PERSOONIA

17 / 3
2000

AN INTERNATIONAL
MYCOLOGICAL JOURNAL

PERSOONIA

An International Mycological Journal

Published by the Nationaal Herbarium Nederland, Universiteit Leiden branch, The Netherlands

Persoonia is a journal devoted to mycology, with emphasis on the taxonomy of fungi. Papers on morphology, cytology, ultrastructure, genetics, or chemistry are only accepted when the link to taxonomy is clear.

Publication in Persoonia is not restricted to members of the staff of National Herbarium only, but limited space will also be available for other authors and invited papers. Those interested are requested to contact the Editors.

All manuscripts submitted to Persoonia are externally reviewed before acceptance or refusal.

Correspondence concerning manuscripts for Persoonia should be directed to the Editors.

Persoonia will be published once a year, with about 150 pages per part. Four parts will constitute a volume. Persoonia can be obtained by subscription or by exchange.

Exchange with mycological journals or with periodicals regularly containing mycological papers will be appreciated.

Correspondence concerning orders and subscriptions should be addressed to the Publications Department, Nationaal Herbarium Nederland, Universiteit Leiden branch, P.O. Box 9514, 2300 RA Leiden, The Netherlands.

PERSOONIA
Volume 17, Part 3, 339–375 (2000)

TYPE STUDIES IN COPRINUS SUBSECTION LANATULI

C.B. ULJÉ[1] & M.E. NOORDELOOS[2]

As a prelude to a monograph of the genus *Coprinus*, types were studied of a number of species said to belong to *Coprinus* subsection *Lanatuli* (*Coprinus alnivorus*, *C. alutaceivelatus*, *C. ammophilae*, *C. arachnoideus*, *C. asterophoroides*, *C. brunneistragulatus*, *C. bubalinus*, *C. citrinovelatus*, *C. colosseus*, *C. jonesii*, *C. lagopides*, *C. marcidus*, *C. pachydermus*, *C. palmeranus*, *C. roseistipitatus*, *C. scobicola*, *C. spadiceisporus*, *C. sylvicola*, *C. tectisporus*, *C. undulatus* and *C. xerophilus*). As a result *Coprinus alnivorus* and *C. lagopides* are transferred to subsection *Alachuani*.

Whilst preparing a series of monographic studies and a treatment of the genus *Coprinus* for the Flora agaricina neerlandica type collections were studied of a number of species described in subsect. *Lanatuli*, including those from other continents. The results have been published in the form of a revision of the subsection for the Netherlands (Uljé & Noordeloos, 1999; Uljé et al., 2000).

Since type material is often scanty and / or in bad condition, not all the desired characters were available. Type material of old names has usually not been preserved or is now lost. This is the case in *C. cinereus* J. Schaeff., *C. pseudoradiatus* Kühner & Joss. ex. Watling, *C. lagopus* Fr.: Fr., *C. funariarum* Métrod, *C. lagopus* var. *sphaerosporus* Kühner & Joss. and *C. erythrocephalus* (Lév.) Fr. Unfortunately a number of type collections were not received, even in the case of some recently described species. Some taxa have been excluded from this paper because they have been described and illustrated in full elsewhere. These are *Coprinus bicornis* Uljé & Horvers, *C. calosporus* Bas & Uljé, *C. spelaiophilus* Bas & Uljé, *C. ochraceolanatus* Bas, *C. geesterani* Uljé and *C. kriegIsteineri* Bender (Bender, 1987; Uljé, 1992; Uljé & Bas, 1993). For species treated in the present paper, original descriptions have been included for a better understanding of the taxa concerned.

PRESENTATION AND ABBREVIATIONS

The figures of basidiocarps are all based on dried material and show the specimens (enlargement × 1) that were found in the collections studied. The enlargement of the spores is × 2000, while all other microscopical features are shown at × 800. For further explanation and abbreviations see Uljé & Noordeloos (1996).

TYPE STUDIES

1. **Coprinus alnivorus** Van De Bogart, Mycotaxon 4 (1976) 241 — Fig. 1B

Holotype: USA, Washington state, Lewis, Cispus Center, Gufford Pinchot Nat. Forest, 25 Oct. 1975, *F. Van De Bogart 3370* (WTU).

---

[1] Van Dijkstraat 21, 2405 XE Alphen a/d Rijn, The Netherlands.

[2] Nationaal Herbarium Nederland, Universiteit Leiden branch, P.O. Box 9514, 2300 RA Leiden, The Netherlands.

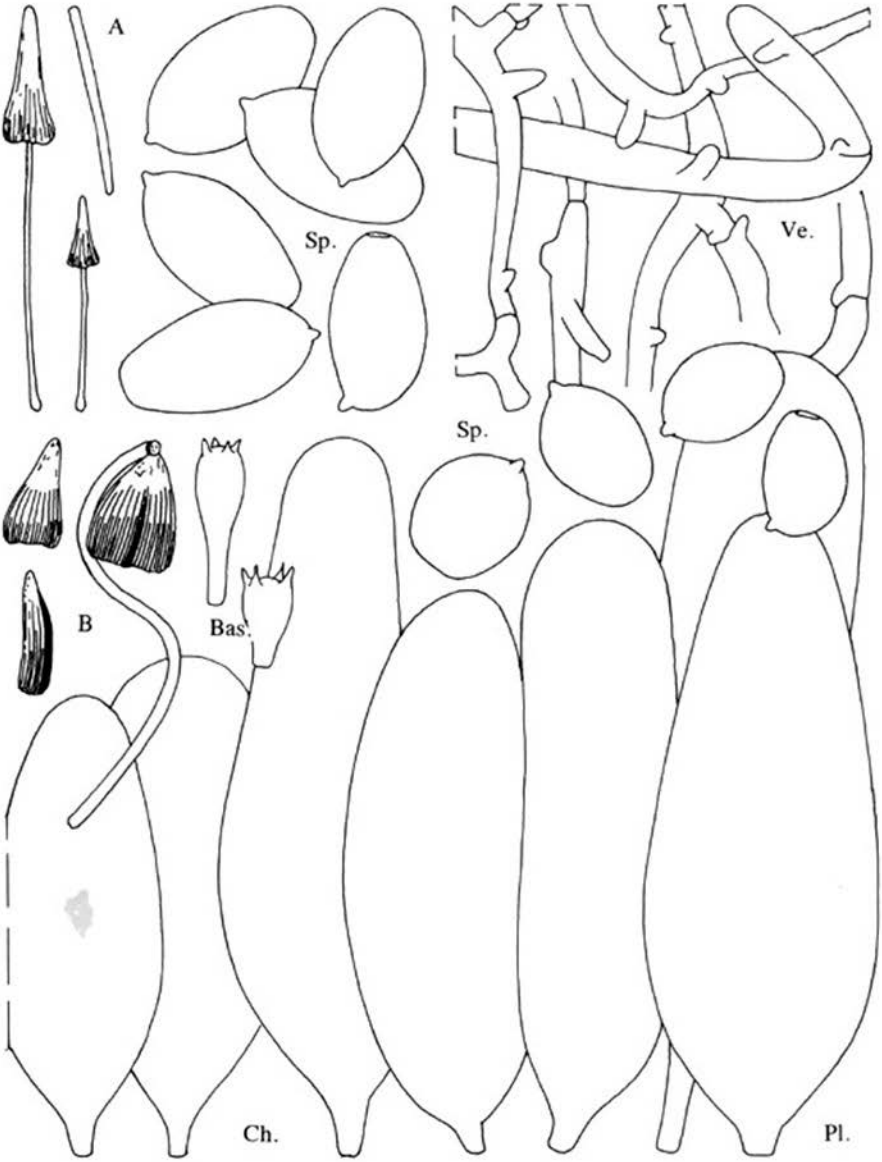


Fig. 1A. *Coprinus sylvicola* (holotype). Dried basidiocarps and spores. — B. *Coprinus alnivorus* (holotype). Dried basidiocarps, spores, pleurocystidia, cheilocystidia, basidia and veil.

Original description. Pileus at first short-glandiform, then campanulate, then margin becoming laciniate and somewhat revolute, when unexpanded 2.0 cm in length, expanding to 2.0 cm in width. At first white except pale brown at the apex, then becoming grey, then black, but only brownish grey at the apex. Surface at first with a thin arachnoid universal veil with some minute squamules, in maturity the arachnoid veil largely vanishing but the minute squamules persisting although scattered, surface eventually slightly plicate-striate. Pileal margin at first connected to the stipe with a prominent, scaly white annulus. Flesh thin and fragile. Stipe slender, tapering only slightly from base towards apex, 9.0 cm × 4.0–6.0 mm, hollow, lumen with some loosely interwoven hyphal webbing, surface smooth, glabrous, white. Flesh slightly fibrous, but very fragile. Loose membranous annulus present, 1.0 mm in width, white, very friable and soon disintegrating into small fragments. Lamellae lanceolate, free, very crowded, at first white, then black. Autolysis complete. Odor faint odor of mushrooms.

Spores subglobose to short ellipsoidal, 7.5–10.7 × 6.2–7.5 µm, apiculus small, often not visible, germ pore apical 1.5 µm in diameter. Color soot black en masse and at first dark purple or brownish purple microscopically, then soon black and opaque in 3% KOH. Wall smooth. Basidia trimorphic, short clavate and 16.5–17.5 × 8.0–10.5 µm, clavate and 18.0–26.0 × 8.0–9.0 µm, long pedicellate-clavate and 27.0–29.0 × 8.0–9.0 µm, all 4-spored. Cheilocystidia clavate to ellipsoidal-fusiform, apices obtuse to subacute, 28.0–135.0 × 11.0–35.0 µm; hyaline, thin walled, smooth. Pleurocystidia ellipsoidal to subfusiform, apices obtuse to slightly branching, 145.0–182.0 × 30.0–45.0 µm, hyaline, thin walled, smooth. No other cystidia present. Pileal surface a cutis of slender, cylindrical, radially oriented, hyaline, thin walled hyphae. Universal veil of small scales and a thin arachnoid web on pileal surface and base of stipe, scales ar web consisting of slender, non swollen, thin walled, hyaline, cylindrical, septate and clamped hyphae, very interwoven, some branching, most cells separating readily at the septations, 2.5–10.0 µm in diameter, some scales with membranous surface. Clamp-connections present on the hyphae of stipe base, in the universal veil, and in the lamellar trama.

Habitat. Lignicolous, on hard scarcely rotted wood of *Alnus* sp. in a hardwood rain forest.

This species is similar in many features to *C. arachnoideus* and likewise appears to be transitional to section *Lanatuli* in its veil characteristics and possession of pleurocystidia. It differs from *C. arachnoideus* in most of its microscopical features.

Observations on the holotype. Spores [20, 1, 1] 8.0–9.6 × 5.4–7.3 µm, ovoid with slightly conical base and rounded to somewhat truncate apex, and almost central, hardly visible, 1.3–1.5 µm wide germ pore, dark red-brown; Q = 1.25–1.50, av. Q = 1.35; av. L = 8.8, av. B = 6.5 µm. Basidia 16–38 × 8–10 µm, 4-spored, surrounded by (5–)6–7(–8) pseudoparaphyses. Pleurocystidia 90–125 × 27–40 µm, subutriform, narrowly ovoid or subcylindric. Cheilocystidia 80–120 × 28–38 µm, narrowly ovoid, (sub)utriform, oblong or subcylindric. Pileipellis hyphoid. Veil made up of hyphoid, cylindrical, thin-walled elements, up to 150 × 3–8 µm, rather sparse branched and diverticulate. Clamp-connections present.

Notes. The holotype collection of *Coprinus alnivorus* consists of fragments of a single basidiocarp in good condition. The large cystidia noted by Van De Bogart were not found in the material examined.

Although Van De Bogart (1976) suggested *Coprinus alnivorus* might have an affinity to subsection *Lanatuli*, it definitely belongs to subsect. *Alachuani* on account of the branched and diverticulate veil. It has not been recorded from Europe (Uljé & Noordeloos, 1997).

2. **Coprinus alutaceivelatus** Van De Bogart, Mycotaxon 8 (1979) 270 — Fig. 2

Holotype: USA, Washington state, Seattle, 20 Oct. 1973, *F. Van De Bogart 2516* (WTU).

Original description. Pileus at first glandiform, then conical, then campanulate. Prior to expansion 1.0–2.0 cm in length and after expansion 1.7–2.9 cm in breadth. At first tan from universal veil tissue, apex under veil medium brown, with maturity pileus yellow-brown under the tan veil and apex brown

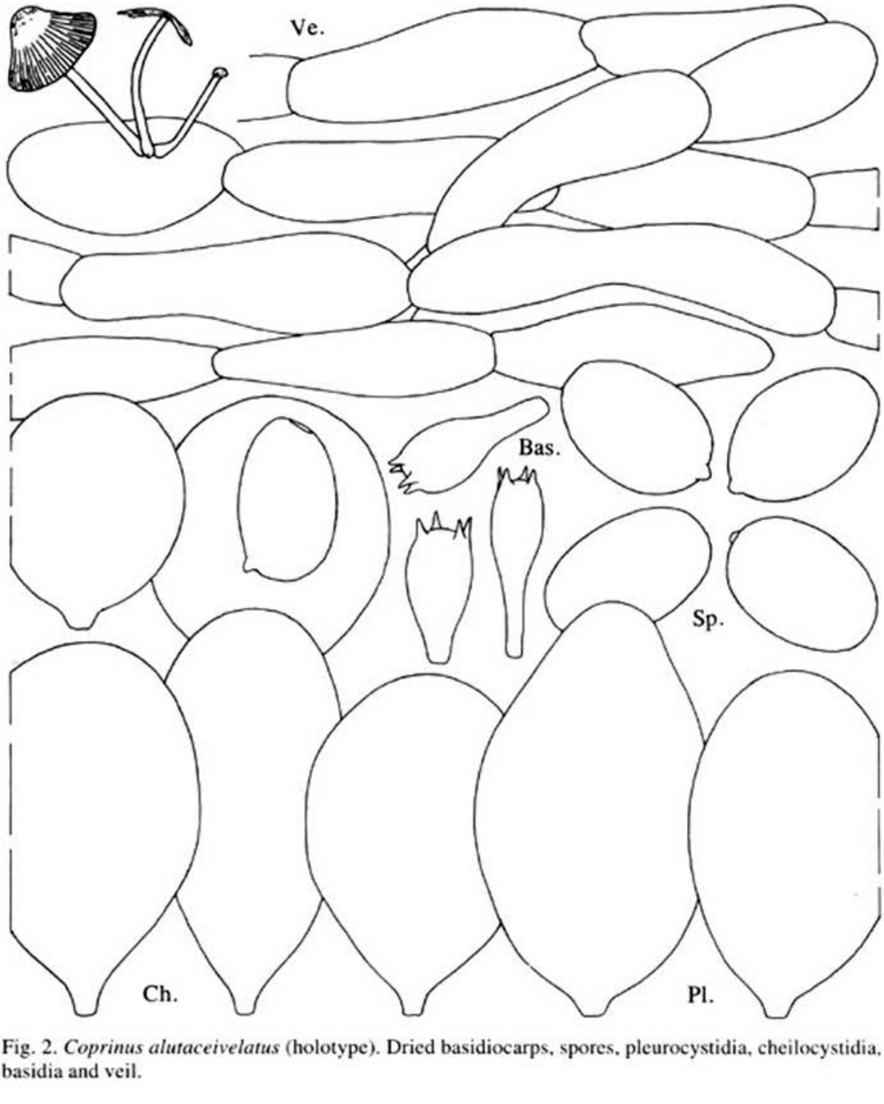


Fig. 2. *Coprinus alutaceivelatus* (holotype). Dried basidiocarps, spores, pleurocystidia, cheilocystidia, basidia and veil.

under the veil remnants. Surface covered at first then plicate-striate under small felt-like irregular veil remnants. Flesh thin and membranous. Stipe hollow, no mycelial web or thread present, very thin and slightly tapered towards the apex, 1.0–2.5 cm × 2.0–3.0 mm, white, opaque, surface glabrous and silky, faint annular or volval ring present at the base, flesh moderately thick and fibrous. Lamellae lanceolate, lamellulae very numerous, 0.8–12.5 × 1.0–3.0 mm, at first very crowded, then less so. White, then brownish black, finally soot black. Autolysis complete. Odor none. Taste not observed.

Spores ellipsoidal, mostly round in cross-section, a few slightly flattened, 8.7–11.3 × 6.2–8.8 × 6.2–7.5 µm, lacking a perisporium, apiculus of medium size and usually visible, germ pore eccentric, 1.2 µm diameter. Color en masse soot black, microscopically purple-brown be coming greyish in 3% KOH. Wall smooth. Basidia dimorphic, short clavate and 20.0–22.5 × 12.5 µm, clavate and 26.2–32.5 × 12.5–15.0 µm, all 4-spored. Cheilocystidia globose to short ellipsoidal, 22.5 µm in diameter to 70.0 × 45.0 µm, hyaline, thin walled, smooth. Pleurocystidia ellipsoidal, 56.0–75.0 × 35.0–44.5 µm, very numerous, mostly bridging between two opposing lamellae, hyaline, thin walled, smooth. No other cystidia present. Pileal surface somewhat cellular but all the cells elongated in a radial direction. Pileal context pale yellow-brown in 3% KOH. Universal veil felt-like and at first continuous over pileal surface, soon breaking up into small irregular patches, tan, composed of somewhat interwoven chains of cells. Cells cylindrical to greatly swollen, constricted at the septa, seldom branched, hyaline, smooth, thin walled. Cells 2.5–23.0 µm in diameter. Annular line at stipe of similar cells. Clamp-connections rare on stipe.

Habitat. Terrestrial, on soil and conifer needle duff. Loosely clustered.

The tan color of the universal veil and yellow-brown pileal context are distinctive features of this species. The eccentric germ pore of this species and of *C. bubalinus* distinguish them from others of this section present in the western states.

Observations on the holotype. Spores [20, 1, 1] 11.3–12.1 × 7.3–7.8 µm, ellipsoid with rounded base and apex, and eccentric, c. 2 µm wide germ pore, dark red-brown; Q = 1.50–1.60, av. Q = 1.55; av. L = 11.8, av. B = 7.6 µm. Basidia 16–36 × 10–14 µm, 4-spored, surrounded by 3–6 pseudoparaphyses. Pleurocystidia 55–80 × 28–40 µm, obovoid, ellipsoid, ovoid or subcylindric. Cheilocystidia 35–60 × 25–40 µm, (sub)globose to ellipsoid. Veil made up of hyphoid, thin-walled elements, up to 80 × 4–18 µm, cylindrical, somewhat inflated or with median constriction; terminal cells ellipsoid, clavate or fusoid. Clamp-connections not found.

Notes. The poor type collection consists of a single basidiocarp, two stipes, and a small part of a stipe. However, all microscopical features could be found in the material. Clamp-connections were not found, but according to Van De Bogart these are present, though rare, on elements of the stipe. The length of the spores appeared to be considerably larger than in the original description.

3. **Coprinus ammophilae** Courtecuisse, Doc. mycol. 18 (72) (1988) 76 — Fig. 3

Holotype: France, reg. Pas de Calais, Stella-Plage, March 1950, *R. Courtecuisse 84.1109.01* (herb. Courtecuisse).

Original description. Chapeau 10–15 mm de diamètre, d'abord campanulé à sommet un peu aplati puis étalé. Marge denticulée fimbriée à ciliée. Voile fibrillo-pelucheux, gris-souris, labile, reposant sur une cuticule gris-perle plus ou moins foncée, fortement fissurée radialement. Lames peu serrées, avec lamelles intermédiaires, arquées, basses, collariées à faces grises ponctuées de noir et arête soulignée de noir. Stipe fragile, 20–30 × 1.5–2 mm, cylindracé, un peu épaissi sous les lames, blanc, entièrement fibrilleux, ponctué de noir au sommet. Chair subnulle, grise dans le stipe et gris-brunâtre dans le chapeau qui est translucide sur 1/2 rayon. Carpophores assez rapidement déliquescents.

Spores (9.5–)10–12(–13) × (6–)6.5–7.5(–8) µm, très sombres, elliptiques à face ventrale souvent plus plane, très légèrement lenticulaires. Pore germinatif present, assez larges, axial. Basides 4-sporiques, clavées, parfois étranglées au sommet ou juste sous celui-ci, stipitées, 45–50 × 5.5–15 µm plus les stérigmates qui sont arqués vers l'intérieur. Pseudoparaphyses trapues, trapézoïdales ou presque rectangulaires, 30–35 × 16–20 µm. Boucles presentes. Voile du type *Lanatuli*, formé de chaines de cellules allongées, 20–65 × 15–35 µm, plus fines dans les derniers articles (jusque × 8 µm) qui sont atténués-coniques. Pigment membranaire lisse ou légèrement ponctué dans le voile. Revêtement du stipe identique mais avec quelques cellules plus courtes, presque ovales.

Récoltes. Le Crotoy (Somme). Etang de pêche de la Baie de la Maye. Ammophilion. Le 11.11.82. Leg.: RC no 82111131; Stella-Plage (Pas-de-Calais). Cordon de dune secondaire. Ammophiletum. Le

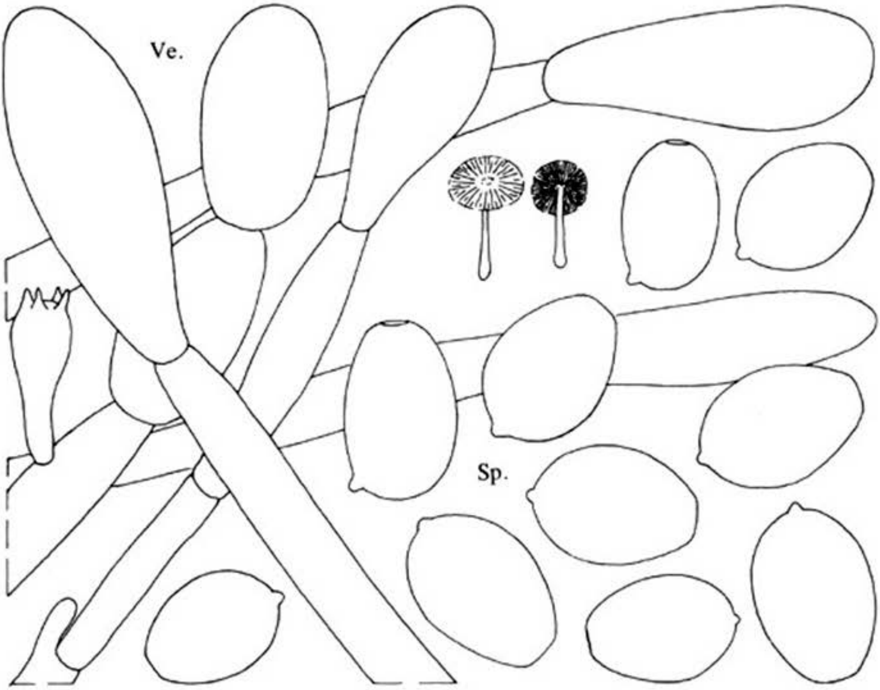


Fig. 3. *Coprinus ammophilae* (holotype). Dried basidiocarps, spores, basidia and veil.

9.11.84. Leg.: RC, M. Bon et J. Vast; no 84110901; Merlimont (Pas-de-Calais). Sable humide parmi les oyats et d'autres graminées (fétuques...) près d'un ruisseau artificiel. Le 2.11.86. Leg.: RC et M. Citerin; Pors-Morvan (Côtes du Nord). Plestin-les-Graves. Cordon dunaire et un talus sableux. Euphorbio-Ammophiletum avec quelques Agropyron. Le 20.11.86. Leg.: RC et D. Réaudin; no 86112001.

La description qui précède n'est pas très complète, mais résulte pourtant de l'observation de plusieurs récoltes effectuées en des lieux et à des moments distincts. Son caractère incomplet est dû à la déliquescence des carpophores, problème général avec les coprins, mais surtout à la croissance du champignon dans la dune blanche. La présence inévitable de grains de sable sur les fructifications, en particulier au niveau de la cuticule (souvent déjà très gênante chez les champignons charnus que l'on peut pourtant arriver à 'nettoyer' sans leur causer trop de dommages) s'est révélée ici extrêmement préoccupante. L'observation, si importante, de la structure vélaire a été très difficile et n'a pu être réalisée correctement que sur le type et sur l'exemplaire breton. Néanmoins, l'aspect macroscopique du voile rattache évidemment cette espèce aux *Lanatuli* et nous étions persuadé depuis longtemps d'avoir à faire à un nouveau taxon. Nous avons attendu de la retrouver plusieurs fois afin de compléter sa description dans la mesure du possible et de nous assurer de son caractère original. Nous nous décidons donc à la publier, même si nous sommes conscient du fait que sa diagnose pourra encore être enrichie à la faveur de récoltes ultérieures, moins 'ensablées' que les précédentes.

Les travaux sur le genre *Coprinus* que nous avons consultés (en particuliers, Orton et Watling, 1979) nous mènent à proximité de *C. lagopus*, espèce qui diffère macroscopiquement de la nôtre par son chapeau beaucoup 'plus digitiforme-cylindracé', son stipe souvent très élancé et aussi par son habitat terricole subhygrophile, généralement sylvatique.

Observations on the holotype. Spores [20, 1, 1] 9.7–12.2 × 7.1–8.4 µm, ellipsoid or ovoid with rounded base and apex, and central, rather truncate, c. 1.8 µm wide germ pore, dark red-brown; Q = 1.30–1.50, av. Q = 1.35–1.40; av. L = 11.1, av. B = 8.0 µm. Basidia, pseudoparaphyses and cystidia collapsed. Veil made up of hyphoid, thin-walled elements, 50–100 × 20–30 µm, usually somewhat inflated and constricted at septa; terminal cells clavate. Clamp-connections present.

Notes. The collection consists of two very badly preserved basidiocarps. Only spores and minute veil fragments could be observed.

4. **Coprinus arachnoideus** Van De Bogart, Mycotaxon 4 (1976) 238 — Fig. 4

Holotype: USA, Washington State, Seattle, March 1950, *F. Van De Bogart 2161* (WTU).

Original description. Pileus at first long glandiform, then conic, then campanulate. Prior to expansion 1.8 cm in length and after expansion 3.0 cm in breadth. Pale creamy white at first, soon becoming pale grey-tan to pale creamy grey-tan. Small shallow plicate striations developing as pileus becomes mature. Surface covered at first with a thin wispy fibrillar universal veil that soon breaks up into small scattered irregular patches. Flesh thin and membranous. Stipe hollow, slender, nearly equal but with a slight swelling at the base and slightly narrowed towards the apex, 4.0–6.5 cm × 2.2–3.6 mm. White, opaque, glabrous except for a few small bits of loosely interwoven fibrillose tomentum scattered around the stipe base. Flesh thin and fragile. Lamellae linear, some short lamellae present, 0.6–1.6 cm × 5.0 mm, broadly adnate, crowded, with no appreciable spreading by the limited amount of plicate striation, white, then soot black. Autolyses complete. Odor and taste not observed.

Spores ovate in dorsal view and ellipsoidal in lateral view, flattened, 11.2–13.8 × 7.5–8.8 × 6.2–7.3 µm, suprahilar depression present on most, apiculus small, visible only in lateral view, germ pore eccentric, 1.3–1.8 µm in diameter. Color en masse black, microscopically deep purple-brown in 3% KOH. Wall smooth. Basidia dimorphic, short clavate and 22.0–25.0 × 12.0 µm, long clavate and 30.2–35.2 × 13.0–15.0 µm, all 4-spored. Cheilocystidia globose to ellipsoidal, 12.5 µm in diameter to 50.0 × 39.0 µm, mostly with a short pedicel 3.0–6.0 µm long, hyaline, smooth. Pleurocystidia ellipsoidal, 77.0–98.2 × 42.5–58.0 µm, pedicellate, pedicels 1.0–12.0 µm long, hyaline, smooth. No other cystidia present. Pileal surface a cutis of more or less radially oriented hyphae, the surface cells two or three times as long in the radial orientation as in any other direction.

Universal veil of fibrillar nature, interwoven. Individual elements occurring in long chains of more or less cylindrical cells, hyaline, thin walled, some swollen and somewhat constricted at the septations, others not swollen. Some cells irregular, the chains composed of cells of varied sizes all along its length, some of them branched or anastomosed. The same types of chains of cells found on both the pileal surface and at the stipe base. Universal veil cell size 16.2–12.5 × 2.5–33.8 µm. Clamp-connections absent.

Habitat. Terrestrial, on prepared soil mixes in a greenhouse, solitary.

This species differs from most of the other species of section *Coprinus* in its lack of any web or thread of hyphae inside the lumen of the stipe, its lack of refractive plugs in the sterigmata, its adnate lamellae and its lack of clamp-connections. *C. arachnoideus* differs from *C. alnivorus* microscopically. It resembles some of the species of section *Lanatuli* in its universal veil characters and in the possession of pleurocystidia.

Observations on the holotype. Spores [20, 1, 1] 10.6–15.0 × 6.7–9.1 µm, ellipsoid or ovoid with rounded base and apex, and strongly eccentric, c. 1.6 µm wide germ pore, dark red-brown; Q = 1.45–1.65, av. Q = 1.60; av. L = 13.3, av. B = 8.3 µm. Basidia 20–30 × 11–13 µm, 4-spored, surrounded by 5–7 pseudoparaphyses. Pleurocystidia 90–125 × 30–50 (–60) µm, obovoid, ellipsoid or subcylindric. Cheilocystidia 40–100 × 25–40 µm, (sub)-globose to ellipsoid or subcylindric. Veil made up of hyphoid, thin-walled elements, 40–60 × 14–25 µm, usually somewhat inflated and constricted at septa; terminal cells ellipsoid or clavate. Clamp-connections sparse, not distinct.

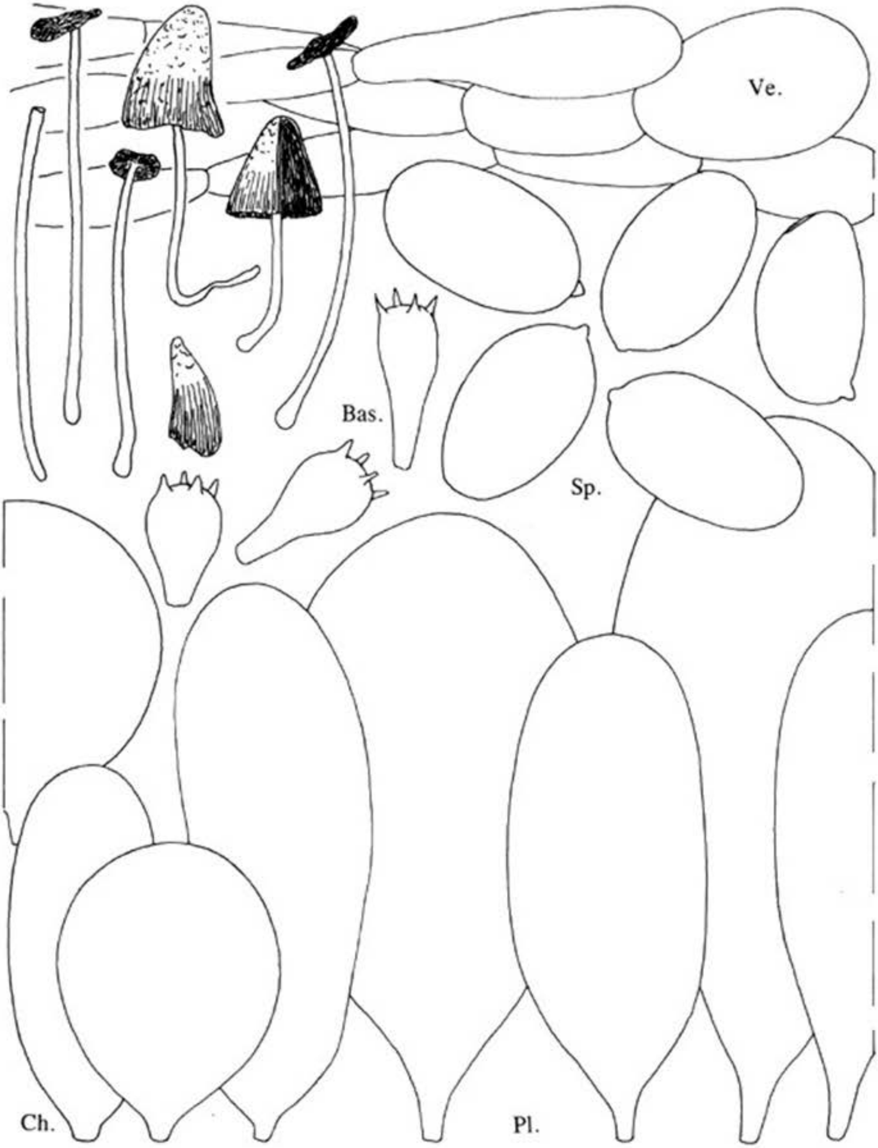


Fig. 4. *Coprinus arachnoides* (holotype). Dried basidiocarps, spores, pleurocystidia, cheilocystidia, basidia and veil.

Notes. The holotype is in a fairly good condition, and consists of four basidiocarps and a fragment of another one. Although said to be absent in the original description, we observed some clamp-connections in the veil.

5. **Coprinus asterophoroides** Van De Bogart, Mycotaxon 4 (1976) 252 — Fig. 5

Holotype: USA, Washington, Beverly, 5 Aug. 1974, *F. Van De Bogart 3333* (WTU).

Original description. Pileus at first rounded, then hemispherical, then campanulate, then plane, and finally mostly lysed, when unexpanded 2.0–3.0 cm long, expanding to 4.0–6.0 cm broad. Universal veil white when young, then cuticle darkening to black or blackish brown as universal veil recedes, apex remaining white with universal veil. Universal veil of a felt-like consistency, very thick, soon torn into a distinctly stellate persistent remnant as pileus expands. Pileal surface becoming deeply plicate striate. Pileal margin becoming revolute or curling under and eventually reduced to tattered shreds. Stipe hollow, slender, 7.0–11.5 cm × 3.0–6.0 mm. Stipe lumen with a distinct and persistent hyphal strand in the center. Surface mostly smooth and glabrous, some appressed fibrils near the bottom or occasionally small scales on the lower half. White at first, then slowly blackening as lysis proceeds, opaque. Flesh very thin and fragile. Lamellae lanceolate, free and remote, very crowded, soot black when mature, autolysis complete.

Spores ovate to ovate-ellipsoidal, slightly flattened, 17.5–20.0 × 11.2–12.5 µm, apiculus usually small, germ pore apical to very eccentric, 1.8 µm in diameter. Color soot black en masse and a dark brownish purple-black microscopically in 3% KOH. Wall smooth. Basidia trimorphic, short clavate and 35.0–39.0 × 20.0–22.5 µm, clavate and 50.0–54.0 × 20.0–22.5 µm, subululiform and 52.0–61.5 × 20.0–21.5 µm, sterigmata with dark somewhat refractive plugs, apex of basidia dark grey-brown, all 4-spored. Cystidia not seen. Pileal surface of slender, cylindrical, radially aligned, thin-walled hyphae. Many hyphae with irregular patches of dark brown pigment on the cell walls. Universal veil composed of long parallel, radially aligned chains of long, often somewhat swollen cells, constricted at the septae, larger cells of the chains bound together by slender, branched and anastomosed hyphae. All cells of universal veil hyaline and thin walled. Large cells 12.5–63.5 µm in diameter. Cells of the binding hyphae 3.5–11.0 µm in diameter. Clamp-connections present in universal veil and rarely on the stipe, usually very irregular.

Habitat. Terrestrial, on sandy soil in dry open sagebrush desert area.

This species is closely related to *C. asterophorus* Long & Miller and to *C. xerophilus* Van De Bogart. It shares many morphological features as well as the arid habitat with both. *C. asterophoroides* differs from *C. asterophorus* in possessing a distinct and persistent hyphal strand in the stipe lumen, the universal veil remaining white even when dried, the germ pore often very eccentric, the much larger diameter of the universal veil elements, the absence of a bulbous volvate stipe base, and the larger and much broader basidia with pigmented apices. *C. asterophoroides* differs from *C. xerophilus* in the universal veil remaining stellate, the smaller germ pore, the absence of a bulbous volvate stipe base, and the pigmented apex of the basidia.

Observations on the holotype. Spores [40, 2, 1] 14.8–20.6 × 10.7–14.2 × c. 11.5–12.0 µm, ovoid or ellipsoid with rounded base and apex, and eccentric, 1.8–2.1 µm wide germ pore, very dark red-brown; Q = 1.40–1.65, av. Q = 1.45–1.50; av. L = 17.4–18.6, av. B = 11.6–12.8 µm. Basidia 32–60 × 20–25 µm, 4-spored. Pseudoparaphyses and cystidia collapsed. Veil made up of hyphoid, thin-walled elements, 20–150 × 20–50(–60) µm, usually somewhat inflated and constricted at septa; terminal cells ellipsoid or clavate. Clamp-connections not found.

Notes. The type material consists of two old basidiocarps. No cystidia could be located nor could pseudoparaphyses be found.

6. **Coprinus brunneistragulatus** Van De Bogart, Mycotaxon 8 (1979) 246 — Fig. 6

Holotype: USA, Washington state, Insula, 6 Oct. 1968, *F. Van De Bogart 194* (WTU).

Original description. Pileus at first ovate, then conical, then campanulate, and finally revolute. Prior to expansion 2.0–2.5 cm in length, after expansion 4.0–6.0 cm in breadth. At first dark grey with lighter colored universal veil patches and dark greyish brown at the apex, with maturity becoming darker grey and brownish black at the apex. Some plicate striations developing under the universal veil, the striations

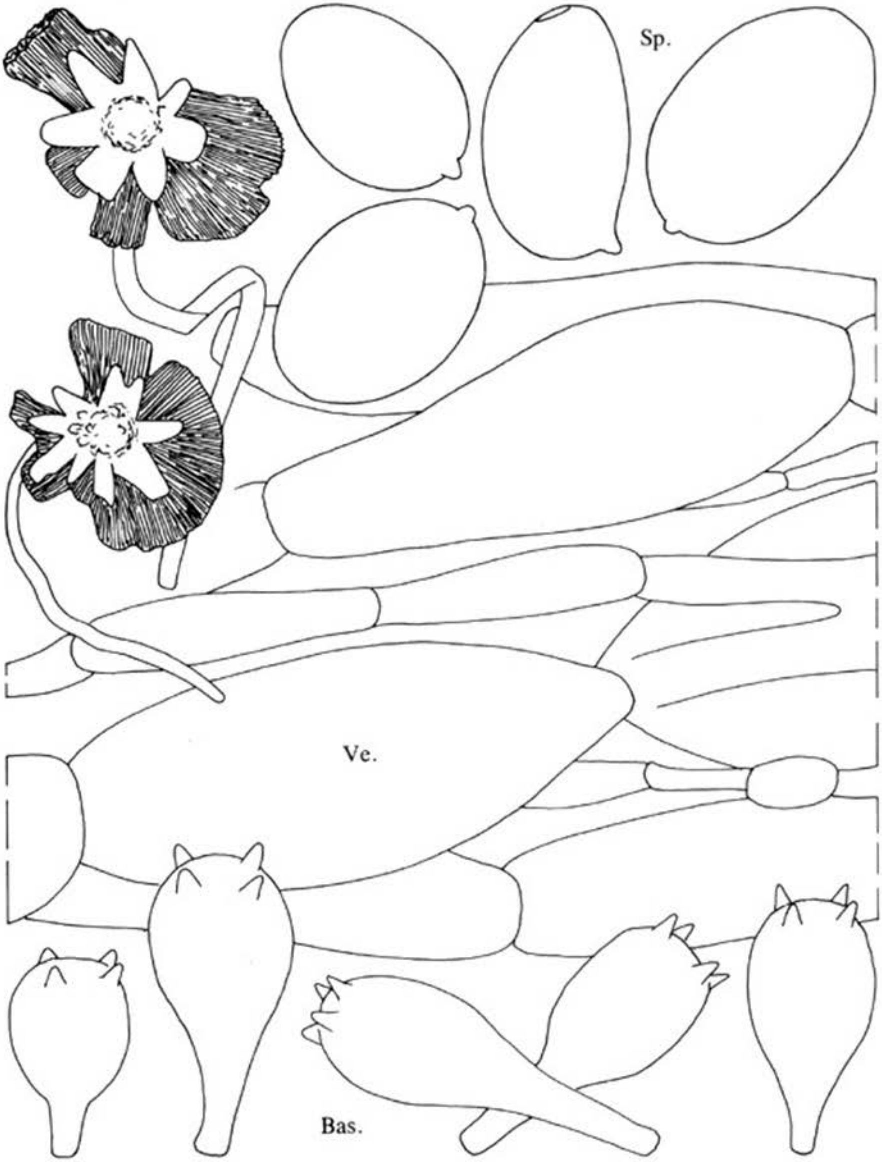


Fig. 5. *Coprinus asterophoroides* (holotype). Dried basidiocarps, spores, basidia and veil.

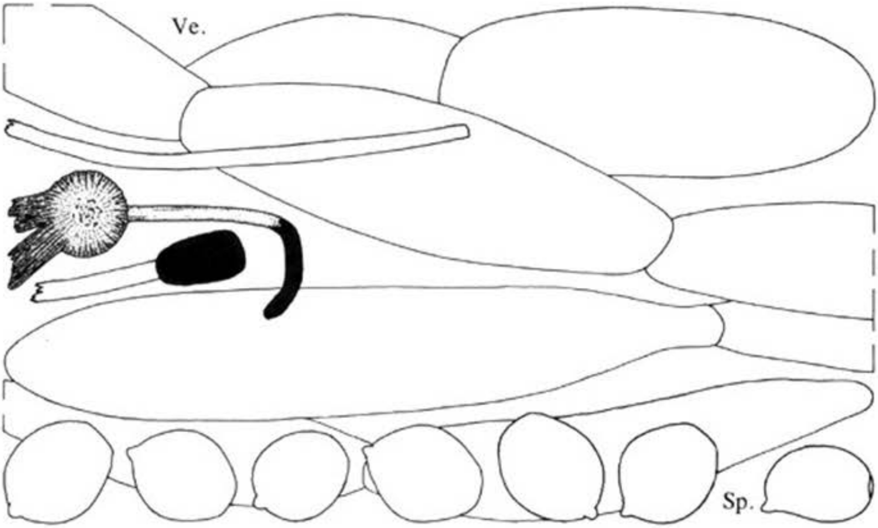


Fig. 6. *Coprinus brunneistragulatus* (holotype). Dried basidiocarps, spores and veil.

often masked at least in part by the veil. Surface completely covered at first, and partly covered at maturity by a feltlike universal veil that breaks up into irregular patches as the pileus expands. Flesh thin and membranous even at the apex. Stipe hollow, thin, slender, tapered from base to apex, 10–12 cm × 2–5 mm. Base nearly abrupt. White or faintly greyish, opaque. Surface somewhat fibrillose. Flesh thin, fragile and easily broken. Lamellae narrowly lanceolate, some lamellulae present, 0.5–2.8 cm × 3–4 mm, free or slightly adnexed when young, crowded at first, then less so as pileus expands and plicate striation develops. Pale then blackish brown. Autodigestion incomplete, most of the lamellae lysing but usually most of the pileal surface remaining. Odor and taste not observed.

Spores subglobose to broadly limoniform, round in cross-section, 6.9–8.8 × 6.2–7.5 µm, apiculus tiny but often visible, germ pore apical, 1.0–1.4 µm in diameter. Color en masse brownish black, microscopically deep purple-brown in 3% KOH. Contents guttulate or not. Wall with a prominent pale brown perisporium that shows best on spores of young specimens but is also found on those of older specimens. Cheilocystidia globose 12.5–38.0 µm in diam., or ellipsoidal with rounded ends, 44.0–50.0 × 17.0–22.0 µm, hyaline, thin walled, smooth. Pleurocystidia long ellipsoidal, ends usually rounded, 110.0–142.0 × 45.0–52.0 µm, hyaline, smooth, thin walled, numerous, often bridging between two opposing lamellae. No other cystidia present. Pileal surface of radially oriented hyphae. Universal veil of large patches adhering to the pileus, composed of chains of smooth, thin walled, hyaline, cylindrical to greatly swollen hyphae, 40.0–150.0 × 11.2–44.0 µm, constricted at the septae in most cases. The chains of cells seem to be adherent to each other but are seldom anastomosed. Clamp-connections present on stipe and universal veil.

Habitat. Terrestrial on moist, shaded lawns, solitary.

This species resembles *Coprinus lagopides* P. Karst. in most ways but differs markedly in the presence of a pigmented perisporium.

Observations on the holotype. Spores [20, 1, 1] 6.7–8.4 × 6.0–7.0 µm, ovoid or ellipsoid, tending to quadrangular, with rounded base and rather truncate apex, and central, c. 1 µm wide germ pore, very dark red-brown; Q = 1.10–1.20, av. Q = 1.15; av. L = 7.8, av. B = 6.6 µm. Basidia, pseudoparaphyses and cystidia collapsed. Veil made up of hyphoid, thin-walled elements, 20–100 × 15–36 µm, usually somewhat inflated and constricted at septa; terminal cells cylindrical with obtuse apex or ellipsoid. Clamp-connections not found.

Notes. The holotype is in a very bad condition. Only a stipe, a part of stipe with collapsed pileus as a black mass at apex and a small part of a pileus remain.

7. **Coprinus bubalinus** Van De Bogart, Mycotaxon 8 (1979) 266 — Fig. 7A, 7B

Holotype: USA, California, Lafayette, April 1972, *F. Van De Bogart 3821* (WTU).

Original description. Pileus at first rounded oblong, then ellipsoidal, then conical, then campanulate, finally somewhat revolute. Prior to expansion 1.0–3.5 cm in length and after expansion 3.0–6.0 cm in breadth. Surface at first covered a white universal veil. Veil fragile, soon breaking up into irregular patches revealing a honey colored, yellow-tan to light ochre pileal surface. Color of pileal apex similar. Entire pileus blackens with lysis. Moderately plicate-striate. Surface under the veil somewhat lubricous. Margin of young pileus curved in to stipe. Flesh buff colored, thin fragile. Stipe hollow and somewhat pithy. The pithy material drying into gelatinous lumps. Slender, slightly tapered, at first 1.5–4.0 × 1.0–1.4 cm, when mature 6.0–8.0 × 0.4–0.8 cm, whitish buff, bruising tan, opaque, surface faintly pruinose, small evanescent remnants of the universal veil present on young specimens about 4.0 mm above the base. Base merges into a fine white mycelium. Flesh fragile. Lamellae lanceolate, some lamellulae also present, 1.0–2.7 cm × 1.0–3.0 mm, crowded, free or slightly adnexed, at first whitish tan, then mottled grey-black, immature lamellar margins whitish cinereous. Autolysis complete unless halted by drying. Odor fungoid or earthy. Taste fungal.

Spores ellipsoidal, slightly flattened, 10.0–14.1 × 6.7–8.5 × 6.2–6.8 µm, lacking a perisporium, apiculus small, germ pore eccentric, 1.7–2.1 µm in diameter. Color en masse black, microscopically purplish black and soon deep brownish black in 3% KOH. Wall smooth. Basidia trimorphic but not completely separate and distinct in sizes and shapes, short clavate and 22.0–28.0 × 11.0–12.0 µm, clavate and 34.0–39.0 × 11.5–12.0 µm, long clavate and 40.0–49.0 × 14.5 µm, all 4-spored. Cheilocystidia globose 10.0–50.0 µm in diameter or ellipsoidal 50.0–65.0 × 22.0–28.0 µm, some with pedicel, 0.1–5.0 µm in length, hyaline, thin walled, smooth. Pleurocystidia ellipsoidal, 70.0–93.0 × 28.0–43.0 µm, some with pedicel, 0.1–3.0 µm in length, hyaline, thin walled, smooth. Some bridging between two opposing lamellae. No other cystidia present. Pileal surface of mature sporocarps composed of swollen cells, mostly elongate in a radial direction, some isodiametric cells also present. Universal veil felt-like or arachnoid or pruinose, at first continuous over pileal surface, soon breaking up into small irregular patches, composed of hyphae with cylindrical to very swollen cells, 12.0–116.0 × 12.0–36.0 µm, the swollen cells with constricted septa, some cells branched, all hyaline, thin walled, smooth. Cells at tip of hyphal chains mostly clavate-swollen. Same cell types present in veil remnants on pileus and stipe base. Clamp-connections rarely present on stipe only.

Habitat. Lignicolous, on walnut and mulberry slash, solitary or small clusters.

This species seems to be closely related to *C. sylvicola*, *C. marcidus* and *C. alutaceivelatus*. The pithy material in the stipe of young sporocarps which upon drying becomes gelatin-like lumps is somewhat distinctive. *Coprinus bubalinus* resembles *C. alutaceivelatus* in its overall appearance and the presence of eccentric germ pores on spores of both. It differs in its lack of pigmented pileal context and in having trimorphic basidia as opposed to dimorphic. The color of the pileal surface below the universal veil is much more yellow in *C. bubalinus* than the more nearly brown surface of *C. alutaceivelatus*.

Observations on the holotype. Spores [20, 1, 1] 11.7–14.4 × 8.1–9.6 × c. 7–8.5 µm, ellipsoid or ovoid, with rounded base and apex, and strongly eccentric, 1.8–2.2 µm wide germ pore, very dark red-brown; Q = 1.35–1.55, av. Q = 1.45–1.50; av. L = 13.1, av. B = 8.9 µm. Basidia 24–46 × 12–15 µm, 4-spored, surrounded by 5–7(–8) pseudoparaphyses. Pleurocystidia 70–120 × 40–70 µm, subglobose, ellipsoid, oblong, utriform or subcylindrical. Cheilocystidia 40–120 × 30–70 µm, (sub)globose, ellipsoid, oblong or subutriform. Pileipellis a layer of spheropedunculate cells. Veil made up of hyphoid, thin-walled elements, 30–100 × 10–40(–50) µm, usually not inflated, constricted at septa and branched in part, mixed with clavate, ellipsoid or (sub)globose cells; terminal cells clavate, ellipsoid or subglobose. Clamp-connections not found.

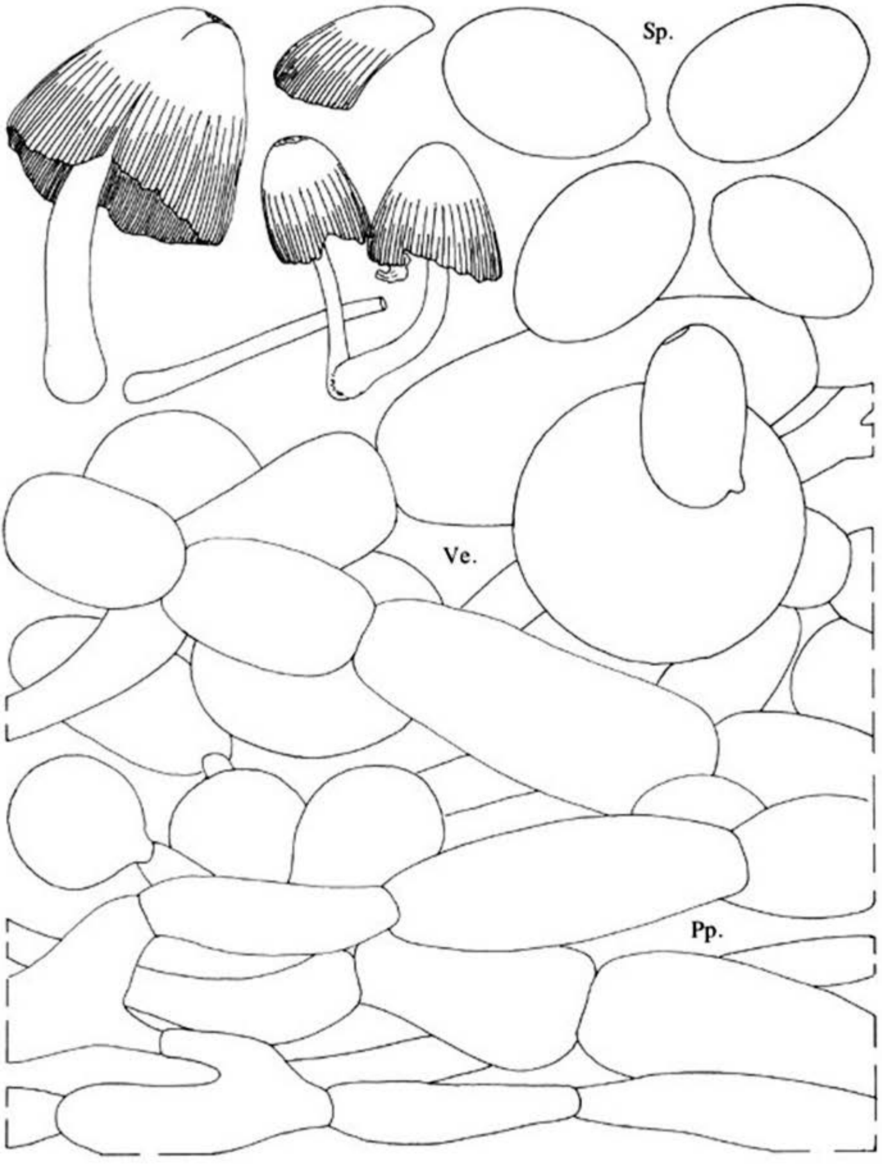


Fig. 7A. *Coprinus bubalinus* (holotype). Dried basidiocarps, spores, pileipellis and veil.

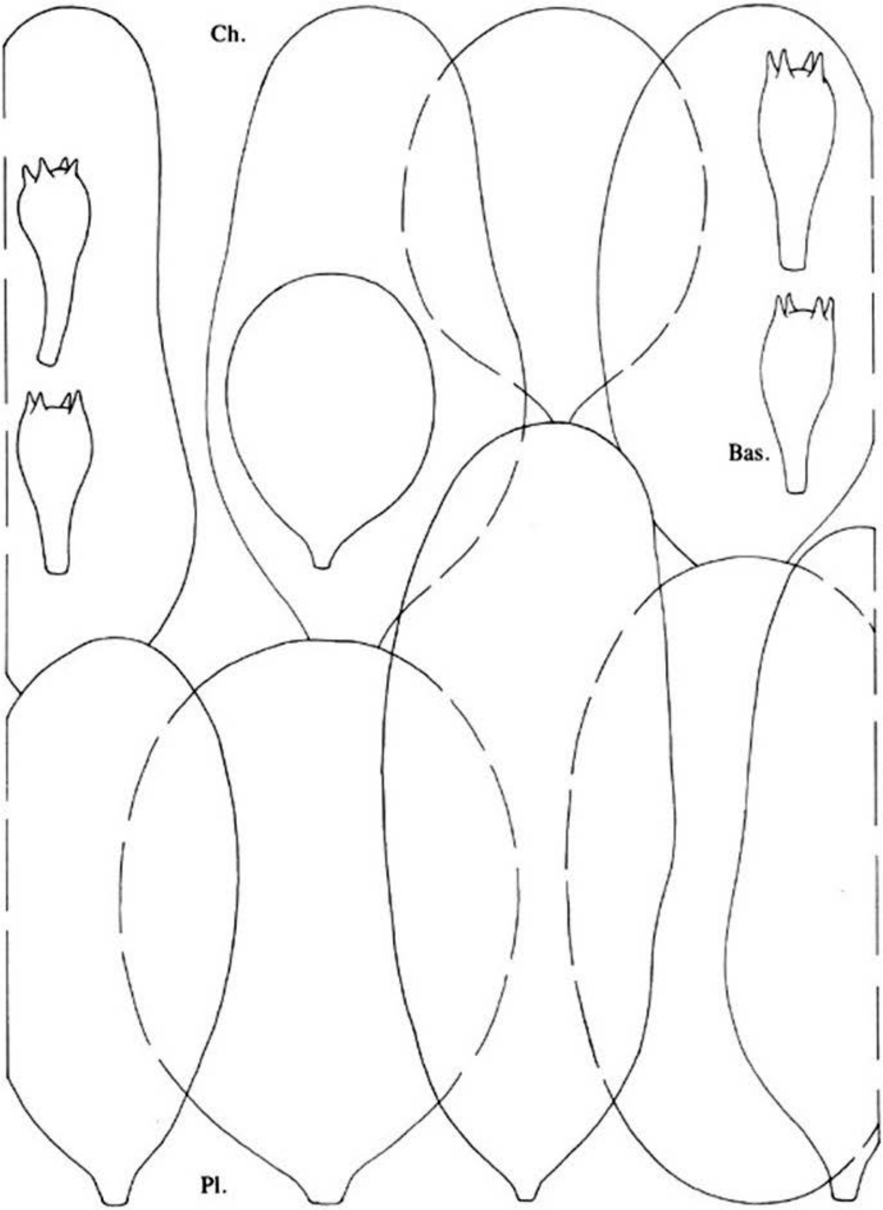


Fig. 7B. *Coprinus bubalinus* (holotype). Pleurocystidia, cheilocystidia and basidia.

Notes. The holotype consists of three whole basidiocarps and a fragment, all in a rather good state. All microscopical features could be found in the material. Our measurements show somewhat broader spores both in side and in frontal view. The pileipellis was described as composed of elongate, swollen cells in radial direction. We found that the pileipellis was a hymeniderm.

8. **Coprinus citrinovelatus** E. Ludw. & P. Roux, Z. Mykol. 61 (1995) 35 — Fig. 8

Holotype: Germany, Berlin-Düppel, on wood-chips, 30 May 1982. Gregarious (G, B).

Original description. Hut jung kegelig, bis 2 cm hoch, später flach aufschwirmend und 3–4 cm breit, zuletzt schalenförmig vertieft. Häutig dünn. Jung glatt, mit zunehmender Reife bis zur Mitte faltig gefürcht. Grundfarbe hellgrau. Im Primordialstadium vollständig übersponnen von einem anfangs kräftig ockergelben, später hell zitronengelbem faserig-haarigen Velum, das bis zuletzt auf dem Scheitel erhalten bleibt. Lamellen jung hell umbrabraun, dann umbraschwärzlich, an den Schneiden gelblich (!). Stiel 3–6 × 0.15–0.3 cm. Basis lange etwas knollig abgesetzt. Abwärts verdickt. Ebenfalls von gelbem Velum übersponnen, im unteren Teil lange regelrecht gestiefelt. Zuletzt – zumindest im oberen Bereich – weizs; ringlos, in frühen Stadien bisweilen mit leichter knotiger Verdickung. Fleisch nicht zerflieszend, sondern welkend. Unangenehm nach Mist riechend.

Basidien 4-sporig. Sporen (10–)11–14 × 6.5–7.5 µm; in Frontansicht ellipsoid bis ovoid, dabei überwiegend schlank, manchmal fast zylindrisch-ellipsoid; in Seitenansicht leicht abgeflacht; am Apikalus meist etwas spitz ausgezogen; glatt, in KOH dattelbraun. Keimporus zentral, deutlich, bis 2 µm breit. Cheilozystiden überwiegend keulig, selten auch subutriform bis breithalsig-fläschenformig, blaßgelb; 40–110 × 15–35 µm. Pleurozystiden vorhanden; ähnlich geformt. HDS zellig, aus zu bis 30 µm breiten Elementen. Velum überwiegend aus zylindrischen, bisweilen etwas unregelmäßigen Elementen; kein Kugelzellen. Schnallen vorhanden.

R. Watling, dem Abbildung und Material des Fundes vorgelegt wurden, verneinte definitiv eine Identität mit seinem *C. luteocephalus*, stufte die Art aber sicher zurecht als "very close" (sehr nahestehend) ein. Die Haubtunterschiede ergeben sich aus der Tabelle 1.

	Coprinus luteocephalus	*Coprinus citrinovelatus*
Vorkommen	Auf Pferdemist zens, Affiinit	auf Erdboden, teilweize Hoilzrestchen ansit-
Sporenform	Ellipsoid-mandelformig, in Front-anisicht ellipsoid	überwiegend schlank ellipsoid bis fast zylindrisch-ellipsoid
Sporegröße	10.5–12.5 × 5–7.5 µm	11–14 × 6.5–7.5 µm
Cheilozystiden	Ballonförmig, bis ellipsoid, diam. –18 µm, hyalin	neben ballonförmig, und ellipsoiden auch subutriforme bis breithalsig-lageniforme, diam. –35 µm, gelbwandig

Observations on the holotype. Spores [50, 5, 2] 11.1–13.8 × 6.3–7.5 µm; Q = 1.60–1.95, av. Q = 1.70–1.80; av. L = 11.7–12.3, av. B = 6.7–7.1 µm, dark red-brown with central, c. 1.8 µm wide germ pore. Basidia 18–34 × 8–9 µm, 4-spored, surrounded by (3–)4–6 (–7) pseudoparaphyses. Pleurocystidia 70–100 × 25–32 µm, oblong to subutriform. Cheilocystidia 50–90 × 20–32 µm, ellipsoid, oblong or subutriform. Elements of veil 25–100 × 8–14 µm, of type 'Lanatuli', very sparse, yellowish incrusted.

Notes. Coprinus citrinovelatus appeared to be a later synonym of *C. ochraceovelatus* Bas (Uljé & Noordeloos, 1999).

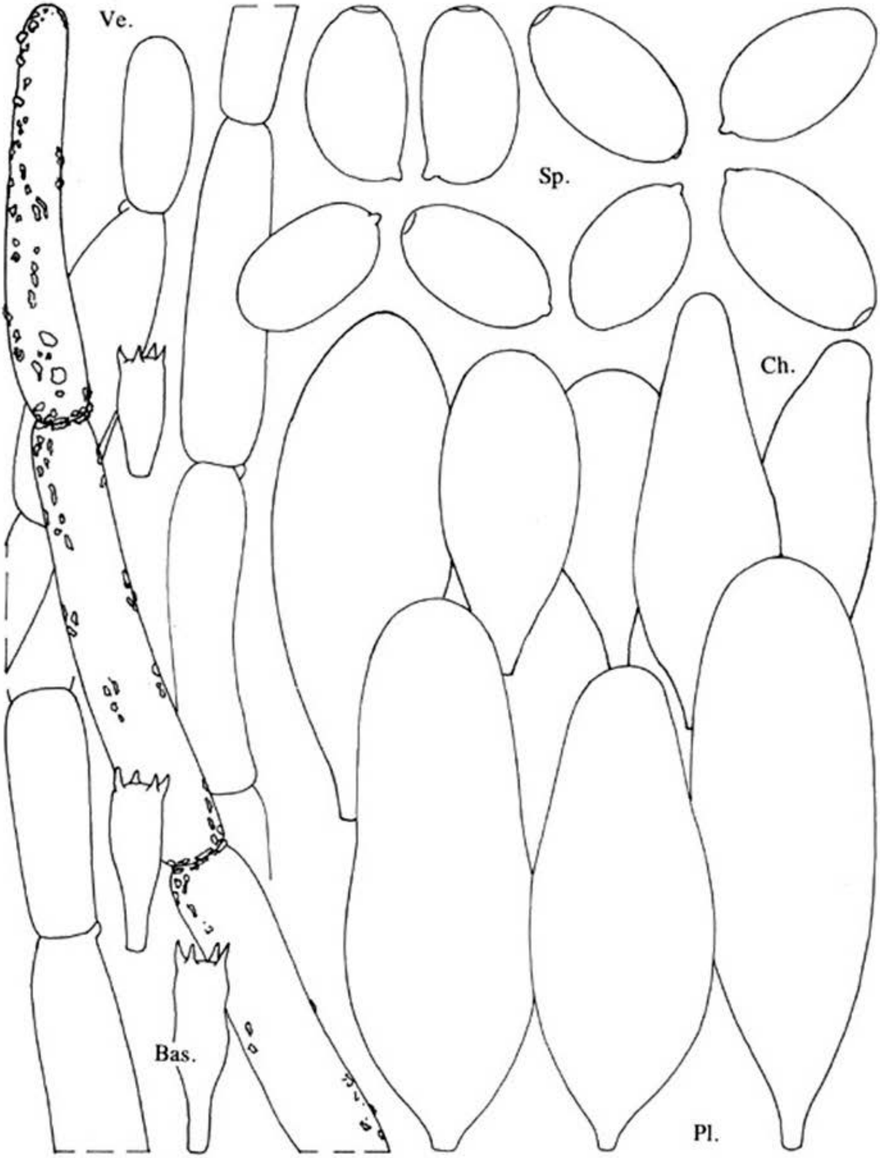


Fig. 8. *Coprinus citrinovelatus* (holotype). Spores, pleurocystidia, cheilocystidia, basidia and veil.

9. **Coprinus colosseus** Van De Bogart, Mycotaxon 4 (1976) 265 — Fig. 9A, 9B

Holotype: USA, Washington State, Redmond, 2 May 1966, *F. Van De Bogart 143* (WTU).

Original description. Pileus oblong-oval at first, then narrow conical, then narrow campanulate, then broadly shallow campanulate, and eventually laciniate-revolute. Prior to expansion 13.0–25.4 cm in length and after expansion 8.0–14.0 cm broad, the smaller size due to autodigestion during expansion. White with brownish-tipped scales and pale brown pileal apex at first and then gradually darkening with maturity and autolysis. Plicate striation limited in development, involving little or none of the lamellar trama. Surface covered with a universal veil of rather small scales that are white to white with brownish tips. Scales firmly attached when pileus is immature but becoming loose and easily removable as pileus matures. Flesh mostly thin and membranous but up to 3.0 mm in thickness at apex. Stipe hollow, the lumen containing a loose yarnlike thread of loosely interwoven filaments. Almost equal but with a slight tapering from base to apex, 35.0–50.5 × 1.5–2.5 cm, the base abrupt and embedded up to 8 additional centimeters into the soil. A small loose annulus present on some specimens. Surface seeming smooth and glabrous. White at first, then as spores are produced and autolysis proceeds the apical flesh slowly blackening internally as well as externally. Flesh opaque, coarse and fibrous. Rhizomorphs of compact white hyphae penetrating about 15.0 cm into the substrate from some specimens. Lamellae linear, almost all long, 8.0–25.0 × 1.5–2.3 cm, free but attached to a small collarium. Extremely crowded at first and remaining crowded throughout sporulation and lysis, pale but becoming soot black. Autolysis almost complete, nearly the entire pileus affected. Odor and taste none.

Spores ovate in dorsal view and ovate-ellipsoidal in lateral view, somewhat flattened, 16.8–20.0 × 9.8–13.7 × 8.4–11.3 µm, apiculus large and conspicuous, germ pore somewhat eccentric to very eccentric 1.8–3.1 µm in diameter. Color en masse soot black, microscopically an extremely dark smoky black color in 3% KOH. Contents seeming minutely guttulate or granular in 3% KOH. Wall smooth. Basidia trimorphic, short clavate and 31.5–35.5 × 16.0–18.0 µm, long clavate and 42.5–48.5 × 17.0–18.0 µm, very long clavate-pedicellate and 54.0–65.0 × 19.0–20.0 µm, all 4-spored, all sterigmata with a large refractive or pigmented plug. Cheilocystidia globose or ellipsoidal-ovate, globose 20.0–37.5 µm in diameter, ellipsoidal-ovate 35.0–50.0 × 20.0–25.0 µm, hyaline, smooth. No other cystidia present. Pileal surface of radially oriented hyphae. Universal veil scales composed of cylindrical septate hyphae, mostly swollen and somewhat constricted at the septations, smooth, hyaline, thin-walled cells 17.5–165.0 × 5.0–38.0 µm. A thin tomentum present at base of stipe, composed of slender, nonswollen, hyalin, smooth, thin-walled, branched and interwoven septate hyphae, the cells tending to be long and straight. Clamp-connections rare on stipe cuticle.

Habitat. Terrestrial, on loose, crumbly soil in a dense brushy scrub frondose forest, in large loose clumps, rare.

This species is well marked by its huge overall size, large spore size, and by the darkening of the stipe apex. The last two features it shares with *C. sterquilinus*, a coprophilous species which is much smaller.

Observations on the holotype. Spores [20, 1, 1] 16.9–21.1 × 10.9–13.6 × c. 9–11.5 µm, ellipsoid or ovoid, with rounded base and apex, and eccentric, c. 2.5 µm wide germ pore, very dark red-brown; Q = 1.45–1.60, av. Q = 1.55; av. L = 18.8, av. B = 12.2 µm. Basidia 40–65 × (14–)16–20 µm, 4-spored, surrounded by 7–13 pseudoparaphyses. Pleurocystidia absent. Cheilocystidia 20–50 × 20–35 µm, (sub)globose. Pileipellis hyphoid. Veil made up of hyphoid, thin-walled elements, 30–150 × 8–30 µm, in part somewhat inflated, constricted at septa; terminal cells clavate, ellipsoid or subcylindric. Clamp-connections not found.

Notes. The holotype consists of just two basidiocarps in a rather bad state. The basal ring described by Van De Bogart was not found in either of the specimens.

