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BASIDIOMYCETES OF SOUTH-EAST ASIA

2. On *Scenedium apiarium*, with a discussion of the nomenclatural status of the genus *Hexagonia* Pollini (*Hexagona* Fr.)

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Scenedium apiarium (Polyporaceae s.lat.) is described and illustrated. The nomenclatural problems associated with *Hexagonia* are discussed. *Hexagonia* Pollini, typified by *H. mori*, is a possible synonym of *Polyporus*. The name '*Hexagona* Fr.' was never validly published. The tropical species formerly included in *Hexagonia* belong to *Scenedium*.

Among wood-rotting polyporoid fungi, the genus *Hexagonia* 'Fries' is one of the more conspicuous genera. Owing to its often large and more or less hexagonal pores, the genus was easily recognized and became a depository for all polypores with such pores and corky to woody pilei. Thanks to the excellent revision of the genus by Fidalgo (1968b), *Hexagonia* is now well defined and comprises seven to fourteen species. Almost all species of *Hexagonia* show a tropical distribution, with only one somewhat deviating species (*H. nitidia*) recognized in Europe; the latter species, however, is according to Donk better placed in a separate genus *Apoxona*.

Hexagonia, as restricted by Fidalgo (1968b), is characterized by lignicolous, sessile basidiocarps with coriaceous to corky consistency. Pilei are dimidiate or flabelliform, applanate to conchate, with a smooth or velutinous to strigose upper surface. The brown context becomes dark brown to black in KOH. The hymenial surface is poroid, not lamellate, with large or small, often hexagonal pores; tubes are in one layer, not distinctly stratified. Hyphal pegs are often abundant, yellow to dark brown, conical, and mainly composed of skeletal hyphae. The hyphal system of the context and dissepiment trama is trimitic. Generative hyphae are hyaline, thin-walled, with clamps. Skeletal hyphae are yellowish brown to distinctly brown, thick-walled, rarely solid, unbranched, with secondary septa. Binding hyphae are hyaline to yellowish brown, thick-walled to solid, strongly branched to coralloid. Basidia collapse easily and then form a honeycomb pattern; they are hyaline, clavate, and four-spored. Spores are hyaline, cylindrical, thin-walled, smooth inamyloid; they are rarely found in herbarium specimens.

The genus *Hexagonia* resembles genera like *Trametes* (incl. of *Coriolus*) and *Cerrena* but differs in its yellowish brown skeletal and binding hyphae which are more reminiscent of *Corioloopsis*. Although *Hexagonia*, as defined by Fidalgo (1968b), is easily recognized, there remain problems concerning the typification of the genus, and the question whether '*Hexagona* Fr.' is identical with *Hexagonia* Pollini. Fidalgo (1968a) believed that the genus '*Hexagona* Fr.' is different from *Hexagonia* Pollini, whereas Donk (1969) argued that '*Hexagona* Fr.' is nothing but a validation of *Hexagonia* Pollini and that only one genus which must be called *Hexagonia* Pollini ex Fries is involved.

With the recent change of the starting point for nomenclature of fungi, this additional aspect has to be considered, and since the underlying problems are rather complex, it seems worthwhile to discuss the essential points in detail.

(i) *Hexagonia* Pollini (1816) was described as a monotypic genus, the only included species being *H. mori* Pollini (1861), a polyporoid, lignicolous species from Italy with elongated hexagonal pores. Prior to the change of the starting point, that genus was unavailable because it was published before 1821, but now it is acceptable as a validly published generic name.

(ii) In 1836 (*Flora Scanica*: 339), Fries listed a genus *Hexagona* (sic!) with a short description but he did not cite the author of the genus nor any specific names; he also introduced the slightly different spelling of the name. In the same year, Fries (1836, *Genera Hymen.*: 11) mentioned the authorless genus *Hexagona* again, furnished a short description and indicated that the genus contained twelve species.

(iii) Finally, Fries (1838: 496) gave descriptions of *Hexagona* and its twelve species. He distinctly and without reservation referred the genus to Pollini, calling it '*Hexagona*. (Pollini, pl. nov.; p. 35)', and included the type species of *Hexagonia*: '*H. Mori*, Poll. pl. nov. p. 35' (loc. cit.: 496). Apart from this European species, all other eleven species were of tropical origin. Fries had not seen specimens of *H. mori*, but he obviously knew Pollini's publication which not only contains lengthy descriptions but also good drawings of that species. The diagnosis of *Hexagonia* which Fries published (sub *Hexagona*) (Fries, 1838: 496) does not contradict his description of *H. mori* (loc. cit.: 497) and there is no reason to assume that it was Fries' intention to publish a genus different from that of Pollini. His reference to Pollini, instead, is without any reservation, and the inclusion of the type species *H. mori* (as fifth species) indicates that he fully accepted Pollini's genus, which he emended by also including eleven tropical taxa. We know that the genus *Hexagonia* Pollini as emended by Fries (1838) is artificial. The twelve species initially included by Fries belong to four or five different and not closely related genera. This, however, was not known to Fries himself who, also in subsequent publications (Fries, 1851: 101, as '*Epicr.* 5-8'; 1874: 590), included *H. mori* in his systematic treatments of *Hexagonia*.

The first author to study the problem from a nomenclatural point of view was O. Kuntze (1898) who indicated *H. mori* as the type of *Hexagonia* Pollini (and was followed by Hariot, 1891: 204; Murrill, 1907: 47; Donk, 1960: 225; and others). Kuntze separated the heterogeneous tropical species which Fries had included in the emended genus

Hexagonia, and placed them in the genus *Scenedium* (Klotzsch) O. Kuntze. This decision, as far as the separation from *Hexagonia* s.str. is concerned, was and still is correct, and is probably more convincing after the recent change of the starting point for fungi.

(iv) The new starting point for fungi is Linnaeus 1753, but names in Fries, *Systema Mycologicum* (1821–1832) and Elenchus *Fungorum* (1828) are protected. The genus *Hexagonia* as emended by Fries (1838) is not protected and has consequently no priority over *Hexagonia* Pollini (1816). Hence, the discussion as to whether Fries (1838) published a new genus *Hexagona* not typified by *H. mori* is useless and does not influence the nomenclatural status of the validly published genus *Hexagonia* Pollini (1816).

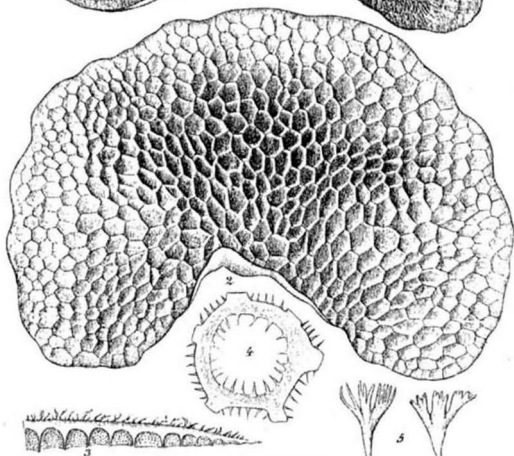
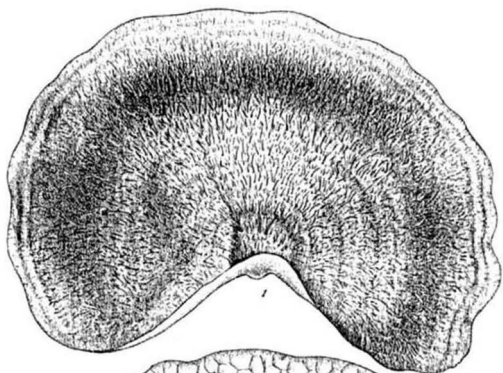
The problem remains, however, what to do with the species now included in *Hexagonia* ss.auct. (Fidalgo, 1968b). The genus *Favolus* is often cited in connection with *Hexagonia mori* or with other species of *Hexagonia*. But this name is not available for the following reasons:

Favolus Palisot (1803) was based mainly on *F. hirtus* Palisot (1803), a species with wide hexagonal pores collected in Africa. Although Palisot de Beauvois wrote that one of Bulliard's species (the name of which was not given) and several other species also belong to *Favolus*, only *F. hirtus* was specifically mentioned and was consequently accepted as the generic type by many mycologists. Fries (1821: 342) adopted Palisot de Beauvois name, although as a subgenus '*Favolus*. Pal. l.c.' of *Polyporus*, and included the type species as '10. *P. Fav. hirtus*, ...' also in *Polyporus*. In the *Epicrisis* Fries (1838: 496) transferred the species to *Hexagonia* where it has remained (Fidalgo, 1968b; Ryvarden & Johansen, 1980). *Favolus* Palisot (1803) is therefore the oldest generic name for the tropical species of *Hexagonia*, but it was unfortunately sanctioned by Fries (1821) only at the subgeneric level.

In the *Elenchus*, one of the 'sanctioning' books, Fries (1828: 44) described a completely different genus under the same name *Favolus*. This monotypic genus was based on *F. brasiliensis* Fr., a species from Brazil, with *Merulius alveolarius* DC. mentioned as a possible second species. In this publications *Favolus* Palisot is not cited under *Favolus* Fr., while *F. hirtus* Palisot is only mentioned under *Polyporus* (l.c.: 73) with reference to his treatment of the species in volume 1 of *Systema Mycologicum*.

Thus, Fries (1828) in describing a completely different genus also called *Favolus*, created a later homonym of *Favolus* Palisot (1803); *Favolus* Fr. would have to be dropped, had it not been published in one of the 'sanctioning' books. Hence, we have to accept *Favolus* Fr. and reject the older name *Favolus* Palisot. The genus *Favolus* Fr., as typified by *F. brasiliensis* Fr., is closely related to *Polyporus*. It differs mainly in having clampless generative hyphae (*Polyporus*, except for *P. badius*, has clamped generative hyphae) and a dimittic hyphal system with slightly branched skeletal hyphae (*Polyporus* is dimittic with binding hyphae instead); all hyphae are hyaline. The differences between *Polyporus* (incl. *Hexagonia mori*) and *Favolus* Fr. are not great, but the tropical *Hexagonia* species with a trimitic hyphal system of brownish skeletal and binding hyphae are widely different.

This leaves us with the following set of genera:



Polyporus Wightii Kl.

(a) Genera with hyaline hyphae and a dimitic hyphal system:

Polyporus Mich. ex Adans.: Fr. 1821. —

Type species: *Polyporus tuberaster* (Pers.) Fr. 1821.

Hexagonia Pollini 1816. —

Type species: *H. mori* Pollini 1816.

Favolus Fr. 1828 (sanctioned). —

Type species: *F. brasiliensis* Fr. 1828.

(b) Genera with brownish hyphae and a trimitic hyphae system:

Favolus Palisot 1803 (unavailable because of *Favolus* Fr. 1828). —

Type species: *Favolus hirtus* Palisot 1803.

Hexagonia sensu Fr. 1838 pro parte (excl. of type).

Fortunately, there are two validly published generic names, *Scenidium* (Klotzsch) O. Kuntze 1898 and *Pogonomyces* Murrill 1905, that are available for tropical species of *Hexagonia*. The first one, *Scenidium*, is the oldest one. It was introduced first as *Polyporus* trib. *Scenidium* Klotzsch 1832 for *Polyporus wightii*, and elevated to generic rank by O. Kuntze (1898: 515). The type, *Polyporus wightii* Klotzsch, is one of the typical members of tropical *Hexagonias*. Thus *Scenidium*, being the oldest available name for the group of tropical species formerly called *Hexagonia*, has to be accepted.

SCENIDIUM (Klotzsch) O. Kuntze

Scenidium (Klotzsch) O. Kuntze, Rev. Gen. Pl. 3(2): 515. 1898.—Type species: *Polyporus wightii* Klotzsch 1833.

Favolus Palisot, Fl. Oware 1: 1. 1803; non *Favolus* Fr. 1828.—Type species: *Favolus hirtus* Palisot 1803.

Hexagonia sensu Fr. 1838, pro parte (excl. type); non *Hexagonia* Pollini 1816.

Pogonomyces Murrill in Bull. Torrey bot. Club 31: 609. 1905.—Type species: *Boletus hydnoides* Swartz 1788.

For a long while the status and typification of *Hexagonia* has been under discussion, resulting in a lot of confusion. Obviously there was, and perhaps still is, a great reluctance to abandon the generic name *Hexagonia*, not because it is the name of a large genus, but because *Hexagonia* is one of the few generic names with an obvious meaning (hexagonal pores). But we should keep in mind that this type of pore, which gave the impetus for the erection of the genus, is observed in several unrelated genera of polypores and a few agaricoid genera. According to Fidalgo (1968b), more than 200 specific combinations have been made in *Hexagonia*, only a very small portion of which apply to the seven species of *Hexagonia* which she accepted. Thus the name *Hexagonia* is not as distinctive as first thought, making it easier to accept the oldest valid name *Scenidium*. This proposal was already made by O. Kuntze in 1898 who also has made almost all necessary specific combinations in *Scenidium*. With the adoption of *Scenidium* as the

Fig. 1. *Scenidium wightii*. Illustration from Klotzsch (1832), showing (1) upper and (2) lower surface, (3) longitudinal and (4) horizontal section with hyphal pegs, and (5) tufts of hairs.

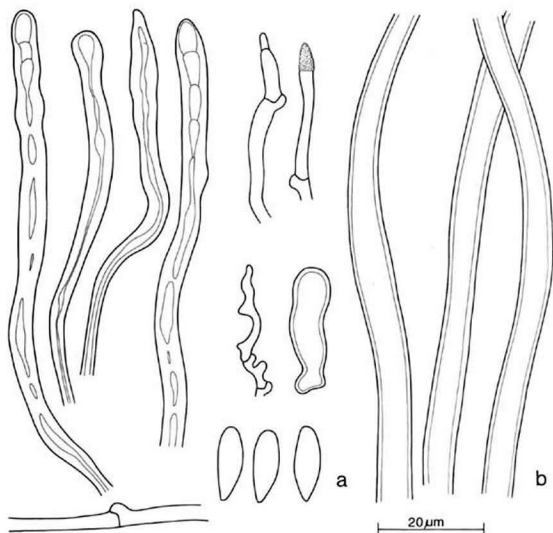


Fig. 2. *Scenidium apiarium*. — a. Elements of the catagymenium: skeletal hyphae, gerative hypha, hyphidia, and spores. — b. Skeletal hyphae of hairs. (From *Boden Kloss*, 2.IX.1927).

oldest available name for tropical Hexagonias, a solution based on the rules of the Code of Nomenclature and the prescribed startingpoint books, a major problem has been solved; in the words of Fidalgo (1968: 38) 'among the polypores there are very few names that were so much confused as *Favolus* and *Hexagona*'.

After a cursory study of some tropical species, one taxon, viz. *Scenidium apiarium*, has been studied in detail and is here described and illustrated.

Scenidium apiarium (Pers.) O. Kuntze

Scenidium apiarium (Pers.) O. Kuntze, Rev. Gen. Pl. 3: 516. 1898.

Polyporus apiarius Pers. in Gaudichaud, Bot. Voy. Uranic Freyc. 169–170. 1827 ('1826').

Hexagonia apiaria (Pers.) Fr., Epicr. Syst. Mycol. p. 497. 1838. (for further synonyms see Fidalgo, 1968b: 41).

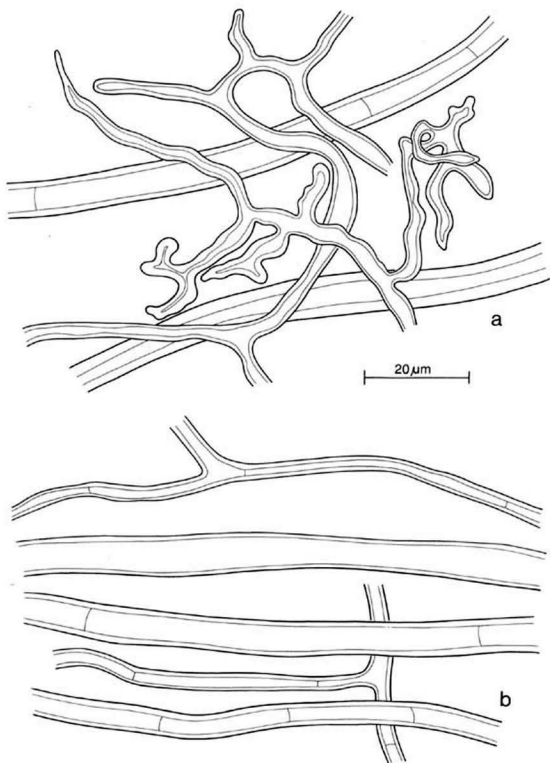


Fig. 3. *Scenidium apiarium*. — a. Skeletal and binding hyphae from the dissepiments. — b. Skeletal hyphae from the context. (From *Boden Kloss*, 2.IX.1927).

Basidiocarp annual, pileate, sessile, dimidiate to flabelliform, usually applanate, rarely slightly concave, 4–15 cm broad, 3–8 cm in radius, 0.3–1.0(–2.0) cm thick, coriaceous to corky. Upper surface of pileus pale brown to dark brown, old specimens somewhat blackish, strigose, densely or sparsely covered with fasciculated hairs, hairs often somewhat branched, almost entirely composed of longitudinally arranged skeletal hyphae; some specimens, especially older ones, almost glabrous. Context brown, dark brown to blackish with KOH, thin, usually not more than 1–2 mm thick. Hymenial surface poroid with regular hexagonal to slightly elongated pores (2–4 per cm). Tubes greyish to ochraceous, up to 1(–1.5) cm long. Hyphal pegs common, up to $200 \times 80 \mu\text{m}$, brownish, built up by straight or slightly torulose, yellowish brown skeletal hyphae with few hyaline generative hyphae. Hyphal system trimitic. Generative hyphae hyaline to pale yellowish, 2–4 μm , thin- to somewhat thick-walled (0.2–0.4 μm), with clamps. Skeletal hyphae yellowish to brownish, 3–5–8 μm wide, thick-walled (0.8–1.5 μm), not or only slightly branched. Binding hyphae yellowish, 1.5–3 μm wide, thick-walled (0.6–1.5 μm), branched to torulose. Catahymenium mainly composed of skeletal hyphae, some sparingly branched binding hyphae, as well as hyphidia or short generative hyphae; these generative hyphae are hyaline, straight or somewhat torulose, thin-walled, and with tips either thick-walled or encrusted with small granules or crystals, and breaking off easily. Basidia mostly collapsed, hyaline, clavate, $20\text{--}30 \times 6\text{--}8 \mu\text{m}$, four-spored. Spores hyaline, cylindrical to narrowly ellipsoid, $11\text{--}16 \times 4.5\text{--}6 \mu\text{m}$.

Habitat. — On deciduous wood.

Specimens examined. — AUSTRALIA. Queensland, *Hartmann 52* (K); — Bloomfield River, *Bauer* (K). — Behar, Soane River, herb. *Hooker 1867* (K). — Port Denison, Fitzalan, 1882, *F. von Mueller* (K).

INDONESIA. Irian Jaya, Humboldt Bay, ridge, 14.I.1912, 500 ft., *L. S. Gibbs 5401* (K). — Monotoari, 14.I.1913, 500 ft., *L. S. Gibbs 5700* (K). — Arfak Mts., foothills, XII.1913, 400 ft., *L. S. Gibbs 6149* (K). — Keravat, Rabaul, X.1955, *W. P. K. Findlay* (K).

PAPUA NEW GUINEA. Presumably Kaitaki, 1935, *Carr 11265* (K). — Matanakunai, Open Bay, Gazelle Peninsula, New Britain Distr., 9.IV.1968, *P. A. Wright FM 627* (K). — Lae, S.P.T. Logging Rds., 18.VIII.1968, *P. A. Wright FM 868* (K).

BRITISH SOLOMON ISLANDS. Without locality, II.1885, *Guppy* (K). — Guadalcanal, late 1972, *G. Jackson G 8* (K).

MALAYSIA. Malaya, Kedah, Pulau Dayang Bunting Langkani, 23.VIII. 1925, *R. E. Holttum 15116* (K). — Malaya, Pohang, Krau Game Reserve, Kuala Lompat Post, 9.III.1977, *S. F. Sharma F/057* (K). — Sabah, Banguay Island, 2.IX.1927, *C. Boden Kloss* (Fungi of Borneo 19226; K).

THAILAND. Without locality, 1859, *Mouhot* (K). — Without locality, III.1928, *T. D. Cockerell* (K). — Pha nok Kao, Loci, 22.II.1958, *P. S. 1358* (K). — Without locality, 1963, *J. Khan* (K).

PHILIPPINES. Without locality, in herb. Berkeley (K). — Without locality, *Cuming 1989* (K). — Luzon, Prov. of Benquet, XI. 1909, *H. M. Curran* (For. Bur. 19226; K). — Luzon, Prov. of Bulacan, Angat, II.1919, *M. Ramos & G. Eidano* (Bur. Sci. 34264; K). — Luzon, Prov. of Ilocos Norte, Burgos, II–III.1917, *M. Ramos* (Bur. Sci. 27821; K). — Luzon, Prov. of Tayabas, Mt. Malaraya, XI.1907, *H. M. Curran & M. R. Merritt* (For. Bur. 8956; K). — Luzon, Prov. of Bataan, Mt. Mari-veles, IX.1904, *A. D. E. Elmer* (K). — Davao, Mindanao, 25.III.1904, *E. B. Copeland 635* (K).

HONG KONG. On living *Bischofia* trees, 17.VI.1904, no collector mentioned (Herb. Hong Kong 1326; K).

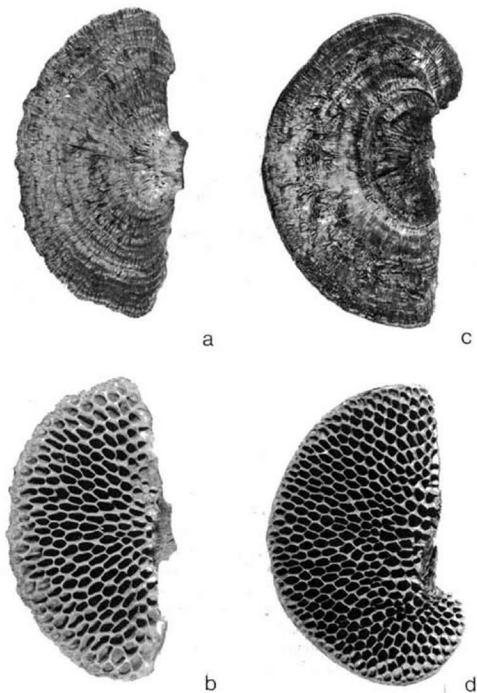


Fig. 4. *Scenidium apiarium*. — a, b. Thailand, 22.II.1958, leg. P.S. — c, d. Thailand, III.1928, Cockerell. (All natural size.)

SRI LANKA. Without locality, Gardner (K). — Anuradhapura Dist., Ritigala Nat. Res., IX.1972, A. H. M. Jayasuriya 2133 (L).

The species is not uncommon in Asia and has been described fairly recently by Cunningham (1965), Fidalgo (1968b), and Ryvarden & Johansen (1980). It is easily recognized because of its wide, hexagonal pores and the branched hyphal fascicles on the surface of the pileus.

