricolor s.l. (3/1)
Orbilia cardui (1)
Orbilia carpoboloides (8)
Orbilia cejpii (3)
Orbilia clavuliformis (2)
Orbilia crenatomarginata (8)
Orbilia delphinus (4)
Orbilia dryadum (1)
Orbilia epipora (8)
Orbilia eucalypti (27)
Orbilia euonymi (2)
Orbilia fabacearum (1)
Orbilia filiformis (2)
Orbilia flagellispora (1)
Orbilia flavida (3)
Orbilia ?frangulae (1)
Orbilia gambelii (2)
Orbilia latispora (1)
Orbilia lentiformis (2)
Orbilia leucostigma (3)
Orbilia luteorubella (6/4)
Orbilia maeandrina (1)
Orbilia mali (1)
Orbilia nemaspora (1)
Orbilia ocellata (2)
Orbilia orientalis (2)
Orbilia phanosoma (1)
Orbilia phragmotricha (21)
Orbilia pleiolentiformis (1)
Orbilia plurivacuolata (2)
Orbilia pseudoaristata (1)
Orbilia pseudocylindrospora (1)
Orbilia quaestiformis (5)
Orbilia rosea (5/2)
Orbilia rubrovacuolata (11)
Orbilia sarraziniana (27/8)
Orbilia subaristata (2)
Orbilia subclavuliformis (1)
Orbilia subovoidea (1)
Orbilia subsphaerospora (2)
Orbilia subtrapeziformis (2)
Orbilia tremulae (3/3)
Orbilia vibrioides (1)
Orbilia vinosa (18)
Orbilia xanthoguttulata (10)
Orbilia xanthostigma (9)
- *Salix alba*
Hyalorbilia orbiliicola (1)
Hyalorbilia subfusispora (1)
Orbilia aristata (1)
Orbilia aurantiorubra (3)
Orbilia auricolor s.l. (1)
Orbilia clavuliformis (1)
Orbilia eucalypti (1)
Orbilia euonymi (1)
Orbilia fabacearum (1)
Orbilia gambelii (1)
Orbilia ?leucostigma (1)
Orbilia obtusispora (1)
Orbilia pseudoaristata (1)
Orbilia quaestiformis (1)
Orbilia rubrovacuolata (1)
Orbilia sarraziniana (1)
Orbilia trapeziformis (1)
Orbilia vinosa (1)
Orbilia vitalbae (1)
Orbilia xanthoguttulata (1)
- *Salix atrocinerea*
Hyalorbilia inflatula (1)
Orbilia eucalypti (1)
Orbilia rosea (1)
Orbilia rubrovacuolata (2)
Orbilia sarraziniana (1)
Orbilia vinosa (1)
Orbilia xanthoguttulata (1)
- *Salix aurita*
Hyalorbilia fusispora (1)
Orbilia arachnovinosa (1)
Orbilia aristata (2)
Orbilia aurantiorubra (1)
Orbilia epipora (1)
Orbilia flagellispora (1)
Orbilia plurivacuolata (1)
- *Salix aurita* × *cinerea*
Hyalorbilia juliae (1)
Orbilia aprilis (1)
- *Salix aurita* × *caprea*
Hyalorbilia orbiliicola (1)
Orbilia aristata (1)
Orbilia aurantiorubra (2)
Orbilia auricolor s.l. (1)
Orbilia eucalypti (2)
Orbilia filiformis (1)
Orbilia phragmotricha (2)
Orbilia subclavuliformis (1)
Orbilia ?tremulae (2)
Orbilia xanthoguttulata (1)
- *Salix babylonica*
Orbilia ?hesperidea (1)
Orbilia pseudoaristata (1)
- *Salix bebbiana*
Orbilia delphinus (1)
Orbilia dixiensis (1)
Orbilia euonymi (1)
Orbilia gambelii (1)
Orbilia ?macrodelphinus (1)
Orbilia multiphanosoma (1)
Orbilia navajoana (1)
Orbilia subtrapeziformis (1)
- *Salix breviserrata*
Orbilia xanthoguttulata (1)
- *Salix cantabrica*
Orbilia asturiensis (1)
Orbilia phragmotricha (2)
Orbilia subtrapeziformis (1)
- *Salix caprea*
Hyalorbilia ?hergiswiliana (1)
Hyalorbilia juliae (2)
Hyalorbilia orbiliicola (6)
Hyalorbilia rotifera (1)
Hyalorbilia subfusispora (13)
Orbilia angiosubvinosa (2)
Orbilia aprilis (7)
Orbilia arachnovinosa (1)
Orbilia aristata (12/1)
Orbilia asturiensis (1)
Orbilia aurantiorubra (21)
Orbilia auricolor s.l. (1)
Orbilia caulicola (1)
Orbilia clavuliformis (3)
Orbilia crenatomarginata (1)
Orbilia dryadum (2)
Orbilia eucalypti (12)
Orbilia euonymi (3)
Orbilia filiformis (4)
Orbilia flagellispora (2)
Orbilia flavida (1)
Orbilia flavidorosella (1)
Orbilia leucostigma (1)
Orbilia luteorubella (2)
Orbilia ocellata (1)
Orbilia phragmotricha (8)
Orbilia plurivacuolata (3)
Orbilia quaestiformis (1)
Orbilia rubella (4)
Orbilia sarraziniana (4)
Orbilia subaristata (1)
Orbilia subtrapeziformis (1)
Orbilia trapeziformis (4)
Orbilia tremulae (1/5)
Orbilia vinosa (14)
Orbilia vitalbae (4)
Orbilia xanthoguttulata (7)
Orbilia xanthostigma (1)
Retiarius bovicornutus (1/1)
- *Salix caprea* × *cinerea*
Hyalorbilia erythrostigma (1)
- *Salix cinerea*
Hyalorbilia erythrostigma (1)
Hyalorbilia orbiliicola (7)
Hyalorbilia rotifera (1)
Hyalorbilia subfusispora (3)
Lecophagus ellipsoideus (1)
Orbilia aprilis (4)
Orbilia ?arachnovinosa (1)
Orbilia aristata (2)
Orbilia aurantiorubra (9)
Orbilia clavuliformis (1)
Orbilia eucalypti (11)
Orbilia flagellispora (1)
Orbilia leucostigma (1)
Orbilia phragmotricha (4)
Orbilia sarraziniana (4)
Orbilia vinosa (5)
- *Salix eleagnos*
Orbilia aristata (1)
Orbilia clavuliformis (1)
- *Salix eleagnos* var. *angustifolia*
Orbilia ovoidea (1)
Orbilia polyspora (1)
- *Salix appendiculata*
Hyalorbilia ?hergiswiliana (1)
Orbilia arachnovinosa (2)
Orbilia filiformis (1)
Orbilia flagellispora (1)
Orbilia phragmotricha (1)
- *Salix exigua*
Orbilia bicknellensis (1)
Orbilia aff. *lacrimispora* (1)
- *Salix fragilis*
Orbilia aprilis (1)
Orbilia aristata (1)
Orbilia epipora (1)
Orbilia eucalypti (1)
Orbilia ?luteorubella (1)
Orbilia sarraziniana (1)
Orbilia ?xanthostigma (1)
- *Salix glauca*
Orbilia canadensis (1)
Orbilia eucalypti (1)
Orbilia flagellispora (1)
- *Salix herbacea*
Orbilia subtrapeziformis (1)
- *Salix myrsinifolia*
Orbilia eucalypti (1)
- *Salix phylicifolia*
Orbilia aristata (1)
Orbilia eucalypti (1)
Orbilia phragmotricha (1)
- *Salix purpurea*
Orbilia eucalypti (1)
- *Salix rhamnifolia*
Orbilia aristata (1)
Orbilia lentiformis (1)
- *Salix rosmarinifolia*
Orbilia aurantiorubra (1)
- *Salix viminalis*
Hyalorbilia juliae (1)
Hyalorbilia orbiliicola (1)
Orbilia eucalypti (2)
Orbilia polyspora (1)
Orbilia vitalbae (1)
- *Salix alba* var. *vitellina* f. *tristis*
Orbilia aristata (1)

ROSALES
Urticalean Rosids
• Cannabaceae
- *Humulus lupulus*
Orbilia aristata (2)
Orbilia auricolor s.l. (1)
Orbilia trapeziformis (1)

• Moraceae
- *Broussonetia* sp.
Orbilia bannaensis (1)
- *Broussonetia papyrifera*
Orbilia comma (1)
- *Ficus benjamini*
Orbilia floridensis (1)
Orbilia neocomma (1)
- *Ficus carica*
Hyalorbilia erythrostigma (1)
Hyalorbilia fusispora (1)
Orbilia albovinosa (1)
Orbilia caulicola (1)
Orbilia comma (2)
Orbilia cylindrosoma (1)
Orbilia ficicola (6)
Orbilia flavida (1)
Orbilia gambelii (2)
Orbilia obtusispora (1)

Orbilia pleiolentiformis (1)
Orbilia rhamni (2)
Orbilia ungulata (1)
Orbilia vinosa (1)
Orbilia vitalbae (2)
- Ficus irregularis
Orbilia blumenaviensis (1)
- Maclura aurantiaca
Orbilia carpoboloides (1)
- Maclura pomifera
Orbilia carpoboloides (1)
- Morus **sp.**
Orbilia carpoboloides (1)
- Morus nigra
Orbilia comma (1)
- Morus rubra
Orbilia carpoboloides (1)

• Ulmaceae
- *Ulmus* sp.
Hyalorbilia fagi (1)
Hyalorbilia fusispora (4)
Hyalorbilia juliae (5)
Hyalorbilia multiguttulata (1)
Lecophagus subglobosus (1)
Orbilia aprilis (3)
Orbilia aristata (1)
Orbilia aurantiorubra (20)
Orbilia auricolor s.l. (4)
Orbilia carpoboloides (29)
Orbilia ?clavispora (1)
Orbilia comma (41)
Orbilia crenatomarginata (2)
Orbilia epipora (1)
Orbilia eucalypti (1)
Orbilia fabacearum (1)
Orbilia maeandrina (1)
Orbilia mammillata (1)
Orbilia nemaspora (1)
Orbilia ovoidea (1)
Orbilia paravitalbae (1)
Orbilia phragmotricha (1)
Orbilia pilifera (17)
Orbilia rosea (1)
Orbilia rubella (2)
Orbilia sarraziniana (4/1)
Orbilia sinensis (2)
Orbilia subtrapeziformis (1)
Orbilia vinosa (1)
Orbilia xanthoguttulata (6)
Orbilia xanthostigma (3)
Orbilia xinjiangensis (1)
- Ulmus americana
Orbilia carpoboloides (3)
- Ulmus glabra
Orbilia auricolor s.l. (1)
Orbilia carpoboloides (1)
Orbilia ?clavispora (1)
Orbilia comma (18)
Orbilia eucalypti (2)
Orbilia ?frangulae (1)
Orbilia leucostigma (1)
Orbilia pseudoaristata (1)
Orbilia rubella (7)
Orbilia vinosa (1)
Orbilia xanthoguttulata (2)
Orbilia xanthostigma (1)
- Ulmus laevis
Hyalorbilia juliae (2)
Hyalorbilia subfusispora (1)
Orbilia aurantiorubra (5)
Orbilia carpoboloides (4)
Orbilia ficicola (2)
Orbilia phragmotricha (1)
Orbilia pilifera (3)
Orbilia siculispora (4)
- Ulmus minor
Hyalorbilia erythrostigma (1)
Hyalorbilia inflatula (2)
Hyalorbilia juliae (1)
Hyalorbilia ulmi (1)
Lecophagus subglobosus (1)
Orbilia arachnovinosa (1 mol. extr.)
Orbilia aristata (1)
Orbilia aurantiorubra (5)
Orbilia auricolor s.l. (2)
Orbilia carpoboloides (7)
Orbilia cercidicola (2)
Orbilia comma (13)
Orbilia eucalypti (1)
Orbilia gambelii (1)
Orbilia ?milinana (1)
Orbilia pilifera (17)
Orbilia pseudoaristata (1 mol. extr.)
Orbilia quaestiformis (1)
Orbilia ?sarraziniana (1)
- Ulmus pumila
Orbilia cercidicola (1)
- Zelkova serrata
Orbilia eucalypti (1)

• Urticaceae
- *Cecropia* sp.
Orbilia tenuissima (2 leaves)
- Urtica dioica
Orbilia ?phragmotricha (1)
Orbilia cylindrosoma (2)
Orbilia flavida (1)
Orbilia oxyspora (2)

• Rosaceae
- indet. woody *Rosaceae*
Hyalorbilia erythrostigma (1)
Orbilia aprilis (1)
Orbilia cejpii (1)
Orbilia sarraziniana (1)

Amygdaloideae
Amygdaleae
- *Prunus* sp.
Hyalorbilia juliae (1)
Orbilia aprilis (1)
Orbilia lentiformis (1)
Orbilia ovalis (1)
Orbilia subtrapeziformis (1)
- Prunus avium
Hyalorbilia inflatula (1)
Hyalorbilia fusispora (1)
Hyalorbilia subfusispora (1)
Orbilia aprilis (4)
Orbilia crenatomarginata (1)
Orbilia orientalis (1)
Orbilia trapeziformis (2)
Orbilia tremulae (1)
Orbilia xanthoguttulata (1)
- Prunus cerasus
Orbilia crenatomarginata (1)
- Prunus domestica
Hyalorbilia juliae (1)
Hyalorbilia subfusispora (1)
Orbilia aprilis (1)
Orbilia aristata (1)
Orbilia delphinus (1)
Orbilia gambelii (1)
Orbilia ovalis (1)
Orbilia ovoidea (1)
Orbilia pleiogambelii (1)
Orbilia subtrapeziformis (1)
Orbilia vinosa (2)
- Prunus dulcis
Orbilia carpoboloides (1)
Orbilia flavidorosella (1)
Orbilia obtusispora (1)
- Prunus lusitanica
Hyalorbilia ?erythrostigma (1)
Orbilia xanthostigma (1)
- Prunus lusitanica **subsp.** ***hixa***
Hyalorbilia erythrostigma (1)
Hyalorbilia polypori (2)
Orbilia xanthostigma (5)
- Prunus mahaleb
Orbilia frullaniae (1)
Orbilia trapeziformis (1)
- Prunus padus
Orbilia aristata (1)
Orbilia aurantiorubra (1)
Orbilia carpoboloides (1)
Orbilia luteorubella (1)
Orbilia pseudoaristata (1)
Orbilia vinosa (1)
Orbilia xanthostigma (2)
- Prunus persica
Hyalorbilia arcuata (1)
Hyalorbilia oviparasitica (1 roots)
- Prunus serotina
Hyalorbilia fusispora (1)
Hyalorbilia inflatula (1)
- Prunus spinosa
Hyalorbilia berberidis (1)
Hyalorbilia erythrostigma (2)
Hyalorbilia fusispora (1)
Hyalorbilia inflatula (3)
Hyalorbilia juliae (3)
Hyalorbilia subfusispora (4)
Orbilia aprilis (3)
Orbilia aristata (6)
Orbilia eucalypti (2)
Orbilia filiformis (1)
Orbilia obtusispora (1)
Orbilia ?rosea (1)
Orbilia trapeziformis (1)
Orbilia tremulae (2)
Orbilia vinosa (6)
- Prunus virginiana
Orbilia delphinus (1)
Orbilia maeandrina (1)

Kerrieae
- Coleogyne ramosissima
Orbilia ?barrowensis (1)
Orbilia bicknellensis (1)
Orbilia cercocarpi (1)
Orbilia multimaeandrina (1)
Orbilia ocellata (1)

Maleae
- Aronia melanocarpa
Orbilia aristata (1)
- Amelanchier alnifolia
Orbilia delphinus (1)
Orbilia idahoensis (1)
Orbilia maeandrina (1)
- Amelanchier lamarckii
Orbilia aristata (2)
Orbilia vinosa (1)
- Amelanchier ovalis
Orbilia ovalis (2)
Orbilia pleioalbidorosea (1)
- Amelanchier utahensis
Orbilia ?commarosa (2)
Orbilia delphinus (2)
Orbilia lentiformis (1)
Orbilia maeandrina (2)
Orbilia microsoma (1)
Orbilia multimaeandrina (1)
Orbilia multitrapezoidea (1)
Orbilia ocellata (1)
Orbilia ?pleioalbidorosea (1)
- *Cotoneaster* sp.
Orbilia tremulae (2)
- Cotoneaster integerrima
Orbilia cotoneastri (1)
- *Crataegus* sp.
Orbilia aprilis (1)
Orbilia aristata (1)
Orbilia cejpii (1)
Orbilia eucalypti (1)
Orbilia euonymi (1)
Orbilia flagellispora (2)
Orbilia xanthoguttulata (1)
- Crataegus laevigata
Hyalorbilia juliae (1)
Orbilia aprilis (2)
- Crataegus monogyna
Hyalorbilia erythrostigma (1)
Orbilia aprilis (2)
Orbilia subaristata (2)
Orbilia vinosa (2)
Orbilia vitalbae (1)
- Cydonia oblonga
Hyalorbilia subfusispora (1)
- Eryobotrya japonica
Retiarius superficiaris (1 leaves)
- Malus domestica
Hyalorbilia fusarioiodes (1 leaves)
Hyalorbilia fusispora (1)
Hyalorbilia inflatula (2)
Hyalorbilia juliae (2)
Hyalorbilia subfusispora (3)
Hyalorbilia ulicicola (3)
Orbilia aprilis (1)
Orbilia aristata (6)
Orbilia carpoboloides (1)
Orbilia clavuliformis (3)
Orbilia cylindrosoma (1)
Orbilia eucalypti (7)
Orbilia filiformis (1)
Orbilia mali (3)
Orbilia milinana (1)
Orbilia occulta (2)
Orbilia ocellata (1)
Orbilia pseudoaristata (1)
Orbilia regalis (1)
Orbilia rehmii (1)
Orbilia trapeziformis (2)
Orbilia ?tremulae (1)
Orbilia vinosa (6)
Orbilia xanthostigma (2)
Orbilia zhongdianensis (1)
- Malus pumila
Orbilia ?delphinus (1)
- Malus sylvestris
Orbilia mali (1)
- Malus **×** ***scheideckeri***
Orbilia vibrioides (1)
- Pyrus caucasica
Orbilia subtrapeziformis (1)
- Pyrus communis
Hyalorbilia inflatula (1)
Hyalorbilia juliae (1)
Orbilia aprilis (1)
Orbilia aristata (1)
Orbilia ocellata (1)
Orbilia ovoidea (1)
Orbilia vinosa (2)
- Pyrus pyraster
Orbilia auricolor s.l. (1)
- Pyrus spinosa
Orbilia subaristata (2)
- *Sorbus* sp.
Orbilia aristata (1)
Orbilia ocellata (1)
Orbilia tremulae (1)
Orbilia vinosa (1)
- Sorbus aria
Hyalorbilia inflatula (2)

Orbilia aristata (1)
Orbilia eucalypti (1)
Orbilia filiformis (1)
Orbilia polyspora (1)
Orbilia xanthostigma (2)
- Sorbus aucuparia
Hyalorbilia helicospora (2)
Hyalorbilia inflatula (4)
Lecophagus vermicola (1)
Orbilia aprilis (3)
Orbilia arachnovinosa (3)
Orbilia aristata (3)
Orbilia auricolor s.l. (2)
Orbilia cejpii (3)
Orbilia eucalypti (6)
Orbilia montigena (1)
Orbilia phragmotricha (1)
Orbilia pseudoaristata (1)
Orbilia rosea (1)
Orbilia subtrapeziformis (2)
Orbilia tremulae (1/2)
Orbilia vinosa (1)
Orbilia xanthostigma (1)
- Sorbus chamaemespilus
Orbilia vinosa (1)
- Sorbus domestica
Hyalorbilia fagi (1)
Orbilia filiformis (1)
Orbilia phragmotricha (1)
Orbilia subtrapeziformis (1)
Orbilia trapeziformis (1)
- Sorbus torminalis
Orbilia aprilis (1)
Orbilia auricolor (1)
Orbilia trapeziformis (1)
Orbilia vinosa (1)

Rosoideae

- Fallugia paradoxa
Mycoceros ?antennatissimus (1)
- *Polylepis* sp.
Orbilia colombiana (1)
- Potentilla fruticosa
Orbilia delphinus (1)
- *Rosa* sp.
Orbilia eucalypti (1)
Hyalorbilia berberidis (1)
Hyalorbilia inflatula (1)
Orbilia angiosubvinosa (1)
Orbilia aristata (5)
Orbilia carpoboloides (1)
Orbilia clavuliformis (1)
Orbilia delphinus (3)
Orbilia eucalypti (6)
Orbilia euonymi (1)
Orbilia gambelii (5)
Orbilia ocellata (3)
Orbilia ovalis (1)
Orbilia ovoidea (1)
Orbilia pleiogambelii (1)
Orbilia plurivacuolata (1)
Orbilia polyspora (1)
Orbilia quaestiformis (1)
Orbilia rosicola (1)
Orbilia septispora (1)
Orbilia subaristata (7)
Orbilia subclavuliformis (2)
Orbilia subocellata (2/1)
Orbilia subovoidea (4)
Orbilia subtrapeziformis (2)
Orbilia aff. *subvitalbae* (1)
Orbilia trapeziformis (2)
Orbilia ?tremulae (1)
Orbilia vinosa (11)
- Rosa canina
Hyalorbilia fagi (1)
Orbilia clavuliformis (1)
Orbilia eucalypti (2)
Orbilia quaestiformis (1)
Orbilia subaristata (1)
Orbilia subtrapeziformis (1)
Orbilia vinosa (4)
- Rosa sicula
Orbilia pleioalbidorosea (1)
- Rubus armeniacus
Orbilia eucalypti (1)
Orbilia pseudoaristata (1)
Orbilia quaestiformis (1)
Orbilia subclavuliformis (1)
- Rubus bifrons
Hyalorbilia subfusispora (1)
Orbilia aristata (1)
Orbilia breviaristata (1)
Orbilia eucalypti (1)
Orbilia filiformis (1)
Orbilia subclavuliformis (1)
Orbilia vitalbae (1)
***- Rubus fruticosus* (agg.)**
Hyalorbilia erythrostigma (1)
Hyalorbilia fusispora (1)
Hyalorbilia latispora (2)
Hyalorbilia multiguttulata (1)
Hyalorbilia subfusispora (3)
Orbilia aristata (9)
Orbilia bicknellensis (1)
Orbilia breviaristata (3/1)
Orbilia cardui (2)
Orbilia caulicola (1)
Orbilia clavuliformis (3)
Orbilia eucalypti (4)
Orbilia euonymi (1)
Orbilia flagellispora (1)
Orbilia flavida (1)
Orbilia gambelii (1)
Orbilia obtusispora (1)
Orbilia polyspora (1)
Orbilia quaestiformis (3)
Orbilia rubrovacuolata (14)
Orbilia sarraziniana (1)
Orbilia subaristata (1)
Orbilia subclavuliformis (1)
Orbilia trapeziformis (1)
Orbilia vinosa (3/1)
Orbilia vitalbae (2)
- Rubus grandifolius
Orbilia caulicola (1)
Orbilia subclavuliformis (1)
- Rubus idaeus
Orbilia aristata (2)
Orbilia rubrovacuolata (1)
- Rubus silesiacus
Orbilia aristata (1)
- Rubus ulmifolius
Hyalorbilia erythrostigma (1)
Orbilia rubrovacuolata (1)

Dryadoideae

- *Cercocarpus* sp.
Orbilia delphinus (1)
Orbilia idahoensis (1)
- Cercocarpus betuloides
Orbilia cercocarpi (1)
Orbilia delphinus (1)
Orbilia maeandrina (1)
Orbilia multimaeandrina (2)
Orbilia ocellata (1)
- Cercocarpus intricatus
Orbilia ?obtusispora (1)
Orbilia ?ponderosae (1)
- Cercocarpus ledifolius
Orbilia arizonensis (1)
Orbilia delphinus (1)
Orbilia euonymi (1)
Orbilia flexisoma (1)
Orbilia gambelii (1)
Orbilia maeandrina (1)
Orbilia ?obtusispora (1)
Orbilia pleionavajoana (1)
Orbilia purshiae (1)
Orbilia subovoidea (1)
- Dryas octopetala
Orbilia aff. *angustoaristata* (2 leaves)
Orbilia inconspicua (3 leaves)
- Purshia tridentata
Orbilia euonymi (1)
Orbilia ?idahoensis (1)
Orbilia ?obtusispora (1)
Orbilia vinosa (1)
- Purshia stansburyana
Orbilia arizonensis (3)
Orbilia calyptrata (2)
Orbilia ?flexisoma (3)
Orbilia lentiformis (1)
Orbilia aff. *lentiformis* (3)
Orbilia macrodelphinus (4)
Orbilia maeandrina (4)
Orbilia microsoma (1)
Orbilia multimaeandrina (2/1)
Orbilia purshiae (5)
Orbilia serpentina (1)
Orbilia stansburyanae (1)

'Rhamnus clade'

• Elaeagnaceae
- Elaeagnus angustifolia
Hyalorbilia subfusispora (1)
Lecophagus vermicola (1)
Mycoceros antennatissimus (1)
Orbilia aprilis (1)
Orbilia ocellata (1)
- Elaeagnus pungens
Orbilia aurantiorubra (1)
- Hippophae rhamnoides
Hyalorbilia juliae (1)
- Shepherdia rotundifolia
Orbilia ?obtusispora (1)
Orbilia pleionavajoana (1)
Orbilia ?pleioserpens (1)

• Rhamnaceae
- Frangula alnus
Hyalorbilia fusispora (1)
Hyalorbilia helicospora (1)
Hyalorbilia inflatula (1)
Orbilia aprilis (4)
Orbilia aristata (4)
Orbilia aurantiorubra (3)
Orbilia breviaristata (1)
Orbilia breviclava (1)
Orbilia clavuliaristata (1)
Orbilia eucalypti (5)
Orbilia frangulae (4)
Orbilia phragmotricha (1)
Orbilia subclavuliformis (1)
Orbilia tremulae (1)
Orbilia vinosa (4)
- *Rhamnus* sp.
Orbilia aprilis (1)
- Rhamnus alaternus
Orbilia microserpens (1)
Orbilia multiserpens (1)
Orbilia rhamni (3)
Orbilia subaristata (1)
Orbilia subovoidea (1)
Orbilia vinosa (1)
- Rhamnus alpina
Orbilia obtusispora (1)
Orbilia somedana (1)
Orbilia subtrapeziformis (3)
Orbilia vinosa (1)
- Rhamnus cathartica
Hyalorbilia subfusispora (1)
Orbilia aprilis (1)
- Rhamnus crenulata
Orbilia vinosa (1)
- Rhamnus myrtifolia
subsp. *myrtifolia*
Orbilia gambelii (1)
Orbilia ocellata (1)

OXALIDALES

• Cunoniaceae
- Weinmannia racemosa
Orbilia cunninghamii (1)
Orbilia xanthostigma (1)