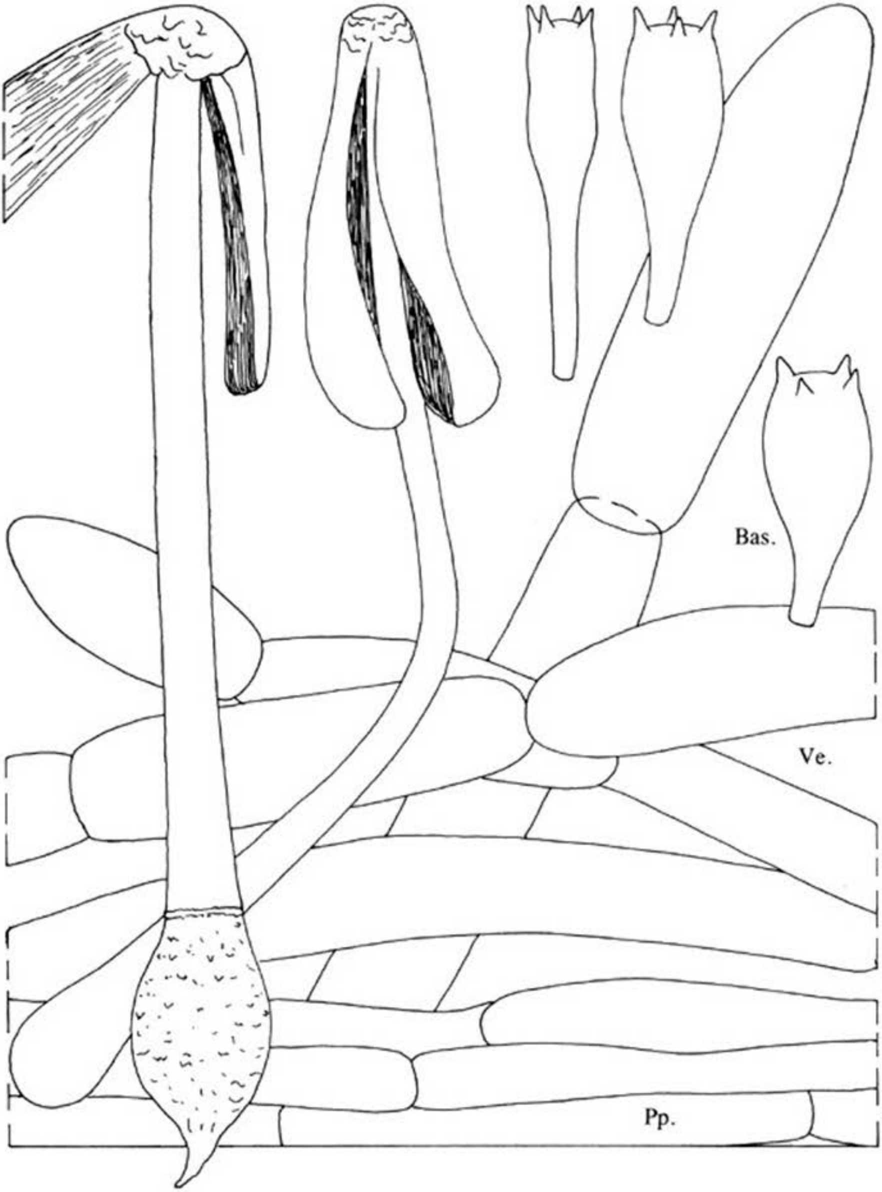


Fig. 9A. *Coprinus colosseus* (holotype). Dried basidiocarps, basidia, pileipellis and veil.

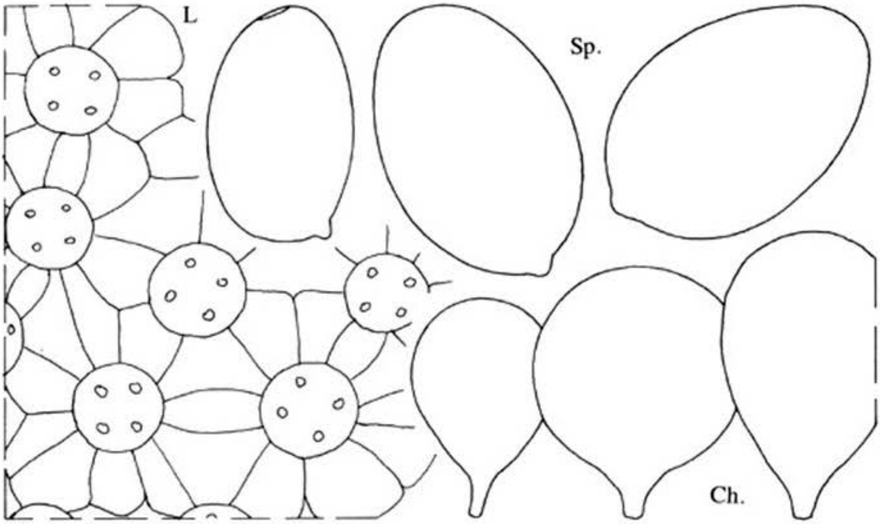


Fig. 9B. *Coprinus colosseus* (holotype). Basidia surrounded by pseudoparaphyses and cheilocystidia.

10. **Coprinus jonesii** Peck, Bull. Torrey bot. Club 22, 1 (1895) 206 — Fig. 10

Holotype: USA, Vermont, Burlington, April 1891, *Prof. L.R. Jones* (NYS).

Original description. Plant fragile; pileus 1–2 in. broad, submembranous, campanulate becoming broadly convex or expanded and split or revolute on the margin, very blunt or truncate at the apex when young, everywhere covered with tawny-gray or pale-cervine floccose scales which wholly and partly disappear with age revealing the striate surface beneath; lamellae crowded, linear, free, at first white or whitish, becoming black; stem equal or slightly tapering upward, minutely floccose, hollow, white; stem 2–3 in. long, 2–3 lines thick.

Spores black, broadly elliptical, .0003 to .00035 in. long, .00025 in. broad, with an apiculus at one end.

Habitat. In a cellar.

Observations on the holotype. Spores [40, 2, 1] 6.6–8.3 × 5.8–7.1 µm; Q = 1.12–1.23, av. Q = 1.18; av. L = 7.6, av. B. 6.4 µm, medium red-brown with central, c. 1.3 µm wide germ pore. Basidia 16–30 × 6.5–8 µm, 4-spored, surrounded by 3–5 pseudoparaphyses. Pleurocystidia 75–135 × 35–50 µm, utriform or subcylindric. Cheilocystidia 40–100 × 17–40 µm, subglobose, ellipsoid, ovoid, oblong, utriform or subcylindric. Veil 15–45 µm wide, hyphoid, elements constricted at septa, and with clavate to fusoid, sometimes ellipsoid terminal elements. Clamp-connections present, small.

Notes. The type-material is in good condition and consists of a sufficient number of basidiocarps.

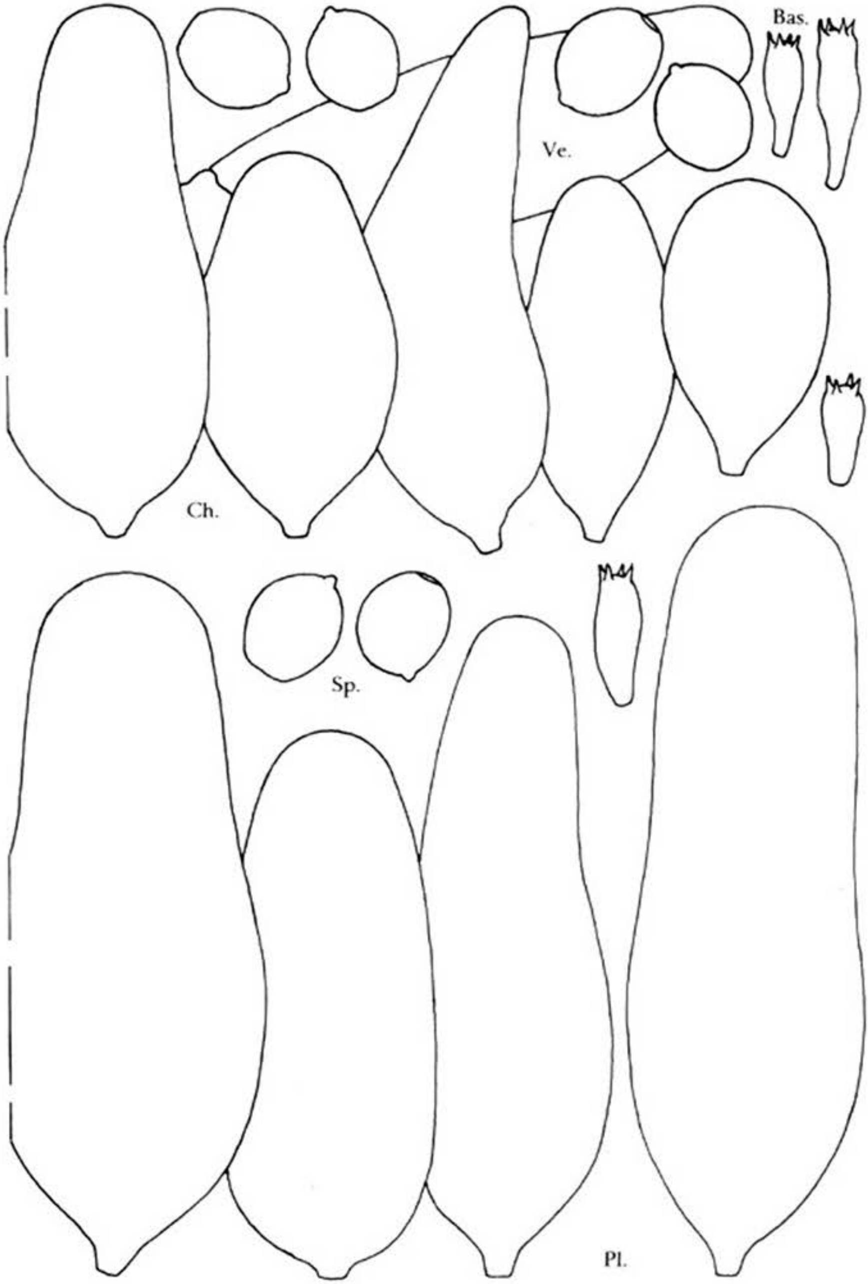


Fig. 10. *Coprinus jonesii* (holotype). Spores, pleurocystidia, cheilocystidia, basidia and veil.

11. **Coprinus lagopides** P. Karst., Meddn Soc. Fl. Fauna fenn. 5 (1879) 23. (Symb. Mycol. fenn. VI) — Fig. 11A

Lectotype: Finland, Tammala, Mustiala, 28 Oct. 1878, *P.A. Karsten 3757* (H).

Original description. Pileus 2–3 cm. latus. Stipes 3–4 cm. longus.
Sporae subsphaerroideae, irregulares, atrae (s. micr.), longit. 6–8 mmm, crassit. 5–6 mmm.
Mustalia, supra terram, m. Octobri semel.

Observations on the lectotype. Spores [10, 1, 1] 9.0–10.7 × 6.9–7.8 µm; Q = 1.27–1.39, av. Q = 1.30; av. L = 9.6, av. B = 7.5 µm, ovoid or (broadly) ellipsoid, warty, also on truncate apex, with central, c. 1.6 µm wide germ pore.

Notes. The material is in bad condition. Only the spores could be observed. On account of the warty spores and characters of the veil, *C. lagopides* is an older synonym of *C. phlyctidosporus* Romagn. in sect. *Alachuani* (Uljé & Noordeloos, 1999).

An additional collection at H, also labelled *Coprinus lagopides* (Finland, Travastia australis, Tammela, Mustala, 4 Aug. 1884, *P.A. Karsten 3758*), appeared to be identical with the current concept of *C. lagopides*, which must be considered a misapplication. The correct name for *C. lagopides* sensu auct. is *C. jonesii* Peck (Uljé & Noordeloos, 1999).

Observations on collection P.A Karsten 3758. (Fig. 11B). Spores [40, 1, 1] 7.8–9.2 × 7.0–7.9 µm; Q = 1.05–1.21, av. Q = 1.16; av. L = 8.7, av. B = 7.5 µm, ovoid, tending to conical at base, truncate at apex, with central, c. 1.3 µm wide germ pore. Veil 10–40 µm wide, made up of chains of cylindrical, somewhat inflate elements, constricted at septa. Clamp-connections present, small.

12. **Coprinus marcidus** Van De Bogart, Mycotaxon 8 (1979) 262 — Fig. 12

Holotype: USA, Montana, Flathead, 8 Sept. 1972, *F. Van De Bogart 2185* (WTU).

Original description. Pileus at first glandiform, then conic, then plano-convex and finally revolute. Prior to expansion 4.0–5.0 mm in length and after expansion 10.0 mm in breadth. Pale grey or white at first under a dark grey to greyish black universal veil layer, then becoming pale grey with white striae where the surface overlies each lamellar trama, and dark grey at the apex. Surface becoming deeply plicate-striate. Universal veil at first obscuring the pileal surface with a continuous fibrillose dark grey to almost black layer that eventually splits into shredlike remnants and becomes widely scattered with a few larger fragments at the pileal apex. Flesh thin at the apex. Stipe slender or filiform, 3.5 cm × 0.6–1.1 mm, tapering slightly from base to apex, hollow but with the lumen containing a column of water. Pale grey to glassy straw color, opaque at base to semitranslucent at apex. Surface covered with coarse and strigose grey fibrils at base and part way up the stipe, apical half glabrous. Flesh extremely thin, watery, and fragile. Lamellae narrowly lanceolate or ellipsoidal, with some lamellulae, 2.0–4.3 × 1.0 mm, free from stipe apex but with all lamellae attached to a rudimentary collarium. Crowded at first then subdistant as plicate striation develops with pileal expansion, pale then soot black. Autodigestion incomplete, only the margins affected by lysis. Odor and taste none.

Spores ellipsoidal, 8.7–13.8 × 6.2–8.3 × 6.2–7.5 µm, mostly round in cross-section but with some larger spores slightly flattened, apiculus large and prominent, germ pore apical, 1.2–1.5 µm in diameter. Color en masse soot black microscopically deep purplish black 3% KOH., walls smooth. Basidia trimorphic, short clavate and 20.0–22.0 × 10.0 µm, long clavate and 30.0–32.0 × 10.0 µm, ululiform and 35.0–36.5 × 8.6–10.0 µm, all 4-spored. Cheilocystida probably present but not observed due to partially lysed condition of lamellar margins. Pleurocystidia few in number, located near the lamellar margins only, ellipsoidal, 60.0–80.0 × 23.0–26.0 µm, apices rounded, hyaline, thin walled, smooth. No other cystidia present. Pileal surface of radially elongated cells, two to three times as long as broad, cell walls

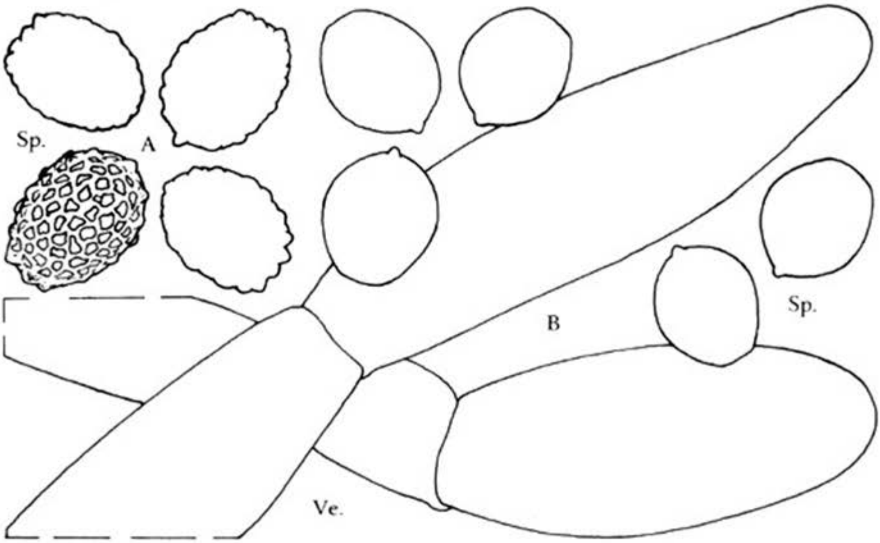


Fig. 11. *Coprinus lagopides* (holotype). A. Spores; B. coll. *P.A. Karsten 3758*. Spores and veil.

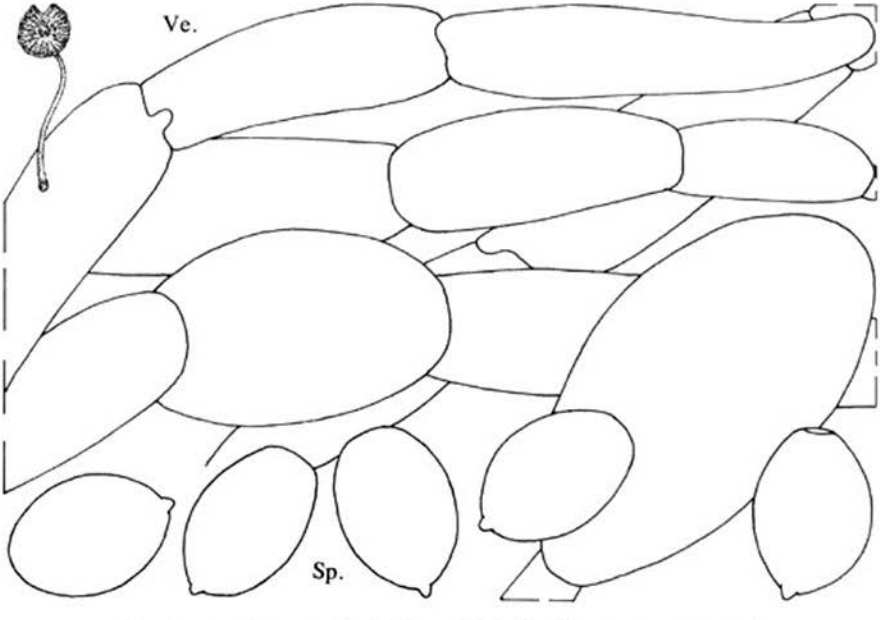


Fig. 12. *Coprinus marcidus* (holotype). Dried basidiocarp, spores and veil.

pale brown in 3% KOH. Universal veil present on pileus and at stipe base as a dark fibrillose layer that splits into small irregular parches but not into small upturned scales. Fibrils and patches composed of chaines of elongate cells 50.0–100.0 × 10.0–27.5 µm, hyaline to pale brownish, thin walled, swollen, constricted at the septa, usually with clamp-connections, unbranched. Some of the chains of cells present at stipe bases are little or not swollen and resemble normal cylindrical hyphae. Clamp-connections present on universal veil on stipe, in pileal trama, and in the lamellar trama.

Habitat. Lignicolous, on a piece of wood buried in a thick moss carpet on the floor of a conifer forest. Solitary.

This species possesses several distinctive features, of which the dark color of the veil and the pronounced absence of autodigestion except the lamellar margins are the most outstanding ones. More subtle but still distinctive characters are the pleurocystidia that are rather small and few in number, and the slightly colored cells of the pileal surface which are elongated radially but do bear some resemblance to the appearance of a cellular type of surface.

Observations on the holotype. Spores [20, 1, 1] 11.2–12.3 × 7.7–8.5 µm, ellipsoid or ovoid, with slightly conical base and truncate apex, and central to slightly eccentric, c. 1.6 µm wide germ pore, dark red-brown; Q = 1.35–1.55, av. Q = 1.45; av. L = 11.7, av. B = 8.1 µm. Basidia c. 26 × 10 µm, 4-spored, surrounded by 3–5 pseudoparaphyses. Cystidia collapsed. Pileipellis hyphoid. Veil made up of hyphoid, thin-walled elements, 40–180 × 7–32(–40) µm, in part somewhat inflated, constricted at septa; terminal cells clavate, ellipsoid or subfusiform. Clamp-connections present, small.

Notes. The type collection consists of just one small basidiocarp with a very dark veil.

13. **Coprinus pachydermus** Van De Bogart, Mycotaxon 8 (1979) 274 — Fig. 13

Holotype: USA, Washington State, Univ. Washington, 5 Oct. 1971, *F. Van De Bogart 237* (WTU).

Original description. Pileus glandiform at first, then conic, then campanulate, and finally revolute and somewhat laciniate. Prior to expansion 0.8–1.1 cm in length and after expansion 1.8–2.2 cm in breadth. Pale grey-white to medium brown at apex at first, then generally darkening as spores mature. Surface faintly striate, but very little plicate striation develops. Entire surface covered at first by a hyaline to pale brown fibrous-scaly universal veil, and when fresh small glistening drops are present. The universal veil is loosely attached and easily dislodged and lost. The true surface is smooth and glabrous. Flesh thin and membranous. Stipe hollow, slender and thin, tapered slightly from base to apex, 6.0–8.5 cm × 2.0–3.0 mm. White, slightly translucent. Surface slightly woolly to silky at apex, becoming increasingly woolly towards the base. Flesh thin and fragile. Lamellae narrowly lanceolate, some short lamellae present, 4.0–10.0 × 2.0–3.0 mm, free and remote, crowded and remaining so until destroyed by lysis, pale then black. Autodigestion destroys the entire pileus. Odor and taste none.

Spores ellipsoidal, nearly round in cross-section, 10.0–11.5 × 6.0–6.4 µm, lacking a perisporium, apiculus large and conspicuous, germ pore apical, 1.2–1.4 µm in diameter. Color en masse soot black, microscopically deep brown in 3% KOH. Spores mostly with one guttule. Walls smooth. Basidia dimorphic, short clavate and 16.5–19.0 × 7.0–8.0 µm, long clavate and 25.0–27.5 × 7.5 µm, all 4-spored. Cheilocystidia probably present but destroyed by lysis of lamellar margin. Pleurocystidia scattered widely over entire lamellar face, not plentiful, not bridging the interlamellar spaces, subglobose and 45.0–50.0 µm in diameter or short ellipsoidal and 68.0 × 40.0–48.0 µm, apices rounded, hyaline, thin walled, smooth. No other cystidia present. Pileal surface of radially oriented hyphae. Universal veil present on pileus as small white upturned loose scales composed of bundles of chains of ellipsoidal to subcylindrical elements, the chains of elements often exceeding 1200 µm in length. Individual cells 50.0–210.0 × 10.0–45.0 µm in size, hyaline, mostly somewhat swollen and constricted at the septa, some of them thin walled but most with walls up to about 1.5 µm thick, smooth, usually with clamp-connections, unbranched. Clamp-connections present on the universal veil, in the pileal trama, and also (a few) on the stipe surface.

Habitat. Lignicolous or sublignicolous, on an open compost pile of rotting wood chips and sawdust. In loose groups.

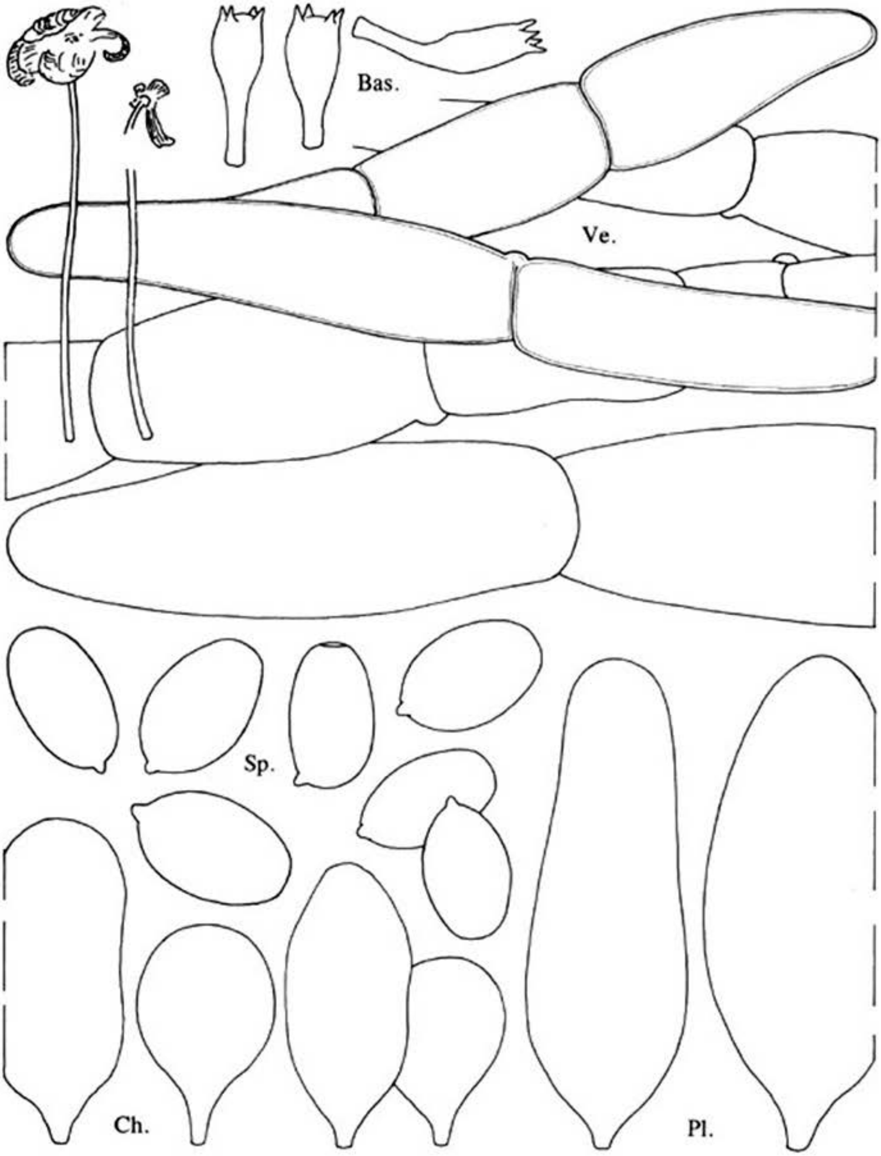


Fig. 13. *Coprinus pachydermus* (holotype). Dried basidiocarps, spores, pleurocystidia, cheilocystidia, basidia and veil.

The exceptionally thick walls of most of the cells of the universal veil and the short subglobose pleurocystidia are distinctive.

Observations on the holotype. Spores [20, 1, 1] 9.3–11.0 × 5.7–7.2 µm, ellipsoid or ovoid, with rounded base and apex (base in part tending to conical), and central to slightly eccentric, c. 1.3 µm wide germ pore, medium to dark red-brown; Q = 1.40–1.75, av. Q = 1.55; av. L = 10.1, av. B = 6.5 µm. Basidia 22–34 × 6–9 µm, 4-spored, surrounded by 3–5 pseudoparaphyses. Pleurocystidia 60–90 × 24–35 µm, utriform or subcylindric. Cheilocystidia 30–50 × 18–25 µm, (sub)globose, ellipsoid or subutriform. Pileipellis hyphoid, made up of mainly inflate hyphae; elements 20–100 × 10–30 µm. Veil made up of hyphoid, thin- or slightly thick-walled elements (0.2–0.7 µm thick), 40–180 × 12–40 µm, in part somewhat inflated and constricted at septa; terminal cells subfusiform. Clamp-connections present.

Notes. The type material consists of a single basidiocarp and a fragment in bad condition, but most microscopical features could be found.

14. **Coprinus palmeranus** Van De Bogart, Mycotaxon 4 (1976) 248 — Fig. 14

Holotype: USA, Washington state, Mason, Olympic National Park, Oct. 1974, *F. Van De Bogart 3340* (WTU).

Original description. Pileus at first glandiform, then conic, then campanulate and becoming revolute, when unexpanded 3.2 cm in length, expanding to 3.0 cm in width. White and light brown at the apex when young, becoming grey-white and brown at the apex with maturity, covered at first with small scales of the universal veil with maturity the universal veil scales becoming scattered and evanescent, slightly plicate striate where not covered with veil, margin at ,first attached to stipe by partial veil, flesh very thin and membranous. Stipe hollow, the lumen stuffed with a loose webbing of hyphae, slender, base bulbous with a slender subtending rhizomorph, shaft tapering slightly towards apex, 8.5 cm × 3.0–7.0 mm, surface smooth and mostly glabrous with an occasional loose fibril, white and opaque, base with a scurfy area and a small free white membranous annulus, flesh somewhat fibrous although fragile. Lamellae lanceolate, free, very crowded, few short lamellulae present, at first white, then pink, then brown, then dark brown, then black. Autolysis complete.

Spores moderately flattened, laterally broadly ellipsoidal, dorsally narrowly ovate, 8.7–10.0 × 5.6–6.3 × 4.3–5.7 µm, apiculus present, small, germ pore slightly eccentric, 1.8 µm in diameter. Color soot black en masse and a dark purplish grey microscopically in 3% KOH. Wall smooth. Basidia trimorphic, short clavate and 20.0–22.5 × 12.5 µm, clavate and 31.2–37.5 × 10.0–11.3 µm, ululiform and 45.0–49.0 × 10.0–12.5 µm, sterigmata with refractive plugs, all 4-spored. Cheilocystidia globose, obovate, lageniform, and ellipsoidal, 10.0 µm in diameter to 46.5 × 19.0 µm. No other cystidia present. Pileal surface a cutis of slender, radially oriented thin-walled hyaline hyphae. Universal veil scales composed of parallel chains of cells, cells cylindrical, some swollen and constricted at the septa, all hyaline, thin-walled 5.0–19.0 in diameter. Annulus membranous, composed of mostly slender cylindrical cells, sparsely septate, somewhat interwoven and anastomosed, hyaline, thin-walled, 2.5–11.5 µm in diameter. Clamp-connections present in stipe context, not common.

Habitat. Terrestrial, on clay soil in open grassy maple woods.

This species bears a striking resemblance to *C. comatus* in its overall appearance. It differs mainly in its much smaller stature and much smaller size of the spores and basidia.

Observations on the holotype. Spores [20, 1, 1] 9.3–11.0 × 6.5–7.8 µm, ovoid with rounded base and apex (base tending to conical), and slightly eccentric, c. 1.5 µm wide germ pore, dark red-brown; Q = 1.35–1.55, av. Q = 1.40; av. L = 10.1, av. B = 7.2 µm. Basidia 20–50 × 10–13 µm, 4-spored, surrounded by 6–9 pseudoparaphyses. Pleurocystidia absent. Cheilocystidia 25–50 × 14–26 µm, (sub)globose, ellipsoid, ovoid, oblong or utri-

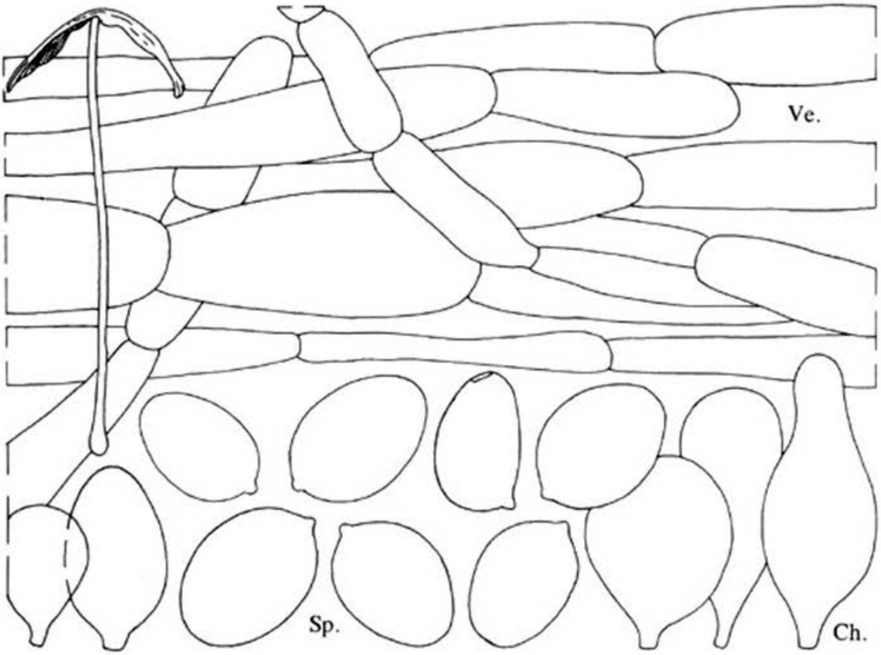


Fig. 14. *Coprinus palmeranus* (holotype). Dried basidiocarp, spores, cheilocystidia and veil.

form. Pileipellis hyphoid, made up of mainly cylindrical hyphae; elements 30–140 × 6–22 µm. Veil made up of cylindrical, thin-walled elements, 40–150 × 4–20(–28) µm, somewhat constricted at septa; terminal cells cylindrical with rounded or tapering apex, sometimes slightly fusoid. Clamp-connections absent.

Notes. The annulus, noted by Van De Bogart, has not been found in the type material.

15. **Coprinus roseistipitatus** Van de Bogart, Mycotaxon 4 (1976) 262 — Fig. 15

Holotype: USA, Washington state, Lewis, Cispus Center, Gufford Pinchot Nat. Forest, 25 Oct. 1975, *F. Van De Bogart 3369* (WTU).

Original description. Pileus at first glandiform, then conic, then campanulate with margins somewhat revolute and laciniate, when unexpanded 2.5 cm in length, expanding to 3.5 cm in width. Pale brown at first and remaining so at the apex, the remainder soon whitish, then black with whitish striae marking the interlamellar spaces. Pileal surface at first covered with smooth universal veil which then become scaly, then scales scattered and evanescent exposing plicate-striate surface. Margin attached to stipe by an annulus at first. Flesh thin and fragile. Stipe slender, tapering gradually toward the apex, 11.5 cm × 4.0–6.5 mm, hollow, lumen with a thinly dispersed webbing of hyphae, surface silky, wrinkled, white at base, in maturity the upper half of the stipe becoming pale pinkish grey, fading to grey when dried, annulus prominent, loose, becoming black on under surface when mature; stipe flesh thin and fragile although fibrous. Lamellae lanceolate, very crowded, free and remote, at first white, then pale pinkish brown, then black. Autolysis complete.

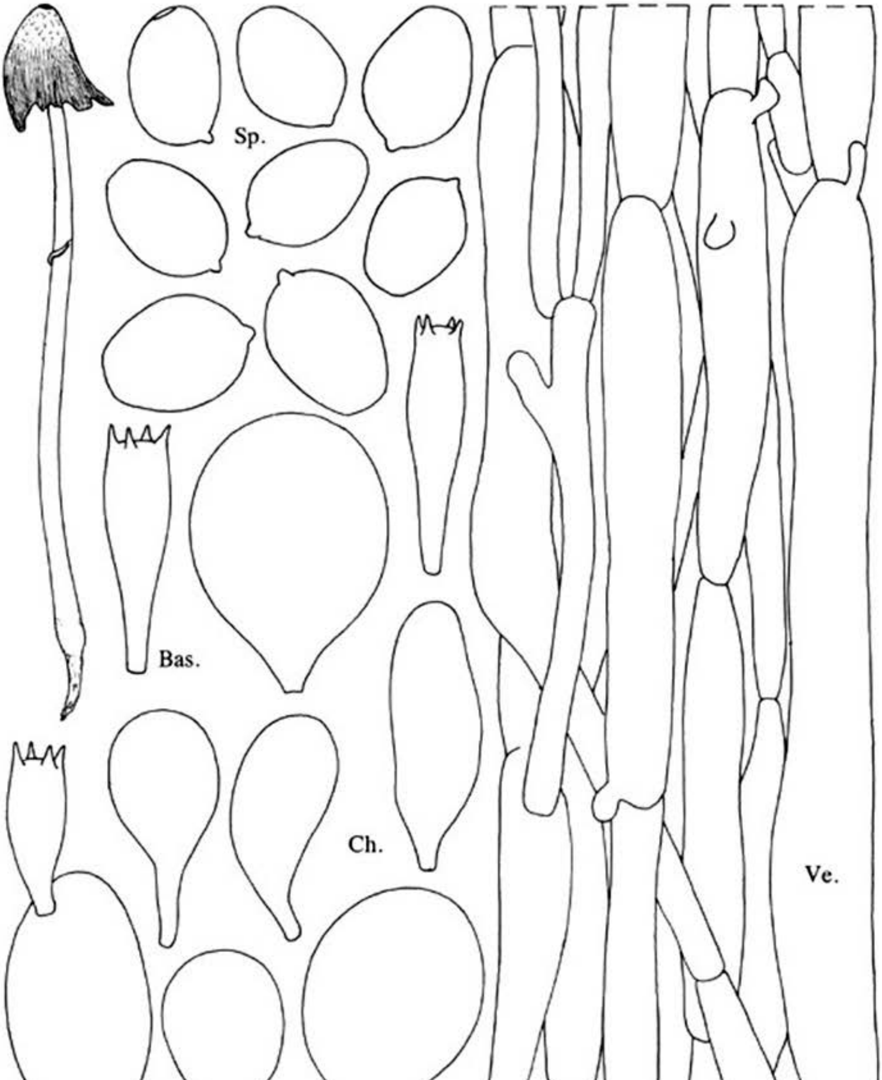


Fig. 15. *Coprinus roseistipitatus* (holotype). Dried basidiocarp, spores, cheilocystidia, basidia and veil.

Spores nearly ovate, the apex slightly narrowed in dorsal view, 9.0–11.0 × 5.5–6.5 × 7.0–7.8 µm, apiculus large and distinct, germ pore somewhat eccentric, 1.5–2.5 µm in diameter. Color soot black en masse and nearly black microscopically in 3% KOH. Wall smooth. Basidia trimorphic, clavate and 25.0–28.0 × 8.0–11.5 µm, long clavate and 40.0–43.5 × 8.0–10.0 µm, ululiform and 48.0–50.0 × 9.0–10.0 µm, all 4-spored, all sterigmata with refringent plugs, all basidia with a median grey pigment band. Cheilocystidia obovate, oblong, clavate, subglobose, occasionally interconnected, mostly pedicellate, 30.0–70.0 × 17.0–33.0 µm, pedicels up to 20 µm in length, cells distinctly pink en masse until destroyed by lysis. No other cystidia present. Pileal surface a compact layer of cylindrical, septate, thin-walled, radially oriented hyphae, in maturity mostly pigmented dark grey-brown, some cells dark, some light, some pigment in the walls, some pigment the intercellular spaces. Universal veil of scales on pileus and tomentum at stipe base. Scales of long parallel chains of slightly swollen cells, cells cylindrical, 5.0–22.0 µm in diameter, thin-walled, hyaline, rarely branching, showing some tendency to separate at the septa, smooth. Tomentum at stipe base very thin, composed of slender, cylindrical, hyaline, thin-walled hyphae, seldom branched, very interwoven, 3.0–6.0 µm in diameter, septation sparse. Annulus 1.0 µm wide. Clamp-connections absent.

Habitat. Coprophilous, on rabbit or deer dung in a very moist hardwood rain forest. Substrate covered a thin but persistent white felt-like mycelium.

This species somewhat resembles *C. sterquilinus* but differs in the brown color of the universal veil when young, the much smaller spores, the pink color of the stipe apex, the pink cheilocystidia, the blackening of the undersurface of the annulus, and the median grey band on each basidium.

Observations on the holotype. Spores [20, 1, 1] 8.7–10.7 × 6.3–7.9 µm, ovoid with rounded base and apex (base tending to conical), and slightly eccentric, c. 1.6 µm wide germ pore, dark red-brown; Q = 1.30–1.45, av. Q = 1.40; av. L = 9.7, av. B = 6.9 µm. Basidia 20–50 × 10–13 µm, 4-spored, surrounded by 5–8 pseudoparaphyses. Pleurocystidia absent. Cheilocystidia 30–48 × 14–38 µm, subglobose, ellipsoid, oblong or utriform. Pileipellis hyphoid, made up of mainly cylindrical hyphae; elements 30–150 × 4–18 µm. Veil made up of cylindrical, thin-walled elements, 30–150 × 4–18 µm, somewhat constricted at septa; terminal cells cylindrical with rounded or tapering apex. Only pseudoclamps found.

Notes. The collection consists of a single good basidiocarp. A part of the ring is still present on this specimen. The apex of the sterigmen is dark. This character is also found in *C. spadiceisporus*.

16. **Coprinus scobicola** P.D. Orton, Notes R. bot. Gdn Edinb. 32 (1972) 147 (Notes on British Agarics IV) — Fig. 16

Holotype: England, Devon, Plym Bridge, on sawdust, 29 Aug. 1956, *Orton 964* (E).

Original description. Cap ovoid or cylindric-ovoid 16–22 × 9–11 mm, them expanded-convex up to 30 mm broad, sometimes split at the margin, grey then tinged clay-buff at centre, at first covered with white "recurved fibrillose scales, those at centre often dirty brownish and thick and shaggy, then becoming" smooth as cap expands and plicate-striate to disc. Gills narrowly adnate to free, soon grey then black, crowded, edge white flocculose when fresh. Stem 35–50 × 2.5–4 mm, attenuated upwards, white, at first minutely flocculose with 'tomentose base, becoming' smooth as cap expands, hollow. Flesh very thin, grey at disc. Smell none. Spore-print blackish.

Spores ellipsoid or slightly ellipsoid-amygdaliform with central germ-pore, 11.5–14 × 7–8.5 µm, very dark sub micr. Basidia 2-spored. Marginal cystidia pyriform or shortly vesiculose, 30–54 × 24–44 µm. Facial cystidia cylindric-vesiculose, 80–110 × 30–40 µm. Hyphae of veil on cap cylindric or narrowed at septa, ca. 50–100 × 8–20 µm.

Habitat. On sawdust.

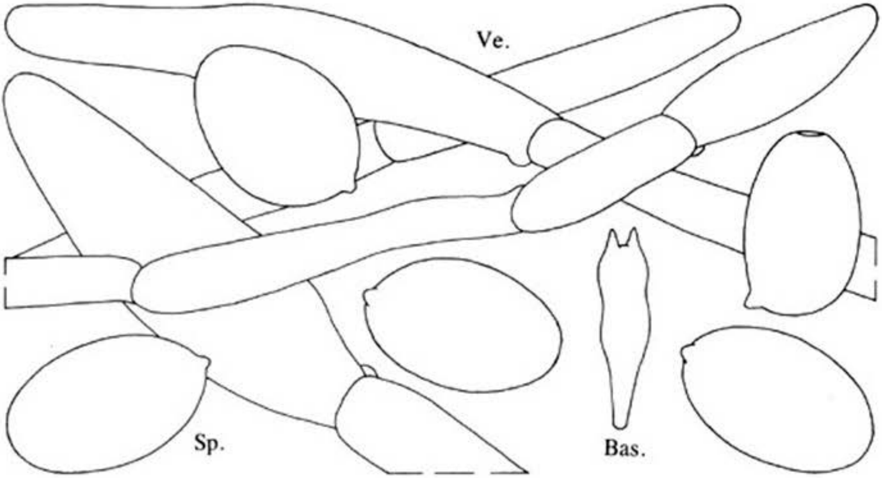


Fig. 16. *Coprinus scobicola* (holotype). Spores, basidium and veil.

Superficially resembling *C. episcopalis* but well characterised by different habitat and 2-spored basidia. It belongs to section *Picacei* with narrow to fairly broad hyphae (1–20 µm broad) in the veil.

Observations on the holotype. Spores [20, 1, 1] (11.5–)12.6–14.0(–16.3) × (7.8–)8.3–9.3(–10.4) µm, ovoid or ellipsoid with rounded base and apex, and central to slightly eccentric, c. 1.8 µm wide germ pore, very dark red-brown; Q = 1.40–1.60, av. Q = 1.50; av. L = 13.3, av. B = 8.8 µm. Basidia 23–32 × 7–8 µm, 2-spored, surrounded by 4–5 pseudoparaphyses. Cystidia collapsed. Pileipellis hyphoid. Veil made up of cylindrical, thin-walled elements, 70–150 × 4–17 µm, somewhat constricted at septa or not; terminal cells fusoid, (sub)cylindrical with rounded apex or tapering towards obtuse apex. Clamp-connections present, small.

Notes. The holotype consists of two basidiocarps in a bad state. The spores were found to be broader and slightly larger than in the original description.

17. **Coprinus spadiceisporus** Van De Bogart, Mycotaxon 4 (1976) 245 — Fig. 17

Holotype: USA, Washington State, exact locality and date unknown, *F. Van De Bogart 217* (WTU).

Original description. Pileus at first ovate-ellipsoidal, then conical, then campanulate, and eventually somewhat revolute, when unexpanded from 3.0–3.8 cm long, expanding to 5.0 to 6.0 cm wide. Whitish when young but soon grey from ripening spores, the apex pale brownish, soon entirely dark greyish brown, except the apex which remains paler brown. Radial pileal striations apparent even at young stage and soon developing into plicate striations. Surface covered with a universal veil of small somewhat appressed scales of dingy or dirty white color, becoming much looser in age and more scattered but even then more or less persistent. Flesh rather thin and membranous. Leaves and debris stuck to pileal surface. Stipe hollow, rather stout for *Coprinus*, 10.0–12.0 cm × 5.0–8.0 mm. Prominent, loose, white, felty annulus present, about 1 mm in width. Hollow center filled with a weblike mass of loose hyphae. Outer surface smooth and glabrous except for a loose tomentum of woolly hairs at the base. White in color at first but

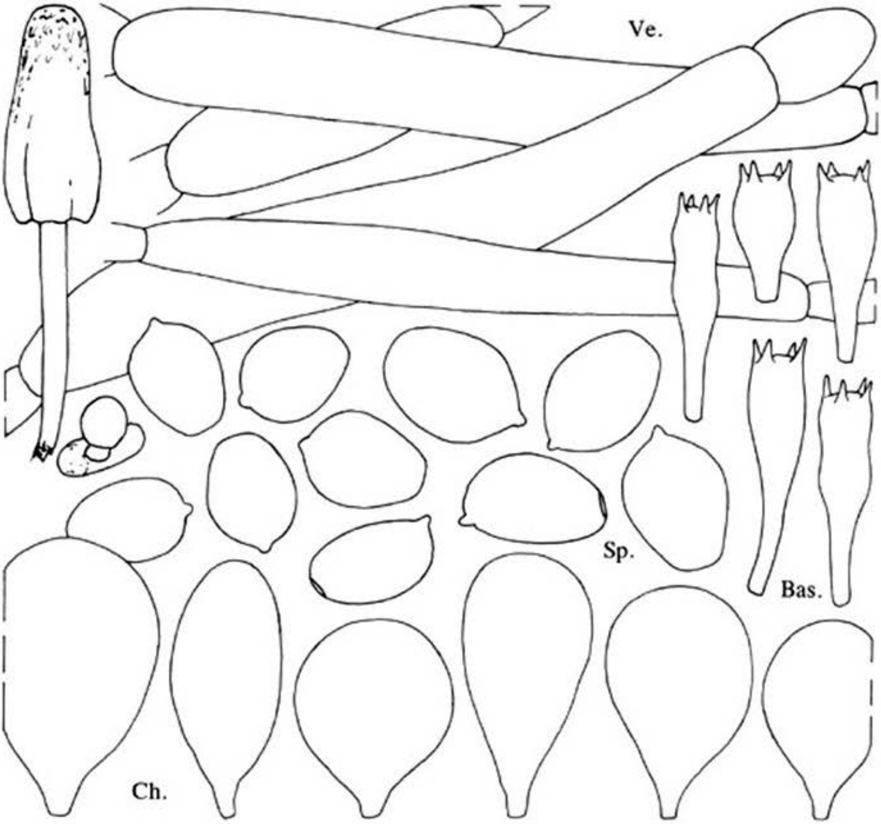


Fig. 17. *Coprinus spadiceisporus* (holotype). Dried basidiocarps, spores, cheilocystidia, basidia and veil.

soon darkening to light brownish over most of its length and becoming dark, almost black near the apex, opaque. Flesh rather thick and fibrous for a *Coprinus*. Lamellae lanceolate, 2.5–4.0 mm broad, free and remote, crowded, dark brownish black when mature. Autolysis complete.

Spores ovate-ellipsoidal, slightly flattened, basal end broader than apical end, 8.1–10.0 × 6.2–6.9 × 5.0–5.6 µm, apiculus and germ pore both prominent, germ pore eccentric, 1.5–2.0 µm in diameter. Color dark blackish brown en masse and a clear translucent chestnut brown microscopically in 3% KOH. Wall smooth. Basidia trimorphic, short clavate and 12.5–17.5 × 10.0–11.2 µm, long clavate and 20.0–25.0 × 10.0–11.2 µm, ululiform and 28.7–35.0 × 10.0–11.2 µm, all 4-spored. Cheilocystidia globose to more or less ovate, 15.0 µm in diameter to 42.5 × 30.0 µm intermixed with thin filamentous hyphae on gill edge. No other cystidia present. Pileal surface a cutis of radially oriented hyphae. Universal veil scales composed of fibrils aligned parallel to each other and composed of chains of unbranched, often swollen cells 6.2–20.0 µm in diameter, often constricted at the septations and then catenulate, also tending to break up into single loose cells. All cells of the universal veil with smooth, thin, hyaline walls, and all adjacent cells of the universal veil tending to be of similar size and shape. Clamp-connections present on the hyphae of the stipe surface and occasionally on the universal veil.

Habitat. Coprophilous, on rabbit or deer dung.

This species shares a peculiar feature with two other species of section *Coprinus, C. sterquilinus* and *C. colosseus*, namely, the discoloring and eventual blackening of the apical portion of the stipe flesh. The ovate, flattened spores with their clear light brown color seem distinctive.

Observations on the holotype. Spores [20, 1, 1] 8.2–10.3 × 5.8–7.3 µm, ovoid or slightly mitriform with rounded or conical base and rather truncate apex, and slightly eccentric, 1.6–1.8 µm wide germ pore, dark red-brown; Q = 1.25–1.45, av. Q = 1.35; av. L = 9.1, av. B = 6.7 µm. Basidia 22–42 × 10–12 µm, 4-spored, surrounded by 5–8 pseudoparaphyses. Pleurocystidia absent. Cheilocystidia 30–50 × 17–30 µm, (sub)globose, ellipsoid or oblong. Pileipellis hyphoid, made up of mainly cylindrical hyphae; elements 50–130 × 10–20 µm. Veil made up of cylindrical, thin-walled elements, 30–180 × 6–25 µm, somewhat constricted at septa; terminal cells cylindrical with rounded or tapering apex. Only pseudoclamps found.

Notes. The holotype consists of a single young specimen and a primordium on a small twig. White mycelium is still visible at the base of the stipe. The apex of the sterigmen is dark, as in *C. roseistipitatus*.

18. **Coprinus sylvicola** Van De Bogart, Mycotaxon 8 (1979) 257 — Fig. 1A

Holotype: USA, Oregon, Camp Kilowan, 27 April 1972, *F. Van De Bogart 297* (WTU).

Original description. Pileus at first long, slightly tapered from base to apex but almost cylindrical, with the apex obtusely rounded, becoming conic, then campanulate with a flaring margin, and finally revolute, prior to expansion 1.5–2.0 cm in length and after expansion 1.8–2.3 cm in breadth, medium grey and apex medium grey-brown at first, but soon becoming generally dark grey and dark grey-brown at the apex. Some plicate striations present early under the universal veil and often prominent in partially expanded pilei. Surface almost smooth but close examination reveals minute reddish brown scales or filaments. Flesh thin. Stipe hollow, slender, slightly tapered from base to apex, 7.0–9.0 cm × 1.5–2.5 mm, greyish to dirty white, opaque. Surface mostly smooth and glabrous but with a few appressed scalelike patches on lower one-third of stipe. Flesh thin, fragile, and brittle. Lamellae narrowly linear-lanceolate, few, if any, lamellulae, 1.8 cm × 1.5–2.0 mm, free and remote, extremely crowded at first then subdistant due to development of plicate striations as pileus expands, white, then pale reddish brown, then dark blackish brown, and finally soot black. Autodigestion destroying most of each lamella and most of the rest of the pileus. Odor and taste none .

Spores ellipsoidal with tapering ends nearly round in cross-section, 13.7–15.0 × 7.2–7.8 µm, lacking a perisporium, apiculus large and prominent, germ pore apical, 1.0–1.2 µm in diameter, Color soot black en masse, microscopically deep purple-black in 3% KOH. Walls smooth. Basidia variable in shape and size. The shapes intergrade from clavate to long clavate to subululiform ululiform, and sizes range from 25.0–51.0 × 10.0–12.0 µm. All 4-spored. Cheilocystidia ovate to ellipsoidal, 48.0–77.5 × 22.5–40.0 µm, hyaline, thin walled, smooth. Some hyaline, smooth, thin walled, branched and anastomosed cylindric hyphae 1.5–6.3 µm in diameter present, also along lamellar margin. Pleurocystidia ovate to ellipsoidal, 63.0–75.5 × 30.0–40.0 µm, hyaline, smooth, thin-walled, few in number and present mostly near the lamellar margin. No other cystidia present. Pileal surface of radially oriented hyphae. Universal veil on pileus and at base of stipe of loose scales composed of long chains of swollen cells, 38.0–102.0 × 3.0–25.0 µm, constricted at the septa, hyaline, thin walled, smooth, seldom branched. Pileal context pallid yellow-brown in 3% KOH. The subhymenium of each side of each Lamella is also yellow-brown in 3% KOH while the thin layer of median lamellar trama is hyaline. Clamp-connections present on stipe, universal veil, pileal trama, and lamellar trama.

Habitat. Terrestrial or sublignicolous, on leaves and debris among chunks of rotten conifer wood lying on the soil in an old second-growth mixed forest. Small loose groups.

This species is notable for the variation and intergradation in sizes and shapes of the basidia, the very long, almost cylindrical shape of the unexpanded pileus, and the yellow-brown color of the pileus context and the subhymenium.

Observations on the holotype. Spores [20, 1, 1] 11.8–13.8 × 7.1–7.9 µm, ellipsoid or ovoid with somewhat conical base and rather truncate apex, and central, c. 1.6 µm wide germ pore, very dark red-brown; Q = 1.60–1.90, av. Q = 1.75; av. L = 13.2, av. B = 7.5 µm. Basidia, pseudoparaphyses, cystidia and veil collapsed. Clamp-connections present.

Notes. The type material is in a very bad state and consists of two old specimens.

19. **Coprinus tectisporus** Van De Bogart, Mycotaxon 8 (1979) 276 — Fig. 18

Holotype: USA, Washington State, Seattle, Mar. 1950, *F. Van De Bogart 2171* (WTU).

Original description. Pileus at first long glandiform, then becoming conic, then campanulate and finally revolute. Prior to expansion 1.0–1.4 cm in length an after expansion 1.0 cm in breadth. Pale whitish at first then becoming grey with whitish scales, apex becoming dark grey. Fine plicate striations develop as pileus expands. Surface at first covered with a white fibrillose universal veil composed of parallel fibrils which soon breaks up into small, loose, white, recurved scales, exposing the smooth, glabrous surface. Flesh thin and fragile even at the apex. Stipe hollow, slender, 4.0–5.0 cm × 1.5–3.0 mm, enlarged at the base somewhat and inserted into substrate about 1.0 cm, tapering from base to apex, base ornamented with a ring of fibrils marking the site of attachment of the margin of the unexpanded pileus. Surface minutely fibrillose almost to apex, white and opaque. Flesh thin and fragile. Lamellae narrowly lanceolate, some lamellulae present, 0.4–1.3 cm × 3.0 mm, free and close to adnexed, extremely crowded at first, then less crowded as plicate striation develops when pileus expands, pale then deep purplish black. Autodigestion complete. Odor and taste not observed.

Spores ellipsoidal, round in cross-section, 10.9–15.0 × 7.5–8.8 µm, apiculus medium sized and generally visible, germ pore apical, 2.4–2.6 µm in diameter. Color en masse deep purplish black, microscopically deep purple to almost opaque black in 3% KOH. Walls thick 1.8–1.9 µm, smooth when first mounted in 3% KOH, then, after some minutes soaking and gentle pressure on the coverglass, a loose brownish perisporium may be dislodged. Basidia dimorphic, clavate and 18.0–23.0 × 10.0 µm, ululiform 28.0–31.5 × 10.0 µm, all 4-spored. Cheilocystidia mostly globose but some ellipsoidal cells also present, globose and 18.5–39.0 µm in diameter, ellipsoidal and 40.0 × 20.0 µm, smooth, thin walled, hyaline. Pleurocystidia broadly ovate to ellipsoidal, very numerous, 77.5–137.5 × 42.5–55.0 µm hyaline, thin walled, smooth. No other cystidia present. Pileal surface of radially oriented cylindric hyphae. Universal veil present on pileus as scales composed of loosely aggregated chains of cells, and at the base of the stipe as a fringe of similar chains of cells. Most cells in each chain are swollen and constricted at the septa, some cells cylindrical and not swollen, all thin walled, smooth, hyaline, 37.5–313.0 × 5.0–52.5 µm. Clamp-connections present on universal veil, in lamellar trama, and a few in the stipe.

Habitat. Terrestrial, on soil mix in a greenhouse, solitary or in loose clusters.

The perisporium and thickness of the spore wall are distinctive features of this species.

Observations on the holotype. Spores [20, 1, 1] 12.1–15.1 × 7.9–9.0 µm, cylindrical ellipsoid or ellipsoid with rounded base and apex, and central, c. 1.8 µm wide germ pore, dark to very dark red-brown; episporium present; Q = 1.45–1.85, av. Q = 1.60; av. L = 13.3, av. B = 8.4 µm. Basidia 15–40 × 8–10.5 µm, 4-spored, surrounded by (3–)4–5(–6) pseudoparaphyses. Pleurocystidia 70–100 × 30–50 µm, ellipsoid, oblong, utriform or subcylindric. Cheilocystidia 60–90 × 32–45 µm, (sub)globose, ellipsoid or oblong. Pileipellis hyphoid, made up of mainly cylindrical hyphae. Veil made up of cylindrical, thin-walled elements, 40–150 × 10–50 µm, somewhat constricted at septa; terminal cells cylindrical with rounded or tapering apex. Clamp-connections not distinct.

Notes. The holotype of *C. tectisporus* is in rather a good condition and consists of three young and two very young basidiocarps, together with some fragments of old basidiocarps.

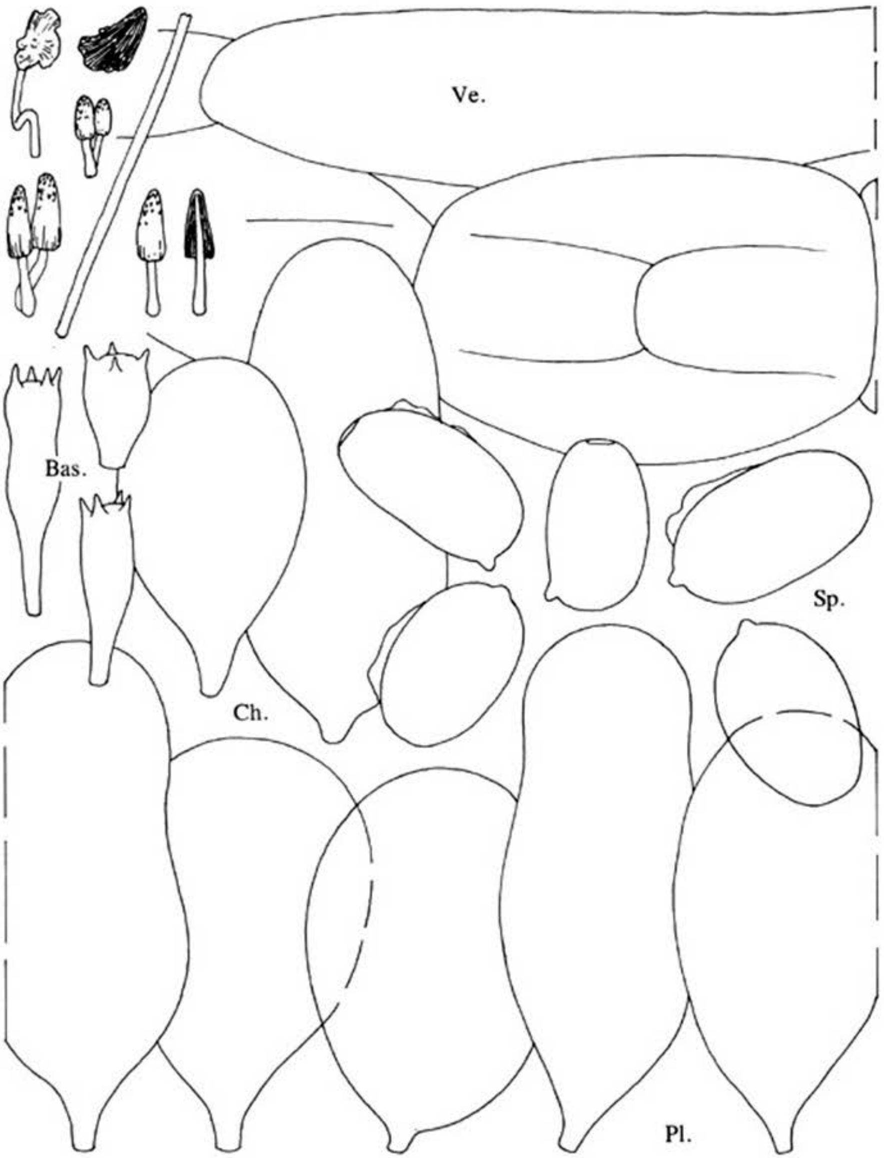


Fig. 18. *Coprinus tectisporus* (holotype). Dried basidiocarps, spores, pleurocystidia, cheilocystidia, basidia and veil.

20. **Coprinus undulatus** Van De Bogart, Mycotaxon 8 (1979) 250 — Fig. 19

Holotype: USA, Washington State, Thurston, 20 Nov. 1973, *F. Van De Bogart 2182* (WTU).

Original description. Pileus at first long-glandiform or truncate-ellipsoidal, then narrowly conic then narrowly conic, then narrowly campanulate, and finally becoming laciniate and somewhat revolute. Prior to expansion 1.0–3.1 cm in length and after expansion 1.0–3.4 cm in breadth, covered at first by white to pale tan universal veil, the surface beneath pale brown to hygrophanous brown at the apex, at maturity becoming dark hygrophanous grey with a hint of brown and dark brownish grey at the apex, faintly striate at first, eventually becoming slightly plicate-striate. The plicate striations do not seem to involve the trama of any of the lamellae. Universal veil thin, interwoven, adherent, by maturity mostly disappearing. Flesh thin and membranous but up to 1.0 mm thick at the apex. Stipe hollow, slender, tapered from base to apex, 2.0–6.0 cm × 1.5–6.0 mm. White and opaque. When young, loose hyphae often present in upper half of lumen. Most of surface smooth and glabrous silky in appearance. In button stages, some small patches of universal veil at the base. Base somewhat fleshy, fragile by the end of spore production. Lamellae narrowly lanceolate, mostly full length, only a few lamellulae present, 0.9–3.0 cm × 2.0–5.0 mm, free, extremely crowded and remaining so until lysis. White, then pale bronze, then bronze, then grey, and finally sooty black. Autodigestion complete, with the entire pileus lysed. Odor and taste none.

Spores globose, 7.9–11.3 μm in diameter, round in any section, lacking a perisporium, apiculus large, 1.2 × 1.2 μm, germ pore apical, 2.2–2.5 μm in diameter. Color en masse sooty black, microscopically dark purple-brown in 3% KOH. Contents seem finely granular. Wall smooth. Basidia dimorphic, short clavate and 20.2–27.0 × 9.0–10.7 μm, long clavate and 31.5–37.0 × 10.3–11.3 μm all 4-spored. Cheilocystidia variable in shape, sphaerocysts 11.2–36.0 μm in diameter, ovate to ellipsoidal, 22.5–92.4 × 17.0–29.3 μm, hyaline, smooth, thin walled, forming a broad band on the lamellar margin. Pleurocystidia long-oblong to long-ellipsoidal 112.0–168.0 × 27.0–58.3 μm, apices rounded, pedicels usually present, about 6 μm long, hyaline, thin walled, smooth. No other cystidia present. Pileal surface of thin-walled, radially oriented hyphae that revive poorly. Universal veil of cylindrical filaments, not swollen or constricted at the septa although of large diameter, 23.6–110.0 × 5.1–10.0 μm, thin walled, with abundant cytoplasm in fresh material, hyaline, most cells curved. Cells tending to form hypha-like chains although many loose cells are present, and very often there are collapsed empty cells. A few cells branch once, and some show slightly thickened spots on the cell wall. Veil present mostly on pileal surface and in small amounts at the base of the stipe of young specimens. The chains of veil elements are more or less radially oriented but sinuous due to the curvature in the wall of most cells. Clamp-connections present only (?) on stipe.

Habitat. Terrestrial or subcoprophilous on prepared compost intended for commercial production of *Agaricus brunnescens* in closed controlled-environment buildings. In large clusters.

The universal veil elements and spores of this species are distinctive, and the habitat seems to be unique. Personal communications with the staff mycologist of the Ostrom Mushroom Company of Lacey, Washington, indicate that this species is considered a pest, detrimental to obtaining maximum yields of *Agaricus brunnescens* Peck, Bull. Torrey Bot. Club 27: 16, 1900 (= *A. bisporus*). The spores or mycelium of *Coprinus undulatus* appear to be capable of surviving the company's present sterilization techniques for the compost.

Observations on the holotype. Spores [20, 1, 1] 9.3–11.3 × 9.3–10.2 × 7.7–8.3 μm, (sub)-globose, with eccentric, c. 1.3 μm wide germ pore, dark red-brown; Q = 1.00–1.15, av. Q = 1.05–1.10; av. L = 10.5, av. B = 9.8 μm. Basidia 16–28 × 9–10.5 μm, 4-spored, surrounded by 5–7 pseudoparaphyses. Pleurocystidia absent. Cheilocystidia 40–60 × 10–18 μm, clavate or oblong. Pileipellis hyphoid, made up of mainly cylindrical hyphae. Veil made up of cylindrical, thin-walled elements, 30–100 × 3–18 μm, somewhat constricted at septa or not; terminal cells cylindrical, not distinct. Clamp-connections not found.

Notes. The type collection consists of one old and six young basidiocarps.The veil on the pilei is collapsed, and was therefore examined from the base of the stipes.

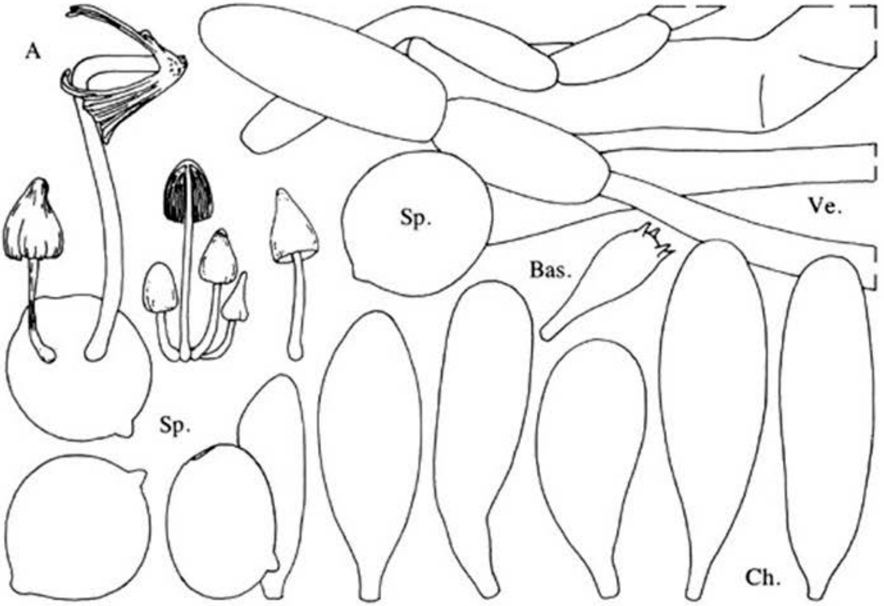


Fig. 19. *Coprinus undulatus* (holotype). Dried basidiocarps, spores, cheilocystidia, basidium and veil.

21. **Coprinus xerophilus** Van De Bogart, Mycotaxon 4 (1976) 255 — Fig. 20

Holotype: USA, Utah, Nephi, Juab, 15 June 1957, *F. Van De Bogart 2159* (WTU).