Only three species of *Scenidium* have been reported from Asian or Australasian countries, viz. *Scenidium apiarium*, *S. asperum*, and *S. papyraceum*. *Scenidium asperum* was placed in *Hexagonia* by Fidalgo (1968b) while Ryvarden and Johansen treated the species under *Corioloopsis*, a closely related genus. The differences between the two genera are small; *Scenidium* often has larger spores and pores than *Corioloopsis*. Since *S. asperum* has in young state the typical forked 'hairs' on the surface of the pileus, it is here retained in *Scenidium*. The species *S. papyraceum* is rather widespread in North, South and Central America (including the West Indies) while only one record from South Africa and New Caledonia is cited by Fidalgo (1968b).

Distribution of species of *Scenidium* in Asia and Australasia (in alphabetical order).

Scenidium apiarium: Australia, Cambodia, China, India, Indonesia (Celebes, Java, New Guinea), Japan, Malaysia (Malaya), New Zealand, Philippines, Rawak Islands, Samoa, Sri Lanka, Taiwan, Vietnam.

Scenidium asperum: Assam, Australia, Cambodia, China, India, Indonesia (Flores, Java, Kalimantan, Krakatau, New Guinea, Salak, Sewarang), Malaysia (Malaya), New Caledonia, Philippines, Sabah, Sakhalin Island, Samoa, Singapore, Solomon Islands, Sri Lanka, Taiwan, Vietnam.

Scenidium papyraceum: New Caledonia.

The following fourteen species are accepted in *Scenidium*: *Scenidium apiarium* (Pers.) O. Kuntze 1898, ***Scenidium asperum*** (Jung.) comb. nov. (basonym: *Polyporus asper* Jung. in Verh. Batav. Genootsch. 17: 60. 1838), *S. capillaceum* (Pat. & Gaill.) O. Kuntze 1898, *S. hirtum* (Palisot: Fr.) O. Kuntze 1898, ***Scenidium hydroideum*** (Sw.: Fr.) comb. nov. (basonym: *Boletus hydroides* Swartz, Nov. Gen. Spec. Pl.: 149. 1788; Fries, Syst. Mycol. 1: 362. 1821), *S. niam-niamense* (P. Henn.) O. Kuntze 1898, *S. nitidum* (Dur. & Mont.) O. Kuntze 1898, *S. papyraceum* (Berk.) O. Kuntze 1898, ***Scenidium pobeguinii*** (Hariot) comb. nov. (basonym: *Hexagonia pobeguinii* Hariot in Bull. Soc. mycol. France 8: 28. 1892), *S. speciosum* (Fr.) O. Kuntze 1898, *S. tenue* (Hook.) O. Kuntze 1898, *S. umbrinellum* (Fr.) O. Kuntze 1898, *S. velutinum* (Pat. & Har.) O. Kuntze 1898, ***Scenidium zambesianum*** (Torrend) comb. nov. (basonym: *Hexagonia zambesiana* Torrend in Brotéria (Bot.) 12: 59–60. 1914).

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HYDROPUS CONICUS, A NEW SPECIES FROM NORWAY

C. BAS* & Ø. WEHOLT**

Hydropus conicus spec. nov., belonging to *Hydropus* section and subsection *Floccipedes*, is described from fallen needles of *Pinus* in Norway.

A rather unusual looking mycenoid agaric was collected by one of us (Ø. W.) on fallen pine needles in southeastern Norway. It is characterized by a conical, olivaceous grey, subviscid pileus, very distant, adnate lamellae, non-amyloid spores, very long, slender, thin-walled, smooth pleurocystidia arising from just below the subhymenium, and a pileipellis consisting of a broad-celled subpellis and a thin suprapellis of narrow, smooth, repent hyphae.

It is clear that this material does not fit in *Mycena* proper. In fact, in both Smith's (1947: 60) and Kühner's (1938: 159) monographs of *Mycena* s.l. it keys out in '*Floccipedes*', a group of species now considered to be a section of the genus *Hydropus* (Singer, 1975: 401, 1982: 112). We have been unable, however, to find a description of a taxon belonging to that group covering the specimens described here.

***Hydropus conicus* Bas & Weholt, spec. nov. — Figs. 1–5**

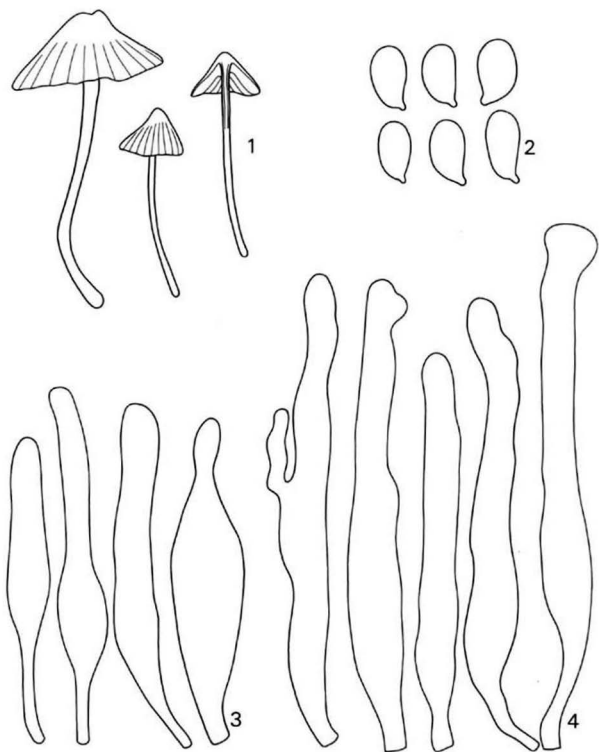
Pileus 14–30 mm latus, conicus, olivaceo-griseus, subviscidus. Lamellae adnato-subdecurrentes vel emarginatae, valde distantes, pallide olivaceo-griseae, intervenosae. Stipes 30–39 × 1.2–2 mm, albidus vel pallide griseus, deorsum pallide olivaceo-griseus, probabiliter subpruinosis, subviscidus vel siccus. Sporae 8–9.3 × 4.3–5.6 μm, inamyloideae. Basidia 2- et 4-sporigera. Pleurocystidia abundantia, 85–115 × 8–12 μm, sublageniformia vel cylindracea, tenui-tunicata. Pileipellis cutis hyphis tenuibus, repentibus, glabris composita. Fibulae frequentes. — Typus: 'Norway, Østfold, Borge, Bevö, 27.XI.1982, Ø. Weholt' (L, O).

Pileus 14–30 mm diam., almost acutely conical, more obtuse with age, with slightly deflexed to straight, distinctly and long sulcate-striate, somewhat lobed margin, olivaceous grey, greasy-subviscid. Lamellae ascending, first adnate-subdecurrent, later broadly to slightly emarginately adnate, very distant (10–15 reaching stipe), moderately broad, greyish-whitish with olivaceous tinge, paler towards edge, here and there anastomosing, strongly intervenose. Stipe 30–30 × 1.2–2 mm, slightly tapering downwards, hollow, somewhat hyaline and whitish to greyish-whitish at apex, slightly darker towards base (pale pileus colour), subviscidus, probably pruinose at upper part. Smell and taste not recorded.

Spores [20/1] 8–9.3 × 4.3–5.6 μm, Q 1.5⁵–1.8, average Q 1.7, somewhat adaxially flattened, elongate-ellipsoid to elongate or elongate-ovoid, usually somewhat tapering towards moderately large obtuse apiculus, colourless, thin-walled, smooth, inamyloid, non-cyanophilous. Basidia 32–38 × 5.9–7.3 μm, 4- and 2-spored, with clamp. Pleuro-

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Figs. 1-4. *Hydropus conicus*, type. — 1. Basidiocarps ($\times 1$). — 2. Spores ($\times 1500$). — 3. Cheilocystidia ($\times 1000$). — 4. Pleurocystidia ($\times 1000$).

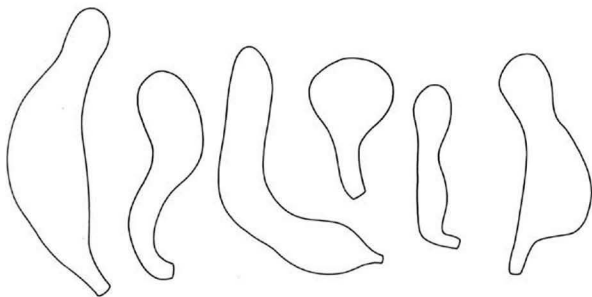


Fig. 5. *Hydropus conicus*, type. — Caulocystidia from apex of stipe ($\times 1000$).

cystidia abundant, $85-115 \times 8-12 \mu\text{m}$, very slenderly sublageniform to cylindrical, with obtuse, often somewhat irregularly shaped apex, thin-walled, colourless, often with (sub)granular to clotty contents, arising from tramal hyphae just below subhymenium. Cheilocystidia interspersed among basidia, on the average somewhat shorter and somewhat more ventricose than pleurocystidia. All cystidia metachromatic in Chresyl blue. Pseudocystidia absent. Lamellitrama irregular, consisting of up to $35 \mu\text{m}$ wide, agglutinate, slightly thick-walled, colourless hyphae, near edge almost collenchymatic, not or very weakly dextrinoid, strongly metachromatic in Chresyl blue; subhymenium c. $15 \mu\text{m}$ thick, made up of small ($2-5.5 \mu\text{m}$), thin-walled, agglutinate, somewhat angular cells (sticking together when section of lamella is squashed); also in young basidiocarp lamellitrama strictly irregular and hyphae agglutinate near edge, but slightly more regular, although strongly undulating near pileus. Pileipellis made up of a thick subpellis composed of up to $140 \mu\text{m}$ long and up to $50 \mu\text{m}$ wide inflated cells (frequently once or twice constricted) with vague olivaceous grey pigment (probably vacuolar) and a thin ($5-15 \mu\text{m}$) subrapellis of gelatinizing and desintegrating and therefore hardly discernible, $1.8-4.6 \mu\text{m}$ wide, thin-walled, branching, repent, smooth hyphae at least partly arising from apices of inflated cells of subpellis, without dermatocystidia. Stipitepellis not or hardly gelatinized, with scattered narrow hairs and scattered rather small and often irregularly shaped, clavate to subtriform cells. Stipitetrama sarcodimitic, mainly composed of very long cylindrical cells ($800 \mu\text{m}$ and more long, up to $30 \mu\text{m}$ wide) with tapering ends and rather scanty $2-6 \mu\text{m}$ wide, thin- to very slightly thick-walled, here and there branching hyphae; walls weakly to distinctly dextrinoid and strongly metachromatic in Chresyl blue; vascular hyphae absent. Clamps present.

Habitat & distribution.—On thick layer of needles of *Pinus*; known only from type-locality in southeastern Norway.

Collection examined.—NORWAY, Østfold, Borge, Bevö, 27 Nov. 1982, *Ø. Weholt* (type; L, O).

In Kühner's monograph of *Mycena* (1938) *Hydropus* was still completely included in that genus. In the first general key in that work the present species keys out in the 'Floccipedes' if we consider the trama of the stipe continuous with that of the pileus. Because of the rather thin wall of the hollow stipe and the loose tissue in the central part of the pileus this is rather difficult to observe in the dried material of the present species but is indeed almost certainly the case here. However, none of the four species in Kühner's *Floccipedes* agrees with our material.

In Smith's monograph (1947) our species keys out in section *Omphaliariae* if the gills are considered horizontal to arcuate or decurrent, but none of his species there combines smooth cheilocystidia and abundant pleurocystidia with elongate-ellipsoid, inamyloid spores. The other possibilities with Smith are then section *Floccipedes* if we accept the stipe as floccose or section *Typicae* if we don't.

In Smith's section *Floccipedes* (non-amyloid spores) none of the three species included agrees with our species; *Mycena floccipes* (Fr.) Kühn. comes closest, because of the large pleurocystidia, but has (sub)globose spores.

In Smith's section *Typicae* we arrive with the key at a small group of species, viz. *M. trichoderma* Joss. apud Kühn., *M. kaufmanniana* A. H. Smith, and *M. pseudotenax* A. H. Smith, of which only the last one has inamyloid spores. Moreover, *M. pseudotenax* has a pileipellis rather similar to that of our species, in addition a 'slippery feel', and also grows on needle beds. It differs however from our species in several minor characters such as more crowded lamellae, smaller spores ($5.5-7 \dots 8 \times 3.5-4 \mu\text{m}$), and shorter cystidia ($50-60 \dots 90 \times 10-12 \dots 15 \mu\text{m}$).

A species with cystidia in length ($60-100 \mu\text{m}$) very similar to those of our species is *Hydropus scabripes* (Murrill) Sing., but there the spores are amyloid (be it not strongly) and in addition the lamellae are more crowded and very narrowly adnate, the pileus is brown, the cystidia are broader ($\times 10-20 \mu\text{m}$) and somewhat more ventricose, and the hymenophoral trama is very regular.

With Moser's key to *Hydropus* (1983: 184) our species cannot be named, even if we assume that the stipe in our material was flocculose in the beginning and became glabrous later on. (The floccosity of the stipe is probably not a very reliable character in this group of fungi, judging from Smith's note in his monograph on page 233 under 'Observations'.)

It should be mentioned here that the very irregular hymenophoral trama and the agglutinate hyphae with slightly thickened walls in that trama and in the subhymenium seem to be aberrant in *Hydropus* (see Singer 1982: 13). Nevertheless our species seems best placed in this genus.

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HIRSUTELLA GUIGNARDII AND STILBELLA KERVILLEI, TWO TROGLOBIOTIC
ENTOMOGENOUS HYPHOMYCETES

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Descriptions of two synnematos, entomogenous hyphomycetes occurring on insects in caves are presented, and their taxonomy and nomenclature clarified. New combinations are proposed for *Isaria guignardii* and *Stilbum kervillei*. The biological interaction between these two fungi is described.

The fungal flora of caves has been extensively investigated by Lagarde (1913, 1917a and b, 1922), a work that has been largely overlooked by the mycological community. Unfortunately Lagarde's rich collections have apparently been lost, but the excellent illustrations render his papers quite valuable. Among the fungi Lagarde discussed are several entomogenous fungi found on troglobiotic insects.

During some recent excursions in caves in Southern Limburg (Netherlands), numerous insects were observed which were heavily parasitized by various Hyphomycetes. Most of these were parasitized by the ubiquitous *Beauveria bassiana* and *Paecilomyces farinosus*, but two other Hyphomycetes with distinct synnemata were also encountered. These species are usually referred in the literature as *Isaria guignardii* and *Stilbella kervillei*. Although several authors (Maheu 1906; Lagarde 1917a, 1917b; Petch 1932, 1937; Pacioni 1980) have reported on these cave-dwelling fungi, the taxonomy and nomenclature is still poorly defined. In this paper, the nomenclature of both fungi is discussed and descriptions in vivo and in vitro are given. The interaction between the two fungi is also discussed. Terminology for phialides is from Evans & Samson (1982).

Hirsutella guignardii (Maheu) Samson, Rombach & Seifert, *comb. nov.* — Figs. 1-2

Isaria guignardii Maheu in *Annls Sci. nat.*, Ser. 9, Bot. 3: 115. 1906 (basionym). — *Mahevia guignardii* (Maheu) Lagarde in *Archs Zool. exp. gén.* 56: 292. 1917. — *Troglobiomyces guignardii* (Maheu) Pacioni in *Trans. Br. mycol. Soc.* 74: 244. 1980.

Hirsutella dipterigena Petch in *Trans. Br. mycol. Soc.* 21: 53. 1937.

Isaria guignardii Maheu f. *major* Martinez & Guinea in *Boln. R. Soc. esp. Hist. nat.* 31: 219. 1931.

Conidiomata either stromatic or synnematos, one or both types frequently occurring on the same host. Stromata highly developed on specimens infected with *S. kervillei*, emerging between segments of the host cadaver, spreading to form a crust-like, adpressed, smooth, golden brown, irregular mass over much of the exoskeleton of the abdomen and parts of the thorax and head, up to 200 μm thick; composed of a surface layer, up to 25 μm thick, of textura epidermoidea in surface view, of golden brown

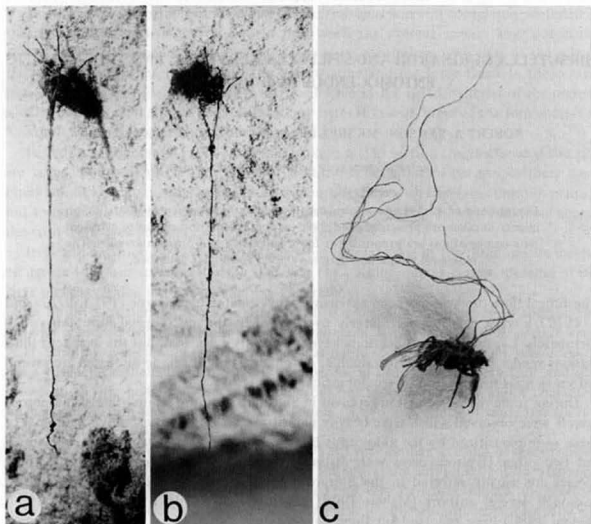


Fig. 1. *Hirsutella guignardii*. — a–b. On helemyzid flies in caves in Maastricht. Note that the synnemata are pendulous from the insect host ($\times 3$). — c. On helemyzid fly from Switzerland sent by Dr. G. Pacioni ($\times 5$).

cells with thin, smooth walls; below this is a white plectenchyma of interweaving hyphae which are hyaline, branched, septate, and $1.5\text{--}2\ \mu\text{m}$ wide with smooth, thin walls. Synnemata emerging singly or in groups of up to 6 from the thorax and abdomen or from the stromata, pendulous from the host which is usually adhering to the wall of the cave, filiform, acicular, or terete, curved or sinuous, yellow-brown, pallid brown to grey; simple or composed of several individual fascicles which emerge independently on the host and then twist together to form a compound stalk which ultimately fuses into a single unit, usually unbranched or bifurcately branched one or two times at the base in specimens infected with *S. kervillei*, but uninfected specimens may have perpendicular branches up to $800\ \mu\text{m}$ long emerging from the main synnema; surface smooth and spirally twisted, hirtellous in fertile regions; up to 6 cm long, $75\text{--}250\text{--}(800)\ \mu\text{m}$ wide at the base; fertile portions of the synnemata irregularly scattered along the synnemata,

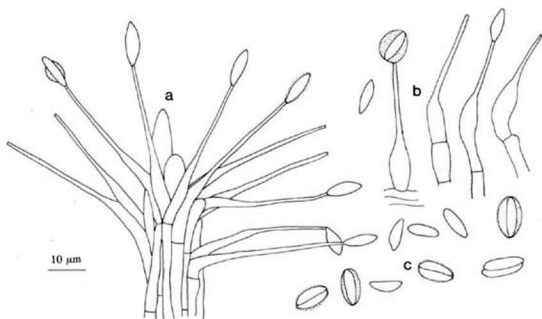


Fig. 2. *Hirsutella guignardii*. Camera lucida drawings of phialides and conidia. — a. Part of tip of synnema. — b. Phialides occurring along the synnema. — c. Conidia.

or synnemata entirely sterile in specimens infected with *S. kervillei*, or forming a more or less continuous layer in uninfected specimens, the bases of the synnemata usually sterile. Hyphae of the synnemata arranged in a parallel ascending spiral, somewhat divergent at the growing terminus, hyaline to subhyaline apically, becoming yellow-brown in the basal parts of the synnemata, septate, septa more frequent in basal parts of the synnemata, 2–4 μm wide, walls smooth and thin. Phialides arising singly and laterally from the hyphae of the stroma, or terminally at the apex of the synnema, originating as lateral bumps on the hyphae which elongate, develop a basal septum, then develop a neck, lageniform to subulate, subhyaline, (13–)20–35(–50) μm long in entirety, 4–6 μm wide at base, transition from the basal portion to the neck gradual or relatively abrupt, necks cylindrical, acicular to subulate, 15–25(–45) μm long, 0.5–1 μm wide at the tip. Conidia usually developing in a viscous mucus, 1–2 per phialide, the poles of the conidia often extending slightly beyond the mucous membrane, ellipsoidal-fusiform, hyaline, 7.5–10 \times 2.5–3 μm , the walls smooth and thin, the mucus translucent grey, ovoid to globose, 7–13 \times 4–6 μm .

Conidia of *H. guignardii* do not germinate on agar, but the fungus may be isolated by plating out hyphal bodies from inside the host. The fungus grows slowly on 2% malt extract agar, attaining a diameter of 2–5 mm after 2 weeks at 12° to 18°C, much slower than other species of *Hirsutella*. The colony is originally whitish, but the colour changes to straw yellow to dark brown after three to four weeks. Phialides and conidia identical to those produced on the host are produced from the scanty brown aerial mycelium, but no synnematal formation occurs.

Notes.—The material examined is listed after the description of *Stilbella kervillei*.

Hirsutella guignardii has been reported only from cavernicolous dipteran and coleopteran hosts in Europe. The long phialides and the ellipsoid-fusiform conidia, $7.5-10 \times 2.5-3 \mu\text{m}$, distinguish this species from others in the genus.

Maheu (1906) described *Isaria guignardii* from the beetle *Quedius mesomelinus* from catacombs in Paris. Lagarde (1913) identified several specimens on coleopteran hosts as *I. guignardii*. Recently Pacioni (1980) examined and redescribed several Italian specimens of *I. guignardii*. Both Maheu and Pacioni erected new genera for *I. guignardii* because of the branching of the synnemata, but for reasons outlined in the general discussion, we reject this concept. As the holotype of Maheu and the specimens of Lagarde are not known to exist, Pacioni neotypified *I. guignardii* with one of his specimens on a coleopteran host.

Hirsutella dipterigena was briefly described by Petch (1937) from cave-inhabiting flies in England. The holotype material of *H. dipterigena* is in very poor condition, but several other specimens in Petch's herbarium (K) are in better condition. Specimens of *H. guignardii* identified by Pacioni on helemomyzid flies from caves in Switzerland differ from specimens of *H. dipterigena* in Petch's herbarium only by the highly branched synnemata. The characteristic long phialides ($30-60 \mu\text{m}$ long) giving rise to large conidia ($8-10 \mu\text{m}$ long) are present in all collections. *H. dipterigena* Petch is therefore synonymous with *H. guignardii*. Pacioni (1980) did not consider Petch's species.

Hirsutella eleutheratorum (Nees) Petch, commonly found on coleopteran larvae and adults throughout the world, is very similar to *H. guignardii*. Although Lagarde (1917) placed *I. guignardii* in a separate genus *Mahevia*, he later (1922) considered it a synonym of *I. eleutheratorum*, based on personal communication with P. Vuillemin, but called the species *Tilachlidium eleutheratorum*. Petch (1932) considered *I. guignardii* synonymous with *H. eleutheratorum*. Pacioni (1980) after examining the holotype and several of his own collections, considered it distinct from *H. guignardii*. We agree with this conclusion since the species differ in ecology as well as in the dimensions of the phialides and conidia.

No type material of *I. guignardii* forma *major* Martinez & Guinea could be obtained. However, judging from the protologue it is indistinguishable from *H. guignardii*.