ZYGOPHYLLALES

- Larrea tridentata
Orbilia arizonensis (1)
Orbilia aff. *breviclava* (1)
Orbilia calyptrata (3)
Orbilia cryptogena (6)
Orbilia ?flexisoma (1)
Orbilia lacrimispora (1)
Orbilia lentiformis (2)
Orbilia macrodelphinus (1)
Orbilia multicercocarpi (1)
Orbilia aff. *multidelphinus* (1)
Orbilia multigambelii (2)
Orbilia multiurosperma (4)
Orbilia multivirgula (1)
Orbilia ?navajoana (2)
Orbilia ?obtusispora (1)
Orbilia pleiocreosoteris (1)
Orbilia aff. *pleionavajoana* (1)
Orbilia pleioserpens (1)
Orbilia pluristomachia (3)
Orbilia sedonensis (1)
Orbilia sonorensis (4)

Malvids

BRASSICALES

• Brassicaceae
- Brassica oleracea
Orbilia auricolor s.l. (1)
Orbilia ?oligospora (1)

• Koeberliniaceae
- Koeberlinia spinosa
Orbilia pleiomesaverdiana (1)

CROSSOSOMATALES

- Glossopetalon spinescens
Orbilia lentiformis (1)
Orbilia myriourosperma (1)
Orbilia pleiourosperma (1)
Orbilia pluristomachia (1)

MALVALES

• Cistaceae
- *Cistus* sp.
Orbilia gambelii (1)
Orbilia ocellata (1)
Orbilia pleiogambelii (1)
Orbilia subaristata (1)
Orbilia subovoidea (1)
- Cistus albidus
Orbilia cisti (1)
- Cistus crispus
Orbilia vinosa (1)
- Cistus ladanifer
Orbilia aff. *aradi* (1)
Orbilia vinosa (4)
- Cistus laurifolius
Orbilia delphinus (1)
Orbilia ocellata (1)
Orbilia vinosa (4)
- Cistus monspeliensis
Orbilia corculispora (1)

Orbilia vinosa (3)
- ***Cistus symphytifolius***
Orbilia vinosa (1)

• Malvaceae
Bombacoideae
- ***Adansonia digitata***
Orbilia euphorbiae (1)
- ***Adansonia gregorii***
Orbilia brachychitonis (1)
Orbilia carminorosea (1)
Orbilia euphorbiae (3)

Byttnerioideae
- ***Guazuma ulmifolia***
Orbilia blumenaviensis (1 mol. extr.)
- ***Theobroma cacao***
Orbilia auricolor s.l. (1 fruits)
Orbilia tenuissima (1 fruits)

Malvoideae
- ***Abutilon grandifolium***
Orbilia abutilonis (1)
- ***Althaea ficifolia***
Orbilia cylindrosoma (1)
- ***Althaea officinalis***
Orbilia auricolor s.l. (1)
- ***Hibiscus* sp.**
Orbilia ?trapeziformis (1)
- ***Hibiscus syriacus***
Orbilia ficicola (1)
- ***Hibiscus tiliaceus***
Orbilia spirillospora (1)
Orbilia ?subfabacearum (1)
- ***Lavatera* sp.**
Orbilia auricolor s.l. (1)
- ***Lavatera arborea***
Orbilia auricolor s.l. (1)

Sterculioideae
- ***Brachychiton gregorii***
Orbilia acaciae (1)
Orbilia brachychitonis (2)
Orbilia gregorii (1)
Orbilia ?multigambelii (1)
Orbilia ?pleiogambelii (1)

Tilioideae
- ***Tilia* sp.**
Hyalorbilia erythrostigma (1)
Hyalorbilia inflatula (5)
Hyalorbilia ?japonica (1)
Hyalorbilia juliae (2)
Hyalorbilia subfusispora (2)
Orbilia aprilis (2)
Orbilia auricolor s.l. (1)
Orbilia ?battenii (1)
Orbilia ?cejpii (1)
Orbilia crenatomarginata (21)
Orbilia dryadum (1)
Orbilia epipora (2)
Orbilia eucalypti (4)
Orbilia ficicola (1)
Orbilia naumburgensis (1)
Orbilia phragmotricha (1)
Orbilia rubella (1)
Orbilia sarraziniana (2)
Orbilia ?scolecospora (1)
Orbilia trapeziformis (1)
Orbilia xanthoguttulata (1)
Orbilia xanthostigma (3)
- ***Tilia amurensis***
Orbilia orientalis (1)
- ***Tilia cordata***
Hyalorbilia inflatula (2)
Hyalorbilia juliae (1)
Hyalorbilia subfusispora (1)
Orbilia clavispora (1)
Orbilia crenatomarginata (2)
Orbilia dryadum (1)
Orbilia eucalypti (4)
Orbilia jurana (1)
Orbilia naumburgensis (4)
Orbilia orientalis (1)
Orbilia polybrocha (1)
Orbilia trapeziformis (1)
Orbilia tremulae (1)
Orbilia xanthoguttulata (2)
- ***Tilia platyphyllos***
Hyalorbilia fusispora (1)
Hyalorbilia inflatula (3)
Hyalorbilia juliae (2)
Orbilia auricolor s.l. (2)
Orbilia crenatomarginata (2)
Orbilia filiformis (2)
Orbilia aff. *orientalis* (2)
Orbilia trapeziformis (1)
- ***Tilia tomentosa***
Orbilia aristata (1)
Orbilia clavuliformis (1)
Orbilia eucalypti (1)
Orbilia crenatomarginata (1)

• Thymelaeaceae
- ***Daphne gnidium***
Orbilia paravitalbae (1)
Orbilia ?sarraziniana (1)
- ***Daphne mezereum***
Orbilia auricolor s.l. (1)
- ***Thymelaea hirsuta***
Orbilia bicknellensis (1)
Orbilia eucalypti (1)
- ***Thymelaea lythroides***
Orbilia lentiformis (1)

SAPINDALES
• Anacardiaceae
- ***Mangifera indica***
Orbilia vermiformis (1)
- ***Pistacia lentiscus***
Hyalorbilia erythrostigma (1)
Orbilia aprilis (1)
Orbilia multiurosperma (1)
Orbilia pseudoaristata (1)
Orbilia subaristata (1)
Orbilia subovoidea (1)
Orbilia vinosa (1)
Orbilia xanthoguttulata (1)
- ***Pistacia terebinthus***
Orbilia bicknellensis (1)
Orbilia navicularis (1)
Orbilia pleioalbidorosea (1)
Orbilia vinosa (1)
Orbilia xanthoguttulata (1)
- ***Rhus laurina***
Orbilia auricolor s.l. (1)
Orbilia flagellispora (1 leaves)
- ***Rhus typhina***
Orbilia aristata (2)
Orbilia quaestiformis (1)
Orbilia trapeziformis (1)
- ***Cotinus coggygria***
Orbilia aristata (1)
Orbilia vinosa (1)

• Meliaceae
- ***Swietenia macrophylla***
Hyalorbilia citrina (1)

• Rutaceae
- ***Citrus aurantium***
Orbilia hesperidea (1)
- ***Citrus × limon***
Orbilia senegalensis (1)
- ***Geijera parviflora***
Hyalorbilia aff. *orbiliicola* (1)
Orbilia acaciae (1)
Orbilia ?coniferarum (1)
Orbilia corculispora (1)
Orbilia geijerae (1)

• Sapindaceae
Sapindoideae
- ***Koelreuteria paniculata***
Hyalorbilia erythrostigma (1)
Hyalorbilia hergiswiliana (1)
Orbilia montigena (1)

Dodonaeoideae
- ***Dodonaea viscosa* subsp. *angustissima***
Orbilia ?angustoaristata (1)
Orbilia australiensis (1)
Orbilia austrocylindrica (1)
Orbilia fimbriata (1)
Orbilia pleiovirgula (1)
Orbilia aff. *pubescens* (1)

Hippocastanoideae
- ***Acer* sp.**
Hyalorbilia ?fagi (2)
Hyalorbilia ?fomentarii (1)
Hyalorbilia fusispora (1)
Hyalorbilia inflatula (4)
Hyalorbilia juliae (1)
Hyalorbilia subfusispora (2)
Orbilia aprilis (2)
Orbilia ?cejpii (1)
Orbilia crenatomarginata (1)
Orbilia cupularis (1)
Orbilia cylindrosoma (1)
Orbilia dryadum (2)
Orbilia ebuli (1 leaves)
Orbilia epipora (1)
Orbilia eucalypti (1)
Orbilia filiformis (2)
Orbilia flexisoma (1)
Orbilia georgiana (2)
Orbilia luteorubella (1)
Orbilia microsoma (1)
Orbilia montigena (1)
Orbilia multimaeandrina (1)
Orbilia navajoana (1)
Orbilia nemaspora (4)
Orbilia ovalis (1)
Orbilia ovoidea (1)
Orbilia paramontigena (1)
Orbilia polybrocha (1)
Orbilia renispora (1)
Orbilia rosea (2)
Orbilia sarraziniana (2/1)
Orbilia subovoidea (1)
Orbilia subtrapeziformis (1)
Orbilia trapeziformis (1)
Orbilia vinosa (4)
Orbilia aff. *vinosa* (1)
Orbilia xanthoflexa (2)
Orbilia xanthostigma (3)
- ***Acer campestre***
Hyalorbilia fagi (1)
Hyalorbilia inflatula (1)
Hyalorbilia juliae (1)
Hyalorbilia lunata (1)
Hyalorbilia subfusispora (1)
Orbilia aprilis (1)
Orbilia aristata (1)
Orbilia euonymi (1)
Orbilia filiformis (3)
Orbilia pleioeuonymi (1)
Orbilia subaristata (1)
Orbilia trapeziformis (1)
Orbilia ungulata (1)
Orbilia vinosa (2)
- ***Acer glabrum***
Orbilia aristata (1)
Orbilia euonymi (1)
Orbilia gambelii (1)
Orbilia ?pubescens (1)
- ***Acer henryi***
Orbilia obtusispora (1)
- ***Acer macrophyllum***
Orbilia xanthostigma (1)
- ***Acer negundo***
Orbilia obtusispora (1)
- ***Acer platanoides***
Hyalorbilia juliae (1)
Orbilia aprilis (1)
Orbilia clavuliformis (1)
Orbilia eucalypti (1)
Orbilia euonymi (2)
Orbilia ?frangulae (1)
Orbilia phragmotricha (1)
Orbilia xanthostigma (1)
- ***Acer pseudoplatanus***
Hyalorbilia fusispora (1)
Hyalorbilia ?hergiswiliana (1)
Hyalorbilia inflatula (2)
Hyalorbilia polypori (1)
Hyalorbilia subfusispora (4)
Orbilia aristata (3)
Orbilia aurantiorubra (1)
Orbilia clavuliformis (1)
Orbilia crenatomarginata (1)
Orbilia eucalypti (2)
Orbilia euonymi (2)
Orbilia filiformis (6)
Orbilia leucostigma (1)
Orbilia phragmotricha (1)
Orbilia quaestiformis (2)
Orbilia subsphaerospora (1)
Orbilia ?trapeziformis (1)
Orbilia vinosa (3)
Orbilia vitalbae (1)
Orbilia xanthoguttulata (1)
Orbilia xanthostigma (1)
- ***Acer rubrum***
Orbilia crenatomarginata (1)
- ***Aesculus hippocastanum***
Hyalorbilia fagi (1)
Hyalorbilia fusispora (1)
Hyalorbilia juliae (1)
Hyalorbilia subfusispora (1)
Orbilia auricolor s.l. (1)
Orbilia eucalypti (2)
Orbilia euonymi (1)
Orbilia filiformis (1)

• Simaroubaceae
- ***Ailanthus altissima***
Orbilia aurantiorubra (1)
Orbilia carpoboloides (1)

MYRTALES
• Lythraceae
- ***Punica granatum***
Hyalorbilia orbiliicola (1)
Orbilia aristata (1)
Orbilia clavuliformis (2)
Orbilia eucalypti (1)
Orbilia gambelii (1)
Orbilia mali (1)
Orbilia myriosphaera (1)
Orbilia subaristata (2)
Orbilia subclavuliformis (1)

• Melastomataceae
- ***Melastoma* sp.**
Hyalorbilia anonyma (1)

• Myrtaceae
Orbilia austrocylindrica (1)
Orbilia multicurvula (1)

- ***Calytrix*** **sp**.
Orbilia myrioobliqua (1)
- ***Leptospermum scoparium***
Orbilia ?xanthostigma (1)
- ***Melaleuca*** **sp**.
Orbilia acaciae (1)
Orbilia aff. *australiensis* (1)
Orbilia austroobtusispora (1)
Orbilia cejpii (1)
Orbilia flexispora (1)
Orbilia microserpens (1)
Orbilia myrioeuonymi (1)
Orbilia nothovinosa (1)
Orbilia aff. *parviclava* (1)
Orbilia pleioaustraliensis (1)
- ***Melaleuca rhaphiophylla***
Orbilia pseudoflagellispora (1)
- ***Calothamnus*** **sp**.
Orbilia australiensis (1)
Orbilia hesperidea (1)
Orbilia myrioobliqua (1)
- ***Agonis flexuosa***
Orbilia austroobtusispora (1)
- ***Chamelaucium ciliatum***
Orbilia aviaristata (1)
Orbilia ?multiaustrocylindrica (1)
Orbilia ?subclavuliformis (1)
Orbilia triangulispora (1)
- ***Eremaea*** **sp**.
Orbilia ?myriella (1)
Orbilia ?nothoaprilis (1)
- ***Eremaea pauciflora***
Hyalorbilia juliae (1)
Orbilia amberina (1)
Orbilia austrocylindrica (2)
Orbilia curvativitalbae (1)
Orbilia eremaeae (1)
Orbilia eucalypti (1)
Orbilia microserpens (1)
Orbilia multicurvula (2)
Orbilia pleistovitalbae (2)
Orbilia plurililacina (1)
- ***Eucalyptus*** **sp**.
Orbilia albidorosea (2)
Orbilia arachnopus (2)
Orbilia austrocylindrica (1)
Orbilia austroobtusispora (1)
Orbilia austropleiomicrosoma (1)
Orbilia austroregalis (1)
Orbilia colombiana (1)
Orbilia coronohesperidea (1)
Orbilia ?cotoneastri (1)
Orbilia eucalypti (2)
Orbilia hesperidea (1)
Orbilia kingsiana (1)
Orbilia megaocculta (1)
Orbilia microserpens (1)
Orbilia multinanosoma (1)
Orbilia ?multiserpens (3)
Orbilia nothovinosa (1)
Orbilia ?parviclava (1)
Orbilia aff. *pleioaustraliensis* (1)
Orbilia pleioaustrocylindrica (1)
Orbilia pleioserpens (1)
Orbilia pleistolilacina (2)
Orbilia plurililacina (1)
Orbilia rubella (1)
Orbilia rubrovacuolata (2)
Orbilia scolecospora (1)
Orbilia subalbovinosa (1)
Orbilia subclavuliformis (1)
Orbilia velutina (1)
- ***Eucalyptus camaldulensis***
Hyalorbilia orbiliicola (1)
Hyalorbilia ulicicola (2)
Orbilia albidorosea (1)
Orbilia ?gambelii (1)
- ***Eucalyptus globulus***
Orbilia alba (1)
Orbilia albidorosea (1)
Orbilia ?bembicodes (1)
Orbilia cejpii (1)
Orbilia ?cotoneastri (1)
Orbilia crenatomarginata (1)
Orbilia eucalypti (4)
Orbilia ?xanthostigma (1)
- ***Eucalyptus gomphocephala***
Orbilia xanthoguttulata (1)
- ***Eucalyptus gunnii***
Hyalorbilia lunata (1)
Orbilia clavuliformis (1)
- ***Eucalyptus jacksonii***
Orbilia aviaristata (1)
Orbilia ?pseudoflagellispora (1)
Orbilia lilacina (1)
Orbilia nanosperma (1)
- ***Eucalyptus viminalis***
Orbilia nemaspora (1)
Orbilia ?scolecospora (1)
- ***Lamarchea hakeifolia***
Hyalorbilia pleioerythrostigma (1)
Orbilia austroobtusispora (1)
Orbilia gemma (1)
Orbilia kingsiana (1)
Orbilia lamarcheae (1/1)
Orbilia myriolilacina (1)
Orbilia pseudoflagellispora (1)
Orbilia ?pubescens (1)
- ***Myrtus communis***
Orbilia hesperidea (1)
Orbilia serpentina (1)

• Onagraceae
- ***Epilobium*** **sp**.
Orbilia epilobii (1)
- ***Epilobium angustifolium***
Orbilia flavida (1)
Orbilia quaestiformis (1)
- ***Epilobium hirsutum***
Orbilia epilobii (5)
Orbilia sarraziniana (1)
- ***Oenothera biennis***
Orbilia auricolor s.l. (1)

Superasterids
CARYOPHYLLALES
• Sarcobataceae
- ***Sarcobatus vermiculatus***
Orbilia bicknellensis (2)
Orbilia aff. *gregorii* (1)
Orbilia lentiformis (2)
Orbilia maeandrina (1)
Orbilia multicreosoteris (1)
Orbilia myrioolneyae (1)
Orbilia sarcobati (3)
Orbilia vermiculati (4)

• Cactaceae
- ***Carnegiea gigantea***
Orbilia cactacearum (1)
Orbilia carnegieae (1)
Orbilia saguarina (1)
- ***Cylindropuntia bigelovii***
Orbilia cactacearum (1)
Orbilia ?carnegieae (1)
- ***Cylindropuntia versicolor***
Orbilia macrotrapeziformis (1)
Orbilia multigambelii (1)
- ***Ferocactus*** **sp**.
Orbilia desertorum (1)
- ***Myrtillocactus cochal***
Orbilia denticulata (1)
- ***Opuntia*** **sp**.
Orbilia bicknellensis (1)
Orbilia calyptrata (1)
Orbilia ?serpentina (1)
- ***Opuntia maxima***
Orbilia succulenticola (1)
- ***Stenocereus thurberi***
Orbilia cactacearum (2)
Orbilia saguarina (1)

• Amaranthaceae
Amaranthoideae
- ***Ptilotus polystachyus***
Orbilia aff. *nothoaprilis* (1)

Betoideae
- ***Beta vulgaris***
Hyalorbilia aff. *multiguttulata* (1 roots, mol. extr.)
Hyalorbilia oviparasitica (2 roots, mol. extr.)

Chenopodioideae
- ***Atriplex*** **sp**.
Orbilia barrowensis (1)
Orbilia lanternae (1)
Orbilia lentiformis (1)
Orbilia ?livistonae (1)
Orbilia multiaustrocylindrica (1)
Orbilia ?multigambelii (2)
Orbilia multiurosperma (1)
Orbilia octocercocarpi (1)
Orbilia pleioaustraliensis (1)
Orbilia aff. *pleiomesaverdiana* (1)
- ***Atriplex canescens***
Orbilia multigambelii (1)
- ***Atriplex confertifolia***
Orbilia macroserpens (1)
Orbilia sonorensis (1)
Orbilia ?vermiculati (1)
- ***Atriplex halimus***
Orbilia halimi (2)
Orbilia multiurosperma (1)
- ***Atriplex hastata***
Orbilia obtusispora (1)
- ***Atriplex nummularia***
Orbilia atriplicis (1)
Orbilia bicknellensis (1)
Orbilia lentiformis (1)
Orbilia aff. *multitrapezoidea* (1)
Orbilia pluristomachia (1)
Orbilia myriostomachia (1)
- ***Krascheninnikovia lanata***
Orbilia bicknellensis (2)
Orbilia ?cactacearum (1)
Orbilia calyptrata (1)
Orbilia multigambelii (2)
Orbilia plurilentiformis (2)
Orbilia ?ungulata (1)
- ***Spinacia oleracea***
Orbilia polybrocha (1)

Suaedoideae
- ***Suaeda vera***
Hyalorbilia fusispora (1)
Hyalorbilia ulicicola (2)
Orbilia cardui (1)

• Caryophyllaceae
- ***Saponaria officinalis***
Orbilia caulicola (1)

• Polygonaceae
- ***Polygonum pennsylvanicum***
'*Dactylellina*' *entomopaga* (1 root)
- ***Reynoutria*** **sp**.
Orbilia quaestiformis (1)
Orbilia ?ungulata (1)
- ***Reynoutria japonica***
Orbilia caulicola (1)
Orbilia gambelii (1)
Orbilia quaestiformis (1)
Orbilia ungulata (2)
- ***Reynoutria sachalinensis***
Hyalorbilia herbicola (1)
Orbilia caulicola (1)
Orbilia ?cotoneastri (1)
Orbilia ungulata (2)
- ***Rumex sp***.
Orbilia aristata (1)
Orbilia filiformis (1)
Orbilia flavida (1)
- ***Rumex lunaria***
Orbilia pleiomicrosoma (1)

• Tamaricaceae
- ***Tamarix africana***
Hyalorbilia ulicicola (1)
- ***Tamarix anglica***.
Hyalorbilia juliae (1)
Hyalorbilia ulicicola (1)
Orbilia aprilis (3)
Orbilia vinosa (1)
- ***Tamarix gallica***
Orbilia vinosa (1)
- ***Tamarix ramosissima***
Orbilia quaestiformis (1)

SANTALALES
• Loranthaceae
- ***Nuytsia floribunda***
Orbilia brachychitonis (1)
Orbilia ?eucalypti (1)
Orbilia myrioobliqua (1)
Orbilia nothovinosa (1)

Asteriids
CORNALES
• Cornaceae
- ***Cornus*** **sp**.
Hyalorbilia orbiliicola (1)
Hyalorbilia erythrostigma (1)
Hyalorbilia subfusispora (1)
Lecophagus vermicola (2)
Orbilia aristata (2)
Orbilia clavuliaristata (1)
Orbilia ?clavuliformis (1)
Orbilia eucalypti (3)
Orbilia occulta (1)
Orbilia pseudoaristata (1)
Orbilia ?tremulae (1)
Orbilia vinosa (1)
- ***Cornus alba***
Orbilia clavuliformis (1)
Orbilia vinosa (1)
- ***Cornus alternifolia***
Orbilia aristata (1)
Orbilia clavuliformis (1)
- ***Cornus florida***
Orbilia clavuliaristata (2)
- ***Cornus mas***
Hyalorbilia hergiswiliana (1)
Orbilia aprilis (1)
Orbilia clavuliformis (3)
Orbilia euonymi (1)
- ***Cornus sanguinea***
Hyalorbilia berberidis (1)
Hyalorbilia fusispora (1)
Hyalorbilia inflatula (1)
Hyalorbilia juliae (2)
Hyalorbilia orbiliicola (1)
Hyalorbilia rotifera (1)
Hyalorbilia subfusispora (5)
Lecophagus ellipsoideus (1)
Orbilia aristata (16)
Orbilia clavuliformis (2)
Orbilia eucalypti (5)

Orbilia euonymi (1)
Orbilia filiformis (1)
Orbilia flagellispora (4)
Orbilia ?frullaniae (1)
Orbilia pseudoaristata (5)
Orbilia ?sarraziniana (1)
Orbilia subaristata (10)
Orbilia aff. *subaristata* (1)
Orbilia subclavuliformis (1)
Orbilia xanthoguttulata (1)
- Cornus stolonifera
Orbilia eucalypti (1)

• Hydrangeaceae
***- Hydrangea* sp.**
Hyalorbilia berberidis (1)
- Hydrangea macrophylla
Hyalorbilia erythrostigma (1)

ERICALES
• Balsaminaceae
- Impatiens glandulifera
Orbilia oxyspora (1)

• Ericaceae
Ericoideae
- Calluna vulgaris
Orbilia aff. *arachnovinosa* (2)
- Corema album
Orbilia ?paracylindrospora (1)
***- Erica* sp.**
Hyalorbilia ?ulicicola (1)
Orbilia ?subulivinosa (1)
Orbilia vibrioides (1)
Orbilia vinosa (1)
- Erica arborea
Hyalorbilia helicospora (1)
Hyalorbilia lunata (2)
Hyalorbilia polypori (1)
Hyalorbilia tortuosa (1)
Orbilia aprilis (1)
Orbilia arachnovinosa (1)
Orbilia hesperidea (3)
Orbilia leucostigma (1)
Orbilia subcylindrospora (1)
Orbilia subulivinosa (1/1)
Orbilia vinosa (1)
Orbilia xanthostigma (3)
- Erica platycodon
Orbilia dryadum (1)
Orbilia ?subulivinosa (1)
Orbilia xanthostigma (7)
- Erica scoparia
Orbilia aprilis (3)
Orbilia vibrioides (1)
***- Rhododendron* sp.**
Retiarius ?bovicornutus (1 leaves)
- Rhododendron dahuricum
Orbilia arachnovinosa (1)
- Rhododendron ferrugineum
Orbilia aff. *arachnovinosa* (1)
Orbilia vinosa (2)
- Rhododendron ponticum
Orbilia aprilis (1)

Arbutoideae
- Arbutus andrachne
Orbilia curvativitalbae (2)
Orbilia octoserpentina (2)
Orbilia serpentina (2)
Orbilia vibrioides (1)
- Arbutus menziesii
Orbilia ?eremaeae (1)
Orbilia ?subclavuliformis (1)
Orbilia ?trapeziformis (1)
Orbilia vibrioides (1)
- Arbutus unedo
Orbilia hesperidea (3)
Orbilia subaristata (1)
Orbilia subovoidea (1)
Orbilia vinosa (2)
- Arctostaphylos patula
Orbilia aff. *dixiensis* (1)
Orbilia hesperidea (1)
Orbilia pleionavajoana (1)
Orbilia vibrioides (1)
Orbilia ?vinosa (1)
- Arctostaphylos pungens
Orbilia pleionavajoana (1)

• Fouquieriaceae
- Fouquieria splendens
Orbilia aff. *multicercocarpi* (1)

• Lecythidaceae
- Barringtonia racemosa
Hyalorbilia arcuata (1)
Orbilia cejpii (1)
Orbilia aff. *fusiformis* (1)

Lamiids
GENTIANALES
• Apocynaceae
***- Cynanchum* sp.**
Orbilia aff. *caudata* (1)
- Nerium oleander
Orbilia eucalypti (1)
Orbilia rubella (1)
- Vincetoxicum hirundinaria
Orbilia flavidorosella (2)
- Periploca laevigata
Orbilia hesperidea (2)
Orbilia pleiomicrosoma (1)
Orbilia pleioungulata (1)
Orbilia vinosa (1)

• Rubiaceae
- Plocama pendula
Orbilia pleioungulata (5)
- Psydrax latifolia
Hyalorbilia ?orbiliicola (1)
Orbilia aff. *lacrimispora* (1)
Orbilia multiserpens (1)
Orbilia octoserpentina (2)
- Rubia fruticosa
Orbilia gambelii (1)
Orbilia obtusispora (1)
Orbilia pleioungulata (1)

SOLANALES
• Convolvulaceae
- Ipomoea costata
Orbilia euphorbiae (1)
Orbilia ?livistonae (1)

• Solanaceae
- Atropa belladonna
Orbilia ebuli (1)
Orbilia filiformis (1)
Orbilia quaestiformis (1)
Orbilia rosella (3)
- Cyphomandra betacea
Orbilia auricolor s.l. (1)
- Lycium intricatum
Orbilia pleioungulata (2)
- Nicotiana glauca
Orbilia bicknellensis (1)
- Solanum lasiophyllum
Orbilia urosperma (1)
- Solanum lycopersicum
Orbilia ?oxyspora (1)
- Solanum tuberosum
Orbilia ?elegans (1)

LAMIALES
• Bignoniaceae
- Campsis radicans
Hyalorbilia texensis (1)
Orbilia cejpii (1)
Orbilia hesperidea (1)
- Tabebuia rigida
Orbilia blumenaviensis (1)

