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THE GENUS AMANITA IN SINGAPORE AND MALAYA

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(With 12 Plates and 56 Text-figures)

A rather extensive series of collections of the genus *Amanita* from Malaya and Singapore, provided the basis of 22 species described as new. The obscure species *Amanita eriophora* (Berk.) Gilb., *A. fritillaria* (Berk.) Sacc., *A. virginea* Mass., *Armillaria squamosa* Mass., and *Collybia elata* Mass. are redescribed and the last two transferred to *Amanita*. *Amanita similis* Boed. is reduced to the rank of a subspecies of *A. hemibapha* (Berk. & Br.) Sacc. and *A. hemibapha* sensu Boed. described as *A. hemibapha* subsp. *javanica*. *Amanita rubrovolvata* Imai is recorded for the first time from outside Japan.

During a period of about 15 years the senior author was in a position to collect fungi in the neighbourhood of Singapore and, to a lesser extent, also in Malaya. One of the genera found to be rather well represented in the area concerned, was the genus *Amanita*. Several decades of collections of this genus were gathered, preserved, extensively annotated, and many specimens depicted in colour. The collector was able to distinguish most of the species represented in his material already in the field, indicating these by means of numbers.

Later on, the collections and data were handed over to the junior author, who completed the microscopical descriptions, checked the literature of the genus *Amanita*, and studied types and additional material of related species as far as necessary.

The result of the combined efforts is, that in the present paper 22 new species are described and five previously published but incompletely known species are redescribed.

A rather detailed synonymy of the subgeneric and sectional names is given. This is done because several of these names could be used for entirely different subdivisions of the genus, depending on the types to be selected, since the original species formed heterogeneous lots. In these cases the application of these names is fixed by choosing suitable lectotypes.

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All the collections and drawings referred to in the present paper are deposited in the Rijksherbarium at Leiden, unless otherwise mentioned.

AMANITA Pers. ex Hook.

Amanita Pers., Tent. mycol. 65. 1797; *ex* Hook., Fl. scot. 19. May 1821. — *Agaricus* tribus *Amanita* (Pers.) *ex* Fr., Syst. mycol. **1**: 9, 12. 1821. — Lectotype (Clements & Shear, Gen. Fungi 348. 1931): *Agaricus muscarius* L.; cf. Donk *in* Beih. Nova Hedw. **5**: 22. 1962.

For a more complete enumeration of synonyms and a generic description one is referred to Singer (1951: 381; 1962: 422).

The more observations become available, the more one becomes convinced that the genus *Amanita* in a broad sense is a very natural taxon, and that none of the generic segregations is to be maintained. It even turns out to be rather difficult clearly to define as sections the groups distinguished by Gilbert (1940) and raised by him to generic rank.

For instance, *Amanitopsis* Roze and *Amanita* sensu Gilb. 1940 (= *Amanita* sect. *Caesareae* Sing.) cannot be separated on any character of importance. Therefore, they are united in the present paper into the single section *Vaginatae* (Fr.) Quél. There exists a long gradating series of intermediates between the exannulate, fragile *A. vaginata* (Bull. ex Fr.) Vitt. with globulose spores on one side and the annulate, fleshy *A. caesarea* (Scop. ex Fr.) Grev. with ellipsoid spores on the other. *Amanita princeps* Corner & Bas and *A. hemibapha* (Berk. & Br.) Sacc., both described in this paper, represent interesting members of this series. Huijsman (1959: 21) already provided some morphological evidence for the close relationship of *A. caesarea* with the *A. vaginata* group.

It seems hardly necessary to say that the two subgenera of *Amanita* with non-amyloid spores, viz. *Vaginaria* Forq. ex Quél. and *Pseudo-amanita* Sing. formerly distinguished by Singer (1951: 386) are indefensible in our opinion, as they separate the *A. vaginata* group from the *A. caesarea* group. We heartily agree with their recent union by Singer (1962: 426).

Gilbert (1940: 71) kept *A. farinosa* Schw. by itself in the monotypical genus *Amanitella* Earle. Singer (1951: 387) put this species into *Amanita* subg. *Vaginaria* sect. *Ovigerae* Sing. However, a very closely related species, *A. obsita* Corner & Bas, described in the present paper, is placed in section *Amanita* (syn., *Amanitaria* Gilb.; *Amanita* sect. *Muscariae* (Fr.) Quél. sensu Sing.).

As *A. farinosa* may have a distinctly bulbous base to the stipe (see Gilbert 1941:

pl. 26) and has a friable volva as well as ellipsoid spores, it certainly does not belong to section *Vaginatae*, even though an annulus is lacking. The cuticle of *A. farinosa* is well developed and has a gelatinous upper layer (observed in *Hesler 22331*). Its pulverulent appearance is due to the thin and very incoherent volva. Moreover, in the present paper, two new species, viz. *A. mira* and *A. sychnopyramis*, both also without an annulus, are placed in section *Amanita*, and the annulate *A. rubrovolvata* Imai with a volva very similar to that of *A. farinosa* appears to belong there too. Therefore, the incorporation of *Amanitella* Earle in *Amanita* sect. *Amanita* seems justified.

Singer's section *Ovigerae* (1951: 386; 1962: 427) is rather artificial and heterogeneous. At present it would seem preferable to keep the species resembling *A. vaginata* but possessing ellipsoid spores, in the same section as those with globulose spores.

The infrageneric classification of the genus *Amanita* adopted in the present paper may be learned from the following key.

KEY TO THE SUBGENERA AND SECTIONS

1. Spores not amyloid. Margin of pileus mostly (in Malaya and Singapore always) distinctly striate-sulcate. Short gills nearly always truncate . . . . Subgenus *Amanita*
  2. Stipe with bulbous base. Volva mostly breaking up; if more or less membranous, then attached to greater part of bulb . . . . Section *Amanita*, p. 283
  2. Stipe without bulbous base. Volva mostly deeply sheathing, sometimes breaking up . . . . Section *Vaginatae*, p. 294
1. Spores amyloid. Margin of pileus mostly smooth (in Malaya and Singapore striate in some small species with small gills attenuate) . . . . Subgenus *Lepidella*
  3. Volva sheathing, sometimes circumcised and leaving flat patches on pileus, in that case, however, bulb of stipe marginate and spores globulose; sometimes consisting of two layers, the inner one breaking up and covering pileus, the outer forming a sheathing volva or else a membranous calyptra on centre of pileus.
    4. Volva sheathing or circumcised. Margin of pileus neither exceeding gills nor appendiculate. Flesh seldom discolouring. Spores globulose to ellipsoid. Mostly rather slender species with white to coloured cuticle . . . . Section *Phalloideae*, p. 277
    4. Volva sheathing, often consisting of a membranous outer layer and a friable inner one rendering the pileus micaceous, pulverulent, or squamulose. Margin sometimes exceeding gills and sometimes appendiculate. Flesh rather often rubescent. Spores broadly ellipsoid to subcylindrical. Mostly rather robust species with white to brown cuticle . . . . Section *Amidella*, p. 275
  3. Volva breaking up, leaving base of stipe naked or covered with powdery, flocculose, warty, patch-like or ridges-forming remnants.
    5. Pileus with well defined, mostly coloured cuticle, not exceeding gills, never appendiculate. Remnants of volva on pileus easily washed off. Gills white to cream. Ring thin, membranous, rarely breaking up into fibrillose patches. Stipe with comparatively small bulb. Spores globulose to ellipsoid . . . . Section *Validae*, p. 261
    5. Pileus with sometimes ill-defined, often white to pale cuticle, with margin mostly exceeding gills and appendiculate. Remnants of volva on pileus often more or less adnate. Gills white to deep ochraceous yellow, sometimes greenish-yellowish. Ring membranous, or thick and disrupting, or friable and rendering the stipe flocculose-pulverulent. Stipe sometimes rooting, often with large, sometimes marginate bulb. Spores globulose to subcylindrical . . Section *Lepidella*, p. 244

Subgenus LEPIDELLA (Gilb.) Vesely emend. [1]

Amanita [subgen.] *Euamanita* Lange *in* Dansk bot. Ark. **2**: 5, 7. 1915 (not valid; see Art. 21 and 32, of the 'Code' ed. 1961); *emend.* Sing. *in* Ann. mycol., Berl. **34**: 352. 1936; *in* Lilloa **22**: 387. 1951. — Lectotype (Sing. 1951): *A. phalloides* (Fr.) Link.

Lepidella Gilb. *in* Bull. Soc. mycol. France **41**: 303. 1925; not *Lepidella* Tiegh. *in* C. R. Acad. Sci., Paris **153**: 1198. 1911. — *Amanita* subgen. *Lepidella* (Gilb.) Vesely *in* Atl. Champ. Europe **1** (*Amanita*): 4, 54. 1934. — *Aspidella* Gilb. *in* Bres., Iconogr. mycol. **27** (1): 73, 79. 1940. (name change). — *Amanita* subgen. *Aspidella* (Gilb.) Gilb., Not. Amanites XXX [3]. 1941. — Type: *Amanita vittadinii* (Moretti) Vitt.

Amplariella Gilb. *in* Bres., Iconogr. mycol. **27** (1): 70, 76. 1940. — *Amanita* subgen. *Amplariella* (Gilb.) Gilb., Not. Amanites XXX [2]. 1941. — Type: *Amanita ampla* Pers. ex Larb. [= *A. excelsa* (Fr.) Gonn. & Rab.].

Amanitina Gilb. *in* Bres., Iconogr. mycol. **27** (1): 72, 78. 1940. — *Amanita* subgen. *Amanitina* (Gilb.) Gilb., Not. Amanites XXX [3]. 1941. — Type: *Amanita phalloides* (Fr.) Link.

Amidella Gilb. *in* Bres., Iconogr. mycol. **27** (1): 71, 77. 1940. — *Amanita* subgen. *Amidella* (Gilb.) Gilb., Not. Amanites XXX [3]. 1941. — Type: *Amanita volvata* Peck.

Lepidella is the oldest epithet available in subgeneric rank among those which have been typified with a species of *Amanita* with amyloid spores. Therefore, the subgen. *Lepidella* is emended here to cover all the species of *Amanita* with amyloid spores.

As a generic name, *Lepidella* Gilb. was illegitimate, it being an older homonym of *Lepidella* Tiegh. (Loranthaceae). It was changed into *Aspidella* Gilb. However, when adapted to the subgeneric level '*Lepidella*' became available again.

Section LEPIDELLA

Lepidella Gilb. — *Aspidella* Gilb. (see above).

Aspidella subgen. *Nitidella* Gilb. *in* Bres., Iconogr. mycol. **27** (1): 74. 1940 (not val. publ.). — *Amanita* sect. *Nitidella* (Gilb.) Konr. & Maubl., Agaricales 67. 1948 (not val. publ.). — Type: "*Amanita solitaria* Bull." [= *Amanita strobiliformis* (Paul. ex Vitt.) Gonn. & Rab.].

Amanita sect. *Strobiliformes* Sing. *in* Lilloa **22**: 388. 1951 (not val. publ.). — Type: *Amanita strobiliformis* (Paul. ex Vitt.) Gonn. & Rab.

Amanita sect. *Roanokensis* Sing. *in* Lilloa **22**: 388. 1951 (not val. publ.); *ex* Sing. *in* Sydowia **15**: 67. 1962. — Type: *Amanita roanokensis* Coker.

For the scope of this section, see the key to the subgenera and sections above.

KEY TO THE SPECIES OF SECTION *Lepidella*

1. Remnants of volva on pileus large, thick, pyramidal, angular or lumpish, dark brown warts. Pileus dingy pinkish. Stipe dingy vinaceous pink, squamulose, exannulate, with dark brown rim or large warts at base. Flesh turning vinaceous to purplish. Spores 10–11 μ, globulose . . . . *A. sculpta*, p. 255
1. Remnants of volva on pileus a pulverulent layer, flat patches, or pyramidal warts gradually diminishing in size toward margin of pileus.
   2. Volva merely forming conical or pyramidal warts on pileus.
      3. Pileus entirely covered with large, white, pyramidal warts with ferruginous-brown tips. Stipe stout, pale with small brownish scales. Spores 7–10.5 × 7–9.5 μ, globulose to broadly ellipsoid . . . . *A. perpasta*, p. 250

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[1] In order to avoid the less desirable name *Amanita* subgen. *Peplophora* Quél., this subgeneric name has been typified by a species with non-amyloid spores (see p. 283).

3. Pileus entirely covered with small, conical, unicoloured warts.
    4. Fruit-body white. Stipe exannulate, with bulbous to broadly clavate base, entirely covered with small warts. Spores 7–9 × 6–7.5 μ, subglobulose to broadly ellipsoid . . . . *A. virginea*, p. 248
    4. Fruit-body except gills flesh-coloured pink. Ring membranous, persistent. Stipe slenderly clavate, with small, narrow, transverse scales and scattered patches of volva at somewhat strobiliform base. Spores 7–10 × 6–8.5 μ, broadly ellipsoid to ellipsoid . . . . *A. timida*, p. 245
2. Volva not merely forming conical or pyramidal warts on pileus.
    5. Pileus covered with a greyish umber to umber, flocculose, felted or micaceous layer sometimes breaking up into crusts, patches, warts or small particles.
        6. Fruit-body small, slender. Pileus greyish white, covered with small micaceous, umber particles. Stipe white at apex, brown at base, entirely flocculose. Bulb small, attenuated into a small, pointed root. Flesh white, unchanging. Spores 6.5–9 (–10) × 5–7.5 μ, broadly ellipsoid to elongated-ellipsoid *A. vestita*, p. 252
        6. Fruit-body tall. Pileus brown to yellowish, covered with a flocculose-felted, greyish umber, unequally thick layer, sometimes breaking up into patches and warts. Upper two thirds of stipe covered with greyish lilac or greyish violet felt. Bulb fusiform or marginate with more or less rooting base. Flesh white, slowly rufescent. Spores 8–12 × 7–10.5 μ, broadly ellipsoid . . *A. eriophora*, p. 253
    5. Pileus covered with white to yellowish-brownish, flat patches.
        7. Stipe below ring glabrous, without remnants of volva, with rhizoids at base. Gills becoming deep ochraceous. Pileus whitish, with whitish to yellowish-brownish, thin patches. Smell strong. Spores 5.5–7.5 × 5–6.5 μ, globulose to broadly ellipsoid . . . . *A. gymnopus*, p. 259
        7. Stipe near base with patches or flocculose, without rhizoids, soon hollow. Gills white to cream. Pileus whitish, with very few, large, thick patches. Spores 7–8.5 × 5–7 μ, broadly ellipsoid to elongated-ellipsoid . . . . *A. centunculus*, p. 258

Amanita timida Corner & Bas, *sp. nov.* — Figs. 1, 2

Pileus 47–120 mm latus, initio globosus, dein convexus vel applanatus, margine appendiculatus neque striatus, siccus, albus vel incarnatus, verrucis conicis, minutis, duris, roseis vel incarnatis dense obsitus. Lamellae sub-confertae, albae vel cremeae. Stipes 65–160 mm longus, apice 6–16, basi 16–27 mm latus, clavatus vel subclavatus, substrobiliformis, solidus, annulatus, a summo albus, striatus, pruinosus, infra annulum subincarnatus, squarrulosus, volvae fragmentis dispersis, concoloribus, angulatis, planis vel recurvis. Annulus 10–15 mm latus, floccoso-membranaceus, supra striatus, albus, infra subincarnatus, margine verrucosus. Caro alba, rubescens, odore *Trigonellae foenum-graecum*. Sporae 7–10 × 6–8.5 μ, subellipsoideae vel ellipsoideae, amyloideae. Typus: *E. J. H. Corner s.n.*, 30 Oct. 1934, Singapore. Mac Ritchie Reservoir (L).

Etymology: timidus, timid (on account of the blushing context).

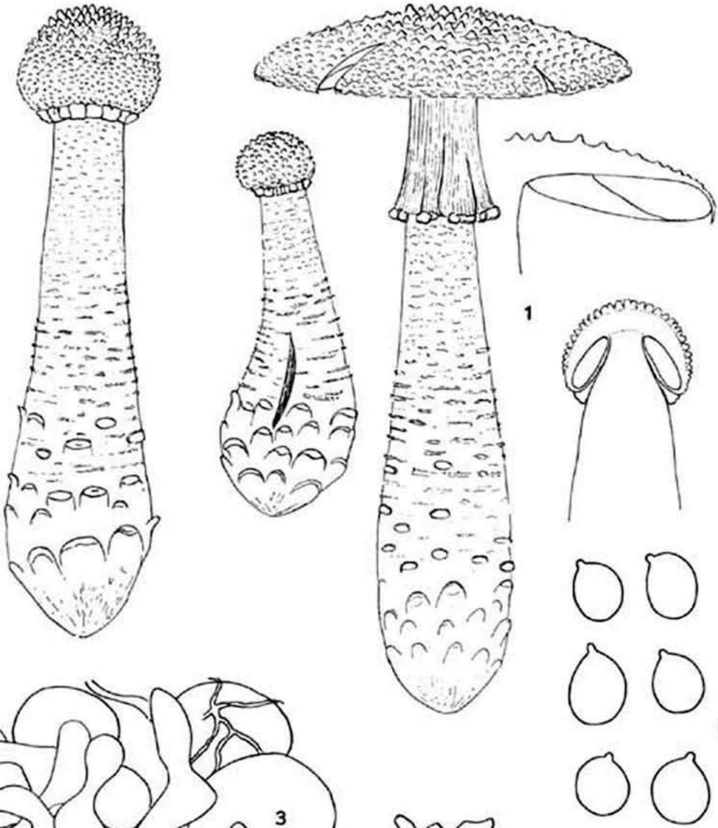
Pileus 47–120 mm wide, globose when young, convex to plane with age, without umbo, not striate at margin, dry, densely echinate with hard, micaceous, pale pink to flesh-coloured, small, pyramidal warts, 1.5–3 mm high and 1.5–2 mm wide over centre, smaller over limb, reduced to small, subfloccose, flesh pink points near margin, easily broken off over disc, becoming separated on expansion, displaying the white, pale pinkish or (when old or rained upon) flesh-coloured, subfloccose-felted flesh; margin often splitting on expansion, appendiculate with rather small membranous fragments of partial veil, sometimes with a few large angular warts similar to those on edge of annulus. Gills free, somewhat crowded, 45–56 primaries with 1–3(–7) attenuate shorter ones between each pair, rather thick, 6–13 mm wide, white then cream; edge micaceous-pruinose, irregularly serrulate. Stipe 65–160 mm long, 6–16 mm wide at apex, 16–27 mm at clavate to subclavate base, stout, solid, firm, straight or slightly curved, above ring finely longitudinally striate, pruinose and white; below ring pale pinkish flesh-coloured (except for white extreme base), with small, ascending, scarcely recurved, fibrillose, pale flesh-coloured, about 0.5–2 mm long scales and also with a few scattered, larger, hard, concolorous warts, 3–5 mm high and wide, as remnants of volva, more or less cubic in middle of stipe, flattened, with slightly recurved tips and more crowded at base of stipe (not in rings), making this part more or less strobiliform. Ring 15–30 mm below apex of stipe, 10–15 mm wide, pendant, floccose-membranous, thick, white and striate above, pinkish flesh-coloured beneath; round edge with big, hard, angular, pinkish flesh-coloured, 3–5.5 mm thick warts. Flesh 5–12 mm thick in centre, 3–6 mm half-way to margin, firm, persistently so in stipe, becoming spongy-felted in pileus, white, after an hour or more very slowly becoming pinkish in places on breaking. Whole fruit-body pinkish flesh-coloured when old or when rained upon; eventually pinkish rufescent at base of stipe. Smell faint, of fenugreek.

Spores (Fig. 2) 7.1–9.9 × 5.6–8.4 μ (fresh, 8–10 × 6.5–8 μ), broadly ellipsoid to ellipsoid, seldom subglobulose (length-breadth ratio 1.1–1.4, average 1.2–1.25), colourless, thin-walled, smooth, with a small to medium-large apiculus, with somewhat oleaginous granular contents, amyloid. Basidia 53–57 × 10–11 μ, remarkably long, slenderly clavate with long stalks, 4-spored, with clamps; sterigmata straight, up to 6 μ long. Marginal cells 20–55 × 12–35 μ, mostly pyriform, hyaline, smooth, rather numerous. Trama of gills rather irregelarly bilateral; central strand not clearly set off, composed of 3–14 μ wide, more or less longitudinal hyphae; divergent zones with elongate to short cylindrical, 5–15 (–20) μ wide cells, shorter and broader near subhymenium; subhymenium ramose to subcellular-ramose, with cells at base of basidia short cylindrical and rather narrow. Cuticle hardly differentiated, merely a denser part of trama of pileus with relatively more numerous hyphae, about 200 μ wide; without radial hyphae and without gelatinized hyphae; not separable from basal tissue of warts. Remnants of volva on pileus composed of very variable cells, more or less arranged in erect chains in apex of warts, with globulose to ellipsoid cells, up to 60 × 45 μ, and all kinds of transitional forms between those and cylindrical cells, e.g. citriform, fusiform, clavate and more irregularly shaped cells; base of warts consisting of 3–12 μ wide, interwoven hyphae with scattered, elongated cells and scattered, short, terminal rows of small inflated cells; oleiferous hyphae present. Remnants of volva on base of stipe nearly similar to those on pileus, but in their basal parts with some large, globulose cells with long peduncles. Trama of stipe with longitudinal, terminal broad, fusiform-clavate, up to 250 × 70 μ large cells, and strikingly numerous broad hyphae, mostly 5–8 μ wide, with narrower, more crowded hyphae near surface. Annulus made up of loosely interwoven, longitudinal, 3 μ and more wide hyphae, and elongate, up to 15 μ wide cells; upper side with numerous clavate cells. Clamps numerous.

HABITAT.—Terrestrial in jungle.

COLLECTIONS EXAMINED.—Singapore, Mac Ritchie Reservoir, 30 Oct. 1934 (type; several specimens; some dried and some in liquid); 7 Nov. 1934 (some dried specimens); both *E. J. H. Corner s.n.* (as *Amanita* 9).

There are no other species with small conical warts on the pileus, which have a pinkish colour and a slenderly clavate stipe in section *Lepidella*. The present species is rather similar to *A. virginea* Mass., which, however, is entirely white and has an exannulate, broadly clavate-bulbous stipe never strobiliform at the base.



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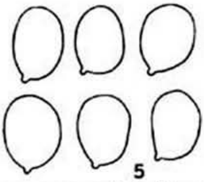

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Figs. 1, 2. *Amanita timida*. — 1. Fruit-bodies, drawn after specimens preserved in liquid (× 1). — 2. Spores (× 1250).

Figs. 3, 4. *Amanita sculpta*. — 3. Crushed remnants of veil from pileus (× 325). — 4. Anomalous bud (× $^1/_2$).

Fig. 5. *Amanita vestita*. — Spores (× 1250).

AMANITA VIRGINEA Mass.—Figs. 6–8

Amanita virginea Mass. *in* Kew Bull. **1908**: 1.
Amanita sumatrensis Boed. *in* Sydowia **5**: 326. 1951.

Pileus 100–155 mm wide, convex, then plane or slightly concave, not striate at margin, dry, white (to pale cream according to Boedijn), covered with a thin, soft, mealy, white layer, set with hard, conical, white, separable warts 2–3 mm high and wide (more slender in type; up to 4 mm long and 1—2 mm broad according to Boedijn), crowded over disc, smaller and softer and about 1 mm high and wide toward appendiculate margin; smooth and glabrous in old specimens after rain. Gills free, rather crowded, 86–121 primaries with 1–3 attenuate shorter ones between each pair, broad, 12–18 mm wide, white, with minutely floccose-micaceous, denticulate edge. Stipe 60–100 mm long, 20–50 mm wide at base, 15–25 mm at apex, solid (becoming hollow according to Massee, Boedijn), clavate-bulbous at base, more or less annulate, white, mealy, with small transverse scales up to apex, with 1–3 mm large, more or less conical warts derived from volva, often in transverse rows, where bulbous base passes into stipe, and with small flattened warts on bulb. Ring lifted up by expanding pileus, rather thick, covered with mealy small scales on underside, white, breaking and falling to pieces on expansion of pileus, leaving a narrow, irregular pendant collar, 3–5 mm wide, situated at extreme apex of stipe. Flesh 9–12 mm thick in centre of pileus, 2–3 mm half-way to margin, rather firm, white.

Spores (Fig. 8) fresh 8–9 × 6–6.5 μ (in type, 6.8–8.1 (–9.0) × 6.0–7.4 μ, length-breadth ratio 1.1–1.3, average 1.2) broadly ellipsoid, colourless, smooth, with cloudy granular contents, amyloid. Basidia 37–48 × 9–10.5 μ, 4-spored; sterigmata 3–4 μ long. Marginal cells ellipsoid to globulose (12–27 μ long according to Boedijn). Trama of gill composed of rather loose hyphae, consisting of 60–200 × 4–20 μ large cells; subhymenium compact, 2–3 cells thick; cells 15–25 × 12–20 μ. Remnants of volva on pileus and stipe made up of inflated, 20–60 × 12–40 μ large cells; narrow hyphae absent.

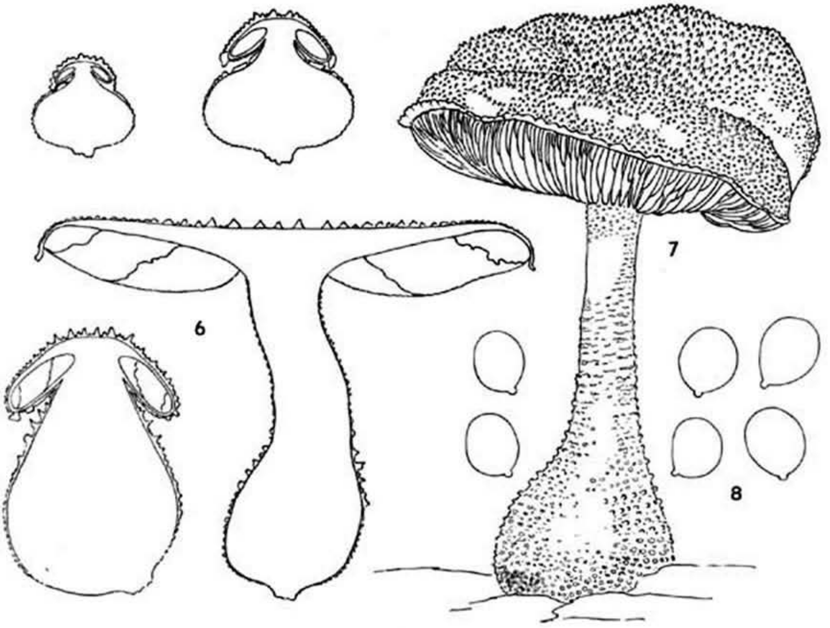
HABITAT.—Terrestrial in jungle. In Botanic Gardens in Singapore under *Quercus argentea*, appearing late in the rainy seasons, twice every year, about April and December.

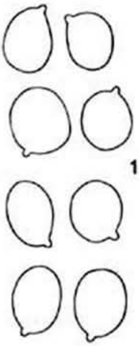
DISTRIBUTION.—Singapore, Malaya (occasionally observed by Corner), Sumatra (Boedijn, l.c., as *A. sumatrensis* Boed.; original drawing in herb. Boedijn consulted) and Java (witness an excellent water-colour drawing with microscopical analyses by van Overeem, no. 1495, in Herb. bogoriense).

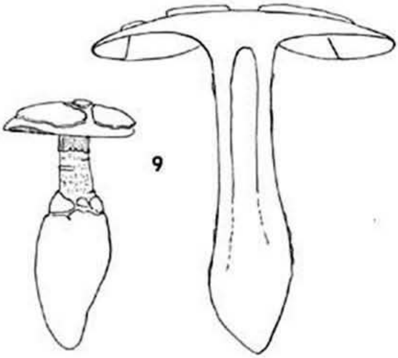
COLLECTIONS EXAMINED.—Singapore, Botanic Gardens, *Ridley 87 I* (type; 1 dried specimen; water-colour drawing; K); Gardens' Jungle, 1932 (many buds, in all stages, on liquid); 13 Dec. 1933 (several large pencil drawings), last two *E. J. H. Corner s.n.* (as *A. virginea*).

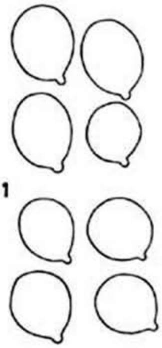
OBSERVATIONS.—The above description was made by the senior author from fresh material. All additions are bracketed. Because only buds were preserved, only the young tissues could be studied afterwards. An account of these observations follows.

Trama of gills bilateral; central strand distinct and wide, with longitudinal hyphae; divergent zones rather narrow, with narrow hyphae perpendicular to subhymenium; subhymenium not yet distinct from divergent zones. Cuticle hard to distinguish, forming a thin hyaline layer over centre of pileus, between remnants of volva and context of pileus, composed of crowded, repent, narrow, slightly gelatinized hyphae. Remnants of volva on pileus pseudoparenchymatic, consisting of erect chains of inflated cells, 10–55 × 8–40 μ, mostly ellipsoid, sometimes glob-









Figs. 6–8. *Amanita virginea*. — 6. Fruit-bodies (× 1/2). — 7. Reproduction of type drawing (× 1/2). — 8. Spores of type (× 1250).

Figs. 9, 10. *Amanita centunculus*. — 9. Fruit-bodies, reconstructed from dried specimens and description (× 1). — 10. Spores (× 1250).

Fig. 11. *Amanita perpasta*. — Spores (× 1250).

ulose, ovoid, clavate and elongate to cylindrical; narrow hyphae absent and oleiferous hyphae scarce. Flat small warts on lower part of bulb composed of inflated cells, mixed with hyphae. Tissue between velum partiale and stipe similar to warts on pileus, but cells not exceeding 35 × 25 μ, mostly smaller. Annulus composed of loosely interwoven hyphae with short, rather broad, terminal, small, clavate cells. Clamps numerous.

A study of the type specimen and the type drawing left no doubt as to Corner's collections described above and *A. virginea* Mass. being conspecific. The microscopical structure of the type was hard to analyse. Especially clamps were difficult to find, but in the end some were observed in the trama of the gills.

Massee's description of the remnants of the volva on the base of the stipe is not clear, even when the type specimen and the type drawing are consulted. His account of the size of the spores is incorrect.

Among the white species of section *Lepidella* with conical warts on the pileus *A. virginea* is easy to characterize by its broadly clavate-bulbous, entirely squamulose stipe, the white gills and the thick, disrupting annulus. For a comparison with *A. timida*, see p. 246.

Amanita perpasta Corner & Bas, *sp. nov.*—Pl. 1*a*, Fig. 11

Pileus 40–170 mm latus, convexus, dein expansus, siccus, margine appendiculata, haud striata, verrucis multangulatis vel pyramidalibus, adnatis, albidis, apice subferruginosis omnino obtectus. Lamellae liberae, modice confertae, latae, albae vel cremeae. Stipes 50–140 mm altus, basi 30–55, apice 7–16 mm latus, clavato-bulbosus vel ventricosus, albus albidusve, annulatus, verrucis granulisve brunneolis ornatus; volvae reliquis nullis. Annulus superus, 2 mm crassus, 20–25 mm latus, albidus vel brunneolus, infra verrucosus. Caro alba, leviter flavescens. Sporae 7–10 × 6.5–9.5 μ, globulosae vel late ellipsoideae, amyloideae. Typus: *E. J. H. Corner s.n.*, 4 Sept. 1942, Singapore, Bukit Timah (L).
Etymology: perpastus, well-fed.

Pileus 40—170 mm across, convex then plane, not striate at margin, dry, entirely and regularly covered with adnate, 2–9 mm wide, 2–5 mm high conical or truncate-conical warts to polygonal small scales with conical, sometimes even recurved appendages changing into small erect crowded scales toward margin; firm conical tips or appendages of warts and scales subferriginous brown, basal parts whitish to pale brown, sometimes with radiating subferriginous fibrils on surface; narrow interstices between scales pallid-cream; hence whole pileus at first somewhat ferruginous brown and echinate, then pallid to brownish and sprinkled with distant hard upright subferruginous warts; margin ragged-appendiculate with pale brownish fragments of partial veil. Gills free, rather crowded, 66–79 primaries with 1–3 (–7) rounded obliquely truncate to attenuate shorter ones between each pair, thick, broad, 4–17 mm wide, cream-white. Stipe 50–140 mm long, 30–55 mm wide at base, 7–16 mm at apex, clavately bulbous or very ventricose with pointed base or short, attenuate root, hard, firm, white to pallid, subfloccose-pruinose above ring, more or less concentrically scaly with small, 1–2 mm wide flattened brownish scales or granules below ring; scales closer and smaller and in closer circles toward base. Ring pendant from extreme apex of stipe, 20–25 mm wide, about 2 mm thick, floccose-membranous, pallid and striate above, brownish and coarsely verrucose below with subconical warts. Flesh white (turning slightly yellowish according to drawing), rather dry and firm, rather thick, 8–17 mm wide in centre, 4–11 mm half-way to margin. Smell slight, not distinctive.

Spores (Fig. 11), 6.8–8.8 × 6.6–8.2 μ (fresh, 8–10.5 × 7.5–9.5 μ), globulose to broadly ellipsoid or obovoid (length-breadth ratio 1.0–1.25, average 1.1), colourless, thin-walled, smooth, with medium-large to large apiculus, with homogeneous opalescent contents, amyloid. Basidia 48–60 × 10–14 μ, subclavate to clavate, tapering into a long stalk, with four 4–5 μ long sterigmata; contents with oily drops, especially when young. Marginal cells numerous, 20–45 × 10–30 μ, globulose to clavate, thin-walled, colourless, forming a thick sterile margin, very soon collapsing. Trama of gills in type distinctly bilateral; central strand distinct, about 30 μ wide, dense, composed of 3–10 μ wide longitudinal hyphae; divergent zones about 175 μ wide, rather dense, made up of rather abruptly diverging 3–10 (–15) μ wide hyphae with rather short cells, in outer part nearly perpendicular to subhymenium; subhymenium ramose-subcellular, thin and hard to distinguish from divergent zones, with elongate to globulose up to 10 μ wide cells; in older specimen from Malaya trama of gills much looser and more irregular; central strand hardly distinguishable, all elements slightly wider, but truly inflated cells absent. Cuticle only distinguishable at base of warts on centre of pileus of young type specimen, thin, composed of very thin, about 2 μ wide, radial hyphae with conglomerations of numerous yellowish oleiferous hyphae just underneath, apparently very soon disappearing and then warts seemingly continuous with trama of pileus. Remnants of volva on pileus: subferruginous tips of warts consisting of small cells, up to 35 μ wide, globulose to broadly ellipsoid or ovoid, arranged in chains, brownish near surface, colourless in inner part, forming a dense, firm pseudoparenchyma, traversed by 3–5 μ wide, yellowish-brownish oleiferous hyphae, especially near surface; pale basal parts of warts composed of 5–15 μ wide interwoven colourless hyphae, with enormous radiating yellow-brown oleiferous elements on surface; with narrow transitional zone between tissues of tip and base. Upper layer of ring with 5–8 μ wide hyphae with short cylindrical cells, lower layer composed of 3–20 μ wide inflated cells forming a pseudoparenchyma. No clamps observed.

HABITAT.—Terrestrial, in humus in jungle.

COLLECTIONS EXAMINED.—Malaya, Negri Sembilan, Gunong Angsi, 500 m altitude, 4 July 1930 (sector of pileus and part of ring in liquid); Singapore, Bukit Timah, 4 Sept. 1942 (type; sector of pileus in liquid; water-colour drawing); both *E. J. H. Corner s.n.* (as *Amanita* 7).

OBSERVATIONS.—The velum universale consists of two layers: an outer brownish pseudoparenchymatic one and an inner one of rather broad interwoven hyphae, the latter layer apparently closely adhering to the cuticle. As the velum universale covers the whole pileus, the structure of the cuticle can be studied only in a cross-section of a wart. In the young type specimen one finds a thin layer of repent hyphae at the base of the warts on the centre of the pileus, accentuated by numerous yellowish-brownish oleiferous hyphae which are situated just beneath this layer. In a section of a wart from near the margin of the same pileus, the thin cuticle is not (longer?) discernable, but its probable place is indicated by the layer with numerous oleiferous hyphae. The warts of the older specimen from Malaya, seem to be continuous with the trama of the pileus. There, only the brown tips of the scales would appear to belong to the velum universale.

Amanita perpasta is well characterized by the fleshy pale cap, entirely covered with conical to polygonate warts with subferruginous brown tips, the thick brownish squamulose stipe without remnants of the volva and the globulose to broadly ellipsoid spores.

Amanita vestita Corner & Bas, *sp. nov.*—Pl. 1*b*, Fig. 5

Pileus 20–45 mm latus, plano-convexus vel applanatus, centro leviter depressus, margine appendiculatus neque striatus, siccus, pallide griseolus, pulvere umbrino obsitus. Lamellae subconfertae, albae. Stipes 40–80 mm longus, apice 3–7, basi 10 mm latus, subbulbosus, solidus, radicula acuta praeditus, pruinoso-flocculosus, a summo albus, deorsum brunneolus. Annulus raro praesens, albus, pruinoso-flocculosus. Caro alba. Sporae 6.5–9(–10) × 5–7.5 μ, subellipsoideae vel ellipsoideae, amyloideae. Typus: *E. J. H. Corner s.n.*, 23 March 1943, Singapore, Botanic Gardens (L).

Etymology: vestitus, coated.

Pileus 20–45 mm wide, plano-convex to plane with slightly depressed centre, slightly undulate, not striate at margin, dry, pale greyish white, covered with small micaceous umber particles, condensed to a soft, 1 mm thick layer over centre; margin appendiculate with soft white remnants of partial veil. Gills free or slightly adnexed, fairly crowded, 40–50 primaries with 1–3 obliquely truncate to attenuate shorter ones between each pair, 3–5 mm wide, rounded near margin of pileus, milk-white. Stipe 40–80 mm long, 3–7 mm wide at apex, 10 mm at subbulbous base, with short pointed root, solid; upper part white to whitish, mostly covered with minute white flocculose remnants of ring; lower part brownish, with umber mealy-flocculose remnants of friable volva. Ring sometimes incompletely present, white, flocculose-mealy. Flesh white, rather soft, 2–2.5 mm thick in centre of pileus.

Spores (Fig. 5) 7.3–9.3 × 5.6–6.8 μ (fresh, 6.5–9–10 × 5–7.5 μ), broadly ellipsoid to ellipsoid or obovoid, sometimes even elongate ellipsoid (length-breadth ratio 1.25–1.45 (–1.6), average 1.35–1.4), colourless, thin-walled, smooth, with small to medium-large apiculus, with cloudy contents, amyloid. Basidia 30–40 × 9–10 μ, 4-spored; sterigmata 4 μ long. Marginal cells scattered, 30–60 × 10–30 μ, globulose to clavate, colourless or with fuliginous-umber sap, thin-walled. Trama of gills thin, bilateral; central strand distinct, about 20 μ wide, composed of compacted 3–8 μ wide hyphae; divergent zones with cylindrical to elongate ellipsoid, 4–12 μ wide cells; subhymenium rather narrow, 20–30 μ wide, cellular, composed of ellipsoid to globulose, 8–18 μ long cells. Cuticle rather thin, not separable from inner part of remnants of volva, made up of (subradial?) loosely interwoven, 3–10 μ wide hyphae. Remnants of volva on pileus mainly consisting of cells 15–70 μ wide, globulose to ellipsoid, with fuliginous-umber contents, mostly arranged in loosely interwoven short chains, mixed with 2.5–6 μ wide hyphae and with some fusiform-inflated cells. Remnants of volva on base of stipe nearly similar, but globulose cells more rarely in rows and branching hyphae more numerous, with globose cells attached to them. Trama of stipe with mostly terminal longitudinal fusiform-clavate cells, up to 300 × 40 μ, similar near surface. No clamps observed.

HABITAT.—Terrestrial in jungle; solitary.

COLLECTIONS EXAMINED.—Singapore, Botanic Gardens, Gardens' Jungle 1929 (notes only); 23 March 1943 (type; one specimen in liquid; water-colour drawing); both *E. J. H. Corner s.n.* (as *Amanita* 2).

This species with its brownish, pulverulent volva, friable ring, rooting bulb, and ellipsoid spores, undoubtedly comes very close to *A. cinereoconia* Atk. (1909: 366) from North America. Especially the description of that species given by Bigelow (1959: 127) fits the Malayan material rather well; only the remnants of the veil on the cap of his specimens are more conical and his specimens tend to be larger (2.5–7–11 cm). However, the specimens on A. H. Smith's photograph, reproduced by Gilbert (1941: pl. 66), are very robust with rather big bulbs and look quite different from the Malayan specimens described above.

In the original description of *A. cinereoconia*, Atkinson described the spores as subelliptical to suboblong, 8–12 × 4–6 μ; apparently the length-breadth ratio was about 2! Likewise, the spores of A. H. Smith's specimen depicted by Gilbert (1940: 197) measure 10–11.5 × 5–6 μ and their length-breadth ratio ranges between 1.7 and 2.1. Although according to the accounts of Coker (1917: 86) and Bigelow (1959: 86) the spores may be less elongate, their length-breadth ratio seems to vary from 1.5 to 2.1, which is considerably more than in *A. vestita*, where it varies from 1.3 to 1.5, exceptionally to 1.6.

Summarizing, one may say that *A. vestita* from the tropical rainforest in Singapore strongly resembles *A. cinereoconia* from North America, but that the latter species appears to have more slender spores, tends to form larger fruit-bodies, and grows in a totally different climate.

A. griseofarinosa from Japan, recently described by Hongo (1961: 39), is rather similar to the two species discussed above, both as to habit and colours. In this species, however, according to the drawings and the description, the spores seem to be still shorter than in *A. vestita*. Moreover, the spores of *A. griseofarinosa* are considerably larger, viz. 9.5–11.5 × 7.5–9.5 μ against 6.5–9 (–10) × 5–7.5 μ in *A. vestita*, and the subbulbous base of the stipe is not rooting.

AMANITA ERIOPHORA (Berk.) Gilb.—Figs. 12–15

Agaricus (*Amanita*) *eriophorus* Berk. *in* Hook. J. Bot. **2**: 43. 1850. — *Amanitopsis eriophora* (Berk.) Sacc., Syll. Fung. **5**: 26. 1887. — *Amanita eriophora* (Berk.) Gilb. *in* Bres., Iconogr. mycol. **27** (2): 230. 1941.

Pileus 90–220 mm wide, hemispherical at first, becoming convex with flattened centre, then plane or slightly concave, sometimes with umbo, not striate at margin, pale dingy brown to pale brownish or yellowish, slightly viscid (judging from microscopical structure of cuticle), at first entirely covered with subfloccose-felted greyish umber universal veil of unequal thickness, later on with greyish brown, subfloccose-felted, adnate large flat patches and scattered irregular more or less conical warts, 6–16 mm wide, 3–6 mm high, widely spaced toward margin, crowded over centre; margin more or less appendiculate with grey felted fragments of ring. Gills free, but with slight decurrent lines on apex of stipe, crowded, 140–165 primaries with 1–3 attenuate shorter ones between each pair, broad, 8–16 mm wide, white then cream; edge entire, often thinly felted or appendiculate with greyish lilac tissue of partial veil, especially near apex of stipe. Stipe 120–160 mm high (excluding rooting part), 15–22 mm wide at apex, 25–37 mm wide just above shortly cylindrical, subglobose, or napiform, sometimes strongly marginate, 30–70 mm long, and 35–55 mm wide, bulbous base tapering into a stout, 20–35 mm long, solid, firm, whitish to pallid root; upper two thirds thinly covered with greyish lilac felt of partial veil; lower third more or less smooth, often pale dull rufescent with age; bulb covered with adnate volva, sometimes with a thick, free, erect or recurved, entire or split, up to 20 mm high rim or with merely a slight ridge. Ring ill-defined, floccose-felted, greyish lilac, either forming a vague thickened felted girdle on stipe, about two thirds from apex, or fragments hanging down from margin of pileus.

Flesh 11–22 mm thick in centre of pileus, 5–8 mm thick half-way to margin, white, firm, very slowly but distinctly rufescent on bruising or cutting, pinkish with age. Smell, faint, slightly nutty.

Spores (Fig. 14–15) 9.1–10.9 × 7.3–9.3 μ (fresh, 9–10 × 7–8.5 μ), broadly ellipsoid, sometimes subglobulose (length-breadth ratio 1.1–1.25, average 1.2), colourless, thin-walled, smooth, with rather large apiculus, with cloudy-oleaginous contents, amyloid. Basidia 40–48 × 11–13 μ, 4-spored; sterigmata 4 μ long. Marginal cells 35–60 × 12–25 μ, clavate colourless, forming a sterile edge. Trama of gills seems to be composed of hardly inflated, sometimes up to 20 μ wide, hyphae; subhymenium apparently subcellular-ramose, with rather small cells. Cuticle rather thin, consisting of subradial, interwoven, 2.5–8 μ wide, brownish hyphae and some up to 20 μ wide oleiferous hyphae; gelatinized near surface. Remnants of volva on pileus made up of a mixture of variously shaped cells, easily breaking up on boiling or crushing, mainly consisting of brown, globulose to ellipsoid cells often in short chains and up to 60 μ, seldom 110 μ, long, mixed, however, with rather broad, 3–12 μ (mostly 5–8 μ) wide branching hyphae often forming very irregular elements, passing into inflated cells by gradually thicker and shorter cells; also some up to 20 μ wide oleiferous hyphae present. Trama of stipe with longitudinal, slenderly clavate, mostly terminal cells, up to 300 × 35 μ. Remnants of ring on stipe a mixture of hyphae and inflated cells. No clamps observed.

HABITAT.—Terrestrial in jungle; in small groups.

DISTRIBUTION.—India (Darjeeling), Singapore, Malaya.

COLLECTIONS EXAMINED.—Singapore, Reservoir Jungle, 26 March 1931 (several dried slices of at least two specimens) *E. J. H. Corner s.n.* (as *Amanita* 8); also observed by Corner in Malaya, Johore, Tebrau, 24 Sept. 1939.

OBSERVATIONS.—It seems unlikely that the thick fleshy rim on the bulb depicted in some of the specimens is formed only by the volva; most likely the trama of the bulb participates in its formation.

The type of *A. eriophora* (*J. D. Hooker 111*, Darjeeling), kindly put at our disposal by the director of the Herbarium at Kew, seems to represent an old specimen of the species described above. The habit, the colours, the spores and the microscopical structure of the remnants of the volva on the pileus are rather similar. As appears from Hooker's water-colour drawing, of which recently a copy was kindly presented to the Rijksherbarium at Leiden, the stipe of the type was nearly entirely pale greyish violet and floccose, and the bulb whitish, broadly fusiform and slightly rooting.

However, there are also some differences. The pileus of the type is covered entirely with a thin pruinose-subfloccose brown layer derived from the volva and, according to a note by Hooker on the drawing, gelatinous in the centre. However, Hooker added, "... I expect only from drenching rain." Moreover, the margin of the pileus of the specimen depicted is shortly striate.

All these differences are easy to explain, if one assumes the type to be an old specimen, collected after heavy rains, which caused the more wart-like remnants of the volva on the pileus to disappear. In the specimens from Singapore very thin powdery-flocculose remnants of the volva also occur, nearly everywhere on the pileus between the more patch-like remnants. This is clearly seen in the drawing (Fig. 12).

In the specimens from Singapore the flesh was slowly rufescent. Nothing alike is mentioned in the type description, but in the type drawing the flesh of the stipe is dingy greyish-brownish.

Berkeley incorrectly stated the gills to be adnate. In both Hooker's and Corner's drawing the more or less pointed gills just reach the apex of the stipe.

Some microscopical features of the type are: Spores 8.2–12.2 × 7.0–10.7, subglobulose to broadly ellipsoid, sometimes globulose (length-breadth ratio 1.0–1.25, average 1.1–1.15), with rather large apiculus, amyloid. Remnants of the volva on the pileus consisting mainly of ellipsoid, brown cells up to 70 × 40 μ arranged in short, easily disrupting chains, mixed with about 10 μ wide, irregular subcylindrical elements and rather thin, radial hyphae. Context of stipe showing *Amanita* structure. No clamps observed.

Because of the friable ring, the dark-coloured velum universale and the more or less rooting, bulbous base of the stipe, this very large and handsome species bears some resemblance to *A. cinereoconia* Atk. (1909: 366) from North America and *A. vestita* Corner & Bas from Singapore. It differs, however, from both by the blushing flesh, the different colours of cuticle and velum partiale, and the large size; in addition, from *A. cinereoconia* by the shorter spores.

Another species, comparable to *A. eriophora* is *A. borneensis* Boed. (1951: 324), placed, erroneously in our opinion, in subgenus *Amanitina* by its author. [2] Judging from the original pencil drawing, kindly placed at our disposal by Dr. K. B. Boedijn, this species has almost the same habit as *A. eriophora*, but the bulbous base of the stipe is more or less globose and not rooting. In addition, the cap and stipe are pinkish brown, the gills dingy pinkish and the spores globulose, (7.5–) 8–9 (–11) μ, which clearly distinguishes the species from *A. eriophora*. Nevertheless, these two species are rather closely related and seem to find their natural place somewhere near *A. cinereoconia* and *A. vestita*.

Amanita sculpta Corner & Bas, *sp. nov.*—Pl. 2, Figs. 3, 4

Pileus 100–240 mm latus, convexus, centro leviter depressus, dein applanatus, margine appendiculatus neque striatus, pallide roseo-brunneus vel pallide griseo-brunneo-vinosus, siccus, verrucis magnis crassisque, solidis, pyramidalibus vel irregularibus, purpureo-brunneis ornatus. Lamellae liberae, confertae, latae, modice crassae, albae vel cremeae. Stipes 120–240 mm longus, sursum attenuatus, apice 7–16 mm latus, basi bulbosus et 20–65 mm latus, plenus, annulatus, sordido-albidus vel sordido-vinosus, farinoso-floccosus vel floccoso-squamosus, ad basin margine purpureo-brunneo vel verrucis purpureo-brunneis ornatus. Annulus floccoso-submembranaceus vel friabilis, pallide sordido-vinaceus. Caro solida, alba, vinaceo-brunnescens vel purpurascens. Odore piri maturi. Sporae 10–11 μ, globulosae vel subglobulosae, amyloideae. Typus: *E. J. H. Corner s.n.*, 9 July 1940, Singapore, Bukit Timah (L).

Etymology: sculptus, sculptured.

Pileus 100–240 mm wide, convex, sometimes with depressed centre, then plane, not striate at margin, slightly exceeding gills, incurved at first, pale brownish pink to pale greyish madder brown, whitish or greyish pinkish toward margin, dry, set with distant, dark madder brown or chocolate brown, erect, firm, 3–16 mm high, 2–15 mm wide warts, slender conical to pyramidal over centre, more angular or

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[2] Boedijn (1951: 323) emended *Amanitina* Gilb. (which he considered a subgenus), by describing the volva as "more or less strongly coalescent with bulbous base, often only present as rings," thus leaving out one of the most important features of this up till now rather natural taxon, namely the sheathing to circumcised volva. In this way '*Amanitina*' was thrown open to foreign elements. As a matter of fact Boedijn's first species, *A. borneensis*, belongs to '*Aspidella*' and the second, *A. neglecta*, to '*Amplariella*'. Only his *A. tjibodensis* appears to be a true member of '*Amanitina*'.

lumpish near margin, easily breaking off, attached by a pale, radiating base; finally whole pileus dingy madder brown; margin appendiculate with floccose-submembranous, pale dingy vinaceous remnants of partial veil. Gills free, crowded, 140–200 primaries with 0–1 obliquely truncate to rounded attenuate shorter ones between each pair, broad, 7–16 mm wide, rather thick, white to pale cream, often with edge pale dingy vinaceous powdery from remnants of partial veil. Stipe 120–240 mm long, 12–40 mm wide above, 20–65 mm at base, more or less thickened downward, with napiform or fusiform bulbous base, stout, solid, fibrous, dingy whitish, mealy-floccose to floccose-squamulose with pale dingy vinaceous remnants of partial veil, with coarser madder brown, sometimes recurved squamules toward base and some stout, firm, lumpish, madder brown warts or an abrupt margin around base; whole stipe becoming madder brown with age. Ring thick submembranous, floccose-arachnoid, disrupting, pale dingy vinaceous, leaving remnants at edge of pileus, at edges of gills, and on stipe. Flesh 11–20 mm thick in centre of pileus, 5–9 mm half-way to margin, firm, sappy, white, turning dull brownish vinaceous, dull vinaceous purplish or dull purplish on cutting or bruising. Smell faint, of ripe pears. All parts of young primordium white, but all outer parts colouring when volva starts disrupting.

Spores (fresh!) 10–11 μ, subglobulose, colourless, smooth, with cloudy-vacuolate contents (no spores in preserved specimens). Basidia 45–50 × 12–13 μ, clavate, 4-spored; sterigmata 5–6 μ long. Marginal cells numerous, forming a thick sterile margin along edges of gills, 18–40 × 16–30 μ, globulose to ellipsoid, terminal on 1.5–3 (–6) μ wide hyphae, often with pale madder brown walls. Pleurocystidia absent, but some brownish, basidium-like, distinctly pseudo-amyloid cells present, connected with similar hyphae in trama of gills. Trama of gills bilateral; central strand and divergent zones not set off from each other, composed of loose, slightly interwoven longitudinal to divergent, 3–15 μ wide hyphae with cells up to 80 μ long, slightly more crowded in central strand, sometimes up to 25 μ wide near subhymenium; some of these hyphae brownish, with wavy walls, turning brownish red in Melzer's solution; subhymenium narrow, about 20 μ wide (perhaps wider in mature specimens?), ramose-subcellular, with cells ellipsoid-sybcylindrical, 10–20 × 5–10 μ. Cuticle hardly differentiated, formed by a 400 μ wide layer denser than trama of pileus, composed of repent, interwoven, 2–10 (–15) μ wide hyphae, scattered elongate cells up to 20 μ wide, sometimes with slightly thickened walls, and some oleiferous hyphae, up to 20 μ wide; only the upper 10–30 μ wide layer consisting of more slender slightly gelatinized hyphae, 1.5–5 μ wide. Remnants of volva on pileus (Fig. 3) made up of a dense tissue of (i) ellipsoid to globulose, mostly terminal, cells up to 80 × 70 μ, (ii) 5–8 μ wide hyphae, passing into chains of very irregularly inflated elongate, often branching elements, and (iii) very thin branching hyphae, 1.5–2 μ wide; madder brown pigment in walls, not in sap. Remnants of volva on base of stipe similar, but inflated cells more ellipsoid, up to 90 × 50 μ. Trama of stipe with longitudinal, terminal, clavate, or mostly broadly clavate cells, up to 300 × 50 μ; floccose covering made up of shorter clavate cells, mixed with hyphae, some of which with refractive contents and slightly swelling

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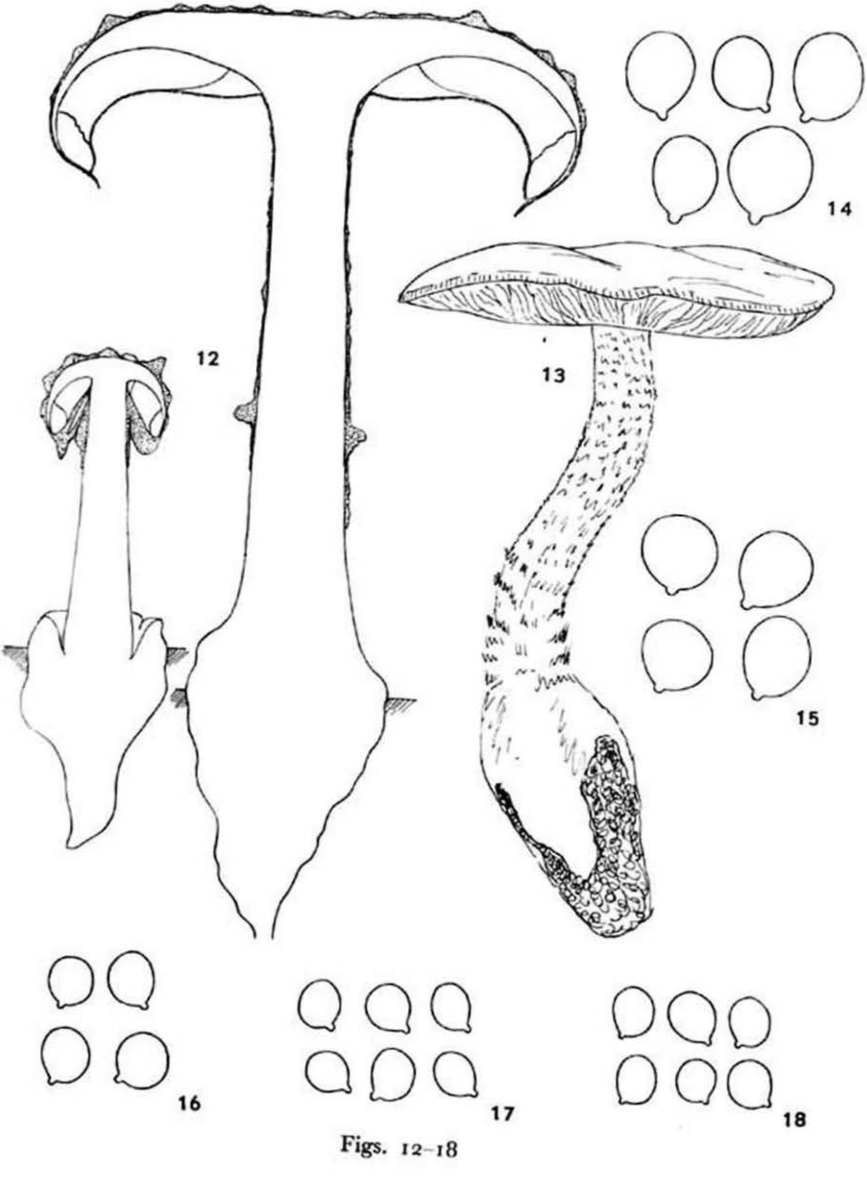
EXPLANATION OF FIGURES 12-18

Figs. 12–15. *Amanita eriophora.* — 12. Fruit-bodies (× $^{1}/_{2}$). — 13. Reproduction of type drawing (× $^{1}/_{2}$). — 14. Spores (× 1250). — 15. Spores of type (× 1250).

Fig. 16. *Amanita gymnopus.* — Spores (× 1250).

Fig. 17. *Amanita pausiaca.* — Spores (× 1250).

Fig. 18. *Amanita xanthomargaros.* — Spores (× 1250).



Figs. 12–18

in KOH and then here and there constricted by encrusting matter. No clamps observed.

HABITAT.—Terrestrial in forest; solitary.

COLLECTIONS EXAMINED.—Singapore, Bukit Timah, 15 Oct. 1939 (one bud in liquid); 9 July 1940 (type; one dried specimen without mature spores; water-colour drawing); 2 Sept. 1940 (water-colour drawing); all *E. J. H. Corner s.n.* (as *Amanita* 14); observed several other times on same spot, but never elsewhere in Singapore and Malaya.

OBSERVATIONS.—One quarter grown fruit-body (Fig. 4) was described separately on account of the naked stipe; the remnants of the volva being restricted to the pileus and forming there very high, irregular warts.

According to Corner's observations on fresh material, the discoloration of the volva is due to discoloration of the hyphal walls or granules on the outside of the hyphae.

Amanita sculpta stands rather isolated in section *Lepidella* on account of the strong purplish to vinaceous brown discoloration of the whole fruit-body except the gills, of the thick volva forming large conical to angular lumpish warts, and of the more or less globulose spores. The most closely related species seems to be *A. ochrophylla* (Cooke & Mass.) Clel. from Australia. The flesh of this species discolours to brick red and the spores are subglobulose, but the volva is much thinner and the ring well-shaped.

Amanita centunculus Corner & Bas, *sp. nov.*—Figs. 9, 10

Pileus 50–60 mm latus, convexus, dein applanatus, margine haud striatus, albus, siccus, verrucis raris, magnis, planis, angulatis, albis vel brunneolis. Lamellae confertae, crassae, angustae, albae. Stipes 40–50 × 10–13 mm, subbulbosus, subradicatus, cavescens, albus, floccoso-pruinosus, subannulatus, basi initio verrucis planis, albis brunneolisve tectus, dein flocculosus. Annulus 6–10 mm latus, fragilis, totus appressus, albus, striatus, saepe laceratus. Caro alba. Sporae 7–8.5 × 5–6 μ, subellipsoideae vel longe ellipsoideae, amyloideae. Typus: *E. J. H. Corner s.n.*, 16 Aug. 1939, Singapore, Bukit Timah (L).

Etymology: centunculus, small blanket (on account of the large patches on the pileus).

Pileus 50–60 mm wide, convex then plane, not striate at margin, white, dry, with a few, sometimes only three, large, flat, angular, white then brownish, felted-membranous, 5–15 mm wide, 1–2 mm thick patches of volva, otherwise partly glabrous and smooth, partly thinly and finely felted to scurfy-pruinose. Gills free, crowded, about 100 primaries with 1(–3) truncate, obliquely truncate or (longer ones) attenuate lamellulae between each pair, rather thick and narrow, 3–4 mm wide, white, with a thickly micaceous-pruinose edge. Stipe 40–50 × 10–13 mm, slightly enlarged toward subbulbous, shortly rooting base, becoming widely hollow, white, wholly finely floccose-pruinose, more or less annulate; base at first with some white to brownish patches, later on obscurely and thinly peronate with fading remnants of volva, finally merely flocculose. Ring 6–10 mm wide, superior, pendant, but entirely attached to stipe, white, more or less split and lacerate, felted-floccose, striate on upper side. Flesh white, rather soft, thick, 5–6 mm in centre of pileus. Smell like in *A. strobiliformis*.

Spores (Fig. 10) 7.3–8.5 × 4.7–6.2(–7.8) μ (fresh, 7–8.5 × 5.5–6 μ), broadly ellipsoid, ellipsoid, or elongate ellipsoid, seldom subglobulose (length-breadth ratio (1.05–)1.2–1.6, average 1.35), colourless, thin-walled, smooth, with medium-large apiculus, with cloudy vitreous contents, amyloid. Basidia 30–38 × 9–11 μ, 4-spored, granular; sterigmata 4 μ long. Marginal cells 20–50(–70) × 10–30 μ, clavate to globulose, thin-walled, colourless, forming a thick sterile edge. Trama of gills bilateral, with rather large, elongate to clavate cells, up to 100 × 25 μ or 80 × 35 μ. Cuticle about 200–250 μ wide; upper part gelatinous, with irregularly interwoven, 1.5–3 μ wide hyphae; lower part with more crowded, up to 8 μ wide radial hyphae. Remnants of volva on pileus consisting of globulose, ellipsoid and piriform, probably terminal cells, up to 40 × 25 μ, mixed with many, 1.5–7 μ wide, branching hyphae and scarce, elongate cells. Remnants of volva on base of stipe as on pileus, but hyphae more numerous; inflated cells mostly directly on thin hyphae, sometimes, however, with some short cylindrical intervening cells. Trama of stipe with terminal, longitudinal, cylindrical-clavate, up to 250×45 μ large cells; without cortex. Floccose covering of stipe (derived from partial veil) consisting mainly of clavate cells, up to 60 × 30 μ, mixed with rather narrow hyphae. No clamps observed.

HABITAT.—Terrestrial in forest; solitary or in small groups.

COLLECTIONS EXAMINED.—Singapore, Bukit Timah, 16 Aug. 1939, *E. J. H. Corner s.n.* (type; dried fragments of 3 specimens) (as *Amanita* 11).

This entirely white species, with a bulbous and slightly rooting stipe, large, flat, and thick patches on the pileus, and an incoherent ring, resembles *A. strobiliformis* (Paul. ex Vitt.) Gonn. & Rab. from Europe. It is, however, easily distinguished by the small size, the relatively short stipe becoming widely hollow, and the considerably smaller spores, viz. 7.5–8.5 × 5.0–6.0(–7.5) μ against 10–13 × 7–10 μ in the latter species.

Another small species of section *Lepidella*, viz. *A. nana* Sing. (1941: 85) from Russia, differs by slightly pointed scales composed of hyphae on the pileus, and larger spores, viz. 10.5–13.5 × 7–10 μ. *Amanita silvicola* Kauffm. (1926: 123) from North America, which also has a relatively short stipe, is different on account of the thin velum universale and a different type of bulb.

The hollow stipe of *A. centunculus* is a very conspicuous feature within section *Lepidella*. To be sure, the stipe may become more or less hollow in some other species, such as *A. pulverulenta* Beeli, *A. lanosa* Beeli, and *A. boudieri* Barla forma *beillei* (Beauseigneur) Gilb., but in all these the character is not so pronounced as in the present species.

Amanita gymnopus Corner & Bas, *sp. nov.*—Pl. 4*a*, Fig. 16

Pileus 50–110 mm latus, convexus, dein applanatus vel concavus, saepe subumbonatus, margine haud striatus, initio albus, dein cremeus vel pallide brunneus, siccus, verrucis tenuibus, applanatis, 1–7 mm latis, albis vel pallide ochraceo-brunneis. Lamellae subconfertae, initio pallide ochraceo-cremeae, dein flavo-ochraceae. Stipes 60–140 mm longus, apice 7–11, basi 16–25 mm latus, clavato-bulbosus, solidus, durus, albus vel flaveolus, basi pallide roseobrunnescens, subglaber, volvae fragmentis nullis, vulgo radiculis praeditus; apice pruinosus vel subsquamulosus. Annulus angustus, fragilis, albus vel flaveolus, striatus. Caro alba vel pallide flaveola, rubescens, odore forti. Sporae 5.5–7.5 × 5–6.5 μ, globosae vel ellipsoideae, in cumulo albae, amyloideae. Typus: *E. J. H. Corner s.n.*, 20 April 1941, Malaya, Johore, Gunong Panti (L).

Etymology: γυμνός, naked; πούς, foot.

Pileus 50–110 mm wide, convex, then plane or concave, often subumbonate, not striate at margin, slightly exceeding gills, white, becoming pale yellowish, cream or pale brownish, especially near edge, dry, minutely appressedly cottony-felted, set with small, thin, flat, floccose-membranous, white to pale brownish ochraceous patches from volva, 1–3 mm wide, larger and more distinctly patch-like, 4–7 mm wide over disc, washing off in wet weather. Gills free, rather crowded, 70–85 primaries with 1–7 rounded-attenuate shorter ones between each pair, pale cream-ochraceous, then deep ochraceous, thick, broad, 5–10 mm wide. Stipe 60–140 mm long, 7–11 mm wide above, 16–25 mm at clavate-bulbous base, tapering upward, with dilated apex 12–28 mm wide, solid, firm, fibrous, white, then pale yellowish or tinged pale pinkish brown especially at base, nearly smooth, minutely rimose, pruinose or even subsquamulose toward apex, glabrous below, without any trace of volva, mostly with some rhizomorphs. Ring narrow, 3–5 mm wide, pendant from upper part of stipe, whitish to pale yellowish, striate on upper side, smooth beneath, generally breaking up and falling off on expansion of pileus. Flesh 6–12 mm thick in centre of pileus, 2–5 mm half-way to margin, firm and sappy at first, rather dry and soft in old specimens, white to pale yellowish, especially in stipe, very slowly turning pale reddish brown on cutting or bruising. Smell strong, of burnt sugar and iodoform. Spore print white.

Spores (Fig. 16) 5.2–6.7 × 4.9–6.7 μ (fresh, 7–7.5 × 6–6.5 μ), globulose to broadly ellipsoid (length-breadth ratio 1.0–1.25, average 1.15), colourless, thin-walled, smooth, with medium-sized apiculus, with cloudy granular (slightly oily?) contents, sometimes with one small gutta, amyloid. Basidia 44–48 × 6.5–9 μ, conspicuously slender, 4-spored; sterigmata 4–5 μ long. Marginal cells in preserved specimen scarce, inflated, up to 30 μ wide. Trama of gills distinctly bilateral; central strand and divergent zones not set off from each other, composed of up to 12(–15) μ wide hyphae slightly constricted at septa, with up to 85 μ long cells; subhymenium about 40 μ wide, subramose-cellular, with cells ellipsoid and up to 25 μ long in inner parts and globulose, about 7–10 μ wide at base of basidia. Cuticle about 150 μ wide, composed of 3–10 μ wide, repent, colourless hyphae, interwoven but tending to a radial arrangement especially in lower part, not gelatinized near surface. Remnants of volva on pileus made up of 3–10 μ wide, interwoven, winding hyphae, often slightly constricted at septa, and scattered elongate to slender clavate (mostly terminal?), up to 20 μ wide cells (globulose and ellipsoid cells entirely lacking). Trama of stipe with terminal longitudinal, slenderly clavate to broadly clavate, up to 350 μ long, mostly up to 50 μ, sometimes even 75 μ wide cells; near surface covered by strands of 2–14(–20) μ wide, longitudinal hyphae. No clamps observed.

Habitat.—Terrestrial in jungle; gregarious.

Collections examined.—Malaya, Johore, Gunong Panti, 250–400 m altitude, 20 April 1941 (type; fragments of 3 specimens in liquid), *E. J. H. Corner s.n.* (as *Amanita* 19).

This remarkable species has several outstanding features: (i) there are no traces of the volva on the base of the stipe; (ii) the bulb of the stipe mostly bears one or more rhizomorphs; (iii) the gills become deep ochraceous; (iv) the species has a peculiar smell. Even in the preserved material the stipes are remarkably firm. The remnants of the volva on the pileus are more membranous than floccose, as they are easily detachable from the cuticle as thin membranous patches.

Amanita gymnopus seems to be related to *A. foetens* Singer (1953: 15) from Argentina, which also has a strongly reduced volva, yellow gills, a strong (although different) smell and globulose or almost globulose spores, but differs by the farinaceous warts on the pileus, the unchangeable flesh, the rather thick non-striate annulus, and other features.

Section VALIDAE (Fr.) Quél.

Agaricus [sect.] *Validae* Fr., Monogr. Amanit. Succiae 10. 1854. — *Amanita* [sect.] *Validae* (Fr.) Quél. *in* Mém. Soc. Emul. Montbéliard, ser. II, **5**: 69. 1872 (Champ. Jura **1**: 30); Sing. *in* Lilloa **22**: 388. 1951 ("sect"). — Lectotype (Sing., l.c.): *Amanita valida* (Fr.) Quél. [= *Amanita excelsa* (Fr.) Gonn. & Rab. s.l.].

Amanita [sect.] *Obliteratae* Quél., Fl. mycol. France 303. 1888. — Lectotype: *Amanita rubens* (Scop.) Quél. [= *Amanita rubescens* (Pers. ex Fr.) S. F. Gray].

Amanita [sect.] *Incompletae* J. Schroet. *in* Kryptog.-Fl. Schlesien **3** (1): 677. 1889; P. Henn. *in* Natürl. PflFam. **1** (1**): 273 ("sect"). 1898. — Lectotype: *Amanita spissa* (Fr.) Opiz [= *Amanita excelsa* (Fr.) Gonn. & Rab. s.l.].

Amplariella Gilb. *in* Bres., Iconogr. mycol. **27** (1): 73, 78. 1940. — *Amanita* subgen. *Amplariella* (Gilb.) Gilb., Not. Amanites XXX [4]. 1941. — *Amanita* sect. *Amplariella* (Gilb.) Konr. & Maubl., Agaricales 65. 1948. — Type: *Amanita ampla* Pers. ex Larb. [= *Amanita excelsa* (Fr.) Gonn. & Rab. s.l.].

