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NOTES ON THE GENUS PSATHYRELLA—II

Three new species of Psathyrella

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(With 3 Plates and 22 Text-figures)

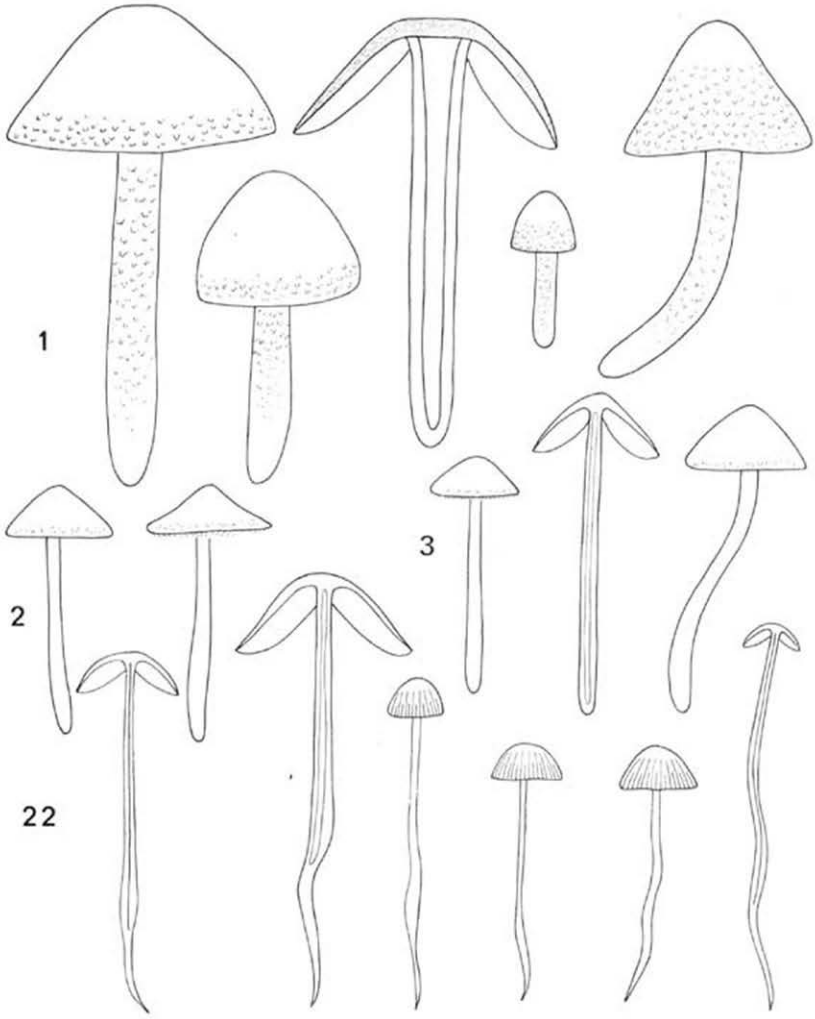
Description of three new and very striking species of *Psathyrella: P. amstelodamensis* (thick-walled muricate cystidia, abundant veil, phaseoliform spores, spore-print dark reddish-brown), *P. narcoticus* (stem conspicuously rooting, strong smell of scatol, cheilocystidia covered with abundant mucoid deposits, staining bluish-green in NH_4OH), *P. pervelata* (very thick and scaly universal veil, subcapitate to subutriform cystidia, flesh of cap hardly and trama of gills not pigmented).

During the past ten years the species of the genus *Psathyrella* have had our very special attention, the result of which being that our herbarium now contains some 470 collections of this genus, practically all of them provided with elaborate notes and habit sketches and quite a few with colour-photographs. We have come to realise that while studying the species of this genus one should be very much aware of a number of considerations, listed below, which have to be taken into account in distinguishing new species of this genus.

(i) Within one and the same species the size of the carpophores is practically of no importance. Only quite recently we undertook a thorough examination of what looked like being a very interesting, be it minute, specimen of *Psathyrella*, only to discover in the end that it represented *P. spadiceogrisea*, which normally is quite a large species.

(ii) Within one and the same species the habit of the carpophores and the shape of the cap vary very considerably and so are of little importance; both depend very much on age and the usual environmental variation.

(iii) The colour of the cap in this genus is extremely variable. The cap is (usually strongly) hygrophanous and the process of drying out already begins in the early stages. Most caps also usually readily loose pigment on ageing and through rain. This point was already stressed by us in an earlier paper (Kits van Waveren, *1971:* 257, 277) and the very same goes for the hygrophanous species of *Conocybe* (Watling, *1971:* 281; Kits van Waveren, *1970:* 122). Kühner & Romagnesi (*1953:* 355) state that in *P. gracilis* the trama of the cap is "sensiblement incolore (seulement un peu brunie sur les jeunes dans la moité supérieure de la chaire piléique, ou même uniquement dans l'hypoderme), totalement hyaline sur adulte dans le chapeau". But we found that although in old specimens of this species the prevailing colour is



FIGS. 1-3. *Psathyrella amstelodamensis*, habit sketches. — 1. Amsterdam, Amsterdamse Bos, 9 June and 27 July 1960. — 2. Amsterdam, Amsterdamse Bos, 27 July 1960 (different locality). — 3. Denekamp, Singraven, 28 Oct. 1961. — (Natural size.)
FIG. 22. *Psathyrella narcotica*, habit sketches. Bakkum, 22 Nov. 1969. — (Natural size.)

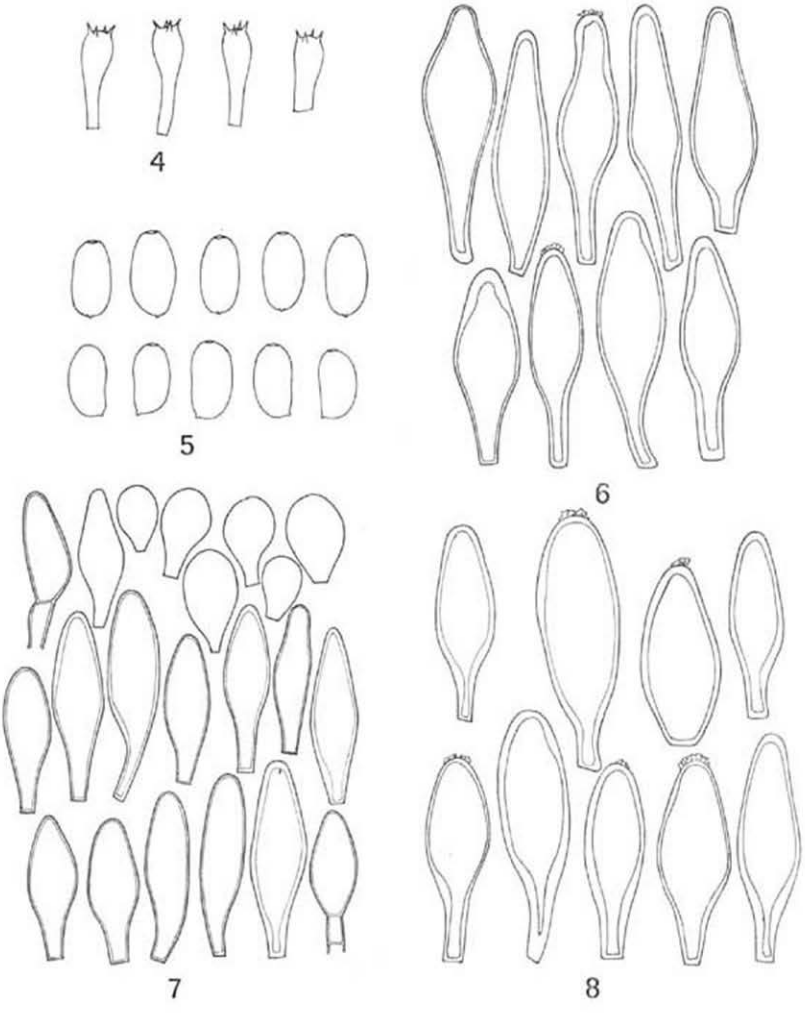
mud-grey, some shade of brown, particularly in the centre, is practically always present, whereas the caps of primordia are definitely reddish-brown.

(iv) In species which possess a universal veil, this veil may not only partly or completely disappear on ageing and through rain, but the extent to which the veil is primarily developed may also vary. We have found specimens, which undoubtedly represented *P. fulvescens* Romagn., but were provided with such a large amount of velar tissue that at first sight they were believed to be a different species.

(v) Within one and the same species the size and shape of the spores is—as we all know—subject to some variation. The size and shape of the pleurocystidia, however, often designated as being very specific, may vary a good deal more (Kits van Waveren, *1971:* 271 and the pleurocystidiograms for *P. microrrhiza*, p. 276). Kühner & Romagnesi (*1953:* 358) correctly describe the pleurocystidia of *P. microrrhiza* as "tantôt obtuses, tantôt aigues, selon les formes". Moreover we found, as was to be expected, both in *Coprinus* (Kits van Waveren, *1968:* 156 *fig. 22, 23* for *C. velox*) and in *Psathyrella* the pleurocystidia in young specimens to be distinctly smaller than those in old specimens. In *P. amstelodamensis*, to be described below, we found the walls of the pleurocystidia in mature specimens very thick (0.9–2.7 μ and sometimes locally up to 3.2–3.6 μ) and the cells distinctly brown, whereas in young specimens the thickness of the walls was considerably less, the cells besides being colourless. In any species of *Psathyrella* differences in individual maturity between the pleurocystidia of carpophores of seemingly the same age or even between the pleurocystidia on one and the same gill, no doubt account for the existing and sometimes considerable differences in size and shape of these cells.

(vi) We fully agree with Orton's statement (*1960:* 367) that "facial cystidia will be found to be more consistent in shape and therefore taxonomically more important than the marginal." Nevertheless we feel the marginal cells (practically always of two types: cystidia and spheropedunculate cells) should always be studied carefully as the overall picture of the cellular lining may turn out to be of some taxonomic value and in quite a few instances indeed is very characteristic (Kits van Waveren, *1971:* 277).

(vii) The smaller the difference between a new species of *Psathyrella* to be described and one already well known, but rare, the larger the number of collections on which this new species is to be based, should be. Such in view of the possibility that the small difference found, may lie within the range of the normal variation of the already known species, of which—because of its being rare—the variability still is little known or unknown. This is why in a previous paper (Kits van Waveren, *1971:* 265) we described with considerable reluctance two new forms of *P. gracilis*. Both *P. gracilis* f. *clavigera* and *P. gracilis* f. *albolimbata* were based on only but still four collections. If, on the other hand, like in two of the three species to be described below (the third species is based on four collections) the difference with any known species is very outstanding, we feel it is fully justified to base the new species on only one collection.



FIGS. 4-7. *Psathyrella amstelodamensis* Dorst, 1 Dec. 1963. — 4. Basidia. — 5. Spores. — 6. Pleurocystidiogram. — 7. Cheilocystidiogram. (Fig. 5: × 1212; Figs. 4, 6, 7: × 575).

FIG. 8. *Psathyrella amstelodamensis*, Amsterdam, Amsterdamse Bos, 27 July 1960. Pleurocystidiogram (× 575)

Bearing these seven points in mind, we wish to describe the following three new and very remarkable species of *Psathyrella*.

ACKNOWLEDGEMENTS.—We are greatly indebted to Mr. and Mrs. M. Montessori, who by giving a very substantial donation to "Persoonia" enabled us to give colour-pictures of two of our species. We also wish to thank very much indeed Dr. R. A. Maas Geesteranus for making the Latin descriptions of the three new species.

Psathyrella amstelodamensis Kits van Waveren, *spec. nov.*

Plate 9, Figs. 1–12

Pileus 10–40 mm latus, primo campanulatus, margine recto vel interdum incurvato, postea conico-campanulatus vel conicus, demum convexus, nonnumquam subumbonatus vel apice applanatus vel umbilicatus, exstrius, udus rugulosus, obscure purpureo-umbrinus, mox obscure ochraceo-umbrinus, hygrophanus, siccus alutaceus vel pallide ochraceus.

Velum album, luxurians e floccis et fascibus fibrillosis formatum. Flocci margine adpressi denticulati interdum apicem attengentes, haud appendiculati.

Lamellae 2–4 mm latae, anguste adnatae, perconfertae, ex ochraceo obscure rubiginosae, acie albae.

Stipes 30–60 × 2–10 mm, fistulosus, acqualis, apice parum attenuatus, haud radicatus, albus, minute fibrilloso-striatus, normaliter veli reliquis lanoso-flocculosis obtectus, ad apicem vulgo a lamellis striatus.

Caro in pileo 2–3 mm crassa, obscure umbrina, in stipite alba.

Odor nullus.

Sporae accumulatae rubiginosae, ellipsoideae, phaseoliformes, (7.2–)8.1—9.9(–10.8) × (4.1–)4.5–5.4 μ, poro germinativo c. 1 μ diam., in aqua observatae pallide rubiginosae.

Basidia 4-sporigera, 16–25 × 8–9.6 μ.

Pleurocystidia 40–75 × 10–25 μ, numerosissima, fusiformia, ventricosa, lageniformia, clavata, saepe pedunculata, apice obtuse rotundata, crasse tunicata, 0.9–1.8(–3.6) μ, praesertim ad basin, apicibus muricatis, cinnamomea in NH_4OH.

Cheilocystidia 30–57.5 × 10–22.5 μ, numerosissima, pleurocystidiis similia, tunicis minus crassis. Cellulae spheropedunculatae 10–25 × 7.5–25 μ, cheilocystidiis intermixtae paucae.

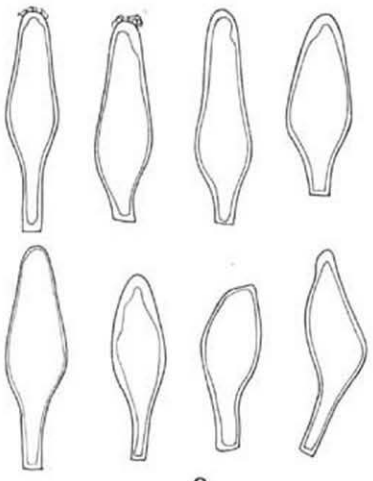
Cuticula pilei cellularis, cellulae 24–48 μ diam.

Ad terram argillosam, mensibus VII—XII.

TYPUS.—The Netherlands, Noord-Holland, Amsterdam, Amsterdamse Bos, 27 Juli 1960, *E. Kits van Waveren* (L).

MARKED KEY CHARACTERS.—Fairly strongly developed universal veil; spores phaseoliform and rather pale reddish-brown; dark reddish-brown spore-print; exceedingly numerous, very thick-walled, muricate, ventricose or fusiform or clavate and often pedunculate pleurocystidia and very numerous similar but thinner-walled cheilocystidia.

MACROSCOPIC CHARACTERS.—*Cap* 10—40 mm broad, firm and slightly fleshy, in the early stages campanulate with marginal area perpendicular or sometimes even somewhat incurved or appressed against the stem, later variable in shape, conical-campanulate or conical, finally expanding to convex, sometimes with large but indistinct umbo, sometimes flattened or even provided with a small umbilicus at the apex, not striate or only striatulate at the margin, with smooth surface, slightly to distinctly rugulose when moist, dark purplish-brown (M. 2.5 YR 3/2; 10 R 3/2, 3/3, 3/4) to very dark brown (M. 7.5 YR 3/2), soon dark ocre-brown, slightly paler towards the margin, hygrophanous, drying out to alutaceous or very pale brown



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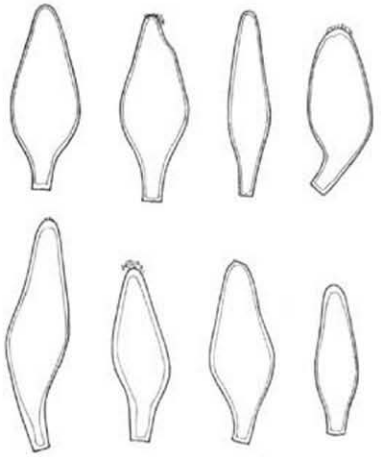

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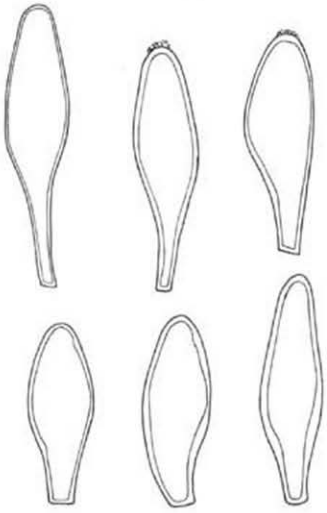

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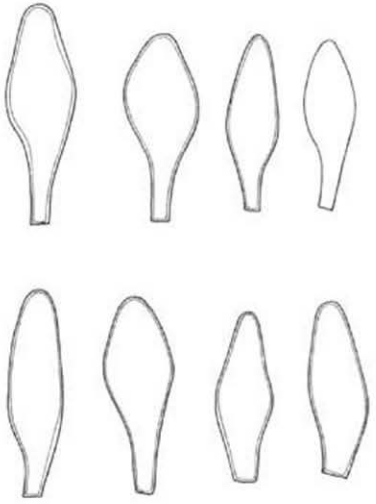

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FIGS. 9-12. *Psathyrella amstelodamensis*. — 9, 10. Denekamp, Singraven, 28 Oct. 1961. Pleurocystidiograms of two different specimens (× 575). — 11, 12. Amsterdam, Amsterdamse Bos 27 July 1960. Pleurocystidiograms. 11. Of mature specimen. 12. Of young specimen. (Both figs.: × 575).