Original description. Pileus short glandiform to subglobose, then rounded conic, then broadly campanulate and eventually revolute, apex remaining somewhat broadly domelike, upon expansion becoming 1.6 to 4.0 cm broad, white a first and remaining white where covered by the universal veil. Margins eventually becoming black due to spore production and lysis. Surface showing only a small amount of plicate striation where not covered by the universal veil along the margin, mostly covered by a thick, densely interwoven universal veil which may remain in one caplike piece or break up into irregular patches and areolae, the surface under the universal veil usually becoming evident only upon complete pileal expansion and then mostly along the pileal margin. Flesh under the thick universal veil thin and membranous, only becoming about 1.0 mm thick at the apex. Stipe hollow, stuffed with widely spaced and more or less loose hyphae that sometimes form a fine webbing or a slender yarnlike thread in the center of the lumen, somewhat slender, nearly equal above the distinctly bulbous base, 4.0–7.5 cm × 2.5–6.0 mm, and the base itself 6.0–12.0 mm in diameter, white and opaque. Bulb of stipe base with a distinct volvate ridge on its upper surface, well separated from the stipe shaft. Flesh fairly thick and fibrous, up to 1.5 mm thick, the base tending to be solid. Surface of base outside of the volva covered with sand grains and debris. Lamellae narrowly ovate to lanceolate, some short lamellulae present, but sometimes few in number 0.8–2.8 × 1.0–1.2 cm, free and remote to free and close, crowded at first, then somewhat less crowded with the limited development of plicate striation as the pileus expands, pale then black. Autolysis fairly complete, the lamellae all lysing and only the universal veil and part of the pileal surface remaining. Odor and taste unknown.

Spores broadly ovate to somewhat mitriform in dorsal view, ovate-ellipsoidal in lateral view, somewhat flattened 17.5–22.6 × 11.2–16.3 × 10.6–12.5 µm, apiculus sometimes large and conspicuous, and some-

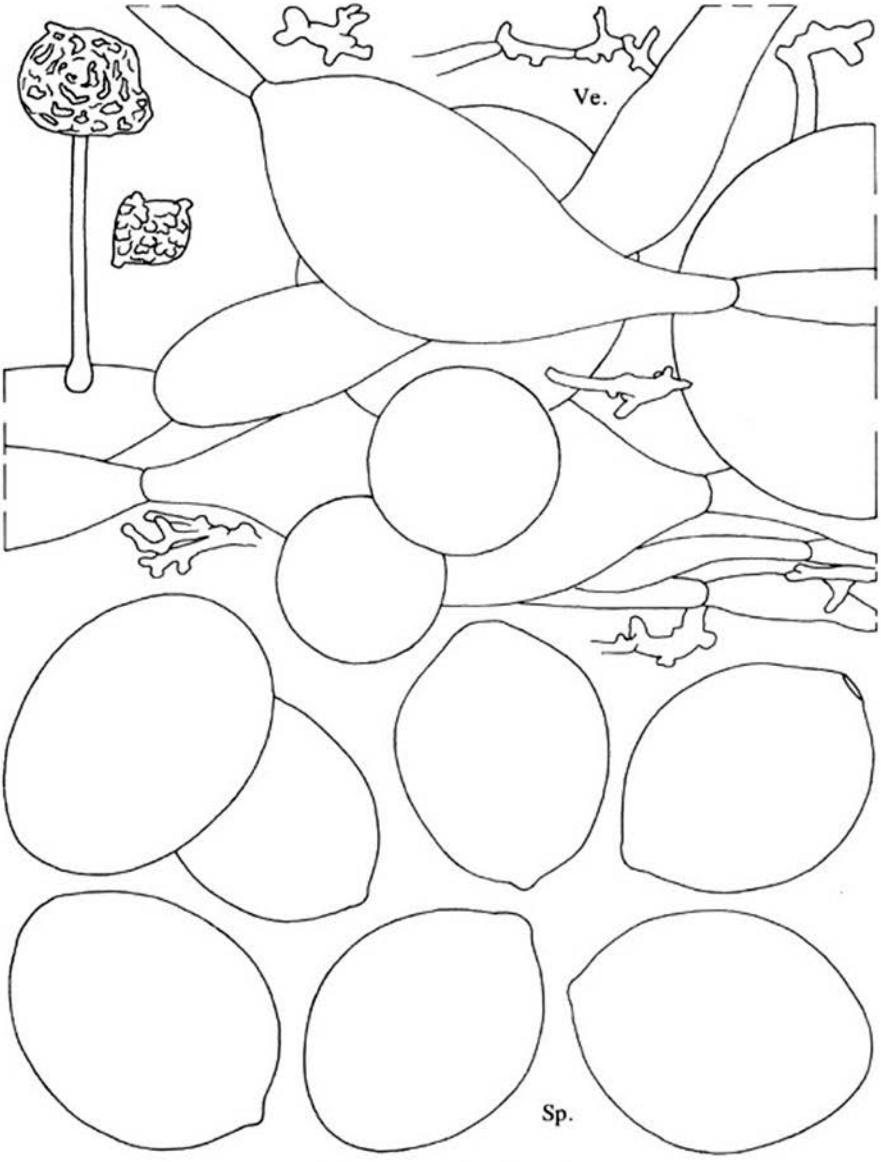


Fig. 20. *Coprinus xerophilus* (holotype). Dried basidiocarps, spores and veil.

times small and not conspicuous, germ pore eccentric and broad, 2.5–3.2 µm in diameter. Color en masse soot black, microscopically deep clear brown to deep purplish brown in 3% KOH. Wall smooth. Basidia trimorphic, short clavate and 38.8–47.5 × 18.8 µm, long clavate and 50.0–62.5 × 17.5–18.8 µm, subululiform and 53.8–60.5 ×17.5–25.0 µm, all 4-spored, sterigmata pigmented or plugged. Cheilocystidia probably present but destroyed by lysis of lamellar margin. No other cystidia present. Pileal surface a cutis of radially oriented hyphae. Universal veil consisting of a thick feltlike portion on the pileus and a distinct volvate rim on the upper part of the bulbous base of the stipe, the pileal universal veil composed of long chains of cylindrical to sausagelike swollen cells that are constricted at the septations. All cells smooth, hyaline, and thin walled, 25.0–195.0 × 3.7–50.5 µm. Some narrow hyphae interwoven among the swollen cells and sometimes anastomosed with them, appearing to bind the larger filaments together. The volval universal veil composed of the same kind of elements but having a larger proportion of the slender nonswollen filaments. Clamp-connections present on stipe and sometimes on universal veil elements.

Habitat. Terrestrial, on sandy or gravelly soil in dry to semi-arid areas, solitary or in groups of scattered individuals.

This species is closely related to two other species, *C. asterophorus* and *C. asterophoroides*. It differs from *C. asterophorus* in its larger flattened spores, much larger basidia, persistent stipe thread, nonasteriform universal veil remnant on the pileus, and white universal veil as opposed to honey yellow to chamois. *C. xerophilus* differs from *C. asterophoroides* in its pileal universal veil of scattered patches, larger germ pore, presence of a bulbous volvate stipe base, and lack of a pigmented apex of the basidia. These species bear a striking superficial resemblance to the gasteroid genus *Montagnea*.

Observations on the holotype. Spores [20, 1, 1] 16.0–21.3 × 11.7–16.4 µm, (broadly) ellipsoid or tending obovoid with rounded base and apex, with slightly eccentric to almost central, c. 1.8 µm wide germ pore, very dark red-brown, almost black; Q = 1.25–1.40, av. Q = 1.30; av. L = 19.2, av. B = 14.8 µm. Basidia, pseudoparaphyses and cystidia collapsed. Veil a mixture of hyphoid, ellipsoid or fusoid elements, 10–125 × 2–50 µm, and (sub)globose cells, up to 80 µm in diam.; connective hyphae numerous, collaroid, diverticulate and 1.5–4 µm wide. Clamp-connections not found.

Notes. The type material is in bad condition and consist of only a single entire basidiocarp plus a fragment. Only the characteristics of the veil and spores could be determined.

ACKNOWLEDGEMENTS

The directors of the herbaria B, E, G, H, NYS, WTU and Dr. R. Courtecuisse, Lille are thanked for loan of the collections.

REFERENCES

Bender, H. 1987. Coprinus krieglsteineri nov. spec. und Coprinus bisporiger in der BR Deutschland. Beitr. Kenntn. Pilze Mitteleur. III: 215–221.

Uljé, C.B. 1992. A new species of Coprinus from the Netherlands. Persoonia 14: 565–569.

Uljé, C.B. & C. Bas. 1993. Some new species of Coprinus from the Netherlands. Persoonia 15: 357–368.

Uljé, C.B., F. Doveri, & M.E. Noordeloos. 2000. Additions to Coprinus subsection Lanatuli. Persoonia 17: 465–471.

Uljé, C.B. & M.E. Noordeloos. 1996. Type studies in Coprinus subsect. Alachuani. Proc. Kon. Ned. Akad. v. Wetensch. 99: 105–124.

Uljé, C.B. & M.E. Noordeloos. 1997. Studies in Coprinus IV – Coprinus sect. Coprinus. Subdivision and revision of subsection Alachuani. Persoonia 16: 265–333.

Uljé, C.B. & M.E. Noordeloos. 1999. Studies in Coprinus V – Coprinus sect. Coprinus. Revision of subsection Lanatuli Sing. Persoonia 17: 165–199.

Van De Bogart, F. 1976. The genus Coprinus in Western North America, part. 1. Sect. Coprinus. Mycotaxon 4: 233–275.

PERSOONIA
Volume 17, Part 3, 377–406 (2000)

STUDIES IN TROPICAL AFRICAN LACTARIUS SPECIES
8. A synopsis of the subgenus Plinthogali

ANNEMIEKE VERBEKEN

Universiteit Gent, Vakgroep Biologie, Lab. Plantkunde, K.L. Ledeganckstraat 35,
B-9000 Gent, Belgium. E-mail: mieke.verbeken@rug.ac.be

A review is given of the tropical African representatives of the genus *Lactarius* subgenus *Plinthogali* (Burl.) Hesler & Smith. In this subgenus the new section *Nigrescentes* Verbeken (incl. *L. orientalis* stat. nov.) is defined for species with a blackening context. For the species with a rather smooth, sometimes shiny cap and latex changing to greyish-brownish when drying, the section *Pseudofuliginosi* Verbeken sect. nov. is proposed (incl. *Lactarius atroolivinus* Verbeken & Walleyn spec. nov.). All other representatives are provisionally classified in the section *Plinthogali* (incl. *Lactarius sulcatus* Verbeken & Walleyn spec. nov., *L. tenellus* Verbeken & Walleyn nom. nov.) before a more worldwide revision permits a further split of this diverse group. A checklist of the species is given, supplemented with illustrated descriptions of some species.

The taxonomic position of *Arcangeliella dolichocaulis* Pegl., showing affinities with *Lactarius* subgenus *Plinthogali*, is discussed.

In an account of North American *Lactarius* species Burlingham (1908) defines the group *Plinthogalae* as medium-sized milkcaps with a dry, pruinose to velvety, dark brown, smoky brown or putty-coloured to paler pileus, a rather firm context, pruinose gills which become darker with age, mild or acrid, and salmon-coloured or white latex which is either unchanging or changing to salmon-pink, at least where in contact with the broken flesh, or in some species becoming yellow. Seven species are included in this group, which is accepted as a section by Singer (1942).

Hesler & Smith (1979) emend the section *Plinthogali* (Burl.) Sing. to subgenus level as follows: cap a typical velvety to unpolished and dry pileus, with blackish, fuscous, date-brown, alutaceous, dingy buff or dull white colours; latex white, cream or rarely brown, usually changing to reddish, vinaceous, lilac or violet or staining injured surfaces with these colours; true cystidia mostly absent; pileipellis a trichoderm (a palisade ss. auct.), less frequently a cellular layer with a turf above it; spore-ornamentation often prominent. They distinguish two sections: section *Plinthogali*, including species with a blackish, dark to medium brown pileus, a brown intracellular pigment in the pileipellis and mostly a well developed pilear trichoderm, and the section *Fumosi* Hesler & Smith for species with a paler pileus and a reduced or not evident trichodermal structure of the pileipellis.

Bon (1980) splits the section *Plinthogali* into a subsection *Ruginosi* M. Bon for species with winged spores [ornamentation up to 2–3(–4) µm high] and a subsection *Fuliginosi* (Konr.) Bon (invalid), for species with more or less completely reticulate spores [ornamentation up to 1–1.5(–2) µm high].

In tropical Africa, the subgenus *Plinthogali* seems well represented and more diverse than in North America or Europe. Some members are well characterized by a remarkable colour-change of the latex and a strong staining of the context. Their latex appears at first watery and transparent, then turns to blood-red, grey and finally black. The context is cream and becomes first greyish pink or greyish red, finally black. In dried condition, those species are easily recognized by the black colour of the context. Owing to this striking character which is not known outside Africa, these species are placed here in a new section, *Nigrescentes*. As to the other species, both the classifications of Hesler & Smith (1979) and Bon (1980) are considered highly artificial and not applicable on a worldwide scale. Hesler & Smith (1979) themselves admit that their proposed sections were very difficult to separate within the format of a key. This is not surprising as they put such obviously closely related species as *Lactarius ruginosus* Romagn. and *L. subplinthogalus* Coker in different sections. We do not consider the absolute height of the spore-ornamentation as a taxonomically valuable character for distinguishing subsections, especially not when taking into account that it is partly related to the size of the spores, which is very variable in this group, and that it would necessitate separating such closely related taxa as *Lactarius pterosporus* Romagn. and *L. acris* (Bolt.: Fr.) S.F. Gray. A further detailed revision of this subgenus on a worldwide basis (esp. including more tropical members) should result in a global and natural classification of this group; we therefore prefer to limit the proposal of new sections and subsections, but indicate some groups that might form natural stirps.

MATERIAL AND METHODS

Microscopic features are studied in congo-red in ammonia. Spore-ornamentation is described and illustrated as observed in Melzer's reagent. For details on terminology we refer to Verbeken (1995, 1998). Line-drawings are made with the aid of a drawing tube at magnifications 6700 × for spores, 3200 × for individual elements and 1100 × for sections and surface views. Stippling indicates refractive contents in cystidia and lactifers, intracellular pigmentation in the elements of pilei- and stipitipellis. Basidia length excludes sterigmata length.

Spores are measured in side view in Melzer's reagent, excluding the ornamentation, and measurements are given as (MINa) [AVa−2*SD]−*AVa*−*AVb*−[AVb + 2*SD] (MAXb) in which AVa = lowest mean value for the measured collections, AVb = greatest mean value, and SD = standard deviation. Q stands for 'quotient length/width' and is given as (MINQa) *Qa*−*Qb* (MAXQb) in which Qa and Qb, stand respectively for the lowest and highest mean quotient for the measured specimens.

Colour-codes are from Kornerup & Wanscher (1978). L+l/cm means number of lamellae (L) and lamellulae (l) per cm at pileus mid-radius.

RESULTS

1. **Lactarius** subgenus **Plinthogali** (Burl.) Hesler & Smith, emend. Verbeken

Lactarius subgenus *Plinthogali* (Burl.) Hesler & Smith, N. Amer. Species Lactarius: (1979) 99 (ut '*Plinthogalus*').

Basionym: *Lactaria* group *Plinthogalae* Burl., Mem. Torrey Club 14 (1908) 83.

Lactarius sect. *Plinthogali* (Burl.) Sing., Annls mycol. 40 (1942) 123. — *Lactarius* sect. *Pterospori* R. Heim, Bull. Jard. bot. État 25 (1955b) 45 (invalid, descr. gall.). — *Lactarius* subg. *Venolactarius* R. Heim, Prodr. Fl. Mycol. Madagascar 1 (1938) 31 (nom. nud.). — *Lactariella* Schroet., Fl. Schles. 3 (1) (1889) 544.

Pileus small to moderately large, plano-convex, applanate to slightly depressed, sometimes infundibuliform; pellis dry, velvety, finely tomentose, sometimes wrinkled, sometimes veined, rarely viscid or shiny, dull coloured: blackish, dark brown, leather brown, greyish brown to pale brown, ochraceous or greyish yellow. Stipe cylindrical, slender, mostly concolorous. Lamellae adnexed, adnate to decurrent, rather dense, whitish, greyish, cream, in some species yellowish orange; edge concolorous, in some species dark brown. Context whitish, unchanging or changing to greyish pink, red, reddish, brownish or black. Latex white or transparent, unchanging or changing to grey, reddish or even black (vinaceous, lilac or violet: not seen in African species). Spore-deposit white, cream, dark cream to pale brown.

Spores often globose to subglobose; ornamentation up to 2 µm and more, winged, or composed of irregularly conical warts and then with abundant lower connections or ridges, sometimes zebroid, never composed of isolated elements; plage often distally amyloid. Hymenophoral trama subregular to irregular, composed of hyaline hyphae and lactifers. Pileipellis a hymeniderm, a palisade, sometimes a trichoderm, always with an upper layer of regular, thin-walled elements, often with dark intracellular pigmentation.

Type: *Lactarius lignyotus* Fr.

KEY TO THE SECTIONS

1a. Latex first watery and transparent, changing to grey or even black; context cream, changing to greyish pink or greyish red, finally black (exsiccata mostly partly black); pleurocystidia present, hyaline, thin-walled . . . . sect. *Nigrescentes*

b. Latex first white (seldom pink), unchanging or changing to vinaceous, pink, lilac or violet; context not blackening; pleurocystidia absent (rarely present, and then with granular or needle-like content) 2

2a. Pileus rather smooth, sometimes shiny; pileipellis an ixotrichoderm; latex changing to greyish-brownish when drying . . . . sect. *Pseudofuliginosi*

b. Not with this combination of characters . . . . sect. *Plinthogali*, s.l.

2. **Lactarius** sect. **Nigrescentes** Verbeken, *sect. nov.*

Pileus parvus ad moderate grandis, plano-convexus, applanatus ad leviter depressus; pileipellis sicca, velutina, leviter tomentosa, interdum venosa, non glutinosa, atra, atrabrunnea vel griseoflavida. Stipes cylindratus, gracilis, concolorus. Contextus primo rosescens vel rubescens, deinde nigrescens. Lamellae adnatae ad decurrentes, confertae, albidae, griseae, cremeae. Latex hyalinus, grisescens, rubescens vel nigrescens.

Sporae globosae ad subglobosae vel ellipsoideae, alatae vel subalatae, cristis usque ad 2 µm altis ornatae. Pleuromacrocystidia presentia. Pileipellis hymeniderma, saepe pigmento brunneo intracellulare.

Typus: *Lactarius melanogalus* R. Heim ex R. Heim, Bull. Jard. bot. État 25 (1955) 46.

Pileus small to moderately large, plano-convex, applanate to slightly depressed; pellis dry, velvety, finely tomentose, sometimes wrinkled, sometimes veined, never viscid or shiny, blackish, dark brown, leather brown, greyish brown to pale brown or greyish yellow, never brightly coloured. Stipe cylindrical, slender, mostly concolorous. Lamellae adnexed, adnate to decurrent, rather dense, whitish, greyish, cream. Context changing to greyish pink, red, reddish and finally black. Latex transparent, changing immediately to grey or reddish or even black.

Spores globose to subglobose or ellipsoid; ornamentation up to 2 µm and more, winged, or with irregularly conical warts and then with abundant lower connections. True pleurocystidia present, hyaline, thin-walled. Pileipellis a hymeniderm, always with an upper layer of regular, thin-walled elements, often with dark intracellular pigmentation.

Type: *Lactarius melanogalus* R. Heim ex R. Heim, Bull. Jard. bot. État 25 (1955) 46.

KEY TO THE SPECIES

1a. Spores ellipsoid; Q = 1.24–1.64 2
b. Spores globose to subglobose, rarely ellipsoid; Q = 1.01–1.20 3
2a. Spores entirely winged; pileus and stipe greyish yellow to yellowish brown; pileus without papilla, not veined . . . . *L. orientalis*
b. Spores partially winged, with conical warts and lower ridges present; pileus and stipe dark brown; pileus with a distinct papilla . . . . *L. griseogalus*
3a. Ornamentation of the spores 1–2 µm high; spores 7.3–7.5 × 6.5–6.7 µm; latex finally bluish black . . . . *L. melanogalus*
b. Ornamentation of the spores up to 1(1.3) µm high; spores 7.9–8.3 × 7.3–7.6 µm; latex finally beige to cream . . . . *L. baliophaeus*

The representatives of this section are described and illustrated by Verbeken (1996). The microscopic description of *L. griseogalus* R. Heim, which was made from typematerial in bad condition, was extended later with some illustrations made from the specimen *Nicholson 179* (K) (Fig. 1), which is in much better condition but unfortunately lacks fieldnotes. This specimen has spores measuring 7.5–*8.8*–10.0(10.4) × 6.7–*7.3*–7.8 µm (Q = 1.07–*1.21*–1.35; n = 20), thus somewhat broader than those of the type.

Since our first observations on these species, many more collections of *L. baliophaeus* var. *orientalis* have come to our attention, all of them easily separable from the 'type variety' by the differently shaped spores. In fact, no intermediate cases have been observed. It is difficult to discriminate between these two taxa unambigously in the field, but *L. baliophaeus* var. *orientalis* seems to lack the ochraceous/beige cap colours and the crenulate margin characteristic for *L. baliophaeus* var. *baliophaeus* (Plate 1). These observations have convinced us that this variety deserves species rank:

Lactarius orientalis (Verbeken) Verbeken, *stat. & comb. nov.* — Plate 2

Basionym: *Lactarius baliophaeus* var. *orientalis* Verbeken, Persoonia 16 (1996) 219.

3. **Lactarius** sect. **Plinthogali** s.l.

Lactarius sect. *Plinthogali* (Bull.) Sing., Ann. Mycol. 40 (1942) 123.

Lactarius group *Fuliginosi* Konr., Bull. trimest. Soc. mycol. Fr. 51 (1935) 185 (invalid). — *Lactarius* sect. *Fumosi* Hesler & Smith, N. Amer. Species Lactarius (1979) 103. — *Lactarius* sect. *Ruginosi* M. Bon, Doc. mycol. 10 (37–38) ('1979' 1980) 92.

Pileus small to moderately large, plano-convex, applanate to slightly depressed, sometimes infundibuliform; pellis dry, velvety, finely tomentose, sometimes wrinkled, sometimes veined, never viscid or shiny, blackish, dark brown, leatherbrown, greyish brown to pale

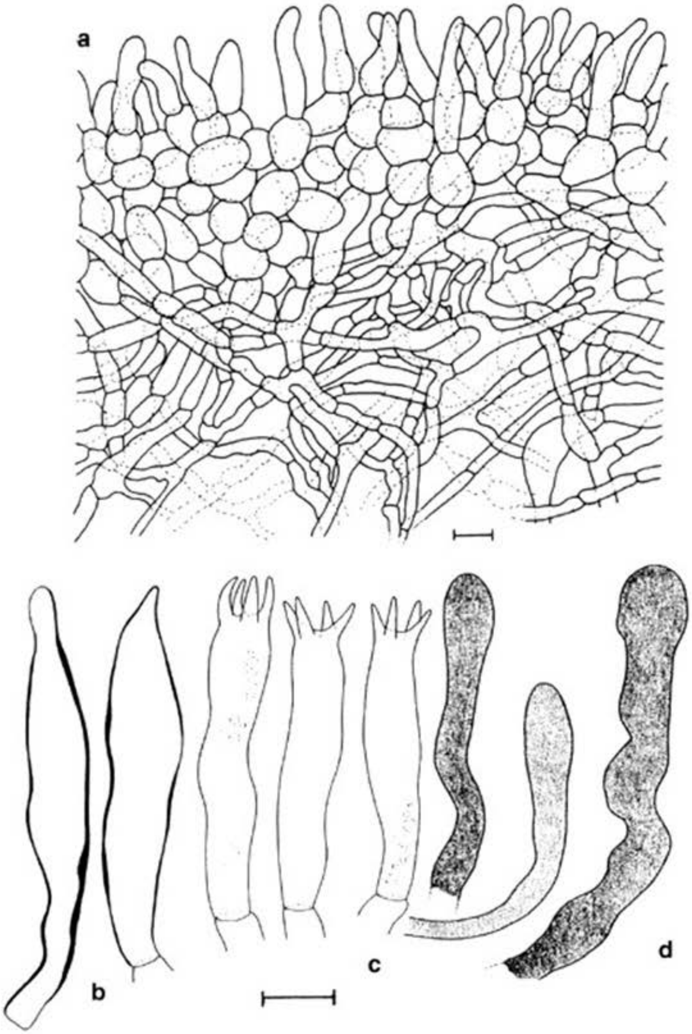


Fig. 1. *Lactarius griseogalus*. a. Section of pileipellis (type); b. pleurocystidia; c. basidia; d. pleuropseudocystidia (b–d: *Nicholson 179*; bar = 10 µm).

brown or greyish yellow, never brightly coloured. Stipe cylindrical, slender, mostly concolorous. Lamellae adnexed, adnate to decurrent, rather dense, whitish, cream, in some species yellowish orange; edge concolorous, in some species dark brown. Context whitish, unchanging or changing to greyish pink, reddish or brownish. Latex white, unchanging or changing (to vinaceous, pink, lilac or violet: not seen in African species). Spore-deposit white, cream, dark cream to pale brown.

Spores often globose to subglobose; ornamentation up to 2 µm and more, winged, or with irregularly conical warts and then with abundant lower connections, sometimes zebroid, never composed of isolated elements. True pleurocystidia mostly absent. Pileipellis a hymeniderm, a palisade, sometimes a trichoderm, always with an upper layer of regular, thin-walled elements, often with dark intracellular pigmentation.

Type: *Lactarius lignyotus* Fr.

OBSERVATIONS

1. This section consists of a fairly large number of temperate and tropical species, showing great variability. Further research is needed to look for valuable characters (e.g. spore-deposit colour) which may reveal the relationships between these species. Within the African representatives some groups of species can be recognised (e.g. *L. kabansus*–*L. tenellus* and *L. melanodermus*–*L. nudus*–*L. congolensis*–*L. sulcatus*), but some other species seem to be very isolated (*L. sulcatulus*).

2. It should be noted that several of Heim's species are only known from the type, most often old collections in very bad condition and microscopically insufficiently documented. Their place in the proposed key should be regarded as provisional since more collections are needed to fully clarify their identity.

KEY TO THE SPECIES

The species in **bold** are fully described here. The others have already been well described elsewhere (see checklist).

1a. Spore-ornamentation zebroid 2
b. Spore-ornamentation reticulate, winged 3
2a. Pileus fuliginous brown; stipe solid; spores subglobose, Q = 1.00–*1.04*–1.12 *L. kalospermus*
b. Pileus greyish brown to yellowish brown; stipe hollow and fragile; spores ellipsoid, Q = 1.16–*1.22*–1.31 .... ***L. sulcatulus***
3a. Spore-ornamentation up to 1 µm high, regularly ornamented, never with conspicuous spiny aspect 4
b. Spore-ornamentation up to 1.5 µm high or more, often heavily winged or conspicuously spiny 8
4a. Lamellae very distant, 3+5 to 3+6/cm .... ***L. rumongensis***
b. Lamellae rather crowded, 6+16 to 8+20/cm 5
5a. Lamella-edge not concolorous, darker grey than lamella-side or dark brown; spores globose to subglobose, sometimes ellipsoid 6
b. Lamella-edge concolorous, spores ellipsoid to elongate 7
6a. Spores 7.7–8.1 × 7.0–7.5 µm; pileipellis a hymeniderm, terminal elements cylindrical to clavate, up to 12 µm broad .... ***L. saponaceus***
b. Spores 5.8–6.5 × 5.1–5.9 µm; pileipellis a trichoderm to trichopalisade, terminal elements long and slender, up to 5 µm broad .... ***L. pusillisporus***
7a. Pileus up to 7 cm diam. or more, brown to dark brown, sometimes brownish grey when older, especially when sun-exposed, margin not crenulate; lamellae soon ochraceous

orange; context in stipe base distinctly orange; terminal elements of the pileipellis obovoid to broadly clavate, 10–20 × 8–15 µm .... *L. kabansus*

b. Pileus up to 4 cm diam., young dark brown, soon paler greyish, margin more or less crenulate; young lamellae contrastingly white with cap and stipe (as in *L. lignyotus*); context in stipe base never orange; terminal elements of the pileipellis cylindrical, long and slender, 10–40 × 6–10 µm .... ***L. tenellus***

8a. Spore-ornamentation winged, composed of regular ridges, having everywhere the same height; context whitish, not changing, sometimes pale orange; lamellae yellowish or brownish orange 9

b. Spore-ornamentation not regularly winged, composed of ridges which are locally higher and acute, sometimes giving the impression of being rather spiny; context changing to pink or reddish to brownish; lamellae white or greyish 2

9a. True pleurocystidia present; pileus olivaceous brown .... *L. nudus*

b. True pleurocystidia absent 10

10a. Lamella-edge brown .... *L. congolensis*

b. Lamella-edge concolorous with lamella 11

11a. Pileus dark fuliginous brown; context changing pinkish; spores very highly ornamented with wings up to 2 µm high .... *L. melanodermus*

b. Pileus pale brown; context unchanging; spore-ornamentation up to 1.5 µm high ***L. sulcatus***

12a. Pileus covered with thick radial veins; smell not fish-like; stipe with a large collar of orange hairs around the base .... *L. adhaerens*

b. Pileus at most slightly wrinkled; smell fish-like; no such subiculum 13

13a. Pellis cream with dark ochraceous brown squamules; pileus never with a papilla *L. pseudolignyotus*

b. Pellis dark brown, finely tomentose; pileus sometimes with a papilla .... *L. acutus*

Lactarius pusillisporus Verbeken — Fig. 2

Lactarius pusillisporus Verbeken, Bull. Jard. bot. Belg. 65 (1996) 206.

Pileus 30–75 mm diam., plano-convex when young, applanate to plano-concave, sometimes subumbilicate or subumbonate, mostly regular; margin regular, incurved then straight, faintly striate, paler; pellis not dehiscent, dry, velvet-like, felty in the centre, smoother and wrinkling towards the margin, brownish orange, reddish blond to light brown and yellowish brown (5C3–4–5DE5); centre dark brown to brownish beige (6F5–6F3); margin pale yellow (4A3). Stipe 35–60 × 5–10 mm, slightly eccentric to central, cylindrical, long and slender, slightly tapering downwards, concolorous with pileus, paler towards the apex and the base, dry, felty. Lamellae adnexed, narrowly adnate to adnate, unequal with lamellulae of different lengths, moderately spaced (3+6 to 8+11/cm), paper-like, thin, white to cream, pale brown when older; edge entire, dark grey to dark brown. Context firm, elastic, white to cream, sometimes changing pale greyish, unchanging with $FeSO_4$ (but pale greyish green in *Verbeken 94.427*), unchanging with NH_4OH, KOH or HCl; taste not remarkable (very sweet in *Verbeken 94.427*); smell sweet, agreeable. Latex quite abundant to very abundant, white, unchanging; taste mild to a little astringent. Spore-deposit pale brown.

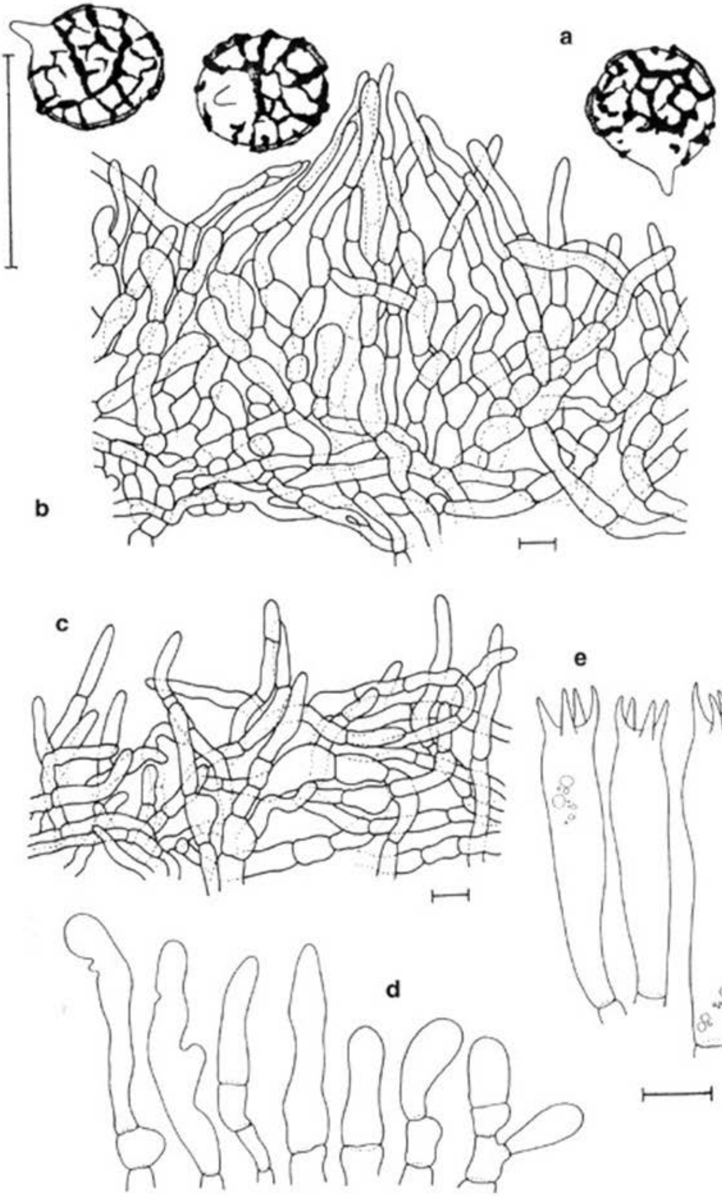


Fig. 2. *Lactarius pusillisporus* (type). a. Spores; b. section of pileipellis; c. section of stipitipellis; d. marginal cells; e. basidia (bar = 10 µm).

Spores subglobose to ellipsoid, 5.3–*5.8*–*6.5*–7.1 × 4.5–*5.1*–*5.9*–6.5 µm (Q = 1.01–*1.10*–*1.16*–1.25; n = 100); ornamentation amyloid, composed of ridges up to 0.75 µm high, forming an almost complete reticulum with some isolated warts; plage inamyloid. Basidia 35–45 × 7–11 µm, cylindrical to slightly clavate, 4-spored. True pleurocystidia absent. Pleuropseudocystidia not abundant, 3–6 µm diam., emergent, cylindrical, with rounded apex; content oleiferic. Lamella-edge sterile; marginal cells 15–35 × 3–5 µm, irregularly cylindrical to fusiform, sometimes clavate, content pale brown. Hymenophoral trama irregular, composed of hyaline hyphae; lactifers not abundant, sphaerocytes absent. Pileipellis a trichoderm to trichopalisade, 70–100 µm thick; terminal elements cylindrical, long, slender, 20–60 × 3–5 µm, arising from broadly cylindrical to almost spherical basal elements. Stipitipellis a trichoderm; terminal elements 25–45 × 3–5 µm, septate. Clamp-connections absent.

Examined material. BURUNDI: Bururi Prov., Nyamirambo, Rumonge Forest Reserve, 850–950 m alt., miombo woodland dominated by *Brachystegia utilis*, March 1994, *Verbeken 94.285* (holotypus BR, isotypus GENT), idem, *Verbeken 94.011, 94.022, 94.044* & *94.427* (all at BR).

Lactarius rumongensis Verbeken — Fig. 3

Lactarius rumongensis Verbeken, Bull. Jard. bot. Belg. 65 (1996) 208.

Pileus 25–75 mm diam., thin, plano-convex to applanate; margin first regular, then irregular and strongly crenulate, sometimes grooved and striate; pellis not dehiscent, smooth in the centre, concentrically wrinkling towards the margin, with remarkable veins forming a reticulum at the margin, yellowish white, greyish yellow to brownish grey (4A2, 4B3, 5CD2–3), paler towards the margin, hygrophanous. Stipe 15–50 × 5–10 mm, cylindrical, subbulbous at the base, sometimes tapering downwards, long and slender, dry, smooth, slightly darker than pileus, brownish grey, paler towards the base, solid, firm. Lamellae adnate, unequal with lamellulae (1 to 3 between 2 lamellae, regular pattern), very distant (3+5 to 3+6/cm), 4–10 mm broad, elastic, paper-like, with remarkable venation when older, white to creamy; edge entire, concolorous. Context thin, firm, whitish, unchanging with $FeSO_4$; taste mild, smell pleasant. Latex not abundant to quite abundant, white to waterlike; taste mild. Spore-deposit dark cream to light brown.

Spores subglobose, 7.4–*8.4*–*8.8*–9.8(10.0) × 6.8–*7.8*–*8.0*–8.8(8.9) µm (Q = 1.01–*1.08*–*1.09*–1.17; n = 60); ornamentation amyloid, forming a complete reticulum, ridges 0.5–1 µm high; plage sometimes distally amyloid. Basidia 40–60 × 10–12 µm, cylindrical to clavate, 4-spored, exceptionally 2-spored. True pleurocystidia absent. Pleuropseudocystidia abundant, 4–6 µm diam., cylindrical to tortuous, with rounded apex. Lamella-edge sterile; marginal cells 25–40 × 4–5(6) µm, cylindrical to fusiform, septate, sometimes branched. Hymenophoral trama subregular to irregular, with hyaline hyphae and laticiferous hyphae. Pileipellis a hymeniderm; elements 10–20 × 3–5 µm, fusiform, sometimes clavate, sometimes thick-walled; terminal elements of laticiferous hyphae present, not abundant. Stipitipellis a regular hymeniderm; elements 13–25 × 3–6 µm, cylindrical to clavate, sometimes slightly thick-walled. Clamp-connections absent.

Examined material. BURUNDI: Bururi Prov., Nyamirambo, Rumonge Forest Reserve, 850–950 m alt., miombo woodland dominated by *Brachystegia utilis*, March 1994, *Verbeken 94.006* (holotypus BR, isotypus GENT) & *94.018* (BR). — ZAIRE: Equateur Prov., Binga, 380 m alt., drier Guineo-Congolian rainforest with *Gilbertiodendron dewevrei*, Nov. 1928, *Goossens-Fontana 808* (BR).

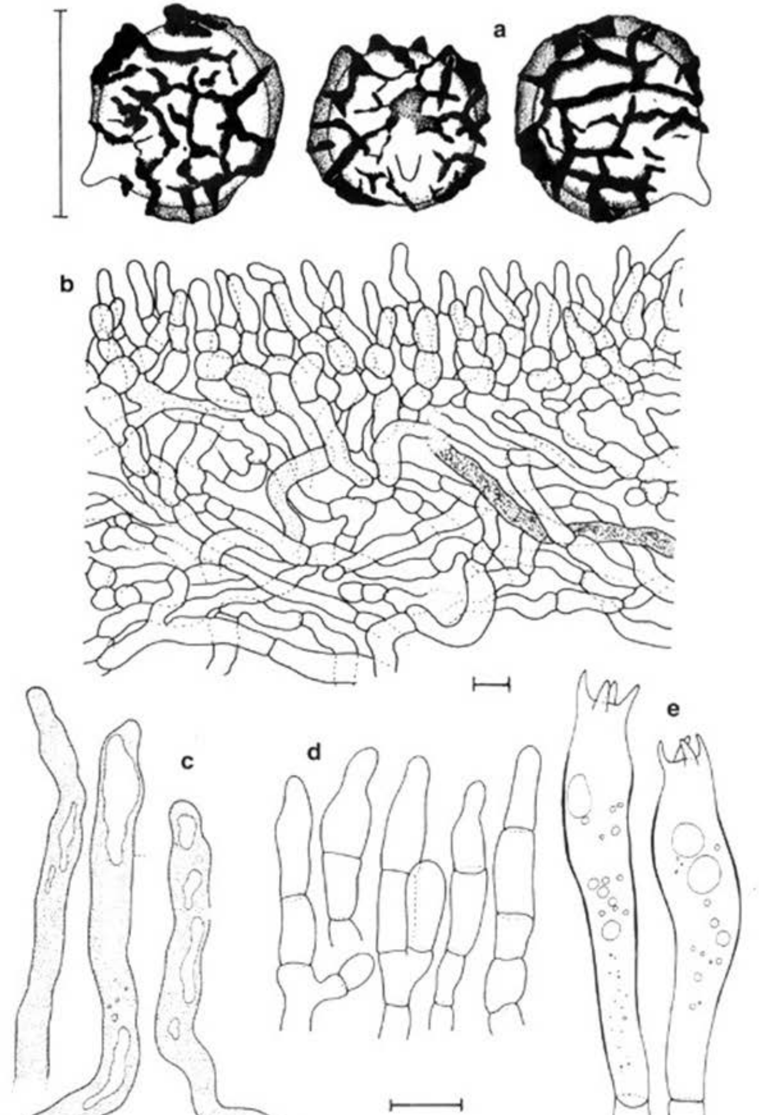


Fig. 3. *Lactarius rumongensis* (type). a. Spores; b. section of pileipellis; c. pleuropseudocystidia; d. marginal cells; e. basidia (bar = 10 µm).

Lactarius saponaceus Verbeken — Fig. 4, Plate 3

Lactarius saponaceus Verbeken, Bull. Jard. bot. Belg. 65 (1996) 209.

Pileus 50–65 mm diam., applanate and slightly depressed in the centre; margin regular, straight, faintly striate, paler; pellis not dehiscent, dry, felty, greyish yellow to orange grey (4AB3, 5B2), brown in the centre, pale yellow at the margin (4A3). Stipe 15–40 × 5–13 mm, eccentric to central, cylindrical, tapering downwards, pale brown to greyish brown, white at the base, dry, felty. Lamellae adnate to decurrent, quite dense (8+7 to 8+24/cm), unequal with 1–3 lamellulae between 2 lamellae, paper-like, elastic, thin, pale yellow (4A3); edge entire, dark grey to dark brown (very conspicuous in young specimens). Context firm, thick in pileus (4–5 mm), solid in stipe, white, unchanging, unchanging with $FeSO_4$, NH_4OH, HCl; taste astringent in *Verbeken 94.353*, strongly soap-like and disgusting in *Verbeken 94.302*. Latex not abundant, although very abundant when pileus and stipe are separated, white, unchanging; taste soap-like and disgusting in *Verbeken 94.302*. Spore-deposit pale brown to dark cream.

Spores globose to subglobose, sometimes ellipsoid, 7.0–*7.7–8.1*–9.3 × 6.8–*7.0–7.5*–8.2 µm (Q = 1.00–*1.08–1.11*–1.22; n = 80); ornamentation amyloid, composed of ridges up to 1 µm high, forming an incomplete reticulum with isolated warts and ridges; plage inamyloid. Basidia 50–65 × 9–11 µm, cylindrical to slightly fusiform, 4-spored. True pleurocystidia absent. Pleuropseudocystidia very abundant, 4–6 µm diam., emergent, irregularly cylindrical, mucronate to tortuous; content oleiferic, sometimes guttulate. Lamella-edge sterile; marginal cells 15–35 × 4–6 µm, cylindrical to fusiform, with pale brown content. Hymenophoral trama irregular, composed of hyaline hyphae; lactifers abundant. Pileipellis a hymeniderm, 40–50 µm thick; terminal elements of suprapellis cylindrical to clavate, 15–25(35) × 5–12 µm, without brown pigment; subpellis composed of short to cylindrical cells. Stipitipellis a hymeniderm; terminal elements longer and narrower, 10–30 × 5–7 µm. Clamp-connections absent.

Examined material. BURUNDI: Bururi Prov., Nyamirambo, Rumonge Forest Reserve, 850–950 m alt., miombo woodland dominated by *Brachystegia utilis*, March 1994, *Verbeken 94.302* (BR) & *94.353* (holotypus BR, isotypus GENT).

Lactarius sulcatulus Verbeken — Fig. 5, Plate 4

Lactarius sulcatulus Verbeken, Bull. Jard. bot. Belg. 65 (1996) 210.

Pileus 10–45 mm diam., very thin, plano-convex, applanate to broadly infundibuliform, with very distinct and acute papilla in the centre; margin thin, crenulate, undulate, slightly grooved, fimbriate to serrate in older specimens; pellis not dehiscent, dry, mat, wrinkled, with very fine radial venation superposed on the radial grooves which start in the centre, greyish yellow (4BC4) to yellowish brown (5EF5), light brown to yellowish brown (5DE4) in the centre; papilla and extreme margin darker brown (5F6–8). Stipe 15–23 × 4–6 mm, cylindrical to very flattened and with a longitudinal fold, slightly tapering downwards, slender, mat, slightly felty, yellowish white to pale yellow (3–4A23), firm, solid. Lamellae broadly adnate to subdecurrent, unequal with abundant lamellulae of different lengths, distant (6/cm), rather broad [2–4(5) mm], thin, rarely anastomosing, yellowish white (3A2) when young, cream when older (3–4A2); edge entire, concolorous. Context thin, whitish, usually regularly fistulose, slightly changing to reddish brown in the stipe, in older specimens reddish

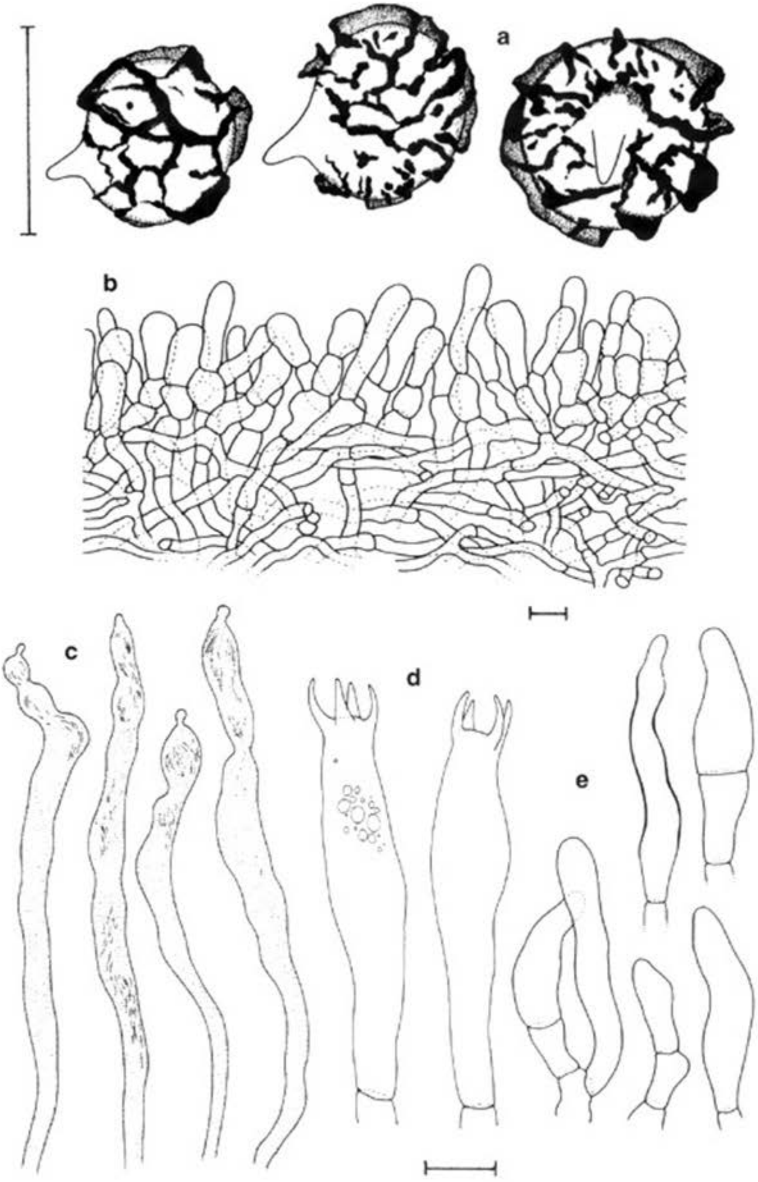


Fig. 4. *Lactarius saponaceus* (type). a. Spores; b. section of pileipellis; c. pleuropseudocystida; d. basidia; e. marginal cells (bar = 10 µm).

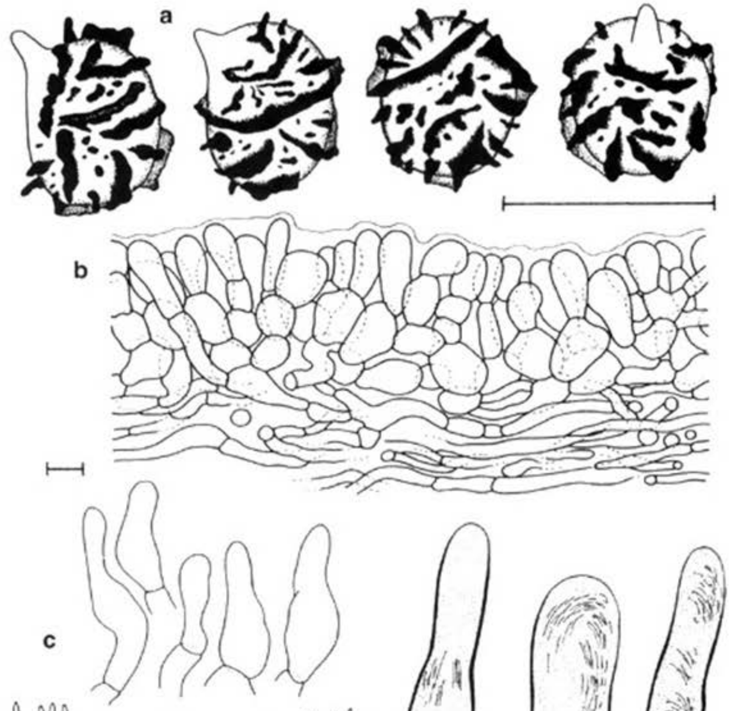


Fig. 5. *Lactarius sulcatulus* (type). a. Spores; b. section of pileipellis; c. marginal cells; d. basidia; e. pleuropseudocystidia (bar = 10 µm).

in the centre of the stipe, unchanging with NH_4OH, NaOH, anilated H_2O, phenol, $FeSO_4$; reddish brown after a while with phenolaniline; smell papaya-like; taste agreeable, mild, a bit spicy. Latex present, scarce, watery, whitish to transparent, unchanging or changing slightly brownish (?); taste papaya-like. Spore-deposit pale-coloured, not white.

Spores ellipsoid, 7.5–*8.1*–8.6 × 6.0–*6.6*–7.0(7.2) µm (Q = 1.16–*1.22*–1.31; n = 20); ornamentation amyloid, zebroid, composed of ridges, mostly parallel, seldom branched; some isolated elongated warts present, ridges up to 1 µm high; plage inamyloid or with distal amyloid spot. Basidia 50–55(60) × 9–11 µm, subcylindrical to subclavate, 4-spored. True pleurocystidia absent. Pleuropseudocystidia abundant, mostly emergent, 10–13(15) µm diam. in the upper part, cylindrical to clavate, with rounded apex, thin-walled or slightly thick-walled; content needle-like and oleiferic. Lamella-edge sterile; marginal cells 15–25 × 4–7 µm, cylindrical to irregularly fusiform, thin-walled, hyaline. Hymenophoral trama irregular, composed of lactifers and hyaline, thin-walled hyphae. Pileipellis hymeniderm-like, two-layered, covered by a slime-layer; terminal elements of suprapellis clavate to broadly clavate, 10–20 × 5–12 µm, thin-walled; subpellis thin, composed of isodiametric cells, 10–15(20) µm diam. Stipitipellis between a trichoderm and a hymeniderm; elements of the suprapellis 10–50 × 5–8 µm, cylindrical, with rounded apex, sometimes septate; subpellis rudimentary, composed of a few, small, isodiametric cells, 5–10(20) µm diam., mixed with long and slender hyaline hyphae. Clamp-connections absent.

Examined material. ZAIRE: Kivu Prov., Irangi, rain forest, April 1972, *Rammeloo Z414* (holotypus GENT).

Lactarius sulcatus Verbeken & Walleyn, *spec. nov.* — Fig. 6, Plate 5

Pileus 45–55 mm diam., leviter plano-concavus, margine valde striato ad sulcato crenulato, pileipellis leviter velutina, brunnea. Stipes 20–40 mm longus, 7–11 mm crassus, subcylindratus, basin versus attenuatus, laevis, pallide brunneus. Lamellae adnatae, distantes, albidae. Contextus albidus, gustu mitis. Latex non abundans, albus.

Sporae globosae ad subglobosae, 7.2–*8.1*–8.9 × 7.0–*7.4*–8.0 µm, subreticulatae, alatae, cristis usque ad 1.5 µm altis ornatae, macula suprahilaris interdum distale amyloidea. Basidia 55–65 × 10–12 µm, cylindrata vel subclavata, tetraspora. Macropleurocystidia absentia. Pseudopleurocystidia rara, non emergentia, 4–6(9) µm diam. Pileipellis trichopalliformis, gelatinosa, elementa suprapellis 15–40 × 3–6 µm, irregulare cylindrata vel subtortuosa, subpellis ex cellulis sphaeris vel irregularis.

Holotypus: Zimbabwe, road from Mutare to Bvumba at peg 15.5 km, grid 1932B2, *Brachystegia spiciformis*-dominated miombo woodland, 11 Feb. 1999, *Verbeken 99-176* (GENT).

Pileus 45–55 mm diam., slightly plano-concave; margin directed slightly upwards in mature specimens, strongly crenulate, deeply and densily grooved (up to 1 cm long); surface velvety, chamois-leather-like, yellowish brown to brown (5E5–6E4), slightly darker in the centre and in the grooves. Stipe 20–40 × 7–11 mm, almost regularly cylindrical, tapering at the base, smooth, soft, concolorous but paler, paler to whitish at the top and at the base. Lamellae broadly adnate, distant (4–5/cm halfway the radius), with abundant lamellulae (often in a regular pattern), whitish (4A2), papery thin, not very brittle; edge even, concolorous. Context thin-fleshed near margin, moderately thick in pileus centre, solid in stipe, whitish, slightly greyish brown in older specimens, unchanging with gaiac and $FeSO_4$; taste mild; smell not particular. Latex not abundant, white, unchanging; taste mild.

Spores globose to subglobose, 7.2–*8.1*–8.9 × 7.0–*7.4*–8.0 µm (Q = 1.01–*1.07*–1.12; n = 20); ornamentation composed of rounded ridges up to 1.5 µm high, forming a subcomplete and rather dense reticulum; plage distally amyloid. Basidia 55–65 × 10–12(15) µm,

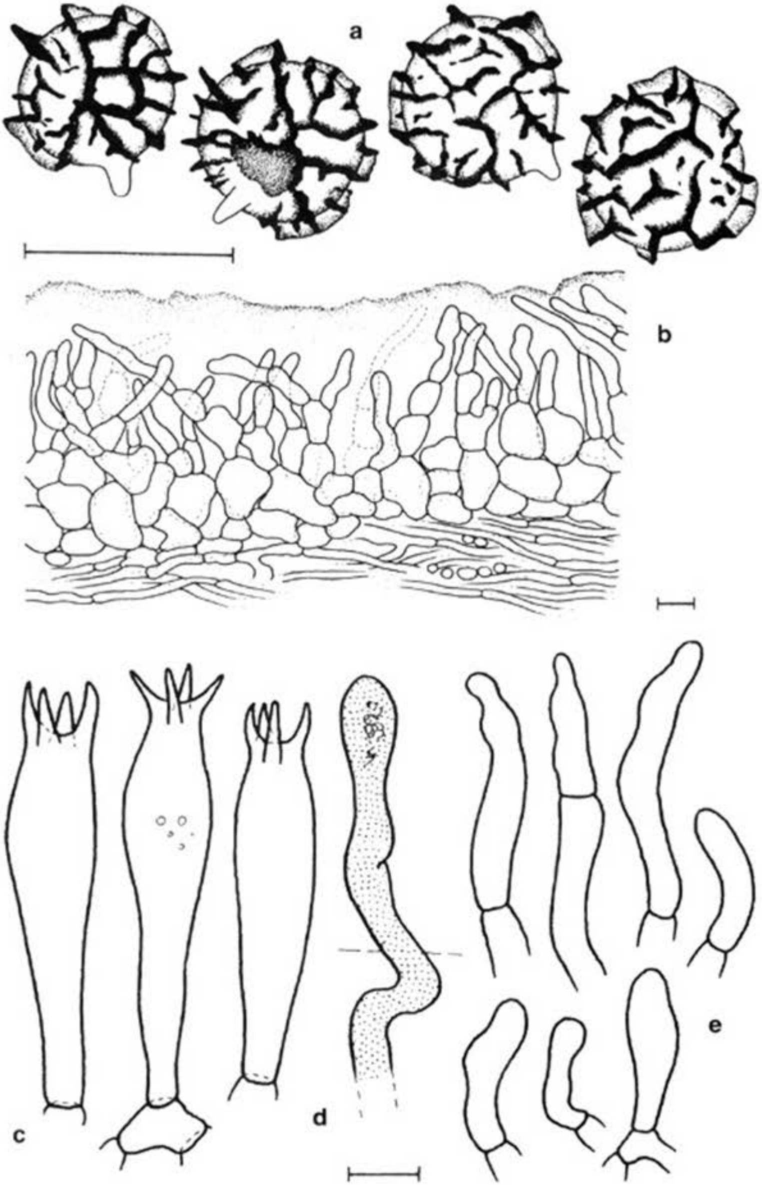


Fig. 6. *Lactarius sulcatus* (type). a. Spores; b. section of pileipellis; c. basidia; d. pseudocystidium; e. marginal cells (bar = 10 µm).

cylindrical to subclavate, 4-spored; sterigmata 6–10 × 1–2 µm. True pleurocystidia absent. Pseudopleurocystidia scarce, never emergent, 4–6(9) µm diam., irregularly cylidric, with a very dense granular content. Lamella-edge sterile, composed of marginal cells; marginal cells irregularly cylindrical to subfusiform, 15–40 × 4–8 µm, hyaline, thin-walled. Hymenophoral trama mainly composed of hyphae, some swollen compartments present, but no distinct nests of sphaerocytes. Pileipellis 60–80 µm thick, a palisade embedded in a slime layer; terminal elements subcylindrical to irregular, 20–40 × 3–6 µm, thin-walled (walls not gelatinizing), hyaline; cellular layer 30–40 µm thick, composed of rather small (10–20 µm diam.) globose cells. Pileipellis 80–120 µm thick, a trichopalisade embedded in a slime layer composed of chains of elements; terminal elements 15–40 × 3–6 µm, irregularly cylindrical to subtortuous; lower elements globose up to 20 µm diam. or irregular, with pale brown intracellular pigmentation. Stipitipellis a trichoderm.

Examined material. ZIMBABWE: road from Mutare to Bvumba at peg 15.5 km, grid 1932B2, *Brachystegia spiciformis*-dominated miombo woodland, 11 Feb. 1999, *Verbeken 99-176* (GENT, holotypus).

Lactarius tenellus Verbeken & Walleyn, *nom. nov.* — Plate 8

Basionym: *Lactarius kabansus* var. *pallidus* Verbeken, Bull. Jard. bot. Belg. 65 (1996) 202, non *Lactarius pallidus* Pers., Tent. Disp. meth. Fung. 64 (1797).

New field observations have convinced us to upgrade this relative of *L. kabansus* Pegler & Piearce to species level. As well as the clear microscopical distinction with *L. kabansus* (terminal elements of the pileipellis obovoid to broadly clavate, 10–20 × 8–15 µm in *L. kabansus*; terminal elements of the pileipellis cylidrical, long and slender, 10–40 × 6–10 µm in *L. tenellus*, Fig. 7), additional macroscopical differences were established during recent fieldwork. *Lactarius tenellus* has a rather dark brown cap when very young which, together with its contrasting white lamellae, makes it reminiscent of *L. lignyotus*. The cap colour typically fades to grey, almost without brownish components, while *L. kabansus* has brown to dark brown colours, eventually also becoming very pale when specimens are exposed to the sun (Plate 7). *Lactarius kabansus* is usually a more robust species, with an irregular, deflexed margin, while *L. tenellus* is a slender species with a crenulate margin. The initially pure white lamellae of *L. tenellus* become more yellowish, but not as soon and as ochraceous orange as in *L. kabansus*. In case of doubt, cutting the stipe base seems to be an unambiguous test: the context in the base of the stipe is white and stays white in *L. tenellus*, while in all encountered specimens of *L. kabansus*, even in old and insect-infected ones, the stipe base is orange when cut. As to the spores, no conspicuous differences have been observed.

4. **Lactarius** sect. **Pseudofuliginosi** Verbeken, *sect. nov.*

Pileus infundibuliformis, umbilicatus vel papillatus, margine valde undulato vel crenulato saepe striato, pileipellis laevis, interdum leviter glutinosa ex ochraceo vel olivaceo brunnea. Stipes cylindratus, laevis, impolitus interdum leviter velutinus interdum pruinosus. Lamellae adnatae ad leviter decurrentes, distantes, pallide flavae ad pallide brunneae. Contextus firmus, ex griseo albidus, gustu acrissimus. Latex abundans, albus, grisescens vel brunnescens.

Sporae globosae ad ellipsoidea, reticulatae, alatae, macula suprahilaris interdum distale amyloidea. Pleuromacrocystidia presentia vel absentia. Pileipellis ixotrichoderma, pigmento brunneo intracellulare.

Typus: *Lactarius atroolivinus* Verbeken & Walleyn.

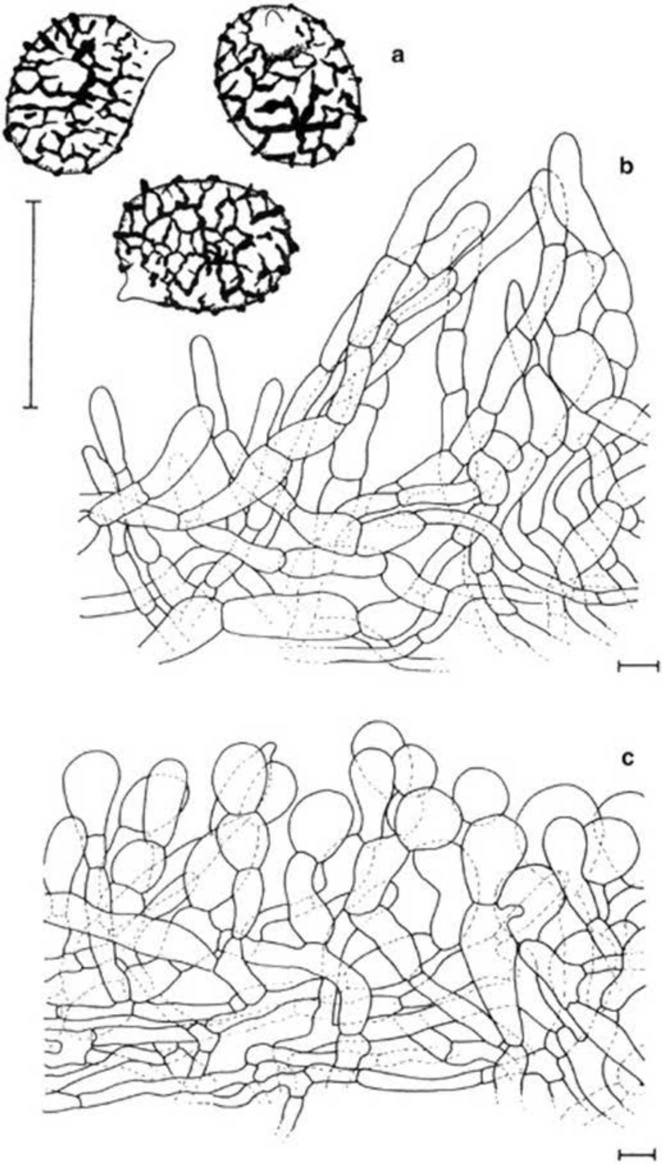


Fig. 7. *Lactarius kabansus*. a. Spores (type); c. section of pileipellis (*Buyck 3369*). — *Lactarius tenellus*. b. Section of pileipellis (*Buyck 3410*; bar = 10 µm).

Pileus infundibuliform, umbilicate or papillate; margin strongly undulate or crenulate, often striate; pellis, smooth, sometimes shiny and slightly sticky, with brownish, ochraceous or olivaceous tinges. Stipe cylindrical, smooth, mat, sometimes finely felty, sometimes pruinose. Lamellae broadly adnate to slightly decurrent, unequal with abundant lamellulae of different lengths, distant, pale yellow to pale brown. Context rather firm, with greyish tinge and burning acrid taste. Latex abundant, white, drying greyish or brownish; taste very acrid.

Spores globose to ellipsoid; ornamentation amyloid, composed of ridges up to 2(2.5) µm high, forming a reticulum with a strongly winged aspect; plage strongly distally amyloid. True pleurocystidia absent or present and then with distinct needle-like content. Lamella-edge sterile. Pileipellis ixotrichoderm-like, locally with brownish intracellular pigmentation.

Type: *Lactarius atroolivinus* Verbeken & Walleyn.

OBSERVATIONS

Three taxa have a rather distinct position within the subgenus because of their pileipellis-structure: they lack globose or swollen elements and the elements are embedded in a distinct slime-layer. A trichoderm-like structure is unusual within the subgenus, but other characters such as spore-ornamentation, the dark intracellular pigmentation in the pileipellis, and macroscopic habit strongly argue for a position in the subgenus *Plinthogali*. Macroscopically the taxa are recognized by the dull brownish, often olivaceous or ochraceous colours and a smooth, even shiny, pileus.

Because of its olivaceous colours and macrocystidia with needle-like content, *L. atroolivinus* could be a link to certain species in the subgenus *Piperites* (Fr.) C.H. Kauffm.

KEY TO THE TAXA

1a. Pleuromacrocystidia abundant; pileus with blackish olivaceous tinges; spores ornamented with narrow, fine ridges . . . . *L. atroolivinus*

b. Pleuromacrocystidia absent; pileus rather brownish; spores more heavily ornamented 2

2a. Ascending elements in the pileipellis 5–9 µm broad, subclavate or subfusiform; pileus mat and very finely felty . . . . *L. undulatus* var. *undulatus*

b. Ascending elements in the pileipellis very narrow (2–4 µm), cylindrical, more poorly represented; pileus smooth and shiny, slightly viscid . . . . . . *L. undulatus* var. *rasilis*

Lactarius atroolivinus Verbeken & Walleyn, *nov. spec.* — Fig. 8, Plate 6

Pileus 30–100 mm diam., infundibuliformis, distincto umbilico, margine undulato ad crenulato, pileipellis laevis, leviter glutinosa, ex olivaceo atrobrunnea. Stipes 30–60 mm longus, 10–16 mm crassus, subcylindratus, laevis, pruinosus, griseobrunnescens. Lamellae adnatae, moderate distantes ad distantes, atroflavidae. Contextus brunneogriseus, gustu mitis deinde acrissimus. Latex moderate abundans, albus tum cremeus, olivaceobrunnescens.

Sporae globosae ad subglobosae, 8.7–*9.3*–9.8 × 7.7–*8.5*–9.2 µm, subreticulatae, alatae, cristis usque ad 2.5 µm altis ornatae, macula suprahilaris interdum distale amyloidea. Basidia 50–65 × 12–15 µm, subclavata, tetraspora. Pleuromacrocystidia abundantia, 50–70 × 6–8 µm, fusiformia. Pleuropseudocystidia moderate abundantia, non emergentia, 3–4 µm diam. Pileipellis ixotrichoderma.

Holotypus: Zimbabwe, Penhalonga, hill behind Harris' garden, grid 1832B3, young *Brachystegia spiciformis*-dominated miombo woodland with *Uapaca kirkiana* on hill ridge, 9 Feb. 1999, *Verbeken 99-143* (GENT, holotypus).

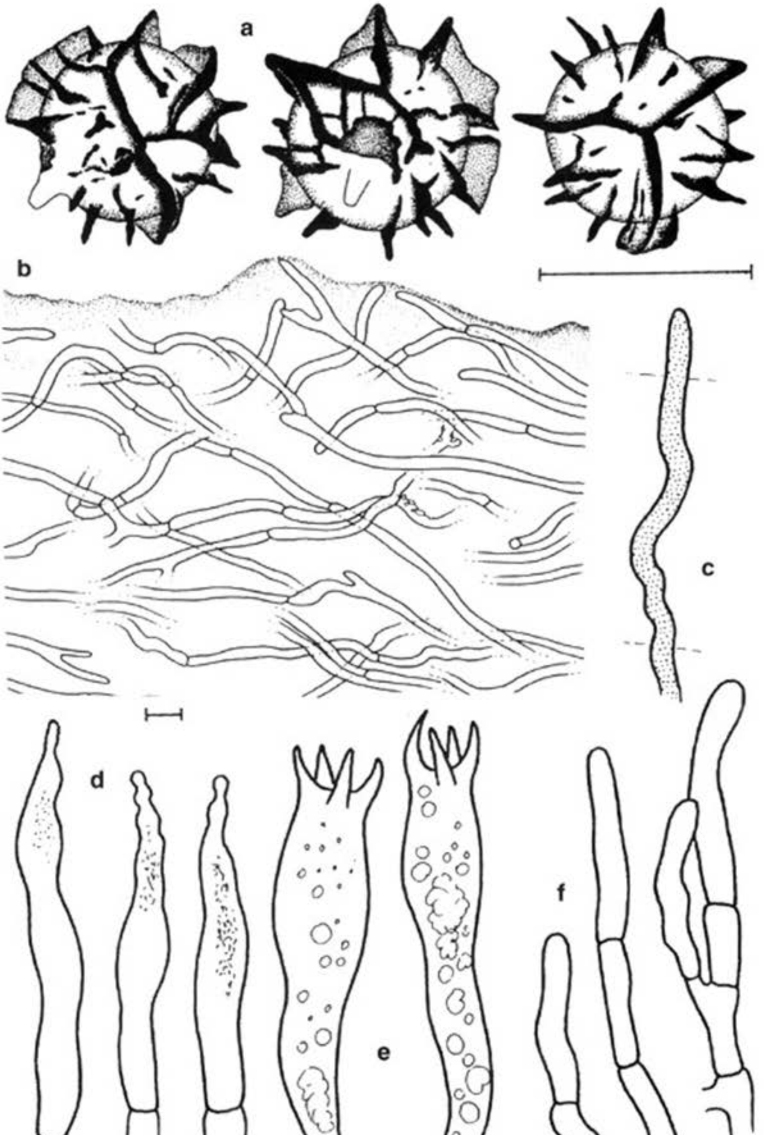


Fig. 8. *Lactarius atroolivinus* (type). a. Spores; b. section of pileipellis; c. pseudocystidium; d. pleuromacrocystidia; e. basidia; f. marginal cells (bar = 10 µm).