For the scope of this section, see the key to the subgenera and sections on p. 243.

KEY TO THE SPECIES OF SECTION *Validae*

1\. Small species with margin of pileus distinctly striate.

  2\. Pileus yellow to pale yellow, set with brighter yellow, conical warts. Stipe white, with yellowish, floccose remnants of volva at subbulbous base. Ring white with yellowish edge. Spores 6.5–8(–9) × 5–7 μ, subglobulose to broadly ellipsoid *A. xanthella*, p. 274

  2\. Pileus greyish brown or olivaceous brown.

    3\. Pileus greyish umber to pale brownish grey, sprinkled with minute fuliginous particles. Stipe pale grey to whitish, with 1–3 faint greyish pruinose circles from volva at subbulbous base. Ring white with fuliginous edge, at or below middle of stipe. Spores 6.5–9.5 × 5–6.5 μ, broadly ellipsoid to ellipsoid . . . *A. demissa*, p. 272

    3\. Pileus olivaceous brown. Stipe yellow-olivaceous, with yellowish apex 5

1\. Small to large species with margin of pileus smooth or only shortly striate with age.

  4\. Fruit-bodies in places with yellow and olivaceous tinges. Spores small, 4.5–7 × 4.5–6 μ.

    5\. Pileus fuscous to olivaceous brown, yellowish near margin, with yellow-tipped, umber warts. Stipe pale greyish brown with yellowish apex and 2–3, partly fuscous, partly yellow, scurfy rings at base. Ring pale yellow with deep yellow edge. Spores 5.5–7 × 4.5–6 μ, subglobulose to broadly ellipsoid . . *A. xanthomargaros*. p. 270

    5\. Pileus olivaceous brown, with small greyish patches. Stipe pale yellow-olivaceous with yellow apex and 2–3 rings of fuscous-olivaceous small warts at base. Ring white, with yellowish verruculose edge. Spores 5–6 × 4.5–5 μ, globulose to broadly ellipsoid . . . . *A. pausiaca*, p. 271

  4\. Fruit-bodies without olivaceous and yellow tinges. Spores > 6 μ, except in *A. tristis*.

    6\. Remnants of volva on pileus blackish brown, darker than pileus.

      7\. Pileus 50–100 mm across, umber to pale greyish umber, with small conical or truncate-conical warts, scurfy near margin, innately fibrillose, slightly viscid. Stipe appressedly fuscous-fibrillose in vague zones, with 2–4 rows of small fuscous-umber, scurfy warts at base. Ring brownish grey, often breaking into appressed patches. Cuticle consisting of narrow hyphae. Spores 6–8 × 5.5–7.5 μ, globulose to broadly ellipsoid . . . . *A. fritillaria*, p. 265

      7\. Pileus 25–70 mm across, umber to pale greyish brown, dry, innately and darkly streaked, with powdery, subvillose remnants of volva, forming a thin covering or thin patches or irregular warts and sometimes small conical warts over centre. Stipe grey or greyish brown, with dark fibrillose innate streaks, with one to several, often incomplete, rows of dark, minute patches or with a dark pruinose-felted covering at base. Ring greyish fuliginous with dark edge. Cuticle with large elongate cells among hyphae. Spores 6–10 × 5–8 μ, subglobulose to broadly ellipsoid . . . . *A. pilosella*, p. 267

6\. Remnants of volva on pileus greyish, brownish, ochraceous or whitish, paler than pileus.

8\. Remnants of volva rendering base of stipe distinctly verrucose or squarrose.

9\. Base of stipe more or less turbinate, upper part covered with rings of white to greyish subangular warts. Pileus 65–80 mm, grey-fuscous, with greyish white, small conical warts. Stipe pale grey, flocculose-felted. Ring white, striate, with fuscous denticulate edge. Spores 5–6(–7) × 4–5 μ . . . . *A. tristis*, p. 264

9\. Base of stipe fusiform to slender-fusiform, entirely covered with irregularly disposed recurved scales. Pileus 25–65 mm, sepia, with small, pale brown, conical warts. Stipe pale sepia, subsquamulose below ring. Ring whitish, striate, with entire or denticulate brown edge. Spores 6.5–7.5 × 5.5–6.5 μ *A. squamosa*, p. 262

8\. Remnants of volva on base of stipe forming scurfy-pruinose rings or lacking.

10\. Pileus 60–80 mm, sepia, with moderately large, pale conical warts. Stipe cylindrical, pallid, smooth except floccose apex, with 1–2 rows of fuscous particles at base. Ring whitish with fuscous edge, striate. Spores 8–10 × 7.5–8.5 μ . . . . *A. species* 1, p. 267

10\. Pileus 45–65 mm, fuscous brown, with large, flat, brown patches with white tips. Stipe 60–80 × 3–4 mm, with clavate base, white to pale brownish, minutely fibrillose, without remnants of volva. Ring white with brownish edge, not striate. Spores 7–7.5 × 6 μ . . . . *A. species* 2, p. 269

Amanita squamosa (Mass.) Corner & Bas, *comb. nov.*—Figs. 19, 20

Armillaria squamosa Mass. *in* Kew Bull. **1908**: 3 (basionym).

Pileus 25–65 mm wide, convex to slightly concave, not striate at margin, sepia-fuscous over centre, paler toward margin, innately fibrillose, dry, rather closely set with small, pale brownish, more or less conical warts over centre, diminishing in size toward margin. Gills free, subdistant, rather wide, white to very pale ochraceous; short gills attenuate. Stipe 50–80 mm long, 4–6 mm wide at apex, 10–15 mm wide at fusiform, subbulbous base, solid, pale brownish, sometimes sepia-brown at base, apex entirely covered by ring, subglabrous, sometimes slightly and minutely dark-squamulose near base; fusiform base entirely and irregularly set with pale brown scales with slightly recurved tips. Ring rather wide, membranous, whitish, slightly striate on upper side, with brown, often more or less denticulate edge. Flesh white, slightly colouring ochraceous buff (?) on cutting.

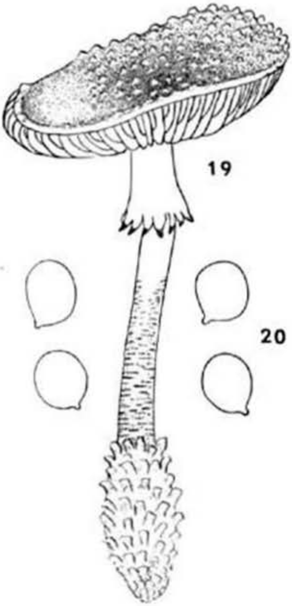
EXPLANATION OF FIGURES 19-26

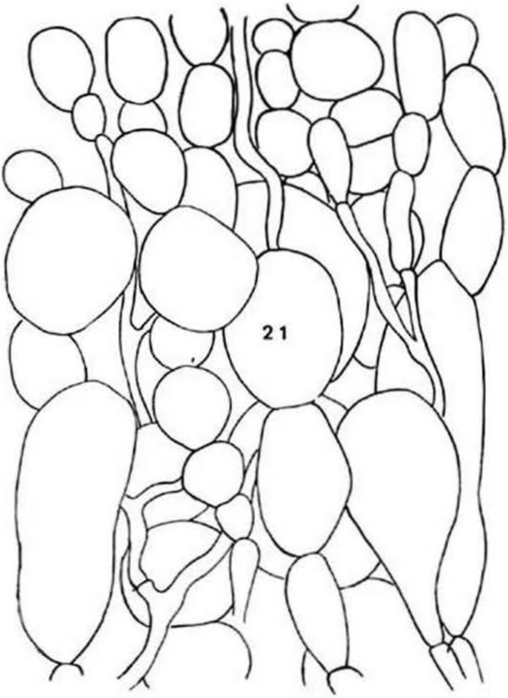
Figs. 19, 20. *Amanita squamosa.* — 19. Reproduction of type drawing (× 1). — 20. Spores of type (× 1250).

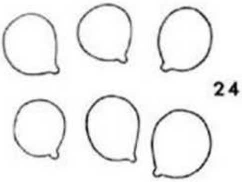
Figs. 21, 22. *Amanita fritillaria* f. *malayensis.* — 21. Crushed conical wart from pileus (× 325). — 22. Spores (× 1250).

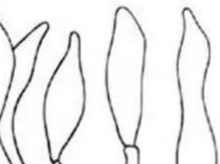
Fig. 23. *Amanita fritillaria.* — Spores of type (× 1250).

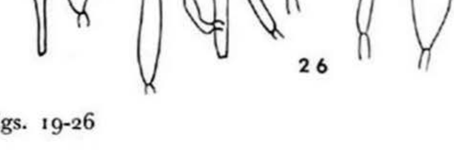
Figs. 24–26. *Amanita pilosella.* — 24. Spores (× 1250). — 25. Cuticle (× 140). — 26. Inflated cells from cuticle (× 140).











Figs. 19-26

Spores (Fig. 20) 6.5–7.5 × 5.5–6.5 μ (fresh presumably slightly larger), subglobulose to broadly ellipsoid (length-breadth ratio 1.1–1.3, average 1.15–1.2), with small apiculus, amyloid. Cuticle consisting of more or less radial, about 2–4 μ wide hyphae. Remnants of volva on pileus mainly consisting of globulose to ellipsoid, brownish cells, 25–55 × 20–50 μ, apparently mostly forming erect chains.

HABITAT.—Terrestrial in forest.

COLLECTIONS EXAMINED.—Singapore, *Ridley 61 I* (type; 1 dried specimen; water-colour drawing; K); Singapore, Botanic Gardens, 28 Nov. 1940, *E. J. H. Corner s.n.* (as *Amanita* 12 p.p.; water-colour drawing; no material preserved); *E. M. Burkill 273* (water-colour drawing without data).

OBSERVATIONS.—The above description is based on the drawings cited, on Massee's description, and on the type material. In the collection of the senior author there is only a drawing of this species, united with *A. tristis* (see p. 264) under '*Amanita* 12'.

Within section *Validae*, *A. squamosa* is very well characterized by the squarrose, fusiform base of the stipe. This feature reminds one of section *Lepidella*, where recurved scales on the base of the stipe occur in some species. In all other characters, however, *A. squamosa* very much resembles the species of section *Validae*. At first, the senior author even doubted whether *A. squamosa* really differed from *A. tristis* (see below). However, in that species the colours are more greyish, the scales on the base of the stipe restricted to the upper part of the bulb and not patent, the spores smaller, and the fruit-bodies larger.

Amanita tristis Corner & Bas, *sp. nov.*—Pl. 3a, Fig. 27

Pileus 60–80 mm latus, plano-convexus, centro leviter depressus, margine haud striatus, siccus vel subviscidus, centro fusco-griseus, margine griseolus, striis obscuris virgatus, verrucis minutis, conicis pustulatisve, griseolis indutus. Lamellae confertae, albae vel pallide ochraceae. Stipes 70–80 mm longus, apice 8–10, basi 20–22 mm latus, bulbosus, solidus, annulatus, pallide griseus, flocculoso-subcoactatus; bulbus turbinatus verrucis angulatis, griseolis vel albidis concentrice ornatus. Annulus amplus, 10–20 mm latus, albus, striatus, margine saepe verrucis griseis appendiculatus. Caro alba, pallide ochracescens. Sporae 5–6(–7) × 4–5 μ, subellipsoideae vel ellipsoideae, amyloideae. Typus: *E. J. H. Corner s.n.*, 24 Aug. 1939, Singapore, Botanic Gardens (L).

Etymology: tristis, sombre.

Pileus 60–80 mm wide, plano-convex with slightly depressed centre, not striate at margin, dry or slightly viscid, dark fuscous-grey over centre, paler toward margin, with darker fibrillose streaks, set with small, conical to wart-like, pale greyish remnants of volva diminishing in size toward margin. Gills free, crowded, intermixed with attenuate small ones, white to very pale ochraceous. Stipe 70–80 mm long, 8–10 mm wide at apex, 20–22 mm wide at bulbous base, solid, at apex entirely covered by ring, lower part pale grey, finely cottony-subvillose; upper part of the turbinate bulb set with 2–3 concentric circles of pale greyish to whitish, more or less angular, thick, flat, small warts. Ring large, ample, 10–20 mm wide, hanging from apex of stipe, white and striate on upper side, greyish cottony-flocculose beneath, often with grey warts at edge. Flesh white, tinged slightly pale ochraceous-buff on cutting, grey near surface.

Spores (Fig. 27) 4.9–6.1(–7.0) × 4.3–4.6 μ, broadly ellipsoid to ellipsoid, seldom subglobulose (length-breadth ratio (1.1–)1.25–1.45(–1.55), average 1.3–1.35), with small apiculus, amyloid. Marginal cells present, globulose, up to 30 μ wide. Cuticle consisting of a gelatinous upper layer and a lower layer with radial, 1.5–8 μ wide, brown hyphae. Remnants of volva on pileus composed of globulose to ellipsoid, probably mostly terminal, up to 80 × 45 μ or 70 × 70 μ large, brownish cells and rather many 3–9 μ wide, branching hyphae. No clamps observed.

HABITAT.—Terrestrial in jungle.

COLLECTIONS EXAMINED.—Singapore, Botanic Gardens, Gardens' Jungle, 24 Aug. 1939 (type; dried fragment of 1 specimen); 28 Nov. 1940 (water-colour drawing); both *E. J. H. Corner s.n.* (as *Amanita* 12).

OBSERVATIONS.—The above description is based on the material of '*Amanita* 12' and on three of the four fruit-bodies depicted on the plate bearing the same number. The fourth fruit-body depicted appears to belong to *A. squamosa* (see above). As the description of '*Amanita* 12' contains a combination of the characters of *A. tristis* and *A. squamosa*, no data could be taken from it.

Of '*Amanita* 5', only a description is available and that seems to refer to large specimens of *A. tristis*. They differ from the specimens described above by (i) a larger pileus, viz. 100–150 mm wide, (ii) a taller stipe, viz. 120–150 mm long, which is white instead of grey and turns slightly brownish on handling, (iii) a white ring without a coloured edge, and (iv) persistently white flesh. All other characters, spore-size included, agree with *A. tristis*. However, as no material could be studied afterwards, the data mentioned above are not incorporated in the description of the present species.

On account of its volva characters, *A. tristis* reminds one of *A. sepiacea* Imai from Japan. In both species, the upper part of the bulb is set with rings of more or less angular, rather thick, flat warts. However, *A. sepiacea* has a more sepia coloured pileus and globulose to subglobulose, slightly larger spores. For comparison of *A. tristis* with *A. squamosa* (Mass.) Corner & Bas, see p. 264.

AMANITA FRITILLARIA (Berk.) Sacc.—Pl. 3*c*, Figs. 21–23

Agaricus (*Amanita*) *fritillarius* Berk. *in* Hook. J. Bot. **4**: 97. 1852. — *Amanitopsis fritillaria* (Berk.) Sacc., Syll. Fung. **5**: 26. 1887. — *Amanita fritillaria* (Berk.) Sacc., Syll. Fung. **9**: 2. 1891.

Pileus 50–100 mm wide, becoming plane or concave, with or without umbo, with smooth margin, dark umber to rather pale greyish umber, fuscous over centre, innately darker fibrillose, slightly viscid, thickly set with darker, small, soft, umber-fuscous remnants of volva as conical warts 1.5–2.5 mm wide and 1.5–2 mm high over disc, diminishing to scurfy flocks near margin. Gills free, crowded, about 100 primaries with 0–1–3 attenuate smaller ones between each pair, white, 6–9 mm wide. Stipe 90–110 mm long, 10–12 mm wide at apex, 15–20 mm at subglobose to slightly turbinate base, somewhat attenuate upward, solid, becoming more or less hollow, pale brownish or greyish brownish, whitish at apex, entirely finely and appressedly fuscous-fibrillose in vague peronate zones, marked with greyish brown patches of velum partiale in upper part when ring present or nearly down to base when no ring is formed; base set with 2–4 rows of small fuscous-umber scurfy warts 0.5–1 mm wide as remnants of volva. Ring present and pendant from middle of stipe or just above it, 8–10 mm wide, brownish grey with very small umber-fuscous warts on edge, floccose-membranous, or absent. Flesh white, becoming slightly ochraceous on cutting or bruising, 5–10 mm thick in centre of pileus.

Spores (Fig. 22) 6.0–7.6 × 5.4–6.6(–7.6) μ (fresh 7–8 × 6.5–7.5 μ), globulose to broadly ellipsoid (lenght-breadth ratio 1.0–1.25, average 1.1–1.15), smooth, thin-walled, colourless, with small apiculus, cloudy-granular, amyloid. Basidia

25–35 × 7–11 μ, 4-spored; sterigmata about 5 μ long. Marginal cells numerous, up to 45 μ, globose, ellipsoid or clavate. Trama of gills distinctly bilateral; central strand and divergent zones passing into each other (because all central elongated broad elements curve outward), with cells up to 200 μ long and 30 μ wide and slender cylindrical in centre, shorter and broader near subhymenium, mixed with narrow hyphae; subhymenium about 40 μ wide, cellular, not distinctly set off from trama, with cells about 25 μ wide in inner part and about 7 μ wide at base of basidia. Cuticle about 80 μ wide, composed of a gelatinized, 10–20 μ thick upper layer with distant, fading, brown hyphae and a lower layer with crowded, radially interwoven, brown hypahe, the latter 2.5–4.5 μ wide and with scattered slightly clavate darker tips of hyphae in upper part and up to 8 μ wide in lower part. Remnants of volva on pileus (Fig. 21) mainly consisting of chains of brown, inflated cells, globulose to ellipsoid, up to 100 μ wide, more rarely clavate to elongate, up to 180 × 45 μ, mixed with rather scarce hyphae; chains and hyphae in warts on disc all perpendicular to surface of pileus. Remnants of volva on base of stipe consisting of brown, polymorphous inflated cells, up to 40 μ wide, mixed with rather numerous 1.5–7 μ wide hyphae. Trama of stipe with longitudinal clavate cells, up to 350 μ long and 60 μ wide, mostly terminal, sometimes in short chains; near surface with brown hyphae and scattered, brown, clavate cells. No clamps observed.

HABITAT.—Terrestrial in forest; in small troops or solitary; frequent.

DISTRIBUTION.—India (Assam), Singapore.

COLLECTIONS EXAMINED.—Singapore, Botanic Gardens, Gardens' Jungle, 25 Nov. 1940 (fragments of 1 specimen in liquid; water-colour drawing); Bukit Timah 13 Dec. 1940 (water-colour drawing); both *E. J. H. Corner s.n.* (as *Amanita* 5^b).

OBSERVATIONS.—Eaten with relish and immediately on sight by monkeys.

The director of the Kew Herbarium kindly enabled us to study the type specimen of *A. fritillaria* [Herb. Hook., *Agaricus* (*Amanita*) *fritillarius*, Khasia, Pomrang, Sept. 18, 1850, no. 35]. It is a dried, half specimen with many, small, blackish remnants of the volva on the brown pileus. These remnants are more or less conical over the centre of the pileus and pass via flattened conical warts into small patches near the margin. Warts and patches appear to consist of erect chains of mainly ellipsoid, dark brown cells, similar to those in the Malayan material described above, but somewhat smaller. There is no striking difference in structure of the volva between the Malayan and the Indian material.

The base of the stipe of the type is incomplete, and neither Berkeley's description nor J. D. Hooker's water-colour drawing (of which recently a copy was presented to the Rijksherbarium, Leiden) provide any information about the remnants of the volva at the base of the stipe.

The upper part of the cuticle of the type consists of gelatinized, thin, radial hyphae. The spores (Fig. 23) are amyloid and of about the same size as those of the collection from Singapore, but more ellipsoid, viz. 7.4–8.6 × 5.6–7.0 μ and broadly ellipsoid to ellipsoid (length-breadth ratio 1.2–1.5, average 1.3–1.35).

Judging from Hooker's drawing, the pileus of the type was rather pale grey, the stipe pale grey, and streaked with dark grey, and the ring grey and striate.

From the foregoing it is clear that the up till now insufficiently known *A. fritillaria* belongs to section *Validae* and is very similar to Corner's '*Amanita* 5b'. However, the Malayan material is here described as a new form of that species[3] to stress

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[3] *Amanita fritillaria* forma **malayensis** Corner & Bas, *f. nov.* A typo differens sporis globulosis vel subellipsoideis. Type: *E. J. H. Corner s.n.*, 25 Nov. 1940, Singapore, Botanic Gardens (L).

the points of difference, viz. the more ellipsoid spores, the smaller cells in the remnants of the volva on the pileus, and the paler grey colour of the pileus of the type of *A. fritillaria*.

From *A. pilosella* Corner & Bas, the present species differs by the viscid cuticle without hair-like elements and the larger size.

Amanita spissacea Imai from Japan is very similar, but seems to have a more floccose stipe and flat and larger patches on the pileus. Moreover, the remnants of the volva on the base of the stipe are powdery.

Compare also the next species, *Amanita* species 1, which may be another form or variety of *A. fritillaria*.

AMANITA SPECIES 1—Pl. 5*b*
(allied to *A. fritillaria*)

Pileus 60–80 mm wide, becoming concave, subumbonate, with smooth or faintly striate margin, sepia, fuscous-umber in centre, with innate dark fibrillose streaks near margin, dry or slightly viscid, set with stout, firm, separable, conical, paler, greyish sepia warts, 2–4 mm wide and 1–2 mm high, but smaller near margin. Gills free, crowded, about 100 primaries with 1–3 shorter ones between each pair, 5–6 mm wide, cream-white, greyish toward base. Stipe 110 × 10–12 mm, subcylindrical, slightly tapering at apex, pale brownish or pallid-whitish and smooth below ring, greyish and slightly appressedly floccose with broken remnants of velum partiale above ring, at base set with 1–2 rows of slight, scurfy, greyish warts 0.5–1 mm wide. Ring pendant in upper part of stipe, spreading, pallid-whitish, striate, membranous-subfloccose, with fuscous scurfy particles on edge. Flesh firm, solid, white, turning slightly ochraceous on cutting, 8 mm thick in centre of pileus.

Spores (fresh) 8–10 × 7.5–8.5 μ, subglobose, colourless, cloudy-vacuolate or 1-guttate.

HABITAT.—Terrestrial in jungle; solitary.

COLLECTIONS EXAMINED.—Singapore, 16 Aug. 1940 (water-colour drawing; no material preserved), *E. J. H. Corner s.n.* (as *Amanita* 5^a).

OBSERVATIONS.—The split base of the stipe of the specimen depicted is anomalous.

This species is close to *A. fritillaria*, of which it may be a form or variety. It differs by larger and paler warts on the pileus, by a pale smooth stipe and perhaps by slightly larger spores. As no material is preserved, a conclusion would be premature.

Amanita pilosella Corner & Bas, *sp. nov.*—Pl. 4*b*, Figs. 24–26

Pileus 25–70 mm latus, initio convexus, dein applanatus, interdum umbonatus, margine glaber vel leviter striatus, umbrinus, fuliginosus vel griseolo-brunneus, pallescens, striis obscuris virgatus, minute fibrilloso-coactatus, siccus, fragmentis volvae pruinoso-scabrosis vel verrucosis, umbrinis vel nigro-fuliginosis obsitus. Lamellae confertae, albae vel griseolae, margine albae vel fuliginosae. Stipes 40–110 mm longus, apice 3.5–6, basi 5–12 mm latus, subclavatus vel bulbosus, solidus, griseus vel fuscus, striis fibrillosis, innatis, obscuris virgatus, subfibrillosus vel subflocculosus, supra annulum fragmentis annuli griseolis indutus, basi fragmentis volvae nigro-fuligineis, pruinoso-coactatis vel verruculosis obsitus vel concentrice zonatus. Annulus angustus, submembranaceus, griseus, striatus, margine nigro-fuliginosus. Caro alba vel brunneola. Sporae 6.5–10 × 5–8 μ, subglobulosae vel subellipsoideae, amyloideae. Typus: *E. J. H. Corner s.n.*, 10 April 1941, Singapore, Reservoir Jungle (L).

Etymology: pilosellus, minutely hairy (on account of the cuticle which contains hair-like cells).

Pileus 25–70 mm wide, convex to plane or somewhat concave, sometimes slightly umbonate, smooth to faintly striate at margin, umber, fuliginous or greyish brown, paler on expansion, especially toward margin, with innate dark fibrillose streaks, minutely dark greyish brown fibrillose-subvillose, especially toward margin, dry (perhaps slightly viscid when old), with powdery-subvillose, umber, fuliginous or blackish remnants of volva, forming a thin scurfy-pruinose covering, especially near margin, or thin flat patches 1–2.5 mm wide, or irregular warts 1–3 mm wide, and sometimes, on centre of pileus, conicial warts, 0.5–1 mm high and wide. Gills free, crowded, 50–90 primaries with (0–)1–3 attenuate shorter ones between each pair, white or greyish white; edge white or fuliginous-umber. Stipe 40–110 mm long, 3.5–6 mm wide at apex, 5–12 mm wide at subclavate to bulbous base, attenuate upward, solid, entirely grey, fuscous-grey, greyish umber or fuscous, with dark fibrillose innate streaks, subfibrillose to subflocculose, with greyish patches above ring from shattered velum partiale; upper part of bulbous base with one to several mostly incomplete rows of fuliginous to blackish, minute, pruinose-felted patches, or entirely fuliginous pruinose-felted by volva. Ring rather narrow, pendant, floccose-membranous, dark to pale grey and striate at upper side, greyish and fuliginous pruinose or flocculose at underside, with slightly thickened, but entire, pruinose-flocculose, fuliginous to blackish edge, 15–30 mm below apex of stipe. Flesh white or slightly brownish, 1.5–4.5 mm thick in centre of pileus, thin over limb.

Spores (Fig. 24) (5.5–)6.4–7.9 × (4.3–)5.1–7.0 μ (fresh, 7–10 × 5.5–8 μ), subglobulose to broadly ellipsoid [length-breadth ratio 1.05–1.3(–1.4), average 1.15–1.2], cloudy-vacuolate to multiguttulate, with rather small apiculus, thin-walled, smooth, colourless, amyloid. Basidia 28–45 × 9–13(–14) μ, 4-, rarely 2-spored. Marginal cells 25–60 × 12–30 μ, a mixture of globose, ellipsoid and clavate cells and thin hyphae, sometimes with umber sap (hardly distinguishable in preserved material, thus contrasting with pigment in cells of volva); forming a broad sterile margin along edge of gills. Trama of gills distinctly bilateral; central strand with narrow and inflated hyphae, the latter with cells up to 100 μ long and up to 15(–25) μ wide; divergent zones with inflated cylindrical to ellipsoid or clavate cells, up to 60 × 25 μ, passing gradually into a thick cellular subhymenium, with globulose cells decreasing from 30 μ wide in inner part to 5 μ at base of basidia. Remnants of volva on cap consisting mainly of brown, globulose to ellipsoid cells, up to 100 μ wide, terminal or forming easily disintegrating chains, the latter in central conical warts perpendicular to surface of pileus, mixed with scarce to rather frequent, 3–7 μ wide, brown hyphae. Cuticle thin, composed of crowded, irregularly radial, 2–6 μ wide, brown hyphae, partly covered by rather distant, not or only slightly embedded, 3–12 μ wide brown hyphae, with scattered, slightly protruding, inflated elongate, mostly terminal cells (Fig. 25–26), up to 230 μ long and to 40 μ broad. Remnants of volva on base of stipe consisting of globose, ellipsoid, clavate or citriform, brown cells mixed with many hyphae. Trama of stipe with inflated, longitudinal, terminal clavate cells, up to 300 × 30 μ. Surface of stipe with brown narrow hyphae and scattered slenderly clavate brown cells. No clamps observed.

HABITAT.—Terrestrial in jungle; solitary; frequent every rainy season.

COLLECTIONS EXAMINED.—Singapore, Reservoir Jungle, 10 April 1941 (type; one specimen in liquid; water-colour drawing); 15 April 1941 (water-colour drawing); Botanic Garden, Garden's jungle, 30 Aug. 1944 (annotated, not preserved) Bukit Timah, 21 Aug. 1939 (one dried specimen); Singapore (without further information), 23 April 1940 (two specimens in liquid); all *E. J. H. Corner* (as *Amanita* 1^a and 1^b).

This small to medium-sized species evidently belongs to the difficult group of dark-coloured species within section *Validae*. It is, however, easy to distinguish by the dry cuticle with elongate, inflated, slightly protruding cells.

The remnants of the volva on the pileus vary considerably as to size and form, hence, the two forms here distinguished.

1. Forma PILOSELLA (Pl. 4*b*) Pileus 25–35 mm wide, with rather thick irregular warts, especially on the centre of the pileus, composed of large, mainly terminal, brown sphaerocysts, up to 100 μ wide, mixed with rather frequent hyphae. Edge of gills white. ('*Amanita* 1^b').

2. Forma **atroconica** Corner & Bas, *forma nov.*[4] Pileus 35–70 mm wide, with more regular patches of the volva on the limb of the pileus and conical warts on the centre, composed of rather scarce hyphae and slightly smaller and darker sphaerocysts up to 70 μ wide and mostly disposed in chains, the latter perpendicular to the pileus in the central warts. Edge of gills fuliginous, rarely white. The following collections of those enumerated above appears to belong to this forma: Singapore, 23 April 1940; Bukit Timah, 21 Aug. 1939 ('*Amanita* 1^a').

The senior author already separated both forms in his field-notes on account of the difference in colour of the edge of the gills. However, the material available being scanty, the taxonomical importance of these two forms is uncertain.

Amanita pilosella is undoubtedly closely related to *A. spissacea* Imai from Japan, which has the same dark brown pileus with darker greyish pulverulent patches from the volva, the same pulverulent grey remnants of the volva on the base of the stipe and the same spores. However, *A. spissacea* is larger and considerably more fleshy, has an umbonate pileus and a dark squamulose covering of the stipe below the ring; its cuticle seems to lack the streaky appearance of that of *A. pilosella*.

Amanita neglecta Boedijn (1951: 324) seems to be related, too. In that species, however, the colours are different, viz. the cap is dirty brown and the stipe is pinkish buff with appressed darker scales below the pale yellow ring.

AMANITA SPECIES 2—Pl. 1*c*

(allied to *A. pilosella*)

Pileus 45–65 mm wide, becoming plane, fuscous brown, paler toward margin, darker in centre, innately streaked, slightly viscid, set with large, 5–7.5 mm wide and 1 mm high, pale fuscous brown patches with whitish flat tops. Gills free, crowded, 50–60 primaries with 0–1 shorter ones between each pair, white, thin, 3–4 mm wide. Stipe 60–80 mm long, 3–4 mm wide at apex, 7–8 mm at base, attenuate upward, white to very pale brownish white, above ring surface breaking up into minute fibrillose patches and below ring into short fine fibrils; subbulbous base without any trace of volva. Ring pendant, 4–5 mm wide, floccose-felted membranous, white with a pale brownish edge, not striate, about 20 mm below apex of stipe. Flesh white, rather thin.

Spores (fresh) 7–7.5 × 6 μ, subglobose to broadly ellipsoid, colourless, 1-guttate. Remnants of volva on pileus composed of sphaerocysts.

HABITAT.—Terrestrial in forest.

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[4] Pileus centro verrucis conicis. Lamellae margine saepe fuliginosae. Typus: *E. J. H. Corner s.n.*, 23 April 1940, Singapore (L).

COLLECTIONS EXAMINED.—Singapore, Reservoir Jungle, 10 April 1941 (water-colour drawing & notes; no material preserved), *E. J. H. Corner s.n.* (as *Amanita* 18).

This species reminds one of *A. pilosella* by the small size, the darkly streaked pileus, the brown-rimmed ring, and the small spores. However, it seems easy to distinguish by the large, flat, pale brown, white-topped patches on the pileus, the absence of remnants of the volva at the base of the stem, the much paler colours, and the viscid surface of the pileus.

Amanita xanthomargaros Corner & Bas, *sp. nov.*—Pl. 7*b*, Fig. 18

Pileus 45 mm latus, plano-convexus, margine haud striatus, fusco-brunneus vel olivaceo-brunneus, centro fuscus, margine flaveolus, striis obscuris virgatus, siccus, verrucis conicis, umbrinis, apicibus flavis tectus. Lamellae confertae, albae. Stipes 55 mm longus, apice 3 mm latus, basi 8 mm latus, clavatus et submarginatus, solidus, annulatus, pallide griseolo-brunneus, apice flaveolus, leviter pruinoso-flocculosus, basi fragmentis volvae flocculosis, flavis vel fuscis zonatus. Annulus membranaceus, pallide sordide flavus, margine flavus. Caro alba, pallide brunnescens vel griseo-brunnescens. Sporae 5.5–7 × 4.5–6 μ, subglobulosae vel subellipsoideae, amyloideae. Typus: *E. J. H. Corner s.n.*, 8 Nov. 1940, Singapore (L).
Etymology: ξανϑός, golden yellow; μαργαρος, pearl.

Pileus 45 mm wide, plano-concave, with non-striate margin, fuscous-brown to olivaceous-brown, fuscous over disc, yellowish near margin, with innate, dark, radiating fibrils, dry, set with numerous, friable, soft, conical umber-brown warts with yellow tips, 1–1.5 mm high, 1–2 mm wide. Gills free, crowded, 66 primaries with 0–1 attenuate shorter ones between each pair, white, 5 mm wide, with white edge. Stipe 55 mm long, 3 mm wide at apex, 8 mm at clavate, submarginate base, attenuate upward, solid, pale greyish brown, yellowish at apex, wholly lightly pruinose-cottony above and below ring, at base with 2–3 powdery scurfy, incomplete circles, the upper one fuscous and yellow, the others light yellow. Ring pendant, spreading, 3 mm wide, membranous, pale dingy yellow, deeper yellow at entire, smooth edge. Flesh white, becoming pale brownish or greyish-brownish on cutting, especially in stipe, 3 mm thick in centre.

Spores (Fig. 18) 5.4–6.4 × 4.4–5.3 μ (fresh: 6–7 × 5–6 μ), subglobulose to broadly ellipsoid [length-breadth ratio (1.05–)1.1–1.3(–1.35), average 1.2–1.25], colourless, thin-walled, smooth, with small apiculus, 1-guttate, amyloid. Basidia 23–30 × 7.5–9 μ, 4-spored. Marginal cells vesiculose, colourless, in preserved material scarce and up to 30 μ wide. Trama of gills loose, irregularly bilateral, without distinct central strand, with elongate cells up to 135 × 30 μ in central part and more ellipsoid cells, up to 60 × 30 μ in outer part, mixed with hyphae; subhymenium 40–50 μ wide, cellular, with cells 10–25 μ wide, small near base of basidia, larger and more ellipsoid in inner part. Cuticle about 60–80 μ wide, made up of a gelatinized, 10–20 μ wide upper layer with 2–4 μ wide, irregularly disposed, distant, brown hyphae, and a lower layer with rather crowded, 4–10 μ wide, irregular to subradial, brown hyphae; near margin without gelatinized upper part and with elongate, hair-like, brown cells, up to 180 × 15 μ. Remnants of volva on pileus consisting of mainly sphaerocysts, 45–80 μ wide and brown in base of warts, 25–40 μ wide and yellow in tips of warts, sometimes disposed in short chains, but mostly abruptly terminal on 2–7 μ wide, rather numerous hyphae; chains and hyphae more or less perpendicular to surface of pileus, especially in tips of warts. Remnants of volva on base of stipe consisting of 20–50 μ wide sphaerocysts in chains or terminal, brown in upper ring, yellow in lower rings, mixed with 3–8 μ wide hyphae. Trama of stipe with terminal, clavate, longitudinal cells, up to 330 μ long and 40 μ wide, with scattered thin, loose hyphae on brownish hyphae at surface. No clamps observed.

HABITAT.—Terrestrial in jungle; solitary.

COLLECTIONS EXAMINED.—Singapore, along Thomson Road, 8 Nov. 1940 (type; one specimen in liquid; water-colour drawing), *E. J. H. Corner s.n.* (as *Amanita* 16).

This species reminds one of the European *A. francheti* (Boud.) Fayod (= *A. aspera* ss. auct.), but the latter has a viscid, not fibrillosely streaked pileus, wholly yellowish warts, a whitish stipe, and larger spores, viz. 7.5–11 × 5.5–7 μ.

Amanita xanthomargaros is more closely related to *A. pausiaca*. These two species have in common (i) their habit, (ii) the olivaceous-brown, dry pileus, (iii) the yellow edge of the ring, (iv) the yellowish apex of the stipe, (v) the rows of small warts at the base of the stipe, and (vi) the small spores. However, in *A. pausiaca*, the remnants of the volva form greyish patches instead of yellow-tipped conical warts on the pileus, and fuscous-olivaceous warts at the base of the stipe instead of yellow ones. Moreover, the spores of *A. pausiaca* are slightly more globulose (average length-breadth ratio 1.1–1.15) than those of *A. xanthomargaros* (1.2–1.25). Nevertheless these two species may turn out to be conspecific, if more material becomes available.

Amanita pausiaca Corner & Bas, *sp. nov.*—Fig. 17

Pileus 60 mm latus, applanatus, centro depressus, margine minute striatus, fuligineo-olivaceus, centro fuscus, striis fibrillosis, obscuris virgatus, siccus, verrucis planis, minutis, griseolis tectus. Lamellae confertae, albae. Stipes 70 mm longus, apice 6, basi 13 mm latus, clavato-subbulbosus, solidus, pallide flavo-olivaceus, apice flavus, supra annulum pruinosus, infra annulum fibrillosus, basi fragmentis volvae fusco-olivaceis, verruculosis concentrice ornatus. Annulus membranaceus, 10 mm latus, albus, margine flaveolus et subverrucosus. Caro alba. Sporae 5–6 × 4.5–5.5 μ, globulosae vel subellipsoideae, amyloideae. Typus: *E. J. H. Corner s.n.*, 3 July 1930, Malaya, Negri Sembilan (L).

Etymology: pausiacus, olivaceous.

Pileus 60 mm wide, plane with slightly depressed centre, finely sulcate-striate at margin, bistre-olivaceous, darker and more fuscous in centre, innately streaked with darker fibrils, dry, more or less concentrically spotted with small greyish patches. Gills distantly free, crowded, 81 primaries with 1–3 attenuate shorter ones between each pair, white, 5–6 mm wide. Stipe 70 mm long, 6 mm wide at apex, 13 mm at subbulbous, clavate base, solid, pale yellow-olivaceous, clearer yellow near apex, fibrillose below ring, minutely pruinose above, at base with 2–3 rings of fuscous-olivaceous small warts of volva. Ring pendant, membranous, 10 mm wide, white with yellowish subverrucose edge. Flesh white, fuscous olive below surface of pileus, thin, 4 mm thick in centre of pileus.

Spores (Fig. 17) 5.1–6.1 × 4.4–5.8 μ, globulose to broadly ellipsoid (length-breadth ratio 1.0–1.2, average 1.1–1.15), smooth, colourless, with medium-large apiculus, amyloid. Cuticle rather thin, made up of 1.5–4.0 μ wide hyphae with brown contents, radial in inner part, irregular and gelatinized in upper part. Remnants of volva on base of stipe consisting mainly of globulose, seldom ellipsoid or fusiform, presumably mostly terminal cells, pale yellowish-brownish in NH_4OH, mixed with many 2.5–4 (–7) μ wide branching hyphae. Trama of stipe *Amanita* structure; clavate cells up to 200 × 30 μ and perhaps larger. No clamps observed.

HABITAT.—Terrestrial in forest.

COLLECTIONS EXAMINED.—Malaya, Negri Sembilan, Angsi Forest Reserve, 3 July 1930 (type; two dried slices), *E. J. H. Corner s.n.* (as *Amanita* spec.).

This species is characterized by colours like those of *A. phalloides* and a volva like that of *A. rubescens*. Moreover, the very small spores are distinctive. Compare *A. xanthomargaros* (p. 270).

Amanita demissa Corner & Bas, *sp. nov.*—Pl. 5a, 6a, Figs. 28, 29

Pileus 15–35 mm latus, initio campanulatus, dein plano-convexus vel applanatus, centro depressus vel subumbonatus, margine striatus, griseo-umbrinus, pallescens, flocculis volvae fuligineis centro verrucis conicis obsitus. Lamellae subdistantes, albae. Stipes 25–50 mm longus, apice 2–3, basi 3–6 mm latus, subbulbosus, cavus, annulatus, pallide griseolus vel albidus, basi fragmentis volvae griseis, pruinosis leviter zonatus. Annulus angustus, medius vel inferus, albus, margine fuliginosus. Caro alba. Sporae 6.5–9.5 × 5–6.5 μ, subellipsoideae vel ellipsoideae, amyloideae. Typus: *E. J. H. Corner s.n.*, 21 Aug. 1939, Singapore, Bukit Timah (L).

Etymology: demissus, lowered, let down (on account of the low annulus).

Pileus 15–35 mm wide, campanulate to plano-convex, becoming plane at last, sometimes slightly umbonate, sometimes slightly depressed in centre, $^1/_3$ striate from margin toward centre, greyish umber or umber-grey, paler toward margin, becoming pale brownish grey or grey in centre and whitish at margin, presumably slightly viscid, sprinkled with minute, soft, scurfy, fuliginous, easily separable particles, 0.5–1 mm wide and about 0.3 mm high, forming conical warts in centre. Gills free, not crowded, 34–43 primaries with 1–3 attenuate shorter ones between each pair, thin, 1.5–3 mm wide, white. Stipe 25–50 mm high, 2–3 mm wide at apex, 3–6 mm wide at subbulbous base, attenuate upward, hollow (cavity not drawn in all figures), brittle, annulate, pale greyish white with white apex or wholly pallid whitish, slightly fibrillose, remnants of volva at base as 1–3 faint uneven circles of fine greyish pruina. Ring narrow, pendant, at or below middle of stipe, not spreading, white with fuliginous scurfy particles on edge. Flesh 1.5–2.5 mm thick in centre of pileus, very thin over limb, soft, white. Smell slight, indistinct.

Spores (Fig. 28) 6.4–8.5 (–10.1) × 4.7–6.4 μ (fresh, 7–9.5 × 5–6.5 μ), broadly ellipsoid to ellipsoid [length-breadth ratio 1.1–1.5 (–1.6), average 1.3], often dorsally flattened, smooth, thin-walled, colourless, 1-guttate or merely cloudy-granular, amyloid. Basidia 28–40 × 9–10.5 μ, 4-spored, rarely 3- or 2-spored; sterigmata 3 μ long. Marginal cells scattered along gill-edge, 16–40 μ wide, vesiculose. Trama of gills impossible to analyse in dried material. Remnants of volva on pileus (Fig. 29) consisting mainly of 15–55 (–80) μ wide, thin-walled, smooth sphaerocysts with pale fuliginous sap, mostly arranged in long chains perpendicular to surface of pileus, sometimes terminal on rather scarce, 2.5–6 μ wide, hyphae. Cuticle made up of a thin gelatinous upper layer with 1.5–3 μ wide, very distant, irregularly disposed, brown hyphae, and a somewhat thicker lower layer of crowded, slightly

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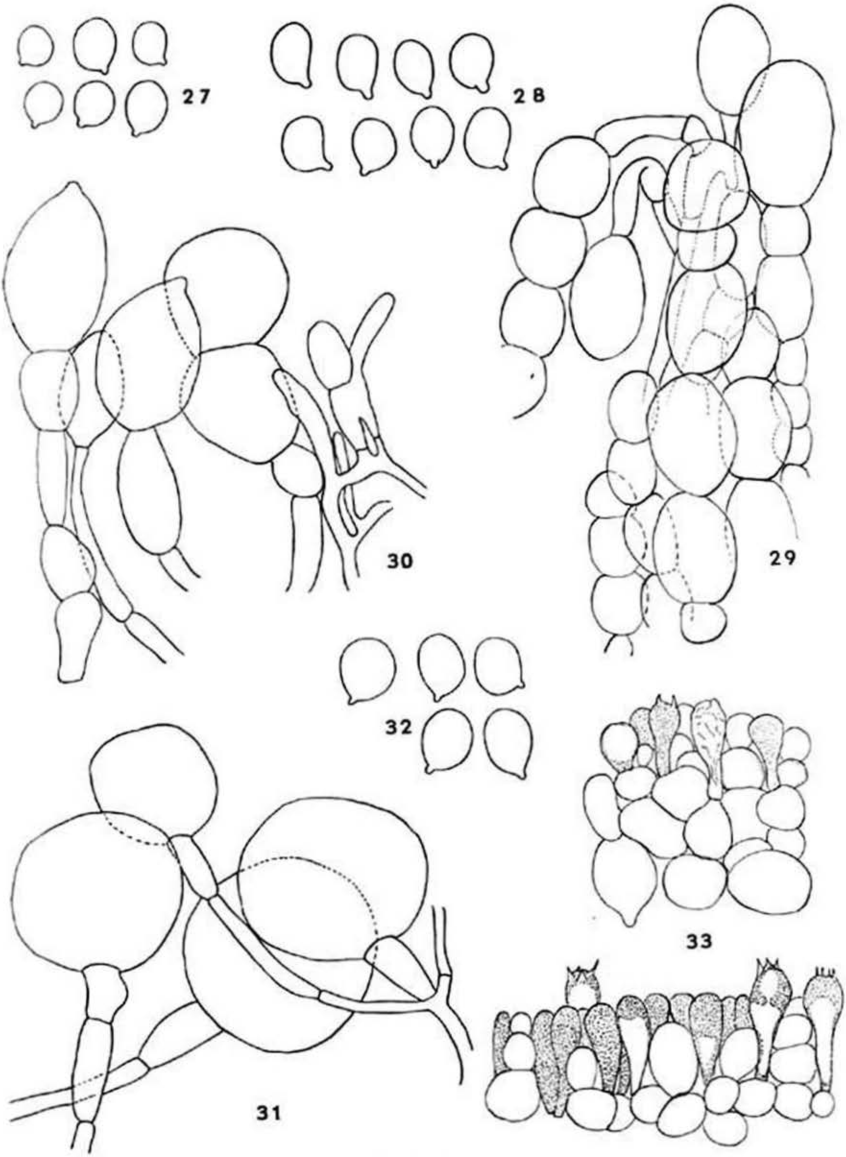
EXPLANATION OF FIGURES 27–33

Fig. 27. *Amanita tristis.* — Spores (× 1250).

Figs. 28, 29. *Amanita demissa.* — 28. Spores (× 1250). — 29. Crushed apex of wart from pileus (× 500).

Figs. 30, 33. *Amanita xanthella.* — 30. Crushed apex of wart from pileus (× 500). — 31. Crushed base of wart from pileus (× 500). — 32. Spores (× 1250). — 33. Hymenium with sterile cells (× 500).



Figs. 27–33

interwoven, radial, brown hyphae up to 8 μ wide. Remnants of volva on base of stipe made up of brown sphaerocysts and many loosely interwoven hyphae. Trama of stipe with longitudinal, cylindrical to cigar-shaped cells, terminal or in short chains, up to 420 × 45 μ. No clamps observed.

HABITAT.—Terrestrial in forest; occurring every rainy season (March-April, Aug.-Sept.); developing quickly; nearly always solitary and scarce.

COLLECTIONS EXAMINED.—Singapore, Bukit Timah, 21 Aug. 1939 (type; dried fragments of two specimens); 3 Sept. 1940 and Dec. 1940 (both water-colour drawings); Botanic Gardens 18 Aug. 1940 (water-colour drawing); also observed in Mandai Rd. forest; all *E. J. H. Corner s.n.* (as *Amanita* 1).

Amanita demissa seems to possess all the characters of a small species of section *Amanita*, viz. a hollow stipe, a striate margin of the pileus and a narrow non-striate annulus. However, the spores are amyloid and therefore the species has to be placed in section *Validae* where it does not find close allies.

Amanita xanthella Corner & Bas, *sp. nov.*—Pl. 7*a*, Figs. 30–33

Pileus 20–45 mm latus, subconcavus, margine striatus, luteus vel luteolus, siccus, verrucis conicis, minutis, luteis ornatus. Lamellae liberae, confertae, usque ad 6 mm latae, albae, acie luteola. Stipes 30–60 mm longus, apice 2–4, basi 6–12 mm latus, subbulbosus, e pleno cavus, albus, subfibrilloso-flocculosus, annulatus; basis fragmentis volvae flavis, flocculosis tecta. Annulus inferus, angustus, albus, acie luteola. Caro alba. Sporae 6.5–8 (–9) × 5–7 μ, subglobosae vel subellipsoideae, amyloideae. Typus: *E. J. H. Corner s.n.*, 27 March 1943, Singapore, Bukit Timah (L).

Etymology: xanthellus, latin diminutive of ξανϑός, golden yellow.

Pileus 20–45 mm wide, shallow concave with flat margin, about $^1/_3$ tuberculate-striate from margin toward centre, pale yellow, deeper yellow in centre, dry, set with small, mealy, bright yellow, pyramidal warts, about 1–1.5 mm high and wide, crowded in centre, scattered and smaller toward margin. Gills free, crowded, thin, up to 6 mm broad, about 42 primaries with 0–1 (–3) attenuate shorter ones between each pair, white, with very pale yellow, entire edge. Stipe 30–60 mm long, 2–4 mm wide at apex, 6–12 mm at subbulbous base, solid, becoming hollow, white, slightly fibrillose-floccose above and below ring; base set with small, 0.5 mm or less wide, yellow mealy flocks as remnants of volva. Ring narrow, pendant, white with edge set with yellow mealy particles, in lower third of stipe. Flesh white, firm.

Spores (Fig. 32) 6.5–7.4 (–8.1) × 5.1–7.1 μ (fresh, 7–9 μ), subglobulose to broadly ellipsoid (length-breadth ratio 1.05–1.3), sometimes ovoid or obovoid, with rather narrow apiculus, colourless, thin-walled, with granular opalescent-vitreous contents, amyloid. Basidia 25–36 × 8–12 μ, with four sterigmata up to 5 μ long, in hymenium often interspaced by, up to 15 μ wide, isodiametric or broadly clavate hyaline cells (Fig. 33). Marginal cells rare, globulose, 17–24 μ wide; edge of gills partly fertile. Trama of gills subcellular, very indistinctly bilateral, made up of ellipsoid and globulose cells, up to 70 × 35 μ, mixed with hyphae; subhymenium consisting of large sphaerocysts (Fig. 33), not delimited from trama. Fragments of volva on pileus with terminal globulose cells, up to 70 μ across, with yellow sap, in base and with more or less erect chains of smaller inflated and cylindrical yellow cells in apex of warts (Fig. 30–31). Fragments of volva on base of stipe consisting of terminal yellow sphaerocysts, up to 60 μ wide, mixed with 3–10 μ wide hyphae. Cuticle 25–80 μ thick, composed of intermixed, distant, apparently imbedded, 2–5 μ wide hyphae with yellow vacuolar pigment. Hypoderm consisting of more or less radial hyphae with inflated fusiform cells, not sharply delimited. Trama of stipe with cylindrical to clavate terminal cells, up to 225 × 45 μ, narrow hyphae and some twisting refractive hyphae up to 10 μ wide, scarcely septate; on bulbous base with large sphaerocysts and 5–10 μ wide hyphae. No clamps observed.

HABITAT.—Terrestrial in forest; solitary.

COLLECTIONS EXAMINED.—Singapore, Bukit Timah, 27 March 1943 (type; one fragmented specimen in liquid; water-colour drawing), *E. J. H. Corner s.n.* (as *Amanita* 20).

OBSERVATIONS.—The great difference between the results of the measurements of the spores of fresh and of preserved material, may be due to the fact that the mature spores got lost in the preservation liquid.

In a tentative arrangement of the material, this species was put into section *Muscariae* on account of its great resemblance to *A. mira* (see p. 290), although the attenuate short gills caused some doubt. Nevertheless, it was a bit of a surprise later on to find the spores to be amyloid. In this way the number of species in section *Validae*, characterized by bright colours and a striate margin of the pileus, is increased again after its reduction by the removal of *A. rubrovolvata* (see p. 287).

The only species more or less comparable with *A. xanthella* are the yellow *A. flavipes* Imai (1933: 428) and *A. bella* Imai apud Gilb. (1941: 364), both from Japan. However, neither of these has conical warts on the pileus and both have larger spores, viz. 7.5–10 × 5–6.5 μ.

Section AMIDELLA (Gilb.) Konr. & Maubl.

Amidella Gilb. *in* Bres., Iconogr. mycol. **27** (1): 71, 77. 1940.—*Amanita* subgen. *Amidella* (Gilb.) Gilb., Not. Amanites XXX[3]. 1941.—*Amanita* sect. *Amidella* (Gilb.) Konr. & Maubl., Agaricales 61. 1948.—Type: *Amanita volvata* Peck.

Amanita sect. *Baccatae* Sing. *in* Lilloa **22**: 387. 1951 (nom. prov.); Sing. *in* Rev. Mycol. **18**: 17. 1953 (not val. publ.).—Type: "*Amanita baccata* (Fr.) Quél." [= *Amanita agglutinata* (Berk. & Curt.) Sing.].

For the scope of this section, see the key to the subgenera and sections on p. 243.

Amanita duplex Corner & Bas, *sp. nov.*—Pl. 5*c*, Fig. 34

Pileus 40–100 mm latus, subconcavus, subumbonatus, margine haud striatus, pallide cinereo-brunneus vel pallide cinereo-bubalinus, siccus, volvae fragmentis pulverulento-coactatis, brunneo-griseis tectus, centro volvae laciniis membranaceis, albis, 10–25 mm latis ornatus. Lamellae confertae, albo-cremeae. Stipes 60–120 × 7–10 mm, basi subbulbosus, solidus, albus vel pallidus, exannulatus, apice pruinosus, brunneo-griseus, infra nunc verrucis minutis, recurvis, nunc volvae annulo appresso, membranaceo obsitus. Volva 25 mm alta, 12–25 mm lata, fere omnino adnata, alba, limbo 2–4 mm lato. Caro alba. Sporae 6.5–7.5 × 5–5.5 μ, subellipsoideae vel ellipsoideae, amyloideae. Typus: *E. J. H. Corner s.n.*, 4 Sept. 1942, Singapore, Bukit Timah (L).

Etymology: duplex, double (on account of the volva consisting of two layers).

Pileus 40–100 mm wide, shallowly saucer-shaped, somewhat umbonate, not striate at margin, pale greyish-brownish, pale greyish buff or pale greyish hazel, dry, innately fibrillose, at first covered with a slightly greyer, pruinose-felted, 0.2 mm thick layer, breaking up into granules, concentric crust-like patches, and rings, but in centre covered by a membranous, white (brownish ochre discoloured by soil), smooth, 10–25 mm wide patch from top of volva. Gills free, crowded, about 130 primaries with 1(–3) rounded truncate shorter ones between each pair (mostly more truncate than in water-colour drawing), cream-white, 3–7 mm wide, with minutely eroded edge. Stipe 60–120 × 7–10 mm, tall, subcylindrical or slightly thickened downward, with hardly bulbous base, solid, whitish to pallid, exannulate, at least in upper two thirds covered with a pale brownish grey pruinose layer from ring, disrupted on elongation of stipe; on lower third with irregular small recurved squamules or with ring-like patch just above volva (as in specimen depicted). Volva at base of stipe up to 25 mm high, 12–25 mm wide, smooth, white, nearly entirely attached to base of stipe, with only a 2–4 mm wide free limb. Flesh 4–8 mm thick in centre, 1–1.5 mm half-way to margin, white, firm, then rather soft.

Spores (Fig. 34) 6.5–7.3 × 4.8–5.6 μ (fresh, 7–7.5 × 5.5 μ), ellipsoid to broadly ellipsoid (length-breadth ratio 1.25–1.45, average 1.35), colourless, thin-walled, smooth, with narrow, but sometimes rather long apiculus, with opalescent contents, amyloid. Basidia 4-spored, 32–36 × 9–11 μ; sterigmata about 4 μ long. Marginal cells numerous, small, 10–20(–30) μ wide, globulose to subglobulose. Trama of gills bilateral; central strand narrow, dense, made up of 5–10 μ wide hyphae and elongated cells up to 20 μ wide; divergent zones with elongate to ellipsoid or clavate cells up to 90 × 30 μ; subhymenium about 40 μ wide, composed of elongate to globulose cells, from 30 × 12 μ in inner part, to 8 × 8 μ at base of basidia. Cuticle about 200 μ wide, composed of a gelatinized, about 80 μ wide upper layer of radial 1.5–5 μ wide hyphae, and a lower layer of radial, up to 25 μ wide hyphae strongly constricted at septa, and forming chains of fusiform to ellipsoid cells. Remnants of volva on pileus: central patch absent in preserved fragment; crust-like patches composed of globulose, ellipsoid and piriform cells, with pale brown sap, often arranged in short chains, seemingly seated on a (more or less gelatinized?) thin layer of radial, 1.5–4 (–10) μ wide hyphae (difficult to make out whether this layer is inner layer of volva or belongs to cuticle; the first alternative seems more plausible). No clamps observed.

HABITAT.—Terrestrial in forest.

COLLECTIONS EXAMINED.—Singapore, Bukit Timah, 4 Sept. 1942 (type; one sector of pileus in liquid; water-colour drawing), *E. J. H. Corner s.n.* (as *Amanitopsis* 11).

OBSERVATIONS.—The universal veil of this species is composed of at least two distinct layers. Unfortunately the outer layer could not be studied as no parts of it were preserved. Most probably, however, it is composed of repent, interwoven hyphae and forms the central membranous patch over the centre of the pileus, the outer layer of the volva ring near the base of the stipe and the smooth covering of the base itself. The inner part of the universal veil consists of rather small inflated cells forming short chains and, therefore, is more liable to break up, thus forming crust-like patches all over the pileus. These pulverulent patches, however, are removable from the cuticle and rather coherent. As mentioned in the description, the chains of sphaerocysts seem to be seated on a thin layer of radial hyphae. This may be a third (innermost) layer of the universal veil.

Amanita duplex is rather difficult to place. It seems to take an intermediate position between sections *Lepidella* and *Amidella*. As a large part of the pileus is covered by pulverulent remnants of the universal veil one would be inclined to assign this species to section *Lepidella*. However, in this section one looks in vain for close allies and the slightly limbate volva in combination with the membranous patch on the centre of the pileus would be a peculiar feature there.

In section *Amidella*, however, several species occur which have a pulverulent or squamulose covering of the cuticle, besides a sheathing volva, for instance *A. fulvopulverulenta* Beeli, *A. goossensiae* Beeli, *A. agglutinata* (Berk. & Curt.) Sing., *A. lepiotoides* Barla, etc. It is very likely that in these species the pulverulent or fibrillose patches on the pileus are derived from a friable inner layer of the volva, as previously stated by Gilbert (1941: 309).

Therefore, although in *A. duplex* the volva is less sheathing than in the species enumerated above, its natural place seems to be in their vicinity. Form and size of the spores of *A. duplex* present no difficulties to that solution and, moreover, some of the species mentioned above have a friable ring, too.

Within section *Amidella*, *A. duplex* is easily distinguished on account of its very pale greyish-brownish pileus covered with numerous, slightly more greyish, crust-like patches, the friable ring, the unchanging flesh', and the relatively small spores.

Section PHALLOIDEAE (Fr.) Quél.

Agaricus [sect.] *Phalloideae* Fr., Monogr. Amanitarum Sueciae 3. 1854.—*Amanita* [sect.] *Phalloideae* (Fr.) Quél. *in* Mém. Soc. Emul. Montbéliard, ser II, **5**: 66. 1872 (Champ. Jura **1**: 28); Konr. & Maubl., Agaricales 63. 1948 ("sect.").—*Amanitina* [sect.] *Phalloideae* (Fr.) Gilb. *in* Bres., Iconogr. mycol. **27** (1): 72. 1940.—Lectotype (Sing. *in* Lilloa **22**: 387. 1951): *Agaricus phalloides* Fr.

Amanita [sect.] *Limbatae* Quél., Fl. mycol. France 307. 1888.—Lectotype: *Amanita phalloides* (Fr.) Link.

Amanita [sect.] *Volvati* J. Schroet. *in* Kryptog.-Fl. Schlesien **3** (1): 680. 1889; P. Henn. *in* Natürl. PflFam. **1** (1**): 275. 1889 ("*volvatae*"; "sect.").—Lectotype: "*Amanita bulbosa* Bull." [= *Amanita phalloides* (Fr.) Link].

Amanita [sect.] *Sphaerosporae* Lange *in* Dansk bot. Ark. **2** (3): 5, 7. 1915.—Lectotype: *Amanita mappa* (Batsch ex Fr.) Gonn. & Rab. [= *Amanita citrina* (Schaeff.) ex Roques].

Amanita [sect.] *Semilimbatae* Gilb., Genre Amanita 61, 172. 1918.—Lectotype: *Amanita citrina* (Schaeff.) ex Roques.

Amanita sect. *Volvoamanita* G. Beck *in* Pilz- u. Kräuterfreund **5**: 230, 235. 1922.—Lectotype: *Amanita phalloides* (Fr.) Link.

Amanitina [sect.] *Virosellae* Gilb. *in* Bres., Iconogr. mycol. **27** (1): 78. 1940.—Lectotype: *Amanita virosa* (Fr.) Quél.

Amanita [subsect.] *Mappae* Gilb., Genre Amanita 61, 172. 1918.—*Amanitina* [sect.] *Mappae* (Gilb.) Gilb. *in* Bres., Iconogr. mycol. **27** (1): 78. 1940.—*Amanita* [sect.] *Mappae* (Gilb.) Konr. & Maubl., Agaricales 64. 1948.—Lectotype: *Amanita citrina* (Schaeff.) ex Roques.

Amanitina Gilb. *in* Bres., Iconogr. mycol. **27** (1): 72, 78. 1940.—*Amanita* subgen. *Amanitina* (Gilb.) Gilb., Not. Amanites XXX [3]. 1941.—*Amanita* [sect.] *Amanitina* Kühn. & Romagn., Fl. anal. Champ. sup.: 431. 1953 (not val. publ.).—Type: *Amanita phalloides* (Fr.) Link.

For the scope of this section, see the key to the subgenera and sections on p. 243.

KEY TO THE SPECIES OF SECTION *Phalloideae*

1. Spores globulose to subglobulose, average length-breadth ratio < 1.15.
   2. Pileus umber, finely innately streaked near margin. Stipe white with small pale grey, flocculose-scurfy patches or fibrils. Ring and volva greyish. Spores $7.5–9 \times 7–8.5\ \mu$ *A. privigna*, p. 281
   2. Pileus umber to mouse-coloured, rather conspicuously darkly streaked. Stipe white and smooth. Ring and volva white. Spores $7.5–11 \times 6.5–10\ \mu$ . . . *A. alauda*, p. 282

1. Spores broadly ellipsoid to ellipsoid, sometimes subglobulose, average length-breadth ratio > 1.15.
   3. Gills broad and rather distant. Pileus 90–100 mm wide, with a thick cuticle, at first dark sepia, later one pale greyish sepia. Stipe with slightly pointed clavate-bulbous base, white, smooth, flocculose-squamulose near apex, annulate. Limb of volva without sphaerocysts. Spores 5.5–8 × 5–6 μ . . . . *A. elephas*, p. 278
   3. Gills narrow and crowded. Pileus 40–60 mm wide, with a moderately thick to thin cuticle, grey or umber.
      4. Stipe up to 60 mm long, annulate, white. Pileus not streaked, umber to greyish mouse-coloured. Stipe pruinose to flocculose-pruinose, with globose, slightly radicating base. Volva fleshy-membranous; its limb with sphaerocysts. Spores 6–9 × 4.5–7 μ *A. modesta*, p. 279
      4. Stipe up to 160 mm long, exannulate, pale greyish below. Pileus with dark innate streaks, leaden grey. Stipe in lower two thirds finely fibrillose, in upper third subpruinose, with subbulbous-subradicating base. Spores 7–8.5 × 5.5–6.5 μ *A.* species 3, p. 280

Amanita elephas Corner & Bas, *sp. nov.*—Pl. 6*b*, Fig. 36

Pileus 90–100 mm latus, initio campanulatus, dein applanatus vel concavo-applanatus, subumbonatus, margine haud striatus, sepiaceus, dein sordide pallide sepiaceus, margine striis minutis, innatis, obscuris virgatus, nunc nudus, nunc verrucis paucis albis, magnis, tenuibus obtectus, siccus vel subviscidus. Lamellae liberae, subdistantes, pallide cremeae. Stipes 120 mm longus, apice 8 mm crassus, basi 20–25 mm crassus, clavato-bulbosus, solidus, albus, infra glaber, a summo floccoso-squamulosus, annulatus, volvatus. Annulus 12 mm latus, amplus, floccoso-membranaceus, laceratus, supra striatus. Volva semilibera, 28–35 mm alta, alba, membranacea, appressa. Caro alba, dein pallide ochracea. Sporae 5.5–8 × 5–6 μ, subglobulosae vel subellipsoideae, amyloideae. Typus: *E. J. H. Corner s.n.*, 16 Aug. 1940, Botanic Gardens, Singapore (L).

Etymology: elephas, elephant (on account of the thick cuticle).

Pileus 90–100 mm wide, campanulate when young, becoming subumbonate plane to plano-concave with age, not striate at margin, dark sepia at first, pale sepia or pale sepia-grey with paler spots later on, darker innately fibrillose in outer half of limb, smooth, glabrous or with a few large, irregular, thin, membranous, white patches from volva, dry to slightly viscid (presumably very viscid when wet). Gills free, not crowded, about 65 primaries with 1–3 rounded-attenuate shorter ones between each pair, broad, 9–10 mm wide, whitish cream. Stipe 120 mm long, 8 mm wide at apex, 13 mm near base, 20–25 mm at slightly pointed clavate-bulbous base, solid, firm, white, smooth below ring, somewhat floccose-scaly above ring. Volva 28–35 mm high, lower half attached to bulb of stipe, upper half forming a thin but tenacious, membranous limb, with even margin or split on one side, white, smooth, appressed. Ring 12 mm wide, pendant from 30 mm below apex of stipe, rather spreading, floccose-membranous, easily torn, white to cream, striate on upper side. Flesh white, turning slightly ochraceous when cut, thin over limb.

Spores (Fig. 36) 5.4–6.8 × 4.6–5.6 μ (fresh, 7–8 × 5.5–6 μ), subglobulose to broadly ellipsoid or obovoid (length-breadth ratio 1.05–1.25, average 1.15–1.2), colourless, thin-walled, smooth, with small apiculus, cloudy-vacuolate, amyloid. Basidia 32–38 × 7–11 μ, 4-spored; sterigmata up to 4 μ long. Marginal cells numerous, up to 45 × 35 μ, globulose, ellipsoid or clavate, colourless. Trama of gills distinctly bilateral; central strand and divergent zones passing into each other, consisting of 5–20 μ wide longitudinal to divergent hyphae with cylindrical to elongated ellipsoid, 30–100 μ long cells; subhymenium 40 to 60 μ wide, cellular, with 8–20 μ wide cells. Cuticle about 400 μ wide (in bud even 800 μ), composed of a gelatinized, about 200 μ wide, upper layer with 3–5 μ wide, very distant hyphae, irregular near surface, subradial in lower part, and a dense, about 200 μ wide lower layer with, up to 15 μ wide, irregularly interwoven hyphae, slightly constricted at septa. Limb of volva composed of crowded, flexuosely interwoven, up to 10 (–18) μ wide, slightly thick-walled hyphae and some scattered elongated cells, up to 120 × 25 μ, on outside covered by irregular, densely interwoven, thin-walled, 2–4 μ wide hyphae and on inner side by slightly irregular to longitudinal, 3–8 μ wide hyphae with scattered elongated, ellipsoid and clavate cells; all with slightly thickened walls. Trama of stipe with clavate terminal longitudinal cells, up to 350 × 35 μ and narrow, longitudinal hyphae near surface. No clamps observed.

HABITAT.—Terrestrial in jungle.

COLLECTIONS EXAMINED.—Singapore, Botanic Gardens, Gardens' Jungle, 16 Aug. 1940 (type; a half specimen in liquid; water-colour drawing); Reservoir Jungle, 15 April 1941 (bud in liquid; water-colour drawing); both *E. J. H. Corner s.n.* (as *Amanita* 15).

Amanita elephas has much in common with *A. modesta* (see below); however, the different structure of the volva (no sphaerocysts), the thick cuticle, the broad, not crowded gills, and the large size demonstrate that it is different.

As *A. elephas* is close to *A. phalloides* (Fr.) Link it might well be poisonous.

Amanita modesta Corner & Bas, *sp. nov.*—Pl. 8*a*, Fig. 35

Pileus 40–50 mm latus, convexo-applanatus, interdum concavus, subumbonatus, margine haud vel breviter striatus, umbrinus vel griseo-murinus, nudus, viscidus. Lamellae confertae, angustae, albo-cremeae. Stipes 40–60 × 4–5 mm, bulbo globoso, acuto vel subradicato, 8–15 mm lato, solidus vel cavus, albus, pruinosus vel flocculosus, annulatus, volvatus. Annulus 5–7 mm latus, floccoso-membranaceus, saepe laceratus, supra striatus, albus. Volva semilibera, carnoso-membranacea, 15–22 mm alta, alba. Caro alba. Sporae 6–9 × 4.5–7 μ, subglobulosae vel ellipsoideae, amyloideae. Typus: *E. J. H. Corner s.n.*, 3 Dec. 1940, Singapore, Reservoir Jungle (L).

Etymology: modestus, modest.

Pileus 40–50 mm wide, plano-convex with depressed centre to concave, slightly umbonate, with margin smooth to shallowly and shortly sulcate-striate, umber to greyish mouse-coloured, with centre sometimes inclining to purplish umber, paler toward margin, glabrous, smooth, viscid to slightly viscid. Gills free, crowded, 76—100 primaries with 0–3 attenuate shorter ones between each pair, rather narrow, 3–4 mm wide, cream-white; edges often eroded, especially those of shorter gills. Stipe 40–60 × 4–5 mm, cylindrical, with globose, often pointed or even slightly radicating base, 8–15 mm wide, solid to hollow, white, wholly white pruinose or floccose-pruinose above and below ring. Volva fleshy-membranous, firm, sheathing, 15–22 mm high, 8–15 mm wide, mostly 2-lobed, white, smooth, lower half adnate to bulb. Ring 5–7 mm wide, pendant from apex of stipe, floccose-membranous, delicate, often torn, white, striate above, somewhat floccose-scurfy below; edge uneven. Flesh 2.5–3 mm thick in centre of pileus, thin over limb, white, soft.

Spores (Fig. 35) 5.9–7.8 × 4.1–6.2 μ (fresh, 7–9 × 5.5–7 μ), subglobulose to ellipsoid often slightly attenuate toward apiculus (length-breadth ratio 1.1–1.45, aver. 1.2–1.25), colourless, thin-walled, smooth, with small apiculus, with cloudy contents, amyloid. Basidia 4-spored, rarely 2- or 1-spored, 25–36 × 8–10 μ; sterigmata about 5 μ long. Marginal cells rather numerous, globulose, up to 30 (–50) μ wide. Trama of gills bilateral, loose; central strand with elongated cells up to 150 × 20 μ and ellipsoid to clavate cells up to 100 × 55 μ; divergent zones with elongated-ellipsoid to ellipsoid cells up to 85 × 30 μ; subhymenium about 40 μ wide, cellular, consisting of 10–25 μ wide, globulose to ellipsoid cells. Cuticle made up of a gelatinized upper layer, about 40 μ wide, with 2–5 μ wide, distant, interwoven-subradial hyphae and a lower layer, about 100 μ wide, of rather crowded (slightly embedded?), up to 20 μ wide hyphae constricted at septa and irregularly inflated especially at ends of cells; pigment intracellular, umber. Limb of volva with outer surface composed of irregular, densely interwoven 2.5–6 (–10) μ wide, multiseptate hyphae; the inner surface composed of more or less gelatinized narrow hyphae and scattered sphaerocysts; the inner part mainly of numerous inflated cells, mostly sphaerocysts, up to 60 μ wide. Trama of stipe with terminal, longitudinal, slenderly clavate cells, up to 300 × 30 μ; at surface with many oleiferous, slenderly clavate cells and patent ends of thin hyphae. No clamps observed.