(M. 10 YR 8/3), the centre remaining pale ocre (M. 10 YR 7/4), while drying and when dry neither micaceous nor showing traces of pink.

Veil rather strongly developed, white, in young specimens forming numerous appressed denticle-like flocci and bundles of fibres (sometimes arranged in zones), reaching up to 1/2–1/3 from the margin inwards to even up to the apex and a dense zone along the margin of the cap, not appendiculate, rarely less developed but then still present as scattered fibres and minute flocci either up to 1/2–2/3 from the margin inwards or near the margin only.

Gills ventricose, 2—4 mm broad, ascending and narrowly adnate, conspicuously crowded, in the early stages pale brown, then brown with a trace of purple, finally via dark purplish-brown to strikingly dark chocolate-brown or red-brown (M. 5 YR 3/3; 7.5 YR 3/2), with white edges, in dried herbarium material strikingly crowded and dark reddish-brown with white edge.

Stem 30–60 × 2–10 mm, cylindrical, often very slightly and gradually thickening towards the base, hollow, not rooting, white, surface minutely fibrous-striate, normally covered with rather woolly-floccose velar remnants, sometimes only with scattered velar fibres, the apex pruinose and coarsely striate from the gills.

Flesh of cap 2—3 mm thick in centre and very dark brown or greyish brown; of stem white but inner lining of cavity very pale brown.

Smell indistinctive.

Spore-print dark reddish-brown (M. 5 YR 4/2, 4/3).

Pigmentation (studied at 60 × enlargement under binocular lens, for technique see Kits van Waveren, *1971:* 249). Flesh of cap between "ridges" of gills rather dark ocre-brown (M. 7.5 YR 5/4, 4/4, darker towards centre of cap and paler towards the edge); "ridges" of gills towards the centre of the cap dark brown (M. 7.5 YR 4/2), towards the margin dark yellowish brown (M. 10 YR 3/4, 4/4). Trama of the gills along the base very distinctly brown (paler than M. 7.5 YR 4/4, also 7.5 YR 5/6), in the basal 1/3–1/2 portion of the gills yellowish-brown (slightly more yellow than M. 10 YR 6/3), gradually changing into greyish-yellow (M. 5 Y 7/3) in the peripheral 2/3–1/2 portion and at the edge pale grey (M. 5 Y 7/2).

MICROSCOPIC CHARACTERS.—*Spores* ellipsoid, in lateral view phaseoliform, sometimes subcylindrical and sometimes slightly and irregularly narrowing towards the base, (7.2–)8.1–9.9(–10.8) × (4.1–)4.5–5.4 μ with small ($\pm$ 1 μ) and fairly distinct pore and with very small hilar appendix, pale brown with a trace of red (M. 5 YR 5/4; 7.5 YR 5/4) when mounted in water and dark redbrown in NH_4OH (colour fading after a while), thin-walled, not opaque.

Basidia 4-spored, 16–25 × 8–9.6 μ.

Pleurocystidia exceedingly numerous, variable in shape, ventricose, fusiform, clavate, often pedunculate, the stalk gradually passing into the much wider body, the apex always very obtuse, 40–75 × 10–25 μ; walls in mature specimens almost always very thick (0.9–1.8 μ but often locally up to 2.7 μ or sometimes even 3.2–3.6 μ), the thickest part (often with considerable narrowing of the lumen) normally at or near the base of the cell, but fairly often at the apex; apex often muricate, encrusted with crystals or/and minute granular deposits; mature pleurocystidia appear distinctly pale brown when the microscope is focussed on the surface of the cells; when the microscope is focussed on the equatorial plane the walls in optical section appear pale yellowish.

Marginal cystidia exceedingly numerous, of the same shape as but smaller than the pleurocystidia, 30–57.5 × 10–22.5 μ, the walls of practically all thickened but thinner than those of the pleurocystidia, often with encrustations at the apex, either colourless (thin walls) or slightly brown (thicker walls); in between them a fairly small number of spheropedunculate cells, 10–25 × 7.5–15 μ, which may easily be overlooked.

Pigmentation under microscope (tissue mounted in NH_4OH 10 %). Hyphae of hypodermis fairly strongly coloured by brownish membranal pigment with great numbers of yellow coloured hyphal septa and very numerous encrustations on both the narrow hyphae of the hypodermis and the broad hyphae of the underlying flesh. Trama of the gills distinctly but not very strongly brownish by membranal pigment (strongest at the base); a fair number of yellow hyphal septa and rather few encrustations.

Cap cuticle cellular, diameter of cells 24–48 μ.

Caulo- and *pileocystidia* none.

Clamps present at the narrow, colourless superficial hyphae of the stem.

HABITAT.—Terrestrial in rich and particularly clayey soil by roadsides or in deciduous woods. June—December. Very rare.

COLLECTIONS EXAMINED.—The Netherlands, Overyssel, Denekamp, Estate "Singraven", 28 Oct. 1961, *E. Kits van Waveren* (L). Noord-Holland, Amsterdam, Amsterdamse Bos 9 June 1960, 27 July 1960, two localities (type, L), *E. Kits van Waveren*. Noord-Brabant, Dorst near Breda, 18 Sept. 1963, 1 Dec. 1963, *P. B. Jansen* (L).

OBSERVATIONS.—Although the shape and size of the specimens from the four localities vary considerably (see Plate 9 and Figs. 1–3) and although the two specimens of the Denekamp collection showed rather few velar remnants, the specimens of these five collections no doubt represent one and the same species; their microscopical and very typical characters are fully identical and the dried specimens of these five collections all look strikingly alike.

At first sight the description, given above seems to fit in rather well with the description and Plate 12 of *P. olympiana*, given by Smith (*1941:* 36). There are, however, a few striking differences. The main and most important difference lies in the development of the universal veil, of which Smith (basing his description on no less than four collections from widely dispersed localities!) stated that in *P. olympiana* only "scattered remains of the rudimentary veil" are present and that the veil is "distinct though scanty". Kühner & Romagnesi (*1953:* 369) state of the veil of *P. olympiana* (this species by them believed to be "assez commun") that it is "présent, bien que rudimentaire". Singer (*1962:* 508) even ranks *P. olympiana* under *Psathyrella* subgenus *Homophron* (Britz.) Sing., the species of this subgenus according to Singer having "veil none". In all three collections from the Amsterdamse Bos the veil was rather strongly developed (see Plate 9), velar flocci in young and even semi-mature specimens even reaching up to the apex in abundance. As for the specimens from Dorst, the only notes the excellent mycologist, Mr. P. B. Jansen took down for his find were: "*Psathyrella* with *Inocybe* cystidia and a lot of veil" and the very good water colour picture of these specimens made by the late Mrs. M. Jansen-van der Plaats shows a narrow marginal zone full of white velar remnants, which in the youngest specimen depicted, reach up to midway the centre of the cap and a woolly-hairy coating of the stem.

Smith further describes the colour of the mature gills as being "drab" (= between grey and brown), whereas in all our specimens it was strikingly dark chocolate-brown to red-brown, this colour, no doubt, mainly being due to the rather pale

reddish-brown colour of the spores. The gills of all our dried material still are strikingly red-brown.

Smith's specimens were growing "on old wood and debris of elder and cotton wood", whereas the specimens of all our collections were terrestrial and always growing in clayey soil (in one of our Amsterdam collections a cluster was growing in rich soil against a small and hardly visible rotting tree stump).

Next, Smith describes the cystidia as being "fusoid, ventricose to subcylindric" and having their walls "usually slightly thickened, especially towards the apex". In our material the pleurocystidia indeed also were fusoid and ventricose, but often clavate, their walls, however, being very thick in mature specimens and usually thickest at or near their base (with narrowing of the lumen) or equally thick all over. Sometimes only they were thickest at the apex. Also, the apices of the cystidia, depicted by Smith, are decidedly either very acute or subacute, whereas in our material the apices are conspicuously obtuse.

On the basis of these differences we believe our species not to be conspecific with *P. olympiana*.

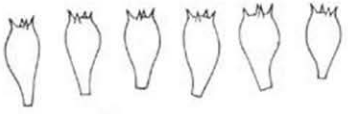
The pleurocystidia of young specimens are colourless and their walls are decidedly thinner. Among the very thick-walled pleurocystidia of mature specimens a varying but usually small number of thinner walled ("young") pleurocystidia are always found.

If the species of *Psathyrella* subgenus *Homophron* are to be defined as having no universal veil, like Singer (*1962:* 507) and Kühner & Romagnesi (*1953:* 369) do, neither *P. olympiana* nor *P. amstelodamensis* should be listed with the species of subgenus *Homophron*. The reason being that according to Smith *P. olympiana* has "scattered remnants of a rudimentary veil", *P. amstelodamensis* even having a conspicuous universal veil. This is why indeed Kühner & Romagnesi do not place *P. olympiana* in the *Homophron* section. Nevertheless Singer does list *P. olympiana* with the species of subgenus *Homophron*.

If, however, the presence of thick-walled muricate pleurocystidia is the deciding criterium for the species of subgenus *Homophron*, our species most certainly qualifies for that subgenus and so does *P. olympiana*.

Psathyrella macquariensis Singer (*1959:* 392) listed by Singer (*1962:* 508) under subgenus *Homophron*, has according to Singer's description bean-shaped spores, a veil, which is said to be "not conspicuous", and pleurocystidia, which, although "not or very little encrusted" have walls which are not thickened.

Psathyrella subcernua (S. Schulz.) Sing., on account of its muricate cystidia also listed by Singer under subgenus *Homophron*, has, according to Schulzer von Müggenburg (*1877:* 427) a cap, which is "valde dilute umbrino-albido". Maire (*1952:* 51) calls the colour of the cap of this species "alutacé pâle" (thus as in *P. cernua*) and the spores small (6.5–8 × 3–3.5 μ). According to Kühner & Romagnesi (*1953:* 373, Note 23) the spores of this species are "très petites", measuring 7–7.7 × 3.7–4.2 μ. According to von Höhnel (*1907:* 99) the pleurocystidia of this species are "zerstreut stehende kurze, dickbauchige, oben im kurzen



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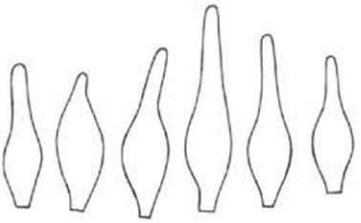

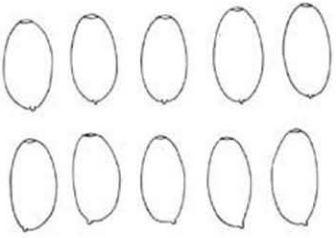

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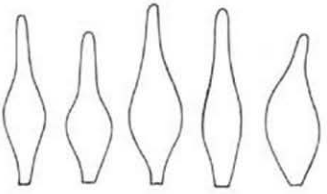

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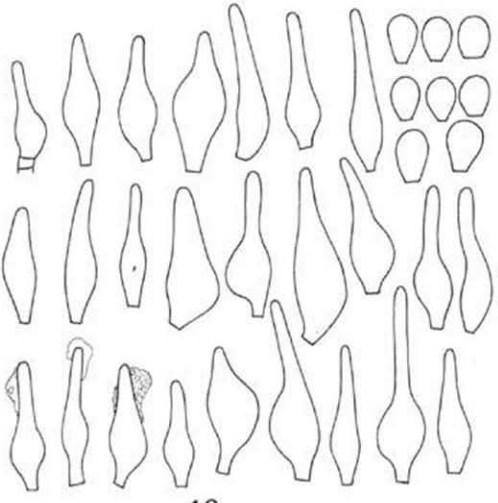

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FIGS. 13-16. *Psathyrella narcoticus* (Bakkum, 22 Nov. 1969). — 13. Basidia. — 14. Spores. — 15. Pleurocystidiogram. — 16. Cheilocystidiogram. (Figs. 13, 15, 16: × 575; Fig. 14: × 1212).

Fortsätze bis zum Verschwinden des Lumens verdickte, 26–30 × 14–20 μ Cystiden", very much, therefore, like those of *P. cernua* and very unlike those of our species.

Psathyrella spadicea (Schaeff. ex Fr.) Sing., *P. pygmaea* (Bull. ex Fr.) Sing. and *P. cernua* (Vahl ex Fr.) Moser, all three species with muricate pleurocystidia, of course are quite different species.

For a moment we believed that—because of the thick-walled cystidia—our species might be Orton's (*1960:* 379) *Psathyrella xanthocystis*, according to Orton conspecific with *Drosophila jerdonii* (Berk. & Br.) sensu Kühn. & Romagn. as described by Kühner & Romagnesi (*1953:* 359). But Orton's species has a "fugacious pendulous ring", an appendiculate veil, forming "dentate scales at margin at first", the spores are not phaseoliform (having described *P. flexispora* and other species in the genus *Psathyrella* with phaseoliform spores, Orton would certainly have noticed such spores in *P. xanthocystis*) and the pleurocystidia, although being thick-walled are—judging from Orton's figure 495—only so near the apex. The apex, besides, is very acute and the cystidia are described as "acutely lageniform or fusiform with short point, apex 3–5 μ". Our species has no annulus, the veil is not appendiculate, the spores are phaseoliform and the shape of the cystidia is quite different. Orton's figure 200, depicting a carpophore of his species, does not resemble our species in the least.

Psathyrella muricellata (Sing.) Sing. as described by Singer (*1938:* 13) also has thick-walled muricate cystidia, but the cap is strongly striate ("diaphano-striato usque centrum in udo"), so it cannot be more or less fleshy like in *P. amstelodamensis* and besides the cap is only 15 mm broad and there is no veil ("velo omnino deficiente").

Bresinsky (*1966:* 14) described a species, which he called *Psathyrella* cf. *olympiana* and which undoubtedly must be the same as our *P. amstelodamensis*, his description fully covering our description of the latter. It is particularly noteworthy that he described the cap as being "rundlich mit weissen Velumresten" and as being "glockig-breitkegelig-verflacht".

Psathyrella narcotica Kits van Waveren, *spec. nov.*

Figs. 13–16, 22

Pileus 9–20(–26) mm latus, submembranaceus, e semigloboso campanulatus postec subconvexus demum tantum subexpansus, ½–⅓ pellucido-striatus, primo melleo-gilvus, mox cinerascens demum murinus et ravidus, centro subochraceus, hygrophanus, sicco albus-alutaceus.

Velum nullum.

Lamellae ascendentes, strictae, ad pilei marginem rotundatae, subdistantes, 1–3 mm latae, primo cinereae mox obscure purpureo-ravidae, modice vel late sinuato-adnatae, acie albae.

Stipes 25–62 × 1–2(–2.5) mm, aequalis, apice parum attenuatus, albus, fistulosus, radicatus (10–25 mm).

Caro in pileo 0.5–2 mm crassa, mollea vel gilva, in stipite alba.

Odor fortis, *Coprino narcotico* similis.

Sporae accumulatae purpureo-atratae, (9.5–)9.9–11.7 × 5–5.9 μ, ellipsoideo-amygdaliformes poro germinativo magno, 1.5—2 μ diam., in aqua observatae rubiginosae.

Basidia 4-sporigera.

Pleurocystidia 35–55 × 10–15 μ, dispersa, lageniformia, hyalina, tenui-tunicata.

Cheilocystidia 27.5–50 × 7.5–15 μ, numerosa, lageniformia, tenui-tunicata, hyalina, apicibus collisque materia mucoidea granulosa ope NH_4OH virescente obtecta. Cellulae spheropedunculatae 10–15 × 7.5–10 μ, cheilocystidiis intermixtae.

Cuticula pilei cellularis, cellulae 16–72 μ.

Ad terram inter gramines.

Typus:—The Netherlands, Noord-Holland, Bakkum ("Koningsbos"), 22 Nov. 1969, *E. Kits van Waveren* (L).

MARKED KEY CHARACTERS.—Strong smell of scatol (exactly like *Coprinus narcoticus*), conspicuously rooting stem, very little pigment in flesh of cap and practically none in trama of gills (cap predominantly grey), spores 9.9–11.7 × 5–5.9 μ, lageniform pleuro- and cheilocystidia, the latter abundantly covered with mucoid deposits at the apices and along the necks, staining bluish-green in NH_4OH 10 %.

MACROSCOPIC CHARACTERS.—*Cap* 9–20(–26) mm broad, semiglobose to campanulate, in final stages only slightly expanded, strongly striate up to 2/3 from margin inwards, in the early stages pale yellowish brown (slightly paler than M. 10 YR 5/4 or slightly browner than M. 2.5 Y 7/4, 6/4), the striate part from margin inwards very soon becoming distinctly greyer (M. 2.5 Y 6/2; 10 YR 6/2 and sometimes 5 Y 6/1), in later stages grey to pale brownish-grey (M. 10 YR 6/1, 6/2; 2.5 Y 6/2), only the centre very slightly browner, in final stages dark grey (M. 10 YR 4/1, 4/2) in centre dark greyish-brown (M. 10 YR 4/3) and at the margin distinctly purplish-grey (M. 5 YR 4/1), rapidly and strongly hygrophanous to almost white, alutaceous (M. 10 YR 8/1, 8/2, 2.5 Y 8/2) only at the apex very pale brown (M. 10 YR 8/3), neither rugulose, nor micaceous, nor showing traces of pink.

Veil absent on both cap and stem, not seen even in young specimens.