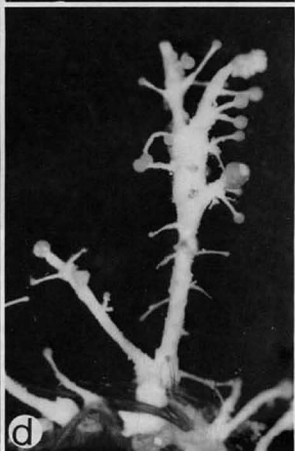
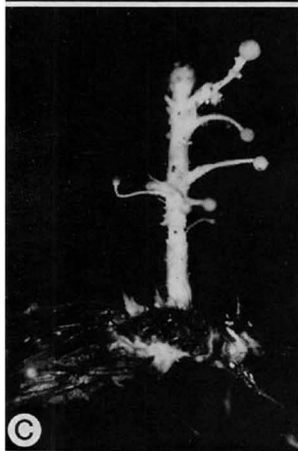
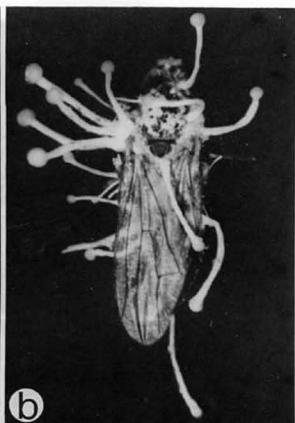
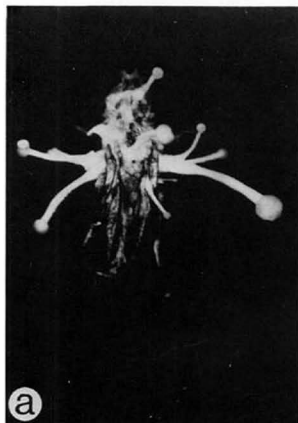
***Stilbella kervillei* (Quélet) Samson, Rombach & Seifert, *comb. nov.* — Figs. 3–5**

Stilbum kervillei Quélet in Gadeau de Kerville in Bull. Soc. Amis Sci. nat. Rouen, 1884: 302 (basionym).

Stilbella arndtii Lingelsheim in Ber. dt. bot. Ges. 39: 149. 1921.

Synnemata solitary, crowded, or caespitose, arising from all parts of the insect corpse or from synnemata of *H. guignardii*, unbranched, or branched, the branches perpendicular to the main axis and curving antrorsely, or branched palmately with 3–5 synne-

Fig. 3. *Stilbella kervillei* on flies collected in caves, Southern Limburg. — a–b. Hosts with several unbranched synnemata ($\times 7$). — c–d; Polycephalous synnemata ($\times 10$).



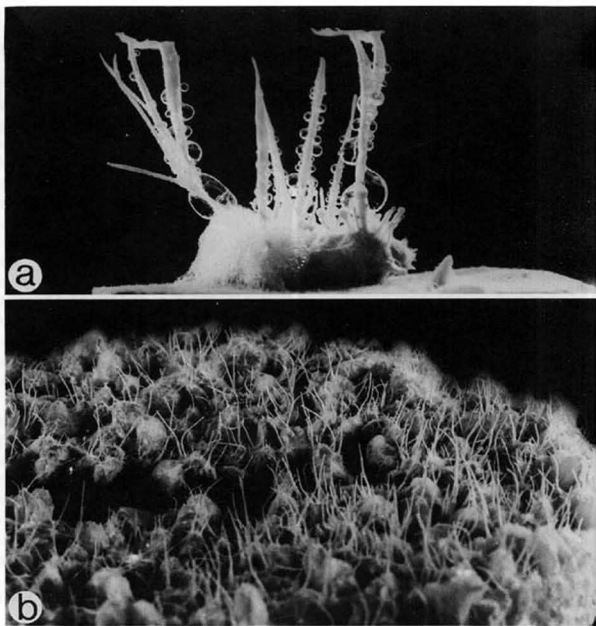


Fig. 4. *Stilbella kervillei*, CBS 426.82, pure cultures. — a. On 2% malt extract agar. Note that the apices of some synnemata are bent because of contact with lid of the petri dish. — b. On sterilized rice.

mata arising from one stalk, cylindrical and capitate, or subulate and capitate, straight, nodding or sinuous, pubescent to subvillose, white with a yellow to yellow orange terminal spore mass, 800–6000 μm tall, 50–300(–600) μm wide. Hyphae of the synnemata interweaving, individually hyaline, septate, 1.5–4 μm wide with smooth, thin walls, with B-phialides arising laterally along the entire stalk. Phialides of two types, A-type phialides terminal on conidioma, B-type phialides lateral on conidioma, producing A- and B-conidia respectively. A-phialides produced in a divergent, terminal capitulum on the synnemata or its branches, lateral or terminal on the conidiophores, or in whorls

of 3–4, narrowly lageniform, hyaline, with thin smooth walls, 7–24 μm long, 1.5–2 μm wide at base, often with cylindrical phialides inserted laterally below the septa, up to 14.5 μm long and 0.5 μm wide. Spore mass terminal, translucent or opaque, yellow to orange-yellow, mucoid, globose to subglobose, 150–1000 μm diam., containing both A- and B-conidia. A-conidia obovate to broadly obpyriform, hyaline, aseptate, with smooth, thin walls, 2–3 \times 1–2 μm . B-phialides arising laterally from hyphae of the synnemata or from branches thereof, or in terminal whorls of 2–4 on short conidiophores, narrowly lageniform or subulate, curved or straight, symmetrical or asymmetrical, hyaline, with thin smooth walls, 2–3.5 μm wide at the base, 6–27 μm long, with a cylindrical to acicular neck, up to 12 μm long, 0.5–1 μm wide, terminating in an inconspicuous collar-ette. B-conidia aseptate, hyaline, fusiform, catenulate, 3–4.5 \times 1.5–2 μm , with smooth, thin walls.

Cultures isolated from either A- or B-conidia grow and produce synnemata readily on 2% malt extract agar or on sterilized rice (Fig. 4). Synnemata formed in culture may be up to 4 cm long, if sufficient space to allow for this growth is provided, are typically filiform, unbranched, more villose than those produced on insects, and have a terminal spore mass, although some lack this mass of A-conidia. Both A- and B-phialides are formed in single conidium isolates. Cultures on sterilized rice have abundant fluffy, white, superficial mycelium. Synnemata are produced in complete darkness. The fungus is capable of growing and producing synnemata as low as 9°C.

Material examined.—Herbarium specimens: *H. guignardii* and *S. kervillei* both present: *Stilbum kervillei*, holotype collection. Grottes, près de Rouen, Sept. 1882, *H. Gadeau de Kerville*, Herb. Quélet, (PC); *Stilbella kervillei*, *Hirsutella guignardii*, CBS 003324–003328, numerous specimens on heleomyzid flies, *R. A. Samson*, *M. C. Rombach*, cave 'de Cluysberg', Bemelen, Maastricht, March and May, 1982 (herb. CBS); CBS 003329 and 003330 on heleomyzid flies, *M. H. Teenstra-Eeken*, caves S-Limburg, 1966; *Stilbella kervillei*, IMI 56174, on undetermined Dipteran, *Miss M. Hazelton*, Wise Eel Cave, Frosterly, Co. Durham, England, 23.III.54, det. E. W. Mason. This folder also contains several dried cultures comparable to those of the CBS isolate (IMI); *Stilbella kervillei*, IMI 50742, on *Hirsutiella* on fly, *R. T. Seelers*, Scoska Cave, England, 20.4.51, det. E. W. Mason (IMI); *Stilbella kervillei*, two specimens on *Ichneumon* sp., *U. Passauer*, Heuwegstellen, Niederösterreich, 3 Dec. 1977 and 24 Jan. 1976 (W).

Hirsutella guignardii only present: *Troglobiomyces guignardii* (Maheu) Pacioni, on *Heleomyza serrata*, *Y. Basset*, Grotte de Chemin de Fer NE 14, 4.III.1980 (AQU); *Hirsutella dipterigena*, holotype, on flies, *L. Armstrong*, Pinhole Cave, Creswell, England, March 1934 (K).

Living cultures: CBS 426.82, *Stilbella kervillei*, pure culture isolated from conidia of herb CBS 003324; CBS 611.83, *Hirsutella guignardii*, pure culture isolated from internal hyphal material from fly, CBS 003328.

Notes.—*Stilbella kervillei* has been reported only from European limestone caves, from various species of flies in the genera *Blepharoptera*, *Heleomyza* and *Scoliocentra*. It is distinguished from other species of *Stilbella* by its consistent association with *H. guignardii* on dipteran hosts, the pubescent white synnemata with yellow spore masses, the B-type phialides which produce catenulate conidia, and the *Sesquicillium*-like A-type phialides which produce small obovoid conidia.

The nomenclature of the species is somewhat confused. It was originally described by Quélet (in Gadeau de Kerville, 1884) in *Stilbum*, but *Stilbum* has been replaced by *Stilbella* Lindau as the genus for these hyphomycetes (Benjamin, 1968). When Lingelsheim (1921) described *Stilbella arndtii*, he discussed *Stilbum kervillei* as if it were a species of *Stilbella*, but did not in any way suggest a generic transfer. Mason (1931) referred to

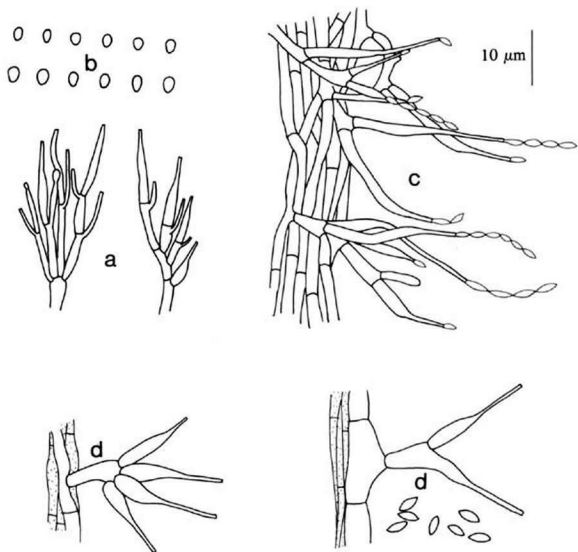


Fig. 5. *Stilbella kervillei*, camera lucida drawings. — a–c. Southern Limburg specimens. — a. A-type phialides. — b. Conidia from A-type phialides. — c. Portion of synnema with B-type phialides and chains of conidia. — d. Holotype of *Stilbella kervillei*, showing whorls of B-type phialides arising from *Hirsutella* synnema.

the species as *Stilbella kervillei* (Quélet) Lindau, apparently implying that the fungus was a member of *Stilbella* sensu Lindau, but Lindau made no such transfer. Petch (1937) referred to the fungus as *Stilbella kervillei* (Quélet) Lingelsheim, again a transfer that was never made. As *Stilbella* is currently the most suitable genus for *Stilbella kervillei*, we have formally proposed the transfer above.

For reasons mentioned in the general discussion, *S. kervillei* might ultimately be regarded a species of *Polycephalomyces*, because of the distinctive arrangement of phialides it shares with *P. cylindrosporus* Samson & Evans (Samson & al., 1981). The correct generic placement is further confused by the occurrence of two kinds of phialides, pro-

ducing conidia either in chains or in slime, on the same conidiomata. This is unknown in other species of *Stilbella*, including the entomogenous taxa, but is known for some species of *Hirsutella* (Evans & Samson, 1982). Catenuate conidia, as produced by the B-type phialides of *S. kervillei* are also unique in *Stilbella* sensu stricto. Petch (1938) observed the B-type phialides of *S. kervillei*, but interpreted them as the phialides of the *Hirsutella* host. However, the conidia produced by the *Hirsutella* are much larger, and are produced in slime rather than chains. The production of both A- and B-type phialides in single conidium isolates of *S. kervillei* proves they are part of the same genome.

Stilbella arndtii was described from the fly *Blepharoptera serrata* in caves in Poland (Lingelsheim, 1921). It was separated from *S. kervillei* on the basis of its smooth stalk, white head, and the absence of superficial mycelium. We have not been able to locate the type specimen, but follow Petch (1937) in considering the two fungi conspecific.

Petch (1937) examined several collections of a fungus he called *Stilbella ramosa*, transferring the species from *Stilbum* where it had originally been described by Peck (1874). He concluded that it was an earlier name for *S. kervillei*, but did not examine Peck's type specimen. Ten years later, Mains (1948) examined Peck's specimen and transferred the species to *Polycephalomyces*, making no mention of *S. kervillei*. Although we have not examined the holotype, we consider Petch's conclusion that these two fungi are conspecific dubious for several reasons. *Stilbella ramosa* has synnemata with a brown coloration at the base; it grows on larvae rather than mature insects; and it has never been recorded as occurring in caves.

OBSERVATIONS AND GENERAL DISCUSSION

Parasitism of *Hirsutella guignardii* by *Stilbella kervillei*

Petch (1937) was the first to observe that *S. kervillei* was invariably associated with *Hirsutella guignardii* and that synnemata of the *Stilbella* frequently grew directly from the brown clavae of the *Hirsutella*, which were often covered by a scanty white mycelium. In the original description of *S. kervillei*, Quélet (in Gadeau de Kerville, 1884) mentioned a filiform *Isaria* species very similar to *I. eleutheratorum* Nees, and in fact both synnemata and stromata of *H. guignardii* occur on the holotype of *S. kervillei*. Invariably on the specimens we have examined, if the *Stilbella* is present so too is the *Hirsutella*. However, the *Hirsutella* is known to occur independently, as is shown by Pacioni's specimens, and the successful isolation of this species from hyphal bodies in host cadavers convinces us that it is a true entomopathogenic species. The tendency of *Stilbella* B-type phialides to occur in whorls on the *Hirsutella* clavae (Fig. 5d), the scanty white mycelium that covers these clavae, and the frequent growth of *Stilbella* synnemata from those of the *Hirsutella*, suggest that the *Stilbella* is in fact a mycoparasite rather than an insect parasite. In mixed culture, our isolate of *S. kervillei* overgrows *H. guignardii*, but this may reflect a difference in competitive ability on agar rather than actual parasitism, as no haustoria or penetration pegs were observed in these mixed cultures. Although it seems

relatively clear that the *Stilbella* is a mycoparasite, the overall similarity with *P. cylindrosporus* suggests it may have evolved from an entomogenous ancestor.

Specimens of *H. guignardii* infected with *S. kervillei* display several morphological anomalies when compared with uninfected specimens. Synnemata of infected specimens lack a regularly developed conidiogenous zone, instead having scattered phialides along the stipe, or no phialides at all. The stromata are much more highly developed when the *Stilbella* is present, and are often quite inconspicuous on healthy specimens. Lateral perpendicular branches on the synnemata, as seen on Pacioni's specimens of *H. guignardii*, are not seen on *Hirsutella* infected with *Stilbella*.

Adaptations to life in caves

The limestone caves are relatively cool habitats, where the only light is provided by flashlights of human intruders. According to Teenstra-Eeken & Engel (1967), the temperature in caves in southern Netherlands is 5–12°C and the relative humidity 90–100% throughout the year. Cultures of both *S. kervillei* and *H. guignardii* are capable of growing and sporulating at relatively low temperatures. *H. guignardii* grows well at temperatures as low as 12°C. *S. kervillei*, although growing more slowly, produces synnemata as low as 9°C, and as high as 25°C, with optimal growth occurring at 21°C.

The formation of synnemata in the absence of light for both fungi is worthy of note. Although no synnemata of *H. guignardii* were formed in our pure cultures, *S. kervillei* produced fertile synnemata when grown in complete darkness. The ability to produce synnemata in complete darkness is not unusual, but is shared by *Penicillium clavigerum* (Carlile & al. 1962), *Beauveria felina* (= *Isaria cretacea*) (Taber & Vining, 1959), *Trichurus spiralis* (Fahmy & Yusef, 1974) and *Stilbella thermophila* (Al-Hassan & Fergus, 1967). Light is essential for synnematal initiation or production in many hyphomycetes, including most other species of *Stilbella* known in pure culture (Seifert, unpublished data). Production of synnemata in some entomogenous fungi is not a simple matter of presence or absence of light. Samson & Evans (1976) described synnema development in the entomogenous species *Paecilomyces fumosoroseus*. This fungus may produce synnemata in nature on a host which is completely buried and hence hidden from light. Cultures of this species, however, require light for synnema formation.

Branching of synnemata as a generic character

The genus *Polycephalomyces* was established by Kobayasi (1941) for *P. formosus*, growing on coleopterous larvae in Japan. The genus was said to differ from *Stilbella* by possessing branched, many-headed synnemata. *Stilbella kervillei* often possesses polycephalous synnemata on natural substrata, but rarely produces branched synnemata in culture. In fact, specimens of *S. kervillei* have been identified in the past as *Polycephalomyces* (Teenstra-Eeken & Engel, 1967). The reverse situation is true in *Stilbum albocitrinum* Ellis & Everhart, which produces only unbranched synnemata in nature, but may produce highly branched synnemata when grown in culture (Seifert, unpublished data). Clearly, synnematal branching alone is not sufficient to distinguish genera in this group.

Unfortunately, it is not possible to make a conclusive statement on the tenebility of *Polycephalomyces* at this time. Neither Kobayasi (1941) nor Mains (1948), who added two species to *Polycephalomyces*, illustrated the conidiophores of their fungi. The conidiogenous cells and conidiophores of *S. kervillei* are remarkably similar to those of the only species of *Polycephalomyces* available to us, *P. cylindrosporus*, and distinctly different from those of known saprobic species of *Stilbella*. It is possible that *Polycephalomyces* may be distinguished from *Stilbella* by these phialides, but as the specimens of Kobayasi and Mains are too fragile to be sent on loan, we are presently unable to make conclusions.

A similar situation occurs with *H. guignardii*, which may produce racemously branched synnemata in healthy specimens, but rarely produces branched synnemata when infected by the *Stilbella*. Lagarde (1922) and later Pacioni (1980) used this branching as a diagnostic character of their genera *Mahevia* and *Troglobiomyces*. As both genera have *Isaria guignardii* as type species, *Troglobiomyces* is an obligate synonym of *Mahevia*. *I. guignardii* as illustrated by Lagarde and by Pacioni is clearly a *Hirsutella*, and we cannot accept *Mahevia* as a distinct genus based on synnematal branching alone.

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THE HYPHOMYCETE GENUS ENGYODONTIUM
A LINK BETWEEN VERTICILLIUM AND APHANOCLADIUM

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Sporotrichum araneorum Cavara is redescribed from living cultures and found to have two kinds of conidiogenesis: phialidic and polyblastic. The latter type which is most conspicuous in this fungus, fits the genus *Engyodontium* de Hoog. This genus is considered to be a link between *Verticillium* and *Aphanocladium* and its generic diagnosis is extended to include both progressive and retrogressive formation of new conidiiferous pegs. *Sporothrix (Tritirachium) rectidentatum* (Matsushima) de Hoog and *Cephalosporium araneorum* Petch, in which some polyblastic conidiogenous cells with narrow denticles were also found, are transferred to *Engyodontium*. For the latter species the new name *E. arachnophilum* is proposed. The genus now comprises six species, including *E. geniculatum*, sp. nov. In addition, *Acremonium obclavatum* W. Gams is described as a new species for isolates that match the description formerly given by Gams for *Verticillium tenuipes*.

De Hoog (1972) distinguished the genera *Tritirachium* Limber and *Acrodontium* de Hoog because they have cicatrized and denticulate conidiogenous rachids, respectively, and differ in pigmentation. This distinction was not recognized in some subsequent publications (Matsushima, 1975), but we still believe that it is useful and reflects natural affinities. The fungus described as *Tritirachium rectidentatum* Matsushima (1975) does not belong to either genus. It has hyaline conidiophores and the blastoconidia are usually formed on perpendicular denticles in a retrogressive order; it was tentatively classified in *Sporothrix* by de Hoog (1978). Its carbohydrate composition was found recently to deviate from that of other *Sporothrix* species by having glucose, mannose and galactose as major compounds in combination with a low chitin level (Weijman & de Hoog, 1984).

Recently several araneogenous isolates similar to *T. rectidentatum* came to our notice. This taxon also forms lateral blastoconidia retrogressively on perpendicular denticles. Part of the conidiogenous cells is definitely phialidic (matching *Verticillium* sect. *Prostrata* W. Gams); the first-formed phialoconidium is generally falcate and the 1-3 subsequent phialoconidia are ellipsoidal, similar to the lateral blastoconidia which arise soon afterwards. Often only one terminal conidium is formed which is ellipsoidal.

Dr D. W. Minter (CMI, Kew) kindly supplied a specimen (IMI 246085) tentatively identified as *Sporothrix rectidentata*, which formed scattered conidia on long, thin den-

ticles. The sequence of conidiation could not be established. This specimen seems to link *T. rectidentatum* with *Rhinotrichum parvisporum* Petch, the type of the genus *Engyodontium* de Hoog (1978). The order of conidium production in this species could not be elucidated with certainty, but it appeared to be progressive. *Tritirachium album* Limber with sympodial, progressive conidiogenesis and conidia borne on distinct denticles, was also classified in this genus by de Hoog (1978).

It is now clear that the sequence of conidiogenesis does not allow a fundamental distinction that would justify generic segregation in this group. The above species are inter-related and, like *Verticillium* sect. *Prostrata*, seem to represent anamorphs of the Clavicipitales, while the major part of *Sporothrix* is connected with the Ophiostomatales. We prefer, therefore, to classify these species in *Engyodontium*, irrespective of the retrogressive or progressive sequence of conidiogenesis. Some affinity may exist between *Engyodontium*, *Aphanocladium* W. Gams (1971) and *Pleurodesmospora* Samson & al. (1980). In *Pleurodesmospora* the conidia are produced in basipetal chains from numerous lateral and terminal denticles, whilst *Aphanocladium* is characterized by solitary conidia, produced either by flask-shaped phialides or denticulate structures which may be interpreted as reduced phialides. These latter structures also occur in species of *Engyodontium*, but there the true phialides are *Verticillium*-like (awl-shaped to subulate). Hence *Engyodontium* shows features which link the anamorph genera *Verticillium* and *Aphanocladium*.

In most species of *Engyodontium* the supporting hyphae tend to shrivel rapidly, leaving a very thin, cobweb-like net with conidia.