HABITAT.—Terrestrial in jungle.

COLLECTIONS EXAMINED.—Singapore, Reservoir Jungle, 3 Dec. 1940 (type; several specimens in liquid; water-colour drawing); Malaya, Johore, Tebrau, 24 Sept. 1939 (one specimen in liquid); both *E. J. H. Corner s.n.* (as *Amanita* 13).

Among the dark-coloured species with ellipsoid spores of section *Phalloideae* only *A. pseudoporphyria* Hongo (1957: 141, fig. 2a–c) seems related and even bears a great resemblance to the present one. However, the Japanese species has more slender spores (1.3–1.6), a floccose-squamose stipe and is associated with conifers. Its spore-size was checked from a duplicate of the paratype, *Hongo 1219*, Otsu-city, 16 July 1955, preserved in the Rijksherbarium, Leiden.

A third collection originally attributed to the present species (*Amanita* 13, Singapore, Bukit Timah, 4 Oct. 1944; some fragments in liquid) has to be excluded. Its spores are larger (7.6–9.5 × 4.7–5.6 μ), more elongated (1.5–1.85) and ellipsoid-subreniform. The insufficiency of both data and material renders this collection unidentifiable.

AMANITA SPECIES 3

Pileus 60 mm wide, becoming concave and slightly umbonate, not striate at margin, leaden grey, darker over centre, with dark innate streaks, subviscid, smooth, without remnants of volva. Gills free, crowded, 130 primaries with 1–7 subtruncate to attenuate shorter ones between each pair, narrow, rather thick, 3 mm wide, white then cream. Stipe 160 mm long, 9 mm wide at apex, 15 mm at base (from dried specimen apparently subbulbous-subradicating), solid, rather stout and firm, pale greyish white and finely fibrillose, upper third white and slightly pruinose, exannulate. Volva 20 mm high, free as in *A. phalloides*, white. Flesh white, firm, 7 mm thick in centre, 2–2.5 mm half-way to margin. Smell faint, not unpleasant.

Spores 7.2–7.9 × 5.6–6.7 μ (fresh, 7–8.5 × 5.5–6.5 μ), subglobulose to broadly ellipsoid or obovoid (length-breadth ratio 1.1–1.3, average 1.2), thin-walled, colourless, smooth, with small apiculus, cloudy vacuolate, amyloid. Basidia 4-spored. Marginal cells numerous, inflated. Cuticle with 2–5 μ wide, distant irregular hyphae near surface and slightly wider, crowded, radial to subradial hyphae in lower part; hyphae with grey or umber sap. Trama of stipe *Amanita* type.

HABITAT.—Terrestrial.

COLLECTIONS EXAMINED.—Singapore, Bukit Timah, 21 Aug. 1939 (1 dried specimen), *E. J. H. Corner s.n.* (as *Amanitopsis* 6).

The specimen preserved was already in a bad condition before drying. It is impossible now to study the structure of the volva and the base of the stipe, while the description is rather vague on these points. Moreover, it is difficult to know from a single specimen whether the absence of an annulus is incidental or characteristic.

The present species seems to be most closely related to *A. modesta* Corner & Bas. It is similar in many respects, such as the colour of the pileus, the closeness of the narrow gills, the shape and size of the spores, and perhaps the shape of the base of the stipe. It seems to differ only in the very long, somewhat greyish stipe, the absence of an annulus, and the streaky pileus. From *A. elephas* Corner & Bas it differs in the crowded narrow gills and the exannulate stipe.

Amanita privigna Corner & Bas, *sp. nov.*

Pileus 50–60 mm latus, plano-convexus, margine haud striatus, griseo-umbrinus vel fuligineo-umbrinus, striis minutis, obscuris virgatus, subviscidus, glaber. Lamellae subconfertae, albae vel cremeae. Stipes 50–60 mm longus, apice 7–8, basi 10–12 mm latus, subbulbosus, albus, verrucis scabrosis fibrillosisve, griseolis ornatus. Volva 8–12 mm alta, carnoso-membranacea, quadripartita, griseola. Annulus membranaceus, griseus, minute striatus. Caro alba. Sporae 7.5–9 × 7–8.5 μ, globulosae vel subglobulosae, amyloideae. Typus: *E. J. H. Corner s.n.*, 16 Aug. 1939, Singapore, Bukit Timah (L).

Etymology: privigna, stepdaughter (the species being poorly endowed with characteristic features).

Pileus 50–60 mm wide, becoming subumbonately plano-convex, with smooth margin, livid umber, fuliginous umber in centre, paler and finely innately streaked toward margin, slightly viscid, smooth, glabrous. Gills free, rather crowded, 70 primaries with 1–3 obliquely truncate to attenuate shorter ones between each pair, narrow, 3–4 mm wide, white, becoming pale cream. Stipe 50–60 mm long, 10–12 mm wide at subbulbous base, 7–8 mm wide at apex, subequal, white with small, pale grey, floccose-scurfy patches or fibrils above and below ring, pure white at extreme apex. Volva 8–12 mm high, lower third attached to subbulbous base of stipe, upper two thirds forming a slightly spreading fleshy-membranous limb, split into 4 parts, pale grey, white at base, rather firm, in dried specimen constricted at joint with stipe. Ring 8–12 mm broad, pendant from about 10 mm below apex of stipe, membranous, grey, finely striate on upper side, smooth on underside, fairly firm and persistent. Flesh white, fairly firm, 4–5 mm thick in centre, gradually thinning toward margin.

Spores 7.4–9.0 × 6.7–8.5 μ (fresh, 8–9 × 7–8 μ), globulose to subglobulose, sometimes broadly ellipsoid (length-breadth ratio 1.0–1.2, average 1.05–1.1), colourless, thin-walled, smooth, with small apiculus, with cloudy vitreous contents, amyloid. Basidia 4-spored. Marginal cells 20–45 × 10–40 μ, clavate, piriform or globose, colourless, thin-walled, forming a sterile edge to the gill. Cuticle gelatinized near surface, with narrow, 2–6 μ wide, radial hyphae with pale brown intracellular pigment. Limb of volva composed of densely interwoven, mostly 3–8 μ wide hyphae and scattered elongated to slender clavate, seldom globose cells, e.g. 80 × 45 μ, 130 × 25 μ, 60 × 60 μ, etc.; outer surface covered by interwoven, up to 5 μ wide, irregular hyphae. No clamps observed.

HABITAT.—Terrestrial in forest; solitary.

COLLECTIONS EXAMINED.—Singapore, Bukit Timah, 16 Aug. 1939 (type; 1 dried specimen), *E. J. H. Corner s.n.* (as *Amanita* 10).

The present species belongs to the dark-coloured, volvate species with globulose spores of section *Phalloideae*.

Amanita fuliginea Hongo (1953: 69) from Japan is rather similar. However, an examination of authentic material of that species (*Hongo 711*, 4 Aug. 1953, Mii-dera, Otsu) kindly put at our disposal by Dr. T. Hongo, showed that the cuticle of that species is quite different, viz. only slightly gelatinized and with 5–8 (–18) μ wide, repent, subradial, dark brown hyphae. Moreover, the stipe of *A. fuliginea* is brownish squamulose-fibrillose, the volva is white and the ring turns brownish.

Amanita alauda Corner & Bas (see below) differs by the rather conspicuously streaked cuticle with 3–10 (–15) μ wide hyphae and the white stipe, ring, and volva.

Amanita alauda Corner & Bas, *sp. nov.*—Pl. 6*c*, Fig. 37

Pileus 30 mm latus, concavus, umbonatus, margine haud striatus, nudus, sepiaceus vel murinus, striis obscuris virgatus, viscidus. Lamellae confertae, 3 mm latae, albae, demum cremeae. Stipes 55 × 5 mm, subbulbosus, solidus, albus, glaber, annulatus, volvatus. Annulus 8 mm latus, membranaceus, albus, supra striatulus. Volva semilibera, sublobata, 10 mm alta, alba. Caro alba. Sporae 7–11 × 6.5–10 μ, globulosae vel subglobulosae, amyloideae. Typus: *E. J. H. Corner s.n.*, 4 Dec. 1940, Singapore, Botanic Gardens (L).

Etymology: alauda, lark (on account of the variegated brown pileus).

Pileus 30 mm wide, becoming umbonate concave, with non-striate margin, without remnants of volva, sepia or pale purplish umber to mouse-coloured, darker over disk, streaked by innate dark fibrils, especially near margin, smooth, viscid. Gills free, crowded, 66 primaries with 0–1 attenuate shorter ones between each pair, white then cream, 3 mm wide. Stipe 55 × 5 mm, cylindrical with subbulbous base, firm, solid, annulate, white, smooth. Ring about 8 mm wide, hanging down from apex of stipe, membranous, white, finely striate on upper side, soon collapsing. Volva 10 mm high, 8–9 mm wide, white; lower half connected with base of stipe; upper half forming an irregularly split membranous limb with indistinct lobes. Flesh white.

Spores (Fig. 37) 7.1–8.4 (–9.2) × 6.3–8.3 μ (fresh, 9–11 × 8–10 μ), globulose to subglobulose (length-breadth ratio 1.0–1.15, average 1.05–1.1), colourless, thin-walled, smooth, with small apiculus, with cloudy opalescent contents, amyloid. Basidia 35–45 × 10–13 μ, 4-spored, with about 5 μ long sterigmata. Marginal cells scattered, clavate to ellipsoid, up to 30 × 20 μ in preserved specimen. Trama of gills bilateral; the very distinct central strand with clavate to cylindrical, often terminal cells up to 120 × 25 μ; the rather indistinct and narrow divergent zones with scattered ellipsoid to subcylindrical cells up to 60 × 30 μ; the subhymenium about 40 μ wide, cellular-subramose, with cells 10–20 μ wide, the innermost cells hardly larger than those at base of basidia. Cuticle about 200 μ thick, irregular with slight radial tendency, composed of brown, 3–10 (–15) μ wide hyphae, constricted at septa, with many darker brown, non-inflated tips of hyphae; the upper part (75–100 μ wide) with distant hyphae, embedded in gelatinous matter. Limb of volva mainly consisting of 3–15 (–25) μ wide, interwoven, sublongitudinal hyphae, with some scarce sphaerocysts up to 100 μ wide in inner part. Trama of stipe with cylindrical to clavate, longitudinal, up to 370 × 50 μ cells terminal or in short chains. Surface of stipe consisting of 3–6 μ wide longitudinal hyphae. No clamps observed.

HABITAT.—Terrestrial in jungle; solitary.

COLLECTIONS EXAMINED.—Singapore, Botanic Garden, Garden's Jungle, 4 Dec. 1940 (type; two half specimens in liquid; water-colour drawing), *E. J. H. Corner s.n.* (as *Amanita* 17).

Among the dark-coloured species with globulose spores of section *Phalloideae*, particularly *A. murinacea* Pat. (1928: 29) from Madagascar and *A. fuliginea* Hongo (1953: 69, fig. 1; coloured plate in Imazeki & Hongo, 1957: pl. 18 fig. 103) from Japan seem to be comparable to the present species. The former is insufficiently described. It is not clear whether its mouse grey cap is streaked or not. However, it seems to be different on account of the strongly bulbous base of the stipe, the dry, silky pileus, and the larger size. *Amanita fuliginea* differs by the ring turning brownish, the brownish squamulose-fibrillose stipe and the less streaky, subviscid to dry pileus.

A remarkable feature of *A. alauda* is the viscid cuticle giving a strong impression of being fibrillose, which is caused by the rather wide, dark brown hyphae embedded in the gelatinous matter of the upper layer.

Subgenus AMANITA

Amanita subgen. *Vaginaria* Forq., Champ. sup. 45. 1888 (not val. publ.); *ex* Quél., Fl. mycol. France 302. 1888.—Lectotype (Sing. *in* Lilloa **22**: 386. 1951): *Amanita vaginata* (Bull. ex Fr.) Vitt.

Amanita [subgen.] *Peplophora* Quél., Fl. mycol. France 303. 1888; Quél. & Bat., Fl. monogr. Amanites Lépiotes 22. 1902 ("subgen.").—Lectotype: *Amanita muscaria* (L. ex Fr.) Hook.

Amanitopsis Roze *in* Bull. Soc. bot. France **23**: 50, 51. 1876.—*Amanita* subgen. *Amanitopsis* (Roze) Lange *in* Dansk bot. Ark. **2** (3): 6. 1915.—Lectotype (fixed by conservation): *Agaricus vaginatus* Bull. ex Fr.

Amanitaria Gilb. *in* Bres., Iconogr. mycol. **27** (1): 70, 76. 1940.—*Amanita* subgen. *Amanitaria* (Gilb.) Gilb., Not. Amanites XXX [2]. 1941.—Type: *Amanita pantherina* (DC. ex Fr.) Schummel.

Amanita subgen. *Pseudoamanita* Sing. *in* Ann. mycol., Berl. **34**: 336, 352. 1936 (not val. publ.); *ex* Sing. *in* Acta Inst. bot. Acad. Sci URSS (ser. II, Plant. crypt.) **6**: 389. 1951.—Lectotype (Sing. *in* Lilloa **22**: 385. 1951): *Amanita muscaria* (L. ex Fr.) Hook.

Spores non-amyloid.

Section AMANITA

Agaricus [sect.] *Muscariae* Fr., Monogr. Amanitarum Sueciae 6. 1854.—*Amanita* [sect.] *Muscariae* (Fr.) Quél. *in* Mém. Soc. Emul. Montbéliard, ser. II, **5**: 67. 1872 (Champ. Jura etc. **1**: 29); Sing. *in* Lilloa **22**: 386. 1951 ("sect.").—Lectotype (Gilb. *in* Bull. Soc. mycol. France **46**: 173. 1931): *Agaricus muscarius* L. ex Fr.

Amanita [sect.] *Circumscissae* Quél., Fl. mycol. France 304. 1888; *emend.* Sing. *in* Ann. mycol., Berl. **41**: 162. 1943.—Lectotype: *Amanita muscaria* (L. ex Fr.) Hook.

Amanita [sect.] *Marginatae* J. Schroet. *in* Kryptog.-Fl. Schlesien **3** (1): 679. 1889; P. Henn. *in* Natürl. PflFam. **1** (1**): 275. 1898 ("sect.").—Lectotype: *Amanita muscaria* (L. ex Fr.) Hook.

Amanita [sect.] *Ovisporae* Lange *in* Dansk bot. Ark. **2** (3): 5, 8. 1915.—Lectotype: *Amanita muscaria* (L. ex Fr.) Hook.

Amanita [sect.] *Floccosae* Gilb., Genre Amanita 81, 172. 1918.—Lectotype: *Amanita muscaria* (L. ex Fr.) Hook.

Amanitella Earle *in* Bull. N.Y. bot. Gard. **18**: 449. 1909.—*Amanita* [sect.] *Amanitellae* Gilb., Genre Amanita 156, 173. 1918 (name change).—Type: *Amanita farinosa* Schw.

Amanitopsis sect. *Pulveratae* Imai *in* Bot. Mag., Tokyo **47**: 430. 1933.—Type: *Amanitopsis farinosa* (Schw.) Atk.

Amanitaria Gilb. *in* Bres., Iconogr. mycol. **27** (1): 70, 76. 1940.—*Amanita* subgen. *Amanitaria* (Gilb.) Gilb., Not. Amanites XXX [2]. 1941.—*Amanita* sect. *Amanitaria* (Gilb.) Konr. & Maubl. Agaricales 59. 1948.—Type: *Amanita pantherina* (DC. ex Fr.) Schummel.

For the scope of this section, see the key to the subgenera and sections on p. 243.

KEY TO THE SPECIES OF SECTION *Amanita*

1. Volva forming a narrow membranous rim or ridge around top of bulbous base of stipe and membranous, flat patches on pileus. Pileus pale ochraceous buff to dingy buff, with darker centre and whitish patches. Stipe white to dingy cream, exannulate, but often with volva ring. Spores 7–9.5 × 6–8.5 μ, globulose to subglobulose . . *A. elata*, p. 286

1. Volva forming small conical warts or powdery to felted remnants on bulbous base of stipe and conical warts or a powdery-felted layer, breaking up into minute warts on pileus.

2. Pileus covered with conical warts.

3. Pileus dark brown to brown, with greyish white to greyish brown warts. Stipe whitish, with greyish or brownish white, scurfy remnants of volva round top of bulbous base, exannulate. Spores 6.5–8 μ, globulose to subglobulose. *A. sychnopyramis*, p. 291

3. Pileus clear-coloured, red, orange, yellow or pale yellow, with yellow to yellowish warts.

4. Pileus red to orange in centre. Stipe mostly exannulate. Shorter gills truncate. Spores 6.5–8.5 × 6–7.5 μ, globulose to subglobulose. . . . . . *A. mira*, p. 290

4. Pileus yellow to pale yellow in centre. Stipe mostly (?) annulate. Shorter gills attenuate. Spores 6.5–8 × 5–7 μ, subglobulose to broadly ellipsoid (see *A. xanthella*, p. 274)

2. Pileus covered with powdery-felted layer, breaking up into minute warts.

5. Pileus orange-scarlet with reddish to orange remnants of volva. Stipe yellow, with reddish orange powdery zones at base. Ring yellow with orange margin. Spores 7.5–10 (–11) μ, globulose . . . . *A. rubrovolvata*, p. 287

5. Pileus pallid with greyish umber remnants of volva. Stipe white, flocculose-pruinose, fuliginous pruinose or with fuliginous felted ridge at base, exannulate. Spores 6–8.5 × 5.5–7.5 μ, globulose to broadly ellipsoid . . . . *A. obsita*, p. 292

EXPLANATION OF FIGURES 34–44

Fig. 34. *Amanita duplex.* — Spores (× 1250).

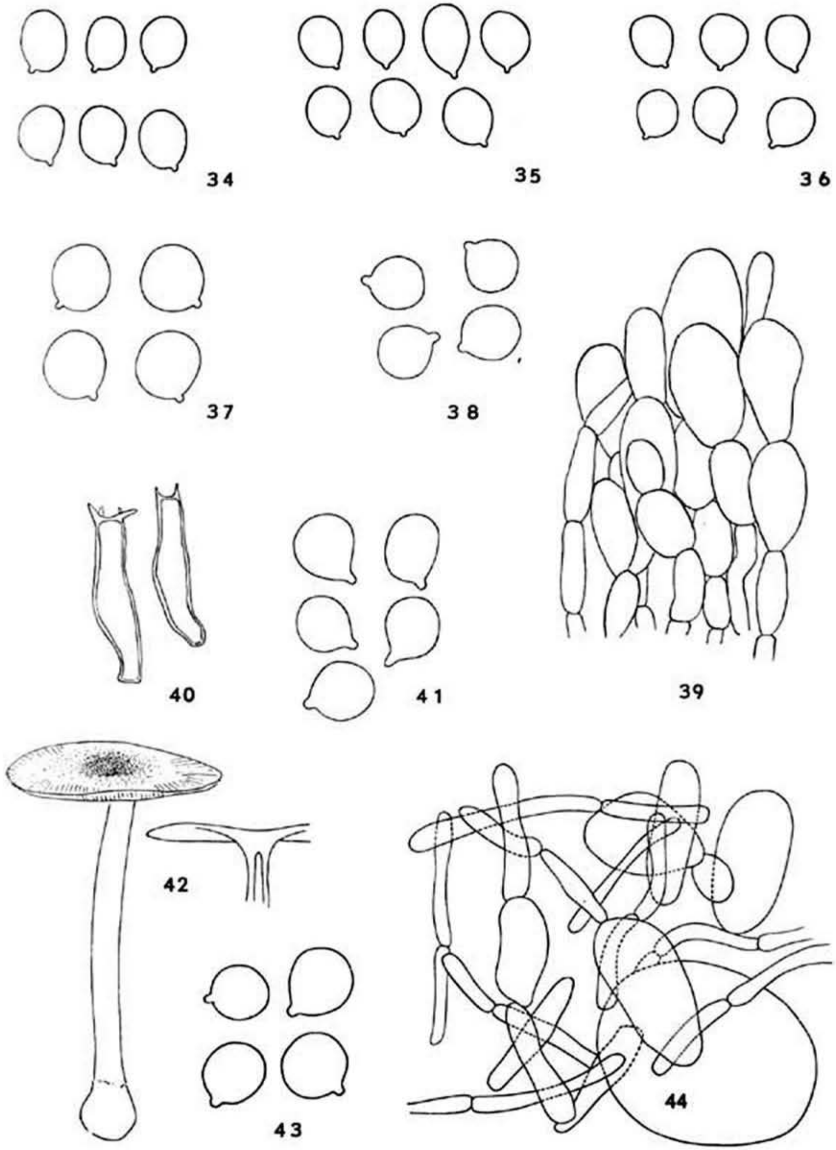
Fig. 35. *Amanita modesta.* — Spores (× 1250).

Fig. 36. *Amanita elephas.* — Spores (× 1250).

Fig. 37. *Amanita alauda.* — Spores (× 1250).

Figs. 38, 39. *Amanita sychnopyramis.* — 38. Spores (× 1250). — 39. Crushed wart from pileus (× 500).

Figs. 40–44. *Amanita elata.* — 40. Thick-walled basidia (× 500). — 41. Spores (× 1250). — 42. Reproduction of type drawing (× $^{1}/_{2}$). — 43. Spores of type (× 1250). — 44. Crushed patch of veil from pileus of type (× 500).



Figs. 34–44

Amanita elata (Mass.) Corner & Bas, *comb. nov.*—Pl. 9*a*, Figs. 40–44

Collybia elata Mass. *in* Kew Bull. **1914**: 73 (basionym).

Pileus 35–90 mm wide, campanulate to convex when young, becoming plano-convex with depressed centre or concave with flat margin with age, $^1/_4$ to $^1/_3$ tuberculate-striate from margin toward centre, pale dingy ochraceous buff or dingy buff with very faint sulphur yellow tinge, more or less umber or fuliginous in centre, pallid whitish toward margin, glutinous-viscid, then smeary, glabrous or with some small, scattered, irregularly shaped, dingy white, rather thick, floccose-membranous, flat patches, easily washed off by rain. Gills free, crowded, 72–125 primaries, with 0–1 (–3) truncate shorter ones between each pair, 3–6 mm wide, white to cream, slightly transversely veined at base near margin of cap; edge presumably minutely flocculose. Stipe 50–130 × 4–15 mm, equal or attenuate upward, with globose or subglobose, seldom slightly turbinate, marginate, 8–19 mm wide, bulbous base, solid, becoming hollow, white to cream or slightly greyed, somewhat floccose-scabrid below, whitish pruinose above with narrow, 2–6 mm high rim of volva round top of bulb, without ring derived from partial veil but often somewhere with a spurious, irregularly shaped, dingy white or pale dingy ochraceous, ascending ring, derived from volva. Flesh white, firm, 2–4 mm thick in centre of pileus, thin over limb. Smell unpleasant, as in *A. phalloides* (Fr.) Link.

Spores (Fig. 41, 43) 7.0–8.5 × (6.0–) 6.8–7.7 μ (fresh, 7–9.5 × 6–8.5 μ), globulose to subglobulose, seldom broadly ellipsoid [length-breadth ratio 1.0–1.1 (–1.2)], with rather large apiculus, colourless, thin-walled, smooth, with one medium-large gutta or several small ones, sometimes non-guttate, non-amyloid. Basidia 38–47 × 10–12 μ, with four, up to 5 μ long sterigmata; in collection of 18 March 1931 many with thickened walls, (Fig. 40), especially near edge of gill. Marginal cells forming a broad sterile margin along edge of gill consisting of branching hyphae 3 μ and more wide, cylindrical cells about 8–12 μ wide, with rounded ends, sometimes forming short chains; and inflated cells, up to 25 μ across, often with oily contents. Trama of gills rather distinctly bilateral, composed of a central strand with elongated inflated cells e.g. 60–200 × 20–40 μ and narrow hyphae, bordered by zones with diverging hyphae and inflated ellipsoid cells e.g. 50–70 × 25–40 μ which gradually pass into a broad cellular subhymenium of cells, diminishing in size from 20 (–35) μ to 5–10 μ at base of basidia. Trama of rim of volva on top of bulb consisting of numerous, 3–12 μ wide branching hyphae, often constricted at septa, some hyphae with oily contents and inflated cells up to 60 × 40 μ, but mostly about 40–50 × 25–35 μ, often terminal but sometimes forming short chains. Cuticle with 10–40 μ thick hyaline upper layer, composed of 1.5–4.5 μ wide, irregularly arranged, distant hyphae, apparently slightly embedded, but not dissolved, and with 20–40 μ thick lower layer of more or less radially arranged, very crowded, narrow, coloured hyphae with intracellular pigment. Trama of stipe with a firmer outer part, composed of terminal clavate cells up to 220 × 36 μ, and 2–5 μ wide hyphae, and a softer inner part composed of 4–10 μ wide hyphae, rather small, ellipsoid, constricted, terminal, inflated cells, and many 6–14 μ wide hyphae with oily contents. No clamps observed.

HABITAT.—Terrestrial in forest in Singapore: Botanic Gardens' Jungle, Bukit Timah Forest and other remnants of forest. Common every rainy season and often very abundant.

COLLECTIONS EXAMINED.—Singapore, Botanic Gardens, Gardens' Jungle, 22 Sept. 1913. *E. M. Burkill 150* (type; several dried specimens; water-colour drawing; K); Botanic Gardens, Aug. 1929 & 18 March 1934 (both dried); Reservoir Jungle, 4 Nov. 1940 & 26 Sept. 1943 (both water-colour drawings, the second also specimens in liquid); except type, all *E. J. H. Corner s.n.* (as *Amanitopsis* 3).

OBSERVATIONS.—The fresh pileus being described by the senior author as glutinous-viscid, it is somewhat amazing to find the cuticle of the preserved specimens with only a thin hyaline upper layer with non-dissolving hyphae. However, it may be that the specimens had already lost a more glutinous outer layer. As a matter of fact all specimens preserved by the senior author had also lost the remnants of the volva on the pileus.

Amanita elata greatly resembles *A. gemmata* (Fr.) Gillet and is undoubtedly closely related to that species. However, *A. gemmata* differs by (i) a thinner, more paper-like volva, (ii) as a rule larger and more ellipsoid spores [according to 100 measurements of the junior author on 10 Dutch collections, 8–11 (–12) × (6.0–) 7–8.5 μ, the average length-breadth ratio per find ranging from 1.1–1.4], (iii) a golden yellow to ochraceous yellow pileus, becoming brownish only in centre, (iv) the absence of a smell, (v) the occasional presence of a true ring derived from the partial veil and the very rare presence of a spurious ring derived from the volva, only just above the bulb, as in *A. pantherina* (DC. ex Fr.) Schummel.

It is even more difficult to separate the present species from *A. diemii* Sing. (1954: 120) from Patagonia. However, this species differs from *A. elata* by (i) a golden yellow to orange ochre yellow pileus turning brown with age from centre toward margin, (ii) the margin of the cap often set with white denticules of the volva, (iii) the entirely coarsely floccose-granular stipe, (iv) the short ellipsoid, slightly larger spores, (viz. 8.2–10 × 7.5–9 μ), (v) the absence of a smell, (vi) the presence of clamps in the trama of the gills. Dr. R. Singer, Buenos Aires, who studied colour-slides of the water-colour drawings and the description of the present species, also looks upon *A. elata* and *A. diemii* as different species (in litt.).

It was somewhat surprising to find this typical species of *Amanita* described as a species of *Collybia*. The type is well preserved and it is not difficult to recognize in it the species depicted by Corner.

The pileus of the type (Fig. 42) has a sulcate-striate margin and bears some patches derived from the volva. However, these may easily escape attention, as some of the pilei are almost completely covered with paper, on account of the glutinous surface of the fresh pileus. The exannulate stipe has a more or less globose bulbous base on which the margin of the volva is easy to distinguish. The spores are non-amyloid and globulose; their size is 6.8–8.4 × 6.7–7.9 μ and their length-breadth ratio 1.00–1.05. The trama of the stipe has *Amanita* structure.

AMANITA RUBROVOLVATA Imai.—Figs. 45–47

Amanita rubrovolvata Imai *in* Bot. Mag., Tokyo **53**: 392. 1939.—*Amplariella rubrovolvata* (Imai) Gilb. *in* Bresadola, Iconogr. mycol. **27** (1): 79. 1940.

DESCRIPTIONS & ILLUSTRATIONS.—Imai apud Gilb. *in* Bresadola, Iconogr. mycol. **27** (3): pl. 56. 1941; Hongo *in* J. Jap. Bot. **30**: 216, fig. 1 (4–6). 1955; Imazeki & Hongo, Colour. Ill. Fungi Japan 46, pl. 19 fig. 107. 1957.

Pileus 35–40 mm wide, becoming plane, tuberculate-striate half-way from margin toward centre, orange scarlet, paler toward margin, subviscid, covered with a powdery micaceous, reddish orange to orange, separable down, the latter sometimes breaking up with age in scattered, thin, crust-like patches. Gills free, crowded, up to 4 mm wide, 58–82 primaries with 0–1 truncate shorter ones between each pair, white. Stipe 35–75 × 6–7 mm, subequal, with subglobose, 8–13 mm wide bulbous base, hollow in mature specimens, yellow to pale yellow, sometimes deeper yellow either toward base or toward apex, minutely pruinose-floccose above ring, minutely pruinose-fibrillose below; remnants of volva forming two powdery flocculose reddish orange zones, one on upper part of basal bulb and the other, 2 to 7 mm higher up on stipe. Ring in the middle or in the upper fourth of stipe, 2–6 mm wide, pendant, floccose-membranous, thin, white above, pale yellow below, with powdery orange margin. Flesh 2–2.5 mm thick in centre of pileus, membranous over limb, pale yellowish, orange beneath cuticle of pileus, deeper yellow near surface of stipe.

Spores (Fig. 47) 7.5–9.9 (–11.3) × 7.4–9.9 μ (in alcohol-formalin material 6.8–7.9 μ across), globulose to subglobulose [length-breadth ratio 1.0–1.1 (–1.13)], with rather broad apiculus, colourless, thin-walled, with one medium-large gutta or several small ones, non-amyloid. Basidia 35–40 (–45) × 9–11 μ, with 4 about 5 μ long sterigmata. Some rare, up to 35 μ wide, globulose marginal cells observed. Edge of gills for the greater part fertile. Trama of gills rather distinctly bilateral, with a rather broad central strand of 2.5–6 μ wide hyphae mixed with cylindrical cells up to 50 × 12 μ; on both sides bordered by a zone with slightly diverging hyphae and cylindrical or inflated cells, passing gradually in the about 25 μ thick ramose-subcellular subhymenium with 6–10 μ wide globulose cells just beneath the hymenium. Fragments of volva on pileus (Fig. 45) composed of irregularly arranged, loosely interwoven, short chains of globulose to shortly ellipsoid, 15–55 × 13–35 μ large cells mixed with 2–5 μ wide hyphae; fragments of volva on base of stipe (Fig. 46) mainly consisting of loosely interwoven long chains of short cylindrical to ellipsoid, 18–40 × 6–20 μ large cells, the bigger ones often slightly constricted in the middle. Cuticle a 25–40 μ thick layer of crowded, subradial, 2–5 μ wide hyphae, covered by a hyaline, at least 25 μ thick layer with irregularly arranged, very distant, thin, gelatinizing hyphae. Trama of stipe composed of clavate terminal up to 220 × 60 μ large cells and short chains of sausage-shaped and ellipsoid cells, mixed with 4–8 μ wide hyphae. No clamps observed.

HABITAT.—Near oak in highlands (1500 m alt.); solitary.

DISTRIBUTION.—Japan, Malaya.

COLLECTIONS EXAMINED.—Malaya, Pahang, Cameron's Highlands, 31 July 1934 (dried), 1 Aug. 1934 (dried and in alcohol-formalin), both *E. J. H. Corner s.n.* (as *Amanita* 21).

OBSERVATIONS.—On the dried specimen of 31 July 1934 the remnants of the volva on the bulb seem to comprise more than the orange reddish zone on the upper part of the bulb, described above. The bulb bears at its sides a pale thin layer of wadding, closely adherent to, but easily distinguished from, the more solid tissue of the bulb and forming a very narrow free limb in its upper part. It seems that only the outermost layer of the basal part of the volva is coloured a reddish orange. In the specimens depicted by Imai (l.c.) this outer layer is still undisturbed and covering the greater

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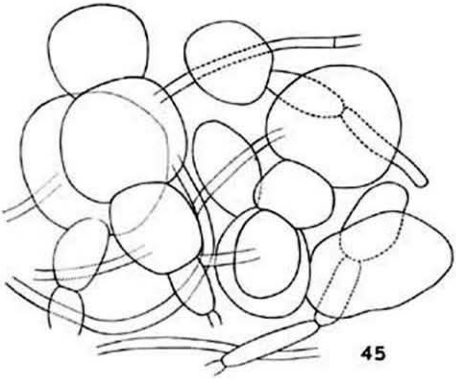
EXPLANATION OF FIGURES 45–51

Figs. 45–47. *Amanita rubrovolvata.* — 45. Crushed remnants of veil from pileus (× 500). — 46. Crushed remnants of veil from base of stipe (× 500). — 47. Spores (× 1250).

Figs. 48–50. *Amanita mira.* — 48. Spores (× 1250). — 49. Crushed warts from pileus (× 500). — 50. Apical cells of chains in warts from pileus (× 500).

Fig. 51. *Amanita princeps.* — Spores (× 1250).



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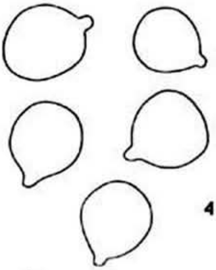

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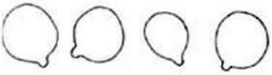

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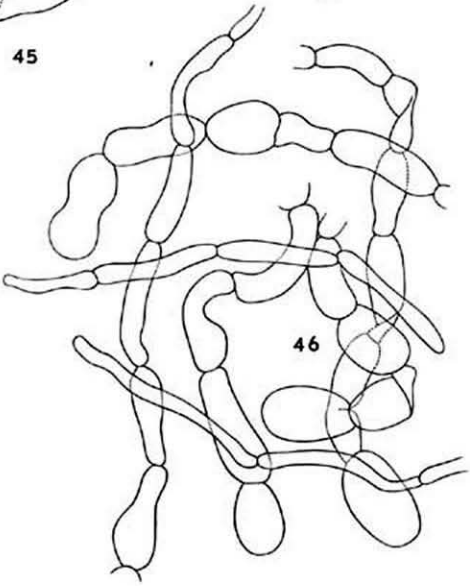

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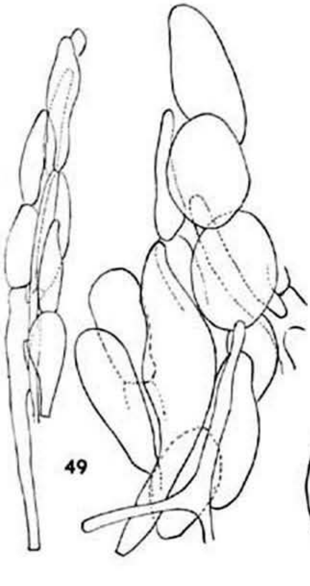

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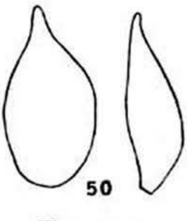

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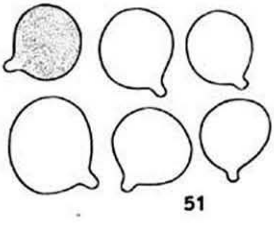


51

Figs. 45-51

part of the bulb. In those depicted by Imazeki & Hongo (l.c.) this outer layer was nearly completely lost and the bulb almost entirely pale-coloured. In the present specimens this coloured outer layer is preserved only at the upper part of the bulb and at the volva ring at the base of the stem.

Through the kindness of Dr. S. Imai (Yokohama) a specimen of the type-collection (Japan, prov. Mutsu, Towada-mura, 27 Sept. 1935, coll. *S. Imai s.n.*) could be studied. Here the structure of the volva at the base of the stipe is exactly the same as in the Malayan specimen described above.

In a young specimen (*Hongo 936*) of the present species kindly sent by Dr. T. Hongo (Otsu), inflated cells were present on the edge of the gills.

Gilbert placed *A. rubrovolvata* in *Amplariella* (= sect. *Validae*) on account of its amyloid spores. Imai did not mention this character in the original description. However, Hongo stated that the spores were non-amyloid. Our experience of the type and the collections described above, affirms Hongo's statement. Apparently *A. rubrovolvata* has to be placed in section *Amanita*, where it also fits better in view of the strongly striate margin of the pileus, the bright colours and the globulose spores.

The present record is the first from outside Japan.

Amanita mira Corner & Bas, *sp. nov.*—Pl. 9c, Figs. 48–50

Pileus 40–90 mm latus, campanulatus, dein applanatus, centro depressus, margine fortiter striatus, aurantio-ruber, aurantius vel flavo-aurantius, subviscidus, verrucis minutis, cuspidatis, flavis, dein albescentibus ornatus. Lamellae confertae, 4–10 mm latae, albae. Stipes 50–110 mm longus, 5–9 mm crassus, basi subbulbosus et 8–15 mm latus, e pleno cavus, albus, subfibrillosus. Volva adnata, flava, concentrice squamoso-diffracta. Annulus vulgo evanidus. Caro alba. Sporae 6.5–8.5 × 6–8 μ, globulosae vel subglobulosae, non-amyloideae. Typus: *E. J. H. Corner s.n.*, 16 Aug. 1939, Singapore, Bukit Timah (L).

Etymology: mirus, wonderful.

Pileus 40–90 mm wide, campanulate to plane with depressed centre, finely tuberculate-striate half-way from margin toward centre, orange-red to pale clear orange in centre, yellow orange, ochre-yellow, or bright yellow toward pale margin, generally becoming dingy fuliginous olive or bistre from centre outward to margin with age, subviscid, sprinkled with small firm yellowish to whitish pyramidal warts about 1 mm high and 1–2 mm wide, but often glabrous after rain. Gills free, crowded, thin, 4–10 mm wide, white, 80–100 primaries with 0–1 truncate shorter ones between each pair; edge entire. Stipe 50–110 × 5–9 mm, equal or tapering upward, with 8–15 mm broad subbulbous base, solid, becoming hollow, white or slightly greyish, finely appressed fibrillose, with 2–3 more or less complete rings of small subfloccose yellow warts at the base (as on pileus) or with a yellow floccose-felted, slightly warty, coating of the base, mostly exannulate, only once seen with a distinct pendant collapsed ring at apex of stem. Flesh white, yellowish below cuticle of pileus, 3–5 mm thick in centre of pileus, membranous over limb.

Spores (Fig. 48) 6.4–7.9 × 6.2–7.7 μ (fresh, 7.0–8.5 × 6.5–7.5 μ), globulose to subglobulose (length-breadth ratio 1.0–1.1), colourless, thin-walled, with one large gutta or several small ones, non-amyloid. Basidia 30–40 × 10–13 μ, with four, about 4 μ long sterigmata. Marginal cells 15–35 × 5–15 μ, cylindric, clavate or piriform, colourless, thin-walled, smooth, forming a sterile edge to the gill. Trama of gills (hardly analyzable in dried material) with many large inflated cells e.g. 65 × 35, 80 × 50, 125 × 50 μ. Fragments of volva on pileus composed of more or less erect chains of narrow to wide cylindric, ellipsoid and clavate cells, 27–72 ×

7–40 μ, the apical ones often more or less acuminate, mixed with 4–8 μ wide hyphae (Fig. 49–50). Remnants of volva on base of stipe consisting of ellipsoid, ovoid and clavate cells up to 40 × 30 μ, mixed with 4–6 μ wide hyphae. Cuticle about 150 μ thick, made up of 3–7 μ wide, repent, agglutinated hyphae, intermixed in centre of cap, wavy-radially near margin, with vacuolar yellow to umber pigment, with scattered repent, rounded terminal members of hyphae (without hyaline gelatinous upper layer). Trama of stipe (hardly analyzable in dried material) with terminal clavate cells up to 40 μ wide and apparently up to 150 μ and longer, with many twisting refractive hardly septate hyphae up to 25 μ wide. No clamps observed.

HABITAT.—Terrestrial in forest; common every rainy season.

COLLECTIONS EXAMINED.—Singapore, Bukit Timah, 16 Aug. 1939 (type) & 21 Aug. 1939 (both dried); Singapore, Botanical Garden, 28 Nov. 1940 (water-colour drawing), and Singapore, Reservoir Jungle, 15 Sept. 1940 (water-colour drawing); all *E. J. H. Corner s.n.* (as *Amanitopsis* 4).

OBERVATIONS.—Eaten by two monkeys without discomfort.

This species bears a certain resemblance to *Amanita muscaria* (L. ex Fr.) Hook., but is easily distinguished by the smaller and globulose spores, by the different structure of the remnants of the volva on the pileus which results in small firm pyramidal warts, and by the generally lacking annulus. *Amanita muscaria* has never been observed in Malaya.

Amanita sychnopyramis Corner & Bas, *sp. nov.*—Pl. 8*c*, 9*b*, Figs. 38, 39

Pileus 20–75 mm latus, e convexo applanatus vel concavus, margine striatus, brunneo fuscus vel griseo-umbrinus, striis obscuris virgatus, subviscidus, verrucis conicis, minutis, griseolis vel brunneo-griseis tectus. Lamellae liberae, confertae, 3–9 mm latae, albae. Stipes 40–80 mm longus, apice 5–11, basi 8–15 mm latus, subbulbosus, demum cavus, albus, basi brunneo-griseolus, exannulatus. Volva adnata, griseola vel brunneola, concentrice squamuloso-diffracta. Caro alba. Sporae 6.3–8.1 μ, globulosae vel subglobulosae, non-amyloideae. Typus: *E. J. H. Corner s.n.*, 21 Aug. 1939, Singapore, Bukit Timah (L).

Etymology: συχνός, many; πυραμις, pyramid.

Pileus 20–75 mm wide, convex to plane with depressed centre, finally even concave, $^1/_3$ tuberculate-striate but often faintly from margin toward centre, fuscous fawn or greyish brown, umber or fuscous bay over centre, streaked by innate darker fibrils, paler toward margin, slightly viscid, slightly viscose-papillose over centre, set with pale greyish white, grey or greyish-brownish small floccose pyramidal warts 0.5–2 mm wide, 0.3–1.5 mm high (eventually washing off with rain). Gills free, crowded, 3–9 mm wide, thin, white, 80–100 primaries with 1–3 truncate shorter ones between each pair. Stipe 40–80 mm long, 5–11 mm wide at apex, 8–15 mm wide at swollen, slightly pointed base, tapering upward, becoming hollow, white, greyish-brownish near base, the upper part of the swollen base set with pale greyish or brownish white, very small, scurfy particles, 0.2–0.5 mm wide, arranged in several irregular circles, exannulate. Flesh white, soft, brittle in stem, 2.5–3.5 mm thick in centre of pileus.

Spores (Fig. 38) 6.3–8.1 μ, globulose to subglobulose (length-breadth ratio 1.0–1.1), colourless, thin-walled, with one large gutta or many small ones, with rather large apiculus, non-amyloid. Basidia 26–32 × 10–11 μ, with four, 3.5 μ long sterigmata; contents finely granular. Marginal cells 20–50 × 10–25 μ, clavate, piriform or subglobose, hyaline, colourless, thin-walled, forming a sterile edge to the gill. Remnants of volva on pileus (Fig. 39) composed of more or less erect chains of inflated, ellipsoid, broadly clavate or broadly cylindrical, 25–40 × 18–27 μ cells with fuliginous-umber sap, mixed with 3.5–7 μ broad hyphae. Remnants of volva on base of stipe consisting of hyphae and ellipsoid, clavate and cylindrical cells. Cuticle thin, made up of 1.5–4 μ broad repent hyphae, wavily radially arranged, with scattered, sometimes slightly broader terminal members of hyphae, slightly gelatinized near surface; pigment brown, vacuolar. Tissue of stipe with large, terminal, clavate cells, e.g. 200 × 35 μ. No clamps observed.

HABITAT.—Terrestrial in forest.

COLLECTIONS EXAMINED.—Singapore, Bukit Timah, 21 Aug. 1939 (type; dried fragments of at least 2 specimens); 16 Aug. 1939 (dried fragments of 2 specimens); 23 Aug. 1940 (water-colour drawing) and 7 April 1941 (water-colour drawing); all *E. J. H. Corner* s.n. (as *Amanitopsis* 5).

Amanita sychnopyramis stands rather by itself because of the conical warts on the brown pileus, the small globulose spores, and the lack of the annulus. It reminds one somewhat of the species with conical warts in section *Validae*. However, the non-amyloid spores, truncate short gills and striate margin of the pileus leave no doubt about its place in section *Amanita*, where it is most closely related to *A. mira* (see p. 290).

Amanita obsita Corner & Bas, *sp. nov.*—Pl. 8*b*, Figs. 52, 53

Pileus 20–45 mm latus, convexus, dein applanatus, centro depressus vel concavus, margine fortiter striatus, albidus vel pallidus, interdum centro pallide fuscus, siccus, volvae fragmentis pulverulentis griseo-umbrinis obsitus. Lamellae liberae, subdistantes, albae dein cremeae. Stipes 26–70 mm longus, apice 2–5, basi 4–8 mm latus, subbulbosus, cavus, albus, floccoso-pruinosus, exannulatus. Volva adnata, fuliginosa, subfloccoso-marginata vel pulverulento-diffracta. Caro alba. Sporae 6–8 × 5–7 μ, globulosae vel ellipsoideae, non-amyloideae. Typus: *E. J. H. Corner s.n.*, 15 Oct. 1939, Singapore, Bukit Timah (L).

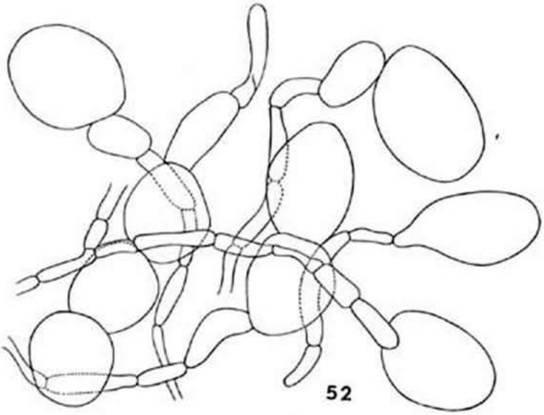
Etymology: obsitus, entirely covered.

Pileus 20–45 mm wide, convex, becoming plane with slightly depressed centre or concave, sulcate-striate almost to centre, pallid-whitish, sometimes pale fuscous in centre, sprinkled with fine greyish umber powder, dense over disk, or covering powdery layer breaking up into minute warts, up to 0.5 mm wide, dry. Gills free, subdistant, 40–75 primaries with 0–1 truncate shorter ones between each pair, occasionally forked, 2–4 mm wide, white then pale cream. Stipe 26–70 mm long, 4–8 mm wide at base, 2–5 mm at apex, cylindrical or attenuate upward, with slightly bulbous base, hollow (not drawn in figures), rather fragile, white, wholly finely cottony pruinose, at base finely fuliginous pruinose or merely finely felted with pale greyish umber cottony substance forming an abrupt but slight ridge, without warts, exannulate. Flesh 1.5–2.5 mm thick in centre, very thin over limb, soft, fragile, white.

Spores (Fig. 53) 5.8–6.7 × 5.2–6.1 μ [fresh, 6.5–7.5 (–8) × 6–7 (–7.5) μ], globulose to broadly ellipsoid (length-breadth ratio 1.0–1.15, average 1.1), colourless, thin-walled, smooth, 1-guttate, sometimes cloudy vacuolate, with small to medium-large apiculus, non-amyloid. Basidia 32–40 × 10–12 μ, with 4, about 4 μ long, sterigmata. Marginal cells 13–26 × 7–15 μ, clavate to subcylindrical, thin-walled, colourless, forming sterile edge to gill. Trama of gills hard to analyse in dried material, containing large ellipsoid cells up to e.g. 60 × 40 μ and sphaerocysts up to 40 μ wide. Remnants of volva on pileus (Fig. 52) consisting of loosely interwoven, 2.5–6 μ wide hyaline hyphae and 15–45 μ wide sphaerocysts terminal or in short chains and with umber sap. Cuticle impossible to analyse in dried specimen. No clamps observed.

HABITAT.—Terrestrial in jungle; solitary.

COLLECTIONS EXAMINED.—Singapore, Bukit Timah, 15 Oct. 1939 (type; one fragmented pileus) and 30 April 1940 (water-colour drawing); Botanic Gardens, Gardens' Jungle, 13 Aug. 1940 (water-colour drawing); all *E. J. H. Corner s.n.* (as *Amanitopsis* 7).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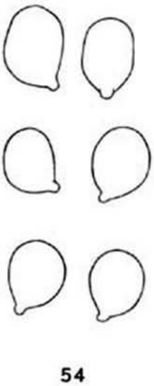
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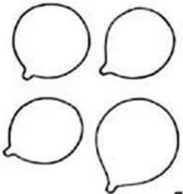
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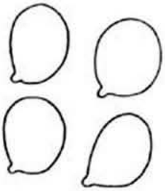
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Figs. 52–53. *Amanita obsita.* — 52. Crushed remnants of veil from pileus (× 500). — 53. Spores (× 1250).

Fig. 54. *Amanita hemibapha* subsp. *similis.* — Spores (× 1250).

Fig. 55. *Amanita cinctipes.* — Spores (× 1250).

Fig. 56. *Amanita species* 4. — Spores (× 1250).

This species is very similar to *A. farinosa* Schw. from southern North America and Japan. However, it has a pale cap covered by darker brown powdery remnants of the volva, whereas *A. farinosa* has a brown cap covered with "drab" powdery remnants. Comparing the Malayan specimen with collections of *A. farinosa* from North America (*Hesler 22331*, North Carolina) and Japan (*Hongo 2018*) the sphaerocysts in *A. obsita* appear to be of a much darker brown than those of *A. farinosa*. Although several authors state the spores of *A. farinosa* to be globulose, they are broadly ellipsoid to ellipsoid in the collections mentioned above (length-breadth ratio 1.25–1.4, average 1.3 in the first one and 1.1–1.35, average 1.2 in the second), which is more or less in accordance with figures of the spores of that species as published by Gilbert (1941: 125, 199). Thus it seems justified to consider the Malayan material to represent an autonomous tropical ally of *A. farinosa*.

Undoubtedly, *A. farinosa* and *A. obsita* are closely related to *A. subvaginata* (Clel. & Cheel) Gilb. from Australia, New S. Wales, placed in *Amanitopsis* by Gilbert (1941: 75). This exannulate species has the same small size, the same striate pileus, covered with greyish powder of the volva, and small globulose spores (7.5–9 μ wide). The basal part of the volva, however, is more coherent and forms a slightly marginate greyish coating of the bulbous base of the stipe.

Section VAGINATAE (Fr.) Quél.

Agaricus [sect.] *Vaginatae* Fr., Monogr. Amanit. Sueciae 2. 1854.—*Amanita* [sect.] *Vaginatae* (Fr.) Quél. *in* Mém. Soc. Emul. Montbéliard, ser. II, **5**: 64. 1872 (Champ. Jura **1**: 27); Sing. *in* Lilloa **22**: 386. 1951 ("sect.").—Lectotype (Sing. l.c.): *Agaricus vaginatus* Bull. ex Fr.

Amanitopsis sect. *Volvatae* Imai *in* Bot. Mag., Tokyo **47**: 428. 1933 (presumably an unintentional name change of *Vaginatae* Fr.).—Lectotype: *Amanitopsis vaginata* (Bull. ex Fr.) Roze.

Amanitopsis Roze *in* Bull. Soc. bot. France **23**: 50, 51. 1876.—*Amanita* subgen. *Amanitopsis* (Roze) Lange *in* Dansk bot. Ark. **2** (3): 6.—*Amanita* sect. *Amanitopsis* (Roze) Konr. & Maubl., Agaricales 58. 1948.—Lectotype (fixed by conservation): *Agaricus vaginatus* Bull. ex Fr.

Amanita sect. *Caesareae* Sing. *in* Ann. mycol., Berl. **41**: 162. 1943 (not val. publ.); *ex* Sing. *in* Acta Inst. bot. Acad. Sci. URSS (ser. II, Plant. cryptog.) **6**: 389. 1950.—Lectotype (Sing. *in* Lilloa **22**: 385. 1951): *Amanita caesarea* (Scop. ex Fr.) Grev.

Amanita sect. *Ovigerae* Sing. *in* Lilloa **22**: 386. 1951 (not val. publ.); *ex* Sing. *in* Sydowia **15**: 67. 1962.—Type: *Amanita biovigera* Sing.

For the scope of this section, see the key to the subgenera and sections on p. 243.

KEY TO THE SPECIES OF SECTION *Vaginatae*

1. Annulate species with sheathing volva.
    2. Spores broadly ellipsoid to ellipsoid, 8–12 × 6–9 μ. Colours extremely variable. Pileus red, orange, yellow, olivaceous or greyish brown, mostly lighter and pinkish, yellowish or melleous at margin, glabrous. Stipe yellow with concolorous, orange, or red, fibrillose scales. Gills whitish to pale yellow, with pinkish to yellow edge. Ring orange, yellow or greyish. Volva white to greyish . . . . *A. hemibapha*, p. 295
    2. Spores globulose to subglobulose, 9–13 × 8–12 μ. Very large species. Pileus pale dingy buff. Gills white to cream. Stipe white to pale buff. Volva large, fleshy with membranous limb, white, with pale buff patches. Ring present but fragile *A. princeps*, p. 297
1. Exannulate species with sheathing or friable volva.
    3. Volva friable, forming at base of stipe 2–4 greyish brown floccose rings, often broken into warts. Pileus mouse grey to pale greyish brown, with dark centre and greyish brown floccose patches or warts of volva. Stipe greyish brown, with dark fibrillose scales. Spores 8–11 × 8–10 μ, globulose to subglobulose . . . . . *A. cinctipes*, p. 299
    3. Volva sheathing.

4. Spores broadly ellipsoid to ellipsoid.
    5. Spores 9–11.5 × 7–8.5 μ. Pileus $^1/_2$ striate, leaden grey, glabrous. Gills white. Stipe whitish, minutely cottony. Volva wide-sheathing, membranous-subcarnous, white . . . . *A.* species 4, p. 301
    5. Spores 11–13 × 9.5–11 μ. Pileus greyish brown, glabrous. Gills white to pale brownish. Stipe pale brownish drab to whitish. Volva whitish buff, split on one side *A.* species 5, p. 301
4. Spores globulose to subglobulose.
    6. Very large species with pale dingy buff pileus 2
    6. Medium-large to small species with grey to greyish brown pileus.
        7. Spores 11–13 (–15) μ. Pileus 25–80 mm wide, $^1/_2$ striate-tuberculate, grey to greyish brown, glabrous. Gills subdistant, up to 7 mm broad, white; short gills lacking. Stipe white to pale brownish, slightly fibrillose-floccose. Volva more or less cylindrical, deeply sheathing, white . . *A. angustilamellata*, p. 302
        7. Spores 8–11 × 7–10 μ. Pileus 20–40 mm, mouse grey, with large flat grey patches. Gills crowded, white. Stipe pale silvery grey, minutely fibrillose. Volva cyathiform, closely fitting, with narrow free margin, grey *A.* species 6, p. 302

AMANITA HEMIBAPHA (Berk. & Br.) Sacc. subsp. **similis** (Boed.) Corner & Bas, *comb. nov.*—Pl. 11, Fig. 54.

Amanita similis Boedijn *in* Sydowia **5**: 322. 1951 (basionym).

Pileus 60–130 mm wide, cylindric-campanulate at first, becoming plane to slightly concave and subumbonate, $^1/_3$–$^1/_2$ sulcate-striate from margin toward centre, fuliginous-bistre, fuscous-olivaceous or olivaceous-umber at first with outer striate part varying from vinaceous pink, rufescent orange to pale orange or yellowish, wholly olivaceous-umber with age, innately streaked, glabrous, viscid at first. Gills free, crowded, 90–100 primaries with 0–3 (–7) truncate, obliquely truncate or sometimes attenuate shorter ones between each pair, 5–10 mm wide, pale yellow or yellowish white with deep yellow, orange or pinkish orange, micaceous-floccose edge. Stipe 100–180 mm long, 6–13 mm wide at apex and 7–17 mm wide near base, extreme base slightly attenuate, firm, hollow, but sometimes with floccose, pithy septa, canary yellow, pale yellow orange or pale yellow, marked with zig-zag transverse orange, pinkish orange or concolorous, fibrillose to floccose-fibrillose zones below ring, bright orange, pinkish orange or pale orange-yellow, striate, fibrillose above ring, annulate, with sheathing volva. Volva 25–50 × 10–30 mm, white, sometimes dingy brownish stained, rather thick, floccose-firm, with irregularly lobed edge, attached at very base of stipe, with indistinct limbus internus inserted in inner side of volva some millimeters above joint with stipe. Ring pendant at 25–30 mm from apex of stipe, thin, membranous, 12–17 mm wide, pinkish orange, pale orange or orange-yellow, slightly striate above, more yellowish, subfloccose below, scarcely spreading, soon collapsed. Flesh soft, pale yellowish to yellowish white, deeper yellow below surface, 4–8 mm thick in centre of pileus, thin over limb.

Spores (Fig. 54) 7.0–9.9 × (5.4–) 6.1–8.6 μ (fresh, 8–11 × 7–9 μ, sometimes 7–9 × 5.5–7.5 μ), broadly ellipsoid to ellipsoid, sometimes subglobulose (length-breadth ratio 1.05–1.4, average 1.2), with rather broad apiculus, colourless, thin-walled, smooth, cloudy-vacuolate, multiguttulate or 1-guttate, non-amyloid. Basidia 35–50 × 10–13 μ and 25–35 × 7–9 μ, dimorphic, 4-spored; sterigmata about 4 μ long. Marginal cells 20–90 × 10–30 μ, clavate, piriform or ellipsoid, with yellow sap, mixed with numerous thin hyphae, forming a rather broad sterile margin along edge of gills. Trama of gills impossible to analyse in dried material.

Volva with outer layer consisting of more or less longitudinal, 1.5–6 μ wide hyphae and inner layer composed of up to 90 μ wide inflated cells, mixed with thin hyphae. Cuticle 40–80 μ thick, consisting of a, 20–40 μ wide, hyaline, gelatinized upper layer with very scattered, thin, fading hyphae and a 20–40 μ thick lower layer of crowded radial, 2–5 μ wide hyphae with orange-yellow to fuliginous sap. Trama of stipe consisting of longitudinal, clavate to cylindrical cells, up to 225 × 55 μ, mixed with thin hyphae. Clamps observed on coloured hyphae of cuticle.

HABITAT.—Terrestrial in forest; solitary or gregarious, coming up soon after rains (March and August in Singapore).

DISTRIBUTION.—Java (type-locality); Malaya & Singapore, frequent throughout the country; Borneo, once a large troop observed by the senior author in 1961 near the Mesilau River, on Mt. Kinabalu at about 1700 m alt. in oak-forest.

COLLECTIONS EXAMINED.—Malaya, Johore, Gunong Panti, Aug. 1929 (dried); Negri Sembilan, Angsi Forest Reserve, 750 m alt., 3 July 1930 (dried); Singapore, Bukit Timah, 16 Aug. 1939 (dried), 18 Dec. 1940 & 16 Febr. 1943 (last two water-colour drawings); all *E. J. H. Corner s.n.* (as *Amanita* 3).

Amanita hemibapha, extremely variable as to the colours of the pileus, is recognizable by (i) the yellow stipe with sometimes concolorous, but mostly brighter coloured appressed fibrillose scales, (ii) the yellow to yellowish gills with brighter coloured edge, (iii) the attenuate base of the stipe, (iv) the white to greyish deeply sheathing, rather fleshy volva, attached only to the extreme point of the base of the stipe, and (v) the tropical distribution.

The red and orange forms very much resemble *A. caesarea* from the northern temperate zones, but in these forms the orange to red fibrillose-scaly zones on the stipe are distinctive.

Amanita hemibapha was first described from Ceylon (Berkeley & Broome 1871: 149, pl. 33 fig. A) from preserved material and a water-colour drawing sent to England by Thwaites (no. 700). The pileus was described and depicted as scarlet with a yellow margin, the stipe described as yellow and depicted as white; but both the description and the reproduced drawing are rather poor. This was also the opinion held by Petch (1910: 373), who published a description of the same species based on two of his own collections from Ceylon which he found in good accordance with Thwaites' original drawings consulted by him. Petch described the pileus as deep crimson with a broad, bright yellow margin, the stipe as yellow, covered with thin, appressed, reddish patches and the ring as yellow.

Boedijn (1951: 320) published a description of *A. hemibapha* based on material from Java. He gave the pileus of this species as orange-yellow to ochre yellow, sometimes with a brown tinge, paler toward the margin and the stipe as yellow with orange buff scales and the ring orange buff.

Two unpublished plates, kindly put at our disposal, illustrate this form very well. One of them (herb. Boedijn) is a coloured pencil drawing by Dr. K. B. Boedijn from his collection from the Poentjak pass, 18 Oct. 1941. In this rather pale figure no scales on the stipe are discernable. The other plate (Herb. bogoriense) is an excellent water-colour drawing by van Overeem (no. 1464, under the unpublished name *A. aureo-annulosa* Overeem) without data, but undoubtedly drawn from specimens from Java, as van Overeem never collected in the tropics outside Java.

Undoubtedly, the material from Java, described by Boedijn, belongs to *A. hemibapha*. However, it is quite remarkable that the deep red colour of the pileus, which seems to be constant on Ceylon, is lacking in the material from Java.

In the collections from Singapore and Malaya (Pl. 11), described above, the colour of the pileus ranges from fuliginous-bistre to brownish olivaceous with a pinkish to yellowish tinged margin, the stipe is bright to pale yellow with pinkish orange to concolorous fibrillose scales, and the ring pinkish to orange-yellow.

From the written accounts there would seem to exist considerable differences in colour between the material from Java and that from Malaya. Comparing, however, Corner's most pronouncedly olive-coloured drawing (Pl. 11*a*) with van Overeem's plate, one finds a very great resemblance. In the former the yellow of the pileus is mixed with olivaceous-brown, in the latter with reddish brown.

Amanita similis Boedijn (1951: 322) seems to represent an extreme of the series of colour forms of *A. hemibapha*. Its pileus is described as greyish brown to pale brownish olive with a melleous to chamois margin, its stipe as greyish yellow with brighter yellow base and apex, with concolorous fibrils, and the ring as greyish. Only the greyish tinge of the ring, the middle of the stipe and the volva would differentiate *A. similis* from the specimens collected by the senior author in which the fibrils on the stipe were sometimes concolorous, too. Therefore, it seems reasonable to consider the Malayan material identical with *A. similis*. However, if this is accepted, then the gap between *A. similis* and *A. hemibapha* is considerably narrowed.

One would be inclined to put together into one very variable species all the above mentioned colour forms. However, since the variability would seem to be linked up with the geographical distribution, the best solution of the problem at present is to divide *A. hemibapha* into three subspecies:

Subspecies HEMIBAPHA: Pileus crimson red, with yellow margin. Stipe yellow with reddish scales. Ring yellow. Distribution: Ceylon.

Subspecies JAVANICA Corner & Bas [5]: Pileus orange-yellow to ochre yellow, sometimes with reddish brown tinge, with yellow margin. Stipe yellow with orange scales. Ring orange buff. Distribution: Java.

Subspecies SIMILIS (Boed.) Corner & Bas: Pileus fuliginous-bistre to brownish olivaceous, with pinkish, yellowish or melleous margin. Stipe bright yellow to pale dingy yellow, with pinkish orange to concolorous scales or fibrils. Ring pinkish orange to greyish. Distribution: Java, Borneo, Singapore, and Malaya.

Amanita princeps Corner & Bas, *sp. nov.*—Pl. 10, Fig. 51

Pileus 100–200 mm latus, initio ovoideus vel convexus, dein concavo-applanatus, subumbonatus, margine sulcato-striatus, pallide ochraceo-isabellinus, vulgo nudus, interdum verrucis albis, applanatis, tenuibus ornatus, subviscidus. Lamellae liberae, confertae, albae, dein cremeae. Stipes 160–240 mm altus, apice 9–15, basi 13–25 mm latus, initio solidus, dein

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[5] AMANITA HEMIBAPHA subspecies **javanica** Corner & Bas, *subsp. nov.* (*A. hemibapha* sensu Boedijn *in* Sydowia **5**: 320. 1951). A typo differens pileo aurantiaco flavo brunneove. Typus: *K. B. Boedijn s.n.*, 18 Oct. 1941, Java, Poentjak pass (BO).

celeriter cavus, albus vel pallide bubalinus, infra subflocculosus, a summo pruinosus, annulatus vel exannulatus, volvatus. Annulus amplus, albus, tenuis, submembranaceus, evanidus. Volva 50–80 × 25–40 mm, sacciformis, crassa, alba, verrucis tenuibus, pallide bubalinis obtecta. Caro alba. Sporae 9–13 × 8–12 μ, globulosae vel subglobulosae, subtiliter verruculosae, non-amyloideae. Typus: *E. J. H. Corner s.n.*, Sept. 1930, Singapore, Bukit Timah (L).

Etymology: princeps, prominent.

Pileus 100–200 mm wide, ovoid to convex when young, plane or slightly concave to almost cyathiform with age, subumbonate, $^{1}/_{4}$ sulcate-striate from margin toward centre (already distinctly striate when emerging from volva), light biscuit colour or pale, slightly greyed, brownish ochraceous, slightly darker toward disk, paler toward white or pallid margin, glabrous or occasionally with few thin white fugacious patches of volva, slightly viscid at first. Gills free, distant from apex of stipe, crowded, 134–150 primaries, 0 (–1) truncate shorter ones between each pair, 10–17 mm wide, thin, white, then cream, with flocculose-denticulate edge. Stipe 160–240 mm long, 13–25 mm wide at base and 9–15 mm wide at apex, stout, brittle, fibrous, becoming hollow, still solid in 40 mm high bud, already hollow in specimen just emerging from volva, white or very pale buff, somewhat floccose below, pruinose-pulverulent above, annulate or exannulate, with sheathing volva. Volva 50–80 × 25–40 mm, white, thick, fleshy with membranous limb, outer layer cracking and peeling in thin, very pale buff patches, often with a narrow 1–1.5 mm high limbus internus; attached only to the very base of stipe. Ring ample, pendulous, thin, floccose-membranous, easily torn, usually dropping off in bits from underside of pileus on expansion, or splitting radially in strips, white or pale ochraceous buff, faintly striate above, subfloccose below, attached at the very apex of stipe. Flesh white, cream in base of stipe, rather soft, very putrescent, 6–9 mm thick in centre of pileus, about 1 mm thick half-way to margin. Smell faint, like that of *A. phalloides* (Fr.) Link.

Spores (Fig. 51) 8.7–11.5 × 7.9–10.1 μ (fresh, 10–13 × 9–12 μ), globulose to subglobulose (length-breadth ratio 1.0–1.15, average 1.1), colourless, very slightly thick-walled?, densely and minutely verruculose, with 1-guttate or multiguttulate contents, with large, prominent apiculus, non-amyloid. Basidia 4-spored, 45–65 × 14–16 μ, perhaps dimorphic (not intermixed with pseudoparaphyses). Marginal cells very abundant in young specimen, forming a broad margin along edge of gill, globulose, mostly 20–30 μ wide, sometimes up to 40 μ. Trama of gills very distinctly bilateral; central strand and adjacent zones with divergent hyphae composed of ellipsoid and cylindrical cells up to 110 × 25 μ, mixed with 2 μ and more wide hyphae, the outermost cells perpendicular to subhymenium; subhymenium about 15–25 μ wide, densely ramose-subcellular, with cells up to 10 μ across. Outermost peeling layer of volva consisting of very crowded, slightly coloured 2.5–5 μ wide hyphae. Membranous limb of volva on outer side with 2.5–5 μ wide interwoven or sublongitudinal hyphae and scattered oleiferous hyphae up to 12 μ wide; inner side nearly similar, but with very scattered sphaerocysts up to 110 μ wide. Young fleshy volva, up to 4 mm thick, still covering pileus in bud (about 35 mm high) composed of numerous large sphaerocysts mixed with thin hyphae. Cuticle about 150 μ thick in young specimen, consisting of a hyaline gelatinous upper layer with very distant, thin, nearly faded hyphae and many superficial oleiferous hyphae up to 12 μ wide, passing gradually into a lower layer of 3–7 μ wide and more crowded hyphae; hyphae of both layers interwoven near centre, radial over limb. Trama of stipe with large terminal clavate cells. Clamps abundant on thin hyphae of volva and cuticle.

HABITAT AND DISTRIBUTION.—Terrestrial in forest in Singapore; one large troop every rainy season in fern-valley in Bukit Timah Forest; occasionally also in the Reservoir Jungle; not seen anywhere else in Malaya. A denizen of the deep forest.

COLLECTIONS EXAMINED.—Singapore, Bukit Timah, Sept. 1930 (buds in liquid); March 1931 (type; two specimens, just emerged from volva, with inner veil still closed, in liquid); Reservoir Jungle, 29 Nov. 1940 (water-colour drawing); a spore print without data; all *E. J. H. Corner s.n.* (as *Amanita* 4).

OBSERVATIONS.—Monkeys refused to eat this species.

Although the very finely and densely verruculose spores of *A. princeps* are unique within the genus *Amanita*, there is no doubt that the species should be classed in this genus.

A remarkable feature of *A. princeps* is the fact that the part of the young volva covering the pileus mainly consists of sphaerocysts, while the limb of the volva and consequently remnants of the volva on the pileus derived from it consist nearly entirely of hyphae. The last phase of the growth of the upper part of the volva is apparently entirely the result of hyphal growth, so that the originally rather crowded sphaerocysts become widely scattered.

Amanita cinctipes Corner & Bas, *sp. nov.*—Pl. 12*b*, *c*, Fig. 55

Pileus 45–120 mm latus, convexo-applanatus, centro depressus, margine sulcato-striatus, murinus vel pallide griseolo-brunneus, centro obscuro, verrucis applanatis vel conicis, floccosis obtectus. Lamellae confertae, albae vel griseolae, acie concolore vel griseo-brunnea. Stipes 90–200 mm altus, apice 6–13, basi 10–17 mm crassus, haud bulbosus, cavus, fragilis, griseolus vel griseo-brunneus, fibrillosus squamosusve, exannulatus. Volva adnata, floccosa, friabilis, annulos griseo-brunneo relinquens. Caro alba. Sporae 8–11 × 8–10 μ, globulosae vel subglobulosae, non-amyloideae. Typus: *E. J. H. Corner s.n.*, 19 March 1931, Singapore, Botanic Gardens, Gardens' Jungle (L).

Etymology: cinctus, girdle; pes, foot.