Pileus 30–100 mm diam., regularly infundibuliform, with a typical *Clitocybe*-shape, with a distinct, sometimes suddenly deep and narrow umbilicus; margin incurved and staying slightly incurved, broadly wavy, crenulate in older specimens; surface smooth, shiny, with very small, almost indistinct radially wrinkles, very slightly sticky, very dark brown, almost blackish at margin, greyish brown (7F3–4) but more intense towards the centre (6F4–6E3), overall tinged dark brown to blackish brown with an olivaceous shade. Stipe 30–60 × 10–16 mm, subcylindrical, slightly tapering at the base, smooth, dryer than the pileus, with a somewhat pale, almost pruinose aspect which makes it look like plaster, greyish brown (6E3), not unicolorous, locally grey (6C1) in young specimens, with plastery greyish tinge, with a very dark narrow zone just beneath the lamellae, and right underneath this darker zone slightly paler than in the rest of the stipe. Lamellae broadly adnate, moderately distant to distant (4 to 7/cm halfway the radius), papery thin, not very brittle, with very abundant lamellulae of many different lengths (no regular pattern), dark blonde (5D4), staining dark in old specimens. Context rather thick and firm, brownish-grey (same tinge as pileus, but paler), immediately blue with gaiac; smell a bit fatty, faintly of *L. quietus*; taste first mild, but soon very acrid, burning. Latex moderately abundant, white, slightly cream, drying dark olivaceous brown (5E4) after more than 30 minutes, unchanging with KOH, slightly cream on paper.

Spores globose to subglobose, 8.3–*9.2*–*9.3*–10.0 × 7.7–*8.3*–*8.5*–9.2 µm (Q = 1.00–*1.08*–*1.10*–1.17; n = 40); ornamentation amyloid, composed of narrow and acute ridges, up to 2.5 µm high, forming a very incomplete reticulum; plage distally amyloid. Basidia 50–65 × 12–15 µm, 4-spored, subclavate, with guttulate or densely granular content; sterigmata 9–11 × 1–3 µm. Pleuromacrocystidia abundant, sometimes slightly emergent, 50–70 × 6–8 µm, narrowly fusiform, with tapering or mucronate apex; content needle-like. Pleuropseudocystidia rather abundant, never emergent, 3–4 µm diam., narrow, cylindrical, with rounded apex. Lamella-edge sterile; composed of marginal cells which are narrowly cylindrical, 30–45 × 4–6 µm, hyaline, thin-walled. Hymenophoral trama mixed; filamentose with some sphaerocytes present; lactifers abundant. Pileipellis an ixotrichoderm, 100–120 µm thick, composed of very loosely interwoven repent and ascending hyphae; hyphae 2–4 µm diam., thin-walled, some with a brown intracellular pigmentation; some incrustations also present; embedded in a slime-layer but never with gelatinized walls. Stipitipellis a trichoderm, locally a cutis, not embedded in a slime-layer, but composed of hyphae of 4–6 µm diam. and with a rather rigid wall; no pigmentation present.

Examined material. ZAMBIA: Kitwe, Dec. 1978, *Piearce 593/2* (K, previously identified by myself as *L. undulatus* var. *rasilis*). — ZIMBABWE: road from Mutare to Bvumba at peg 15.5 km, grid 1932B2, *Brachystegia spiciformis*-dominated miombo woodland, 11 Feb. 1999, *Verbeken 99-175* (GENT); Penhalonga, hill behind Harris' garden, grid 1832B3, young *Brachystegia spiciformis*-dominated miombo woodland with *Uapaca kirkiana* on hill ridge, 9 Feb. 1999, *Verbeken 99-143* (GENT, holotypus).

Lactarius undulatus var. **undulatus** — Fig. 9

Lactarius undulatus Verbeken, Bull. Jard. bot. Belg. 65 (1996) 210.

Pileus 75 mm diam., broadly infundibuliform with an umbilicate centre; margin straight, strongly undulate, strongly striate to grooved; pellis not dehiscent, mat, very finely felty, sepia to horn, ochraceous towards the centre. Stipe 42 × 11 mm, long, slender, cylindrical, mat, very finely felty, clay-buff to hazel-buff, cream at the apex. Lamellae adnate to slightly

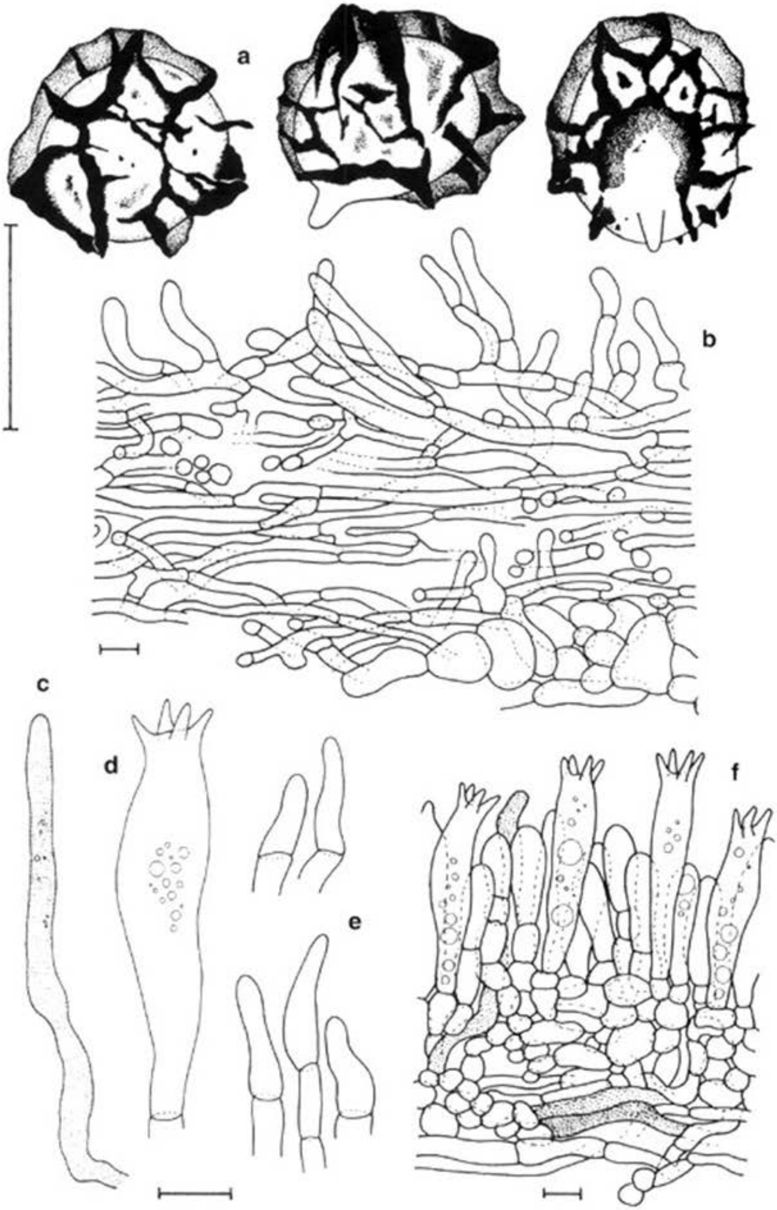


Fig. 9. *Lactarius undulatus* (type). a. Spores; b. section of pileipellis; c. pseudocystidium; d. basidium; e. marginal cells; f. hymenium (bar = 10 µm).

decurrent, unequal with lamellulae of different lengths, very distant (5/cm), cream to pale milky coffee-colour. Context with very acrid taste; smell unpleasant to mealy. Latex very abundant, white, becoming grey and then slightly brown; taste very acrid. Spore-deposit not observed.

Spores ellipsoid, 8.2–*10.0*–11.8(–12.4) × (6.1–)6.7–*7.9*–9.2 µm (Q = 1.16–*1.26*–1.36; n = 20); ornamentation amyloid, composed of ridges up to 2(2.5) µm high, forming a reticulum with strongly winged aspect; some low isolated warts present; wall sometimes rugose; plage strongly distally amyloid. Basidia 45–55 × 11–14 µm, subfusiform to fusiform, 4-spored; content guttulate. True pleurocystidia absent. Pseudopleurocystidia rather scarce, narrowly cylindrical, with rounded apex, 3–4 µm diam.; content oleiferic. Lamella-edge sterile; marginal cells not abundant because of the presence of narrow, parallel hyphae which border the lamella; some marginal cells narrowly cylindrical, with rounded apex, 10–30 × 3–5 µm, hyaline, thin-walled. Hymenophoral trama subregular, composed of hyaline, narrow hyphae; lactifers abundant. Pileipellis ixotrichoderm-like, two-layered; suprapellis composed of ascending elements, 20–60 × 5–9 µm, subclavate or subfusiform, sometimes septate, thin-walled, often with brownish content; subpellis composed of narrow, hyaline hyphae, locally with brownish content. Stipitipellis two-layered; suprapellis composed of ascending elements, 20–50 × 5–8 µm, cylindrical, subclavate or subfusiform, sometimes septate, thin-walled, often with brownish content; subpellis ixocutis-like, composed of narrow, hyaline hyphae, locally with brownish content. Clamp-connections absent.

Examined material. CAMEROON: South Western Prov., Korup NP, near Mundema, 100–150 ft., transect P'-P24, Jan. 1989, *Watling 21468* (holotypus, E).

Lactarius undulatus var. **rasilis** Verbeken — Fig. 10

Lactarius undulatus var. *rasilis* Verbeken, Bull. Jard. bot. Belg. 65 (1996) 210.

Pileus 70 mm diam., thin, elastic, broadly infundibuliform, with small, broad papilla in the centre; margin slightly deflexed, strongly undulate and crenulate, strongly striate to grooved; pellis not dehiscent, smooth, shiny, humid and slightly sticky, dark brown (5EF6), paler in the centre, ochraceous brown in the centre. Stipe 55 × 8 mm, long, slender, cylindrical, slightly curved, smooth, mat, slightly striate in the upper part, brown (5E4), pale greyish in the upper part, fragile, fistulose, with ochraceous rhizomorphs at the base. Lamellae adnate to slightly decurrent, unequal with abundant lamellulae of different lengths, very distant (5/cm), rather broad (5–7 mm), moderately thick, elastic, not fragile, pale yellow to greyish yellow (4AB3); edge entire, concolorous. Context rather firm, thin, fragile in stipe, dirty white (6B2), changing pale greyish brown in pileus, changing brownish orange (6C3) in stipe, unchanging with anilated H_2O, NH_4OH, phenolaniline, brownish with NaOH, pale pinkish with phenol; taste very acrid; smell not remarkable. Latex very abundant, watery, white, changing to yellowish when drying, later greyish; taste very acrid. Spore-deposit pale cream.

Spores subglobose to ellipsoid, 8.2–*9.2*–10.3 × 7.3–*8.1*–8.8 µm (Q = 1.05–*1.14*–1.24; n = 20); ornamentation amyloid, composed of ridges up to 2(2.5) µm high, forming a reticulum with strongly winged aspect; some low isolated warts present; wall sometimes rugose; plage strongly distally amyloid. Basidia 50–65 × 9–11 µm, cylindrical to subfusiform, 4-spored. True pleurocystidia absent. Pseudopleurocystidia scarce, narrowly cylindrical, with rounded apex, 3–4 µm diam.; content oleiferic. Lamella-edge sterile; marginal cells

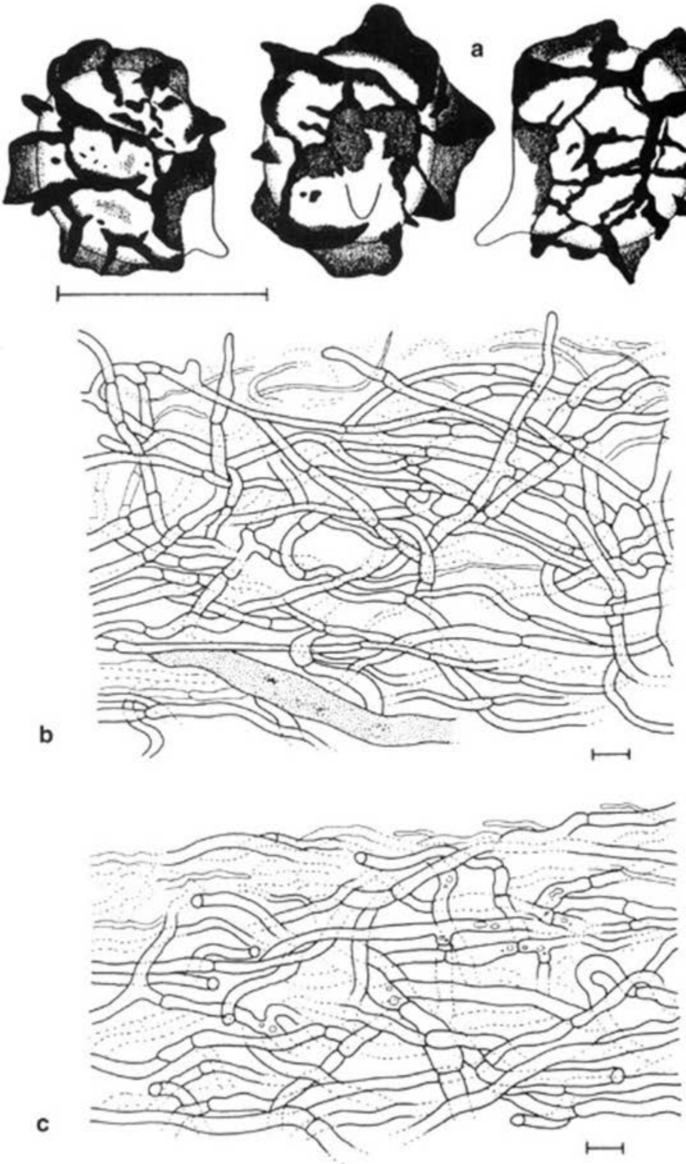


Fig. 10. *Lactarius undulatus* var. *rasilis* (type). a. Spores; b. section of pileipellis; c. section of stipitipellis (bar = 10 µm).

not abundant because of the presence of narrow, parallel hyphae which border the lamella; some marginal cells narrowly cylindrical, with rounded apex, 13–25 × 3–5 µm, hyaline, thin-walled. Hymenophoral trama subregular, composed of hyaline, narrow hyphae; lactifers abundant. Pileipellis one-layered, ixotrichoderm-like, composed of recumbent, narrow hyphae, more or less parallel; some terminal, very narrow (2–4 µm), ascending elements present, embedded in a slime-layer; locally brownish intracellular pigmentation. Stipitipellis ixocutis-like, composed of narrow, recumbent, parallel hyphae; locally brownish intracellular pigmentation. Clamp-connections absent.

Examined material. ZAIRE: Kivu Prov., Irangi, rain forest, April 1972, *Rammeloo Z415* (holotypus GENT).

5. Checklist of the subgenus Plinthogali in tropical Africa

Extended descriptions other than the original descriptions are cited under 'Select. descr.' Countries where the species has been collected are listed alphabetically under 'Distribution'; for each country, herbaria are listed where material of the species is kept.

acutus – *Lactarius acutus* R. Heim, Bull. Jard. bot. État 25 (1955) 73.
Holotypus: *Heim D74* (PC).
Type locality: Guinea, near Macenta, ± N 08°35', W 09°27'.
Known distribution: Cameroon (E), Guinea-Conakry (PC), Congo-Kinshasa (BR).

adhaerens – *Lactarius adhaerens* R. Heim, Candollea 7 (1938) 375.
Holotypus: *Heim J18* (PC).
Type locality: Madagascar, South of Antanambé, ± S 16°26', E 49°50'.
Select. descr.: R. Heim, Prodr. Fl. Mycol. Madagascar 1 (1938) 32.
Icon.: R. Heim, Prodr. Fl. Mycol. Madagascar 1 (1938) pl. 1b.
Known distribution: only known from type locality.

atroolivinus – *Lactarius atroolivinus* Verbeken & Walleyn, this paper.
Holotypus: *Verbeken 99-143* (GENT).
Type locality: Zimbabwe, hill north of Penhalonga, S 18°53', E 32°42'.
Known distribution: Zambia (K), Zimbabwe (GENT).

baliophaeus – *Lactarius baliophaeus* Pegl., Kew Bull. 23 (1969) 237.
Holotypus: *Holden GC66* (K).
Type locality: Ghana, Tafo, N 06°44', W 01°37'.
Select. descr.: Verbeken, Persoonia 16 (1996) 215.
Known distribution: Burundi (BR, PC), Ghana (K), Senegal (BR), Zambia (PC).

congolensis – *Lactarius congolensis* Beeli, Bull. Soc. r. Bot. Belg. 60 (1928) 164.
Syn.: *Lactarius craterelloides* Heim & Gooss.-Font. ap. R. Heim, Bull. Jard. bot. État 25 (1955) 52; *Lactarius unicolor* Gooss.-Font. & Heim ap. R. Heim, Bull. Jard. bot. État 25 (1955) 77.
Holotypus: *Goossens-Fontana 528* (BR).
Type locality: Congo, Diobo Akuba, N 02°37', E 20°50'.
Select. descr.: Verbeken, Edinburgh J. Bot. 52 (1996) 63.
Icon.: R. Heim, Fl. Iconogr. Champignons Congo 4 (1955) pl. 14, fig. 9 & pl. 15, fig. 4;

R. Heim, Bull. Jard. bot. État 25 (1955) pl. 3, fig. 4 & pl. 5, fig. 4ab.
Known distribution: Congo (BR).

griseogalus – *Lactarius griseogalus* R. Heim, Rev. Mycol. (Paris) 32 (1967) 204.
Holotypus: *Heim LM2189* (PC).
Type locality: Central African Republic, Bébé savanna, close to Filifi river, (?) N 05°50', E 15°22'.
Select. descr.: R. Heim, Israel J. Bot. 15 (1966) 158.
Known distribution: Central African Republic (PC), Nigeria (K).

kabansus – *Lactarius kabansus* Pegler & Piearce, Kew Bull. 35 (1980) 487.
Holotypus: *Piearce 600.3* (K).
Type locality: Zambia, Kitwe, Chimwemwe market, S 12°49', E 28°13'.
Select. descr.: Buyck, Brussels Admin. Gén. Coop. Dévelopm., Publ. Agricoles 34 (1994) 106.
Icon.: Buyck, Brussels Admin. Gén. Coop. Dévelopm., Publ. Agricoles 34 (1994) fig. 80; Karhula et al., Karstenia 38 (1998) fig. 22; Ryvarden et al., Introduction larger fungi South Central Africa (1994).
Known distribution: Benin (BR), Burundi (BR, PC), Congo (BR), Kenya (K), Malawi (K), Tanzania (H), Zambia (E, K, PC), Zimbabwe (BR, GENT).

kalospermus – *Lactarius kalospermus* (Beeli) Verbeken & Walleyn, Edinburgh J. Bot. 53 (1996) 69.
Basionym: *Laccaria kalosperma* Beeli, Bull. Soc. r. Bot. Belg. 66 (1933) 22.
Holotypus: *Goossens-Fontana 859* (BR).
Type locality: Congo, Binga, N 02°28', E 20°31'.
Select. descr.: Verbeken, Edinburgh J. Bot. 52 (1996) 69.
Known distribution: only known from type locality.

melanodermus – *Lactarius melanodermus* Heim & Gooss.-Font., Bull. Jard. bot. État 25 (1955) 50.
Holotypus: *Goossens-Fontana 4039* (BR).
Type locality: Congo, Binga, N 02°28', E 20°31'.
Icon.: R. Heim, Fl. Iconogr. Champignons Congo 4 (1955) pl. 14, fig. 7; R. Heim, Bull. Jard. bot. État 25 (1955) pl. 5, fig. 3a–b.
Known distribution: Cameroon (E), Congo (BR).

melanogalus – *Lactarius melanogalus* R. Heim ex R. Heim, Bull. Jard. bot. État 25 (1955) 46.
Based on *Lactarius melanogalus* R. Heim, Boissiera 7 (1943) 268, nom. nud., descr. gall.
Lectotypus: *Goossens-Fontana 979* (BR).
Type locality: Zaire, Binga, N 02°28', E 20°31'.
Select. descr. & lectotypification: Verbeken, Persoonia 16 (1996) 211.
Icon.: R. Heim, Fl. Iconogr. Champignons Congo 4 (1955) pl. 14, fig. 6; R. Heim, Bull. Jard. bot. État 25 (1955) pl. 5, fig. 1–2.
Known distribution: Benin (BR), Congo (BR), Ghana (K), Ivory Coast [R. Heim, Fl.

Iconogr. Champignons Congo 4 (1955)], Cameroon [E; R. Heim, Bull. Jard. bot. État 25 (1955)], Gabon [R. Heim, Fl. Iconogr. Champignons Congo 4 (1955)], Zambia (PC).

nudus – *Lactarius nudus* R. Heim, Bull. Jard. Bot. État 25 (1955) 53.
Holotypus: *Goossens-Fontana 1006* (BR).
Type locality: Congo, Binga, N 02°28', E 20°31'.
Icon.: R. Heim, Fl. Iconogr. Champignons Congo 4 (1955) pl. 14, fig. 8; R. Heim, Bull. Jard. bot. État 25 (1955) pl. 5, fig. 5a–c.
Known distribution: only known from type locality.

orientalis – *Lactarius orientalis* (Verbeken) Verbeken, this paper.
Basionym: *Lactarius baliophaeus* var. *orientalis* Verbeken, Persoonia 16 (1996) 219.
Holotypus: *Verbeken 94.472* (BR, isotypus GENT).
Type locality: Burundi, Rumonge Forest Reserve, Nyamirambo hill, S 04°07', E 29°37'.
Select. descr.: Verbeken, Persoonia 16 (1996) 219.
Known distribution: Burundi (BR, GENT, PC), Zambia (PC), Zimbabwe (GENT).

pusillisporus – *Lactarius pusillisporus* Verbeken, Bull. Jard. bot. Belg. 65 (1996) 206.
Holotypus: *Verbeken 94.285* (BR, isotypus GENT).
Type locality: Burundi, Rumonge Forest Reserve, Nyamirambo hill, S 04°07', E 29°37'.
Known distribution: Burundi (BR).

rumongensis – *Lactarius rumongensis* Verbeken, Bull. Jard. bot. Belg. 65 (1996) 208.
Holotypus: *Verbeken 94.006* (BR, isotypus GENT).
Type locality: Burundi, Rumonge Forest Reserve, Nyamirambo hill, S 04°07', E 29°37'.
Known distribution: Burundi (BR, PC), Congo (BR).

saponaceus – *Lactarius saponaceus* Verbeken, Bull. Jard. bot. Belg. 65 (1996) 209.
Holotypus: *Verbeken 94.353* (BR, isotypus GENT).
Type locality: Burundi, Rumonge Forest Reserve, Nyamirambo hill, S 04°07', E 29°37'.
Known distribution: Burundi (BR, PC), Zambia (PC), Zimbabwe (GENT).

sulcatulus – *Lactarius sulcatulus* Verbeken, Bull. Jard. bot. Belg. 65 (1996) 210.
Holotypus: *Rammeloo Z414* (GENT).
Type locality: Congo, Kivu, Irangi, S 01°53', E 28°27'.
Known distribution: Congo (GENT), Zimbabwe (GENT).

sulcatus – *Lactarius sulcatus* Verbeken & Walleyn, this paper.
Holotypus: *Verbeken 99.176* (GENT).
Type locality: Zimbabwe, road from Mutare to Bvumba at peg 15.5 km.
Known distribution: only known from type locality.

tenellus – *Lactarius tenellus Verbeken & Walleyn*, this paper.
Basionym: *Lactarius kabansus* var. *pallidus* Verbeken, Bull. Jard. bot. Belg. 65 (1996) 202.
Holotypus: *Verbeken 94.157* (BR, isotypus GENT).
Type locality: Burundi, Rumonge Forest Reserve, Nyamirambo hill, S 04°07', E 29°37'.
Known distribution: Burundi (BR, PC), Congo (BR), Malawi (K), Tanzania (K, WAG), Zambia (K, PC).

undulatus – *Lactarius undulatus* Verbeken, Bull. Jard. bot. Belg. 65 (1996) 210.
Holotypus: *Watling 21468* (E).
Type locality: Cameroon, Korup NP, N 04°55', E 08°52'.
Select. descr.: this paper.
Known distribution: only known from type locality.

undulatus var. **rasilis** – *Lactarius undulatus* var. *rasilis* Verbeken, Bull. Jard. bot. Belg. 65 (1996) 210.
Holotypus: *Rammeloo Z415* (GENT).
Type locality: Congo, Kivu, Irangi, S 01°53', E 28°27'.
Select. descr.: this paper.
Known distribution: Congo (GENT).

INSUFFICIENTLY KNOWN TAXA

fulgens – *Lactarius fulgens* R. Heim, Candollea 7 (1938) 377.
Holotypus: *Heim 140* (PC).
Type locality: Madagascar, N of the Isle of St.-Marie, ± S 16°50', E 49°56'.
Select. descr.: R. Heim, Prodr. Fl. Mycol. Madagascar 1 (1938) 44.
Icon.: R. Heim, Prodr. Fl. Mycol. Madagascar 1 (1938) pl. 1d.
Known distribution: only known from type locality.

Observations

The type material of this species consists of one basidiome which had been preserved in alcohol. As the alcohol has evaporated in the course of time, the specimen is in very bad condition. The spore-ornamentation can hardly be observed in Melzer's reagent; nor can the structure of the pileipellis and stipitipellis be identified. The former consists of small and short cylindrical elements, 10–30 × 3–6 µm, thin-walled and with granular content. These were only observed in surface view.

fulgens var. **africanus** – *Lactarius fulgens* var. *africanus* R. Heim, Bull. Jard. Bot. État 25 (1955) 70.
Holotypus: *Heim B21* (PC).
Type locality: Ivory Coast, Toulépleu forest, near Danané, N 06°37', W 08°27'.
Known distribution: only known from type locality.

Observations

Spores globose to subglobose, sometimes ellipsoid, 5.2–*6.0*–6.8 × 4.7–*5.4*–6.1 µm (Q = 1.01–*1.11*–1.17; n = 30); ornamentation amyloid, composed of irregular ridges and warts, forming an almost complete reticulum; ridges up to 0.8 µm high; plage inamyloid. Basidia 35–45 × 8–10 µm, cylindrical to subclavate, 4-spored. True pleurocystidia not observed. Pseudopleurocystidia fairly abundant, 2–5 µm diam., cylindrical to tortuous, with rounded apex; content oleiferic. Hymenophoral trama irregular, composed of narrow, hyaline hyphae and abundant lactifers.

The type material of this taxon consists of a small piece of a basidiome in very bad condition. The spore-ornamentation is hardly visible in Melzer's reagent; most probably the specimen has been preserved in alcohol before drying completely. Given the bad condition of the specimen, it has been impossible to identify the structure of stipitipellis and pileipellis. A surface view of the pileipellis could be observed. It probably consists of pseudoparen-

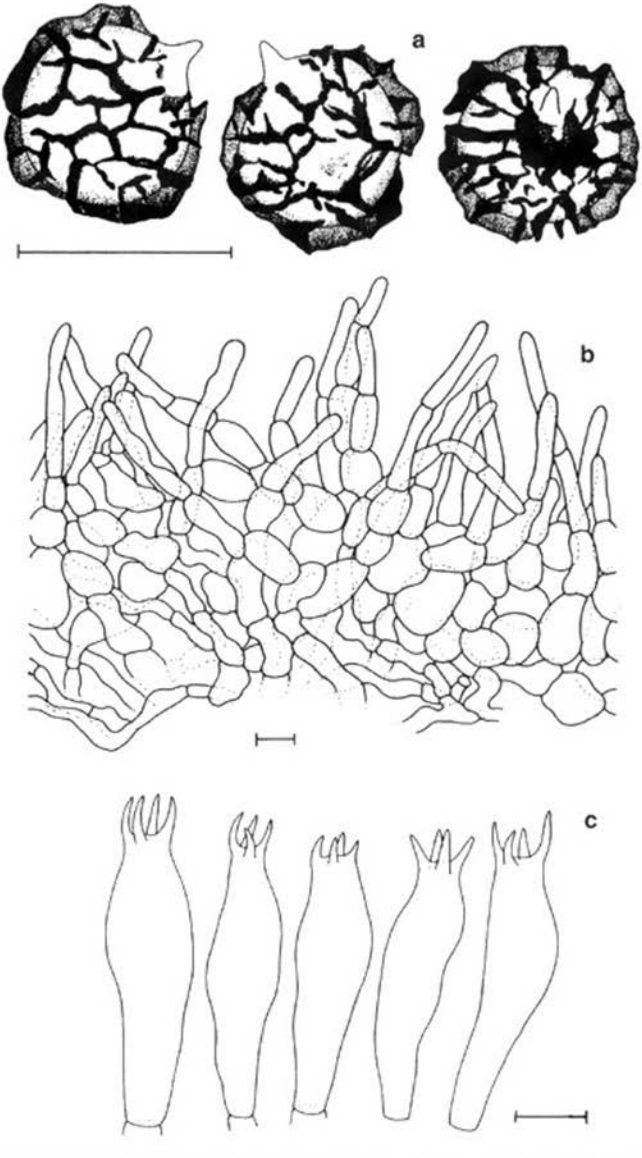


Fig. 11. *Arcangeliella dolichocaulis* (type). a. Spores; b. section of pileipellis; c. basidia (bar = 10 µm).

chymatous subpellis with a suprapellis composed of slender cylindrical elements, 20–35 × 4–8 µm. *Lactarius fulgens* var. *africanus* most probably represents a good species on its own but new collections and observations are needed to clarify its identity.

6. **Observations on Arcangeliella dolichocaulis Pegl.**

Arcangeliella dolichocaulis is described by Pegler (1982) from Zambian miombo woodland as an epigeal, agaricoid mushroom with a smooth, glabrous and dry pileipellis, a well-developed stipe and an exposed, sinuate, globulose, somewhat radiating to alveolate labyrinthoid hymenophore, forming numerous, small irregular locules without any geotropical orientation. It contains copious latex, which is white, unchanging and tastes like cedarwood with a bitter after-taste. We examined the type (*Rose 7701*, K) and observed the following microscopic characters (Fig. 11):

Spores 7.8–*8.5*–9.7 × 6.7–*7.7*–9.0 µm, subglobose (Q = 1.05–*1.10*–1.21); ornamentation amyloid, consisting of an almost complete reticulum with ridges up to 1.5 µm high; plage distally amyloid; basidia 4-spored, clavate to subfusiform, 35–45 × 9–12 µm; true cystidia and pseudocystidia lacking; hymenophoral trama consisting of thin-walled hyaline hyphae which are more or less parallel and embedded in some slimy consistence; lactifers scarcely present; pileipellis and stipitipellis a palisade with a well developed layer of isodiametric cells and a suprapellis of thin-walled, 1–3-septate cylindrical elements.

Pegler (1982) has already stated that the basidiomes of *Arcangeliella dolichocaulis* are completely agaricoid apart from the glebulose hymenophore and are closer to *Lactarius* than to *Arcangeliella* as defined by Pegler & Young (1979). Indeed, if this species had a normal hymenophore and pseudocystidia, it would fit perfectly in *Lactarius* subgenus *Plinthogalus* because of the winged spore-ornamentation with distally amyloid plage and the structure of the pileipellis. The particular shape and structure of the hymenophore could be interpreted as aberrant, but the lack of pseudocystidia makes a position in *Lactarius* unacceptable.

A more recent definition of *Arcangeliella* is given by Thiers (1984). The main differences with the type specimen of *A. dolichocaulis* are: pileus rarely becoming fully expanded; margin typically attached to the stipe, breaking free at maturity (hard to observe in *A. dolichocaulis* as there are no young specimens, but the pileus is perfectly expanded and no trace of an attachment is visible); gleba lamelliform with highly branched, intervenose lamellae (and thus not without any geotropical orientation); cystidia usually present, often rare and inconspicuous or differentiated as pseudocystidia or macrocystidia; pileipellis a differentiated layer of more or less repent hyphae, a trichodermium, ixotrichodermium or a turf of free hyphal tips.

Arcangeliella dolichocaulis thus differs from other representatives of *Arcangeliella* by its agaricoid and fully expanded basidiome, the shape of the hymenophore and the lack of cystidia. We therefore feel like placing it in a new genus (*Porolactarius* ad int.), but have decided to wait for more records of this species, as thus far only a single carpophore is known.

ACKNOWLEDGEMENTS

The National Foundation for Scientific Research (NFWO, Belgium) is acknowledged for funding part of this research, including the collecting trips in Burundi and Zimbabwe. The families Buyck and Sharp are thanked for their hospitality and field assistance. Ruben Walleyn is thanked for photography and useful comments.

REFERENCES

Bon, M. 1980. Clé monographique du genre Lactarius. Doc. mycol. 10 (40): 1–85.

Burlingham, G.S. 1908. A study of the Lactariae of the United States. Mem. Torrey bot. Club 14: 1–109., pl.1–15.

Hesler, L.R. & A.H. Smith. 1979. North American species of Lactarius. Ann Arbor.

Kornerup, A. & Wanscher, J.H. 1978. Methuen handbook of colour. London.

Pegler, D. 1982. Agaricoid and boletoid fungi (Basidiomycota) from Malawi and Zambia. Kew Bull. 37: 254–271.

Pegler, D. & Young, T.W.K. 1979. The gasteroid Russulales. Trans. Br. mycol. Soc. 72: 353–388.

Singer, R. 1942. Das System der Agaricales. II. Annls mycol. 40: 1–125.

Thiers, H.D. 1984. The genus Arcangeliella Cav. in the Western United States. Sydowia 37: 296–308.

Verbeken, A. 1995. Studies in tropical African Lactarius species. 1. Lactarius gymnocarpus Singer ex R. Heim and allied species. Mycotaxon 55: 515–542.

Verbeken, A. 1996. Studies in tropical African Lactarius species. 3. Lactarius melanogalus and related species. Persoonia 16: 209–223.

Verbeken, A. 1998. Studies in tropical African Lactarius species. 5. A synopsis of the subgenus Lactifluus (Burl.) Hesler & A.H. Sm. emend. Mycotaxon 66: 363–386.

PERSOONIA
Volume 17, Part 3, 407–433 (2000)

MYCELIAL MORPHOLOGY, MITOSPORES AND PRIMORDIUM FORMATION OF SIMOCYBE SUMPTUOSA IN LABORATORY CULTURES

H. CLÉMENÇON

Institut d'Ecologie, Université de Lausanne, CH-1015 Lausanne, Switzerland.
E-mail: Heinz.Clemencon@ie-bsg.unil.ch

In laboratory cultures *Simocybe sumptuosa* produces tiny slime drops with curved, binucleate conidia and ellipsoid, terminal or fusiform intercalary, binucleate chlamydospores. Chlamydospores occur also within the agar medium, but conidia do not. Noduli also form, and in one culture a few basidiomes developed. The mycelium is significantly denser beneath the noduli than between the noduli. Carpogenesis has been studied using stained microtome sections. *Simocybe sumptuosa* is exocarpic amphicleistoblemate.

Mycelia of *S. sumptuosa* (P.D. Orton) Sing. grow well in petridishes on various media at 20°–25°C, the most suitable ones being potato dextrose agar and oat meal agar. Two to three weeks after inoculation the agar surface is covered with a mycelium bearing innumerable, very small droplets of milky white slime that contain strongly curved conidia and ellipsoid aleuria. After another 3–4 weeks small, white pustules of aerial hyphae become visible. These are the first stages of the noduli eventually leading to primordium formation. The noduli soon overgrow neighbouring slime droplets. Most noduli cease further growth and die, but in one culture on PDA a small number of brownish primordia and young basidiomes have developed. This culture has been left unattended for about 6 weeks on a bench in the teaching laboratory where it became contaminated with bacteria that, unfortunately, have not been characterised. Despite many efforts, no other culture ever produced primordia, even when many noduli were present, but the material available allowed the analysis of carpogenesis of *S. sumptuosa*, as well as some observations on the morphology of the mycelium.

Carpogenesis of *Simocybe*-species is poorly known. So far only one single primordium of *S. centunculus* has been investigated (Reijnders, 1963: 82, as *Naucoria centunculus*). It was in a rather advanced developmental stage, and the only significant information that could be gained is the presence of a rudimentary 'partial veil' that lead to the conclusion that *S. centunculus* is 'paravelangiocarpous'. Since this primordium was collected in nature, nothing is known about mycelial morphology and mitospores that might be formed by this species.

MATERIAL AND METHODS

Basidiomes of *S. sumptuosa* (P.D. Orton) Sing. growing on deciduous wood were collected on September 6, 1995 by Dr. Beatrice Senn-Irlet in the Nijenrode Park, Breukelen, province of Gelderland in Holland. Cultures were derived from a spore-print and are kept in our laboratory under the access number BSI 95/68. It is available from the Centraalbureau voor Schimmelcultures, The Netherlands, as strain CBS 102149.

Potato dextrose agar (PDA) was prepared from dehydrated mashed potatoes following Lacy & Bridgmon (1962) and distributed in 9 cm plastic petridishes. After inoculation the dishes were sealed with Parafilm and incubated at approximately 20 °C in a 12h/12h light/dark cycle.

Small agar blocks with noduli or young basidiomes were cut out and fixed in aldehyde gas, dehydrated with methoxyethanol and embedded in a modified methacrylate mixture (Clémençon, 1990, no ethyleneglycol dimethylether, diethyleneglycol monobutylether replaced by 8% of terpineol, azoisobutyronitril replaced by 0.3% benzoyl peroxide and 0.04% N,N-dimethyl aniline). The terpineol acts as a softener, lessens the deteriorating effects of the benzoyl peroxide on the fungal cells and facilitates the removal of the gelatin capsule from the methacrylate block. The gelatin can be peeled off like an egg shell from a hard-boiled egg.

Sections were cut at 5–7 µm thickness using a tungsten carbide knife on an ordinary rotary microtome originally designed for cutting paraffin blocks. They were then placed on a drop of distilled water saturated with terpineol on a microscope slide and dried on a hot plate at roughly 60 °C. Before staining it is necessary to bake the sections onto the microscope slides (placed in a staining rack) for 1–2 h at 115–120 °C. This evaporates some of the terpineol in the embedding plastic (thus facilitating the penetration by the staining solutions) and avoids blistering of the sections during the staining at the elevated temperature used.

The most brilliant and crisp staining is with aluminium-zirconium haematoxylin resulting in blue cell content and reddish hyphal walls:

Mordant 'AZ':	Distilled water	270 ml
	Aluminium chloride	30 g
	Zirconium oxychloride	0.6 g
Haematoxylin:	Haematoxylin 10% in ethanol	3 ml
	Distilled water	300 ml
	Sodium periodate	60 mg

Staining schedule (hot = 55–65 °C; rt = room temperature; batches of 20 slides in a rack):

1	Rinse in hot distilled water	2–3	minutes
2	AZ hot	4–5	minutes
3	Rinse in distilled water rt	~ 1	minute
4	Hot distilled water I	5	minutes
5	Hot distilled water II	5	minutes
6	Hot haematoxylin	2–3	minutes
7	Rinse in distilled water rt	~ 1	minute
8	Hot distilled water	1–2	minutes
9	Hot tap water	1–2	minutes
10	Rapidly rinse in distilled water rt and dry at 55–65 °C		
11	Mount in Entellan or Eukitt		

Notes: If the washing with hot distilled water in steps 4 and 5 is too short then enough AZ stays in the plastic to react with the haematoxylin resulting in a pink grey background staining. If well washed, the methacrylate takes a yellow background staining that is easily removed in steps 8 and 9. The tap water must be slightly alkaline (if not so add a trace of sodium carbonate). If the sections have not been baked at 115–120 °C blisters will form during hot staining. Hot staining is much quicker than staining at room temperature (which takes 24–36 h) and assures uniform staining throughout the entire thickness of the section, which is usually not the case in cold staining. The liquids (300 ml) are pre-heated in plastic staining jars using a household microwave oven at 600 W for 90–95 seconds, but the sections themselves are not exposed to microwave treatment.

Hyphal density in the agar has been estimated in microtome sections through the culture medium after staining with AZ haematoxylin. Using the 'threshold', 'make binary' and 'skeletonize' functions of the image analysis program NIH Image 1.62 by Wayne Rasband, the total mass of the hyphae present in a selected area of the cross section is estimated as the total number of black pixels. Since the hyphae are oriented at different angles with respect to the plane of observation the hyphal mass is underestimated and represents only about 88% of the real value, as detailed analyses of a few images have shown. The surface photographed for analysis measured 529 µm × 395 µm = 0.209 mm^2, and the total hyphal length contained in 1 mm^2 of the section is therefore 4.785 times bigger. Since the sections are 5 µm thick, the total biomass in 1 mm^3 amounts to 200 times the mass contained in 1 mm^2 of a section. As 1.44 pixels are equivalent to 1 µm, the mycelial mass contained in mm^3 of agar can be expressed in µm. For each estimation 11 successive microtome sections have been analysed. All estimates are made within the first 400 µm below the agar surface.

RESULTS

Mycelial morphology

The hyphae of the vegetative mycelium of *S. sumptuosa* are 2–4.5 µm wide, thin walled and roughly cylindrical. They bear clamp-connections at almost every septum, and the dolipore swelling is just visible in SDS Congo red (Clémençon, 1998), but the porus itself is too narrow to be seen. The narrow growth front on the agar surface consists of more or less parallel, radial hyphae, and the hyphal mat behind the growth front is woven from interlaced hyphae. Within the agar the hyphae are loosely arranged and run in all directions, but in cultures producing noduli the distribution is not uniform. Two different petridish cultures producing noduli have been analysed. In the first culture the hyphal masses beneath two noduli were 14.90 m/mm^3 (SD = 1.63, N = 11) and 12.48 m/mm^3 (SD = 0.97, N = 11), as compared to 7.26 m/mm^3 (SD = 1.03, N = 11) at a control site without nodulus. In a second culture there were 10.9 m/mm^3 (SD = 1.58, N = 11) beneath a nodulus and 4.41 m/mm^3 (SD = 0.73, N = 11) under a site without nodulus. This means that beneath a nodulus there are 1.7–2.5 times as many hyphae than at a location without a nodulus. These hyphal lengths may be impressive, but assuming a mean hyphal diameter of 3 µm, the total hyphal volumes amount to 10.4%, 8.7% and 5.1% of the agar volume for the first culture and to 7.6% and 3.1% for the second culture. All differences are statistically significant.

No special hyphal differentiations are visible beneath the noduli or at any other location of the mycelium, but the contents of some hyphae and of a few chlamydospores stain brown in iodine solution indicating the possible presence of glycogen. In cultures older than 4 months many empty hyphae with secondary septa can be seen.

Mitospores

Almost the entire surface becomes covered with tiny milky-white slime droplets that contain strongly curved conidia and ellipsoid chlamydospores (Figs. 1–3, 12).

Conidia are borne in short chains at the end of a hypha or in small clusters on the sides of hyphae (Fig. 4). Several conidial chains form a slimy head (Fig. 5), as the conidia are released by gelification of the wall of the mother hyphae. Conidia are binucleate and contain lipids. The nuclei are already visible in water mounts and are strongly stained by cotton blue in lactic acid (Fig. 6), iron aceto carmine and DAPI; the lipids can be stained with Sudan III dissolved in lactophenol (Fig. 7). The conidial wall is very thin, inamyloid and hardly stains in Congo red and Cotton blue. The clamp-connection often forms a small asymmetrical blister at the base of the conidium (Fig. 8).

Besides terminal aleuria some intercalary, more or less fusiform chlamydospores are present in the mycelium. Both types of chlamydospores are binucleate, contain large amounts of lipids (Fig. 10) and bear a basal clamp-connection. The two nuclei can already be seen in water mounts, become more distinct in iodine solutions and are deeply stained in Cotton blue mounts. Chlamydospore walls are inamyloid, strongly cyanophilic and stain deeply with Congo red. Toluidine blue does not stain the walls, even after heating the slides to the boiling point.

Chlamydospores and conidia frequently occur in the same head (Fig. 9), and both are present together in the same slime droplet.

Conidia are produced only on the agar surface, but chlamydospores are also formed deep within the agar medium (Fig. 11).

In situ germination of chlamydospores has been observed, but this is a rare event. No attempts have been made to estimate the germination rates on fresh media.

Noduli and carpogenesis

Noduli are formed anywhere on the mycelium except near the centre of the culture. They soon overgrow the slime drops and develop on top of them (Figs. 12, 13). Young noduli are connected to the mycelium by a few hyphae and consist of a very loose web of undifferentiated hyphae. On the surface some elongate vesicular cells are present (Fig. 13). Neighbouring noduli may fuse and produce a single primordium (Fig. 19A). Mature noduli are round cushion-shaped or roughly spherical and brown (Figs. 14, 17). They are densely woven from thin-walled, cylindrical hyphae forming an irregular context with a few small air spaces. Near the base some crystals form small clusters surrounded by a thin amorphous mass staining deeply with aluminium zirconium haematoxylin (Figs. 14, 15, 20, 21). The surface is completely covered with a layer of radially arranged, inflated hyphae with vesicular-fusiform end cells (Figs. 14, 16). This layer grows out from the nodulus context and can be named a noduloblema.

For the study of carpogenesis four representative primordia have been selected (Fig. 19). Primordium A consists of an erect shaft emerging from a nodulus and bearing a small pileus initial (in the case figured the shaft actually emerges from two fused noduli, but this is not the rule). Primordium B has grown a thin veil and a small pileus with a smooth prehymenial palisade on its underside. In primordium C general enlargement of all parts has started, and lamellae begin to develop. Primordium D has a very elongated stipe and a few gills, but the partial veil has not grown noticeably.

Fig. 18 shows a primordium intermediate between C and D, but one which has not been sectioned. The veil forms a woolly cover on the stipe and a thin fibrous cover on the pileus, and a few hyphae bridge the gap between the pileus margin and the stipe. This veil consists of a cauloblema, a pileoblema and an amphicleistoblema, as shown below.

Primordium A — Carpogenesis starts with the formation of an erect shaft growing out from the nodulus (Fig. 20). The bottom of the nodulus can be identified by the presence of some crystals and the irregular arrangement of the hyphae (Fig. 23). The shaft does not grow out from the surface of the nodulus but originates from its centre. Here the upward-growing generative hyphae are very thin and loosely arranged. The region corresponding to the centre of the nodulus shows some mucilage (Fig. 23), but higher up the shaft is exempt of mucilage.

In the upper half of the shaft the hyphae form a denser stipe initial with only a few small air spaces. Towards the periphery the hyphae have begun to inflate and to form a tube of denser context. The sides of the shaft are covered with a rudimentary cauloblema consisting mainly of isolated vesicular hyphal end cells.

On top of the shaft is a small pileus initial consisting of a dense context woven from irregularly arranged vegetative hyphae, but it is not sharply delimited from the stipe initial (Fig. 22). It generates a voluminous pileoblema consisting of two zones that are easily distinguished although they are not distinctly separated. The inner zone resembles the noduloblema in the radial arrangement of inflated hyphae with vesicular end cells. The outer zone consists of periclinal hyphae also bearing vesicular end cells (Fig. 22). The development of the primordia shows that the inner pileoblema becomes the pileipellis, whereas the outer pileoblema contributes to the veil.

Primordium B — Fig. 24 shows the general organisation of this developmental stage. The total length has not increased significantly, but the pileus has formed and its underside is lined with a smooth prehymenial palisade. The cauloblema and the pileoblema bridge the gap between the pileus and the stipe thus creating an amphicleistoblema and a secondary prehymenial cavity. This primordium confirms that the erect shaft (the future stipe) grows from the centre of the nodulus.

The growth direction of the hyphae of the metablemas is indicated by the orientation of the vesicular end cells and can also be determined by looking at the clamp-connections, whose open ends point away from the hyphal tips. A fine bundle of hyphae of the cauloblema growing from the stipe surface over the pileus margin and showing many upright vesicular end cells can be seen in Fig. 25. The hyphae of the cauloblema grow over a considerable part of the pileus, and they intermingle with downward growing hyphae from the pileoblema, as seen in Figs. 26A–D. The origin of the hyphae of the pileoblema is shown in Fig. 27. Just below the prehymenial cavity many young hyphae rich in cytoplasm emerge from the stipe surface and grow in the direction of the palisade. This is a young cauloblema (Figs. 28, 28A). A hypha of the cauloblema located on the pileus surface is visible in the same photographs, its growth direction being indicated by the orientation of the clamp-connection (Figs. 28, 28B, arrows). The cauloblema and the pileoblema intermingle on the pileus surface (Fig. 29) and also on the stipe surface (Fig. 30).

The pileus margin begins to be differentiated, but it is not yet present on the entire circumference of the pileus. It is only about 50 µm wide and its hyphae project beyond the level of the prehymenial palisade (Fig. 31). Hyphae of the cauloblema not only grow on the pileus surface, but some of them penetrate into the pileus margin (Fig. 32). The prehymenial palisade forms a continuous ring around the stipe. Lamellae are not yet formed (Figs. 33, 34).

In this developmental stage the hyphae begin to inflate as a means to increase the volume of the basidiome, as documented in Figs. 36–40. The stipe consists of a lateral, tube-like part consisting of short-celled, slightly inflated hyphae and a central pith with thin-walled, faintly staining hyphae.

Primordium C — The size increase is accompanied by inflation of most hyphae of the central pileus context. Air spaces have also increased somewhat in the pileus, leading to a less dense structure as compared to the primordium B (Fig. 42). The first thromboplerous hyphae appear in the pileus context (Fig. 41). Many short hyphae grow out from the stipe surface thus increasing the mass of the cauloblema (Fig. 48), but the outer pileoblema and the cleistoblema have become thinner by the expansion of the pileus. As the stipe has not yet stretched significantly, the structure of its context is the same as the one in primordium B (Fig. 47). It is interesting to note that some medullar hyphae do not reach the pileus. They bear slightly inflated terminal cells reminiscent of acrophysalides (Figs. 45, 46). The first lamellae begin to form, as indicated by the bulge of the palisade in Fig. 49. The gill trama is subregular and slightly divergent, and a few hyphae running roughly parallel to the gill edge are also present (as is frequently the case in mature gills near the edge). The palisade is evenly covering the young gills, without any indication of a differentiation on the gill edge (Figs. 50, 51).

Primordium D — The stipe has much elongated and so have the cells of its lateral part (Fig. 56). The pileus has expanded by further cell inflation and air space formation (Figs. 52, 53). The lamellae are now regular, radial, downward growing ridges with a subregular, slightly diverging gill trama of cylindrical, not yet inflated hyphae (Fig. 54). The gill edges are differentiated by the presence of vesicular cells, the future cheilocystidia. The pileoblema and the cleistoblema have become scantier, but the cauloblema has increased its mass, not by gaining in thickness, but by covering the total length of the stipe. Terminal hyphal end cells in the medulla are confirmed (Fig. 57; compare Figs. 45 and 46).

Legends to Figures 1–25, 41–48

Figs. 1–3. *Simocybe sumptuosa*, slime drops on the agar surface in a petri dish, PDA, 4 weeks, room temperature. — 1. Surface view of a living culture; 2 & 3. cross sections showing strongly curved conidia and vesicular chlamydospores (aleuria). In some mitospores two nuclei can be seen. — Aldehyde gas fixation, methacrylate, aluminium zirconium haematoxylin.

Figs. 4–9. *Simocybe sumptuosa*, conidia and chlamydospores. — 4. Spiral growth during conidium formation; 5. a small slimy head of conidia; 6. conidia stained with cotton blue dissolved in lactic acid. The wall is acyanophilous (or only very weakly stained), but the two nuclei stain deeply; 7. lipids stained with Sudan III in lactophenol; 8. wall stained with Congo red. Please note the empty appendices formed by the mother cell wall; 9. a slimy head with conidia and chlamydospores, stained with Congo red. The chlamydospore walls are thicker and stain strongly, the thin conidial walls do not stain well.

Figs. 10 & 11. *Simocybe sumptuosa*, chlamydospores. — 10. On the surface of the nutrient agar. Lipids stained with Sudan III in lactophenol; 11. within the nutrient agar (PDA). — Aldehyde gas fixation, methacrylate, aluminium zirconium haematoxylin.

Figs. 12 & 13. *Simocybe sumptuosa*, Young noduli growing over the slimy heads of mitospores. — 12. Surface view of a living culture, PDA, 2 months, room temperature; 13. near median cross section. Under the nodulus 2 slimy heads are buried. The structure is still very loose. Vesicular, club-shaped cells are already present on the surface. Aldehyde gas fixation, methacrylate, aluminium zirconium haematoxylin.

Figs. 14–16. *Simocybe sumptuosa*, mature nodulus, near median cross section. — 14. An almost homogeneous, dense plect of cylindrical, strongly interwoven hyphae bears a well-developed metablema (that may be called a noduloblema) of radial, inflated hyphae bearing elongate vesicular cells. Near the base a few clusters of crystals are located between the hyphae (white arrow); 15. close up view of the location indicated by the arrow in Fig. 14; 16. close up view of the noduloblema. — Scale bar valid for Figs. 15 &16. Aldehyde gas fixation, methacrylate, aluminium zirconium haematoxylin.

Figs. 17–19. *Simocybe sumptuosa*, nodules and primordia. Scale bar valid for all Figs. — 17. At left two ochre brownish noduli near maturity, still without surface hyphae. At right two dark brown noduli beginning to form surface hyphae (one hypha clearly visible on the upper nodulus). Please note the dense population of slimy heads on the agar surface; 18. a primordium with light brownish stipe and ochre brown pileus, photographed to show the woolly cauloblema and the hyphae of the pileoblema; 19. near median longitudinal sections of the four developmental stages discussed: A. a conical erect shaft has been formed by two coalescent noduli. The dark spots in the base are crystals; B. the pileus has been formed, the metablemas are well developed, the prehymenial palisade and the prehymenial cavity are already present, but the lamellae have not yet begun to grow; C. the lamellae grow into the cavity. The stipe is already hollow. The cleistoblema still bridges the gap between the pileus margin and the stipe surface; D. the stipe elongates, the metablemas have slightly grown, but the cleistoblema begins to tear apart. — Aldehyde gas fixation, methacrylate, aluminium zirconium haematoxylin. The subsequent figures showing details of each developmental stage of these primordia do not necessarily stem from the sections shown here.

Figs. 20 & 21. *Simocybe sumptuosa*, developmental stage A. — 20. The cauloblema with its vesicular cells is still poorly developed. The pileoblema consists of an inner layer of radially arranged inflated hyphae and a loose outer layer of repent hyphae. The dark spots in the plect of the nodulus are crystals (white arrow). The inner part of the nodulus shows a looser structure than the mature nodulus in Fig. 14. This loosening at primordium formation is confirmed by the other primordia studied (e.g. Fig. 24). The shaft is already differentiated into a medulla of thin hyphae and a peripheral zone of short-celled inflated hyphae. On top of the shaft and beneath the pileoblema the pileus initial takes the form of a small area of tightly entangled hyphae; 21. crystals from the base of a crushed nodulus. — Aldehyde gas fixation, methacrylate, aluminium zirconium haematoxylin.

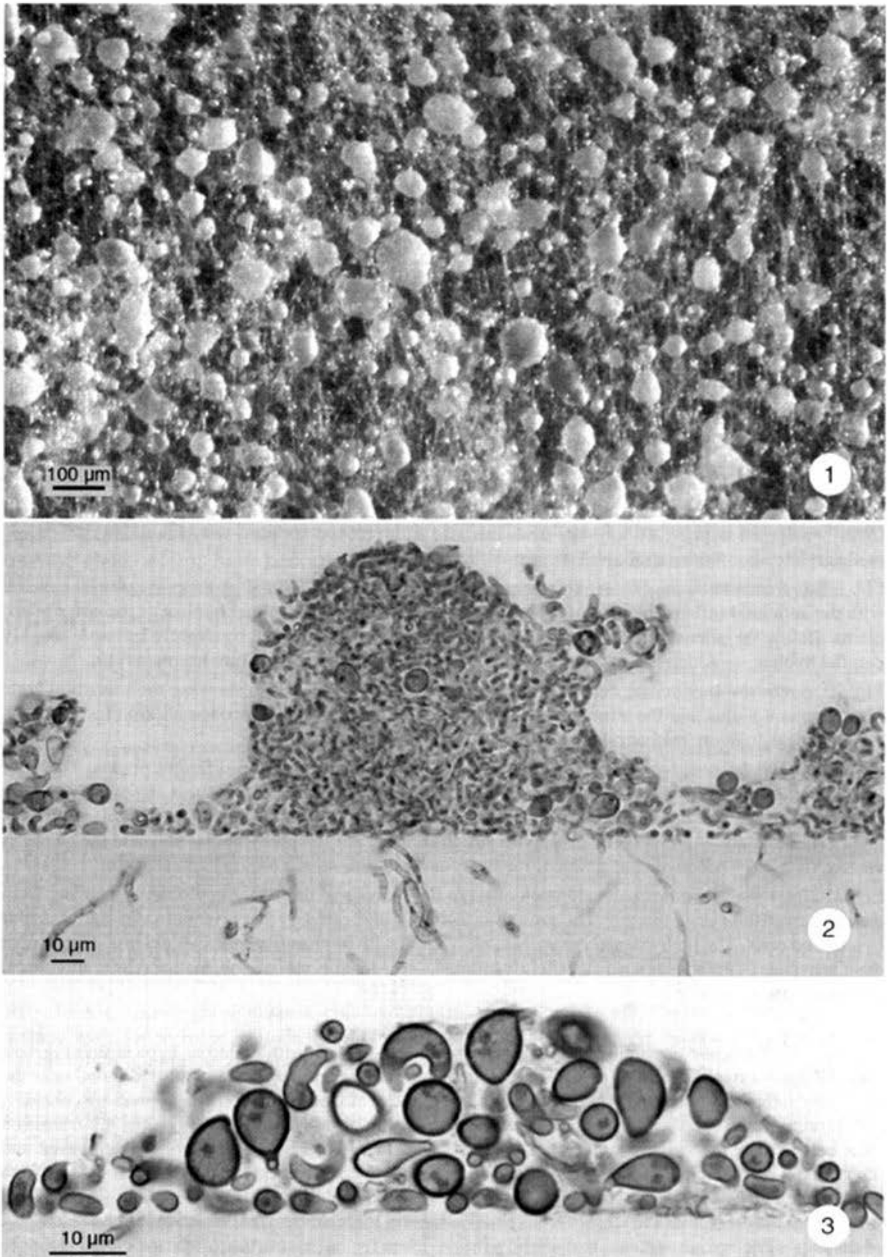
Fig. 22. *Simocybe sumptuosa*, developmental stage A, top of Fig. 20, showing the pileus initial covered with the anticlinal inflated hyphae of the inner pileoblema and the periclinal hyphae of the outer pileoblema. Below the pileus initial the upper part of the erect shaft is formed by slightly inflated, roughly parallel hyphae. — Aldehyde gas fixation, methacrylate, aluminium zirconium haematoxylin.

Fig. 23. *Simocybe sumptuosa*, developmental stage A, bottom of Fig. 20, showing the transition zone between the nodulus and the stipe medulla. In this zone we find some mucilage absent elsewhere. — Aldehyde gas fixation, methacrylate, aluminium zirconium haematoxylin.

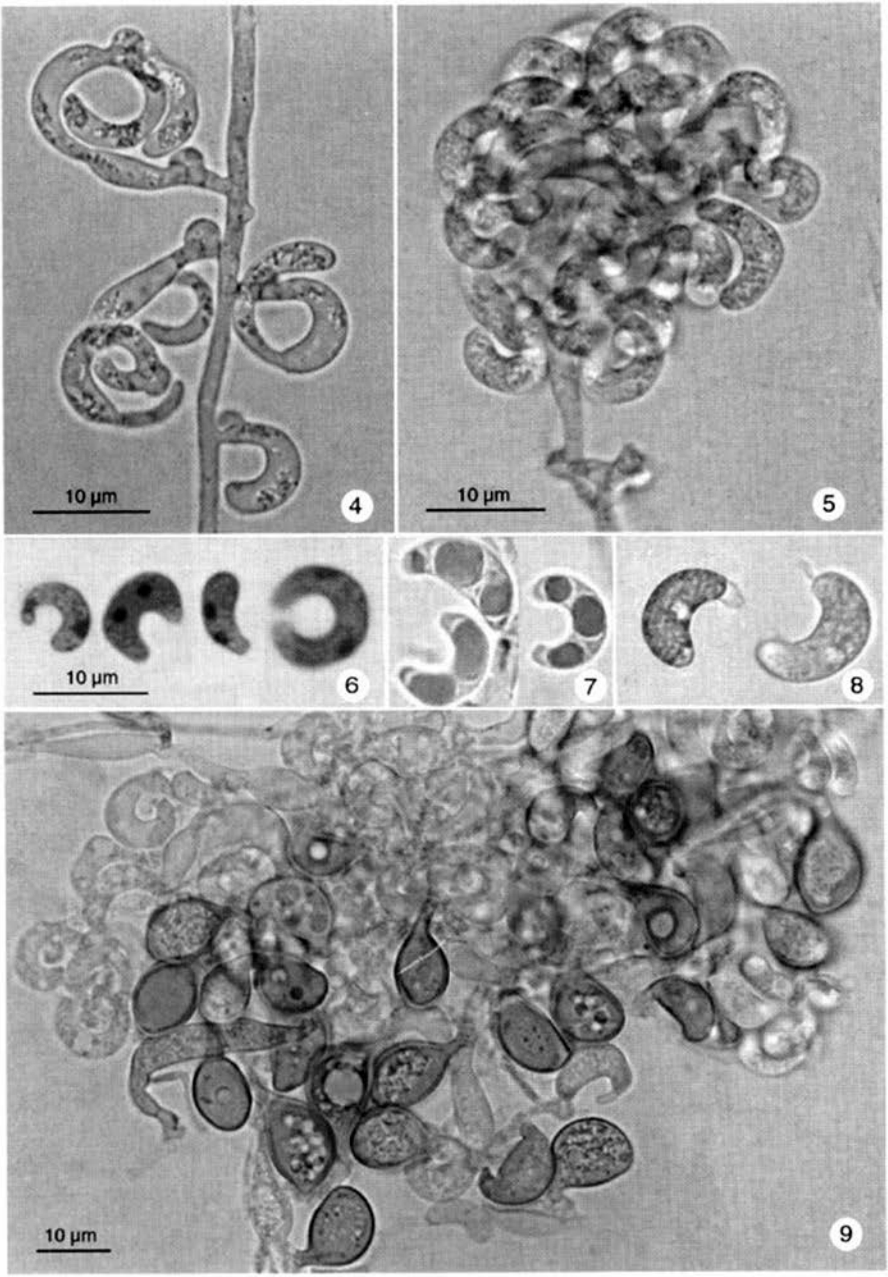
Fig. 24. *Simocybe sumptuosa*, developmental stage B, identification of the different organs. The term 'partial veil' is used here in the same way 'tree' or 'fruit' is used in botany, i.e. without any morphogenetic implications. The nodulus is not very sharply delimited from the stipe, but it can be recognised without great difficulty, although its core has a loose structure. Beneath the prehymenial palisade the cavity is clearly visible. — Aldehyde gas fixation, methacrylate, aluminium zirconium haematoxylin.

Fig. 25. *Simocybe sumptuosa*, developmental stage B. Analysis of the veil, a cauloblema growing from the stipe over the pileus margin. The growth direction is indicated by the orientation of the vesicular hyphal end cells. The prehymenial cavity is loosely filled with hyphae from the cauloblema. Please note that the hyphae of the stipe are already slightly inflated. — Aldehyde gas fixation, methacrylate, aluminium zirconium haematoxylin.

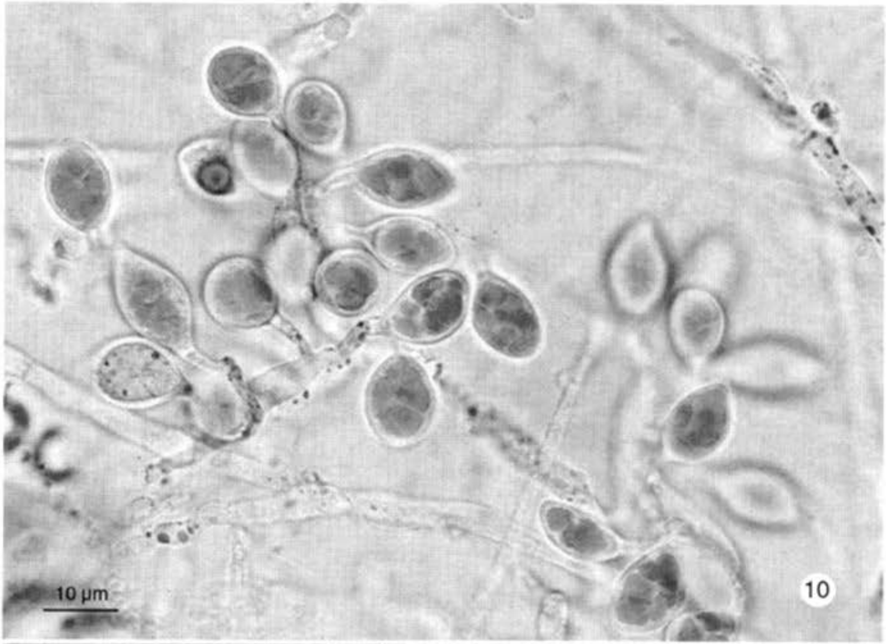
Figs. 41–48. *Simocybe sumptuosa*, developmental stage C. — 41. Thromboplerous hyphae staining dark with AZ-haematoxylin begin to appear in the pileus trama. The zone photographed is situated near the periphery at the left side of the pileus; 42. context from the centre of the pileus. The hyphae are considerably more inflated and the interhyphal spaces bigger than in primordium B (cf. Fig. 37); 43. transition zone between the prehymenial palisade and the stipe surface. The palisade becomes disorganised and intergrades with the cauloblema; 44. context of the pileus from the centre of the transition zone from stipe to pileus. The hyphae are not yet inflated; 45 & 46. stipe medulla just below the pileus (Fig. 45) and from the central region of the stipe. The hyphae on top are more densely packed than in the central part of the stipe. The arrows indicate two slightly inflated free hyphal end cells. Some nuclei and dolipore swellings are visible; 47. lateral part of the stipe. The structure has not changed significantly from that in primordium B (cf. Fig. 38); 48. short celled cauloblema from the central part of the stipe. — The scale bar applies to all figures. Aldehyde gas fixation, methacrylate, aluminium zirconium haematoxylin.