• Boraginaceae
- Cordia borinquensis
Hyalorbilia citrina (1)
- Echium leucophaeum
Orbilia gambelii (1)
Orbilia subaristata (1)
- Echium vulgare
Orbilia caulicola (1)
Orbilia flavida (3)
- Symphytum officinale
Orbilia oxyspora (1)

• Lamiaceae
- Bystropogon odoratissima
Orbilia hesperidea (1)
- Lavandula canariensis
Orbilia cejpii (1)
Orbilia pleioungulata (1)
Orbilia vinosa (1)
***- Rosmarinus* sp.**
Orbilia polyspora (1)
- Rosmarinus officinalis
Orbilia gambelii (4)
Orbilia subclavuliformis (1)
Orbilia subovoidea (2)
Orbilia vinosa (1)
- Sideritis soluta
Orbilia ?paravitalbae (1)

• Oleaceae
***- Fraxinus* sp.**
Hyalorbilia fagi (1)
Hyalorbilia inflatula (1)
Orbilia clavuliformis (1)
Orbilia epipora (1)
Orbilia ovalis (1)
Orbilia rubrovacuolata (1)
Orbilia ?sinensis (1)
Orbilia subaristata (2)
- Fraxinus angustifolia
Orbilia epipora (1)
Orbilia sarraziniana (1)
- Fraxinus anomala
Orbilia multimaeandrina (1)
Orbilia aff. *paloverdensis* (1)
- Fraxinus excelsior
Hyalorbilia fomentarii (1)
Hyalorbilia fusispora (3)
Hyalorbilia inflatula (15)
Hyalorbilia juliae (2)
Hyalorbilia subfusispora (1)
Hyalorbilia tortuosa (1)
Hyalorbilia ulicicola (1)
Orbilia aristata (5)
Orbilia aurantiorubra (1)
Orbilia auricolor s.l. (1)
Orbilia aff. *auricolor* (1)
Orbilia comma (1)
Orbilia crenatomarginata (1)
Orbilia dryadum (2)
Orbilia eucalypti (10)
Orbilia euonymi (1)
Orbilia filiformis (2)
Orbilia ?flagellispora (1)
Orbilia fraxini (8)
Orbilia gambelii (1)
Orbilia jacaensis (1)
Orbilia lentiformis (1)
Orbilia luteorubella (1)
Orbilia mali (1)
Orbilia obtusispora (2)
Orbilia phragmotricha (1)
Orbilia poitevinica (2)
Orbilia polybrocha (1)
Orbilia pseudoaristata (1)
Orbilia pyrenaica (1)
Orbilia rhopalota (1)
Orbilia rosea (2)
Orbilia rubrovacuolata (1)
Orbilia sarraziniana (7)
Orbilia ?sinensis (1)
Orbilia trapeziformis (2)
Orbilia vinosa (2)
Orbilia ?vitalbae (1)
Orbilia xanthoguttulata (2)
Orbilia xanthostigma (5)
- Fraxinus mandshurica
Hyalorbilia citrina (1)
- Fraxinus ornus
Orbilia clavuliformis (1)
Orbilia ungulata (1)
- Fraxinus velutina
Orbilia pluristomachia (1)
- Forsythia* × *intermedia
Orbilia eucalypti (1)
- Jasminum fruticans
Orbilia gambelii (1)
- Ligustrum vulgare
Hyalorbilia juliae (1)
Hyalorbilia subfusispora (1)
Orbilia aprilis (2)
Orbilia aristata (1)
Orbilia clavuliformis (2)
Orbilia eucalypti (1)
Orbilia pleioeuonymi (1)
Orbilia vinosa (2)
- Olea europaea
Hyalorbilia fusispora (1)
Orbilia corculispora (1)
Orbilia eucalypti (1)
Orbilia gambelii (4)
Orbilia ?halimi (1)
Orbilia hesperidea (2)
Orbilia microserpens (1)
Orbilia myriosphaera (1)
Orbilia obtusispora (2)
Orbilia serpentina (1)
Orbilia subaristata (2)
Orbilia subclavuliformis (1)
Orbilia subsphaerospora (1)
Orbilia vinosa (4)
- Picconia excelsa
Hyalorbilia lunata (1)
Hyalorbilia polypori (1)
- Phillyrea media
Orbilia vinosa (1)
- Syringa reticulata
Orbilia aprilis (1)
- Syringa vulgaris
Orbilia aprilis (1)
Orbilia aristata (3)
Orbilia corculispora (1)
Orbilia euonymi (2)
Orbilia gambelii (1)
Orbilia ?pseudoaristata (1)
Orbilia vinosa (1)
Orbilia vitalbae (1)

• Paulowniaceae
- Paulownia tomentosa
Orbilia eucalypti (2)

• Plantaginaceae
- Digitalis purpurea
Hyalorbilia ?herbicola (1)
Orbilia auricolor s.l. (1)
Orbilia quaestiformis (1)

• Scrophulariaceae
***- Buddleja* sp.**
Orbilia tremulae (1)

- Buddleja davidii
Orbilia epipora (1)
***- Verbascum* sp.**
Orbilia auricolor s.l. (1)
Orbilia ?cardui (1)
Orbilia flavida (1)
Orbilia vitalbae (1)
- Verbascum densiflorum
Orbilia flavida (1)
Orbilia quaestiformis (1)
- Verbascum lychnitis
Orbilia flavida (1)

Campanulids
APIALES
• Araliaceae
- Hedera helix
Hyalorbilia juliae (1)
Orbilia ?aristata (1)
Orbilia auricolor s.l. (2)
Orbilia euonymi (1)
Orbilia obtusispora (1)
Orbilia vitalbae (1)
***- Kalopanax* sp.**
Orbilia xanthostigma (1)

• Apiaceae
Hyalorbilia ?herbicola (1)
Orbilia caulicola (2)
Orbilia cylindrosoma (1)
Orbilia ebuli (1)
Orbilia flavida (1)
Orbilia quaestiformis (1)
***- Angelica* sp.**
Orbilia auricolor s.l. (1)
Orbilia oxyspora (1)
- Angelica archangelica
Orbilia oxyspora (1)
- Angelica sylvestris
Orbilia cardui (1)
Orbilia caulicola (1)
Orbilia ?flavida (1)
Orbilia oxyspora (3)
- Anthriscus sylvestris
Orbilia caulicola (1)
- Bupleurum salicifolium
Orbilia eucalypti (1)
- Eryngium campestre
Orbilia bicknellensis (1)
- Foeniculum vulgare
Orbilia bicknellensis (1)
Orbilia ?cylindrosoma (1)
Orbilia flavida (3)
Orbilia oxyspora (1)
Orbilia quaestiformis (2)
Orbilia ungulata (1)
***- Heracleum* sp.**
Orbilia oxyspora (1)
- Heracleum mantegazzianum
Orbilia flavida (1)
- Heracleum sphondylium
Orbilia auricolor (1)
Orbilia caulicola (4)
Orbilia cylindrosoma (1)
Orbilia flavida (3)
Orbilia oxyspora (1)
Orbilia quaestiformis (4)
Orbilia ungulata (3)
***- Opopanax* sp.**
Orbilia gambelii (1)
- Oenanthe crocata
Orbilia atlantis (4)
Orbilia auricolor s.l. (1)
Orbilia ?epilobii (3)
Orbilia oxyspora (2)
Orbilia ?rectispora (2)
- Pastinaca sativa
Orbilia auricolor s.l. (1)
Orbilia caulicola (2)
Orbilia oxyspora (1)
Orbilia vitalbae (1)
- Seseli libanotis
Orbilia flavida (1)
- Smyrnium olusatrum
Orbilia oxyspora (1)

• Pittosporaceae
- Pittosporum phillyreoides
Orbilia angustoaristata (1)
Orbilia ?livistonae (1)
Orbilia megahesperidea (1)
Orbilia multiserpens (1)
Orbilia aff. *myrioolneyae* (1)
Orbilia pleioaustraliensis (1)

AQUIFOLIALES
• Aquifoliaceae
- Ilex aquifolium
Hyalorbilia erythrostigma (1)
Hyalorbilia helicospora (1)
Hyalorbilia inflatula (1)
Hyalorbilia subfusispora (3)
Orbilia aprilis (4)
Orbilia aristata (2)
Orbilia atlantis (1)
Orbilia eucalypti (1)
Orbilia euonymi (1)
Orbilia gambelii (1)
Orbilia pleioeuonymi (1)
Orbilia rubrovacuolata (1)
Orbilia vibrioides (1)
Orbilia vinosa (3)
- Ilex canariensis
Hyalorbilia berberidis (1)
Hyalorbilia lunata (1)
Orbilia ?subulivinosa (1)
Orbilia xanthostigma (6)

ASTERALES
• Asteraceae
Orbilia cardui (1)

Asteroideae
- Achillea millefolium
Orbilia ?ocellata (1)
- Adenostyles alliariae
Orbilia auricolor s.l. (1)
Orbilia ?rosea (1)
- Artemisia filifolia
Orbilia lentiformis (1)
Orbilia mesaverdiana (1)
Orbilia multimaeandrina (1)
Orbilia ocellata (2)
Orbilia plurilentiformis (2)
Orbilia subsiculispora (1)
- Artemisia herba-alba
Orbilia serpentina (1)
- Artemisia thuscula
Hyalorbilia fusispora (1)
Orbilia obtusispora (1)
- Artemisia tridentata
Orbilia dixiensis (1)
Orbilia lentiformis (1)
Orbilia mesaverdiana (2)
Orbilia multiphanosoma (2)
Orbilia plurilentiformis (1)
Orbilia ?serpentina (1)
Orbilia spathulata (2)
- Artemisia vulgaris
Orbilia cylindrosoma (1)
- Baccharis halimifolia
Orbilia auricolor s.l. (1)
Orbilia eucalypti (1)
- Baccharis salicifolia
Orbilia bicknellensis (1/1)
Orbilia brachychitonis (1)
Orbilia macrodelphinus (1)
Orbilia multimaeandrina (1)
Orbilia ocellata (1)
Orbilia plurilentiformis (1)
Orbilia serpentina (1)
Orbilia subcryptogena (1)
- Baccharis sarothroides
Orbilia bicknellensis (1)
Orbilia pleiomicrosoma (1)
Orbilia serpentina (1)
***- Chrysothamnus* sp.**
Orbilia lentiformis (1)
Orbilia myriourosperma (1)
Orbilia pleiomesaverdiana (1/1)
Orbilia sonorensis (1)
- Chrysothamnus viscidiflorus
Orbilia aff. *delphinus* (1)
Orbilia lentiformis (1)
Orbilia ?macrotrapeziformis (1)
Orbilia aff. *multidelphinus* (1)
Orbilia ocellata (1)
Orbilia pleiolentiformis (1)
- Conyza canadensis
Orbilia caulicola (1)
Orbilia cookei (1)
- Ericameria nauseosa
Orbilia bicknellensis (1)
Orbilia delphinus (1)
Orbilia dixiensis (1)
Orbilia lentiformis (1)
Orbilia mesaverdiana (1)
Orbilia multimaeandrina (1)
Orbilia multiphanosoma (3)
Orbilia multitrapezoidea (1)
Orbilia myriophanosoma (1)
Orbilia ocellata (3)
Orbilia pleiolentiformis (1)
Orbilia plurilentiformis (1)
Orbilia serpentina (1)
- Helianthus tuberosus
Orbilia ebuli (2)
Orbilia oxyspora (1)
- Kleinia neriifolia
Orbilia eucalypti (1)
Orbilia pleiomicrosoma (1)
- Petasites hybridus
Orbilia auricolor s.l. (1)
***- Senecio* sp.**
Hyalorbilia latispora (1)
Orbilia quaestiformis (1)
- Solanecio gigas
Orbilia ?caudata (1)
Orbilia euphorbiae (1)
Orbilia aff. *menageshae* (2)
***- Solidago* sp.**
Orbilia ?cardui (1)
Orbilia solidaginis (1)
- Solidago canadensis
Orbilia vitalbae (1)
- Tanacetum vulgare
Orbilia caulicola (1)
Orbilia flavida (2)
Orbilia quaestiformis (2)
- Tussilago farfara
Orbilia cardui (1)

Cichorioideae
- Cichorium intybus
Orbilia bicknellensis (1)
Orbilia pleiolentiformis (1)
- Sonchus pinnatus
Orbilia vinosa (1)

Carduoideae
***- Arctium* sp.**
Orbilia auricolor s.l. (4)
- Arctium lappa
Orbilia auricolor s.l. (3)
Orbilia caulicola (1)
- Arctium minus
Orbilia oxyspora (1)
***- Carduus* sp.**
Orbilia ?oxyspora (1)
- Carlina xeranthemoides
Orbilia gambelii (1)
Orbilia ocellata (1)
- Centaurea jacobaea
Hyalorbilia ?herbicola (1)
***- Cirsium* sp.**
Orbilia ?cylindrosoma (1)
Orbilia vitalbae (1)
- Cirsium arvense
Orbilia oxyspora (1)
- Cirsium palustre
Orbilia atlantis (2)
Orbilia epilobii (1)
Orbilia minutispora (1)
- Cirsium vulgare
Orbilia oxyspora (2)
- Echinops sphaerocephalus
Orbilia caulicola (2)
Orbilia flavida (4)
Orbilia quaestiformis (3)
- Onopordum acanthium
Orbilia auricolor s.l. (1)

• Campanulaceae
- Lobelia giberroa
Hyalorbilia ?brevistipitata (1)
Orbilia lobeliae (1)

• Goodeniaceae
- Verreauxia reinwardtii
Orbilia amberina (1)
Orbilia curvativitalbae (1)
Orbilia lilacina (1)
Orbilia plurililacina (1)
Orbilia triangulispora (1)

DIPSACALES
• Adoxaceae
***- Sambucus* sp.**
Orbilia vibrioides (1)
- Sambucus ebulus
Orbilia ebuli (1)
Hyalorbilia erythrostigma (1)
Orbilia caulicola (3)
Orbilia cylindrosoma (3)
Orbilia ebuli (3/1)
Orbilia flavida (2)
Orbilia ?paravitalbae (1)
Orbilia ungulata (2)
Orbilia vitalbae (1)
- Sambucus nigra
Hyalorbilia erythrostigma (1)
Hyalorbilia fusispora (2)
Hyalorbilia rotifera (1)
Hyalorbilia ulicicola (2)
Orbilia aprilis (5)
Orbilia ?cejpii (1)
Orbilia cylindrosoma (1)
Orbilia dryadum (1)
Orbilia eucalypti (2)
Orbilia euonymi (3)
Orbilia ficicola (1)
Orbilia filiformis (3)
Orbilia oxyspora (1)
Orbilia pleioeuonymi (3)
Orbilia quaestiformis (2)
Orbilia sarraziniana (1)
Orbilia ungulata (1)
Orbilia vitalbae (1)
Retiarius ?revayae (1)

- Sambucus racemosa
Orbilia aprilis (2)
Orbilia epipora (1)
Orbilia eucalypti (1)
Orbilia euonymi (2)
Orbilia filiformis (1)
Orbilia quaestiformis (1)
Orbilia subtrapeziformis (1)
Orbilia vinosa (3)
Orbilia vitalbae (2)
- Viburnum lantana
Orbilia aristata (1)
Orbilia quaestiformis (1)
Orbilia vitalbae (1)

• Caprifoliaceae
Caprifolioideae
***- Lonicera* sp.**
Orbilia euonymi (1)
Orbilia vinosa (1)
- Lonicera altaica
Orbilia concoloris (1)
Orbilia delphinus (2)
Orbilia euonymi (1)
Orbilia mongolica (1)
Orbilia ocellata (1)
- Lonicera etrusca
Orbilia albovinosa (1)
Orbilia gambelii (1)
Orbilia vitalbae (1)
- Lonicera implexa
Orbilia albovinosa (1)
Orbilia hesperidea (1)
Orbilia obtusispora (1)
Orbilia subclavuliformis (1)
Orbilia subsphaerospora (1)
- Lonicera microphylla
Orbilia basiflexa (1)
Orbilia concoloris (1)
Orbilia delphinus (1)
Orbilia maeandrina (1)
- Lonicera periclymenum
Hyalorbilia fusispora (1)
Orbilia aristata (1)
Orbilia delphinus (1)
Orbilia eucalypti (2)
Orbilia quaestiformis (1)
Orbilia septispora (1)
Orbilia vinosa (1)
- Lonicera tatarica
Hyalorbilia fusispora (1)
Hyalorbilia juliae (2)
Lecophagus ellipsoideus (1)
- Lonicera xylosteum
Hyalorbilia juliae (1)
Orbilia aristata (1)
Orbilia cylindrosoma (1)
Orbilia euonymi (2)
Orbilia filiformis (2)
Orbilia gambelii (1)
Orbilia ovoidea (1)
Orbilia subclavuliformis (1)
Orbilia subovoidea (1)
Orbilia vinosa (3)
- Symphoricarpos albus
Hyalorbilia subfusisporа (2)

Diervilloideae
***- Weigela* sp.**
Orbilia ?fissilis (1)

Dipsacoideae
- Knautia arvensis
Orbilia flavida (1)

PROTOZOA
Myxobacteria
***- Polyangium* sp.**
?*Orbilia epipora* (*Dactylella polyctona*) (1)

Animals

IMBRICATA (rhizopods)
- indet. testaceous rhizopods
Hyalorbilia tenuifusaria (1)
Orbilia ?xanthostigma (1)
- Euglypha laevis
Hyalorbilia ?inflatula (1)
Hyalorbilia quadridens (1)
Tridentaria *glossopaga* (1)
- Geococcus vulgaris
Hyalorbilia ?inflatula (1)

AMOEBOZOA
- Arcella vulgaris (testate amoeba)
?*Orbilia epipora* (*Tridentaria tylota*) (1)
- Difflugia constricta
Tridentaria carnivora

NEMATODA
- indet. nematodes
Lecophagus vermicola (?7)
Haptocara latirostrum (1)
- ?Aphelenchoides parietinus
Tridentaria implicans (1)
- Cactodera sp.
Hyalorbilia ulicis (1 eggs)
- Globodera pallida
Hyalorbilia fusarina (1 eggs)
- Globodera rostochiensis
Hyalorbilia oviparasitica (2 females)
- Heterodera glycines
Hyalorbilia ulicis (1 eggs)
- Heterodera schachtii
Hyalorbilia aff. *multiguttulata* (2 females)
Hyalorbilia oviparasitica (1 eggs)
***- Meloidogyne* sp.**
Hyalorbilia oviparasitica (4 eggs)
Hyalorbilia ulicis (1 eggs)
- Acrobeloides maximus*, *Panagrellus redivivus*, *Plectus parvus*, *Rhabditis terricola*, *Turbatrix aceti etc. (nematodes used to induce trapping organs in *Arthrobotrys*, *Dactylellina*, *Gamsylella*, and *Drechslerella*)

ROTIFERA
- indet. rotifers
Orbilia bembicodes (1)

Bdelloidea
- indet. bdelloid rotifers
Lecophagus ellipsoideus (4)
***- Adineta* sp.**
Lecophagus muscicola (4)
Lecophagus navicularis (1)
Lecophagus longisporus (2)
***- Philodina* sp.**
Lecophagus ?muscicola/longisporus (1)

Ploima
***- Lecane* sp.**
Lecophagus muscicola (2)

TARDIGRADA
- indet.
Lecophagus muscicola (1)
Lecophagus longisporus (1)
- Acutuncus antarcticus
Lecophagus '*antarcticus*' (1)
ARTHROPODA
Crustacea
Dactylellina copepodii (1)

Arachnida
- Acari
Orbilia alba (1)

Collembola
Orbilia alba (1)
- Sminthurides ?serratus
'*Dactylellina*' *entomopaga* (1)

Diptera
Orbilia alba (1)
- Chironomus sp.
Orbilia multiformis (1)

Coleoptera
- Pissodes strobi
Orbilia auricolor s.l. (1)
- Scolytus multistriatus
Orbilia arachnovinosa (1 mol. extr.)
Orbilia pseudoaristata (1 mol. extr.)

Dung

- Capreolus capreolus
Orbilia auricolor [*O. cladodes*] (2)
Orbilia oligospora (2)
Pseudorbilia bipolaris (1)
- Equus asinus
Orbilia ?oxyspora (1)
- Equus caballus
Orbilia oxyspora (1)
Orbilia auricolor (1)
Orbilia quaestiformis (1)
- Lepidoptera sp.
Orbilia oxyspora (1)
- Lepus europaeus
Orbilia auricolor s.l. (1)
Orbilia leporina (1)
Orbilia rectispora (1)
- ***Marsupials*** (kangaroo, wallaby)
Hyalorbilia ?inflatula (1)
Orbilia ?tremulae (1)
- ?Muridae
Orbilia oxyspora (1)
- Oryctolagus cuniculus
Orbilia auricolor s.l. (3)
Orbilia elegans (2)
Orbilia ellipsospora (1)
Orbilia oxyspora (1)
***- Ovis* sp.**
Orbilia sp. H.B. 8749 (1)
Orbilia elegans (1)

Bones

- Sus scrofa
Orbilia auricolor s.l. (1)
Orbilia sarraziniana (1)

Textile

Orbilia aristata (1)
Orbilia aurantiorubra (1)
Orbilia auricolor s.l. (3)
Orbilia blumenaviensis (1)
Orbilia brasiliensis (1)
Orbilia carpoboloides (5)
Orbilia ?clavispora (1)
Orbilia clavuliformis (1)
Orbilia eucalypti (1)
Orbilia flavida (1)
Orbilia flavidorosella (1)
Orbilia ?latispora (1)
Orbilia neocomma (1)
Orbilia phragmotricha (1)
Orbilia quaestiformis (1)
Orbilia subclavuliformis (1)
Orbilia ?vinosa (1)
Orbilia vitalbae (1)

Soil

Bryorbilia arenicola (1)
Orbilia sarraziniana (2)
Orbilia terrestris (2)

Appendix 2. List of countries in which *Orbiliomycetes* were recorded

Numbers in parentheses indicate the number of collections of a species (uncertain records after the slash or with '?'), for countries and continents the number of recorded species and after the slash the total number of collections. Included are those species for which an apothecial state is known, but also a few so far purely anamorphic taxa which are treated with collection data in this monograph. An asterisk (*) means that many further collections are reported in the literature. Literature reports without a sufficient description are omitted.

AFRICA: **mainland** (30/36)
Algeria (3/3)
Orbilia albovinosa (1)
Orbilia ?auricolor s.l. (1)
Orbilia ?milinana (1)

Ethiopia (8/11)
Hyalorbilia ?brevistipitata (1)
Hyalorbilia ?herbicola (1)
Orbilia aethiopica (1)
Orbilia ?caudata (1)
Orbilia euphorbiae (1)
Orbilia jugulospora (1)
Orbilia lobeliae (1)
Orbilia menageshae (2/3)

Eritrea (1/1)
Orbilia euphorbiae (1)

Kenya (1/1)
Orbilia ?menageshae (1)

Morocco (4/4)
Orbilia auricolor s.l. (1)
Orbilia eucalypti (1)
Orbilia lentiformis (1)
Orbilia vinosa (1)

Namibia (6/6)
Orbilia acaciae (1)
Orbilia caudimaeandrina (1)
Orbilia maeandrina (1)
Orbilia myrioflexa (1)
Orbilia namibica (1)
Orbilia pluristomachia (1)

Senegal (2/2)
Orbilia ?filiformis (1)
Orbilia senegalensis (1)

South Africa (7/7)
Amphosoma natalense (1)
Hyalorbilia japonica (1)
Orbilia auricolor s.l. (1)
Orbilia corculispora (1)
Orbilia jinguangsiensis (1)
Orbilia tenuissima (1)
Orbilia xanthostigma s.l. (1)

Tunisia (1/1)
Orbilia serpentina (1)

AFRICA: **islands**
Islands near Madagascar (14/15)
Comoros (11/12)
Hyalorbilia citrina (1)
Hyalorbilia ?japonica (1)
Hyalorbilia ?juliae (1)
Orbilia blumenaviensis (1)
Orbilia euphorbiae (1)
Orbilia ?fissilis (1)
Orbilia ?juruensis (1)
Orbilia nemaspora (2)
Orbilia ?rosea (1)
Orbilia vermiformis (1)
Orbilia ?yuanensis (1)

Mascarene Islands (3/3)
Orbilia ?aristata (1)
Orbilia eucalypti (1)
Orbilia vinosa (1)

AFRICA: **Macaronesia** (61/228)
Azores (1/2)
Hyalorbilia ?ulicicola (2)

Madeira (12/19)
Hyalorbilia inflatula (2)
Hyalorbilia lunata (1)
Hyalorbilia polypori (2)
Orbilia caulicola (1)
Orbilia cejpii (1)
Orbilia clavuliaristata (1)
Orbilia eucalypti (2)
Orbilia leucostigma (2)
Orbilia subclavuliformis (1)
Orbilia ?subulivinosa (2)
Orbilia vibrioides (2)
Orbilia xanthostigma (2)

Canary Islands (54/207)
Hyalorbilia berberidis (1)
Hyalorbilia brevistipitata (1)
Hyalorbilia erythrostigma (1)
Hyalorbilia fusispora (1)
Hyalorbilia helicospora (1)
Hyalorbilia inflatula (1)
Hyalorbilia lunata (11)
Hyalorbilia polypori (7)
Hyalorbilia tortuosa (4)
Orbilia acaciae (5)
Orbilia adenocarpi (10)
Orbilia amarilla (1)
Orbilia asomatica (5)
Orbilia aurantiorubra (1)
Orbilia beltraniae (8)
Orbilia ?bicknellensis (2)
Orbilia cejpii (3)
Orbilia corculispora (3)
Orbilia curvatitrapeziformis (1)
Orbilia desertorum (1)
Orbilia dorsalis (1)
Orbilia dryadum (10)
Orbilia ellipsospora (1)
Orbilia eucalypti (4*)
Orbilia euonymi (2)
Orbilia euphorbiae (1)
Orbilia flavida (1)
Orbilia flavidorosella (2)
Orbilia gambelii (5)
Orbilia hesperidea (3)
Orbilia ?luteorubella (1)
Orbilia liliputiana (2)
Orbilia macrodelphinus (1)
Orbilia microsoma (1)
Orbilia milinana (1)
Orbilia obtusispora (4)
Orbilia ocellata (1)
Orbilia ?paravitalbae (1)
Orbilia patellarioides (1)
Orbilia pisciformis (13)
Orbilia pleiogambelii (1)
Orbilia pleiomicrosoma (5)
Orbilia pleioungulata (12)
Orbilia pseudeuphorbiae (23)
Orbilia rubrovacuolata (2)
Orbilia scolecospora (6)
Orbilia serpentina (1)
Orbilia subaristata (3)
Orbilia subtrapeziformis (1)
Orbilia ?subulivinosa (2)
Orbilia succulenticola (11/1)
Orbilia ?tenuissima (1)
Orbilia vinosa (9)
Orbilia xanthostigma (5*)