Gills ascending, straight or ventricose only near the margin of the cap, moderately or even broadly adnate, not crowded, 1–3 mm broad, in early stages light grey to slightly purplish-grey (M. 5 YR 6/1, 6/2) with only a trace of brown (M. 10 YR 6/3) at the base, in later stages darker purplish-grey (M. 5 YR 5/1), towards the base hardly a trace of brown (M. 10 YR 6/2) and at the base sometimes pale yellowish-brown (slightly paler than M. 10 YR 5/4), in the final stages dark to very dark purple-grey (M. 5 YR 4/1 or even 3/1) but at the base with still a faint trace of brown (M. 10 YR 4/2); edge white and minutely flocculose.

Stem cylindrical but usually slightly and gradually thickening towards the somewhat thickened base, 25–65 × 1–2(–2.5) mm excluding the very marked root, white but pale isabelline in lower 1/2–1/3, apex pruinose, hollow; root 10–25 mm, tapering towards its end, neither hollow nor fixed to either wood or dung.

Flesh of cap 0.5–2 mm thick in centre, pale yellowish-brown (somewhat paler than M. 10 YR 5/4), of stem alongside gills concolorous with cap, otherwise whitish, but pale isabelline in lower 1/2–1/3.

Smell strongly of scatol, exactly like *Coprinus narcoticus*.

Spore-print purple-black.

Pigmentation (studied at 60 × enlargement, for technique, see Kits van Waveren, *1971*: 249). Flesh of cap between "ridges" of gills very pale brown, paler than M. 10 YR 7/2, rather towards M. 2.5 Y 7/2 and M. 5 Y 7/2; "ridges" of gills very pale yellowish-brown (M. 10 YR 8/3; 5 Y 7/3); trama of gills hyaline, very pale grey (M. 10 YR 7/1; 5 Y 7/1), practically colourless, only a trace of yellowish-brown at the base (M. 2.5 Y 7/2).

MICROSCOPIC CHARACTERS. — *Spores* ellipsoid-amygdaliform, (9.5–)9.9–11.7 × 5–5.9 μ, with large (1.5–2 μ) distinct pore and small hilar appendix, fairly dark reddish-brown (M. 2.5 YR 3/6) when mounted in water and very dark red-brown in NH_4OH, wall fairly thick, not opaque.

Basidia 4-spored, 17.6–22.4 × 9.6–10.8 μ.

Pleurocystidia scattered, lageniform, 35–55 × 10–15 μ (ventricose part), hyaline, thin-walled, often a few minute bluish-green (in NH_4OH) granular deposits on the apex.

Marginal cystidia very to fairly densely packed, of the same lageniform but more variable shape as, but smaller than the pleurocystidia, 27.5–50 × 7.5–15 μ (ventricose part), hyaline, thin-walled; in between them a variable and mostly small number of inconspicuous small spheropedunculate cells, 10–15 × 7.5–10 μ; everywhere on the apices and along the necks of the cystidia very small, medium-sized and large (diameter up to 16 μ) irregularly shaped, often elongated but also globose, minutely to coarsely granular deposits, which stain very bright bluish-green in NH_4OH 10 %.

Pigmentation (tissue mounted in NH_4OH 10 %). Hyphae of hypodermis only slightly coloured by yellowish-brown membranal pigment, few yellow coloured hyphal septa and hardly any encrustations. Trama of the gills practically colourless, a trace of yellowish-brown membranal pigment at the base only, no yellow hyphal septa and no encrustations.

Cap cuticle cellular, diameter of cells 16–32 μ.

Caulo- and *pilocystidia* none.

Clamps present at the narrow colourless superficial hyphae of the stem.

HABITAT.—terrestrial, in grass.

COLLECTIONS EXAMINED.—The Netherlands, Noord-Holland, dunes of County Watersupply just north of Bakkum ("Koningsbos"), 22 Nov. 1969, *E. Kits van Waveren* (type, L).

OBSERVATIONS.—In vain we have searched the literature for a species of *Psathyrella* having the extraordinary combination of the following outstanding characters: very strong 'narcoticus' smell, strongly rooting stem, predominantly grey cap, rather large spores and cheilocystidia covered with masses of mucoid deposits, staining bluish-green in NH_4OH.

Some 20 specimens of all stages were growing gregariously, but not cespitose, in grass, very close to a very small well, where cattle come and drink. The cap of the largest specimen (diam. 26 mm) had a somewhat different colour, being yellowish-brown (M. 10 YR 5/4) all over, obviously being slightly more pigmented than the other specimens.

In the literature we have come across only two species of *Psathyrella* in the description of which a very marked smell is mentioned. Peck (*1872:* 70) described *P. odoratus* Peck as having a "strong odor, resembling *Sambucus pudens*". Apart from the fact that this smell is quite different from the smell of our plant, which smells of *Coprinus narcoticus*, Peck's species is described as having a "dark reddish-brown or chestnut colored" cap, which is "dirty white or clay colored with a pinkish tinge, subatomaceous and radiately wrinkled when dry". The colour of the gills is "dingy flesh, then rosy brown, finally black" and no root is mentioned.

Next, Møller (*1945:* 179) described *P. saponacea*. His very elaborate description

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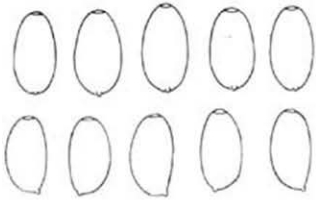
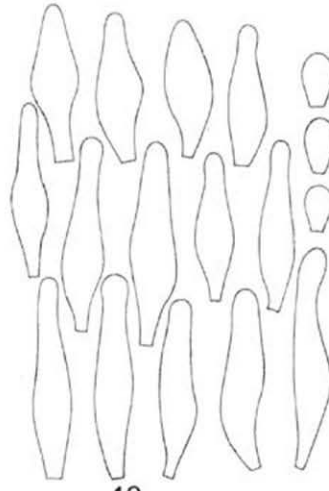


18



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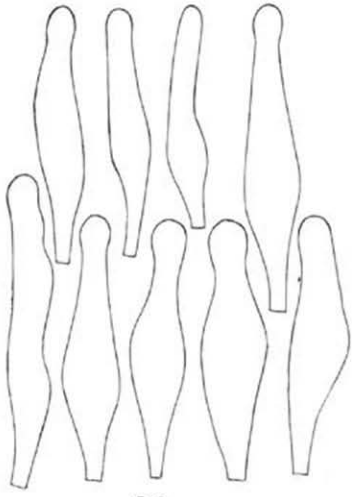
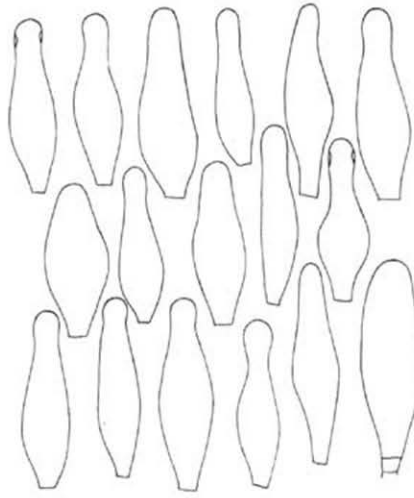


20



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FIGS. 17-21. *Psathyrella pervelata* (Amsterdam. Amsterdamse Bos, 30 Sept. 1961). — 17. Basidia. — 18. Spores. — 19. Cheilocystidiogram. — 20. Pleurocystidiogram of mature specimen. — 21. Pleurocystidiogram of young specimen. (Figs. 17, 19, 20, 21: × 575; Fig. 18: × 1212).

For Fig. 22, see p. 296.

does not mention the presense of a root, the species has a rudimental veil, "pallid eye-blue" gills in young specimens, a "distinct soap-like smell (like that of *Tricholoma saponaceum*)" and "broadly capitate" pleurocystidia. No mention is made of mucoid deposits on the cheilocystidia. So this species cannot be conspecific with our species either.

Psathyrella pervelata Kits van Waveren, *spec. nov.*

Plates 10, 11, Figs. 17-21

Pileus primo 8–14 mm latus, 10–20 mm altus, cylindrico-campanulatus, centro pallide ochraceus, marginem versus albus, demum 25–35 mm latus, convexus vel applanatus, ½—⅓ pellucido-striatus, murinus, ad marginem cinereus, centro subochraceus, hygrophanus, siccus albus vel subisabellinus.

Velum luxurians, album, appendiculatum, primo ad margimem squamulis distincte pannosis ornatus et squamulis flocculosis dispersis erectis et recurvatis vel praecipue discum.

Lamellae 7–5 mm latae, primo albae, dein cinereae, demum ravidae, subventricosae, anguste, adnatae, acie albae.

Stipes 50–75 × 2–4 mm, aequalis, apice parum attenuatus, fistulosus, haud radicatus, fragilis, albus, exannulatus.

Caro in pileo 1–2 mm crassa, pallide cinerea, centro subisabellina, in stipite alba.

Odor nulles.

Sporae accumulatae purpureo-atratae, (8.1–)9–9.9 × 4.5–5 μ, ellipsoidea-amygdaliformes, poro germinativo magno, 1,5–1.8 μ diam., in aqua observatae rubiginosae.

Basidia 4-sporigera, 20.8–25.6 × 9.6–10.4 μ.

Pleurocystidia 60–80 × 10–17.5 μ, dispersa, fusiformia, manifeste subcapitata vel subutriformia, hyalina, tenui-tunicata.

Cheilocystidia 32.5–57.5 × 10–12.5 μ, pleurocystidiis similia, hyalina, tenui-tunicata. Cellulae spheropedunculatae 12.5–15 × 7.5–10 μ, cheilocystidiis intermixtae, creberrimae.

Cuticula pilei cellularis, cellulae 16–56 μ diam.

Ad terram argillosam.

Typus.—The Netherlands, Noord-Holland, Amsterdam, Amsterdamse Bos, 30 Sept. 1961, *E. Kits van Waveren* (L).

MARKED KEY CHARACTERS.—Heavily developed woolly-scaly white universal veil; very little pigment in trama of both cap and gills, the former being predominantly grey; subcapitate to subutriform cystidia.

MACROSCOPIC CHARACTERS.—*Cap* in the early stages cylindrical-campanulate to campanulate, 8–14 mm broad and 10–20 mm high, not striate, pale ocre (M. 7.5 YR 6/6) to pale brown (M. 10 YR 7/4) in the centre, still paler (M. 10 YR 8/4) towards the edge, the peripheral 1/3—1/2 being white; in the process of ripening the cap expands via convex to finally plane (sometimes with vague umbo), 25–35 mm broad, loosing practically all brown colour, becoming striate up to 1/3–1/2 from margin inwards and predominantly mouse-grey, near the margin very pale grey (M. 7.5 YR 7/0), towards the centre darker grey (M. 2.5 Y 6/0; 5 YR 7/1, 6/1; 10 YR 6/1), in the centre in the end with only a trace of brown (M. 2.5 Y 7/2); hygrophanous, drying out to just white with a trace of isabelline in the centre, while drying and when dry neither micaceous, nor rugulose, nor showing traces of pink.

Veil strongly developed, white and consisting of a very thick, woolly-floccose, easily detersible coating on both cap and stem, particularly in the younger stages forming appendiculate conspicuous ragged, large (up to 2 × 2 mm!) scales at the

margin of the cap and a dense fibrillose woolly-scaly covering of erect and recurved flocci, the coating of the stem being increasingly woolly-scaly towards the base.

Gills in early stages pure white, later via pale grey to grey (M. 2.5 Y 6/0, 5/0; 10 YR 5/1), finally dark grey with a trace of purple (M. 5 YR 4/1), ascending, slightly ventricose, 3–5 mm broad, narrowly adnate, edge white.

Stem in mature specimens 50–75 × 2–4 mm, very slightly and gradually thickening towards the base, fragile, pure white, shining in upper part (not covered by the velar coating of the lower ± 3/4 portion), not rooting, apex pruinose, hollow, no annulus.

Flesh of cap in centre 1–2 mm thick, very pale grey with a trace of isabelline, flesh of stem white.

Smell indistinctive.

Spore-print purple-black.

Pigmentation (studied at 60 × enlargement under binocular lens, for technique, see Kits van Waveren, *1971:* 249) Flesh of cap between "ridges" of gills pale yellowish with a trace of brown (± M. 2.5 Y 8/4) and towards the margin increasingly paler (M. 5 Y 7/3); 'ridges' of gills in central half of the cap light olive-brown (M. 2.5 Y 5/6), towards the margin increasingly paler, via pale olive (M. 5 Y 6/4) to pale yellow (M. 5 Y 7/4) near the margin of the cap. Trama of the gills in basal half very pale yellowish-brown (± M. 5 Y 7/3) and in peripheral half practically colourless (M. 5 Y 7/2), at the edges M. 5 Y 7/1.

MICROSCOPIC CHARACTERS. — *Spores* ellipsoid-amygdaliform, (8.1–)9–9.9 × 4.5–5 μ, with large and distinct pore (1.5–1.8 μ) and small hilar appendix, fairly dark reddish-brown (M. 2.5 YR 3/6) when mounted in water and very dark brown in NH_4OH, wall fairly thick, subopaque.

Basidia 4-spored, 20.8–25.6 × 9.6–10.4 μ.

Pleurocystidia scattered, fusiform with broadly rounded apices, almost all of them distinctly subcapitate to subutriform, 60–80 × 10–17.5 μ (ventricose part) × 6–8 μ (below apex) × 7.5–10 μ (apex), hyaline, thin-walled.

Marginal cystidia in fairly large numbers and of the same shape as but smaller than the pleurocystidia, 32.5–57.5 × 10–12.5 μ (ventricose part), hyaline; in between them rather large numbers (± 60 % of all marginal cells) of fairly small spheropedunculate cells (12.5–15 × 7.5–10 μ).

Pigmentation (tissue mounted in NH_4OH 10 %): Hyphae of hypodermis very pale brownish-yellow by membranal pigment in the absence of yellow hyphal septa and encrustations. Trama of gills practically colourless, very pale yellowish in the basal part, neither yellow hyphal septa nor encrustations.

Cap cuticle cellular, the cells rather irregularly shaped and mostly rather large, diam. 16–56 μ.

Caulo- and *pileocystidia* none.

Clamps present at the superficial hyphae of the stem.

Veil consisting of chains of narrow but mostly quite broad, cylindric or slightly fusiform hyphae, 32—80 × 6.4—25.6 μ, mostly 40—64 × 14.4—19.2 μ, constricted at the hyphal septa (cellular picture as a result identical with that of the veil of the species of the *Lanatuli* group of *Coprinus*).

HABITAT.—Terrestrial in clayey soil.

COLLECTIONS EXAMINED.—The Netherlands, Noord-Holland, Amsterdam, Amsterdamse Bos, 30 Sept. 1961, *E. Kits van Waveren* (type, L).

OBSERVATIONS.—The very heavily developed veil, the shape of the cystidia and the almost complete lack of pigment in both the trama of the cap and of the gills are characteristic of this species. This lack of pigment results in the cap in the early

stages being white in the peripheral half and in the later stages being mouse-grey due to the spore-covered gills, shining through. Among the pleurocystidia of one of the young specimens we came across an occasional cell, which had a slight thickening of the wall just below the subcapitate apex (see fig. 21).

Smith has described a number of species with a more or less heavily developed and often appendiculate white veil. Most of these species are quite different from *P. pervelata* (quite different colour of the cap, veil appressed and not forming erect, recurved scales and flocci, quite different spore-size, quite different shape of the cystidia, densely cespitose growth, etc.) The only two species, which seem to come rather close to *P. pervelata* are *P. candidissima* Smith (*1950:* 122) and *P. hirta* Peck (*1898:* 197), the latter species having been elaborately redescribed by Smith (*1934:* 483). The cap of *P. candidissima*, a strikingly white species, is said to be "at first coated with a layer of snow white fibrils more or less radially arranged and which become aggregated into fascicles before disappearing entirely", but the cap is "snow white when young, scarcely changing colour in age" and the gills are "snow white, becoming 'light drab' ", the stems are thick (4–6 mm), the spores have an indistinct germ-pore and the pleurocystidia are distinctly plump (32–40 × 10–15 μ).

As for *P. hirta*, Peck described the cap as being "when young adorned with erect or spreading tufts of white, easily detersible hairs" and also stated that the species "has some points of similarity to *P. gossypina* and *P. pennata*". But the gills are called "adnate and often furnished with a decurrent tooth", the species is believed to grow on dung or "dungy ground", the spores are very small (5–5.5 × 2.5–3 μ) and no description of the cystidia is given. The description given by Smith of cap, veil and stem of *P. hirta* tallies very well with our species. The cap is being called "pure white at first, becoming ochraceous tawny with a russet tinge, fading to ochraceous buff, when young covered by recurved or erect fibrillose scales, margin fringed", the stem is called "very fragile, at first densely covered by a white fibrous coating of recurved fibrous scales"; but the spores are very large (10–12 × 5–6 μ and of the type they were even found to be larger, 12–14 × 5.5–7.5 μ) and the cystidia are merely fusoid-ventricose, not subcapitate-subutriform.

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EXPLANATION OF PLATES 9–11

PLATE 9

Psathyrella amstelodamensis. Amsterdamse Bos; at left, 9 July 1960, at right, 27 July 1960. (Slightly enlarged.)

PLATES 10, 11

Psathyrella pervelata, Amsterdamse Bos; 30 September 1961. (Slightly enlarged.)

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THE GENUS CONOCYBE SUBGENUS PHOLIOTINA II.