Pileus 45–120 mm wide, becoming plano-convex with depressed centre, $^1/_3$–$^1/_4$ sulcate-striate from margin toward centre, mouse grey to pale greyish brown, darker, greyish brown to fuliginous umber at centre, subviscid, set with scattered, grey to greyish brown remnants of volva, varying from floccose patches, 4–10 mm wide, to floccose, erect, pyramidal warts 1–2.5 mm high. Gills free, crowded, 65–127 primaries with 0–1 (–3) truncate shorter ones between each pair, 3–11 mm wide, white to greyish, with or without grey-brown edge. Stipe 90–200 mm high, 10–17 mm wide at base, 6–13 mm wide at apex, hollow, rather fragile, entirely pale or dark greyish to greyish brown, paler near apex, with darker, appressed, fibrillose scales, often forming incomplete transverse zones, especially in lower part, at base with 2–4 dark greyish brown, floccose, volva rings, often broken into warts or scales, exannulate. Flesh 3–4 mm thick in centre of pileus, thin over limb, white.

Spores (Fig. 55) 8.2–11.1 × 7.8–10.1 μ (fresh, 9–11 μ), globulose to subglobulose (length-breadth ratio 1.0–1.1, average 1.05), with rather small apiculus, colourless, thin-walled, smooth, hyaline, 1-guttate or multiguttulate, non-amyloid. Basidia 40–50 × 12–15 μ, with 4 sterigmata, 5 μ long. Marginal cells none. Trama of gills hard to analyse in dried material, subhymenium rather thin, densely ramose with irregular small cells, without globose cells. Remnants of volva on pileus consisting of globose to ellipsoid terminal cells up to 60 μ wide and with umber sap and 2–5 μ wide hyphae. Remnants of volva on base of stipe as those on pileus, but sphaerocysts sometimes in short chains; deeper parts less coloured and with more hyphae. Cuticle composed of an entirely gelatinized upper layer about 25 μ thick and a lower layer about 25 μ thick consisting of crowded radial hyphae, thin in upper part, quickly increasing in diameter downward. Trama of stipe with clavate, terminal, longitudinal cells up to 250 × 45 μ and oleiferous hyphae up to 18 μ wide and especially present near inner surface. No clamps observed.

HABITAT.—Terrestrial in jungle. Probably common in lowland forest in Malaya and Singapore.

COLLECTIONS EXAMINED.—Singapore, Botanic Gardens, Gardens' Jungle, 19 March 1931 (type; several dried specimens); Aug. 1939 (dried); 16 Aug. 1940 (water-colour drawing); Mandai Road Forest, 20 Aug. 1939 (dried); Reservoir Jungle, 6 Dec. 1940 (water-colour drawing); also observed in Bukit Timah Forest Reserve and in Malaya, Johore, Gunong Panti; all collected or noticed, *E. J. H. Corner s.n.* (as Amanitopsis 1).

OBERVATIONS.—Monkeys were observed to eat this species without discomfort.

This species is very close, perhaps too close to *A. inaurata* Secr. from Europe. However, at present it seems preferable to keep it apart on account of (i) the smaller spores and basidia (8–11 × 8–10 μ and 40–50 × 12–15 μ against those of *A. inaurata* (10–) 11–13 (–22) × 10–12.5 (–21) μ and 60–80 × 16–18 μ; the occurrence of very large spores in *A. inaurata* is due to 2-spored and 1-spored basidia), (ii) the absence of an umbo on the pileus, (iii) a more delicate habit, (iv) a tendency of the volva to form small pyramidal warts on the pileus, and (v) a slightly different colour of the pileus; the beautiful yellowish brown tints in older specimens of *A. inaurata* seem to lack entirely in the more greyish *A. cinctipes*.

In all of the many Dutch collections of *A. inaurata* studied, the fruit-bodies appear to be considerably stouter than those of *A. cinctipes*. This cannot be said of the American specimens of *A. inaurata* depicted by Peck (1900: pl. 44 fig. 1–10, as *Amanitopsis strangulata*) and the Japanese ones by Imazeki & Hongo (1957: pl. 18 fig. 100), but it still has to be proved that these specimens are conspecific with the European *A. inaurata*, especially those of Peck. However, all authors consulted, agree that the size of the spores of *A. inaurata* is larger than 10 μ and usually exceeds 11 μ, which is in accordance with our observations.

Judging from the water-colour drawings, *A. cinctipes* varies considerably. The type collection is most similar to Pl. 12*c*. Especially in this case it is a pity that the specimens depicted have not been preserved, so that one has to rely on the senior author's observations in the field for the conclusion that both forms depicted are really conspecific.

AMANITA VAGINATA (Bull. ex Fr.) Vitt. *sensu lato*

A. vaginata and its close allies appear to have a world-wide distribution and the number of forms, varieties and 'small' species within this group is undoubtedly considerable. However, since the classification of the European representatives of this group is still highly unsatisfactory, it is understandable that our knowledge of the extra-European forms is still more scanty and confused.

Thus far the differences in colour were stressed too much, while the characters of the spores (form) and of the volva (form, attachment to the stipe, microscopical structure and the presence and insertion of a limbus internus) were neglected too much.

When using the size of the spores as a differentiating character, it should be kept in mind that in several members of the *A. vaginata* group, 1-, 2-, and 4-spored basidia may occur in the same fruit-body.

As no material was preserved of most of the finds of this group in Malaya and Singapore, very little can be contributed in this paper to the knowledge of the tropical allies of *A. vaginata*. The few identifications in the following enumeration are done with reservation.

AMANITA SPECIES 4—Fig. 56

? *Amanita ovalispora* Boed. *in* Sydowia **5**: 320. 1951.

Pileus 60 mm wide, becoming plane with depressed centre, $^1/_2$ striate-sulcate from margin toward centre, leaden grey, darker in centre, slightly viscid, glabrous. Gills free, crowded, 74 primaries with 0–1 shorter ones between each pair, white, 5.5 mm wide, thin. Stipe 125 mm long, 5 mm wide above, 9 mm wide below, hollow, pallid-whitish, minutely cottony, almost smooth, exannulate, with sheathing volva. Volva 20 mm high and wide, sheathing, attached only at very base of stipe, membranous-subcarnous, with edge not lobed, white, with rather narrow limbus internus inserted in innerside of volva, some millimetres above connection with stipe. Flesh white, soft, 3 mm thick in centre, 0.5 mm halfway to margin.

Spores (Fig. 56) 9.0–11.0 × 7.1–8.7 μ (fresh, 9–11.5 × 7–8.5 μ), broadly ellipsoid (length-breadth ratio 1.1–1.4, average 1.25–1.3), with medium-large apiculus, colourless, mostly 1-guttate, thin-walled, smooth, non-amyloid. Volva on inner and outer surface with interwoven sublongitudinal, 3–5 (–8) μ wide hyphae; the interior consisting mainly of hyphae and some very scattered inflated cells. Cuticle rather thin, consisting of a gelatinized upper layer and a lower one of interwoven, subradial, 1.5–3 μ wide hyphae with brown contents. Trama of stipe with large, clavate, terminal, longitudinal cells, up to 420 × 60 μ, and rather numerous oleiferous hyphae, up to 18 μ wide. No clamps observed.

HABITAT.—Terrestrial in jungle.

COLLECTIONS EXAMINED.—Malay, Pahang, Tembeling Estate, 8 Nov. 1930 (1 dried sp.), *E. J. H. Corner s.n.* (as *Amanitopsis* 2 pr.p.)

The Malayan specimen described above differs from *A. ovalispora* Boed. from Java (of which we were unable to study material) by (i) the grey cap lacking brown, (ii) the wider volva and (iii) the broader spores, viz. 9–11 × 7–8.7 against 8–11 × 6–7 μ. The spores depicted by Boedijn have a length-breadth ratio between 1.4 and 1.6, those of the Malayan specimen 1.1–1.4. Nevertheless both collections may be conspecific.

AMANITA SPECIES 5

Pileus 65 mm wide, plane, with sulcate-striate margin, greyish brown, glabrous, subviscid. Gills free, crowded, white or pale brownish near base. Stipe 90 × 8 mm, stout, cylindrical, hollow, pale brownish drab to whitish, exannulate, with sheathing volva. Volva 35 mm high, 12 mm wide at base, firm, floccose-felted, buff-white, split on one side, embedded in soil. Flesh white.

Spores 11–13 × 9.5–11 μ, broadly ellipsoid, multiguttulate.

HABITAT.—Terrestrial in forest.

COLLECTIONS EXAMINED.—Singapore, Bukit Timah, 19 Nov. 1939 (no material preserved), *E. J. H. Corner s.n.* (as *Amanitopsis* 8).

OBSERVATIONS.—A monkey did eat this species without discomfort.

This species resembles *A. ovalispora* Boed. but has considerably larger spores. It differs from *A. vaginata* and allied species by the ellipsoid spores.

AMANITA ANGUSTILAMELLATA (Höhn.) Boed.—Pl. 12*a*

Amanitopsis vaginata var. *angustilamellata* Höhn. *in* S. B. Akad. Wiss. Wien (Math.-Nat. Kl., Abt. I) **123**: 74. 1914.—*Amanita angustilamellata* (Höhn.) Boed. *in* Sydowia **5**: 318. 1951.

Pileus 25–80 mm, becoming plane with depressed centre, $^1/_2$ tuberculate-striate from margin toward centre, greyish brown to brownish grey, darker over disk, glabrous. Gills subdistant, without short ones, up to 7 mm broad, white. Stipe 50–160 × 4–12 mm, slightly attenuate upward, hollow, white to pale brownish or pale fawn, slightly fibrillose-floccose, exannulate, with sheathing volva. Volva 13–30 mm high, more or less cylindrical, deeply sheathing, often split on one side, white.

Spores 11–13 (–15) μ, globulose, 1-guttate.

HABITAT.—Terrestrial in forest.

COLLECTIONS EXAMINED.—Singapore, Bukit Timah Forest, 28 Nov. 1940 (water-colour drawing; no material preserved), *E. J. H. Corner s.n.* (as *Amanitopsis* 2a).

OBSERVATIONS.—Eaten by monkeys.

Boedijn's description of the present species fits the material from Singapore rather well. From the grey European *A. vaginata* sensu stricto this species seems to be different by the longer striation of the margin of the pileus and by a different type of volva.

From *Amanitopsis endochorda* (Berk. & Br.) Petch sensu Petch from Ceylon it differs according to Petch's (1910: 374) description by the non-umbonate pileus and the pale, less ornamented stipe. The colour of the pileus of *Amanitopsis endochorda* seems to vary considerably; normally the horizontal margin is brown or blackish brown, the depressed area light brown and the umbo dark brown, but sometimes the pileus is purple grey or 'French grey'. So it is possible that Petch's description covers more than one taxon.

Petch (1924: 121) finally concluded that the true *Agaricus* (*Collybia*) *endochordus* Berk. & Br., which he had rediscovered, really was a species of *Collybia* and transferred it accordingly. So the species which he previously described under the name *Amanitopsis endochorda* (Berk. & Br.) Petch is still without a name. There is, however, no merit in renaming it before it has become better known.

It is unlikely that the narrow gills of *Amanita angustilamellata* are a reliable distinctive feature, as narrow gills occur in several European forms of the *A. vaginata* group.

AMANITA SPECIES 6

Pileus 20–40 mm wide, becoming plane, sulcate-striate at margin, greyish mouse-colour, covered with large flat grey patches of volva, dry. Gills free, crowded, white, 4 mm wide. Stipe 50–80 × 5 mm, equal, hollow, pale silvery grey, minutely fibrillose, not squamulose, exannulate, with sheathing volva. Volva 10 mm high and broad, cyathiform, with narrow free margin, closely fitting, grey. Flesh, white, soft.

Spores 8–9 × 7–8.5 μ or 8–11 × 7–10 μ, 1-guttate. Basidia 47–60 × 10–13 μ and 30–45 × 10–13 μ, dimorphic.

COLLECTIONS EXAMINED.—Singapore, Botanic Gardens, Garden's Jungle and Reservoir Jungle (no material preserved), *E. J. H. Corner* (as *Amanitopsis* 2).

It is not certain that this species is related to *A. vaginata*. Apparently, the grey volva falls apart rather easily and is its lower part adherent to the base of the stipe. Moreover, the spores being comparatively small, it is still possible that the present species belongs to the group of *A. farinosa*.

However, two water-colour drawings (no. 2b) by Ridley's artist originally referred to the present species by the senior author, show very slender specimens, which have a small, nearly naked, striate pileus with a depressed centre, are entirely grey, except the whitish volva, and have an exannulate stipe. Unfortunately the volva and the base of the stipe are rather vague in these drawings. They strongly remind one of a very slender form of typical *A. vaginata*. They may also represent the grey forms included by Petch (1910: 347) in his *Amanitopsis endochorda* (see discussion under *A. angustilamellata*).

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EXPLANATION OF THE PLATES

PLATE 1

Fig. a. *Amanita perpasta* (× 1). — Fig. b. *Amanita vestita* (× 1). — Fig. c. *Amanita* species 2 (× 1).

PLATE 2

Amanita sculpta (× $^1/_2$).

PLATE 3

Fig. a. *Amanita tristis* (× $^1/_2$). — Fig. b. *Amanita squamosa* (× $^1/_2$). — Fig. c. *Amanita fritillaria* forma *malayensis* (× $^1/_2$).

PLATE 4

Fig. a. *Amanita gymnopus* (× $^1/_2$). — Fig. b. *Amanita pilosella* forma *pilosella* (× 1).

PLATE 5

Fig. a. *Amanita demissa* (× 1). — Fig. b. *Amanita* species 1 (× $^1/_2$). — Fig. c. *Amanita duplex* (× $^1/_2$).

PLATE 6

Fig. a. *Amanita demissa* (× 2). — Fig. b. *Amanita elephas* (× $^1/_2$). — Fig. c. *Amanita alauda* (× 1).

PLATE 7

Fig. a. *Amanita xanthella* (× 1). — Fig. b. *Amanita xanthomargaros* (× 1).

PLATE 8

Fig. a. *Amanita modesta* (× 1). — Fig. b. *Amanita obsita* (× 1). — Fig. c. *Amanita sychnopyramis* (× 1).

PLATE 9

Fig. a. *Amanita elata* (× $^1/_2$). — Fig. b. *Amanita sychnopyramis* (× $^1/_2$). — Fig. c. *Amanita mira* (× $^1/_2$).

PLATE 10

Amanita princeps (× $^1/_2$).

PLATE 11

Fig. a-b. *Amanita hemibapha* subspecies *similis* (× $^1/_2$).

PLATE 12

Fig. a. *Amanita angustilamellata* (× $^1/_2$). — Fig. b-c. *Amanita cinctipes* (× $^1/_2$).

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THE SORDARIACEAE OF INDONESIA

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The Hague

(With 12 Text-figures)

A survey is given of the Sordariaceae of Indonesia. The family is represented by seven genera containing 18 species in all. The new genus *Zygopleurage* Boedijn is introduced. *Pleurage longicollis* (Ames) Boedijn, *Bombardia caudata* (Curr.) Boedijn, and *Zygopleurage zygospora* (Speg.) Boedijn are proposed as new combinations.

Formerly practically all dung-inhabiting Sphaeriales with dark-coloured ascospores were placed in the family of the Sordariaceae. In this family were brought together such genera as *Sordaria*, *Pleurage*, *Coniochaeta*, *Hypocopra*, *Bombardia*, *Delitschia*, *Sporormia*, and *Pleophragmia*.

Cain (3) in a paper on the coprophilous Sphaeriales of Ontario discussed all these genera without trying to place them in families. He considered *Pleurage* to be a synonym of *Sordaria*, whilst he introduced the new genus *Zygospermella*.

Cl. Moreau (14) in his latest publication on this subject excluded *Hypocopra*, *Delitschia*, *Sporormia*, and *Pleophragmia*, while accepting the following genera as belonging to the Sordariaceae, viz. *Sordaria*, *Bombardioidea*, *Pleurage*, *Neurospora*, *Gelasinospora*, *Coniochaeta*, *Bombardia*, and *Triangularia*.

All these genera, with the exception of *Coniochaeta*, are certainly related to each other, agreeing, as they do, in having spores with a germ-pore. In *Coniochaeta* the ascospores have a germ-slit, hence the genus is here excluded from the Sordariaceae.

Moreau in the same paper further assumed that the species of *Pleurage* with many-spored asci were mere forms of those which possess 8-spored asci. However, as long as this assumption has not been proved by cultural methods showing that forms with many-spored asci can be derived from such with 8-spored asci, and vice versa, I am not prepared to accept the theory.

From Indonesia nine species of *Sordaria*, mostly described by Cesati (4) and Penzig & Saccardo (17) were mentioned in literature. Later authors showed that none of the species mentioned belonged to *Sordaria*, and the majority not even to the Sordariaceae at all, as is shown in the following list.

1. *Sordaria botryosa* Penz. & Sacc. = *Bombardia pulvis-pyrius* (Penz. & Sacc.) Höhn.
2. — *caudata* (Curr.) Sacc. = *Bombardia caudata* (Curr.) Boedijn.
3. — *caulicola* Ces. = *Anthostomella caulicola* (Ces.) Sacc.
4. — *microspora* Ces. = *Rosellinia microspora* (Ces.) Sacc.

5. *Sordaria oblectans* Ces. = *Rosellinia oblectans* (Ces.) Cooke.
6. — *pachydermatica* Ces. = *Rosellinia* or *Coniochaeta*.
7. — *punctiformis* Ces. = *Coniochaeta*.
8. — *sarawacensis* Ces. = *Pleurage?*
9. — *tjibodiana* Penz. & Sacc. = *Coniochaeta?*

My own studies in dung-inhabiting fungi of Indonesia yielded 18 species of Sordariaceae, and, since the group is cosmopolitan, I expect that most species will prove to occur in that region.

SORDARIACEAE

Mycelium in substratum well-developed. Perithecia pyriform, subconical to more or less elongate, immersed to superficial, glabrous to more or less hairy, the neck mostly rather short. Perithecial wall brown, semitranslucent or opaque. Hairs solitary or agglutinated into fascicles. Asci with 4, 8, 16, 32, 64, 128, 256, or 512 spores, thin-walled, with a ring-like thickening at the more or less flattened apex, and with a refractive sphere in one genus. Paraphyses thread-like or monilioid, soon deliquescent. Spores uniseriate, biseriate, or conglobate, at first hyaline, then dark to black, mostly smooth, rarely with low ribs or pitted, 1-celled and surrounded by a gelatinous layer, or 2-celled, with one, rarely two, germ-pores, and with gelatinous appendages (secondary appendages) at the poles; in the 2-celled forms, one cell ellipsoid and black, the other cylindrical, colourless, and empty (primary appendage); sometimes two black cells are developed, either one at each pole of the cylindrical spore, or both united into a 2-celled body in the middle of the spore.

Mostly growing on dung, sometimes on dead vegetable matter.

NEUROSPORA Shear & Dodge

Neurospora Shear & Dodge *in* J. agr. Res. **34**: 1025. 1927.

Perithecia pyriform, dark brown, glabrous, immersed to superficial. Asci 4- or 8-spored, cylindrical, short-stalked, with ring-like thickening at the apex. Paraphyses thread-like, soon deliquescent. Spores uniseriate, ellipsoid, dark brown, with longitudinal, sparingly anastomosing pale-coloured low ribs, with a germ-pore at each pole. Perithecia found only in cultures. Conidial fructifications, belonging to the form-genus *Monilia*, predominating.

On every kind of vegetable matter, especially when recently heated or burned.

The first person to report on a *Neurospora* from the tropics was Möller (13) who gave a full account of the life-history of what he called *Melanospora erythraea*, a species now currently known as *Neurospora erythraea* (A. Möll.) Shear & Dodge. However, from his record (pp. 75–80) it is quite obvious that he originally studied a fungus with 4-spored asci, viz. *Neurospora tetrasperma* Shear & Dodge, while the material he got at a later date (p. 81) was a species with 8-spored asci, *Neurospora sitophila* Shear & Dodge. The diagnosis Möller gave (p. 294) combines the characters of both species mentioned above, hence *Neurospora erythraea* should be discarded.

NEUROSPORA SITOPHILA Shear & Dodge

Neurospora sitophila Shear & Dodge *in* J. agr. Res. **34**: 1026. 1927.

Perithecia more or less immersed to nearly free, dark brown, globose to subglobose, 322–414 μ in diam., with a broad short neck, 57–80 μ long, 80–115 μ broad. Asci 8-spored, cylindrical, short-stalked, thin-walled with a ring-like thickening at the more or less truncate apex, 190–199 × 15–19 μ. Spores uniseriate, ellipsoid, dark brown, with pale, sparingly anastomosing longitudinal ribs and a germ-pore at each pole, 22–31 × 12–17 μ. Paraphyses seen only in the young stage.

JAVA: Bogor, Dec. 1953, *Boedijn*, in cultures of the conidial state.

The following is the conidial fructification.

MONILIA SITOPHILA (Mont.) Sacc.

Penicillium sitophilum Mont., Syll. cryptog. 301. 1856. — *Monilia sitophila* (Mont.) Sacc. *in* Michelia **2**: 359. 1880.

Colonies of a bright orange colour, powdery to cottony, several centimeters thick, by confluence often covering very large areas. Mycelial threads branched and septate, 8–12 μ broad. Conidiophores not sharply delimited from the vegetative hyphae, more or less dichotomously branched, the ultimate branches richly septate and falling apart into separate cells which constitute the conidia. Conidia variable as to shape and size, either subglobose, ellipsoid, or cylindrical, whilst those, originating from the place where previously two branches divaricated, possess a short appendage; thin-walled, 7–17 (–32) × 6–11 μ. All aerial parts contain the orange pigment as minute granules.

Whereas the perithecia are found only in artificial cultures, the fungus in its conidial state is abundant throughout Indonesia. It grows on nearly every kind of dead vegetable matter, especially when recently heated or burned. In clearings where the jungle has been burned down to make place for a plantation, every bit of charred wood soon becomes thickly covered with this orange mould.

Monilia sitophila is extensively used especially in West Java in the manufacturing of a certain kind of cakes called "ontjom beureum" which consist of pressed-out seeds of *Arachis hypogaea*. These cakes are inoculated with the mould which by its enzymatic action renders them more digestable. The product offered for sale is wholly covered with the orange mould.

Heim, Nouvel, & Saccas (10) stated *Monilia sitophila* to be synonymous with *Coccospora aurantiaca* Wallr. However, this assumption must be based on an error, for Damon & Downing (7), who had studied the type of *Coccospora aurantiaca*, were able to demonstrate without any doubt that this species belonged to the Mycelia sterilia, being close to if not a member of *Sclerotium*.

SORDARIA Ces. & De Not.

Sordaria Ces. & De Not. *in* Comm. Soc. crit. ital. **1**: 225. 1863.

Perithecia more or less immersed, then nearly superficial, pyriform, dark-coloured, glabrous or sparingly hairy, rarely covered with tomentum. Asci 8-spored, cylindrical with a ring-like thickening at the apex. Paraphyses more or less monilioid, soon deliquescent. Spores uniseriate, rarely partly biseriate, 1-celled, ovoid to ellipsoid, at first hyaline, becoming black with maturity, surrounded by a gelatinous layer, rarely wholly covered with short gelatinous threads. One germ-pore at the base of the spore.

Mostly growing on dung, especially of herbivores, sometimes on dead vegetable matter. In a few cases isolated from seeds.

SORDARIA FIMICOLA (Rob. ex Desm.) Ces. & De Not.

Sphaeria fimicola Rob. ex Desm. *in* Ann. Sci. nat. (Bot.) ser. 3, **11**: 353. 1849. — *Sordaria fimicola* (Rob. ex Desm.) Ces. & De Not. *in* Comm. Soc. crit. ital. **1**: 226. 1863. — *Hypocopra fimicola* (Rob. ex Desm.) Sacc., Syll. Fung. **1**: 240. 1882. — *Fimetaria fimicola* (Rob. ex Desm.) Griff. & Seaver *in* North Amer. Fl. **3**: 69. 1910.

Hypocopra fimeti sensu Fuck. *in* Jb. nassau. Ver. Nat. **23–24**: 240. 1870.

Sordaria iowana Ell. & Holw. *in* J. Mycol. **4**: 65. 1888. — *Hypocopra iowana* (Ell. & Holw.) Sacc., Syll. Fung. **9**: 490. 1891.

Sordaria ostiolata Ell. & Ev. *in* Bull. Torrey bot. Cl. **24**: 458. 1897.

Perithecia pyriform, dark-coloured, glabrous, half way immersed in the substratum, 300–372 × 250–270 μ, neck up to 90 μ diam. Asci 8-spored, cylindrical, with ring-like thickening at the flattened apex, 143–162 × 15–18 μ. Paraphyses more or less monilioid, soon deliquescent. Spores obliquely uniseriate, olivaceous to nearly black, ellipsoid, rounded at the top, more or less acute at the base, with a germ-pore at the lower end, surrounded by a gelatinous layer, 17–20 × 10–12 μ.

JAVA: Bogor, Febr. 1954, *Boedijn*, on horse dung.

In this collection the spores are rather short, but otherwise the material agrees well with the current descriptions.

SORDARIA HUMANA (Fuck.) Wint.

Hypocopra humana Fuck. *in* Jb. nassau. Ver. Nat. **23–24**: 241. 1870. — *Sordaria humana* (Fuck.) Wint. *in* Bot. Z. **30**: 835. 1872. — *Hypocopra fimeti* var. *humana* (Fuck.) P. Karst. *in* Bidr. Känn. Finl. Nat. Folk **23**: 50. 1873. — *Fimetaria humana* (Fuck.) Griff. & Seaver *in* North Amer. Fl. **3**: 67. 1910.

Hypocopra fermenti Fuck. *in* Jb. nassau. Ver. Nat. **23–24**: 241. 1870. — *Sordaria fermenti* (Fuck.) Wint. *in* Abh. naturf. Ges. Halle **13**: 21. 1873.

Sordaria sphaerospora Ell. & Ev., North Amer. Pyren. 128. 1892. — *Hypocopra sphaerospora* (Ell. & Ev.) Sacc., Syll. Fung. **2**: 280. 1895.

Hypocopra fimicola var. *felina* Speg. *in* An. Mus. nac. Buenos Aires **19**: 341. 1909.

Sordaria papillosa Bayer *in* Acta Soc. Sci. nat. Morav. 1. 1924.

Perithecia pyriform, dark-coloured, glabrous, more or less immersed to nearly superficial, 390–483 × 264–380 μ, the neck 92–126 × 80–115 μ. Asci 8-spored, cylindrical, with a ring-like thickening near the more or less flattened top, 169–195 × 18–20 μ. Paraphyses monilioid, soon disappearing. Spores obliquely uniseriate, at first hyaline, then greenish, black at maturity, ovoid, rounded at the top, more acute at the base, with a germ-pore at the lower end and surrounded by a gelatinous layer, 23–27 × 14–16 μ.

JAVA: Bogor, May 1956, *Boedijn*, on rabbit dung.

The present species closely resembles *Sordaria fimicola*, but the spores are distinctly longer and, more especially, broader.

SORDARIA BARBATA Hansen — Figs. 1–5

Sordaria barbata Hansen *in* Vidensk. Medd. naturhist. For. 334. 1877. — *Hypocopra barbata* (Hansen) Sacc., Syll. Fung. **1**: 243. 1882.

Pleurage multicaudata Griff. *in* Mem. Torrey bot. Cl. **11**: 85. 1901. — *Sordaria multicaudata* (Griff.) Sacc., Syll. Fung. **17**: 603. 1905.

Perithecia pyriform, at first semi-immersed, then nearly superficial, covered with a pale grey tomentum, but the neck soon glabrous and black, 1 mm and more long, 0.5–1 mm broad, the neck 300–400 μ broad; old perithecia becoming wholly glabrous. Hairs of the tomentum hyaline to subhyaline, septate, sometimes branched, often slightly undulating, 30–75 × 2–4 μ. Asci and paraphyses forming a solid white mass which may be pressed out of the perithecium as a whole. Asci 8-spored, with a long undulating stalk, more or less cylindrical, often swollen in the middle, with a ring-like thickening at the apex which is distinctly attenuated, 512–640 × 47–62 μ. Paraphyses abundant, long, thread-like, hyaline, 4–6 μ wide, afterwards deliquescent. Spores at first uniseriate, later partly or irregularly biseriate, hyaline with coarse, granular contents when young, becoming yellow, then greenish, finally black, ellipsoid, with a germ-pore at the base, 47–57 × 25–34 μ, wholly covered with short gelatinous threads 4–5 μ long which at the poles may reach 6–9 μ.

JAVA: Bogor, March 1953, Jan. 1956, *Boedijn*, on horse dung.

The spores ripen very slowly, and always in few asci at a time. Abortion of spores is frequent, and abnormally large (60–70 × 34–48 μ) or small (34–43 × 21–27 μ) ones are often to be found. Germination sometimes already takes place in the ascus, with short profusely septate threads. The hairs covering the perithecia in the collections mentioned above are shorter and paler than normal, but otherwise the material agrees well with the original description.

TRIANGULARIA Boedijn

Trigonia Beyma thoe Kingma *in* Cbl. Bakt. (2 Abt.) **89**: 736. 1933; not *Trigonia* Aubl., Hist. Pl. Gui. franç. **1**: 387. 1775. — *Triangularia* Boedijn *in* Ann. mycol., Berl. **32**: 302. 1934.

Perithecia pyriform, mostly glabrous, dark-coloured, superficial. Asci 8-spored, cylindrical, stalked, with ring-like thickening near the apex. Paraphyses thread-like, deliquescent. Spores uniseriate, at first 1-celled, ellipsoid, smooth, hyaline; afterwards an oblique cross-wall separates a small portion at the base of the spore; the upper portion grows out into a more or less triangular black cell with a germ-pore at the apex, while the basal portion remains hyaline, and becomes empty and flat.

On plant debris.

TRIANGULARIA BAMBUSAE (Beyma) Boedijn

Trigonia bambusae Beyma thoe Kingma *in* Cbl. Bakt. (2 Abt.) **89**: 736. 1933. — *Triangularia bambusae* (Beyma) Boedijn *in* Ann. mycol., Berl. **32**: 302. 1934.

Perithecia pyriform, superficial, nearly black, 250–400 × 150–300 μ, glabrous or with a few hairs. Asci 8-spored, cylindrical, with a ring-like thickening near the apex, 150–160 × 10–16 μ. Paraphyses thread-like, soon deliquescent. Spores uniseriate, at first 1-celled, ellipsoid, smooth and hyaline, later on flattened on one side and 2-celled through the formation of an oblique septum near the base, 18–21 × 8–14 μ.

JAVA: on a culm of bamboo (without further data; culture in C.B.S., Baarn).

PLEURAGE Fr. ex O. Kuntze

Schizothecium Corda, Icon. Fung. **2**: 29. 1838. — *Pleurage* Fr., Summa Veg. Scand. **2**: 418. 1849 (nom. prov.); *ex* O. Kuntze, Rev. Gen. Pl. **3**: 504. 1898.

Perithecia pyriform, more or less conical to elongated, immersed or nearly superficial, usually hairy, with the hairs either simple or agglutinated into fascicles. Perithecial wall brown, mostly semitranslucent; neck black and opaque. Asci with 4, 8, 16, 32, 64, 128, 256, or 512 spores, cylindrical, club-shaped to fusiform, with a ring-like thickening near the apex. Paraphyses thread-like to more or less monilioid, soon deliquescent. Spores uniseriate, biseriate to conglobate, at first typically club-shaped, smooth and hyaline; afterwards the swollen part of the spore separated by a cross-wall from the remainder, and transformed into a black, ellipsoid cell with an apical germ-pore; the cylindrical basal part hyaline and empty (primary appendage); secondary appendages gelatinous, homogenous, or fibrillar, issuing from the top of the spore and the end of the primary appendage, either singly or in rings. In some species creeping hyphae of the mycelium produce globose, hyaline microconidia on short phialides.

Mostly on dung, rarely on other substrata.

Some authors claim that *Schizothecium* Corda is an older name for the present genus and, therefore, must have priority. Cl. Moreau (14) indicated the existence of the earlier name *Schizothecium* Fenzl, but this is an error for *Schizotechium* Fenzl, which leaves Corda's generic name unendangered (see also Ames, 1). Even so, however, *Schizothecium* cannot be used for the present genus, as the original diagnosis, repeated below, supplies insufficient information, and is wholly ambiguous.

Schizothecium Corda. — Perithecium superficiale membranaceum dein lateraliter fissum. Nucleus gelatinosus, sporis continuis heterogeneis pedicellatis, floccis liberis brevibus mixtis, gelatinae immersis.

Nicht allein die eigenthümliche seitliche Spaltung der Perithecie charakterisirt diese Gattung, ihre wesentlicher Unterschied besteht in der Entstehung ihrer Sporen und im Baue ihres Nucleus. Die häutige, aus einer äusseren (fig. 105, 12a) aus grosszelligen Flocken und kleienähnlichen, einer mittleren dichtzelligen (fig. 12b), und einer inneren die Kernflocken bildenden Schichte (fig. 12c) bestehende Perithecie umschliesst dem schleimigen Sporenkern (fig. 7 fig. 9), welcher aus einem mit Molekülkornchen erfüllten Schleime besteht, in welcher die sich ablösenden Flocken der innersten Flockenschichte der Perithecie mit den grossen dunkel gefärbten ungetheilten nackten und kurzgestielten Sporen (fig. 8, 9) untermischt liegen. Jede Spore selbst besteht aus einer einfachen, schwach durchscheinenden im Querschnitte (fig. 10) etwas flachgedrückten, eiförmigen Sporenhaut (fig. 11) mit einigen Oeltropfen erfüllt. Der Sporenstiel ist hell, weiss und mithin von einer der Sporenhaut heterogenen Substanz.

1. *Sch. fimicolum* Tab. XIII fig. 105. — Solitarium conicum, atrum, dein plicatum, vel incurvum furfuraceum, sporis ovato-oblongis atrofuscis, pedicello tenui, albo, pellucido.

This vague description is equally applicable to the genus *Bombardia*, hence *Schizothecium* Corda is a nomen dubium which must be rejected. Fries did not know Corda's genus, but, thinking the name *Schizothecium* to be preoccupied, introduced the name change *Pleurage* which is equally incorrect. The next name to be considered is *Podospora* Ces., but most authors regard this as synonymous with *Sordaria*. Since *Pleurage* has been extensively used by Griffith and especially by Cl. Moreau, who gave a clear definition of the genus, I think it best to retain the name *Pleurage*, in spite of the fact that according to the Code it is unacceptable.

PLEURAGE APPENDICULATA (Auersw. ex Niessl) Cl. Moreau

Sordaria appendiculata Auersw. *ex* Niessl *in* Verh. Nat. Ver. Brünn. **10**: 188. 1872. — *Podospora appendiculata* (Auersw. ex Niessl) Niessl *in* Hedwigia **22**: 156. 1883. — *Podospora fimiseda* var. *appendiculata* (Auersw. ex Niessl) Winter *in* Rab., KryptFl. **1**: 170. 1887. — *Pleurage appendiculata* (Auersw. ex Niessl) Cl. Moreau, Genres Sordaria et Pleurage 246. 1953.

Sphaeria amphicornis J. B. Ell. *in* Bull. Torrey bot. Cl. **6**: 109. 1876. — *Sordaria amphicornis* (J. B. Ell.) Sacc., Syll. Fung. **1**: 235. 1882. — *Podospora amphicornis* (J. B. Ell.) Ell. & Ev., North Amer. Pyremomyc. 130. 1892. — *Pleurage amphicornis* (J. B. Ell.) O. Kuntze, Rev. Gen. Pl. **3**: 505. 1898.

Sphaeria eximia Peck *in* Rep. N.Y. State Mus. **28**: 78. 1876.

Pleurage superior Griff. *in* Mem. Torrey bot. Cl. **11**: 68. 1901. — *Sordaria superior* (Griff.) Sacc., Syll. Fung. **17**: 603. 1905.

Perithecia pyriform to subconical, brown, 380–483 × 253–345 μ, especially on the upper half covered with straight, brown, septate hairs, 46–69 × 3–4 μ, which at the top are often swollen to 5–6 μ. Asci 8-spored, more or less clavate, with ring-like thickening at the truncate apex, 201–227 × 26–32 μ. Paraphyses monilioid, deliquescent. Spores irregularly biseriate; spore-body proper ellipsoid, smooth, black at maturity, 27–35 × 12.5–17 μ, with a germ-pore at the apex; primary appendage cylindrical, hyaline, empty, 21–39 × 3–4 μ; with two long secondary appendages of a fibrillar structure, one at the apex of the spore-body, the other at the base of the primary appendage, tapering, sometimes slightly undulating, gelatinous, 38–84 × 2–3 μ.

JAVA: Bogor, April 1956, *Boedijn*, on horse dung.

PLEURAGE ANSERINA (Ces. ex Rab.) O. Kuntze

Sphaeria anserina Ces. *ex* Rab. *in* Hedwigia **1**: 116. 1857. — *Malinvernia anserina* (Ces. ex Rab.) Rab. *in* Hedwigia **1**: 116. 1857. — *Podospora anserina* (Ces ex Rab.) Niessl *in* Hedwigia **22**: 156. 1883. — *Sordaria anserina* (Ces. ex Rab.) Wint. *in* Abh. naturf. Ges. Halle **13**: 99. 1893. — *Pleurage anserina* (Ces. ex Rab.) O. Kuntze, Rev. Gen. Pl. **3**: 504. 1998. — *Bombardia anserina* (Ces. ex Rab.) Migula *in* Thomé, KryptFl. **10**: 123. 1913.

Sordaria penicillata Ell. & Ev. *in* J. Mycol. **4**: 78. 1888. — *Podospora penicillata* (Ell. & Ev.) Ell. & Ev., North Amer. Pyrenomyc. 131. 1892.

Perithecia pyriform, semi-immersed, brown, semitranslucent, sparingly hairy, 391–600 × 161–380 μ, with the neck black and opaque, 138–172 × 92–126 μ. Asci 4-spored, cylindrical, stalked, with ring-like thickening at the flattened apex, 169–195 × 20–24 μ. Paraphyses more or less monilioid, afterwards deliquescent. Spores uniseriate; spore-body proper ellipsoid, smooth, dark to black, 28–38 × 17–19 μ, with a germ-pore at the top; primary appendage cylindrical, hyaline, empty, 23–36 × 4–5 μ; with two long homogenous secondary appendages, one at the apex of the spore-body, the other at the end of the primary appendage, tapering, often curved, gelatinous, up to 78 μ long, 2–4 μ wide.

JAVA: Bogor, April 1956, *Boedijn*, on horse dung.

I failed to observe the small secondary appendages at the base of the primary appendage, but in all other characters the present collection fully agreed with *Pleurage anserina*.

PLEURAGE SETOSA (Wint.) O. Kuntze

Sordaria setosa Wint. *in* Abh. naturf. Ges. Halle **13**: 97. 1873. — *Philocopra setosa* (Wint.) Sacc., Syll. Fung. **1**: 249. 1882 — *Podospora setosa* (Wint.) Niessl *in* Hedwigia **22**: 156. 1883.

— *Pleurage setosa* (Wint.) O. Kuntze, Rev. Gen. Pl. **3**: 505. 1898. — *Bombardia setosa* (Wint.) Migula *in* Thomé, KryptFl. **10**: 128. 1913.
Podospora hirsuta Dangeard *in* Botaniste 345. 1907.

Perithecia pyriform, partly immersed, brown, semitranslucent, 667–805 × 494–530 μ, with numerous simple hairs near the base of the neck which is black, opaque, 207–264 × 92–126 μ. Asci about 128-spored, fusiform, short-stalked, attenuated near the truncate apex which shows a strong ring-like thickening, 240–262 × 63–77 μ, 18.5–35 μ wide at the apex. Paraphyses long, monilioid, disappearing at maturity. Spores conglobate; spore-body ellipsoid, smooth, dark to black, 21–24 × 11–13 μ, with a germ-pore at the top; primary appendage cylindrical, hyaline, empty, 4–6 × 1.5–3 μ, soon shrivelling; secondary appendages short, homogeneous, 8–16 × 1.5–3, one at the top of the spore-body, the other at the end of the primary appendage, also soon disappearing.
JAVA: Bogor, March 1956, *Boedijn*, on horse dung.

PLEURAGE CURVICOLLA (Wint.) O. Kuntze

Sordaria curvicolla Wint. *in* Hedwigia **10**: 161. 1871. — *Philocopra curvicolla* (Wint.) Sacc., Syll. Fung. **1**: 250. 1882. — *Podospora curvicolla* (Wint.) Rehm *in* Rab., KryptFl. **1**: 176. 1887. — *Pleurage curvicolla* (Wint.) O. Kuntze, Rev. Gen. Pl. **3**: 505. 1898.
Philocopra curvicolla var. *penicillato-setosa* Mouton *in* Bull. Soc. Bot. Belg. **25**: 145. 1886.

Perithecia pyriform, immersed, brown, semitranslucent, 500–550 × 319–348 μ' the neck black, opaque, 170–188 × 90–101 μ/ both the neck and the base of the perithecia are covered with brown hairs which are either solitary or agglutinated into more or less elongated, flat, triangular fascicles, the former being unbranched, septate, 17–24 × 2–3 μ, the latter 40–92 μ long and 10–17 μ broad at the base, with the separate threads sparingly septate and rather thick-walled. Asci about 256-spored, few in number, broadly claviform to nearly obovoid, with broadly rounded apex which shows a ring-like thickening, 153–176 × 102–112 μ. Paraphyses thread-like, soon deliquescent. Spores conglobate; spore-body smooth, ellipsoid, black, with a germ-pore at the top, 15–19 × 10–12 μ; primary appendage short-cylindrical, empty, hyaline, 5–7 × 2–3 μ; secondary appendages at top of spore and end of primary appendage, small, and soon disappearing.
JAVA: Bogor, July 1949, *Boedijn*, on goat dung.

Pleurage longicollis (L. Ames) Boedijn, *nov. comb.*

Schizothecium longicolle L. Ames *in* Sydowia **5**: 120. 1951 (basionym).

Perithecia pyriform to elongate, more or less immersed, brown, semitranslucent, sparingly hairy in the upper half, 575–862 × 368–540 μ, the neck dark, opaque, 115–241 μ broad. Asci about 512-spored, few in number, broadly ellipsoid, with rounded apex which shows a ring-like thickening, 374–390 × 102–140 μ. Paraphyses more or less thread-like, soon deliquescent. Spores conglobate; spore-body smooth, ellipsoid, black, 17–22 × 9–12 μ, with a germ-pore at the top; primary appendage short-cylindrical, hyaline, empty, 3–8 × 1.5–2 μ, soon shrivelling; secondary appendages small, soon disappearing.
JAVA: Bogor, March 1956, *Boedijn*, on goat dung.

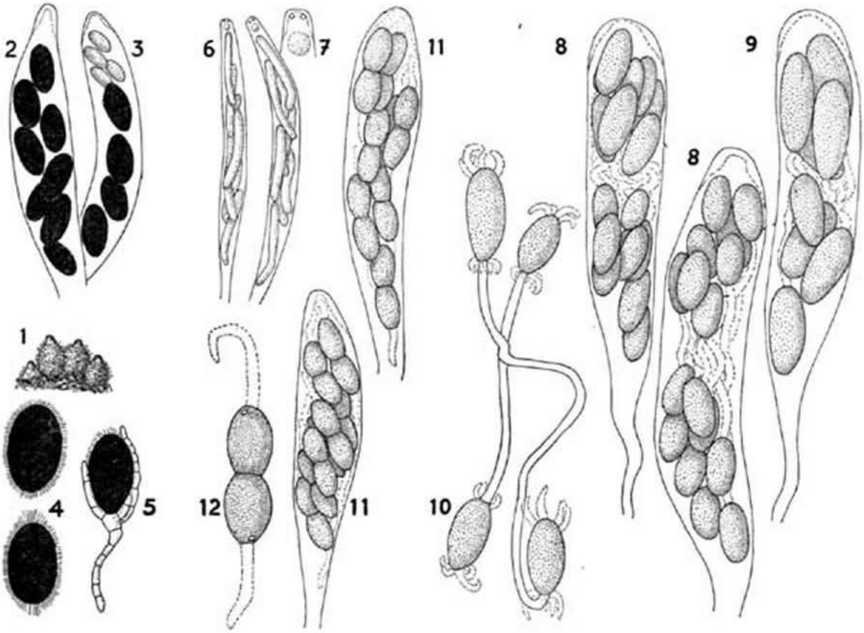
The necks of the perithecia in the present collection are rather short.

PLEURAGE VESTITA (Zopf) Griff.

Eusordaria vestita Zopf *in* Z. Naturw. **56**: 556. 1883. — *Podospora vestita* (Zopf) Rehm *in* Rab., KryptFl. **1**: 176. 1887. — *Pleurage vestita* (Zopf) Griff. *in* Mem. Torrey bot. Cl. **11**: 76. 1901. — *Bombardia vestita* (Zopf) Migula *in* Thomé, KryptFl. **10**: 126. 1911.

Perithecia pyriform, partly immersed to nearly superficial, brown, semitranslucent, glabrous, 600–750 × 350–400 μ, with the neck black, opaque, 190–200 × 90–102 μ. Asci 8-spored, more or less clavate, with ring-like thickening near the apex, 182–211 × 32–41 μ. Paraphyses thread-like, soon deliquescent. Spores biseriate, spore-body smooth, ellipsoid, black, with a germ-pore at the top, 28–35 × 17.5–20 μ; primary appendage long-cylindrical, empty, hyaline, 17–29 × 3.5–5 μ; with several secondary appendages measuring 8–20 × 1.5–2 μ arranged in rings round the top of the spore and at the end of the primary appendage, the latter ring being the smaller one.

JAVA: Bogor, July 1949, *Boedijn*, on goat dung.



Figs. 1–5. *Sordaria barbata* Hansen. — 1. Perithecia. — 2. Normal ascus. — 3. Ascus with four aborted spores. — 4. Ascospores covered with gelatinous threads. — 5. Germinating ascospore.

Figs. 6–7. *Bombardia manihotis* Fernier. — 6. Asci containing immature spores. — 7. Top of ascus enlarged to show the refractive sphere.

Fig. 8–10. *Zygopleurage zygospora* (Speg.) Boedijn. — 8. Two asci with normal spores. — 9. Ascus containing four spores with terminal cells of twice the normal size. — 10. Ascospores with the middle part of variable length.

Figs. 11–12. *Zygospermella insignis* (Mouton) Cain. — 11. Two asci. — 12. Ascospore enlarged to show the laterally placed germ-pores.

BOMBARDIA Fr.

Bombardia Fr., Summa Veg. Scand. **2**: 389. 1849.

Perithecia pyriform, ovoid to more or less elongate, with the base immersed in the substratum or nearly superficial, glabrous or hairy, dark, the neck black and opaque. Perithecial wall two- to three-layered; in the former case consisting of an outer layer of angular areas of thick-walled cells separated from each other by a tissue of thin-walled cells, and an inner layer of nearly hyaline elongate cells; in the latter, consisting of a thin, coloured outer layer, a thick, nearly colourless, cartilaginous median layer, and a thin inner layer of brown cells. Asci 8-spored, with a ring-like thickening at the apex and a refractive sphere just under the top. Paraphyses mostly very long, more or less monilioid, deliquescent. Spores biseriate, at first typically cylindrical, smooth and hyaline, with a short, gelatinous appendage at each pole; afterwards the top of the spore swells to form an ellipsoid, black cell, with a germ-pore at the apex, while the lower part remains cylindrical and hyaline, and becomes empty (primary appendage).

On dead vegetable matter and on dung.

The refractive sphere represents a character of extreme taxonomical importance, but, unfortunately, it gradually disappears in herbarium specimens.

BOMBARDIA COPROPHILA (Fr.) Kirschst.

Sphaeria coprophila Fr., Syst. mycol. **2**: 342. 1823. — *Hypoxylon coprophilum* (Fr.) Fr., Summa Veg. Scand. **2**: 384. 1849. — *Sordaria coprophila* (Fr.) Ces. & De Not. *in* Comm. Soc. crit. ital. **1**: 226. 1863. — *Podospora coprophila* (Fr.) Wint. *in* Rab., KryptFl. **1**: 172. 1887. — *Pleurage coprophila* (Fr.) O. Kuntze, Rev. Gen. Pl. **2**: 505. 1898. — *Bombardia coprophila* (Fr.) Kirschst. *in* KryptFl. Brandenb. **7**: 185. 1911. — *Lasiosordaria coprophila* (Fr.) Chenant. *in* Bull. Soc. mycol. France **24**: 87. 1919.

Cercophora mirabilis Fuck. *in* Jb. nassau. Ver. Nat. **23–24**: 245. 1870.

Sphaeria bovilla Cooke, Handb. Brit. Fungi **2**: 874. 1871.

Bovilla capronii Sacc., Syll. Fung. **2**: 360. 1883.

Pleurage albicans Griff. *in* Mem. Torrey bot. Cl. **11**: 79. 1901.

Perithecia globose-pyriform to more or less elongate, semi-immersed to nearly superficial, blackish brown, 512–800 × 288–510 μ, with the neck black, 103–210 μ broad, and near their apex either hairy or verrucose. The hairs are pale brown to subhyaline, 1- to 2-celled, with pointed tip and often strongly swollen base, united into small groups of 23–45 × 9–7 μ. Sometimes the hairs are almost absent, being replaced by protruding groups of cells, giving the perithecial wall a warty appearance. Asci 8-spored, numerous, cylindrical, with a long, often undulating stalk and a ring-like thickening at the slightly attenuated apex, 146–270 × 13–22 μ; refractive sphere under the apical ring, 4–5 μ in diam. Paraphyses numerous, very long, hyaline, 2–3 μ wide, afterwards deliquescent. Spores at first biseriate, then often irregularly uniseriate, long-cylindrical when immature, hyaline and with a gelatinous secondary appendage at each pole; later on the top part of the spore is transformed into a smooth, ellipsoid, black cell, 18–25 × 9–14 μ, with a germ-pore at its apex, whilst the cylindrical, hyaline lower part, measuring 24–41 × 3–5.5 μ, becomes the empty primary appendage; secondary appendages tapering, 8–9.5 × 2–3 μ, soon disappearing.

JAVA: Bogor, July 1949, *Boedijn*, on goat dung; March 1953, *Boedijn*, on horse dung.

Like in most species of *Bombardia*, the spores ripen slowly and not simultaneously, so that one and the same ascus may contain both immature and mature spores. In a perithecium there are often only a few ripe spores, but the immature ones are liberated just as well, and they are perfectly capable of germinating.

BOMBARDIA MANIHOTIS Fernier — Figs. 6–7

Bombardia manihotis Fernier *in* Rev. Mycol. **19** (Suppl. colon. No. 1): 2, 6. 1954.

Perithecia pyriform, semi-immersed, brown, 700–750 × 500–540 μ, the neck 150–180 μ broad. Asci 8-spored, cylindrical, stalked, with a ring-like thickening at the flattened apex, 173–192 × 13–18 μ; refractive sphere just under the top, 4–5 μ in diam. Paraphyses thread-like, soon deliquescent. Spores irregularly biseriate, at first cylindrical, hyaline, mostly curved near the base, later on consisting of a smooth, ellipsoid, black cell with a germ-pore at the apex, 17–21 × 8–11 μ, and a cylindrical, hyaline, empty primary appendage, 16–25 × 5–6 μ; secondary appendages small, gelatinous, one at the top of the spore, the other at the end of the primary appendage, fugacious.

JAVA: Bogor, April 1956, *Boedijn*, on dead stems of *Manihot utilissima*.

BOMBARDIA ARACHNOIDEA (Niessl) Cain

Podospora arachnoidea Niessl *in* Hedwigia **35**: 143. 1896. — *Sordaria arachnoidea* (Niessl) Sacc. & Syd. *in* Sacc., Syll. Fung. **14**: 492. 1899. — *Pleurage arachnoidea* (Niessl) Griff. *in* Mem. Torrey bot. Cl. **11**: 73. 1901. — *Bombardia arachnoidea* (Niessl) Cain *in* Univ. Toronto Stud. biol. No. 38: 73. 1934.

Perithecia globose-pyriform, more or less immersed to nearly superficial, brown, hairy to nearly glabrous, 342–390 × 258–282 μ, the neck darker, 72–120 × 54–60 μ. Asci 8-spored, cylindrical, short-stalked, with a ring-like thickening at the more or less flattened top, 143–170 × 10–13 μ; refractive sphere just under the apex of the ascus. Paraphyses thread-like, soon deliquescent. Spores irregularly biseriate, at first cylindrical and hyaline, 27–40 × 3–5 μ, afterwards consisting of a smooth, ellipsoid, black cell with a germ-pore at the top, 15–18 × 8–10 μ, and a cylindrical, hyaline, empty primary appendage, 20–25 × 3–5 μ; secondary appendages rather long, gelatinous, tapering, 10–37 × 1.5–2.5 μ, one at the top of the spore, the other at the end of the primary appendage.

JAVA: Bogor, June 1949, *Boedijn*, on horse dung.

It is with some hesitation that the material mentioned is assigned to the present species, because the authors quoted above describe the perithecia as being much larger. However, there is no discrepancy as to all other characters.

BOMBARDIA PULVIS-PYRIUS (Penz. & Sacc.) Höhn.

Rosellinia pulvis-pyrius Penz. & Sacc. *in* Malpighia **11**: 393. 1897. — *Bombardia pulvis-pyrius* (Penz. & Sacc.) Höhn. *in* S.B. Akad. Wiss. Wien (Math.-naturw. Kl., I Abt.) **118**: 1487. 1909.

Sordaria botryosa Penz. & Sacc. *in* Malpighia **11**: 394. 1897. — *Bombardia botryosa* (Penz. & Sacc.) Höhn. *in* S.B. Akad. Wiss. Wien (Math.-naturw. Kl., I Abt.) **118**: 1486. 1909.

Perithecia gregarious, ovoid, superficial, blackish brown, 500–600 × 300–350 μ, glabrous. Asci 8-spored, cylindrical, stalked, with a ring-like thickening at the more or less flattened top, 150–200 × 10–14 μ; refractive sphere just under the apex of

the ascus. Paraphyses long, thread-like, soon deliquescent. Spores irregularly biseriate, at first, cylindrical and hyaline, 36–42 × 3–4 μ, afterwards consisting of a smooth, ellipsoid, black cell with a germ-pore at the top, 16–19 × 9–11 μ, and a cylindrical, hyaline, empty primary appendage, 14–20 × 3–4 μ; secondary appendages gelatinous, 6–8 μ long, one at the top of the spore, the other at the end of the primary appendage; both the primary and secondary appendages soon disappearing.
Java: Tjibodas, 1896, *Penzig*, on dead branches; Dec. 1930, *Boedijn*, on dead stems.

In his note, von Höhnel (11) felt inclined to regard the present species as a mere form of *B. botryosa*. This is certainly correct, but I have chosen the name *Bombardia pulvis-pyrius*, because that name has page priority.

Bombardia caudata (Curr.) Boedijn, *nov. comb.*

Sphaeria caudata Curr. *in* Trans. Linn. Soc. Lond. (Bot.) **22**: 320. 1859 (basionym). — *Sordaria caudata* (Curr.) Sacc., Syll. Fung. **1**: 236. 1882.

Perithecia conical, partly immersed or nearly superficial, brown, up to 0.5 mm in diam. Asci 8-spored, cylindrical, stalked, with a ring-like thickening at the top, 150 × 14–15 μ; refractive sphere just under the apex of the ascus. Paraphyses thread-like, soon deliquescent. Spores biseriate, at first cylindrical and hyaline, 30–40 × 6 μ, afterwards consisting of a smooth, ellipsoid, black cell with a germ-pore at the top, 17–24 × 9–10 μ, and a cylindrical, hyaline, empty primary appendage, 30–32 × 4–5 μ; secondary appendages short, pointed, soon disappearing.
Java: Tjibodas, *Penzig*, on rotten wood.

Description partly after Penzig & Saccardo (17), partly after Dennis & Wakefield (8), as no recent collections were available.

Zygopleurage Boedijn, *nov. gen.*

Perithecia pyriformia, superficialia, nuda. Asci late cylindraceo-clavati, stipitati, superne subtruncati, octospori. Sporae biseriatae, initio longe vermiformes, dein utrumque ad finem cellulam ellipsoideam nigram gignentes. Cellulae terminales poro germinativo apiculi appendicibusque parvis digitiformibus munitae. — Typus generis: *Sordaria zygospora* Speg.

Perithecia more or less pyriform, immersed with the base to superficial, brown, glabrous, the wall semitranslucent, and the neck black and opaque. Asci 8-spored, long-clavate, stalked, with a ring-like thickening at the apex. Paraphyses more or less monilioid, soon deliquescent. Spores irregularly biseriate, at first long-cylindrical, smooth, colourless, afterwards developing two terminal, ellipsoid, black cells which remain connected with the long, often undulating, hyaline middle part of the spore, and possess a germ-pore at the free end; secondary appendages gelatinous, arranged in rings round the top and base of the coloured cells.

When the spores are set free, the dark terminal cells soon separate, while the thread-like connective portion and the secondary appendages disappear. Since each dark cell acts as a spore, the originally 8-spored asci actually produce 16 spores.

Zygopleurage zygospora (Speg.) Boedijn, *nov. comb.* — Figs. 8–10

Sordaria zygospora Speg. *in* Michelia **1**: 227. 1878 (basionym). — *Philocopra zygospora* (Speg.) Sacc., Syll. Fung. **1**: 251. 1882. — *Podospora zygospora* (Speg.) Niessl *in* Hedwigia **22**: 156. 1883. — *Pleurage zygospora* (Speg.) O. Kuntze, Rev. Gen. Pl. **3**: 505. 1898.

Perithecia pyriform, semi-immersed, brown, semitranslucent, 600–1020 × 378–630 μ, the neck black, opaque, 133–180 μ broad, and the cells of the perithecial wall brown, angular, 3–7 μ long. Asci 8-spored, more or less clavate, stalked, with ring-like thickening at the flattened top, 286–305 × 44–56 μ. Spores irregularly biseriate, at first long-cylindrical, mostly variously bent and undulating, afterwards developing two terminal, ellipsoid, black cells, 35–44 × 15–22 μ, which remain connected with the very long, 4–6 μ wide, contorted, hyaline, and seemingly empty middle part of the spore, and possess a germ-pore at their free end; secondary appendages arranged in rings, the larger one round the apex of the black cells, the smaller one round their base.

JAVA: Bogor, July 1949, March 1956, *Boedijn*, on dung of rabbits, goats, sheep.

When mature the asci look as if they contain 16 spores in two groups of eight, but in reality these are the terminal cells which become disconnected only after they have been discharged, loosing in the process the seoondary appendages.

Spore-abortion is not rare, and asci containing groups of small and large terminal cells are often seen. Also, the asci may contain four spores, of which the terminal cells measure 44–60 × 18–23 μ.

ZYGOSPERMELLA Cain

Zygospermum Cain *in* Univ. Toronto Stud. biol. No. 38: 73. 1934; not *Zygospermum* Thwaites ex Baill., Etud. gén. Euphorb. 620. 1858. — *Zygospermella* Cain *in* Mycologia **27**: 227. 1935.

Perithecia globose-pyriform, immersed or becoming superficial, glabrous or hairy, dark brown, opaque, with short neck. Asci 8-spored, cylindrical, stalked, with a ring-like thickening at the apex. Paraphyses thread-like, deliquescent. Spores biseriate, at first cylindrical and hyaline, then through inflation of the central portion developing a two-celled dark body, with a laterally placed germ-pore at the free end of each ellipsoid cell; the remainder of the spore-body extending as primary appendage on either side of the two central cells.

ZYGOSPERMELLA INSIGNIS (Mouton) Cain — Figs. 11–12

Delitschia insignis Mouton *in* Bull. Soc. Bot. Belge **36** (C.R. 2): 13. 1897. — *Zygospermum insigne* (Mouton) Cain *in* Univ. Toronto Stud. biol. No. 38: 76. 1934. — *Zygospermella insignis* (Mouton) Cain *in* Mycologia **27**: 227. 1935.

Perithecia globose-pyriform, more or less immersed, glabrous, blackish brown, about 500–600 μ in diam., with short neck. Asci 8-spored, cylindrical, stalked, with a ring-like thickening at the distinctly flattened apex, 204–247 × 31–39 μ. Paraphyses thread-like, deliquescent. Spores biseriate, at first more or less cylindrical and hyaline, through inflation of the central portion very soon developing a two-celled dark body, measuring 44–67 × 14–21 μ, and with a laterally placed germ-pore at the free end of each ellipsoid cell; the remainder of the spore-body extending as primary appendage on either side of the two central cells, 32–45 × 5–8 μ.

JAVA: Bogor, Febr. and March 1956, *Boedijn*, on dung of sheep and rabbits.

DISCUSSION

In the Sordariaceae as here delimited, I would admit the following genera: *Neurospora*, *Gelasinospora*, *Bombardioidea*, *Sordaria*, *Triangularia*, *Pleurage*, *Bombardia*, *Zygopleurage*, and *Zygospermella*. Of these, *Gelasinospora* and *Bombardioidea* have as yet not been collected in Indonesia.

The genera *Coniochaeta*, *Hypocopra*, *Delitschia*, *Sporormia*, and *Pleophragmia*, which are often considered also to belong to the present family, are to be excluded.

When trying to arrange the genera according to their relationships, the best course is to follow Chenantais (5) and Fernier (9) who used especially the spore-characters as the leading principle in building up their system.

In my opinion *Neurospora* is the most primitive genus. Its ascospores are 1-celled, and possess two germ-pores, while the ornamentation consists of low, longitudinal, sparingly anastomosing ribs. Perithecia, however, are rare, and as yet practically known only from cultures. It is the conidial state which is predominantly found in nature, belonging to the form-genus *Monilia*. With the exception of a few genera, in which inconspicuous microconidia can be found, all others lack conidial fructifications.

The next genus, *Gelasinospora*, is closely related to *Neurospora*, with which it share the 1-celled ascospores with two germ-pores, but their ornamentation consists of pits instead of ribs.

Very close, too, is *Bombardioidea*, a genus proposed by Cl. Moreau (14) to accommodate *Sordaria bombardioidea*. Superficially, *Bombardioidea* resembles *Sordaria*, but differs in (i) its perithecia which are coriaceous and of a peculiar shape, and (ii) its spores which possess two germ-pores.

Sordaria, as opposed to *Bombardioidea*, has a more or less membranous perithecial wall, and the ascospores possess only one germ-pore which is situated at their base.

Triangularia is a genus that can be derived from *Sordaria*, and, indeed, the 1-celled, ellipsoid, colourless immature spores of the former do resemble those of the latter very closely. In the course of the development, however, an oblique cross-wall separates a small portion at the base of the spore, whilst the upper portion grows out into a more or less triangular black cell with a germ-pore at its apex. A most distinctive feature is that the basal cell remains colourless, and becomes empty and flat.

This last-named character furnishes a bridge between *Triangularia* and *Pleurage*. In the latter, the spores also possess a hyaline basal cell which is even separately known as the primary appendage, because it is so much more pronounced. The immature spores of *Pleurage* are typically claviform, consisting of an ellipsoid upper portion and an elongated, stem-like lower portion. With age the two parts become separated by a cross-wall, and the upper one turns black and develops a germ-pore at its apex. A further difference from *Triangularia* are the gelatinous secondary appendages which are found at the top of the spore and the end of the primary appendage.

A species which in view of the development of its spores deserves special mention is *Pleurage dagobertii* Moreau. The spores develop essentially in the same manner as described above, but the ellipsoid portion is at the base of the spore, and the primary appendage at the top. Consequently, the germ-pore is also at the base. Another difference is the lack of secondary appendages.

The remaining three genera can be derived from *Pleurage*, from which they differ in that the immature spores rather than being clavate are more or less long-cylindrical.

In *Bombardia* the apical portion of the originally cylindrical and hyaline spore swells to a dark ellipsoid cell with a germ-pore at the top. Consequently, the ripe spores of *Bombardia* and *Pleurage* are practically the same, except for the secondary appendages which are usually small and inconspicuous in the former genus. However, a character which distinguishes *Bombardia* from all other genera of the Sordariaceae is the presence of a refractive sphere in the top of the ascus.

The spores in *Zygopleurage* are originally also long-cylindrical and hyaline, but then two dark ellipsoid cells are formed, one at each end of the spore, which till after the discharge remain connected by the colourless middle part of the spore. The germ-pores are situated at the free ends of the dark cells, and both cells possess secondary appendages.

In *Zygospermella* the central portion of the spore inflates to form two dark cells in juxtaposition, with at the free end of each ellipsoid cell a primary appendage and a laterally placed germ-pore which is never seen opposite a primary appendage.

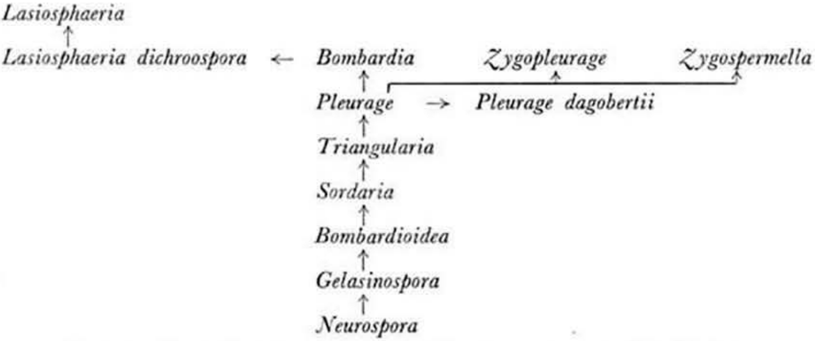


Diagram illustrating suggested relationships among genera of Sordariaceae.

When trying to connect the Sordariaceae with other groups, it is of interest to point out that there is a remarkable resemblance between *Bombardia* and *Lasiosphaeria*. Both genera have in common that (i) the asci possess a refractive sphere below their apex, and (ii) the spores are long-cylindrical. In *Lasiosphaeria dichroospora* Ell. & Ev. a cross-wall separates a large cell from the remainder of the spore-body. Although this cell, unlike the situation in *Bombardia*, does not swell, it does become dark-coloured, hence the specific name. In other species of *Lasiosphaeria* several cross-walls divide the spore which in most cases takes on a pale colour.

The ripening of the spores in *Bombardia* is extremely slow and irregular, whilst immature spores frequently show septation. They are even discharged when still immature, but that does not impair their capacity to germinate. These characters provide additional evidence of the great resemblance between *Bombardia* and *Lasiosphaeria*. In this connection it should also be remembered that many species of the former, as is the rule in those of the latter, are found on dead vegetable matter.

The above diagram is suggested to illustrate the possible relationships among the genera of the family. Apart from some additions, the scheme is based on the work of Chenantais and Fernier.

I hereby wish to thank Prof. Dr H. C. D. de Wit, Wageningen, for his help in preparing the Latin diagnosis.

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STUDIES ON DISCOMYCETES – II

On four species of Fimaria

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(With five Text-figures)

Four species of *Fimaria* Vel. are described. The following new combinations are made: *Fimaria hepatica* (Batsch per Pers.) Brumm., *F. cervaria* (Phill. apud J. Stevenson) Brumm., and *F. theioleuca'* (Roll.) Brumm. *Ascobolus vinosus* Berk., *A. fuckelii* J. Kunze, *A. piceus* (Limminghe) ex Cooke, and *Fimaria murina* Vel. are reduced to the synonymy of *Fimaria hepatica*.

While investigating the taxonomy of the dark-spored Ascobolaceae the author came across a number of species that had been wrongly placed in the genus *Ascobolus*. Among these was a small group of closely related species of operculate Discomycetes with smooth, hyaline ascospores, transferred by various authors to such genera as *Ascophanus*, *Coprobia*, and *Humaria* sensu auct. non Fuckel (= *Octospora* Hedw. per S. F. Gray emend. Korf). Close examination of herbarium specimens or fresh material of four different species shows that there is only a superficial resemblance with *Ascophanus* and that the affinity with *Coprobia* and *Octospora* is rather remote. *Fimaria* Velenovský of which the author was able to study the type is a valid generic name available for these species.

FIMARIA Vel.

Fimaria Vel., Monogr. Discom. Boh. **1**: 331. 1934. — Lectotype: *Fimaria murina* Vel.

Velenovský's generic description of *Fimaria* runs: "Genus, omnino generi *Humaria* affine, sed apoth. margine late membranaceo-limbata, plerumque in cilias acutas fimbriata, paraph. simpl.-filif. vel ramosae. — In fimis, raro in limis."

Fimaria was published with four species, two of which are also described in this paper. Although Velenovský's generic description is rather clear, a more detailed one is given here:—

Apothecia superficial or partly immersed, often sessile on a narrow base, sometimes with a short stalk, up to 5 mm across. Receptacle at first closed and subglobular, then opening and expanding, with a broad membranaceous, lobed, dentate, crenulate or fimbriate margin, usually covered with a thin net-work of septate, branched hyphae, often reddish-brown, purplish-brown, brown or pale yellowish-brown. Excipulum clearly differentiated, of large cells, with intercellular pigment. Asci operculate, cylindrical, with short stalk, rounded above, the wall not blue in Melzer's reagent. Ascospores uniseriate, shortly ellipsoid to oblong-ellipsoid, at first colourless, finally with yellowish-brown contents, without oil drops or granules when mature, smooth. Paraphyses very thin, filiform, hyaline, with the upper parts often surrounded by intercellular, amorphous pigment.

On dung or on soil contaminated with dung.

The amount of pigment in the fruit-bodies varies considerably even in the same species. The yellowish-brown contents of ripe ascospores show a strong fluorescence in ultra-violet light, a phenomenon common to many species of Humariaceae and Ascobolaceae.

The genus differs from *Ascophanus* in the form of the asci, the structure of the excipulum, and the development of the fruit-bodies. Some species of *Fimaria* show a superficial resemblance with *Ascophanus* because of their occurrence on dung or on soil contaminated with it, and also because the hyaline tips of the ripe asci surrounded by a dark pigment give the disk a dotted or even roughened appearance (Fig. 1b). *Fimaria* may be separated from *Octospora* and *Coprobia* chiefly by its different pigmentation, the typical development of the fruit-bodies, and the broad membranaceous margin of the receptacle.

The genus should be placed in the Humariaceae near *Octospora* and *Lamprospora*.

Fimaria hepatica (Batsch per Pers.) Brumm., *comb. nov.*

Peziza hepatica Batsch, Elench. Fung. Contin. 1: 199, pl. 26, f. 138. 1786 (devalidated name). — *Peziza hepatica* Batsch *per* Pers., Mycol. eur. **1**: 243. 1822. — *Aleuria hepatica* (Batsch per Pers.) Gillet, Champ. franç. 208. 1886. — *Humaria hepatica* (Batsch per Pers.) Sacc., Syll. Fung. **8**: 140. 1889. — *Ascophanus hepaticus* (Batsch per Pers.) Boud., Hist. Class. Discom. Eur. 76. 1907. — *Humarina hepatica* (Batsch per Pers.) Seaver, North Am. cup-fungi, Operc. 139. 1928. — Type: represented by Batsch l.c. fig. 138. — Illustrative specimen: Broome, Bowood, Bathford, Wiltshire, Great Britain, I. 1864, in Rabenhorst, Fungi eur. exs. No. 612 (*Peziza hepatica*).

Ascobolus vinosus Berk. *in* Hooker, Engl. Fl. **5** (2): 209. 1836. — *Ascophanus vinosus* (Berk.) Dennis, Brit. Cup Fungi 41. 1960. — Holotype: Berkeley, "on a mole-hill overgrown with moss, and covered with rabbits' and sheeps' dung", England (K-A1927).*

[*Ascobolus testaceus* (Moug. apud Fr.) Wallr. *sensu* Fuckel *in* Jb. nass. Ver. Naturk. **27–28**: 58. 1873; Fuckel, Fungi rhen., fasc. 12, No. 2680. 1874; not *Ascobolus testaceus* (Moug. apud Fr.) Wallr. *sensu* Moug. *in* Wallr., Fl. Crypt. Germ. **2**: 513. 1833; nor *Ascobolus testaceus* P. Henn. *in* Hedwigia **41**: 32. 1902. —] *Ascobolus fuckelii* J. Kunze, Fungi sel. fasc. 3, No. 286. 1879; *in* Oest. bot. Z. **30**: 67. 1880. — *Ascophanus fuckelii* (J. Kunze) Rehm *in* Rabenh., Krypt.-Fl., Ed. 2, Pilze **3**: 1090. 1895. — Type: Fuckel, Fungi rhen. No. 2680.