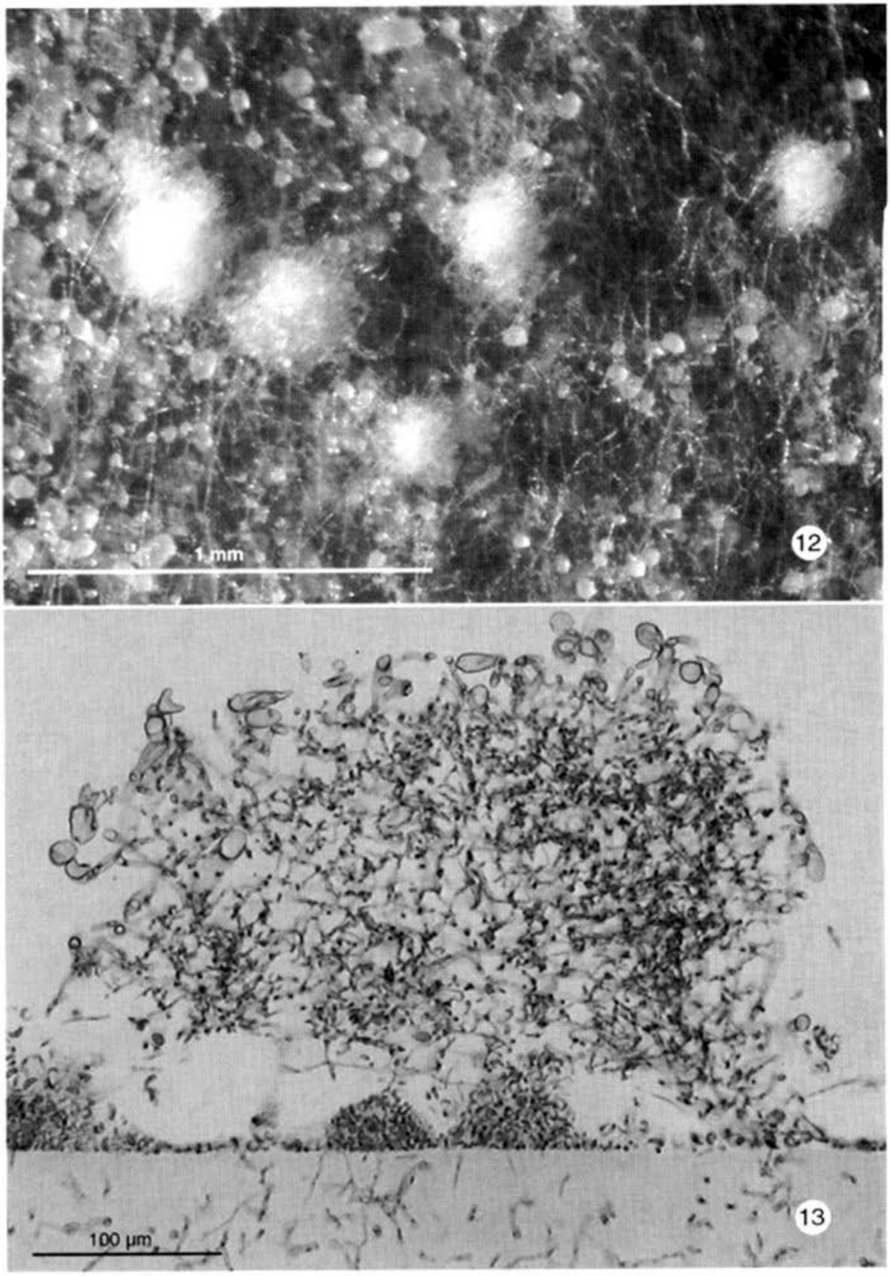
Figs. 1–3 (legend on p. 412).



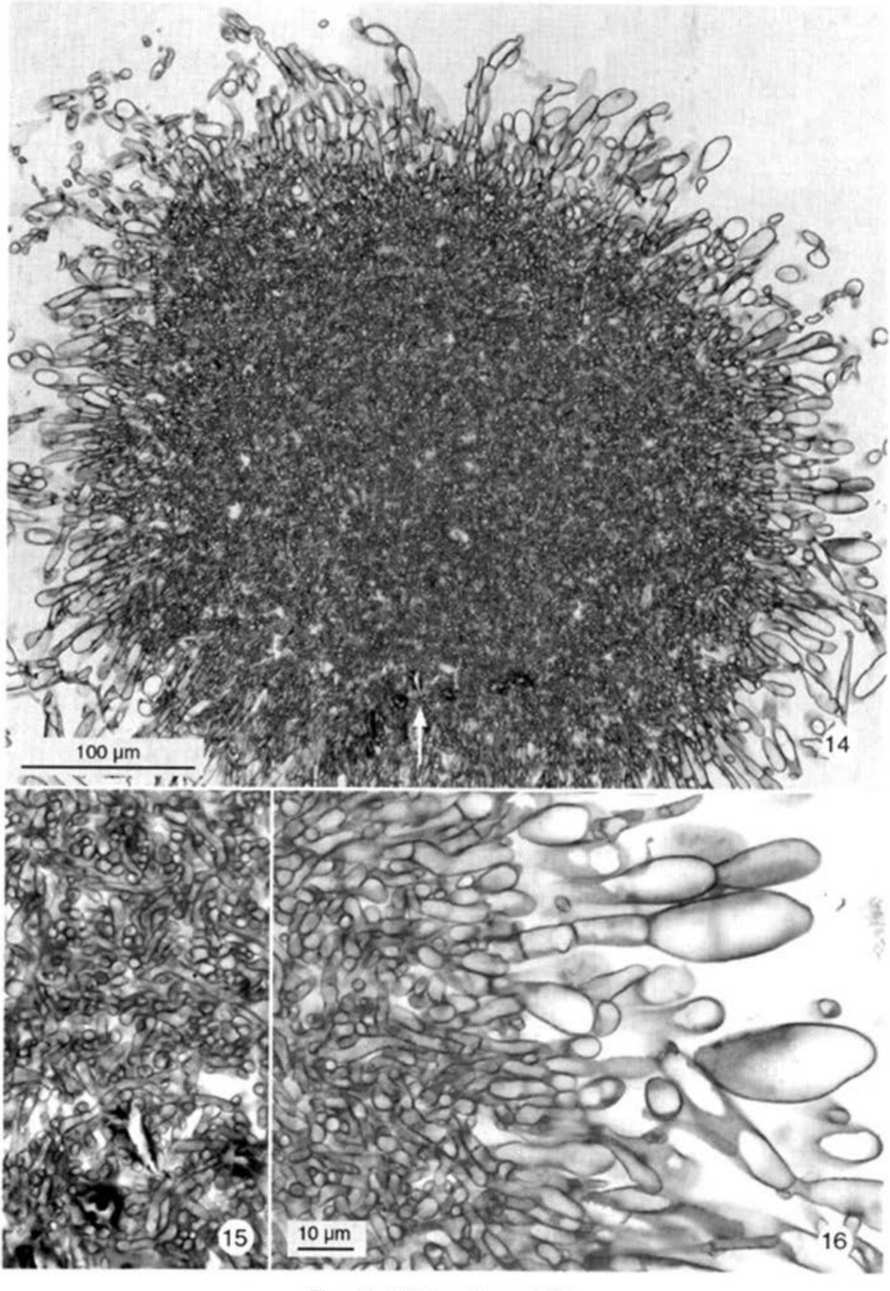
Figs. 4–9 (legend on p. 412).



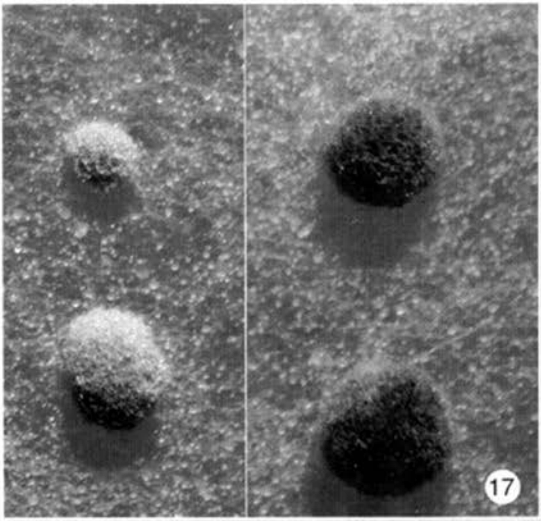
Figs. 10 & 11 (legend on p. 412).

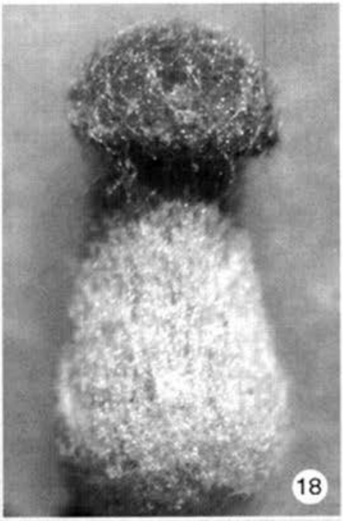


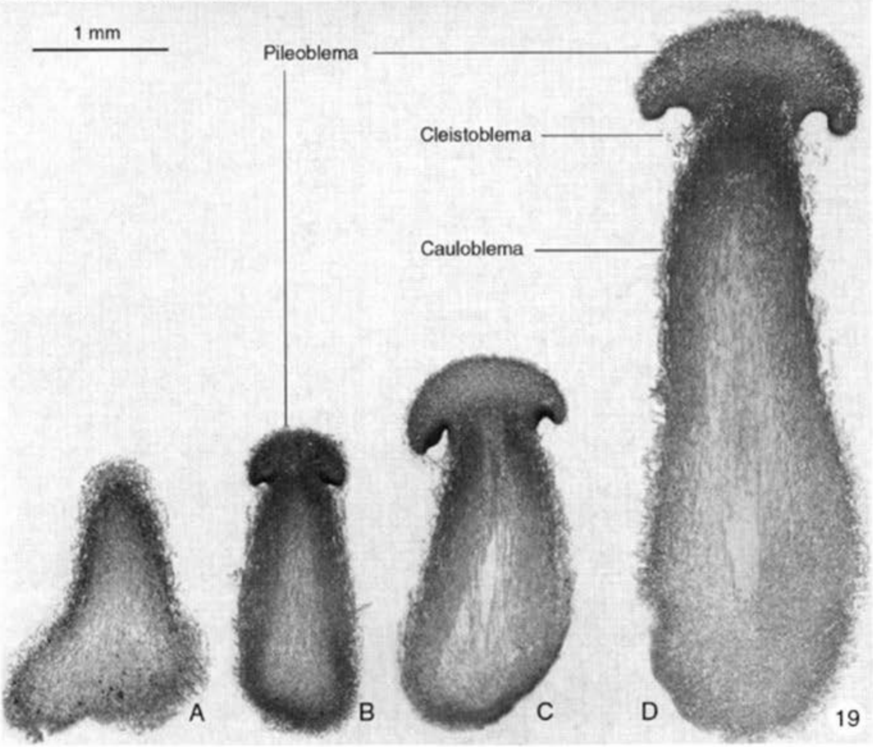
Figs. 12 & 13 (legend on p. 412).



Figs. 14–16 (legend on p. 412).

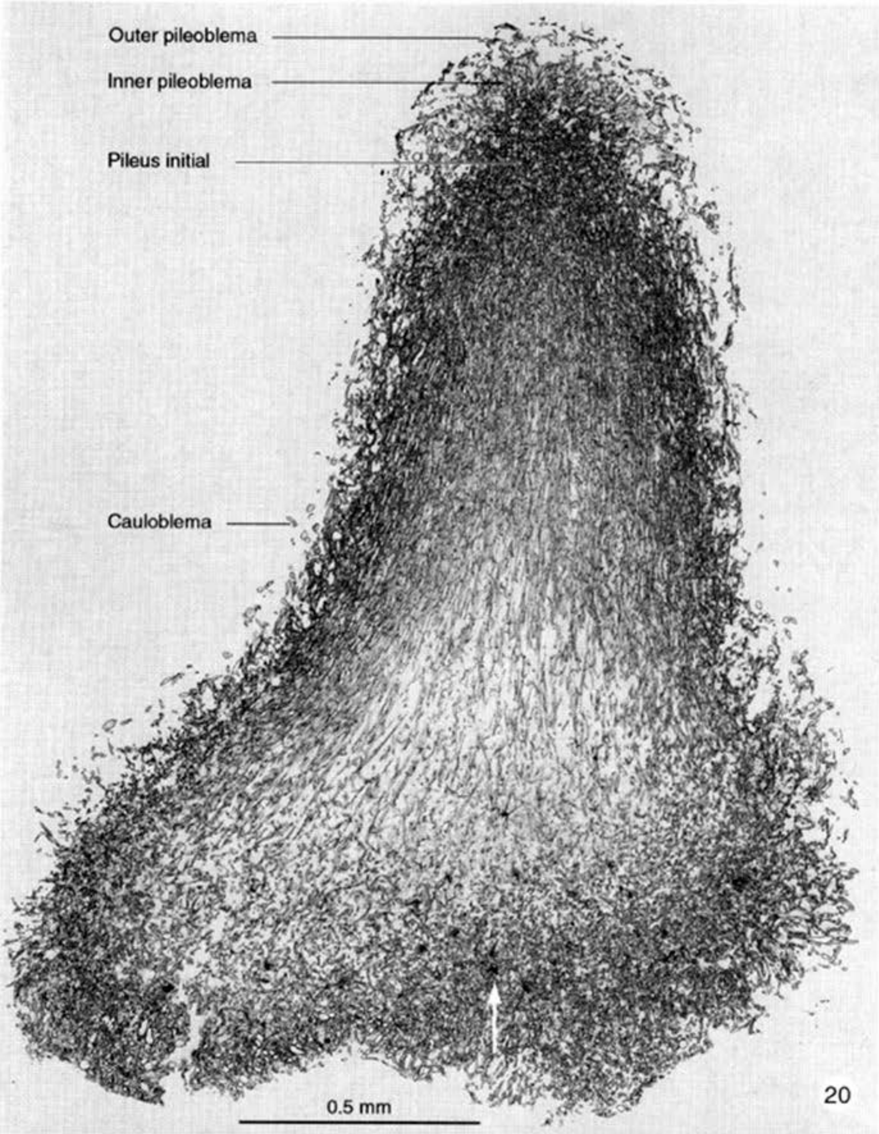

17

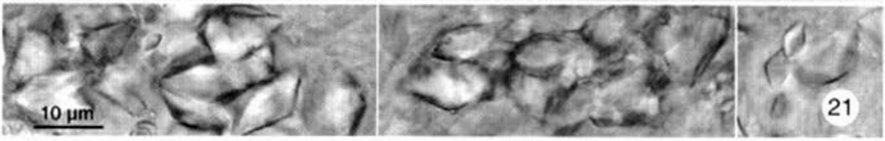

18



19

Figs. 17–19 (legend on p. 413).





Figs. 20 & 21 (legend on p. 413).

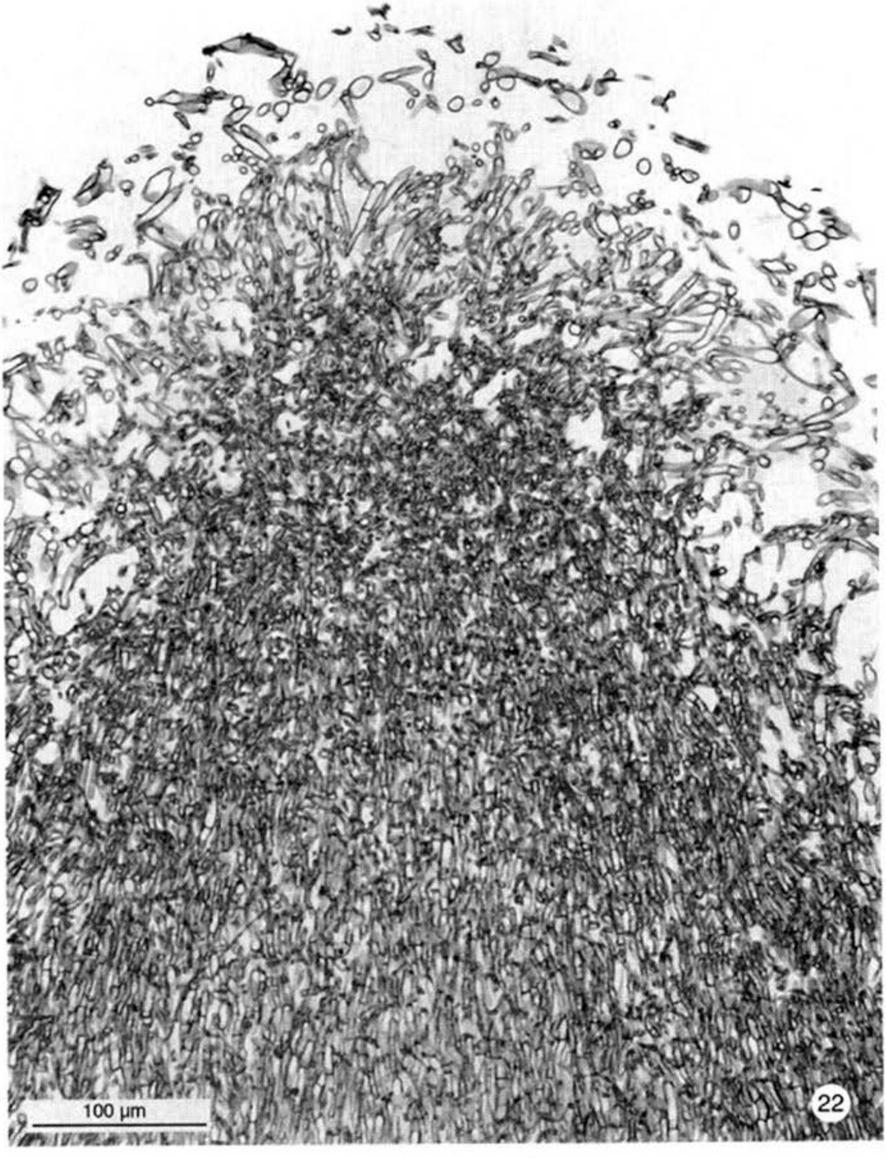


Fig. 22 (legend on p. 413).

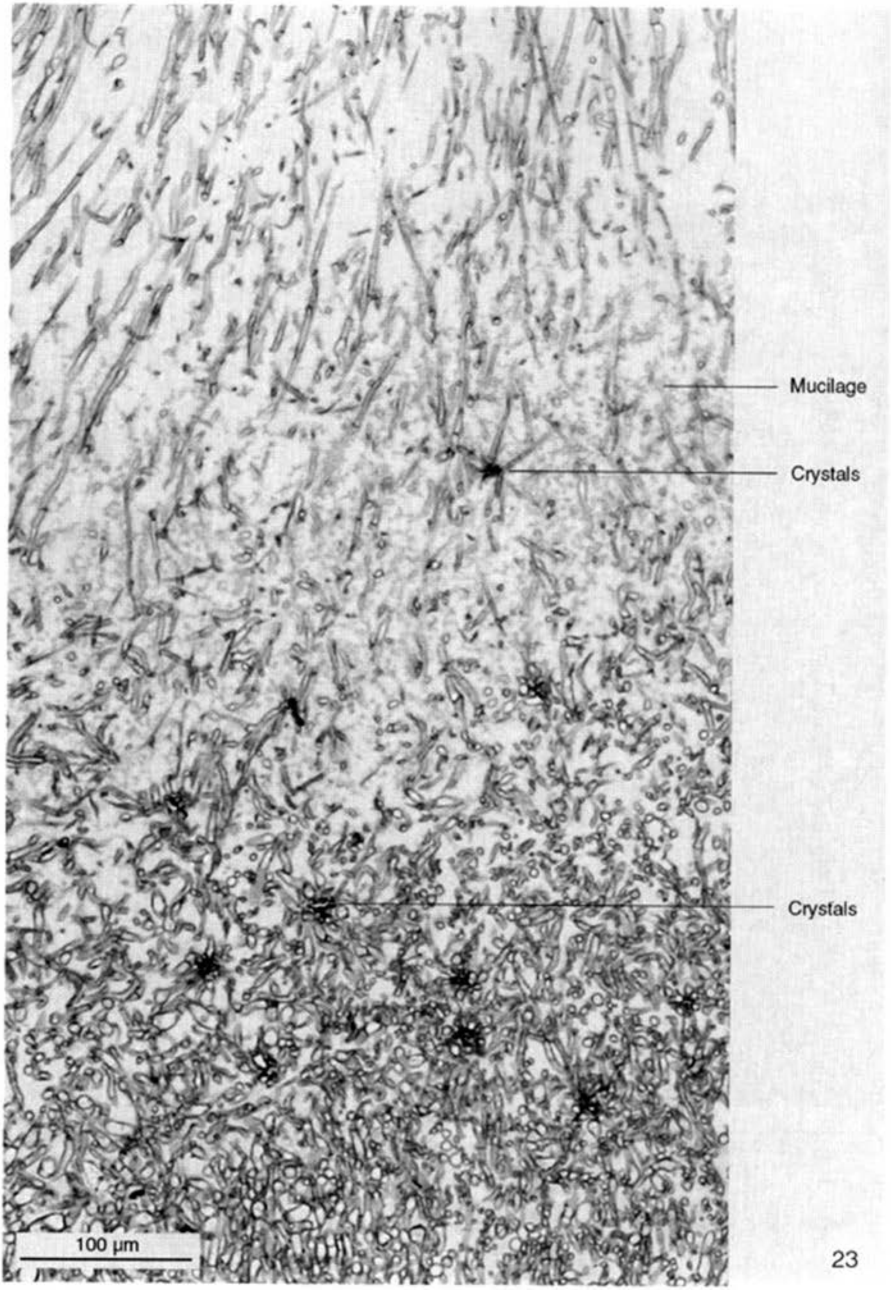


Fig. 23 (legend on p. 413).

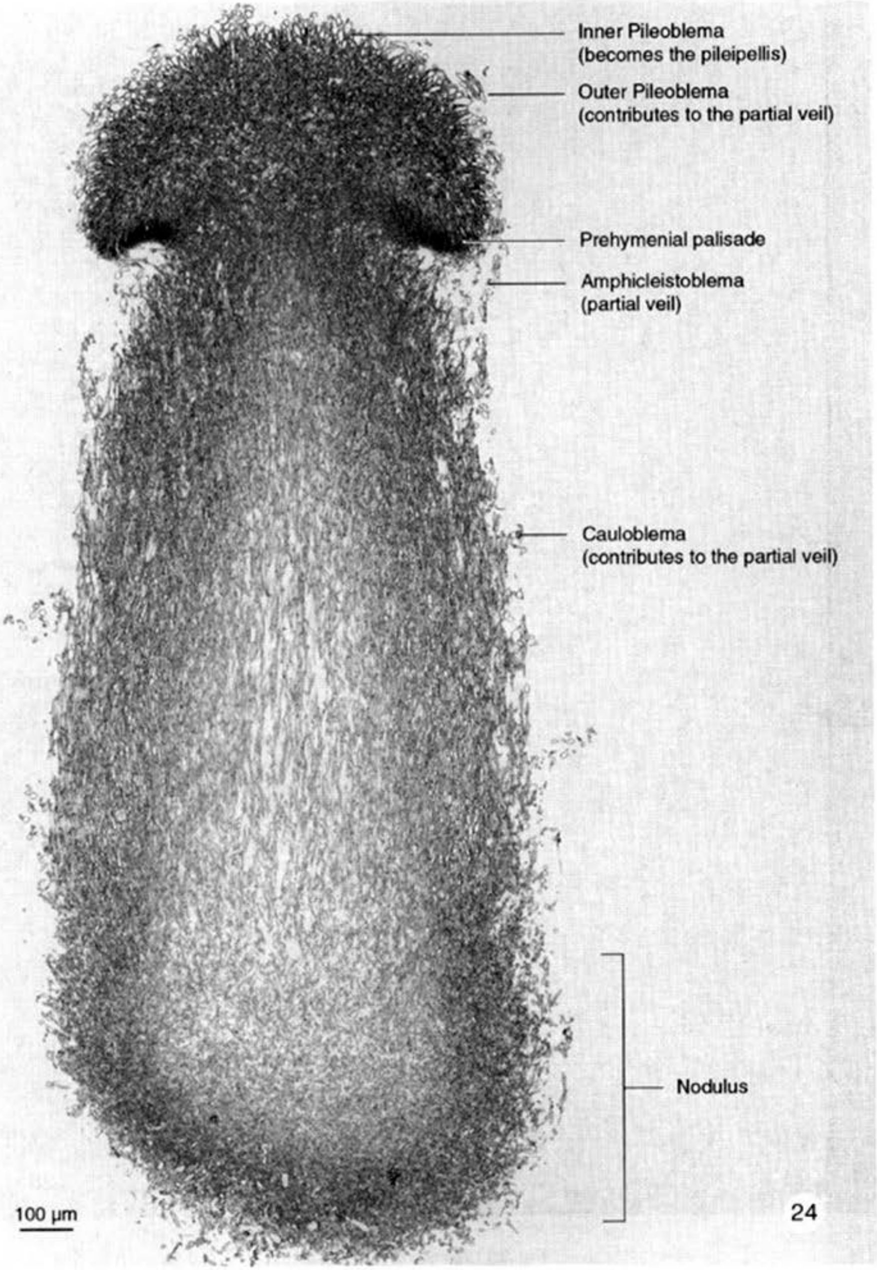


Fig. 24 (legend on p. 413).

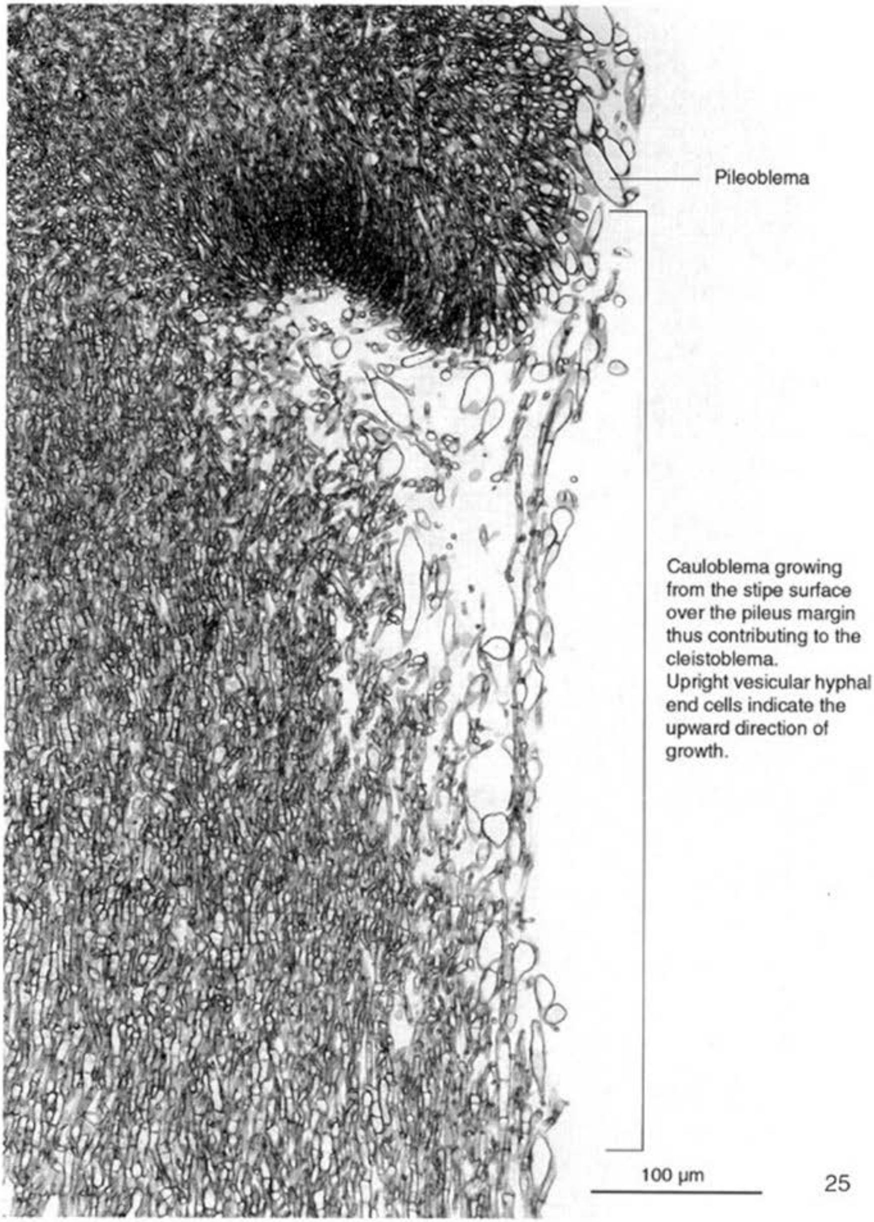


Fig. 25 (legend on p. 413).

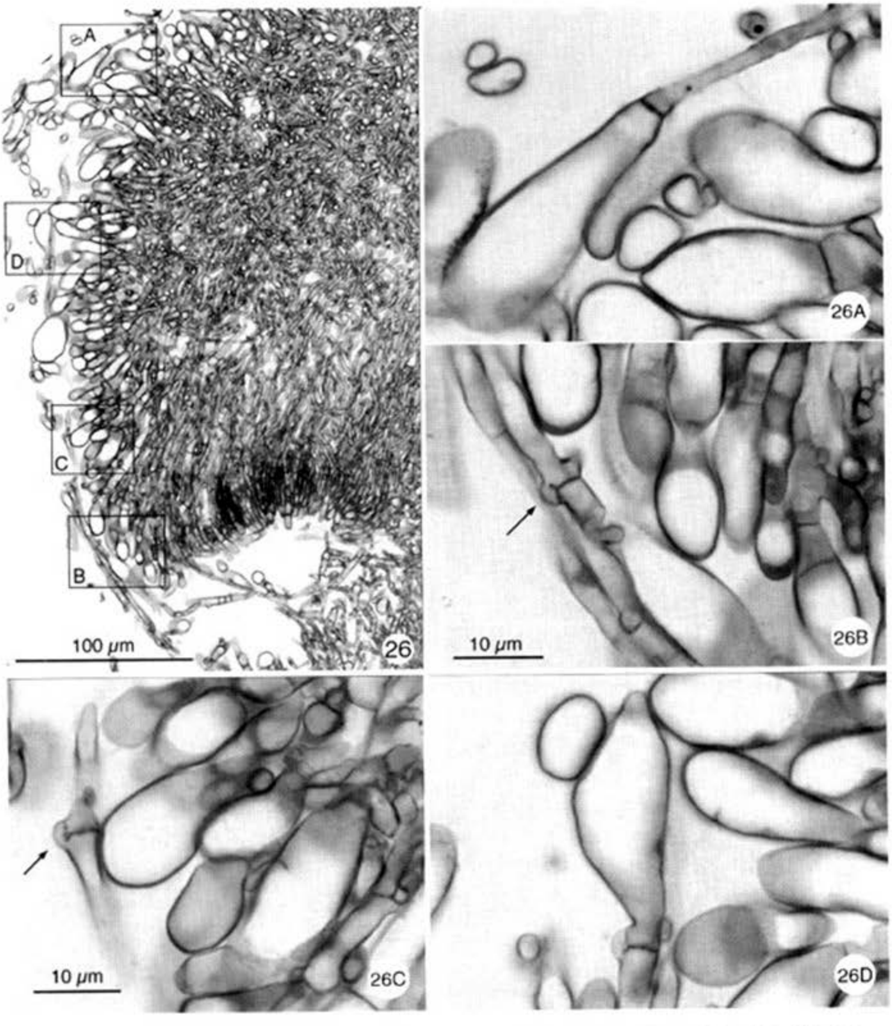
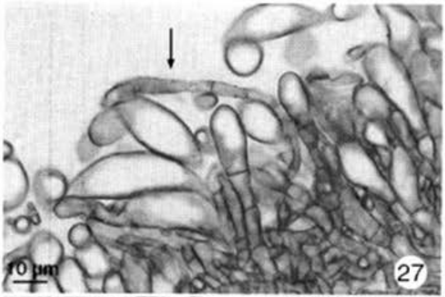
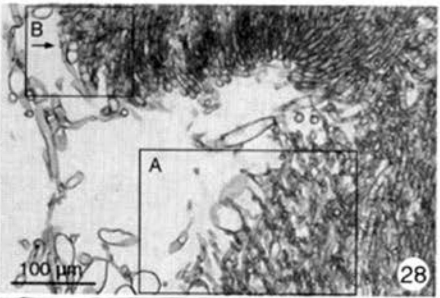


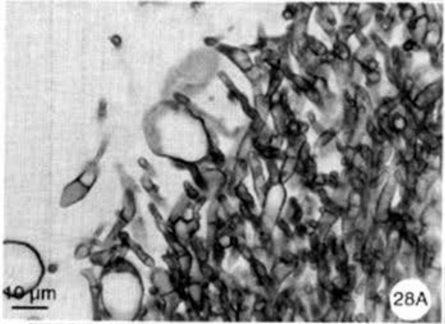
Fig. 26. *Simocybe sumptuosa,* developmental stage B. Analysis of the veil. — 26A & B. Pileoblema growing down, identified by the vesicular hyphal end cell and the orientation of a clamp-connection (arrow); 26C & D. cauloblema growing up, identified by the vesicular hyphal end cell and the orientation of a clamp-connection (arrow). — Aldehyde gas fixation, methacrylate, aluminium zirconium haematoxylin.



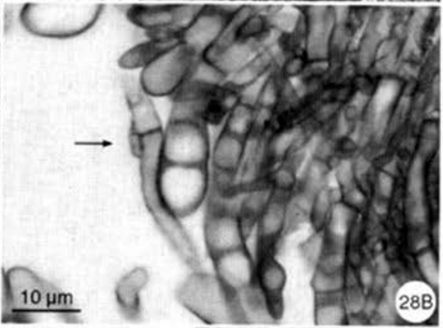
27



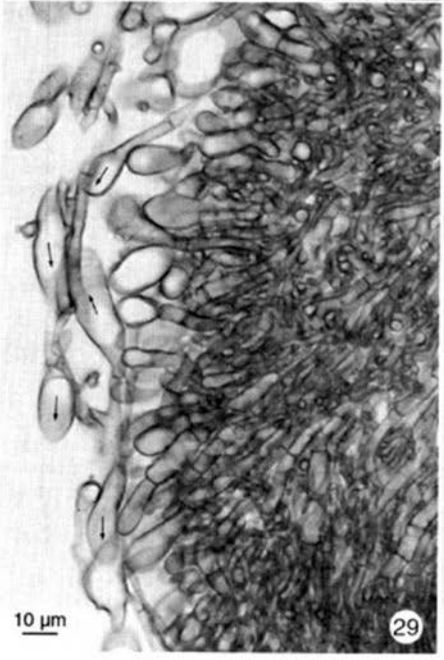
28



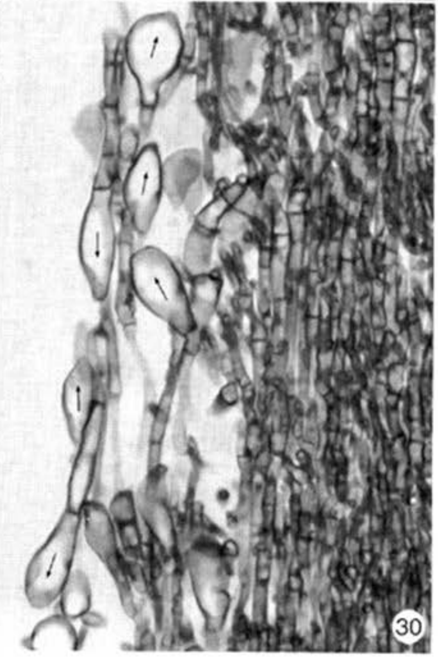
28A



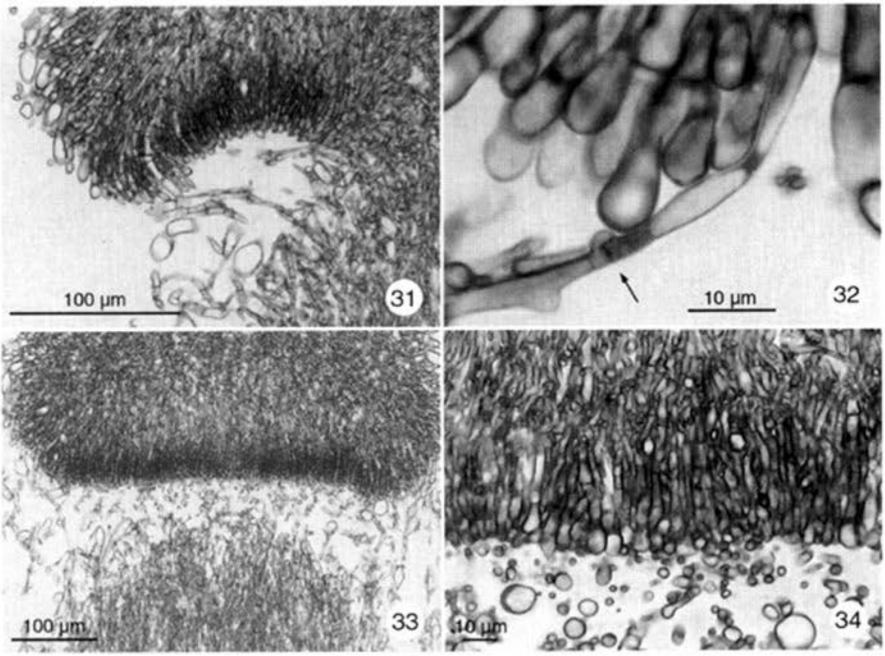
28B



29



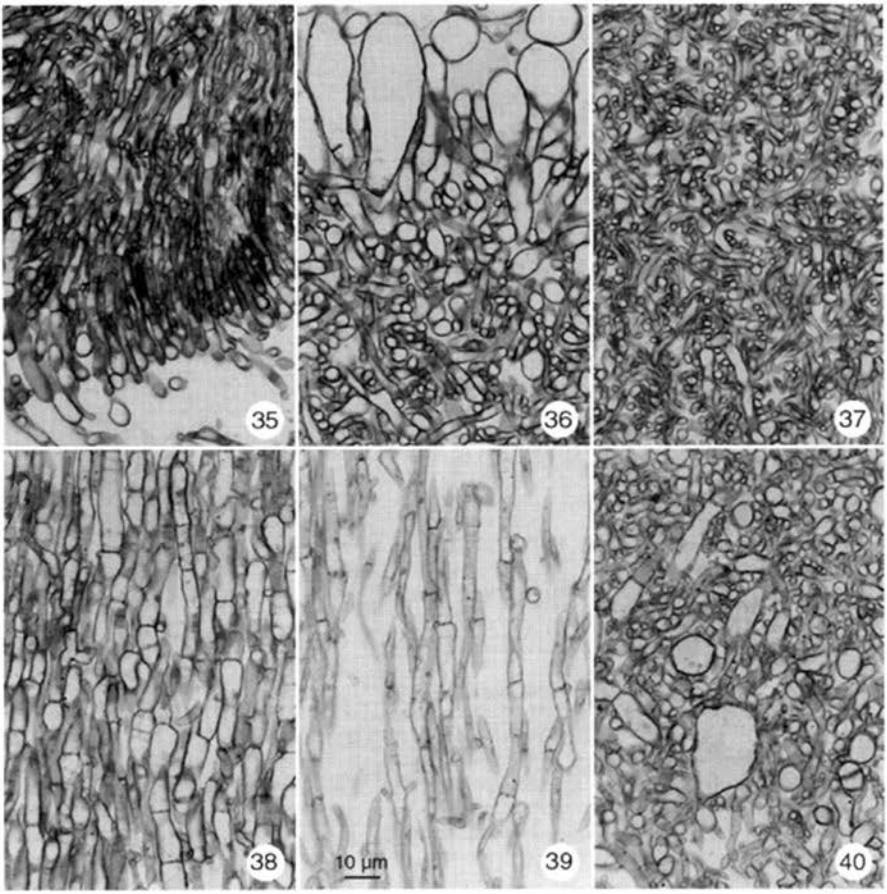
30



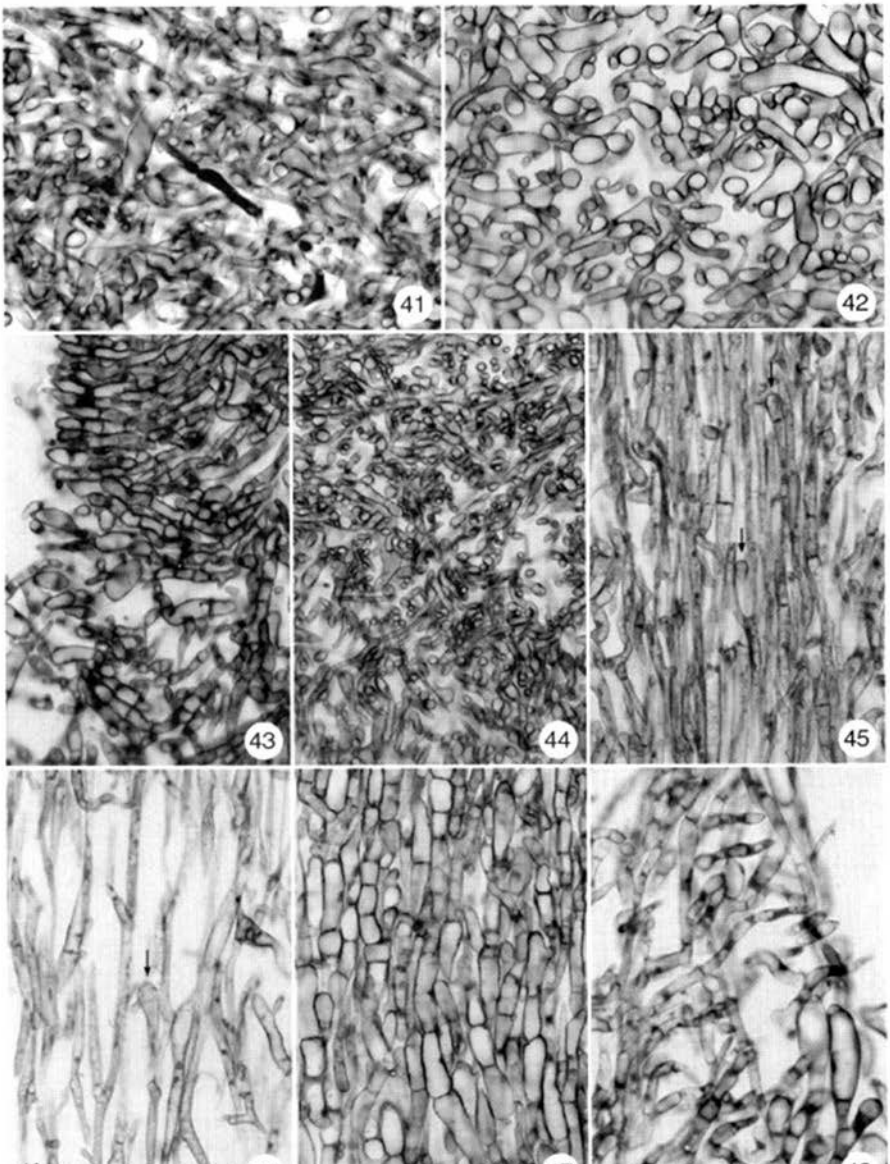
Figs. 31–34. *Simocybe sumptuosa*, developmental stage B. Anatomy of the prehymenial palisade and the pileus margin. — 31. The pileus margin is about 50 µm thick and differentiated from the prehymenial palisade by the longer hyphae that have grown beyond the level of the palisade. It contains one strikingly inflated hypha looking empty in this photograph. Elsewhere on the same primordium the pileus margin is not as nicely differentiated; 32. a hypha from the cauloblema penetrates between the hyphae of the right pileus margin. Its growth direction is indicated by the clamp-connection (arrow); 33 & 34. tangential sections through the pileus. The prehymenial palisade is still flat, lamellae have not yet begun to form. — Aldehyde gas fixation, methacrylate, aluminium zirconium haematoxylin.

←

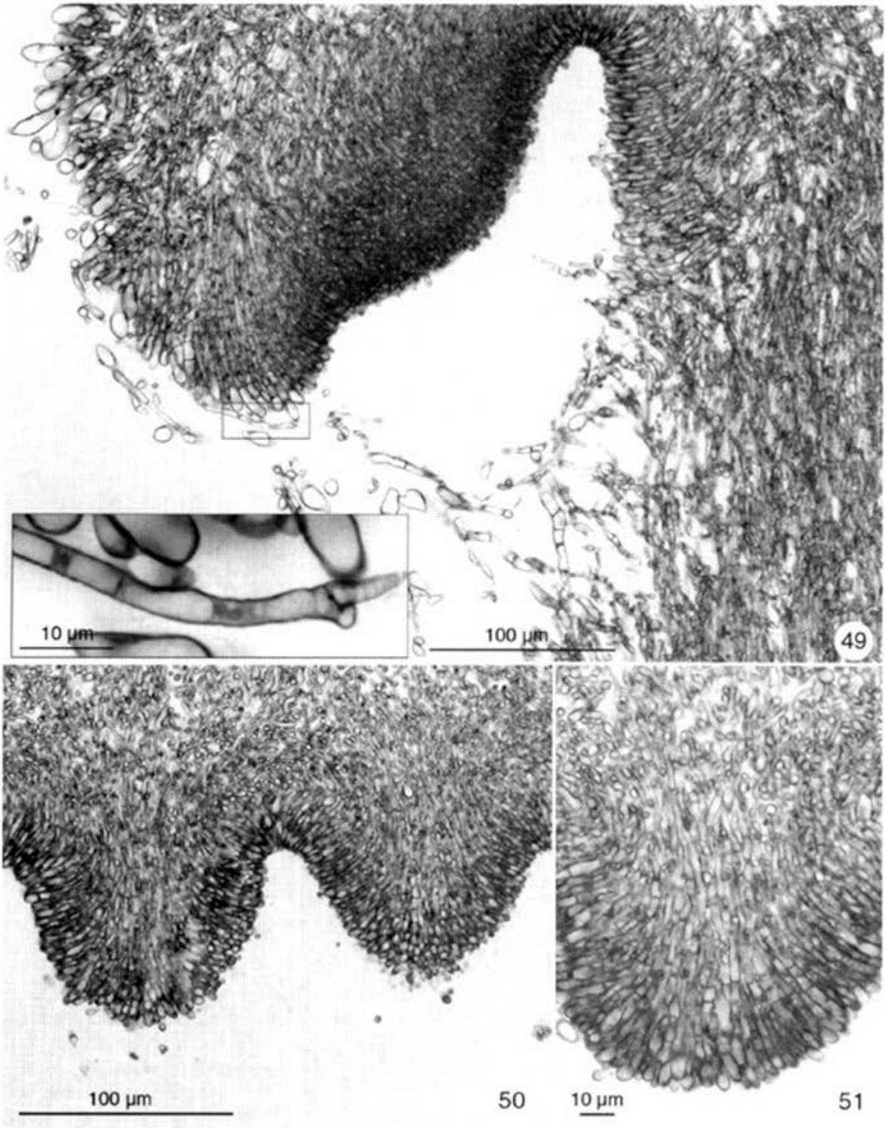
Figs. 27–30. *Simocybe sumptuosa*, developmental stage B. Analysis of the veil. — 27. A hypha of the outer pileoblema (arrow) grows out from the inner pileoblema; 28. cauloblema, general view for the next two figures; 28A. top of the stipe with many young hyphae of the cauloblema growing out from the stipe surface in the direction of the prehymenial palisade; 28B. a hypha of the cauloblema located on the pileus margin. The opening of the clamp-connection (arrow) indicates the upward growth direction; 29. pileoblema and cauloblema on the left side of the pileus. The arrows indicate the growth directions. Hyphae growing downward belong to the pileoblema, upward growing ones to the cauloblema; 30. pileoblema and cauloblema covering the left side of the stipe. — Aldehyde gas fixation, methacrylate, aluminium zirconium haematoxylin.



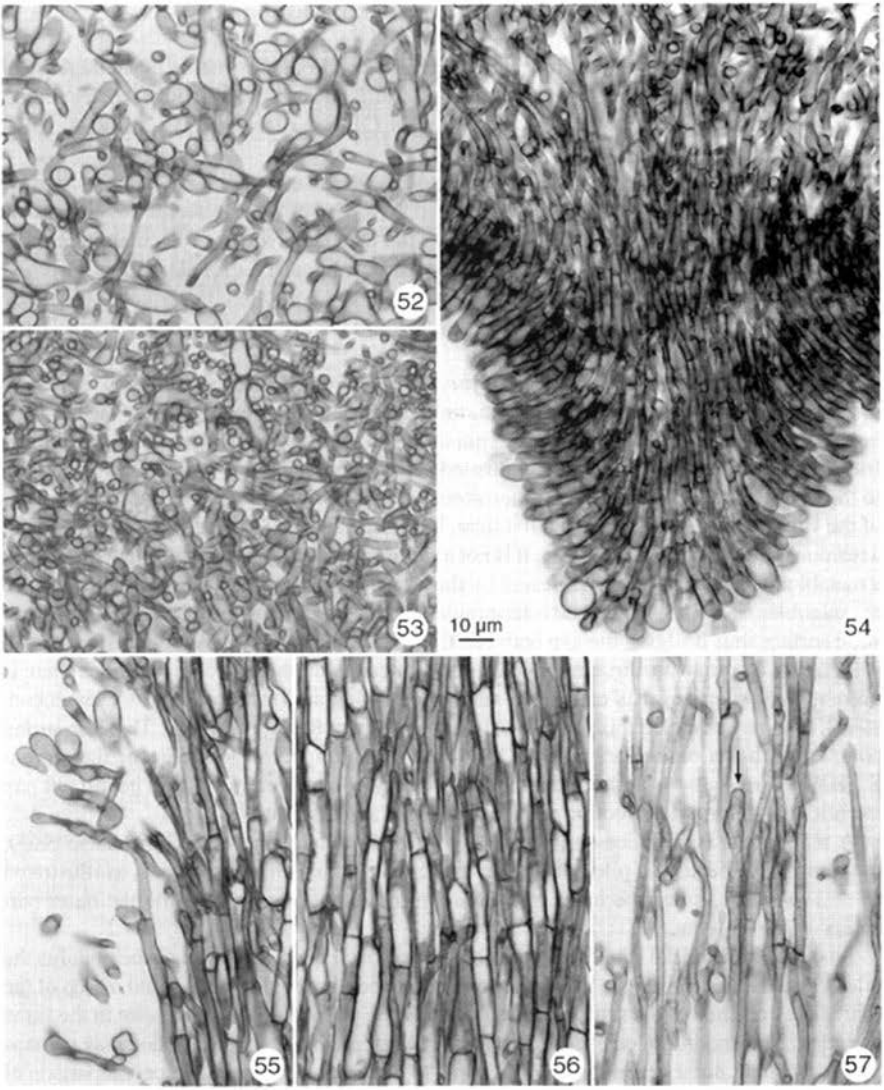
Figs. 35–40. *Simocybe sumptuosa*, developmental stage B. Beginning of the inflation of context hyphae by turgescence. — 35. Hyphae located over the left pileus margin and the prehymenial palisade. Only a few hyphal cells are inflated; 36. on top of the pileus under the pileoblema some hyphae are considerably enlarged; 37. in the centre of the pileus the context hyphae are significantly thinner than at the periphery of the pileus, but some are inflated; 38. inflated hyphae from the lateral part of the stipe; 39. some hyphae from the central pith of the stipe are slightly inflated, others are not. Some nuclei and dolipore-swellings are just visible in this photograph. The hyphal walls stain less intensely than the walls elsewhere in the primordium, maybe because they are thinner or because these hyphae do not belong to a mechanically supporting system (as compared to the hyphae of the lateral parts of the stipe); 40. basal part of the nodulus with strongly inflated hyphal cells. — The scale bar applies to all figures. Aldehyde gas fixation, methacrylate, aluminium zirconium haematoxylin.



Figs. 41–48 (legend on p. 413).



Figs. 49–51. *Simocybe sumptuosa*, developmental stage C. Formation of the gills. — 49. The scanty partial veil consists mostly of the hyphae of the cauloblema, but some hyphae of the pileoblema are also present making the partial veil an amphicleistoblema. The inset shows the region marked by the rectangle where a downward growing pileoblema hypha is located on the pileus margin. Please note the clamp-connection indicating the growth direction, the two nuclei and the dolipore swellings; 50 & 51. the first gills are covered with a continuous palisade. The gill trama is subregular and slightly diverging. — Aldehyde gas fixation, methacrylate, aluminium zirconium haematoxylin.



Figs. 52–57. *Simocybe sumptuosa*, developmental stage D. — 52 & 53. The contexts from the central part (52) and the basal part (53) of the pileus are slightly more dilated than in the previous stage (cf. Figs. 42, 44); 54. the gill edge is already differentiated from the future hymenium by the presence of inflated cells. The structure of the gill trama has not changed significantly; 55–57. stipe surface, lateral stratum (= the mechanically supporting structure) and medulla from the central region of the stipe. The arrow indicates a slightly inflated free hyphal end cell. — The scale bar applies to all figures. Aldehyde gas fixation, methacrylate, aluminium zirconium haematoxylin.

CONCLUSIONS AND DISCUSSION

Mycelial morphology is slightly changed during basidiome formation by an increase of hyphal density in the nutrient agar beneath the noduli, but special structures, such as dense masses of short cells filled with glycogen (e.g. in *Coprinus trisporus*, Clémençon, 1997: 846) are lacking.

Conidia and chlamydospores of *Simocybe* are described for the first time. The exact mechanism of conidiogenesis has not been discussed here. Therefore no attempt has been made to identify the anamorph state with a genus of the Deuteromycetes. The chlamydospores of *S. sumptuosa* are usually terminal aleuria, but some intercalary, irregularly fusiform chlamydospores are also formed. Clearly the two types are homologous variants of a single mitospore. Conidia and chlamydospores may occur in the same mitosporogenic heads, but the differentiating mechanism is unknown.

In her monograph of the genus *Simocybe* Senn-Irlet (1995) wrote that a veil is lacking or could never be seen in the material she studied. This may be true for mature basidiomes, but as Reijnders (1963) showed for *S. centunculus*, a spurious veil is present in very young fruit-bodies of this species. This is confirmed here for a species very close (if not identical) to the one studied by Reijnders. Furthermore, in *S. sumptuosa* the origin and development of the veil could be studied for the first time. This analysis shows clearly that the veil is not a residual outer part of a matrix (i.e. it is not a rudimentary innate veil) but a new formation, a metablema produced by the stipe and by the pileus. The cauloblema is independent from the pileoblema, but both meet and intermingle on the lateral pileus surface and on the upper stipe surface thus bridging the gap between the pileus margin and the stipe. The partial veil is therefore a composite structure and can be termed an amphicleistoblema. Since there is no matrix *S. sumptuosa* is exocarpic amphicleistoblemate (terminology of Clémençon, 1997), or it may be called mixangiocarpic (terminology of Reijnders, 1963). This is in strong contrast with the paravelangiocarpy proposed by Reijnders (1963: 82) for the similar *S. centunculus*, but this author could not study very young specimens, and he did not pay attention to the growth direction of the hyphae of the partial veil.

A metablema is not necessarily equivalent to a 'velum emanatum' (Reijnders, 1963), but it may also become a pileipellis, or it may result in two different organs, as illustrated by *S. sumptuosa*, since the inner pileoblema turns into a pileipellis while the outer part enters a cleistoblema.

Since the stipe initial (the erect shaft) originates from the central part of the nodulus the pileus initial could simply be the upper part of the nodulus that has been lifted on top of the shaft. The presence of the same vesicular cells on the pileus initial would point in the same direction. This 'nodulopileate' developmental type is certainly conceivable and may perhaps occur in nature, but it probably does not apply to *S. sumptuosa*, as the direct comparison of the structures of the nodulus and the pileus initial reveals differences in hyphal diameter and hyphal spacing (Figs. 22 & 23).

Figs. 19A–D suggest that after having formed the erect shaft the pileus is formed while the total length of the primordium does not increase significantly. Only after completion of the pileus formation (but without the gills) does growth continue. But since the developmental stages A–D are not from a single primordium, the suggested pattern must remain a hypothesis that should be tested using time lapse cinematography.

REFERENCES

Clémençon, H. 1990. Fixierung, Einbettung und Schnittfärbungen für die plectologische Untersuchung von Hymenomyceten mit dem Lichtmikroskop. Mycol. helv. 3: 451–466.

Clémençon, H. 1997. Anatomie der Hymenomyceten. Teufen, Switzerland.

Clémençon, H. 1998. Observing the Dolipore with the Light Microscope. Inoculum, April 1998. Suppl. Mycologia 49: 3.

Lacy, M.L. & G.H. Bridgmon. 1962. Potato-dextrose agar prepared from dehydrated mashed potatoes. Phytopathology 52: 173.

Reijnders, A.F.M. 1963. Les problèmes du développement des carpophores des Agaricales et de quelques groupes voisins. Den Haag.

Senn-Irlet, B. 1995. Die Gattung Simocybe Karsten in Europa. Mycol. helv. 7: 27–61.

PERSOONIA
Volume 17, Part 3, 435–456 (2000)

CONTRIBUTIONS TOWARDS A MONOGRAPH OF PHOMA (COELOMYCETES) VI – 1

Section Phyllostictoides: Characteristics and nomenclature of its type species Phoma exigua

H.A. VAN DER AA[1], G.H. BOEREMA[2] & J. DE GRUYTER[3]

A description is given of the morphological characters of *Phoma* section *Phyllostictoides* and its taxonomical position is discussed. A key is provided for the varieties of the type species *Phoma exigua* Desm., followed by a host-fungus and a fungus-host index. Two new varieties are proposed: *Phoma exigua* var. *forsythiae* (Sacc.) comb. nov. and *Phoma exigua* var. *noackiana* (Allesch.) comb. nov. The synonymy, selected literature, a representative culture and data on ecology and distribution are given for all varieties.

Previous papers of this series deal with the section *Phoma* (De Gruyter & Noordeloos, 1992; De Gruyter et al., 1993, 1998), *Peyronellaea* (Boerema, 1993), *Plenodomus* (Boerema et al., 1994, 1996 and Boerema & de Gruyter, 1999), *Heterospora* (Boerema et al., 1997, 1999) and *Sclerophomella* (Boerema & de Gruyter, 1998).

The section *Phyllostictoides* was introduced by Van der Aa et al. (1990). The infrageneric name was adopted from a cultural study by Žerbele (1971), who proposed it as a provisional name of a 'group-like section' without a Latin description (personal information from Dr. V.A. Mel'nik, St. Petersburg). The section name was formally validated by Boerema: *Phoma* sect. *Phyllostictoides* Žerbele ex Boerema (Boerema, 1997). It comprised species with pycnidia similar to those of the section *Phoma:* thin-walled, pseudoparenchymatous, glabrous but sometimes with hyphal outgrowths, a predetermined opening or ostiole, but sometimes remaining closed for a long time with final formation of a pore. The conidia have a broad range of shapes and sizes and are mainly aseptate in vitro, but in vivo the larger conidia often become two or even more celled by secondary septation (see Fig. 1). The percentage of septate conidia depends on environmental conditions and may vary in vivo between 5 and 95 (Van der Aa & van Kesteren, 1979). Under normal laboratory conditions the majority of conidia always remain aseptate in vitro, but usually some two- or more-celled conidia also occur.

Section *Phyllostictoides* includes species with and without chlamydospores; if present they are unicellular, solitary or formed in series or complexes. Many species of this section are anamorphs of species of *Didymella* Sacc. The type species of section *Phyllostictoides* is *Phoma exigua* Desm. Žerbele (1971) used the synonym *Ascochyta althaeina* Sacc. & Bizz., see Van der Aa & van Kesteren (1971).

Phoma exigua is a plurivorous species, very common in Eurasia but also reported repeatedly from Australasia and the Americas. The fungus has frequently been redescribed as a new species since the middle of the nineteenth century, supposedly specific for at least every

---

[1] Centraalbureau voor Schimmelcultures, Oosterstraat 1, 3742 SK Baarn, The Netherlands.
[2] Karel Doormanstraat 4^5, 2041 HD Zandvoort, The Netherlands.
[3] Plantenziektenkundige Dienst, P.O. Box 9102, 6700 HC Wageningen, The Netherlands.

Table I. Differential criteria of the infraspecific taxa of *Phoma exigua* in vitro.

variety (item)	Margin colony OA, MA	Growth-rate OA	Growth-rate MA	Growth-rate CA	E	Aerial mycelium OA	Colony OA	Reverse OA	Colony MA	Reverse MA
exigua (1)	irregular	(25–)50–85	(25–)40–75	35–50(–70)	+	variable	variable	variable	variable	variable
linicola (2)	irregular	20–45	20–45	20–45	+	velvety to floccose, white to olivaceous grey	olivaceous grey/ olivaceous black	olivaceous grey/ olivaceous black	olivaceous grey/ olivaceous black	olivaceous grey/ olivaceous black
heteromorpha (3)	irregular	40–50	20–30	20–30	–/+	floccose, white, or pale olivaceous grey/ glauceous grey	grey olivaceous to olivaceous grey/ olivaceous black	grey olivaceous to olivaceous grey/ olivaceous black	grey olivaceous to olivaceous grey/ olivaceous black	leaden grey/ leaden black,partly grey olivaceous, sometimes salmon near margin
populi (4)	irregular	40–65	20–40	20–40	–	floccose, pale olivaceous grey to glauceous grey	colourless to grey olivaceous at centre	colourless to pale olivaceous grey, grey olivaceous/ olivaceous at centre	grey olivaceous, citrine to greenish olivaceous at margin	leaden grey to olivaceous black, greenish olivaceous/ grey olivaceous near margin
diversispora (5)	regular to slightly irregular	65–80	35–60	60–>	–	velvety to floccose/ woolly, pale olivaceous grey/grey olivaceous	grey olivaceous to olivaceous	olivaceous to leaden grey	buff, to grey olivaceous/olivaceous black	leaden grey to olivaceous black, or umber/ honey to olivaceous
noackiana (6)	regular to slightly irregular	75–85	65–75	80–>	–	velvety to floccose, olivaceous grey, with compact tufts of white aerial mycelium	olivaceous to iron grey, or grey olivaceous to olivaceous	olivaceous to leaden grey/ leaden black	greenish olivaceous to olivaceous	leaden grey to olivaceous black, olivaceous at margin
lilacis (7)	regular, on MA irregular	60–80	60–80	60–80	–	typical compact tufts, white	greenish olivaceous	greenish olivaceous	greenish olivaceous/ grey olivaceous, olivaceous near margin	olivaceous, leaden grey
viburni (8)	regular to slightly irregular	65–85	65–85	65–85	–	tufted velvety to finely floccose, white to (pale) olivaceous grey	colourless to grey olivaceous/olivaceous grey	olivaceous grey	olivaceous grey, sometimes with buff to saffron	leaden grey/grey olivaceous at margin
forsythiae (9)	regular	65–85	65–85	65–85	–	velvety/ finely floccose/woolly, white to (pale) olivaceous grey, partly tufted	colourless to grey olivaceous	olivaceous grey	olivaceous grey	leaden grey, grey olivaceous at margin

new host genus, and placed in the coelomycetous genera *Phoma*, *Phyllosticta* and *Ascochyta*, due to the rigid application of criteria used in the Saccardoan system for anamorph genera. In this contribution nomenclature and synonymy of this species and a number of infraspecific taxa is given and their characters in vivo and in vitro are described. The subspecific taxonomy is supported by Amplified Fragment Length Polymorphism studies (AFLP), which will be published separately (Abeln et al., in press).

MATERIAL AND METHODS

Methods are as described in De Gruyter & Noordeloos (1992) and De Gruyter et al. (1993). In combination with other characteristics, the presence (+) or absence (–) of a colourless metabolite known as 'antibiotic E' is a useful diagnostic criterium for species of *Phoma*. The production of 'E' was first described from ubiquitous strains of *Phoma exigua* (E is derived from *exigua*), see Boerema & Höweler (1967). It can be demonstrated by adding a drop of concentrated NaOH to the margin of colonies on MA which produces an initial blue-green colour reaction, turning to brownish-red (oxidation reaction). Logan & O'Neill (1970) showed the metabolite to have bactericidal and fungicidal properties. The production of 'antibiotic E' is stimulated by light, so that the NaOH-test is best examined after the plates have been exposed to daylight for several days.

Isolates and original samples studied are present in herbarium and culture collections of CBS, Baarn and the Plant Protection Service, PD, Wageningen.

Synonyms in the respective genera *Phoma*, *Ascochyta* and *Phyllosticta* are listed in chronological order, and within the year in alphabetical order. The bulk of the synonyms was originally described in the genus *Phyllosticta*; this fits well with the name of the section. The synonyms described in the genus *Phyllosticta* are only briefly explicated, usually without information about host plant and the type specimen. All will be treated in more detail by Van der Aa, who will publish a revision of all species described in the genus *Phyllosticta* Pers. s.l. Herbaria and culture collections are abbreviated according to the codes in the Index Herbariorum (Holmgren et al., 1981).

It should be noted that only synonyms which have not been published previously are included. A complete synonymy will be published later in the monograph of the genus *Phoma* by Boerema et al.

KEY TO THE VARIETIES OF PHOMA EXIGUA s. l. — Table I

1a. NaOH oxidation reaction positive, green, later red (E^+ reaction) 2
b. NaOH oxidation reaction negative or varying 3
2a. Growth-rate variable on OA and MA, (25–)50–85 mm; colonies colourless or with various grey to greenish tinges, or olivaceous to olivaceous black; plurivorous wound and weakly parasitic fungus[4] .... 1. *P. exigua* var. *exigua*
b. Growth-rate relatively slow on OA and MA, 20–45 mm; colonies compact, olivaceous grey to olivaceous black; seed-borne pathogen of *Linum usitatissimum*
2. *P. exigua* var. *linicola*

---

4) The concept of *Phoma exigua* may also include plurivorous wound and weak parasitic E^- strains, see Addendum under var. *inoxydabilis*.

3a. Growth-rate moderate to fast on OA, 35–65 mm, on MA and CA relatively slow, 20–45 mm 4
b. Growth-rate fast on OA, MA and CA, 60–85 mm 5
4a. Growth-rate moderate on OA, 40–50 mm, relatively slow on MA and CA, 20–25 (– 30) mm; on OA colonies rather dark, grey olivaceous to olivaceous grey/olivaceous black, with white to pale olivaceous grey/glauceous grey aerial mycelium; specific pathogen of *Nerium oleander* . . . . 3. *P. exigua* var. *heteromorpha*
b. Growth-rate on OA 41–66 mm, on MA and CA relatively slow, 20–40 mm; colonies on OA colourless to grey olivaceous, with pale olivaceous grey to glaucous grey aerial mycelium; an opportunistic pathogen on *Populus* spp. (occasionally on *Salix*)
4. *P. exigua* var. *populi*
5a. Colony on OA grey olivaceous/olivaceous to iron grey; on herbaceous plants 6
b. Colony on OA colourless to grey olivaceous/olivaceous grey or greenish olivaceous; on woody plants 7
6a. Growth-rate fast on OA and CA, 60–85 mm, on MA moderate, 40–60 mm; on OA with velvety to floccose/woolly, pale olivaceous grey/grey olivaceous aerial mycelium; chlamydospores may be produced; seed-borne pathogen of *Phaseolus vulgaris* and *Vigna unguiculata* in western Europe and Africa . . . . 5. *P. exigua* var. *diversispora*
b. Growth-rate fast on OA, MA and CA, 65–85 mm; on OA with velvety to floccose, olivaceous grey, and compact tufts of white aerial mycelium; chlamydospores may be produced; pathogen of *Phaseolus vulgaris* in (South) America
6. *P. exigua* var. *noackiana*
7a. On OA with abundant, compact tufted, white aerial mycelium, covering the entire greenish olivaceous colony; specific pathogen of *Syringa vulgaris* (occasionally on *Forsythia*) . . . . 7. *P. exigua* var. *lilacis*
b. On OA sparse to abundant, velvety to finely floccose tufted, mainly (pale) olivaceous grey aerial mycelium; colony colourless to grey olivaceous/olivaceous grey 8
8a. On OA abundant velvety/finely floccose, tufted, mainly (pale) olivaceous grey aerial mycelium; pathogen of *Viburnum* spp. (occasionally on *Lonicera*)
8. *P. exigua* var. *viburni*
b. On OA velvety to finely floccose/woolly, partly tufted, mainly (pale) olivaceous grey aerial mycelium; weak pathogenic on *Forsythia* spp. . . . . 9. *P. exigua var. forsythiae*

In general fresh isolates of the host-specific varieties of *P. exigua* show less variability in vitro than the plurivorous var. *exigua*, i.e. more stable cultural characters.

However, slower growing segments may be obtained from fast growing colonies.

INDICES TO THE HOST – SPECIFIC VARIETIES OF PHOMA EXIGUA (nos 2–11)

[The plurivorous var. *exigua* (1) may occur also on the hosts listed]

HOST–FUNGUS INDEX

The number of the variety in the descriptive part is listed (nos 2–11; incl. addendum) with additional data and distribution.

Capsicum annuum (Solanaceae) (Seed infection: 'fruitrot-leafspot')	no. 11: '*P. exigua* var. *capsici*' [invalidly published infraspecific taxon from China; identity doubtful, may refer to *Phoma destructiva* Plowr.]