Some European exannulate species and North American annulate species *

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(With 78 text-figures and 2 Graphs)

Pholiota septentrionalis is transferred to the genus *Conocybe*, under the first available name i.e. *P. intermedia*, the taxon *Conocybe intermedia* var. *brunnea* is validated and given specific rank. The differences between these two taxa are given and a new species, *C. fibrillosipes*, is described. The new Section *Intermediae* is proposed and incorporated into *Conocybe* subg. *Pholiotina*. — The name *Conocybe appendiculata* Kühner 1935 is validly published and a full description given. — The following new species are described: *Conocybe fimicola*, *C. flexipes*, *C. pinguis* and *C. stercoraria*. The identity of *Galera mycenoides* is discussed.

During a study of the Bolbitiaceae it was found necessary in subgenus *Pholiotina* not only to provide Latin descriptions to validly publish the names of certain species—names already widespread in the literature—, but to describe several new taxa and re-examine the taxonomic position of certain members of the subgenus.

In order to accomplish the task it has been necessary to examine collections originally used by other authors in their published studies. I have through the kindness of Prof. A. H. Smith not only been able to examine in detail the holotype and paratypes of *Pholiota intermedia* but also to collect fresh material from the type locality within the Great Lake region and to examine his extensive collections of members of the Bolbitiaceae. I am also grateful to Prof. R. Kühner for the loan of the material he used in drawing up his excellent descriptions published in "Le Genre *Galera*".

Observations on the Bolbitiaceae—VI
Pholiota septentrionalis and its allies

Thirty six years ago Smith (*1934*) described *Pholiota intermedia* basing the name on a fungus with the following characters: (a) nine-pin (i.e. skittle)-shaped cheilo-

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cystidia, (b) corticate, viscid pileus, (c) small, non-truncate basidiospores, (d) striate annulus and (e) lignicolous habit. Unfortunately, however, the name was preoccupied by *Pholiota intermedia* Sing. (*1930*), a name given to a fungus growing in the Caucasus on *Carpinus betulus* and *C. orientalis;* Smith later made the necessary correction, renaming his fungus *Pholiota septentrionalis (1935)*. In his first article Smith drew attention to the fact that the pileus cuticle of his new species was composed of large, inflated cells (i.e. hymeniderm) and related the fungus to *Pholiota erebia, P. filaris*, and *P. rugosa;* the first of these three species is referable now to the genus *Agrocybe* and the other two to the genus *Conocybe*. Although possessing a pileal hymeniderm, *A. erebia* has one which is less pronounced than that of either of the two other species mentioned by Smith. Nevertheless the presence of such a structure when correlated with a brown spore-deposit and fairly complex spore-structure places this species, *P. filaris, P. rugosa.* and *P. intermedia* in the Bolbitiaceae as it is currently defined.

A year after Smith's publication J. E. Lange & R. Kühner (*apud* Kühner, *1935*) described a closely related fungus under the name *Conocybe intermedia* var. *brunnea;* the variety differed in habitat (on ground amongst herbs, i.e. not lignicolous), long stipe (up to 50 mm) and the presence of a veil, fragments of which did not form a distinct annulus but adhered to the margin of the pileus. Smith in his original description of *P. intermedia*, however, had mentioned that in a few of his collections the margins of the pilei of some specimens were adorned with thick, membranous patches from the veil and the annulus in these instances was lacking. It was this more than any other character which probably led Lange & Kühner to treat their fungus as a variety and not as a distinct species, but compare the earlier discussion by Kits van Waveren *(1970)* and Watling *(1971)*. Kühner *(1935)* in describing the variety *brunnea* referred *P. septentrionalis*, as *P. intermedia*, to the genus *Conocybe;* Lange (*1938*) on the other hard used the epithet *brunnea* at specific level and at the same time transferred the fungus to the genus *Galera*.[1] Kühner & Romagnesi (*1953*) have also given this fungus specific rank but they retained it in the genus *Conocybe;* they used the epithet *brunnea*.

Moser has keyed out this fungus in all three editions of Gams' "Kleine Krytogamenflora" and did so in the genus *Pholiotina* Fayod. It has been argued by both Watling (*1965*) and Kits van Waveren (*1970*) that *Pholiotina* should, however, only be recognised at subgeneric level within *Conocybe*. Although *P. septentrionalis* is anomalous in some ways within the subgenus *Pholiotina* (see below) it is quite typical of the genus *Conocybe*.

Singer (1950) has described four "varieties"[2] under *Pholiotina septentrionalis:*—

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[1] *Galera* (Fries) Kummer, 1871 is a later homonym of *Galera* Blume, 1825 (Orchidaceae) and cannot therefore be used.

[2] Singer himself states that three "varieties" are to be found but in fact lists four, probably meaning three variants plus the type variant.

(a) Michigan "variety" with short stipe, close lamellae, annuliform veil, narrow to broad cheilocystidia and lignicolous habit.
(b) European "variety" (including collections from Altai but not those from the Caucausus) with longer stipe, more distant lamellae, annuliform or fragmentary veil, narrow to moderately broad cheilocystidia and either terricolous or lignicolous habit.
(c) Caucasus "variety" with longer stipe, closer lamellae, annuliform veil, moderately broad to broad cheilocystidia and lignicolous habit.
(d) Florida "variety" with short or long stipe, more distant lamellae, non-annuliform veil, narrow cheilocystidia and lignicolous habit.

Singer's observations are based on six collections and the notes of Kühner (*1935*), Lange (*1938*), and Smith (*1934*, and probably some personal reports). It is difficult, however, to ascertain what longer in respect to the stipe, and closer in respect to the gills really means without any quantitative expression for the characters within any one population and measurements with which they can be contrasted. The variants in Singer's account appear to be compared with the Michigan variant.

In the genus *Conocybe* the first specific epithet for this Michigan variant is that originally proposed by A. H. Smith and transferred by Kühner i.e. *intermedia*.

CONOCYDE INTERMEDIA (A. H. Smith) Kühner—Figs. 1–7, 13–16

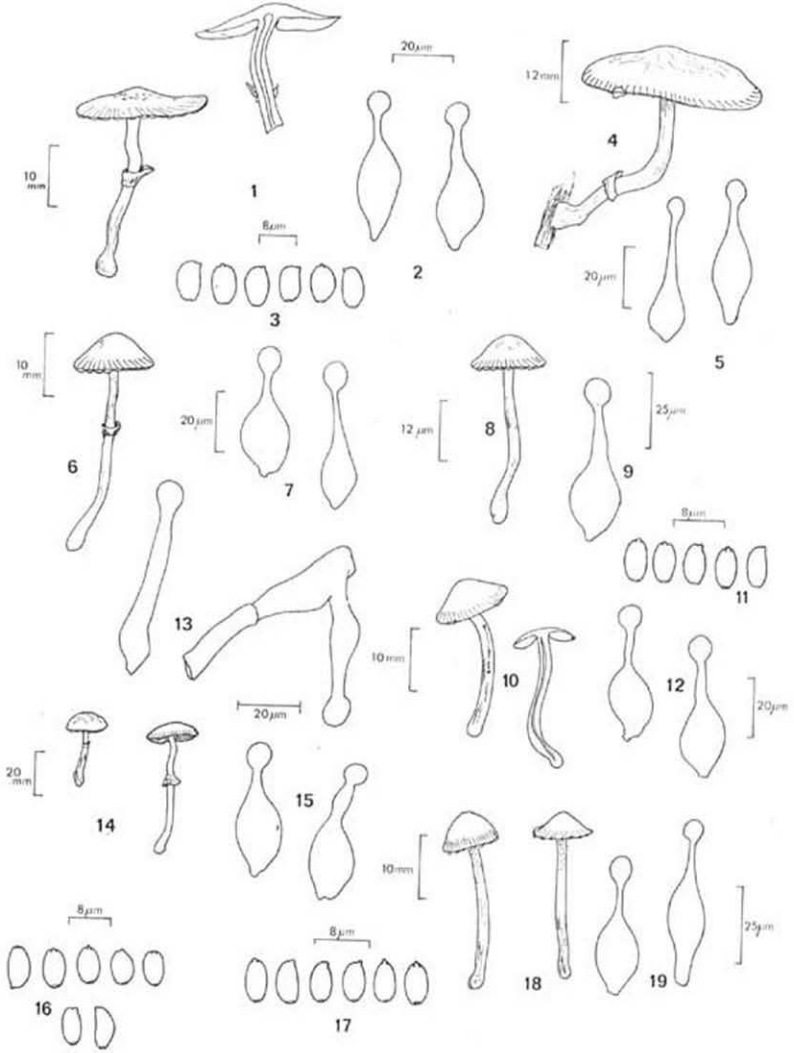
Pholiota intermedia A. H. Smith *in* Annls mycol. **32**: 479. 1934; not *Pholiota intermedia* Sing. *in* Beih. bot. Zbl. **46** (2): 227. 1930. — *Conocybe intermedia* (A. H. Smith) Kühner, Genre *Galera* 143. 1935. — *Pholiotina intermedia* (A. H. Smith) Sing. *in* Beih. Bot. Zbl. (B) **56**: 179. 1936. — *Pholiota septentrionalis* A. H. Smith *in* Mycologia **27**: 227. 1935 (avowed substitute name). — *Pholiotina septentrionalis* (A. H. Smith) Sing. *in* Notul. Syst. crypt. Inst. Komarov **5**: 90. 1945 ("1941"); *in* Trudy bot. Inst. Komar. (II, Spor. Rast.) **6**: 425. 1950 [but quoted as "(Smith) Singer apud Vasilieva ex Singer comb. nov." *in* Sydowia **4**: 143. 1950].

Pholiotina septentrionalis subsp. *smithii* Sing. *in* Trudy bot. Inst. Komar. (II, Spor. Rast.) **6**: 425. 1950.

Pileus 10–20(–30) mm, convex to obtusely conic, expanding to nearly plane or with slight obtuse umbo, smooth, glabrous, moist to slightly viscid, hygrophanous, 'chestnut brown'[3] to 'sudan brown' when young, ochraceous tawny at maturity and fading to dull buff or ochraceous buff on drying, striate to half-way when moist and becoming rugulose at maturity particularly at disc. *Stipe* 10–30 × 1.5–3 mm, buff at first, pale yellow at base darkening to become 'bistre' on handling or with age, fibrillose-scurfy at the apex; *annulus* median or inferior, membranous, striate above, yellowish, forming patches along the margin of the pileus in some fruit-bodies. *Lamellae* crowded, narrow to moderately adnate or adnate descending, ochraceous, with ± even margin, *Flesh* thin; *odour* and *taste* not distinct.

Basidia 4-spored, 14–18 × 7–8 μ, clavate, hyaline in KOH or flushed pale cinnamon, intermixed with some basidioles. *Basidiospores* 6–7.5(–8) × 4–4.5 μ, smooth, ovoid to subellipsoid in face-view, obscurely phaseoliform in side-view, not truncate although

[3] Colours in quotation marks follow Ridgway (*1912*).



FIGS. 1–19. Habit sketches and microscopic characters of *Conocybe intermedia* and *C. brunnea*. — 1–7, 13–16: *C. intermedia*. — 1–3 (Watling A 330/C 709). 1. Habit sketch and section. 2. Cheilocystidia. 3. Basidiospores. — 4, 5 (Watling A 392/G 667). 4. Habit sketch. 5. Cheilocystidia. — 6, 7 (Watling A 328/G 715). 6. Habit sketch. 7. Cheilocystidia. — 13–16 (Smith 33–714, type). 13. Caulocystidia. 14. Habit sketch. 15. Cheilocystidia. 16. Basidiospores. — 8–12, 17–19: *C. brunnea*. — 8, 9 (Watling A 326/G 811). 8. Habit sketch. 9. Cheilocystidium. — 10–12 (A 263/G 772). 10. Habit sketch. 11. Basidiospores. 12. Cheilocystidia. — 17–19 (Watling G 387). 17. Basidiospores. 18. Habit sketch. 19. Cheilocystidia. — (Magnification as indicated.)

with a distinct, small germ-pore, cinnamon-brown in mass, cinnamon-rust in KOH and NH_4OH. *Pleurocystidia* not seen. *Cheilocystidia* skittle-shaped, 18–26(–37) × 7–10 μ, ventricose with narrow neck and head 4–6 μ in diameter. *Hymenophoral trama* cinnamon in KOH, of interwoven or inflated cells about a central strand of swollen cells. *Pileal surface* a hymeniderm of clavate pedicellate cells with walls of pedicels in many somewhat thickened and deep rust-brown in NH_4OH, with or without accompanying pileocystidia. *Pileus trama* of floccose, inflated cells, pale cinnamon in NH_4OH but darker towards the base of hymeniderm. *Stipe surface* of parallel to subparallel, hyaline or slightly buff hyphae, many of which terminate in inflated and/or capitate cells. *Clamp-connections* present, particularly on hyphae of stipe and velar remnants.

Scattered on rotting wood and in rich humus near rotten logs of hardwood, particularly *Fagus*, June-September. Common in the Great Lakes Region of North America.

COLLECTIONS EXAMINED.—

UNITED STATES

Michigan: Holotype and paratypes. Blisswood, Harbor Springs, Emmet Co., 19 August 1953, *Smith 33-714* (HOLOTYPE) (consisting of four mature specimens, 3 immature specimens and a detached pileus); Cross Village, Emmet Co., 19 August 1933, *Smith 33-708;* Harbor Springs, Emmet Co., 21 August 1933, *Smith 33-732* (this collection is better placed in *Conocybe brunnea*—see below); Silver Creek, near Emerson, Chippewa Co., 25 August 1933, *Smith 33-769;* near Superior State Forest, north of Newberry, Luce Co., 28 August 1933, *Smith 33-787;* ibid., 30 August 1933, *Smith 33-823;* Huron Mountains, Big Bay, Marquette Co., 16 September 1933, *Smith 33-991*—all in MICH; slides in (E).[4]

Other material (Michigan). Kent Lake, Oakland Co., 17 September 1938, *Smith 10999* (MICH); The Gorge, near Univ. Mich. Biological Station, Cheboygan Co., 21 August 1949, *Harding 329* (MICH); ibid., 24 August 1949, *Harding 73* (MICH); near Pellston, Cheboygan Co., 10 September 1949. *Harding 384* (MICH). On decayed logs, Harbour Springs, Emmet Co., 21 July 1951, *S. C. Hoare* (DAOM): Upper Tahquamenon Falls, Luce Co., 23 July 1951, *A. H. Smith* (DAOM); Colonial Point, Emmet Co., 14 September 1949, *Smith 33697* (MICH); Tahquamenon Chippewa Co., 24 August 1957, *Smith 57440*, and 27 August 1957, *Smith 57723* (MICH); Emerson, Chippewa Co., 16 August 1965, *Watling A 286/G 730* & *A 287/G 762* (E); Tahquamenon, Chippewa Co., 25 July 1965, *M. Wells, Watling A 171/G 822* (E); Whitehouse Landing, Chippewa Co., 18 July 1965, *Watling A 330/G 709* (E); Hulbert, Chippewa Co., *Watling A 403/G 668* and *A 392/G 607* (E); Whitehouse Landing, Chippewa Co., *Watling A 328/G 715* (E).

New York State: Warren Co., 22 August 1934, *Smith 513* (MICH); North Creek Road, Warren Co., 1 September 1934, *Smith 640* (MICH); Pack Forest, Warrensburg, Warren Co., 16 September 1934, *Smith 791* and *949* (MICH).

Tennessee: India Creek, Great Smoky Mts. National Park, Bount Co., 21 July 1946, *Hesler 17661* (MICH).

CANADA

Ontario: Paradise Lake, Lake Timagami, 2 September 1946, *Smith 4471* (MICH); Ramsayville, 14 September 1954, *Ruth Macrae* (DAOM). As *C. togularis*: Needle Point Magmtawa, *Howard A Kelly Myc. Herb. 1852* (MICH).

[4] Abbreviations for Herbaria follow Lanjouw & Stafleu (*1964*).

In Michigan U.S.A. *P. intermedia* is very common, particularly in the hardwood slashings of the upper areas of Lower Michigan and in the areas around the Tahquamenon water-shed of the Upper Peninsula. However, not only has typical material of this species been collected but also a second fungus with rather more distant, bright tawny ('raw sienna') gills, similar in fact to those mentioned below under Smith 41704. Such collections regularly possessed a marginal veil amd very rarely was there any evidence of a ring to be found; in the true *P. intermedia*, however, the reverse was true. The development of the ring was frequently positively correlated with crowded, dull coloured gills ('sudan brown' to 'bistre'). Thus in a single area of hardwood timber one could locate Smith's original fungus and one which agreed in all ways with European material of what Kühner called *Conocybe intermedia* var. *brunnea*.

It is true that intermixed populations of the two fungi were found in some of the areas in which collecting was carried out and so variability within a single species might be suspected, but when specimens of each were compared side by side there were at least two very obvious differences. It is quite a frequent phenomenon to find closely related, but autonomous, agaric species growing within a single, small area e.g. members of the genus *Coprinus* section *Setulosi* on a single manure-heap. Thus in some areas of woodland *C. intermedia* grew to the exclusion of other members of *Conocybe* subgenus *Pholiotina*, whilst in other areas *C. intermedia* grew in association with an exannulate member of the same group. These two fungi in fact might have slightly different fruiting periods in any one given locality, but one cannot be certain without much longer periods of study. *Conocybe intermedia* would appear to be the earlier fruiting of the two.