NORTHERN AMERICA
(~176/618)
Canada (31/44)
Amphosoma resinicola (1)
Hyalorbilia ?anonyma (1)
Hyalorbilia ?fagi (1)
Hyalorbilia inflatula (1)
Hyalorbilia orbiliicola (1)
Hyalorbilia ?subfusispora (1)
Lecophagus vermicola (1)
Orbilia abutilonis (1)
Orbilia auricolor s.l. (1)
Orbilia brettii (1)
Orbilia brochopaga (1)
Orbilia canadensis (2)
Orbilia carpoboloides (4)
Orbilia ?cejpii (1)
Orbilia ?clavipisca (1)
Orbilia clavuliformis (2)
Orbilia crenatomarginata (3)
Orbilia ?eremaeae (1)
Orbilia eucalypti (2)
Orbilia flagellispora (1)
Orbilia flavida (1)
Orbilia flexisoma (1)
Orbilia ?frangulae (1)
Orbilia ovalis (1)
Orbilia pilifera (3)
Orbilia spathulata (1)
Orbilia subtrapeziformis (1)
Orbilia ?trapeziformis (1)
Orbilia vibrioides (2)
Orbilia vinosa (3)
Orbilia xanthostigma s.l. (1)

Greenland (3/3)
Orbilia canadensis (1)
Orbilia eucalypti (1)
Orbilia flagellispora (1)

USA (~1/55/5711)
Amphosoma macrosporum (1)
Amphosoma resinicola (1)
Hyalorbilia citrina (1)
Hyalorbilia ?erythrostigma (1)
Hyalorbilia ?fagi (3)
Hyalorbilia ?inflatula (1)
Hyalorbilia japonica (2)
Hyalorbilia oviparasitica (3)
Hyalorbilia subfusispora (1)
Hyalorbilia texensis (1)
Hyalorbilia tortuosa (1)
Lecophagus muscicola (1)
Mycoceros ?antennatissimus (1)
Orbilia angiosubvinosa (1)
Orbilia ?aprilis (3)
Orbilia aristata (3)
Orbilia arizonensis (7)
Orbilia atrolentiformis (1)
Orbilia aurantiorubra (1)
Orbilia auricolor s.l. (3)
Orbilia ?barrowensis (2)
Orbilia bicknellensis (14)
Orbilia brachychitonis (1)
Orbilia ?breviclava (1)
Orbilia brochopaga (2)
Orbilia cactacearum (4)
Orbilia calyptrata (13)
Orbilia carnegieae (1/1)
Orbilia carpoboloides (6)
Orbilia cejpii (2/3)
Orbilia cercocarpi (2)
Orbilia clavipisca (4)
Orbilia clavuliaristata (3/1)
Orbilia clavuliformis (1)
Orbilia ?commarosa (2)
Orbilia concoloris (1)
Orbilia coniferarum (6)
Orbilia cookei (1)
Orbilia cryptogena (6)
Orbilia cucumispora (5)
Orbilia cupularis (1)
Orbilia curvatitrapeziformis (1)
Orbilia delphinus (22/1)
Orbilia denticulata (2)
Orbilia dixiensis (3/1)
Orbilia dryadum (4)
Orbilia edulis (1)
Orbilia epipora (1)
Orbilia ?eremaeae (1)
Orbilia eucalypti (7)
Orbilia euonymi (7)
Orbilia flavida (1)
Orbilia flexisoma (6)
Orbilia floridensis (1)
Orbilia ?frangulae (1)
Orbilia gambelii (8)
Orbilia georgiana (5)
Orbilia ?gregorii (2)
Orbilia hesperidea (4)
Orbilia idahoensis (3/1)
Orbilia junci (6)
Orbilia lacrimispora (3/1)
Orbilia ?laevimarginata (2)
Orbilia lentiformis (19/3)
Orbilia leucostigma s.l. (1)
Orbilia luteorubella (1)
Orbilia macroasca (2)
Orbilia macrodelphinus (12)
Orbilia macrohesperidea (1)
Orbilia macroserpens (2)
Orbilia macrotrapeziformis (2/1)
Orbilia maeandrina (25)
Orbilia magnifica (6)
Orbilia ?megahesperidea (1)
Orbilia mesaverdiana (4)
Orbilia microsoma (5)
Orbilia ?montigena (1)
Orbilia ?multiaustrocylindrica (1)
Orbilia multicercocarpi (2/1)
Orbilia multicreosoteris (2)
Orbilia multidelphinus (1/2)
Orbilia multigambelii (9)
Orbilia multihamulata (2)
Orbilia multimacroasca (1)
Orbilia multimaeandrina (13)
Orbilia multiphanosoma (8)
Orbilia multiserpens (1)
Orbilia multitrapezoidea (5)
Orbilia multiurosperma (4)
Orbilia multivirgula (1)
Orbilia myriophanosoma (4)
Orbilia myrioolneyae (3)
Orbilia myriourosperma (5)
Orbilia navajoana (5/2)
Orbilia nemaspora (10)
Orbilia neocomma (1)
Orbilia ?obtusispora (5)
Orbilia occulta (4)

Orbilia ocellata (13)
Orbilia octosporoides (1)
Orbilia oligospora (1)
Orbilia ophiosoma (6)
Orbilia osteospermae (1)
Orbilia oxyspora (2)
Orbilia paloverdensis (1/1)
Orbilia paradoxoides (1)
Orbilia phanosoma (3)
Orbilia pileosoma (2)
Orbilia pisciculus (1)
Orbilia ?pleioalbidorosea (2)
Orbilia pleiocreosoteris (1)
Orbilia pleiolentiformis (4)
Orbilia pleiomesaverdiana (2/3)
Orbilia pleiomicrosoma (5/1)
Orbilia pleionavajoana (5/1)
Orbilia pleioserpens (3)
Orbilia ?pleioungulata (1)
Orbilia pleiourosperma (2)
Orbilia plurilentiformis (7)
Orbilia pluristomachia (7)
Orbilia ?plurivacuolata (1)
Orbilia polybrocha (3)
Orbilia ponderosae (1)
Orbilia pubescens (2)
Orbilia purshiae (6)
Orbilia regalis (1)
Orbilia renispora (9)
Orbilia saccharifera (1)
Orbilia saguarina (2)
Orbilia sarcobati (3)
Orbilia sarraziniana (1)
Orbilia sedonensis (3)
Orbilia serpentina (9)
Orbilia sinensis (2)
Orbilia sonorensis (9)
Orbilia spathulata (2)
Orbilia spermoides (7)
Orbilia stansburyanae (1)
Orbilia subcryptogena (1)
Orbilia subovoidea (1)
Orbilia subsiculispora (1)
Orbilia subtrapeziformis (1)
Orbilia tenuispora (1)
Orbilia tremuloidis (1)
Orbilia ?ungulata (1)
Orbilia vermiculati (6)
Orbilia vibrioides (1)
Orbilia vinosa (3/5)
Orbilia xanthoflexa (3/3)
Orbilia ?xanthoguttulata (1)
Orbilia xanthostigma s.l. (9)
Orbilia yuccae (1)

USA (Alaska) (2/2)
Orbilia ocellata (1)
Orbilia ?subclavuliformis (1)

POLYNESIA
Hawaii (1/1)
Orbilia abutilonis (1)

MIDDLE AMERICA (23/79)
Costa Rica (1/1)
Orbilia aureocrenulata (1)

Dominica (4/4)
Hyalorbilia citrina (1)
Orbilia auricolor s.l. (1)
Orbilia tenuissima (1)
Orbilia xanthostigma s.l. (1)

Guadeloupe (3/3)
Hyalorbilia ?japonica (1)
Orbilia blumenaviensis (1)
Orbilia tenuissima (1)

Jamaica (2/6)
Orbilia auricolor s.l. (3)
Orbilia tenuissima (3)

Martinique (8/11)
Hyalorbilia citrina (3)
Orbilia aureocrenulata (1)
Orbilia blumenaviensis (1)
Orbilia ?brochopaga (1)
Orbilia martinicensis (1)
Orbilia nemaspora (2)
Orbilia vermiformis (1)
Orbilia xanthostigma s.l. (1)

Mexico (7/13)
Orbilia auricolor s.l. (1)
Orbilia blumenaviensis (1)
Orbilia cocois (1)
Orbilia denticulata (1)
Orbilia desertorum (6)
Orbilia eucalypti (2)
Orbilia flagellispora (1)

Puerto Rico (15/41)
Hyalorbilia citrina (14)
Hyalorbilia inflatula (2)
Hyalorbilia japonica (3)
Hyalorbilia puertoricensis (2)
Orbilia aureocrenulata (3)
Orbilia auricolor s.l. (1)
Orbilia blumenaviensis (4)
Orbilia jesu-laurae (1)
Orbilia milinana (1)
Orbilia nemaspora (4)
Orbilia ?brochopaga (1)
Orbilia pilosa (2)
Orbilia subuliformis (1)
Orbilia tenuissima (1)
Orbilia xanthostigma s.l. (1)

SOUTH AMERICA (31/50)
Argentina (5/6)
Orbilia carpoboloides (1/1)
Orbilia eucalypti (1)
Orbilia nemaspora (1)
Orbilia ?scolecospora (1)
Orbilia xanthostigma s.l. (1)

Bolivia (1/1)
Orbilia gaillardii (1)

Brazil (8/12)
Hyalorbilia citrina (5)
Orbilia aureocrenulata (1)
Orbilia blumenaviensis (1)
Orbilia brasiliensis (1)
Orbilia caudata (1)
Orbilia disseminata (1)
Orbilia juruensis (1)
Orbilia neocomma (1)

Chile (1/1)
Orbilia xanthostigma s.l. (1)

Colombia (4/4)
Orbilia ?caulicola (1)
Orbilia colombiana (1)
Orbilia eucalypti (1)
Orbilia ?flavidorosella (1)

Ecuador (7/9)
Hyalorbilia andina (1)
Hyalorbilia anonyma (1)
Hyalorbilia citrina (1)
Orbilia auricolor s.l. (1)
Orbilia brochopaga (1)
Orbilia elegans (3)
Orbilia oxyspora (1)

French Guiana (2/2)
Orbilia guyanensis (1)
Hyalorbilia citrina (1)

Paraguay (1/1)
Orbilia tenuissima (1)

Peru (4/5)
Hyalorbilia ?erythrostigma (2)
Orbilia colombiana (1)
Orbilia puyae (1)
Orbilia ?xanthostigma (1)

Trinidad and Tobago (3/3)
Orbilia alba (1)
Orbilia ?crenatomarginata (1)
Orbilia pilosa (1)

Venezuela (6/6)
Hyalorbilia citrina (1)
Hyalorbilia ?inflatula (1)
Orbilia gaillardii (1)
Orbilia ?oxyspora (1)
Orbilia ?tenuissima (1)
Orbilia ?xanthostigma (1)

ANTARCTICA
Antarctica (2/3)
Lecophagus ?muscicola (1)
Orbilia auricolor s.l. (2)

ASIA (128/376)
China (excl. Taiwan) (92/213)
Arthrobotrys nonseptatus (1)
Hyalorbilia andina (3)
Hyalorbilia arcuata (8)
Hyalorbilia berberidis (3)
Hyalorbilia biguttulata (1)
Hyalorbilia brevistipitata (2)
Hyalorbilia erythrostigma (5)
Hyalorbilia ?fagi (3)
Hyalorbilia inflatula (3*)
Hyalorbilia japonica (7)
Hyalorbilia ?juliae (3)
Hyalorbilia lunata (3)
Hyalorbilia macrohelicospora (1)
Hyalorbilia multiguttulata (2)
Hyalorbilia nodulosa (1)
Hyalorbilia ?oreadum (6)
Hyalorbilia ?polypori (2)
Hyalorbilia ?texensis (1)
Hyalorbilia tortuosa (1)
Hyalorbilia ?ulicicola (7)
Orbilia acicularis (3)
Orbilia alba (1)
Orbilia apiculata (1)
Orbilia arcospora (1)
Orbilia ?aureocrenulata (1)
Orbilia auricolor s.l. (5*)
Orbilia bannaensis (1)
Orbilia ?battenii (2)
Orbilia biforma (1)
Orbilia binchuanensis (1)
Orbilia blumenaviensis (10)
Orbilia bomiensis (1)
Orbilia brevicauda (1)
Orbilia brochopaga (2)
Orbilia ?cardui (1)
Orbilia caudata (1)
Orbilia cejpii (4)
Orbilia ?clavispora (1)
Orbilia corculispora (2)
Orbilia crenatonemaspora (4)
Orbilia dorsalis (3/3)
Orbilia dryadum (1/3)
Orbilia ?elegans (2)
Orbilia ellipsospora (1)
Orbilia epipora (1)
Orbilia eucalypti (1*)
Orbilia falciformis (1)
Orbilia ?farnesianae (1)
Orbilia fissilis (1)
Orbilia fusiformis (2/2)
Orbilia hoana (10/1)
Orbilia javanica (2)
Orbilia jinguangsiensis (2)
Orbilia jugulospora (2)
Orbilia juruensis (3)
Orbilia laevimarginata (7/2)
Orbilia latispora (5/2)
Orbilia leucostigma s.l. (1)
Orbilia limoniformis (2)
Orbilia longquanensis (1)
Orbilia luteorubella (2*)
Orbilia lysipaga (6)
Orbilia milinana (2/1)
Orbilia multiformis (2)
Orbilia myrioeuonymi (1)
Orbilia nemaspora (1)
Orbilia neocomma (1)
Orbilia oligospora (*)
Orbilia ?orientalis (4)
Orbilia oxyspora (2)
Orbilia ?polybrocha (1)
Orbilia pseudobrevistipitata (1/1)
Orbilia pseudopolybrocha (3)
Orbilia quercus (3)
Orbilia rectispora (1/1)
Orbilia rosea (5/2)
Orbilia sarraziniana (2*)
Orbilia scaphoides (1)
Orbilia scolecospora (2)
Orbilia sinensis (4/2)
Orbilia sp. XJ-2009 (1)
Orbilia ?stilbospora (1)
Orbilia ?subfabacearum (1)
Orbilia tenuispora (8)
Orbilia tenuissima (1)
Orbilia tianmushanensis (1)
Orbilia tonghaiensis (2/2)
Orbilia tremulae (1)
Orbilia umbilicata (1/1)
Orbilia vermiformis (1)
Orbilia xanthostigma s.l. (3*)
Orbilia xinjiangensis (1)
Orbilia yuanensis (6)
Orbilia yunnanensis (6/2)
Orbilia zhongdianensis (1)
Pseudorbilia bipolaris (1)

India (1/1)
Orbilia auricolor s.l. (1)

Indonesia (3/3)
Hyalorbilia ?inflatula (1)
Orbilia javanica (1)
Orbilia neglecta (1)

Japan (20/37)
Hyalorbilia citrina (3)
Hyalorbilia japonica (5)
Hyalorbilia tortuosa (1)
Lecophagus muscicola (1)
Orbilia auricolor s.l. (1)
Orbilia ?battenii (1)
Orbilia ?cejpii (1)
Orbilia dryadum (2)
Orbilia fissilis (1)
Orbilia ?frangulae (1)
Orbilia multiformis (2)
Orbilia orientalis (1)
Orbilia ?renispora (1)
Orbilia sarraziniana (1)
Orbilia sinensis (1)
Orbilia spirospora (1)
Orbilia tenuispora (1)
Orbilia umbilicata (1/1)

Orbilia ?xanthoflexa (1)
Orbilia xanthostigma s.l. (9)

Kyrgyzstan (1/1)
Orbilia ?cardui (1)

Mongolia (13/20)
Orbilia aristata (2)
Orbilia basiflexa (1)
Orbilia concoloris (2)
Orbilia ?coniferarum (1)
Orbilia delphinus (6)
Orbilia euonymi (1)
Orbilia lentiformis (1)
Orbilia maeandrina (1)
Orbilia mongolica (1)
Orbilia ocellata (1)
Orbilia phanosoma (1)
Orbilia phragmotricha (1)
Orbilia subtrapeziformis (1)

Pakistan (2/2)
Orbilia ?caudata (1)
Orbilia ?trapeziformis (1)

Philippines (1/1)
Orbilia pseudobrevistipitata (1)

Russian Federation (East) (20/32)
Hyalorbilia ?fagi (1)
Hyalorbilia inflatula (1)
Hyalorbilia ?japonica (1)
Hyalorbilia sibirica (1)
Orbilia arachnovinosa (1)
Orbilia aristata (1)
Orbilia cardui (1)
Orbilia crenatomarginata (2)
Orbilia dryadum (1)
Orbilia epipora (1)
Orbilia fissilis (1)
Orbilia lentiformis (1)
Orbilia orientalis (1)
Orbilia oxyspora (1)
Orbilia phragmotricha (1)
Orbilia rosea (1)
Orbilia sarraziniana (5)
Orbilia tremulae (2)
Orbilia ?umbilicata (1)
Orbilia xanthostigma s.l. (6/1)

Singapore (1/1)
Orbilia blumenaviensis (1)

Taiwan (19/26)
Hyalorbilia arcuata (3)
Hyalorbilia biguttulata (1)
Hyalorbilia japonica (2)
Hyalorbilia tortuosa (1)
Hyalorbilia ?ulicicola (1)
Orbilia brochopaga (1)
Orbilia ?caudata (1)
Orbilia ?dorsalis (1)
Orbilia dryadum (1)
Orbilia eucalypti (2)
Orbilia hoana (1)
Orbilia javanica (2)
Orbilia jugulospora (1)
Orbilia oxyspora (1)
Orbilia ?polybrocha (1)
Orbilia sinensis (1/1)
Orbilia tenuispora (1)
Orbilia xanthostigma s.l. (1)
Orbilia yuanensis (2)

Tajikistan (1/2)
Orbilia terrestris (2)

Thailand (7/8)
Hyalorbilia arcuata (1)
Hyalorbilia ?erythrostigma (1)
Hyalorbilia tortuosa (1)
Orbilia ?caudata (1)
Orbilia milinana (1)
Orbilia nemaspora (1)
Orbilia ?renispora (2)

Turkey (13/28)
Orbilia aprilis (1)
Orbilia carpoboloides (1)
Orbilia eucalypti (1)
Orbilia euonymi (7)
Orbilia flavida (1)
Orbilia gambelii (1)
Orbilia ovalis (1)
Orbilia pleiomicrosoma (2)
Orbilia subaristata (7)
Orbilia subovoidea (2)
Orbilia subvinosa (1)
Orbilia vinosa (2)
Orbilia xanthostigma (1)

Vietnam (2/2)
Hyalorbilia tortuosa (1)
Orbilia ?subfabacearum (1)

AUSTRALASIA (158/508)
Australia (154/456)
Hyalorbilia arcuata (1)
Hyalorbilia citrina (1)
Hyalorbilia ?erythrostigma (2)
Hyalorbilia inflatula (4)
Hyalorbilia juliae (1)
Hyalorbilia ?orbiliicola (8)
Hyalorbilia pleioerythrostigma (1)
Hyalorbilia polypori (1)
Orbilia myriostomachia (1)
Orbilia acaciae (5)
Orbilia ?acuum (1)
Orbilia albidorosea (4)
Orbilia allantoobliqua (1)
Orbilia amberina (4)
Orbilia anguliobliqua (3)
Orbilia angustoaristata (2/1)
Orbilia angustoobliqua (1)
Orbilia anigozanthi (2)
Orbilia arachnopus (2/1)
Orbilia astrovinosa (3)
Orbilia ?atlantis (1)
Orbilia atriplicis (1)
Orbilia auricolor s.l. (1)
Orbilia australiensis (17/3)
Orbilia austrocylindrica (7)
Orbilia austroobtusispora (5)
Orbilia austroocculta (1)
Orbilia austropleiomicrosoma (3)
Orbilia austroregalis (2)
Orbilia aviaristata (2)
Orbilia aviceps (6)
Orbilia aviflagellata (1)
Orbilia bambusina (2)
Orbilia barrowensis (2)
Orbilia bicknellensis (1)
Orbilia brachychitonis (5)
Orbilia ?breviaristata (1)
Orbilia carminorosea (1)
Orbilia ?carpoboloides (1)
Orbilia cejpii (3)
Orbilia commarosa (8)
Orbilia ?coniferarum (1)
Orbilia corculispora (5)
Orbilia coronohesperidea (6)
Orbilia curvatimyriella (1)
Orbilia curvatinavajoana (2)
Orbilia curvatiobliqua (1)
Orbilia curvativitalbae (6)
Orbilia ?dixiensis (1)
Orbilia ?dryadum (1)
Orbilia eremaeae (1)
Orbilia eucalypti (15)
Orbilia euphorbiae (5)
Orbilia farnesianae (2)
Orbilia fimbriata (1)
Orbilia ?flagellispora (1)
Orbilia flexispora (1)
Orbilia ?fusiformis (1)
Orbilia geijerae (1)
Orbilia gemma (1)
Orbilia gregorii (1)
Orbilia helicoobliqua (2)
Orbilia helicovinosa (1)
Orbilia hesperidea (5/2)
Orbilia kingsiana (5)
Orbilia ?lacrimispora (1)
Orbilia lamarcheae (1)
Orbilia lanternae (1)
Orbilia lentiformis (1)
Orbilia lilacina (2)
Orbilia livistonae (4/1)
Orbilia macrocarpa (2/1)
Orbilia macrotrapeziformis (3)
Orbilia maeandrina (1)
Orbilia mammifera (2)
Orbilia megahesperidea (1)
Orbilia megaocculta (1)
Orbilia microserpens (11)
Orbilia mirabilis (2/1)
Orbilia multiaustraliensis (2/1)
Orbilia multiaustrocylindrica (1/2)
Orbilia multicurvula (4)
Orbilia multigambelii (1/3)
Orbilia multinanosoma (1)
Orbilia multiserpens (7/6)
Orbilia ?multitrapezoidea (2)
Orbilia multivinosa (1)
Orbilia ?multivirgula (2)
Orbilia myriella (4/2)
Orbilia myrioauris (2)
Orbilia myrioaustraliensis (3)
Orbilia myrioeuonymi (3)
Orbilia myriofusiclava (8)
Orbilia myriofusoidea (1)
Orbilia myriohesperidea (1)
Orbilia myriolilacina (3)
Orbilia myriomuscula (5)
Orbilia myrionamibica (2/1)
Orbilia myrionanosoma (3)
Orbilia myrioobliqua (14)
Orbilia ?myrioolneyae (1)
Orbilia myriopseudoregalis (1)
Orbilia nanosperma (1)
Orbilia ?navajoana (1)
Orbilia neocomma (3)
Orbilia nothoaprilis (1/4)
Orbilia nothovinosa (7/2)
Orbilia octocercocarpi (3)
Orbilia octoserpentina (6)
Orbilia palmicola (1)
Orbilia paracaudata (1)
Orbilia paraobliqua (2)
Orbilia parviclava (1/2)
Orbilia phanosoma (5)
Orbilia phragmitis (1)
Orbilia pleioaustraliensis (11/1)
Orbilia pleioaustrocylindrica (2)
Orbilia pleiocoronohesperidea (3/1)
Orbilia pleiocrescens (1)
Orbilia ?pleiogambelii (1)
Orbilia pleiohesperidea (2)
Orbilia pleiolentiformis (1)
Orbilia pleioobtusispora (1)
Orbilia pleioquaestiformis (1)
Orbilia pleioserpens (6/4)
Orbilia pleiostomachia (1)
Orbilia pleioungulata (4)
Orbilia pleiovinosa (1)
Orbilia pleiovirgula (1)
Orbilia pleiovitalbae (1)
Orbilia pleistolilacina (2)
Orbilia pleistoobliqua (1)
Orbilia pleistovitalbae (2)
Orbilia plurililacina (4)
Orbilia pluristomachia (5)
Orbilia ?pseudeuphorbiae (1)
Orbilia pseudoaristata (1)
Orbilia pseudoflagellispora (2/1)
Orbilia ?pubescens (2)
Orbilia ?puyae (1)
Orbilia ?saguarina (3)
Orbilia scandens (2)
Orbilia scolecospora (1)
Orbilia serpentina (5/1)
Orbilia spirillospora (1)
Orbilia stilbospora (1)
Orbilia subalbovinosa (1)
Orbilia ?subclavuliformis (1)
Orbilia subfabacearum (2)
Orbilia ?tremulae (2)
Orbilia triangulispora (2)
Orbilia urosperma (1)
Orbilia velutina (1)
Orbilia wannerooensis (2)
Orbilia xanthostigma s.l. (1/1)

New Zealand (5/52)
Hyalorbilia ?ulicicola (1)
Lecophagus muscicola (1)
Orbilia cunninghamii (20)
Orbilia ?luteorubella (2)
Orbilia xanthostigma s.l. (17)

MELANESIA (3/3)
Papua New Guinea (1/1)
Orbilia oxyspora (1)

Solomon Islands (2/2)
Orbilia juruensis (1)
Orbilia ?xanthostigma s.l. (1)

EUROPE (231/5317)
Andorra (1/1)
Orbilia vinosa (1)

Austria (60/232)
Hyalorbilia berberidis (1)
Hyalorbilia erythrostigma (3)
Hyalorbilia fagi (6)
Hyalorbilia fusispora (1)
Hyalorbilia inflatula (11)
Hyalorbilia juliae (3)
Hyalorbilia multiguttulata (1)
Hyalorbilia orbiliicola (1)
Hyalorbilia polypori (1)
Hyalorbilia subfusispora (1)
Orbilia alpigena (6)
Orbilia ?angustoaristata (2)
Orbilia aprilis (5)
Orbilia arachnovinosa (1/1)
Orbilia aristata (8)
Orbilia aurantiorubra (12)
Orbilia auricolor s.l. (3)
Orbilia breviclava (1)
Orbilia carpoboloides (8)
Orbilia cejpii (2)
Orbilia clavuliformis (3)
Orbilia comma (4)
Orbilia crenatomarginata (9)
Orbilia crenatovinosa (5)
Orbilia cylindrosoma (1)
Orbilia dryadum (2)

Orbilia epipora (2)
Orbilia eucalypti (11)
Orbilia euonymi (5)
Orbilia ?fraxini (1)
Orbilia ficicola (9/2)
Orbilia ?fissilis (1)
Orbilia flagellispora (2)
Orbilia inconspicua (2)
Orbilia leucostigma (5)
Orbilia luteorubella (2)
Orbilia ?lysipaga (1)
Orbilia mali (1)
Orbilia obtusispora (2)
Orbilia orientalis (1)
Orbilia ovalis (1)
Orbilia ovoidea (1)
Orbilia oxyspora (1)
Orbilia phragmotricha (6)
Orbilia pilifera (3)
Orbilia pleioeuonymi (1)
Orbilia pseudoaristata (1)
Orbilia polybrocha (1)
Orbilia rosea (2/1)
Orbilia sarraziniana (14)
Orbilia septispora (1)
Orbilia sphaerospora (1)
Orbilia subaristata (1)
Orbilia subcylindrospora (1)
Orbilia subtrapeziformis (2)
Orbilia trapeziformis (5)
Orbilia tremulae (3)
Orbilia vinosa (13)
Orbilia xanthoguttulata (5)
Orbilia xanthostigma (19)

Azerbaijan (7/9)
Hyalorbilia fagi (3)
Hyalorbilia ?japonica (1)
Orbilia epipora (1)
Orbilia sarraziniana (1)
Orbilia ?scolecospora (1)
Orbilia sinensis (1)
Orbilia xanthostigma (1)