KEY TO THE SPECIES

- 1a. Conidiiferous rachids with denticles concentrated in the apical region 2
- b. Conidiiferous rachids with widely scattered denticles 3
- 2a. Rachids straight with very thin, c. 1 μm long denticles; conidiophore branching irregular or verticillate 1. *E. parvisporum*
- b. Rachids geniculate with regularly spaced, butt-shaped denticles; conidiophore branching strictly verticillate 2. *E. album*
- 3a. Conidiiferous denticles on long, geniculate rachids 4
- b. Conidiiferous denticles on straight conidiogenous cells 5
- 4a. Conidia slightly curved, $2.8\text{--}3.7 \times 0.8\text{--}1.0 \mu\text{m}$ 5. *E. arachnophilum*
- b. Conidia straight, ellipsoidal to obovate, $2.5\text{--}3.0 \times 1.2\text{--}1.5 \mu\text{m}$ 6. *E. geniculatum*
- 5a. Terminal conidia phialidic, in groups of 1–5, often slightly curved to falcate 4. *E. aranearium*
- b. Terminal conidia always formed singly, straight 6
- 6a. Conidia arising from thorn-like, tapering protrusions; conidiophores profusely branched at obtuse or right angles 7. *E. sp.*
- b. Conidia arising from short, narrowly cylindrical denticles; conidiogenous cells in scanty whorls 3. *E. rectidentatum*

1. *Engyodontium parvisporum* (Petch) de Hoog — Fig. 1a

The species was described by Petch (1931) and De Hoog (1978) from a dried collection (K) from arthropod remains collected in Sri Lanka. It is possible that the extremely thin denticles may appear somewhat wider in fresh collections.

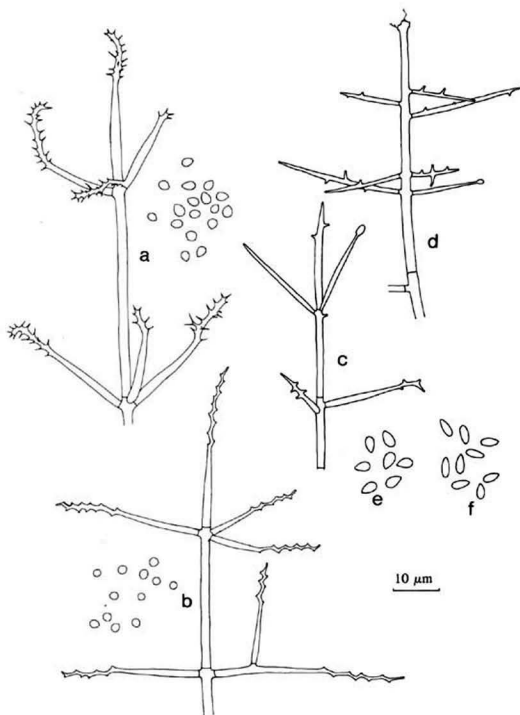


Fig. 1. a. *Engyodontium parvisporum*, specimen *Petch R-400* (herb. K.). — b. *E. album*, CBS 348.55, 2-week-old culture on MEA. — c-f. *E. rectidentatum*; c, e. IMI 223175, holotype specimen, d, f. IMI 215001, dried specimen.

2. *Engyodontium album* (Limber) de Hoog — Fig. 1b

The fertile structures are usually strictly verticillate, though in CBS 504.83, received from Prof. H. Seeliger and isolated as a probable contaminant from human brain abscess, no distinguishable main branches were present.

Descriptions and illustrations of the species were given by Limber (1940), De Hoog (1972) and Matsushima (1975). Judging from the diagnoses, *Tritirachium fungicola* Shvartsman & al. (1973) and *Sporotrichum gorlenkoanum* Kuritzina & Sizova (1967) are identical. Unfortunately no type material of either species was available for study.

3. *Engyodontium rectidentatum* (Matsushima), *comb. nov.* — Fig. 1c-f

Tritirachium rectidentatum Matsushima, Ic. Microf. Matsushima lect.: 160. 1975 (basionym). — *Sporothrix rectidentata* (Matsushima) de Hoog, in Persoonia 10: 64. 1978.
Acrodontium album Kushwaha & Agrawal in Mykosen 20: 97. 1976.

Colonies reaching 15–16 mm diam. in 6 days on 2% malt extract agar at approx. 20°C, white, cottony, reverse uncoloured. Odour none. Vegetative hyphae 1.2–2.5 µm wide. Conidiogenous cells arising in whorls from prostrate aerial hyphae, 18–35 × 0.8–1.2 µm, consistently polyblastic, bearing thin, perpendicular denticles, 0.5–1.5 µm long, scattered along the upper half. Conidia ovoid to fusiform, with apiculate base, hyaline, smooth-walled, 3.2–9 × 1.0–1.5 µm. Chlamydospores absent.

Material examined. — Living cultures: CBS 206.74 = IMI 179090, ex air over sugar-cane field, Gorakhpur, India, received from Kamal. — CBS 641.74, ex buried keratinous material, India, received from S. C. Agrawal. — CBS 247.82 = IMI 215001, isolated by S. K. Shrivastava, Gyanpur, India, July 1977.

Herbarium specimens: IMI 223175 = MFC 1439 (slide), type of *T. rectidentatum*, ex forest soil, Yaku Island, Kogashima, Japan, July 1971. — IMI 179837, type of *A. album*, ex soil of teak forest, R. K. S. Kushwaha, Dec. 1973. — IMI 114485, ex soil, India, received from M. N. Gupta (CMI).

The conidial dimensions are somewhat variable, e.g. CBS 641.74 has longer conidia (4.0–9.0 µm) than CBS 206.74 (3.2–4.5 µm), but in both they are significantly shorter than in *E. araneorum* and never curved. *Engyodontium rectidentatum* is found mainly in soil, while *E. araneorum* seems to be restricted to spiders.

The dried specimen IMI 215001 has no verticillate conidiophores; the conidiogenous cells are formed as orthotropic needles on mature conidiophores. Subcultures of this isolate, however, are indistinguishable from the other isolates of *E. rectidentatum*.

4. *Engyodontium araneorum* (Cavara), *comb. nov.* — Fig. 2–3

Sporotrichum araneorum Cavara, Fungi Longob. exsicc. 5: fasc. 240. 1895 (basionym). — *Acremonium tenuipes* Petch in Trans. Br. mycol. Soc. 21: 64. 1937 [non *Acremonium araneorum* Petch 1931]. — *Verticillium tenuipes* (Petch) W. Gams, *Cephalosporium*-art. Schimmelp.: 176. 1971.

? *Cephalosporium falcatum* Petch in Trans. Br. mycol. Soc. 11: 259. 1926 = *Verticillium falcatum* (Petch) W. Gams, *Cephalosporium*-art. Schimmelp.: 187. 1971.

Colonies reaching 10 mm diam. in 10 days in 2% malt extract agar at 20°C, white, cottony; reverse uncoloured. Odour none. Vegetative hyphae 1.5–2.0 µm wide. Conidio-

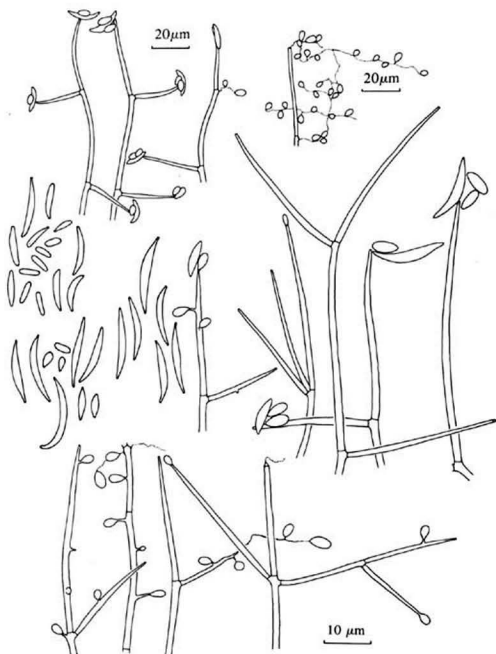


Fig. 2. *Engyodontium aranearum*, CBS 241.81, on various media. Note phialidic development in young cells and blastic conidiation in older cells.

genous cells arising singly or in scanty whorls from the aerial hyphae, $20-35(-40) \times 1.2-1.5 \mu\text{m}$. Conidiogenesis of two kinds: (a) polyblastic with several short, cylindrical, perpendicular denticles ($0.5-1.0 \mu\text{m}$ long), scattered along the upper half, producing ovoid to almost ellipsoidal, straight conidia, $3.0-5.5(-6.5) \times 1.0-1.5 \mu\text{m}$; (b) phialidic, with few conidia usually transversely attached to the tip of the conidiogenous cells; primary conidia fusiform to falcate, rarely becoming 2-celled, $8-17 \times 1.5-1.8 \mu\text{m}$, sub-

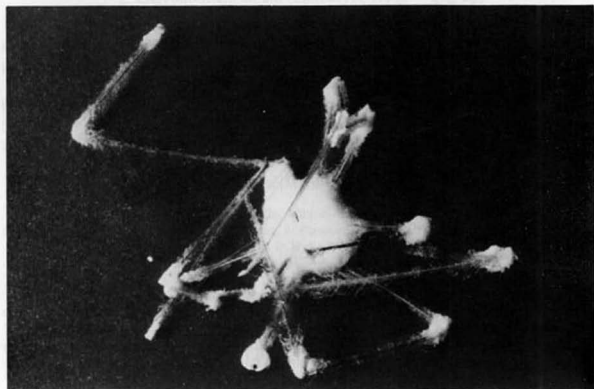


Fig. 3. Unidentified Opilionid spider (CBS 003321), showing colonies of *Engyodontium araneorum*, on legs and body ($\times 2.5$).

sequent ones usually shorter. In some rare cases both conditions occur together on one conidiogenous cells. Chlamydo-spores absent.

The species attacks spiders, mainly Opilionids, in moist localities all over the world and forms whitish powdery cushions, particularly on the joints of the legs.

Material examined. — Herbarium specimens: *Sporotrichum araneorum*, Fungi Longob. exsicc. 240 (isotype in B). — *Acremonium tenuipes* on spiders (Opilionids) in a greenhouse, Cambridge, Mass., *W. G. Farlow*, Jan. 1890 (two specimens annotated by Petch in FH). — *Cephalosporium falcatum*, on a fly attached to the lower surface of a leaf, Hakgala, Sri Lanka, *T. Petch*, March 1922 (holotype in K). — CBS 003320, on Opilionid, Lisse, Netherlands, *M. Elders*, 19 Feb. 1980. — CBS 003321, on Opilionid, Leiden, Netherlands, *C. Bas*, March 1981.

Living cultures: CBS 658.80, ex spider, isolated by *G. J. Samuels* (G. J. S. 80-101), Auckland, New Zealand. — CBS 241.81, ex spider, isolated by *G. Zimmermann*, Darmstadt, FRG, 1981.

When both phialidic and polyblastic conidiogenesis were observed in one culture, repeated attempts were made to purify the fungus. Conidia of both types consistently developed from single-conidium isolates of either type of conidia. The proportion of each type was influenced, however, by the medium: on 2% MEA the phialidic type developed, on potato-carrot agar and SEA the polyblastic type was more abundant. The polyblastic conidiophores collapse very rapidly and more readily than in *E. rectidentatum* when exposed.

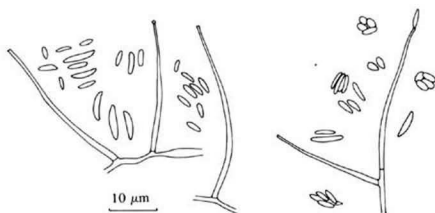


Fig. 4. *Cephalosporium falcatum*. Type specimen (herb. K).

Engyodontium araneorum can be confused with *Verticillium psalliotae* Treschow, which also has falcate, larger ($6-9 \times 1.5-1.8 \mu\text{m}$), primary, and ellipsoid-fusiform, smaller, secondary conidia, but both types are formed always terminally on phialides. Colonies of this fungus usually become reddish in reverse, a phenomenon never observed in *E. araneorum*. *Verticillium psalliotae* is a ubiquitous fungus and sometimes occurs as a mycoparasite or on insects but is not known from spiders. Another similar fungus is *E. arachnophilum* (see below) which has smaller, falcate conidia, $2.8-3.7 \times 0.8-1.0 \mu\text{m}$.

When Gams (1971) examined Cavara's specimen of *Sporotrichum araneorum*, he was unaware of the *rectidentatum*-type of conidiogenous cells and overlooked the lateral denticles. From the illustration accompanying the specimen, it is evident that Cavara (1895) also ignored these structures as did Petch (1937). Upon re-examination of the same slides, a few lateral denticles were seen. Petch (1937) mentioned two specimens of *A. tenuipes* preserved at FH. These were also examined in the present study and found to be *E. araneorum*. His other specimens preserved at K, however, represent different species (Gams, 1971). Polyblastic conidiogenesis was illustrated for *S. araneorum* by Nannizzi (1934).

On a slide prepared from the type specimen of *C. falcatum* Petch (in K, Fig. 4), Gams (1971) found oval or slightly curved conidia which were not sufficiently distinctive of the species and he suggested that another collection in Petch's herbarium ('*Cephalosporium longisporum*, Explor. Puerto Rico No. 725') might be used as neotype of *C. falcatum*. The conidia in that specimen were, however, significantly broader ($10.2-11.8 \times 2.6-3.0 \mu\text{m}$) than in Petch's diagnosis ($10-13 \times 1.5-2.0 \mu\text{m}$). A new species may eventually have to be described for this fungus when more material becomes available. Renewed study of the type specimen of *C. falcatum* has revealed some more conidia which fit the original diagnosis and a few solitary, non-denticulate phialides. The conidia agree with the phialidic conidia described for *C. falcatum*, but the synonymy with *E. araneorum* cannot be proved. The unnamed *Verticillium* sp. described by Sartory & al. (1931) from spiders 'in association with a *Sporotrichum*' may have been this species as well.

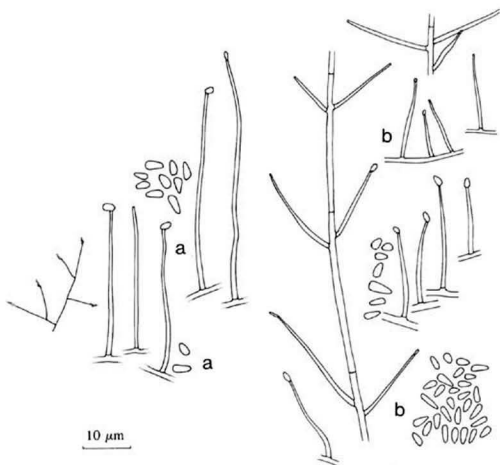


Fig. 5. *Acremonium obclavatum*. — a. CBS 311.74, 2-week-old culture on MEA. — b. CBS 510.82.

Strains which produce only *V. tenuipes*-type phialides (Gams, 1971), with no evidence of polyblastic conidiogenous cells, are considered better accommodated in the anamorph genus *Acremonium* and the following new species is proposed:

4a. *Acremonium obclavatum* W. Gams, *sp. nov.* — Fig. 5

Coloniae post 10 dies 18–26 mm diam. 25°C, albae, lanosae, margine fimbriata circumdatae. Hyphae vegetativae 0.5–1.5 µm latae. Hyphae aerae plus minusve prostratae, numquam fasciculatae. Phialides orthotropicae singulae, numquam verticillatae, plerumque ex hyphis aeriis profundis oriundae; phialides (15–)30–52 µm longae, e 0.8–1.2 µm prope basim ad 0.5 µm sursum attenuatae. Conidia oblique expulsa, apice latiore collari affixa, catenis imbricatis irregularibus cohaerentia; conidia obclavata ad fere ellipsoidea, 2.0–4.5 × 1.0–2.0 µm. Chlamydosporae absentes.

Typus CBS 311.74 (isotypus IMI 185383), vivus et exsiccatus, isolatus ex aere, prope Gorakhpur in India, a Kamal, 1974.

Colonies on 2% MEA reaching 18–26 mm diam. in 10 days at 25°C, white, cottony, about 3 mm deep, with fimbriate margin. Reverse either remaining white or later becoming greenish (particularly at higher temperature) or pale reddish in some strains. Vegetative hyphae 0.5–1.5 µm wide. Aerial hyphae more or less prostrate, never fasciculate,

Orthotropic phialides generally arising singly (never in whorls) in the deeper layers of the aerial hyphae, occasionally also from submerged hyphae; phialides (15–)30–52 μm long, 0.8–1.2 μm wide at the base, tapering to about 0.5 μm at the tip. Conidia extruded obliquely from the phialide tip, attached at the broader end, forming short imbricate chains, obclavate to almost ellipsoidal, 2.0–4.5 \times 1.0–2.0 μm . Chlamydo-spores absent. Prismatic crystals commonly present in the medium.

Equally good growth occurring at 34°C, no growth occurring at 37°C.

Material examined.—Living cultures: CBS 311.74 = IMI 185383, from air above a sugar-cane field in Gorakhpur, India, received from Kamal; CBS 250.76, from soil in Saugar, India, *S. C. Agrawal*.—CBS 586.81, from tannin-bearing barks and tan liquors in Madras, India, *C. K. Rao*.—CBS 510.82 from rust pustules on *Arachis hypogaea*, Madras, India, *B. P. R. Vittal*.

The four isolates from India fit in *Acremonium* sect. *Albo-lanosa* Morgan-Jones & W. Gams (1982) by forming exclusively solitary phialides. Contrary to the opinion expressed in that paper (p. 313), the senior author feels, that fungi with just a few verticillate conidiophores should be left in *Verticillium* sect. *Prostrata*, and that sect. *Albo-lanosa* of *Acremonium* should be reserved for fungi with exclusively solitary phialides. The present species is quite distinct with its obclavate conidia arranged in imbricate chains.

5. *Engyodontium arachnophilum* Evans & Samson, *nom. nov.*—Fig. 6

Cephalosporium aranearum Petch in Trans. Br. mycol. Soc. 16: 226. 1931 (basionym, non *Engyodontium aranearum* (Cavara) W. Gams & al.).—*Verticillium aranearum* (Petch) W. Gams, *Cephalosporium*-art. Schimmelp.: 186. 1971.

Teleomorph: *Torrubiella alba* Petch in Trans. Br. mycol. Soc. 16: 226. 1931.

Spider hosts covered by white to yellow mycelium, often extending around the host onto the leaf surface, or occurring on old synnemata of *Gibellula*. Vegetative hyphae hyaline, smooth-walled, 1.2–2.0 μm wide. Conidiogenous cells single or two–three in a whorl, mostly phialidic, but also polyblastic, occasionally formed on the same conidiophore. Phialides awl-shaped, straight or slightly bent, 12–30 μm long, with a base 1.0–1.5 μm wide (for a more detailed description of these phialides see Gams, 1971). Polyblastic cells with a straight or slightly bent base, 1.0–1.5 μm wide, and a thin (0.4–0.7 μm) rachis, covered with 1–8 conspicuous denticles, 1.0–4.5 \times 0.4–0.6 μm . Conidia fusiform, slightly curved, mostly with rounded ends, 2.8–3.7 \times 0.8–1.0 μm . Chlamydo-spores not observed.

Material examined.—*Cephalosporium aranearum*, on spiders, Nuwara Eliya, Sri Lanka, collected by *T. Petch* (K, see also Gams, 1971: 186).—CBS 003337 = R.S. 0050, on spider, on cocoa leaf, Tafo, Ghana, *H. C. Evans*, Jan. 1972.

Petch (l.c.) and Gams (1971) had overlooked the presence of denticulate conidiogenous cells in this fungus, but in recent collections from Ghana this structure was quite evident in addition to the simple phialides characteristic of *Verticillium* sect. *Prostrata*. A renewed study of Petch's specimens (Fig. 6a) showed that polyblastic (or possibly polyphialidic) conidiogenous cells were also present in this material. Therefore we trans-

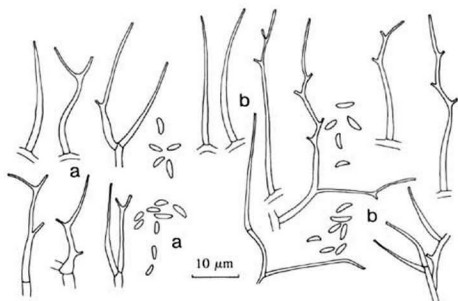


Fig. 6. *Engyodontium arachnophilum*, conidiogenous structures and conidia. — a. Petch's specimens. — b. CBS 003337.

fer this fungus to *Engyodontium*. Like *E. aranearum* it forms a link between this genus and *Verticillium* sect. *Prostrata*.

6. *Engyodontium geniculatum* Evans & Samson, *sp. nov.* — Fig. 7

Mycelium hospitem (insectum vel araneam) obtegens, album, saepe ad substratum evadens. Hyphae vegetativae hyalinae, leves, tenuitunicatae, 1.2–2.0 µm latae. Cellulae conidiogenae singulae vel verticillatae ex hyphis aeriis oriundae, 20–100 × 1.0–2.2 µm, raro phialides, saepius polyblasticae. Ambo formae nonnumquam in uno conidiophoro junctae. Cellulae conidiophorae seu phialides subulatae, sursum ad 0.5 µm angustatae, seu polyblasticae e basi recta vel curvata et rhachide angusta (0.5–0.8 µm) geniculata nonnullis denticulis conidiiferis (1.0–3.0 × 0.2–0.5 µm) praedita constantes. Conidia ellipsoidea vel obovata, levia, hyalina, 2.5–3.0 × 1.2–1.5 µm. Chlamydosporae et teleomorphosis ignotae.

Typus CBS 003323 = R.S. 0033, in Homoptero quodam (Flatidae), folio Theobromae cacaouis adfixo, prope Tafo in Ghana, coll. *H. C. Evans*, 15.1.1972.

Arthropod host covered by fine, white mycelium often extending around the host onto the leaf surface. Vegetative hyphae hyaline, smooth-walled, 1.2–2.0 µm wide. Conidiogenous cells arising singly or in whorls from aerial hyphae, 20–100 × 1.0–2.2 µm, rarely phialidic, more often polyblastic. Both types sometimes occurring on the same conidiophore. Phialides awl-shaped to subulate, apically narrowing to 0.5 µm. Polyblastic conidiogenous cells with a straight, occasionally sinuous base and a thin (0.5–0.8 µm) rachis, which is covered with several to many conspicuous denticles, 1.0–3.0 × 0.2–0.5 µm, occurring in regular or irregular geniculate rachids. Conidia ellipsoidal or obovoidal, smooth-walled, hyaline, 2.5–3.0 × 1.2–1.5 µm. Chlamydospores and teleomorph not observed.

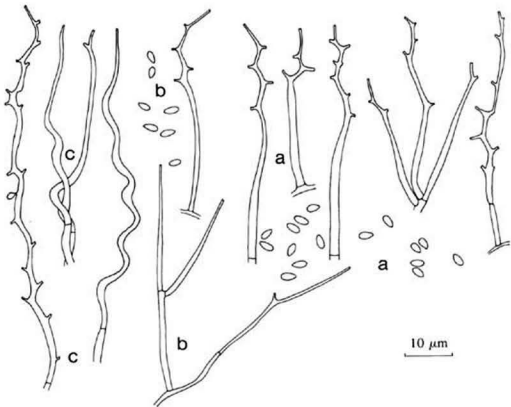


Fig. 7. *Engyodontium geniculatum*, conidiogenous structures. — a. CBS 003323. — b. CBS 003333. — c. CBS 003334.

Material examined.—Herbarium specimens (all specimens collected by *H. C. Evans* in Tafo, Ghana, on cocoa leaves): CBS 003323 (= R.S. 0033), holotype, on unidentified Flatidae (Homoptera), Jan. 1972. — CBS 003333 = R.S. 0075 and CBS 003334 = R.S. 130, both on spiders, Apr. and May 1972. — CBS 003335 = R.S. 144, on nymphs of *Steatococcus* sp. (Coccidae, Homoptera), May 1972.