[*Peziza picea* Limminghe in Herb. —] *Ascobolus piceus* (Limminghe) *ex* Cooke *in* Grevillea **21**: 74. 1893. — Type: Limminghe, on sandy soil, s. loc., I. 1818 ("*Peziza picea* in herb. Limminghe", BM-A2815, K-A1998).

Fimaria murina Vel., Monogr. Discom. Boh. **1**: 331; **2**: pl. 24, f. 15. 1934. — Lectotype: PR 150853 (as *Boudiera murina*).

MISAPPLIED NAME.—*Humaria testacea* (Moug. apud Fr.) J. Schroeter *sensu* J. Schroeter *in* Cohn, Krypt.-Fl. Schles. **3** (2): 36. 1893; Pilze Schlesiens No. 1753 = *Fimaria hepatica*.

EXCLUDED.—*Ascobolus vinosus* Berk. & Broome *in* Ann. Mag. nat. Hist. **15**: 448, pl. 16, f. 25. 1865 = *Saccobolus versicolor* (P. Karst.) P. Karst. overgrown by a sporulating Hyphomycete (K-A1939).

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* For a more accurate indication of herbarium specimens, especially when insufficiently labelled, the usual abbreviation of the herbarium is followed by the author's revision-number.

Ascobolus vinosus Berk. *sensu* Broome *in* Rabenhorst, Fungi eur. No. 658. 1864 = *Lamprospora miniata* (Cr.) De Not. (BM, G, M).

Ascobolus vinosus Berk. *sensu* Fuckel, Fungi rhen. No. 1852. 1866; *in* Jb. nass. Ver. Naturk. **23–24**: 289. 1870; P. Syd., Myc. march. No. 2168. 1888 = *Ascophanus carneus* (Pers. per Pers.) Boud.

Ascobolus vinosus Berk. *sensu* Boudier *in* Ann. Sci. nat. (Bot.) V, **10**: 221–222, pl. 6, f. 11. 1869 = *Ascobolus roseopurpurascens* Rehm. This name is used for this species by most authors of floras and handbooks since 1869.

Ascobolus vinosus Berk. *sensu* Ellis & Everhart, N. Am. Fungi No. 2620. 1891 = *Ascobolus amoenus* Oudemans.

Apothecia densely crowded or gregarious, superficial or partly immersed, 1–3 (–4) mm diameter, 0.3–0.8 mm high. Receptacle at first closed and subglobular, then opening by a laciniate orifice and lenticular or hemispherical, finally often more or less saucer-shaped; vinaceous-brown, pale or dark reddish-brown; smooth, often covered with a thin layer of colourless hyphae which are also connected with the substrate; with a rather broad, lobed or crenulate, membranaceous, often paler coloured margin which may disappear in old fruit-bodies. Disk concave, then flat, of about the same colour as the receptacle, dotted with the hyaline tips of ripe and almost ripe asci. Hymenium 170–190 μ thick. Hypothecium about 15 μ thick, but often not clearly differentiated, of closely compacted isodiametric cells 4–9 μ diameter. Flesh of varying thickness, of subglobular or oblong cells 10–26 (–35) × 8–10 (–30) μ, hyaline. Excipulum 29–55 μ thick, often of only a few layers of subglobular, thick-walled cells 20–35 μ diameter (textura globulosa), with intercellular, amorphous, vinaceous-brown pigment, covered with hyaline, branched hyphae 5–8 μ thick. Asci broadly cylindrical, with a short stalk, rounded above, 170–200 × 19–25 μ, 8-spored, the wall not blue in Melzer's reagent. Ascospores uniseriate, ellipsoid or oblong-ellipsoid, at first colourless, but at maturity with pale yellowish-brown contents, 22–35 (–38.5) × 10–13 μ, smooth. Paraphyses simple or branched, septate, cylindrical, sometimes slightly swollen underneath the septa, 2.5–3.5 μ thick, clavate at the 4–8 μ thick tip, with hyaline contents, sometimes the walls in the upper part pale brownish, covered in the upper part (up to 60 μ from the tip) by intercellular, amorphous, vinaceous-brown pigment.

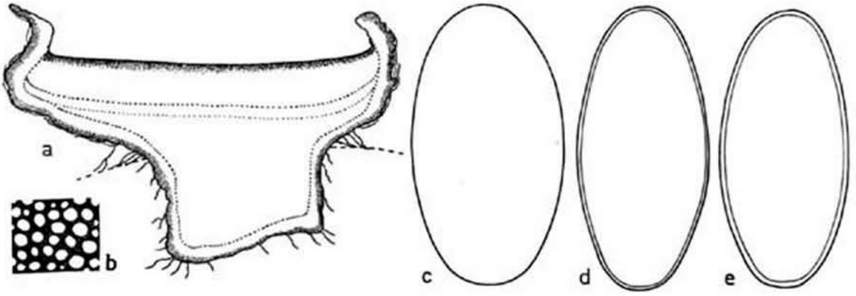

Fig. 1. *Fimaria hepatica*. — a. Diagrammatic section of apothecium (× 40). — b. Top view of hymenium (× 125). — c–e. Ascospores (× 1600); c. lateral view; d, e. optical section (a–d from Schoeter, Pilze Schlesiens 1753, e from type of *Fimaria murina*).

HABITAT.—On dung of mouse and rabbit and on soil which has been in contact with dung of these animals.

ILLUSTRATIONS.—Batsch, Elench. Fung. Contin. 1: pl. 26, f. 138. 1786; Berkeley, Outl. Brit. Fungol. pl. 23, f. 1. 1860; Berkeley & Broome *in* Ann. Mag. nat. Hist. III, **15**: pl. 15, f. 19. 1865; Cooke, Mycographia pl. 22, f. 85. 1876; Patouillard, Tab. anal. Fung. **1**: f. 485. 1886; Velenovský, Monogr. Discom. Boh. **2**: pl. 24, f. 15. 1934; Dennis, Brit. Cup Fungi pl. VIII, f. I. 1960.

SPECIMENS EXAMINED.—GREAT BRITAIN: *Berkeley*, s. loc., s. dat., in British fungi 159 (*Ascobolus vinosus*, BM, E, K); *Berkeley* No. 42, s. loc., s. dat. (PC-A 2312); *Berkeley*, Badminton, Gloucestershire, XII. 1864 (K-A1937); *Berkeley*, s. loc., s. dat. (K-A 1925); *Berkeley*, "on a mole-hill overgrown with moss, and covered with rabbits' and sheeps' dung", s. loc., s. dat. (holotype of *Ascobolus vinosus*, K-A 1927).

BELGIUM: *Libert*, Malmédy, s. dat, in Reliquia Libertianae No. 95 (BR-A336).

FRANCE: *Léveillé*, on rabbit dung, Bois de Boulogne, 1850 (PC-A2315[1]); *Persoon*, near Versailles, s. dat. (*Ascobolus purpureus*, an unpublished name, L 910.256–878).

GERMANY: *J. Kunze*, in fields, "Oberfeld" near Eisleben, X. 1878, in Fungi sel. No. 286 (*Ascobolus fuckelii*, BM, BRSL, GRO).

POLAND: *Schroeter*, on rabbit dung, Wrocław: Oswitz, s. dat., in Pilze Schlesiens No. 1753 (*Humaria testacea*, HBG).

CZECHOSLOVAKIA: *Velenovský*, on soil near nest of mice, Solopisky, Bohemia, 31. X. 1925 (lectotype of *Fimaria murina*, PR 150853); *Velenovský*, on dung of mouse, Hubíčhov, Mnichovice, Bohemia, X. 1927 (PR 151039).

UNKNOWN COUNTRY: *Limminghe*, on sandy soil, s. loc., I. 1818 ("*Peziza picea* in herb. Limminghe", type of *Ascobolus piceus*, BM-A2815, K-A1998).

This is probably the most common species of the genus. According to Seaver (1928: 139) this species is also found in Colorado, U.S.A. The ascospores show a considerable variation in length, sometimes even in the same fruit-body.

Although Batsch's description is rather short and only based on full-grown fruit-bodies, a striking unanimity as to the conception of his species exists in literature. The description and illustration of Berkeley & Broome (1865: 445) certainly established the stability we find in the works of Cooke (1876: 42), Phillips (1887: 99), Rehm (1894: 946) and Seaver (1928: 139).

FIMARIA LEPORUM (Alb. & Schw. per Pers.) Vel. sensu Fuckel

Peziza granulosa var. *ββ*, *leporum* Alb. & Schw., Consp. Fung. 337. 1805 (devalidated name). — *Peziza granulosa* var. *leporum* Alb. & Schw. *per* Pers., Mycol. eur. **1**: 298. 1822. — *Pezzia leporum* (Alb. & Schw. per Pers.) Fuck., Fungi rhen. 1877. 1866. — *Ascobolus leporum* (Alb. & Schw. per Pers.) Fuck. *in* Jb. nass. Ver. Naturk. **23–24**: 288. 1870. — *Humaria leporum* (Alb. & Schw. per Pers.) Sacc., Syll. Fung. **8**: 138. 1889. — *Coprobia leporum* (Alb. & Schw. per Pers.) Boud., Hist. Class. Discom. Eur. 69. 1907. — *Fimaria leporum* (Alb. & Schw. per Pers.) Vel., Monogr. Discom. Boh. **1**: 331. 1934. — Type locality: Germany, Ober Lausitz.

The modern conception of this species is based on Fuckel, Fungi rhen. No. 1877. 1866; *in* Jb. nass. Ver. Naturk. **23–24**: 288. 1870.

Apothecia gregarious, sessile or substipitate, 1–3 mm diameter. Receptacle at first closed and subglobular, then opening and more or less scutellate; reddish-brown or purplish-brown; almost smooth, covered with a thin net-work of hyphae, often with small fragments of the substratum adhering, with a prominent membranaceous margin almost disappearing with age. Disk concave or flat, brown or purplish-brown, smooth, dotted with the hyaline tips of ripe asci. Hymenium about 140 μ thick. Hypothecium about 15 μ thick, of closely compacted hyphae 1.7–3.5 μ thick, also with some larger cells up to 13 × 7.5 μ. Flesh of varying thickness, up to 210 μ thick in the centre consisting of strongly branched hyphae with oblong or irregularly shaped cells 10–24 × 5–14 μ (of which the contents strongly stain in cotton blue or congo red) and of subglobular cells 10–30 μ diameter, hyaline. Excipulum 15–30 μ thick, of rather thick-walled, subglobular or oblong cells 9–15 × 5–13 μ (textura globulosa or textura angularis), brownish, with intercellular pigment and pigment in the cell-walls, covered with a net-work of strongly branched hyphae 3–5.5 μ thick. Asci cylindrical, with a short stalk, rounded above, up to about 140 μ long and 14–15 μ wide, 8-spored, the wall not blue in Melzer's reagent. Ascospores uniseriate, broadly ellipsoid, at first hyaline, finally with pale yellowish-brown contents, 14.4–15.9 × 9.8–10.8 μ, smooth; sometimes with a single, central oil drop when immature. Paraphyses branched, septate, filiform, 2.0–2.5 μ thick, shortly clavate and 3–5 μ thick at the tip, hyaline, with reddish- or purplish-brown, amorphous pigment among the upper parts.

HABITAT.—On dung of rabbit and hare.

ILLUSTRATIONS.—Cooke, Mycographia pl. 19, f. 75. 1875; Cooke *in* Grevillea **3**: pl. 43, f. 201. 1875.

SPECIMENS EXAMINED.—*J. Kunze*, on rabbit dung, Nonnenthal near Eisleben, Germany, end IV. 1875, in J. Kunze, Fungi sel. No. 188 (GRO, HBG, PAD).

The material in Fuckel's Fungi rhen. No. 1877 is in very poor condition.

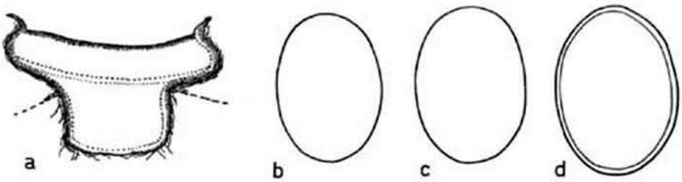

Fig. 2. *Fimaria leporum*. — a. Diagrammatic section of apothecium (× 40). — b–d. Ascospores (× 1600); b, c. lateral view; d. optical section. — From J. Kunze, Fungi sel. No. 188 (GRO).

This species is well-characterized by its broadly ellipsoid ascospores. It was also collected by Svrček (1959: 96) from different localities in Bohemia.

Fimaria cervaria (Phill. apud J. Stevenson) Brumm., *comb. nov.*

Peziza cervaria Phill. *apud* J. Stevenson, Mycologia scotica 308. 1879. — *Humaria cervaria* (Phill. apud J. Stevenson) Sacc., Syll. Fung. **8**: 143. 1889. — *Ascophanus cervarius* (Phill. apud J. Stevenson) Boud., Hist. Class. Discom. Eur. 76. 1907. — Type locality: East Scotland, Great Britain.

Apothecia gregarious, superficial, sessile or substipitate, 1.5–3 mm diameter, about 1 mm high. Receptacle at first subglobular, then more or less scutellate, with a short stalk-like base; chestnut-brown or purplish-brown; smooth and covered with a net-work of brown hyphae; margin thin, crenulate or fimbriate. Disk concave, chestnut-brown or purplish-brown, almost smooth. Hymenium about 150 μ thick. Hypothecium about 25 μ thick, of closely compacted cells 4–10 × 3–7 μ. Flesh up to 900 μ thick in the central part, of small isodiametric cells 7–14 μ diameter and of large oblong cells 19–53 × 5–12 μ, hyaline. Excipulum near the margin

25–40 μ thick, near the base up to 75 μ thick, of subglobular, angular or slightly elongated cells 8–40 μ diameter (textura angularis or textura globulosa), with intercellular, amorphous, purplish-brown pigment, especially in the outer few layers of cells and between the hyphae which cover the excipulum; covering hyphae 2–3.5 μ thick, near the margin often forming a more or less fimbriate layer. Asci

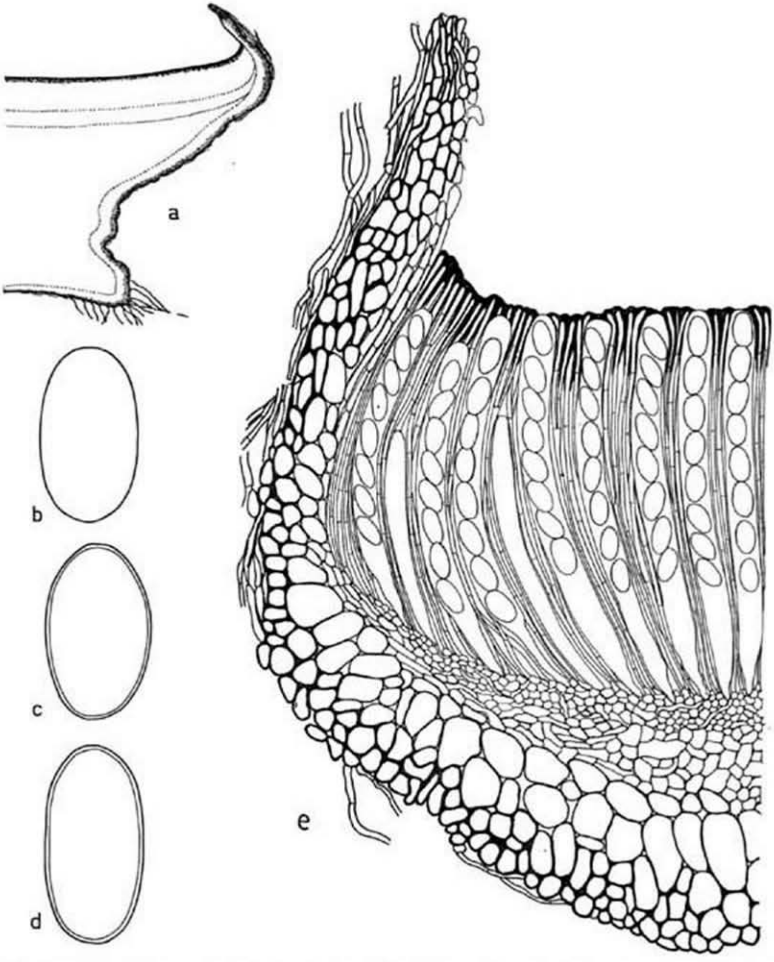

Fig. 3. *Fimaria cervaria.* — a. Diagrammatic section of apothecium (× 40). — b–d. Ascospores (× 1600); b. lateral view; c, d. optical section. — e. Section of margin of apothecium (× 400) (from *Gremmen 1712*).

cylindrical, with a very short stalk, rounded above, 150–175 × 10–12.5 μ, 8-spored, the wall not blue in Melzer's reagent. Ascospores uniseriate, ellipsoid or oblong-ellipsoid, at first colourless, finally often with pale yellowish-brown contents, 14.4–17.0 × 7.0–8.5 μ, without oildrops or granules when mature, smooth. Paraphyses branched, especially in the upper parts, septate, filiform, about 2.0 μ thick, not or only very slightly enlarged, 2.0–3.0 μ thick at the tip, hyaline but near the tip often with pale brownish walls, with intercellular, amorphous, purplish-brown pigment covering the tips.

HABITAT.—Only known from dung of deer.

ILLUSTRATIONS.—None published thus far.

SPECIMEN EXAMINED.—GREAT BRITAIN: *Gremmen 1712*, on dung of deer, Loch-an-Eilean, near Aviemore, Scotland, 29. V. 1960 (L, Herb. Gremmen).

U.S.A.: *Cain*, on deer dung, Ringwood, near Ithaca, New York, 6. IX. 1952 (TRTC 24287).

Both collections fully agree with Phillips' description.

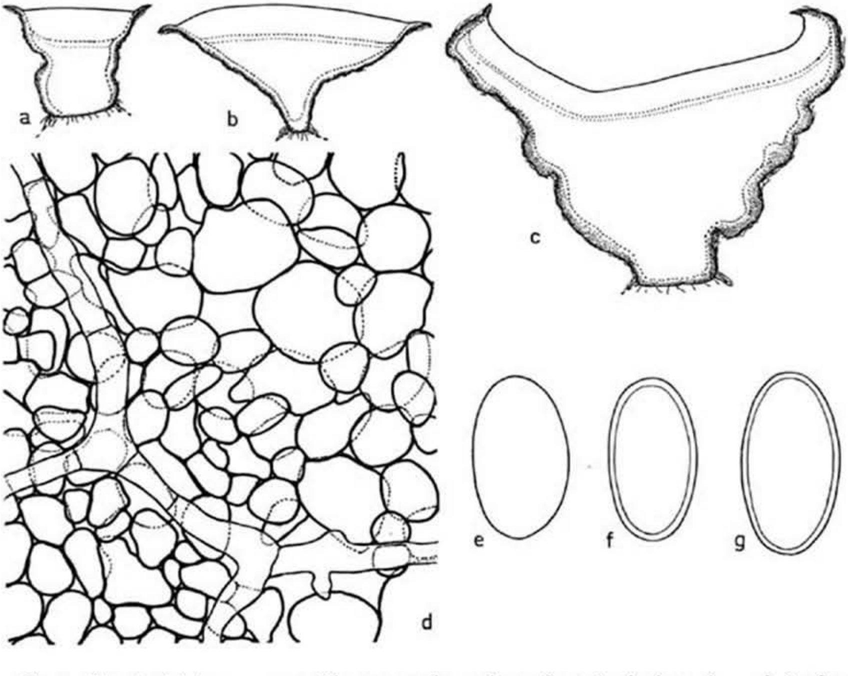

Fig. 4. *Fimaria theioleuca.* — a–c. Diagrammatic sections of apothecia (× 25). — d. Surface view of portion of excipulum (× 750). — e–g. Ascospores (× 1600); e. lateral view; f, g. optical section (a, b, d–g from *van Brummelen 648*, c. from Webster's collection).

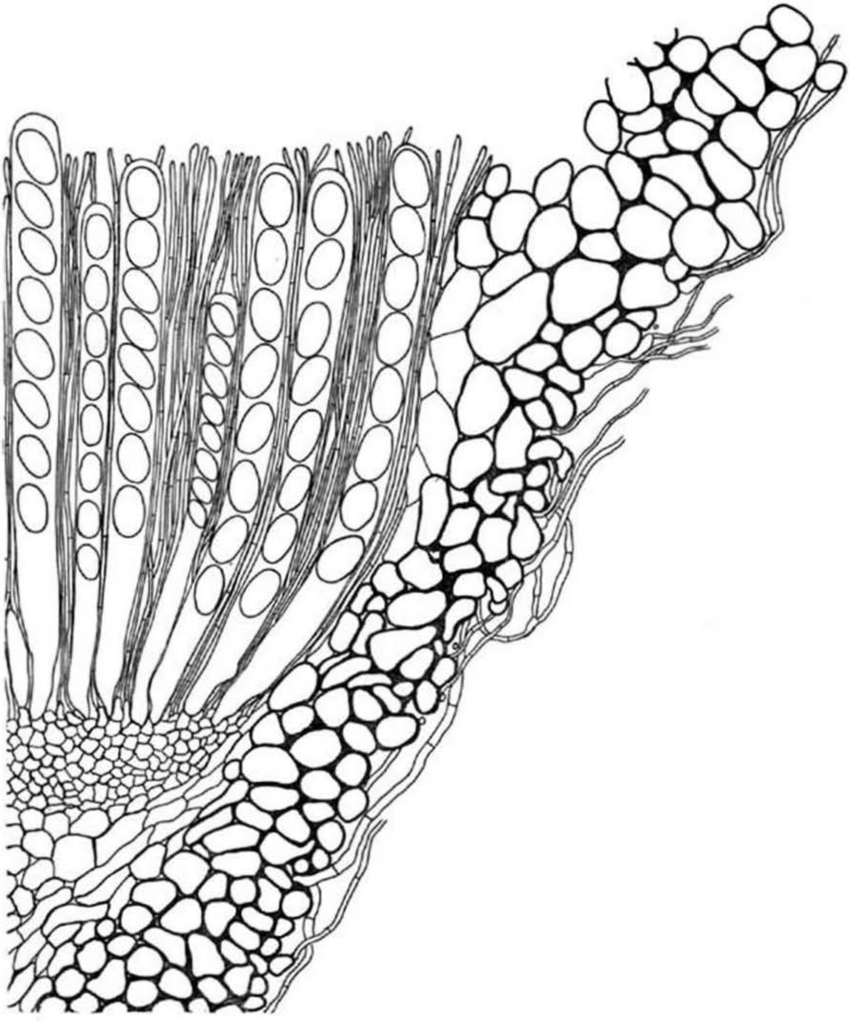

Fig. 5. *Fimaria theioleuca*. — Section of margin of apothecium (× 600) (from *van Brummelen 648*).

Fimaria theioleuca (Roll.) Brumm., *comb. nov.*

Pseudombrophila theioleuca Rolland *in* Bull. Soc. mycol. Fr. **4**: 57, pl. 15, f. 3a–c. 1888. — *Humaria theioleuca* (Roll.) Sacc., Syll. Fung. **8**: 126. 1889.—Type locality: France, Paris, Botanic Garden.

Apothecia solitary or gregarious, substipitate or stipitate, 1–4 mm diameter, up to 1.5 mm high. Receptacle at first closed and subglobular, then opening and turbinate with a narrow or stalk-like base; pale yellowish-brown or darker brown; smooth or folded, covered with a net-work of branched hyphae; margin entire, membranaceous, brown, often somewhat fimbriate at the outside. Disk flat, then convex, pale yellowish, smooth. Hymenium 155–175 μ thick. Hypothecium 20–30 μ thick, of closely compacted, isodiametric cells 5–9 μ diameter. Flesh of varying thickness, in the central part up to about 1000 μ, of subglobular of oblong cells 11–43 × 9–28 μ, hyaline. Excipulum near the margin 25–35 μ thick, in the margin 20–28 μ thick, in the lower parts up to 72 μ thick,, of subglobular, thick-walled cells 11–30 (–40) μ diameter (textura globulosa), with brownish cell-walls and intercellular pigment especially in the outer layers, covered with a net-work of septate, branched, hyaline or encrusted 3–9 μ thick hyphae which is often more dense and fimbriate toward the margin. Asci cylindrical, with a short stalk, rounded above, 155–180 × 13–15 μ, 8-spored, the wall not blue in Melzer's reagent. Ascospores uniseriate, ellipsoid, at first colourless, finally with pale yellowish-brown contents, 13.2–15.7 × 7.7–8.3 μ, smooth, without oil drops or granules. Paraphyses branched, septate, filiform 1.2–1.8 μ thick, not enlarged upward, hyaline, with granular contents, without any pigment.

HABITAT.—Known from dung of deer, rabbit and sheep.

ILLUSTRATIONS.—Rolland, l.c.

SPECIMENS EXAMINED.—GREAT BRITAIN: *Webster*, on rabbit dung, University of Sheffield, 5. XII. 1961 (L).

NETHERLANDS: *van Brummelen* 648, on dung of deer, Elspeet, Gelderland, 3. IV. 1959 (L).

This species was incorrectly placed by Rolland and Boudier (1907: 65) in the genus *Pseudombrophila* Boud. which is characterized by small clusters of short, coloured, septate, obtuse hairs on the outside of the receptacle. These hairs are quite different from the hyphae covering the outer surface of the apothecia in the present species. The collection mentioned above fully agrees with Rolland's description and certainly belongs to the genus *Fimaria*.

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NOTES ON 'CYPHELLACEAE'—II *

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The author introduces two new genera, *Mniopetalum* Donk & Sing. (based on a new species, *M. globisporum* Donk) and *Episphaeria* Donk (based on *Cyphella fraxinicola* Berk. & Br.). Three other genera in an emended circumscription are discussed: *Stigmatolemma* Kalchbr., *Phaeosolenia* Speg., and *Cyphellopsis* Donk. *Rhodocyphella* W. Cooke is reduced to the synonymy of *Stigmatolemma*; and *Maireina* (Pilát) W. Cooke, to the rank of a section of *Cyphellopsis*, which is tentatively considered to consist of a single complex species for which the name *Cyphella monacha* Speg. apud Roum. is temporarily used. New combinations are made in *Mniopetalum* (1), *Episphaeria* (1), *Stigmatolemma* (3), *Phaeosolenia* (2). Most of these names are used (but not validly published) in a recent work of Singer where also the genera mentioned above are described and discussed.

After the publication of the first instalment of the present series two publications appeared that were concerned with this artificial family. The first of these, by W. B. Cooke (*1961*), aimed at presenting a monograph of the whole family, except for a few smaller groups which were covered by some previous papers by the same author (*1951*, *1957*). I agree with very little of its contents, particularly with the artificial and erratic classification adopted in it. The second publication I have in mind is that of Singer (*1962*) who paid special attention to those 'Cyphellaceae' that are considered by him and myself as of an agaricaceous nature. On the whole, Singer's conclusions closely confirm my own view that many 'Cyphellaceae' are nothing but 'reduced' agarics. In my opinion a similar situation exists in connection with those gastromycetes that have been regarded as intimately related to agarics. Such gastromycetes I would consider derived from the agarics, having lost their ability to discharge their spores forcibly and all that this implies (to formulate for once my opinions in the language of phylogeny for brevity).

Not only does the artificial family of the 'Cyphellaceae' contain a significant agaricaceous element, it also includes some taxa that are related to various Aphyllophoraceae, for instance, *Aleurodiscus* Rab. ex J. Schroet. (in part), *Cytidia* Quél. (emended), *Auriculariopsis* Maire (cf. Donk, *1959*: 66, 70, 76). In addition, I find it difficult to make up my mind about a considerable residue. It is as yet impossible to be sure that these left-overs do not include groups worthy of recognition as one or more distinct familes, but I am inclined to think that on the whole this is not the case, and that most elements of the residue lacking pronounced tendencies to form more or less resupinate or effuso-reflexed fruit-bodies are agaricaceous. I would

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* Part I was published *in* Persoonia **1**: 25–110. 1959.

make this sweeping statement conditional in so far that I am not at all convinced that *Schizophyllum* is agaricaceous, and that it may well appear that some 'Cyphellaceae' will have to be transferred to a family Schizophyllaceae Quél. (Donk, *1959:* 37 & cf. also Singer, *1962:* 179). Such a family might cover not only *Schizophyllum* Fr. per Fr. but also (to mention some examples) *Plicatura* Peck, and, more doubtfully, *Stromatoscypha* Donk [= *Porotheleum* (Fr. per Fr.) Fr.], *Phaeodepas* Reid, and perhaps a few other taxa still to be delimitated.

The continued use of the family name 'Cyphellaceae' (even between inverted commas) has invoked misunderstanding and criticism, but is hardly in need of an explanation. As long as the 'family' is maintained for convenience's sake or is regarded as a rapidly dwindling one, there is little sense in replacing it (perhaps several times depending on the consecutive removal of type genera), so much the more as no legitimate substitute is available. The name Leptotaceae was never validly published and at any rate would be as inapt as 'Cyphellaceae' as soon as one transfers *Leptotus* to the Agaricales (where it belongs in my opinion). The name Porotheleaceae favoured by Cooke (*1961:* 13) is not maintainable either because the generic name *Porotheleum* is illegitimate as a later homonym.

However, the principal aim of the present instalment is not to discuss these questions in full, but rather to publish validly some names applied by Singer (*1962*). I also take this opportunity to add a few miscellaneous notes. I am much indebted to Dr. R. Singer for many fruitful discussions on these agaricaceous 'Cyphellaceae' and their relationship during the period in 1960–1 when he was a guest at the Rijksherbarium, Leiden.

Mniopetalum Donk & Sing., *gen. nov.*

Mniopetalum Donk & Sing.; Sing., Agar., 2nd Ed., 328. 1962 (lacking Latin description).

A *Leptoglosso* P. Karst. emend. pigmento membranarum nullo differt. Sporophorum album, ab origine cupulatum, sessile vel in pedunculum stipitiformem breviter attenuatum; contextus e hyphis uniformibus formatus, parietibus hypharum tenuibus, inamyloideis, haud gelatinosis, fibulas gerentibus, hyphis exterioribus vix diversis (pilis specialibus nullis), apice obtusis. Hymenophorum faciem interiorem vestiens, leve, vel lamellas paucas praebens, cremeum. Cystidia nulla. Basidia clavata, sterigmata apicalia 4 gerentia. Sporae subglobosae, manifeste apiculatae, hyalinae, parietibus tenuibus, levibus, inamyloideis. Muscicolum. — Typus: *Mniopetalum globisporum* Donk.

DESCRIPTION.—Sing., Agar., 2nd Ed., 328. 1962.
EXAMPLES.—*Mniopetalum globisporum* Donk; *M. bryophilum* (Pers. per Fr.) Donk.

This may be considered a segregate from *Leptoglossum* P. Karst. from which it differs *inter alia* in the lack of membrana-pigments (white fruit-bodies). The type species is decidedly 'cyphellaceous' in that it lacks gills in contrast to the second example which is decidedly agaricaceous when fully developed. For further discussion, see Singer (l.c.).

Mniopetalum globisporum Donk, *sp. nov.*

MISAPPLICATION.—*Cyphella muscicola* Fr. *sensu* Pat., Tab. anal. **1**: 19 *f. 31.* 1883.

DESCRIPTIONS & ILLUSTRATIONS.—Pat., Tab. anal. **1**: 19 *f. 31.* 1883 (*Cyphella muscicola*); Bourd. *in* Bull. Soc. mycol. France **48**: 209. 1932 (*Phaeocyphella muscicola*); Donk *in* Meded. Nederl. mycol. Ver. **18–20**: 131. 1931 (*Cyphella muscicola*).

Sporophorum cupulatum, sessile vel substipitatum, demum disciformi-applanatum, plena maturitate saepe irregulare, 1–5 mm diam., extus album, subtomentoso-sericeum, intus semper leve, cremeum vel subochraceum. Hyphae parietibus tenuibus, saepe localiter inflatae. Sporae subglobosae, apiculo submediano prominente, 5.4–6 × 4.2–5.1 μ (apiculo excluso), incolores, parietibus levibus, inamyloideis. In *Mnio horno* Hedw. — Typus: Neerlandia, Zuid-Holland, Dubbeldam, leg. C. Venverloo (L 956.148–046).

Fruit-body scattered to crowded in small groups on a white cobwebby mycelium, when young cup-shaped and dorsally sessile or attached by the substipitate vertex, then disk- to shield-shaped with a tendency to develop more strongly at one side, up to 5 mm in diameter, usually smaller, thin-membranous with somewhat waxy disk; margin slightly incurved, finally usually wavy, but may become lobed and crisped; outside subtomentose-silky, white, pale cream coloured when dry in well developed fruit-bodies; disk smooth, not thrown into folds or veins, cream coloured (rather dark cream when mature). Hyphae thin-walled, anastomosing, 2.7–5.5(–7.2) μ wide, often with abrupt inflations (–8–12 μ wide) at one or both sides of a cross-wall (which then is often oblique) or where branching; toward outside becoming narrower and rarely inflated, branched, with blunt tips; clamps present, often irregular. Hymenium somewhat thickening; subhymenium of short branches. Basidia 5.4–7 × 23–27 (–30.6) μ, with 4 sterigmata, up to 7.5 μ long. Spores globular to mostly shortened-pipshaped, with very prominent, submedian apiculus, 5.4–6 × 4.2–5.1 μ (without 1.5–2 μ long apiculus), colourless or perhaps faintly yellowish; contents often with a large oil-drop (spores taken from dried specimens); walls firm, smooth, non-amyloid.

On living mosses, especially on *Mnium hornum* Hedw.

TYPE.—Netherlands, Zuid-Holland, Dubbeldam, leg. C. Venverloo, 11 Nov. 1956 (L 956.148–046).

DISTRIBUTION.—Netherlands (6 collections), Germany, and presumably throughout western Europe.

This species differs from the next (judging from Kühner's description) in that the hymenium remains smooth; even luxurious collections with numerous fruit-bodies do not show any tendency to form folds or gills. It may also be more selective as to host which in all collections I recently re-examined appeared to be *Mnium hornum.*

The spores may be slightly coloured but of this I am not quite certain. Previous indications of the spores being coloured in the above cited descriptions under the name *Cyphella muscicola* were perhaps correct to a slight extent but this could also have been caused by staining since the hymenium darkens to a saturated cream colour. No spore prints were obtained.

The specific epithet 'globisporum' was chosen to express that none of the muscicolous western European species of 'Cyphellaceae' (principally belonging to *Leptoglossum* P. Karst.) had such short spores, although the spores are rarely exactly globose.

The cyphellas on mosses have been so badly confused that it is impossible to discuss them without having them disentangled first, which would require many pages—and a profound knowledge on the subject which I do not claim. However, if one excludes (a) the species with ornamented, dark coloured spores [*Chromocyphella muscicola* (Fr.) Donk, *1959:* 95] and (b) those with greyish-brown or brownish colours and smooth, pip-shaped to ellipsoid spores [which may be slightly coloured; viz. *Leptoglossum* P. Karst. pr. p., inclusive of *L. retirugum* (Bull. per Fr.) Ricken]; and concentrates one's attention on the remaining white-coloured species, then *Mniopetalum* is easily recognizable among the rest. In fact, as far as my knowledge goes, *M. globisporum* is unique among the muscicolous cyphellas of western Europe in having the following combination of characters: (i) originally cup-shaped, often short-stalked fruit-bodies, which are (ii) white outside and become cream inside, (iii) possess clamps, and (iv) smooth, colourless or perhaps faintly tinted spores of (v) nearly globular shape. It should not be confused with another similarly coloured species, viz. *Thelephora muscigena* Pers. ≡ *Cyphella laevis* (Fr.) Lundell, which has much less typically cyphelloid fruit-bodies, narrower hyphae, and differently shaped, smaller ovoid-ellipsoid spores (for a description, see for instance Donk, *1931:* 132).

I believe that the first description containing sufficient microscopical details for a correct interpretation is that by Patouillard (cited above) as *Cyphella muscicola* Fr.; although he does not mention clamps, the description and figure agree. The spores were stated to be globular, and measure about 4–4.5 μ in diameter when calculated from the figure. This spore size is too small but the discrepancy falls within the range of expectable inaccuracies of Patouillard's work of that time. The same fungus was described under the same name by Bourdot and Donk as cited above. [1]

The fungus does not seem to be very rare in western Europe and it has perhaps been previously described as a distinct species. For instance, it may be that *Helvella membranacea* Holmskj. [2] represents an exceptionally luxurious group of fruit-bodies of this species. Nannfeldt (*1955:* 31) referred Holmskjold's plate to *Leptotus* (= *Leptoglossum*) *retirugus*, but I am not certain that this was correct. On account of the definitely cupulate and short-stalked young fruit-bodies remaining white throughout their development as well as the branched but non-anastomosing veins I hesitate to follow him. On the other hand, owing to the persistently white hymenial surface (distincly coloured in *Mniopetalum globisporum*) and its venation, and perhaps also by the kind of moss it inhabits, I am not prepared to identify *Helvella membranacea* with the species under discussion. [3]

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[1] Bourdot's description was based on the same specimens collected and described by Donk; Bourdot's indication "sans boucles" was a *lapsus*.

[2] *Helvella membranacea* Holm [later on Holmskjold] *in* Skr. Vidensk. Selsk. nye Saml. **1**: 286 *f.* 7 *on unnumbered pl.* 1781; Beata Ruris Otia Fung. dan. imp. **2**: 52 *pl. 28.* 1799; (devalidated name). — *Merulius membranaceus* (Holmskj.) per Purt., App. Midl. Fl. 180. 1821, in part.; = *Merulius lobatus* var. *crenatus* Pers., Mycol. eur. **2**: 23. 1825.

[3] Holmskjold's species name was misapplied by Dickson and others (Vahl), and Persoon introduced for *Helvella membranacea* Holmskj. sensu Dicks. the name *Merulius lobatus* Pers. ≡ *Leptoglossum lobatum* (Pers. per Fr.) Ricken. This species has become well known during the last decades.

The next species to be considered is *Thelephora lutescens* Pers.[4] Its original description runs: "gregaria concava lutescens, externe albicans. / Rarius eam in musci inveni, aestate. Formam habet magis regularem, fere uti *Peziza*. Hymenium lutescens aut subochraceum." This does not permit us definitely to accept Persoon's name: the all too short description could have been drafted from *Mniopetalum globisporum* but also from *Chromocyphella muscicola* ("albicans", "subochraceum") or other species, inclusive of some discomycetes. The name has been applied a few times; by Lloyd[5] to a quite insufficiently described fungus with fruit-bodies of the general habit of a species of *Calyptella* Quél.; and by Cooke[5] to a fungus which I do not recognize from his description, although the spores would agree, "subglobose . . . 4–5 × 4.5–6 μ". Cooke also reported that a specimen (K) labelled as *Thelephora lutescens* Pers. in Persoon's handwriting proved to be *Chromocyphella galeata* (Schum. per Fr.) W. Cooke [= *Chromocyphella muscicola* in my conception].

Other cyphellaceous species to be mentioned in this connection but too insufficiently described by their authors for certain recognition are *Cyphella neckerae* (Fr.) Fr.,[6] *Peziza muscigena* Desm.,[7] and *Cyphella elegans* Saut.[8] These are all muscicolous, with externally white, urceolate to campanulate fruit-body, but in none of them do I recognize *Mniopetalum globisporum*. Some may even be discomycetes.

Cyphella chromospora Pat.[9] differs in the minute fruit-bodies 0.25–0.5 mm across, the remarkably short sterigmata, and perhaps the darker coloured spores, which resemble those of *Mniopetalum globisporum* in being globular and about 4 μ in diameter (measured from the figure).

Recently Cooke (*1961:* 134, 135) described some muscicolous species with more or less globular spores, viz. *Leptoglossum peckii* W. Cooke, *L. septentrionale* W. Cooke, and *L. sublutescens* W. Cooke. The descriptions are inadequate for contemporary purposes and may also be expected to be inaccurate. Since these names were not validly published (no types indicated) they are merely briefly mentioned in the interest of future studies.

Mniopetalum bryophilum (Pers. per Fr.) Donk, *comb. nov.*

Agaricus bryophilus Pers., Obs. mycol. **1**: 8 *pl. 3 f. 1.* 1796 (devalidated name). — *Merulius bryophilus* (Pers.) Pers., Syn. Fung. 495. 1801 (devalidated name). — *Cantharellus bryophilus*

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[4] *Thelephora lutescens* Pers., Mycol. eur. **1**: 116. 1822. — *Cyphella muscicola* var. *lutescens* (Pers.) Fr., Syst. mycol. **2**: 203. 1822. — *Cyphella lutescens* (Pers.) Streinz, Nomencl. Fung. 231. 1861 (as synonym); Lloyd, Mycol. Notes **7**: 1228 *pl. 257 f. 2553.* 1923, misapplied. — *Leptoglossum lutescens* (Pers.) W. Cooke *in* Beih. Sydowia **4**: 132. 1961. — *Phaeocyphella lutescens* (Pers.) Pilát ("in herb."); W. Cooke *in* Beih. Sydowia **4**: 135. 1961 (as synonym); ≡ *Cantharellus persoonii* Duby, Bot. gall. **2**: 1017. 1830.

[5] For references, see preceding footnote.

[6] *Peziza neckerae* Fr., Syst. mycol. **1**: 324. 1821 (nomen nudum). — *Cyphella muscicola* var. *neckerae* Fr., Syst. mycol. **2**: 202. 1822. — *Cyphella neckerae* (Fr.) Fr., Epicr. 568. 1838.

[7] *Peziza muscigena* Desm., Cat. Pl. omises 16. 1823.

[8] *Cyphella elegans* Saut. *in* Hedwigia **15**: 152. 1876.

[9] *Cyphella chromospora* Pat., Tab. anal. **1**: 19 *f. 32.* 1883.

(Pers.) *per* Fr., Syst. mycol. **1**: 325. 1821; not *C. bryophilus* Peck apud Sacc. & al. *in* Harriman Alaska Ser. **5**: 46. 1904. — *Merulius bryophilus* (Pers. per Fr.) Pollini, Fl. veron. **3**: 627. 1824; Pers., Mycol. europ. **2**: 25. 1825. — *Leptotus bryophilus* (Pers. per Fr.) P. Karst. *in* Bidr. Känn. Finl. Nat. Folk **32**: 243. 1879. — *Dictyolus bryophilus* (Pers. per Fr.) Quél., Ench. Fung. 140. 1886. — *Leptoglossum bryophilum* (Pers. per Fr.) Ricken, Blätterp. 6. 1910. — *Mniopetalum bryophilum* (Pers. per Fr.) Sing., Agar., 2nd Ed., 329. 1962 (generic name not validly published; incomplete reference).

DESCRIPTIONS & ILLUSTRATIONS.—Pers., Obs. mycol. **1**: 8 *pl. 3 f. 1.* 1796 (*Agaricus*); Kühner *in* Bull. Soc. Nat. Oyonnax **8**: 77 *f. 1.* 1954 (*Leptoglossum*).

Persoon was reluctant to ascribe the species to *Merulius* or *Cantharellus*; he considered it an agaric notwithstanding the fact that the gills were often branched toward the margin of the cap.

Episphaeria Donk, *gen. nov.*

Episphaeria Donk; Sing., Agar., 2nd Ed., 666. 1962 (lacking Latin description).

Sporophorum discoideum vel cupuliforme, sessile, minutum, tenue, extus album, villosum, intus cremeum vel pallide ochraceo-brunneum; contextus e hyphis uniformibus formatus, parietibus hypharum tenuibus, inamyloideis, haud gelatinosis, fibulas gerentibus, hyphis exterioribus vix diversis (pilis specialibus nullis), laxis, parum incrustatis, apice obtusis. Hymenophorum faciem interiorem vestiens, leve, cremeum. Cystidia nulla. Basidia clavata, sterigmata apicalia 4 gerentia. Sporae ovoideo-ellipsoideae, demum ochraceae, parietibus subincrassatis, levibus, inamyloideis, poro germinativo non observato. In fungis sphaeriaceis corticolis invenitur. — Typus: *Cyphella fraxinicola* Berk. & Br.

DESCRIPTION.—Sing., Agar., 2nd Ed., 666. 1962.
TYPE AND ONLY SPECIES.—*Episphaeria fraxinicola* (Berk. & Br.) Donk.

The only species now known to make up this genus was considered a generically distinct unit by Donk (*1959:* 93) in a discussion under *Chromocyphella* De Toni & Levi when the latter genus was redefined and *Phaeosolenia* Speg. as well as other species were excluded from that genus and where he remarked that *Cyphella fraxinicola* Berk. & Br. had no suitable described genus to receive it.

Singer considers the genus obviously related to *Crepidotus* (Fr.) Kumm. sect. *Crepidotus*, that is to the species of that genus with smooth spore-walls and of which *Crepidotus mollis* (Schaeff. per Fr.) Kumm. is an outstanding example. In a more general way I had come to a similar conclusion.

Cooke (*1961:* 123, 124) includes *Cyphella fraxinicola* as a synonym of *Phaeosolenia densa* (Berk.) W. Cooke. It is certainly not only quite distinct from that species but also has no relation to it.

Other cyphellaceous species reported as growing on sphaerias are *Cyphella parasitica* Berk. & Br. and *C. parasitica* subsp. *tenerrima* P. Karst. I have not yet studied their types, but they seem not to belong here.

Episphaeria fraxinicola (Berk. & Br.) Donk, *comb. nov.*

Cyphella fraxinicola Berk. & Br. *in* Rab., Fungi eur. exs. No. 1816 (nomen nudum); *in* Ann. Mag. nat. Hist. IV **15**: 32. 1895, basionym. — *Chaetocypha fraxinicola* (Berk. & Br.) O.K., Rev. Gen. Pl. **2**: 847. 1891. — *Phaeocyphella fraxinicola* (Berk. & Br.) Rea, Brit. Bas. 704. 1922. — *Episphaeria fraxinicola* (Berk. & Br.) Sing., Agar., 2nd Ed., 667. 1962 (generic name not validly published; incomplete reference).

DESCRIPTION & ILLUSTRATION.—Reid *in* Trans. Brit. mycol. Soc. **41**: 439 *f. 23.* 1958 (*Phaeocyphella*).
MONOTYPE.—England, Batheaston (Broome, K.); part of this collection distributed by Rabenhorst, cited above.

It is possible that this species has an earlier name, viz. *Peziza episphaeria* Mart. per Pers., [10] a minute species growing on "*Sphaeria adusta*", but the all too short and ambiguous description, would seem to exclude *Episphaeria fraxinicola*. The species called *Cyphella episphaeria* by Quélet may be Martius's, but Quélet gave the spores as 10–13 μ which is decidedly too big for the species under discussion.

STIGMATOLEMMA Kalchbr. emend.

Stigmatolemma Kalchbr. *in* Grevillea **10**: 104. 1882.
Rhodocyphella W. Cooke *in* Beih. Sydowia **4**: 105. 1961. — Holotype: *Cyphella cupulaeformis* Berk. & Rav.

DESCRIPTION.—Sing., Agar., 2nd Ed., 281. 1962. The genus should be broadened to receive some species in which the spores are not even in outline as will be discussed below.
MONOTYPE.—*Stigmatolemma incanum* Kalchbr.
EXAMPLES.—*Stigmatolemma incanum* Kalchbr.; *S. conspersum* (Pers.) Donk; *Solenia subporiaeformis* Burt; *Cyphella taxi* Lév. sensu Pilát; *Stigmatolemma urceolatum* (Wallr. ex Fr.) Donk; *S. poriaeforme* (Pers. ex Mérat: Fr.) W. Cooke; *S. taxi* (Lév.) Donk; &c.

This emended genus *Stigmatolemma* seems homogeneous although some of its species are currently included in *Solenia* and others in *Cyphella*; these two groups are superficially dissimilar, but the microscopic characters testify to their mutual relationship. The individual fruit-bodies are sessile and have a more or less gelatinous context; the outside is greyish by a coating of lime oxalate crystals and the rather dark hymenium contrasts well with it. Microscopically, some features of the hyphae can be found in most species: short inflations at both sides of septa and numerous H-shaped anastomoses.

Stigmatolemma has long been considered a doubtful genus. However, the redescription of the type species by Talbot (*1956:* 479 *f. 21*) made it possible to emend it and to re-introduce it as a good genus. At first Cooke (*1957:* 687) treated the taxon as a subgenus of *Porotheleum* (Fr. per Fr.) Fr. (≡ *Stromatoscypha* Donk) and the type as a synonym of *Solenia poriaeformis* (Pers. ex Mérat) Fr. ≡ *Porotheleum poriaeformis* (Pers. ex Mérat) W. Cooke. This association of *Stigmatolemma* with *Stromatoscypha* has little merit bcause the two are only very superficially alike. Moreover, Cooke's restriction of '*Stigmatolemma*' to species with densely crowded

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[10] *Peziza episphaeria* Mart., Fl. erlang. 465. 1817 (devalidated name). — *Peziza episphaeria* Mart. *per* Pers., Mycol. eur. **1**: 257. 1822; Fr., Syst. mycol. **2**: 100. 1822. — *Cyphella episphaeria* (Mart. per Pers.: Fr.) Quél., Champ. Jura Vosges **2**: 109. 1873 ["(Mart.?)"].

fruit-bodies can also not be upheld because some species with scattered fruit-bodies appear closely related.

Donk (*1959*) concluded that *S. incanum* (the type) seemed to come close to *Peziza conspersa* Pers. (*Solenia grisella* Quél.), and that if it could be proved to have a gelatinous context like this and some other species he mentioned, it should serve as the type of a well-defined genus, *Stigmatolemma*, which would not only contain species with cups crowded on a common stroma (and which Cooke referred to *Porotheleum*), but also others with scattered cups not connected by any stroma (p. 80). Moreover, he remarked that an agaric genus like *Resupinatus* (C. Nees) ex S. F. Gray had its counterpart among the 'Cyphellaceae' in *Stigmatolemma* (p. 37). Romagnesi (*1950*) reached a similar conclusion as to the affinities of one of the species: "*C*[*yphella*] *poriaeformis:* tissus gélifiés, flous, bruns, spore ronde, cf. *Scytinopsis Kavinii.*" The latter species will be found in Kühner & Romagnesi's flora (*1953:* 68) as *Geopetalum kavinii* (Pilát) Kühn. & Rom. Of particular interest is the following remark:—

> "*Solenia poriaeformis* (D.C.) rappelle . . . à *Scytinotopsis Kavinii* Pilát . . . et cette ressemblance est tout aussi grande au microscope, qui laisse voir un tissu très spécial, d'aspect flou, partiellement coloré de brun (vers l'extérieur, le pigment est clairement incrustant) . . .. On retrouve d'ailleurs à l'extérieur de la cupule de cette *Solenia* des hyphes en cornes de cerf, à bourgeonnement obtus, comme notre *Scytinotopsis* nous en avait lui-même montré. Les relations des *Solenia* grises avec ces Pleurotacées sont donc particulièrement évidentes."— Romagnesi (*1953:* 409).

These remarks may have induced Cooke (*1961:* 128) to raise his subgenus to generic rank, but without extending it to species with scattered fruit-bodies and leaving some others in other genera. Singer (*1962:* 281) has accepted *Stigmatolemma* in the sense I suggested and agrees that it may be considered a reduced genus of his tribus Resupinatae which now includes *Asterotus* Sing., *Resupinatus*, and *Hohenbuehelia* S. Schulz. It would seem that Singer also studied the fragment of the type of *S. incanum* known to be in existence (BPI = "NFC").

Rhodocyphella W. Cooke was introduced for two species (type, *Cyphella cupulaeformis* Berk. & Rav. apud Berk.) of which the spores were considered to "bear a striking resemblance to those of certain ,pink-spored agarics". Apparently Cooke had the agaric genus *Rhodophyllus* Quél. in mind and it may be assumed that the first syllables of that name were used in the composition of the new name, otherwise 'Rhodocyphella' would be a misnomer because nothing of the cyphelloid genus is rose-coloured. The spores of *Rhodocyphella* are neither pink nor do they very much resemble the spores of *Rhodophyllus*. For some further details, see below under *Stigmatolemma taxi*.

STIGMATOLEMMA INCANUM Kalchbr.

Stigmatolemma incanum Kalchbr. *in* Grevillea **10**: 104. 1882. — *Porotheleum incanum* (Kalchbr.) Sacc., Syll. Fung. **6**: 423. 1888.

DESCRIPTION & ILLUSTRATION.—Talbot *in* Bothalia **6**: 479 *f. 21*. 1956 (*Porothelium*).

MONOTYPE.—Union of South Africa, Somerset East (MacOwan; portion in hb. Lloyd 17,601–BPI, comm. P. A. Karsten).

Some years ago Cooke (*1957:* 690) reported on "a portion of probable type of *Stigmatolemma incanum* Kalchbr., of which a specimen from Karsten is found in the Lloyd Herbarium as *Porothelium incanum.*" He identified it with *Solenia poriaeformis* (Pers. ex Mérat) Fuck., but did not give any other information about it than that it had spores 7 × 4 μ. In the original description the spores are described as "ovatae-globosae, inaequales, 0.0015 mm longae hyaliniae". Given the corrected measurements, the original description supplies a fair picture of a species of a genus for which I had been seeking a name, and to which such species as *Solenia poriaeformis*, *Peziza conspersa* Pers., *Cyphella taxi* Lév., and a few others belong. However, the corrected spore measurements Cooke gave for the type specimen show the spores to be ellipsoid and thus to be different from those of *Solenia poriaeformis* (which he interpreted too inclusively); in any case they show that *Stigmatolemma incanum* cannot be that species, which has globose spores 4.5–6 μ in diameter.

As far as my present knowledge goes *S. incanum* seems to fall in a small group of species that also combines the habit of cups crowded on a distinct 'stroma' with ellipsoid spores. They are *Peziza conspersa* Pers. (spores 6–11 × 3–4.5 μ, on bark of *Abies pectinata* in central Europe), *Solenia subporiaeformis* Burt (spores 5–6 × 3 μ, Venezuela), and *Porotheleum cinereum* Pat. (spores 8–9 × 5, Equador). Further studies of the types of the two latter species, of *S. incanum*, and of a few other species may prove some of them to belong to the same species. The published descriptions are all too incomplete to decide the matter.

Stigmatolemma conspersum (Pers.: Fr.) Donk, *comb. nov.*

Thelebolus hirsutus DC., Fl. franç. **2**: 272. 1805 (devalidated name). — Type locality: Switzerland, Neuchâtel (leg. Chaillet). → *Peziza conspersa* Pers.

Peziza conspersa Pers., Mycol. eur. **1**: 271. 1822; Fr., Syst. mycol. **2**: 108. 1822.—*Tapesia conspersa* (Pers.: Fr.) Sacc., Syll. Fung. **8**: 379. 1889; ≡ *Thelebolus hirsutus* DC. (a name listed as synonym under *Peziza conspersa* when the latter name was published by Persoon).

Solenia grisella Quél. *in* Bull. Soc. bot. France **24**: 329 *pl. 6 f. 13.* 1878. — *Henningsomyces grisellus* (Quel.) O.K., Rev. Gen. Pl. **3** (2): 483. 1898. — *Cyphella grisella* (Quél.) Bourd. & G., Hym. France 163. "1927" [1928]. — Type locality: France, Jura.

MISAPPLICATION.—*Solenia porioides* (A. & S. per Pers.: Fr.) Fuck *sensu* Fuck., Fungi rhenani exs. No. 2503. 1873; *in* Jb. nassau. Ver. Naturk. **27—28**: 6. 1873.

DESCRIPTIONS & ILLUSTRATIONS.—Secr., Mycogr. suisse **3**: 306. 1833 (*Peziza*); Quél. *in* Bull. Soc. bot. France **34**: 329 *pl. 6 f. 13.* 1878 (*Solenia grisella*): Bourd. & G., Hym. France 163. 1928 (*Cyphella grisella*).

TYPE LOCALITY. — Switzerland, Neuchâtel (leg. Chaillet).

SPECIMENS EXAMINED. — GERMANY. Schörzingen, Württemberg, F. L. Sautermeister (BP, as *Solenia porioides*). — SWITZERLAND. Neuchâtel, Morthier (distributed by Fuckel, Fung. rhenani exs. No. 2503, as *Solenia porioides*; hb. Oudemans-GRO); Corielles near Neuchâtel, Morthier (as *Solenia grisella*). — FRANCE. Vosges, Corcieux, Galzin (hb. Bourdot 4740-PC, as *Solenia grisella*).

The type locality of this very distinct species is Neuchâtel (Switzerland), from where it was described as *Thelebolus hirsutus* by de Candolle after material received from Chaillet. The original description is not very detailed and the substrate is mentioned merely as "l'écorce des vieux arbres". De Candolle compared the fungus with *Thelebolus stercoreus* Tode, remarking that it differed from that species in the common membrane on which the fruit-bodies were seated. He considered the cups as globular bodies, open at the top by a pore, "par lequel s'échappe la matière interne qui renferme les graines".

This erroneous view was not adopted by Persoon, who recognized the true nature of the fruit-bodies as cups and renamed the species *Peziza conspersa*. We may safely assume that Persoon formed his opinion on material communicated to him by his industrious correspondent Chaillet who also furnished de Candolle with material. The substrate is still only given as bark of trees.

Fries (l.c.) adopted Persoon's name, indicating that he had seen a specimen sent by G. Kunze from Neuchâtel, "ad cortices arborum". [11] There may be grave doubt as to whether or not he received the present species. From his description one might suspect that Fries had *S. poriaeformis* which (in 1822) he did not yet know as such from specimens! An aggravating circumstance is that when he received *Peziza pruinata* Schw. from its author (a fungus now considered synonymous with *Solenia poriaeformis*) he promptly identified it with *P. conspersa:* "Postquam hujus specimina Schweiniziana cum *Pez. conspersae* Chaillet! scrupulose comparare licuit, utramque plantam conjungo. Ceterum paene certum mihi videtur hanc plantam cum Ill. Decandolle optime pro *Theleboli* species haberi."—Fries (*1828:* 10). Yet, I do not believe the point settled that Fries got the wrong fungus. The comparison by Fries with a lichen speaks rather for the present fungus than for *S. poriaeformis:* "Primo obtutu *Thelephoram* frequentissime papillosam (*T. granulosum*) l. potius Lichenem refert subiculo late effuso, indeterminato, furfuraceo. ... Ad *Pezizae* genus vix pertinet fungus maxime memorabilis. *Pyrenoteis* habitu proximus, sed vita non perennis neque capulae corneae quare vix Lichen." A decisive factor would have been a more precise indication of the habitat. *Solenia poriaeformis* grows on rotten frondose wood, while *Peziza conspersa* is found only on bark and on fallen branches of *Abies pectinata*. This latter substrate is for the first time mentioned in literature by Secretan (l.c.), who unequivocally described *Peziza conspersa* from "l'écorce des sapins" after a specimen from—Chaillet!: "... le farineux dont [les cupules] sont couvertes leur donne un aspect gris blanc .... Si on humecte la plante, le creux

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[11] An exclamation mark was placed after the citation of *Thelebolus hirsutus* D.C. This would seem to indicate that Fries saw a specimen he considered certain, rather than that he had seen the specimen from Chaillet on which de Candolle based the specific name.

de la coupe est plus visible, et la pezize prend une teinte brun-roux. Cette espèce forme des taches grises . . .."

Stigmatolemma conspersa is identical with *Solenia grisella* Quél., well described by Bourdot & Galzin under the name of *Cyphella grisella*.

This species was distributed by Fuckel as *Solenia porioides*, implying that it was *Peziza porioides* A. & S. This is a misapplication, in my opinion, because the latter fungus represents nothing else but *Porotheleum fimbriatum* ≡ *Stromatoscypha fimbriatum* (Pers. per Fr.) Donk (cf. Donk, *1959:* 81, 82).

The present species is very distinct from *Stigmatolemma poriaeformis* with which it has been identified by Cooke (*1957:* 688).

Stigmatolemma urceolatum (Wallr. ex Fr.) Donk, *comb. nov.*

Solenia urceolata Wallr. ("in litt.") *ex* Fr., Elench. **2**: 28. 1828.—"*Peziza urceolata* W. in litt.", Wallr., Fl. crypt. Germ. **2**: 488. 1833 (as synonym). [12] — *Henningsomyces urceolatus* (Wallr. ex Fr.) O.K., Rev. Gen. Pl. **3** (2): 483. 1898. — *Solenia poriaeformis* var. *urceolatus* (Wallr. ex Fr.) Pilát *in* Ann. mycol., Berl. **23**: 168 *f. 19: 5–7.* 1925. — *Cyphella urceolata* (Wallr. ex Fr.) Bourd. & G., Hym. France 162. "1927" [1928]. → *Peziza aleuritica* Wallr.

Peziza aleuritica Wallr., Fl. crypt. Germ. **2**: 488. 1833 = *Solenia urceolata* Wallr.) ex Fr.

Cyphella brunnea Phill. apud Phill. & Plowr. *in* Grevillea **13**: 49. 1884. — *Chaetocypha brunnea* (Phill. apud Phill. & Plowr.) O.K., Rev. Gen. Pl. **2**: 847. 1891. — Type locality: Great Britain, Shrewsbury.

DESCRIPTIONS & ILLUSTRATIONS.—Fr., Elench. **2**: 8. 1828 (*Solenia*); W. G. Sm., Syn. Brit. Bas. 425 *f. 104.* 1908 (*Cyphella brunnea*; subhymenium incorrect); Pilát *in* Ann. mycol., Berl. **23**: 168 *f. 19: 5–7.* 1925 & *in* Publ. Fac. Sci. Univ. Charles No. 29: 14 *f. 3a: 5–7.* 1925 (*Solenia porieaformis* var.); Bourd. & G., Hym. France 162. 1928 (*Cyphella*).

Fruit-body gregarious, scattered, here and there somewhat crowded, cup-shaped or rather urn-shaped, sessile, 0.5–1.2 mm across; hymenium pale, then fuscous; outside micaceous-farinaceous by heavy incrustation, whitish, greyish; substance elastic toughish-waxy, somewhat gelatinous, fragile and somewhat rigid when dry. Hyphae in the main parallel to surfaces, thin, 1.5–3 μ in diameter, often branching from clamps, slightly inflated at both sides of cross-walls (inflations up to 4.5 μ in diameter), those of outer layer somewhat stouter, brownish, –4 μ in diameter, those of subhymenium ascendent, indistinct, imbedded in granular mass. Basidia 22–30 × 5–7 μ; sterigmata 4, very thin, straight, about 5 μ long. Spores globose with very small submedian apiculus, even in outline, smooth, with somewhat granular contents, 4.5–6 μ.

HABITAT.—On bark of frondose trees, shrubs, and liana: *Vitis vinifera*, *Syringa vulgaris*, *Clematis vitalba*, also, according to Bourdot & Galzin (l.c.) on *Ulmus*, *Acer*, *Sambucus*.

DISTRIBUTION.—Europe.

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[12] See also next footnote.

TYPE.—Germany, Thuringia (UPS, labelled "*Solenia urceolata* mihi / n. 197 / *Clematis*").

SPECIMENS EXAMINED.—GERMANY. Saxony, near Grossenhain, on dry stalks of *Artemisia abrotanum*, Auerswald (hb. Schroeter-BRSL, as *Cyphella griseopallida*); Lichterfelde near Berlin on vine twigs, P. Sydow (Mycoth. marchica No. 3735, as *Cyphella cinereofusca*). — FRANCE. Trou d'Enfer near Millau, Aveyron, on *Clematis*, Galzin 13,344 (hb. Bourdot-PC); Montmorency, on bark of *Syringa*, Boudier (hb. Boudier-PC, as *Cyphella griseopallida*).

When Fries published this species as *Solenia urceolata* he indicated that Wallroth had sent him a sample under the name of *Peziza urceolata*. Fries, evidently, did not take up the earlier published name *Peziza urceolata* Vahl per Pers. although he suspected it to be the same: "Verosimile est *P. urceolatum* Fl. Dan. t. 1077. f. 1. huc pertinere quae vero extus pilosiuscula, cum nostra specimina flocculoso-farinacea." [13] In the Index to the "Systema mycologium" in Volume 3 (p. 158) the name is listed thus: "[SOLENIA] urceolata El. II. [28]", without any implication that *Peziza urceolata* Vahl was basionym. Wallroth rejected his earlier name and substituted it by *Peziza aleuritica*, which I consider an isonym of Fries's.

The species was determined as *Cyphella griseopallida* Weinm. by Schroeter and Boudier, under which name specimens are found in their herbaria as cited above. Since the original description of *C. griseopallida* calls the fruit-body wholly grey-pallid presumably inclusive of the disk it seems unlikely that Weinmann's fungus is identical with the one described above. *Cyphella griseopallida* sensu Fuck. is *Cellypha goldbachii* (Weinm.) Donk (*1959:* 85).

I am convinced that Cooke (*1961:* 101) erred when he cited *Cyphella brunnea* as a synonym of *Merismodes fasciculatus* (Schw.) Donk apud Sing.

Stigmatolemma taxi (Lév.) Donk, *comb. nov.*

Cyphella taxi Lév. *in* Ann. Sci. nat. (Bot.) II **8**: 336 *pl. 8 f. 10.* 1837 (figure of hymenium and explanation); II **16**: 237 *pl. 15 f. 6.* 1841. — *Chaetocypha taxi* (Lév.) O.K., Rev. Gen. Pl. **2**: 848. 1891.

Cyphella cupulaeformis Berk. & Rav. apud Berk. *in* Grevillea **2**: 5. 1873. — *Chaetocypha cupulaeformis* (Berk. & Rav. apud Berk.) O.K., Rev. Gen. Pl. **2**: 847. 1891 ("*cupuliformis*"). — Monotype: U.S.A., S. Carolina (Ravenel 1403, K).

DESCRIPTIONS & ILLUSTRATIONS.—Burt *in* Ann. Missouri bot. Gdn **1**: 369 *pl. 19*

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[13] This conclusion is at variance with a previous one (Donk, *1959:* 64) which considered *Solenia urceolata* as published by Fries a mere recombination of *Peziza urceolata* Vahl per Pers. I now take the latter name as different from *Solenia urceolata*. Its corrected citation runs:

Peziza urceolata Vahl *in* Fl. dan. **6**/Fasc. 17: 10 *pl. 1017 f. 3.* 1790 (devalidated name); not *P. urceolata* "Rutstr. diss. p. 19" (devalidated name; n.v.). — *Peziza urceolata* Vahl *per* Pers., Mycol. eur. **1**: 316. 1822; Schw. *in* Schr. naturf. Ges. Leipz. **1**: 124. 1822; Fr., Syst. mycol. **2**: 148, 201. 1822 (sp. inquir.). — A nomen dubium.

f. 9. 1914 (*Cyphella cupulaeformis*); Coker *in* J. Mitchell sci. Soc. **36**: 150 *pl. 30 f. 3.* 1921; **64**: 145 *pl. 25 fs. 14, 15.* 1948 (*Cyphella cupulaeformis*).

Fruit-bodies scattered, somewhat gregarious, at most a few crowded together, sessile, cup- or bowl-shaped, 0.5–0.95 mm high, 0.6–1.25 mm across; outside grey, micaceous by a heavy incrustation of easily detersile crystals; margin straight, entire, somewhat incurved when dry; hymenium even, fuscous; substance toughish-waxy, somewhat gelatinous, rigid and hard when dry. Hyphae partially flexuous, fine, 1.25–2.5 μ in diameter, more or less inflated often at both sides of cross-walls (inflations up to 5.5 μ in diameter), clamped. Basidia 18–25 × 4–6 μ, with 2–4, thin sterigmata 4–6 μ long. Spores globular or shortly ovoid, somewhat, but distinctly, angular in outline, with fine but distinct and slightly excentric apiculus, colourless, 4.75–5.75 × 4.5–5.25 μ.

On bark and rotten wood of *Taxus baccata* and *Juniperus virginianus*.

DISTRIBUTION.—Europe; North America.

TYPE.—France, Paris (Léveillé, PC).

SPECIMENS EXAMINED.—FRANCE. Paris, "in Horto Regio Musaei Parisiensis ad truncum scariosum *Taxi baccatae*" as published, Léveillé (PC). — U.S.A. Georgia, Darien (distributed by Ravenel, Fungi amer. exs. No. 224 & by Cooke, Fungi select. exs. s.n., as *Cyphella cupulaeformis*).

The outstanding feature is the angular spores by which this species can be easily distinguished from the other members of the genus. The scattered fruit-bodies remind one rather of *Stigmatolemma urceolatum* (Wallr. ex Fr.) than of *Stigmatolemma poriaeforme* (Pers. ex Mérat) W. Cooke. The occurence on coniferous hosts may be another important character.

The spores are usually devoid of 'spines' (which neither Burt nor I have ever seen), but Coker (*1948:* 145) described them as follows:—

> "Spores (good spore print on slide) shaped like 'Jack rods,' a few showing only two or three papillae but most with four in outline, making the spore 'squarish' or slightly rectangular, 4–5 × 5–6 μ, not counting the projections, otherwise up to 6.5 × 7.4–8 μ."

The adoption of the name *Cyphella taxi* needs some explanation. The spores were given by the author as "ovales" and were depicted in a figure of a section through the hymenium, still attached to the basdia, as ellipsoid and even in outline. However, this figure is out of proportion and highly schematic. The other figures, showing fruit-bodies, leave no doubt that a species of *Stigmatolemma* was depicted; the description also bears this out. Examination of what was certainly the type revealed that the spores are almost globular and angular in outline. Practically the same spores were encountered in the American specimens cited above, determined as *Cyphella cupulaeformis* and distributed by the co-author of that species.

Misled by Léveillé's erroneous data on the spores, Pilát (*1927:* 116 *pl. 1 fs. 10–12*) described a species with the spores "kurz elliptisch, . . . 5.8–7 × 2.8–3 μ" as *Cyphella taxi*. His drawings show them somewhat flattened adaxially and ovoid-ellipsoid. The collection on which his report is based was found on *Juniperus communis*. Assuming the spores to have been correctly described and depicted, Pilát's fungus cannot be *S. taxi*; however, it may be *Cyphella subgelatinosa*, described from North America, South Carolina, on *Alnus serrulata*. Burt (*1914:* 370) recorded some detached spores for this latter species which seem to agree, although slightly larger, 8 × 3.5 μ. (Burt's microscopical measurements are notoriously on the low side.)

Cooke (*1961:* 110) considered *Cyphella taxi* a synonym of *Cyphella ampla* Lév. [= *Auriculariopsis ampla* (Lév.) Maire] "on the basis of a specimen which appears to be the type, loaned by [PC]." Cooke may well have studied the same collection as I did 30 years ago.

Cyphella grisea Petch (*1922:* 7). — This species seems close to *Stigmatolemma taxi* (encrusted outside, subgelatinous substance). Its spores which were described as "globose, 4 μ diameter, with scattered spines up to 3 μ long". It was not stated whether the substrate was coniferous or not ("on bark of living trees").

PHAEOSOLENIA Speg.

Phaeosolenia Speg. *in* Anal. Mus. nac. Buenos Aires **8**: 53. 1902.