The European variant.—Unlike some authorities I propose to keep the taxon formerly known as *C. intermedia* var. *brunnea* as an autonomous species closely related to *C. intermedia* and characterised particularly by the colour and number of the gills; I wish to reduce slightly the emphasis placed in the past on habitat, stature of the fruit-body and position of the velar remnants.

Conocybe intermedia var. *brunnea* has not been validly published according to Article 36 of the "International Code of Botanical Nomenclature" (*1966*). The following validation is therefore proposed:—

Conocybe brunnea J. E. Lange & Kühner ex Watling, *sp. nov.*—Figs. 8–12, 17–19

Conocybe intermedia var. *brunnea* J. E. Lange & Kühner *apud* Kühner, Genre *Galera* 143. 1935 (not validly published; lacking Latin description). — *Galera brunnea* (J. E. Lange & Kühner) J. E. Lange *in* Dansk bot. Ark. **9** (6): 39. 1938 (not validly published). — *Pholiotina septentrionalis* subsp. *brunnea* (J. E. Lange & Kühner) Sing. *in* Trudy bot. Inst. Komar. (II, Spor. Rast.) **6**: 425. 1960 (not validly published). — *Pholiotina intermedia* var. *brunnea* (J. E. Lange & Kühner) Moser *in* Kl. Krypt Fl. **2**: 190. 1953 (not validly published). — *Conocybe brunnea* (J. E. Lange & Kühner) Kühner & Romagn., Fl. anal. Champ. sup. 343. 1957 (not validly published).

? *Galera ravida* Velenovský, Česká Houby 546. 1922, *fide* Kühner, Genre *Galera* 143. 1935.

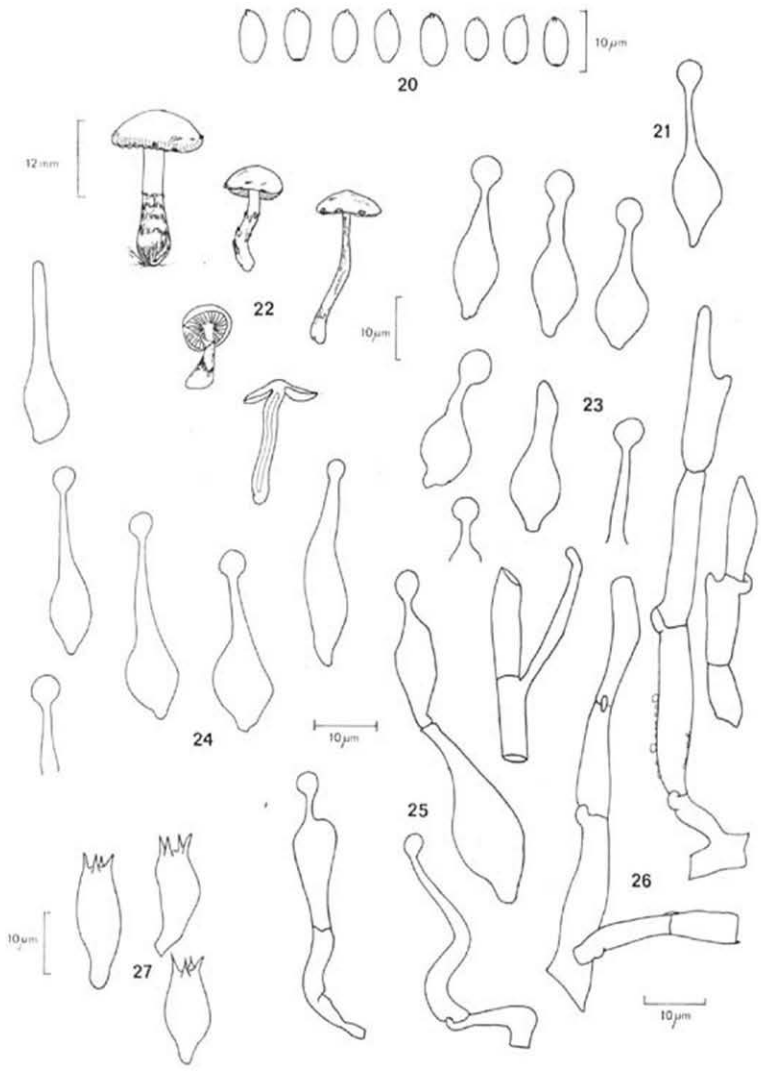
MISIDENTIFICATIONS.—*Pholiotina septentrionalis* (A. H. Smith) Singer *sensu* Moser *in* Kl. Krypt-Fl. (Pilze) **b/2** (3. Ausg.): 230. 1967.
Naucoria tremulenta forma *typica* Heim & Romagn. *in* Bull. Soc. mycol. Fr. **50**: 175. 1934.

Pileus 9–14(–20) mm e convexo vel conico-convexo expansus, umbonatus, badius vel castaneus, sicco ochraceo-mellinus vel flavido-ochraceus, jove pluvio striatus. Stipes 25–40 × 1.5–3 mm, aequalis, sursum leviter attenuatus vel deorsum incrassatus, farctus vel anguste cavus, ochraceo-brunneus mox sursum umbrinus vel obscure fuscus, mellino-flocculosus. Lamellae ferrugineae. Basidia 4-sporigera, 20–26 × 6–7.5 μ. Basidiosporae phaseoliformes-ellipsoideae, laeves, (6.0–)6.5–8(–9.5) × 3.5–4.5(–5.0) μ. Cystidia acici lamellarum apicibus capitatis, 25–45 × 5–7.5 μ. Cystidia stipitis similia.
TYPUS.—Boissy-Saint Leger, Paris, France, 5 x 1932, *R. Kühner* (Herb. Kühner, Lyon, France).

Pileus 9–14(–20) mm, convex or conico-convex, expanding to become broadly conic with slight umbo, 'bay' or 'chestnut' when fresh and young, paler at maturity, becoming rusty tawny, hygrophanous, ochraceous 'clay-colour' or yellow-buff when dry, minutely striate to half-way when moist; margin appendiculate with minute, white or creamy, fugacious, membranous scales. *Stipe* 25–40 × 1.5–3 mm equal, slightly attenuated upwards or thickened at base, stuffed then hollow, pale clay-buff or whitish then yellowish brown, darker towards the base particularly at maturity or after excessive handling, floccose throughout very rarely with apical ring. *Lamellae* crowded, broad, ventricose-adnate, rust-brown with irregular margin which in fresh specimens is whitish. *Flesh* buff in pileus, more deeply coloured under pileus-disc, 'bistre' in stipe-base, darkening upwards.
Basidiospores (6–)6.5–8(–9.5) × 3.5–4.5(–5) μ, ellipsoid to elongate ovoid in face-view, obscurely subcylindrical to phaseoliform in side-view, smooth, pale cinnamon-rust to honey-brown in NH_4OH, with a distinct although small germpore about 1 μ broad. *Basidia* clavate, 4-spored, 20–26 × 6–7.5 μ. *Pleurocystidia* not seen. *Cheilocystidia* numerous (15–)25–45 × 5–7.5(–9) μ, ventricose with apex drawn out into thin neck up to 2 μ broad, and surmounted by subglobose to ellipsoid head up to 6 μ broad, usually 3.5–5.5 μ broad. *Hymenophoral trama* of short, swollen units up to 25 μ broad, surrounding regularly arranged, slightly inflated cells constituting a central strand. *Pileal surface* a hymeniderm of clavate, pedicellate cells up to 22 μ broad with slightly to strongly coloured pedivels, often associated with tibiiform pileocystidia up to 40 μ long. *Pileus trama* of floccose, inflated cells, pale cinnamon in NH_4OH. *Stipe surface* of parallel to subparallel, clamp-connected, hyaline or slightly buff hyphae many of which terminate in capitate cells. *Velar remnants* of irregularly asperulate to smooth, yellowish brown, diverticulate hyphae, 3—6 μ broad, clamp-connected and shortened, some giving rise to cells similarly shaped to those at gill-margin and with head 1–5 μ broad and body 4.5–9 μ broad.
On rich soils, rendzinas and brown-earths etc., amongst herbaceous debris and under herbs, in woodland clearings or wet depressions, by roadsides, more rarely in Europe on rotten wood; more frequently on woody debris in North America.
TYPE.—In humus and amongst leaves in humid depression, Boissy-Saint Leger, Paris, France, 5 x 1932, R. Kühner (in Herb. Kühner, Lyon, France and slide in E).
COLLECTIONS EXAMINED (all in E).—

BRITISH ISLES

Hampshire: Denny, New Forest, 19 October 1958, *Orton 1478*. — Herefordshire: Covenhope, 22 November 1959, *Orton 2020*. — Inverness-



FIGS. 20–27. *Conocybe fibrillosipes* (type). — 20. Basidiospores. 21. Cheilocystidia. 22. Habit sketch and section. 23. Pileocystidia. 24. Cheilocystidia. 25. Caulocystidua. 26. Veil constituents. 27. Four-spored basidia. — (Magnification as indicated.)

shire: Guisachen near Tomich, 31 August 1957, *Watling G 69/C 138.* — Midlothian: near Cramond, 16 October 1965, *Watling G 550.* — Perthshire: Kindrogan, 25 August 1968, *Watling G 1189.* — Ross and Cromarty: Rassal Nature Reserve, 14 September 1963, *Watling G 387.* — Surrey: Juniper Hall, Mickleham, 5 October 1952, *Orton 45,* 1 October 1955, *Orton 616,* and 4 October 1955, *Orton 620;* Gomshall, 22 September 1958, *Orton 1477.* — Sussex: North Amersham Common, near Chichester, 5 September 1967, *Kits van Waveren.* — Yorkshire: Langcliffe Wood, Settle, 29 August 1958, *D. M. Henderson, Watling G 144;* Nun Appleton, 16 September 1961, *Watling G 180;* Deep Dale, Barnard Castle, 21 September 1963, *Watling G 417* and 23 September 1963, *Watling G 419;* Brignall Bank Wood, Barnard Castle, *T. Hering,* 23 September 1967, *Watling G 425.* — Spore prints only; Orton collections: 18 September 1951; 17 and 19 September 1953; 3 October 1954; Mountain Wood, Surrey, 17 August 1953; 16 September 1959; Denny area, New Forest, Hants., 18 October 1958.

FRANCE

Type collection, and Boissy-Saint Leger, Paris 30 September 1932 (slides in E).

NETHERLANDS

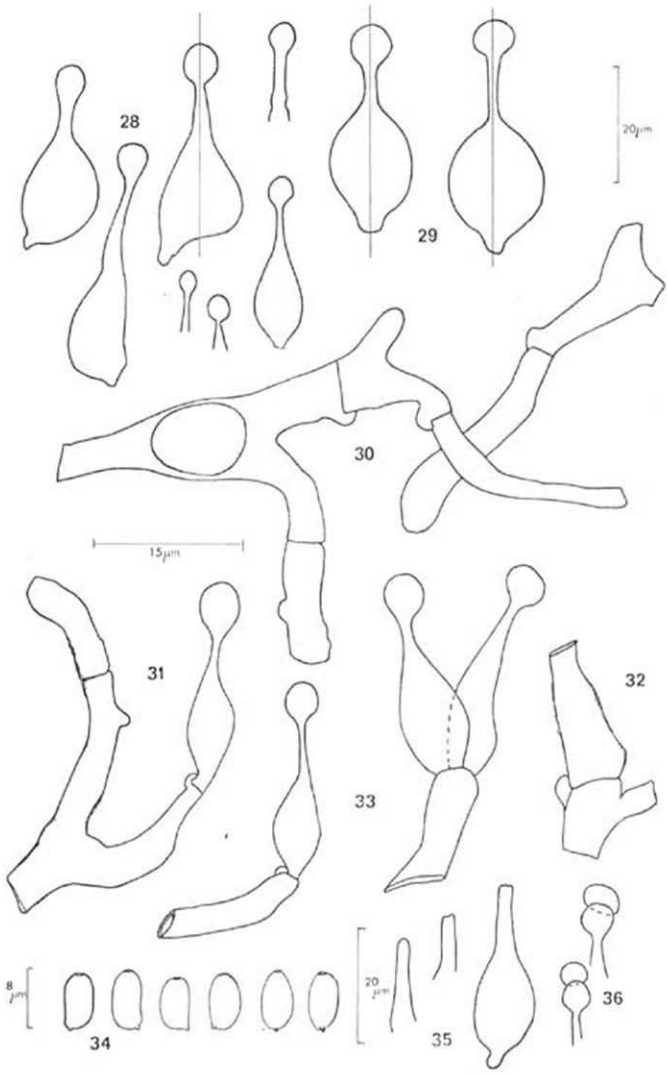
"Ada Hoeve", Ommen, *Kits van Waveren* 26 September 1964.

UNITED STATES

Michigan: Whitehouse, Emerson, Chippewa Co., 12 August 1965, *Watling A 263/G 772* & *A 326/G 811* (E); Hulbert, Chippewa Co., 25 August 1965. *Watling A 312/G 622, A 394/G 591* & *A 395/G 590* (E); Sugar Is., 23 August 1965 *Watling A 372/G 588* (E); Tahquamenon, Chippewa Co., 12 September 1969, *Watling G 865* (E).

Smith (personal communication) found a collection, Smith 41704, which had much brighter coloured ('raw sienna') gills than *C. intermedia* and a significant development of pileocystidia. However, on careful examination of many collections of fungi in this complex it has been observed that the development of pileocystidia occurs to some degree in all fruit-bodies; the presence of such structures is therefore considered of little taxonomic importance. It may be found subsequently that the environmental conditions prevailing in the field at the time of fructification may influence the abundance of pileocystidia as has been shown in experiments with members of the *Conocybe pubescens* group (Herregods, *1952;* Watling, unpublished data; *1964*). The gill-colour, however, is significant and Smith 41704 should be referred to *Conocybe brunnea.* There may even be a very slight difference in basidiospore-shape between this collections and those of *C. intermedia,* a fact noted after several score collections of both species had been examined.

The habitat of *C. brunnea* is a fairly reliable character in Western Europe; nevertheless although typically terrestrial it has to my knowledge been collected growing on wood by Orton (on *Alnus,* personal communication) and by Kits van Waveren (personal communication). I have made several collections on wood in North America of a fungus I consider this very same species. However, when considering growth on woody substrates it should be noted that the term lignicolous, when applied to certain American fungi, has a different meaning to that normally used and understood by West European mycologists. The woodlands of Europe in most cases have



FIGS. 28–36. Characters of *Conocybe* Section *Intermediae*. — 28. Cheilocystidia (*C. brunnea*, *C. fibrillosipes*, *C. intermedia*). — 29. Typical lecythiform cystidia of *Conocybe* subgenus *Conocybe* (*C. magnicapitata;* Watling G 207). — 30–36: *Conocybe brunnea*. 30–32. Hyphae of veil. 33. End-cells of hyphae of stipe-cortex. 34. Basidiospores. — 35. Cheilocystidia with capitulum (apex) broken off. 36. Cheilocystidia with apical droplet. (35 and 36 are often mistaken as entire cystidia). — (Magnification as indicated.)

been influenced by man for a very long time and so have been radically changed. In marked contrast the hardwood forests of North America have been highly modified by white man only in comparatively recent historic time. Unlike many West European wooded areas where the forest floor is cleared of the major amount of its woody debris very quickly, so that trunks and large branches do not litter the ground, American woodlands particularly those of the Great Lake Region, Appalachians, Great Smoky Mountains and New England are difficult to collect in because of the vast amount of woody detritus. Many areas formerly felled have now grown up with secondary growth timber, some of which although usually of poor quality is also being cut; this latter felling adds to the number of large trunks, stumps and branches already there forming a carpet of detritus in various stages of decay. Using Grainger's apparatus for testing woody substrates (*1946*) it is here suggested that wood under the conditions found in N. American slashings will support a typically terrestrial flora including *C. brunnea* when the maximum value of the spring balance registers as little as 21bs pressure.

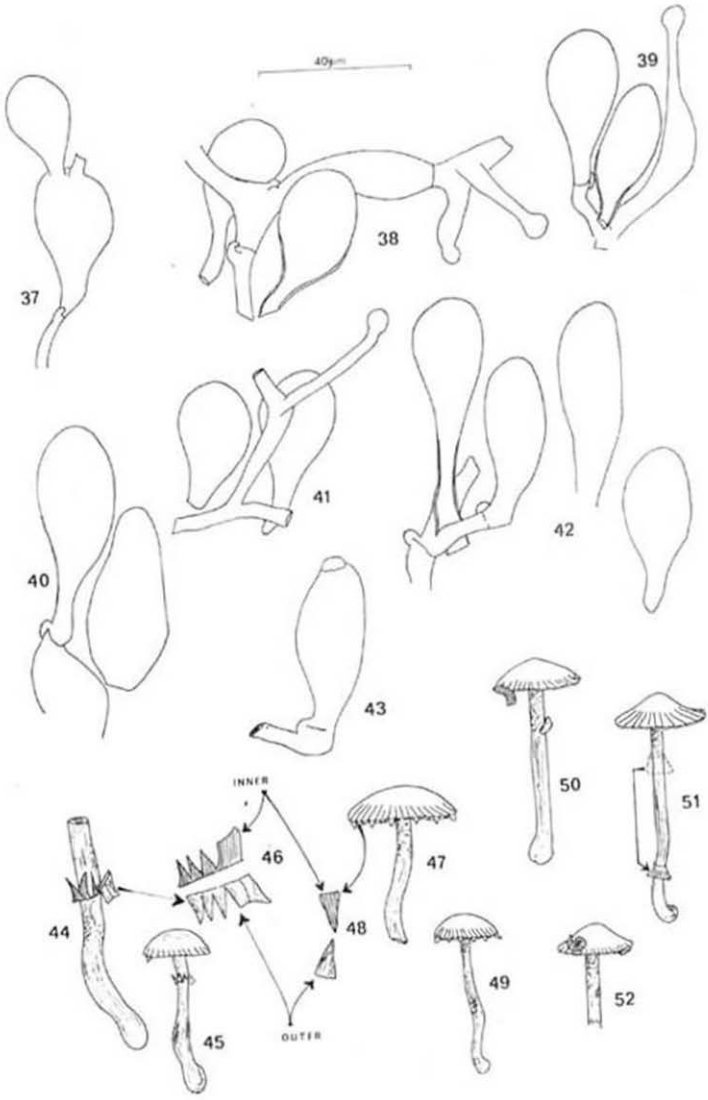
Singer (*1950*) believes that there is no evidence for any correlation between the two fungi described above and their geographical distribution but from my own observations, based on several score collections, this suggestion may not give an entirely true picture.