Engyodontium geniculatum is known only from herbarium material collected in Ghana. It is characterized by the long polyblastic (or possibly polyphialidic) conidiogenous cells with geniculate rachids covered by numerous distinct denticles.

Acrodontium myxomyceticola Crane & Schoknecht (1982) is similar to *E. geniculatum*, but lacks the pronounced remote denticles and the rachis is less distinctly geniculate.

Engyodontium geniculatum does not appear to be host-specific since it was found on both spiders (Araneida) and insects (Homoptera). Although apparently restricted to spiders, *E. arachnophilum* occasionally occurs on hosts previously colonized by *Gibellula*. This may indicate that these species are in fact facultative or fungicolous parasites rather than true pathogens.

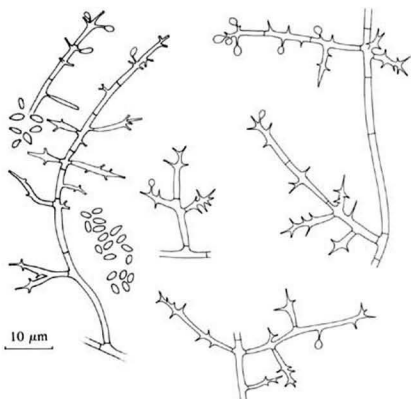


Fig. 8. *Engyodontium* sp., from slide IMI 246085.

7. *Engyodontium* sp.—Fig. 8

Conidiophores arising more or less orthotropically from undifferentiated hyphae, composed of 1–4 cells which may bear short secondary branches; conidiogenous cells $7\text{--}15 \times 1.0\text{--}1.8 \mu\text{m}$, with scattered, perpendicular, thorn-like, tapering denticles, $2.0\text{--}3.5 \mu\text{m}$ long. Conidia ellipsoidal, thin-walled, hyaline, $2.2\text{--}2.6 \times 1.5\text{--}2.2 \mu\text{m}$. Chlamydospores absent.

Material examined.—IMI 246085 (slide), ex culture isolated from thermometer, Royal Botanic Garden, Kew, England, *B. L. Brady*, Nov. 1979.

The specimen probably represents a new *Engyodontium* species characterized by short conidiogenous cells with thorn-like denticles and orthotropic branches. Since, however, only a slide is now available for study, we are reluctant to attribute a formal name. Moreover, as there are also similarities with *Myriodontium keratinophilum* Samson & Polonelli (1978), the true identity of this taxon can only be elucidated after examination of living cultures.

ACKNOWLEDGEMENTS

We are indebted to Drs D. W. Minter, B. L. Brady, A. H. S. Onions (CMI) and the curators of the herbaria, K, B and FH for supplying material. Mr. K. Seifert is acknowledged for his comments on the manuscript.

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NOTES ON CUP-FUNGI—I

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The soil inhabiting *Ascobolus terrestris* sp. nov. and the coprophilous *Thecotheus agramulosus* Kimbr. are described from French collections.

***Ascobolus terrestris* Brumm., spec. nov.**—Figs. 1, 2

Apothecia sessilia, 1–2 mm diam. Receptaculum initio subglobulare, deinde cupulatum, denique expansum, dilutissime lilacinum, laeve, margine obtuso. Excipulum textura globulosa. Asci cylindrici, $210\text{--}240 \times 19 \mu\text{m}$, 8-sporei, parietibus iodo caerulescentibus. Ascosporeae ellipsoideae, $16.2\text{--}18.5$ (-19.6) \times $8.7\text{--}9.7$ (-10.2) μm , arte verrucis rotundis instructae. Paraphyses tenues, filiformes, simplicae vel ramosae, $1.5\text{--}2.0 \mu\text{m}$ crassae, apice leviter incrassatae. Ad terrum argillosam inter muscos infra abietem albam. — Typus: *G. Moyne 81.08.26.13*, Frasne, Doubs, Gallia, 26.VIII.1981 (L).

Apothecia solitary or in small groups, superficial, sessile, 1–2 mm diameter, 0.5–1 mm high. Receptacle at first subglobular, then cup-shaped, finally expanded, very pale lilac, almost white; surface smooth; margin obtuse, slightly discernible. Disc concave then flat, roughened by protruding ripe asci, lilac-violet dotted with the darker ripe ascospores. Hymenium 200–230 μm thick. Hypothecium not clearly differentiated. Flesh of varying thickness, hyaline, near the base up to 150 (-180) μm thick, at the margin very thin or absent, consisting of isodiametric and oblong thin-walled cells $7\text{--}18 \times 7\text{--}12 \mu\text{m}$. Excipulum of varying thickness, 20–200 μm thick, near the base 100–200 μm thick, at the margin 20–45 μm wide, almost colourless, consisting of subglobular and oblong cells $7\text{--}19 \times 7\text{--}12 \mu\text{m}$ (textura globulosa). Asci cylindrical, narrower towards the base, rounded above, operculate, $210\text{--}240 \times 14.5\text{--}19 \mu\text{m}$, 8-spored, the wall clearly blue in Melzer's reagent. Ascospores 1–2-seriate, at maturity irregularly arranged in the upper part of the ascus, ellipsoid (length/width ratio 1.7–2.0, average 1.88), at first hyaline, then pinkish violet to violet, becoming brownish at maturity, $16.2\text{--}18.5$ (-19.6) \times $8.7\text{--}9.7$ (-10.2) μm (without ornamentation), sometimes swollen up to $21 \times 12.5 \mu\text{m}$, with homogeneous contents, ornamented with a regular pattern of rather closely placed rounded warts $0.3\text{--}1.1 \mu\text{m}$ wide and $0.5\text{--}1.0 \mu\text{m}$ high. Paraphyses septate, slender filiform, sometimes curved, simple or branched, hyaline, $1.5\text{--}2.0 \mu\text{m}$ thick, enlarged up to $5 \mu\text{m}$ at the tip, not embedded in coloured mucus, without granules.

Habitat. — On damp loamy soil among young mosses, under *Abies alba*.

Etymology. — From Latin, *terrestris*, pertaining to the earth, growing on the ground.

Specimen examined. — FRANCE, Dép. Doubs, Frasne, 26.VIII.1981, *G. Moyne 81.08.26.13* (L, holotype).

This species of *Ascobolus* was kindly sent for identification, together with several others, by Dr. G. Moyne. It was collected again a few weeks later from the same locality near Frasne.

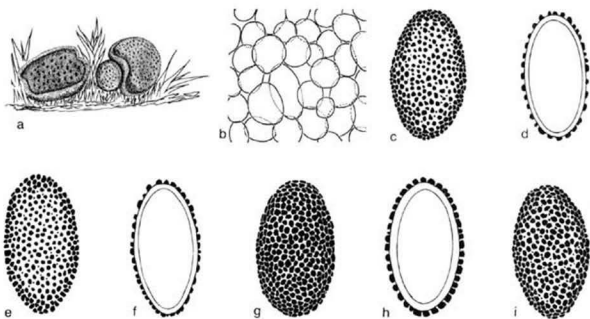


Fig. 1. *Ascobolus terrestris*, type. — a. Habit of fruit-body $\times 10$. — b. Texture of excipulum seen from outside $\times 800$. — c, e, g, i. Ascospores $\times 1600$. — d, f, h. Ascospores in optical section $\times 1600$.

Ascobolus terrestris is close to *A. geophilus* Seaver but differs in the smaller fruit-bodies, the absence of greenish yellow pigment in the receptacle and hymenium, the smaller ascospores and the ascospore ornamentation (cf. van Brummelen, 1967).

On average, typical mature ascospores of *A. terrestris* do not exceed $20\ \mu\text{m}$ in length (inclusive of the pigment layer), while those of *A. geophilus* are longer.

In *A. geophilus* the pigment layer is initially deposited on the ascospore walls as a uniform smooth layer. On further ripening the pigment layer forms fine cracks in all directions, eventually followed by still further partitioning. This results in a network of fine fissures and finally sometimes in a pattern of warts.

In *A. terrestris* the regular dense pattern of rounded warts is present from the beginning of pigment precipitation on the ascospore wall.

There is a more remote relationship of *A. terrestris* with two other soil inhabiting species of *Ascobolus*, viz. *A. behntziensis* Kirschst. and *A. albinus* Seaver. Both have larger fruit-bodies and ascospores, a furfureous or rough receptacle, and a different colour.

Thecotheus agranulosus Kimbr. — Figs. 3, 4

Thecotheus agranulosus Kimbr. in *Mycologia* 61: 112. 1969.

Apothecia gregarious or in small groups, superficial, sessile, $0.4\text{--}1.5\ \text{mm}$ diam., $0.4\text{--}0.6\ \text{mm}$ high. Receptacle at first obconical or subpyriform, then turbinata, becoming expanded, finally discoid to pulvinate, brownish purple to purplish grey; surface pruinose; margin broad, smooth, slightly incurved. Disc flat, then convex, studded with the apices of the far-protruding asci, pale purplish grey. Hymenium up to $300\ \mu\text{m}$ thick. Hypothecium $40\text{--}50\ \mu\text{m}$ thick. Flesh $90\text{--}160\ \mu\text{m}$ thick, consisting of subglobular cells $8\text{--}18\ \mu\text{m}$ diameter strongly intermingled with filamentous hyphae $2\text{--}3\ \mu\text{m}$ wide.

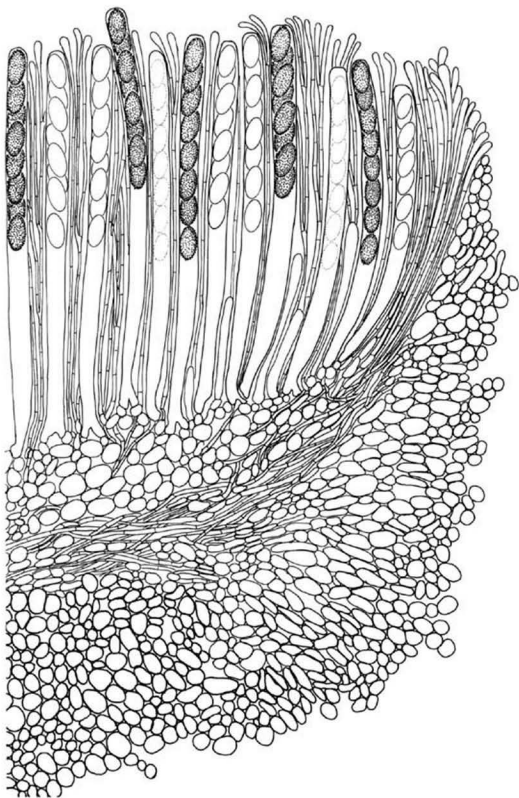


Fig. 2. *Ascobolus terrestris* (type), median section of margin of fruit-body $\times 400$.

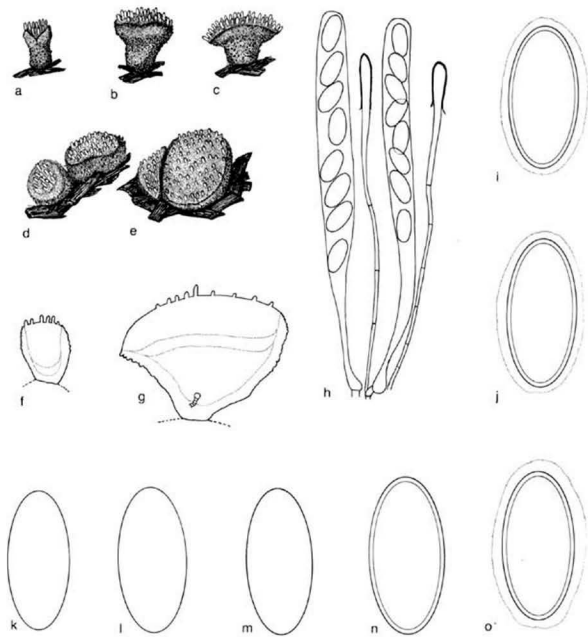


Fig. 3. *Thecothetes agranulosus*, van Brummelen 6574. — a–e. Habit of fruit-bodies $\times 25$. — f, g. Diagrammatic sections of fruit-bodies $\times 40$. — h. Asci and paraphyses $\times 400$. — i, j, n, o. Ascospores in optical section $\times 1600$. — k–m. Ascospores $\times 1600$.

Excipulum clearly differentiated, 50–90 μm thick, at the margin 50–75 μm wide, consisting of subcylindric hyphae with subglobular or inflated terminal cells 9–14(–16) μm wide (textura globulosa) with intercellular amorphous purplish brown pigment. Asci cylindrical, narrower towards the base, with a somewhat truncate apex, 250–290 \times 16.5–21.0 μm , 8-spored; the wall staining blue over the full length in iodine. Ascospores 1–2-seriate, irregularly arranged, ellipsoid (length/width ratio 1.9–2.2, average 2.07, rarely up to 2.4), (18.5–)19.0–21.0(–22.5) \times (9.2–)9.5–10.0(–10.5) μm without oil globules,

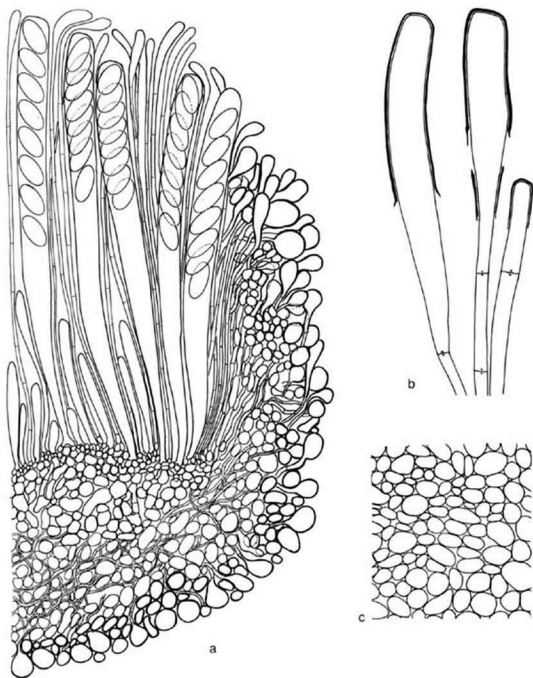


Fig. 4. *Thecotheus agranulosus*, van Brummelen 6574. — a. Median section of margin of fruit-body $\times 400$. — b. Detail of tips of paraphyses $\times 1600$. — c. Texture of excipulum seen from outside $\times 400$.

smooth, with a uniform thin ($0.2\text{--}0.3\ \mu\text{m}$) outer layer staining with methyl blue, and a thick gelatinous envelope surrounding each spore. Paraphyses filiform, septate, branched, about $2.0\ \mu\text{m}$ thick, enlarged up to $4\text{--}6\ \mu\text{m}$ at the tip, covered with a layer of amorphous purplish brown pigment.

Habitat. — On dung of donkey.

Specimen examined.—FRANCE. Dép. Var., Île de Port-Cros, cultured on dung of donkey (comm. Dr. J.-C. Donadini No. 2.82), 5.III.—30.VI.1982, *van Brummelen 6574* (L).

In March 1982 Dr. J.-C. Donadini sent to Leiden some dung of a donkey from Port-Cros, which proved to be of considerable interest. On further culturing a rich growth of *Thecotheus agranulosus* developed.

As this species has not previously been recorded outside North America and the only (original) description (Kimbrough, 1969) was based on dried specimens, a full description is given above based on living material. The different origins of the material may explain some differences found between the two descriptions.

While Kimbrough (l.c.) described asci only 175–225 μm long and paraphyses with hyaline little-swollen tips, the fresh material showed strongly inflated and protruding asci 250–290 μm long and strongly swollen ends of paraphyses covered with a rather uniform layer of amorphous purplish brown pigment.

In several series of sections of fruit-bodies at different stages of development the excipulum was found to consist of subcylindrical hyphae with subglobular or inflated terminal elements. A *textura angularis* or an epidermoid arrangement in the superficial layer, as described by Kimbrough, could not be found.

Within the genus *Thecotheus* this species is distinguished by its smooth ascospores of which only eight are formed in an ascus. Although the ascospores are smooth, secondary wall material is deposited or condensed to form a relatively thick smooth and uniform layer on the episore. This secondary wall material stains intensely with methyl blue or cotton blue. Such a smooth layer of secondary wall material is also found in species of *Peziza* with smooth ascospores, like *P. ammophila* and *P. vesiculosa* (cf. Merkus, 1975, 1976).

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Kummer (1871) created the genus *Clitopilus*, which agrees with *Clitopilus* Fr. 1838 and consequently with *Agaricus* tribus *Mouceron* Fr. 1821. As a consequence of the invalid status of the name *Agaricus* tribus *Clitopilus* Fr. 1838, Kummer must be considered the author of the generic name *Clitopilus*. According to I.C.B.N. art. 72 (esp. note 1), *Clitopilus* Kumm. must be considered as a new name and has to be cited as *Clitopilus* Kumm. without reference to the invalidly published name *Agaricus* tribus *Clitopilus* Fr. 1838. *Clitopilus* Kumm. is lectotypified (Donk, 1949) by the type of its nomenclatura ancestor *Agaricus* tribus *Mouceron* Fr. 1821, viz. *Agaricus prunulus* Scop.: Fr.

Clitopilus scyphoides (Fr.) Sing.

Agaricus scyphoides Fr., Syst., mycol. 1: 163. 1821. — *Omphalia scyphoides* (Fr.) Kumm. Führ. Pilzk.: 106. 1871. — *Omphalina scyphoides* (Fr.) Quél., Enchir. fung.: 42. 1886. — *Clitocybe scyphoides* (Fr.) P. D. Orton in Trans. Br. mycol. Soc. 43: 174. 1960. — *Clitopilus scyphoides* (Fr.) Sing. in Farlowia 2: 554. 1946.

Agaricus cretatus Berk. & Br. in Anns Mag. nat. Hist., Sér. 3, 7: 373. 1861. — *Clitopilus cretatus* (Berk. & Br.) Sacc., Syll. fung. 5: 702. 1887.

Cantharellus hrbanovi Velen. in Mykologia 3: 77. 1926. — *Clitopilus hrbanovi* (Velen.) Sing. in Sydowia 31: 237. 1979.

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Clitopilus scyphoides f. *mutilus* sensu Sing. in Farlowia 2: 555. 1946.

Excluded names. — *Clitocybe scyphoides* sensu P. D. Orton in Trans. Br. mycol. Soc. 43: 174. 1960 (= *Clitocybe* spec.); *Omphalia scyphoides* sensu J. Lange, Fl. agar. dan. 2: 57, pl. 59A. 1936 (= *Clitocybe* spec.).

Neotype-study of *Clitopilus scyphoides* (Fig. 1). —

Fungi Exsiccati Suecici 707, Upland, Upsala, Slottsbacken, 22 July 1938, *Seth Lundell*. On bare soil, in sparse lawn amongst *Trifolium repens* etc. under frondose trees (Neotype, design. mihi, C.).

Spores 6–8.1 × 3.2–4.2 μm, ellipsoid in outline with 6–9 ribs. Basidia 18–32 × 7–9.5 μm, 4-spored. Cystidia not seen. Pileipellis a cutis of narrow, cylindrical, 2–5 μm wide hyphae. Clamp-connections absent.

Type-study of *Agaricus cretatus*. —

Herbarium Mycologicum Berkeleyanum 850, Aug. 20, 1860, *Kevii Cliff* (K).

Spores 6–8.5 × 3.2–4.5 μm, ellipsoid in outline with 5–8 distinct ribs. Intact basidia not found.

The holotype of *Agaricus cretatus* is in rather poor state, and consist of about 8 specimens with omphalinoid habit, glued to a piece of paper. The spores, however, agree perfectly with the common interpretation of *Clitopilus cretatus* of modern authors. In the preparations also rounded, rough spores, 6–8 μm in diameter were found, most pro-

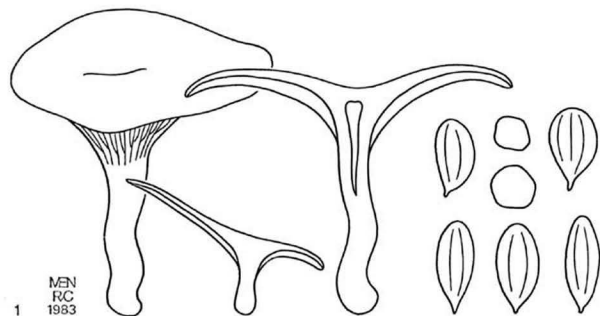


Fig. 1. *Clitopilus scyphoides* f. *scyphoides*. — Habit ($\times 3$) and spores ($\times 2100$). (Habit from Exc. N.M.V. 29 Sept. 1974; spores from neotype).

Fig. 2. *Clitopilus scyphoides* f. *reductus*. — Habit ($\times 3$) and spores ($\times 2100$). (All figs. from holotype).

Fig. 3. *Clitopilus scyphoides* f. *omphaliformis*. — Habit ($\times 3$) and spores ($\times 2100$). (All figs. from *C. Bas 1515*).

bably from a mould. It is almost certain that Masee (1893: 245) saw these spores when he studied the type of *Agaricus cretatus*.

I agree with Singer (1946: 554) that *Agaricus scyphoides* most probably represents the same fungus as *Agaricus cretatus*. The descriptions of Fries (1821, 1874, and espe-

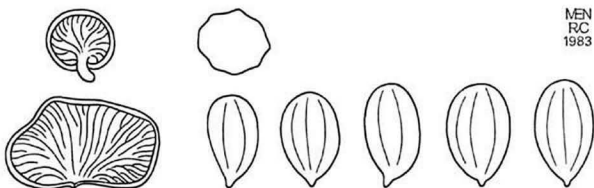


Fig. 7. *Clitopilus hobsonii*. — Habit ($\times 3$) and spores ($\times 2100$). (Habit from *M. E. Noordeloos 1701*, spores from holotype).

Collections examined. — NETHERLANDS, prov. Noord-Holland, Ankeveen, Nov. 1966, *J. Daams s.n.* (holotype, L); Vogelenzang, Vogelenzangse bos, 5 Oct. 1961, *C. Bas 2574* (L); prov. Noord-Brabant, Drimmelen, 28 Dec. 1958, *P. B. Jansen* (L); Breda, Emer, 5 Dec. 1970, *P. B. Jansen* (L). — DENMARK, Jylland, Jaegerspris, 5 Dec. 1982, *S. Elborne 754* (C).

Clitopilus daamsii resembles *C. hobsonii* very much in having a strongly reduced often sessile basidiocarp, but differs microscopically in having much larger spores. Some collections have mixed 2- and 4-spored basidia, others exclusively 4-spored basidia, but even in the latter the spores are distinctly larger than in *C. hobsonii*. For this reason I consider it a taxon with the rank of species, and not a mere variety of *C. hobsonii*.

I have named this tiny *Clitopilus* after Jasper Daams, former president and present honorary member of the Netherlands' Mycological Society, to honour his great stimulating influence on Netherlands mycology over almost 50 years.