Belgium (21/40)
Hyalorbilia berberidis (1)
Hyalorbilia erythrostigma (1)
Hyalorbilia inflatula (2)
Hyalorbilia juliae (1)
Hyalorbilia multiguttulata (1)
Hyalorbilia rotifera (1)
Orbilia aristata (4)
Orbilia aurantiorubra (3)
Orbilia auricolor (4)
Orbilia carpoboloides (2)
Orbilia cladodes (1)
Orbilia eucalypti (3)
Orbilia ?flavida (1)
Orbilia leucostigma (1)
Orbilia orientalis (1)
Orbilia oxyspora (1)
Orbilia rectispora (2)
Orbilia rubrovacuolata (4)
Orbilia sarraziniana (1)
Orbilia septispora (4)
Orbilia trapeziformis (1)

Croatia (25/70)
Hyalorbilia juliae (1)
Orbilia albovinosa (1)
Orbilia aprilis (2)
Orbilia auricolor s.l. (2)
Orbilia coniferarum (1)
Orbilia corculispora (1)
Orbilia ?cotoneastri (1)
Orbilia dalmatica (1)
Orbilia eucalypti (1)
Orbilia euonymi (1)
Orbilia flavida (1)
Orbilia gambelii (6)
Orbilia hesperidea (12)
Orbilia myriosphaera (2)
Orbilia obtusispora (4)
Orbilia polyspora (2)
Orbilia subaristata (5)
Orbilia subclavuliformis (4)
Orbilia subovoidea (2)
Orbilia subsphaerospora (2)
Orbilia ?ungulata (1)
Orbilia vibrioides (2)
Orbilia vinosa (13)
Orbilia vitalbae (1)
Orbilia xanthostigma (1)

Czechia (42/90)
Hyalorbilia berberidis (5)
Hyalorbilia fusispora (1)
Hyalorbilia inflatula (3)
Hyalorbilia juliae (2)
Hyalorbilia polypori (2/1)
Hyalorbilia subfusispora (1)
Orbilia acuum (1)
Orbilia aprilis (4)
Orbilia aristata (2)
Orbilia aurantiorubra (2)
Orbilia auricolor s.l. (3)
Orbilia cardui (4/1)
Orbilia carpoboloides (2)
Orbilia ?clavispora (1)
Orbilia clavuliformis (1)
Orbilia cotoneastri (1)
Orbilia crenatomarginata (2)
Orbilia cyparissias (1)
Orbilia dryadum (1)
Orbilia ?ebuli (1)
Orbilia eucalypti (5)
Orbilia euonymi (2)
Orbilia ?flagellispora (1)
Orbilia flavidorosella (1)
Orbilia leporina (1)
Orbilia leucostigma (2)
Orbilia luteorubella (4)
Orbilia minutispora (1)
Orbilia oxyspora (2/1)
Orbilia pleistoeuonymi (1)
Orbilia polybrocha (1)
Orbilia pseudoaristata (2)
Orbilia rectispora (1)
Orbilia ?rosea (4)
Orbilia rosella (1)
Orbilia ?rubrovacuolata (1)
Orbilia ?sarraziniana (2)
Orbilia septispora (1)
Orbilia trapeziformis (1)
Orbilia tremulae (2)
Orbilia vinosa (5)
Orbilia xanthostigma (6)

Denmark (21/50)
Hyalorbilia inflatula (5)
Hyalorbilia juliae (1)
Orbilia aprilis (9)
Orbilia ?aristata (1)
Orbilia aurantiorubra (1)
Orbilia auricolor s.l. (1)
Orbilia comma (6)
Orbilia crenatomarginata (2)
Orbilia dryadum (3)
Orbilia epipora (1)
Orbilia eucalypti (1)
Orbilia euonymi (1)
Orbilia filiformis (1)
Orbilia graminis (1)
Orbilia leucostigma (3)
Orbilia rectispora (1)
Orbilia rosea (2)
Orbilia sarraziniana (2)
Orbilia septispora (1)
Orbilia vinosa (4)
Orbilia xanthostigma (3)

Estonia (9/13)
Hyalorbilia berberidis (2)
Hyalorbilia fomentarii (1)
Hyalorbilia inflatula (3)
Hyalorbilia juliae (2)
Hyalorbilia polypori (1)
Hyalorbilia tortuosa (1)
Orbilia auricolor s.l. (1)
Orbilia leucostigma s.l. (1)
Orbilia oxyspora (1)

Finland (18/39)
Hyalorbilia berberidis (3)
Hyalorbilia inflatula (5)
Hyalorbilia polypori (1)
Orbilia ?arachnovinosa (1)
Orbilia aristata (2)
Orbilia auricolor s.l. (3)
Orbilia ebuli (2)
Orbilia epipora (2)
Orbilia eucalypti (2)
Orbilia leucostigma (1)
Orbilia luteorubella (1)
Orbilia phragmotricha (9)
Orbilia plurivacuolata (1)
Orbilia rosea (1)
Orbilia vinosa (1)
Orbilia vitalbae (1)
Orbilia xanthoguttulata (3)
Orbilia xanthostigma (1)

France (136/1181)
Amphosoma atroolivaceum (29)
Amphosoma resinicola (7/1)
Hyalorbilia berberidis (4)
Hyalorbilia erythrostigma (13)
Hyalorbilia ?fagi (1)
Hyalorbilia fomentarii (2)
Hyalorbilia fusispora (24)
Hyalorbilia helicospora (4)
Hyalorbilia herbicola (1)
Hyalorbilia ?hergiswiliana (1)
Hyalorbilia inflatula (39)
Hyalorbilia juliae (13)
Hyalorbilia lunata (1)
Hyalorbilia multiguttulata (2)
Hyalorbilia orbiliicola (3)
Hyalorbilia subfusispora (4/1)
Hyalorbilia tortuosa (5)
Hyalorbilia ulicicola (39)
Lecophagus pini (2)
Lecophagus subglobosus (2)
Lecophagus vermicola (3)
Lilapila gallica (5)
Lilapila jurana (2)
Lilapila oculispora (11)
Lilapila oculisporella (19)
Orbilia albovinosa (1)
Orbilia alpigena (3)
Orbilia aprilis (38)
Orbilia arachnovinosa (5)
Orbilia aradi (1)
Orbilia aristata (16/2)
Orbilia atlantis (6)
Orbilia aurantiorubra (37)
Orbilia auricolor s.l. (32)
Orbilia beatricis (1)
Orbilia breviaristata (7)
Orbilia cardui (2/1)
Orbilia carpoboloides (21/2)
Orbilia caulicola (8)
Orbilia cejpii (4/2)
Orbilia cercidicola (3)
Orbilia cisti (1)
Orbilia clavuliformis (4)
Orbilia comma (9)
Orbilia coniferarum (1)
Orbilia corculispora (30)
Orbilia cotoneastri (2)
Orbilia crenatomarginata (14)
Orbilia cupressi (1)
Orbilia cylindrosoma (1)
Orbilia cylindrospora (10)
Orbilia delphinus (3/2)
Orbilia dryadum (1/4)
Orbilia epilobii (1/5)
Orbilia epipora (7)
Orbilia eucalypti (62)
Orbilia euonymi (17)
Orbilia fabacearum (8)
Orbilia ficicola (6)
Orbilia filiformis (13)
Orbilia fissilis (1/1)
Orbilia flagellispora (7)
Orbilia flavida (7)
Orbilia foliicola (1)
Orbilia frangulae (1)
Orbilia fraxini (1)
Orbilia frullaniae (1/1)
Orbilia gambelii (24)
Orbilia ?graminis (2)
Orbilia hesperidea (5)
Orbilia jacaensis (1)
Orbilia lentiformis (1)
Orbilia leucostigma (6)
Orbilia luteorubella (2)
Orbilia maeandrina (1)
Orbilia mali (3)
Orbilia ?mammillata (1)
Orbilia microlentiformis (1)
Orbilia microsoma (1)
Orbilia montigena (2)
Orbilia myriolentiformis (1)
Orbilia myriosphaera (6)
Orbilia obtusispora (16/1)
Orbilia ocellata (2)
Orbilia olivacea (3)
Orbilia orientalis (5)
Orbilia ovalis (3)
Orbilia ovoidea (8)
Orbilia oxyspora (5)
Orbilia paracylindrospora (1)
Orbilia patellarioides (13)
Orbilia phragmotricha (12)
Orbilia pilifera (14)
Orbilia pilosa (1)
Orbilia pleioeuonymi (4/1)
Orbilia pleiogambelii (5)
Orbilia pleiolentiformis (1)
Orbilia pleiomicrosoma (3)
Orbilia pleistoeuonymi (1)
Orbilia plurivacuolata (1)
Orbilia poitevinica (1)
Orbilia polyspora (17)
Orbilia pseudoaristata (2)
Orbilia pseudocylindrospora (1)
Orbilia pyrenaica (1)
Orbilia quaestiformis (15)
Orbilia quercus-ilicis (1)
Orbilia rectispora (3)
Orbilia rosea (14/4)
Orbilia rubrovacuolata (28)
Orbilia sarothamni (1)
Orbilia sarraziniana (14)
Orbilia septispora (1)
Orbilia spermoides (1)

Orbilia sphaerospora (9)
Orbilia subaristata (13)
Orbilia subclavuliformis (25/1)
Orbilia subcylindrospora (3)
Orbilia subdelphinus (2)
Orbilia subocellata (1)
Orbilia subovoidea (3)
Orbilia subsphaerospora (1)
Orbilia subtrapeziformis (9)
Orbilia subulivinosa (1)
Orbilia subvinosa (21/2)
Orbilia subvitalbae (2)
Orbilia trapeziformis (25)
Orbilia tremulae (8/4)
Orbilia ungulata (4)
Orbilia vibrioides (10)
Orbilia vinosa (77)
Orbilia vitalbae (6/1)
Orbilia xanthoguttulata (13)
Orbilia xanthostigma (22/1)
Pseudorbilia bipolaris (1)
Retiarius ?bovicornutus (1)

Georgia (3/3)
Orbilia ?xanthostigma (1)
Hyalorbilia fagi (1)
Hyalorbilia caucasica (1)

Germany (98/1257)
Amphosoma atroolivaceum (2)
Hyalorbilia berberidis (3)
Hyalorbilia erythrostigma (6)
Hyalorbilia fagi (7)
Hyalorbilia fomentarii (1)
Hyalorbilia fusispora (2)
Hyalorbilia helicospora (6)
Hyalorbilia ?hergiswiliana (2)
Hyalorbilia inflatula (74)
Hyalorbilia juliae (28)
Hyalorbilia latispora (1)
Hyalorbilia multiguttulata (1)
Hyalorbilia orbiliicola (1)
Hyalorbilia oreadum (1)
Hyalorbilia polypori (4)
Hyalorbilia resinae (1)
Hyalorbilia rotifera (1)
Hyalorbilia subfusispora (54)
Hyalorbilia tortuosa (1/1)
Lecophagus ellipsoideus (2)
Lecophagus muscicola (1)
Liladisca acicola (1)
Orbilia alpigena (2)
Orbilia aprilis (78)
Orbilia arachnovinosa (2/1)
Orbilia aradi (1)
Orbilia aristata (74)
Orbilia aurantiorubra (23)
Orbilia auricolor s.l. (30/1)
Orbilia bembicodes (1)
Orbilia breviaristata (2)
Orbilia cardui (2/1)
Orbilia carpoboloides (8)
Orbilia caulicola (8)
Orbilia cejpii (7/3)
Orbilia ?clavispora (1)
Orbilia clavuliaristata (1)
Orbilia clavuliformis (18)
Orbilia comma (22)
Orbilia crenatomarginata (25)
Orbilia cylindrosoma (7)
Orbilia cylindrospora (4)
Orbilia dryadum (16)
Orbilia ebuli (2)
Orbilia elegans (2)
Orbilia epilobii (3)
Orbilia epipora (10)
Orbilia eucalypti (109)
Orbilia euonymi (30)
Orbilia filiformis (19)
Orbilia fissilis (1/1)
Orbilia flagellispora (2)
Orbilia flavida (2)
Orbilia flavidorosella (2)
Orbilia flavovacuolata (1)
Orbilia fraxini (3)
Orbilia graminis (1)
Orbilia jurana (1)
Orbilia leucostigma (36)
Orbilia luteorubella (15)
Orbilia mali (2)
Orbilia mammillata (3)
Orbilia montigena (5)
Orbilia naumburgensis (5)
Orbilia obtusispora (9/1)
Orbilia ocellata (3)
Orbilia oligospora (1)
Orbilia orientalis (4)
Orbilia oxyspora (7/1)
Orbilia phragmotricha (8)
Orbilia pleioeuonymi (7)
Orbilia pleistoeuonymi (2)
Orbilia plurivacuolata (4)
Orbilia polybrocha (2)
Orbilia pseudoaristata (2)
Orbilia quaestiformis (9)
Orbilia rectispora (11)
Orbilia rehmii (1)
Orbilia rosea (13/2)
Orbilia rosella (2)
Orbilia rubella (9)
Orbilia rubrovacuolata (1)
Orbilia sarraziniana (51/12)
Orbilia septispora (4)
Orbilia siculispora (8)
Orbilia solidaginis (1)
Orbilia subclavuliformis (1)
Orbilia subsphaerospora (1)
Orbilia trapeziformis (22)
Orbilia tremulae (13/12)
Orbilia ungulata (2)
Orbilia vibrioides (1)
Orbilia vinosa (89)
Orbilia vitalbae (14/1)
Orbilia xanthoguttulata (13)
Orbilia xanthostigma (107/18)
Orbilia zhongdianensis (2)
Retiarius bovicornutus (1)

Great Britain (48/222)
Hyalorbilia berberidis (5)
Hyalorbilia ?biguttulata (1)
Hyalorbilia erythrostigma (2)
Hyalorbilia fusispora (1)
Hyalorbilia ?herbicola (1)
Hyalorbilia inflatula (7)
Hyalorbilia juliae (1)
Hyalorbilia lunata (2)
Hyalorbilia rotifera (1)
Hyalorbilia subfusispora (5)
Hyalorbilia ulmi (1)
Orbilia aprilis (21)
Orbilia aristata (1)
Orbilia atlantis (5)
Orbilia aurantiorubra (10)
Orbilia auricolor s.l. (5)
Orbilia battenii (1)
Orbilia ?cardui (1)
Orbilia carpoboloides (5)
Orbilia caulicola (2)
Orbilia clavispora (1)
Orbilia clavuliformis (2)
Orbilia comma (9)
Orbilia corculispora (8)
Orbilia crenatomarginata (1)
Orbilia dryadum (1)
Orbilia epilobii (3)
Orbilia epipora (2)
Orbilia eucalypti (26)
Orbilia euonymi (2)
Orbilia fabacearum (1)
Orbilia graminis (1)
Orbilia leucostigma (1)
Orbilia luteorubella (6)
Orbilia mammillata (1)
Orbilia oxyspora (2)
Orbilia quaestiformis (5)
Orbilia rectispora (1)
Orbilia rosea (21)
Orbilia rubrovacuolata (13)
Orbilia sarraziniana (13)
Orbilia scaphoides (1)
Orbilia septispora (2)
Orbilia trapeziformis (1)
Orbilia tremulae (2)
Orbilia vibrioides (4)
Orbilia vinosa (14)
Orbilia xanthostigma (10)

Greece (12/25)
Orbilia bicknellensis (2)
Orbilia corculispora (1)
Orbilia eucalypti (1)
Orbilia gambelii (5)
Orbilia hesperidea (2)
Orbilia myriosphaera (2)
Orbilia ?obtusispora (1)
Orbilia serpentina (1)
Orbilia subaristata (5)
Orbilia subclavuliformis (1)
Orbilia subovoidea (1)
Orbilia vinosa (3)

Hungary (11/31)
Hyalorbilia inflatula (1)
Hyalorbilia juliae (3)
Lecophagus ellipsoideus (3)
Lecophagus vermicola (7)
Mycoceros antennatissimus (7)
Orbilia aprilis (2)
Orbilia eucalypti (2)
Orbilia ficicola (1)
Orbilia xanthostigma (1)
Retiarius revayae (2)
Retiarius goenczoelii (2)

Ireland (3/5)
Hyalorbilia inflatula (1)
Orbilia eucalypti (1)
Orbilia rubrovacuolata (3)

Italy (19/24)
Hyalorbilia fagi (1)
Hyalorbilia ?inflatula (1)
Orbilia aprilis (1)
Orbilia arachnovinosa (1)
Orbilia aristata (1)
Orbilia auricolor s.l. (1)
Orbilia carpoboloides (1)
Orbilia ?cejpii (1)
Orbilia eucalypti (3)
Orbilia filiformis (1)
Orbilia hesperidea (1)
Orbilia ?quercus-ilicis (1)
Orbilia rosea (1)
Orbilia sarraziniana (1)
Orbilia subsphaerospora (1)
Orbilia trapeziformis (1)
Orbilia vinosa (2)
Orbilia vitalbae (1)
Orbilia xanthostigma (3)

Latvia (1/1)
Orbilia bembicodes (1)

Lithuania (6/8)
Orbilia bembicodes (1)
Orbilia eucalypti (1)
Orbilia flagellispora (1)
Orbilia mammillata (2)
Orbilia multiformis (1)
Orbilia vibrioides (2)

Liechtenstein (8/8)
Amphosoma resinicola (1)
Hyalorbilia fusispora (1)
Hyalorbilia juliae (1)
Orbilia aristata (1)
Orbilia eucalypti (1)
Orbilia leucostigma (1)
Orbilia ?tremulae (1)
Orbilia ungulata (1)

Luxembourg (68/702)
Amphosoma atroolivaceum (8)
Hyalorbilia erythrostigma (10)
Hyalorbilia fusispora (1)
Hyalorbilia helicospora (6)
Hyalorbilia inflatula (12/1)
Hyalorbilia juliae (15)
Hyalorbilia latispora (3)
Hyalorbilia orbiliicola (19)
Hyalorbilia resinae (1)
Hyalorbilia rotifera (9)
Hyalorbilia subfusispora (26)
Lecophagus ellipsoideus (5)
Lecophagus vermicola (6)
Orbilia aprilis (35)
Orbilia aradi (16)
Orbilia aristata (51)
Orbilia aurantiorubra (21)
Orbilia auricolor s.l. (12/2)
Orbilia breviaristata (2)
Orbilia cardui (1)
Orbilia carpoboloides (3)
Orbilia caulicola (17)
Orbilia ?cejpii (1)
Orbilia ?clavispora (1)
Orbilia ?clavuliaristata (1)
Orbilia clavuliformis (2)
Orbilia comma (10)
Orbilia crenatomarginata (2)
Orbilia cylindrosoma (5/1)
Orbilia epipora (2)
Orbilia eucalypti (65)
Orbilia euonymi (22)
Orbilia fabacearum (1)
Orbilia filiformis (8)
Orbilia flagellispora (5)
Orbilia flavida (33)
Orbilia flavidorosella (9)
Orbilia frangulae (3/2)
Orbilia fraxini (1)
Orbilia graminis (5)
Orbilia ?leporina (1)
Orbilia leucostigma (3)
Orbilia ?luteorubella (4)
Orbilia obtusispora (7/2)
Orbilia ocellata (3)
Orbilia oxyspora (1)
Orbilia ?paravitalbae (1)
Orbilia phragmotricha (7)
Orbilia pleioeuonymi (3)
Orbilia plurivacuolata (1)
Orbilia poitevinica (1)
Orbilia polybrocha (1)
Orbilia pseudoaristata (7)
Orbilia quaestiformis (35)
Orbilia rosea (1)

Orbilia ?rubrovacuolata (1)
Orbilia sarraziniana (7/4)
Orbilia septispora (12)
Orbilia subaristata (9)
Orbilia subclavuliformis (6)
Orbilia trapeziformis (3/1)
Orbilia tremulae (5/12)
Orbilia ungulata (9)
Orbilia vinosa (50)
Orbilia vitalbae (14)
Orbilia xanthoguttulata (10)
Orbilia xanthostigma (24/1)
Retiarius ?revayae (1)

North Macedonia (1/1)
Orbilia xanthostigma (1)

Malta (1/1)
Orbilia flagellispora (1)

Montenegro (23/31)
Hyalorbilia inflatula (1)
Hyalorbilia fusispora (1)
Hyalorbilia orbiliicola (2)
Hyalorbilia ulicicola (1)
Orbilia adenocarpi (1)
Orbilia ?albovinosa (1)
Orbilia aristata (1)
Orbilia aurantiorubra (1)
Orbilia auricolor s.l. (1)
Orbilia carpoboloides (1)
Orbilia clavuliformis (3)
Orbilia crenatomarginata (1)
Orbilia eucalypti (3)
Orbilia flagellispora (2)
Orbilia foliicola (1)
Orbilia gambelii (1)
Orbilia mali (1)
Orbilia sphaerospora (1)
Orbilia subaristata (2)
Orbilia subclavuliformis (1)
Orbilia subtrapeziformis (1)
Orbilia vinosa (2)
Orbilia ?xanthostigma (1)

The Netherlands (30/59)
Hyalorbilia berberidis (1)
Hyalorbilia erythrostigma (1)
Hyalorbilia fusispora (5)
Hyalorbilia inflatula (1)
Hyalorbilia juliae (4)
Hyalorbilia latispora (1)
Hyalorbilia oviparasitica (1)
Hyalorbilia tortuosa (1)
Orbilia aprilis (6)
Orbilia aristata (1)
Orbilia aurantiorubra (2)
Orbilia auricolor s.l. (1)
Orbilia carpoboloides (2)
Orbilia clavispora (1)
Orbilia clavuliformis (1)
Orbilia comma (1)
Orbilia elegans (1)
Orbilia epipora (1)
Orbilia eucalypti (4)
Orbilia euonymi (6)
Orbilia leucostigma (2)
Orbilia oxyspora (5)
Orbilia quaestiformis (2)
Orbilia rectispora (1)
Orbilia rubrovacuolata (2)
Orbilia sarraziniana (1)
Orbilia scaphoides (1)
Orbilia subclavuliformis (1)
Orbilia xanthostigma (1)
Orbilia xinjiangensis (1)

Norway (22/34)
Hyalorbilia inflatula (2)
Hyalorbilia resinae (1)
Hyalorbilia subfusispora (1)
Orbilia arachnovinosa (1)
Orbilia aristata (1)
Orbilia aurantiorubra (2)
Orbilia breviaristata (1)
Orbilia canadensis (1)
Orbilia coccinella (1)
Orbilia comma (3)
Orbilia eucalypti (1)
Orbilia filiformis (1)
Orbilia flagellispora (1)
Orbilia luteorubella (1)
Orbilia phragmotricha (2)
Orbilia quaestiformis (1)
Orbilia rubella (3)
Orbilia subtrapeziformis (1)
Orbilia vinosa (4)
Orbilia xanthoguttulata (2)
Orbilia xanthostigma (2)
Pseudorbilia bipolaris (1)

Poland (39/125)
Amphosoma atroolivaceum (1)
Hyalorbilia berberidis (4)
Hyalorbilia fagi (1)
Hyalorbilia herbicola (1)
Hyalorbilia inflatula (3)
Hyalorbilia juliae (9)
Hyalorbilia latispora (1)
Hyalorbilia polypori (2)
Hyalorbilia resinae (1)
Hyalorbilia subfusispora (6)
Hyalorbilia tortuosa (1)
Orbilia aprilis (8)
Orbilia aristata (12)
Orbilia aurantiorubra (3)
Orbilia auricolor s.l. (1)
Orbilia carpoboloides (1)
Orbilia clavispora (3)
Orbilia clavuliformis (9)
Orbilia comma (1)
Orbilia ?concoloris (1)
Orbilia crenatomarginata (3)
Orbilia eucalypti (7)
Orbilia euonymi (3)
Orbilia fabacearum (1)
Orbilia filiformis (3)
Orbilia fraxini (2)
Orbilia mammillata (2)
Orbilia ocellata (5)
Orbilia orientalis (1)
Orbilia oxyspora (1)
Orbilia phragmotricha (1)
Orbilia pleistoeuonymi (2)
Orbilia quaestiformis (4)
Orbilia sarraziniana (2)
Orbilia subtrapeziformis (1)
Orbilia trapeziformis (2)
Orbilia vinosa (10)
Orbilia xanthoguttulata (4)
Orbilia xanthostigma (2)

Portugal (21/28)
Hyalorbilia berberidis (1)
Hyalorbilia fusispora (1)
Hyalorbilia inflatula (1)
Hyalorbilia juliae (1)
Hyalorbilia orbiliicola (1)
Orbilia aurantiorubra (2)
Orbilia carpoboloides (1)
Orbilia eucalypti (2)
Orbilia ?flavidorosella (1)
Orbilia gambelii (1)
Orbilia ?halimi (1)
Orbilia multiserpens (1)
Orbilia obtusispora (1)
Orbilia ?paracylindrospora (1)
Orbilia rhamni (3)
Orbilia rubella (2)
Orbilia subclavuliformis (1)
Orbilia subsphaerospora (1)
Orbilia ?subtrapeziformis (1)
Orbilia trapeziformis (1)
Orbilia vinosa (3)

Romania (4/4)
Orbilia auricolor (1)
Orbilia lentiformis (1)
Orbilia pleiolentiformis (1)
Orbilia xanthostigma (1)

Russian Federation (West) (32/88)
Hyalorbilia fagi (1)
Hyalorbilia fusispora (1)
Hyalorbilia inflatula (1)
Hyalorbilia juliae (1)
Hyalorbilia polypori (4)
Orbilia aprilis (11)
Orbilia aurantiorubra (6)
Orbilia auricolor s.l. (2)
Orbilia carpoboloides (4)
Orbilia cercidicola (3)
Orbilia clavuliformis (1)
Orbilia ?clavispora (1)
Orbilia comma (2)
Orbilia crenatomarginata (1)
Orbilia cylindrosoma (1)
Orbilia ellipsospora (1)
Orbilia epipora (1)
Orbilia lentiformis (3)
Orbilia leucostigma (2)
Orbilia mammillata (1)
Orbilia montigena (1)
Orbilia phragmotricha (1)
Orbilia pleistoeuonymi (1)
Orbilia quaestiformis (3)
Orbilia ?rosea (1)
Orbilia sarraziniana (4)
Orbilia siculispora (1)
Orbilia subtrapeziformis (1)
Orbilia tremulae (2)
Orbilia vinosa (2)
Orbilia xanthoguttulata (2)
Orbilia xanthostigma (16/5)

Serbia (52/108)
Hyalorbilia berberidis (2)
Hyalorbilia fagi (2)
Hyalorbilia fusispora (1)
Hyalorbilia herbicola (1/1)
Hyalorbilia hergiswiliana (1)
Hyalorbilia inflatula (2)
Hyalorbilia juliae {1}
Hyalorbilia multiguttulata (2)
Hyalorbilia orbiliicola (2)
Hyalorbilia subfusispora (1)
Orbilia aprilis (3)
Orbilia aristata (4)
Orbilia ?atlantis (1)
Orbilia aurantiorubra (2)
Orbilia auricolor s.l. (4/1)
Orbilia cardui (1)
Orbilia carpoboloides (4)
Orbilia cejpii (1)
Orbilia ?clavispora (1)
Orbilia clavuliformis (3)
Orbilia comma (2)
Orbilia crenatomarginata (5)
Orbilia cylindrosoma (1)
Orbilia dryadum (1)
Orbilia ebuli (1)
Orbilia epipora (1)
Orbilia eucalypti (7)
Orbilia euonymi (1)
Orbilia ficicola (2)
Orbilia ?fraxini (1)
Orbilia gambelii (2)
Orbilia milinana (1)
Orbilia montigena (5)
Orbilia nemaspora (2)
Orbilia obtusispora (1)
Orbilia orientalis (2/1)
Orbilia oxyspora (1)
Orbilia ?phragmotricha (1)
Orbilia quaestiformis (1)
Orbilia rectispora (1)
Orbilia sarraziniana (2)
Orbilia septispora (3)
Orbilia sinensis (1)
Orbilia subaristata (1)
Orbilia trapeziformis (3)
Orbilia tremulae (2)
Orbilia ungulata (2)
Orbilia vinosa (5)
Orbilia vitalbae (3)
Orbilia xanthoguttulata (2)
Orbilia xanthostigma (3)