Forsythia hybrids (Oleaceae) (Disease: Shoot Blight)	no. 9: *P. exigua* var. *forsythiae* [known from weakened shrubs in Europe] no. 7: *P. exigua* var. *lilacis* [only occasionally isolated]
Linum usitatissimum (Linaceae) (Disease: Damping-off, Foot Rot)	no. 2: *P. exigua* var. *linicola* [seed-borne pathogen known from Europe and New Zealand]
Lonicera sp. (Caprifoliaceae)	no. 8: *P. exigua* var. *viburni* [only occasionally isolated]
Nerium oleander (Apocynaceae) (Disease: Dieback; Leaf Necrosis)	no. 3: *P. exigua* var. *heteromorpha* [pathogen recorded in Europe and North America]
Phaseolus vulgaris (Leguminosae) (Disease: Black Node Disease)	no. 5: *P. exigua* var. *diversispora* [pathogen known from Europe and East Africa] no. 6: *P. exigua* var. *noackiana* [pathogen recorded in S and C America]
Populus spp., esp. *P. nigra* and *P.* (×) *euramericana* (Salicaceae) (Disease: Necrotic Black Lesions)	no. 4: *P. exigua* var. *populi* [pathogen found in Europe]
Salix sp. (Salicaceae)	no. 4: *P. exigua* var. *populi* [only occasionally isolated]
Syringa vulgaris (Oleaceae) (Disease: Damping-off; Leaf Necrosis, Dieback of Shoots)	no. 7: *P. exigua* var. *lilacis* [pathogen known from Europe, North America and New Zealand]
Viburnum spp. (Caprifoliaceae) (Disease: Leaf Spot; Stem Lesions, Shoot Blackening)	no. 8: *P. exigua* var. *viburni* [pathogen recorded in Eurasia and North America]
Vigna unguiculata (Leguminosae) (Disease: Black Node Disease)	no. 5: *P. exigua* var. *diversispora* [pathogen indigenous to Africa]
Vinca spp., esp. *V. minor* (Apocynaceae) (Disease: Stem Blight, Leaf Spot)	no. 3: *P. exigua* var. *heteromorpha* no. 10: *P. exigua* 'var. *inoxydabilis*' [applied to different E$^-$ strains from Europe and North America; identity doubtful, type lost]

FUNGUS–HOST INDEX

'*P. exigua* var. *capsici*' (11) (not valid; identity doubtful)	*Capsicum annuum* (Solanaceae)
P. exigua var. *diversispora* (5)	*Phaseolus vulgaris*, *Vigna unguiculata* (Leguminosae)
P. exigua var. *forsythiae* (9)	*Forsythia* hybrids (Oleaceae)
P. exigua var. *heteromorpha* (3)	*Nerium oleander* *Vinca minor* (Apocynaceae)

P. exigua 'var. *inoxydabilis*' (10) (type lost; identity doubtful)	*Vinca* spp., esp. *V. minor* (Apocynaceae)
P. exigua var. *lilacis* (7)	*Syringa vulgaris* *Forsythia* hybr. (occasionally) (Oleaceae)
P. exigua var. *linicola* (2)	*Linum usitatissimum* (Linaceae)
P. exigua var. *noackiana* (6)	*Phaseolus vulgaris* (Leguminosae)
P. exigua var. *populi* (4)	*Populus* spp., esp. *P. nigra* and *P.* (×) *euramericana* *Salix* sp. (occasionally) (Salicaceae)
P. exigua var. *viburni* (8)	*Viburnum* spp. *Lonicera* sp. (occasionally) (Caprifoliaceae)

DESCRIPTIVE PART

1. **Phoma exigua** Desm. var. **exigua** — Fig. 1

Phoma exigua Desm., Annls Sci. nat., Bot. III, 11 (1849) 282, var. *exigua* [varietal name originally differentiated as 'Var. *a*' (p. 282), against 'Var. *b. minor*' (p. 283) = *Phoma herbarum* Westend., sect. *Phoma* (De Gruyter et al., 1993)].

Phoma niesslii Sacc., Michelia 2 (1882) 618 [cf. holotype, PAD].

Phoma catalpicola Oud., Ned. kruidk. Archf III, 2 (3) (1902) 737 [cf. holotype, L].

Ascochyta potentillarum Sacc., Michelia 1 (2) (1878) 170 [cf. description and collections sub *Phyllosticta argentinae* auct.].

Ascochyta adzamethica Shoshiashvili, Izv. Gruzinsk. Opytyn. Stantsii Rast., A. [Phitopathol.] 2 (1940) 272 [cf. Mel'nik (1977: 'synonymous with *Ascochyta phaseolorum* Sacc.')].

Phyllosticta cynarae Westend., Bull. Acad. Roy. Sci. Belgique, Cl. Sci., II, 2 (1857) 568. — *Ascochyta cynarae* (Westend.) H. Zimm., Verh. Naturf. Vereins Brünn 52 (1913) 100 = *Ascochyta cynarae* Died., Krypt. Fl. Mark Brandenb. 9 [Pilze 7, Heft 2] (1912 '1915') 381 = *Diplodina cynarae* Killian & Maire, Bull. Soc. Hist. Nat. Afrique N. 19 (1928), 22 [cf. holotype, BR and several isotypes in Westendorp exsicc. 1140, BR; synonymy partly adopted from Mel'nik, 1977].

Phyllosticta daturae Westend., Herbier L. Pire, Herbarium name, 1860 [cf. material on which the name was based, BR; living culture from type host *Datura stramonium*, CBS 587.67].

Phyllosticta alismatis Sacc. & Speg., Michelia 1 (2) (1878) 144. — *Ascochyta boydii* Grove, J. Bot. 56 (1918) 315, replaced name [cf. description and several secondary collections, in vivo and in vitro (CBS 476.69); (holo-)type not available and probably not preserved].

Phyllosticta calycanthi Sacc. & Speg., Michelia 1 (2) (1878) 139 [cf. holotype, PAD].

Phyllosticta capparidis Sacc. & Speg., Michelia 1 (2) (1878) 139 [cf. holotype, PAD].

Phyllosticta capsulicola Sacc. & Speg., Michelia 1 (2) (1878) 152 [cf. holotype, PAD].

Phyllosticta celosiae Thüm., J. Sci. Math. Phys. Nat., Sér. 1, 6, 24 (1878) 230 [cf. topotype, S; holotype not available].

Phyllosticta filipendulae Sacc. & Speg., Michelia 1 (2) (1878) 150. — *Phyllosticta filipendulina* Sacc. & Speg., Michelia 1 (2) (1878), corrigenda after p. 275, replaced name; not *Phyllosticta filipendulae* Sacc., Michelia 1 (2) (1878) 145 [type not available (not in PAD); cf. description and cf. Wollenweber & Hochapfel (1936; sub *Ascochyta pirina* Pegl. ['(Fr.) Pegl.'] = *Phoma exigua* Desm. fide Boerema & Dorenbosch, 1973).

Phyllosticta glechomae Sacc., Michelia 1 (2) (1878) 151. — *Ascochyta glechomae* (Sacc.) Baudyš & Picb., Práce Morav. Přír. Společň. 3 (2) (1926) 30 [cf. holotype, PAD, and several sec. collections, confirmed in vitro].

Phyllosticta gomphrenae Sacc., Michelia 1 (2) (1878) 151 [cf. holotype, PAD].

Phyllosticta erythraeae Sacc. & Speg., Michelia 1 (2) (1878) 152 [cf. holotype, PAD].

Phyllosticta lappae Sacc., Michelia 1 (2) (1878) 151. — *Ascochyta lappae* (Sacc.) Jaap, Annls mycol. 12 (1914) 26. — *Ascochyta lappae* (Sacc.) Petr., Annls mycol. 18 (1920) 119 = *Ascochyta lappae* Kabát & Bubák, Hedwigia 47 (1908) 357; further synonyms, see Mel'nik, 1977: 99 [cf. holotype, PAD].

Phyllosticta sonchi Sacc., Michelia 1 (2) (1878) 141. — *Ascochyta sonchi* (Sacc.) Grove, J. Bot. 40 (1922) 48; further synonyms listed by Mel'nik (1977: 102) [cf. holotype, PAD].

Phyllosticta tropaeoli Sacc. & Speg., Michelia 1 (2) (1878) 152. — *Ascochyta tropaeoli* (Sacc. & Speg.) Bond.-Mont., Bot. Mater. Otd. Sporov. Rast. Bot. Inst. Akad.Nauk S.S.S.R. 4 (1938) 42 [cf. description; type not available; not in PAD].

Phyllosticta verbasci Sacc., Michelia 1 (2) (1879) 531 [cf. holotype, PAD and secondary collections, confirmed in vitro, CBS449.81].

Phyllosticta eupatorina Thüm., Hedwigia 19 (1880) 179 [cf. isotype ex herb. Sydow, S].

Phyllosticta juliae Speg., An. Soc. cient. arg. 10 (1880) 28 [cf. holotype, LPS].

Phyllosticta hualtata [as '*hualtatae*'] Speg., An. Soc. cient. arg. 13 (1882) 11 [cf. holotype, LPS].

Phyllosticta gillesii Speg., An. Soc. cient. arg. 13 (1882) 11 [cf. holotype, LPS].

Phyllosticta orontii Ellis & Martin, Am. Naturalist 16 (1882) 1002 [cf. holotype, NY].

Phyllosticta solani [as '*iolani*', spelling of species name is corrected] Ellis & Martin, Am. Naturalist 16 (1882) 1002 [cf. holotype, NY].

Phyllosticta stigmaphylli Speg., An. Soc. cient. arg. 13 (1882) 12 [cf. holotype, LPS].

Phyllosticta chenopodii Sacc., Syll. Fung. 3 (1884) 55 [as *Phyllosticta chenopodii* Westend., Michelia 1 (2) (1878) 150, misidentification] illegitimate, homonym of *Phyllosticta chenopodii* Westend., l.c. = *Phoma heteromorphospora* Aa & Kesteren, Persoonia 10 (1980) 542 [cf. Arx, 1970, 140; holotype not available in PAD].

Phyllosticta filipendulina var. *ulmariae* Sacc., Syll. Fung. 3 (1884) 41 [cf. holotype, PAD].

Phyllosticta pentastemonis Cooke, Grevillea 14 (1885) 90 [cf. holotype, K].

Phyllosticta potamia Cooke, Grevillea 14 (1885) 39 [cf. holotype, K].

Phyllosticta ivaecola Ellis & Everh., J. Mycol. 2 (1886) 37 [cf. holotype, NY; sec. collections in Brenckle, Fungi dakotensis 338, NY, L].

Phyllosticta mentzeliae Ellis & Everh., J. Mycol. 2 (1886) 4 [cf. holotype, NY].

Phyllosticta dahliicola Brunaud, Bull. Soc. bot. Fr. 34 (1887) 429 [as '*dahliaecola*']. — *Ascochyta dahliicola* (Brunaud) Petr., Annls mycol. 25 (1927) 202 [cf. description; type not known to be in existence].

Phyllosticta fatiscens Peck, Rep. N.Y. St. Mus. nat. Hist. 40 (1887) 58 [cf. descriptions based on type material by Peck, l.c., Ellis & Everh. (1900) and Seaver (1922); additional sec. collections, NY, L].

Phyllosticta sagittifoliae [as '*sagittaefoliae*'] Brunaud, Rev. mycol. 9 (1887) 13 [cf. description; type not known to be in existence].

Phyllosticta zahlbruckneri Bäumler, Beitr. Kryptog. Flora Pressburger Comitates 1 (1887) 7 [cf. description and sec. collections in Petr., Fungi polon. exsicc. No. 129, L and Petr., Flora bohem. morav. exsicc. Sér 2, Abt. 1 Pilze No. 1271, L].

Phyllosticta antennariae Ellis & Everh., J. Mycol. 5 (1888) 9 [cf. holotype, NY].

Phyllosticta calaminthae Ellis & Everh., J. Mycol. 5 (1889) 145 [cf. holotype, NY and isotypes, NY and L].

Phyllosticta orontii Ellis & Martin var. *advena* Ellis & Everh., J. Mycol. 5 (1889) 146 [cf. holotype, NY].

Phyllosticta molluginis Ellis & Halst., J. Mycol. 6 (1890) 33 [cf. holotype, NY].

Phyllosticta otites Brunaud, Actes Soc. linn. Bordeaux 44, Sér. 5, 4 (1890) 242 [cf. description; type not known to be in existence].

Phyllosticta petasitidis Ellis & Everh., Proc. Acad. Nat. Sci. Philadelphia (1891) 76 [cf. holotype, NY].

Phyllosticta dircae Ellis & Dearness, Canad. Rec. Sci. 5 (1893) 267 [cf. holotype, NY and isotypes in Ellis & Everh. N. Am. Fungi, sec. Sér. No. 2838, NY, L and B].

Phyllosticta melampyri Allesch., Hedwigia 33 (1894) 70 [cf. holotype, M].

Phyllosticta alpina Allesch., Hedwigia 34 (1895) 257 [cf. holotype, M].

Phyllosticta calthae Ellis & Everh., Inedit. [cf. Cash, A record of the fungi named by J.B. Ellis, I–III (1952), 300], herbarium name [cf. the material on which the name is based; coll.: 1895, NY].

Phyllosticta eupatorii Allesch., Hedwigia 34 (1895) 264 [cf. holotype, M].

Phyllosticta desertorum Sacc., Malpighia 10 (1896) 272 [cf. holotype, PAD].

Phyllosticta helianthemicola Allesch., Ber. bayer. bot. Ges. 4 (1896) 31 [cf. holotype, M].

Phyllosticta carpathica Allesch. in Sydow [often cited as 'Allesch. & Sydow'], Hedwigia 36 (1897) (157). — *Ascochyta carpathica* (Allesch.) Keissler [as '(Allesch. & Sydow) Keissler'], Ann. Naturhist. Mus. Wien 35 (1922) 21 = *Ascochyta carpathica* f. *caulivora* Grove, J. Bot. 60 (1922) 46 [cf. holotype, M; isotypes, B and S].

Phyllosticta hieracii Allesch. in Sydow, Hedwigia 36 (1897)159 [cf. holotype, S, isotypes in Sydow, Mycotheca marchica No. 4473, S and B, and several sec. collections, CBS; identification confirmed in vitro].

Phyllosticta inulae Allesch. in Sydow, Hedwigia 36 (1897) 159 [cf. holotype, M, isotypes in Sydow, Mycotheca marchica No. 4475, S and B].

Phyllosticta lampsanae Sydow, Hedwigia 36 (1897) 159 [cf. holotype, S and isotype, B].

Phyllosticta pygmaea Allesch. in Allesch. & P. Henn., Pilze aus dem Umanakdistrict, in C. Vanhöffens Botanische Ergebnisse der von der Gesellschaft für Erdkunde zu Berlin unter Leitung Dr. v. Drygalski's ausgesandten Grönlandsexpedition, nach Dr. Vanhöffen's Sammlungen bearbeitet; A, Kryptogamen. Bibltheca bot. 42 (1897) 10 [cf. description; type not available in herb. Allesch., M and B].

Phyllosticta spaethiana Allesch. in Sydow, Hedwigia 36 (1897) 160 [cf. holotype, M and topotypes in Sydow, Mycoth. marchica No. 4482, S and B].

Phyllosticta adenostylis Allesch., Rabenh. Krypt-Flora [ed. 2] Pilze 6 [Lief. 60] (1898 [vol. dated '1901']) 99 [cf. holotype, M].

Phyllosticta mimuli Ellis & Fautrey, Rev. Mycol. 20 (1898) 59 [cf. holotype, NY].

Phyllosticta monardae Ellis & Bartholomew, Trans. Kansas Acad. Sci. 16 (1898) 165 [cf. holotype, NY].

Phyllosticta nupharis Allesch., Rabenh. Krypt.-Flora [ed. 2] Pilze 6 [Lief. 61] (1898 '1901') 133. — *Phoma westendorpii* Tosq. in Westend., Bull. Acad. Roy. Sci, Belgique, II, 2 (1857) 564 not *Phyllosticta westendorpii* Thüm., Pilzflora Sibiriens 304 (1880) [cf. holotype, BR and sec. collections; identification confirmed in vitro, CBS].

Phyllosticta pentastemonis f. *pentastemonis-azurei* Allesch., Rabenh. Krypt.-Flora [ed. 2] Pilze 6 [Lief. 61] (1898) [vol. dated '1901'] 135. — *Phyllosticta pentastemonis* var. *major* Allesch., in correspondence between A. Allesch. and P. Sydow, fide Allesch., l.c. and next in Sydow, Mycotheca marchica No. 4478 (herbarium name). — *Phyllosticta pentastemonis* var. *pentastemonis-azurei* [as '*pentastemonis azurei*'] (Allesch.) Cejp, Nova Hedwigia 13 (1967) 192 [cf. holotype, in Sydow, Mycotheca marchica 4478, sub nomen *Phyllosticta pentastemonis* var. *major* Allesch., B].

Phyllosticta pentastemonis f. *pentastemonis hybridi* Allesch., Rabenh. Krypt.-Flora [ed. 2] Pilze 6 [Lief. 61] (1898 '1901') 135 [cf. descriptions by Allesch., l.c. and Diedicke, 1912].

Phyllosticta datiscae Sydow, Hedwigia 38 (1899) (135) [cf. holotype, B].

Phyllosticta halophila Speg., An. Mus. nac. Hist. nat. B. Aires 6 (1899) 313 [cf. holotype, LPS].

Phyllosticta canescens Ellis & Everh., Bull. Torrey bot. Club 27 (1900) 54 [cf. holotype, NY].

Phyllosticta gei Bres., Hedwigia 39 (1900) 325, illegitimate name; a later homonym of *Phyllosticta gei* Thüm., Byull. Moskovsk. Obshch. Isp. Prir. 56 (1881) 130, which is quite another species [cf. holotype, S].

Phyllosticta mucunae Ellis & Everh., The North American Phyllostictas. Vineland, New Jersey (1900) 48 [cf. holotype, NY].

Phyllosticta nymphaeacea Ellis & Everh., North American Phyllostictas. Vineland, New Jersey (1900) 73 [cf. holotype, NY].

Phyllosticta pucciniospila C. Massal., Atti Ist. Veneto Sci. 59 (1900) 687 [cf. holotype, VER, and cf. Van der Aa & Van Kesteren (1971) and Boerema & Dorenbosch (1973), both under the misspelled name '*Phyllosticta pucciniophila*'].

Phyllosticta ariaefoliae f. *ulmifolia* Bres. in Krieger, Fungi saxon. No. 1632 (1901) [cf. syntypes, L and M].

Phyllosticta stachidis var. *arvensis* Allesch., Rabenh. Krypt.-Flora [ed. 2] Pilze 6 [Lief. 61] (1898 '1901') 151 [cf. holotype, M].

Phyllosticta aloides Oud., Beih. bot. Zbl. (1902) 12 [cf. holotype, L].

Phyllosticta stratiotis Oud., Ned. kruidk. Archf, III, 2 (3) (1902) 747 [cf. holotype, L].

Phyllosticta strelitziaecola Allesch., Rabenhorst, Krypt.-Flora 1, 7 (1903) 780. — *Phoma strelitziae* var. *major* Tassi, Atti Reale Accad. Fisiocrit. Siena, IV, 8 (1896) 5 [cf. holotype, SIENA].

Phyllosticta tassiana Allesch., Rabenh. Krypt.-Flora [ed. 2] Pilze 1, 7 [Lief. 86] (1903) 757. — *Phoma crassipes* f. *foliicola* Tassi, Bull. Lab. Orto. bot.Reale Univ. Siena 1900 (1900) 17 [cf. holotype, SIENA].

Phyllosticta aricola Bubák, Bull. Herb. Boissier, II, 6 (1906) 403 [cf. description].

Phyllosticta berlesiana Sacc., Annls mycol. 4 (1906) 491 [cf. holotype, PAD].

Phyllosticta scrophulariae-bosniacae Bubák, Bull. Herb. Boissier, II, 6 (1906) 406 [cf. description].

Phyllosticta cinchonae Koord., Verh. K. Akad. Wet. Amst. [Afd. Natuurk.] Sect. 2, 13 (1907) 203 [cf. holotype, B].

Phyllosticta taraxaci Hollós, Ann. Mus. Hist. nat. Hung. 5 (1907) 456. — *Ascochyta taraxaci* (Hollós) Grove, J. Bot. 60 (1922) 48 [cf. description; Herb. Hollós destroyed during second World War and type therefore not available].

Phyllosticta balsaminae Voglino, Atti Accad. Sci. Torino 43 [1907–1908] (1908) 93 [cf. description].

Phyllosticta heterospora Speg., Revista Mus. La Plata 15 (1908) 33 [cf. holotype, LPS and isotype, S].

Phyllosticta abutilonis P. Henn., Hedwigia 48 (1908) 13 [cf. holotype, B and syntype, S].

Phyllosticta bletiae H. Zimm. Verh. Naturf. Vereins Brünn 47 [1908] (1909) 84 [cf. holotype, S].

Phyllosticta stachidis var. *annua* H. Zimm. Verh. Naturf. Vereins Brünn 47 [1908] (1909) 88 [cf. description].

Phyllosticta belgradensis Bubák & Ranoj., Annls mycol. 8 (1910) 381 [cf. holotype, S].

Phyllosticta erodii Speg., An. Mus. nac. Hist. nat. B. Aires III, 20 (1910) 334 [cf. holotype, LPS].

Phyllosticta lychnidis Bondartsev, Izv. glav. bot. Sada SSSR 12 (1912)102 [cf. holotype, LE-41809].

Phyllosticta sordida Speg., An. Mus. nac. Hist. nat. B. Aires III, 23 (1912) 113 [cf. holotype, LPS].

Phyllosticta bonanseana Sacc., Annls mycol. 11 (1913) 547 [cf. holotype, PAD].

Phyllosticta phlomidis Bondartsev & Lebedeva, Mater. Mikol. Obsl. Rossii 7, 1. Pars. gribi in Prov. Voronezh [collected in 1912] (1914) 53 [cf. holotype, LE-41829; isotype, LEP].

Phyllosticta valerianae Smith & Ramsb., Trans. Br. mycol. Soc. 5 (1915) 158 [cf. holotype, BM].

Phyllosticta polemonii Smith & Ramsb., Trans. Br. mycol. Soc. 5 (1916) 244 [cf. holotype, BM and sec. collections; identification confirmed in vitro, CBS].

Phyllosticta sesami Woron., Věstn. Tiflissk. bot. Sada 3 (1916) 12 [cf. holotype, LEP].

Phyllosticta mercurialicola C. Massal. in Sacc., Fungi veronensis ecc., Madonna Verona (1918), 10; Syll. Fung. *25* (1931) 36 [cf. holotype, VER].

Phyllosticta hydrocotyles A. L. Smith, Trans. Br. mycol. Soc. 6 (1919) 153 [cf. holotype, BM].

Phyllosticta aconitina Petr., Annls mycol. 19 (1921) 87 [cf. isotypes L, S and B].

Phyllosticta crotalariae Speg., An. Mus. nac. Hist. nat. B. Aires 31 (1922) 425 [cf. holotype, LPS].

Phyllosticta sinapi Bond.-Mont., Bolezni Rast. 2 (1923) 70 [cf. holotype LE-41866].

Phyllosticta crinodendri Speg., Revista Chilena Hist. Nat. 27 (1924) 58 [cf. holotype, LPS].

Phyllosticta gueldenstaedtiae Murashk., Trudy Sibirsk. Sel'skokhoz. Akad. 5 (1925) 2 [cf. holotype, LEP].

Phyllosticta anagallidis Hollós, Mat. Term. Közlem. [Magy. tudom. Akad.] 35, 1 (1926) 45 [cf. holotype, B].

Phyllosticta bellidis Hollós, Mat. Term. Közlem. [Magy. tudom. Akad.] 35, 1 (1926) 45 [cf. description; type probably not being in existence].

Phyllosticta vernonicida Speg., Boln. Acad. nac. Cienc. Córdoba 29 (1926) 168 [cf. description; type not available in LPS].

Phyllosticta cardaminis-amarae Petr., Annls mycol. 25 (1927) 229 [cf. isotype, S].

Phyllosticta alliicola Lobik, Bolezni Rast. 17 (1928) 165 [cf. description; type not available].

Phyllosticta salviae Lobik, Bolezni Rast. 17 (3–4) (1928) 169 [cf. holotype, LE-41856].

Phyllosticta staticis-gmelini Lobik in Lobik & Volgunov, Mater. Florist. Faunist. Obsl. Tersk. Okr., Pyatigorsk (1928) 38 [cf. holotype, LE-41874].

Phyllosticta suaedae Lobik, Bolezni Rast. 17 (3–4) (1928) 164 [cf. holotype, LE-41876].

Phyllosticta xanthosomatis Petr. & Cif., Annls mycol. 28 (1930) 28 [cf. holotype, S].

Phyllosticta falcata Ziling, Trudy Bot. Inst. Akad. Nauk S.S.S.R., Ser. 2, 3 (1936) 689 [cf. holotype, LEP].

Phyllosticta balcanica Bubák & Picb., Annls mycol 35 (1937) 139 [cf. description].

Phyllosticta aecidiicola Hulea, Bul. Sti. Acad. Populare Române Republ. [Sect. Scient.] 22 (1939) 210 [cf. holotype, BUCM].

Phyllosticta scrophulariaecola [as '*scrophulariicola*'] Petr., Annls mycol. 39 (1941) 259 [cf. isotypes, in F. Petrak, Mycoth.. gener. No. 1345, W and B].

Phyllosticta senecionicola Petr., Annls mycol. 39 (1941) 257 [cf. holotype, S and isotypes, in Cryptog. exs. ed. Mus. Hist. natur. Vindebonensi No. 3550 (PRC, W and L) and F. Petrak Mycoth. gener. No. 292 (W and B)].

Phyllosticta pogostemonis Khokhr., Bot. Mater. Otd. Sporov. Rast. Bot. Inst. Akad. Nauk S.S.S.R. 7 (1951) 145 [cf. holotype, LEP].

Phyllosticta alternantherae Negru, Contr. Bot. Cluj (1958) 63 [cf. description; type no longer exists: information BUCM]; illegitimate homonym of *Phyllosticta alternantherae* Bat., Bolm Sec. Agric. Ind. Com. Est. Pernambuco 19 (1952) 5 [cf. the description quite another *Phoma* species].

Phyllosticta elettariae Chowdhury, Lloydia 21 (1958) 152 [cf. Mathur, 1979 and in accordance with the description].

Phyllosticta actinidiae Ablak. & Koval, Bot. Mater. Gerb. Bot. Inst. Komarova Akad. Nauk S.S.S.R. 13 (1960) 243 [cf. description].

Phyllosticta hoveniae Gucevič, Izv. Akad. Nauk Armyansk. S.S.R., Biol. Nauki 15 (1962) 67 [cf. holotype, LECB].

Phyllosticta pentastemonitis Sandu & Serea in Sandu, A. Lažar, Hatmanu & Serea, Lucr. Şti. Inst. Agron. Isasi (1962) 92 [cf. holotype, BUCM].

Phyllosticta circaeae Mel'nik, Novosti. Sist. Nizsh. Rast. (1965) 149 [cf. holotype, LE-41742].

Phyllosticta gerberae Dzhalag., Novosti. Sist. Nizsh. Rast. (1965) 156 [cf. holotype, LE-41784].

Phyllosticta bellidicola Nelen, Novosti. Sist. Nizsh. Rast. (1966) 224 [cf. description].

Phyllosticta myosotidicola Nelen, Novosti. Sist. Nizsh. Rast. (1966) 225 [cf. holotype, LE-41816].

Phyllosticta monardicola Cejp, Česká Mykol. 20 (1966) 210 [cf. holotype, PRC].

Phyllosticta caucasica Cejp, Nova Hedwigia 13 (1967 '1966') 186 [according to the description; type not available].

Phyllosticta armeniaca Tasl., Mikol. Fitopatol. 1 (1967) 111 [cf. description].

Phyllosticta arborea Cejp, Nova Hedwigia 13 (1967) 184 [cf. description; type not present in herbarium K. Cejp, PRC; pers. information from K. Cejp].

Phyllosticta caucasica Tasl., Mikol. Fitopatol. 1 (1967) 111; later homonym of *P. caucasica* Cejp [cf. holotype, LE-41736].

Phyllosticta daturicola Cejp, Nova Hedwigia 13 (1967) 188 [cf. the description; type not available, not in PRC (pers. information K. Cejp)].

Phyllosticta erigerontis Tasl., Mycol. Fitopatol. 1 (1967) 109 [cf. holotype, ERHM; isotype LE-41769].

Phyllosticta sisymbrii Byzova in Byzova et al., Fl. spor. Rast. Kazakh. 5, 1 (1967) 80 [cf. holotype, AA].

Phyllosticta ballotaecola Cejp in Cejp, Dolejš & Zavrel, Zprávy Vlastiv. Ústavu v Olomouci, Cislo 143 (1969) 2 [cf. holotype, PRC].

Phyllosticta torilidis Cejp in Cejp, Dolejš & Zavrel, Zprávy Vlastiv. Ústavu v Olomouci, Cislo 143 (1969) 12 [cf. holotype, PRC].

Phyllosticta celosiae Cejp, Mycol. Pap. 117 (1969) 3; illegitimate, homonym of *P. celosiae* Thüm., 1878, l.c. [cf. isotype, IMI 119661].

Phyllosticta doellingeriae Cejp, Zprávy Vlastiv. Ústavu v Olomouci, Cislo 143 (1969) 6 [cf. holotype, PRC].

Phyllosticta hypericicola Cejp, Nova Hedwigia 18 (1969) 563 [cf. description; type not available; not in PRC: pers. information K. Cejp].

Phyllosticta lythri Cejp, Nova Hedwigia 18 (1969) 564 [cf. description; type not available; not in PRC: pers. information K. Cejp].

Phyllosticta macrospora Cejp, Zprávy Vlastiv. Ústavu v Olomouci, Cislo 143 (1969) 8 [cf. holotype, PRC].

Phyllosticta rosae-sinensis Cejp, Mycol. Pap. 117 (1969) 4 [cf. syntype in Exsicc. Dr Karel Cejp, PRC].

Phyllosticta zambiensis Cejp, Mycol. Pap. 117 (1969) 5 [cf. holotype, IMI; isotype, PRC].

Phyllosticta gaillardiae Movss., Nov. Sist. niz. Rast 6 (1970 '1969') 197 [cf. description].

Phyllosticta pimpinellae Cejp, Fassat. & Zavrel, Zprávy Vlastiv. Ústavu v Olomouci, Cislo 153 (1971) 4 [cf. holotype, PRC].

Phyllosticta telekiae Cejp, Fassat. & Zavrel, Zprávy Vlastiv. Ústavu v Olomouci, Cislo 153 (1971) 8 [cf. holotype, PRC].

Phyllosticta magnoliae Shreem., Indian J. Mycol. Pl. Pathol. 3 (1974 '1973') 114. Illegitimate name; later homonym of *Phyllosticta magnoliae* Sacc., Michelia 1 (2) (1878) 139 [cf. type and living culture, IMI 130810].

Phyllosticta carthami Cejp & Dolejš, Fol. Mus. Rerum. Nat. Bohemiae Occid., Bot. 7 (1976) 4 [cf. holotype, PRC].

Phyllosticta coriandri Cejp & Dolejš, Fol. Mus. Rerum. Nat. Bohemiae Occid., Bot. 7 (1976) 5 [cf. holotype in Dr. Karel Cejp, Fungi imperfecti exsiccati, PRC].

Phyllosticta galinsogae Cejp & Dolejš, Fol. Mus. Rerum. Natur. Bohemiae Occid., Bot. 7 (1976) 6 [cf. holotype, PRC].

Previous studies of this fungus added more than a hundred names to its synonymy (Boerema & Höweler (1967), Boerema (1970), Van der Aa & Van Kesteren (1971), Boerema (1972) and Boerema & Dorenbosch (1973)).

The history of the fungus is summarized by Morgan-Jones & Burch (1988). The most striking morphological character of the fungus in vivo is the great variability of size, shape and septation of the conidia. Therefore, the host-specific varieties can only be differentiated according to characters in vitro. They are also recognizable in the AFLP patterns which will be published separately by Abeln et al. (in press).

Description in vitro

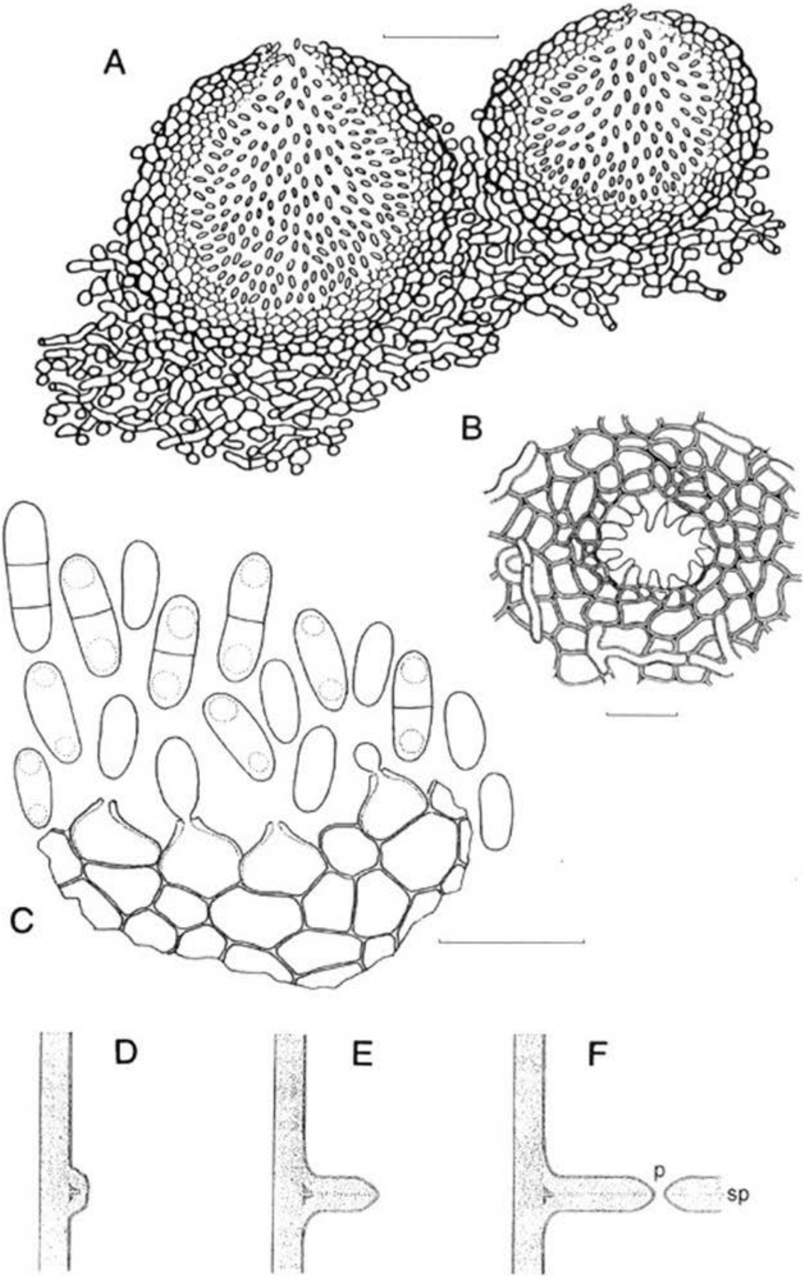
OA: growth-rate (25–)50–85 mm, with irregularly scalloped or lobed margin and with floccose, white to pale olivaceous grey/olivaceous grey aerial mycelium; colony colourless or with various grey greenish tinges, olivaceous grey to greenish olivacous/grey olivaceous or olivaceous to olivaceous black, usually colourless towards margin; reverse similar.

MA: growth-rate (25–)40–75 mm, with irregularly scalloped or lobed margin and with floccose, grey olivaceous to dull green aerial mycelium; colony grey olivaceous/dull green to olivaceous black, often with saffron/ochraceous to amber patches, and white near margin; reverse similar.

CA: growth-rate 35–50(–70) mm, with irregularly scalloped or lobed margin and with floccose, white to grey olivaceous aerial mycelium; colony grey olivaceous to olivaceous grey; reverse leaden grey to leaden black, often with cinnamon to greyish sepia/chestnut patches; reverse similar.

In general the growth-rate on OA is somewhat faster then those on MA and CA.

Pycnidia scarce to scattered, partly submerged in the agar, 75–200 µm diam., globose to subglobose or irregular, solitary or confluent, glabrous, with usually 1(–2) non-papillate ostioles, olivaceous to olivaceous black; walls made up of 2–5(–7) layers of cells, outer layer(s) pigmented; conidial exudate white to yellowish or rosy buff/salmon or rosy vinaceous. Conidiogenous cells 3–8 × 3–8 µm, globose to bottle shaped. Conidia aseptate, (2.5–)4–7(–12) × 2–3.5 µm, av. 5.5–7.5 × 2.5–3.0, Q = 1.5–4.0, av. Q = 2.3–2.6 or 1(–2) septate, (5.5–)7–10(–13) × 2.5–3.5(–5) µm, variable in shape, subglobose, ellipsoidal to oblong, or allantoid, usually with small guttules.


A
B
C
D
E
F
p
sp

NaOH spot test: positive on OA and MA: greenish, then red (E^+ reaction: production of antibiotic E).

Chlamydospores absent, however, swollen olivaceous cells, constricted at the septa, occur.

Crystals absent.

Description in vivo

Pycnidia on leaves and stems of living or withering plants, usually irregularly scattered, seldom arranged concentrically, sometimes on typical leaf spots, but more often on old leaf spots caused by other organisms or on necrotic tips and borders of leaves or on irregular lesions on stem, single or some grown together, globose or somewhat depressed, 100–200 µm in diam., with a roundish ostiolum, lined with papillate subhyaline cells. Pycnidial wall 1–3 outer layers with pale to dark brown, isodiametrical cells, occassionally intermixed with hyphal elements, and 1–3 layers inner cells which are hyaline, isodiametric or somewhat flattened. Conidiogenous cells ampulliform phialids, hardly differentiated from the inner wall cells but with a periclinal thickening of the conidiogenous locus. Blastoconidia ellipsoidal with rounded ends, or irregularly in shape, one celled or 1 (–2)-septate, with or without constrictions at the septae, one-celled conidia 5.5–11.0 × 1.8–4.0(–6) µm, 2(–3)-celled conidia 7.5–14.0(–16.0) × 2.5–4.0(–6.0) µm. Conidial slime dirty white to pale salmon in colour.

Ecology and distribution. Phoma exigua var. *exigua* is a world-wide recorded wound and weak parasitic soil fungus, which in Eurasia has been isolated from more than 200 host genera. The fungus is an opportunistic plant parasite which may cause necroses on leaves and stems, and may produce a rot on fleshy roots and tubers, or at the bases of leaves and stems: Leaf- and Stem Necroses, Pod spot of legumes, Root Rot of carrot, chichory etc., Gangrene of potatoes, Tuber Rot of dahlia, Foot Rot of lettuce etc.

On dying plant substrates, in the close proximity of soil, it is the most common pycnidial fungus found in Europe. The extensive synonymy can be explained by the unlimited plurivorous character of the fungus and its extreme variability in size and septation of conidia. Notable are the many specific 'host-indicating names', formerly described in the genus *Phyllosticta*.

As a producer of notorious cytochalasins A and B (= phomine) the fungus was initially known as '*Phoma* stam S 298'. For literature references see e.g. Boerema & Hamers (1990).

Representative cultures. CBS 431.74 ex *Solanum tuberosum* (Solanaceae), the Netherlands, CBS 101150 (PD 79/118) ex *Cichorium intybus* (Compositae), the Netherlands and CBS 101155 (PD 87/719) ex *Helianthus annuus* (Compositae), France.

←

Fig. 1. *Phoma exigua* var. *exigua*, type species of *Phoma* sect. *Phyllostictoides*. A. Vertical section of pycnidia and subtending mycelium, from 14-day-old colony; B. superficial view of an ostiolum, lined internally with papillate hyaline cells; C. conidiogenous cells and conidia; D→F. diagrammatic representation of electron-microscope observations on the frequently occurring secondary septation of the conidia. It occurs as an annular ingrowth from the lateral wall, leaving a pore (p) in the centre. The septum consists of a middle lamella, the septal-plate (sp.) at both sides covered with wall-layers which for some distance are 'attached' to the lateral conidial wall. Drawings A, C after Morgan-Jones & Burch (1988; with permission); B after Boerema & Höweler (1967); D, E after Boerema & Bollen (1975). Vertical section, bar 50 µm; ostiolum, conidiogenous cells and conidia, bar 10 µm.

Note. The present concept of the species separates a number of host-specific varieties, which are listed below[5]. In general the varieties of *Phoma exigua* with a specific host relation show in vitro a little variability in general appearance.

2. **Phoma exigua** var. **linicola** (Naumov & Vassiljevsky) Maas

Phoma exigua var. *linicola* (Naumov & Vassiljevsky) Maas, Neth. J. Pl. Path 71 (1965) 118. — *Ascochyta linicola* Naumov & Vassiljevsky, Mater. mikol. Fitopat. Ross. 5 (1926) 3. — *Phoma exigua* f. sp. *linicola* (Naumov & Vassiljevsky) Malc. & E.G. Gray, Trans. Br. mycol. Soc. 51 (1968) 619.

Phoma linicola É.J. Marchal & Verpl., Bull. Soc. r. Belg. 59 (1926) 22; not *Phoma linicola* Bubák, Annln naturh. Mus. Wien 28 (1914) 203 [= *Phoma exigua* Desm. var. *exigua*, no. 1], nor *Phoma linicola* Naumov, Mater. Mikol. Fitopat. Ross. 5 (1926) 3.

Phoma belgica Cash, in Trotter, Sylloge Fung. 26 (1972) 934.

Diplodina lini Moesz & Smarods in Moesz, Magy. bot. Lap. 29 (1930) 35.

Selected literature. Maas (1965), Boerema & Höweler (1967), Boerema (1976).

Differentiating characters. Growth-rate on OA and MA is relatively slow, 20–45 mm; colonies compact, distinct pigmented, olivaceous grey to olivaceous black.

NaOH reaction is positive: production of antibiotic E.

Ecology and distribution. This variety represents a noxious seed-borne pathogen of cultivated flax (*Linum usitatissimum*), causing Damping-Off, Foot Rot and Dead Stalks. Checked records are from East and West Europe and New Zealand. Similar slow-growing E$^+$ isolates are occasionally also isolated from other plants. AFLP studies (Abeln et al., in press) indicate a close relation to var. *heteromorpha* (no. 3), pathogen of the oleander (the hosts of both varieties are of mediterranean origin).

Representative culture. CBS 116.76 (ATCC 32332, IMI 197074, PD 75/544) ex Linum usitatissimum (Linaceae), the Netherlands.

3. **Phoma exigua** var. **heteromorpha** (S. Schulz. & Sacc.) Noordel. & Boerema

Phoma exigua var. *heteromorpha* (S. Schulz. & Sacc.) Noordel. & Boerema, Versl. Meded. plziektenk. Dienst Wageningen 166 (Jaarboek 1987) (1988) 109 [erroneously without page indication of the basionym; reference added in printed Errata slip]. — *Phoma heteromorpha* S. Schulz. & Sacc., Hedwigia 23 (1884) 107. — *Ascochyta heteromorpha* (S. Schulz. & Sacc.) Curzi, Boll. Reale Staz. Patol. veg. 13 (1933) 399.

Phoma oleandrina Delacr., Bull. Soc. mycol. Fr. 21 (1905) 190.

Selected literature. Curzi (1933), Mercier & Metay (1977), Keim (1979), Noordeloos & Boerema (1988).

Differentiating characters. Differs from the type variety *exigua* mainly by its extreme morphological variability ('*heteromorpha*'). Growth-rate is moderate on OA, 40–50 mm, and relatively slow on MA and CA, 20–25(–30) mm; colonies are relatively dark, grey olivaceous to olivaceous black, with often white aerial mycelium.

Usually no demonstrable production of antibiotic E, but some strains showed on MA a slight positive reaction with NaOH.

---

[5] It should be noted that two specific pathogens formerly classified as varieties of *Phoma exigua*, on account of additional comparative studies now are placed (again) in species rank: *P. exigua* var. *foveata* (Foister) Boerema = *Phoma foveata* Foister; *P. exigua* var. *sambuci-nigrae* (Sacc.) Boerema & Höweler = *Phoma sambuci-nigrae* (Sacc.) Monte et al. Both species will be treated in Contribution VI-2.

Ecology and distribution. This fungus is known as a noxious pathogen of oleander (*Nerium oleander*) in production nurseries: Dieback (Canker) and Leaf Necrosis.

Confirmed records are from France, Italy and the United States, but probably the pathogen occurs everywhere the host is commercially grown. Natural infection appeared to occur only through wounds. The fungus has been also isolated from necrotic stems and leaves of *Vinca minor* (also Apocynaceae).

Genetically var. *heteromorpha* belongs to the same group as var. *linicola* (no. 2), pathogen of flax (Abeln et al., in press).

Representative culture. CBS 443.94 (PD 98/2328) ex *Nerium oleander* (Apocynaceae), Italy.

4. **Phoma exigua** var. **populi** De Gruyter & Scheer

Phoma exigua var. *populi* De Gruyter & Scheer, J. Phytopathol. 146(1998) 413.
Selected literature. Butin (1957), Magnani (1966, 1969), De Gruyter & Scheer (1998).

Differentiating characters. Growth-rate on OA 41–66 mm, on MA and CA relatively slow, 20–40 mm.

No production of antibiotic E (NaOH reaction is negative).

Ecology and distribution. This opportunistic pathogen of poplars causes distinct necrotic bark lesions; especially cultivars of *Populus nigra* and *Populus* (×) *euramericana* proved to be susceptible. In European literature before 1998 the disease has been ascribed to *Phoma urens* Ellis & Everh., but De Gruyter & Scheer (l.c.) established that the American holotype of that species contained a quite different species of *Sclerophoma*.

The disease symptoms resemble Canker of poplar caused by *Cryptodiaporthe populea* (Sacc.) Butin ex Butin [anam. *Chondroplea populea* (Sacc.) Kleb.]. *Phoma exigua* var. *populi* has also been isolated from a species of *Salix*.

The fungus on poplars is so far recorded in Germany, the Netherlands and Italy.

Representative culture. CBS 100167 (PD 93/217) ex *Populus* (×) *euramericana* 'Robusta' (Salicaceae), the Netherlands.

5. **Phoma exigua** var. **diversispora** (Bubák) Boerema

Phoma exigua var. *diversispora* (Bubák) Boerema in Boerema & Kesteren, Gewasbescherming 11 (1980) 122. — *Phoma diversispora* Bubák, Österr. bot. Z. 55 (1905) 78.
Selected literature. Boerema et al. (1981), Boerema et al. (1993).

Differentiating characters. Growth-rate fast on OA and CA, 60–85 mm, on MA moderate, 35–60 mm; on OA with velvety to floccose/woolly, pale olivaceous grey/grey olivaceous aerial mycelium; reverse usually dark olivaceous black.

Unicellular conidia vary more widely in width than those of the type variety *exigua* ('*diversispora*').

Chlamydospores may be formed, best observed on water agar (WA), 10–25 µm diam.

No production of the antibiotic E (NaOH reaction is negative).

Ecology and distribution. The primary host of variety *diversispora* is probably cowpea (*Vigna unguiculata*), originally native of Central and West Africa. However, in Western

Europe and East Africa var. *diversispora* is particularly known as seed-borne pathogen of dwarf beans or snap beans *(Phaseolus vulgaris)*. The African genus *Vigna* and the American genus *Phaseolus* are closely related and generally susceptible to their mutual pathogens. Affected hosts show a black discolouration of stem nodes and petioles: Black Node Disease.

Representative culture. CBS 102.80 (IMI 331907, PD 79/61) ex *Phaseolus vulgaris* (Leguminosae), Kenya.

Note. In South America similar disease symptoms on beans are caused by the related var. *noackiana*, see below. The plurivorous weak parasite var. *exigua* may produce brown specks on mature bean pods (Speckle Disease).

6. **Phoma exigua** var. **noackiana** (Allesch.) Aa, Boerema & de Gruyter, *comb. nov.*

Phyllosticta noackiana Allesch., Bolm. Inst. agron. Campinas 9 (1898) 85 [basionym; holotype on leaf of *Phaseolus*, coll. F. Noack, Campinas, Brasil, B].

Selected literature. Obando-Rojas (1989).

Differentiating characters. This var. *noackiana* may be called an American nephew of the African var. *diversispora* (no. 5). It differs only little in cultural characters: growth-rate fast on OA, MA and CA, 65–85 mm; on OA with compact tufts of white aerial mycelium, as well as velvety to floccose olivaceous grey aerial mycelium.

Chlamydospores may be formed, best observed on water agar (WA), up to 20 µm diam. No production of antibiotic E (NaOH reaction is negative).

Obando-Rojas (1989) proved that var. *noackiana* and var. *diversispora* are distinctly different in enzyme composition. Both varieties are genetically different, but belong to the same group (Abeln et al., in press).

Ecology and distribution. This variety is in South- and Central America repeatedly found on beans *(Phaseolus vulgaris)* with disease symptoms resembling the Black Node Disease, in (eastern) Africa and (western) Europe caused by *Phoma exigua* var. *diversispora* (no. 5). Study of herbarium material showed that in the 19th century the fungus has been described as a separate species of *Phyllosticta*, found on leaves of bean, collected in Brazil. The occurrence of large necrotic spots on the leaves is one of the symptoms of the disease, which usually starts at the nodes and at leaf junctions.

Representative culture. CBS 100353 (PD 87/718) ex *Phaseolus vulgaris* (Leguminosae), Guatamala.

7. **Phoma exigua** var. **lilacis** (Sacc.) Boerema

Phoma exigua var. *lilacis* (Sacc.) Boerema, Phytopathol. Medit. 18 (1980 '1979') 105. — *Phoma herbarum* f. *lilacis* Sacc., Michelia 2 (1880) 93.

Selected literature. Boerema (1980).

Differentiating characters. Cultures of this variety on OA, MA and CA can easily be differentiated from var. *exigua* by a rather fast growth-rate, 60–80 mm diam. Colonies on OA have abundant, compact tufted, white aerial mycelium, covering the entire greenish olivaceous colony.

No production of antibiotic E (NaOH reaction is negative).

Ecology and distribution. This variety is known as a pathogen of lilac *(Syringa vulgaris)*, causing Damping-Off of seedlings, Leaf Necroses and Dieback of shoots. The fungus is also found on seed capsules which indicates the possibility of transmission by seeds. It is probably not always a primary pathogen and may follow Bacterial Blight caused by *Pseudomonas syringae* v. Hall. Occasionally *Phoma exigua* var. *lilacis* has been isolated from necrotic tissue of a *Forsythia* hybrid (also Oleaceae).

Confirmed records on lilac are from France, Germany, Italy, the Netherlands, USA and New Zealand. The fungus probably occurs wherever the host, originally native of Central and South-East Europe, is cultivated.

Representative culture. CBS 569.79 (IMI 331909, PD 72/741) ex *Syringa vulgaris* (Oleaceae), the Netherlands.

8. **Phoma exigua** var. **viburni** (Roum. ex Sacc.) Boerema

Phoma exigua var. *viburni* (Roum. ex Sacc.) Boerema in De Gruyter & Scheer, J. Phytopathology 146 (1998) 414. — *Phyllosticta viburni* Roum., Fungi gall. exs. Cent. 21 (1882) No. 2036; Revue mycol. 4 (1882) 99 [nomen nudum]. — *Ascochyta viburni* (Roum.) ex Sacc., Syll. fung. 3 (1884) 387; not *Ascochyta viburni* Lasch, Fungi europ. exs./Klotzschii Herb. mycol. Cont. [ed. Rabenh.] Cent. 14 (1850), No. 1354 [nomen nudum = *Phoma macrostoma* Mont. var. *macrostoma*, to be treated in Contrib. VI–2]. — *Phoma viburni* (Roum. ex Sacc.) Boerema & Griffin, Trans. Br. mycol. Soc. 63 (1974) 110.

Phyllosticta roumeguerei Sacc., Michelia 2 (1880) 88 [as 'Roumeguerri']; not *Phoma roumeguerei* Sacc., Michelia 2 (1880) 89.

Phyllosticta lantanoides Peck, Rep. N. Y. State Mus. 38 (1885) 94.

Phyllosticta viburnicola Roum., Revue mycol. 7 (1885) 89; not *Phoma viburnicola* Oudem., Versl. gewone Vergad. wis- en natuurk. Afd. K. Akad. Wet. Amst. 9 (1900) 298 [sect. *Phoma* (de Gruyter & Noordeloos, 1992)].

Phyllosticta punctata Ellis & Dearness, Canad. Rec. Sci. 5 (1893) 268.

Selected literature. Boerema & Griffin (1974), Rai & Rajak (1993), De Gruyter & Scheer (1998).

Differentiating characters. Apart from the specific host relation this variety differs only little in cultural characters from var. *forsythiae* (no. 9). Growth-rate on OA, MA and CA relatively fast, 65–85 mm, regular, on OA with tufts of velvety to finely floccose, white to pale olivaceous grey aerial mycelium; slower growing colony sectors may occur.

No production of antibiotic E (NaOH reaction negative).

Var. *viburni* is genetically distinct from var. *forsythiae* (Abeln et al., in press).

Ecology and distribution. A common pathogen of cultivated *Viburnum* spp. Occasionally it has been isolated from *Lonicera* sp. (also Caprifoliaceae) and some other woody plants (mostly in the neighbourhood of *Viburnum* plants). The disease is known as Leaf Spot, Stem Lesions and Shoot Blackening. Most conspicuous are the necrotic leaf spots with a purplish margin. The variability of the conidia explains the various synonyms in the genus *Phyllosticta* sensu Sacc.. When treating it as a species of *Phoma*, Boerema & Griffin (1974) noted the difficulty of distinguishing it from E^--isolates of *P. exigua*.

The records of this fungus are from Europe (Germany, Great Britain, the Netherlands, France) and North America (Canada, United States); but probably it may be found everywhere the hosts are cultivated.

Representative culture. CBS 100354 (PD 84/448) ex *Viburnum opulus* (Caprifoliaceae), the Netherlands.

9. **Phoma exigua** var. **forsythiae** (Sacc.) Aa, Boerma & de Gruyter, *comb. nov.*

Phyllosticta forsythiae Sacc., Michelia 1 (1) (1877) 93 [basionym: lectotype on leaf spot, on *Forsythia suspensa* 'Fortunei' (as *F. fortunei*), Paris, France, coll. P.A. Hariot, 1914, PAD (with handwritten note and drawing by P.A. Saccardo; holotype on withering leaves of *F. suspensa* apparently not preserved)]. — *Ascochyta forsythiae* (Sacc.) Höhn. in H. Zimmer., Verh. Naturf. Vereins Brünn 47 (1909 '1908') 36.

Ascochyta forsythiae Died., Krypt.-Fl. Mark Brandenb. 9 [Pilze 7, Heft 2] (1912) [vol. dated '1915'] 383, fide Mel'nik, 1977.

Differentiating characters. Growth-rate fast on OA, MA and CA , 65–85 mm after 7 days, on OA and MA regular, on CA lobed; on OA velvety to finely floccose/woolly, partly tufted, mainly (pale) olivaceous grey aerial mycelium.

No production of antibiotic E (NaOH reaction is negative).

The cultural characteristics of this variety resemble very much those of var. *viburni*, see no. 8.

Ecology and distribution. This variety is frequently isolated from weakened and badly growing shrubs of *Forsythia* hybrids in Europe. The fungus has been found on dead leaves and may occur in association with circular leaf spots, but most characteristic are dead flower buds encircled by brown bark lesions and with discolouration of the wood. The identity of this variety with Saccardo's *Phyllosticta forsythiae* has been based on comparison with the lectotype and various secondary collections on the type host in PAD and CBS.

Representative culture. CBS 101213 (PD 92/959) ex *Forsythia* sp. (Oleaceae), the Netherlands.

ADDENDUM

Doubtful infraspecific taxa of *Phoma exigua* (incorporated in index).

10. **Phoma exigua** 'var. **inoxydabilis** Boerema & Vegh'

Phoma exigua 'var. *inoxydabilis* Boerema & Vegh', in Vegh, Bourgeois, Bousquet & Velastegui, Bull. trimest. Soc. Mycol. Fr. 90 (1974) 130 [as manuscript name refered to as *'nonoxydabilis'* Boerema & Vegh, cf. Bousquet & Barbier, Phytopath. Z. 75 (1972) 364 and Boerema & Dorenb., Stud. Mycol. 3 (1973) 27].

Phoma herbarum f. *vincae* Brunaud, Actes Soc. Linn. Bordeaux 40 [= Sér. IV, 10] (1886) 75.

Phyllosticta vincae-majores Allesch., Rabenh. Krypt.-Flora [ed. 2] Pilze 6 [Lief. 61] (1898) [vol. dated '1901'] 155.

Phyllosticta vincae-minores Bres. & Krieger, Hedwigia 39 (1901) 325.

The authors of this variety noticed that European and American isolates of *P. exigua* obtained from Stem Blight and Leaf Spot of *Vinca minor* (Apocynaceae) did not show the oxidation reaction with NaOH (*'inoxydabilis'*): no production of the antibiotic E. However, in the early seventies it was still not known that various strains or varieties of *P. exigua* do not produce the metabolite E.

Additional studies of *P. exigua* isolates from *Vinca* have shown that they do not represent one cultural type, but include strains quite different in growth-rate and other cultural as well as genetic characteristics (Abeln et al., in press).

The French type culture of var. *inoxydabilis*, PC 2198, has been lost (information Dr. J. Mouchacca, PC). A very similar slow growing Dutch isolate, CBS 101205 (= PD 77/434), showed genetic similarity with the E^- variety *heteromorpha*, no. 3 (pathogen of *Nerium oleander*, also Apocynaceae!).

The cultural characteristics of the Dutch isolate CBS 372.75 deposited in 1975 (PD 75/01, ATCC 32161, IMI 194763) fully agree with those of a *P. exigua* isolate (E^-) from *Phlox*, CBS 101201, as does a recent Dutch isolate of *P. exigua* (E^-) from *Vinca*, CBS 101204 (PD 98/2324). These isolates belong indeed to one separate group when studied by AFLP (Abeln et al., in press).

In summary, Stem Blight and Leaf Spot of *Vinca* is not associated with one host-specific '*inoxydabilis*'-variety of *P. exigua*. The listed synonyms may also refer to different strains of *P. exigua*. This conclusion agrees with the experimental study of the *Vinca* disease by Jansen (1965). She obtained the typical leaf spots and dieback of shoots after inoculating with isolates from *Vinca* spp., as well as with an arbitrary isolate of *P. exigua* (from *Dahlia* tuber rot). She supposed that the relevant disease of *Vinca* is primarily induced by unfavourable environmental conditions.

11. **Phoma exigua** 'var. **capsici** L.Z. Liang'

Phoma exigua 'var. *capsici* L.Z. Liang', Acta Microbiol. sin. 31 (2) (1991) 161 [nom. inval.].

This infraspecific taxon, based on pathogenic *Phoma* isolates from seeds of *Capsicum annuum* in Beijing, China, was introduced without a Latin description and type indication. Therefore this varietal name is not validly published (ICBN Arts 36.1, 37.1–5).

In the English summary of the Chinese paper by Liang (l.c.) the cultures of the fungus were characterized as black tinged, relatively fast growing with a regular margin, and showing no colour reaction with NaOH (no production of antibiotic E). Further is noted that the fungus "does not agree with any of the 5 described varieties of *P. exigua* by Boerema & Höweler (1967), except for morphological similarity of conidia". In pathogenicity tests it "could produce round or irregular lesions on leaves". The annotation that the fungus "was found in 21 seed samples of *Capsicum annuum* out of 30 tested with infection ranging from 0.5–65.5%", points to a true pathogen. Without a representative culture it is difficult to give a justified opinion on the identity of the pathogen. However, it should be noted that seeds of *Capsicum annuum* may be severely infected by *Phoma destructiva* Plowr. (Neergaard, 1956), a fungus often confused with *P. exigua* (e.g. in Japan), see Boerema & van Kesteren (1981). *Phoma destructiva* produces also dark colonies with a regular margin and gives no colour reaction with NaOH. It may cause foliar lesions and fruit rot (source of seed infection).

ACKNOWLEDGEMENTS

We are grateful to the curators of the following herbaria, who loaned type specimens: Alma-Ata (AA), Berlin (B), London (BM), Meise (BR), Bucuresti (BUCM), Baarn (CBS), Yerevan (ERHM), Egham (IMI), Kew (K), Leiden (L), St. Petersburg (LE, LECB and LEP), La Plata (LPS), München (M), New York (NY), Padova (PAD), Paris (PC), Praha (PRC), Stockholm (S), Siena (SIENA), Verona (VER), Vienna (W).

Thanks are expressed to Dr. D. van der Mei, who reviewed and corrected an earlier version of this paper, and to Mr. D. Yarrow for correcting the English text. The authors are much indebted to Maria M.J. Dorenbosch (Miek), former mycologist at the Plant Protection Service in Wageningen, whose cultural studies contributed substantially to the present concept of *Phoma exigua*.

REFERENCES

Aa, H.A. van der & H.A. van Kesteren. 1971. The identity of Phyllosticta destructiva Desm. and similar Phoma-like fungi described from Malvaceae and Lycium halimifolium. Acta bot. neerl. 20: 552–563.

Aa, H.A. van der & H.A. van Kesteren. 1979. Some pycnidial fungi occurring on Atriplex and Chenopodium. Persoonia 10 (2): 267–276.

Aa, H.A. van der, M.E. Noordeloos & J. de Gruyter. 1990. Species concepts in some larger genera of the Coelomycetes. Stud. Mycol. 32: 3–19.

Abeln, E.C.A., A.M. Stax, J. de Gruyter & H.A. van der Aa. (in press). Genetic discrimination of varieties of Phoma exigua on basis of AFLP fingerprints.

Arx, J.A. von. 1970. A revision of the fungi classified as Gloeosporium. Bibltheca mycol. 24; J. Cramer, Lehre.

Boerema, G.H. 1970. Additional notes on Phoma herbarum. Persoonia 6 (1): 15–48.

Boerema, G.H. 1972. Ascochyta phaseolorum synonymous with Phoma exigua. Neth. J. Pl. Path. 78: 113–115.

Boerema, G.H. 1976. The Phoma species studied in culture by Dr. R.W.G. Dennis. Trans. Br. mycol. Soc. 67: 289–319.

Boerema, G.H. 1980 ('1979'). Damping off of lilac seedlings caused by Phoma exigua var. lilacis (Sacc.) comb. nov. Phytopathol. Mediterr. 18: 105–106.

Boerema, G.H. 1993. Contributions towards a monograph of Phoma (Coelomycetes) II. Section Peyronellaea. Persoonia 15 (2): 197–221.

Boerema, G.H. 1997. Contributions towards a monograph of Phoma (Coelomycetes) V. Subdivision of the genus in sections. Mycotaxon 64: 321–333.

Boerema, G.H. & G.J. Bollen. 1975. Conidiogenesis and conidial septation as differentiating criteria between Phoma and Ascochyta. Persoonia 8 (2): 111–144.

Boerema, G.H., G. Crüger, M. Gerlagh & H. Nirenberg. 1981. Phoma exigua var. diversispora and related fungi on Phaseolus beans. Z. Pflanzenkrankh. Pflanzenschutz 88: 597–607.

Boerema, G.H. & M.M.J. Dorenbosch. 1973. The Phoma and Ascochyta species described by Wollenweber and Hochapfel in their study on fruit-rotting. Stud. Mycol. 3.

Boerema, G.H. & M.J. Griffin. 1974. Phoma species from Viburnum. Trans. Br. mycol. Soc. 63: 109–114.

Boerema, G.H. & J. de Gruyter. 1998. Contributions towards a monograph of Phoma (Coelomycetes) VII. Section Sclerophomella: Taxa with thick-walled pseudoparenchymatous pycnidia. Persoonia 17 (1): 81–95.

Boerema, G.H. & J. de Gruyter. 1999. Contributions towards a monograph of Phoma (Coelomycetes) III. Supplement: Additional species of section Plenodomus. Persoonia 17 (2): 273–280.

Boerema, G.H., J. de Gruyter & P. van de Graaf. 1999. Contributions towards a monograph of Phoma (Coelomycetes) IV. Supplement: An addition to section Heterospora: Phoma schneiderae spec. nov., synanamorph Stagonosporopsis lupini (Boerema & R. Schneider) comb. nov. Persoonia 17 (2): 281–285.

Boerema, G.H., J. de Gruyter & H.A. van Kesteren. 1994. Contributions towards a monograph of Phoma (Coelomycetes) III – 1. Section Plenodomus: Taxa often with a Leptosphaeria teleomorph. Persoonia 15 (4): 431–487.

Boerema, G.H., J. de Gruyter & M.E. Noordeloos. 1997. Contributions towards a monograph of Phoma (Coelomycetes) IV. Section Heterospora: Taxa with large sized conidial dimorphs, in vivo sometimes as Stagonosporopsis synanamorphs. Persoonia 16 (3): 335–371.

Boerema, G.H. & M.E.C. Hamers. 1990. Check-list for scientific names of common parasitic fungi. Series 3c; Fungi on bulbs: 'additional crops' belonging to the Araceae, Begoniaceae, Compositae, Oxalidaceae and Ranunculaceae. Neth. J. Pl. Path. 96, Suppl. 1[6].

Boerema, G.H. & L.H. Höweler. 1967. Phoma exigua Desm. and its varieties. Persoonia 5 (1): 15–28.

---

6) The complete series 'Check-list for scientific names of common parasitic fungi' compiled by G.H. Boerema and Coworkers was reprinted in 1993 with a cumulative index. Libri Botanici 10. IHW Verlag, Eching, D.

Boerema, G.H. & H.A. van Kesteren. 1981. Mycological diagnostic problems. EPPO Bull. 11 (2): 113–118.

Boerema, G.H., W.M. Loerakker & M.E.C. Hamers. 1996. Contributions towards a monograph of Phoma (Coelomycetes) III – 2. Misapplications of the type species-name and the generic synonyms of section Plenodomus (Excluded species). Persoonia 16 (2): 141–190.

Boerema, G.H., R. Pieters & M.E.C. Hamers. 1993. Check-list for scientific names of common parasitic fungi. Supplement Series 2c, d (additions and corrections): Fungi on field crops: pulse (legumes), forage crops (herbage legumes), vegetables and cruciferous crops. Neth. J. Pl. Path. 99, Suppl. 1[7].

Butin, H. 1957. Die Blatt- und rindenbewohnenden Pilze der Pappel unter besondere Berücksichtigung der Krankheitserreger. Mitt. biol. Bundesanst. Land- Forstw. 91: 1–64.

Curzi, M. 1933. L' "Ascochyta heteromorpha" N.C. nella necrosi dell' oleandro e nell' inoculazione sperimentale. Boll. R. Staz. Patol. veg. Roma II, 13: 380–422.

Diedicke, H. 1912–1915. Kryptogamenflora der Mark Brandenburg und angrenzender Gebiete, Band IX, Pilze VII, Sphaeropsideae, Melanconieae. Heft I: 1–240, 31. Mai 1912; Heft II: 241–416, 22. November 1912; Heft III: 416–640, 15. März 1914; Heft IV: 641–800, 15. September 1914; Heft V: 801–962, 30. Mai 1915. Leipzig. Verlag Gebr. Borntraeger.

Ellis, J.B. & B.M. Everhart. 1900. The North American Phyllostictas with descriptions of the species published up to August 1900. Vineland, N.J. 1900: 1–79.

Gruyter, J. de & M.E. Noordeloos. 1992. Contributions towards a monograph of Phoma (Coelomycetes). I – 1. Section Phoma: Taxa with very small conidia in vitro. Persoonia 15: 71–92.

Gruyter, J. de, M.E. Noordeloos & G.H. Boerema. 1993. Contributions towards a monograph of Phoma (Coelomycetes). I – 2. Section Phoma: Additional taxa with very small conidia and taxa with conidia up to 7 µm long. Persoonia 15 (3): 369–400.

Gruyter, J. de, M.E. Noordeloos & G.H. Boerema. 1998. Contributions towards a monograph of Phoma (Coelomycetes). I – 3. Section Phoma: Additional taxa with very small conidia and taxa with conidia longer than 7 µm. Persoonia 16 (4): 471–490.

Gruyter, J. de & P. Scheer. 1998. Taxonomy and pathogenicity of Phoma exigua var. populi var. nov. causing necrotic bark lesions on poplars. J. Phytopathol. 146: 411–415.

Holmgren, P.K., W. Keuken & E. Schofield. 1981. Index Herbariorum, Part 1, The herbaria of the world. 7th Edition. The Hague/Boston: W. Junk BV Publishers.

Jansen, M.J.C.M. 1965. Bladvlekken en scheutsterfte bij Vinca species veroorzaakt door Phoma exigua. Versl. Meded. Plziektenk. Dienst Wageningen 142 (Jaarb. 1964): 153–154.

Keim, R. 1979. Pruning wound dieback of oleander. Pl. Dis. Reprt 63: 499–501.

Liang, L. 1991. A new variety of Phoma exigua [Chinese with English summary]. Acta Microbiol. sin. 31 (2): 160–162.

Logan, C. & R. O'Neill. 1970. Production of an antibiotic by Phoma exigua. Trans. Br. mycol. Soc. 55: 67–75.