DESCRIPTIONS.—Donk *in* Persoonia **1**: 93. 1959 (in obs. under *Chromocyphella*; quoted below); Sing., Agar., 2nd Ed., 667. 1962.
MONOTYPE.—*Phaeosolenia platensis* Speg.
EXAMPLES.—**Phaeosolenia inconspicua** (Berk. & C.) Donk, *comb. nov.*[14] [basionym, *Peziza inconspicua* Berk. & C. *in* Proc. Amer. Acad. **4**: 128. 1858; *Phaeosolenia inconspicua* (Berk. & C.) Donk, Sing., Agar., 2nd Ed., 668. 1962, incomplete reference]; *P. pelargonii* (Kalchbr. apud Thüm.) W. Cooke[15]; *P. densa* (Berk.) W. Cooke (original sense); **Phaeosolenia endophila** (Ces.) Donk, *comb. nov.* [basionym, *Solenia endophila* Ces. *in* Rab., Fungi eur. exs. No. 1513. 1872 (with description) & cf. *in* Hedwigia **11**: 179. 1872; *Phaeosolenia endophila* (Ces.) Donk, Sing., Agar., 2nd Ed., 668. 1962, incomplete reference]; *P. platensis* Speg. is perhaps not specifically distinct from the preceding one.

This genus was taken up by Donk (*1959:* 93) when discussing the emended genus *Chromocyphella* De Toni & Levi: "Some of [the components that drifted into that genus] are congeneric with *Cyphella endophila* Ces., and if in its turn this species is congeneric with *Phaeosolenia platensis* Speg. (as I suspect from the description) then this group may be set apart under the generic name *Phaeosolenia* Speg. Such a genus would differ from *Chromocyphella* in a restricted sense by its characteristic hairs at the outside (patent, rather short, heavily encrusted by easily detersile crystals of lime-oxalate) and the more elongate, smooth, somewhat thick-walled spores."

Cooke (*1961:* 121) subsequently accepted the genus but made it an undefinable lot. Singer (*1962:* 669) took it up in the above sense. He placed it in the Crepidotaceae but did not compare it with any genus of that family. I consider the genus agaricaceous, but at the moment would rather not suggest relationship to any specified group, although one might mention *Phaeomarasmius* Scherffel in its connection as reminescent of *Phaeosolenia* in several respects.

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[14] Talbot (*1956:* 474 *f. 9*) reviewed the species as it occurred in Africa, describing it under the name *Cyphella variolosa* Kalchbr. (synomyms listed). The species also occurs in Asia and a description of it under the name *C. versicolor* Berk. & Br. was published by Petch (*1912:* 278).

[15] For description and discussion, see Talbot (*1956:* 473 *f. 13*, as *Cyphella pelargonii* Kalchbr. apud Thüm.). It was tentatively treated as distinct from *Phaeosolenia inconspicua*.

Cooke (*1961:* 123) made his conception of *Phaeosolenia densa* almost identical with the genus as here circumscribed, except for *P. pelargonii* which he kept apart, and for the inclusion of some synonyms representing generically widely different species. In my opinion *P. densa* is specifically different from all the rest he included and as far as the specimens I saw is restricted to New Zealand.

Patouillard placed all cyphellaceous species with coloured spores together in *Phaeocyphella* Pat. [≡ *Chromocyphella* De Toni & Levi]. This single character has proved to be insufficient for characterizing a natural group and *Chromocyphella* has been emended and reduced to a few species (Donk, *1959:* 92). Other segregates from Patouillard's genus are the present genus *Phaeosolenia* Speg. and *Episphaeria* Donk (see p. 336).

The fruit-bodies are densely coated by crystalline matter deposited on the hairs and, hence, often appear white. This crystalline deposit is easily rubbed off and then shows the coloured tissue underneath. Usually the fruit-bodies are densely crowded (whether or not on a dark-coloured mycelium often appearing paler by incrustation) and then may resemble forms of *Cyphellopsis* Donk when the fruit-bodies are rather cup-shaped, or of *Solenia* Pers. per Fr. sensu stricto when the fruit-bodies are elongated. The resemblance between all three genera is only superficial. Forms with rather scattered fruit-bodies also occur.

CYPHELLOPSIS Donk emend.

Cyphellopsis Donk *in* Meded. Nederl. mycol. Ver. **18–20**: 128. 1931.

Cyphella subgen. *Mairina* Pilát *in* Ann. mycol., Berl. **23**: 160. 1925. — *Maireina* [!] (Pilát) W. Cooke *in* Beih. Sydowia **4**: 83. 1961. — Lectotype (W. Cooke, l.c.): *Cyphella bresadolae* Grelet (mentioned by W. Cooke, l.c., as "*Cyphella monacha* Speg."). → *Cyphella* subgen. *Maireiella* Pilát (typonym).

Cyphella subgen. *Maireiella* Pilát *in* Publ. Fac. Sci. Univ. Charles No. 29: 60. 1925 ≡ *Cyphella* subgen. *Mairina* Pilát (typonym).

? *Pseudodasyscypha* Velen., Novit. mycol. 167. 1939. — Lectotype (Donk *in* Reinwardtia **1**: 219. 1951): *Cyphella hyperici* Velen. — Cf. Donk, l.c.

DESCRIPTIONS.—Donk *in* Persoonia **1**: 98. 1959 (in obs. under *Lachnella*; quoted below); Reid *in* Kew Bull. **15**: 265. 1961; Sing., Agar., 2nd Ed., 405. 1962.

LECTOTYPE (Donk *in* Reinwardtia **1**: 210. 1951).—*Solenia anomala* (Pers. per Fr.) Fuck.

EXAMPLES.—Sect. *Cyphellopsis*.—*Cyphellopsis anomala* (Pers. per Fr.) Donk; *C. mellea* (Burt) Reid; *C. subglobispora* Reid.

Sect. **Maireina** (Pilát) Donk, *sect. & stat. nov.* (basionym, *Cyphella* subgen. *Mairina* [!] Pilat *in* Ann. mycol., Berl. **23**: 160. 1925; type species, *Cyphella bresadolae* Grelet).—*Cyphella monacha* Speg. apud Roum.

As originally conceived I included in *Cyphellopsis* the present emended taxon as well as *Lachnella* Fr. emend. Donk (*apud* Sing., *1951:* 343; *1959:* 97), "but soon concluded that *Cyphellopsis* may be kept apart generically because of the colour of the hairs (brown and somewhat darkening in KOH solution) and the fact that these hairs undergo neither any considerable transformation nor deformation in KOH solution. There is one species of *Cyphellopsis* that shares with *Lachnella* the big basidia and spores. For the present I still believe the two genera as closely related" (Donk, *1959:* 98).[16]

Reid and Singer have adopted this emendation. However, Cooke (*1961:* 96) reduced the genus still more by including only the *Cyphellopsis anomala* complex, emphasizing the hairs in his key to the genera of Cyphellaceae (p. 15) as follows: "Receptacles covered with brown hairs, of which at least some have inflated tips." Such tips have been interpreted as conidia by some authors. I am not convinced that they really represent conidia.

The *Cyphellopsis anomala* complex (which includes *inter alia* also *Solenia populicola* Pat. and *S. confusa* Bres.) belongs taxonomically and nomenclaturally to the toughest problems I have as yet encountered. In my herbarium I have tentatively applied the name *Solenia populicola* to some collections with long, allantoid spores (much longer than in *S. confusa*) but I am not prepared at the moment to publish validly the combination "*C[yphellopsis] populicola* (Pat.) Donk" mentioned by Singer (*1962:* 406).

Cyphella subgen. *Maireina* Pilát was introduced for two species, viz. (i) *Cyphella albocarnea* Quél. which species as at that time interpreted by Pilát he would later call *Cyphella eruciformis* (Batsch per Pers.) Fr. (Pilát, *1933:* 47) and (ii) *Cyphella bresadolae* Grelet = *Cyphella monacha*, which is discussed below. When Cooke (*1961:* 83) raised this taxon to generic rank he selected "*Cyphella monacha* Speg." as type species. One will find the name he should have mentioned (*C. bresadolae*) listed by him (p. 90) as a synonym of *C. monacha.*

At the same time Cooke excluded the white-haired element (*C. eruciformis*) and raised the taxon to generic rank he emended *Maireina* to include species defined thus (in his key to the tribes and genera of his Solenoideae, pp. 14, 15): "Spores hyaline. / Spores smooth. / Receptacles separate, rarely occurring so close together as to appear fasciculate or conglobate, or rarely with branched stipes. / Receptacles without [brown] surface hairs [,of which at least some have inflated tips]. / Receptacles with special granule-incrusted surface hairs, hairs usually with thick walls. / Surface hairs yellow to brown". In several of the species Cooke included the spores are slightly, but distinctly, coloured, as they also may be in *Cyphellopsis*.

Apart from the fact that *Maireina* became the receptacle of several what I consider unrelated species, it appears that the one generic feature used for separating *Maireina* from *Cyphellopsis* (viz. the occasionally inflated hair tips) is a weak one, which I do not believe to be of generic value. It is a pity that Cooke did not elaborate on his reasons for delimiting these genera as he did.

Moreover, the introduction of the generic name *Maireina*, for the genus as conceived by Cooke, appears superfluous for he included *Cyphella hyperici* Velen.,

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[16] Singer (*1962:* 413) recently extended *Lachnella* by two new sections, viz. '*Metuloidifera*' and '*Pulchra*', both of which should apparently be excluded again. I am sure of this as to the type species of section *Pulchra*; the type species of section *Metuloidifera* I have not yet studied.

the type species of the generic name *Pseudodasyscypha* Velen. (as cited above), an earlier and as far as I can see validly published name (alternative name dating from before 1953). Clearly he should have taken up *Pseudodasyscypha*. Both Velenovský's original account, and Cooke's re-description are inadequate to form a definite opinion about the type species of *Pseudodasyscypha*, which, however, might well appear closely related to *Cyphellopsis fusca*.

CYPHELLA MONACHA Speg. apud Roum.

MISAPPLICATION.—*Cyphella fulva* Berk. & Rav. apud Berk. & Br. sensu Berk. & Br. *in* Ann. Mag. nat. Hist. III **7**: 379. 1861 (British collection).

The big-spored complex making up section *Maireina* is perhaps nothing but a single somewaht variable species, the correct name of which has not yet been established. It is a very characteristic one and in certain respects intermediate between *Lachnella* and *Cyphellopsis* (typical section); the habit of the fruit-bodies as well as the basidia and spores are almost typical of the former; and the dark colour, of the latter. It is at once distinguishable from the other species of *Cyphellopsis* by the larger basidia and more voluminous spores and by its scattered fruit-bodies.

For the European component of this comlpex I temporarily use the name *Cyphella monacha* although it is presumably not the correct one. I do not venture to take up the early name *Cyphella fulva* as basionym. When Berkeley & Broome recorded a British collection (cited as "F. Currey, Esq.") they did so under the name "*C. fulva*, Berk & Rav.", adding the remark, "This seems to be the same species with what Mr. Ravenel has gathered in South Carolina, and which has also occurred in other parts of the United States, though the American specimens are generally fasciculate. The species is very near to *Cantharellus fasciculatus*, Schw." This American element represents *Merismodes fasciculata* (Schw.) Donk apud Sing. and the name *Cyphella fulva* Berk. & Rav. was on this occasion validy published for it by a short differential description ("generally fasciculate"). [17] The description of the British collection runs: "Membranaceous, cup-shaped, the mouth more or less directed downwards, tawny, externally tomentose. Spores ovate, .0006 inch long. On dead bark." This is not much, but shape and size of the spores turn the scale. The re-description by Massee (*1892:* 140) sufficiently supplements the gross as well as the microscopical characters to remove most of the doubt as to the identity of the British fungus: "Spores colourless, elliptical, 16 × 8 μ. . . . outside with long, brown, aseptate curved hairs." A study of the collection at Kew affirmed its identity with the fungus under discussion.

Other names belonging to the same complex are *Cyphella ravenelii* Berk. 1873, *C. monacha* Speg. apud Roum. 1880, *C. obscura* Roum. 1882 (nomen nudum; at least

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[17] By using the author's citation "Berk. & Rav." Berkeley & Broome made it clear that the name was given to the American element; in the discussion they showed that they felt not quite certain, that the British collection was conspecific ("seems").

in part), *C. texensis* Berk. & C. ex Cooke 1891, *C. sydowii* Bres. 1892, *C. tephroleuca* Bres. 1898, *C. gregaria* H. & P. Syd. 1900, *C. leochroma* Bres. 1900, *C. marginata* McAlp. 1902, *C. bresadolae* Grelet 1922 (superfluous name), *Peziza cinereo-fulva* Schw. sensu Sacc. 1881 (as *Cyphella*), and undoubtedly some more. Several of these Cooke (*1961*) maintained as distinct species but his key is unsatisfactory and some of the characters used therein are hardly workable, so I am not yet convinced he has proved their specific status. Other examples of the above list were referred by Cooke (*1961:* 123) to *Phaeosolenia* Speg. [*Cyphella cinereofusca* sensu Sacc., as a synonym of *P. densa* (Berk.) W. Cooke] and *Lachnella* [*Cyphella sydowii*, on p. 69 as a synonym of *Lachnella alboviolascens* (A. & S. per Pers.) Fr., but on p. 91 as a synonym of *Maireina monacha* (Speg. apud Roum.) W. Cooke].

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AGLAOTHECIUM GROENH., A NEW LICHEN GENUS FROM MALAYSIA

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(With seven Text-figures)

The new genus *Aglaothecium* Groenh. is proposed to accomodate the new species *A. saxicola* Groenh. The development of bitunicate asci as occurring in cryptothecioid genera is compared with that of the supposedly unitunicate but thick-walled asci which are common in Lecideaceae and Lecanoraceae. The question is discussed whether bitunicate asci are always indifferent to iodine.

Aglaothecium Groenh., *gen. nov.*

Thallus crustaceus, uniformis; apothecia sessilia, orbicularia, lecideinea; asci 8-spori, unitunicati, membrana tenui cincti, iodo indifferentes; sporae obovoideae, decolores, primum transversaliter septatae demum submuriformes, cellulis rectangularibus, membrana septisque tenuibus; paraphyses simplices in apice non incrassatae; excipulum gonidiis destitutum, e hyphis pachydermaticis, septatis, ramosis, e media excipuli basi radiatim divergentibus conglutinatisque compositum. — Species generis typica: *Aglaothecium saxicola* Groenh., gonidiis protococcoideis.

Aglaothecium saxicola Groenh., *spec. nov.* — Figs. 1-3

Thallus epilithicus, crustaceus, uniformis, irregulariter areolato-diffractus vel subcontinuus, mediocris, laete isabellinus, sat laevigatus, subnitidus vel opacus, soraliis isidiisque destitutus, K–, Ca–, KCa–; margo ignotus; cortex imperfecte evolutus; gonidia viridia, globosa, protococcoidea, zonam continuam formantia; medulla alba, tenuis.

Apothecia sessilia, dispersa, orbicularia, ad basin plus minusve constricta, 0.3-0.5 mm lata; discus primum laete fulvus demum atro-purpureus, planus, nudus, opacus; margo sat tenuis, obscure atro-purpureus vel subniger, integer, persistens, discum bene superans; hymenium 90-105 μ altum, laete fulvum vel subdecolor, hyalinum, purum, J–, vel laete rubro-brunneum; asci 8-spori, clavati, membrana tenui in apice non incrassata cincti, unitunicati, J–; sporae 1-2-seriatae, obovoideae, decolores, primum transversaliter septatae demum submuriformes, septis transversis 4-6, septis longitudinalibus 1-2, loculis rectangularibus, septis et membrana tenuibus, 6-7 × 16-20 μ; paraphyses simplices, in apice non incrassatae, sat laxe cohaerentes; excipulum in regione hypotheciali decolor aut laete ochraceum, in parte exteriore atropurpureum, K–, ex hyphis pachydermaticis, septatis ramosisque, bene conglutinatis, e media excipuli basi radiatim divergentibus formatum, extus glabrum. — Holotypus: *Groenhart 1742.*

Thallus thin to thickish, irregularly cracked to almost continuous, pale isabelline, rather smooth, slightly shining to dull, without reactions with K, Ca, and KCa, cortical layer poorly developed or almost absent; apothecia sessile, scattered, orbicular, somewhat constricted at the base, 0.3-0.5 mm across; disk pale to blackish purple, plane, naked, dull; margin rather thin, entire, persistent, dark purplish to blackish; hymenium (including the 10–15 μ thick ascogenous layer) 90–105 μ thick, almost colourless to pale fulvous, hyaline, pure (i.e. not insperse), J+ reddish brown; the narrow ascogenous layer composed of densely interwoven ascogenous hyphae; asci 8-spored, clavate, with short, rounded base, unitunicate, J–; spores 1–2-seriate, obovoid, colourless, with 4–6 transversal septa and usually with 1–2 longitudinal septa, the cells rectangular, with thin septa and wall, 6–7 × 16–20 μ; paraphyses unbranched, not thickened at the tips; excipulum in the hypothecial region colourless to pale ochre, otherwise with a blackish-purplish pigment, K–, composed of thick-walled, septate, branched hyphae running radiately from the centre of the base of the excipulum to its circumference, there to form a more or less well delimited cortical layer of parallel, strongly conglutinated hyphae with somewhat elongate lumina; close to the cortical layer, especially in the lower part of the excipulum, irregular spaces occur between the hyphae, up to 3 μ wide; in the centre of the excipulum and in the hypothecial part the hyphae are densely conglutinated, with rather short and narrow lumina.

EAST JAVA: Pass of Ngantgang, 14 July 1937, *P. Groenhart 1742* (type), on rock, ± 1000 m alt. (L).

The new genus differs from all genera of the Lecideaceae by its thin-walled, unitunicate asci which are indifferent to iodine. In these genera, of which at least several may prove to be heterogeneous, species prevail with thick-walled asci, usually becoming blue with iodine, and which very probably must be considered to be bitunicate. This difference in ascus type gives rise to the question whether or not *Aglaothecium* should be placed in the Lecideaceae. The answer to this question depends on the taxonomic evaluation of the characters of the asci and the excipular structures.

The ascogonal apparatus[1] can be regarded as the true ascocarp of the fungus, and as such is of much more importance to the (sexual) reproduction of the plant than are the parascogonal tissues.[2] It is evident, therefore, that taxonomically the characters of the ascogonal apparatus are to be valued higher than those of the additional tissues. As a consequence the genus *Aglaothecium* is not to be ranged in the Lecideaceae, although the structure of the exciple of the new genus shows a strong similarity to the excipular structures in some of the genera of that family. It is not known at present which are the nearest relatives of *Aglaothecium* that possess unitunicate asci only.

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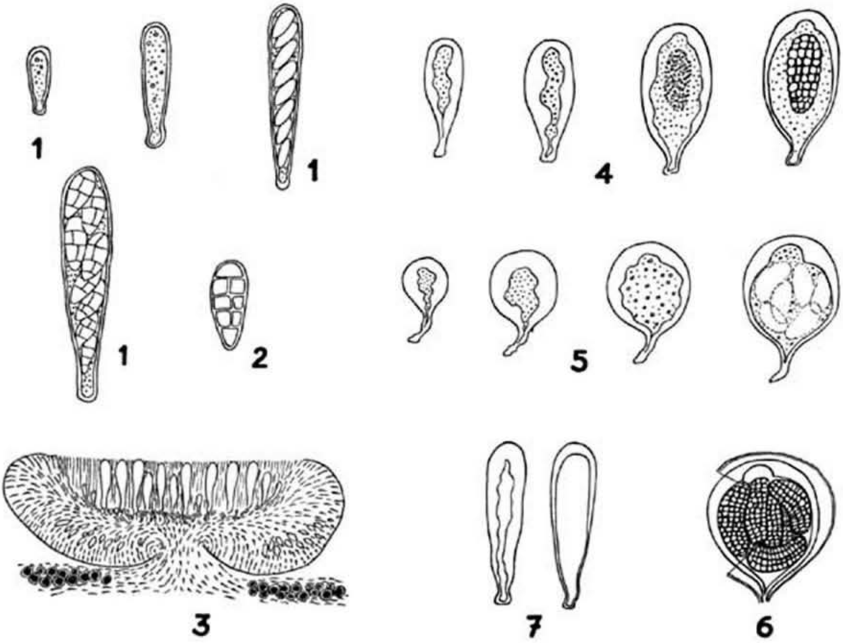
[1] That is, the ascogon (or its substitute), the ascogenous hyphae, the asci and the spores.

[2] These are all additional tissues composed of differentiated hyphae, produced under the influence of the sexual stimulus which leads to the initiation of the ascogon. A tissue is called protascogonal if produced before the ascogon is initiated, as for instance the stromal tissue in the Ascoloculares; synascogonal if produced simultaneously, or almost so, with the initiation of the ascogon, as for instance the excipulum and paraphyses in Ascohymeniales.

In lichens a second category of additional tissue occurs which is more or less actively or passively added to the true ascocarp and its parascogonal tissues by the thallus, as for instance the carbonaceous excipuli and the thalline walls in Graphidaceae, and the thalline warts of the Pertusariaceae.



Figs. 1–3. *Aglaothecium saxicola* Groenh. — 1. Developmental stages of the ascus. — 2. Spore. — 3. Apothecium (diagrammatic).

Fig. 4. *Cryptothecia* sp. — Developmental stages of the ascus.

Fig. 5–6. *Myriostigma* sp. — 5. Developmental stages of the ascus. — 6. Ascus with ruptured exoascus.

Fig. 7. Developmental stages of the ascus common in Lecideaceae and Lecanoraceae.

THE NATURE OF THE THICK-WALLED ASCI IN LECIDEACEAE AND OTHER LICHEN TAXA

The problem whether the thick-walled asci in Lecideaceae and other lichen taxa are to be considered bitunicate or merely unitunicate with a thick wall, has not yet been satisfactorily solved. Luttrell (1951) thought that the occurrence of bitunicate asci was correlated with the ascolocular (loculoascolocular) nature of the ascocarps. As a consequence he referred the Lecanorales (including the Lecideaceae) to the Unitunicatae, because the Lecanorales are ascohymenial fungi. Korf (1958) considered the Lecideales to be unitunicate and the Lecanorales bitunicate. He did not indicate on which characters his view was based, simply stating that "All members of the Lecanorales which I have studied have bitunicate asci." It should be pointed out, however, that both groups have thick-walled asci which usually stain blue with iodine.

In fact, one can only be sure of the bitunicate nature of the asci, if both endoascus and exoascus can be shown separately. This, however, is but rarely possible, at least in lichens. In *Cryptothecia* Stirt. em. Groenh. and *Myriostigma* Krempelh. the asci are not enclosed in ascocarps, but are found rather evenly distributed within the thallus, or more or less concentrated in fertile portions of it. In *Myriostigma* (Figs. 5–6) the asci are large, globose, and 8-spored. A scraping made from a fertile portion of the thallus, and mounted in a solution of iodine (or eosine to which KOH is added), needs only a moderate pressure on the cover glass to liberate a number of thick-walled endoasci from the very thin-walled exoasci. This method, however, fails completely in the case of *Cryptothecia*, although both genera are very closely related. In the last named genus (Fig. 4) the more or less ellipsoid, monosporous asci remain intact, giving no evidence of being composed of an endoascus and exoascus. Yet, there is no doubt about the bitunicate nature of the asci, if carefully compared with those in *Myriostigma*.

In both genera, the lumen of the mature asci is filled with an ascoplasma which stains purple if mounted in a iodine solution and sharply contrasts with the ascus wall. In both genera, too, there is a dome-shaped extension of the lumen protruding into the thick top of the ascus wall, while the side walls gradually taper toward the base. There is, apart from the number and shape of the spores, no difference between the asci of both genera other than in size and shape.

A similar diversity of the asci is found in *Stirtonia*, the true members of *Helminthocarpon*, in the Arthoniaceae, and in the species of several other genera. Pressure on the cover glass may cause the endoasci to become liberated, or they remain half enclosed in the exoasci, or again, as in most of the cases, the asci remain intact. The dome-shaped extension of the lumen may be of a different shape from that in cryptothecioid genera, or indistinct, or completely lacking. The asci themselves vary considerably as to shape and size, but the feature they all have in common is the wall which is thick at the top and the sides of the ascus, but tapering toward the base.

However, the way the asci develop is probably of even greater importance. In the young stage, the asci are invariably thick-walled, but the wall is of unequal thickness, being irregularly wavy on the inner side. As a consequence the enclosed ascoplast is very variable and irregular in outline, but has its conical to rounded expansion toward the top of the ascus as a rule well indicated. In the course of development, however, the wall becomes gradually thinner and its inner side smoothed out until the final shape is reached as described above.

The thick-walled asci in Lecideaceae (Fig. 7) and other ascohymenial groups all develop in exactly the same manner, frequently showing the dome-shaped extension of the lumen at the top in the immature asci.

The present author, therefore, is strongly inclined to consider the thick-walled asci mentioned above to be principally bitunicate, even if it is true that in a later stage there is no trace left of the dome-shaped extension of the lumen, and apparently no easy way can be found to demonstrate the endo- and exoascus separately.

On the other hand, in view of the tendency to gelatinization in lichens, the possiblity of the ascus being unitunicate with a gelatinized wall should not be precluded. Gelatinization, in the first instance, is a means which enables the lichen fungus to live under such environmental conditions as would otherwise prevent its existence. Therefore, gelatinization is in the first place of importance for the vegetative activities of the lichen. As far as gelatinization occurs in ascocarps it is considered to be of importance for the dispersal of the spores, at the same time preventing the asci from drying up. The fact, however, that species with thick-walled asci are found to grow under the same conditions as species with thin-walled asci,would point in favour of the assumption that asci do not need thick or gelatinized walls as protection against exsiccation. Moreover, in cryptothecioid lichens the asci are not even enclosed by a differentiated gelatinized tissue; they lie more or less scattered inside the thallus (which is usually thin) and with their apical portion often projecting beyond the surface. Finally, it would be difficult to explain why asci, developing along exactly the same lines, should have a double ascus wall in one case and a single one in another.

According to Luttrell (1951) bitunicate asci are indifferent to iodine. This may hold true for the species studied by him, but it does not necessarily mean that asci, at least those in lichens, are of the non-bitunicate type if they do turn blue in iodine. Nor has it been proved, or is there any reason to assume, that bitunicate asci are all insensitive to iodine. The production in lichens of pigments, lichen acids, and amyloid matter is often restricted to limited areas, but there is as yet no evidence of a correlation between the occurrence of such substances and the anatomical structure of the areas producing them. Why then should one assume such a correlation in the case of unitunicate and bitunicate asci?

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SUR LE PROBLEME LEPIOTA HELVEOLA BRES.

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(Avec 21 figures dans le texte)

Lepiota helveola Bres. est comparé avec les espèces voisines. *Lepiota helveola* sensu Joss. et auct. recent. plur. est attribué à *Lepiota subincarnata* J. E. Lange. Description de *Lepiota ochraceofulva* P. D. Orton et d'une espèce nouvelle, *L. roseo-lanata* Huijsm., suivie de quèlques observations sur le sectionnement du genre *Lepiota* (Pers.) ex S. F. Gray.

1.—INTRODUCTION

Le manque de clarté qui règne au sujet de *Lepiota helveola* Bres. (1882: 15, pl. 16 f. 2) provient d'un enchevêtrement des résultats de plusieurs causes dont je vais énumérer les plus importantes.

1. L'existence d'une divergence entre la diagnose de *L. helveola* et de la figure accompagnante.

2. Le fait que certaines espèces voisines répondent, à peu près, à la diagnose de *L. helveola* et sa conséquence quasi inévitable que le nom *L. helveola* se trouve fréquemment mal appliqué.

3. La rareté de *L. helveola* et sa distribution géographique paraissant plutôt méridionale.

4. Le fait que pour la délimitation précise des espèces dans le genre *Lepiota* (Pers.) ex S. F. Gray sensu lato, la connaissance exacte des caractères microscopiques du revêtement piléique est indispensable; la description de ceux-ci n'a cependant pas été effectuée d'une façon systématique avant Kühner (1936: 177–238).

5. Le phénomène, dont je vais présenter un exemple, que les erreurs ont une forte tendance à se perpétuer et à se ramifier.

René Maire qui a débrouillé tant de questions litigieuses en mycologie a cependant mal interprété *Lepiota helveola*. Maire (1917: 187), notamment, a considéré comme identiques *Lepiota helveola*, *L. helveola* sensu Patouillard [1889: 44, f. 608 =?*L. pseudohelveola* Kühn. ex Hora (1)] et *L. helveola* var. *barlae* (= *L. subincarnata* ou

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(1) Bien que la description latine de Hora de *Lepiota pseudohelveola*, comme d'ailleurs celle de *L. kuehneri*, semble porter plutôt sur les échantillons de Kühner — on comparera les descriptions de Kühner (1936: 221, 228) avec celles de Hora (1960: 449, 448) — les règles de nomenclature obligent, bien malheureusement à mon avis, de considérer comme types les récoltes anglaises indiquées par Hora.

L. kuehneri). En outre, Maire a appliqué à *L. clypeolarioides* sensu Kühn., espèce proche de *L. helveola*, le nom inexact *L. brunneo-incarnata* (cf. Kühner, 1936: 229). En rapprochant intimement (le faux) *L. brunneo-incarnata* de *L. helveola* (pris dans un sens extrêmement large), René Maire, avec sa grande autorité, a mis en défaut Konrad (1927: 147) et Josserand (1931: 70, 71) qui, à leur tour, ont imprimé leur influence sur la conception et les travaux de nombreux auteurs.

On peut définir les *Lepiota* du groupe *helveola* comme des *Lepiota* section *Ovisporae* J. E. Lange, caractérisés à la fois par la couleur du revêtement piléique rose (rose-incarnat, rosé, rosé-brunâtre, etc.) et par le pied démuni d'un anneau membraneux et persistant.

On ne confondra donc pas avec les espèces «helvéoloïdes»:

1. *Lepiota pseudohelveola* Kühn. ex Hora (1960: 449, 448) au pied pourvu d'un anneau très évident et persistant et à la couleur du revêtement piléique essentiellement brune.

2. *Lepiota brunneo-incarnata* Chodat & Martin (1889: 222) à revêtement du chapeau brun ou brun-rougeâtre au lieu de rose (meilleure description: Kühner, 1936: 226; meilleures planches: Barla, 1888: pl. 16bis f. 1–9, ut *L. helveola*; J. E. Lange, 1935: pl. 13 f. F).

3. *Lepiota ochraceofulva* P. D. Orton (1960: 284) à revêtement piléique rouille-ocracé, sans trace de rose, et à région discale du chapeau dépourvue de poils allongés (cf. p. 363).

4. *Lepiota roseo-lanata* Huijsm. (cf. p. 364) et, éventuellement, *L. sinopica* Romagn. (1953: 397, nomen nudum; 1957: 4, 91, description valable) qui n'appartiennent pas à *Ovisporae*.

Anticipant sur les résultats des discussions, j'admets seulement deux espèces «helvéoloïdes» à côté de *L. helveola*, notamment, *L. subincarnata* et *L. kuehneri*. Microscopiquement ces trois espèces se séparent ainsi:

1a. Poils unicellulaires (plus rarement uniseptés) du revêtement piléique dépassant très souvent une longueur de 150 µ et pouvant même atteindre une longueur de 300–350 µ; spores ne dépassant pas en moyenne une longueur de 7 µ et une largeur de 4 µ.
  2a. Revêtement du centre du ohapeau constitué d'une couche hyméniforme entre les éléments de laquelle se dressent des faisceaux de poils; spores ellipsoïdes; cheilocystides nombreuses *L. kuehneri* (v.v.)
  2b. Région discale du chapeau dépourvue d'une couche hyméniforme, seulement avec des poils; spores plutôt légèrement phaséoliformes; cheilocystides jamais nombreuses, souvent difficiles à découvrir *L. subincarnata* (v.v.)
1b. Poils unicellulaires du revêtement piléique atteignant à peine une longueur de 150 µ; spores à largeur moyenne dépassant 4 µ; cheilocystides nombreuses *L. helveola* (v.v.)

2.—LES LEPIOTA DU GROUPE HELVEOLA

LEPIOTA HELVEOLA Bres.—Figs. 1–4

Lepiota helveola Bres., Fungi trid. **1**: 15, ?pl. 16 f. 2. 1882.

Descriptions conformes: Quél., Ench. Fung. 6. 1886; Sacc., Syll. Fung. **5**: 38. 1887; Fl. ital. crypt. **14**: 81. 1915.

Descriptions douteuses ou s'appliquant à d'autres espèces: Quél., Fl. mycol. 297. 1888; Quél. & Bataille, Fl. mon. Amanites et Lépiotes 80. 1902; Pat., Tab. anal. Fung. **7**: 44, f. 608. 1889 (= ?*Lepiota pseudohelveola*); vix R. Maire *in* Bull. Soc. Hist. nat. Afr. N. **7**:187. 1916; ?Bres., Icon. mycol. **1**: pl. 32 f. 2. 1927; Joss. *in* Bull. Soc. mycol. France **47**: 65, pl. 3. 1931 (= *Lepiota subincarnata*); Kühn. & Romagn., Fl. anal. 399. 1953 (= *Lepiota subincarnata*); Moser *in* Gams, Kl. Kryptfl. **2**: 120. 1953 (= *Lepiota pseudohelveola*); ed. 2, **2**: 137. 1955 (= *Lepiota subincarnata*); Locq. *in* Friesia **5**: 293. 1956 (= *Lepiota subincarnata*); Egli *in* Schweiz. Z. Pilzk. **37**: 169. 1959 (= ?*Lepiota subincarnata*).

Description sous nom mal appliqué: *Lepiota pseudohelveola* Kühn., J. Favre, Champ. sup. Zone alp. Parc nat. suisse [*in* Ergebn. wiss. Unters. schweiz. Nationalparks **5** (33):] 157, f. 143, pl. 11 f. 12. 1955.

Matériel examiné: ITALIE: «Sopramonte, locis herbidis, 1904, Bresadola» (indiqué ci-dessous comme néotype; S);
FRANCE: Nans-les-Pins, dép. Var, le 6 et 10 oct. 1960, *H. S. C. Huijsman* (L).

Malgré le fait que le type de *Lepiota helveola* n'a pas été conservé par Bresadola, l'étude du matériel de cette espèce de l'herbier Bresadola (S) s'est révélée extrêmement clarifiante et instructive. Parmi les cinq récoltes, toutes effectuées par l'auteur de l'espèce, celui-ci a attribué trois récoltes à *Lepiota helveola* var. *barlae* et les deux autres à *L. helveola*. L'une des deux dernières, ayant les spores de 5,3–7 × 3,6–4,3 μ, ne saurait être attribuée à *L. helveola* laquelle, selon la diagnose, aurait des spores de 8–10 × 6 μ (2). L'autre par contre (Sopramonte, 1904) est d'une grande importance par le fait que Bresadola a noté sur le sachet contenant le matériel: «sp. 8–10 = 5–5½, raro 6 μ». Aucun des autres sachets ne portant une indication manuscrite de Bresadola sur les mesures sporiques, il semble non hasardeux de supposer que l'auteur, dicté par les dimensions des spores, a considéré comme représentative pour *L. helveola* la récolte de Sopramonte. Il faut mettre en relief ici que les échantillons contenus dans les autres paquets avaient les dimensions sporiques remarquablement plus petites. Les mensurations personnelles du matériel de Sopramonte m'ont donné des valeurs de 7–9,2 × 4,6–5,5 μ, s'écartant peu de celles trouvées par Bresadola, tandis que les spores des quatre autres récoltes oscillaient entre les extrêmes 5–7,8 × 3,3–4,3 μ.

Rien ne contredisant la supposition que la récolte de Sopramonte (1904), réalisée et déterminée par Bresadola et conservée dans «Naturhistoriska Riksmuseum» à Stockholm, appartient à *Lepiota helveola*, j'indique cette récolte-ci comme néotype de *L. helveola*. La désignation d'un néotype est ici d'autant plus désirable parce que la diagnose de *L. helveola* et la planche accompagnante dans «Fungi tridentini» correspondent mal, si bien qu'il serait inopportun de considérer les figures comme lectotype. Notamment, le brun rosé du chapeau et du pied des champignons figurés, couleur pas dûe probablement à une décoloration postérieure au tirage, s'accorde mal avec le «carneo-lateritius» de la description; quant à l'anneau,

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(2) Ayant examiné un nombre assez élevé d'échantillons de l'herbier Bresadola, je puis affirmer que les mesures sporiques de l'abbé italien sont, en général, d'une précision suffisante.

on le devine à peine «fugax» d'après le dessin, etc. Ce qui donne aussi à penser c'est que Bresadola a atténué les divergences dans «Iconographia mycologica» (l.c.), en modifiant légèrement la description et en en retouchant les figures originales sur plusieurs points. Enfin, le fait que les spécimens contenus dans les trois sachets étiquetés *L. helveola* var. *barlae* appartiennent à deux espèces (*L. subincarnata* et *L. kuehneri*) et que sur les deux sachets portant le nom *L. helveola*, l'un renferme l'espèce indiquée et l'autre *L. subincarnata* prouve que Bresadola n'était pas au clair avec *L. helveola* ou, au moins, qu'il interprétait cette espèce d'une façon toute collective. Quoi qu'il en soit, la prudence nous incite à séparer la diagnose et la planche accompagnante.

Les caractères microscopiques du néotype de *Lepiota helveola* sont les suivants:

Spores 7–9,2 × 4,6–5,5 μ, ellipsoïdes à sommet assez obtus, pseudo-amyloïdes dans le liquide de Melzer. Basides tétrasporiques. Cheilocystides nombreuses, 20–40 × 9–13 μ, piriformes, claviformes, subfusiformes, etc., à paroi mince, parfois avec une cloison. Pleurocystides pas observées. Revêtement de la région centrale et paracentrale du chapeau à poils unicellulaires, larges de 9–14 μ et ne dépassant pas une longueur de 140 μ, flasques, ondulés, à paroi mince, avec, ça et là, au niveau de leur base, des éléments plus courts, peu différenciés (f. 3, à droite), ne formant pas une couche continue; poils naissant d'un lacis d'hyphes bouclées d'un diamètre de 3–7 μ.

Je fais remarquer que *Lepiota helveola* ne saurait être identique à *L. helveola* sensu Joss. et auct. recent. plur. qui a les spores subphaséoliformes, nettement plus petites, surtout plus étroites, et les lamelles exemptes de cellules marginales très évidentes.

Une seule description récente se rapporte probablement à *L. helveola*. C'est celle de J. Favre (l.c.) qui, avec beaucoup de doute, avait attribué certaines récoltes effectuées dans le Parc National Suisse à *Lepiota pseudohelveola*. Cette dernière espèce a cependant l'anneau membraneux très évident, persistant et non pas des bourrelets annuliformes au pied, la couleur plus brun du chapeau, et les poils du revêtement piléique plus allongés à paroi plus épaisse. On pourrait bien conclure de la discussion de Favre qu'il aurait opté pour *L. helveola*, si cette espèce n'avait pas été interprétée déjà par Josserand d'une autre façon. Les dessins des caractères microscopiques faits par Favre auraient pu être pris du néotype de *L. helveola*. Seulement les spores du matériel suisse semblent être légèrement plus petites (6–8,5 × 4–5 μ) que celles du champignon de Sopramonte (3).

J'attribue à *Lepiota helveola*, avec une pointe de doute, deux spécimens récoltés personnellement le 6 et le 10 octobre 1960, au même endroit, sur le bord herbeux d'une route à Nans-les-Pins (Var, France). Malheureusement, l'un, au pied fortement comprimé et aplati était peu normal et l'autre était incomplet. Vu la rareté de descriptions de *L. helveola* j'en donne, tant bien que mal, la description.

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(3) Les mesures sporiques que j'ai pu effectuer tout récemment sur le matériel du Parc National Suisse, ne s'écartent qu'à peine de celles données par le regretté J. Favre. La forme des spores est celle de *L. helveola*. Mes remerciements vont à Mme Favre de Genève qui a bien voulu me donner l'occasion de vérifier les caractères des spores.

Chapeau 30–42 mm, convexe ou plan-convexe, subomboné, à revêtement feutré-subtomenteux, dépourvu de squamules dressées, rose-incarnat avec une trace de lilas, entre L. 7c et 7b, vers Expo. B42, à centre uni, plus ou moins diffracté dans la région péridiscale, vers la marge à mèches pelucheuses apprimées, contrastant très peu avec la chair mise à nu. Lamelles peu serrées, libres, blanches puis crème, jaunâtre pâle en herbier. Pied 30–40 × 4(–?8) mm, subcylindrique (anormalement aplati dans l'un des deux exemplaires), légèrement tubuleux à moelle soyeuse tapissant la cavité, très pâle en haut, incarnat-rosâtre (Expo. B44) vers la base, aranéo-fibrilleux (un exemplaire) ou (l'autre) à débris vélaires apprimés rosé sale à ± 10 mm du sommet et, en dessous, des méchules disséminées, concolores aux débris mentionnés. Chair assez épaisse dans le chapeau, rose-incarnat dans le cortex et la région basale du pied; odeur insignifiante. Spores 7,8–10 × 4,3–5,2 μ, pseudoamyloïdes, ellipsoïdes à subamygdaliformes. Basides 23–28 × 8,5–9,2 μ, subclaviformes, à quatre stérigmates, bouclées à leur base. Cheilocystides nombreuses, 20–30 × 9–13 μ, généralement claviformes ou subfusiformes, bouclées à leur partie inférieure. Pas de pleurocystides. Revêtement du châpeau à poils unicellulaires obtus, atteignant une longueur de 150 μ et ayant une largeur de 8–13 μ, flasques et couchés, à paroi mince, avec de rares poils raccourcis non basidiformes au niveau de leur base.

Bien que les spores soient un peu plus allongées et moins obtuses au sommet que celles du néotype de Bresadola et que l'on trouve ici moins d'éléments raccourcis au niveau de la base des poils, d'autres caractères, notamment, les dimensions des spores, la présence de nombreuses cheilocystides, les caractéristiques des poils du revêtement piléique, ainsi que évidemment la couleur du chapeau et le manque d'un anneau persistant plaident en faveur de *L. helveola*.

Toutefois, il me faut avouer que je ne suis pas absolument sûr que *L. helveola*, même conçu dans le sens restreint préconisé ici, ne soit pas aussi collectif. Il faudrait effectuer de nouvelles études sur de plus nombreuses récoltes de l'espèce de Bresadola pour être mieux fixé sur l'amplitude de variation de certains de ses caractères. En déplaçant les difficultés et en m'approchant davantage, à mon avis, de la solution du «problème *Lepiota helveola*» que mes prédécesseurs, je me sens autorisé à publier les résultats de mes recherches imparfaites.

Lepiota helveola se distingue à la fois de *L. subincarnata* et de *L. kuehneri* par la plus grande largeur de ses spores et par la flaccidité et la longueur réduite des poils du revêtement du chapeu.

Par son aspect helvéoloïde on pourrait être tenté de placer dans le groupe de *L. helveola* l'espèce qu'on trouve dans la «Flore analytique» de Kühner & Romagnesi sous le nom *Lepiota microsperma* Locq. (nomen nudum). On trouvera plus loin (p. 364) une description de cette espèce qui n'appartient pas à la section *Ovisporae*.

LEPIOTA SUBINCARNATA J. E. Lange—Figs. 5–6

Lepiota subincarnata J. E. Lange, Fl. agar. dan. **1**: 34, pl. 13 f. I. 1935 (nomen nudum); **5**: V. 1940 (description valable).

Bonnes descriptions: Kühn. *in* Bull. Soc. mycol. France **52**: 223. 1936; Romagn. *in* Rev. Mycol. **2**: 90. 1937; Kühn. & Romagn., Fl. anal. 399. 1953.

Synonyme douteux: *Lepiota helveola* var. *barlae* Bres., Fungi trid. **2**: 4. 1892 = *Lepiota me-*

somorpha (Bull. ex Fr.) Kummer sensu Barla, Champ. Alpes-marit. 31, pl. 16 f. 12–17. 1888, fide Bresadola; Bresadola, Icon. mycol. **1**: pl. 33. 1927.

Noms mal appliqués: *Lepiota helveola*, ?R. Maire *in* Bull. Soc. Hist. nat. Afr. N. **7**: 187. 1916 (pro parte?); Joss. *in* Bull. Soc. mycol. France **47**: 65, pl. 3. 1931; Kühn. & Romagn., Fl. anal. 399. 1953; Locq. *in* Friesia **5**: 293. 1956; ?Egli *in* Schweiz. Z. Pilzk. **37**: 169. 1959.

Lepiota forquignoni, Ricken, Blätterp. 323. 1914; J. E. Lange *in* Dansk bot. Ark. **2** (3): 27, pl. 1 f. d. 1915.

?*Lepiota scobinella*, Moser *in* Gams, Kl. Kryptfl. **2**: 120. 1953; ed. 2, **2**: 137. 1955; ?P. D. Orton *in* Trans. Brit. mycol. Soc. **43** (Suppl.): 100, 224. 1960.

Matériel examiné: PAYS-BAS: plusieurs récoltes, provenant surtout des bois longeant les dunes maritimes de l'île de Walcheren, Zeeland; des environs de Haarlem; etc. (L);

ITALIE: trois récoltes de *Bresadola*, (1) «in nemore Capp . . . Oct. 1891, *L. helveola* var. *barlae*»; (2) «Gocciadoro, juxta viam, 1899, *L. helveola*»; (3) «Gocciadoro, sub Abiete, oct. 1900, *L. helveola* var. *barlae*» (S);

FRANCE: Décines, dép. Isère, automne 1930, *M. Josserand* (fragments, L);

SUISSE: «Schwarzgraben» près d'Anet, canton de Berne, le 14 oct. 1959, etc., *H. S. C. Huijsman* (L).

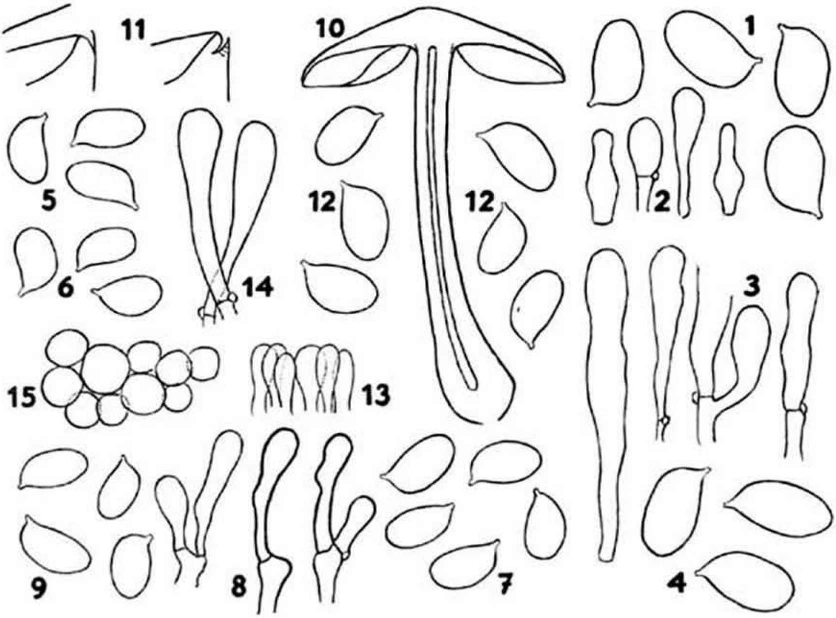
Nous avons déjà vu (p. 358) que *Lepiota helveola* et *L. helveola* sensu Joss. et auct. recent. plur. ne sont pas identiques. Reste à résoudre si *L. helveola* Joss. et auct. ceter. est une espèce autonome, nouvelle, ou un synonyme d'une espèce connue.

Il y a une vigtaine d'années, récoltant régulièrement *Lepiota subincarnata*, j'ai eu souvent l'occasion de me rendre compte de la grande variabilité du port et des dimensions de cette espèce. D'ailleurs, cette même variabilité se retrouve chez d'autres *Ovisporae*, p. e. chez *Lepiota brunneo-incarnata* Chodat & Martin *L. lilacea* Bres., et probablement aussi chez *L. helveola*.

N'ayant jamais négligé de comparer les spécimens frais de *Lepiota subincarnata* aux figures de la planche de *L. helveola* sensu Joss., peinte par Lignier pour Josserand (1931: pl. 3), je ne pus m'empêcher de penser à une identité. Cependant, le manque de données exactes sur la structure du revêtement piléique dans la description de Josserand — datant d'une époque où l'on n'avait pas encore une idée de toute l'importance taxinomique des caractères microscopiques de ce recouvrement pour le genre *Lepiota* — et puis le fait que la couleur des chapeaux figurés était toujours plus ocracée que celle de mes spécimens frais de *L. subincarnata*, m'empêchèrent de fixer mon opinion définitivement. Aussi, je me vis dans l'obligation de remettre la solution de cette question.

Or, en 1956, Locquin, ancien élève de Josserand, après avoir donné une bonne description de *L. subincarnata* sous le nom *L. helveola* sensu Joss., se prononce ainsi: «La planche de Josserand est mal venue au tirage et la teinte rose en est malheureusement absente». Admettant que Josserand et Locquin aient décrit la même espèce, ce qui paraît vraisemblable, on peut en conclure que dans les deux cas il s'est agi de *L. subincarnata*. Mais il y a plus.

Les caractères microscopiques d'un spécimen authentique de *Lepiota helveola* sensu Joss., reçu de M. Josserand, se sont révélés parfaitement identiques à ceux de *L.*



Figs. 1–4. *Lepiota helveola* Bres. — 1. Spores du néotype, 7–9,2 × 4,6–5,5 μ. — 2. Cellules marginales du même exemplaire. — 3. Eléments du revêtement du chapeau de dito. Les poils unicellulaires allongés, couchés chez cette espèce, dont un seul a été figuré à gauche, sont très courts (< 150 μ) comparés à ceux des autres *Ovisporae* et ont la paroi relativement très mince. A droite trois poils raccourcis qui se trouvent en petit nombre au niveau de la base des poils proprement dits et qui ne forment pas une couche continue. — 4. Spores de la récolte de Nans-les-Pins, 7,8–10 × 4,3–5,2 μ.

Figs. 5–6. *Lepiota subincarnata* J. E. Lange. — 5. Spores d'une récolte du «Schwarzgraben», le 14 oct. 1959, 6–7 × 3,3–4 μ. — 6. Spores d'un spécimen authentique de *L. helveola* sensu Joss. de Décines, 5,7–6,7 . . . 7 × 3,3–4 μ.

Figs. 7–9. *Lepiota kuehneri* Huijsm. ex Hora. — 7. Spores d'un spécimen de Kühner du «Paradou», Alger, 6,7–7,5 × 3,6–4,3 μ. — 8. Eléments basidiformes dressés qui forment une couche continue sur le disque du chapeau et au dessus desquels se dressent des faisceaux de poils allongés, raides, qui ne sont pas dans la figure; même exemplaire. — 9. Spores de la récolte de la forêt de la Ste Baume, 6,4–8 × 3,6–4,3 μ.

Figs. 10–15. *Lepiota ochraceofulva* P. D. Orton. — 10. Section médiane d'un carpophore. — 11. Deux esquisses du collarium pendant, légèrement schématisées. — 12. Spores, 6,4–7,8 × 4–5 μ — 13. Cellules marginales. — 14. Eléments basidiformes dressés qui recouvrent, à eux seuls, le centre du chapeau. — 15. Scalp du revêtement du centre du chapeau.

Grossissements. Section médiane (× 1), schémas du collarium (un peu plus élevé), spores (× 1540), autres éléments microscopiques et scalp (× 500).

subincarnata. Les mêmes poils du revêtement piléique, pouvant atteindre une longueur de 300–350 μ, plus rigides, à paroi plus épaisse et se déformant moins facilement par le tapotement du couvre-objet que les poils piléiques de *L. helveola*, mais à paroi moins épaisse, avec moins de pigment de membrane et plus faciles à déformer que ceux de *L. kuehneri*. Absence d'éléments basidiformes dans le revêtement du chapeau. Exactement les mêmes spores subphaséoliformes relativement petites, surtout étroites, que *L. subincarnata*. Enfin, petit caractère, présence de rares éléments stériles, optiquement vides et dépassant un peu le niveau distal des basides, c'est à dire présence de cheilocystides très rudimentaires et dispersées. Voici tout un ensemble de caractères susceptibles de confirmer l'hypothèse d'une identité. Aussi, il m'est impossible de penser à une différence sur le plan spécifique de *L. subincarnata* et de *L. helveola* sensu Joss.

Naturellement *Lepiota subincarnata* est quelque peu variable. Nous avons déjà vu que les dimensions et le port peuvent varier dans de larges limites. Les lamelles se trouvent parfois légèrement atténuées-adnées au pied. Le pourcentage des spores subphaséoliformes est variable selon la récolte. Le nombre des cellules marginales, toujours dispersées, est aussi susceptible de varier, etc.

On peut distinguer avec sûreté *Lepiota subincarnata* de *L. helveola* et de *L. kuehneri* par le revêtement du chapeau à poils allongés, mais dépourvu d'une couche hyméniforme, par les spores légèrement phaséoliformes et par la rareté des cellules marginales.

La meilleure description de *Lepiota subincarnata* est celle de Kühner (l. c.). Il y a lieu de souligner ici que Kühner laisse entrevoir dans la discussion qu'il croit à peine à une différence spécifique de *L. subincarnata* et de *L. helveola* sensu Joss. Aussi, s'étonne-t-on que Kühner & Romagnesi, dans la «Flore analytique» (l. c.), aient placé *L. helveola* sensu Joss., comme espèce distincte, à côté de *L. subincarnata*.

Moser (1953), s'est servi du nom *Lepiota scobinella* pour indiquer un champignon qu'il a mis en synonymie avec *L. helveola* sensu Joss. et avec *L. subincarnata*. Sa description (1955) ne rappelle pas *L. subincarnata*, mais représente plutôt une forme de *L. brunneo-incarnata* à pied peu ornementé, laquelle n'est pas très rare.

Agaricus scobinellus Fr. (1838: 1.1) est une espèce très douteuse, à chapeau dépourvu de rose, dont Fries admit beaucoup plus tard (1874: 26) jamais n'avoir vu du matériel frais. Aussi, Rea (1918: 322, pl. 7) a-t-il repris un *L. scobinella* sans trace de rose («mouse grey» selon la description, ocracé sur la planche). Orton (l. c. p. 224) prétend prendre *L. scobinella* dans le sens de Rea (espèce exempte de rose) et dans le sens de Moser (= *L. helveola* sensu Joss. = *L. subincarnata* sec. Moser), tout en traitant à part *L. subincarnata*. On voit que la confusion au sujet de *L. scobinella* est complète.

Lepiota scobinella étant ininterprétable, il vaudrait mieux supprimer ce nom.

LEPIOTA KUEHNERI Huijsm. ex Hora—Figs. 7–9

Lepiota kuehneri Huijsm. *in* Med. Ned. mycol. Ver. **28**: 27. 1943 (nomen nudum, pas de diagnose latine); *ex* Hora *in* Trans. Brit. mycol. Soc. **43**: 448. 1960.

Description conforme: Kühn. & Romagn., Fl. anal. 400. 1953 (pas de diagnose latine).
Nom mal appliqué: *Lepiota clypeolarioides*, Kühn. *in* Bull. Soc. mycol. France **52**: 228. 1936.

Matériel examiné: AFRIQUE DU NORD: fragments d'un spécimen du «Paradou», Alger, le 16 déc. 1932, leg. *R. Kühner* (L 960.110-374);
ITALIE: Andalo, près de Trente, 1901, leg. *J. Bresadola* (S);
FRANCE: Forêt de la Ste Baume, Var, le 8 oct. 1960, leg. *H. S. C. Huijsman* (L).
(Non examiné le type de Hora, voir note 1, p. 355.)

Au point de vue microscopique les trois récoltes étudiées montrent de petites différences. Mesures sporiques de la récolte du «Paradou»: 5,7–7,5 × 3,6–4,3 μ (mensurations personnelles), 5,5–7 × 3,2–4 μ (Kühner, l. c.); Andalo: 6–8 × 4–4,6 μ; Ste Baume: 6,4–8,1 × 3,6–4,3 μ. Les cheilocystides du matériel provenant de Andalo sont en moyenne un peu plus étroites que celles du matériel de la Ste Baume. (Les cellules marginales du matériel de Kühner étaient difficiles à découvrir sur les lamelles en mauvais état des fragments étudiés.)

La cuticule hyméniforme continue, bien que non cohérente, au centre du chapeau est à elle-seule suffisante à distinguer *L. kuehneri* de *L. helveola* et de *L. subincarnata*. Les poils, ainsi qu'une partie des cellules basidiformes de la couche hyméniforme, ont un pigment membranaire très marqué et la paroi plus épaisse que les poils du chapeau des deux autres espèces. Aussi, la déformation des poils par le tapotement du couvre-objet se fait moins facilement chez *L. kuehneri* que chez *L. helveola* et *L. subincarnata*.

Macroscopiquement, *Lepiota kuehneri* s'écarte des deux autres espèces par la couleur du chapeau, plutôt brunâtre rosé que rose incarnat.

Une autre espèce, *Lepiota ochraceofulva* P. D. Orton, ressemblant quelque peu à *L. kuehneri*, a également le centre du chapeau recouvert d'une cuticule hyméniforme. Elle s'en distingue cependant sans difficulté par l'absence de poils saillants s'élevant au dessus des cellules basidiformes et par la couleur du revêtement piléique rouille-ocracé. Une description de l'espèce de Orton, prise sur du matériel suisse, va suivre.

3.—APPENDICE: ESPECES «NON-HELVEOLOIDES»

LEPIOTA OCHRACEOFULVA P. D. Orton—Figs. 10–15

Lepiota ochraceofulva P. D. Orton *in* Trans. Brit. mycol. Soc. **43**: 284, 313, 428–430, f. 112–114. 1960.

Spécimens décrits: SUISSE: «Schwarzgraben» près d'Anet, canton de Berne, le 29 okt. 1958, leg. *H. S. C. Huijsman* (L).

Trouvée pour la première fois en octobre 1958, en compagnie de M. et Mme F. Marti au «Schwarzgraben», bois mixte sur de la terre noire (tourbe des bas marias), cette espèce était très abondante, dans ce même bois, pendant tout l'arrière-automne de 1959, à partir de la mi-octobre. En 1960 elle s'y trouvait seulement en quelques exemplaires rabougris, tandis qu'en 1961 elle n'y apparut pas du tout.

Lors de mes premières récoltes de *Lepiota ochraceofulva*, encore inédit à ce moment-là, je n'osai pas exclure la possibilité d'être en présence de *L. kuehneri*, lequel m'était encore inconnu à l'époque. Cependant, grâce à l'étude du matériel de Kühner de *Lepiota clypeolarioides* sensu Kühn. (= *L. kuehneri*) j'ai pu me rendre compte plus tard de la structure différente du revêtement piléique de ces deux espèces (cf. le dernier alinéa avant l'Appendice, p. 00). Enfin, par une heureuse récolte de *L. kuehneri*, le 8 octobre 1960, dans la forêt de la Ste Baume, j'ai pu me convaincre de la différence marquée de la couleur du chapeau, brunâtre rosé chez *L. kuehneri* et ocracé-rouillé chez l'autre.

Il est apparent que Orton (l. c.) en écrivant: «This is perhaps another candidate for *L. helveola* Bres.» a aussi été tenté de rapprocher *Lepiota ochraceofulva* du groupe de *L. helveola*.

Chapeau 35–60 mm, hémisphérique-campanulé, puis conico-convexe, à la fin étalé, à mamelon peu marqué ou absent, à marge appendiculée ou fimbriée-craillée dans le jeune âge; revêtement «brun de garance clair» (près de Ség. 182) ou rouille-ocracé (Ség. 193, 192, 191), restant uni dans la région discale et formant une calotte absolument glabre, rompu ailleurs dans une multitude de petites écailles méchuleuses apprimées ou subapprimées se détachant du fond crème sale et se raréfiant vers la marge. Lames serrées, 50–70 lamelles, lamellules de 2–3 longueurs, subventrues, crème à crème-alutacé pâle, touchant à un collarium pendant restant appliqué au pied ou sécédent, à arête très finement fimbriée-denticulée. Pied 50–70 × 4–8 mm, tubuleux, courbé-ascendant, renflé à la base qui peut atteindre un diamètre de 8–16 mm, entouré dans la jeunesse, sauf au sommet, de bourrelets fibrillo-laineux peu cohérents, se désagrégeant en des macules ou des bandelettes brunâtres dispersées sur un fond crème sale, plutôt crème brunâtre sale vers la base. Chair fragile, moyennement charnue dans le chapeau, blanchâtre, jaunâtre sale à la base du pied; odeur faible, de poisson ou de *Lepiota cristata*, saveur insignifiante. Spores 6,4–7,8 × 4–5 μ, ellipsoïdes, pseudo-amyloïdes. Basides à 4 stérigmates, 25–29 × 7,2–8 μ, subclaviformes. Cellules marginales peu différenciées, 5–8 μ de large, formant une bande stérile. Trame des lamelles subrégulière. Epicutis hyméniforme à éléments naissant d'un lacis d'hyphes richement bouclées d'un diamètre de 3,5–9 μ; éléments basidiformes du disque allongées, 35–60 × 9–15 μ, non cohérents, formant un pavé régulier, à pigment de membrane et à rugosités épimembranaires très fines, bouclés à leur base; squamules latérales à éléments plus irrégulièrement disposés, moins allongés et surmontés de rares poils couchés, relativement étroits (5–10 μ) et à paroi mince.

Les mesures maximum du chapeau et du pied peuvent dépasser largement celles des exemplaires de la récolte décrite.

Lepiota roseo-lanata Huijsm., *nov. spec.*—Figs. 16–21

Lepiota microspora Huijsm. *in* Med. Ned. mycol. Ver. **28**: 31, 38. 1943 («Konrad», nomen nudum); non *Lepiota microspora* Massee *in* Kew Bull. **1912**: 254. 1912; nec *Lepiota microspora* (J. B. Ellis) Sing. *in* Lloydia **5**: 132. 1942. — *Lepiota microsperma* Locq. *in* Bull. Soc. mycol. France **68**: 272. 1952 (changement de nom, nomen nudum); Kühn. & Romagn., Fl. anal. 399. 1953 (nomen nudum).

Pileo usque ad 25 mm diam., campanulato vel obtuse conico, dein explanato, vix umbonato, velo universali valde crasso, tomentoso-lanato, testaceo vel sordide roseo, marginem appendiculatum versus in verrucis floccosis indistincte disrupto, obducto. Lamellis subconfertis, angustis, albis vel cremeis, interdum stipite longe remotis, ad discum annuliformem conjunctis. Stipite gracili, longitudine usque ad 40 mm, latitudine usque ad 3 mm, tubuloso, pallide roseo, deorsum leviter obscuriore, vellere floccoso usque ad zonam annulatam superam cincto. Carne crassa in centro pilei, marginem versus tenuissima, alba vel subrosea; odore *Lepiotam cristatam* revocanti, sapore debili. Sporis 4–5.7 × 2.3–3 μ, ellipsoideis vel subcylindricis, ad basin obtusis, apiculo sublaterali, leviter pseudo-amyloideis. Basidiis 15–20 × 5–6 μ, tetrasporis. Cystidiis nullis(?). Cute (= velo universali pilei) ex hyphis tenuibus cylindricis fragilissimis intertextis cellulisque vesiculosis dispersis composita. Hyphis efibulatis.
Ad folia decidua. Typus in Herb. Lugd. Bat. (L 955. 81–475).

Chapeau atteignant un diamètre de 25 mm, obtusément conique ou campanulé, puis étalé, à mamelon large et peu marqué, à revêtement très sec, très épais, tomenteux-laineux, incarnat-rosé, rose brique ou rose sale lavé de lilas, vaguement rompu en verrues floconneuses vers la marge appendiculée et longtemps incurvé où peut apparaître, ça et là, un fond ocracé. Lames assez serrées, lamelles ± 45, lamellules de 2 longueurs, blanches à crème, attachées à un disque en collarium assez large qui peut se séparer du stipe par un sillon circulaire. Pied grêle atteignant une longueur de 40 mm et une épaisseur de 3 mm, continu avec le chapeau, cylindrique, égal, subflexueux, bientôt tubuleux, à fond rose pâle, sauf à la base et au sommet revêtu d'une toison de la même couleur que le revêtement piléique, déchirée de bonne heure en flocons et limitée en haut par une zone ± annuliforme. Chair blanche à rosée, épaisse dans le centre du chapeau, extrêmement mince dans la région marginale; odeur faible, rappelant *Lepiota cristata*; saveur faiblement amarescente(?). Spores 4–5,7 × 2,3–3 μ, faiblement pseudo-amyloïdes, ellipsoïdes ou subcylindriques, parfois légèrement cambrées, à base plus ou moins tronquée et à apicule sublatéral. Basides 15–20 × 5–6 μ, tétrasporiques. Trame des lamelles peu régulière. Cheilocystides nulles (d'après la description de 1943; maintenant les lamelles, en mauvais état, n'en permettent plus la vérification). Revêtement piléique constitué d'hyphes très emmêlées d'une largeur de 3–9 μ, très fragiles, souvent resserrées aux cloisons, à paroi mince, à pigment de membrane ocracé; parmi les hyphes se trouvent éparpillées des cellules vésiculeuses en petit nombre, d'une largeur d'environ 20 μ et de double ou triple longueur. Boucles absentes.
Materiel examiné: PAYS-BAS: près de Roermond, province de Limbourg, le 15 nov. 1938, leg. *C. Ph. Verschueren*, un petit groupe sur des feuilles mortes (hêtre?) (type; L 955.81-475).

Konrad (1928: pl. 13) a figuré (au moins) deux espèces ininterprétables sous le nom *Lepiota brunneo-incarnata*. L'une d'elles, à laquelle appartiennent les figures des spécimens à pied allongé et aux spores petites ressemblent il ne peut plus à *Lepiota roseo-lanata*. Aussi, croyant à une identité, Huijsman (1943) a indiqué l'actuel *L. roseo-lanata* sous le nom *L. microspora* «Konrad», dont il avait emprunté l'épithète spécifique à la désignation «*L. brunneo-incarnata* forme microspore» de Konrad (1927: 147). L'étude du dessin original et des notes manuscrites accompagnantes de Konrad, conservés à l'Institut de botanique de Neuchâtel, a mené cependant à une toute autre conclusion. L'original montre un champignon à revêtement piléique vraiment brun, couleur largement différente du rosé des figures correspondantes de «Icones selectae Fungorum»; elle est même qualifiée de «bistre-noir, lie de vin, purpurin chocolat» dans les notes manuscrites. Cette gamme de couleurs associée aux petites spores permettent de supposer que Konrad ait eu en mains *Lepiota fuscovinacea* Møller & J. E. Lange, supposition corroborée par ce que, plus tard, Konrad (1948: 83) a mis en synonymie, à tort, *Lepiota microspora* à *L. fuscovinacea*.

Il est donc établi dans la mesure du possible, quelque improbable que cela puisse paraître à première vue, que les champignons à pied allongé de la planche 13 de «Icones selectae Fungorum» de Konrad & Maublanc représentent *Lepiota fuscovinacea* d'une façon absolument méconnaissable. Voici un exemple de plus (4) susceptible de souligner combien il est malaisé de juger des champignons d'après les icônes et combien il est nécessaire de conserver les champignons figurés, mesures trop souvent négligées, même par des auteurs comme Konrad et J. E. Lange.

C'est par une interprétation erronée de la structure du revêtement piléique, dûe en partie à une insuffisance de la méthode de recherche, que Huijsman (1943) a attribué son *Lepiota microspora* à la section *Ovisporae*. Pour dissocier les éléments de ce revêtement il a pratiqué la méthode du tapotement en brisant de la sorte en mille morceaux ce tissu extrêmement fragile et en en rendant l'image microscopique indéchiffrable. Pour bien pouvoir examiner ce recouvrement il faut prélever sur lui de petits flocons qu'on doit dilacérer à l'aide de deux épingles dans une solution faible (± 7 %) de potasse caustique. Après avoir pris les précautions nécessaires, l'examen microscopique dévoile la présence d'un fouillis d'hyphes étroites, articulées et resserrées aux cloisons au milieu desquelles se trouvent éparpillées, en nombre peu élevé, des cellules vésiculeuses allongées beaucoup plus larges ayant le caractère de sphérocystes. *Lepiota roseo-lanata* appartient donc à la section *Echinatae* Fayod, ce qui se confirme encore par la grande épaisseur du voile général recouvrant le chapeau et par les petites spores subtronquées à apicule sublatéral. La prépondérance des hyphes étroites explique facilement le fait que le revêtement du chapeau est ici moins apte à former des verrues que dans la plupart des représentants typiques de cette section. Il est à peine nécessaire de relever que dans la section *Ovisporae* la structure de la couche superficielle du voile universel, constitué de poils allongés unicellulaires et d'éléments basidiformes en des proportions variables selon l'espèce, est fondamentalement différente.

Lepiota roseo-lanata est voisin de *L. sinopica* Romagn. Cette dernière espèce a cependant la couleur du chapeau plus orangée, les spores nettement plus courtes, la structure du voile général différente, les hyphes bouclées, etc.

Il y a lieu de mettre en relief ici que *Lepiota roseo-lanata* n'est pas non plus très éloigné de *L. fuscovinacea*, espèce à transférer également à la même section. La nécessité de ce transfert s'impose, entre autres, par l'étude anatomique du voile général de *L. fuscovinacea* comparée à celle de *L. echinacea* sensu Kühner (1936: 211) — ou au moins à l'espèce que je considère comme telle — laquelle appartient incontestablement à *Echinatae* Fayod.

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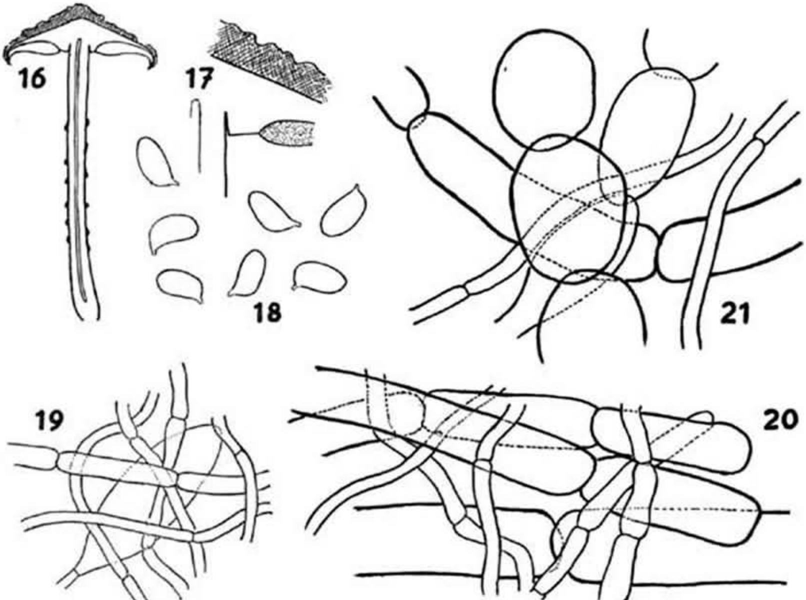
(4) Pour deux exemples analogues on verra *Amanita beckeri* Huijsm. (1962: 349) et *Hohenbuehelia repanda* Huijsm. (1961: 103).