Clitopilus hobsonii (Berk.) P. D. Orton. — Fig. 7

Agaricus hobsonii Berk., Outl. Brit. Fung. 138. 1860. — *Pleurotus hobsonii* (Berk.) Sacc., Syll. fung. 5: 382. 1887. — *Clitopilus hobsonii* (Berk.) P. D. Orton in Trans. Br. mycol. Soc. 43: 174. 1960.

Octojuga pleurotelloides Kühn. in Botaniste 17: 158. 1926. — *Clitopilus pleurotelloides* (Kühn.) Joss. in Bull. mens. Soc. linn. Lyon 10: 1941.

Octojuga fayodii Konr. & Maubl., Icon. sel. fung. 6: 234. 1934.

Misapplied names. — *Claudopus variabilis* sensu Fayod, Ann. Sci. Nat., Sér. 7, 9: 390. 1889, non all (= *Octojuga fayodii*). — *Clitopilus pinsitus* sensu Joss. in Bull. Soc. mycol. Fr. 53: 210. 1937 non Fr. — *Clitopilus septiocoides* sensu Sing. in Lilloa 22: 606. 1951.

Study of the holotype of *Clitopilus hobsonii*. —

Spores $6.0-9.0 \times 4.0-5.5 \mu\text{m}$, ellipsoid in outline, with 7-10 indistinct ribs. Material too poor for the interpretation of other microscopical characters.

Fig. 8. *Leucopaxillus cutefractus*. — Habit ($\times 1.5$), spores ($\times 2100$) and cheilocystidia ($\times 1400$). (All figs. from holotype).

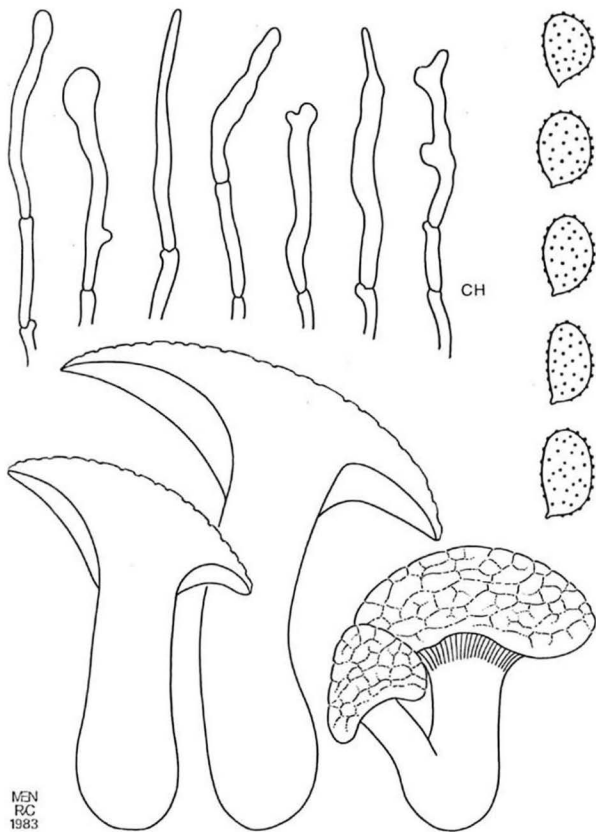




Fig. 9. *Leucopaxillus cutefractus*. — Habit (from holotype).

Fig. 10. *Clitopilus fasciculatus*. — Habit (from holotype).

From the type-study it is evident that *Clitopilus hobsonii* is a good species of *Clitopilus*, and the oldest valid name for *Octojuga pleurotelloides* Kühner.

Clitopilus pinsitus sensu Jossierand (l.c.) most probably represents a luxurious form only of *C. hobsonii*. I have ranged it among the misapplied names awaiting other evidence.

Clitopilus hobsonii is a common species growing terrestrial or on debris of herbaceous or woody plants. The lamellar edge is usually fertile, but occasionally filiform, 2–4 μm wide 'hairs' have been observed, which possibly are of tramal origin (compare *C. daamsii*).

Clitopilus scyphoides f. *reductus* resembles *C. hobsonii* very much, but can be distinguished by its narrower spores.

V. *Leucopaxillus*

Leucopaxillus cutefractus Noordel., *spec. nov.* — Figs. 8, 9

Pileus 40–120 mm latus, conico-convexus, late expansus, haud hygrophanus, haud striatus, pallide isabellinus vel isabellino-ochraceus, initio villosus late irregulariter rimoso-aereolatus. Lamellae moderate confertae, versus basim anastomosae, pallidae. Stipes 25–60 \times 8–22(–30), versus basim inflatus, pileo pallidior. Caro alba, firma. Odor variabilis, subaromaticus, gratus vel leviter nauseosus. Sapor mitis. Sporae 6.3–8.1(–8.6) \times 4.5–5.9(–6.3) μm , ellipsoidae, amyloidae, verruculosae. Basidia 4-sporigera. Cheilocystidia abundantia, cylindricaco-flexuosa, interdum strangulata vel ad apicem coralloidea, 2.5–6 μm crassa. Pileipellis cutis vel trichoderma, hyphis cylindraccis, 4–10 μm latis pigmentis membranaceis vel leviter incrumentibus. Fibulae numerosae. — Holotypus: *Th. W. Kuyper* 1940, 14-X.1981, 'Kwade hoek, Isl. Goeree, Netherlands' (L).

Pileus 40–120 mm broad, thick-fleshed, rounded conico-convex then expanding to almost flattened, usually with broad umbo, more rarely with slightly depressed centre, with involute margin, in marginal zone somewhat irregular lobed or wavy with age, not hygrophanous, not striate, pale isabella creamy with whitish margin of entirely isabella-ochraceous, at centre sometimes slightly darker tending to leather brown, dry, entirely felted-tomentose when young sometimes minutely ribbed and fluffy at margin, becoming areolate-craqued to 'pseudo' squamulose with age, more or less glabrescent in moist weather. Lamellae moderately crowded decurrent, narrow to fairly broad (4–10 mm), often anastomosing, especially in basal part on stipe, pallid, almost white and remaining so on drying, with minutely pruinose-fimbriate, concolorous edge. Stipe 25–60 \times 8–22(–30) mm, usually strongly swollen towards base but extreme base mostly attenuated and almost rooting, white or whitish with isabella-creamy spots, flocculose-squamulose at first then fibrillose-streaky to minutely ribbed, at base white tomentose. Flesh very firm, white. Smell variable, usually sweetish, subaromatic, sometimes slightly rancid-acrid or subfarinaceous, unpleasant. Taste strong, difficult to describe but mild. Sporeprint slightly creamy-pinkish.

Spores 6.3–8.1(–8.6) \times 4.5–5.9(–6.3) μm , average 7–7.6 \times 5–5.5 μm , Q = (1.1–) 1.3–1.4(–1.7), (broadly) ellipsoid in outline, covered with small, rounded, strongly amyloid warts. Basidia 24–52 \times 8–11 μm , 4-spored. Cheilocystidia numerous, rendering lamellar edge usually entirely sterile, irregularly cylindrical-flexuose, sometimes with some apical excrescences subcoralloid, 2.5–5(–6) μm wide. Pileipellis a cutis with transitions to a trichoderm, made up of 4–10 μm wide cylindrical hyphae with numerous free endings, resembling the cheilocystidia. Pigment mainly membranous, sometimes minutely encrusting in pileipellis and upper pileitrama. Pileitrama subregular, made up of 4–12 μm wide cylindrical hyphae. Clamp-connections numerous in all tissues.

Habitat & distribution.— In grassland and in deciduous forest in the coastal dunes on relatively calcareous, humus-rich sandy soil. Known to occur in several places, often in large groups, along the coast of the Netherlands.

Collections examined.— NETHERLANDS: prov. Noord-Holland: Bakkum, 11 Oct. 1962, *anonymus*; Castricum, Geversduin, 19 Sept. 1954, *G. D. Swanenburg de Veye*; idem, 23 Oct. 1955, *R. A. Maas Geesteranus 10846*; prov. Zuid-Holland: Wassenaar, Meyendel, 24 Oct. 1931, *M. Boetje van Ruyven*; idem, 23 Oct. 1955, *R. A. Maas Geesteranus 13453*; idem, Bierlap, 5 Oct. 1974, *C. Bas 6418* and 9 Oct. 1974, *C. Bas 6418a*; Island Goeree, 14 Oct. 1981, *Th. W. Kuyper 1940* (holotype) (all collections in L).

The genus *Leucopaxillus* Boursier is relatively well-known due to the excellent monograph of Singer & Smith (1942) and the contributions by F. H. Moeller (1954) and Bon (1979). However, while working through the available Netherlands' collections of the genus, a taxon was encountered which I was unable to name with the works mentioned above, nor with the keys of Kühner & Romagnesi (1953) and Moser (1983). The species concerned is well represented in the Rijksherbarium with several collections, all from the coastal dune-area. Macroscopically it shows some resemblance to *Leucopaxillus paradoxus* (= *L. albissimus* sensu Singer & Smith s.l., = *L. cerealis* (Lasch) Singer), but in general the collections are slightly darker on the pileus than mentioned for *L. paradoxus* in the descriptions of Boursier (1925), Kühner (1926), Singer & Smith (1942), Pegler (1975) and Malençon & Bertault (1975). But this difference is not so great that one could think of one the dark species like *L. tricolor*, *L. gentianus*, or *L. amarus*. For that reason the Netherlands' collections all were named *L. paradoxus*.

While examining the collections critically I found that all specimens studied had well differentiated cheilocystidia, usually so abundant, that the lamellar edge appeared to be entirely sterile. This is not mentioned in one of the descriptions cited above, and I started to doubt the correctness the identification of our *L. paradoxus*. Also the recent key to the genus *Leucopaxillus* of M. Bon (1979) did not help me out. Choosing for the pale coloured species, the only species with similar cheilocystidia is *L. alboalutaceus* (Moell.) Moell., but that differs among other things in having non-decurrent lamellae and much smaller spores ($4-5(-6) \times 3-4(-4.5) \mu\text{m}$). Trying the other way by choosing for the darker species, I encountered a number of species with similar cheilocystidia, but with a considerably darker pileus than our fungus (*L. gentianus*, *L. mirabilis*, and *L. amarus*). The only species with a more or less similarly coloured pileus seems to be *L. tricolor*, but this species has sulphur yellow lamellae which turn violaceous-chocolate-brown on drying (Michael-Hennig, 1979; Kühner & Romagnesi, 1953; and Singer & Smith, 1942).

Dr. M. Bon (St. Valéry-sur-Somme, France) who kindly checked my descriptions and exciccata of the Netherlands' taxon, agrees that it does not fit into any of the known species of *Leucopaxillus*, with perhaps the exception of *L. albissimus* var. *monticola* Singer & Smith. That variety, which occurs under coniferous trees in the (sub-)alpine regions of the southern United States, differs slightly in having a paler, smoother pileus. Whether this variety is identical with our fungus or not, which is difficult to demonstrate without the type-collection, it seems to be untenable as a variety of *L. albissimus* as the occurrence of cheilocystidia is considered to be a major character on species level in

Leucopaxillus (cf. Singer & Smith, Moeller, Bon, l.c.). Therefore I consider my fungus as a species in its own right, and name it *Leucopaxillus cutefractus* because of the typical craquelé-areolate pileal surface of mature, non-weathered specimens.

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I am very grateful to Dr. C. Bas and Thomas W. Kuyper for critically reading the text of this paper and comments on nomenclatorial problems. The director of the Royal Botanic Gardens, Kew, England, is gratefully thanked for hospitality and the loan of type-specimens. Dr. A. v. Zaayen, Experimental Mushroom Growing Station, Horst, Netherlands, is cordially thanked for the gift of collections of *Clitopilus fasciculatus* and for providing the photograph. I am indebted to Henning Knudsen, Copenhagen, for his hospitality during my stay at the Botanical Museum in July 1983.

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A REVALUATION OF CHAETOMIUM AND THE CHAETOMIACEAE

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A reevaluation is made of the genus *Chaetomium* which comprises about 300 species, and relatives classified in several genera of the Chaetomiaceae, Melanosporaceae and Microascaceae. The classification is based on the size, shape and symmetry of the ascospores, the number of the germ pores, the shape of the asci (clavate, obovate, fusiform or cylindrical) and the size, shape, structure and ornamentation of the ascomata.

In Ascomycetes with pigmented, 1-celled ascospores the presence or absence and the number of germ pores or germ slits are characters used to delimit not only genera, but also families. The Xylariaceae and the Coniochaetaceae contain exclusively Pyrenomycetes with ascospores with a germ slit. Amyloid apical rings are present in the asci of the former family, absent in the latter. All genera included in the Boliniaceae, Sordariaceae, Microascaceae, Melanosporaceae and Chaetomiaceae are characterized by ascospores with germ pores.

Most genera of the Sordariaceae include taxa with ascospores having a single germ pore and cellular or gelatinous sheaths or appendages. The species of the genera *Neurospora* and *Gelasinospora*, usually classified in the Sordariaceae, have unsheathed but ornamented ascospores, often with two or up to eight germ pores. They also include arthric anamorphs of the form genus *Chrysonilia* and therefore may be classified in a separate family (von Arx, 1981, 1982).

The Chaetomiaceae (including the Melanosporaceae and parts of the Microascaceae) at present contain the genera *Chaetomium* Kunze, *Chaetomidium* (Fuckel) Sacc., *Achaetomium* Rai & al., *Achaetomiella* v. Arx, *Boothiella* Lodhi & Mirza, *Farrowia* D. Hawksworth, *Melanospora* Corda, *Sphaerodes* Clem., *Petriella* Curzi, *Pseudallescheria* Negroni & Fischer, *Lophotrichus* R. K. Benjamin, *Thielavia* Zopf, *Corynascus* v. Arx and *Corynascella* v. Arx & Hodges. *Chaetomidium*, *Farrowia*, *Thielavia* and *Boothiella* contain species with ascospores with a single germ pore, while the species of *Melanospora*, *Sphaerodes*, *Achaetomiella*, *Petriella*, *Pseudallescheria*, *Corynascella* and *Corynascus*

have bipolar ascospores (only those of *Corynascus heterothallicus* (v. Klopotek) v. Arx are uniporate). Most of the species classified in *Chaetomium* and *Achaetomium* have uniporate ascospores; in a small number they are bipolar.

All the genera except *Chaetomium* contain less than 15 species, several are monotypic. They are characterized by ascomata which are either ostiolate or non-ostiolate, smooth, often translucent, sometimes covered with undifferentiated, non-erect hyphae. All genera however are characterized by evanescent, stalked, often fasciculate, clavate, obovate or narrow cylindrical asci and 1-celled, pigmented ascospores without appendages of sheaths, but usually with germ pores. In species with ostiolate ascomata the ascospores are not forcibly discharged, but become free in a cirrhous or as a slimy mass, which may become dry but not powdery.

The genus *Chaetomium* contains species with superficial, ostiolate ascomata covered with characteristic hairs or setae. All are saprophytic, often cellulolytic or coprophilous and some are rather common on plant debris, e.g. on straw or paper. They are easily isolated and show abundant fructification on adequate media. The identification of the species is often difficult and time consuming because the genus has long been favoured for taxonomic study, with about 300 taxa having been described. Several are known only by the type specimen.

Dreyfuss (1976) observed in monospore cultures of *Ch. murorum* saltants or mutants which differed both morphologically and physiologically from the original strain as well as from each other. Some of them were reidentified as *Ch. elongatum*, some others formed smooth or nearly smooth ascomata.

Chaetomium species form expanding colonies with superficial, spherical, ovate or ampulliform, ostiolate ascomata covered with characteristic hairs or setae, on which several apparently heterogeneous sections have been distinguished e.g. by Zopf (1881), Bainier (1910), Chivers (1915), Skolko & Groves (1948, 1957), Udagawa (1970), Ames (1963), Mazzucchetti (1965), Seth (1972) and Millner (1975). Sections or species groups with branched or unbranched terminal hairs have been delimited. The branching may be dichotomous, at right angles or irregular. The hairs may be straight, flexuous, arcuate, undulate, circinate, spirally coiled or contorted. Based on these characters up to ten species groups have been distinguished. Several hair types also may be mixed and a distinction is made between terminal and lateral hairs. Hawksworth & Wells (1973) introduced the ornamentation of the terminal hairs seen in SEM as a further character. The definite hair shape and ornamentation however depends on the age of the ascomata and also on culture conditions.

Whiteside (1957) introduced the structure of the ascomatal initials (ascogonia) as a further character for a subdivision of *Chaetomium*. He distinguished the 'globosum type' forming an undifferentiated cluster of hyphae and the 'brasiliense type' forming a coil surrounding an ascogonial cell at the end of a hypha. Dreyfuss (1976) however showed that the structure of the initials may be influenced by the incubation temperature.

Seth (1972) provided a key based on the shape of the ascospores. The shape of the asci (clavate, obovate, fusiform or cylindrical) usually has been neglected. It was indicated in the descriptions given by Ames (1963), but was not considered in the classification.

The shape of the asci and the structure of the ascospores have been introduced as characters to delimit apparently more homogeneous taxa by Sörgel (1960, 1961), Aue & Müller (1967) and Dreyfuss (1976). More attention has been paid to the germ pore of the ascospores, which may be small or distinct, flat or protuberant, apical, subapical or slightly lateral, and occasionally surrounded by a thickened and/or darkened wall. These aspects were studied by Millner & al. (1977), for a rather large number of taxa. These authors and Dreyfuss (1976) observed ascospores with two germ pores, one at each end, in a few species.

THE REVALUATION OF GENERA AND SPECIES GROUPS

The following subdivision of *Chaetomium* and the other genera of the Chaetomiaceae is based on characters of the ascospores and asci in particular. These details were derived from mostly personal observations, but data published by Dreyfuss (1976), Millner & al. (1977), von Arx (1977), Cannon & Hawksworth (1982) and others were employed without re-examination of the respective specimens.

I. Ascospores with one germ pore

A. Asci clavate, obovate or fusiform

a. Germ pore of the ascospores apical.

1. Ascospores $8-13 \times 7-10 \mu\text{m}$, often biapiculate, laterally flattened; ascomata spherical or ovate, ostiolate, $180-400 \mu\text{m}$, with a wall of textura intricata *Ch. globosum* Kunze.

Further species: *Ch. cochliodes* Palliser, *Ch. cruentum* Ames (an albino form of *Ch. globosum*), *Ch. elatum* Kunze (with branched ascomatal hairs, often heterothallic), *Ch. subaffine* Sergejeva (heterothallic), *Ch. umbonatum* Brever (with biumbonate ascospores), *Ch. madrasense* Natarajan (with ascospores with a lateral bulge).

2. Ascospores spherical or nearly so, $10-12 \mu\text{m}$; ascomata with a wall of angular cells, ostiolate
Ch. globosporum Rikhy & Mukerji.

3. Ascospores $7-11 \times 5-9 \mu\text{m}$, biumbonate or biapiculate, laterally flattened, brown; ascomata ampulliform or pyriform, with a wall of angular cells, covered with seta-like, apically often circinate or branched hairs; aleurioconidia (chlamydo-spores) mostly present *Ch. homopilatum* Omvik.

Further species: *Ch. longicollum* Krzem. & Badura, *Ch. malaysensis* (D. Hawksworth) v. Arx, *Ch. seminudum* Ames. The following species differ by larger ascomata and the absence of chlamydo-spores: *Ch. ampullare* Chivers, *Ch. sphaerale* Chivers, *Ch. subspirale* Chivers.

4. Ascospores $6-9 \times 6-7 \mu\text{m}$, roundish, biapiculate or angular, dextrinoid when young, light bluish grey when mature, occasionally darkened near the poles; ascomata obovate, ampulliform or cylindrical, around the ostiolum with a darkened collar and with a wall of angular or elongate cells; terminal hairs in the upper part coiled *Ch. bostrychodes* Zopf.

Further species: *Ch. convolutum* Chivers, *Ch. caprinum* Bainier sensu Chivers, *Ch. quadrangulatum* Chivers.

5. Ascospores $5-8 \times 4-6 \mu\text{m}$, ovate, brown; ascomata $110-180 \mu\text{m}$, ostiolate, covered with dark, stiff setae and/or with dichotomously branched hairs *Ch. indicum* Corda.

Further species: *Ch. cancroideum* Tschudy, *Ch. erectum* Skolko & Groves, *Ch. funicola* Cooke, *Ch. spinosum* Chivers.

6. Ascospores $7-13 \times 6-11 \mu\text{m}$, ovate or pyriform; ascomata spherical or ovate, ostiolate, covered with undulate or spirally coiled hairs; aerial mycelium often abundant, white . . . *Ch. nigricolor* Ames.

Further species: *Ch. semen-citrulli* Sergejeva, *Ch. uniporum* Aue & Müller.

7. Ascospores $12-21 \times 6-11 \mu\text{m}$, ellipsoidal or broadly fusiform, with longitudinal bands; ascomata spherical or ovate, ostiolate, $90-330 \mu\text{m}$, with a wall of textura epidermoidea or angularis; asci often obovate *Ch. murorum* Corda.

Further species: *Ch. depectivum* Malloch & Benny (with slightly longer ascospores), *Ch. piluliferum* Daniels (with a *Botryotrichum* anamorph), *Ch. subspirilliferum* Sergejeva (ascomata small, with undulate, delicate hairs), *Ch. succineum* Ames (ascomatal hairs coiled).

8. Ascospores $10-17 \times 7-10 \mu\text{m}$, limoniform or broadly fusiform; ascomata spherical, non-ostiolate, covered with thick hairs or setae and with a dark wall of angular cells

Chaetomidium fimeti (Fuckel) Sacc.

Further species: *Chaetomidium arxii* Benny, *Chaetomidium cephalothecoides* (Malloch & Benny) v. Arx, *Chaetomidium pilosum* (Booth & Shipton) v. Arx, *Chaetomidium trichorobustum* Seth, *Chaetomium irregulare* Sörgel ex Gams (with irregular ascospores and a translucent ascomatal wall).

9. Ascospores of different size and shape; ascomata spherical, non-ostiolate, with a translucent or a brown wall of textura epidermoidea, smooth or nearly so *Thielavia basicola* Zopf.

Further species: *T. australiensis* Tansey & Jack, *T. emodensis* Udagawa & Sugiyama, *T. hyalocarpa* v. Arx, *T. microspora* Mouchacca, *T. minuta* (Cain) Malloch & Cain, *T. peruviana* (Gochenaux) Malloch & Cain, *T. pseudomaritima* Davidson, *T. terrestris* (Apinis) Malloch & Cain, *T. terricola* (Gilman & Abbott) Emmons, *T. variospora* Cain (Malloch & Cain, 1973; von Arx, 1975).

10. Ascospores triangular in face view, $7-11 \times 4-7 \mu\text{m}$; ascomata pyriform, setose; catenate conidia often present *Ch. (Bommerella) trigonosporum* (Marchal) Chivers.

11. Ascospores $8-14 \times 5-7 \mu\text{m}$, navicular, reniform, ovate, clavate or fusiform, often dextrinoid when young; ascomata small, with a wall of textura angularis, covered with tapering seta or arcuate, occasionally circinate hairs: see II (taxa with biporate ascospores).

b. Ascospores often fusiform, with a subapical or lateral germ pore.