Although I have seen several examples in North America I have not found in Europe the development of a ring and a marginal veil interchangeable in the *Conocybe intermedia* group. Kits van Waveren (personal communication), however, has seen one example; it appears to be a rare phenomenon. Such an interchange of veil types is, neverthetess, commonly seen in the other annulate species of *Conocybe*, e.g. *C. aporos*. Therefore the distribution of velar remnants gives only a guide as to the species concerned.

Conocybe brunnea in Europe is fairly variable, indeed Orton (1957) in an unpublished provisional key to the group split British material into two groups distinguished on the basidiospore-size, the colour of the pileus and the dimensions of the cheilocystidia; later he withdrew this suggestion.

However, Lange's (*1939*) values for spore-dimensions of '*Galera brunnea*' are also at variance to those of Kühner's for '*Conocybe intermedia*' var. *brunnea* and support Orton's suggestion of the possibility of two species being involved. Graphs 1 and 2 show that the averages of sizes of basiodiospores of different collections do not fall into two distinct groups but show a continuous line. Lange comments after his description on the presence of a larger and paler variant. Slight differences in colour and in pileus-size, however, appear to parallel the phenomenon described in collections of *C. percincta* and other species by Kits van Waveren (*1970*); I believe the notes on pileus-colour discussed earlier is relevant here (Kits van Waveren, *1970;* Watling, *1971*).

The habitat for the two variants was thought by Orton also to be different but after careful observations it is concluded, however, that *C. brunnea* fruits irrespective of the neighbouring flowering plant-community.



Figs. 37–53

Florida and Caucasus variants.—As pointed out earlier I am unaware of any name having been given to the Florida 'variety' mentioned by Singer; I have not examined dried material. Nor am I familiar with the fourth 'variety' described by Singer from the Caucasus as *Pholiotina septentrionalis* subspecies *vasilievae* Sing. (*1945*: 98; *1950b*: 425) and refrain at the moment from validating this taxon. One character of this subspecies has been said to be its large size but the type variety can grow to 30 mm. Stature and size, as in many members of the Bolbitiaceae are variable; those of the *C. intermedia* group are usually small agarics 10–20 mm (rarely up to 30 mm; see Figs. 1–7).

It is highly possible that what we are experiencing in different parts of the world is differentiation of *C. intermedia* into a group of very closely related entities differing in only small features, some of which will allow formal description so separating one taxon from the other as autonomous e.g. *C. intermedia*, whilst others can not as yet be so treated. Although in the Coprinaceae and in some other members of the Bolbitiaceae experimentation has confirmed such a point of view unfortunately cultural studies have been unsuccessful in *C. intermedia* agg.

A NEW SPECIES

Conocybe fibrillosipes Watling, *sp. nov.*—Figs. 20–27

Pileus 10–17 mm, convexus vel semiglobatus, haud expansus, fulvo-luteolus, aurantius, ± badius, jove pluvio striatus. Stipes 18–32 × 3–5 mm, luteolo, ochraceo-mellinus vel flavido-ochraceus, fibrilloso-striatus, laneo-flocculosus. Lamellae pallido-ochraceae postremo ferrugineo-mellinae. Basidia 18.5–21 × 6.5–8 μ Basidiospores 6.5–8.5(–9) × 3–5 μ, phaseoliformes-ellipsoideae. Cheilocystidia capitata. Typus.—*Watling G. 102G* (E).

Pileus 10–17 mm, convex, semiglobate, hardly expanding, rich dark tawny orange, ('tawny') tinted with 'chestnut', particularly towards the disc, striate to half-way and covered particularly at margin in small, pale ochraceous fragments of appendiculate and marginal veil. *Stipe* 18–32 × 3–5 mm, distinctly 'yellow ochre', stout, fibrillose-streaky to woolly floccose, particularly towards the base; veil peronate or present as mere flecks of membranous material towards the stipe-apex, then fibrillose-woolly, matt, giving a rough appearance below, floccules finally yellow ochraceous. *Lamellae* pale ochraceous then rusty tawny, fairly close. *Flesh* dark brown in pileus when fresh, slightly ochraceous in stipe-cortex, dark buff in stipe-centre, umber brown ('Saccardo's umber') in stipe-base.

Basidia (2–)4-spored, 18.5–21 × 6.5–8 μ, clavate, hyaline in NH_4OH. *Basidiospores* 6.5–8.5(–9) × 3–5 μ, ellipsoid in face-view, flattened at on side in side-view and

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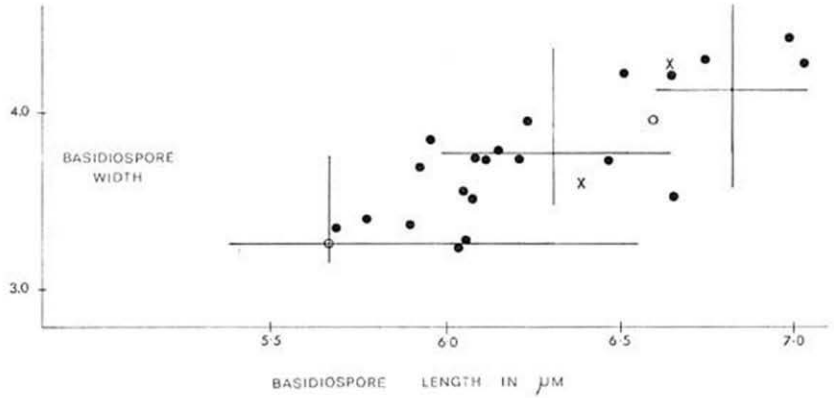
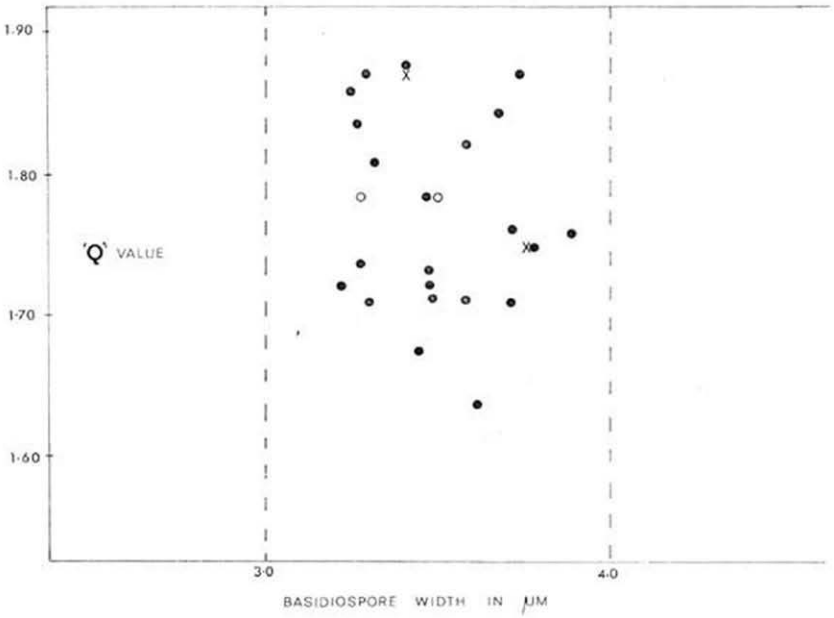
EXPLANATION OF FIGURES 37–53

FIGS. 37–53. — Hymeniderm and veil characters of *Conocybe brunnea* compared with *C. aporos*. — 37–49: *Conocybe brunnea*. 37–43. Constituents of pileal hymeniderm (Watling G 828). — 44–49. Two members of a single population (Watling G 828). 45. Fruit-bodies exhibiting an annulate veil. 49. Fruit-body with appendiculate veil. Magnifications 44, 46 and 47, 48 show details of stipe, ring (both entwined and when straightened out), pileus-margin and appendiculate veil. — 50–52: *Conocybe aporos* (Watling G 1086). Carpophores with broken annulus in part attached to pileus-margin (50), mobile ring (51) and entire annulus distributed on pileus-margin (52). — (Magnification as indicated.)



GRAPH 1



GRAPH 2

faintly phaseoliform, thin-walled, smooth, pale ochraceous in NH_4OH and in Melzer's reagent; germ-pore just visible, approximately 1 μ broad. *Pleurocystidia* absent. *Cheilocystidia* skittle-shaped (tibiform), 16.5–25.5 μ, body 6–8 μ broad and head 2.5–4.5 μ broad. *Pileocystidia* frequent, skittle-shaped (tibiiform) 11.15 μ, body 4.5–9 μ broad, apex 2–3.5 μ broad. *Caulocystidia* at stipe-apex similar to the cheilocystidia, masked by intermixing hyphal filaments from veil. *Hymenphoral trama* of interwoven, swollen cells. *Pileus-surface* a regular hymeniderm of clavate, pedicellate cells.

On roadside amongst herbaceous debris in conifer woodland, Cusick, Pend' Oreille Co., Washington, 12 October 1966, *Watling G 1027* (typus, E).

An easily recognisable species by virtue of its stout stipe whose robustness gives the fungus more the appearance of *Galerina unicolor* (Vahl ex Sommerf.) Sing. than a species of *Conocybe*. The copious yellow-brown veil on the pileus-margin and particularly on the stipe, and the frequent occurrence of pileocystidia in the hymeniderm are also significant.

THE DESIRABILITY FOR A NEW SECTION WITHIN CONOCYBE SUBGENUS PHOLIOTINA

It is unfortunate that neither the basidiospores of *C. intermedia* or *C. brunnea* have been induced to germinate in pure culture, even though fresh spore-deposits have been available, nor have tissue-cultures survived long enough to induce the production of primordia. Thus the finer details of the development of *Conocybe intermedia* and *C. brunnea* are unknown. From the examination of very young fruit-bodies it would appear that there is no reason to suspect that *C. intermedia* and its allies differ in the sequence of stages during their paravelangiocarpic development from those observed in other species of *Conocybe*.

Although there may be a tendency for the larger number of any given population of a member of *Conocybe* subgenus *Pholiotina* to be annulate, dentate specimens may also occur within the same population (see Figs. 44–49). When the veil of a truly annulate species of *Conocybe* splits and adhers to the pileus margin it rarely displays the regular dentate pattern seen in *C. brunnea* (Figs. 50–52). However, when the veil of *C. brunnea* forms a ring its construction from closely adhering units can be easily observed (Figs. 44–49). Examination of herbarium material is deceptive because the very act of collecting may alter the position of the veil particles; indeed they may be even lost altogether by careless collecting and subsequent handling.

Specialised cystidia are to be found widespread on the stipe of many members of the genus *Conocybe*, but in *Conocybe* subgenus *Pholiotina* they appear to be lacking except at the very apex of the stipe and are replaced in the lower part by filamentous, adpressed hyphae which are not or hardly specialised at their apex. One group of

GRAPHS 1, 2. Biometrical data for basidiospores of *Conocybe brunnea*. — Graph 1. Length/width graph; average values in μ. — Graph 2. 'Q' values (numerical value for ratio of average length and width of basidiospores) plotted against spore-width. — X. Collections by R. Kühner, O. Collections of manuscript named segregate; for further details see text.

species appears to be an exception to the rule i.e. *C. intermedia* group, where the clamp-connected hyphae constituting the stipe cortex give rise to numerous skittle-shaped caulocystidia similar in shape to the cheilocystidia (Fig. 33). Similar cells are to be found on the pileus to some degree and on the veil; they are much more easily seen in fresh specimens. Although a few species of *Conocybe* e.g. *C. laricina* in subgenus *Ochromarasmius*, also possess such structures they are normally very uncommon or absent in the hymeniderm of the *C. tenera* group and absent or exceedingly rare in the *C. arrhenii* group.

Cystidial shape found in the *C. intermedia* complex (Fig. 28) is unique in *Conocybe* for although they are capitate they are not truly lecythiform; the capitulum is frequently asymmetric and seated on a thin, tapering neck. The body of the cystidium although generally inflated is rarely as extreme as in the cystidia found in *C. tenera* and related species, and may be even quite narrow and irregular. The variation of cystidial proportions and shape is greater even in a single pileus than in members of several populations of a typical member of sg. *Conocybe*.

The cells of the hymeniderm (Figs. 4 A–G) in *C. intermedia* and allies turn cinnamon brown in alkali and are covered in *C. intermedia* in a distinct, although thin, layer of hyaline gluten which soon disappears at maturity when the pileus becomes dry. Such a layer of gluten is common to many members of the *Bolbitiaceae* but often it is very thin and detectable only by staining with Alcian blue—Schiff's periodic acid (Disbrey and Watling, *1967*) or similar techniques; a truly viscid pileus in European members of the genus *Conocybe* is found in *C. coprophila* in subgenus *Piliferae*.

The *Conocybe arrhenii—C. blattaria* complex has long been considered a unit and the *C. appendiculata—C. vestita* group also show some homogeneity based on developmental studies. However, it would be absurd to place two taxa which are obviously so very closely related as *C. intermedia* and *C. brunnea* in two different sections of a genus the first with *C. blattaria* and the second with *C. appendiculata* simple because of the position of veil present.

I therefore propose to recognise the differences exhibited by *C. intermedia*, *C. brunnea* and *C. fibrillosipes* (representing a stirps in the sense of A. H. Smith) by erecting a special section based on the features discussed above and incorporated in the formal diagnosis below.

Conocybe subgenus *Pholiotina* sect. **Intermediae** Watling, *sect. nov.*

Pileus hygrophanus, aliquantum viscidus, subinde paulum humidus vel siccus, laevis vel subtiliter pubescens propter capitatas pileocystidias, sive interdum praeditus fibrillis vel squamis minutis ad aciem propter albidos vel ochraceos flocculos. Velo annulato vel appendiculato ad marginem pilei dentato. Pleurocystidia absentia; cheilocystidia subcapitata vel distincte capitata, irregulariter tibiiformia sed tum numquam lecythiformia; caulocystidia similia. Basidiosporae phaseoliformes e latere. Typus *C. intermedia* (A. H. Smith) Watling.

The section is therefore based on the tibiiform cells on the pileus, stipe and gill-margin, the rather thin-walled, phaseoliform basidiospores with small germ-pore and the presence of a veil which may be annuliform or dentate. Although distinct in

some characters the epithet *Intermediae* has been chosen for the group in order to reflect the intermediate position in the genus of some of the characters of members of the section and also the specific name by which one member of this group had been known by many in Europe for over twenty-five years.

The section *Vestitae* was described (Watling, *1965*), to cover the non-annulate members of subgenus *Pholiotina;* this section must now be modified in order to exclude *C. brunnea* and should read as follows:

Pileus hygrophanous, dry or at most humid, veil present either as appendiculate, fibrillose or membranous particles at margin; ring absent or exceptionally rare. Pleurocystidia absent; cheilocystidia irregularly branched or simple, cylindrical, fusiform, elongate ventricose, subcapitate or with obtuse apex, never truly tibiiform or lecythiform; caulocystidia similar to cheilocystidia and only at apex of stipe. Pileocystidia absent. Basidiospores ellipsoid to slightly amygdaliform, never phaseoliform.