Maas, P.W.T. 1965. The identity of the footrot fungus of flax. Neth. J. Pl. Path. 71: 113–121.

Magnani, G. 1966. Alterazioni de Phoma sp. su Populus nigra L. coltivato in vivaio. Agric. ital. 66: 197–199.

Magnani, G. 1969. Danni da Phoma urens Ell. et Ev. su pioppi coltivati in viviao. Publ. Centro sper. agr. for. 10 (1): 1–10.

Mathur, R.S. 1979. The Coelomycetes of India. Grover Press, Meerut, India.

Mel'nik, V.A. 1977. Opredelitel' gribov roda Ascochyta Lib. Akademiya Nauk SSSR Leningrad.

Mercier, S. & C. Metay. 1977. Le dépérissement du Laurier-rose. Horticulture Fr. 86: 9–14.

Morgan-Jones, G. & K.B. Burch. 1988. Studies in he genus Phoma. XIII. Concerning Phoma exigua var. exigua, a cosmopolitan, ubiquitous fungus on diseased and dead plant material. Mycotaxon 32: 477–490.

Neergaard, P. 1956. Nye angreb. 6 Årsberetning vedrørende frøpatologisk kontrol: 15–16.

---

[7] The complete series 'Check-list for scientific names of common parasitic fungi' compiled by G.H. Boerema and Coworkers was reprinted in 1993 with a cumulative index. Libri Botanici 10. IHW Verlag, Eching, D.

Noordeloos, M.E. & G.H. Boerema. 1988. Mycologisch-taxonomisch onderzoek. Veroorzakers van bladvlekken, bladnecroses en scheutinsterving bij oleander (Nerium oleander). Versl. Meded. Plziektenk. Dienst Wageningen 166 (Jaarb. 1987): 108–109.

Obando-Rojas, L. 1989. Contribution à l'étude de l'ascochytose du haricot Phaseolus vulgaris L.: identification de souches fongiques en cause et recherche de sources de résistance au sein du genre Phaseolus. Thesis Fac. Sci. agron. Gembloux.

Rai, M.K. & R.C. Rajak. 1993. Distinguishing characteristics of selected Phoma species. Mycotaxon 48: 389–414.

Seaver, F.J. 1922. Phyllostictales. Phyllostictaceae (pars). N. Am. Flora 6 (1).

Vegh, I., M. Bourgeois, J. F. Bousquert & J. Velastegui. 1974. Contribution à l'étude du Phoma exigua Desm., champignon pathogène associé au dépérissement de la pervenche mineure (Vinca minor L.) médicinale. Bull. trimest. Soc. mycol. Fr. 90: 121–133.

Wollenweber, H.W. & H. Hochapfel. 1936. Beiträge zur Kenntnis parasitärer und saprophytischer Pilze. I. Phomopsis, Dendrophoma, Phoma und Ascochyta und ihre Beziehung zur Fruchtfäule. Z. Parasitenk. 8: 561–605.

Žerbele, I.Y. 1971. Ob izmenchivosti gribov roda Ascochyta. Trudy Vsesoyuzn. Nauchno-Issl. Inst. Zashch. Rast. 32 ('29'): 12–21.

PERSOONIA
Volume 17, Part 3, 457–463 (2000)

NOTULAE AD FLORAM AGARICINAM NEERLANDICAM – XXXVII
Notes on Agaricus section Arvenses

MARIJKE M. NAUTA

Nationaal Herbarium Nederland, Universiteit Leiden branch, P.O. Box 9514,
2300 RA Leiden, The Netherlands

Nomenclatural and taxonomical notes are given on species of *Agaricus* section *Arvenses*, together with a key to the accepted species occurring in the Netherlands and adjacent regions. Two new combinations, *Agaricus osecanus* var. *squarrosipes* (Bon & Collin) Nauta and *Agaricus urinascens* var. *excellens* (F. Møller) Nauta are made. A new variety of *Agaricus sylvicola*, var. *squarrosus* Nauta, is described.

In the last few years the species of genus *Agaricus* L. occurring in the Netherlands and adjacent regions have been revised for the Flora agaricina neerlandica. Since the excellent work of Møller (1950, 1952), no revision has been carried out in north western Europe. The present research has revealed that more names exist than species, and a number of taxa have been synonymised. Also, some names which are in use at present have proved to be homonyms or superfluous, and some name changes have become necessary.

In these notes a key to the species and nomenclatural and taxonomical notes are given for section *Arvenses*. Extensive descriptions of the species can be found in the Flora agaricina neerlandica volume 5 (Noordeloos et al., in press).

Agaricus section **Arvenses** Konr. & M., Agaricales I (1949) 104

Surface of pileus yellowish on handling, especially on drying; Schaeffer-reaction on pileus orange, rarely doubtful; stipe annulate; annulus persistent, rarely fragile, with remnants of universal veil as thick flocks or warts on underside; context not discolouring or discolouring slightly yellowish or orange to pinkish in cut basidiocarps; KOH-reaction in context usually positive and yellow; cheilocystidia present, catenate, forming sterile layer around lamella-edge (absent in some taxa not occurring in the Netherlands); spores > 5.5 µm.

KEY TO THE SPECIES OCCURRING IN THE NETHERLANDS AND ADJACENT REGIONS

1. Pileus with yellow to brown scales on paler background; stipe often rooting; cheilocystidia in protuberant clusters and frequently of irregular form; average spore size 8.2–8.8 × 5.5–5.8 µm . . . . *A. augustus*
1. Pileus white to yellowish or yellowish brown, if scales present these are mostly concolorous; stipe not rooting; cheilocystidia not in protuberant clusters; average spore size 6.0–10.7 × 4.1–7.2 µm 2
   2. Average spore size 10.1–10.7 × 6.5–7.2 µm; basidiocarps robust; smell soon unpleasant . . . . *A. urinascens*
   2. Average spore size < 9.5 × 6.0 µm; basidiocarps gracile to robust; smell usually pleasant, like almonds or anise 3

3. Spores 9.0–9.5 × 5.0–5.5 µm; pileus with appressed coarse scales *A. arvensis* var. *macrolepis*
3. Spores < 9.0 µm; pileus without coarse squamules, at most squamulose 4
    4. Average spore size 7.7–8.6 × 5.3–5.9 µm 5
        5. Robust basidiocarps; pileus > 120 mm; stipe usually floccose-squamulose below annulus, bulbous, 100–200 × 20–30 mm (–45 mm at base); mostly in woods .... *A. macrocarpus*
        5. Basidocarps more gracile; pileus usually < 120 mm; stipe at most fibrillose below annulus, at most subbulbous, 55–120 × 10–20 mm (occasionally up to 34 mm at base); mostly in grassland .... *A. arvensis*
    4. Average spore size 6.0–7.5 × 4.1–5.3 µm 6
        6. Basidiocarps gracile, quickly yellowing; annulus usually fragile; average spore size 6.0–6.7 × 4.1–4.7 µm; cheilocystidia globose to clavate *A. sylvicola*
        6. Basidiocarps gracile or robust, slowly and often faintly yellowing; annulus thick, persistent; average spore size 6.5–7.5 × 4.5–5.3 µm; cheilocystidia globose to clavate, in part utriform 7
            7. Stipe cylindrical to rarely subbulbous, (65–)80–120 × 15–28 mm; pileus usually plano-convex, sometimes irregular, at first often minutely fibrillose-floccose, later smooth, 80–175 mm; average spore size 6.8–7.5 × 4.8–5.3 µm; usually in grasslands .... *A. osecanus*
            7. Stipe clavate to bulbous, 50–80 × 8–18 mm, at base 20–26 mm wide; pileus regularly convex, often entirely fibrillose-floccose to squamulose, 65–95 mm; average spore size 6.5–7.2 × 4.5–5.0 µm; in woods *A. pseudoumbrella*

NOTES ON THE ACCEPTED TAXA

Agaricus arvensis Schaeff., Fung. Bavariae (1774) 73

Psalliota arvensis (Schaeff.) Kumm., Führ. Pilzk. (1871) 74. — *Psalliota fissurata* F. Møller, Friesia 4 (1952) 165; *Agaricus fissuratus* (F. Møller) F. Møller, Friesia 4 (1952) 204. — *Psalliota leucotricha* F. Møller, Friesia 4 (1952) 159; *Agaricus leucotrichus* (F. Møller) F. Møller, Friesia 4 (1952) 204.

Excluded. *Agaricus arvensis* sensu Cooke, Ill. Brit. Fungi (1885) pl. 523 (= *Agaricus osecanus*).

KEY TO THE VARIETIES

1. Pileus usually smooth; stipe cylindrical to subclavate, at most fibrillose-squamulose below annulus; spores 7.0–9.0(–9.5) × 5.0–6.0(–6.5) µm .... var. *arvensis*
1. Pileus with coarse squames; stipe with abrupt bulb, below annulus floccose-squamose; spores 9.0–9.5 × 5.0–5.5 µm .... var. *macrolepis*

The name *Agaricus arvensis* was not sanctioned by Fries, since he did not accept it as an independent species, but regarded it merely as a synonym of *A. campestris* (Fries, 1821, 1832). The author-citation "Schaeff.: Fr.", often found in literature, is therefore incorrect.

Agaricus fissuratus is considered conspecific with *A. arvensis*. Although forms with an ochraceous, fissurate cap which match the original description of *A. fissuratus* are found in the Netherlands, these are probably ecological modifications, caused by weather or habitat. Likewise, several intermediate forms can be found between *A. leucotrichus*, in its typical form with an entirely fibrillose-squamulose pileus, and *A. arvensis*, with a smooth pileus. It is not unlikely, however, that in the future advanced methods will reveal more taxa within the variable *A. arvensis*.

Agaricus arvensis var. **macrolepis** Pilát & Pouz., Acta Mus. nat. Prag. 7 B-1 (1951) 134 (as *A. macrolepsis*)

Agaricus arvensis subsp. *macrolepis* (Pilát & Pouz.) Bohus, Ann. Hist.-Nat. Mus. Natl. Hung. 81 (1989) 41.

Selected description. Pilát, Acta Mus. nat. Prag. 7 B-1 (1951) 87–90.

Pileus up to 110 mm, white at first, later ochraceous with rusty tinge, covered with appressed coarse squamules. Stipe 70–110 mm, annulate, with abrupt bulb with flattened underside, white, yellowish on handling, below annulus floccose-squamulose. Context discolouring yellow on damaging. Smell like anise. Spores 9–9.5 × 5–5.5 µm (according to Pilát, 1951).

Habitat & distribution — In spruce forests, described from the Czech Republic, probably more widespread. Not yet recorded for the Netherlands.

Agaricus arvensis var. *macrolepis* Pilát & Pouz. differs from var. *arvensis* in the coarsely squamose surface of the pileus, abruptly bulbous stipe, floccose-squamose surface of the stipe below the annulus, and the larger spores. The taxonomical status of this variety needs further consideration.

Agaricus augustus Fr., Epicr. (1838) 212

Psalliota augusta (Fr.) Quél., Champ. Jura Vosges (1872) 255; *Pratella augusta* (Fr.) Gillet, Hyménomycètes (1878) 561. — *Agaricus perrarus* S. Schulz., Verh. zool. bot. Ges. Wien 29 (1880) 493; *Psalliota perrara* (S. Schulz.) Bres., Fungi trident. 1 (1887) 82; *Agaricus augustus* var. *perrarus* (S. Schulz.) Bon & Cappelli, Doc. mycol. 13 (52) (1983) 16. — *Agaricus peronatus* Mass., Brit. fung.-fl. 1 (1892) 415. [non *Psalliota peronata* Richon & Roze, Atl. Champ. comest. vén. (1885) pl. VII, fig. 13–16.]

Misapplied. Agaricus subrufescens Peck sensu J. Lange, Fl. agar. dan. IV (1939) 55.

Agaricus perrarus S. Schulz. is considered a separate species by some authors on account of the more yellow colours of the pileus and the supposedly bigger spores. However, all transitions between the typical *A. augustus* with a brown squamose pileus and the yellow variant have been found, and no difference in spore size could be established. The very pale-coloured form which was provisionally named var. *alba* nom. prov. by Moser (1967) is sometimes found, but seems to be without taxonomical importance.

Small fruit-bodies of *A. augustus* can sometimes superficially resemble large fruit-bodies of *A. arvensis* var. *macrolepis*. Fruit-bodies of the latter taxon are white to ochraceous, have a bulbous stipe instead of a rooting stipe, a stronger odour of anise, and narrower spores. Cheilocystidia of *A. augustus* are usually present in protuberant clusters.

Agaricus osecanus Pilát, Acta Mus. nat. Prag. 7 B-1 (1951) 133

Psalliota nivescens F. Møller, Friesia 4 (1952) 155; *Agaricus nivescens* (F. Møller) F. Møller, Friesia 4 (1952) 204. — *Psalliota nivescens* var. *parkensis* F. Møller, Friesia 4 (1952) 158; *Agaricus nivescens* var. *parkensis* (F. Møller) F. Møller, Friesia 4 (1952) 204.

According to Møller (1952), *A. nivescens* var. *parkensis* (F. Møller) F. Møller differs from the typical variety of *A. nivescens* in the more gracile stipe, smaller pileus, and occurrence in woods. This matches the description of *A. osecanus* Pilát rather well, and the two names are considered synonyms. No clear line could be drawn, however, between a form with smaller fruit-bodies occurring in woods and a form with larger fruit-bodies occurring in grasslands, and these forms are therefore not distinguished as subspecific taxa.

According to Møller (1952) *A. nivescens* and *A. osecanus* differ in spore size: *A. nivescens* 5–6(–7) × 4–4.5(–5) µm, *A. osecanus* 7–7.5 × 5–5.5 µm. The collections studied, however, showed one continuous range of spores between 6.5–8 µm. Original material of Møller's from C of *A. nivescens* revealed larger spores than given by Møller (1952), viz. 6.6–7.5 × 4.9–5.4 µm (pers. comm. M. Brand), almost entirely within the range of those given for *A. osecanus*.

KEY TO THE VARIETIES

1. Stipe below annulus smooth to longitudinally striate, only near base with scattered squames . . . . var. *osecanus*
1. Stipe below annulus squarrose . . . . var. *squarrosipes*

Agaricus osecanus var. **squarrosipes** (Bon & Collin) Nauta, *comb. nov.*

Basionym: *Agaricus nivescens* var. *squarrosipes* Bon & Collin, Doc. mycol. 17 (67) (1987) 11.
Selected descriptions and figures. Collin, Bull. Soc. mycol. Fr. 109 (1993) pl. 272; Grilli, Micol. Veg. Medit. 9 (1994) 3–8.

Differing from the typical variety in the stipe which is clearly, whitely squarrose below the annulus.

Habitat & distribution — In roadside verges, parks, deciduous woods, on relatively nutrient-rich soil. Very rare in the Netherlands. Also in France and in Italy.

Agaricus pseudoumbrella Bohus, Mikol. Közl. 34 (1995) 26

Agaricus arvensis var. *umbrelloideus* Bohus, Ann. Hist.-Nat. Mus. Natl. Hung. 66 (1974) 82.
Selected description. Bohus, Mikol. Közl. 34 (1995) 26.

Agaricus pseudoumbrella is recognized by the regular convex, slowly yellowing pileus, and the conspicuously bulbous stipe. It is very rare in the Netherlands and only found in the southern part. It can be mistaken for *A. sylvicola* from which it differs in the hardly yellowing pileus and slightly bigger spores and *A. osecanus* from which it differs in the bulbous stipe and the usually fibrillose-squamulose pileus surface. It is rare but widespread in eastern Europe.

Agaricus sylvicola (Vittad.) Peck, Ann. Rep. State Bot. 23 (1872) 97 (as *silvicola*)

Agaricus campestris var. *sylvicola* Vittad., Descr. fung. mang. (1832) 213; *Psalliota sylvicola* (Vitt.) Richon & Roze, Atl. Champ. comest. vén. (1885) pl. VII, fig. 13–16. — *Pratella flavescens* Gillet, Hyménomycètes (1878) 564; *Agaricus flavescens* (Gillet) Britz., Ber. naturh. Ver. Augsburg 27 (1883) 168. — *Agaricus essettei* M. Bon, Doc. mycol. 13 (49) (1983) 56 [nom. nov. for *Agaricus abruptibulbus* Peck sensu auct. eur.].

Misapplied. Agaricus abruptibulbus Peck sensu auct. eur.

Agaricus essettei is often regarded as a separate species, differing from *A. sylvicola* in the stipe with a more abrupt, marginate bulb and slightly larger spores. Since all intermediate forms could be found *A. essettei* is considered conspecific with *A. sylvicola*.

KEY TO THE VARIETIES

1. Stipe below annulus fibrillose, towards base sometimes minutely squamulose var. *sylvicola*
1. Stipe below annulus strikingly squarrose .... var. *squarrosus*

Agaricus sylvicola var. **squarrosus** Nauta, *var. nov.*

A varitate typica stipite distincte squarroso infra annulum differt.

Holotypus: The Netherlands, Noordoostpolder, Kuinderbos, 1 Sept. 1980, *A.M. Brand 8434* (L 989.085-375).

Differing from the typical variety in the stipe which is distinctly squarrose below the annulus.

Habitat & distribution — In deciduous and coniferous woods on rich soil. Very rare in the Netherlands (Bloemendaal; Kuinderbos, Noordoostpolder; estate Oosterhout, Nijmegen), but probably more widespread. Not yet known outside the Netherlands.

Agaricus macrocarpus (F. Møller) F. Møller, Friesia 4 (1952) 204

Psalliota macrocarpa F. Møller, Friesia 4 (1952) 153.

Because of the very big, robust fruit-bodies, *Agaricus macrocarpus* can sometimes be mistaken for *A. urinascens*. It is distinguished from this species by its smaller spores, and the more bulbous, less squamulose stipe. *Agaricus macrocarpus* is distinguished from *A. sylvicola* by its more robust fruitbodies and larger spores, from *A. arvensis* by its larger, more robust fruit-bodies and bulbous stipe.

Agaricus urinascens (Schaeff. & F. Møller) Sing., Lilloa 22 ('1949' 1951) 431

Psalliota urinascens Schaeff. & F. Møller, Ann. mycol. 36 (1938) 79. — *Psalliota arvensis* subsp. *macrospora* Schaeff. & F. Møller, Ann. mycol. 36 (1938) 78; *Agaricus macrosporus* (Schaeff. & F. Møller) Pilát, Acta Mus. nat. Prag. 7 B-1 (1951) 78 [nom. illeg., later homonym of *Agaricus macrosporus* Mont., Annls Sci. nat., Bot. 8 (1837) 370 = *Lentinus*]; *Psalliota macrospora* (F. Møller & Schaeff.) F. Møller, Friesia 4 (1952) 181; *Agaricus albertii* M. Bon, Doc. mycol. 18 (72) (1988) 63 [nom. nov. for *Agaricus macrosporus* (Schaeff. & F. Møller) Pilát]. — *Psalliota straminea* Schaeff. & F. Møller, Ann. mycol. 36 (1938) 78 (as *Psalliota staminea*); *Agaricus stramineus* (Schaeff. & F. Møller) Sing., Lilloa 22 (1951) 432 [nom. illeg., later homonym of *Agaricus stramineus* Scop., F. carn., ed. 2 (1772) 418 (= *Amanita* *phalloides*)]; *Agaricus substramineus* Courtec., Doc. mycol. 16 (61) (1985) 49 [nom. nov. for *Agaricus stramineus* (Schaeff. & F. Møller) Sing.]; *Agaricus stramineosquamulosus* Rauschert, Nova Hedwigia 54 (1992) 215 [nom. nov. for *Agaricus stramineus* (Schaeff. & F. Møller) Sing.; superfluous]; *Agaricus macrosporus* var. *stramineus* (Schaeff. & F. Møller) M. Bon, Doc. mycol. 15 (60) (1985) 25. — *Psalliota collina* Velen., Novit. mycol. nov. (1947) 82. — *Agaricus excellens* (F. Møller) F. Møller, Friesia 4 (1952) 204. — *Agaricus kuehnerianus* Heinem., Num. spec. Bull. Soc. linn. Lyon 43 (1974) 183.

KEY TO THE VARIETIES

1. Stipe short, < 100 mm long, surface below annulus floccose-squamose; pileus soon with yellowish tinges; diameter pileus/length of stipe usually > 1; in grasslands var. *urinascens*
1. Stipe longer, > 100 mm long, surface below annulus smooth and striate, towards base squamose; pileus whitish; diameter pileus/length of stipe usually < 1; in woods var. *excellens*

var. **urinascens**

This species is one of the few within the section Arvenses in which the basidiocarps sometimes show a negative Schaeffer-reaction on the surface of the pileus. The remnants of the general veil on the underside of the annulus in the form of coarse squames, together with other, microscopical, characters, provide sufficient reason to consider this species as belonging to this section.

Although *Psalliota urinascens* was originally regarded and described as a species separate from *P. macrosporus* on account of broader lamellae, disagreeable smell and a negative Schaeffer-reaction (Schaeffer & Møller, 1938), Møller himself later came to the conclusion that the name should be considered a synonym (Møller, 1952).

Agaricus substramineus is only a colour variant of *A. urinascens* without taxonomical meaning. Transitions between the darker variant with straw-coloured squames on the pileus and the white variant with concolorous squames or without squames are numerous.

Agaricus macrosporoides Bohus (1974) is a species which macroscopically resembles *A. urinascens* in many aspects, but differs in the spore size of 8–9.5 × 5.3–6.0 µm. According to Bohus (1974) it occurs in saline pastures. Although a collection has been found in the Netherlands in a meadow near the sea on the isle of Terschelling (1996, *Jalink & Nauta 7509*) which matches the original description also in microscopical characters, the taxonomical status and place of this species which only differs in spore size is too doubtful to include it as a separate taxon. Further collections are required to come to a more definitive conclusion.

Agaricus urinascens var. **excellens** (F. Møller) Nauta, *comb. & stat. nov.*

Basionym: *Psalliota excellens* F. Møller, Friesia 4 (1952) 178.

Agaricus excellens (F. Møller) F. Møller, Friesia 4 (1952) 204; *Agaricus macrosporus* subsp. *excellens* (F. Møller) Bohus, Ann. Hist.-Nat. Mus. Natl. Hung. 70 (1978) 105; *Agaricus macrosporus* var. *excellens* (F. Møller) Bohus, Ann. Hist.-Nat. Mus. Natl. Hung. 81 (1990) 41; *Agaricus albertii* var. *excellens* (F. Møller) Bohus, Ann. Hist.-Nat. Mus. Nat. Hung. 82 (1990) 51 [superfluous].

Differing from var. *urinascens* in the whiter colour of the pileus, the slender habitat with stipe longer than 100 mm and mostly longer than pileus width, and the surface of the stipe directly below the annulus which is striate or smooth instead of squamose as in var. *urinascens*.

Habitat & distribution — In coniferous and deciduous woods. Very rare in the Netherlands, but probably more widespread. Known from surrounding countries such as Denmark, Germany, and England but rare.

Although this variety is reported for the Netherlands at more localities (Chrispijn, 1995), most of the available collections could not be identified with certainty as belonging to this taxon. Either the material was too young, or a sufficient macroscopical description was lacking.

ACKNOWLEDGEMENTS

This study has been carried out for the project 'Flora agaricina neerlandica', with a fellowship granted by the 'Rijksherbariumfonds dr. Kits van Waveren'.

REFERENCES

Bohus, G. 1974. Agaricus studies, IV. Ann. Hist.-Nat. Mus. Natl. Hung. 66: 77–85.

Chrispijn, R. 1995. Agaricus. In: E. Arnolds, T. Kuyper & M. Noordeloos (eds.), Overzicht van de paddestoelen in Nederland: 50–60.

Fries, E. 1821. Systema mycologicum 1. Lund.

Fries, E. 1832. Systema mycologicum, Index. Lund.

Møller, F. 1950. Danish Psalliota species. Preliminary studies for a monograph on the Danish Psalliotae. Friesia 4: 1–60.

Møller, F. 1952. Danish Psalliota species. Preliminary studies for a monograph on the Danish Psalliotae. Part II. Friesia 4: 135–220.

Moser, M. 1967. Die Röhrlinge und Blätterpilze, 3. Aufl. In: H. Gams, Kleine Kryptogamenflora II b/2.

Noordeloos, M.E., Th.W. Kuyper & E.C. Vellinga. In press. Flora agaricina neerlandica vol. 5.

Pilát, A. 1951. The Bohemian species of the genus Agaricus. Acta Mus. nat. Prag. VII B-1: 1–142.

Schaeffer, J. & F. Møller. 1938. Beitrag zur Psalliota-Forschung. Ann. mycol. 36: 64–82.

PERSOONIA
Volume 17, Part 3, 465–471 (2000)

ADDITIONS TO COPRINUS SUBSECTION LANATULI

C.B. ULJÉ[1], F. DOVERI[2] & M.E. NOORDELOOS[3]

Two new *Coprinus* taxa in subsection *Lanatuli*, *C. candidolanatus* and *C. lagopus* var. *vacillans*, are described with an updated key to the subsection.

In 1988 an unknown *Coprinus* species was found in the Netherlands, seemingly belonging to the subsection *Lanatuli* on account of the hairy veil, microscopically composed of chains of sausage-shaped elements. However, clusters of diverticulate elements were also found in the veil, a feature that makes the taxon intermediate between the subsections *Lanatuli* Sing. and *Alachuani* Sing. This anomaly in conjunction with the fact that only a small, single collection was in our possession led us to omit the species from a recent *Coprinus* study of the subsection *Lanatuli* (Uljé & Noordeloos, 1999). Recently a large number of basidiocarps similar to those of our initial find has been collected in Italy so we now describe the new species.

A second *Coprinus* taxon, frail and 'shaky on its legs' even in the young stage, has been known to the first author for a long time, although young specimens were so difficult to find that a good collection has only been made recently. This undescribed but rather common taxon, growing in lawns and having a very supple stipe, is here considered a new variety of *C. lagopus*.

An updated key to the species of subsection *Lanatuli* is included.

Coprinus candidolanatus Doveri & Uljé, *spec. nov.* — Fig. 1

Pileus primo ovoideus usque ellipsoideus, 3–6 × 2–4 mm, demum applanatus vel etiam revolutus, 6–12 mm latus, velo albo niveo, fibrilloso-lanato, in media parte denso, in parte extrema in suberectas fibrillas dehiscente omnino obductus. Cuticula in primordiis albidula, postea cinerascens in medio pileo castanea, radialiter fissurata. Lamellae ascendentes, densae, breves, ex albo nigricantes, cum albidiore margine. Stipes 20–60 × 0.8–1.2 mm, cylindratus, filiformis, alboniveus, fibrillosus, haud bulbosus, ad basim angustior at haud radicans. Odor nullus.

Sporae 7.3–10.7 × 4.8–7.2 µm, in adverso visu ellipsoideae vel ovoideae, perraro subcylindratae, a latere subapplanatae, laeves, fuscobadiae, cum poro germinativo medio, 1.3–1.5 µm lato. Basidia 18–34 × 7–10 µm, tetraspora, trimorpha, a 4–5 pseudoparaphysibus cincta. Cheilocystidia 22–70 × 17–30 µm, (sub)globosa, ovoidea, ellipsoidea, oblonga vel (sub)utriformia. Pleurocystidia 40–90 × 18–30 µm, ellipsoidea, ovoidea, oblonga, (sub)utriformia vel subcylindrata. Pileipellis cylindratis, ellipsoideis vel subglobosis, 10–60 × 10–25 µm, parallelis hyphis instructa. Velum ex duplici specie se ostendens, et contextis, subtilibus, incrustantibus, haud diverticulatis, 25–150 × 15–45 µm, cylindratis vel ellipsoideis vel etiam subglobosis hyphis, et parvioribus, 2–10 µm latis, haud contextis, subtilibus, valde curtis atque diverticulatis, cylindratis vel etiam (sub)globosis hyphis compositum. Fibulae absentes. Ex fimo cervino atque ovino crescens.

---

[1] Van Dijkstraat 21, 2405 XE Alphen aan den Rijn, The Netherlands.

[2] Via Baciocchi 9, 57126 Livorno, Italy.

[3] Nationaal Herbarium Nederland, Universiteit Leiden branch, P.O. Box 9514, 2300 RA Leiden, The Netherlands.

Holotypus: 'Italy, Ferrara, Mesola wood, on deer dung in culture, 13 Apr. 1999, *A. Bizzi & G. Zecchin* (L)'.

Etymology: candidus, white and lanatus, woolly, referring to the white and woolly veil.

Pileus 3–6 × 2–4 mm when still closed, 6–12 mm when expanded, ovoid to ellipsoid, turning applanate at maturity or even revolute at deliquescence; cuticle whitish in early stages, later on greyish with pale ochre to brown disc, slightly grooved up to the centre, fully covered with a fibrous-woolly, snow-white veil, which appears crowded at the disc but at the periphery splits up in separate fibrils, which are slightly upturned at their ends. Lamellae, L = 14–22, l = 0–3, ascending, free, narrow, rather crowded, white in the early stages, later on blackening, with a pale edge. Stipe 20–60 × 0.8–1.2 mm, cylindrical-filiform, often wavy, neither tapering towards the apex nor bulbous, slightly narrowed near the base but without a true pseudorhiza, snow-white, at first covered with many veil fibrils, later on smooth. Context inconspicuous, devoid of particular smell and taste.

Spores [120, 4, 2] 7.3–10.7 × 4.8–7.2 µm; Q = 1.25–1.75; av. Q = 1.45–1.55; av. L = 8.7–9.6 µm, av. B = 5.8–6.5 µm, ellipsoid or ovoid, exceptionally subcylindrical in frontal view, sometimes slightly flattened at one side in side view, rounded at the base and apex, smooth, dark reddish brown in water, with central, 1.3–1.5 µm wide germ pore. Basidia 18–34 × 7–10 µm, 4-spored, trimorphous: 1) claviform, 2) spheropedunculate, and 3) subcylindrical with a distinct median narrowing (the longest ones). Each basidium surrounded by (3–)4–5(–6) pseudoparaphyses. Pleurocystidia 40–90 × 18–30 µm, ellipsoid, ovoid, oblong, (sub)utriform or subcylindrical, with a short basal peduncle. Cheilocystidia 22–70 × 17–30 µm, abundant, (sub)globose, ovoid, ellipsoid, oblong or (sub)utriform, with a short basal peduncle. Pileipellis a cutis, made up of cylindrical, ellipsoid or subglobose, parallel, 10–60 long and 10–25 µm wide elements. Veil made up of two kinds of hyphoid elements: the former arranged in hardly separable chains of cylindrical, ellipsoid or even subglobose elements, mainly thin-walled and hyaline, sometimes slightly thick-walled (walls up to 0.5 µm thick), in part rather strong yellowish encrusted, 25–150(–250) × 15–45 (–60) µm, not diverticulate, very rarely branched, with subglobose, ellipsoid, subcylindrical or fusoid terminal elements; the latter kind of veil made up of much narrower, 2–10(–15) µm wide elements, not arranged in chains, easily separable from each other, thin-walled, densely diverticulate, with up to 10 µm long, finger-like diverticula. Some to many of such elements very short and (sub)globose. Veil on the stipe made up especially of these diverticulate hyphae (diverticula up to 17 µm long, sometimes branched), but often also with remnants of '*Lanatuli*'-veil. Clamp-connections absent.

Habitat & distribution — On pure dung of deer and sheep, solitary or subfasciculate. Very rare. Only known from one locality in Italy and one in the Netherlands.

Collections examined. ITALY: Ferrara, Mesola wood, at least one hundred gregarious or crowded or even fasciculate specimens on fallow deer (*Dama dama*) dung in culture, 13 Apr. 1999, *A. Bizzi & G. Zecchin*, holotype (L), isotype (herb. MCVE no. 794). — THE NETHERLANDS: prov. Limburg, Bemelen, Bemelerberg, 3 Aug. 1988, *E.C. Vellinga* (coll. *Uljé 949*, L).

The two kinds of veil elements, the small basidiocarps, the habitat on dung, the rather broad spores with an average quotient of 1.45–1.55 and the absence of clamp-connections are the main characters to recognize *C. candidolanatus*. *Coprinus pseudoradiatus* Kühn. & Joss. ex Watling and *C. cinereus* (Schaeff.: Fr.) S.F. Gray are the other two coprophilous

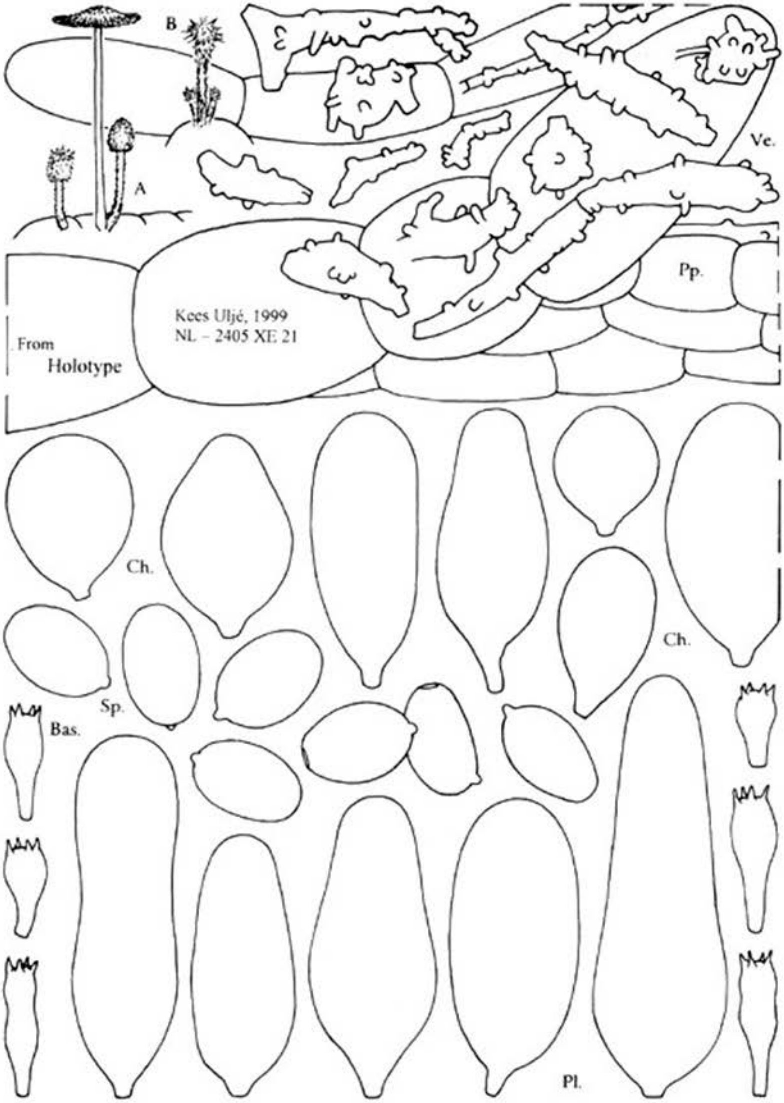


Fig. 1. *Coprinus candidolanatus.* All figures from holotype.

species with up to c. 11 µm long spores, but the former has narrower spores with an average quotient >1.6, while the latter possesses larger basidiocarps. Moreover, both these species, in contrast to our own, are provided with clamp-connections and only one kind of veil, that is to say with chains of sausage-shaped, non-diverticulate, elements.

Coprinus lagopus var. **vacillans** Uljé, *var. nov.* — Fig. 2, Plate 9

Pileus primo usque ad 18 × 8 mm, post expansionem usque ad 32 mm latus, albidulus at celeriter cinereus et in media parte sufflavus vel pallide ochraceus. Velum album, fibrillosum-floccosum, in suberectas fibrillas dehiscens, sicut pileus celeriter evanescens. Lamellae densae, ex albo nigricantes. Stipes 60–150 × 1–3 albus, primo ex fibrilloso-floccoso velo dense tectus, cavus, fragillimus, vacillans atque celeriter proclivis; stipitis basis clavata, usque ad 4 mm lata.

Sporae 9.6–13.8 × 6.3–8.3 µm, ellipsoideae vel ovoideae, interdum oblongae, satis vel aliquando valde fuscobadiae, cum poro germinativo medio, circiter 2 µm lato. Basidia 21–37 × 8–11 µm, tetraspora, a 3–6 pseudoparaphysibus cincta. Pleurocystidia 50–100 × 25–45 µm, (sub)utriformia, oblonga, ellipsoidea vel subcylindrata. Cheilocystidia 40–95 × 22–40 µm, (sub)utriformia, oblonga, ellipsoidea vel (sub)globosa. Pileipellis oblongis, saepe brevibus hyphis instructa. Velum contextis hyphis, 25–125 × 8–40 µm, compositum. Stipitis cortex 130–240 µm crassus. Fibulae adsunt. In secatis herbidis solitarius vel aliquando gregarius crescens.

Holotypus: 'Alphen aan den Rijn, Zegersloot-Zuid, 12 June 1999, *C.B. Uljé 1286* (L)'.

Etymology: vacillans, swinging to and fro.

Pileus up to 18 × 8 mm when still closed, up to 32 mm when expanded, first whitish, soon grey with cream or pale ochre centre below a pure white, hairy-floccose veil that splits up in hairy flocks and, as well as the pileus, very soon disappears. Lamellae, L = c. 35–45, l = 0–3, crowded, free, at first white, soon grey to black. Stipe 60–150 × 1–3 mm, pure white, at first densely covered with bristly, hairy-floccose veil, hollow, very fragile and soon laying down; base up to 4 mm wide, clavate.

Spores [180, 9, 4] 9.6–13.8 × 6.3–8.3 µm; Q = 1.35–2.05, av. Q = 1.55–1.80; av. L = 10.7–12.5 µm, av. B = 6.7–7.9 µm, ellipsoid or ovoid, less frequently oblong, medium-brown, sometimes very dark red-brown, with rounded base and apex, and c. 2 µm wide, central germ pore. Basidia 21–37 × 8–11 µm, 4-spored, surrounded by 3–6 pseudoparaphyses. Pleurocystidia 50–100 × 25–45 µm, (sub)utriform, oblong, ellipsoid or subcylindrical. Cheilocystidia 40–95 × 22–40 µm, (sub)utriform, oblong, ellipsoid or subglobose. Pileipellis a cutis, made up of elongate, often short elements. Veil made up of 25–125 × 8–40 µm, hyphoid elements in chains. Wall of the stipe 130–240 µm thick. Clamp-connections present, c. 3–4 µm in diameter.

Habitat & distribution — Rather common in short-mown lawns, solitary, seldom a few together. Known only from Alphen aan den Rijn (the Netherlands), from several lawns.

Collections examined. THE NETHERLANDS: prov. Zuid-Holland, Alphen aan den Rijn, Zegersloot-Zuid, 7 June 1988, *C.B. Uljé 1280*; ibidem, 8 Sept. 1995, *C.B. Uljé*; ibidem, 10 June 1999, *C.B. Uljé*; ibidem, 12 June 1999, *C.B. Uljé 1286* (holotype, L); Zoetermeer, van Tuylpark, 10 Aug. 1999, *C.B. Uljé*.

The very fragile basidiocarps, the habitat, the usually somewhat less slender spores (often slightly wider than broader) than in *C. lagopus* var. *lagopus* Fr.: Fr., and the thin wall of the stipe are the main characters by which to recognize *C. lagopus* var. *vacillans*. It is difficult to collect young basidiocarps in the field by reason of the very rapid developing and wilting of the pileus. Although the pure (silvery) white stipe is very fragile, it does not disappear as quickly as the pileus and stipes can be found, often in great number, lying on the ground with a black, snotty remnant of the pileus at their extremities. The stipe bends down as soon as it starts to grow, even while the pileus is still closed. Microscopically the wall of the stipe is often thinner than 200 µm, though sometimes reaching 240 µm, whereas in *C. lagopus* var. *lagopus* it usually lies between 200 and 450 µm. Nonetheless, most microscopical features are rather similar to *C. lagopus* so we prefer at the moment to describe it as a new variety rather than to erect a new species.

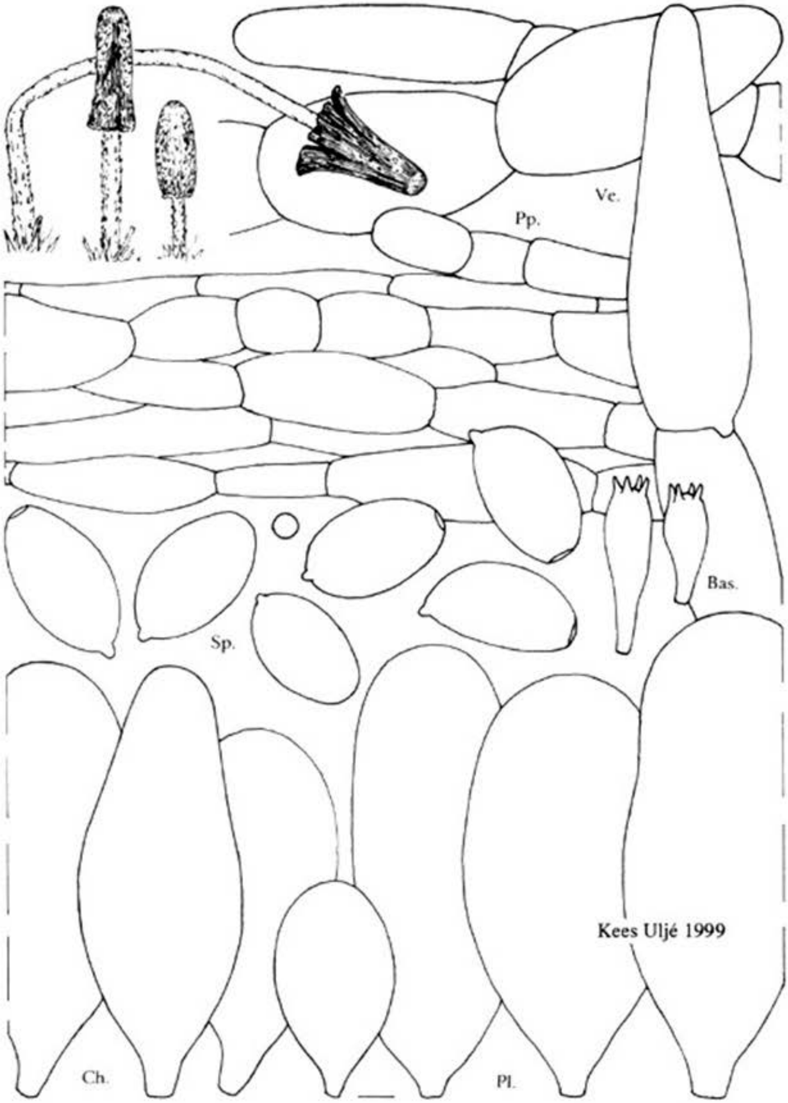


Fig. 2. *Coprinus lagopus* var. *vacillans*. All figures from holotype.

REVISED KEY TO THE SPECIES OF SUBSECTION LANATULI

(For nomenclature and full descriptions see Uljé & Noordeloos, 1999)

1. Spores with rounded-conical nodules .... *C. calosporus*
1. Spores smooth.
   2. Basidia 2-spored.
      3. On dung; veil with some ellipsoid or subglobose elements; average spore breadth < 7.8 µm .... *C. bicornis*
      3. On compost or saw-dust; veil without ellipsoid or subglobose elements; average spore breadth > 7.8 µm .... *C. scobicola*
   2. Basidia 4-spored.
      4. Growing on or near *Ammophila arenaria* in yellow outer dunes .... *C. ammophilae*
      4. Habitat otherwise.
         5. Veil of centre of pileus thick-walled, wall up to 1 µm thick ..... *C. pachydermus*
         5. Veil of centre of pileus thin-walled, wall < 0.5 µm thick.
            6. Veil cream, ochre, yellow, orange or orange-red.
               7. Pileus with beautiful rust-coloured or orange-red veil, visible at least at base of stipe, soon slimy .... *C. erythrocephalus*
               7. Veil cream, yellowish or ochre, not slimy.
                  8. Veil cream or pale ochre; spores very broadly fusiform, av. Q < 1.5; on wood, often in wounds of trees; terminal elements of veil up to c. 40 µm wide, not yellowish encrusted .... *C. spelaiophilus*
                  8. Veil distinctly yellowish or ochre; spores ellipsoid to ovoid, av. Q > 1.5; on clayey soil, mud or wood-chips; terminal elements of veil up to c. 20(–25) µm wide, strongly yellowish encrusted . . *C. ochraceolanatus*
            6. Veil white, silvery grey or grey.
               9. Average spore length < 9.2 µm.
                  10. Average spore breadth > 5.8 µm.
                      11. Medium species; spores with av. Q < 1.3; not on dung; veil with elements of one kind: sausage-shaped in chains .... *C. jonesii*
                      11. Small species; spores with av. Q > 1.3; on dung; veil with two kinds of elements: sausage-shaped and diverticulate *C. candidolanatus*
                  10. Average spore breadth < 5.8 µm.
                      12. On dung or mixed dung; spores with av. Q > 1.6; spores ellipsoid, tending to cylindrical .... *C. pseudoradiatus*
                      12. On wood-chips, soil mixed with pieces of wood or vegetable refuse; spores with av. Q < 1.6; spores ellipsoid, tending to rhomboid .... *C. geesterani*
               9. Average spore length > 9.2 µm.
                  13. Average spore length < 10.8 µm.
                      14. Veil whitish or greyish, hairy-floccose; spores ovoid or ellipsoid; on dung, mixed dung or compost-heaps.
                          15. Veil with one kind of elements, sausage-shaped in chains; pileus up to 30 mm when expanded; number of lamellae > 35; spores 8.4–11.8 × 5.8–7.8 µm .... *C. cinereus*

- 15. Veil with two kinds of elements; pileus up to 12 mm when expanded; number of lamellae < 30; spores 7.3–10.7 × 4.8–7.2 µm . . . . *C. candidolanatus*
- 14. Veil whitish, cream or pale ochre, in small flocks; spores very broadly fusiform; in wounds of often living trees or on stumps *C. spelaiophilus*

13. Average spore length > 10.8 µm.
  - 16. Average spore breadth > 8.2 µm . . . . *C. macrocephalus*
  - 16. Average spore breadth < 8.2 µm.
    - 17. On dung or dung mixed with straw or hay; average spore breadth > 7.8 µm; spores ellipsoid, tending to cylindrica *C. radiatus*
    - 17. On soil, often mixed with rotten pieces of wood, wood-chips, compost-heaps or vegetable refuse; average spore breadth < 7.8 µm; spores ellipsoid.
      - 18. Veil on pileus thin, cobwebby, looking silky; average spore breadth < 6.7 µm . . . . *C. krieglsteineri*
      - 18. Veil on pileus abundant, hairy fibrillose; average spore breadth > 6.7 µm.
        - 19. Stipe very fragile, bending down before pileus expands; exclusively in lawns; stipe wall < 250 µm thick . . . . *C. lagopus* var. *vacillans*
        - 19. Stipe rather firm, upright; usually on wood-chips and vegetable refuse; less frequent in lawns; stipe wall up to 450 µm thick . . . . *C. lagopus* var. *lagopus*

REFERENCE

Uljé, C.B. & M.E. Noordeloos. 1999. Studies in Coprinus V – Coprinus section Coprinus. Revision of subsection Lanatuli Sing. Persoonia 17: 165–199.

PERSOONIA
Volume 17, Part 3, 473–480 (2000)

NOTULAE AD FLORAM AGARICINAM NEERLANDICAM – XXXVIII
Leucoagaricus subgenus Sericeomyces

ELSE C. VELLINGA

University of California at Berkeley, 111 Koshland Hall # 3102, Berkeley CA 94720-3102, USA;
Nationaal Herbarium Nederland, Universiteit Leiden branch, P.O. Box 9514,
2300 RA Leiden, The Netherlands
E-mail: vellinga@uclink4.berkeley.edu; vellinga@nhn.leidenuniv.nl

Leucoagaricus crystallifer spec. nov. is described; this species was formerly known as *L. serenus* in the interpretation of Bon and other authors. *Leucoagaricus serenus* sensu Kühner is neotypified, and the following new combinations are made: *Leucoagaricus sericifer*, and *L. sericifer* f. *sericatellus*.

Leucoagaricus subg. *Sericeomyces* (Heinem.) M. Bon consists of rather elegant, mostly white species, with a dry or slightly viscid pileus covering which is made up of adnate to ascending radially arranged hyphae. The species look disconcertingly similar in the field, and only microscopical examination reveals the differences. Cheilocystidia, pileus covering, and to a lesser extent, spores, yield the best characters for identification. However, spore shape and size are very variable, in part due to the presence of 2- or 1-spored basidia. Furthermore, the number of misshapen spores is often quite high, as it is in sect. *Rubrotincti* Sing. p. p. [*L. sublittoralis* (Kühner ex Hora) Sing. and allies]. The shape of the spores changes late during the maturation process; as a result, spores which are still on the lamella when examined, might have a slightly different shape from those which have been discharged, and studied in a spore print or on the stipe or pileus surface.

Despite the facts that Bon (1993) gave an overview of all taxa published up to that date in Europe, and that several taxa have been described since (e.g. *Sericeomyces cinereopallidus* by Contu, 1994; *S. sardous* by Zecchin & Migliozzi, 1998), there still is confusion about the interpretation of names and not all collections can be assigned to a species. The name *Leucoagaricus serenus* (Fr.) Bon & Boiffard has been used for several different species; this history is here unraveled, *L. serenus* neotypified, and a second taxon currently known under that name is described as a new species.

Due to the application of phylogenetics based on sequences of ribosomal nuclear Large Subunit (LSU) and Internal Transcribed Spacer (ITS) (e.g. Hopple & Vilgalys, 1999; Moncalvo et al., 2000), systematics of the Agaricales in general and of the family Agaricaceae (Johnson & Vilgalys, 1998; Johnson, 1999; Vellinga, in prep.) are quite unsettled and turbulent. Furthermore, the trend in systematics is to arrive at a rankless classification based on phylogenetics (e.g. de Queiroz & Gauthier, 1992, 1994; Hibbett & Donoghue, 1998; Pleijel, 1999). In view of these recent developments, my preference would be to refrain from making new combinations, and from placing the new species in a genus. However, the present survey has a practical aspect in the form of a contribution to the Flora agaricina neerlandica, in which all species have to be placed in a genus. As there are strong indications that *Sericeomyces* Heinem. does not form a monophyletic group (Vellinga, in prep.), a conservative approach is taken, and *Sericeomyces* is here treated as a subgenus of *Leucoagaricus*.

The notation 'Spores [45, 3, 2]' indicates that measurements were made on 45 spores from 3 samples originating from 2 collections. The following abbreviations are used: avl (average length), avw (average width), Q (quotient of length and width), and avQ (average quotient).

All collections studied and depicted, unless stated otherwise, are deposited in the Nationaal Herbarium Nederland, Universiteit Leiden branch, The Netherlands (L).

1. **Leucoagaricus serenus** (Fr.) Bon & Boiffard — Fig. 1

Agaricus serenus Fr., Hymenomyc. Eur. (1874) 38; *Lepiota serena* (Fr.) Quél., Bull. Soc. bot. France 26 (1880) 45; *Pseudobaeospora serena* (Fr.) Locq., Bull. trimest. Soc. mycol. Fr. 68 (1952) 169; *Leucoagaricus serenus* (Fr.) Bon & Boiffard, Bull. trimest. Soc. mycol. Fr. 90 (1974) 301; *Sericeomyces serenus* (Fr.) Heinem., Bull. Jard. bot. natn. Belg. 48 (1978) 403.

Excluded. Lepiota serena sensu J. Lange, Fl. agar. dan. 1 (1935) pl. 11B (= *L. sericifer*). — *Lepiota serena* sensu A. Pears., Trans. Br. mycol. Soc. 32 (1949) 258 (= *L. pinguipes*). — *Leucoagaricus serenus* sensu M. Bon, Doc. mycol. 11 (43) (1981) 52; sensu Candusso, Riv. Micol. 33 (1990) 19; sensu Chr. Lange, Doc. mycol. 25 (98–100) (1995) 251; *Sericeomyces serenus* sensu M. Bon, Fl. mycol. Eur. 3, Lépiotes (1993) 85; sensu Migl. & Bizzi, Micol. ital. 24 (3) (1995) 80; sensu Rodríguez Armas et al., Doc. mycol. 18 (72) (1988) 67 (in all cases *L. crystallifer*).

There are four different interpretations of the name 'serenus'. Fries (1874) described it as a beautiful white mushroom, without giving any microscopic details. In this group of macroscopically extremely similar, white, non-viscid species, microscopical characters are the only differentiating characters. Lange (1935) interpreted *Lepiota serena* as a species with striking, lageniform cheilocystidia; this species is now commonly known as *Sericeomyces sericifer* (Locq.) Døssing. Kühner (1936) denounced this interpretation, and used the name 'serenus' for a species with broadly clavate cheilocystidia. This interpretation has generally been followed (Huijsman, 1943; Wichanský, 1959; Malençon & Bertault, 1970; Wuilbaut, 1986), though of course it has been used for several other species. Pearson

Fig. 1. *Leucoagaricus serenus*. Basidiocarps (× 1), spores, cheilocystidia (all from neotype, *E. C. Vellinga 1604*). Bar is 10 µm.

(1949) misinterpreted the name for a species he was later (in 1952) to describe as *L. pinguipes*, a robust species with ellipsoid spores, close to *L. leucothites* (Vittad.) Wasser. Several authors (Bon, 1981, 1993; Rodríguez Armas et al., 1988; Lange, 1995; Candusso, 1990; Migliozzi & Bizzi, 1995) gave a fourth interpretation. In their descriptions the cheilocystidia are narrowly clavate, with crystals at the apex. Rodríguez Armas et al. (1988) expressed severe doubt whether this really was *S. serenus*; this doubt was supported by Malençon (in Rodríguez Armas et al., 1988), but Bon affirmed the determination (but of course, Bon used the name *S. serenus* for this taxon). In the descriptions given by Candusso (1990), Migliozzi & Bizzi (1995), and Breitenbach & Kränzlin (1995) the cheilocystidia are rather wide, wider than in the more typical collections, and their collections might belong to a different taxon, e.g. *L. menieri* (Sacc.) Sing. Moser (1983) merged the two interpretations, as he stated that 'sterile hairs are clavate or cylindrical'. The species with narrow cystidia with crystals on the top is here described as new, viz. as *L. crystallifer*. The second species, *Leucoagaricus serenus* (Fr.) Bon & Boiffard, is neotypified here in agreement with the interpretations of Kühner (1936) and Huijsman (1943) with the following collection: 'the Netherlands, prov. Limburg, Cadier en Keer, Örenberg, 4-X-1989, *E.C. Vellinga 1604* (L)'. Its field notes and microscopical description are as follows:

Pileus 12–35 mm, when young paraboloid, later applanate with umbo, creamish at umbo, around umbo white and shiny radially fibrillose. Lamellae, in small specimen L = 32, l = (0–)1, moderately crowded, free, slightly ventricose, more or less white, creamish with age, with white finely flocculose edge. Stipe 35–45 × 1.5–3.5 mm, broadening downwards, hollow, whitish cream, with above and below annulus finely pubescent-fibrillose covering. Annulus white, ascending, cottony. Context white and dull in pileus, white and shiny in stipe. Smell not distinct, when cut like rubber component of *Lepiota cristata*-smell.

Spores [25, 2, 1] in side-view 6.7–9.1 × 3.6–4.3 µm, avl × avw = 7.7 × 4.0 µm, Q = 1.6–2.4, avQ = 1.9, oblong, oblong-amygdaloid, with rounded or slightly acute apex, dextrinoid, congophilous, with metachromatic wall in Cresyl Blue. Basidia 23–29 × 8.5–9.5 µm, 4-spored. Cheilocystidia 35–60 × 12–15.5 µm, clavate, thin-walled, with long pedicel. Pleurocystidia absent. Clamp-connections absent. Pileus covering with adnate, narrow, cylindrical, colourless hyphae, c. 3.0 µm in diameter. Stipitipellis a cutis of 3.0–5.0 µm wide cylindrical, colourless hyphae, with some, irregular, loose, slightly wider hyphae. Clamp-connections absent.

The characters of this collection fit well with the description by Kühner (1936), though his basidiocarps were slightly bigger. In most collections studied, the spores were shorter, but otherwise no differences were noted.

It is impossible to distinguish *L. serenus* from *L. crystallifer* in the field. *Leucoagaricus sericifer* and its f. *sericatellus* can also be very similar, and all four taxa may be found growing in a single wood.

The basidiocarps of both *L. serenus* and *L. crystallifer* retain a cream colour in exsiccates, and do not discolour brown on drying, like *L. sericifer* and its f. *sericatellus*.

2. **Leucoagaricus crystallifer** Vellinga, *spec. nov.* — Fig. 2

Leucoagarico sereno similissimus sed cheilocystidia anguste clavata apice crystallis obtecta.

Holotypus: 'The Netherlands, prov. Limburg, Cadier en Keer, Örenberg, 9-X-1991, *E.C. Vellinga 1762* (L)'.

Etymology: 'crystallifer' derived from the Greek, bearing crystals, referring to the crystals on top of the cheilocystidia.

Misapplied. Leucoagaricus serenus sensu M. Bon, Doc. mycol. 11 (43) (1981) 52; sensu Candusso, Riv. Micol. 33 (1990) 19; sensu Chr. Lange, Doc. mycol. 25 (98–100) (1995) 251; *Sericeomyces serenus* sensu M. Bon, Fl. mycol. Eur. 3, Lépiotes (193) 85; sensu Migl. & Bizzi in Micol. ital. 24 (3) (1995) 80; sensu Rodríguez Armas et al. in Doc. mycol. 18 (72) (1988) 67.

Pileus 15–40 mm, campanulate, expanding to plano-convex, and applanate with low umbo, with slightly inflexed margin, with cream to pale ochre coloured umbo, becoming more intensely coloured by two days after picking, around umbo white and radially short-fibrillose to silky-fibrillose, sometimes slightly squamose, with margin slightly exceeding lamellae, rarely with part of annulus attached to it. Lamellae, L = 45–70, l = 0–5, moderately crowded to very crowded, free, and often remote from stipe, sometimes anastomosing, subventricose, 1–3.5 mm wide, cream, very pale beige, with concolorous to white flocculose, rarely even, edge. Stipe 20–70 × 2.5–6 mm, broadening downwards to often bulbous base (up to 8 mm), hollow, white and shiny, lengthwise fibrillose, white-tomentose at basal part, becoming yellow with damage. Annulus white, ascending, sometimes with a very distinct cuff around stipe with a straight lower edge, and a fringed upper margin, and a narrow flaring part. Context white and dull in pileus, white and shiny in stipe. Smell of intact basidiocarp indistinct, of cut basidiocarp variably reported: fungoid, unpleasant, astringent-fungoid, slightly rubberish (like *Lepiota cristata*). Taste indistinct or absent. Spore print probably white.

Spores [10, 10, 150] in side-view 5.5–9.0 × 3.5–4.5(–5.0) µm, avl × avw = 6.3–7.7 × 3.9–4.2 µm, Q = 1.45–2.1, avQ = 1.65–1.9, varying from ellipsoid to oblong with rounded apex to oblong-amygdaloid without or with apical papilla, oblong-ovoid, ellipsoid to oblong, some with apical papilla, dextrinoid, congophilous, cyanophilous, and metachromatic in Cresyl Blue. Basidia 17–28 × 6.5–8.5 µm, 4-spored. Lamella edge sterile. Cheilocystidia

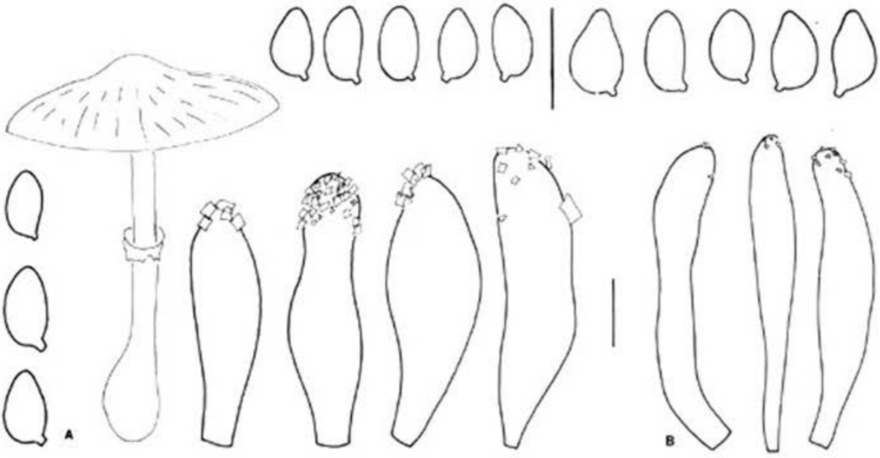


Fig. 2. *Leucoagaricus crystallifer*. Basidiocarp (× 1), spores, cheilocystidia (A. from holotype, *E.C. Vellinga 1762*; B. from *J.P.H.M. Adema*). Bar is 10 µm.

in tufts, 23–51 × 5.5–13 µm, cylindrical, cylindrical-fusiform, narrowly clavate, some with a tendency to be utriform, colourless, slightly thick-walled, with (a few without) small to big crystals at apex. Pleurocystidia not observed. Pileus covering a cutis with bundles of adnate radially arranged hyphae, 3.0–12 µm wide, with adnate to slightly ascending terminal elements with rounded apex, colourless, rarely with some pale brown intracellular pigment in lower lying wider hyphae. Stipitipellis a cutis of narrow, colourless, 2.0–4.0 µm wide cylindrical hyphae, rarely with a loose covering of wider, cylindrical and branched, colourless, hyphae. Clamp-connections absent.

Habitat & distribution — Solitary or in small groups, saprotrophic and terrestrial in humus-rich sandy and loamy soils, in deciduous woods, rather rare in the Netherlands. Sept.–Oct. Widespread in Europe.

Collections examined. THE NETHERLANDS: prov. Noord-Holland, Santpoort, Duin & Kruidberg, 19-IX-1983, *A. G. Becker*; Bloemendaal, Koningshof, 2-X-1995, *E. C. Vellinga 1944*; ibidem, 20-IX-1997, *A. G. Becker*; prov. Zuid-Holland, Wassenaar, Raaphorst, 30-IX-1989, *J. P. H. M. Adema*; prov. Limburg, Bemelen, Bemelerberg, 22-VIII-1993, *J. C. Lennie* (coll. *E. C. Vellinga 1896*); Cadier en Keer, Örenberg, 9-X-1991, *E. C. Vellinga 1762* (holotype, L); Elsloo-Geulle, Bunderbos, 7-IX-1996, *E. C. Vellinga 2019*; Gronsveld, Savelsbos, 22-IX-1979, *Th. W. Kuyper 1308*. — GERMANY: Baden-Württemberg, Gottenheim, Wasenweiler Wald, 3-IX-1998, *H. A. Huijser 6112* and *s. n.* (herb. Huijser).

Leucoagaricus crystallifer was commonly known as *L. serenus* (see also discussion under the latter, and the misapplied names). However, it is easily separated from that species by the narrow, slightly thick-walled cheilocystidia with a distinct crystalliferous apex.

Sericeomyces cinereopallidus Contu comes close, has also relatively narrow, but thick-walled, cheilocystidia with coarse crystals at the top, but the pileus is pale grey, at least at centre, and viscid (Contu, 1994; Migliozzi, 1998).

Three species, viz. *Leucoagaricus menieri*, *L. subvolvatus* (Mal. & Bert.) M. Bon, and *Sericeomyces singeri* M. Bon ex Contu & Signor., are closely related to *L. crystallifer*, as they all have crystals on the cystidia. All three species were described from sandy habitats in the Mediterranean region; they all have a bulbous base, with volval remnants present in *L. menieri* and *L. subvolvatus*, and they differ from each other in spore shape and the extent to which the pileus covering is differentiated (Bon, 1993; Signorello & Contu, 1998). These characters, and the shape of the cystidia, differentiate them from *L. crystallifer*.

Leucoagaricus crystallifer is not uncommon in the Netherlands, and has been collected both in the dune area, and in southern Limburg. Surprisingly, Kelderman (1994) did not describe the present species in his overview of southern Limburg species.

3. **Leucoagaricus sericifer** (Locq.) Vellinga, *comb. nov.* — Fig. 3

Basionym: *Pseudobaeospora sericifera* Locq., Bull. trimest. Soc. mycol. Fr. 68 (1952) 169, nom. nov. for *Lepiota sericea* (Cool) Huijsman, Meded. Ned. mycol. Vereen. 28 (1943) 46, non *L. sericea* Mass. (1912); *Lepiota cristata* var. *sericea* Cool, Meded. Ned. mycol. Vereen. 12 (1922) 23; *Leucoagaricus sericeus* (Cool) Bon & Boiffard in M. Bon, Doc. mycol. 9 (35) (1979) 40; *Sericeomyces sericeus* (Cool) Contu, Cryptog., Mycol. 12 (1991) 6; *Lepiota sericata* Kühn. & Romagn., Fl. anal. Champ. sup. (1953) 405, superfl. nom. nov. for *Lepiota sericea* (Cool) Huijsman; *Sericeomyces sericatus* (Kühn. & Romagn.) Heinem., Bull. Jard. bot. natn. Belg. 48 (1978) 404; *Lepiota sericifera* (Locq.) Locq., Friesia 5 (1956) 294; *Sericeomyces sericifer* (Locq.) Døssing in Knudsen & Hansen, Nordic J. Bot. 11 (1991) 481.

Despite the complicated nomenclatorial history of the name 'sericifer', the combination in *Leucoagaricus* had not been made; this lacuna is now filled.

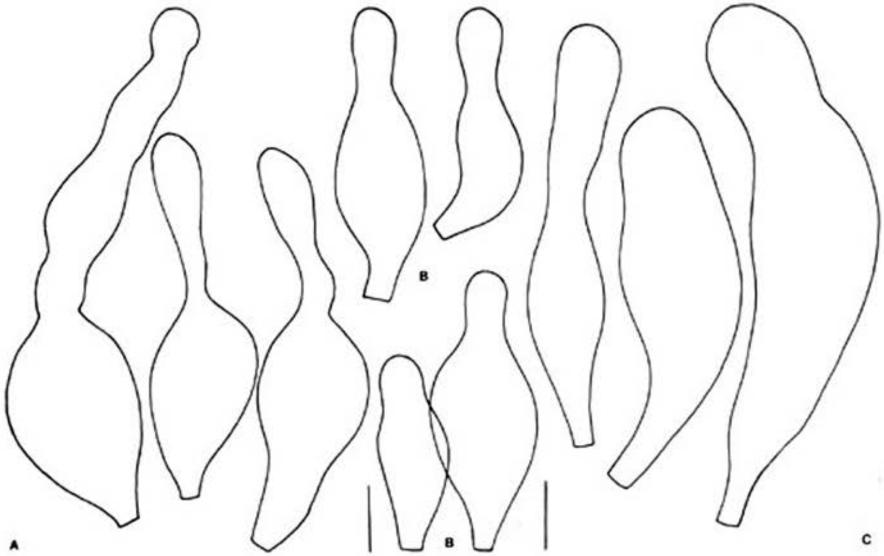


Fig. 3. *Leucoagaricus sericifer* f. *sericifer*. Cheilocystidia (A. from *E.C. Vellinga 2116*; B. from *Jalink & Nauta 6208*; C. from *A.A.R. de Meijer 604*). Bar is 10 µm.

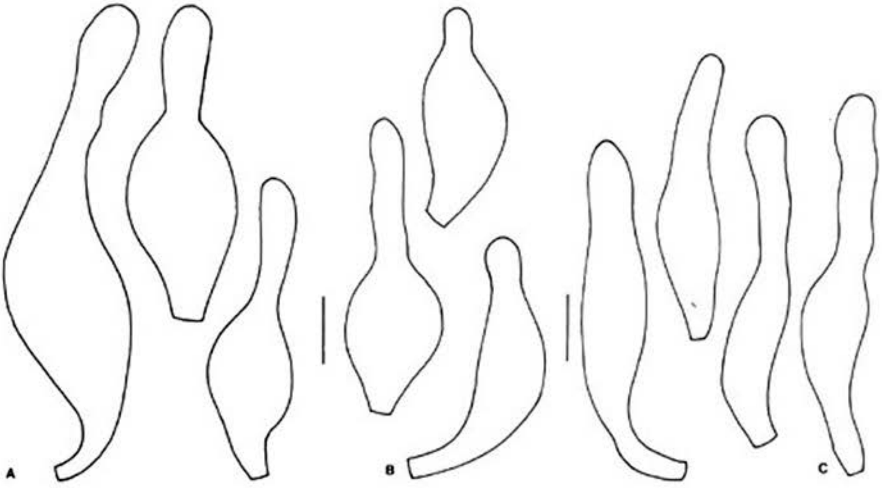


Fig. 4. *Leucoagaricus sericifer* f. *sericatellus*. Cheilocystidia (A. from *E.C. Vellinga 1929*; B. from *E.C. Vellinga 2013*; C. from *C. Bas 8842*). Bar is 10 µm.