Chez la plupart des *Echinatae* (5) les verrues du chapeau, débris du voile général, se composent de chaînes de sphérocystes volumineuses à paroi épaisse, parmi lesquelles s'insinuent un nombre plus ou moins élevé d'hyphes «connectives», étroites, cylindriques. En outre, on aperçoit chez *Lepiota echinacea* un certain nombre de sphérocystes qui, en s'allongeant fortement et en s'étrécissant un peu, passent à des éléments vésiculeux, voire à des articles cylindriques. On assiste ici, pour ainsi dire, à la transformation progressive des chaînes de sphérocystes en de gros poils homologues à ceux qui composent en exclusivité le gros du voile général de *Lepiota fuscovinacea*;



Figs. 16–19. *Lepiota roseo-lanata* Huijsm. — 16. Section médiane d'un carpophore; l'épaisseur du voile général est remarquable ici. — 17. Mode d'insertion des lamelles. — 18. Spores, 4–5,7 × 2,3–3 μ. — 19. Scalp du revêtement du chapeau.

Fig. 20. *Lepiota fuscovinacea* Møller & J. E. Lange. — Scalp du revêtement du chapeau.

Fig. 21. *Lepiota echinacea* J. E. Lange. — Scalp du revêtement du chapeau.

Grossissements. Section médiane (× 1), schéma de l'insertion des lamelles (un peu plus élevé), spores (× 1540), scalps (× 500).

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(5) On ne saurait trop généraliser ici. Les *Echinatae* sont encore extrêmement mal connus, surtout les petites espèces qui sont généralement très rares.

parmi eux s'insinuent les hyphes «connectives» (f. 20) juste comme parmi les éléments volumineux de *Lepiota echinacea* (f. 21). C'est par la disparition totale des éléments sphériques que *Lepiota fuscovinacea* dissimule ses vraies affinités.

L'étude anatomique du revêtement piléique (= la partie du voile général qui recouvre le chapeau) de *Lepiota roseo-lanata* et de *L. fuscovinacea* fait reléguer ces deux espèces dans *Echinatae*. La grande épaisseur de leur voile et les caractéristiques de leurs spores viennent encore souligner la validité de ces rapprochements. Par contre, avec les représentants des autres sections *Lepiota roseo-lanata* et *L. fuscovinacea* n'ont aucune affinité directe. Aussi, peut-on les considérer comme le résultat d'une évolution particulière qui s'est éloignée du sein de la section *Echinatae* dans une direction spéciale pour chacune de ces deux espèces (*L. fuscovinacea*: «cylindrisation» des sphérocystes, prépondérantes; *L. roseo-lanata*: hypertrophie des hyphes «connectives» et réduction des sphérocystes). Cette supposition est corroborée par le fait (cf. Kühner, 1945: 164) que les deux espèces traitées ici, contrairement au gros des *Echinatae*, sont dépourvues de boucles. Il est encore plus remarquable qu'une évolution parallèle à celle de *L. fuscovinacea* s'est produite dans la section *Micaceae* où *Lepiota pulverulenta* (6) se caractérise également par la transformation des sphérocystes du voile général en de grosses cellules cylindriques et par la perte des boucles.

J'insiste ici sur la proche affinité des sections *Echinatae* et *Micaceae*, laquelle s'exprime dans certains traits communs de leur évolution ontogénétique (cf. Atkinson, 1916: 209–228; Greis, 1937: 449–482), dans leurs spores ayant, en principe, la base subtronquée et l'apicule sublatéral, puis dans l'anatomie de leur voile général. Dans les deux sections le voile général est composé de deux sortes d'éléments: de sphérocystes et d'hyphes «connectives» étroites. Dans *Micaceae* tous les éléments de ce voile ont la paroi très mince et un pigment de membrane nul ou à peu près; les sphérocystes — formées en chaînes qui se désagrègent très facilement — abondent; parmi elles s'insinuent en petit nombre les hyphes «connectives» étroites (cf. Huijsman, 1961: 6, f. 5). Aussi, la cohérence du tissu y est minime et le revêtement piléique, «la farine», se détache au moindre attouchement, voire d'un souffle. Dans *Echinatae* ces mêmes éléments ont la paroi épaissie et sont colorés d'un pigment de membrane, généralement brun; puis les hyphes y sont en moyenne moins étroites et plus nombreuses que dans *Micaceae* si bien que la cohérence du tissu y est plus grande. Cette cohérence est maximum chez *Lepiota roseo-lanata* où les sphérocystes manquent à peu près et ont cédé leur place aux hyphes y «connectives» emmêlées et chez *L. fuscovinacea* où les chaînes de sphérocystes — se désagrégeant chez les autres espèces de *Echinatae* avec plus ou moins de facilité — se sont transformées en poils raides et allongés.

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(6) Herink (1961: 217) préfère considérer *Lepiota sistrata* (Fr.) Gill. et *L. pulverulenta* Huijsm. (1960: 328) comme des synonymes. Il m'est impossible de partager cette opinion et de voir *L. pulverulenta* dans le *Agaricus sistratus* Fr.: «pileus . . . subtilissime pruinatus» (1821: 24). Mieux vaudrait considérer *A. sistratus* comme nomen confusum et éviter son emploi par la suite.

Ainsi, la formation de verrues, facilitée par la présence d'un nombre élevé de sphérocystes peu cohérentes chez les autres *Echinatae*, est contrecarrée chez ces deux espèces.

Les sections affines *Echinatae* (incl. *Lepiota fuscovinacea* et *L. roseo-lanata*) et *Micaceae* (dans laquelle on pourrait verser la section *Integrellae* de Kühner à voile général réduit), s'opposent nettement à l'ensemble des sections: *Lepiota* [espèce-type *L. colubrina* (Pers.) S. F. Gray = *L. clypeolaria* (Bull., Herb. Fr. pl. 405. 1788 ex Fr., 1821) Kumm.], *Ovisporae* (J. E. Lange) Kühn. (incl. *Lepiota lilacea* Bres.) et *Stenosporeae* (J. E. Lange) Kühn. [incl. *Lepiota cristata* (Bolt. ex Fr.) Kumm.].

A mon avis le genre *Lepiota* se confine aux sections mentionnées et il faut en exclure (cf., par contre, Singer, 1951: 438) les sections *Sericellae* Kühn. et *Pilosellae* Kühn., dont toutes les espèces ont une endospore métachromatique dans le bleu de crésyl (ce que j'ai vérifié) ainsi que la section *Amyloideae* Sing. à spores amyloïdes. J'espère revenir en détail sur la classification des Agaricaceae senu restricto.

Tous mes remerciements vont au Dr. S. Ahlner de Stockholm qui a mis à ma disposition le matériel de Bresadola de *Lepiota helveola*; aux Professeurs de l'Université de Neuchâtel, C. Favarger et Chs. Terrier, le premier, directeur, le second, membre de l'Institut de Botanique, pour leur amabilité et leur concours; au Professeur R. Kühner de l'Université de Lyon et à M. M. Josserand de cette même ville pour envoi de matériel, respectivement de *Lepiota clypeolarioides* sensu Kühn. et de *L. helveola* sensu Joss.; à M. L. Imler de Schooten (près d'Anvers) pour la vérification de la pseudo-amyloïdicité des spores de *Lepiota roseo-lanata*; à M. et Mme F. Marti de Neuchâtel pour m'avoir indiqué leurs meilleurs «terrains de chasse» et à M. L. Coulot de St. Aubin (Ne.) qui a bien voulu s'occuper de la correction de ce texte au point de vue linguistique.

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THE IDENTITY OF HYDNUM VERSIPELLE FR.

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Ample collections preserved at Uppsala under the name *Hydnum versipelle* and two exsiccata of *Sarcodon laevigatus* were examined and compared with the original descriptions. The material of *Hydnum versipelle* is shown to be heterogeneous, comprising three collections belonging to *Sarcodon amarescens*, and ten collections of a species which has the main characters of *Sarcodon laevigatus*. The few differences observed are attributed to differences of a chemical nature, and *Hydnum versipelle* is formally reduced to the synonymy of *Sarcodon laevigatus*.

Hydnum versipelle was described by Fries in 1861 (p. 31) and 1863 (p. 274), and again, accompanying a plate, in 1867 (p. 4, pl. 1). Much later, a second illustration was published by Bresadola (1932: pl. 1040).

Although Lundell (1959: 18) stated to be acquainted with the species since 1923, it was only after the find in 1954 of material that matched Fries's plate that specimens could be distributed as No. 2643 of the Fungi exsiccati suecici.

From the copy of this exsiccatum at Uppsala, it is obvious that there is a very wide range indeed as to the variability of the surface and colour of the pileus. In young specimens the pileus is plushy-tomentose and of a delicate lilaceous grey. The surface in older specimens has turned into a glabrous pellicle, or shows traces of appressed membranaceous squamules, or again is distinctly scaly, with the tips of the scales free from the surface. The colour (always of the dried material) ranges from ochraceous yellow-brown to a rich dark brown suffused with a purplish tint. The context is of a pale greyish yellow down to the very base of the stipe, but in places suffused with a distinct lilaceous violet tint. The hyphae possess clamp-connections.

How do the specimens described above compare with the material previously identified by Dr. S. Lundell as *Hydnum versipelle?* This material, preserved at Uppsala, comprises two clearly distinct groups: (1) with, (2) without clamp-connections.

Group 1 contains the following collections (ecological data omitted).
1. Västergötland: Lerum, 1 VIII 1943, *T. Nathorst-Windahl* (*Hydnum uplandicum* L[unde]ll. ad int. / *H. versipelle* Fr. sensu Litsch.); **2.** Upland: Alsike sn, Lunsen, SO. om Flottsand, 26 VIII 1945, *B. Norkrans* (*Hydnum uplandicum* Lll. det. Lundell: 1945 / [in pencil] *versipelle.* Lll: [19]53); **3.** Upland: Danmark sn, Lunsen, ca 1 km SW. om Bergsbrunna jvstn, 19 VIII 1945, *G. Fåhraeus* (*Hydnum uplandicum* Lll. ad int. / [in pencil] *versipelle.* Lll: [19]53); **4.** Upland: Danmark sn, "Lunsen", ca 2 km SE. om Bergsbrunna jvstation, 25 VIII 1954, *H. Nilsson & J. Eriksson* (*Hydnum versipelle* Fr. / monstruös form / det. Lundell: [19]54); **5.** Upland: Lena sn, Årby skog, Storvreta, 8 VIII 1923, *Seth Lundell* (*Hydnum fulvum* ad int. det. Romell / *versipelle.* Lll: [19]53); **6.** Upland: Lena sn, Årby skog, Storvreta, 4 VIII 1924,

Seth Lundell (*Hydnum fulvum* ad int. det. Romell / *versipelle*. Lll: [19]53); **7.** Upland: Lena sn, Årby skog, Storvreta, 28 VIII 1927, *Seth Lundell* (*Hydnum uplandicum* Lll. ad int. / *versipelle*. Lll: [19]53); **8.** Upland: Lena sn, Årby skog, Storvreta, 30 VII 1930, *Seth Lundell* (*Hydnum uplandicum* Lll. ad int. / *versipelle*. Lll: [19]53); **9.** Upland: Lena sn, Årby skog, Storvreta, 28 VII 1936, *Seth Lundell* (*Hydnum uplandicum* Lll. ad int. / *versipelle*. Lll: [19]53); **10.** Upland: Lena sn, Årby skog, 10 VIII 1942, *Seth Lundell* (*Hydnum uplandicum* Lll. ad int. / *versipelle*. Lll: [19]53).

Group 2 contains three collections (ecological data omitted).

11. Upland: Börje sn, Klista skog, 6 IX 1945, *Seth Lundell* (*Hydnum versipelle* Fr.); **12.** Upland: Börje sn, Klista skog, 11 VIII 1953, *John Eriksson* (*Hydnum versipelle* Fr. det. Lundell: 1953); **13.** Upland: Lena sn, Årby skog, nära Storvreta, 15 VIII 1923, *L. Romell* (*Hydnum scabrosum* nisi *versipelle* / *Hydnum versipelle* Fr. sensu Bres. det. Lundell 1949).

In Group 1 the surface of the pileus is seen to vary from finely tomentose (at the margin), or glabrous (for the greater part and in most of the specimens) to distinctly scaly in the centre, with the scales membranaceous to fibrillose, adnate or, more rarely, somewhat free at the tips. The colour ranges from delicately lilaceous-grey (at the margin) to yellowish grey-brown, with or without a purplish hue, or even dark brown (even darker than the darkest portion in Fries, 1860: pl. 81). The context, as far as visible (e.g. in Nos. 1, 4, and 8), is of the same greyish yellow as in Fungi exs. suec. No. 2643. The stipe is generally paler than the pileus, being dingy pale brownish or pale purplish brown, sometimes lilaceous grey at the apex, and always white-tomentose at the base. All specimens possess clamp-connections.

It is beyond any doubt that all collections of Group 1 are conspecific with Fungi exs. suec. No. 2643. However, the question which now arises is whether Group 1 agrees with Fries's descriptions and illustration or not.

The colour of the pileus in the dried material, although covering a wide range, is certainly not so rufous as it was described and depicted by Fries, but that colour may have gone lost in drying, and Lundell's colour-description (l.c. p. 18) of the fresh material comes close enough to Fries's illustration.

A notable difference would appear to exist between the colour of the flesh as seen by Fries ("Caro concolor, at pallidior," hence ostensibly rufous) and as described by Lundell ("Flesh . . . white, . . . slowly changing into a faint greyish green.").

From this it might be concluded that either Lundell's material represents a different species from *Hydnum versipelle*, or the discolouring of the flesh is a variable character.

Considering that Fries (1867: 4) stated that his species had been collected on several occasions ("In pinetis Uplandiae pluries lectum."), it would seem strange indeed if the specimens recently found in the same region, and agreeing in the major characters, should prove to be a different species.

It seems, therefore, plausible to assume that the discolouring of the flesh, caused by oxidation, is a variable character, the appearance of which may well depend on age and/or climatic conditions. In this connection it is important to remember that the context in Fungi exs. suec. No. 2643 in places still demonstrates a lilaceous violet hue which was obviously not there in the freshly cut specimen.

The arguments developed in the preceding paragraphs suggest that Lundell's material of Group 1 is identical with Fries's *Hydnum versipelle*. This being the case, it now becomes necessary to indicate the differences between *Hydnum versipelle* and those species of *Sarcodon* which in Europe are its closest relatives. As *Hydnum versipelle* has been shown to possess clamp-connections, there are only two close relatives, *Sarcodon imbricatus* and *S. laevigatus*. Of these, the former may be dismissed on account of its very coarse scales, which leaves only *S. laevigatus* to be considered.

Lundell (1954: 2), it is true, described the colour of the pileus of *Sarcodon laevigatus* as "greyish brown with a distinct tinge of 'Vinaceous-Purple' (Ridgway), sometimes tending towards 'Dull Dusky Purple'," which colours are altogether different from those he mentioned in *Hydnum versipelle*. However, it should be pointed out that Lundell in attributing these colours to *Sarcodon laevigatus* severely curtailed the colour-range of the species, and in any case deviated from the original description given by Swartz. According to the latter author (1810: 243), the pileus is "pallide castaneus l. ferrugineus." It is interesting to see these colours change over the years. Fries (1815: 140) at first omitted "ferrugineus" and intensified "castaneus" by leaving out the word "pallide." Variety *coriaceum* with its grey pileus is here left out of consideration, as its identity is unknown (Maas Geesteranus, 1960: 353). Then (1821: 399) he changed the colour to "rufo-cinereo" and again (1838: 506) to "fusco-cinereo." Finally (1863: 275, 1866: 47, pl. 81; 1874: 599), he described the pileus as dark brown ("mörkbrun," "umbrino").

None of these colours, it is believed, should be regarded as lacking true observation. Rather do they represent the colour-range of the species under various conditions, and Lundell's additional colours are only an extension of that range.

The colour of the pileus in the dried material of the copies of *Sarcodon laevigatus* at Uppsala (Fungi exs. suec. Nos. 2203, 2204) is decidedly more purplish than in most specimens of *Hydnum versipelle* mentioned above, but anyone trying to use the colour of the pileus of No. 3 of Group 1 as the differential character to separate both species, would find himself in a difficult position.

The structure of the surface of the pileus in *Sarcodon laevigatus* as a distinguishing character is no more decisive than its colour, but some remarks need be made with regard to the colour of the context.

Both Swartz and Fries agreed in describing the context as whitish, and Lundell was even more precise in stating the flesh to be white and unchanging when cut. It is worth noticing that in both exsiccata of *Sarcodon laevigatus* certain portions of the context are of the same greyish yellow as in *Hydnum versipelle* (Fungi exs. suec. No. 2643). Other parts, however, are suffused with a distinct lilaceous hue (No. 2203, in the pileus; No. 2204, in the stipe) or of nearly as dark a purplish brown as the surface of the pileus itself (No. 2203, in the apex of the stipe). It follows that in Sweden *Sarcodon laevigatus*, too, is not altogether devoid of that chemical substance which, on exposure to the air, causes the flesh to discolour.

Summarizing, it appears that there is not a single character which plainly separates *Hydnum versipelle* from *Sarcodon laevigatus*. *Hydnum versipelle*, therefore, is here formally reduced to the synonymy of *Sarcodon laevigatus* (Sw. ex Fr.) P. Karst., and removed from the synonymy of *Sarcodon bubalinus* (Maas Geesteranus, 1956: 48).

The addition of *Hydnum versipelle* to *Sarcodon laevigatus* extends the range of variation of that species, although not much. The fruit-bodies which as a rule appear singly may also be found in clusters. The pileus which is plushy in youth becomes glabrous with age, and the smooth pellicle may crack into scales. The scales are membranaceous to fibrillose, appressed or free at the tips. The colour of the pileus, outlined already by Bourdot & Galzin (1924: 111), ranges from a delicate lilaceous grey through yellow-brown and purplish brown to dark umber, with the scales darker and sometimes violet-brown. The stipe is paler than the pileus, with its base always white-tomentose. The context is white down to the base of the stipe and remains unchanged for a long time (Fungi exs. suec. Nos. 2203, 2204; Barla, Champ. Prov. Nice pl. 38 fig. 6. 1859), or passes into a greyish green (Fungi exs. suec. No. 2643; and France, exposition Belfort, L 956.110–779), or again becomes flushed with purplish red (Bourdot & Galzin, 1924: 111; Bresadola, 1932: pl. 1042). The odour has been described as "reminding one of aniseed with a touch of cucumber" and pleasant on drying (Lundell, 1959: 18) "faible, douceâtre, nauséeuse" (Bourdot & Galzin, 1924: 111), strong and nauseating (Bresadola, 1932: pl. 1042), and somewhat like lysol (France, exposition Belfort, L 956.110–779). The taste ranges from "mild, or in old specimens slightly astringent" (Lundell), "amère après un instant de mastication" (Bourdot & Galzin), bitterish (Bresadola), and "disagreeable, farinose-bitterish (the French collection). Barla who gave an unmistakable illustration of the species indicated the taste as good (l.c. p. 79), but the odour of the withering fruit-body as of *Helychrysum stoechas*, which, as this odour resembles fenugreek, strikes as rather doubtful, and may point to a confusion with some species of *Bankera*.

The examples given above illustrate that the variability of the species is most pronounced in such characters as the colour, discolouring, smell and taste of its flesh. This suggests that the differences are rather due to differences of a chemical nature, on which age and/or edaphic and climatic conditions may have their influence.

A few words need finally be said of Group 2, of which the specimens lack clamp-connections and, therefore, belong to a different species. Of the collections enumerated, No. 12 is the most illustrative as it consists of several young and old specimens, some of which have been cut in half. The part that at once attracts attention is the base of the stipe which is white-tomentose in the younger specimens but ash grey with a distinct greenish hue in the older ones. This character, combined with the glabrous to areolate-scaly surface of the pileus, the reddish discolouration of the flesh, and the lack of clamps, readily determine the collection as belonging to *Sarcodon amarescens* (Quél.) Quél.

Ironically, it was precisely on this collection No. 12 that, on a previous occasion

(Maas Geesteranus, 1956: 48), part of the description of *Sarcodon bubalinus* was based, since insufficient attention was paid to the colour of the tomentum at the base of the stipe. Re-examination of the type of *Hydnum bubalinum*, however, does not lead to the conclusion that *Sarcodon amarescens* and *S. bubalinus* should be united.

Grateful acknowledgment is made to the Director of the Institute of Systematic Botany, Uppsala, for the generous loan of precious collections.

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HYPHAL STRUCTURES IN HYDNUMS

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(With 65 Text-figures)

In this paper descriptions are given of the hyphal structure in the hydnaceous genera *Climacodon* P. Karst., *Creolophus* P. Karst., *Donkia* Pilát, *Hydnellum* P. Karst., *Mycoleptodonoides* Nikol., *Mycorrhaphium* Maas G. (which is introduced as a new genus), *Phellodon* P. Karst., *Sarcodon* P. Karst., and *Steccherinum* S. F. Gray.

The following new combinations are proposed: *Hydnellum piperatum* (Coker) Maas G., *Mycorrhaphium adustum* (Schw.) Maas G., *M. pusillum* (Brot. ex Fr.) Maas G., and *Steccherinum murashkinskyi* (Burt) Maas G.

Since the studies by E. J. H. Corner (1932) on the hyphal systems in Polyporaceae, various authors all over the world have followed his lead. They have mainly concerned themselves with the same group. Among the few authors to include the hyphal structure in their specific descriptions of hydnaceous fungi are Cunningham (1958), Ragab (1953), and Reid (1955, and subsequent papers), but no attempt has thus far been made to give a more complete characterization of the hydnaceous genera by describing the hyphae of their type species. The necessity and importance of the anatomical structure for the correct understanding of a genus becomes at once apparent when one considers *Steccherinum* as it was conceived by Banker (1912) and extended by subsequent authors: Miller (1935), Miller & Boyle (1943), and Coker & Beers (1951). *Steccherinum* was well on the way to become a depository of species that, on account of their spore-characters and the colour of the context, could not readily be placed elsewhere. Also, the apparent difficulty experienced by some authors sharply to delimit *Hydnellum* and *Sarcodon* disappears as soon as the hyphal system in both genera is taken into account.

Thus, the purpose of the present paper is to describe as fully as possible within the limits determined by material in dried condition, the hyphal structure in a number of genera, thereby indicating those differential characters which were formerly overlooked.

The genera treated have been chosen at random, and no effort is as yet made to arrive at any kind of classification. It is more likely that, with the spines as the sole character in common, the connection of many of the hydnaceous genera will have to be sought not within the 'Hydnaceae' but, irrespective of hymenial configuration, with groups now widely separated.

Similar descriptions are in preparation for the remaining hydnaceous genera.

A great debt of gratitude is due to the Directors of the Herbarium of the University of California (Berkeley), of the Herbarium of the University of North Carolina (Chapel Hill), of the New York Botanical Garden (New York), of the "Muséum National d'Histoire Naturelle, Laboratoire de Cryptogamie" (Paris), and of the Botanical Department of the National Museum (Prague) for the loan of collections; and to Dr T. L. Nikolajeva, Leningrad, for the generous gift of a part of the type of *Mycoleptodonoides vassiljevae*.

CLIMACODON P. Karst.—Figs. 1–9

Climacodon P. Karst. *in* Rev. mycol. **3**/No. 9: 20. 1 Jan. 1881 & *in* Medd. Soc. F. Fl. fenn. **6**: 15. 1881. — Type species: *Hydnum septentrionale* Fr.

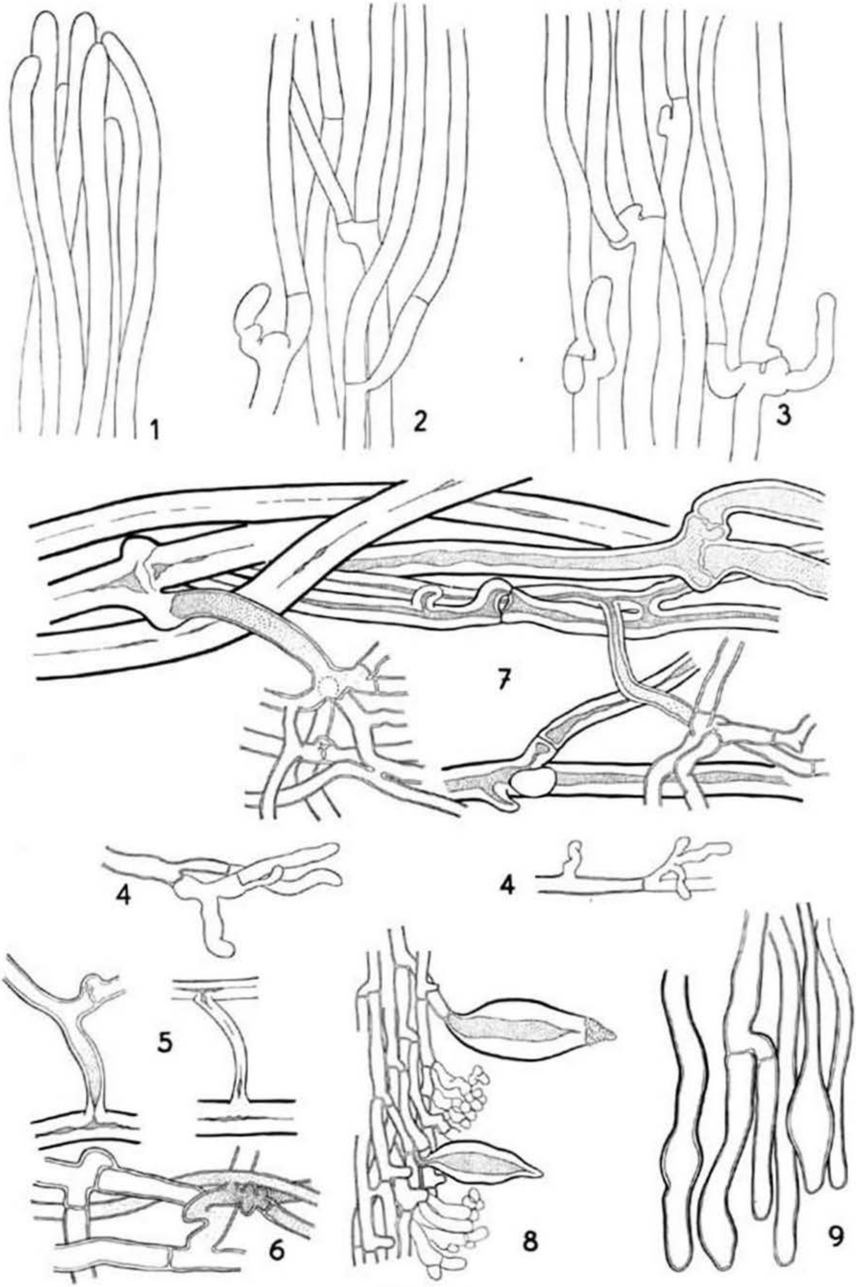
Context tough and fibrous throughout, zoned (at times indistinctly in the dried material), white, consisting of generative hyphae united into bundles, and 'bridge hyphae' connecting them. Generative hyphae not inflating, with clamp-connections in the older stages only, becoming very thick-walled with age. Clamp-connections also lacking in the hyphae of the spines and at the base of the basidia. Cystidia of subhymenial origin, fusiform, thick-walled, often encrusted at the pointed tip.

MATERIAL EXAMINED: *Climacodon septentrionalis* (Fr.) P. Karst. (CANADA, Quebec, Taylor Lake, Gatineau Park; L 959.16-253. — CZECHOSLOVAKIA, several collections; PRC).

The margin in a young specimen of *Climacodon septentrionalis* is strigose-hairy. The hairs consist of tapering bundles of hyphae, the hyphae of each bundle being tightly coherent. The hyphae at the tip of a bundle are straight to somewhat flexuous, 4.5–6.3 μ wide, very thin-walled, with the cell-wall less than 0.5 μ, and filled with an oily matter (Fig. 1). The terminal cells of these hyphae constituting the axis of the bundle are fairly long, the septum separating them from the next cell often occurring at distances of 200–250 μ from the tip of the hyphae. The peripheral hyphae of the bundle do not reach its apex, and usually have much shorter terminal cells, measuring 90–150 μ. The first cross-walls are invariably devoid of clamp-connections, as is illustrated in Fig. 2, which shows the situation at about 170 μ distance from the apex of a bundle. Clamp-connections make their first appearance

EXPLANATION OF FIGURES 1–9

Figs. 1–9. *Climacodon septentrionalis* (Fr.) P. Karst. — 1. Generative hyphae from the tip of a hair at the margin of the pileus. — 2. The same, taken about 170 μ farther down the hair, showing the first appearance of septa. — 3. The same, at a distance of 200–250 μ from the tip of the hair, with clamp-connections at the septa, and side-branches developing from the clamps. — 4. Detail of the apical part of two hyphae from the periphery of a hyphal bundle in a hair, showing the origin of lateral excrescences. — 5. Lateral excrescences with much thickened cell-walls in older tissue, forming a bridge between two adjacent hyphae. — 6. Lateral developing into an intricate knot through ramification and anastomosis. — 7. Detail of the context, showing some thick-walled hyphae of two adjacent hyphal bundles, and two much-branched laterals in the intervening interstice. — 8. Detail of a spine, illustrating the hyphae which toward the side give rise to both subhymenial tissue and cystidia. — 9. Generative hyphae near the margin on the underside of the pileus, with the apical portion fusiformly swollen, which makes them resemble cystidia (all figures × 700).



Figs. 1–9

still farther away from the tips of the hyphae, sometimes, as in the case of axial hyphae, as far as 450 μ, but usually at distances of 200–250 μ (Fig. 3). A peculiarity is that several of the clamps give rise to side-branches. The numerous side-branches, the coherence of the hyphae, and the occasional anastomoses (the latter not illustrated) certainly combine to make it difficult even to tear apart the hairs.

The hairs gradually pass into the context, and the bundles can be followed rearward for several millimetres. When followed in the direction of the base of the pileus, these bundles are seen to diverge and converge alternately, in this way assuming an undulating course. The interstices between the bundles at first grow in size with increasing distance from the margin, but then become smaller again owing to the gradual expansion of the bundles, until an area is reached which is completely made up of a solid mass of bundles. Beyond this area, viz. farther toward the base of the pileus, the interstices appear anew until they, too, are interrupted by another solid area. The alternating sequence of comparatively wide-meshed and compact areas is repeated a great many times throughout the entire length of the pileus, which in a radial section is macroscopically visible as a transverse zonation of the flesh, although often rather indistinctly so in the dried material. In the more marked cases, the zonation is mainly indicated by the compact areas showing as darker curved lines convex toward the margin.

The hyphae, which are of one kind—generative hyphae—, gradually widen with increasing distance from the margin, ultimately reaching a width of 10–11 μ and even twice as much at the septa, but they do not inflate. Simultaneously the cell-walls become thicker, those of the hyphae in the axis of the bundles even obliterating the lumina.

In the hairs mentioned before, the peripheral hyphae of the bundles develop lateral excrescences which may remain simple, but more often tend in their turn to produce side-branches (Fig. 4). Either type of laterals sooner or later fuse with some adjacent hypha, forming a bridge (Fig. 5, which is a detail from much older tissue). They may be called 'bridge hyphae' in accordance with Teixeira (1961: 38). The older the tissue the more pronounced the tendency in the laterals of forming dense knots of side-branches (Fig. 6) in which join through anastomosis side-branches of other laterals. This results in extremely intricate clusters of hyphae which fill the interstices (Fig. 7, showing the less complicated examples). Although the hyphae have the same function as interweaving hyphae (Corner, 1932b: 318 and 1950: fig. 8) they probably cannot be identified with these on account of their different appearance.

The hyphae in the spines are of the same kind as the generative hyphae of the context, but resemble more especially those in the younger stage in that they lack clamp-connections. The hyphae in the axis of a spine are 3.6–7.2 μ wide and often have their lumen completely obliterated, while the peripheral hyphae are narrower, 2.7–4.5 μ wide, with moderately thick to very thin cell-walls. From the side-branches produced by these peripheral hyphae arise both the subhymenial cells and the cystidia (Fig. 8). The body of the latter is more or less fusiform, 27–49 ×

10–14 μ, sometimes long-stalked, often mucronate, with the tip smooth or encrusted, and usually very thick-walled, with the cell-walls 1.5–5 μ thick. The subhymenial cells as well as the basidia lack clamp-connections.

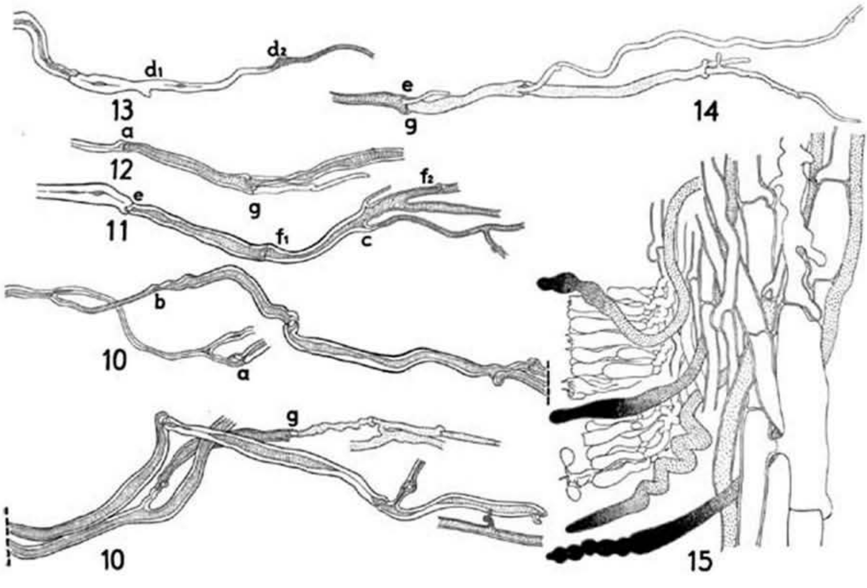
Peculiar hyphae were found close to the margin on the underside of the pileus (Fig. 9) in Fungi exs. suec. No. 251 (PRC). Here, several of the generative hyphae appeared fusiformly swollen at the apex (8–10.5 μ) and even moderately thick-walled, in some respects forming a transition to the cystidia.

CREOLOPHUS P. Karst.—Figs. 10–15

Creolophus P. Karst. *in* Medd. Soc. F. Fl. fenn. **5**: 41. 1879. — Type species: *Hydnum corrugatum* Fr.

Context soft, spongy, not zoned, white, consisting of generative hyphae. Hyphae with clamp-connections, inflating, becoming thick-walled. Tramal hyphae of the spines similar to the generative hyphae but remaining thin-walled. Basidia with clamp-connections. Gloeocystidia constituting the distal ends of tramal hyphae, thin-walled, filled with oily matter.

Material examined: *Creolophus cirrhatus* (Pers. ex Fr.) P. Karst. (Czechoslovakia, several collections in PRC).



Figs. 10–15. *Creolophus cirrhatus* (Pers. ex Fr.) P. Karst. — 10–14. Various generative hyphae; for explanation, see text (× 200). — 15. Detail of a spine, showing tramal hyphae, hymenium, and gloeocystidia, the latter with the contents dotted for greater clarity (× 700).

In a medial section of a young pileus of *Creolophus cirrhatus*, the hyphae at the very margin appear mainly radiately arranged and parallel, except on the surface of the pileus, where occasional free ends of the hyphae are seen to project into the air. While the superficial hyphae are fairly loosely interwoven (which makes the surface appear felted), those deeper down are firmly coherent and practically without intervening spaces. They resist all attempts to being teased apart and can rarely be traced rearward for more than 100 μ uninterruptedly.

A short way back from the margin—a distance which is not a fixed one and probably dependent on the age of the pileus, but which does not exceed 1 mm—a change in the context can be noticed. There is still the thin superficial layer of loosely interwoven hyphae which gradually pass downward into a dense layer of agglutinated parallel hyphae, but from the underside of this second layer hyphae are seen to curve down toward the lower surface of the pileus, either solitary or joined into strands. The farther away from the margin, the more apparent the differentiation of the context. Sooner or later the superficial hyphae collapse, becoming firmly glued to the underlying layer of compacted hyphae. This layer, which toward the base of the pileus may reach a width of 80–120 μ, tends to become cartilaginous and is set off against the remainder of the context as a dark shining line. Concurrently with the collapse of the superficial hyphae, the surface of the pileus becomes glabrous or, at the most, innately fibrillose. The hyphae in the context underneath the cartilaginous layer are no longer radially arranged, nor do they keep together in closely coherent parallel bundles. The hyphae, singly or in bundles, begin to diverge rearward, whilst their course becomes increasingly tortuous, with side-branches running in all directions. This process results in the fairly sudden appearance of meshes which with increasing distance from the margin rapidly grow in size and number. Consequently, the context becomes at once very much loosened and thickened; it retains its homogeneous spongy texture throughout the entire fruit-body, without a trace of zonation.

The hyphae at the margin of the pileus are narrow, 1–4.5 μ wide, and thin-walled. Side-branches and anastomoses are frequent and clamp-connections occur at all septa. Inflation of the cells soon takes place and at the same time the cell-walls begin to thicken. At a distance of about 500 μ from the margin, many of the hyphae have become inflated, some reaching a diameter of 10 μ, while their cell-walls are thickened to 1 μ or somewhat more. However, neither the inflation of the cells, nor the thickening of the cell-walls is a uniform process. A hypha traced back from its distal end toward its origin may show a succession of wide and narrow cells, and some of the proximal cells may have thinner walls than a distal cell. In the same hypha, a narrow cell may be followed by a wide one (Fig. 10a, 12a), or the cell itself inflates to twice or thrice its width (Fig. 10b). On the other hand, wide hyphae may produce narrow branches (Fig. 11c), or taper to narrow threads (Fig. 13 d_1–d_2). The widest hyphae may reach a diameter of 14 μ, with the cell-walls up to 4 μ thick. The walls thicken from one cell to the next (Fig. 11e, 14e) or even in the same cell from the distal end to the proximal end (Fig. 13d_2–d_1, 11f_2–f_1), but the reverse is by no means uncommon. Thin-walled hyphae (Fig. 10g, 12g, 14g) springing from thick-walled cells are obviously younger shoots in an otherwise old tissue and are of common occurrence throughout the fruit-body. Their course is often strongly undulating and some of their constituent cells are found to grow to amazing lengths, one of the longest measuring up to over 700 μ, with the distal end torn off. Although no thick-walled hyphae of that size have been found, there is no reason to believe that these very long thin-walled hyphae belong to a special kind. They grow in the same direction, their growth is unlimited, they are septate and possess clamps, which proves them to be basically the same as the thick-walled hyphae.

The hyphae in the spines agree with the generative hyphae, but they are all thin-walled and the transition from very narrow to very much inflated cells toward the axis of the spine is much more abrupt (Fig. 15). The widest inflated cells may reach a diameter of 14 μ. Clamp-connections are numerous in the hyphae and always present at the base of the basidia. Especially toward the tip of the spine there are numerous slender gloeocystidia protruding beyond the hymenium. They have their origin far back in the axis of the spine and represent the distal ends of tramal hyphae. The apical part of the gloeocystidia, which may reach a width of 4.5–5.5 μ, gradually tapers to a point or is fusiformly swollen. Not infrequently the apex is distinctly torulose. These gloeocystidia are very sparsely septate, and in one case not a single septum was found over a distance of 270 μ, which was as far as the gloeocystidium could be traced back. The oily or resinous contents appears more concentrated toward the apex which in consequence becomes more intensely coloured by Congo red.

Since the time of Karsten, *Creolophus* was not accepted as a separate genus, until it was recently reintroduced by Donk (1962: 231). Of the type species, *Hydnum corrugatum*, the most recent description is the one published by Cejp (1928: 101; 1930: 321), but in view of the fact that this author found the spores to be non-amyloid, the correctness of the identification is open to questioning.

Banker (1906: 135), who did not know *H. corrugatum*, referred the specimens thus reported from various localities in the United States to *Hydnum pulcherrimum* or *H. septentrionale*. Later on (1913: 293), he associated *Hydnum corrugatum* with *H. septentrionale* on account of the similarity of form, colour, and substance, placing both in the genus *Creolophus*.

Whatever *Hydnum corrugatum* may look like, there is no doubt as to the identity of *Creolophus cirrhatus*, and both Karsten's unmistakable description and figure (1899: 144, pl. 7 fig. 100) of that species make it clear what genus this author had in mind.

The most recent transfer was made by Nikolajeva (1950: 343; 1961: 222), who placed *Creolophus cirrhatus* under *Hericium* on the grounds that microscopically the species is hardly distinguishable from *Hericium coralloides* (l.c. 332). This author moreover supposed it permissible to regard the meshes in the context of *C. cirrhatus* as homologous with the spaces separating the branches in *Hericium corralloides*, at the same time pointing out that there exist forms of the latter whereby the branches are contracted and most of the intervening spaces obliterated.

Although these arguments have their merits, more weight should be attributed to the fact that, as related by Donk, the fruit-body in *Creolophus* is dorsiventrally flattened and its context non-amyloid.

Both Bourdot & Galzin (1914: 278; 1928: 443) and Pilát (1934: 314, fig.) mentioned the occurrence of 'paraphysoid filaments' among the basidia bearing microconidia, but whereas the French authors found the conidia arranged in torulose chains, Pilát's figure more or less clearly depicts the conidia in a terminal position. In a study on the conidial production in *Hericium*, Nikolajeva (1956: figs. 4, 5) distinguished between conidia produced in chains (inside a gloeocystidium), and such as develop at the tip of a special hypha, calling them micro- and macroschizospores respectively. From this it becomes apparent that Bourdot & Galzin would have found the former type and Pilát the second. In a later paper Nikolajeva (1958: 73) stated to have found both types in the present species, adding that the development of the conidia chiefly accompanies the mature basidia. This may be the reason that no macroconidia were found in the material examined, since, with a different goal in view, the region mainly near the tip of the spines was investigated. Nor was any observation made to confirm that in the specimens used for the present investigation the contents of the gloeocystidia are liberated in the form of microconidia.

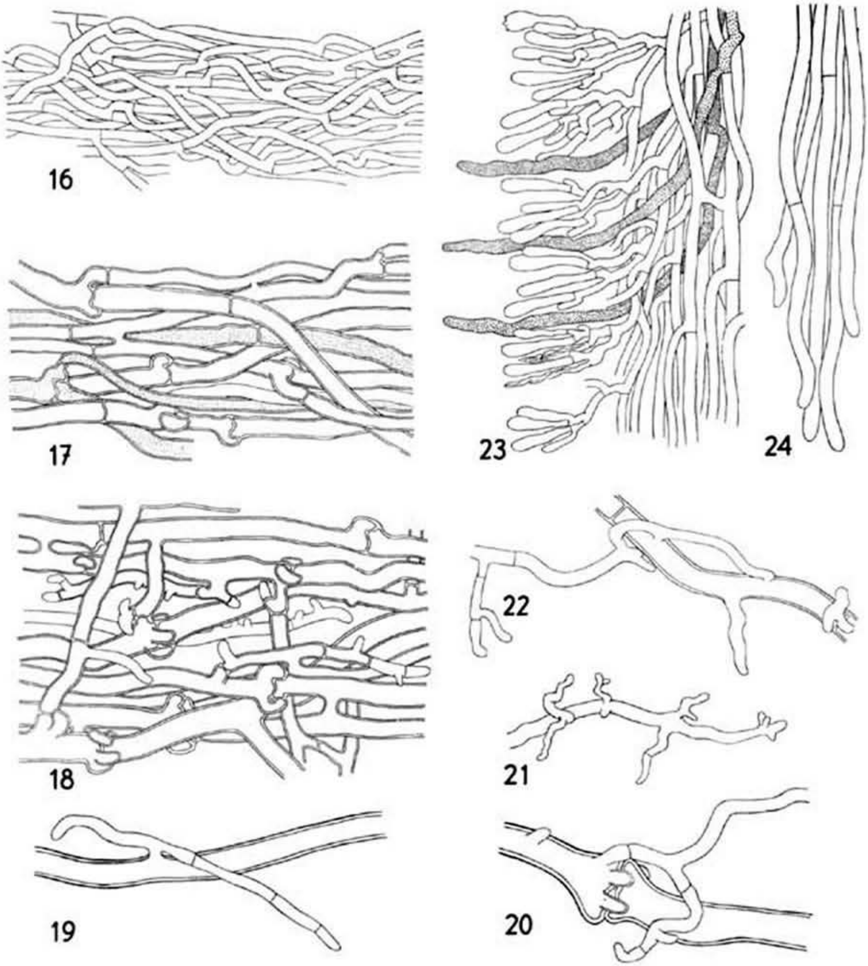
DONKIA Pilát—Figs. 16–24

Donkia Pilát *in* Bull. Soc. mycol. France **52**: 328. 1936. — Type species: *Hydnum pulcherrimum* Berk. & Curt.

Context fairly soft to tough, stringy, zoned in the thicker parts, white (when fresh), consisting of generative hyphae which become increasingly mixed with interweaving hyphae toward the older parts of the pileus. Generative hyphae near the margin of the pileus very thin-walled and lacking clamp-connections, not inflating. Farther away from the margin the hyphae become moderately thick-walled or may even become solid. Clamp-connections appear at some distance from the margin, at first one per septum, then two on opposite sides of a septum, finally in whorls of three to four on the widest hyphae. Tramal hyphae of the spines similar to the hyphae of the youngest parts of the pileus, i.e. without clamp-connections. Basidia lacking clamps. Gloeocystidia numerous.

MATERIAL EXAMINED: *Donkia pulcherrima* (Berk. & Curt.) Pilát (FIJI ISLANDS, Viti Levu, Tamavua-Sawani road; UC 275810. — U.S.A., Florida, Alachua County, Gainesville, Sanchez Hammock; UC 669605. — U.S.A., Louisiana, Baton Rouge; L 957.173–261).

The pileus of a dried specimen of *Donkia pulcherrima* shows a matted upper surface with an embedded or raised network of rather coarse anastomosing fibrils which have a somewhat cartilaginous appearance. Under the microscope it is only just possible to discern that both the outermost layer and the margin are made up of agglutinated and collapsed hyphae from which oozed quantities of an oily substance. It is farther down in the context and at some distance from the margin that the separate hyphae can be made out. These hyphae (Fig. 16, drawn after the



Figs. 16–24. *Donkia pulcherrima* (Berk. & Curt.) Pilát. — 16. Generative hyphae of the context at a distance of about 300 μ from the margin and near the lower surface; margin to the right. — 17. Similar hyphae about 800 μ distant from the margin and near the upper surface of the pileus, showing the presence of clamp-connections. — 18. Similar hyphae about 2.5 mm away from the margin, showing (i) clamp-connections in varying numbers per septum, (ii) lateral excrescences, and (iii) 'bridge-hyphae'. — 19. Divaricating side-branch, about to develop into an interweaving hypha. — 20–22. Various interweaving hyphae. — 23. Tramal hyphae near the axis of a spine, giving rise to gloeocystidia (dotted for greater clarity), and developing the hymenium toward the side of the spine. — 24. Gloeocystidia at the tip of a spine (all figures × 700).

situation at a distance of about 300 μ from the margin and near the lower surface) are of one kind (generative hyphae), 2.2–3.6 μ wide, very thin-walled, with the cell-walls less than 0.5 μ thick, tightly interwoven, flexuous, much branched, with frequent anastomoses, septate, without clamp-connections, and most of them, if not all, filled with an oily substance. Farther back from the margin, the hyphae slowly increase in width and begin to unite into bundles. At some 500 μ away from the margin the first clamp-connections begin to make their appearance, and they become more numerous with increasing distance from the margin (Fig. 17, at about 800 μ from the margin and near the upper surface). The clamps do not occur at all septa, and there is only one clamp per septum. In this part of the pileus the width of the hyphae ranges from 3–5.4 μ, with the cell-walls about 0.5 μ thick. All hyphae are arranged in a strictly longitudinal direction, which holds for the more loosely interwoven hyphae as well as for those of the bundles which by now are clearly defined. Macroscopically (and even seen with a hand-lens) the context in this part of the pileus looks fairly uniform, but farther back a gradual change takes place in that the context appears made up of an arachnoid tissue traversed by anastomosing longitudinal strings. The larger and heavier the pileus, the greater the proportion of the strings in the context.

To return to the microscopical investigation of the context: at a distance of some 2.5 mm from the margin several changes in the hyphae can be noticed (Fig. 18). First, the hyphae are still wider, ranging from 3–10 μ, with the cell-walls 0.5–1.5 μ thick. Secondly, at many of their septa the wider hyphae possess two opposite clamp-connections, which produces a most characteristic picture indeed. However, several others do not stop at that number and develop whorls of three or even four clamps plus a bud. This bud grows out into a branch which, running cross-wise for a short distance, fuses head-on with some adjacent hypha. At irregular intervals on the sides of the hyphae excrescences appear which, too, grow out into side-branches. These may develop at right angles from the parent hypha, or follow the longitudinal direction, or again divaricate, one branch pushing forward and the other backward (see also Fig. 19). These side-branches are notable for their frequent lateral excrescences and the lack of clamp-connections. With increasing distance from the margin—perhaps, more correctly, with increasing thickness of the pileus—both the side-branches arising from just beneath a septum and those springing from the sides of the main hyphae become increasingly longer and more tortuous. They wind their way in every direction (Figs. 20–22), branch in every direction, attach themselves to other hyphae, forming anastomoses, and thus prove themselves to be interweaving hyphae.

The greatest width to which the hyphae have been found to grow is 10–11 μ, whilst their walls as a rule are of moderate thickness, viz. 1–1.8 μ. Occasionally, however, some hyphae have somewhat thicker cell-walls and in one particular case a hypha measuring 7 μ was found to have its lumen completely obliterated (collection from Gainsville). This find is of particular importance as it allows the material to be considered the bridge connecting two extremes: on the one hand the collection from Baton Rouge which has the hyphae thin-walled to moderately thick-walled, on the other the collection from Viti Levu in which already close behind the margin many of the hyphae are so thick-walled as to be practically solid.

Fruit-bodies with a thin pileus appear devoid of any zonation of the context, but in thick-fleshed fruit-bodies there are numerous colour-zones, both vaguely and sharply defined. These zones are caused not by changes in the hyphal structure but by more or less regularly recurring variations in the quantities of the oily matter exuded.

The transition from the generative hyphae of the older parts of the pileus to the tramal hyphae of the spines is abrupt and rather surprising in that at one stroke interweaving hyphae, thickened cell-walls, and clamp-connections are left behind. The tramal hyphae (Fig. 23) are almost identical with the generative hyphae of the youngest parts of the pileus, differing only in the much longer intervals between two septa. The hyphae are all filled with an oily substance and very thin-walled. The widest hyphae, up to 3.6 μ, occur in the axis of a spine. The hyphae become gradually narrower toward its sides, where they develop the basidia which also lack clamps. Certain side-branches, which have their origin near the axis, curve outward and form gloeocystidia. These become increasingly numerous toward the tip of the spine. The tip consists solely of 2.7–3.6 μ wide gloeocystidia (Fig. 24).

A peculiarity of *Donkia pulcherrima* is the sticky sap which in the dried material fills practically every hypha with a brownish oily substance, rendering it exceedingly difficult to study the microscopical structure.

From the appearance of such hyphae as have been illustrated in Figures 5–7, it has been concluded that they are interweaving hyphae. It is clear, however, that this term becomes less and less appropriate the shorter these hyphae grow. Short hyphae connecting two generative hyphae might be called 'bridge hyphae' (Teixeira, 1961: 38), but the gradual transition from one kind to the other sufficiently demonstrates in certain cases the futility of a fixed term.

Miller (1935: 361) and Miller & Boyle (1943: 51) described the hyphae as having "fewer clamp connections in the spines," but in the material cited above they have been shown to be definitely without clamps.

Pilát (1934: 316, fig.) seems to have been the first to observe the presence of gloeocystidia in the species under discussion, but his figure is rather vague with regard to their origin. Later authors (Miller & Boyle and Coker & Beers) did not even mention the gloeocystidia.

Quite recently, Nikolajeva (1961: 194) transferred *Donkia pulcherrima* to the genus *Climacodon*. Although it is true that both genera have several features in common (such as the fibrous construction of the context, the occurrence of 'bridge hyphae', the remarkable absence of clamp-connections in the youngest hyphae and in the spines) one need only compare more attentively their hyphae, clamp-connections, and the origin of the (gloeo-)cystidia, at the same time bearing in mind that the former genus is characterized by its sticky sap, to realize that *Donkia* and *Climacodon* are widely different genera.

HYDNELLUM P. Karst.—Figs. 25–31

Hydnellum P. Karst. *in* Medd. Soc. F. Fl. fenn. **5**: 41. 1879. — Type species: *Hydnum suaveolens* Scop. ex Fr.

Context tough to somewhat fleshy, zoned, pale to variously coloured, consisting of generative hyphae. Hyphae with or without clamp-connections, rarely inflating, thin-walled to thick-walled. Tramal hyphae of the spines similar to the generative hyphae but remaining thin-walled. Concurrently with the presence or absence of clamp-connections in the generative hyphae, the tramal hyphae and the basidia possess or lack clamps. Cystidia or gloeocystidia lacking.

MATERIAL EXAMINED: *Hydnellum suaveolens* (Scop. ex Fr.) P. Karst. (AUSTRIA, Tirol, Seefeld; L 960.260-997. — CZECHOSLOVAKIA, Mt. Brdy near Dobříš; L 955. 132-057. — SWITZERLAND, Neuchâtel, Val de Travers; L 961.54-877); also *Hydnellum velutinum* (Fr.) P. Karst. var. *scrobiculatum* (Fr. ex Secr.) Maas G. (NETHERLANDS, Baarn; L 956.066-066), and *Hydnellum compactum* (Pers. ex Fr.) P. Karst. (GERMANY, Saar, Mettlach; L 953.112-378).

The surface of the pileus in a young specimen of *Hydnellum suaveolens* is plushy, but becomes matted to glabrous toward the centre and with age. Very probably the margin, too, is plushy when young, but this could not be verified from lack of suitable material. It certainly is in other species. The entire pileus consists of one kind of hyphae, the generative hyphae, and those at the surface are seen to project into the air more or less parallel to each other and at right angles to the surface (Fig. 25). They are 2.7–5.4 μ wide, thin-walled, with the cell-walls less than 0.5 μ to up to 0.9 μ, occasionally branched, septate, and with clamp-connections at all septa. The hyphae are filled with a substance (pale and with the appearance of oil in the present species, but much darker and more like resin in such coloured species as of the *Hydnellum velutinum* complex) which appears most concentrated, and hence is more intensely coloured by Congo red, at the tips. Also, the contents darkens with age. Some 80 μ below the apices of the erect hyphae, others are seen lying prostrate with their tips pointing in the direction of the margin of the pileus. It would seem that these hyphae, representing the ultimate level of a previous growth-period, have collapsed and have subsequently been left behind by the advancing hyphae of a new growth. The prostrate hyphae form a transverse zone in the flesh, and the number of hyphae, or in other words the thickness of the zone, presumably depends on the climatic conditions which cause the hyphae to collaps. An extreme case in which the hyphae not only have collapsed but become firmly agglutinated is shown in Fig. 26 which depicts a zone about 650 μ below the surface. This particular zone showed as a very dark line in the context, the colour being probably also caused by the darkened matter in the hyphae. A further example of the very tortuous course of the hyphae and their much darkened contents in a zone has been taken from *Hydnellum velutinum* var. *scrobiculatum* (Fig. 27) which shows the hyphae to have retained their normal width.

In older tissues (Fig. 28), at a distance of about 2 mm from the margin in this particular case, the generative hyphae have gradually widened to 3.5–5.5 μ, with the cell-walls in the main about 1 μ thick. At various points narrow hyphae, 2–4 μ wide and with very thin cell-walls which are hardly coloured by Congo red, can be seen to branch off from the generative hyphae. These hyphae develop blunt outgrowths with which they attach themselves to adjoining generative hyphae, several of which remain firmly entwined by them as far as they can be traced. Especially the occasional side-branches at their base make the narrow hyphae resemble interweaving hyphae which, however, they are not because of their longitudinal and unlimited growth. These narrow hyphae appear to be nothing but young shoots which are constantly being formed throughout the older tissues of the pileus. The older the context, the more kinked the shoots (Fig. 29, showing the situation near the centre of the pileus) and the thicker the cell-walls in general. In the widest hyphae (up to 7.2 μ), the cell-walls may be as thick as 2 μ, whilst some of the narrower hyphae are in places almost solid.

The hyphae in the spines do not differ from the generative hyphae except that in general they are somewhat narrower, measuring 2.7–4.5 μ, the widest being situated in the axis of a spine, with the cell-walls 0.5–0.9 μ (Fig. 30). Branching and anastomosing are frequent, and clamp-connections occur at all septa as well as at the base of the basidia. Cystidia and gloeocystidia are absent.

While it is true that the hyphae in *Hydnellum suaveolens*, like in most other species of this genus, have predominantly parallel walls, inflated hyphae are not entirely lacking. Portions of the hyphae containing resinous matter (e.g. in *Hydnellum diabolus*, and see also Fig. 27) may be considerably swollen, and inflated hyphae are very common indeed in *Hydnellum compactum* (Fig. 31), which explains the fleshy nature of its context. Here, the generative hyphae (which ordinarily are 3.5–5 μ wide near the margin) or portions of them may be seen to become inflated up to 7–12.5 μ farther toward the centre of the pileus.

The fleshy context places *Hydnellum compactum* in a position very near the genus *Sarcodon*, and indeed Quélet once called the species *Sarcodon acer* (Quél.) Quél. The important distinguishing character, however, determining this species as a *Hydnellum*, is the zonation of the context as described above for *H. suaveolens*. If Harrison and Coker had recognized the value of this feature, they certainly would not have experienced any difficulty in distinguishing *Hydnellum* from *Sarcodon*. The former (1961: 25) stated that "it is difficult to draw a sharp line between the two genera . . . under all conditions of growth.", while the latter (1951: 36) found *Sarcodon* "not consistently distinct from *Hydnellum*, the more fleshy species of that genus obscuring a sharp definition." As far as can be judged from the descriptions and figures all the Hydnellums described in Coker & Beers's monograph are true members of the genus, but *Sarcodon piperatus* is not a *Sarcodon*. Examination of the type and some additional material (Nos. 10683, 10687) clearly revealed the zonation of the flesh, which is also readily visible in the photograph (Coker & Beers, 1951: pl. 24). Accordingly, the following recombination is proposed: **Hydnellum piperatum** (Coker) Maas G., *comb. nov.* [*Sarcodon piperatus* Coker *in* J. Elisha Mitchell sci. Soc. **55**: 373, pl. 34. 1939 (basionym). — *Hydnum piperatum* (Coker) Pouz. *in* Česká Mykol. **10**: 68. 1956; not *Hydnum piperatum* (Banker) Sacc. & Trott. *in* Sacc., Syll. Fung. **21**: 373. 1912].

From Coker's description and figures it would at first sight seem that *Hydnellum piperatum* is very near *H. compactum*, but even in the dried material a good many differences can be found which are summarized in the following table.

HYDNELLUM COMPACTUM	HYDNELLUM PIPERATUM
Pileus plano-convex or depressed over a wide area, with the margin plane to ascending.	Pileus often with a rather narrow central depression or with a navel which in mature specimens is in marked contrast with the drooping margin.
Surface of pileus without radiately arranged striations or ridges; not concentrically zoned.	Surface of pileus with radiating striations, fibers, or ridges; near the margin with more or less obscure concentrical zones.
Colour of pileus becoming darker with age, with bistre or olivaceous tints.	Pileus not turning bistre or olivaceous with age.
Stipe gradually flaring upwards into pileus.	Stipe abruptly joining the pileus.
Odour (when fresh) of watermelon (*Citrullus vulgaris* Schrad.), cucumber, French beans, or meal.	Odour "very faint, suggesting some desinfectant or rarely fenugreek." (Coker & Beers, 1951: 42).
Taste instantly acrid, later on bitter and astringent.	Taste "strongly peppery" (Coker & Beers, l.c.).
Spores 5–6 μ diam. (Donk), 5–7 × 5–6 μ (Bourdot & Galzin).	Spores 4.2–5.5 μ diam. (Coker & Beers).

Sarcodon stereosarcinon Wehm. is another example of a species which is marked by the zonation of the context, but in this case the species is a true *Sarcodon*. The zones have their origin not in the deflection of hyphae (as they would in *Hydnellum*), but in the sudden termination of a number of hyphae which, whilst remaining parallel and strictly aligned in a radial direction, are somewhat swollen at their tips and filled to capacity with an oily matter. In some cases large quantities of a brownisch matter have accumulated in between the hyphae, which causes the zones to appear as very dark lines.

EXPLANATION OF FIGURES 25–31

Figs. 25, 26, 28–30. *Hydnellum suaveolens* (Scop. ex Fr.) P. Karst. — 25. Hyphae of the surface of the pileus, some of which project into the air, while others are deflected in the direction of the margin to form a transverse zone. — 26. Transverse zone in the context about 650 μ below the surface of the pileus, consisting of shrivelled hyphae. — 28. Detail of the context at a distance of about 2 mm from the margin (to the left) showing the younger shoots: their origin, their attachment to other hyphae, and their tendency of entwining older hyphae. — 29. Detail of the context near the centre of the pileus showing older generative hyphae with thickened cell-walls, and the kinked contours of the shoots. — 30. Tramal hyphae of a spine giving rise to the hymenium (all figures × 700).

Fig. 27. *Hydnellum velutinum* (Fr.) P. Karst. var. *scrobiculatum* (Fr. ex Secr.) Maas G. — Detail of a transverse zone in the context to show the very tortuous course of the hyphae while retaining their normal width (× 700).

Fig. 31. *Hydnellum compactum* (Pers. ex Fr.) P. Karst. — Fragments of parallel-sided and inflated generative hyphae (× 700).

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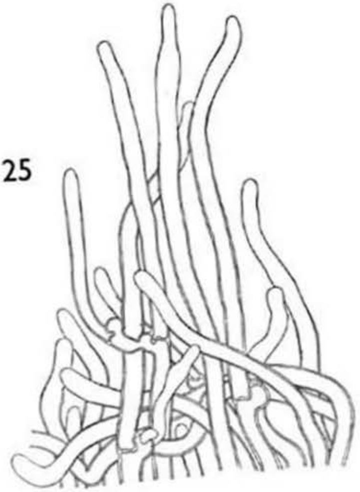

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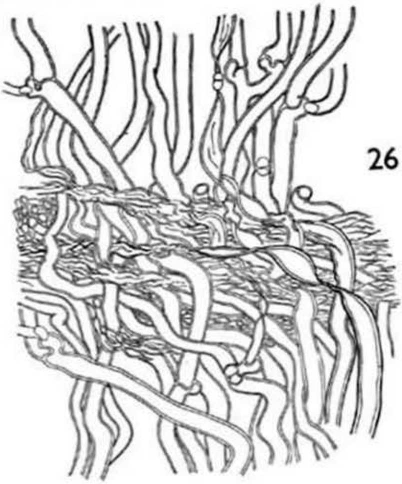

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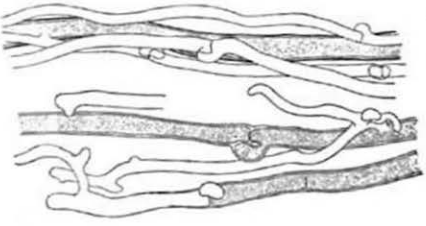

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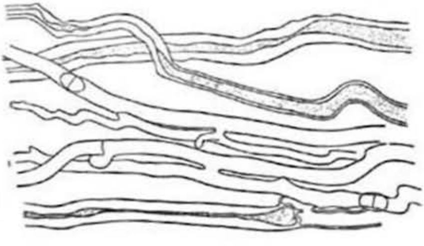

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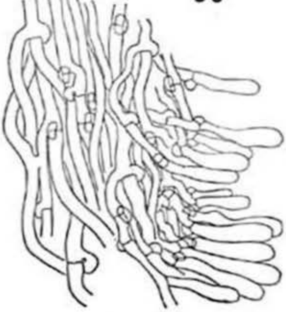

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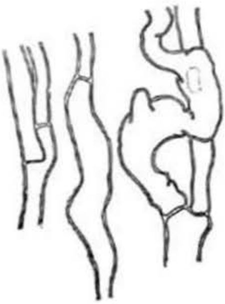


Figs. 25–31

Some comments need here be made in connection with Ragab's paper. This author very justly remarked (1953: 942) that "Any student who has devoted considerable attention to taxonomic study of the Hydnaceae will recognize that little or no attention has been given to the character of the hyphal elements in delimiting genera and species." In his zeal, however, Ragab slightly overshot. Any student who has devoted considerable attention to taxonomic study of the Hydnaceae will recognize that *Phellodon* is a perfectly sound genus which should on no account be united with *Hydnellum*, even if it were true that their hyphal structures are alike. For it would be illogical to maintain that a single character—the similarity of the hyphal structures—should have more weight than the unvarying combination of three other and unrelated features such as spore-colour, spore-ornamentation, and odour. However, the hyphae in both genera are not completely similar. The cell-walls in *Hydnellum* gradually thicken with age, becoming 1–2 μ thick and sometimes even obliterating the lumina of the hyphae. In *Phellodon*, on the contrary, there is not a single species known to have the cell-walls thicker than 0.5 μ in any part of its fruit-body.

MYCOLEPTODONOIDES Nikol.—Figs. 32–34

Mycoleptodonoides Nikol. *in* Bot. Mater. (Not. syst. Sect. cryptog. Inst. bot. Acad. Sci. USSR) **8**: 117. 1952. — Type species: *Mycoleptodonoides vassiljevae* Nikol.

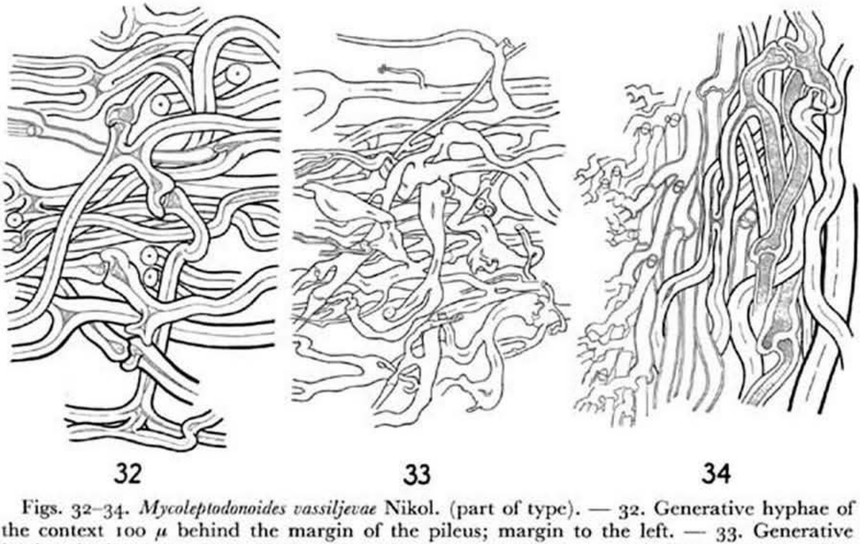
Context rigid, not zoned, pallid, consisting of generative hyphae which are thin-walled only near the margin and the surface of the pileus. The hyphae are branched, with frequent anastomoses, septate, with clamp-connections at all septa, and throughout the greater part of the context very thick-walled or practically without a lumen. In the lower portion of the pileus the generative hyphae become much swollen and very tortuous, and produce much narrower side-branches which connect the hyphae through anastomosis. Tramal hyphae of the spines very thick-walled in the axis, thinner walled toward the sides, branched, anastomosing, with clamp-connections at all septa. Basidia with clamps. Cystidia and gloeocystidia lacking.

MATERIAL EXAMINED: *Mycoleptodonoides vassiljevae* Nikol. (U.S.S.R., "reservatum suputinicum", part of type; L 961.54-850).

The entire pileus is made up of generative hyphae which near the margin, as is apparent from a medial section, mainly run in a radial direction (Fig. 32, showing the situation 100 μ behind the margin). The hyphae are very closely packed (much more so than shown in the figure), much branched, anastomosing, septate, with clamp-connections at all septa, 2.7–5.4 μ wide and very thick-walled or with hardly any lumen at all. Toward the margin (which in the material available could not be studied because the hyphae remained a solid collapsed mass) the hyphae tend to become narrower and thinner walled. The same holds for the hyphae on the surface which are equally hard to distinguish since they are embedded in an amorphous matter.

Farther away from the margin the hyphae gradually increase in width, maintaining much the same radial arrangement, but those deeper down in the context undergo a marked change. They become very tortuous indeed, widen enormously, up to 32 μ, with the cell-walls thickening at the same rate, and assume the oddest shapes (Fig. 33). Another peculiarity is to be found in the narrow hyphae, 2–4 μ in diameter, which branch off from the thickened hyphae at various places. Some are short and winding, others considerably longer and straight, but although it is not exactly known where the latter go or how they terminate, it is suggested that the short and long hyphae do not represent two different kinds. Their function in any case seems essentially the same: connecting one hypha to another, thus strengthening the tissue. Because of their very thick cell-walls and the unlimited growth of the longer hyphae, these side-branches can be identified neither with interweaving hyphae, nor with binding hyphae. Probably they are nothing else but shoots of the generative hyphae, and the occurrence of thicker but otherwise similar (probably older) side-branches seem to strengthen this supposition.

In the spines (Fig. 34) the axis is made up of agglutinated hyphae, 4.5–7.2 μ in diameter and either very thick-walled or practically without lumen. Their course is undulating and they branch and anastomose frequently; clamp-connections are found at all septa. Toward the sides of the spines the thick-walled hyphae are gradually replaced by hyphae with thinner cell-walls, and these eventually give rise to the very wide subhymenial tissue, up to 60–70 μ, which consists of very closely packed and extremely tortuous hyphae, 2–3 μ wide and with the cell-walls less than 0.5 μ thick. The basidia possess clamp-connections. Cystidia and gloeocystidia are absent.



32 33 34

Figs. 32–34. *Mycoleptodonoides vassiljevae* Nikol. (part of type). — 32. Generative hyphae of the context 100 μ behind the margin of the pileus; margin to the left. — 33. Generative hyphae farther away from the margin and the upper surface. — 34. Tramal hyphae about 500 μ away from the base of a spine, very thick-walled in the axis of the spine, becoming thinner walled toward its side, and finally producing the very thin-walled hymenial elements (Figs. 32 and 34, × 700; Fig. 33, × 200).

It will be observed that in the generic description given on an earlier occasion (Maas Geesteranus, 1961: 409) the context was described as fleshy. This term, which suggested itself on account of the presence of inflating, thin-walled hyphae in the context of *M. aitchisonii*, needs reconsideration in view of the very different situation in *M. vassiljevae*. Since very thick-walled generative hyphae do occur in the type material of *Hydnum aitchisonii*, only with less frequency, that species is still considered congeneric with *Mycoleptodonoides vassiljevae*. However, this makes it necessary in the generic description to replace the word "fleshy" by "more or less fleshy to rigid". The description can be further emended by the definite statement that (i) the hyphae in the pileus and the spines have clamp-connections at all septa, and (ii) the basidia possess clamps at their base.

Like in *Mycoleptodonoides aitchisonii* the hyphae in *M. vassiljevae* may become enormously swollen, but it remains to be seen whether the term 'inflating hyphae' should be equally stretched to include such hyphae as are practically solid from the thickening of their walls.

In contrast with the view expressed previously (1961: 411), *Mycoleptodonoides* and *Hydnum* are no longer regarded as related genera. Whereas the former is characterized by the glabrous surface of the pileus composed of agglutinated hyphae and the thickening of the cell-walls of many of the hyphae in the older tissues, the latter shows a tomentose surface of the pileus, whilst all the hyphae remain thin-walled.