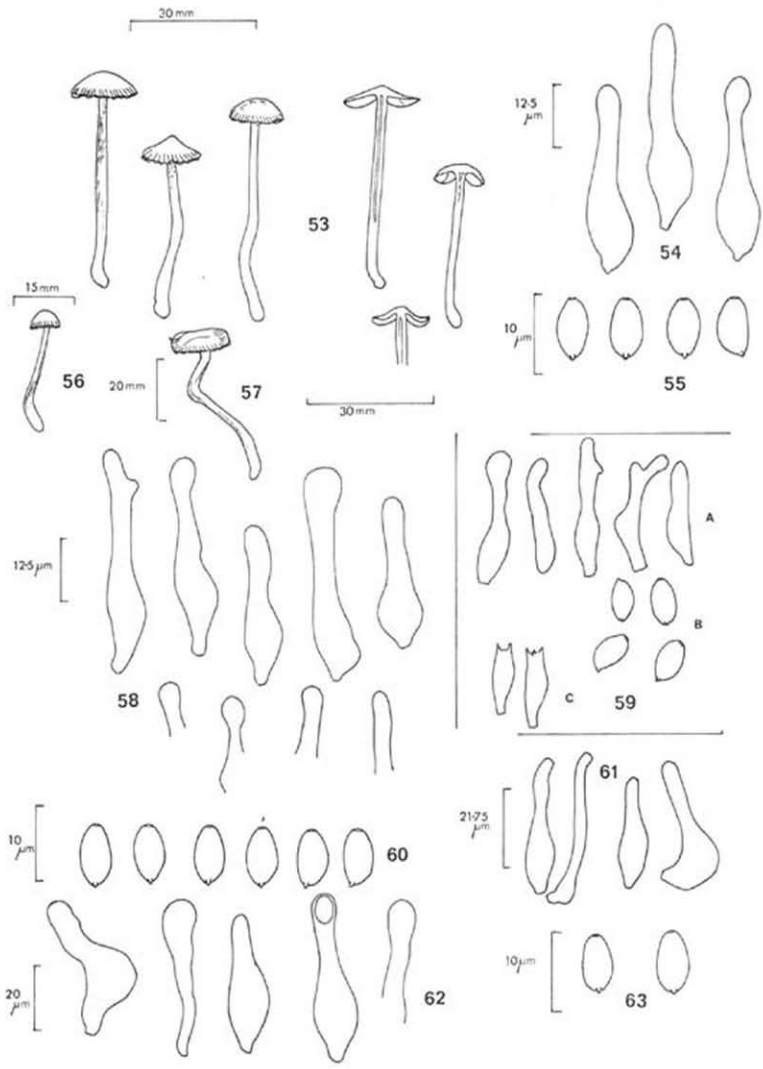
Observations on the Bolbitiaceae—VII
Validation of Conocybe appendiculata

Kühner's monograph dealing with all the European and North African agarics which up to that time had been included in the Friesian genus *Galera* is dated 1935. To effect valid publication all new taxa after December 31st, 1934 must be accompanied by a Latin description (see Art. 36 of the Code 1966). Therefore those taxa described for the first time in Kühner's work are unfortunately invalid. Rules are frequently made after the event and unfortunately it is because of such a decision that the importance of Kühner's work nomenclatorially has been considerably lessened. This is unfortunate for there is a wealth of observations of very high standard included in the study, indeed observations more searching than many of those found in works produced today—some thirty five years later.

Several new taxa were described and discussed in detail in Kühner's manual and through the kindness of Prof. R. Kühner I have been able to re-examine some of the material on which these descriptions were based. Singer *(1959)* has gone part-way in validating some of these taxa although is it debatable if on strict application of the rules these are even now validly published (Watling, *1964*). Of one fairly common species Singer did not include in his list I herewith validate the name. I have based the taxon on the excellent description of J. E. Lange and R. Kühner and the material they used when drawing up this description.

Conocybe appendiculata J. E. Lange & Kühner
ex Watling, *nov. spec.*—Figs. 53–63

Conocybe appendiculata J. E. Lange & Kühner *apud* Kühner, Genre *Galera* 146. 1935 (not validly published, lacking Latin description). — *Pholiotina appendiculata* (J. E. Lange & Kühner) Sing. *in* Beih. bot. Zbl. (B) **56**: 170. 1936; *in* Trudy bot. Inst. Komar. (II, Spor. Rast.) **6**: 434. 1950; *in* Lilloa **22**: 487. 1951; (not validly published). — *Galera appendiculata* (J. E. Lange & Kühner) J. E. Lange *in* Dansk bot. Ark. **9** (6): 39. 1938 (not validly published).



FIGS. 53–63. *Conocybe appendiculata*, habit sketches and microscopic characters. — 53, 56, 57. Habit sketches (Watling G 534, G 228, G 221). — 54, 55 (Watling G 222). 54. Cheilocystidia. 55. Basidiospores. — 58. Cheilocystidia from collections illustrated in 53, 56, 57. — 59 (ex Kühner, 1935). A. Cheilocystidia. B. Basidiospores. C. Basidia. — 60, 62 (Watling G 221). 60. Cheilocystidia. 62. Basidiospores. — 61, 63 (collection Kits van Waveren). 61. Cheilocystidia. 63. Basidiospores.— (Magnification as indicated.)

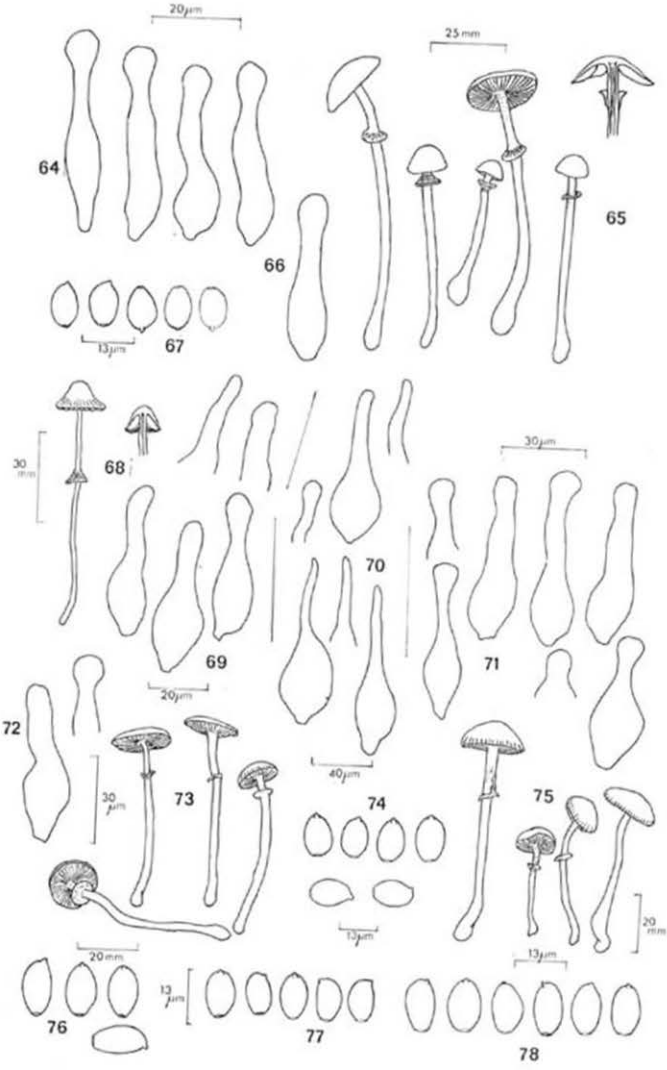
MISIDENTIFICATION.—*Galera ravida* Fr. *sensu* Ricken, Blätterp. 227. 1915, *fide* Kühner, Genre *Galera*. 1935.

Pileus 8–22 mm, e convexo vel conico-convexo expanso-convexus, vulgo leviter umbonatus, ochraceo-mellinus vel flavido-ochraceus, jove sicco flavido-ochraceus vel pallido-ochraceus, jove pluvio striatus, velo albo-appendiculato. Stipes 25–36 × 1.5–2.7 mm, aequalis, sursum leviter attenuatus vel deorsum incrassatus, albido-cremeus, pallido-flavidus vel argillaceo-mellinus, ad basim obscurior, brunnescens sericeo-striatus, ad apicem persistentiore albido-cremeus floccosus. Lamellae adnatae, ex albido-argillaceae, argillaceo-ochreae vel argillaceo-mellinae postremo ferrugineo-mellinae, L 22–32, l (1–)3–5(–7), ad aciem pallidiore flocculosae. Caro pilei concolor, stipitis deorsum obscure fusca. Odor leviter acidulosus. Sporae ellipsoideae non phaseoliformes, 6,5–8,5(–9.0) × 4–5(–5.5) μ, poro germinativo minuto. Basidia 4-sporigera, 15–25 × 5.5–7.5 μ. Cystidia aciei lamellarum curvata flexuosa, elongato-clavata vel subcapitata 25–45 × 5.5–10(–11) μ apicem 2.5–6 μ cervice 2.5–6 (–8) μ. Cellulae cuticulae pilei pyriformes, 10–25 μ diam.

TYPUS.—Bois de Vincennes, environs de Paris, France, 23 ix 1932, *R. Kühner*. (Herb. Kühner, Lyon, France).

Pileus 8—22 mm, convex or conico-convex then expanded, umbonate, deep ochraceous honey or yellowish ochreous ('ochraceous orange') slightly tawny towards disc, paler towards the margin, drying pale yellowish ochre ('yellow ochre') to dirty honey-yellow, slightly striate at edge, with white dentate remains of veil at margin. *Stipe* 25–36 × 1–1.5(–2.7) mm, equal or slightly attenuated upwards, flocculose-pruinose at apex, white, silky fibrillose below, soon discoloured, pale dirty yellowish then brownish, darkening from base up; *veil* very rarely forming an annulate zone, sometimes fragmentary on stipe. *Lamellae* adnate, ventricose or nearly so, fairly wide l 3–5, clay-colour flushed cinnamon then pale clay-ochreous, finally rusty tawny or rusty honey ('cinnamon rufous'), edge heteromorphic, white or paler, flocculose-denticulate. *Flesh* concolorous, drying paler in pileus, dark in stipe below whitish cortex particularly at base. *Smell* very slightly acidulous or absent; *taste* not distinct or insipid.

Basidiospores rusty ochreous in mass, 6.5–8.5(–9) × 4–5(–5.5) μ, ellipsoid in face-view not phaseoliform, slightly flattened on one face in side-view, with small germ-pore which is only just visible in some views, hardly truncate even in side-view, fairly thin-walled, honey-yellow in water, slightly darker in ammoniacal solutions. *Basidia* 4-spored, 15–25 × 5.5–7.5 μ, clavate to cylindric, particularly in upper part, hyaline or very slightly yellowish in ammoniacal solutions. *Pleurocystidia* not seen. *Cheilocystidia* ± subcapitate, vesiculose or not below, sometimes with sinuous or irregularly flexuous neck, 25–45 × 5.5–10(–11) μ neck 2.5–6(–8) μ broad and head 2.5–6 μ broad, less frequently laterally and shortly branched. *Caulocystidia* at apex of stipe, clavate or similar to cheilocystidia, replaced below by open net-work of hyaline, cylindric hyphae with little or no differentiation of end-cells. *Hyphae of veil* hyaline, hardly darkened in ammoniacal solutions, 4–7 μ broad, not constricted at septa. *Clamp-connections* present, particularly on hyphae of veil and stipe-cortex. *Pileal surface* a hymeniderm of pedicellate ellipsoid to pyriform or ovoid cells 10–25 μ broad. *Hymenophoral trama* of regular or of slightly irregular or tangled hyphae, ± constricted at septa, particularly in larger gills and intermixed with swollen subglobose to ellipsoid cells flanked by more filiform cells 4–6 μ broad; *subhymenium* consisting of 1—2 layers of subglobose to ellipsoid cells. *Ammonia-reaction*, negative. *Pileus trama* of openly arranged, floccose swollen hyphae, hyaline or slightly coloured in ammoniacal solutions and more tangled towards the apex of stipe.


20 µm
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74
75
20 mm
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20 mm
13 µm
76
77
78

Figs. 64–78

In copses, edges of woods, and in woodland clearings, on moss covered soil or on base rich soils under herbaceous plants, and amongst herbaceous debris.

TYPE.—On soil amongst herbaceous plants, Bois de Vincennes, Paris, France, 23 ix 1932, R. Kühner, in Herb. Kühner, Lyon, France (slide in E.).

COLLECTIONS EXAMINED (E).—

BRITISH ISLES

Durham: Middlestone Moor, 29 August 1962, *Watling G 308.* — Perthshire: Kindrogan, *J. T. Palmer*, 24 August 1968, *Watling G 1196.* — Somerset: Cleeve Coombe, 12 September 1955, *Orton 614.* — Surrey: Ashurst Valley, 22 September 1961, *Watling G 220* and *G 228;* Mickleham Downs, 22 September 1961, *Watling G 221* and *G 222.* — Yorkshire: Kingthorpe, 10 September 1960, *Watling G 26;* Throxenbury Mere, 12 September 1961, *Watling G 147;* Nun Appleton, 16 September 1961, *Watling G 174* and *G 196;* Newton Dale, 23 October 1964, *Watling G 534.*

Spore-prints only: Clumber Park, Nottinghamshire, 7 September 1956, *P. D. Orton.*

FRANCE

Bois de Vincennes, Paris, 23 September 1932, *R. Kühner.*

R. Kühner *(1935)* records this species from Ozour-la-Ferrière, environs Paris and Grande Chartreuse, (Isère) both in France. Lange *(1938)* records it from Hyallese, Denmark, and Singer in his notes on brown-spored agarics from Russia. Kits van Waveren has sent me material from Holland; Amsterdamse Bos, The Netherlands, 17 vii 1960.

The veil in *C. appendiculata* is typically appendiculate, hence the name, although collections have come to my knowledge (see Kühner, *1935:* 147; Kits van Waveren, personal communication) where the veil was annulate. Probably the same conditions which operate in the *C. brunnea* complex, are found here (see p. 321). It would indeed be extremely useful to examine in detail those collections with a ring, recorded at odd-times as members of the *C. arrhenii* group but reported as having aberrant features; they may represent annulate 'forms' of *C. appendiculata.*

Kühner *(1935)* also describes *C. appendiculata* forma *macrospora* based primarily on the overall similarity yet larger spores. This, however, I believe to be a distinct species and it will be dealt with in a future paper. It differs in the larger more

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EXPLANATION OF FIGURES 64–78

FIGS. 64–78. New species of *Conocybe.* — 64–67. *Conocybe pinguis* (Smith 13260). 65. Habit sketch, from photograph. 64. Cheilocystidia. 67. Basidiospores. 66. Caulocystidium. — 68, 69, 74. *Conocybe flexipes* (Smith 41179). 68. Habit sketch, including section of immature pileus with ring shaded. 69. Cheilocystidia. 74. Basidiospores. — 70, 77. *Conocybe fimicola* (Smith 13856). 70. Cheilocystidia. 77. Basidiospores. — 71–73, 75, 76, 78. *Conocybe stercoraria.* 71, 75, 78. (Smith 13169, type). 71. Cheilocystidia. 75. Habit sketch, from photograph. 78. Basidiospores. 72, 73, 76 (Smith 2576). 72. Cheilocystidia. 73. Habit sketch, from photograph. 76. Basidiospores. — (Magnification as indicated.)

complex spores, cystidial shape, colours of the cap and stem and strong smell. A second closely related taxon with large, thin-walled spores also appears to be distinct although it too has been called forma *macrospora*. It may be this taxon to which Singer *(1962)* wished to refer when he made two entries under *Pholiotina*, *P. appendiculata* Singer and *P. appendiculata* (J. E. Lange & Kühner) Singer.

Observations on the Bolbitiaceae—VIII
Some extra-European annulate species of Conocybe

Several hundred collections of species of *Conocybe* from North America, made by Prof. A. H. Smith during the period 1938–1964 were made available to me through the kindness of their collector during a study of the Bolbitiaceae the author has undertaken. Amongst the large assemblage of species many annulate members of the genus were located and examined; this has resulted in the defining of four new species.

1. **Conocybe stercoraria** Watling, *sp. nov.*—Figs. 71–73, 75, 76, 78

Pileus 10–35 mm e convexo planus, humidus, hygrophanus, glabrus, fulvus vel ochraceo-brunneus, jove sicco pallido-flavidus vel incarnato-ochraceus; ad marginem interdum residuis veli obtectus. Stipes 50–60 × 1.5–2 mm, aequalis, cavus, fragilis, ochraceo-brunneus vel umbrinus, fibrilloso-striatus vel subglaber; annulus fugaceus, membranaceus, medius, albidus, instriatus infra flocculosus. Lamellae L 19–22, l 1–3 adnatae, albidae postremo ferrugineo-mellinae, subconfertae. Caro ochraceo-fulva vel ochraceo-brunnea jove sicco ochracea ad basim umbrinus. Basidia 4-sporigera, 17–20 × 6–7.5 μ. Basidiosporae ellipsoideae, laeves, 8–10(–11) × 5–6 μ, poro germinativo. Cystidia aciei lamellarum (28–)30–37 × 7–10 μ, cylindrico-flexuosa obtusate interdum subcapitata. Cellulae cuticulae pilei pyriformes.

TYPUS.—Hok River, near Spruce, Olympia National Park, Washington State, U.S.A., 17 May 1939, *Smith 13169* (MICH).

Pileus 10–35 mm, obtuse to convex, becoming plane, glabrous, margin ornamented occasionally with a few scattered veil-fragments when annulus fails to form, moist, hygrophanous, tawny to ochraceous brown ('buckthorn brown') minutely striate, fading to light ochraceous buff or 'pinkish buff'. *Stipe* 50–60 × 1.5–2 mm equal, hollow, fragile, dark ochraceous brown (near 'buckthorn brown') above, dark brown near 'bistre' below, darker overall with age, faintly fibrillose-striate, or glabrous; *annulus* very evanescent, median, membranous, fragile, whitish, with very broad often recurved margin, not striate, underside fluffy-cottony. *Lamellae* close, L 19–22 and l 1–3, moderately broad (3–4 mm), depressed adnate and soon seceding, whitish when young but soon concolorous with moist pileus-colour. *Flesh* ochraceous tawny to 'buckthorn brown' drying out more ochraceous, dark brown in stipe-base; *smell* and *taste* not distinct.

Basidia 4-spored, 17–20 × 6–7.5 μ; hyaline in KOH and NH_4OH. *Basidiospores* 8–10(–11) × 5–6 μ, ellipsoid or nearly so in face-view, very slightly flattened in side-view, smooth, bright tawny in alkali, little if any darkening in Melzer's reagent, distinctly truncate from broad germ-pore. *Pleurocystidia* none. *Cheilocystidia* (28–)30–37 × 7–10 μ, ventricose with an obtuse to capitate apex, hyaline, thin-walled, smooth. *Pileocystidia* absent. *Caulocystidia* at apex of stipe similar to those on the gill-margin or more distinctly capitate, below ring replaced by filamentous hyphae, with little differentiation of end-cells. *Hymenophoral trama* interwoven, pale ochraceous in alkali and flanked by more swollen units towards the hymenium.