Slovakia (33/53)
Amphosoma atroolivaceum (1)
Lilapila jurana (2)
Hyalorbilia erythrostigma (1)
Hyalorbilia fagi (1)
Hyalorbilia helicospora (1)
Hyalorbilia hergiswiliana (1)
Hyalorbilia orbiliicola (1)
Hyalorbilia oreadum (1)
Hyalorbilia subfusispora (1)
Orbilia aprilis (3)
Orbilia aristata (3)
Orbilia aurantiorubra (2)
Orbilia carpoboloides (2)
Orbilia cejpii (2)
Orbilia clavuliformis (2)
Orbilia crenatomarginata (1)
Orbilia cylindrospora (2)
Orbilia euonymi (3)
Orbilia ficicola (3)
Orbilia filiformis (1)
Orbilia gambelii (1)
Orbilia montigena (2)
Orbilia phragmotricha (1)
Orbilia pleistoeuonymi (2)
Orbilia quaestiformis (1)
Orbilia rosea (1/2)
Orbilia siculispora (1)
Orbilia ?subulivinosa (1)
Orbilia trapeziformis (2)
Orbilia ungulata (1)
Orbilia vinosa (2)
Orbilia xanthoguttulata (1)
Orbilia xanthostigma (1)

Spain (116/542)
Amphosoma resinicola (1)
Bryorbilia arenicola (1)
Hyalorbilia erythrostigma (7)
Hyalorbilia fagi (2)
Hyalorbilia fusispora (1)
Hyalorbilia ?hergiswiliana (1)
Hyalorbilia inflatula (13)
Hyalorbilia juliae (1)
Hyalorbilia orbiliicola (1)
Hyalorbilia polypori (4)
Hyalorbilia subfusispora (3)
Hyalorbilia ulicicola (11)
Lecophagus ellipsoideus (1)
Orbilia alba (2)
Orbilia albidorosea (3)

Orbilia angiosubvinosa (6)
Orbilia arachnovinosa (3/2)
Orbilia asturiensis (2)
Orbilia ?aradi (1)
Orbilia aurantiorubra (6)
Orbilia auricolor s.l. (16)
Orbilia ?bembicodes (1)
Orbilia bicknellensis (9)
Orbilia blumenaviensis (1)
Orbilia breviaristata (1/1)
Orbilia carpoboloides (11)
Orbilia caulicola (1)
Orbilia cejpii (3)
Orbilia ?cisti (1)
Orbilia ?cocois (1)
Orbilia comma (1)
Orbilia ?cotoneastri (3)
Orbilia crenatofalcata (2)
Orbilia crenatomarginata (4)
Orbilia cylindrosoma (2/1)
Orbilia delphinus (7)
Orbilia desertorum (4)
Orbilia ?dixiensis (1)
Orbilia dryadum (2)
Orbilia ebuli (2)
Orbilia epipora (2)
Orbilia eucalypti (22)
Orbilia euonymi (9)
Orbilia filiformis (3)
Orbilia flagellispora (8)
Orbilia flavida (5)
Orbilia flavidorosella (2)
Orbilia foliicola (1)
Orbilia gambelii (28)
Orbilia graminis (1)
Orbilia halimi (2)
Orbilia hesperidea (1)
Orbilia leucostigma (6)
Orbilia luteorubella (1)
Orbilia microserpens (9)
Orbilia montigena (1)
Orbilia multiurosperma (3)
Orbilia navicularis (1)
Orbilia obtusispora (1)
Orbilia ocellata (6/2)
Orbilia octocorculispora (3)
Orbilia ?oligospora (1)
Orbilia orientalis (5)
Orbilia ovalis (3)
Orbilia ovoidea (2)
Orbilia oxyspora (2)
Orbilia paramontigena (1)
Orbilia paravitalbae (3/1)
Orbilia patellarioides (2)
Orbilia phragmotricha (6)
Orbilia pilifera (17)
Orbilia pleioalbidorosea (3)
Orbilia pleiogambelii (6)
Orbilia pleiolentiformis (1)
Orbilia pleiomicrosoma (3)
Orbilia ?pleioserpens (2)
Orbilia pleioungulata (2)
Orbilia pleistoeuonymi (1)
Orbilia pleistosphaera (1)
Orbilia plurivacuolata (1)
Orbilia polyspora (8)
Orbilia pseudoaristata (1)
Orbilia quaestiformis (1)
Orbilia quercus-ilicis (1)
Orbilia rectispora (1)
Orbilia rhamni (2)
Orbilia rosea (9)
Orbilia rosicola (1)
Orbilia rubrovacuolata (7)
Orbilia sarothamni (1)
Orbilia sarraziniana (18)
Orbilia septispora (2)
Orbilia serpentina (3)
Orbilia sinensis (1/2)
Orbilia somedana (2)
Orbilia sphaerospora (1)
Orbilia subaristata (16)
Orbilia subclavuliformis (9)
Orbilia ?subdelphinus (1)
Orbilia suberis (1)
Orbilia subocellata (3/2)
Orbilia subovoidea (12)
Orbilia subsphaerospora (7)
Orbilia subtrapeziformis (12)
Orbilia subvinosa (2/5)
Orbilia ?subvitalbae (1)
Orbilia trapeziformis (8)
Orbilia tremulae (3/1)
Orbilia ungulata (1)
Orbilia vibrioides (1)
Orbilia vinosa (39)
Orbilia vitalbae (6)
Orbilia xanthoguttulata (11)
Orbilia xanthostigma (14)

Sweden (29/59)
Hyalorbilia berberidis (4)
Hyalorbilia ?hergiswiliana (1)
Hyalorbilia inflatula (5)
Hyalorbilia juliae (1)
Hyalorbilia polypori (1)
Orbilia aprilis (1)
Orbilia arachnovinosa (4)
Orbilia aristata (2)
Orbilia auricolor s.l. (2)
Orbilia cejpii (1)
Orbilia ?clavispora (1)
Orbilia comma (1)
Orbilia cylindrospora (1)
Orbilia epipora (3)
Orbilia eucalypti (5)
Orbilia filiformis (1)
Orbilia inconspicua (1)
Orbilia oligospora (1)
Orbilia phragmotricha (1)
Orbilia pseudoaristata (1)
Orbilia quaestiformis (2)
Orbilia rosea (1)
Orbilia rubella (2)
Orbilia subsphaerospora (1)
Orbilia subtrapeziformis (2)
Orbilia tremulae (1/1)
Orbilia vinosa (6)
Orbilia xanthoguttulata (2)
Orbilia xanthostigma (3)

Switzerland (37/155)
Amphosoma atroolivaceum (1)
Hyalorbilia fusispora (4)
Hyalorbilia helicospora (1)
Hyalorbilia hergiswiliana (1/1)
Hyalorbilia inflatula (7)
Hyalorbilia juliae (1)
Hyalorbilia polypori (5)
Lilapila jurana (12)
Lilapila oculispora (2)
Orbilia alpigena (5)
Orbilia aprilis (1)
Orbilia arachnovinosa (1)
Orbilia aristata (5)
Orbilia aurantiorubra (1)
Orbilia auricolor s.l. (3)
Orbilia comma (4)
Orbilia corculispora (1)
Orbilia crenatomarginata (3)
Orbilia ebuli (1)
Orbilia eucalypti (10)
Orbilia euonymi (3)
Orbilia filiformis (10)
Orbilia flagellispora (7)
Orbilia fraxini (1)
Orbilia jacaensis (1)
Orbilia leucostigma (3)
Orbilia mali (1)
Orbilia phragmotricha (4)
Orbilia rectispora (1)
Orbilia rosea (5/2)
Orbilia sarraziniana (4)
Orbilia subsphaerospora (2)
Orbilia subtrapeziformis (8)
Orbilia tremulae (6/2)
Orbilia vinosa (8)
Orbilia vitalbae (2)
Orbilia xanthoguttulata (3)
Orbilia xanthostigma (2)

Ukraine (12/24)
Hyalorbilia fagi (1)
Hyalorbilia inflatula (2)
Orbilia aurantiorubra (1)
Orbilia carpoboloides (1)
Orbilia comma (1)
Orbilia crenatomarginata (2)
Orbilia epipora (2)
Orbilia flavidorosella (1)
Orbilia leucostigma (2)
Orbilia polybrocha (1)
Orbilia sarraziniana (1)
Orbilia xanthostigma (8/1)

Appendix 3. Index to fungal taxa

Families, genera, subgenera, sections, series, species, and infraspecific taxa of *Orbiliomycetes* treated in this monograph, including taxa referred to other classes.

Appendix 4. List of anamorph-teleomorph connections

Included are all *Orbiliomycetes* species with known teleomorph treated in this monograph, together with their assured or presumed anamorph if any was observed (sorted according to the order in the taxonomic part). Assured connections relate to strains in which the anamorph was obtained in an ascospore isolate or was confirmed by molecular methods; presumed connections relate to conidial states observed on the natural substrate near the apothecia; * = previously published connections (red: strain numbers from literature); numbers in square brackets refer to not included collections; [1] = confirmed by molecular methods only, based on DNA from apothecia and conidia or culture, [2] = id., based on type culture.

Teleomorph species	Anamorph (predominantly form genera)	Connection certain	Ascospore isolate in which no anamorph developed	Ascospore isolate in which conidia developed	Conidia from natural substrate near apothecia
Liladisca					
L. acicola		–	–	–	–
Lilapila					
L. oculispora		–	G.M. 2015-08-30.1	–	–
L. oculisporella		–	G.M. 2015-08-30.4	–	–
L. jurana		–	–	–	–
Amphosoma					
A. resinicola	trinacrium-like	yes	–	H.B. 6491	H.B. 6491, 6992a
A. natalense	trinacrium-like	no	–	–	H.B. 8086a
A. atroolivaceum	trinacrium-like	no	H.B. 6282	–	H.B. 4268, 7248, 8057, 8069a,
A. macrosporum			–	–	–
Lecophagus					
L. ellipsoideus	lecophagus-like	no	–	–	D.M. 81/5, 3.I.2010
L. pini		–	–	–	–
L. subglobosus		–	–	–	–
Bryorbilia					
B. arenicola		–	–	–	–
Pseudorbilia					
P. bipolaris		–	–	–	–
Hyalorbilia					
H. ulicicola	brachyphoris-like	no	–	–	H.B. 6612, 6864, 8592, R.T.L. 10092601
H. caucasica	brachyphoris-like	no	–	–	H.B. 7966
H. polypori	brachyphoris-like	yes	–	H.B. 7557a	H.B. 7952a, 7981, 8245, R.B. 31-08-15-857-BE
H. texensis	brachyphoris-like	no	–	–	H.B. 5552b
H. puertoricensis			–	–	–
H. oreadum	brachyphoris-like	no	–	–	H.B. 7072a
H. andina			–	–	–
H. inflatula	brachyphoris-like (?*Dactylella passalopaga*)	yes	–	H.B. 8150	H.B. 22, 2089, 6618a, 7112, 7623, 7746, 7758, 7879, 7944, 7972, 7973, 7997, 8150, 8173, 8221, 8241a, 8279b, 9973b, E.B. 4626, 18.IX.1996, IV.2018
H. japonica	brachyphoris-like	no	–	–	H.B. 5965, 7987, 8717
H. citrina	brachyphoris-like	no	–	–	H.B. 7983a, 8409a, 9671
H. tortuosa	brachyphoris-like	yes	–	H.B. 7576	H.B. 5902b, 7576, 8317f, P.P. 20080803-GD-Osetno-3
H. fagi	brachyphoris-like	yes	–	H.B. 7847a, 9105	H.B. 4963a, 7934, 7950a, 7988, 8224b, 9724, G.F. 20140053, A.P. 19/27
H. helicospora	brachyphoris-like	no	–	–	H.B. 6461
H. sibirica			–	–	–
H. macrohelicospora			–	–	–
H. arcuata		–	–	–	–
H. nodulosa			–		–
H. lunata	brachyphoris-like	no	–		H.B. 7906a, 9210, N.A. 342
H. juliae	brachyphoris-like		G.M. 2013-12-14.2	–	–
H. fomentarii			–	–	–
H. berberidis			–	–	–
H. fusispora			–	–	–
H. subfusispora	curucispora-like	no	–	–	H.B. 5738, 7684, 8429b, 8.XII.2009, P.P.20091007-1
H. brevistipitata	brachyphoris-like *B. brevistipitata*	yes*	–	HMAS 86810	
H. biguttulata		–	–	–	–
H. multiguttulata		–	H.B. 7253a	–	–
H. erythrostigma	*Trinacrium ?angamosense*	no	–	–	H.B. 6605, 9077a, 27.VII.2017
H. orbiliicola	trinacrium-like	yes[1]	–	–	H.B. 6121b, 6209a, 6244a, 6815c, 6882e, 6990c, 6991b, 7024a, 7604c, 9077b, G.M. 2014-10-30.1, G.M. 2014-10-30.3, I.W.130127, D.S. fg-1096
H. anonyma		–	–	–	–
H. pleioerythrostigma		–	–	–	–
H. latispora	curucispora-like	yes[1]		H.B. 9902c	
H. hergiswiliana	dicranidion-like	no	–	–	H.B. 8235b
H. ulmi		–	–	–	–
H. resinae	brachyphoris-like	no	–	–	H.B. 6631a, 9687
H. herbicola		–	–	–	–

Teleomorph species	Anamorph (predominantly form genera)	Connection certain	Ascospore isolate in which no anamorph developed	Ascospore isolate in which conidia developed	Conidia from natural substrate near apothecia
H. rotifera	brachyphoris-like	no	–	–	H.B. 6908b, 6988b, 7620a, 7627b
Orbilia section ***Lentiformes*** series ***Lentiformes***					
O. patellarioides	vermispora-like	yes	–	H.B. 5001b, 6490a	H.B. 5001b, 5016b, 6729b, 9173a
O. atrolentiformis			–	–	–
O. purshiae	vermispora-like	no	–	–	H.B. 7462a, 8059a, 8002h
O. pileosoma	vermispora-like	no	H.B. 6998c	–	H.B. 5741b
O. lentiformis	trinacrium-like, vermispora-like	yes	–	H.B. 6569c, 6740d	H.B. 5228a, 5705c, 7210, 7891b, LE 294874, LE 294858
O. ocellata	trinacrium-like	yes	H.B. 6736d	H.B. 6475b, 25.VIII.1994	H.B. 5104, 5238, 5784, 6207, 7006a, 7159a, 7531c
O. subocellata	vermispora-like	yes	–	H.B. 6474, 6471b	H.B. 6471b, J.P.P. 10169
O. foliicola	trinacrium-like	yes	–	H.B. 6477c	H.B. 7076b
O. pleiolentiformis			–	–	–
O. flavida	trinacrium-like	yes	–	H.B. 6716	–
O. plurilentiformis			H.B. 6740c	–	–
O. myriolentiformis			–	–	–
O. cucumispora	trinacrium-like	yes		H.B. 6762a	–
Orbilia section ***Lentiformes*** series ***Ovales***					
O. ovalis	dicranidion-like	no	H.B. 6486b, 7246b	–	H.B. 6234a, 6486b, 7156a, G.F. 20160009
Orbilia section ***Lentiformes*** series ***Cercidicola***					
O. cercidicola	vermispora-like	no	–	–	H.B. 7077h, 9151e
Orbilia section ***Lentiformes*** series ***Phanosomates***					
O. macroasca	trinacrium-like	no	–	–	H.B. 8080a
O. multimacroasca nom.prov.					
O. magnifica			–	–	–
O. lanternae			–	–	–
O. tremuloidis			–	–	–
O. phanosoma			H.B. 6998a	–	–
O. multiphanosoma			–	–	–
O. myriophanosoma			–	–	–
O. pleiostomachia			–	–	–
O. pluristomachia	trinacrium-like	yes	–	H.B. 6617a	H.B. 6617a
O. myriostomachia nom.prov.					
O. myriosphaera	trinacrium-like	yes	–	H.B. 6679a	–
O. pleistosphaera			–	–	–
Orbilia section ***Lentiformes*** series ***Microspermae***					
O. pleioeuonymi	vermispora-like	yes	–	G.M. 2013-11-16.1	–
O. euonymi	vermispora-like	no	–	–	H.B. 5812, 6239, 6761b, 7407, 7529, 7639b, 7989a, 10.I.2000, 22.V.2002, 4.V.2009, 14.XI.2013, T.A. 1 & 25, 17.III.2019
O. myrioeuonymi	vermispora-like	no	–	–	H.B. 6822
O. pleistoeuonymi	vermispora-like	yes	–	H.B. 6494a	LE 248029, P.P. 20091227-2
Orbilia section ***Hemiorbilia*** series ***Hesperideae***					
O. arizonensis	trinacrium-like	no	–	–	H.B. 4566
O. australiensis	trinacrium-like	yes	–	H.B. 7208b	
O. pleioaustraliensis	trinacrium-like	yes	–	H.B. 6277e	H.B. 6262e
O. multiaustraliensis			–	–	–
O. myrioaustraliensis			–	–	–
O. palmicola			–	–	–
O. macrocarpa			–	–	–
O. aff. *macrocarpa*			–	–	–
O. navajoana	trinacrium-like	no	–	–	H.B. 5164b
O. pleionavajoana			–	–	–
O. curvatinavajoana			–	–	–
O. hesperidea	trinacrium-like	yes	H.B. 6694	H.B. 6468a	H.B. 5554b, 6452a, 6468a
O. pleiohesperidea			–	–	–
O. coronohesperidea			–	–	–
O. pleiocoronohesperidea			–	–	–
O. aff. *pleiocoronohesperidea*			–	–	–
O. myriohesperidea			–	–	–
O. macrohesperidea			–	–	–
O. megahesperidea			–	–	–
O. montigena	trinacrium-like	no	–	–	H.B. 7838b, 7855a, 7933a
O. alpigena	trinacrium-like	no	–	–	H.B. 7874a, 8272a, 9566a, H.B. 10170a, G.M.
O. paramontigena		–	–	–	–
O. vinosa	trinacrium-like	yes	–	H.B. 6715b, 6264, 6748g, G.M. 2011-04-19.1, 2014-02-14.1, 2011-09-18.1, 2016-05-04.1	H.B. 5004, 5464b, 5941a, 6201b, 6211a, 6413, 6718, 6995a, 7024b, 7249c, 7449a, 8106a, 8235a, 9089, 9366a, G.F. 20130070, CNF 2/4724, T.A. 68a, 8.VI.1997, 5.VI.1999, 24.IX.1999, 20.VI.1999, 7.VIII.1999, 17.VII.2001, 30.I.2000, 13.VII.2002, 9.VI.2003, 21.XII.2003, 26.V.2006, 21.I.2007, 10.III.2016, 5.XII.2018

Teleomorph species	Anamorph (predominantly form genera)	Connection certain	Ascospore isolate in which no anamorph developed	Ascospore isolate in which conidia developed	Conidia from natural substrate near apothecia
O. subvinosa	dwayaangam-like	yes	–	G.M. 2011-09-18.2	H.B. 4939, 5001c, 6490b, 6748f, 7061a, 9173b, R.T.L. 12040101, G.M. 2010-09-05.1, 2009-09-24.1
O. angiosubvinosa	dwayaangam-like	no	–	–	H.B. 9813a, 3.VII.2011, H.B. 5475, H.B. 5923a
O. arachnovinosa	dwayaangam-like	no	–	–	H.B. 7830a, 7838a, 8248a, 9170b, 9368a, 9375, 9796b, 10109, G.M. 2018-09-13.1
O. nothovinosa			–	–	–
O. astrovinosa			–	–	–
O. helicovinosa			–	–	–
O. pleiovinosa			–	–	–
O. multivinosa			–	–	–
O. subulivinosa		–	–	–	–
O. multicurvula			–	–	–
O. velutina	trinacrium-like	yes	–	H.B. 9772a	–
O. nothoaprilis			–	–	–
O. georgiana	vermispora-like	yes*	–	GXU 1472	
O. crenatovinosa	vermispora-like	no	–	–	G.F. 20160008, G.M. 2014-05-10.1
O. aprilis	*Trinacrium tothii*	yes	–	H.B. 6715a, 6801	H.B. 5423, 5626a, 6240, 6715a, 7190, 8246, P.P. 20070825-4-Kuja, P.P. 20061219-003, P.P. 20061206-001, T.A. 67, 30.VIII.1998, 22.X.2000, 3.VI.2004, 22.IV.2006, 25.VI.2011, 29.XII.2015, 21.IV.2017
O. myriofusiclava	vermispora-like	yes	–	H.B. 7237a	H.B. 7237a
O. corculispora	trinacrium-like	yes*	–	H.B. 6279a, B.L. 1501	H.B. 6279a, 8087a, 8590b
O. octocorculispora			–	–	–
O. cryptogena			H.B. 7397a	–	–
O. subcryptogena			–	–	–
O. myriomuscula			–	–	–
O. sarothamni			–	–	–
O. myrioauris			–	–	–
O. concoloris	vermispora-like	no	–	–	H.B. 7897a
O. adenocarpi			–	–	–
Orbilia **section** ***Hemiorbilia*** **series** ***Hemiorbilia***					
O. colombiana	trinacrium-like, descalsia-like	no	–	–	H.B. 8016
O. clavuliformis	trinacrium-like descalsia-like	yes	–	H.B. 6714	H.B. 5823, 6710, 8212, S.H. 605, 24.VI.2007, 12.V.2012
O. asturiensis			–	–	–
O. parviclava			–	–	–
O. breviclava			–	–	–
O. subclavuliformis	trinacrium-like	no	–	–	H.B. 5226a, 7382, 8106b
O. flagellispora	descalsia-like, dwayaangam-like, trinacrium-like	no	–	–	H.B. 4997, 5125b, 5273, 6827, 6984c, 7604a, 7829, 8264, 8266, 8272b, 8359a
O. angustoaristata			–	–	–
O. frullaniae			–	–	–
O. brevicauda			–	–	–
O. clavuliaristata	trinacrium-like	no	–	–	H.B. 7401, 7404
O. aristata	descalsia-like, dwayaangam-like, trinacrium-like	yes	G.M. 2014-06-21.1	H.B. 6713, G.M. 2011-05-20.1	H.B. 5672a, 6030, 6254, 6384, 6448, 6992b, 7026b, 7150c, 7891a, 8263c, 8269b, 8378, 8444a, 8543, 27.V.1999, 27.VII.1999, 26.II.2001, 8.VII.2003, 7.V.2004, 5.XII.2013, P.P. 20060625.-4, G.M. 2014-06-21.1, A.P. 18/43
O. subaristata	descalsia-like, dwayaangam-like, trinacrium-like	yes	G.M. 2014-01-29.1	H.B. 6685a	H.B. 5619a, 6486, 6475a, 6495a, 7005a, 7032a, 7077j, 7272c, 8365a, 22.VI.2006, TA-35, TA-37
O. breviaristata	descalsia-like	no	–	–	H.B. 8376a
O. megaocculta			–	–	–
O. fimbriata			–	–	–
O. occulta	trinacrium-like	yes*	–	GXU1467	–
O. austroocculta			–	–	–
O. spermoides	trinacrium-like	yes	–	H.B. 7517	H.B. 7089a, 7090a, 7497a, 7517, 7604d
O. nanosperma	trinacrium-like	no	–	–	H.B. 7201b
O. aviflagellata			–	–	–
O. aviaristata	trinacrium-like	no	–	–	H.B. 7213a
O. aviceps			–	–	–
O. triangulispora			–	–	–
Orbilia **section** ***Hemiorbilia*** **series** ***Vibrioides***					
O. vibrioides			–	–	–
O. graminis			–	–	–
O. myriobliqua			–	–	–
O. pleistobliqua			–	–	–
O. paraobliqua			–	–	–

Teleomorph species	Anamorph (predominantly form genera)	Connection certain	Ascospore isolate in which no anamorph developed	Ascospore isolate in which conidia developed	Conidia from natural substrate near apothecia
O. anguliobliqua			–	–	–
O. helicoobliqua			–	–	–
O. curvatiobliqua			–	–	–
O. allantoobliqua			–	–	–
O. angustoobliqua			–	–	–
O. junci	*Dwayaangam junci*	yes*	–	J.K. 5568, 5586, 5604	J.K. 5652, 5652
Orbilia section ***Aurantiorubrae*** series ***Regales***					
O. regalis			–	–	–
O. austroregalis			–	–	–
O. aradi	vermispora-like	yes	G.M. 2014-02-23.2	H.B. 7628c	H.B. 7760a, 7867, 7884a
O. aff. aradi			–	–	–
O. mali	vermispora-like	no	–	–	H.B. 7016a, 8502a
O. brachychitonis	vermispora-like	yes	–	H.B. 7578a	H.B. 5681b, 7276e, 7572a, 9.XII.2001
O. euphorbiae	vermispora-like	yes	–	H.B. 9869	H.B. 7295
O. carnegieae	vermispora-like	no	–	–	H.B. 7764e
O. kingsiana			–	–	–
O. puyae	vermispora-like	no	–	–	H.B. 8043a
O. pseudocylindrospora			H.B. 7026a	–	–
O. denticulata	vermispora-like	yes	–	H.B. 6725	H.B. 5430, 6725
Orbilia section ***Aurantiorubrae*** series ***Commatoideae***					
O. caulicola	anguillospora-like	yes	H.B. 7167a	G.M. 2013-07-30.3	H.B. 6401a, 7176, 8346a,
O. cookei			–	–	–
O. stilbospora	vermispora-like	no	–	–	H.B. 8501c
O. pisciformis			–	–	–
O. comma	vermispora-like	yes	–	H.B. 5022, 6639b	H.B. 5742a, 5888, 6310, 7613a, 8199a, P.T. 4/12/16-15, 5.V.2015, 12.II.2019
O. neocomma			–	–	–
O. disseminata			–	–	–
Orbilia section ***Aurantiorubrae*** series ***Rubellae***					
O. saccharifera	vermispora-like	no	–	–	H.B. 5345
O. rubella	vermispora-like	no	–	–	H.B. 6124, 6935, 7442, 8208a,
O. phragmotricha	vermispora-like	yes	G.M. 2013-04-04.1	H.B. 7534	H.B. 7890b
O. paradoxoides	vermispora-like	no	–	–	H.B. 7880a
Orbilia section ***Aurantiorubrae*** series ***Aurantiorubrae***					
O. aurantiorubra	vermispora-like	yes	–	H.B. 5041, 6815a, G.M. 2013-04-03.1	H.B. 6251, 6815a, 6882b, 9087a, J.P.P. 29004, CWU AS 4407, 13.VIII.2009, 4.I.2013, A.P. 18/45, A.P. 19/17
O. jugulospora	vermispora-like	yes	–	HMAS 252529, Or10-gl-01A	–
O. binchuanensis			–	–	–
Orbilia section ***Aurantiorubrae*** series ***Xanthoguttulatae***					
O. xanthoguttulata	dicranidion-like	yes	–	H.B. 6989a, [GXU 1491]	H.B. 7884b
O. succulenticola			–	–	–
O. vermiformis	*Dactylella vermiformis*	yes*	–	YMF 1.01842	H.B. 8031
O. nemaspora	dactylella-like	yes*	–	HMAS 96792	H.B. 5945, J.P.P. 13024
O. crenatonemaspora			–	–	–
O. pseudobrevistipitata	*Dactylella pseuobrevistipitata*	yes*	–	YMF 1.03504	
O. bomiensis			–	–	–
O. spirillospora			–	–	–
Orbilia section ***Aurantiorubrae*** series ***Hyalinia***					
O. crenatomarginata	dactylella-like	no	–	–	H.B. 6635, 7440
O. laevimarginata	dactylella-like	yes*	–	YMFT1.01833, YMFT1.01869, YMFT1.03013	
O. scolecospora			–	–	–
O. crenatofalcata			–	–	–
Orbilia section ***Aurantiorubrae*** series ***Abutilones***					
O. siculispora	dicranidion-like	yes	–	H.B. 8076a	H.B. 7526c, 8546
O. subsiculispora			–	–	–
O. abutilonis	dicranidion-like	no	–		H.B. 7600
O. ficicola	dicranidion-like	yes	–	–	H.B. 10138a, G.M. 2016-10-12.1, G.M. 2016-10-12.2, G.M. 2016-10-12.7, G.M. 2016-10-13.2, G.M. 2016-10-13.1, G.M. 2016-10-12.2, 23.VI.2019
O. suberis			–	–	–
O. milinana			–	–	–
O. lobeliae			–	–	–
O. ebuli			–	–	–
O. somedana			–	–	–