Mycorrhaphium Maas G., *gen. nov.*[1]—Figs. 35–52

Hoc a genere *Steccherinum* S. F. Gray, a quo disiungitur, notis carnis aculeorumque differt. Caro e hyphis unae speciei admodum formata, aculei tametsi hyphis biformibus instructi gloeocystidiis carentes. *Mycoleptodonoides* Nikol. pileo glabro, hyphis pilei partis inferioris immodice turgentibus earumque parietibus pariter incrassatis, atque aculeorum hyphis omnibus aequalibus longe distat. — Typus generis: *Hydnum adustum* Schw.

Differing from *Steccherinum* S. F. Gray in the monomitic context of the pileus and, although the spines do possess skeletal hyphae, in the lack of cystidia. Easily distinguishable from *Mycoleptodonoides* Nikol. in that (i) the pileus in the latter is glabrous, (ii) its hyphae in the lower part of the pileus are very much swollen, while their cell-walls are proportionally thickened, and (iii) the spines lack skeletals. The zonation of the surface of the pileus (and of the context near the margin) may well prove to be a further character by which *Mycorrhaphium* can be distinguished from *Mycoleptodonoides*. — Type species: *Hydnum adustum* Schw.

MATERIAL EXAMINED: **Mycorrhaphium adustum** (Schw.) Maas G., *comb. nov.* [*Hydnum adustum* Schw. *in* Schr. naturf. Ges. Leipzig **1**: 103, pl. 2 figs. 7–9. 1822 (basionym). — *Steccherinum adustum* (Schw.) Banker *in* Mem. Torrey bot. Cl. **12**: 132. 1906. — *Mycoleptodonoides adusta* (Schw.) Nikol. *in* Bot. Mater. (Not. syst. Sect. cryptog. Inst. bot. Acad. Sci. USSR) **8**: 120, figs. 2, 3, pl. 44. 1952] (U.S.A., North Carolina, Hendersonville; UC 669567. — U.S.A., Tennessee, near Knoxville; L 960.340-064. — U.S.A., Baton Rouge; L 959.140-804).

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[1] ETYMOLOGY: ἡ μύκης, fungus; τό ῥάφιον, small needle, which refers to the small, straight, needle-like spines.

Context tough, anoderm, indistinctly zoned (probably only zoned near the margin), white, consisting of generative hyphae. Hyphae not inflating, much branched, often anastomosing, septate, with or without clamp-connections, thin-walled, becoming moderately thick-walled. Trama of the spines dimitic (for exceptions, see detailed description), consisting of generative as well as skeletal hyphae. Basidia with or without clamp-connections. Cystidia or gloeocystidia lacking. Spores almost cylindrical to ellipsoid, smooth, colourless, non-amyloid.

The greater part of the surface of the pileus in *Mycorrhaphium adustum* is minutely velutinous, becoming finely woolly-strigose toward the centre, and showing one to several zones of a matted or glabrescent surface near the margin. Seen under the microscope, the velutinous parts appear made up of a single kind of hyphae, the generative hyphae. These run mainly in radial direction but have their tips curved upward, ending freely into the air, as do the side-branches. In Figure 35, drawn after a section of the pileus about 1 mm distant from the margin, the hyphae are 2–4.5 μ wide. They are very thin-walled, the cell-wall less than 0.5 μ thick, frequently branched, and septate. They possess clamp-connections which, however, do not appear to occur at all septa, a phenomenon also known to occur in Polyporaceae and amply discussed by Teixeira (1962: 62). The free-ending tips of the hyphae retain much the same width all over the surface of the pileus, but tend to cohere into tufts (which are responsible for the strigose appearance in the centre of the pileus), and become thicker walled, with the cell-walls 0.5–0.9 μ (Fig. 36). In the glabrescent zones (e.g. in Fig. 37 which shows the situation at 500 μ distant from the margin) the distal ends of most of the superficial hyphae are deflected in the direction of the margin, lying flush with the surface. Incidentally, one of the hyphae is shown partially filled with resinous matter.

The context is entirely made up of generative hyphae which differ from the superficial hyphae only in that they very gradually increase in width in the older tissues, become somewhat thicker walled, and are more frequently connected by anastomosis. Hyphae of the context 15 mm distant from the margin may be found to measure 4–6.3 μ in width, with the cell-walls up to 1 μ thick.

Throughout the greater part of the pileus the context is uniform, with the hyphae running in several directions, but with a slight predominance of a radial arrangement. Near the margin, however, and convex toward it several faint zones can be seen to interrupt this radial alignment. The zones consist of bundles of more closely cohering hyphae which all converge into an arc (Fig. 38, from a region 270 μ below the surface and 1000 μ behind the margin). The narrower hyphae beyond the arc obviously developed during a renewed growth of what at the time constituted the margin.

The trama of the spines is usually very much different from the context of the pileus in that it consists of both generative and skeletal hyphae. Such cases as in UC 669567 in which the same specimen possesses spines full of skeletals and others completely without any may perhaps be considered exceptional. The origin of the skeletals seems equally subject to some variation. Most skeletals arise in the basal portion of the spine, either as a side-branch or as the distal end of a generative hypha (Fig. 39), but some have their origin deeper in the context of the pileus. They constitute the main body of the axis of a spine but are to an increasing extent substituted by generative hyphae toward the periphery. Running down the length of a spine, in a somewhat undulating course, the skeletals gradually increase in width, up to 4.5–6.3(–7.2) μ, and become steadily thicker walled (Fig. 40, drawn after the situation about half way down the spine). Farther toward the tip of the spine the skeletals taper to 3–4.5 μ in width and their cell-walls at the very apex become less than 0.5 μ thick. They do not curve sideways to form cystidia. At their distal ends the skeletal hyphae are filled with a fluid which causes the spines in the fresh state to turn black when bruised, and to become covered at their tips with blackish crystals in dried specimens. Quite a number of the skeletals appear septate at their apices, with the septa convex toward the apex and sometimes numbering as many as eleven, and becoming thinner the farther away from the apex (Fig. 41).

The tramal hyphae in the spines (Fig. 40) run of necessity more parallel and their septa are spaced at shorter intervals, but otherwise they are not different from the generative hyphae in the context of the pileus. They are 2.7–4.5 μ wide and the peripheral hyphae tend to have somewhat thicker walls than those nearer the axis of the spine. Especially the terminal cells may have the cell-walls 0.5–1 μ thick. These terminal cells end below or at the level of the subhymenial tissue in the middle part of the spine, but close to its tip (at 125 μ distance from the tip in the case examined, Fig. 42), where there is no trace of a subhymenium, they curve outward, projecting freely into the air. They differ from true gloeocystidia in that they are septate and lack resinous contents. It should be noted that the generative hyphae do not reach as far as the skeletals, ending about 60 μ short of the apices of the latter (Fig. 41). The basidia possess clamp-connections.

In connection with the occurrence of septa in the apical portion of the skeletal hyphae in the spines, it may be pointed out that Corner (1932a: 73, fig.1a) described a similar septation in the skeletals of *Polystictus xanthopus*, whilst Boidin (1958a: 335, Fig. 2B) found it in the acanthophyses of *Stereum annosum*. Shortly afterwards Boidin (1958b: 49) used the name 'cloisons de retrait' for cross-walls which in

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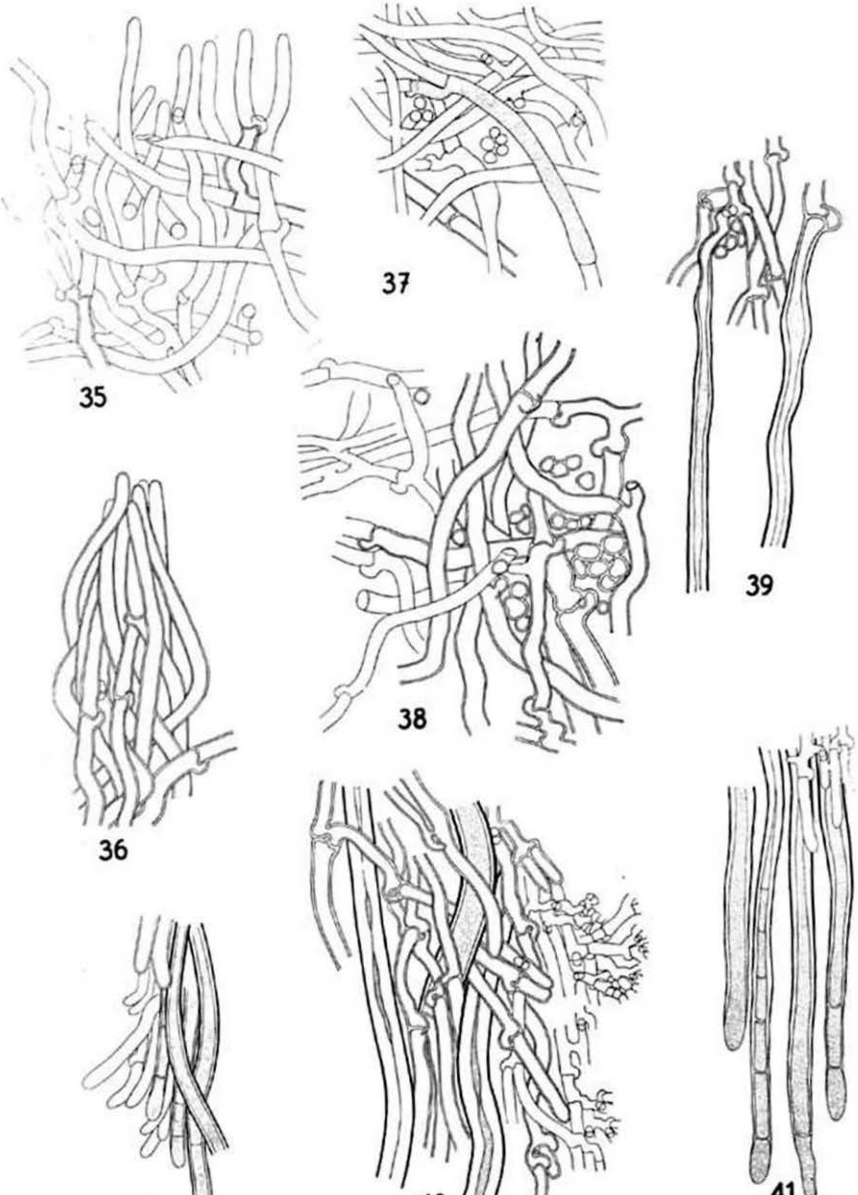
EXPLANATION OF FIGURES 35–42

Figs. 35–42. *Mycorrhaphium adustum* (Schw.) Maas G. — 35. Velutinous surface of the pileus, about 1 mm distant from the margin which is to the left; tips of the hyphae projecting freely into the air. — 36. Finely strigose surface at the base of the pileus, with the hyphae cohering into tufts. — 37. Glabrescent surface of the pileus, showing most of the hyphae deflected in the direction of the margin which is 500 μ distant. — 38. Transverse zone in the context, 270 μ below the upper surface, and 1000 μ behind the margin. Zone convex toward the margin which is to the left. — 39. Origin of skeletal hyphae in the base of a spine. — 40. Detail half way down the spine, showing skeletal and generative hyphae, the latter forming the subhymenial tissue toward the side of the spine. — 41. Skeletals from the tip of a spine, showing the 'cloisons de retrait' in some of them, and some generative hyphae which do not reach as far as the skeletal hyphae. — 42. Detail of the side of a spine 125 μ back from its apex, showing some skeletals and generative hyphae, the tips of the latter curving sideways (all figures × 700).



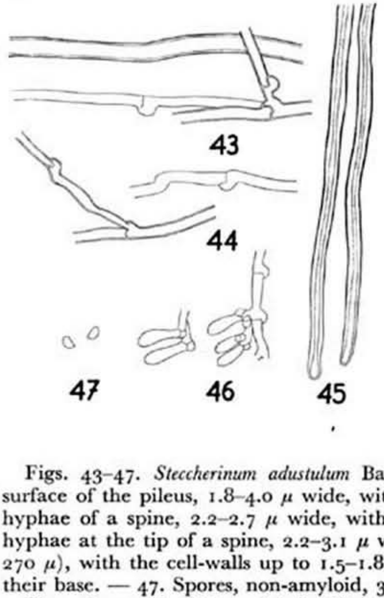
Figs. 35–42

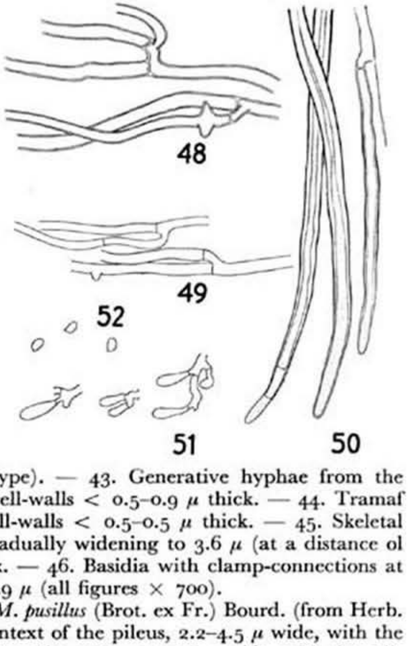
general separate the living contents in hyphae from the dead portions, and which apparently also occur in species of various corticiaceous genera like *Corticium*, *Vuilleminia*, and (1961: Fig. 4, 5) *Peniophora*.

A second species of the present genus is **Mycorrhaphium pusillum** (Brot. ex Fr.) Maas G., *comb. nov.* [*Hydnum pusillum* Brot., Fl. lusit. **2**: 470. 1804; *ex* Fr., Syst. mycol. **1**: 407. 1821 (basionym). — *Leptodon pusillus* (Brot. ex Fr.) Quél., Ench. Fung. 192. 1886; Fl. mycol. 441. 1888. — *Steccherinum pusillum* (Brot. ex Fr.) Banker *in* Mycologia **4**: 313. 1912. — *Pleurodon pusillus* (Brot. ex Fr.) Bourd. & Galz. *in* Bull. Soc. mycol. France **30**: 275. 1914; Hym. France 439. 1928. — *Mycoleptodon pusillus* (Brot. ex Fr.) Bourd. *in* Bull. Soc. mycol. France **48**: 220. 1932].

Banker, who studied material at Uppsala marked "*Hydnum pusillum* Brot.", came to the conclusion that it was identical with, and an earlier name for, his *Steccherinum adustulum*.

Bourdot & Galzin, on the other hand, believed (1914, 1928) that perhaps Fries's *Hydnum luteolum* was not distinct from *H. pusillum*. Afterwards, after having seen further





Figs. 43–47. *Steccherinum adustulum* Banker (type). — 43. Generative hyphae from the surface of the pileus, 1.8–4.0 μ wide, with the cell-walls < 0.5–0.9 μ thick. — 44. Tramal hyphae of a spine, 2.2–2.7 μ wide, with the cell-walls < 0.5–0.5 μ thick. — 45. Skeletal hyphae at the tip of a spine, 2.2–3.1 μ wide, gradually widening to 3.6 μ (at a distance of 270 μ), with the cell-walls up to 1.5–1.8 μ thick. — 46. Basidia with clamp-connections at their base. — 47. Spores, non-amyloid, 3.1 × 1.9 μ (all figures × 700).

Figs. 48–52. *Mycoleptodon luteolus* (Fr.) Bourd./*M. pusillus* (Brot. ex Fr.) Bourd. (from Herb. Bourdot). — 48. Generative hyphae from the context of the pileus, 2.2–4.5 μ wide, with the cell-walls < 0.5–0.9 μ thick. — 49. Tramal hyphae of a spine, 2.2–3.1 μ wide, with the cell-walls c. 0.5 μ thick. — 50. Skeletal hyphae at the tip of a spine, 2.2–2.7 μ wide, gradually widening to 3.6 μ (farther back), with the cell-walls up to 1.8 μ thick. — 51. Basidia without clamp-connections. — 52. Spores, non-amyloid, 2.8–3.1 × 1.9 μ (Figs. 48–51: Herb. Bourdot No. 4189; Fig. 52: Herb. Bourdot No. 41410; all figures × 700).

collections, Bourdot (1932) became convinced that both names referred to one and the same species.

Examination of both Banker's type specimen of *Steccherinum adustulum* (U.S.A., New York, Mohawk, summer [18]90, Mrs. W. C. Lobenstine; NY) and Bourdot's material of *Mycoleptodon luteolus/pusillus* (FRANCE, bois de Séganges, près Moulins, août 1888, *H. B[ourdot]*, Herb. Bourdot 4189; Forêt de Bagnolet, 23 VIII 1927, *F. Rémy*, Herb. Bourdot 41410; PC) showed that with the exception of a single character the former is identical with the latter. The one difference, as illustrated in Figures 43–47 and 48–52, is that the American material possesses clamp-connections, which are absent from the European material. Ten further collections from NY, and two more from France (Montbéliard, Bois de Thür, 3 Aug. 1956, *H. S. C. Huijsman*; L 956.110-617. — Lougres (Doubs), 28 Sept. 1956, *Mrs. L. Huijsman*; L 956.147-373) confirm the fact that the presence of clamps is as constant a feature in the specimens of *Mycorrhaphium pusillum* of North America as is the absence in those of Europe. It would seem that the specimens of both continents belong to two constant races of the same species.

No mention has been made with regard to the number of spores per basidium in either North American or European literature. It proved unexpectedly difficult to ascertain this number from the dried material, the best result being obtained in Bourdot's material from Bagnolet, which gave a faint indication of the basidia producing four sterigmata.

A third collection in Bourdot's herbarium under the name of *Mycoleptodon luteolus* (Franois, près Besançon, X 1928, *P. Cretin*, Herb. Bourdot 42301; PC) contains some resupinate specimens with the upper margin reflexed. These agree in all respects, excepting the clamps, with the resupinate specimens in several of Banker's collections.

Miller (1935: 364) and Miller & Boyle (1943: 53) reported the hyphae of *Steccherinum pusillum* to be thick-walled and without clamp-connections. This, in the American race, is correct only for the skeletal hyphae in the spines.

The fungus described by Benzoni (1933: 10) under *Hydnum pusillum* does not represent this species, as the spores were said to measure 5 × 4 μ, while the fruit-bodies were collected from dead stems of *Pteris aquilina*.

PHELLODON P. Karst.—Fig. 53–55

Phellodon P. Karst. *in* Rev. mycol. **3**/No. 9: 19. 1 Jan. 1881 & *in* Medd. Soc. F. Fl. fenn. **6**: 15. 1881. — Type species: *Hydnum nigrum* Fr. ex Fr.

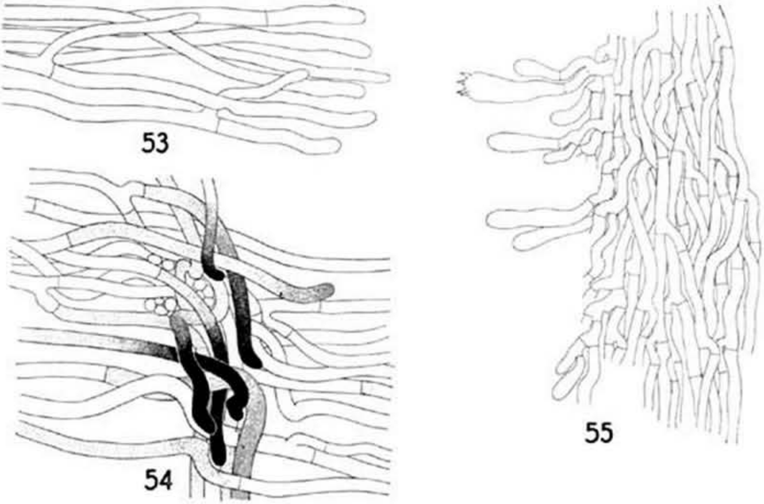
Context firm (with a hard core in some species), zoned, coloured, consisting of generative hyphae. Hyphae not inflating, always thin-walled, without clamp-connections. Tramal hyphae of the spines similar, somewhat narrower, lacking clamp-connections. Basidia without clamps. Cystidia or gloeocystidia absent.

MATERIAL EXAMINED: *Phellodon niger* (Fr. ex Fr.) P. Karst. (CZECHOSLOVAKIA, South Bohemia, Šalmanovice; L 960.216-709. — SWEDEN, Gotland, Othem, Klints; L 960.260-867).

The entire surface of the pileus, which in young specimens of *Phellodon niger* is finely plushy, consists of erect hyphae of a single kind, the generative hyphae. These project into the air more or less parallel to each other and at right angles to the surface (Fig. 53, which has been taken from the very margin). The hyphae are 2.3–3.6 μ wide, very thin-walled, with the cell-walls less than 0.5 μ thick, sparingly branched, septate, without anastomoses or clamp-connections, and filled with an oily matter. Like in *Hydnellum*, the tips of the hyphae deflect after some time, forming a transverse zone which appears nearly black on account of the rapidly darkened contents (Fig. 54). The thickness and density of the zone as well as its distance from the surface vary a great deal.

No matter how far back into the interior of the fruit-body the hyphae are retraced, they retain much the same width, which varies from 2.7 to 4.5 μ, and they never have the cell-walls thicker than 0.5 μ. The hyphae are firmly coherent, much more so than in *Hydnellum*, which makes it hard to be certain whether or not there are anastomoses. If there are, these are extremely rare, which makes it probable that the coherence of the hyphae alone is responsible for the firmness of the tissue.

The hyphae in the spines (Fig. 55) are in general somewhat narrower than the hyphae of the pileus, being 2.2–3.6 μ in diameter, and the septa are spaced at shorter intervals. Side-branches are frequent, anastomoses and clamp-connections



Figs. 53–55. *Phellodon niger* (Fr. ex Fr.) P. Karst. — 53. Generative hyphae from the margin of the pileus. — 54. Generative hyphae at some distance from margin (which is to the right), deflected to form a transverse zone; darkened contents adding to mark the zone. — 55. Detail of a spine, showing tramal hyphae and hymenium (all figures × 700).

are absent. Toward the sides of the spine the side-branches develop the basidia which also lack clamps. There are neither gloeocystidia nor cystidia.

SARCODON P. Karst.—Figs. 56–60

Sarcodon P. Karst. *in* Rev. mycol. **3**/No. 9: 20. 1 Jan. 1881 & *in* Medd. Soc. F. Fl. fenn. **6**: 16. 1881. — Type species: *Hydnum imbricatum* L. ex Fr.

Context soft, fleshy, not zoned,[1] white or coloured, consisting of generative hyphae only. Hyphae inflating, thin-walled to moderately thick-walled, with or without clamp-connections. Spines with tramal hyphae similar to the generative hyphae. Basidia with or without clamp-connections, which coincides with the presence or absence of the latter in the context. Cystidia and gloeocystidia lacking.

MATERIAL EXAMINED: *Sarcodon laevigatus* (Sw. ex Fr.) P. Karst. (FRANCE, Belfort; L 956.110-779); for details also *S. fuligineo-violaceus* (Kalchbr. apud Fr.) Pat. (NETHERLANDS, Nunspeet; L 960.318-845); *S. imbricatus* (L. ex Fr.) P. Karst. (FRANCE, Martignat; L 952.199-125), and *S. scabrosus* (Fr.) P. Karst. (NETHERLANDS, Ulvenhout; L 951.255-224).

The surface of the pileus in mature specimens of *Sarcodon laevigatus* is usually found to be smooth and glabrous, under circumstances becoming areolate or scaly, but in young specimens it is finely velutinous, which character is best retained in the growing margin.

The velutinous margin is composed entirely of closely packed generative hyphae which project at right angles to the surface (Fig. 56). They are 2.7–4.5 μ wide, thin-walled, filled with an oily matter, and possess clamp-connections at all septa. Occasional side-branches arise from some of the hyphae, while processes, developing from the sides of others, touch adjacent hyphae, thus initiating anastomoses. Both side-branches and anastomoses become more frequent in older parts of the pileus (Fig. 57, showing the situation 200 μ farther down the velutinous covering), the side-branches often arising from clamp-connections.

Farther toward the centre of the pileus, the surface changes from velutinous to radiately fibrillose, then becomes glabrous. The explanation is that farther away from the margin increasingly longer portions of the hyphae bend down radially. At first, that is just behind the margin, the individual hyphae are still clearly distinguishable (Fig. 58), but with age, which means farther away from the margin, the cells shrivel and their walls gelatinize and become agglutinated, thus forming a firm and shining pellicle. In the course of the development of the fruit-body this pellicle ruptures into areoles or scales. It is not known whether in the scaly species, such as *Sarcodon imbricatus* and *S. scabrosus*, the pileus in the youngest stages is velutinous, too, as such stages were not available.

The context, which is devoid of any zonation, seems at first sight to be made up of two different kinds of hyphae, one kind composed of very narrow cells, the other of very wide cells. It appears, however, that rearward the narrow hyphae gradually widen into the inflated ones, whilst in their turn the latter can again be seen to arise from narrow-celled hyphae. This succession of narrow (3–5 μ wide)

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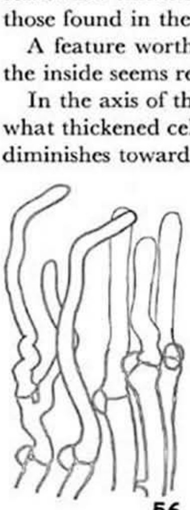
[1] However, see remark on *Sarcodon stereosarcinon*, p. 390.

and inflated (up to 14 μ wide) generative hyphae is illustrated in Fig. 59 (drawn after the situation at a distance of 25 mm from the margin, and 5 mm below the surface). It is of interest to note that even in older tissues of the pileus the hyphae continue to produce actively growing shoots which wedge themselves between the surrounding hyphae. Frequently, some part of the terminal cell of the shoot attaches itself to an adjacent hypha, thus initiating anastomosis, but in rare cases it is the tip of the cell which has become fused.

The cell-walls, which are less than 0.5 μ thick in the narrow hyphae, become somewhat thickened in the inflated hyphae, and may reach a thickness of 1 μ in those found in the base of the spines on the underside of the pileus.

A feature worth mentioning is that in some of the inflated cells the cell-wall on the inside seems reinforced by a spiral rib.

In the axis of the spines hyphae with the cells inflated up to 10 μ and with somewhat thickened cell-walls constitute an important element, but their number rapidly diminishes toward the sides and the tip of the spines. At the periphery of the spines



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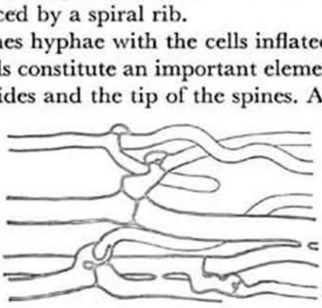

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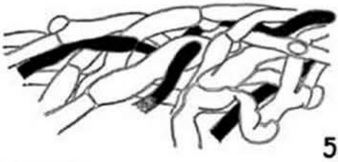

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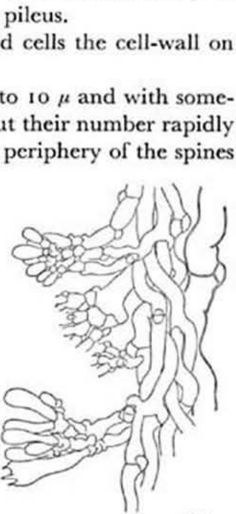

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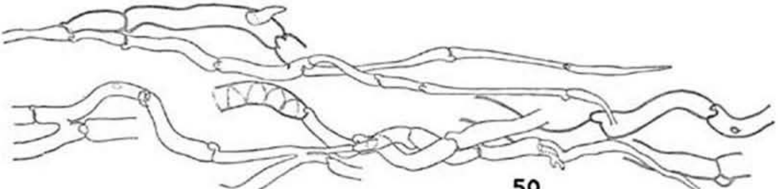

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Figs. 56–60. *Sarcodon laevigatus* (Sw. ex Fr.) P. Karst. — 56. Generative hyphae from the velutinous margin of the pileus. — 57. The same 200 μ farther down the velutinous covering (figure turned 90° round to the right). — 58. Generative hyphae behind the growing margin, deflected radially to form the pellicle. — 59. Detail of the context, showing the succession of narrow and inflated cells in the hyphae; 25 mm behind the margin of the pileus, 5 mm below the upper surface. — 60. Detail of a spine, with tramal hyphae and hymenium (Fig. 59, × 200; all others × 700).

thin-walled hyphae 2.7–6 μ wide prevail, and from these numerous side-branches curve outward to form the hymenium (Fig. 60). There are neither gloeocystidia nor cystidia. Species which possess clamp-connections in the context (*S. imbricatus, S. laevigatus*), also have them in the trama of the spines and at the base of the basidia. If there are no clamps in the context (*S. fuligineo-violaceus, S. scabrosus*), they are also absent from the trama of the spines and the basidia.

STECCHERINUM S. F. Gray—Figs. 61–65

Steccherinum S. F. Gray, Nat. Arrang. Brit. Pl. 1: 597, 651. 1821. — Type species: *Hydnum ochraceum* Pers.

Context pliable, tough, not zoned, pallid to white, dimitic, consisting of generative and skeletal hyphae. Generative hyphae branched, septate, with clamp-connections, thin-walled. Skeletals arising from the generative hyphae, either as a terminal continuation or as a side-branch, thick-walled, aseptate. Trama of the spines dimitic. Basidia with clamp-connections. The tramal cystidia formed by the swollen ends of skeletals curving outward, thick-walled, encrusted.

MATERIAL EXAMINED: *Steccherinum ochraceum* (Pers. ex Fr.) S. F. Gray (NETHERLANDS, 's-Graveland; L 958.319-049).

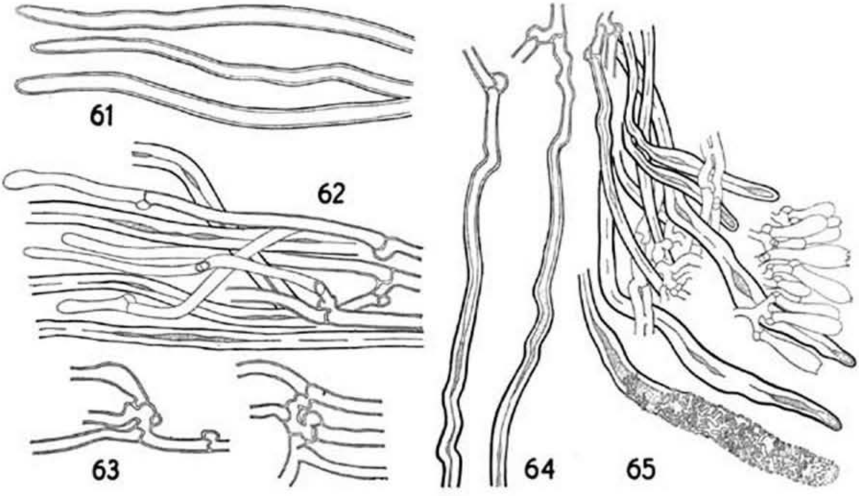
In a young specimen of *Steccherinum ochraceum* the margin of the pileus is minutely plushy and, seen under the microscope, appears to consist of fairly rigid hyphae. These hyphae, which have rounded or slightly pointed tips (Fig. 61), are 3.6–4.5 μ wide at their apices and retain much the same diameter when traced back over a distance of 200 or 300 μ. Their cell-walls, however, gradually thicken rearward. At the apex the cell-walls are about 0.5 μ thick, 100 μ farther back they measure 0.9–1.3 μ, and still 100 μ farther back 1.8–2.2 μ, so that in places the lumina are obliterated. Further characters of these hyphae are the lack of side-branches and septa, their somewhat undulating course, and longitudinal growth. These criteria determine the hyphae as skeletal hyphae. They are found without interruption throughout the entire pileus, which explains the lack of zones in the context. Seen under a low magnification, the context seems made up solely of skeletals, and only under a higher magnification can a second type of hyphae be detected. These hyphae, the generative hyphae, do not reach the extreme margin, but end about 200 μ short of the apices of the skeletals. (Fig. 62). (The strigose to tomentose upper surface of the pileus is likewise formed of these two kinds of hyphae, but here the generative hyphae end at almost the same height as the skeletals.) The generative hyphae are 2–3.6 μ wide at the tip, septate, with clamp-connections at all septa, and extremely thin-walled, with the cell-wall less than 0.5 μ at the apex. Side-branches do occur, rather sparingly at first, but with increasing frequency toward the base of the pileus. A side-branch often originates from a clamp and a second side-branch may arise in its turn from a clamp of the first branch. The knot resulting from this process becomes progressively intricate the more side-branches come into play, and the tangle becomes inextricable when anastomoses with adjoining hyphae are established. Figure 63 shows some simple cases. Obviously, these knots are largely responsible for the resistance of the context to tearing.

Occasionally, hyphae may be found intermediate between generative and skeletal hyphae in that they are extremely long and thick-walled, but possess one or two septa with clamp-connections close to their origin.

At a distance of 600–700 μ from the margin some of the skeletals are seen to originate from a generative hypha, either simply as a terminal continuation or, more frequently, as a side-branch (Fig. 64). It is quite possible that there exist even longer skeletals.

The trama of the spines consists of the same two kinds of hyphae, generative hyphae and skeletals, and here, too, the latter form the bulk. The tip of a spine is entirely formed of skeletal hyphae which are similar to those of the extreme margin of the pileus, except that at their apices some of them have one to several thin cross-walls, the 'cloisons de retrait' of Boidin (see also under *Mycorrhaphium*).

Farther away from the tip of a spine several of the more peripheral skeletals are seen to curve outward, forming the tramal cystidia. The deflected portions are more or less fusiformly swollen, up to 7–10 μ wide, and heavily encrusted (Fig. 65).



Figs. 61–65. *Steccherinum ochraceum* (Pers. ex Fr.) S. F. Gray. — 61. Skeletal hyphae from the extreme margin of the pileus. — 62. Detail of the context 200 μ behind the margin, showing thick-walled skeletals, and thin-walled generative hyphae, the latter with clamp-connections. — 63. Fragments of generative hyphae, forming anastomoses and developing side-branches from the clamps. — 64. The origin of two skeletal hyphae 600–700 μ behind the margin, arising from generative hyphae; skeletals in the spines develop in exactly the same manner. — 65. Detail of a spine, showing skeletals and generative hyphae. The former deflecting sideways and developing into encrusted tramal cystidia; the latter giving rise to the hymenium (all figures × 700).

In the figure some of the cystidia are depicted without their coating of crystals to show their true form.

The generative hyphae showing among the skeletals are thin-walled and possess clamp-connections, but differ from the generative hyphae of the pileus in that anastomoses are much more frequent, while septa occur at much shorter intervals. Toward the sides of a spine the generative hyphae give rise to the subhymenial tissue and the basidia, the former with clamp-connections at all septa, the latter at their bases (Fig. 65).

Apart from the type, the following were examined and recognized as true species of the present genus: *Steccherinum fimbriatum* (Pers. ex Fr.) John Erikss. (NETHERLANDS, 's-Gravenzande, Staelduinen; herb. M. A. Donk); *Steccherinum laeticolor* (Berk. & Curt.) Banker (U.S.A., Iowa, Yellow River, Postville; herb. M. A. Donk); *Steccherinum litschaueri* (Bourd. & Galz.) John Erikss. (according to the description by the original authors); **Steccherinum murashkinskyi** (Burt) Maas G., *comb. nov.* (basionym: *Hydnum murashkinskyi* Burt *in* Ann. Missouri bot. Gdn **18**: 477. 1931; SIBERIA, Distr. Tara; herb. M. A. Donk); *Steccherinum rhois* (Schw.) Banker (U.S.A., Pennsylvania, West Brownsville; UC 525476); and *Steccherinum setulosum* (Berk. & Curt.) Miller (U.S.A., Iowa, Wellman; herb. M. A. Donk).

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NEW GENERA OF FUNGI—VIII [1]

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The genus *Pseudohiatula*, based on hymeniform structure of epicutis with interspersed dermatocystidia or trichodermial-palisadic structure without dermatocystidia, contains species, all belonging in the same tribus (Marasmieae), but does not seem to be sufficiently homogeneous to be maintained sensu lato. It is now restricted to the type species (*P. cyatheae*), and *P. callistosporioides* is united with *Cyptotrama macrobasidium* in the genus *Cyptotrama*; *P. irrorata* and *P. panamensis* (perhaps also *P. ohshimae*) are referable to *Hydropus* (where species with projecting dermatocystidia and with muricate pleurocystidia should be admitted); *P. conigenoides, esculenta, stephanocystis*, and *tenacella* are placed in a new genus, *Strobilurus*, and *P. cinnamomea* in another new genus, *Physocystidium*.

The genus *Pseudohiatula* is characterized by a very specific structure of the epicutis which consists of a corticate hymeniform layer of rather broad elements, with larger dermatocystidia interspersed. On the basis of the species known formerly and under consideration of the characters of the type species known until recently, the species of Marasmieae (Tricholomataceae) with this particular cuticular structure appeared to form a fairly homogeneous group corresponding to an emended concept of the genus *Pseudohiatula* such as circumscribed in my book 'Agaricales in modern taxonomy', 2nd ed., C. Cramer, Weinheim/Bergstr., Germany, 1962.

A revision of the type element of the genus *Pseudohiatula* has become possible because of the discovery of the respective species in Brazil (Singer *in* Vellozia, 1962), but the corresponding readjustment in the generic taxonomy of the Tricholomataceae—Marasmieae has been postponed until more data on the affinities of the other species entering *Pseudohiatula* in the classification of 1962 became available. This is also the reason for the delayed publication of the present part VIII of 'New genera of fungi'.

However, it is now possible to discuss the affinity of these species in their relation to the type species, *Pseudohiatula cyatheae*, and in their relation to other genera of the same tribus. We are now convinced that, within *Pseudohiatula* in its conception of 1962, there are five groups or elements which are not necessarily divided from other genera of the same tribus by a hiatus more evident or sharper than the one that divides them among each other. In other words, it must be admitted that

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[1] Earlier parts of this series have been published as follows: I *in* Mycologia **36**: 358–368. 1944. — II *in* Lloydia **8**: 139–144. 1945. — III *in* Mycologia **39**: 77–89. 1947. — IV *in* Mycologia **40**: 262–264. 1948. — V *in* Mycologia **43**: 598–604. 1951. — VI *in* Lilloa **23**: 255–258. 1951. — VII *in* Mycologia **48**: 719–727. 1956.

Pseudohiatula sensu lato (1962) is perhaps an example of a genus in which too much weight has been given to a single anatomical character—the structure of the cuticular layer of the pileus—whereas in reality, other characters, thus far considered as secondary, appear to show that the genus should be restricted to the only original species and the other elements be separated generically from it. This is a situation comparable to the one prevailing in the case of *Cantharellula* sensu lato, which also had to be split up into a number of related genera (see 'New genera of fungi—VII').

The principal elements of *Pseudohiatula* sensu lato are:

(1) The type, *P. cyatheae* (Sing.) Sing., with amyloid spores, bilateral trama, with irregularly occurring clamp connections, with insititious stipe, habit of a mycenoid-pluteoid agaric, with fuscous intracellular pigment and rounded-free lamellae, growing on Pteridophyta (tree ferns) in the tropics (and in hothouses).

(2) *P. callistosporioides* Sing. (in print) with vaguely pseudoamyloid spores which become slightly pigmented in age, bilateral trama, with constant clamp connections, with basal mycelial fibrils, habit collybioid, with ochraceous-melleous incrusting or membranal pigments and rounded-adnexed or subfree (to broadly adnate) lamellae, growing on dicotyledonous wood (*Alnus jorullensis*) in the (sub-)tropics.

(3) *P. conigenoides* (Ellis) Sing. with all the principal characters of the group of boreal species inhabiting conifer cones (but growing on *Magnolia* cones), with inamyloid small narrow spores which remain hyaline, regular trama of the *Clitocybe*-subtype, without clamp connections, with basal pseudorrhiza, habit collybioid, with frequent crystalline incrustations on the tips of the multinucleate cystidial elements of hymenium and covering layers, growing in the cold-temperate to warm-temperate zones of the Northern hemisphere.

(4) *P. irrorata* (Pat. apud Duss) Sing. with inamyloid spores, regular trama of the *Clitocybe*-subtype, with irregularly occurring clamp connections, without pseudorrhiza, but with sparse mycelial basal fibrils, with frequent crystalline incrustations on the hymenial cystidia, the latter pseudoamyloid, habit collybioid, growing on wood in the tropics.

(5) *P. cinnamomea* (Dennis) Sing. with aberrant epicutis, consisting of a trichodermial palisade of multiseptate elements with pigmented walls and without differentiated dermatocystidia, with regular trama, with numerous clamp connections, without pseudorrhiza, with broad non-muricate cystidia, habit collybioid, lamellae adnate, growing on wood in the tropics.

The question comes up whether these additional elements (2–5) are close enough to existing genera to be incorporated in the latter, or referable to new genera to be described for them. This question cannot be answered for all these species in the same way.

As for group 2, with *P. callistosporioides*, it appears that this is not generically separable from another genus with bilateral hymenophoral trama, viz. *Cyptotrama* Sing. (*in* Lilloa **30**: 375. 1960), with the type species *C. macrobasidium* Sing. We therefore add to it, as second species, *C. callistosporioides* Sing., ined.

Group 3 has repeatedly been compared with *Marasmius*, sect. *Alliacei*, yet does not seem to fit into the genus or section on the grounds of a number of characters, such as constant absence of clamp connections, combined and correlated with the presence of a pseudorrhiza, the presence of muricate-incrusted cystidia and dermatocystidia, etc. Since there is likewise no other genus described until now where the species of this group might reasonably enter, we are proposing the following new genus:

Strobilurus Sing., *gen. nov.*

Habitu collybioideo-submarasmioideo, epicute hymeniformi, dermatocystidiis in pileo et stipite praesentibus, cystidiis hymenialibus muricatis; sporis inamyloideis, subminutis, angustis, levibus; tramate hymenophorali regulari typi *Clitocybarum*, hyphis defibulatis; pseudorrhiza praesente, e conis *Magnoliae* et coniferarum variarum orta. Typus generis: **S. conigenoides** (Ellis) Sing., *comb. nov.* (*Agaricus conigenoides* Ellis *in* Bull. Torr. bot. Cl. **6**: 76. 1876). Aliae species sunt: **S. esculentus** (Wulf. ex Fr.) Sing., *comb. nov.* (*Agaricus esculentus* Wulf. *ex* Fr., Syst. mycol. **1**: 131. 1821); **S. stephanocystis** (Hora) Sing., *comb. nov.* (*Pseudohiatula stephanocystis* Hora *in* Trans. Brit. mycol. Soc. **43**: 455. 1960); **S. tenacellus** (Pers. ex Fr.) Sing., *comb. nov.* (*Agaricus tenacellus* Pers. ex Fr., Syst. mycol. **1**: 131. 1821).

The generic position of group 4 (*P. irrorata*) is obviously in the genus *Hydropus*, provided an emended description of this genus and the incorporation of a new section is permitted. This is so because the not truly bilateral gill trama, the fuscous intracellular pigment of the epicutis, the pseudoamyloid pleurocystidia, and the adnate lamellae and non-insititious stipe place *P. irrorata* in the group of species with inamyloid spores recently (Singer *in* Vellozia, 1962) admitted in *Hydropus*[2] as section *Mycenoides* Sing. from which *P. irrorata* differs in muricate cystidia and long dermatocystidia on the pileus; parts of the trama are gelatinized. It will be noticed that in the genus *Hydropus* in its present circumscription, a certain extension of range in the structure of the epicutis and hypodermium is permitted, and it would not seem correct to exclude *P. irrorata* on the basis of the dermatocystidia or the gelatinized hypodermial hyphae. As for the muricate cystidia, it will be noted that in most genera where these exist, species without murication (or with a strongly reduced one) are likewise admitted.

Consequently, we propose the new section:

Hydropus, sect. **Irrorati** Sing., *sect. nov.*

Sporis inamyloideis; hypodermio gelatinoso; epicute dermatocystidiis permagnis ornata; cystidiis hymenialibus laterum lamellarum nec non ad aciem crystallis muricatis; fibulis sparsis, interdum nullis(?). Typus sectionis: **H. irroratus** (Pat. apud Duss) Sing., *comb. nov.* (*Collybia irrorata* Pat. *apud* Duss, Enum. meth. Champ. Guad. Mart. 49. 1903). — It appears probable that *Marasmius ohshimae* Hongo & Matsuda [*Pseudohiatula ohshimae* (H. & M.) H. & M. ex Hongo] is another species of this section.

As for the fifth group of elements formerly attached to *Pseudohiatula* sensu lato, viz. *P. cinnamomea*, we cannot find any closely related genus or section, except, perhaps, again *Marasmius* sect. *Alliacei* with which we have compared it recently

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[2] The reader is herewith asked to correct a printing error in 'Agaricales in modern taxonomy', 2nd ed., p. 389, line 4, where the spores should have been described as *amyloid*, not *inamyloid*.

(Singer *in* Sydowia **12**: 76. 1958) although we came then to the conclusion—which we maintain—that *Marasmius* is generically different. One may possibly look for affinity in genera of other families (not Tricholomataceae), for example in *Cystoderma* (Agaricaceae) or *Phaeomarasmius* (Cortinariaceae), but in *Cystoderma*, the cuticular layers are much more short-celled, in the way of an epithelium, and there is always a veil; in *Phaeomarasmius*, we know species with very pale spore print, e.g. *P. gregarius* Sing., but not white-spored species. If the complete absence of pigment in the spores were the only difference between *Phaeomarasmius* and *P. cinnamomea*, one might think of similar cases (*Hebeloma* and *Hebelomina*; *Cortinarius* and *Leucocortinarius*) in the Cortinariaceae, but the absence of pleurocystidia in all species of *Phaeomarasmius* known at present and the absence of a veil in *P. cinnamomea* seem to indicate that if there is any affinity between the two, it must be rather remote.

For these reasons, we see ourselves compelled to describe still another independent taxon for *P. cinnamomea:*

Physocystidium Sing., *gen. nov.*

Habitu collybioideo; epicute palisadica, trichodermiali, ex elementis erectis parallelis pluri-cellularibus consistente, sed cellulis elongatis nec subisodiametricis, dermatocystidiis absentibus; pigmento in epicute membranali atque intracellulari; cystidiis hymenialibus ad latera lamellarum tenui-tunicatis, ventricosis vel bulluliformibus, haud muricatis; sporis inamyloideis, ellipsoideis, subminutis, levibus; tramate hymenophorali regulari; hyphis fibulatis, inamyloideis, in hypodermio interdum leniter pigmento incrustatis; pseudorrhiza nulla; pileo cinnamomeo, velutino; stipite cavo, haud insiticio; carne concolori; velo nullo. Ad ligna tropicalia. Species typica: **P. cinnamomeum** (Dennis) Sing., *comb. nov.* (*Collybia cinnamomea* Dennis *in* Trans. Brit. mycol. Soc. **34**: 436. 1951).

This leaves without a definite place one more species of *Pseudohiatula* sensu lato, viz. *P. panamensis* Sing. Although this is a characteristic species, keying out in *Pseudohiatula* sensu lato, but certainly different from all other species, it has not been collected with sufficient macroscopical data to make it possible to arrive at a final conclusion, and some comparative studies would help in bringing about a clearer picture of the relation of this species with others discussed above, but were not obtainable on the material at hand. Nevertheless, it may be anticipated that the characters known to be found in this species refer it to *Hydropus*, probably section *Mycenoides* where it forms, perhaps, some sort of transition to section *Irrorati* because of the configuration of its epicutis.

The conclusions of the present paper are combined and condensed in the following key; this key permits the placing of all the elements which are contained in the genus *Pseudohiatula* sensu lato, and is therefore applicable to all white-spored Marasmieae with corticate and at the same time dermatocystidia-bearing epicutis and those with a trichodermial palisade:

A. Hymenophoral trama distinctly bilateral; spores amyloid, pseudoamyloid, or inamyloid, the old ones sometimes pigmented. Tropical genera . . Subtrib. PSEUDOHIATULINAE[3]

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[3] Subtrib. **Pseudohiatulinae** Sing., *subtrib. nov.* (trib. Marasmiearum familiae Tricholomatacearum). Epicute hymeniformi, dermatocystidiis praedita; tramate hymenophorali manifeste bilaterali. Typus subtribus: *Pseudohiatula* Sing. Genus alterum: *Cyptotrama* Sing.

B. Stipe insititious; lamellae free or subfree; pigment of cuticular layer of pileus sepia-fuscous, intracellular; on tree ferns . . . . *Pseudohiatula* (Sing.) Sing.
P. cyatheae (Sing.) Sing.

B. Stipe at base with mycelial fibrils, not quite insititious; lamellae rounded-subfree to squarely adnate; pigment of cuticular elements melleous to reddish fulvous, partly membranal or incrusting; on wood, rarely on foliage in tropical and subtropical forests
Cyptotrama Sing.

C. Basidia large, 37–44 × 8.2–10 μ; hypodermium not gelatinized; spores 7–7.5 μ broad; lamellae adnate . . . . *C. macrobasidium* Sing.

C. Basidia much smaller; hypodermium gelatinized; spores narrower; lamellae rounded-adnexed to subfree . . . . *C. callistosporioides* Sing.

A. Hymenophoral trama regular (at times of *Clitocybe*-subtype), not distinctly bilateral or absent; spores not amyloid and not pseudoamyloid, hyaline.

D. Epicutis hymeniform, with projecting dermatocystidia interspersed, these and/or the hymenial (pleuro-)cystidia generally muricate with a crystalline (calcium oxalate) incrustation, more rarely not muricate or with resinaceous incrustation; clamp connections often scarce or absent.

E. Mature dried material with epicuticular elements pigmented by a fuscous intracellular pigment; pseudorrhiza none; lamellae adnexed with decurrent ridges or more often adnate, not free or subfree
Subtrib. MYCENINAE: *Hydropus* (Kühn.) Sing.

F. Cystidia muricate; hypodermium gelatinized and other parts of trama also tending to be gelatinized . . . . Sect. *Irrorati* Sing.
H. irroratus (Pat. apud Duss) Sing.

F. Cystidia on sides of lamellae rather inconspicuous; trama not gelatinized, see
H. panamensis (Sing.) Sing.

E. Mature dried material with a different pigment in the epicuticular and hypodermial layers or without pigment. . . . . Subtrib. MARASMIINAE

G. Lamellae free or subfree; clamp connections none; pseudorrhiza present
Strobilurus Sing.

H. On conifer cones; stipe 1–3 mm thick; pileus 5–45 mm broad; lamellae more than 12; pigments in pileus ochraceous to blackish brown, abundant.

I. On pine cones; cystidia with rather thin (up to 0.8 μ) walls, either broadly rounded *or* context bitter and spores in profile subarcuate.

J. Spores in profile slightly arcuate; taste bitter; pileus generally grayish brown; cystidia mostly acute . . . *S. tenacellus* (Pers. ex Fr.) Sing.

J. Spores straight; taste mild; pileus generally ochraceous; cystidia not acute . . . . *S. stephanocystis* (Hora) Sing.

I. On spruce cones (*Picea*); cystidia mostly thick-walled; spores in profile straight . . . . *S. esculentus* (Wulf. in Jacq. ex Fr.) Sing.

H. On *Magnolia* cones; cystidia obtuse or acute, with walls up to 1.5 μ thick; stipe 0.5–1 mm thick; pileus 3–15 mm broad and whitish with ochraceous buff central portion; lamellae mostly up to 12 (not counting lamellulae); American species (New Jersey to Florida) . . *S. conigenoides* (Ellis) Sing.

G. Lamellae adnate or reduced; clamps present . . . . . . (see *Gloiocephala*)

D. Epicutis a trichodermial palisade, without differentiated dermatocystidia; hymenial pleurocystidia not mucronate or incrusted; clamp connections numerous. Tropics
Subtrib. MARASMIINAE: *Physocystidium* Sing.
P. cinnamomeum (Dennis) Sing.

In the following paragraphs, we supplement the present scheme by full descriptions or references to descriptions and illustrations of the species entering the *Pseudohiatula* complex:

1. PSEUDOHIATULA CYATHEAE (Sing.) Sing.

See Vellozia **1**, Rio de Janeiro. 1962.

2. CYPTOTRAMA MACROBASIDIUM Sing.

See Lilloa **30**: 375. 1960.

3. CYPTOTRAMA CALLISTOSPORIOIDES Sing., ined.

See Sydowia (in print).

4. HYDROPUS IRRORATUS (Pat. apud Duss) Sing.

Collybia irrorata Pat. *apud* Duss, Enum. meth. Champ. Guad. Mart. 49. 1903. — *Pseudohiatula irrorata* (Pat. apud Duss) Sing. *in* Lloydia **9**: 118. 1946. — *Micromphale irrorata* (Pat. apud Duss) Dennis *in* Trans. Brit. mycol. Soc. **34**: 457. 1951.

Prunulus pubescens Murrill *in* N. Amer. Fl. **9**: 341. 1916. — *Mycena pubescens* (Murrill) Murrill *in* Mycologia **8**: 221. 1916.

Pileus whitish, tending to pale pinkish buff or sordid ochraceous in the center, becoming dark brown from the center outwards but often remaining pallid in a marginal zone, minutely pubescent, not hygrophanous, often striate in marginal zone, with initially incurved margin, convex, but more or less flattened or even slightly depressed in the center, 8–15 mm broad.

Lamellae pure white or whitish, moderately broad, tridymous when mature, adnate, tending to become somewhat collariate, close; spore print white.

Stipe white, at base becoming concolorous with pileus, white pubescent all over, equal with slightly enlarged base, tubular, 20–45 × 1 mm, at base up to 1.5 mm, subinsititious but with sparse basal mycelial fibrils.

Context white, rather thin, in base later concolorous with surface, otherwise unchanging, flexible, not soft-fleshy, inodorous.

Spores 4–6.2 × 3–3.5 μ, ellipsoid or short-ellipsoid, with strongly eccentric well developed hilar appendage, hyaline, inamyloid with rather thin homogenous wall.

Hymenium: Basidia "18–20 × 3–4 μ, four-spored" (A. H. Smith on type of *P. pubescens*); cystidia both on edges and sides of lamellae, on sides and edges equal but shorter on edges, 40–52 (–70) × 7–24 μ, according to Smith rarely up to 98 μ long, mostly distinctly muricate at apex with a crystalline incrustation, but on edges many non-muricate ones present, varying from almost thin-walled to thick-walled, ventricose with somewhat narrowed apex and rounded-obtuse tip, pseudoamyloid, numerous.

Hyphae: hyaline in trama, inamyloid, with very scattered clamp connections or occasionally without any clamp connections. Hymenophoral trama subregular, consisting of a gelatinized lateral stratum which consists of hyphae which, in age, run in all directions, and may show a slightly diverging tendency in some sections, and with a subregular mediostratum which is much less gelatinized; whole gill trama scarcely subbilateral, but rather thick in KOH mounts, consisting of rather slender hyphae (± 5 μ diam.).

Covering layers: Pileus with a corticated epicutis which consists of broadly vesiculose elements, some piriform, e.g. 21 × 21 μ, filled in age with a fuscous brown intracellular pigment which may appear vacuolar and locally condensed, smooth, with thin walls; dermatocystidia among these cells rather numerous but easily collapsing and in dried material often difficult to demonstrate, causing the pubescent appearance of the pileus, generally thin-walled, but sometimes many thick-walled setoid (but hyaline) hairs present, dermatocystidia not muricate, 75–200 × 9–20 μ, with swollen base and thinner main body or tapering upwards to a rounded tip; surface of stipe with thin- and thick-walled dermatocystidia which resemble those of the pileus.

On decayed wood (type on *Guarea simplicifolia*), logs and vines, sometimes climbing up to 3 m above ground, fruiting from October until January in the lower montane rain forest of Jamaica, Guadeloupe, Trinidad, Venezuela and south to the Bolivian Yungas.

Material studied: GUADELOUPE: Typus (FH). — JAMAICA: *F. S. Earle 563*, Typus of *P. pubescens* (NY). — TRINIDAD: *Dennis 117* (K). — VENEZUELA: *Dennis 117A* (K). — BOLIVIA: Nor-Yungas, Charobamba, *Singer B754* (LIL).

5. **Hydropus panamensis** (Sing.) Sing., *comb. nov.*

Pseudohiatula panamensis Sing. *in* Mycologia **47**: 772. 1955.

For description, see l.c.

6. STROBILURUS TENACELLUS (Pers. ex Fr.) Sing. (sensu Schroet., Kühn. & Romagn.)

Illustrated and described by Bresadola (Icon. mycol. **5**: 210. 1928, as *Collybia esculenta*); Favre (*in* Schweiz. Z. Pilzk. 166–7, fig. 3. 1939), and discussed under the name of *Pseudohiatula favrei* by Tuomikoski (*in* Karstenia **2**: 30. 1953[4]). See also Knecht (*in* Schweiz. Z. Pilzk. **39**: 156–166. 1961).

7. STROBILURUS STEPHANOCYSTIS (Hora) Sing.

This species was first distinguished as a species by Favre (as *Marasmius conigenus*, l.c., p. 646–8, fig. 2), and as a subspecies by Singer (as ssp. *pini* Sing. *in* Ann. mycol., Berl. **41**, 1943). It was correctly stated by Kühner & Romagnesi that the name *A. conigenus* cannot apply to this species, and therefore the latter was keyed out by them (Flore anal. p. 94) as *Collybia stephanocystis* Kühn. & Romagn., but without a Latin diagnosis. This same epitheton was later taken up by Hora to describe validly a new species under *Pseudohiatula*. This is a common species in Europe which I have restudied as to its macro- and microscopical characters, ecology and phaenology, and which is well illustrated and described by various authors, particularly by Bresadola [Icon. mycol. **5**: pl. 210(1). 1928, as *Collybia esculenta*] and Favre (l.c.). Moser has it as *Pseudohiatula conigena*.

What the true *Agaricus conigenus* of Fries really is, is very difficult to state. Kühner & Romagnesi (l.c., p. 96) come to the conclusion (which is also that of Lange) that this is the same as *Baeospora myosurus* (Fr.) Sing., and this is apparently also the conclusion of Tuomikoski. Imazeki & Hongo describe and illustrate a fungus under the name *Pseudohiatula esculenta* ssp. *pini* [*Marasmius conigenus* (Fr. sensu Favre) Favre] (Col. Ill. Fung. Japan, no. 77. 1957) which at first glance may be considered the 'true' *A. conigenus* Fr., and it probably is, only it appears that the small spores

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[4] Like most spring agarics, *S. tenacellus*, more rarely, re-appears in late fall. The fruiting period alone can therefore be no argument against this interpretation of the classical species, as given by Schroeter, Favre, and Kühner & Romagnesi.

would make this a *Baeospora*, and most probably the same as *B. myosurus*, unless the cystidia are actually as illustrated by Favre (and Imazeki & Hongo) for *M. conigenus.*

8. STROBILURUS ESCULENTUS (Wulf. in Jacq. ex Fr.) Sing.

Excellently described and anatomically illustrated by Favre (*in* Schweiz. Z. Pilzk 668, fig. 4. 1939) as *Marasmius conigenus* ssp. *esculentus* and by Lange (Fl. agar. dan **2**: 13, pl. 44 F. 1936).

9. STROBILURUS CONIGENOIDES (Ellis) Sing.

Agaricus conigenoides Ellis *in* Bull. Torr. bot. Cl. **6**: 76. 1876. — *Collybia conigenoides* (Ellis) Sacc., Syll. Fung. **5**: 223. 1887. — *Pseudohiatula conigenoides* (Ellis) Sing. *in* Lilloa **22**: 320. 1951 ('1949').

Marasmius bombycirrhizus Berk. & Cooke *in* Grevillea **6**: 129. 1878.

Agaricus conigenus var. *pubescens* Ellis *in* herb. (no. 410). 1874.

Pileus white to yellowish, generally whitish with ochraceous buff central portion, minutely pubescent, with transparently striate margin, convex to almost applanate, not viscid, 2–15 mm broad.

Lamellae white, tending to become pale buffish yellow, moderately close or subdistant (mostly about 12 through-lamellae or fewer), subfree to free, inserted, moderately broad.

Stipe white, becoming ochraceous yellowish from the base upwards, or remaining whitish, finely pubescent, glabrescent, hollow, 15–40 × 0.5–1 mm; veil none; pseudorrhiza distinct, up to as long as the free portion of the stipe, whitish, silky-fibrillose.

Context white or whitish, unchanging; odor none.

Spores 5–7 × 2.3–2.7 μ, fusoid when seen frontally, slightly arcuate with applanate to convex inner side and oblique hilar portion when seen in profile (like those of *S. tenacellus*), smooth, thin-walled, inamyloid.

Hymenium: Basidia 19.5–22 × 4–4.5 μ, 4-spored; cystidia on edges and sides of lamellae, somewhat metuloid, at first thin-walled, but tending to become rather evenly thick-walled (wall up to 1.5 μ in diameter), hyaline, ampullaceous with gradually attenuate, cylindric or subcapitate apex, with rounded to acute tip, the latter with a hood of crystalline material, 25–42 × 8.5–11 μ.

Hyphae without clamp connections, inamyloid, filamentous; hymenophoral trama regular, slightly of the *Clitocybe*-type when young (with a small outer portion vaguely diverging towards the subhymenium, but trama not divided into mediostratum and lateral stratum), not gelatinized.

Cortical layer: Epicutis of pileus corticating the trama of the pileus by a hymeniform layer of vesiculose to almost subisodiametric cells which are hyaline and pedicellate, 25 × 10–17.5 μ, interspersed with ampullaceous dermatocystidia, the latter likewise hyaline, 40–50 × 7.2–15.5 μ, with a long or short ($^2/_3$ of total length to $^1/_4$ of total length of cell) 'neck', the latter with obtuse or subacute tip and not or indistinctly incrusted. Dermatocystidia numerous also on surface of stipe, gradually transformed into unicellular radiciform fibrils on the pseudorrhiza.

On buried cones of *Magnolia* (inflorescences or fruits), also on superficial fragments of the same, especially *M. glauca*, *M. fraseri*, and *M. grandiflora*, fruiting mainly in August.

Material studied: USA.: New Jersey, Newfield, August 1876, *Ellis* (Typus, FH); 1874, *Ellis* (as *A. conigenus* var. *pubescens*, FH). — West Virginia, *Ellis & Everhart*, NAF second series *3503* (FH). — Tennessee, Great Smoky Mountains Nat. Park, 10 Nov. 1936, *Hesler & Class* (FH). — Cades Cove, 20 Aug. 1940, *D. H. Linder* (FH). — North Carolina, *Coker* (FH). — Florida, Gainesville, Typus of *M. bombycirrhizus* (K).

10. PHYSOCYSTIDIUM CINNAMOMEUM (Dennis) Sing.

See descriptions and illustrations by Dennis (*in* Trans. Brit. mycol. Soc. **34**: 436. text-fig. 13 (p. 432) and pl. 23, fig. 13. 1951) and Singer (*in* Sydowia **12**: 76, fig. 4. 1958 (as *Collybia* and *Pseudohiatula cinnamomea*).

REVIEWS

L. E. Wehmeyer, *A world monograph of the genus Pleospora and its segragates*. (The University of Michigan Press. Ann Arbor.) Pp. xi + 451, 1 chart, 25 text-plates. Price: U.S. $ 15.00.

There are few groups, even among the notorious pyrenomycetes, that have been the source of new species to such an extent as the one covered by this monograph. Its author recognizes a big central and rather heterogeneous genus *Pleospora* (with 100 species) and some affiliated smaller genera, *Platyspora*, a new genus (3 species), *Clathrospora* (8 species), and *Pyrenophora* (7 species). 71 species are excluded from these genera. Dr. Wehmeyer had very profitable hunting, judging from the vast number of synonyms he admits and discusses under the accepted species. One would conclude that quite a number of the species as he defines them are broadly conceived or very variable. In the Chapter "Nomina dubia, confusa, nuda, etc." 62 specific names are treated; and in the Chapter "Species non vidi" no less than 223 specific names are listed or discussed. Thus, it would seem that there is still ample opportunity for further hunting and for redescription of as yet insufficiently known species.

Dr. Wehmeyer has striven to arrange the species of *Pleospora* known to him into subgenera, sections, and series: the probable phylogenetic relationships are presented in a chart. The 25 plates depict spores.

It is regrettable that the synonyms and the names discussed as nomina dubia, &c. are not printed in any special type (they are not even in italics). Not much consistency can be found in the abbreviations of the bibliographic citations of which quite a number are erroneous or incomplete. The method of citing types is often unsatisfactory. In nomenclatorial respects one will come across several deviations from the Code. For an example see Donk *in* Taxon. **11**: 120–122. 1962.

M. A. Donk

E. Müller & J. A. von Arx, *Die Gattungen der didymosporen Pyrenomyceten*. (Beiträge zur Kryptogamenflora der Schweiz. Band 11, Heft 2. 1962.). (Büchler & Co. AG. Wabern-Bern.) Pp. 923, 323 text-figures.

This very important publication is a continuation of "Die Gattungen der amerosporen Pyrenomyceten" by the same authors (J. A. von Arx & E. Müller, 1954). It gives much more than the title of the serial of which it forms a part would suggest. The authors have not set any geographical limits and take stock of the pyrenomycetes of the whole world on the generic level. With this second step they now have covered a considerable portion of the field.

Mycologists needed a review of the genera of pyrenomycetes on a world wide scale for more than half a century. After the survey in Engler & Prantl's "Die natürlichen Pflanzenfamilien" by Lindau (1897) a real torrent of new species and new genera deluged the accepted foundations and turned our knowledge of the groups into an unsurveyable mess. Many of the authors who contributed most to the increase of genera and species did little to put order into the flood or to correlate their findings with preceding work; and those who tried often failed spectacularly (Theissen & Sydow). In fact, the pyrenomycetes (especially the tropical ones) had become such an impenetrable jungle that the interest in these fungi waned considerably. It is my impression that with the present contribution its authors have cut a road deep into this jungle and made a considerable stretch of it accessible again.

Of each genus a generic description and often also a brief discussion and synonyms are given, followed by detailed descriptions of one or more of its species. Nearly all genera are illustrated by one or sometimes more figures showing microscopical sections through a fruit-body. The amount of work, time, and patience that must have gone into the book is staggering and one cannot but hope that the authors will be able to continue on this level and will round off this invaluable recasting of the classification of the pyrenomycetes.

That the adopted classification will pass completely unchallenged is of course not to be expected, but the importance of a work of this kind is that it sifts and classifies an enormous amount of facts into a solid basis for further discussion.

M. A. DONK

R. SINGER, *The Agaricales in modern taxonomy. Second, fully revised edition.* (J. Cramer. Weinheim. 1962.) Pp. vii + 915, frontispiece + 73 plates. Price: DM 120.—.

Since it is not well possible to review this important publication *in extenso* at this place, a few general remarks may suffice. The first edition appeared in 1951 and very soon established itself as the leading handbook to the taxonomy of the Agaricales. Its importance was not merely due to the fact that it filled a sorely felt gap, but also to its intrinsic value, as a survey of the group by a competent and highly original spirit with an astonishing knowledge of details gathered in four contiments by ardent study in both the herbarium and the field. Since the years that elapsed the author has continued expanding his knowledge, especially as to the South American species and also has steadily worked on the improvement of this second edition. Many genera have been radically revised and several important alterations made and the work has become almost a new book rather than a mere second edition.

The General Part perhaps underwent the least changes although many additions were made here, too. In the Special Part the main subdivisions have been kept, except that the Polyporaceae is treated as a distinct family consisting of a small kernel of the family as it is currently defined to which a number of agaric genera formerly included in the Pleurotaceae have been added. The merits of this alteration are still to be proved. The keys to the species of the separate genera have been omitted and replaced by indications where such keys are to be found.

The work is well printed and edited. The illustrations on the plates form a very mixed lot without much apparent coherence and of unequal execution.

There can be no doubt that this second edition will take the place of the first and will hold itself as the standard work on the taxonomy of the Agaricales down to the specific level for many years to come—until the third edition will replace it. It is difficult to imagine who else would be able to replace it.

M. A. DONK

R. SINGER, *Keys for the determination of the Agaricales.* (J. Cramer. Weinheim. 1962.) Pp. 64. Price: DM. 10.—.

This is a reprint of the keys contained in the work reviewed above. The keys lead down to the genera and are supplemented by references to existing keys to the species. This booklet is not only a handy companion to the bigger work but will also be welcome to students who will have no daily access to the main work.

M. A. DONK

M. A. DONK, *The generic names proposed for Agaricaceae.* (Beihefte zur Nova Hedwigia **5.**) (J. Cramer. Weinheim. 1962.) Pp. 320 + (i). Price DM. 80.—.

The author of this work has reviewed the generic names proposed for Hymenomycetes in a series of fourteen numbers, of which thirteen appeared and one is still in press.

These instalments were published in various journals. The present part is the eleventh, and like its companion volume on the Polyporaceae (published in "Persoonia") is issued as an independent unit without much reference to the other parts.

Of every one of the several hundreds of generic names published for agarics details are given on publication, etymology, typification, and where necessary on its history and applications; the nomenclatural status is indicated or discussed in each case. For some taxa validly published and correct names are introduced; a few new combinations are made.

T. W. Johnson, Jr. & F. K. Sparrow, Jr., *Fungi in oceans and estuaries*. (J. Cramer. Weinheim. 30 Augustus 1961.). Pp. xxii + 668, 17 plates. Price DM. 120.—.

The 'marine' fungi have attracted more and more attention during the last few decades and the wealth of information and the number of known species is rapidly increasing. Therefore, it gives considerable satisfaction that a manual appeared which reviews what is known about them. Nearly one half of the book consists of Part I which deals with general topics: it includes a historical résumé, chapters on the relation of fungi and various groups of other organisms and their surroundings, on physiology and an ecology, as well as other chapters. Part II, "Taxonomy", gives descriptions of the taxa and is elucidated by 17 plates of clear line drawings. The bibliography of 49 pages shows that much information is scattered throughout the world literature and that a manual of this kind giving an interpretative survey was long overdue. Moreover, unpublished data have been entered.

It is interesting to find that representatives of the Basidiomycetes are lacking except for one species of Tilletiaceae, the more so because it would appear that the maximum salinity tolerance limit of the various fungi normally considered 'terrestrial' forms are exceptionally high (p. 141). Many wood-loving ascomycetes are recorded in this book, but no Hymenomycetes among which a considerable number of species is known to be wood-loving too.

A work of this kind doubtless will stimulate research on these biologically interesting fiingi. As a manual it will be a very welcome addition not only to the library of the mycologist but also to that of botany departments in view of its extensive general considerations.

M. A. Donk

Scripta botanica—II. (Institutum zoologicum et botanicum Academiae Scientiarum R.P.S.S. estonicae. Tartu. 1962.) Pp. 278, illustr. Price: Rbl. 1. 18.

This publication contains the text of 25 papers presented at a symposium of mycologists and lichenologists from the Soviet Baltic republics. The symposium was held in Tartu September 26–27, 1959, and attended by professionals and amateurs from Latvia, Lithuania, Byelorussia, Estonia, and Leningrad.

The subjects treated cover a wide field, including Peronosporales, Ustilaginales, Uredinales, Agaricales, Polypores, Geoglossaceae, and lichens.

A directory of specialists concludes the publication.

R. A. Maas Geesteranus

R. CIFERRI, *Mycoflora domingensis integrata*. (Quaderno No. 19. 1961.) (Istituto Botanico della Università, Laboratorio Crittogamico. Pavia.) Pp. 539. Price: L. 3000.

This is the second and much enlarged edition of the same author's "Mycoflora domingensis" (1929). It is a check list of all fungi recorded for the region mentioned. Useful information and critical remarks added in some cases (e.g. the Phallales) would have been welcomed in other cases as well. A generic index and a host index conclude the work.

R. A. MAAS GEESTERANUS