1. Ascomata ostiolate, with a wall of textura intricata, covered with partly dark, seta-like, partly light and much branched hairs *Ch. cuniculorum* Fuckel.

2. Ascomata ostiolate, with a wall of textura intricata, covered with at least partly circinate, undulate or coiled hairs *Ch. fusisporum* G. Smith.

Further species: *Ch. gangligerum* Ames, *Ch. gelasinosporum* Aue & Müller, *Ch. jodhpurensis* Lodha, *Ch. perlucidum* Sergejeva, *Ch. raii* Malhotra & Mukerji.

3. Ascomata urniform, with a wide apical opening, smooth, thin-walled; ascospores $20-27 \times 13-16 \mu\text{m}$ *Achaetomium thielavioideum* v. Arx & al.

4. Ascomata spherical, non-ostiolate, smooth, hairy or setose, with a wall of textura epidermoidea
Thielavia hyrcaniae Nicot.

Further species: *T. appendiculata* Srivastava & al., *T. arenaria* Mouchacca, *T. subthermophila* Mouchacca (von Arx, 1975).

5. Ascomata small, ostiolate, with a wall of *textura angularis*, covered with setae or arcuate or undulate hairs see II (taxa with biporate ascospores).

B. Asci cylindrical; ascospores uniseriate, often ovate, attenuated towards the germ pore

1. Thermophilic; ascospores $7-12 \times 7-9 \mu\text{m}$, dark; ascomata spherical or ovate, usually ostiolate, covered with light, branched hairs *Ch. thermophile* LaTouche.

2. Ascospores $10-14 \times 7-9 \mu\text{m}$, biumbonate, brown; asci mostly 4-spored; ascomata ostiolate, $300-450 \mu\text{m}$, covered with branched hairs *Ch. tetrasporum* Hughes.

3. Ascospores $7-13(-17) \times 5-9(-12) \mu\text{m}$, ovate; ascomata ostiolate, covered with spirally coiled, contorted or undulate, often thick and/or branched hairs; asci 8-spored . . . *Ch. crispatum* Fuckel.
Further species: *Ch. brasiliense* Batista & Pontual; *Ch. medusarum* Meyer & Lanneau, *Ch. senegalense* Ames, *Ch. amygdalisporum* Udagawa & Muroi (with larger ascospores: $13-17 \times 9-12 \mu\text{m}$).

4. Ascospores spherical or nearly so, $14-20 \times 12-15 \mu\text{m}$, black, with a protuberant germ pore; asci 4-spored; ascomata non-ostiolate, with a translucent wall of angular cells
Thielavia (*Boothiella*) *tetraspora* (Lodhi & Mirza) v. Arx.

5. Ascospores spherical or nearly so, $10-15 \times 10-13 \mu\text{m}$, black; asci 8-spored; ascomata ostiolate, with a dark wall of *textura intricata*, covered with light hyphae
Achaetomium globosum Rai & Tewari.

Further species: *A. marinum* Chowdhery & Rai.

6. Ascospores fusiform or ellipsoidal, $8-25 \times 5-18 \mu\text{m}$, black or dark brown; asci 8-spored; ascomata ostiolate, with a dark wall of *textura intricata* covered with light, often yellow hyphae
Achaetomium strumarium Rai & al.

Further species: *A. brevisemum* Chowdhery & Rai, *A. cristalliferum* Faurel & Locquin-Linard, *A. luteum* Rai & Tewari and several other species (Chowdhery, 1981).

7. Ascomata spherical, non-ostiolate; ascospores $24-30 \times 11-15 \mu\text{m}$, fusiform
Thielavia tortuosa Udagawa & Sugiyama.

II. Ascospores with two (occasionally one) germ pores asci clavate or obovate (not cylindrical)

1. Ascospores ovate, oblate, ellipsoidal or irregular, thick-walled, $10-19 \times 8-13 \mu\text{m}$; ascomata spherical or ovate, ostiolate, with a dark wall covered with septate hyphae . . . *Ch. megalocarpon* Bainier.

Further species: *Ch. nozdrenkoae* Sergejeva (heterothallic), *Ch. variosporum* Udagawa & Horie, *Achaetomium purpurascens* Udagawa & Sugiyama.

2. Ascospores fusiform, navicular or reniform, $8-16 \times 4-8 \mu\text{m}$, often dextrinoid when young; ascomata ostiolate, mostly small, covered with setae or with arcuate or circinate hairs; anamorphs absent; colonies often coloured by red, yellow or green exudates *Ch. aureum* Chivers.

Further species: *Ch. gracile* Udagawa, *Ch. flavigenum* van Warmelo, *Ch. fusiforme* Chivers, *Ch. mareoticum* Beseda & Yusef, *Ch. turgidopilosum* Ames, *Ch. virescens* (v. Arx) Udagawa.

The following species are similar, but have ascospores with a single, apical or subapical germ pore: *Ch. venezuelense* Ames, *Ch. atrobrunneum* Ames, *Ch. carinthiacum* Sörgel, *Ch. cupreum* Ames, *Ch. lentum* van Warmelo, *Ch. lucknowense* Rai & Tewari.

3. Ascospores ellipsoidal, $7-10 \times 5-8 \mu\text{m}$, dextrinoid when young, yellowish when ripe; ascomata ostiolate or non-ostiolate, with an apical tuft of long, thick-walled hairs; asci obovate; anamorphs absent *Lophotrichus ampullus* R. K. Benjamin.

Further, probably identical species: *L. bartelettii* (Masse & Salmon) Malloch & Cain (often non-ostiolate), *L. martinii* R. K. Benjamin.

4. Ascospores ellipsoidal, fusiform or reniform, $8-11 \times 4-7 \mu\text{m}$, dextrinoid when young, reddish brown when mature; ascomata ostiolate, mostly setose; asci obovate; *Graphium* or *Scedosporium* anamorphs forming 1-celled blastoconidia present *Petriella sordida* (Zukal) Barron & Gilman.

5. Ascospores ellipsoidal, $8-11 \times 4-7 \mu\text{m}$, dextrinoid when young, yellowish when mature; ascomata non-ostiolate; *Graphium* or *Scedosporium* anamorphs forming 1-celled blastoconidia present
Pseudallescheria (Petriellidium) boydii (Shear) McGinnis & al.
P. boydii is a human pathogen, some other species are soil borne (McGinnis & al., 1982).

6. Ascospores ellipsoidal, $10-28 \times 7-17 \mu\text{m}$, smooth, dark brown when mature; ascomata with a translucent wall of angular cells and with an elongate ostiolium of fused hairs or hyphae

Melanospora zamiae Corda.

Cannon & Hawksworth distinguished 12 species; all except *M. chionaea* (Fr.) Corda are close to each other.

7. Ascospores $18-30 \times 10-17 \mu\text{m}$, with a reticulate or striate wall and protuberant, thickened germ pores; ascomata ostiolate or non-ostiolate, with a translucent wall of angular cells

Sphaerodes episphaeria (Phill. & Plowr.) Clem.

Cannon & Hawksworth (1982) accepted 6 species, all except *S. fimicola* (Hanson) Cannon & D. Hawksworth have non-ostiolate ascomata and are close to each other. They classified two ostiolate species with finely reticulate ascospores in a separate genus *Perisciospora*.

8. Ascospores ellipsoidal, $10-14 \times 8-12 \mu\text{m}$, dark when mature; ascomata spherical, small, non-ostiolate, with a wall of irregular cells; *Myceliophthora* anamorphs forming 1-celled, hyaline, often ornamented and catenate blastoconidia present *Corynascus sepedonium* (Emmons) v. Arx.

Further species: *C. heterothallicus* (v. Klopotek) v. Arx (thermophilic, with uniporate ascospores), *C. novoguineensis* (Udagawa & Horie) v. Arx, *C. thermophilus* (Fergus & Sinden) v. Klopotek. The genus may be related to Onygenaceae (*Ctenomyces*, *Arthroderma*) with similar anamorphs.

9. Ascospores ellipsoidal, $12-20 \times 7-14 \mu\text{m}$, smooth, with a thickened wall around the germ pores; ascomata non-ostiolate, with a hyphal wall covered with short hyphae; anamorphs absent

Corynascella humicola v. Arx & Hodges.

Further species: *C. inaequalis* (Pidoplichko & al.) v. Arx, *C. inquinata* Udagawa & Ueda.

III. Ascospores without visible germ pores, but with a thinner wall at the attenuated ends

1. Ascospores fusiform, $22-27 \times 8-9 \mu\text{m}$; ascomata ostiolate or non-ostiolate, covered with unbranched hairs; *Botryotrichum* anamorphs with botryose, 1-celled, hyaline aleurioconidia present
Ch. megasporum Sörgel.

2. Ascospores cylindrical, with attenuated ends, $9-11 \times 2.5-3 \mu\text{m}$; ascomata ostiolate, covered with erect, apically branched hairs; anamorphs absent *Ch. fusum* Ames.

CONCLUSIONS

The genera of the Chaetomiaceae were formerly based on characters of the ascomata, that is ostiolate or non-ostiolate, translucent or with a dark wall, smooth or hairy, spher-

ical or elongate-ampulliform. The shape of the asci (clavate, obovate, fusiform or cylindrical), the size and shape of the ascospores, and the presence or absence, number and position of insertion of the germ pores were neglected. The latter characters, however, are more suited to the delimitation of homogeneous taxa. Therefore the above classification is based on characters of ascospores and asci. If this classification were accepted in the nomenclature, several new genera and numerous new combinations would have to be proposed. An alternative choice would be acceptance of a voluminous genus *Chaetomium*, for all member of the \mathfrak{C} Chaetomiaceae. The genus would then also include taxa with non-ostiolate or with smooth or nearly smooth ascomata, often with a colourless, translucent wall.

Chaetomium globosum, the type species of the genus, is characterized by spherical, ostiolate ascomata with a wall composed of brown hyphae (textura intricata), covered with numerous, flexuous, undulate or coiled, verrucose hairs; by fasciculate, clavate, stalked, evanescent asci and by ascospores with a single apical germ pore. A rather large number of species have similar characters. Those that differ have, for example, an ascomata wall of angular, flattened cells (textura angularis), narrow cylindrical asci; biporate ascospores or a combination of these characters.

The genus *Chaetomidium*, introduced for non-ostiolate counterparts of *Chaetomium* has often not been accepted (e.g. by von Arx and Müller, 1954). Some of the species occasionally have been considered to be related with *Ch. globosum* and *Ch. murorum*. They however differ by the non-ostiolate ascomata, the peculiar structure of the ascomatal wall and the configuration of the ascomatal hairs.

Thielavia and *Boothiella* have been proposed for Chaetomiaceae or Sordariaceae with non-ostiolate ascomata and uniporate ascospores. The type species of the latter genus is characterized by ascomata with a translucent wall, cylindrical, 4-spored asci and ovate ascospores with a protuberant germ pore. It may be related to *Achaetomium globosum* with similar asci and ascospores but with ostiolate ascomata and 8-spored asci. *Chaetomium tetrasporum* is the only *Chaetomium* species with 4-spored, cylindrical asci.

Thielavia basicola, type of the genus *Thielavia*, also has ascomata with a translucent wall, but the asci are clavate and 8-spored and the ascospores fusiform, with a distinct, non-protuberant germ pore at one end (von Arx, 1975). Most of the other *Thielavia* species have a pigmented, non-translucent ascomata wall. Some have ascospores with a subapical germ pore and agree in this respect with *Chaetomium cuniculorum* or *Ch. fusisporum* and their relatives, but also with some *Podospora* species (Sordariaceae).

The genus *Farrowia* is also distinguished with difficulty from *Chaetomium*. Its type species is related to *Ch. homopilatum*; *Ch. seminudum* is an intermediate.

The genus *Achaetomium* differs from *Chaetomium* not only by the ascomata with a thick wall of textura intricata covered with light, spreading (not erect), undifferentiated hyphae, but also by cylindrical asci with uniseriate ascospores. It should be restricted to species with a hyphal, thick ascomatal wall and with uniporate, opaque ascospores. (*Achaetomium luteum* has been described as having biporate ascospores, but these in fact are uniporate.) The *Chaetomium* species with cylindrical asci belonging to the

Chaetomium crispatum species group, differ from *Achaetomium* by having thicker, coiled hairs and smaller, non-fusiform or nearly spherical, but ovate or pyriform, paler ascospores with a germ pore at the attenuated end.

The generic name *Bommerella* may be reintroduced for *Chaetomium trigonosporum*. This species differs from other *Chaetomium* species not only by the triangular ascospores, but also by ampulliform, setose ascomata and by the formation of a *Scopulariopsis*-like anamorph with catenate conidia with a truncate base. It is without doubt intermediate between *Chaetomium* and *Microascus*. The dextrinoid, triangular, uniporate ascospores and the similar anamorphs are common characters.

Malloch (1970) characterized the Microascaceae mainly by the ascospores, which are relatively small, dextrinoid when young, yellowish or reddish brown when mature and have one or two germ pores. In many *Chaetomium* species, however, young ascospores are also dextrinoid (e.g. in *Ch. cupreum*, *Ch. caprinum*, *Ch. fusiforme* or *Ch. bostrychodes*). This character and the pigmentation of mature ascospores do not suffice to distinguish the families. In our opinion the Microascaceae should be restricted to the genera *Microascus* and *Kernia* with small, roundish or ovate, often catenate asci and small ascospores with a single germ pore. Most of the species include a *Scopulariopsis* anamorph. The remaining genera of the Microascaceae sensu Malloch are therefore included above in the Chaetomiaceae with biporate ascospores.

The taxonomic position of *Chaetomium* species with biporate, mostly fusiform and often dextrinoid ascospores such as *Ch. aureum* or *Ch. fusiforme* is not clear. The respective species group is also characterized by small ascomata with a wall of angular cells, covered with unbranched, arcuate hairs. Von Arx (1970) introduced a separate genus, *Achaetomiella* for a similar fungus with biporate ascospores and ampulliform, nearly smooth or slightly setose ascomata. Its type *A. virescens* is now seen to be related to *Ch. gracile* which has similar ascospores, though spherical ascomata covered with arcuate hairs. If the genus *Achaetomiella* were to be maintained, it would have to include species with biporate and others with uniporate ascospores, classified in the *Chaetomium aureum* species group above.

There is little doubt that *Ch. aureum*, *Ch. virescens* and similar species with biporate ascospores are related to species with similar ascospores, classified in *Melanospora*, *Petriella*, *Lophotrichus*, *Neurospora* and other genera.

The ascospores of *Ch. megalocarpum*, *Ch. nozdrenkoeae* and *Ch. variosporum* are also biporate. The three species are closely related, showing common characters such as ovate or irregularly spherical, thick-walled, brown, ascospores and rather large ascomata with a wall of hyphal cells and covered with undifferentiated, pigmented, often branched hyphae or hairs.

One of the few *Chaetomium* species with ascospores in which no germ pores could be observed is *Ch. megasporum*. It has small ascomata covered with hypha-like hairs and relatively large, fusiform ascospores. It also includes a *Botryotrichum* or *Staphylotrichum* like anamorph with botryose, 1-celled, spherical, hyaline conidia. Similar but not botryose but pigmented conidia are known in *Ch. homopilatum* and some related spe-

cies, keyed out by Hawksworth (1975), though these have smaller, limoniform, uniporate ascospores. *Botryotrichum* is rather similar to *Harzia*, *Olpitrichum* and *Myceliophthora*, which include anamorphs of some Onygenaceae and of *Corynascus* and *Melanospora*. Both these genera are characterized by biporate, broadly fusiform or ellipsoidal ascospores, similar in size and shape to those of *Ch. megasporum*. *Chaetomium fusum* also has ascospores without germ pores but is not closely related to *Ch. megasporum*.

In most of the larger species groups defined above, the delimitation of the species is either difficult or impossible and subjective. The *Chaetomium globosum* group, for example, now contains about 20 species and several varieties. Dreyfuss (1976) studied numerous, partly fresh isolates and tried to delimit some of the species and varieties, but the result is not satisfactory. Nearly every strain can be distinguished from any other in some respects, e.g. in the daily growth rate and pigmentation of the colonies or in the shape and size of the ascomatal hairs. The asci and ascospores are alike in shape, but often not in size. It would be much more convenient to reduce the whole group to a few species. *Ch. cochliodes* has been distinguished from *Ch. globosum* by a yellow green exudate and by the often spirally coiled ascomatal hairs. But some strains with this exudate have undulate or coiled hairs. *Ch. globosum* has been restricted to homothallic strains. The heterothallic *Ch. subaffine* can be distinguished also by the formation of phialoconidia (spermatia), by slightly larger ascospores and by thicker, flexuous, tapering ascomatal hairs (Sedlar & al., 1972, 1973; Müller & Sedlar, 1977). It often has been confused with *Ch. olivaceum* Cooke & Ellis.

Another difficulty is the fact that no types are available of most of the older and of many of the recently described species. The descriptions are often incomplete or misleading. Dried specimens often proved to be inadequate for study, because some of the structures has disintegrated and has shrunk. We urge that in future only cultures of Chaetomiaceae are described. Dried specimens should not be killed, because the ascospores remain viable for at least 25 years.

In the first and still the best monograph of *Chaetomium*, Zopf (1881) treated the most common species *Ch. globosum* (as *Ch. kunzeanum* Zopf), *Ch. elatum*, *Ch. muro-rum*, *Ch. spirale*, *Ch. indicum*, *Ch. bostrychodes* and *Ch. cirspatum*. The descriptions and figures are adequate and can serve as type. The size and shape of the asci and ascospores are correctly given and the presence of germ pores is mentioned. These characters have been fully neglected by all later monographers. No type specimens are available of the species described by Bainier (1910) and the descriptions and figures partly are unclear. Some data given by Chivers (1915) are incorrect and the beautiful but unsatisfactory figures have often been copied by subsequent authors, e.g. by Ames (1963) without citation. The cover figure in Ames is reminiscent to a figure published by von Arx & Müller (1954). Most of the common *Chaetomium* species are easily recognized by means of the micrographs published by Matsushima (1971, 1975).

The Sordariaceae are closely related to the Chaetomiaceae but are distinguished having asci with apical rings or thickenings and ascospores with gelatinous sheaths or cellular or gelatinous appendages. The ascospores in *Neurospora*, *Gelasinospora* and related genera are not sheathed but ornamented. The cleistothecial genera *Thielavia* and

Boothiella, here classified in the Chaetomiaceae, can also be included in the Sordariaceae. Their position is questionable but their representatives have evanescent asci without apical rings and unsheathed ascospores. Some cleistothecial Sordariaceae classified in *Zopfella* Winter (hardly distinguishable from *Podospora* Ces.) or *Echinopodospora* Robinson (hardly distinguishable from *Apiosordaria* v. Arx & Gams) also have evanescent asci and unsheathed, but inaequally 2-celled ascospores. Numerous Sordariaceae have ascospores with a subapical germ pore, as do several Chaetomiaceae.

The species of *Chaetomium*, *Achaetomium* and *Melanospora* in which the ascospores are extruded in a mucoid mass are highly adapted to spore dispersal by animals (insects, mites). In this respect they are similar to *Ophiostoma*, *Ceratocystis*, *Sphaeronemella* and *Microascus*. Sordariaceae with ostiolate ascomata and ascospore ejaculation may be the ancestors of *Chaetomium*. Species with ascospores with a subapical germ pore and with an ascomatal wall of *textura intricata* may be descendants of Sordariaceae with corresponding characters classified in *Podospora*. Some *Podospora* species have ascospores similar in shape, symmetry and pigmentation, and the ascospores appendages may be small and dissolving.

Neurospora-like Ascomycetes may be the ancestors of *Chaetomium* species with biporate ascospores and with a wall of *textura angularis*, e.g. *Ch. aureum* or *Ch. gracile*. *Chaetomium crispatum* with its ascospores with an apical germ pore and with cylindrical asci may have been derived from *Sordaria* species. The non-ostiolate Sordariaceae/Chaetomiaceae, e.g. species of *Thielavia* or *Chaetomidium*, may also have been derived from ostiolate relatives or vice versa.

The genus *Chaetomium* in its present delimitation without doubt is a biological, but not a phylogenetical entity of sordariaceous Ascomycetes.

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NOTES AND BRIEF ARTICLES

A NEW APIOSORDARIA FROM SOIL

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In the course of a study of fungi isolated from soil in Spain, an ascomycete belonging to the genus *Apiosordaria* was isolated. It differs from previously described species by much larger and pitted ascospores.

Apiosordaria tenuilacunata Guarro, Martínez & v. Arx, sp. nov.

Ascomatis superficialibus vel semi-immersis, brunneo-nigris, pyriformibus, 400–700 × 330–450 μm , pilosis; pilis laxis, longis, flexuosis, dilute brunneis, septatis, 300–800 × 2–2.5 μm ; collo conico, nigro, 100–150 × 80–100 μm , glabro; peridio membranaceo, prosenchymatico, laminibus carbonaceis; ascis cylindraceis vel clavatis, 8-spores, 90–160 × 22–28 μm ; paraphysibus hyalinis, filiformibus, septatis; ascosporis biseriatis, primo unicellularibus, hyalinis, ellipsoideis vel obovatis, deinde transverse uniseptatis, cellula superiore late ellipsoideae, basi truncata, 27–34 × 18–23 μm , olivaceo-brunnea, episporio foveolato, foramine germinale circa 2 μm diam., ad apicem sito, cellula inferiore hyaline vel dilute flavis, conica, 11–17 × 10–12 μm , postremo collapsa, apiculli hyalino, 1–2 μm , apicem sito.

Typus vivus et exsiccatus: In culturis ex solo, Sierra Prades, Catalonia, 18 Dec. 1979, FFBA 157 (holotypus).

Ascomata superficial or immersed with the base, pyriform, ostiolate, brownish black, 400–700 × 330–450 μm , loosely covered with long, flexuous, pale brown, septate hairs which measure 300–800 × 2–2.5 μm ; neck conical, black, 100–150 × 80–100 μm , glabrous. Peridium membranaceous, prosenchymatous, brown, with carbonaceous incrustations. Asci 8-spored, cylindrical-clavate, rounded above, with a distinct ring-like thickening at the apex, tapering below into a short stalk, 90–160 × 22–28 μm . Ascospores biseriata, at first 1-celled, obovate and hyaline, then becoming 2-celled due to a transverse septum in the lower third; upper ascospore cell broadly ellipsoidal, with a truncate base, 27–34 × 18–23 μm , olivaceous brown, with walls ornamented with shallow pits measuring 2.5–3 μm ; germ pore single, apical in the upper cell, about 2 μm ; lower cell hyaline or pale brown, conical, 11–17 × 10–12 μm , smooth, often collapsed at maturity; apiculus hyaline, 1–2 μm long.

Cultures on oatmeal-salts agar spreading broadly, thin, vegetative mycelium submerged, with surface consisting of a thin growth of rather prostrate hyphae, ascomata numerous, ripening slowly, reverse gray.