Teleomorph species	Anamorph (predominantly form genera)	Connection certain	Ascospore isolate in which no anamorph developed	Ascospore isolate in which conidia developed	Conidia from natural substrate near apothecia
O. rehmii			–	–	–
O. carminorosea	dicranidion-like	no	–	–	H.B. 8777a
O. rosella			–	–	–
O. paravitalbae			–	–	–
O. aethiopica			–	–	–
Orbilia **section *Aurantiorubrae* series *Poitevinicae***					
O. poitevinica	vermispora-like	no	G.M. 2013-04-04.2	–	H.B. 8131, G.M. 2013-04-04.2
Orbilia **section *Aurantiorubrae* series *Piliferae***					
O. pilifera	trinacrium-like	yes	–	H.B. 8076a	H.B. 7095a, 7500, 7567a, 8076a, 8132b, 8172a, 6.XII.2015, V.2015, 2.XI.2016
O. amarilla			–	–	–
O. farnesianae	trinacrium-like	no	–	–	H.B. 8590a, 8997h
O. aff. *farnesianae*	trinacrium-like	yes*	–	HMAS 139700	
O. paracaudata	trinacrium-like	no	–	–	H.B. 6280d
O. floridensis	trinacrium-like	no	–	–	H.B. 6241b
O. caudata	trinacrium-like	no	–	–	H.B. 6296a
O. bannaensis			–	–	–
Orbilia **section *Aurantiorubrae* series *Albovinosae***					
O. gemma			–	–	–
O. navicularis			–	–	–
O. pubescens nom. prov.			–	–	–
O. albidorosea	dwayaangam-like	yes	–	H.B. 6615a	–
O. pleioalbidorosea			–	–	–
O. albovinosa	dicranidion-/ trinacrium-like dwayaangam-like	yes	–	H.B. 7231f	–
O. subalbovinosa			–	–	–
O. pseudoaristata	trinacrium-like	yes	3.XII.2011	–	H.B. 8360a, 8436a, 3.XII.2011
O. pseudoflagellispora			–	–	–
Orbilia **section *Helicoon* series *Helicoon***					
O. rosea	*Anguillospora rosea*	yes*	–	H.B. 7656a, MA-Fungi-38569, B2-1-1-4, D.H.P. 115, HMAS 139672	
O. luteorubella	*Helicoon sessile*	yes*	–	D.H.P. 79 (= H.B. 5168a), H.B. 9424a, HMAS 267649	H.B. 9697, H.V. A327
O. sarraziniana	vermispora-like/ helicoon-like	yes*	H.B. 6727a, G.M.2012-10-18.1	H.B. 7235, 8225, HMAS 139682	H.B. 9691a
O. tianmushanensis	dactylella-like	yes*	–	YMF 1.03563	
O. hoana	anguillospora-like/ vermispora-like	yes	–	H.B. 8780, 8785a, jgs-15	
O. juruensis			–	–	–
O. yuanensis	anguillospora-like/ vermispora-like	yes*	–	H.B. 8768, YMFT 1.01811, YMFT 1.02055	
O. falciformis		–	–	–	–
O. martinicensis		–	–	–	–
Orbilia **section *Helicoon* series *Pseudotripoconidium***					
O. limoniformis		–	–	–	–
O. fusiformis	pseudotripo-conidium-like	yes	–	jgs-3 (= H.B. 8961b)	–
O. subuliformis			–	–	–
O. jinguangsiensis	pseudotripo-conidium-like	yes	–	H.B. 8784	
O. sinensis	*Pseudotripoconidium sinense*	yes*	–	YMF 1.03475, YMF 1.01843, ljs-1	–
O. tenuispora	pseudotripo-conidium-like	yes	–	jgs-11 (= H.B. 8783), YMF 1.03007	–
O. acicularis	pseudotripo-conidium-like	yes*	–	jgs-12, jgs-8 (= H.B. 8764)	–
O. arcospora			–	–	–
Orbilia **section *Habrostictis* series *Habrostictis***					
O. carpoboloides	vermispora-like	yes*	–	H.B. 5353, 6639c, DAOM 176753	H.B. 5051, 6385, 6601, 7406, 9086b, 9233, G.F. 20090147, J.P.P. 11040, LE 248299, 20.III.1866, 11.X.2002, 13.VI.2009, A.P. 19/15
O. brasiliensis			–	–	–
O. mongolica	vermispora-like	no	–	–	H.B. 7893a
O. scandens			–	–	–
O. mammifera			–	–	–
O. flavidorosella	vermispora-like	yes	G.M. 2012-09-18.1	H.B. 8544	–
O. solidaginis			–	–	–
Orbilia **section *Habrostictis* series *Serpentinae***					
O. ophiosoma			–	–	–

Teleomorph species	Anamorph (predominantly form genera)	Connection certain	Ascospore isolate in which no anamorph developed	Ascospore isolate in which conidia developed	Conidia from natural substrate near apothecia
O. lacrimispora			–	–	–
O. multihamulata			–	–	–
O. trapeziformis	trinacrium-like	no	–	–	H.B. 4659, 5508, 5825, 8125, 8133, 8587b, 9151c, A.P. 18/55
O. obtusispora	trinacrium-like	no	–	–	H.B. 7359a, 8139, 8144, H.B. 10110
O. austroobtusispora			–	–	–
O. pleioobtusispora			–	–	–
O. cylindrosoma	trinacrium-like	yes	–	H.B. 6711, 6766	H.B. 6393, 6406a, 6470, 6766, 7231b, 9209a, 31.V.1999
O. acaciae			–	–	–
O. maeandrina	trinacrium-like	no	–	–	H.B. 9086a
O. multimaeandrina	anguillospora-like/ vermispora-like	yes	–	H.B. 6737a	–
O. osteospermae			–	–	–
O. filiformis	tridentaria-like	no	–	–	H.B. 5069, 5588, 7018c, 7448, 7531a, 7532, 8244a, 8248b, 8276, 9007a, 9018a, 9120, J.P.P. 28203, P.P. 20060813-003, P.P. 20060815-1, 23.V.1999, M.R. 6768
O. subtrapeziformis			–	–	–
O. halimi	trinacrium-like	yes	–	H.B. 6472b	H.B. 6472b
O. phragmitis			–	–	–
O. idahoensis			–	–	–
O. flexisoma			–	–	–
O. macrotrapeziformis			–	–	–
O. pyrenaica			–	–	–
O. curvatitrapeziformis			–	–	–
O. edulis			–	–	–
O. wannerooensis			–	–	–
O. delphinus			–	–	–
O. subdelphinus	trinacrium-like	no	–	–	H.B. 8160a
O. spathulata	trinacrium-like	no	–	–	H.B. 6231a
O. macrodelphinus			–	–	–
O. multidelphinus			–	–	–
O. multitrapezoidea			–	–	–
O. livistonae			–	–	–
O. octoserpentina	trinacrium-like	no	–	–	H.B. 6609b
O. serpentina	trinacrium-like	yes	–	H.B. 6525a, 6609d	H.B. 6525a
O. bicknellensis			H.B. 6480a, 6741b	–	–
O. jacaensis			–	–	–
O. urosperma			–	–	–
O. pleiourosperma			–	–	–
O. multiurosperma	trinacrium-like	yes	–	H.B. 6493a	H.B. 6472a, 6493a
O. myriourosperma			–	–	–
O. sedonensis			–	–	–
O. cactacearum			–	–	–
O. sonorensis	trinacrium-like	yes	–	H.B. 6721b	H.B. 6721b
O. mesaverdiana			H.B. 6736a	–	–
O. pleiomesaverdiana			–	–	–
O. quaestiformis	tridentaria-like	yes	–	H.B. 7121, 2.VII.2001	H.B. 6439b, 8001b, 8747, 9112, 9226g, 2.VII.2001, 14.V.2002, 21.VII.2008
O. pleioquaestiformis			–	–	–
O. septispora	tridentaria-like	yes	–	11.IV.1994, G.M. 2012-03-12.1	H.B. 5646, 6035, 7267a, 8398, P.P.20090918-1-CR
O. quercus-ilicis	tridentaria-like	yes	–	H.B. 6477b	–
O. coniferarum	tridentaria-like	no	–	–	H.B. 8545b, 7066b
O. vermiculati	trinacrium-like	yes	–	H.B. 6739b	–
O. caudimaeandrina			–	–	–
O. rosicola nom. prov.			–	–	–
O. paloverdensis			–	–	–
Orbilia section ***Habrostictis*** series ***Ellipsospermae***					
O. vitalbae	trinacrium-like	yes	–	G.M.2013-11-16.2	H.B. 5036, 6135, 7168, 7171b, 6.VI.2013 (2×)
O. dixiensis			–	–	–
O. subvitalbae	trinacrium-like	yes	–	H.B. 6504a	H.B. 6504a
O. ungulata	trinacrium-like	yes		G.M.2013-08-17	H.B. 7819a, 28.VI.1999, 4.VII.1999
O. pleioungulata	trinacrium-like	no	–	–	H.B. 7226c, R.T.L. 12092902
O. calyptrata	trinacrium-like	no	–	–	H.B. 8079c
O. jurana			–	–	–
O. pleiovitalbae	trinacrium-like	yes	–	H.B. 6617d	–
O. pleistovitalbae			–	–	–
O. curvativitalbae			–	–	–
O. commarosa			–	–	–
O. barrowensis	trinacrium-like	yes	–	H.B. 6260b	

Teleomorph species	Anamorph (predominantly form genera)	Connection certain	Ascospore isolate in which no anamorph developed	Ascospore isolate in which conidia developed	Conidia from natural substrate near apothecia
O. gambelii	trinacrium-like	yes	–	H.B. 6466	H.B. 6460, 25.IX,1999, 5775a
O. pleiogambelii	trinacrium-like	no	–	–	H.B. 6481, 6482a
O. multigambelii	trinacrium-like	yes	–	4.XI.2007	H.B. 5712, 6134d
O. myrioflexa			–	–	–
O. octocercocarpi	trinacrium-like	yes	H.B. 6737b	H.B. 6609c	–
O. cercocarpi			–	–	–
O. multicercocarpi			–	–	–
O. macroserpens	trinacrium-like	yes	–	H.B. 6721c	
O. cisti	trinacrium-like	yes	–	H.B. 6500	–
O. pleioserpens			–	–	–
O. saguarina	trinacrium-like	no	–	–	H.B. 7764b
O. microserpens	trinacrium-like	yes	–	H.B. 6519a	H.B. 5493, 6519a
O. pleiocrescens			–	–	–
O. multiserpens			–	–	–
O. myrioolneyae			–	–	–
O. myriella			–	–	–
O. curvatimyriella			–	–	–
O. myriofusoidea			–	–	–
O. multivirgula			–	–	–
O. pleiovirgula nom. prov.			–	–	–
O. namibica			–	–	–
O. myrionamibica			–	–	–
Orbilia section ***Ovoideae***					
O. sphaerospora	vermispora-like	no	–	–	H.B. 6437a, 6490c
O. subsphaerospora			–	–	–
O. canadensis			H.B. 6826	–	–
O. cupularis			–		–
O. ovoidea	vermispora-like	no	H.B. 6489a	–	H.B. 6489a
O. subovoidea	vermispora-like	no	–	–	H.B. 4987a, 6528c, 7417a
O. amberina			–	–	–
O. polyspora	vermispora-like	no	H.B. 7243b	–	H.B. 6274, 7243b, 7251a, 8106d
O. lilacina			–	–	–
O. plurililacina			–	–	–
O. myriolilacina			–	–	–
O. pleistolilacina			–	–	–
O. stansburyanae			–	–	–
O. geijerae			–	–	–
O. pleiocreosoteris nom.prov.			–	–	–
O. multicreosoteris			–	–	–
O. atriplicis			–	–	–
O. subcylindrospora			–	–	–
O. basiflexa			–	–	–
O. octosporoides	vermispora-like	no	–	–	H.B. 5175b
O. pisciculus			–	–	–
O. clavipisca			–	–	–
O. eremaeae			–	–	–
O. ponderosae			–	–	–
O. sarcobati			–	–	–
O. gregorii			–	–	–
O. olivacea	vermispora-like	no	–	–	H.B. 7249a
O. yuccae			–	–	–
Orbilia section ***Orbilia*** series ***Microsomates***					
O. microsoma	trinacrium-like, descalsia-like, arthropod-like	yes	–	H.B. 6738a	–
O. microlentiformis			–	–	–
O. pleiomicrosoma			–	–	–
O. austropleiomicrosoma			–	–	–
O. arachnopus	arthropod-like	no	–	–	H.B. 6302, 6387b
O. multinanosoma			–	–	–
O. myrionanosoma			–	–	–
O. mirabilis	arthropod-like	no	–	–	H.B. 8996a, 9582a
O. myriopseudoregalis			–	–	–
Orbilia section ***Orbilia*** series ***Orbilia***					
O. cylindrospora			–	–	–
O. austrocylindrica			–	–	–
O. pleioaustrocylindrica			–	–	–
O. multiaustrocylindrica			–	–	–
O. beatricis			–	–	–
O. bretti			–	–	–
O. liliputiana	vermispora-like	yes	–	H.B. 6905	–

Teleomorph species	Anamorph (predominantly form genera)	Connection certain	Ascospore isolate in which no anamorph developed	Ascospore isolate in which conidia developed	Conidia from natural substrate near apothecia
O. dalmatica			–	–	–
O. battenii	dicranidion-like	yes	–	H.B. 8004	–
O. gaillardii			–	–	–
O. cejpii	dicranidion-like	yes	–	H.B. 7873a, 8201a, HMAS 139709, jz-46	H.B. 5552a, 6823d, 8578a, G.M. 2018-09-13.2, CUP-MM-000502A
O. paracylindrospora			–	–	–
O. frangulae	dicranidion-like	no	–	–	H.B. 9970, G.M. 2014-07-12
O. plurivacuolata	dicranidion-like	no	–	–	H.B. 5683, G.M. 2016-02-10.2
O. fissilis	*Dicranidion fissile*	yes	–	H.B. 7566a	H.B. 9844
O. eucalypti	*Dicranidion ?fragilis* etc.	yes*	G.M. 2013-04-10.1	H.B. 5023a, 5026, 5281a, 6662, 7043, 17.XI.2002, jz-41, HMAS 139644, ga028	H.B. 5382b, 5683, 5765, 5766a, 6213, 8007, 8045b, 8052, 8263b, 9722b, E.B. 4584, J.C. 50567, S.H. 803, NMLU 0501-80 K, Mats. 2356, 22.XI.2001, 22.IV.2003, 6.II.2005, 30.VIII.2005, 5.VII.2006, 5.II.2011, 4.IV.2011, 2.VI.2011, 23.II.2012, G.M. 2013-04-10.1, 15.XII.2017
O. tremulae	*Dicranidion* aff. *inaequale*	yes*	H.B. 9870	H.B. 6963a	
O. guyanensis			–	–	–
O. umbilicata			–	–	–
O. spirospora			–	–	–
O. minutispora			–	–	–
O. dryadum	dactylella-like	yes*	G.M. 2014-04-23.1	H.B. 7435a, 7805 (= B.L. 6516), 8223	H.B. 5550a, 7954b, 8224a, 8519, 8707, 9978, J.N. 06-228, 25.IX.2010, G.M. 2014-04-23.1
O. cunninghamii	dicranidion-like	yes	–	H.B. 9885	–
O. leucostigma	*Dicranidion ?gracile/tenue/dactylopagum*	yes*	–	D.H.P. 108, H.B. 6810c	H.B. 8317b, 9335
O. xanthostigma	*Dicranidion ?gracile/tenue/dactylopagum*	yes*	–	H.B. 6749, HMAS 139665, D.H.P. 120	H.B. 1237, 6745, 6810d, 7165d, 9193, 9720, 20.IX.1985, 30.X.2000, 5.I.2007, P.P. 20061130-1
O. aureocrenulata			–	–	–
O. renispora	dicranidion-like	yes*	–	GXU 1487	
O. aff. *renispora*			–	–	–
O. xanthoflexa	dicranidion-like	yes*	–	D.H.P 130 (= H.B. 9961), [D.H.P. 91]	–
O. fabacearum			–	–	–
O. subfabacearum	[vermispora-like]	[yes]	–	[Z.F.Y. ym-25 = H.B. 8345]	–
O. coccinella			–	–	–
O. flexispora			–	–	–
Orbilia **section *Arthrobotrys* series *Neodactylella***					
O. atlantis	dactylella-like	no	–	–	H.B. 7239a
O. epipora	*Dactylella ?polyctona*	yes	–	H.B. 8153	H.B. 8153
O. rectispora	*Dactylella nuorilangana*	yes	–	H.B. 7142	H.B. 8529a, 8871a, 9962, 3.VIII.2018
O. xinjiangensis	*Dactylella xinjiangensis*	yes[2]	–	–	H.B. 9646
O. cardui	dactylella-like	no	–	–	H.B. 6245, 7115a, 9891
O. cotoneastri	dactylella-like	yes	–	H.B. 7241a	H.B. 6132, 7241a
O. senegalensis nom. prov.			–	–	–
O. longquanensis nom. prov.	dactylella-like	yes*	–	YMFT 1.01868	
O. beltraniae			–	–	–
O. epilobii	dactylella-like	no	–	–	H.B. 9899, 29.VI.2017
O. zhongdianensis	*Dactylella zhongdianensis*	yes[2]	–	–	H.B. 9641
O. leporina	dactylella-like	no	–	–	H.B. 6187
O. cocois	dactylella-like	no	–	–	H.B. 7647
O. pseudeuphorbiae	dactylella-like	no	–	–	TFC Mic. 22644–22648
O. cupressi	dactylella-like	no	–	–	H.B. 8160b
O. fraxini	vermispora-like	no	–	–	H.B. 9017a, G.M. 2011-05-09
O. rhamni	anguillospora-like	no	–	–	J.B. 0463/14
O. lamarcheae			–	–	–
O. asomatica			–	–	–
O. oxyspora	*Dactylella oxyspora*	yes*	–	H.B. 9390a, K(M) 48656	H.B. 8428b, 9390a, 9447, GJO 75968, J.P.P. 13096, J.P.P. 15134, F.J.B. 40815, L.R. 13-068, K(M) 48656, P.P. 20160501-1
O. dorsalis	*Dactylella dorsalis*	yes*	–	H.B. 8782, YMF 1.01835	–
O. clavispora	*Dactylella clavispora*	yes[2]	–	–	H.B. 8371a, 8606, P.P. 20071006–1
O. aff. *clavispora*	dactylella-like	yes	–	YNOA 0002	–
O. desertorum	dactylella-like	no	–	–	H.B. 5257, 8737, 9448
O. tenuissima			–	–	–

Teleomorph species	Anamorph (predominantly form genera)	Connection certain	Ascospore isolate in which no anamorph developed	Ascospore isolate in which conidia developed	Conidia from natural substrate near apothecia
Orbilia **section** ***Arthrobotrys*** **series** ***Arthrobotrys***					
O. auricolor	*Arthrobotrys ?superbus*	yes	G.M. 2014-10-11.3	H.B. 6664, 6763, 8428a	H.B. 5058, 5094, 6061, 6176, 6722, 6892, 6896, 7327, 7472, 7560, 7718, 8132a, 8161, 8219, 8898a, 9003, 9553, I.W. 140729, P.P. 20070827-1, 5.XI.2010, 2.III.2013, 9.II.2018, J.B. 686/17
O. cladodes	*Arthrobotrys cladodes*	yes*	–	D.H.P. 60 and 90, HMAS 139635, HMAS 96824[1]	–
O. oligospora	*Arthrobotrys oligosporus*	yes*	–	D.H.P. 45/55	–
O. aff. *oligospora*	arthrobotrys-like	yes*	–	HMAS 139637	–
O. multiformis	*Arthrobotrys yunnanensis*	yes*	–	YMF 1.00593	–
O. javanica	*Arthrobotrys javanicus*	yes*	–	HMAS 139636	–
O. elegans	*Arthrobotrys oudemansii*	yes*	–	H.B. 5047 (= CBS 319.94), 6972a	–
O. menageshae	arthrobotrys-like	yes	–	H.B. 9275a	–
O. blumenaviensis	*Arthrobotrys vermicola*	yes*	–	YMF 1.03606, YMF/T 1.03002	H.B. 8029, 8413a
O. neglecta			–	–	–
O. latispora	*Arthrobotrys latisporus*	yes*	–	YMF 1.03213, [YMF 1.03506, YMF 1.03507]	–
O. scaphoides	*Arthrobotrys scaphoides*	yes*	–	BJ08-20	–
Orbilia sp.	*Arthrobotrys musiformis*	yes*	–	Z.F.Yu (pers. comm.), D.H.P. PR 98-20	–
O. terrestris			–	–	–
Orbilia **section** ***Arthrobotrys*** **series** ***Dactylellina***					
O. rubrovacuolata	dactylellina-like	yes	–	H.B. 6598a, 7093b	H.B. 6588, 7093b, C.Y. F/2552
O. mammilata	dactylellina-like *Da. mammillata*	yes	–	H.B. 7165c, 8372a	H.B. 7165c, 7954c, J.W. 001-33/110281
O. quercus	*Dactylellina quercus*	yes*	–	HMAS 88783	–
O. aff. quercus			–	–	–
O. lysipaga	*Dactylellina lysipaga*	yes*	–	HMAS 139697	–
O. ellipsospora	*Dactylellina ellipsospora*	yes*	–	HMAS 88782	–
O. apiculata	dactylellina-like	yes*	–	YMF1.01861	–
O. biforma	dactylellina-like	yes*		YMF1.01859	
Orbilia **section** ***Arthrobotrys*** **series** ***Gamsylella***					
O. alba	gamsylella-like (= *Dactylella alba*)	yes*	–	YMF/T 1.01858 (= H.B. 8312), H.B. 9645a	H.B. 9051a
O. anigozanthi	gamsylella-like	no	–	–	–
Orbilia **section** ***Arthrobotrys*** **series** ***Drechslerella***					
O. pilosa	drechslerella-like	yes*	–	D.H.P. 204	–
O. polybrocha	*Drechslerella polybrocha*	yes*	–	D.H.P. 133 (= H.B. 5296a), H.B. 8317a	–
O. aff. polybrocha			–	–	–
O. pseudopolybrocha	drechslerella-like	yes*	–	glgs-3 (= H.B. 8929), YMF 1.02660, jgs-63	–
O. flavovacuolata			–	–	–
O. naumburgensis	drechslerella-like	yes	–	H.B. 8568	–
O. yunnanensis	*Drechslerella yunnanensis*	yes*	–	HMAS 139691, YMF 1.01863, YMF 1.03216	–
O. orientalis	drechslerella-like	yes*	–	H.B. 7379, 8146a, [H.B. 9895a], [YMF 1.01854, 1.02999, 1.03217]	–
O. brochopaga	drechslerella-like	yes*	–	Ren et al. 2014a	
O. tonghaiensis	drechslerella-like	yes*	–	H.B. 8741, YMFT 1.03003	–
O. spec. 8963			–	–	–
O. spec. 8749	?	no	–	–	H.B. 8749
Orbilia **section** ***Arthrobotrys*** **incertae sedis**					
O. bambusina			–	–	–
O. acuum			–	–	–
O. cyparissias			–	–	–

Appendix 5. List of new taxa, combinations, epitypes, lectotypes, neotypes, and reference specimens

New genera (gen. nov.): (4)
Amphosoma Baral
Bryorbilia Baral & E. Rubio
Liladisca Baral
Lilapila Baral & G. Marson

New or rank-altered subgenera (1), sections (5) and series (23) of *Orbilia*:
subgenus *Habrostictis* (Fuckel) Baral & E. Weber

subgenus *Habrostictis* **section** *Aurantiorubrae* Baral & E. Weber
subgenus *Habrostictis* **section** *Helicoon* (Morgan) Baral & E. Weber
subgenus *Hemiorbilia* **section** *Lentiformes* Baral & E. Weber
subgenus *Orbilia* **section** *Arthrobotrys* (Corda) Baral, E. Weber & Hagedorn
subgenus *Orbilia* **section** *Ovoideae* Baral & E. Weber

section *Arthrobotrys* **series** *Dactylellina* (M. Morelet) Baral & E. Weber
section *Arthrobotrys* **series** *Drechslerella* (Subram.) Baral & E. Weber
section *Arthrobotrys* **series** *Gamsylella* (M. Scholler, Hagedorn & A. Rubner) Baral & E. Weber
section *Arthrobotrys* **series** *Neodactylella* Baral & E. Weber
section *Aurantiorubrae* **series** *Abutilones* Baral & E. Weber
section *Aurantiorubrae* **series** *Albovinosae* Baral
section *Aurantiorubrae* **series** *Commatoideae* Baral & E. Weber
section *Aurantiorubrae* **series** *Hyalinia* Baral & E. Weber
section *Aurantiorubrae* **series** *Piliferae* Baral
section *Aurantiorubrae* **series** *Poitevinicae* Baral
section *Aurantiorubrae* **series** *Regales* Baral & E. Weber
section *Aurantiorubrae* **series** *Rubellae* Baral & E. Weber
section *Aurantiorubrae* **series** *Xanthoguttulatae* Baral, Quijada & E. Weber
section *Habrostictis* **series** *Ellipsospermae* Baral & E. Weber
section *Habrostictis* **series** *Serpentinae* Baral & E. Weber
section *Helicoon* **series** *Pseudotripoconidium* (Z.F. Yu & K.Q. Zhang) Baral & E. Weber
section *Hemiorbilia* **series** *Hesperideae* Baral & E. Weber
section *Hemiorbilia* **series** *Vibrioides* Baral, E.Weber & G. Marson
section *Lentiformes* **series** *Cercidicola* Baral
section *Lentiformes* **series** *Microspermae* Baral & E. Weber
section *Lentiformes* **series** *Ovales* Baral & E. Weber
section *Lentiformes* **series** *Phanosomates* Baral & E. Weber
section *Orbilia* **series** *Microsomates* Baral & E. Weber