4. **Leucoagaricus sericifer** f. **sericatellus** (Malenç.) Vellinga, *comb. & stat.* nov. — Fig. 4

Basionym: *Lepiota sericatella* Malenç. in Mal. & Bert., Fl. Champ. sup. Maroc 1 (1970) 152; *Leucoagaricus sericatellus* (Malenç.) M. Bon, Doc. mycol. 9 (35) (1979) 40; *Sericeomyces sericatellus* (Malenç.) M. Bon, Bull. trimest. Soc. mycol. Fr. 96 (1980) 172; *Sericeomyces sericatus* var. *sericatellus* (Malenç.) Heinem., Bull. Jard. bot. natn. Belg. 48 (1978) 404.

This taxon has been considered a species by some authors (Malençon in Malençon & Bertault, 1970; Bon, 1980, 1981, 1993), by others a variety of *L. sericifer* (Heinemann, 1978). The main characters to separate the two taxa are the number of spores per basidium (4 in *L. sericifer*, and 2 in *L. sericatellus*), and the shape of the cheilocystidia: big, and distinctly lageniform with a long neck and a slightly widened capitulum in *L. sericifer*, and relatively small and lacking a widened capitulum in *L. sericatellus*. Bon (1980) warned of the existence of variants with a high number of 2-spored basidia in *L. sericifer*. The collections examined for this study yielded a huge variation in shape and size of the cheilocystidia, combined with 2-spored and 4-spored basidia (Figs. 3 & 4). Collections exist with 4-spored basidia and relatively small cystidia, alongside collections with 2-spored basidia and big 'typical' sericifer cheilocystidia, and all intermediates. Crystals on the cystidia were never found, though are reportedly present in *L. sericifer* (e.g. Kelderman, 1994). Another difference between the two taxa is said to be the size of the trama elements, relatively narrow in *L. sericifer*, and relatively broad in *L. sericatellus*.

Both *L. sericifer* f. *sericifer* and f. *sericatellus* show the typical brown discoloration of the basidiocarps on drying; exsiccates are easily distinguished from *L. serenus* and *L. crystallifer*.

ACKNOWLEDGEMENTS

Discussions with Henk A. Huijser on lepiotaceous fungi have always been stimulating and insightful. Piet H. Kelderman sent me several interesting collections. Pieter Baas and Machiel E. Noordeloos gave comments on an earlier draft of this paper. Jan Frits Veldkamp corrected the Latin diagnosis and John Lennie proposed some linguistic changes.

REFERENCES

Bon, M. 1980. Agaricales rares ou nouvelles de la zone maritime Picarde (5ᵉ supplément). Bull. trimest. Soc. mycol. Fr. 96: 155–174.

Bon, M. 1981. Clé monographique des 'Lépiotes' d'Europe. Doc. mycol. 11 (43): 1–77.

Bon, M. 1993. Flore mycologique d'Europe 3. Les Lépiotes. Doc. mycol. Mémoirs hors série no. 3. Lepiotaceae Roze.

Breitenbach, J. & F. Kränzlin. 1995. Pilze der Schweiz 4. Band 4. Blätterpilze 2. Teil. Verlag Mykologia, Luzern.

Candusso, M. 1990. Alcune "Lepiote" del litorale toscano. IIᵉ contributo. Riv. Micol. 33: 3–30.

Contu, M. 1994. Stato attuale delle conoscenze sulla flora micologica delle dune sabbiose della Sardegna. Micol. ital. 23 (2): 109–118.

Fries, E.M. 1874. Hymenomycetes europaei sive Epicriseos systematis mycologici. Ed. altera. Ed. Berling, Upsaliae.

Heinemann, P. 1978. Sericeomyces, genre nouveau de Leucocoprineae (Agaricaceae). Bull. Jard. bot. natn. Belg. 48: 399–407.

Hibbett, D.S. & M.J. Donoghue. 1998. Integrating phylogenetic analysis and classification in fungi. Mycologia 90: 347–356.

Hopple Jr., J.S. & R. Vilgalys. 1999. Phylogenetic relationships in the mushroom genus Coprinus and dark-spored allies based on sequence data from the nuclear gene coding for the large ribosomal subunit RNA: divergent domains, outgroups, and monophyly. Mol. Phylogen. Evol. 13: 1–19.

Huijsman, H.S.C. 1943. Observations sur le "genre" Lepiota. Meded. Ned. mycol. Vereen. 28: 3–60.

Johnson, J. 1999. Phylogenetic relationships within Lepiota sensu lato based on morphological and molecular data. Mycologia 91: 443–458.

Johnson, J. & R. Vilgalys. 1998. Phylogenetic systematics of Lepiota sensu lato based on nuclear large subunit rDNA evidence. Mycologia 90: 971-979.

Kelderman, P.H. 1994. Parasolzwammen van Zuid-Limburg. Lepiota s.l. excl. Macrolepiota. Natuurhistorisch Genootschap in Limburg, Maastricht.

Kühner, R. 1936. Recherches sur le genre Lepiota. Bull. trimest. Soc. mycol. Fr. 52: 177–238.

Lange, C. 1995. The genus Leucoagaricus in Denmark; distribution and ecology. Doc. mycol. 25 (98–100): 249–256.

Lange, J.E. 1935–1936. Flora agaricina danica 1. Recato, Copenhagen.

Malençon, G. & R. Bertault. 1970. Flore des champignons supérieurs du Maroc. I. Rabat.

Migliozzi, V. 1997. Un genere alla volta. Nº 5. Boll. Gruppo micol. G. Bres. 40 (1): 12–27.

Migliozzi, V. 1998. Descrizione di Sericeomyces amylosporus e di Sericeomyces cinereopallidus. Micol. Veget. medit. 13: 26–38.

Migliozzi, V. & A. Bizzi. 1995. Lepiotee interessanti o rare. 3º contributo. Lepiota pseudohelveola, L. pseudohelveola var. sabulosa, L. pseudohelveola forma, Sericeomyces serenus e S. sericatellus. Micol. ital. 24 (3): 74–86.

Moncalvo, J.-M., F.M. Lutzoni, S.A. Rehner, J. Johnson & R. Vilgalys. 2000. Phylogenetic relationships of agaric fungi based on nuclear large subunit ribosomal DNA sequences. Syst. Biol. 49: 278–305.

Moser, M.M. 1983. Röhrlinge und Blätterpilze. In: H. Gams, Kleine Kryptogamenflora II b/2. 5. Aufl. Gustav Fischer Verlag, Stuttgart.

Pearson, A.A. 1949. New records and observations. IV. Trans. Br. mycol. Soc. 32: 258–272.

Pearson, A.A. 1952. New records and observations. V. Trans. Br. mycol. Soc. 35: 97–122.

Pleijel, F. 1999. Phylogenetic taxonomy, a farewell to species, and a revision of Heteropodarke (Hesionidae, Polychaeta, Annelida). Syst. Biol. 48: 755–789.

Queiroz, K. de & J. Gauthier. 1992. Phylogenetic taxonomy. Ann. Rev. Ecol. Syst. 23: 449–480.

Queiroz, K. de & J. Gauthier. 1994. Toward a phylogenetic system of biological nomenclature. Trends Ecol. Evol. 9: 27–31.

Rodríguez Armas, L., E. Beltram Tejera, A. Bañares Baudet & M.D. González Luis. 1988. Adiciones a la flora micologica canaria – VI. Doc. mycol. 18 (72): 65–72.

Signorello, P. & M. Contu. 1998. Macromiceti interessate e nuovi dalla Sicilia. Micol. Veget. medit. 13: 59–68.

Wichanský, E. 1959. Bedla jasná a bedla červenolupenná v Kinského sadech v Praze. [Lepiota serena (Fr.) Quél. sensu Kühner et Lepiota naucina (Fr.) Quél. in horto publico Kinského sady dicto in Praga.] Česká Mykol. 13: 57–60.

Wuilbaut, J.J. 1986. A propos de quatre espèces intéressantes (dont une nouvelle pour l'Europe) récoltées dans la région de Mons (Belgique). Doc. mycol. 17 (65): 43–49.

Zecchin, G. & V. Migliozzi. 1998. Una nuova lepiotacea dal territorio sardo: Sericeomyces sardous Zecchin et Migliozzi spec. nov. Micol. ital. 27 (2): 39–44.

PERSOONIA
Volume 17, Part 3, 481–485 (2000)

A NEW SPECIES AND A NEW SECTION OF THE GENUS MYCENA FROM THE NETHERLANDS

A.P. VAN DEN BERG[1], A.E. VAN DEN BERG-BLOK[1], M.E. NOORDELOOS[2] & C.B. ULJÉ[3]

Mycena cecidiophila is newly described and illustrated. It grows on knopper galls on the cups of *Quercus robur*, and was collected from a single site in the Netherlands, Huys ten Donck estate. Although the new species resembles a species of sect. *Sacchariferae*, it differs in the negative Melzer-reaction on the lamella trama. The new section *Cecidiophilae* is therefore proposed here to accommodate the new species, characterized by warty elements of the pileipellis, amyloid spores, and absence of pleuro- and cheilocystidia.

During a foray of a local working group of the Dutch Mycological Society an interesting species of *Mycena* was collected in 'Huys ten Donck' estate at Ridderkerk, Zuid-Holland province, The Netherlands. Under a row of *Quercus robur* L. a large number of old knopper galls (outgrowths on acorn cupules caused by the gall-wasp *Andricus quercuscalicis*) were found, some of which carried one or more small white fruit-bodies of *Mycena*. Although these fruit-bodies were at first reminiscent of *M. adscendens*, which occurred on some of the twigs among the galls, they were different upon closer inspection. Under a magnifying glass (10 ×) the fully expanded pileus showed a consistently brownish centre and a conspicuously fimbriate margin. The stipe was entirely pruinose with a slightly bulbous base. Microscopic examination revealed a complete lack of lamellar cystidia. The species could not be keyed out using the monograph of Maas Geesteranus (1992) as it did not seem to fit in any of the defined sections. It is therefore described here as new, and a new section is proposed to accommodate it.

MATERIAL, PRESENTATION AND ABBREVIATIONS

Spores and lamellar trama were studied in Melzer's reagent and in water, the pileipellis and other details in Congo-red. Colours are described according to the codes of Munsell (1975) and Kornerup & Wanscher (1978), indicated as Mu. and K. & W., respectively. Other abbreviations are: av. - average; L - length of spores; Q - quotient of spore length and width; W - spores in side view. The notation [45, 3, 1] means: 45 spores from 3 specimens from 1 collection were measured.

RESULTS

Mycena cecidiophila, *spec. nov.* — Fig. 1, Plate 10, 11

Pileus 4–10 mm latus, subglobosus, ellipsoideus vel ovoideus, demum campanulatus vel convexus, initio griseo-brunneus margine albidus, demum albus centro brunneus, margine albidus, dentato-fimbria-

---

1) Merellaan 192, 2902 JK Capelle a/d IJssel, The Netherlands.

2) Corresponding author, e-mail: Noordeloos@nhn.leidenuniv.nl. Nationaal Herbarium Nederland, Universiteit Leiden branch, P.O. Box 9514, 2300 RA Leiden, The Netherlands.

3) Van Dijkstraat 21, 2405 XE Alphen a/d Rijn, The Netherlands.

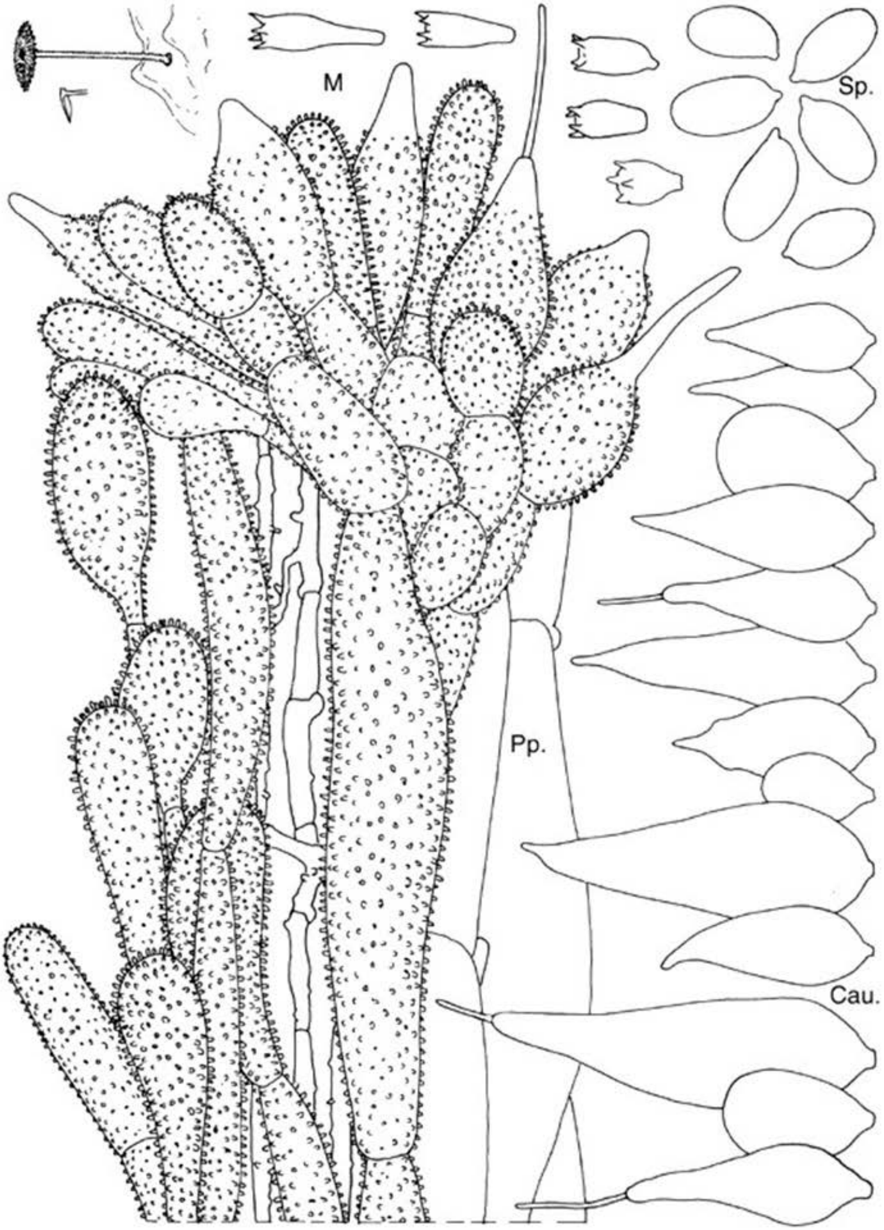


Fig. 1. *Mycena cecidiophila*. Sp. = spores, × 2000; Pp. = pileipellis; M = pileipellis at margin of pileus; Cau. = caulocystidia (all microscopical details × 800, all figs from holotype). (Del. C. Uljé.)

tus. Lamellae anguste-adnatae, albae demum cremeae. Stipes 12–22 × 0.5–0.75 mm, cylindraceus, albus vel pallide brunneus, hyalinus, toto pruinosus, versus basim subbulbosus, villosus.

Sporae 5.0–8.5 × 3.0–4.5 µm, Q = 1.5–2.1, Qav 1.7–1.8, ellipsoidea, ovoidea vel cylindracea, amyloidea. Basidia 11–18 × 6.5–8.0 µm, tetrasporigera. Cheilo- vel pleurocystidia nulla. Pileipellis ex acanthocystis, 20–70 × 8.0–25 µm cylindraceis, subglobosis vel fusiformis confertim verrucosis composita. Trama lamellarum haud amyloidea nec dextrinoidea. Fibulae presentes.

Ad galli putrida cupularum Quercorum.

Holotypus: The Netherlands, prov. Zuid-Holland, Ridderkerk, Huys ten Donck, 13-VII-1998, *A.P. van den Berg & A.E. van den Berg-Blok s.n.* (L).

Pileus 4–10 mm when expanded, at first subglobose, ellipsoid or ovoid, then expanding to campanulate or convex, finally flattened, with deflexed margin becoming slightly recurved when old; in primordia grey-brown at centre (Mu. 10 YR 3/3; K. & W. 5E/F4), white hairy-floccose at sides and base, when expanded whitish with brown centre (Mu. 10 YR 4/3; K. & W. 6E4 finally 10 YR 5/3; 5D/E4 or somewhat paler), minutely pruinose towards margin, dentate-fimbriate at margin (handlens). Lamellae, L = 20–30, l = 1, distant, narrowly adnate, sometimes forming a pseudocollarium, ventricose, white, becoming cream when old, with entire, concolorous margin. Stipe 12–22 × 0.5–0.75 mm, cylindrical with somewhat bulbous base, white or brownish, somewhat hyaline, entirely evenly pruinose, hairy at base.

Spores [45, 3, 1] 5.0–8.5 × 3.0–4.5 µm, on average 5.8–7.0 × 3.4–3.8 µm; Q = 1.55–2.05, Qav = 1.70–1.80; ellipsoid to oblong, rarely subcylindrical in side-view, oblong to ovoid in frontal view with rather pronounced apiculus, amyloid, hyaline, thin-walled. Basidia 11–18 × 6.5–8.0 µm, 4-spored. Cheilo- and pleurocystidia absent. Pileipellis a cutis made up of diverticulate, cylindric or slightly inflated elements, 15–50 × 2.0–6.0 µm, with acanthocyst terminal elements. Acanthocysts clavate, less frequently cylindrical, subglobose or fusiform, 20–70 × 8.0–25 µm, verrucose with nipple-shaped to cylindrical warts up to 2(–2.5) × 1.0 µm; the fusiform type usually with smooth rostrum. Subpellis made up of radially arranged, cylindrical, oblong or fusiform elements, approximately 20–100 × 5.0–30 µm, with smooth walls or with scattered diverticulae. Caulocystidia 30–70 × 10–22 µm, mostly conical to broadly conical, with acute, sometimes rostrate apex, sometimes with needle-like extension, less frequently broadly clavate, ellipsoid or ovoid, with thin, smooth walls. Trama of lamellae not amyloid or dextrinoid. Clamp-connections present.

Habitat & distribution — On decaying knopper galls on *Quercus robur* acorn cups. Only known from the type-locality at Ridderkerk.

Collection examined. THE NETHERLANDS: prov. Zuid-Holland, Ridderkerk, Huys ten Donck, 13 July 1998, on knopper gall, also including specimens obtained from subsequent fructification on the same galls, *A.P. van den Berg & A.E. van den Berg-Blok* (holotype, L).

Mycena cecidiophila has a number of characters which would place it in sect. *Sacchariferae*, in particular the type of pileipellis with acanthocyst terminal elements and amyloid spores. However, all members of this section have well-differentiated cheilocystidia (Desjardin, 1995), with the exception of *M. incarnativelum* Desjardin. More important is the fact that our species does not have amyloid or dextrinoid trama, which is considered an essential feature of sect. *Sacchariferae* (Desjardin, 1995; Maas Geesteranus, 1983; Maas Geesteranus & de Meyer, 1997, 1998). The combination of warty elements in the pileipellis, amyloid spores, absence of cheilocystidia, 4-spored basidia, and negative Melzer-reaction of the lamellar trama does not fit any other section in the classification of Maas Geesteranus (1992). The absence of cheilocystidia suggests a place in sect. *Radiatae*, but in that section the species are medium-sized, with a centrally squamulose pileus and smooth elements in the pileipellis. A new section is therefore proposed here to accommodate our new species:

Mycena section **Cecidiophilae**, *sect. nov.*

Basidiomata statura parva. Sporae amyloideae. Cheilo- vel pleurocystidia nulla. Trama lamellarum iodi haud reagentia. Pileipellis a elementatibus inflatis verrucosis constituis. Caulocystidia conicoidea, glabra.

Holotypus: *Mycena cecidiophila* v.d. Berg, v.d. Berg-Blok, Noordel. & Uljé.

Fruit-bodies small. Spores amyloid. Cheilo- and pleurocystidia absent. Lamellar trama not amyloid. Pileipellis a cutis of inflated, warted elements. Caulocystidia conical, smooth.
Holotype: *Mycena cecidiophila* v.d. Berg, v.d. Berg-Blok, Noordel. & Uljé.

The type locality at the private 'Huys ten Donck' estate is renowned for its mycoflora. To date nearly 500 species have been recorded, many of which are included in the Red List of endangered macrofungi in the Netherlands (Arnolds & Kuyper, 1996). A variety of (primarily deciduous) old trees and shrubs grows on a rich clayey soil. Only a limited number of visitors is allowed access and maintenance is 'fungus-friendly'. A local working group of the Dutch Mycological Society (Working Group Oud-Beijerland) has been organising more or less regular forays to update the old records, during one of which our find was collected. The galls were at least one year old, embedded in litter under various shrubs, and soaking wet due to a period of continuous damp weather. After collecting the galls the fruit-bodies soon collapsed and turned brownish.

In the type locality several knopper galls bearing 1 to 3 fruit-bodies were found. Return visits yielded a few more specimens. Most remarkably, they seemed to be associated exclusively with this type of gall. Some small twigs among the galls carried *M. adscendens*, but not a single instance of mixed occurrence was noted. This suggests that the substrate might be typical for this species.

If the new species were truly confined to the knopper gall substrate, it would be a rare species in nature. Knopper galls appear as irregular outgrowths of acorn cups of *Quercus robur* or *Q. petraea*. They are the result of an infection by the agamic generation of the gall wasp *Andricus quercuscalicis* (Burgsd.). To accommodate the sexual generation, the life cycle of this organism requires a nearby second host (*Q. cerris* L.), which is far less common (planted in parks and lanes). This restricts the occurrence of this type of gall and consequently that of any putatively associated fungus species. In the type locality a few *Q. cerris* trees are indeed present.

To our surprise it was easy to grow more fruit-bodies on the galls by keeping them embedded in soaked humus in a simple transparent container with small holes at a moderately lit spot at home at temperatures around 17°C. Within days after collection a first flush of new fruit-bodies was obtained. Unfortunately the true significance of our find was not immediately recognised and most of the early material was not retained. Occasional basidiocarps continued to appear for several months. At first the only other visibly recognisable fungus species was *Ciboria batschiana* which is specific to the interior tissue of old acorns. Fructification seemed critically dependent on keeping the galls and the humus bed soaked. A later collection of galls from the same site also produced occasional fruit-bodies. On forays at other estates more knopper galls were found, suggesting a general abundance of this type of plant disease during the previous fruiting season [knopper gall occurrence shows strong yearly fluctuation, according to H.A. van der Aa (pers. comm.)]. However, no specimens of the new *Mycena* species were found. Galls collected at these sites and kept under the same conditions as described above did not develop any fruit-bodies. After two months only a few fruit-bodies of *M. galopus* developed on the additional gall collections.

ACKNOWLEDGEMENTS

The authors wish to thank several people who made this publication possible. In chronological order: Ms. Grieta Fransen-Batenburg as the driving force behind the regular visits to the locality, Ms. Joke Anema-Balke, who detected the first fruit-body during our foray and Dr. R.A. Maas Geesteranus, whose expertise was indispensable in deciding to describe our find as a new species.

REFERENCES

Arnolds, E.J.M. & Th.W. Kuyper. 1996. Bedreigde en kwetsbare paddestoelen in Nederland; basisrapport met voorstel voor de Rode lijst. Nederlandse Mycologische Vereniging.

Desjardin, D.E. 1995. A preliminary accounting of the worldwide members of Mycena sect. Sacchariferae. Bibl. Mycol. 159: 1–89.

Kornerup, A. & J.H. Wanscher. 1978. Methuen handbook of colour. London.

Maas Geesteranus, R.A. 1983. Conspectus of the Mycenas of the Northern Hemisphere – 1. Sections Sacchariferae, Basipedes, Bulbosae, Clavulares, Exiguae, and Longisetae. Proc. Kon. Ned. Akad. Wetensch. (Ser. C) 86: 401–421.

Maas Geesteranus, R.A. 1992. Mycenas of the Northern Hemisphere. Kon. Ned. Akad. Wetensch., Verh., Afd. Nat. II. 90.

Maas Geesteranus, R.A. & A.A.R de Meyer. 1997. Mycenae paranaensis. Kon. Ned. Akad. Wetensch., Verh., Afd. Nat. II. 97.

Maas Geesteranus, R.A. & A.A.R de Meyer. 1998. Further Mycenas from the State of Paraná, Brazil. Persoonia 17: 29–46.

Munsell. 1975. Munsell soil color charts. Baltimore.

PERSOONIA
Volume 17, Part 3, 487–490 (2000)

ASCOZONUS MONASCUS, A NEW SPECIES OF ASCOMYCETES FROM GREAT BRITAIN

J. VAN BRUMMELEN[1] & M.J. RICHARDSON[2]

Ascozonus monascus Brumm. & M.J. Richardson, a new coprophilous ascomycete from Scotland, is described and illustrated. It is characterized by ascomata developing only a single multispored ascus, with a subapical ring and a small operculum at the apex, and a few excipular cells near the base.

At the end of December 1998 the second author incubated rabbit dung from the neighbourhood of Edinburgh in a moist chamber. After seven days numerous apparently naked asci developed on the dung surface, on bundles of mycelial hyphae and on the surface of fruitbodies of other coprophilous fungi.

From the structure of the asci, with a conspicuous, subapical ring, a conical apex, and a small operculum it is clear that this fungus belongs to *Ascozonus* (Renny) E.C. Hansen. Since it does not agree with any of the species of *Ascozonus* described thus far, it is described as a new species.

Ascozonus monascus Brumm. & M.J. Richardson, *spec. nov.*

Ascomata solitaria vel arcte aggregata, superficialia, sessilia, 45–60 µm diam., 150–180 µm alta, initio subglobularia, deinde oblongo-ellipsoidea, alba, constans ex asco unico et paraphysibus paucis. Excipulum reductum, textura globulosa. Asci saepe curvati, late clavati, apice conico, annulato operculatoque, 112–145 × 39–50 µm, 150–200-sporis, pariete iodo haud caerulescente. Sporarum fasciculi ovoidei, 57–80 × 32–38 µm. Ascosporae radiantes dispositae, fusiformi-ellipsoideae, saepe leniter asymmetricae, hyalinae, 8.7–9.8(–11.5) × 3.6–4.1(–4.6) µm, laeves. Paraphyses potius rarae, irregulariter cylindricae, sinuosae, ramosae, 2.0–2.5 µm latae, apice leviter inflatae, hyalinae, extremo asci obtectae.

In fimo cunicularum incolit.

Holotypus: Great Britain, Scotland, Newhailes near Edinburgh, *M.J. Richardson 109/98* (L).

Etymology: from Greek, μονος, alone, sole, single, and ασκος, a leathern-bag or sack: with a single ascus.

Ascomata solitary, in small groups, or closely gregarious, sometimes forming a waxy-looking crust, superficial, sessile, 45–60 µm diam., 150–180 µm high, consisting each of a single ascus surrounded by a small number of paraphyses and some excipular cells near the base, at first subglobular and closed (cleistohymenial, Fig. 1D), then opening and oblong-ellipsoid, white. Hymenium and hypothecium not differentiated. Excipulum reduced to a few thin-walled, isodiametric, rounded cells about 10–30 µm diam. (textura globulosa) near the base of the ascus, extending about 50–60 µm up the ascus; without cilia or hairs.

Asci broadly clavate with a short curved base, with a conical pointed apex, 112–145 × 39–50 µm, with a 1.2–1.5 µm thick subapical ring 35–40 µm diam. at the inner side of the wall, ending with an operculum (or 'apical disk') 5–9 µm across, reaching a thickness (after

---

[1] Nationaal Herbarium Nederland, Universiteit Leiden branch, P.O. Box 9514, 2300 RA Leiden, The Netherlands.

[2] 165 Braid Road, Edinburgh EH10 6JE, Scotland, United Kingdom.

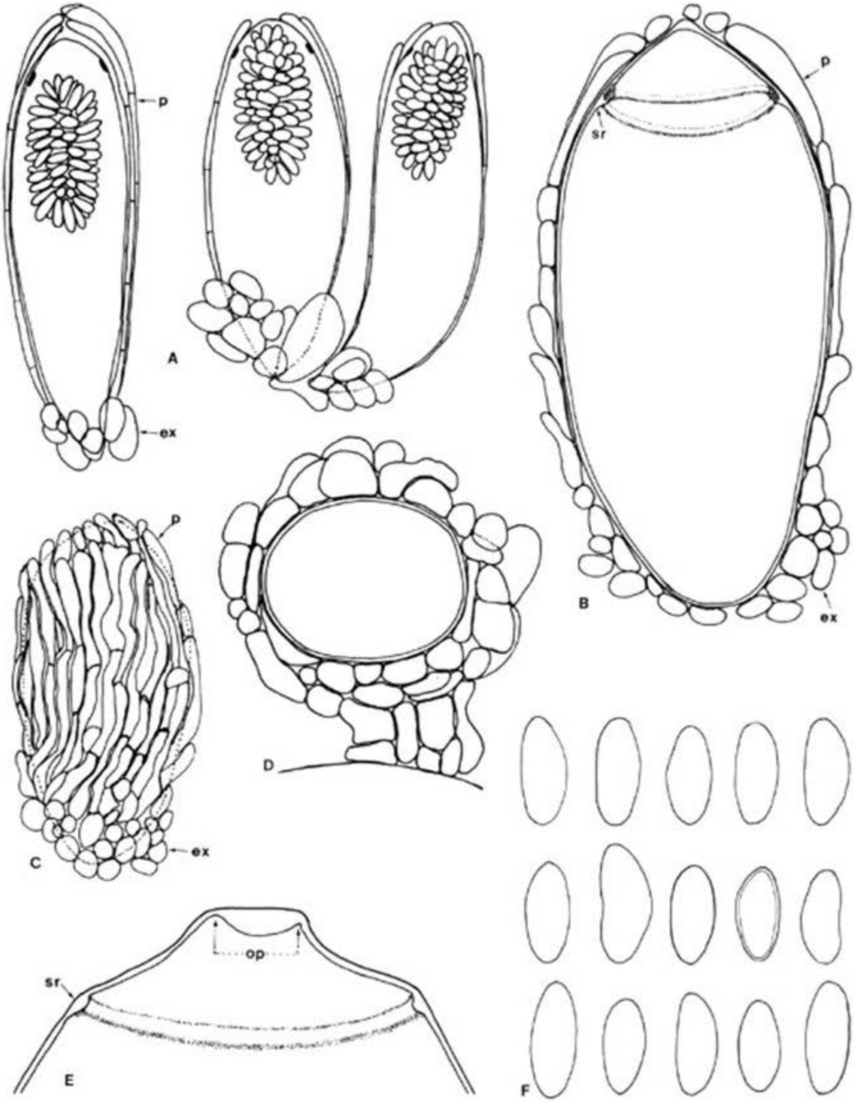


Fig. 1. *Ascozonus monascus*. A. Lateral view of living ripe fruit-bodies, × 400; B. detail of fruit-body in median section without ascospores, showing appressed paraphyses (p) and excipular cells (ex), × 1000; C. lateral view of fruit-body, showing layer of paraphyses covering the ascus, × 600; D. median section through fruit-body in early mesohymenial phase, showing ascus mother cell surrounded by a closed layer of excipular cells, × 1600; E. detail of ascus apex with subapical ring (sr) and operculum (op), × 2000; F. ascospores, × 1600 (all from holotype of *A. monascus*).

swelling) of 2.5 µm in the centre, 150–200-spored, opening at the top along the operculum above the subapical ring with a bi-labiate or laciniate split; the wall not staining blue with iodine. Ascospores united in a single ovoid cluster 57–80 × 32–38 µm, arranged as if radiating from a central spindle and ejected together, fusiform-ellipsoid with rounded or truncate ends, often slightly asymmetrical (length/width ratio 2.2–2.7, average 2.38), hyaline, 8.7–9.8(–11.5) × 3.6–4.1(–4.6) µm, without oil drops or granules, not easily producing air-bubbles, smooth. Paraphyses rather scarce, septate, sinuous, bending inwards at the apex to cover the ascus apex, hyaline, 2.0–2.5 µm thick, enlarged up to 4–7 µm at the tip, not embedded in mucus.

Habitat — Only known from dung of rabbits.

Specimens examined. GREAT BRITAIN: Scotland, Newhailes, near Edinburgh (55°56.4' N, 3°4.6' W), 21.XII.1998, *M.J. Richardson 109/98* (holotype of *Ascozonus monascus*, L); West Lothian, Polkemmet Country Park (55°51.7' N, 3°43.1' W), 29.XII.1998, *M.J. Richardson 111/98*.

As in other species of *Ascozonus*, the tiny, delicate, white fruit-bodies develop on the surface of the dung as well as on hyphal bundles or fruit-bodies of other fungi.

An ascospore number between 150 and 200 as in *A. monascus* has not been recorded before in the genus. The highest ascospore number in *Ascozonus* till now was found in *A. subhirtus* (Renny) E.C. Hansen with up to 128 spores per ascus, but it has many asci in a fruit-body, and a well-developed receptacle with a ciliated margin and several rows of connate hairs below.

In an unpublished series of exact ascospore counts in multi-spored strains of *Thelebolus* and *Ascozonus* the first author could confirm the constant spore number within any given strain as found by Wicklow & Malloch (1971) in *Thelebolus*. As a result of successive mitoses the spore number found was up to 2^n, with the restriction that, as in 8-spored ascomycetes, sometimes in a certain line one or a few abortive spores are produced.

Little attention has been paid to the early development of the ascomata in species of *Ascozonus*. The descriptions and images published by Renny (1871, 1873, 1874) suggest the presence of paragymnohymenial ascomata (Van Brummelen, 1967), but in *A. monascus* the ascogenous system is extremely reduced; neither remnants of an ascogonium nor of an antheridium could be found near the base of young asci. As in *Lasiobolus monascus* Kimbr., the ascus directly develops from the ascogonium (Kimbrough, 1974; Kimbrough & Benny, 1978). In the early stages the ascogonium and the ascus-mother-cell are completely surrounded by excipular cells (Fig. 1D). During the prohymenial or early mesohymenial phase these cleistohymenial ascomata open and the hymenium, here consisting of a single ascus surrounded by several paraphyses, becomes exposed. The ripening ascus shows a restricted receptacle at its base, and remains enclosed with a tight single layer of appressed paraphyses (Fig. 1C).

The operculum at the top of mature asci is often found encircled by an irregular collar consisting of the swollen ends of twelve to twenty paraphyses (Fig. 1B).

While the operculum in most species of *Ascozonus* shows a diameter of 2 to 3 µm, it reaches a width of 5 to 9 µm in the present species.

Studies of ascus apex ultrastructure in species of *Ascozonus* (Van Brummelen, 1974, 1978, 1994, 1998) revealed a most peculiar and constant apical apparatus described as the *Ascozonus* type. The *Ascozonus* type of ascus apical structure shows clear resemblance to both the *Thelebolus* type and the *Octospora* type by the presence of a subapical ring in the lateral ascus wall at some distance below the ascus tip; while in *Ascozonus* and *Thelebolus* the subapical ring is a constant prominent wall thickening which acts as a barrier against dehiscence of the ascus top below the level of the ring, it is a far less pronounced structure, at some distance below the future rather roughly delimited operculum, in the *Octospora* type (typical of the Pyronemataceae). The last can be made visible by staining, electron microscopy, or post-mortem water imbibition of wall layers.

Samuelson (1978) in a study of the ascus apical apparatus in representatives of the Pyronemataceae, studied the ascus of *A. woolhopensis* (Renny) E.C. Hansen. He failed to find the typical operculum and arrived at the remarkable conclusion that the apical apparatus in this species most clearly resembled that of *Anthracobia melaloma* (Alb. & Schw.: Fr.) Boud.

REFERENCES

Brummelen, J. van. 1967. A world-monograph of the genera Ascobolus and Saccobolus (Ascomycetes, Pezizales). Persoonia (Suppl.) 1: 1–260.

Brummelen, J. van. 1974. Light and electron microscopic studies of the ascus top in Ascozonus woolhopensis. Persoonia 8: 23–32.

Brummelen, J. van. 1978. The operculate ascus and allied forms. Persoonia 10: 113–128.

Brummelen, J. van. 1994. Problems in the systematics of Pezizales. In: D.L. Hawksworth, Ascomycete systematics, Problems and perspectives in the nineties. New York.

Brummelen, J. van. 1998. Reconsideration of relationships within the Thelebolaceae based on ascus ultrastructure. Persoonia 16: 425–469.

Kimbrough, J.W. 1974. The structure and development of Lasiobolus monascus sp. nov. (Pezizales, Ascomycetes). Mycologia 66: 907–918.

Kimbrough, J.W. & G.L. Benny. 1978. The fine structure of ascus development in Lasiobolus monascus (Pezizales). Can. J. Bot. 56: 862–872.

Renny, J. 1871. A description of some species of the genus Ascobolus new to England. Trans. Woolhope Nat. Fld. Club 1871: 45–48.

Renny, J. 1873. New species of the genus Ascobolus. Trans. Woolhope Nat. Fld. Club 1872–3: 127–131.

Renny, J. 1874. New species of the genus Ascobolus. J. Bot., Lond. 12: 353–357.

Samuelson, D.A. 1978. Asci of the Pezizales. II. The apical apparatus of representatives in the Otidea-Aleuria complex. Can. J. Bot. 56: 1876–1904.

Wicklow, D. & D. Malloch. 1971. Studies in the genus Thelebolus: temperature optima for growth and ascocarp development. Mycologia 63: 118–131.

PERSOONIA
Volume 17, Part 3, 491–493 (2000)

APHELARIOPSIS KUPEMONTIS: A NEW AURICULARIOID SPECIES FROM CAMEROON

PETER ROBERTS

The Herbarium, Royal Botanic Gardens, Kew, Surrey TW9 3AE, United Kingdom

A new clavarioid fungus with auricularioid basidia is described from Cameroon in West Equatorial Africa.

Only five species of auricularioid fungi have been described with clavarioid (club or coral-shaped) basidiomes, and these are distributed among four separate genera: *Aphelariopsis* Jülich, *Eocronartium* Atk., *Neotyphula* Wak., and *Paraphelaria* Corner. Whilst preparing a paper on holobasidiomycetous clavarioid fungi from Cameroon (Roberts, 1999), a sixth auricularioid species was discovered, the first such recorded from Africa, which is here described as new.

Aphelariopsis kupemontis P. Roberts, *spec. nov.* — Figs. 1, 2

Basidiomata pteruloidea, 40–50 mm alta, dichotome ramosa, griseo-alba. Hyphae hyalinae vel brunneae, 3–5 µm latae, efibulatae. Probasidia subglobosa vel ellipsoidea, 10–12 µm diam., stipitata. Epibasidia tubulosa, usque 40 × 9 µm, incurvata. Basidiosporae cylindraceae, 14.5–16 × 4.5–5 µm, suballantoideae.

Holotype: Cameroon, South West Province, Mount Kupe (path from village), on living *Tabernaemontana* sapling (1 m from ground), 25 Jan. 1995, *M. Cheek 7155* (K(M) 57977).

Basidiomes pterulioid, erect (or at least not pendent), 40–50 mm high, dichotomously branched 4–5 times from base, all branches <1 mm wide, not noticeably thicker or wider at base, but narrower and penicillate at apices (Fig. 2); grey-white when fresh (darkening towards the base) and remaining so when dried; basidiomes gregarious, arising from a thin subicular mat to form a dense, interwoven cluster, the branches agglutinating or anastomosing when dried. Hyphae hyaline in hymenium and branch apices, pale to dark brown in context and subiculum, 3–5 µm diam., with thin to thickened walls, straight and rarely branched in context, somewhat agglutinated, lacking clamp-connexions. Cystidia absent. Basidia arising from all parts of the basidiome surface in a loose or ill-defined hymenium; probasidia subglobose to ellipsoid, 10–12 µm diam., with distinct stem; epibasidia arising apically or laterally from the probasidia, tubular, up to 40 × 9 µm, typically incurving, developing three lateral septa. Basidiospores cylindrical, 14.5–16 × 4.5–5 µm, suballantoid and narrowing towards the apiculus; germination not seen.

Following Jülich (1982), the collection above is clearly congeneric with *Aphelariopsis borneensis* (Jülich) Jülich, the type of *Aphelariopsis* Jülich. The Cameroon specimens have clavarioid basidiomes (Fig. 2) with auricularioid basidia arising from subglobose to ellipsoid probasidia (Fig. 1), typical of *A. borneensis*. However, the latter species was described from Sarawak (Borneo), has smaller (<15 mm high), simple or furcate basidiomes, smaller probasidia (5.5–8 µm diam.), and shorter, curved-cylindrical basidiospores (12–14 µm long)

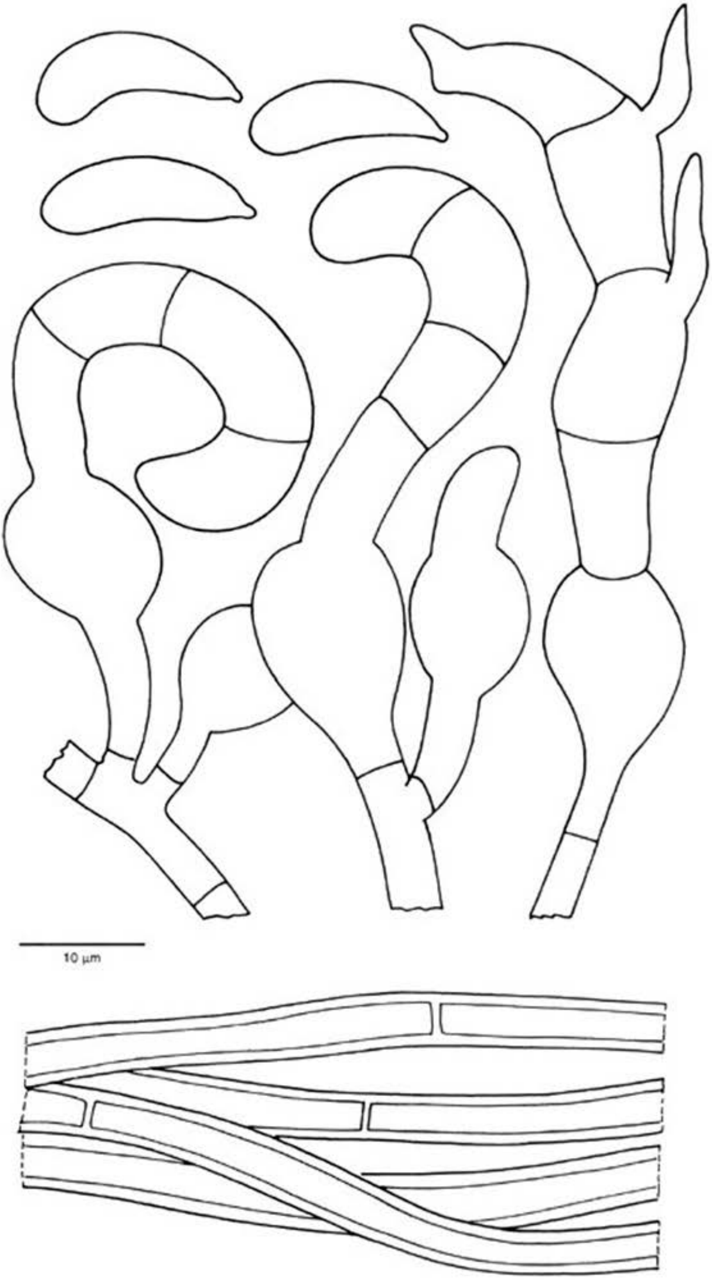


Fig. 1. *Aphelariopsis kupemontis*. Basidiospores, young and mature basidia, and context hyphae.

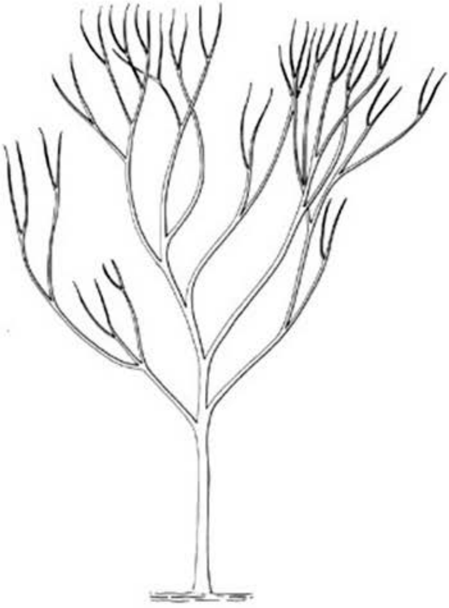


Fig. 2. *Aphelariopsis kupemontis*. Single basidiome (× 2) extracted from a dense interwoven cluster.

(Jülich, 1982). Two other species, *Aphelariopsis colombiana* (Welden) Jülich described from South America and *Paraphelaria amboinensis* (Lév.) Corner described from Indonesia, appear to be related but differ inter alia in having basidia which lack probasidia (Corner, 1966; Jülich, 1982).

REFERENCES

Corner, E.J.H. 1966. Paraphelaria, a new genus of Auriculariaceae. Persoonia 4: 345–350.
Jülich, W. 1982. Basidiomycetes of south-east Asia 1. The genus Paraphelaria. Persoonia 11: 397–406.
Roberts, P. 1999. Clavarioid fungi from Korup National Park, Cameroon. Kew Bull. 54: 517–539.

PERSOONIA
Volume 17, Part 3, 495–496 (2000)

CATATRAMA (TRICHOLOMATACEAE), A GENUS NEW TO INDIA

K.B. VRINDA, C.K. PRADEEP, SIBI MATHEW & T.K. ABRAHAM

Tropical Botanic Garden & Research Institute, Palode, Thiruvananthapuram – 695 562, Kerala, India

Catatrama costaricensis, previously known only from the type specimen, is described and illustrated based on collections from Kerala state, India.

Recently, whilst surveying the agaric flora of Kerala, an interesting fungus was collected in one of the sacred groves of Kerala. Macroscopically the fungus had the appearance of a species of *Lepiota*, but detailed studies revealed that it belonged to the genus *Catatrama* (Tricholomataceae) described from Costa Rica (Franco-Molano, 1991). The collection is described and illustrated below. The description is based on fresh specimens collected by the authors. Colour terminology used is that of Methuen (Kornerup & Wanscher, 1967). Specimens are deposited at the Mycological Herbarium of the Microbiology Division, TBGRI (TBGT) and part at the Royal Botanic Gardens, Kew (K).

Catatrama costaricensis Franco-Molano, Fig. 1A–C

Catatrama costaricensis Franco-Molano, Mycologia 83 (1991) 4.

Pileus 3–6.5 cm diam., convex to plane, broadly umbonate; surface 'light brown' (7D5), covered with 'reddish brown' (8E8) squamules throughout, appressed fibrillose towards the margin, recurved elsewhere, becoming washed off when exposed to rain; margin entire to incised, becoming uplifted with age, non-striate, appendiculate. Lamellae free, creamy white, up to 9 mm wide, close, with lamellulae of different lengths; edge concolorous with sides, entire. Stipe 4–7 cm × 4–8 mm, central, cylindric, solid with slightly dilated base, with white mycelial cords; surface 'light brown' (7D5), with 'reddish brown' (8E8), recurved squamules below, smooth above the annular zone. Annulus fragile, forming indistinct zone at superior part of stipe. Context white, soft, up to 4.5 mm wide at centre, thinning towards margin. Odour pleasant, flower-like.

Spores 5.3–7.5 × 6–7.5 µm, globose, echinulate, inamyloid, lacking germ-pore. Basidia 31.5–36 × 9–10 µm, clavate, 4-spored. Cystidia absent. Hymenophoral trama divergent from a central mediostratum, inamyloid, composed of thin-walled, hyaline hyphae, 7.5–22.5 µm diam. Subhymenium pseudoparenchymatous. Pileal trama composed of thin-walled, hyaline hyphae, 7.5–25.5 µm diam., occasionally with clamp-connections. Pileal cuticle a repent epicutis, disrupted by trichodermial tufts of scale cells. Stipitipellis similar to the pileal cuticle.

Scattered on soil among litter.

Specimens examined. INDIA: Kerala state, Iringole sacred grove: 23 Aug. 1997, *Pradeep 4079*; 3 July 1998, *Sibi 4345*.

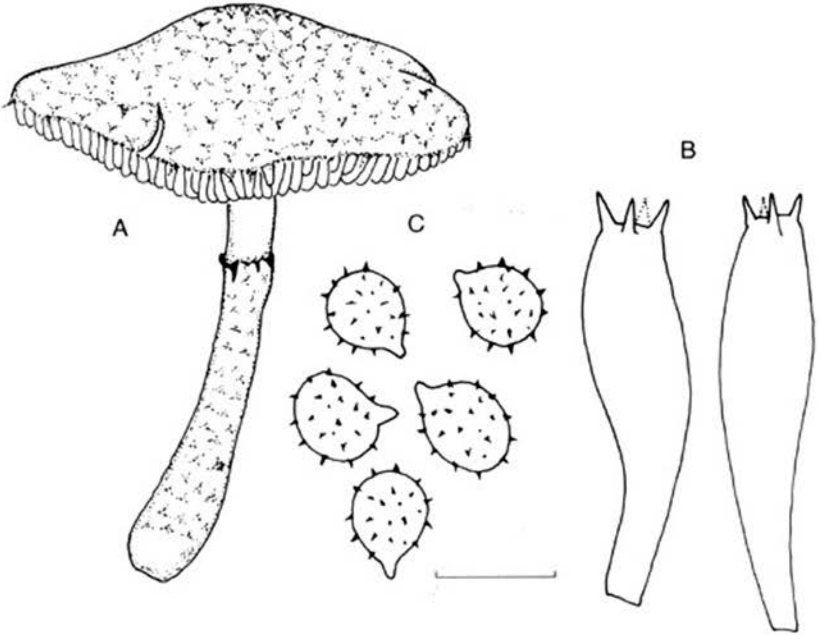


Fig. 1. *Catatrama costaricensis*. A. Habit × 1; B. basidia; C. spores. Bar = 10 µm.

The genus *Catatrama* was established to accommodate a single species, *C. costaricensis* Franco-Molano, an interesting white-spored agaric with a lepiotoid habit, collected on soil in *Quercus pilaris* Trel. forest in southern Costa Rica (Franco-Molano, 1991). The fungus has distinguishing characters: a combination of echinulate, cyanophilic, inamyloid basidiospores, subfree lamellae and bilateral hymenophoral trama. Comparison with the description of the type specimen reveals a good match of our material. Other than the original collection from Costa Rica, no further report of its occurrence has been published.

ACKNOWLEDGEMENTS

The authors are grateful to Dr. P. Pushpangadan, Director, TBGRI, for facilities and encouragement. Two of us (CKP & SM) are thankful to CSIR, New Delhi for financial assistance.

REFERENCES

Franco-Molano, A.E. 1991. Catatrama (Tricholomataceae) a new genus from Costa-Rica. Mycologia 83: 501–505.

Kornerup, A. & J.H. Wanscher. 1967. Methuen Handbook of Colour. 2nd ed. London.

PERSOONIA
Volume 17, Part 3, 497–501 (2000)

BOOKS RECEIVED BY THE RIJKSHERBARIUM LIBRARY

R. Agerer (Ed.). *Colour atlas of ectomycorrhizae. Issue 11.* (Einhorn Verlag, Eduard Dietenberger GmbH, Postfach 1280, D-73502 Schwäbisch-Gmünd, Germany. 1998.)
Price: DM 135,-.

The eleventh issue of this series gives 26 sheets with coloured and/or black-and-white photographs of 11 unidentified and 16 identified species of Ectomycorrhizae. The morphology is extensively described. Several keys are given for the identification of ectomycorrhiza with respect to the tree genera *Abies, Alnus, Betula, Carpinus, Corylus, Cyclobalanopsis, Elaeocarpus, Eucalyptus, Fagus, Larix, Nothofagus, Pasania, Picea, Pinus, Populus, Pseudotsuga, Quercus, Salix, Shorea, Tetraberlinia,* and *Tsuga.* Again, this issue adds a lot of very useful information on the subject, and is of great value for ectomycorrhizal research.

G. Baron. *Understanding lichens.* (The Richmond Publishing Co. Ltd., P.O. Box 963, Slough SL2 3RS, England. 1999.) ISBN 085546-252-3. Pp. 92, 4 coloured pls., 49 figs.
Price: £ 9,95.

The purpose of this book, according to the author, is to arouse in the reader an interest in lichens. Something in which this popular booklet surely succeeds. It provides information on what a lichen is, the lichen thallus, growth forms, reproduction and dispersal, lichen physiology, habitat and substrate and lichen communities. Furthermore it contains chapters on the amateur study of lichens, uses of lichens, classification of lichens and references to important books and journals. All the texts are explained with line-drawings and black-and-white photographs, and 24 pictures are provided of common lichens.

M.T. Basso. *Lactarius Pers.* (Fungi Europaei, vol. 7, Mykoflora, I-17021 Alassio, Italy. 1999.) ISBN 88-87740-00-3. Pp. 844, 62 coloured pls. Bilingual: English and Italian.
Price: unknown.

The seventh volume of this impressive series Fungi Europaei is devoted to the large genus *Lactarius*. It contains an extensive introduction on the macroscopical and microscopical characters of the genus and an overview of the taxonomy of the genus. The author presents her own infrageneric classification, which is essentially based on those of Bon (1983) and Heilmann-Clausen et al. (1998), but emended and in some cases groups are transferred from one subgenus to the other. The main part of the book is devoted to detailed descriptions of each accepted species, including the original diagnosis, a translation in Italian of the original diagnosis, macroscopical and microscopical descriptions, a list of material studied, accompanied by line drawings of the microscopical characters and one or more coloured photographs. In many cases type studies are also given. The book concludes with an extensive list of references. The iconography contains not only 34 coloured plates executed by the authors, but also reproductions of (unpublished) plates by E. Fries, stored in the Herbarium of Stockholm, which may be considered a very valuable addition. This monograph is a valuable addition to the one published by Heilmann-Clausen et al. (1998), especially for the Mediterranean taxa. It is obvious however, that still quite a few taxonomic problems remain in the genus, particularly in the subgenera *Rhysocybella* and *Russularia*.

A. Bidaud, P. Moënne-Loccoz, P. Reumaux. *Atlas des Cortinaires. Pars IX (2)*. (Éditions Fédération Mycologique Dauphiné-Savoie, 70 Rue Edison, F-69330 Meyzieu, France. 2000.) Pp. 307–409, 52 sheets with descriptions and line-drawings, col. pl. 208–260. Price: FF 580.-.

The ninth part of this series is devoted to two very different groups of *Cortinarius*, viz., sect. *Telamonia* with 10 new infrageneric taxa, and 16 new species, varieties and forms, and sect. *Phlegmacium*, with 22 infrageneric taxa, and 44 new species, varieties and forms, respectively. The publication is otherwise similar to the former in this series, with looseleaf coloured plates and separate sheets with descriptions and line-drawings. The printing is good. This contribution will certainly be welcomed by true Cortinariologists of the French school.

G. Cacialli, V. Caroti & F. Doveri. *Contributio ad cognitionem copriniorum. Monografie di Pagine di Micologia I.* (A.M.B., Via A. Volta, 46 – 38100 Trento / Fond. Centro Studi Micologici, Vicenza. 1999.) Pp. 256, 11 text-figs., div. copies of original plates. Price: Lit. 25.000.-.

This book is the first of a series, and aims to provide information on the genus *Coprinus*. The main part of the book is occupied by an alphabetical list of species in this genus with a reference to the original publication and often the original diagnosis, accompanied by a few copies of original plates. Furthermore it comprises a list with abbreviations of the cited journals and books, a list of taxa with an enumeration of the abbreviated publications in which the taxa are treated and, in alphabetical order of the author, a list of those publications. The rest of the book contains a copy of 'Nomenclator fungorum' by W.M. Streinz (1862), containing data on *Coprinus*, a list of publications concerning *Coprinus* in Italy, distribution-maps of *Coprinus* species in Italy, and – in Italian as well as in English – a treatise of fimicolous *Coprinus* in Italy, with a dichotomous key to the species, observations and – sometimes – descriptions on species, accompanied by line-drawings. In this last part of the book comments are made on all known fimicolous species of *Coprinus* in Europe, even though they are not all included in the key.

This is a valuable book and has surely costed a lot of time and effort. Unfortunately, as nearly always, the part with the original diagnoses is not entirely complete. Some easy-to-find combinations are missing, like for example *Coprinus calvescens* (Berk.) Manjula, 1983, from others the original diagnoses were not found by the authors. It would have been advisable if the authors had contacted some libraries abroad where the missing literature might have been available. But these are minor remarks, this book is recommended for the amateur and professional who is interested in *Coprinus*, and will save a lot of time, though the author and literature references still need to be checked.

B. Ing. *The Myxomycetes of Britain and Ireland: An identification handbook.* (The Richmond Publishing Co., Ltd., P.O. Box 963, Slough, SL2 3RS England. 1999.) Pp. 374, many line drawings in the text. Price: £ 35.-.

This is the first book published on British Myxomycetes since the famous monograph of Lister in 1925. The author presents his forty years of intensive studies in the field, laboratory and herbarium with this monograph, which was among others inspired by the late Dutch myxomycetologist Mrs. E. Nannenga-Bremekamp. Introductory chapters deal with ecology, distribution, collections, culture, examination and preservation, and are clearly written and well-illustrated. Before starting with the taxonomic part the author explains how to use the keys. The dichotomic keys are written in a concise and clear style. The species are treated per genus and per family, and illustrated with simple, though informative line-drawings. The appendix contains a very useful list of derivations of the names of myxomycetes, as well as a glossary of terms, and a list of useful addresses. This book will certainly be welcomed by all interested in this groups of intriguing organisms, nowadays considered a phylum unrelated to the true fungi.

A. Montecchi & M. Sarasini. *Funghi ipogei d'Europa.* (Associazione Micologica Bresadola. Via A. Volta, 46, I-38100 Trento. 2000.) Pp. 714, many coloured photographs. In Italian and English. Price: unknown.

As a successor to the 'Atlante Fotographico di Funghi Ipogei', by Montecchi & Lazzari (1993), there is now an even more attractive and more comprehensive book than the previous one. In total 179 species of hypogeous and semi-hypogeous fungi are now depicted and described, 66 more than previous. Of each species two photographs are given, of the fruit-body and the microscopical structures, accompanied by a detailed description, and – when necessary – remarks and taxonomic notes, all in Italian and English. The photographs are of good quality. Keys to family, genus and species are provided at the beginning of each taxonomic group. Also, a glossary is included of the mycological terms used in hypogeous fungi, again both in Italian and in English. By translating all texts into English this book is more accessible to mycologists who had difficulties reading Italian.

M. Moser & W. Jülich (unter Mitarbeit von C. Furrer-Ziogas). *Farbatlas der Basidiomyceten. Lieferung 16.* (Gustav Fischer Verlag, Wollgrasweg 49, D-70599 Stuttgart. 1998.) ISBN 3-437-25686-6. Price: DM 118.-.

The sixteenth issue of this loose-leaf atlas contains pictures of species belonging to the following genera: *Rhizopogon, Amanita, Baeospora, Clitopilus, Collybia, Coprinus, Cortinarius, Entoloma, Gerronema, Inocybe, Kuehneromyces, Lepiota, Lepista, Leucopaxillus, Macrolepiota, Megacollybia, Melanoleuca, Merismodes, Myxomphalia, Albatrellus, Antrodia, Bankera, Cytidia, Hydnum, Inonotus, Sarcodon.*

Genus-descriptions of *Macrocystidia, Megacollybia, Myxomphalia, Pseudoomphalina, Albatrellus, Antrodia, Auriscalpium, Bankera, Bondarzewia, Climacocystis, Cytidia, Daedalea, Daedaleopsis, Dendropolyporus, Hapalopilus, Hydnellum, Hydnum, Inonotus, Laricifomes, Pachykytospora, Sarcodon, Trichaptum* and *Queletia* are provided, in German, English, French and Italian, and following the same concept as in the previous issues.This issue also contains an index to species and genera covering the issues 1-16. Photographs of many rarely depicted species are included, the quality of the plates varies from moderate to good.

V.A. Mukhin & H. Knudsen (eds.). *Arctic and alpine mycology 5. Proceedings of the Fifth International Symposium on Arcto-Alpine Mycology* (Labytnangi, Russia, August 15-27, 1996). (Yekaterinburg Publishers. 1998.) ISBN 5-38464-060-9. Pp. 171, 16 coloured pls., several text-figs. Price: $ 20,-.

Since 1980 Symposia are held every four years on arctic and alpine mycology. During the symposia scientific discussions and field work are combined. This book is the result of the fifth symposium, held in western Siberia. Seventeen contributions of 22 authors are published in this book, all dealing with aspects of arctic or alpine mycology. Relatively many Russian mycologists participated in this symposium, and 8 of the contributions deal with arctic fungi in Russia, concerning various subjects like arctic and alpine agarics from the Yamal peninsula (western Siberia), xylotrophic fungi, Myxomycetes, dryadicolous microfungi and Aphyllophorales from the north Ural. Other contributions refer to Lead and Cadmium contents along a mountain pass road in the Alps, arctic *Inocybe* species in Canada and western Siberia, *Hebeloma* in arctic and alpine tundra in Alaska, arctic Gasteromycetes, and *Cortinarius* subgenus *Telamonia* in Greenland.

I. Nuss. *Mykologischer Vergleich zwischen Naturschutzgebieten und Forstflächen.* (Libri botanici Band 18, IHW-Verlag, Postfach 1119, D-85378 Eching bei München. 1999.) ISBN 3-930167-37-9. Pp. 144, 62 figs., some coloured. In German. Price: unknown.

The results of a two years investigation into the relation between (macro)fungi and their environment in two protected forest areas and two comparable forestry areas are presented in this book. The main conclusions are the high correlation between the mycodiversity and the spectrum of dead wood, and the experience that the amount of Red list fungi in the protected areas is a multiple of the amount in the areas used for forestry, both not very surprising conclusions. The research has been carried out in one of the remnants of a mixed primeval forest (NSG Mittelsteighütte), the other area was situated in a very old oak forest in Bayern.

After a 19 pages introduction about the areas studied and the used methods, some remarks and results are given about the amount of dead wood and the importance for fungi. Of a number of perennial bracket fungi more detailed comparisons are made of the areas. A complete list of all the c. 560 fungi found and lists of the Red list fungi per study area are provided, followed by a discussion of the fungi which are considered important for nature conservation. As a last chapter recommendations are discussed for measures to be taken for conservation and management.

This is an interesting booklet for all who are involved in matters of nature conservation and fungi, although the research is based on the relatively short period for mycological research of only two years.

S. Onofri, A. Graniti & L. Zucconi (Eds). *Italians in the history of mycology. Proceedings of a Symposium held in the Archivio Centrale dello Stato Rome, 4-5 October 1995.* (Mycotaxon Ltd. 1999; orders at Accademia Nazionale delle Scienze, detta dei XL, Villa Lontana, Via Cassia Antica 35, I-00191 Roma, Italy.) ISBN 0-930845-09-9.
Price: unknown.

This interesting book contains a collection of papers presented in the above mentioned Symposium, which was jointly organised by the Italian National Academy of Sciences and the Italian Botanical Society. The papers not only deal with famous Italian mycologists and naturalists like Micheli, De Notaris, Saccardo and Bresadola, but also provide information about less known scientists who worked in the field of mycology, like among others Aldrovandi, Inzenga, Carmignani, Arcangeli, Pellegrini, Tassi, Mattirolo, Ciferri. The book contains 14 papers, in a more or less chronological order, from Plinius the Elder (A.D. 77) until mycologists from the 20th century. Most articles concern the contributions from 1500-1900. One of the articles gives an overview of mycological illustrations, with special reference to Italian contributions, starting with what is believed to be the earliest image of a fungus (*Elaphomyces*; 512 A.D.) in a later Byzantine version of Dioskorides' 'De Natura Medica'. This article is accompanied by beautiful copies of 15 early plates, including the *Elaphomyces*. Also the article about Aldrovandi's contributions to mycology (1522–1605) is illustrated with 6 copies of his plates. This books gives a lot of new information about the role of the Italians in mycology.

C.-G. Papetti, G. Consiglio & G. Simonini. *Atlante fotographico dei Funghi d'Italia, Vol. 1.* (Associatione Micologica Bresadola, I-38100 Trento. 1999.) Pp. 511, numerous coloured photographs. In Italian. Price: unknown.

This field-guide is the first of a series of three books, which will contain photographs and descriptions of about 1500 taxa of higher fungi to be found in Italy. It is meant to be used by amateurs to assist them in the identification of fungi in the field. The first volume contains the most common and well-known fungi. The photographs are of good to excellent quality, as are the descriptions and ecological data. Indications are given as to the culinary value or toxicity of the presented fungi. This book is not only useful for Italian amateur mycologists, but gives a lot of information for all interested in this group of organisms.

M. Traverso. *Il genera Amanita in Italia*. (Editione Associazione Micologica ed Ecologica Romana, Via Sardegna, 161, I-00187 Roma, Italy. 1999.) Pp. 182 , 168 col. figs.
Price: unknown.

This attractively illustrated book gives an overview of the genus *Amanita* in Italy: a genus with many species which toxicity calls for a reliable identification tool. The general part gives an overview of the main characteristics of the genus, with very informative photographs and line drawings to illustrate them. The main part of the book consists of descriptions and photographs of all species known from Italy with information on ecology and the possibilities of confusion with related species. Although the author in some cases uses an outdated nomenclature and a rather narrow species concept, the book offers a good opportunity to learn more about the genus *Amanita*, especially of the species occurring in the Mediterranean.

Plate 1. *Lactarius baliophaeus* (*AV 99-125*).

Plate 2. *Lactarius orientalis* (*AV 99-71*).

Plate 3. *Lactarius saponaceus* (*AV 99-171*).

Plate 4. *Lactarius sulcatulus* (*AV 99-144*).

Plate 5. *Lactarius sulcatus* (type).

Plate 6. *Lactarius atroolivinus* (*AV 99-175*).

Plate 7. *Lactarius kabansus* (*AV 99-126*).

Plate 8. *Lactarius tenellus* (*AV 99-9*).

Plate 9. *Coprinus lagopus* var. *vacillans* Uljé; holotype.

Plate 10. *Mycena cecidiophila*; holotype.

Plate 11. *Mycena cecidiophila*; holotype, detail of pileus.

Instructions to authors

(A more extensive 'Checklist for preparation of manuscripts' is available with the Editors)

Copy, preferably in English, to be sent to the editors, printed on one side of the paper, double-spaced, and with a left margin of about 4 cm. For fractions of numbers the decimal system should be used.

Please send 1) one copy of the manuscript, 2) one set of original line drawings with two copies, and 3) one set of original photographs.

Drawings within A4 size should be in India ink, preferably **not** on transparent or tracing-paper, and **photographs** (also within A4 size) should be mounted ready for publication on glossy paper. Magnification should preferably be indicated by a scale-line. In other cases the author should give the magnification as in the original.

In addition to manuscript copies, authors are urgently requested to submit a diskette or floppy disk with their text file. Preference is for files in Microsoft Word for Macintosh.

Summary. Each paper should be provided with a concise summary.

Citation of literature. Citations in the 'References' should conform to the following format:

For books, e.g.:

Fries, E.M. 1821. Systema mycologicum. Vol. 1. Lundae.

Singer, R. 1975. The Agaricales in modern taxonomy, ed. 3. Vaduz.

For chapters in a book, e.g.:

Pitt, J.I. & R.H. Cruickshank. 1990. Speciation and synonymy in Penicillium subgenus Penicillium towards a definitive taxonomy. In: R.A. Samson & J.I. Pitt (eds.), Modern concepts in Penicillium and Aspergillus classification: 103--119. New York and London.

For journals, e.g.:

Singer, R. & H. Clémençon. 1971. Neue Arten von Agaricales. Schweiz. Z. Pilzk. 49: 118--128.

Titles of journals and other publications are abbreviated mainly in accordance with the 'International Code of Abbreviations for Titles of Periodicals', and with 'A World List of Scientific Periodicals'.

Italics are ***not*** used in the references.
Write out the name(s) of author(s), i.e., do not replace author names with a long dash, when the author(s) is/are the same as in the immediate preceding citation(s).

Note: Use only a period, without a space, between the initial(s) of an author's name. Leave one space between the volume number with colon and page numbers in a journal article. Use double hyphens between page numbers, e.g., Bull. trimest. Soc. mycol. Fr. 80: 88--101.

Keys. For keys the bracketed type is strongly recommended.

Reprint orders can be submitted together with corrected proofs. Authors will, as a rule, not receive free reprints.

ISSN 0031-5850

CONTENTS

Published by

Nationaal Herbarium Nederland

Universiteit Leiden branch
P.O. Box 9514
2300 RA Leiden
The Netherlands