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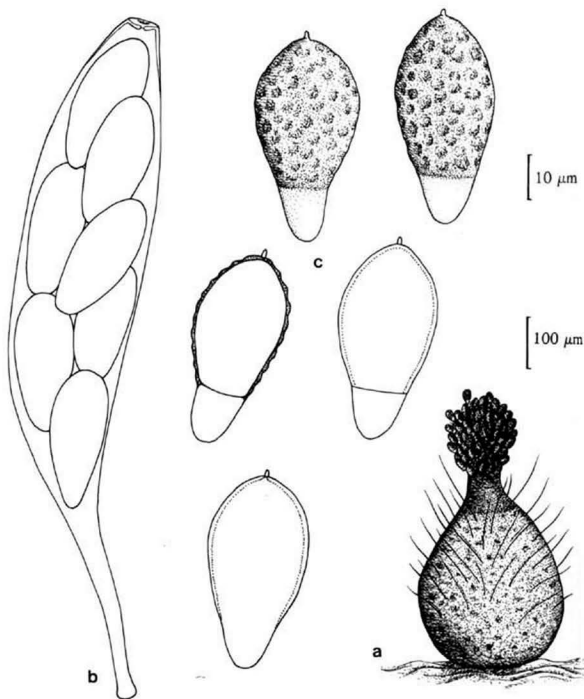


Fig. 1. *Apiosordaria tenuilacunata*. — a. Ascoma. — b. Ascus. — c. Ascospores.

Material studied (living and dried): FFBA 157, in culture from soil, Sierra of Prades, Catalonia, 13 Dec. 1979 (holotype); FFBA 37, in culture from forest soil, Montblanc, Catalonia, 3 May, 1978. Subcultures derived from the type have been deposited in the culture collections of CMI and CBS.

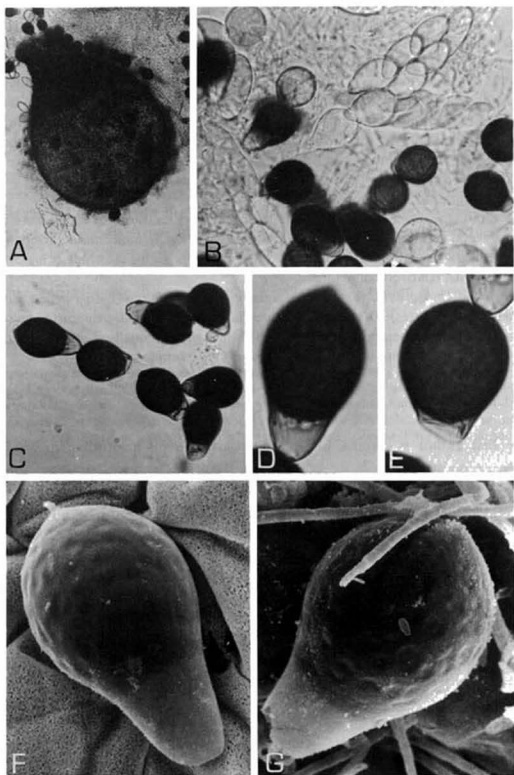


Fig. 2. *Apiosordaria tenuilacunata*. — A. ascoma $\times 80$. — B. Asci and ascospores $\times 320$. — C. Ascospores $\times 320$. — D, E. Ascospores $\times 800$. — F, G. Ascospores $\times 1440$.

The genus *Apiosordaria* was described by von Arx and Gams (1967) for *Pleurae verruculosa* Jensen, a soil borne ascomycete (Sordariaceae) with ostiolate, ampulliform ascomata, cylindrical, 4-spored asci and inequally 2-celled, pigmented and ornamented ascospores. Several new species were added to the genus by Morinaga & al. (1979) and Udagawa (1980). Von Arx (1981) synonymized the genera *Lacunospora* Cailleux and *Jugulospora* Lundqvist with *Apiosordaria*, both being described for similar Sordariaceae with 8-spored asci and with verrucose or pitted ascospores. He maintained *Echinopodospora* Robison described for Sordariaceae with spherical, non-ostiolate ascomata and inequally 2-celled, echinulate ascospores. No intermediate forms with synchronously ostiolate and non-ostiolate ascomata are known. Recently Krug & al. (1983) included *Echinopodospora* in *Apiosordaria*.

The genus *Apiosordaria* now contains 16 species and 1 variety, of which 7 are characterized by non-ostiolate ascomata. The above-described *A. tenuilacunata* differs from all other species with ostiolate ascomata by its very large ascospores measuring $38-48 \times 18-23 \mu\text{m}$ with relatively large pits.

The genus *Apiosordaria* is related to *Gelasinospora* Dowding (with 1-celled, variously ornamented ascospores), *Diplogelasinospora* Cain (with 2-celled, pale, pitted ascospores and non-ostiolate ascomata), *Triangularia* Boedijn (with inequally 2-celled, in face view triangular ascospores) and to the *Podospora-Zopfiella* complex.

ACKNOWLEDGEMENTS

The first author is grateful to Dr. N. Lundqvist for his helpful comments on this fungus.

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CANARIOMYCES NOTABILIS, A PECULIAR ASCOMYCETE FROM
THE CANARY ISLANDS

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The Canary Islands are famous not only for the climate, but also for the flora. Many endemic plants are found, mainly succulents or woody shrubs belonging to the Euphorbiaceae, Fabaceae, Crassulaceae, Boraginaceae and Asteraceae. Monocotyledons are inconspicuous, except for *Phoenix canariensis* and the famous *Dracaena draco*.

Over the last few years I collected on Gran Canaria parasitic and saprophytic fungi on plants and plant debris. These included Ascomycetes belonging to genera such as *Chaetomium*, *Chaetomidium*, *Achaetomium*, *Emericella*, *Ceratocystis* and *Thielavia*. A peculiar ascomycete, found on litter of *Phoenix canariensis* could not be identified. It was isolated by using viable ascospores and the following description is based on agar cultures.

Canariomyces notabilis v. Arx, gen. & spec. nov.—Fig. 1

Ascomata superficialia, sphaerica, glabra, non ostiolata, nigrescentia, 120–180 μm ; pariete e cellulis angularibus applanatis, fuscotunicatis composito; asci numerosi, sphaerici, 8-sporei, tenui-tunicati, evanescentes, 20–26 μm ; ascosporae ellipsoideae vel late fusiformes, primum hyalinae et dextrinoidae, maturitate brunneae, striatae, 11–14 \times 7–8.5 μm , poro germinationis apicali vel subapicali praeditae; conidia breviter cylindracea vel ellipsoidea, hyalina, singulares vel catenata, successione basipetali fragmentatione formata, 10–16 \times 5–7 μm .

Typus vivus et exsiccatus: CBS 548.83, isolatus e radicibus *Phoenix canariensis*, Gran Canaria, Maspalomas, 1982.

Colonies on corn meal agar at 28°C with a daily growth rate of 2.5–3.5 mm, with a floccose or fasciculate, grey aerial mycelium and with an orange or ochraceous exudate; hyphae at first hyaline, partly becoming brown especially in advancing regions, often closely septate, 2–5 μm broad; ascomata maturing within 20 days, superficial, formed from coils of aerial hyphae, spherical, non ostiolate, smooth, with some rhizoidal hyphae at base, dark brown or black, 120–180 μm ; ascomatal wall thin, dark brown, composed of angular or irregular, flattened, 4–8 μm wide cells; asci irregularly arranged, formed on branched ascogenous hyphae, botryose, occasionally catenate, sessile, spherical or broadly obovate, thin-walled, 8-spored, evanescent, 20–26 μm ; ascospores ellipsoidal or broadly fusiform, with attenuated ends, hyaline and dextrinoid when young, containing numerous droplets, brown and often with 2 or 3 darker, longitudinal striae (bands) when mature, 11–14 \times 7–8.5 μm , with an apical or subapical, not protuberant, 1 μm wide germ pore; conidia formed from erect, hyaline conidiogenous hyphae, often in basipetal chains, occasionally solitary, cylindrical, ellipsoidal or clavate, at base or at both ends truncate, hyaline, 1-celled or 1-septate, 9–16 \times 5–7 μm (form genus *Chrysonilia*); hyphae often with lateral, spherical, clavate or lobate, hyaline or pale brown, 3–5 μm long, appressorium-like cells (form genus *Trichosporiella*).

Some characters of *C. notabilis* indicate a relationship with the Sordariaceae or Chaetomiaceae, others agree with those of the Microascaceae. Mature ascospores are similar

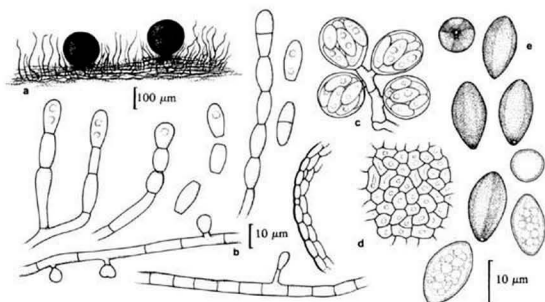


Fig. 1. *Canariomyces notabilis*. — a. Ascomata and aerial mycelium. — b. Conidiogenous hyphae and conidia. — c. Asci. — d. Ascomatal wall. — e. Ascospores.

to those of *Chaetomium murorum* or of some *Chaetomidium* species in size, shape, symmetry, structure and pigmentation. However, they differ in that they are dextrinoid when young and formed in sessile, spherical asci. The asci of *Chaetomium murorum* are clavate or obovate, stalked and often fasciculate. The structure of the ascomatal wall of *C. notabilis* is similar to that of some Microascaceae, classified in *Microascus* and *Kernia*. *Kernia macrospora* Locquin-Linard (1977) also has ascospores with the same size and shape as *C. notabilis*, but they are pale and bipolar and no anamorph is present. The anamorph of *C. notabilis* and the orange exudate are reminiscent of the *Chrysonilia* anamorph of *Neurospora sitophila* and other of *Neurospora* species (von Arx, 1981). It also shows similarities with the form genera *Arthrographis* Cochet ex Sigler & Carmichael and *Mauginiella* Cavara (Sigler & Carmichael, 1976).

The anamorph of *Petriellidium desertorum* v. Arx & Moustafa (= *Pseudallescheria desertorum* (v. Arx & Moustafa) McGinnis & al.) depicted by Locquin-Linard (1977) is also rather similar. In this species the catenate, apparently basipetal conidia are smaller ($4-8 \times 3-4 \mu\text{m}$), the ascomata have a wall of hyphal cells (textura intricata), the asci are broadly clavate or obovate and the ascospores are copper-coloured and bipolar at maturity.

Anamorphs, similar to that of *Canariomyces notabilis* are also known in *Pithoascus langeronii* v. Arx (1978) and *Faurelina indica* v. Arx & al. (1981). In the latter species the catenate conidia are often 2-celled and measure $15-30 \times 4-6 \mu\text{m}$. The ascomata are cleistothecial and the asci catenate. The ascospores are furrowed and striate and have no visible germ pore. The genera *Pithoascus* and *Faurelina* have been classified by Benny & Kimbrough (1980) in a new family Pithoascaceae, which was distinguished from the

Microascaceae only by the absence of germ pores in the ascospores. The anamorph of *Pithoascus langeronii* is known as *Arthrographis langeronii* Cochet (nom. inval.) = *Arthrographis kalrai* (Tewari & Mc Phearson) Sigler & Carmichael = *Arthrographis sulphurea* (Grev.) Stalpers & van Oorschot.

Canariomyces notabilis may represent an ancestral fungus from which at least some Sordariaceae (Neurosporidae), Chaetomiaceae, Microascaceae and Pithoascaceae may be derived. Its classification in a known family of the Sphaeriales is not possible.

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NOTULAE AD FLORAM AGARICINAM NEERLANDICAM — VI-VII
RICKENELLA AND OMPHALINA

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VI. *Rickenella* Raithelhuber

Rickenella swartzii (Fr.) Kuyp., comb. nov. — *Agaricus swartzii* Fr., Obs. mycol. 1: 90. 1815 (basonym).

This species has been known thus far as *Rickenella setipes* (Fr.: Fr.) Raithelhuber. However, the original diagnosis of *Agaricus setipes* (Fries, 1818: 162) clearly refers to another species, as *A. setipes* was characterized as follows: pileus 5–8 mm broad, campanulato-convex; stipe very long, 85–100 mm, setaceous; lamellae greyish; strongly resembling *Agaricus corticola* Pers.: Fr. As far as I can ascertain this protologue refers to a species of *Mycena*. The misapplication of the name *Agaricus setipes* might have arisen when Fries (1873: pl. 75 f. 4) published an illustration of an unnamed variety of *A. setipes*, which undoubtedly represents *Rickenella swartzii*. This unnamed variety was later (Fries, 1874: 164) called *A. setipes* var. *acrocyaneus*.

The use of the epithet *swartzii* is in accordance with Kühner (1938: 608), Smith (1947: 123) and Dennis & al. (1960: 122).

VII. *Omphalina* Quéf.

Furthermore a new combination in *Omphalina* seems desirable:

Omphalina viridis (Hornem.) Kuyp., comb. & stat. nov. — *Agaricus umbelliferus* var. *viridis* Hornem., Fl. dan. 10 (28): 10. 1819 (basonym).

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GALZINIA GEMINISPORA OLIVE NEW TO EUROPE

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During a study of some *Tulasnella* species from the Bourdot herbarium (PC), I examined a specimen collected by Galzin in 1909 and identified by Bourdot as *Tulasnella vernicosa*. Since many species of *Tulasnella* in dry state are invisible to the naked eye, I had to make sections of several parts of the wood surface, but could not detect the typical *Tulasnella* basidia with strongly inflated sterigmata. Instead of a *Tulasnella*, I found some clampless hyphae, strongly urniform basidia with short, subulate sterigmata, and basidiospores of a very unusual shape: they were distinctly forked or two-lobed, with two diverging parts.

A study of the literature showed this to be a North American species of *Galzinia*, viz. *G. geminispora* Olive. This species seems to be very rare in North America (or at least seldom found and reported) and is new to Europe. Because of the unusual shape of the spores, it seems worthwhile to draw attention to this remarkable taxon which, unfortunately, can only be found by chance.

Galzinia geminispora Olive

Galzinia geminispora Olive in Mycologia 46: 794. 1954.

Basidiocarp annual, resupinate, effused, very thin (ca. 20–40 μm), ceraceous, with indeterminate margin. Hyphal system monomitic. Hyphae hyaline, cylindrical, loosely arranged, 1.5–2.5 μm wide, thin- to slightly thick-walled (0.2–0.4 μm), with smooth surface, clamps absent from all septa, with homogeneous contents and conspicuous dolipores at the septa. Cystidia lacking. Hyphidia absent or rare, hyaline, cylindrical, simple or slightly branched, 1.5–2.5 μm wide, thin-walled, smooth. Probasidia globose to broadly ellipsoid, persistent. Basidia hyaline, elongated urniform, usually strongly constricted at the middle, 15–30 \times 4–6 μm , rarely with a transverse septum, thin-walled, smooth, a basal clamp always absent, contents homogeneous, with four subulate sterigmata. Spores hyaline, forked, with two diverging ellipsoid parts, thin-walled, smooth, each part 8–10 \times 2.3–3 μm , with distinct apiculus, inamyloid, contents homogeneous.

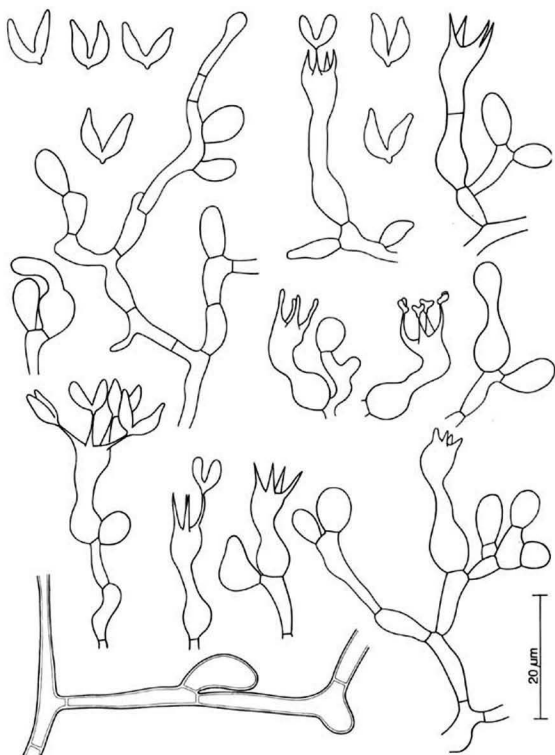
Reactions.—No part of the basidiocarp is amyloid, dextrinoid, or cyanophilous.

Substrate.—Saprophytic on wood of deciduous trees (*Populus*).

Material studied.—FRANCE, Aveyron, St. Sernine, 12.VIII.1909, *Galzin* 4382 (herb. Bourdot 6648, PC).

Distribution.—France, North Carolina (type).

The specimen from France agrees very well with the original description by Olive (1954), except for the length of the basidia which are 15–30 μm long in the French specimen, but 19–68 μm long in the type specimen (according to Olive's description).



Figs. 1. *Galzinia geminispora* (Galzin 4382). Hyphae of subiculum and subhymenium, basidia, and spores.

It should be noted, however, that the illustrations in Olive's publication show mainly basidia which are within the same range as those of the European specimen: nine mature basidia are up to ca. 30 μm long and only one is drawn with a length of 42 μm .

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ON THE CORRECT NAME OF 'AMANITA INAURATA SECR.'

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For nomenclatural reasons the well-known species of *Amanita* usually called '*Amanita inaurata* Secr.', unfortunately is in need of another name.

In the International Code of Botanical Nomenclature (ICBN) since the Leningrad edition (Stafleu & al., 1978) Secretan's 'Mycographie suisse' (1833) is mentioned as an example of a work in which the Linnean system of binary nomenclature is not consistently employed. Consequently none of the specific names in this book are validly published, not even those with a single specific epithet like '*Amanita inaurata*' (ICBN, Art. 23.6(c)).

Earlier, Donk (1962: 171) drew attention to the fact that Secretan's names with *Amanita* are invalid for still another reason; Secretan considered *Amanita* a 'class' of the genus *Agaricus* and not a genus in its own right.

The first valid use of Secretan's name '*Amanita inaurata*' is that by Gillet (1874: 41).

Meanwhile Berkeley & Broome (1854: 396) coined the name *Agaricus ceciliae* for the same species, as I have been able to confirm from consultation of the type-collection preserved at Kew. As far as I know the valid recombination of this name in *Amanita* has not yet taken place.

One of the reasons that the two names mentioned above were scarcely used in the former century, is that Fries (1852: 128) started rather early to use the name *Agaricus strangulatus* for Secretan's species. However, this name was published for the first time in the 'Epicrisis' (1838: 6) and Fries undoubtedly described then another species (stipe with ring; pileus albolividus; habit like Battara's (1755:) pl. 6, fig. A; growing on an ant-hill), which means that Fries in his later publications misapplied this name.

The correct name and synonymy of Secretan's species therefore are as follows:

***Amanita ceciliae* (B. & Br.) Bas, comb. nov.**

Agaricus ceciliae B. & Br. in *Annl. Magaz. nat. Hist.* II 13: 396 (Notic. Brit. Fungi no. 663). 1854 (basionym); ditto, *Berk., Outl. Brit. Fungol.*: 92, pl. 3, fig. 5. 1860. — *Amanitopsis ceciliae* (B. & Br.) Peck in *Ann. Rep. N.Y. St. Mus.* 51: 301. 1899 (not val. publ., not defin. accept.). — *Amanita ceciliae* (B. & Br.) Boud. in *Bull. Soc. mycol. Fr.* 18: 270. 1902 (not val. publ., incident. mention.). [Agaricus] '*Amanita inaurata* Secr., *Mycogr. suisse* 1: 36. 1833 (not val. publ.; ICBN, Art. 23.6). — *Amanita inaurata* Secr. ex Gillet, *Hyménomyc.*: 41. — *Amanitopsis inaurata* (Secr. ex Gillet) Fay. in *Annl. Sc. nat.* VII (Bot.) 9: 317. 1889. — *Amanitopsis vaginata* var. *inaurata* (Secr. ex Gillet) Sacc., *Fl. ital. Cryptog.* 1 (14): 62. 1915. — *Amanita vaginata* f. *inaurata* (Secr. ex Gillet) Veselý in *Annl. mycol.* 31 (4): 280. 1933.

[*Amanita*] '*Amanitopsis inaurata* f. *royeri* L. Maire apud E. J. Gilb., *Genre Amanita*: 155. 1918. — *Amanita vaginata* f. *royeri* (L. Maire apud E. J. Gilb.) Veselý in *Annl. mycol.* 31: 280. 1933.

Misapplied. — *Agaricus strangulatus* sensu Fr. in *Öfv. K. Vet.-Akad. Förh.* 9: 128. 1852; ditto, *Monogr. Hymenomyc. succ.* 1: 3. 1854; ditto, *lc. sel. Hymenomyc.* 1 (2/3): 11, pl. 11. 1869; etc. (non *Agaricus strangulatus* Fr., *Epicr.*: 6. 1838 (= unknown species)).

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BOOKS RECEIVED BY THE RIJKSHERBARIUM LIBRARY

D. N. Pegler. *Agaric flora of the Lesser Antilles*. (Kew Bull. addit. Ser. IX. Her Majesty's Stationary Office, London. 1983.) Pp. 668, 129 Text-figs., 27 Col. Pls. Price: £ 55.-.

This agaric flora is based on studies over a ten year period with extensive collecting, mainly from Martinique and Guadeloupe, and type-studies of species from the neighbouring Caribbean as well as from other tropical American regions.

The inclusion of the results of studies concerning authentic collections by Montagne, Patouillard, Murrill, Berkeley & Curtis, Singer and Dennis gives this work a much wider scope than is suggested by the title.

With the exception of the families Entolomataceae and Polyporaceae, Singer's system of classification is essentially employed. In this flora 18 families are considered, containing 106 genera and 457 species. Each species is fully described and illustrated with line-drawings. Fine colour-photographs of many species give additional information. One new genus and 70 new species are proposed. Keys are provided for the identification of all taxa included.

R. Schubert, H. H. Handke & H. Pankow. *Exkursionsflora für die Gebiete der DDR und der BRD. Band I, Niedere Pflanzen — Grundband*. (Volk und Wissen Volkseigener Verlag, Berlin, 1983.) Pp. 811, 790 Text-figs. Price: 26.- DM (GDR).

This is the first volume of a field-guide for Prof. W. Rothmaler's flora of both German Republics. It is intended as an introduction to the study of non-vascular cryptogams, especially for teachers and students in biology, agriculture, and forestry, as well as for amateurs.

The author of the Cynaophyta and the Phycophyta (187 pp.) is Prof. Dr. H. Pankow, of the Mycophyta (327 pp.) Prof. Dr. H. H. Handke, of the Lichenophyta (103 pp.) and the Bryophyta (164 pp.) Prof. Dr. R. Schubert.

The treatment of each main group consists of a general introduction with instructions on methods of observation, collecting, and cultivation, a list of German handbooks, a glossary of scientific and technical terms, and keys to all taxa treated. Because of restricted space and for ease of survey, many problematic genera and species are not included. The choice of included and excluded taxa seems somewhat arbitrary, but the issue of supplementary volumes treating these groups is intended.