New species (sp. nov.): (331)

Amphosoma atroolivaceum Baral & G. Marson
Amphosoma macrosporum Baral & G. Marson
Amphosoma natalense Baral
Amphosoma resinicola Baral & G. Marson

Bryorbilia arenicola E. Rubio & Baral

Hyalorbilia caucasica Baral & E. Weber
Hyalorbilia fagi E. Weber, Baral & J.W. Guo
Hyalorbilia fomentarii Baral
Hyalorbilia helicospora Baral & G. Marson
Hyalorbilia herbicola Baral, Priou & Perz
Hyalorbilia hergiswiliana Baral, Polhorský & E. Weber
Hyalorbilia japonica Baral, M.L. Wu & Y.C. Su
Hyalorbilia latispora Baral, G. Marson & P. Perz
Hyalorbilia macrohelicospora Baral & Hong Y. Su
Hyalorbilia multiguttulata Baral & B. Declercq
Hyalorbilia orbiliicola Baral, G. Marson, Polhorský & E. Weber
Hyalorbilia pleioerythrostigma Baral
Hyalorbilia puertoricensis Baral
Hyalorbilia resinae Baral
Hyalorbilia rotifera Baral & E. Batten
Hyalorbilia sibirica E. Weber & Baral
Hyalorbilia subfusispora Baral, G. Marson & P. Perz
Hyalorbilia texensis Baral & G. Marson
Hyalorbilia tortuosa Baral, E. Weber, Y.C. Su & M.L. Wu
Hyalorbilia ulicicola Baral & Priou
Hyalorbilia ulmi Baral & E. Batten

Lecophagus ellipsoideus Baral & G. Marson
Lecophagus pini Baral
Lecophagus subglobosus Baral, B. Coué & M. Hairaud

Lilapila jurana Stöckli, G. Marson, Baral, U. Graf, Gilgen, Wergen & E. Weber
Lilapila oculispora Baral & G. Marson
Lilapila oculisporella G. Marson, Baral & E. Weber

Orbilia acaciae Baral & G. Marson
Orbilia acicularis Baral & Hong Y. Su
Orbilia aethiopica Baral & U. Lindem.
Orbilia albidorosea Baral & G. Marson
Orbilia albovinosa Baral
Orbilia allantoobliqua Baral & G. Marson
Orbilia alpigena Baral & E. Weber
Orbilia amberina Baral & G. Marson
Orbilia angiosubvinosa Baral, R. Tena & E. Weber
Orbilia anguliobliqua Baral & G. Marson
Orbilia angustoaristata Baral & G. Marson
Orbilia angustoobliqua Baral & G. Marson
Orbilia anigozanthi Baral & G. Marson
Orbilia arachnopus Baral & G. Marson
Orbilia arachnovinosa Baral & E. Weber
Orbilia aradi Baral & G. Marson
Orbilia arizonensis Baral & G. Marson
Orbilia astrovinosa Baral & G. Marson
Orbilia asturiensis Baral, E. Rubio & J. Linde
Orbilia atlantis Baral, Spooner & Hairaud
Orbilia atriplicis Baral
Orbilia atrolentiformis Baral & G. Marson
Orbilia aureocrenulata Baral
Orbilia australiensis Baral & G. Marson
Orbilia austrocylindrica Baral & E. Weber
Orbilia austroobtusispora Baral
Orbilia austroocculta Baral & G. Marson
Orbilia austropleiomicrosoma Baral & G. Marson
Orbilia austroregalis Baral
Orbilia aviaristata Baral & G. Marson
Orbilia aviceps Baral & G. Marson
Orbilia aviflagellata Baral & G. Marson
Orbilia bambusina Baral
Orbilia barrowensis Baral & G. Marson
Orbilia basiflexa Baral
Orbilia battenii Baral & E. Weber
Orbilia beatricis Baral
Orbilia bicknellensis Baral & G. Marson
Orbilia binchuanensis Baral & Hong Y. Su
Orbilia brachychitonis Baral & G. Marson
Orbilia brettii O. Ceska, Baral, G. Marson & E. Weber
Orbilia breviaristata Baral, Priou & G. Marson
Orbilia breviclava Baral
Orbilia cactacearum Baral & G. Marson
Orbilia calyptrata Baral & G. Marson
Orbilia canadensis Baral & G. Marson
Orbilia carminorosea Baral
Orbilia carnegieae Baral & G. Marson
Orbilia caudimaeandrina Baral & G. Marson
Orbilia caulicola Baral & G. Marson
Orbilia cercidicola Baral, G. Marson & E.S. Popov
Orbilia cercocarpi Baral & G. Marson
Orbilia cisti Baral & E. Weber
Orbilia clavipisca Baral & G. Marson
Orbilia clavuliaristata Baral & E. Weber
Orbilia clavuliformis Baral & G. Marson
Orbilia cocois Baral
Orbilia colombiana Baral & Priou
Orbilia commarosa Baral & G. Marson
Orbilia concoloris Baral & G. Marson
Orbilia coniferarum Baral & E. Weber
Orbilia coronohesperidea Baral
Orbilia crenatofalcata Baral & S. Tello
Orbilia crenatonemaspora Baral & Hong Y. Su
Orbilia crenatovinosa Baral & Friebes
Orbilia cryptogena Baral & G. Marson
Orbilia cucumispora Baral & G. Marson

Orbilia cupressi Baral & E. Weber
Orbilia cupularis Baral & G. Marson
Orbilia curvatimyriella Baral & G. Marson
Orbilia curvatinavajoana Baral & G. Marson
Orbilia curvatiobliqua Baral
Orbilia curvatitrapeziformis Baral, G. Marson & Quijada
Orbilia curvativitalbae Baral & G. Marson
Orbilia cylindrosoma Baral, E. Weber & G. Marson
Orbilia cylindrospora Baral, E. Weber & G. Marson
Orbilia dalmatica Baral
Orbilia delphinus Baral & G. Marson
Orbilia denticulata Baral, R. Galán & G. Marson
Orbilia desertorum Baral & Priou
Orbilia disseminata (Henn.) Baral & E. Weber
Orbilia dixiensis Baral & G. Marson
Orbilia edulis Baral & E. Weber
Orbilia epilobii Baral & E. Weber
Orbilia eremaeae Baral
Orbilia fabacearum Baral & G. Marson
Orbilia farnesianae Baral
Orbilia ficicola G. Marson, Baral & E. Weber
Orbilia filiformis Baral, E. Weber & P. Perz
Orbilia fimbriata Baral & G. Marson
Orbilia flavovacuolata Baral & E. Weber
Orbilia flexisoma Baral & G. Marson
Orbilia floridensis Baral
Orbilia foliicola Baral & E. Weber
Orbilia frangulae G. Marson, Baral & E. Weber
Orbilia fraxini Baral & P. Perz
Orbilia frullaniae Baral & Priou
Orbilia fusiformis Baral & Hong Y. Su
Orbilia geijerae Baral
Orbilia gemma Baral & G. Marson
Orbilia graminis Baral & G. Marson
Orbilia gregorii Baral
Orbilia guyanensis Baral
Orbilia halimi Baral & E. Weber
Orbilia helicoobliqua Baral & G. Marson
Orbilia helicovinosa Baral
Orbilia hoana Baral, Hong Y. Su & Y.C. Su
Orbilia idahoensis Baral & G. Marson
Orbilia jacaensis Baral, Priou & E. Weber
Orbilia jinguangsiensis Baral & H.Y. Su
Orbilia jurana Baral
Orbilia kingsiana Baral & G. Marson
Orbilia lacrimispora Baral & G. Marson
Orbilia lamarcheae Baral
Orbilia lanternae Baral & G. Marson
Orbilia lentiformis Baral & G. Marson
Orbilia lilacina Baral & G. Marson
Orbilia liliputiana Baral, Quijada & E. Weber
Orbilia livistonae Baral
Orbilia lobeliae Baral
Orbilia macroasca Baral & G. Marson
Orbilia macrocarpa Baral & G. Marson
Orbilia macrodelphinus Baral & G. Marson
Orbilia macrohesperidea Baral & G. Marson
Orbilia macroserpens Baral & G. Marson
Orbilia macrotrapeziformis Baral & E. Weber
Orbilia maeandrina Baral & G. Marson
Orbilia magnifica Baral & G. Marson
Orbilia mali Baral
Orbilia mammifera Baral
Orbilia martinicensis Baral, Priou & Lechat
Orbilia megahesperidea Baral & G. Marson
Orbilia megaocculta Baral
Orbilia menageshae Baral & U. Lindem.
Orbilia mesaverdiana Baral & G. Marson
Orbilia microlentiformis Baral
Orbilia microserpens Baral
Orbilia microsoma Baral, G. Marson & E. Weber
Orbilia mirabilis Baral, G. Marson & E. Weber
Orbilia mongolica Baral
Orbilia montigena Baral & E. Weber
Orbilia multiaustraliensis Baral & G. Marson
Orbilia multiaustrocylindrica Baral
Orbilia multicercocarpi Baral & G. Marson
Orbilia multicreosoteris Baral & G. Marson
Orbilia multicurvula Baral & G. Marson
Orbilia multidelphinus Baral
Orbilia multigambelii Baral & G. Marson
Orbilia multihamulata Baral & G. Marson
Orbilia multimaeandrina Baral & G. Marson
Orbilia multinanosoma Baral
Orbilia multiphanosoma Baral & G. Marson
Orbilia multiserpens Baral & G. Marson
Orbilia multitrapezoidea Baral & G. Marson
Orbilia multiurosperma Baral & G. Marson
Orbilia multivinosa Baral & G. Marson
Orbilia multivirgula Baral & G. Marson
Orbilia myriella Baral & G. Marson
Orbilia myrioauris Baral & G. Marson
Orbilia myrioaustraliensis Baral & E. Weber
Orbilia myrioeuonymi Baral & G. Marson
Orbilia myrioflexa Baral
Orbilia myriofusiclava Baral & G. Marson
Orbilia myriofusoidea Baral
Orbilia myriohesperidea Baral
Orbilia myriolentiformis Baral & G. Marson
Orbilia myriolilacina Baral & G. Marson
Orbilia myriomuscula Baral & G. Marson
Orbilia myrionamibica Baral
Orbilia myrionanosoma Baral & G. Marson
Orbilia myrioobliqua Baral & G. Marson
Orbilia myrioolneyae Baral & G. Marson
Orbilia myriophanosoma Baral & G. Marson
Orbilia myriopseudoregalis Baral & G. Marson
Orbilia myriosphaera Baral & E. Weber
Orbilia myriourosperma Baral & G. Marson
Orbilia namibica Baral & G. Marson
Orbilia nanosperma Baral & G. Marson
Orbilia naumburgensis Baral & E. Weber
Orbilia navajoana Baral & G. Marson
Orbilia navicularis S. Tello, Baral & E. Weber
Orbilia nemaspora Baral, Bin Liu, A.I. Romero, Healy & Pfister
Orbilia neocomma Baral, S.F. Li, J.W. Guo, Z.F. Yu & G. Marson
Orbilia nothoaprilis Baral
Orbilia nothovinosa Baral
Orbilia obtusispora Baral & E. Weber
Orbilia ocellata Baral, G. Marson & E. Weber
Orbilia octocercocarpi Baral & E. Weber
Orbilia octocorculispora R. Tena, Baral & E. Weber
Orbilia octoserpentina Baral & G. Marson
Orbilia octosporoides Baral & G. Marson
Orbilia olivacea Baral & G. Marson
Orbilia ophiosoma Baral & G. Marson
Orbilia osteospermae Baral & G. Marson
Orbilia ovalis Baral & G. Marson
Orbilia ovoidea Baral & G. Marson
Orbilia palmicola Baral
Orbilia paloverdensis Baral & G. Marson
Orbilia paracaudata Baral & G. Marson
Orbilia paracylindrospora Baral & E. Weber
Orbilia paradoxoides Baral
Orbilia paramontigena Baral, Bometón & E. Weber
Orbilia paraobliqua Baral & G. Marson
Orbilia paravitalbae Baral, E. Weber, Priou & R. Tena
Orbilia parviclava Baral
Orbilia patellarioides Baral & G. Marson
Orbilia phanosoma Baral & Marson
Orbilia phragmitis Baral
Orbilia pileosoma Baral & G. Marson
Orbilia pisciculus Baral & G. Marson
Orbilia pleioalbidorosea Baral
Orbilia pleioaustraliensis Baral & G. Marson
Orbilia pleioaustrocylindrica Baral, G. Marson & E. Weber
Orbilia pleiocoronohesperidea Baral & G. Marson
Orbilia pleiocrescens Baral & G. Marson
Orbilia pleioeuonymi Baral, G. Marson & Priou
Orbilia pleiogambelii Baral
Orbilia pleiohesperidea Baral
Orbilia pleiolentiformis Baral & G. Marson

Orbilia pleiomesaverdiana Baral & G. Marson
Orbilia pleiomicrosoma Baral & G. Marson
Orbilia pleionavajoana Baral & G. Marson
Orbilia pleioobtusispora Baral
Orbilia pleioquaestiformis Baral & G. Marson
Orbilia pleioserpens Baral & G. Marson
Orbilia pleiostomachia Baral
Orbilia pleioungulata Baral, Quijada & R. Tena
Orbilia pleiourosperma Baral & G. Marson
Orbilia pleiovinosa Baral & G. Marson
Orbilia pleiovitalbae Baral
Orbilia pleistoeuonymi Baral & P. Perz
Orbilia pleistolilacina Baral, G. Marson & E. Weber
Orbilia pleistoobliqua Baral & G. Marson
Orbilia pleistosphaera S. Tello & Baral
Orbilia pleistovitalbae Baral & G. Marson
Orbilia plurilentiformis Baral & G. Marson
Orbilia plurililacina Baral, G. Marson & E. Weber
Orbilia pluristomachia Baral & G. Marson
Orbilia plurivacuolata Baral, G. Marson & E. Weber
Orbilia poitevinica Baral
Orbilia ponderosae Baral & G. Marson
Orbilia pseudoaristata Baral & G. Marson
Orbilia pseudeuphorbiae Baral, Quijada & Beltrán-Tej.
Orbilia pseudocylindrospora Baral & G. Marson
Orbilia pseudoflagellispora Baral & G. Marson
Orbilia purshiae Baral & G. Marson
Orbilia puyae Baral & Priou
Orbilia quaestiformis Baral & G. Marson
Orbilia quercus-ilicis Baral & E. Weber
Orbilia pyrenaica Baral, Priou & E. Weber
Orbilia rhamni Baral & Priou
Orbilia rehmii Baral
Orbilia rubrovacuolata Baral, Priou & E. Weber
Orbilia saguarina Baral & G. Marson
Orbilia sarcobati Baral & G. Marson
Orbilia sarothamni Baral
Orbilia scandens Baral & G. Marson
Orbilia scaphoides (Peach) E. Weber & Baral
Orbilia sedonensis Baral & G. Marson
Orbilia siculispora Baral, E. Weber, Friebes & G. Marson
Orbilia solidaginis Baral
Orbilia somedana Baral & E. Weber
Orbilia sonorensis Baral & G. Marson
Orbilia spathulata Baral & G. Marson
Orbilia spermoides Baral & G. Marson
Orbilia sphaerospora Baral & G. Marson
Orbilia spirillospora Baral & G. Marson
Orbilia spirospora Baral & E. Weber
Orbilia stansburyanae Baral
Orbilia stilbospora Baral
Orbilia subalbovinosa Baral & G. Marson
Orbilia subaristata Baral, G. Marson & Matočec
Orbilia subclavuliformis Baral, E. Weber & Priou
Orbilia subcryptogena Baral & G. Marson
Orbilia subcylindrospora Baral & E. Weber
Orbilia subdelphinus Baral
Orbilia suberis Baral & R. Galán
Orbilia subfabacearum Baral & G. Marson
Orbilia subocellata Baral & E. Weber
Orbilia subovoidea Baral, Matočec & E. Weber
Orbilia subsiculispora G. Marson & Baral
Orbilia subsphaerospora Baral
Orbilia subtrapeziformis Baral, E. Weber & G. Marson
Orbilia subuliformis Baral
Orbilia subulivinosa G. Marson, H.O. Baral, E. Rubio & E. Weber
Orbilia subvinosa G. Marson, Baral & E. Weber
Orbilia subvitalbae Baral & E. Weber
Orbilia tremuloidis Baral & E. Weber
Orbilia tenuispora E. Weber, Baral, H.Y. Su, M.L. Wu, Y.C. Su & Bin Liu
Orbilia trapeziformis Baral & G. Marson
Orbilia triangulispora Baral
Orbilia ungulata Baral, G. Marson & Matočec
Orbilia urosperma Baral & G. Marson
Orbilia velutina Baral & G. Marson
Orbilia vermiculati Baral & G. Marson
Orbilia vibrioides Baral, Priou & G. Marson
Orbilia wannerooensis Baral & G. Marson
Orbilia xanthoflexa Baral, Pfister & Healy
Orbilia yuccae Baral & G. Marson

New names (nom. nov.): (2)

Orbilia cookei Baral

Pyrenopeziza cookei Baral

New provisional names (nom. prov.): (8)

Lilapila gallica G. Marson, Baral & E. Weber

Orbilia multimacroasca G. Marson & Baral
Orbilia myriostomachia Baral
Orbilia pleiocreosoteris G. Marson
Orbilia pleiovirgula Baral
Orbilia pubescens Baral & G. Marson
Orbilia rosicola Baral & E. Weber
Orbilia senegalensis Baral, G. Marson & E. Weber

New combinations (comb. nov.): (38)

Calycina carneorosea (Cooke & Harkn.) Baral

Hyalorbilia anonyma (Rehm) Baral
Hyalorbilia citrina (A.L. Smith) Baral
Hyalorbilia fusarina (Burghouts & W. Gams) E. Weber & Baral
Hyalorbilia fusarioides (D.C. Harris) E. Weber & Baral
Hyalorbilia leguminacea (Juan Chen, L.L. Xu, Bin Liu & Xing Z. Liu) E. Weber & Baral
Hyalorbilia lignatilis (M.H. Mo & K.Q. Zhang) E. Weber & Baral
Hyalorbilia spermatophaga (Drechsler) E. Weber & Baral

Hyaloscypha leucostigma (Fuckel) Baral

Laetinaevia diaphana (Rehm) Baral
Laetinaevia raripila (Höhn.) Baral & Helleman

Leptodontidium diaphanulum (Cooke) Baral

Liladisca acicola (Fuckel) Baral

Mniaecia albida (P. & H. Crouan) Priou & Baral

Orbilia bembicodes (Drechsler) E. Weber & Baral
Orbilia brochopaga (Drechsler) Baral, E. Weber, Bin Liu & Z.F. Yu
Orbilia cladodes (Drechsler) E. Weber & Baral
Orbilia clavispora (J. Chen, L.L. Xu, B. Liu & Xing Z. Liu) Baral, E. Weber, P. Perz & G. Marson
Orbilia elegans (Oudem.) Baral, A. Rubner, E. Weber & Van Ryck.
Orbilia ellipsospora (Preuss) Bin Liu, E. Weber & Baral
Orbilia flagellispora (Raitv. & R. Galán) Baral & G. Marson
Orbilia javanica (Rifai & R.C. Cooke) Bin Liu, Baral & E. Weber
Orbilia latispora (H.Y. Su & X.Y. Yang) Baral, Ying Zhang & E. Weber
Orbilia lysipaga (Drechsler) Bin Liu, Baral & E. Weber
Orbilia mammillata (S.M. Dixon) Baral & E. Weber
Orbilia multiformis (Dowsett, J. Reid & Kalkat) E. Weber & Baral
Orbilia oligospora (Fresen.) Baral & E. Weber
Orbilia oxyspora (Sacc. & Marchal) E. Weber & Baral
Orbilia polybrocha (Drechsler) Baral, E. Weber & Pfister
Orbilia regalis (Cooke & Ellis) Baral
Orbilia rhopalota (Drechsler) Baral & E. Weber
Orbilia rosea (J. Webster & Descals) Baral & E. Weber
Orbilia saccharifera (Berk.) Baral
Orbilia xinjiangensis (J. Chen, L.L. Xu, B. Liu & Xing Z. Liu) E. Weber, Baral & Helleman
Orbilia yunnanensis (Z.F. Yu & K.Q. Zhang) Bin Liu, E. Weber & Baral
Orbilia zhongdianensis (J. Zhang & K.Q. Zhang) Baral, E. Weber & M. Bemmann

Psilachnum rubicundum (Sacc. & Speg.) Baral

Rodwayella haematoidea (Cooke & W. Phillips) Baral & Quijada

New epitypes: **(33)**

Hyalorbilia berberidis: BR5020213021208V, epitype of *Orbilia berberidis*
Hyalorbilia citrina: M-0291768, epitype of *Calloria citrina*
Hyalorbilia erythrostigma: M-0291773, epitype of *Peziza erythrostigma*
Hyalorbilia fusispora: M-0291770, epitype of *Orbilia fusispora*

Orbilia aprilis: M-0291762, epitype
Orbilia aristata: M-0291760, epitype of *Orbilia occulta* var. *aristata*
Orbilia aurantiorubra: M-0291763, epitype
Orbilia cardui: M-0291778, epitype
Orbilia carpoboloides: H.B. 6639c (illustration on Pl. 568: 3), epitype of *Peziza carpoboloides*, ex-epitype culture: CBS 116276
Orbilia cejpii: M-0291774, epitype
Orbilia comma: M-0291759, epitype
Orbilia cotoneastri: M-0177060, epitype
Orbilia crenatomarginata: M-0291776, epitype of *Hyalinia crenatomarginata*
Orbilia dryadum: M-0291769, epitype of *Orbilia alnea* var. *dryadum*
Orbilia ebuli: M-0276476, epitype
Orbilia epipora: M-0291771, epitype of *Peziza epipora*
Orbilia euonymi: M-0291775, epitype
Orbilia flavida: M-0291761, epitype
Orbilia flavidorosella: G.M. 2012-09-18.1 (illustration on Pl. 584: 5), epitype, GenBank KT222391
Orbilia hesperidea: M-0291758, epitype
Orbilia luteorubella: M-0291777, epitype of *Peziza luteorubella*
Orbilia occulta: GXU 1467, epitype *Calloria occulta*
Orbilia oligospora: CBS 115.81, epitype of *Arthrobotrys oligosporus*
Orbilia oxyspora: M-0276548, epitype of *Dactylella oxyspora*
Orbilia phragmotricha: M-0291767, epitype of *Orbiliaster paradoxus*
Orbilia polybrocha: M-0276567, epitype of *Trichothecium polybrochum*
Orbilia polyspora: M-0291765, epitype
Orbilia rectispora: M-0276578, epitype of *Hyalinia rectispora*
Orbilia rubella: M-0291772, epitype of *Peziza rubella*
Orbilia rosea: CCM F-18983, epitype of *Anguillospora rosea*
Orbilia sarraziniana: M-0291764, epitype
Orbilia tremulae: M-0276602, epitype
Orbilia vitalbae: M-0276607, epitype

New lectotypes: **(39)**

Claussenomyces atrovirens: the collection from Kergontès, lectotype of *Helotium flavoviride*

Hyalorbilia andina: FH, lectotype of *Orbilia andina*
Hyalorbilia citrina: K(M) 31762, lectotype of *Calloria citrina*
Hyalorbilia inflatula: W 6467, lectotype of *Orbilia sinuosa*
Hyalorbilia inflatula: PRM 152443, lectotype of *Orbilia linata*
Hyalorbilia inflatula: herb. L.J. Grelet, PC, lectotype of *Hyalinia rectispora* var. *majuscula*

Liladisca acicola: Fungi Rhen. Exs. 1965, M-0206556, lectotype of *Tympanis acicola*

Orbilia arachnovinosa: herb. P.A. Karsten 3196, H-6003827, lectotype of *Orbilia rubinella*
Orbilia auricolor: K, lectotype of *Peziza auricolor*
Orbilia auricolor: herb. E. Mussat, PC, lectotype of *Helotium karstenii*
Orbilia blumenaviensis: S, lectotype of *Helotium blumenaviense*
Orbilia brasiliensis: herb. J. Puiggari 2781, LPS 28075, lectotype of *Calloria brasiliensis*
Orbilia cardui: PRM 149600, lectotype of *Orbilia cardui* var. *farfarae*
Orbilia carpoboloides: herb. L. Fuckel 1894, G, lectotype of *Habrostictis rubra*
Orbilia carpoboloides: M-0206370, lectotype of *Peziza lasia*
Orbilia carpoboloides: S-F9979, lectotype of *Calloria rubrococcinea*
Orbilia clavispora: PRM 151613, lectotype of *Orbilia vestimenti*
Orbilia coccinella: herb. E. Fries, UPS, lectotype of *Peziza coccinella*
Orbilia crenatomarginata: FH 00304814, lectotype of *Hyalinia crenatomarginata*
Orbilia disseminata: S-F9997, lectotype of *Helotium disseminatum*
Orbilia epipora: herb. P.A. Karsten 5278, H-6003825, as *Peziza leucostigma*, lectotype of *Peziza epipora*
Orbilia epipora: S, herb. Sydow, lectotype of *Orbilia sericea*
Orbilia euphorbiae: S-F41427, lectotype of *Humaria euphorbiae*
Orbilia juruensis: K(M) 52784, lectotype
Orbilia luteorubella: herb. P.A. Karsten 5282, H-6003831, lectotype of *Peziza luteorubella*
Orbilia microspora: PRM 151768, lectotype
Orbilia neglecta: PAD, nr. 442 ex parte, lectotype
Orbilia occulta: herb. H. Rehm 770, M-0206545, lectotype of *Calloria occulta*
Orbilia oxyspora: PRM 148826, lectotype of *Orbilia sambuci*
Orbilia regalis: herb. M.C. Cooke 2778, K(M) 35323, apothecia on inner surface of bark, lectotype of *Peziza regalis*
Orbilia rosea: PRM 151737, lectotype of *Orbilia verrucosa*
Orbilia rosea: PRM 151715, lectotype of *Orbilia pseudorubella*
Orbilia rosella: M-0206546, lectotype
Orbilia tremulae: PRM 152382, lectotype
Orbilia vinosa: PRM, illustration in Velenovský's manuscript, lectotype of *Orbilia prunorum*
Orbilia vitalbae: S-F9983, short-spored apothecia, lectotype
Orbilia xanthostigma: L 910.261-262, lectotype of *Peziza aurea*

Patinella stenotheca: herb. P.A. Karsten 3426 (H), lectotype

Pezizella orbilioides: LUX 42532, lectotype

New neotypes: **(3)**

Hyalorbilia inflatula: M-0276411, neotype of *Peziza inflatula*

Orbilia leucostigma: M-0276499, neotype of *Peziza leucostigma*
Orbilia xanthostigma: M-0177061, neotype of *Peziza xanthostigma*

New reference specimens (RefSpec): **(4)**

Orbilia auricolor: M-0276438, RefSpec of *Peziza auricolor*
Orbilia cladodes: CBS 297.84, CBS H-8895, RefSpec of *Arthrobotrys cladodes*
Orbilia lysipaga: CBS 581.91, RefSpec of *Dactylella lysipaga*
Orbilia vinosa: H.B. 6715b, RefSpec of *Peziza vinosa*

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