Pileus-trama floccose, of interwoven hyphae, cinnamon buff in alkali. *Pileal surface* a hymeniderm of clavate cells with either hyaline, thin-walled or rust-coloured pedicels the latter with thick walls. *Clamp-connections* present on hyphae of stipe.

Scattered on horse dung, Hok River near Spruce, Olympia National Park, Washington State, U.S.A. 17 May 1939 (Smith 13169 TYPE). On dung Crescent Beach, Washington U.S.A., 24 September 1935, Smith 2576.

I am sure the second collection belongs to this species but the gills are thin, short and crowded and appear not to be fully developed. I have found on several occasions that the activity of invertebrates can upset the development of the fruit-body; in the case of agarics collembola and mites induce poorly developed gills. This may also account for the slightly different shape of the pileus.

2. **Conocybe fimicola** Watling, *sp. nov.*—Figs. 70, 77

Pileus 10–25 mm conico-convexus, expanso-convexus vel obtuso-umbonatus, glaber humidus, striatus, jove sicco exstriatus, hygrophanus, ferrugineus jove sicco ochraceofulvus. Stipes 30–40 × 2–3 mm, aequalis, farctus, cinnamomeo-bubalinus ad basim ex luteolo-bubalinus prostremo umbrinus, ad apicem fibrilloso-pruinosus ad basim appresso-fibrillosus; annulus medius, membranaceus, bubalinus, striatus, fugaceus. Lamellae adnatae, L 20–25, l 1–3, sordide fulvae, subconfertae. Caro tenuis, fragilis, ferruginea. Basidia 4-sporigera, clavata, 13–19 × 6–7 μ. Basidiosporae 7–9(–10) × 4–4.5 μ, ellipsoideae, laeves, fulvae vel cinnamommeae, poro germinatio parvo instructae. Cystidia aciei 24–32 × 7–10 μ. Cellulae cuticulae pilei pyriformes.

TYPUS.—Lake Crescent, Washington U.S.A. 29 May 1939, *Smith 13856* (MICH).

Pileus 10–25 mm, obtusely conical to obtusely umbonate expanding to broadly conical or with straight then flaring margin, glabrous, moist, minutely striate when fresh, although rapidly non-striate on drying, hygrophanous, entirely russet when fresh, fading to ochraceous tawny. *Stipe* 30–40 × 2–3 mm, equal, hollow, apex mealy, cinnamon buff, base more yellow then darkening bistre, densely fibrillose-pruinose above, more appressed fibrillose with buff-coloured fibrils below; *annulus* median, membranous, buff, striate above at times, evanescent. *Lamellae* adnate slightly ascending, close L 20–25 l 1–3, narrow to moderately broad (3–4 mm) broadest near the stipe, dull tawny ('ochraceous tawny'). *Flesh* thin, fragile, concolorous with pileus; *smell* and *taste* not distinct, mild.

Basidia 4-spored, clavate, 13–19 × 6–7 μ. *Basidiospores* 7–9(–10) × 4–4.5 μ, ellipsoid in face-view, hardly flattened in side-view, smooth, bright tawny to bright cinnamon in water, rust-colour in alkali, with a small apical germ-pore, wall not thickened. *Pleurocystidia* absent. *Cheilocystidia* 24–32 × 7–10 μ fusoid ventricose with narrow neck and ± acute apices, hyaline in KOH and NH_4OH, hardly coloured in Melzer's reagent. *Pileocystidia* absent. *Caulocystidia* at stipe-apex similar to cheilocystidia, below ring replaced by filamentous hyphae with little or no differentiation of the end-cells. *Hymenophoral trama* irregular to subregular, of filamentous central strand and more swollen units beneath and constituting the subhymenium. *Pileus-trama* of floccose, tangled hyphae, cinnamon-buff in KOH and NH_4OH. *Pileal surface* a hymeniderm consisting of clavate to pyriform cells when revived in alkali with rusty cinnamon ± thickned pedicels. *Clamp-connections* not seen in pileus-trama but present on hyphae of stipe.

TYPE.—Gregarious on mature pile of dung. Lake Crescent, Washington State, U.S.A., 29 May 1939, *Smith 13856.*

This species is characterised particularly by the habitat and ring characters; the cheilocystidial shape would place it close to *Conocybe filaris* (Fr.) Kühner.

3. **Conocybe flexipes** Watling, *sp. nov.*—Figs. 68, 69, 74

Pileus 5–15 mm, conicus, convexo-expansus vel campanulatus vix plano-umbonatus, glaber, humidus, hygrophanus, striatus, pallide ochraceo-fulvus vel incarnato-bubalinus. Stipes 50–70 × 1–1.5 mm, aequalis, saepe flexuosus, ad apicem pallido-bubalinus, ad basim pallide ochraceo-fulvo ad apicem pruinosus, ad basim appresso-fibrillosus vel glaber annulus apicalis, membranaceus, pallidus vel pallido-bubalinus ad marginem crassus et plumosus. Lamellae confertae, adnatae, pallido-bubalinae postremo ochracco-fulvae vel fulvae. Caro delicatula, pallido-ochracea. Basidia 4-sporigera, 20–24 × 6.5–8 μ. Basidiosporae 9–11 5–5.5 μ, contracto ovoideae vel ellipsoideae, laeves, poro germinativo parvo instructae. Cystidia acici lamellarum 26–38 × 6–12 μ, cylindrico-flexuosa, obtusata, subcapitata vel capitata, saepe lagenformia. Cellulae cuticulae pilei pyriformes.

TYPUS.—Mount Rainier National Park, Washington, 19 October 1952, *Smith* 41179 (MICH).

Pileus 5—15 mm, obtusely conical when young, convex to campanulate and expanding plano-umbonate, glabrous, moist, translucent striate, hygrophanous, dull 'ochraceous tawny' when moist fading to 'pinkish buff'. *Stipe* 50–70 × 1–1.5 mm, equal, often flexuous, usually fragile pale buff above, pale 'ochraceous tawny' below, pruinose to glabrous above, appressed fibrillose to glabrous below the annulus; *annulus* superior, membranous, pallid to pale buff, striate on upper surface, with thick cottony margin. *Lamellae* close, moderately broad, adnate-seceding, pale buff, becoming 'ochraceous tawny' to near tawny, with edge minutely fimbriate with age. *Flesh* very delicate, pale ochraceous when dry; *smell* and *taste* not distinctive.

Basidia 4-spored, 20–24 × 6.5–8 μ, hyaline or nearly so in KOH. *Basidiospores* 9–11 × 5–5.5 μ, narrowly ovate to ellipsoid in face-view, subellipsoid to slightly ovate in side-view, smooth, cinnamon-rust in KOH, truncate from small apical germ-pore. *Pleurocystidia* not seen. *Cheilocystidia* 26–38 × 6–12 μ, hyaline, thin-walled, variable, ventricose near the base, narrowed to obtuse, with subcapitate or capitate apex, neck frequently quite long and up to 4 μ in diameter. *Pileocystidia* not seen; *caulocystidia* at stipe-apex similar to cheilocystidia or even more variable. *Pileus-trama* floccose-filamentous, pale tawny in KOH. *Pileal surface* a hymeniderm of clavate-pedicellate and inflated cells, pallid in KOH or NH_4OH, with little or no thickening of pedicel, cells often riding over each other particularly near disc. *Hymenophoral trama* of central filamentous strand with more swollen cells laterally distributed. *Clamp-connections* present.

TYPE.—On moss, decaying wood and detritus from herbaceous plants and shrubs, site of old avalanche, Greenlake, Mount Rainier National Park, Washington State, U.S.A., 19 October 1952, *Smith 41179*.

This species has slightly larger spores than the other annulate species of *Conocybe* which have a similar habit. The long, thin, flexuous, strikingly annulate stipe is characteristic. There is little doubt that the fungus described above is what Overholts *(1928)* in his monograph of North American species of *Pholiota* interpreted as *Pholiota mycenoides*. This concept has been followed by North American mycologists (A. H. Smith, personal communication) for the last half-century although there is no evidence that a direct comparison has ever been made between this fungus and the

European material of the same name. It is impossible to correlate the characters of *C. flexipes* with those of the much confused '*Pholiota mycenoides*' a name best considered a nomen ambiguum until further work is carried out in the type locality. Smith & Singer *(1964)* have already discussed some of the problems connected with the use of the epithet *mycenoides* and consider that *Agaricus mycenoides* Fries, 1821 should be referred to the genus *Conocybe* (as *Pholiotina*, according to Singer) thus preferring to reject the concept proposed by Kühner and long used in Europe. Kühner's concept of 1935 was incorporated into the new species *Galerina jaapi* Smith & Singer; Boudier's (1905–10) illustration was cited as representing the *Conocybe* element, but no formal combination was or has since been made.

Boudier's plate would appear to represent *Conocybe blattaria* (Fr.) Kühner as interpreted by Orton *(1960)*, but not that of Kühner *(1935)*. Dennis, Orton & Hora *(1960)* retain the epithet *mycenoides* in *Galerina* but do not mention *G. jaapii*. The epithet *jaapii* was taken up by Singer and Smith because the fungus is that distributed by Otto Jaap as No 10, VIII Fungi selectae exsiccati (1903) under *Pholiota mycenoides*. *Agaricus mycenoides* Fries to British mycologists of past generations would now be a member of the *Galerina praticola* group, a complex dealt with by Bas *(1960)*. Lundell & Nannfeldt in Fungi exsiccati suecici No. 2042 *(1950)* also refer the fungus to *Galerina* as a synomym of *G. paludosa* (Fr) Kühner but to this suggestion I cannot subscribe.

In the character of the ring the Friesian description of *Agaricus mycenoides* is indeed more in keeping with a member of the *Conocybe arrhenii* group (Kits van Waveren, *1970*) than with a species of *Galerina* for the latter are usually characterised by a rather thin, submembranous, fragile, annuliform veil when a ring as such is present. However, Orton (personal communication) points out that the fungus which he refers to *Galerina mycenoides* and which is the concept adopted in the "New Check List" often has a well-developed membranous veil. An illustration by Kreisel *(1961)* of *G mycenoides* also shows a well-developed ring.

The habitat of *A. mycenoides* i.e. on peat and in *Sphagnum* bogs, and the straight and non-ventricose gills would, however, not support the hypothesis that the fungus belongs to the Bolbitiaceae.

From numerous field-observations I am firmly convinced that habitat preferences are often important indicators as to the taxonomic position of an agaric. The base-status of the substrate in or on which the fruit-bodies of an agaric develop appears to be a very important factor in the initiation of these fruit-bodies. Many more pH readings have been analysed since the conspectus to the Bolbitiaceae was published (Watling, *1965*) and these results have confirmed the broad pattern expressed therein, i.e. that species of *Conocybe* are distinctive of base rich soils and substrates, e.g. valley-bottom meadows, protorendzina and rendzina soils, brown earths, fen detritus and alkaline dung (all of pH (5.5–)6–8), whilst species of *Galerina* are characteristic of acid-substrates, e.g. peat, moss-soaks, podsolic soils, poor hill-pasture, acidic glacial drift deposits etc. Fries' *(1857)* field-notes, i.e. peat and *Sphagnum* marshes, therefore would indicate the habitat of a species of *Galerina* rather

than that of a *Conocybe*. Although the ring was indicated as annuliform and has been illustrated well developed e.g. Kriesel *(1961)*, the character of the gills i.e. straight and not ventricose in the original description when coupled with habitat would support the hypothesis that Fries had a species of *Galerina*.

4. **Conocybe pinguis** Watling, *sp. nov.*—Figs. 64–67

Pileus 15—35 mm, convexus postremo planus, primo viscidus, striatus glaber, castaneus postremo ochraceo-fulvus vel sordido-fulvus. Stipes 70–90 × 3–4 mm, aequalis ad basim leviter incrassatus, farctus, ad apicem albidus, ad basim obscuriore ochraceo-brunneus ad apicem fibrillosus vel fibrilloso-squamulosus; annulus crassus, membranaceus, apicalis, supra striatus. Lamellae confertae L 30, l 1–3, adnatae, bubalinae vel ochraceo-fulvae. Caro tenuis, concolora. Basidia 4-sporigera, 18–20 × 7–8 μ. Basidiosporae 7–9 × 4–4.5 μ, subellipsoideae laeves, poro germinativo distincto munitae. Cystidia aciei lamellarum 34—45 × 7–9 μ, cylindrico-flexuosa, capitata vel subcapitata. Cellulae cuticulae pilei pyriformes.

TYPUS.—Clear Water River, Washington State, U.S.A., 9 May 1939, *Smith 13260* (MICH).

Pileus 15–35 mm, convex becoming plane, viscid when young, glabrous, chestnut, ('argus brown') throughout at first, becoming 'ochraceous tawny' at the margin, elsewhere fading to light buff more or less dingy tawny, minutely striate at margin. *Stipe* 70–90 × 3–4 mm, equal or slightly enlarged at base, hollow, whitish above, becoming dark ochraceous brown (near 'dresden brown') below, at first densely fibrillose and with a pale buff fibrillose coating, fibrillose-squamulose above annulus, fibrils evanescent and then darker colours showing through, particularly towards the base; *annulus* thick, membranous, apical, distinctly striate above. *Lamellae* crowded, L 30 l 1–3, narrow (3–4 mm), depressed adnate, soon seceding, pallid ('tilleul buff') becoming 'ochraceous tawny', thin, even or slightly crenulate at margin. *Flesh* thin, concolorous throughout, moderately brittle; *smell* and *taste* mild, not distinctive

Basidia 4-spored, 18–20 × 7–8 μ hyaline in KOH and NH_4OH. *Basidiospores* 7–9 × 4–4.5 μ, narrowly ovoid in face-view, subellipsoid in side-view, slightly flattened on one side, smooth, germ-pore small, indistinct in some views, not clearly truncate, cinnamon in KOH, very slightly darker in Melzer's reagent. *Pleurocystidia* not seen. *Cheilocystidia* abundant, 34–45 × 7–9 μ, narrowly ventricose with capitate to subcapitate apices 5–7 μ broad, at times nearly cylindric-capitate, smooth, hyaline in KOH and NH_4OH. *Pileocystidia* not seen. *Caulocystidia* in groups at apex, cylindric-capitate, 15–35 × 3.5–5 μ. *Hymenophoral trama* somewhat interwoven, of inflated cells 18–40 μ broad, pale cinnamon in KOH and NH_4OH, less swollen towards central floccose strand. *Pileus trama* of interwoven, tangled hyphae, rusty cinnamon in KOH. *Pileal surface* a hymeniderm of pedicellate, clavate cells with pale cinnamon, possibly slightly thickened pedicels. *Clamp-connections* present.

TYPE.—Gregarious on old rotten logs (*Alnus* or ?*Acer*), Clear Water River, Washington State, U.S.A., 9 May 1939. *Smith 13260*.

Distinguished by the viscid pileus, the very prominent ring, spore-size and the dimensions of the cheilocystidia.

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STUDIES ON TALAROMYCES AND RELATED GENERA I.

Hamigera gen. nov. and Byssochlamys

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(With five Text-figures)

The genus *Talaromyces* Benjamin, being a heterogeneous genus is divided into two genera: *Talaromyces*, based on *T. vermiculatus*, characterized by asci developing in chains and *Hamigera* gen. nov., based on *T. avellaneus*, characterized by asci formed singly from croziers. *Talaromyces striatus* is also included in *Hamigera*. Descriptions and drawings are presented of the two species of *Hamigera* and the three species of the closely related genus *Byssochlamys*. A new series of *Penicillium*, the *P. avellaneum* series, is erected to accomodate *P. avellaneum* and *P. ingelheimense*.

According to its description, the genus *Talaromyces* Benjamin (*1955*), based on the type species *T. vermiculatus*, is characterized by soft ascomata with loose-textured to more or less compressed walls composed of interwoven hyphae; ovate to globose asci borne predominantly in short chains or rarely formed singly from croziers; ascospores of very different types and a conidial state belonging in *Penicillium* Link ex Fr.

Talaromyces was equated by Benjamin (*1955*) to the *Penicillium luteum* series of Raper & Thom (*1949*). In the opinion of these latter authors (Raper & Thom, *1949*; Raper, *1957*) the genus *Penicillium* should include both imperfect and perfect species. This view, however, is not in accordance with the 'International Code of Botanical Nomenclature' (Art. 59).

Because of its soft ascomata *Talaromyces* is quite different from the other perfect penicillate genus: *Eupenicillium* Ludwig (Stolk & Scott, *1967*; Scott, *1968*). The latter genus is characterized by sclerotioid ascomata, that are very hard to gritty when young.

The closely related genus *Byssochlamys* Westling (*1909*), type species *B. nivea* Westling, is usually separated from *Talaromyces* on the basis of asci produced in naked clusters and its conidial state belonging to *Paecilomyces* Bainier. However, re-examination of the ascomata of a few, well-developed, fresh isolates of *B. nivea* and *B. fulva* showed that the clusters of asci are not always naked, but are usually surrounded by inconspicuous, very scanty, loose wefts of hyaline, thin, branched and sometimes radiating hyphae. In *Byssochlamys* asci are produced from croziers.

Recently two new species of *Talaromyces* have been described, *T. emersonii* Stolk (*1965*) and *T. leycettanus* Evans & Stolk (*1971*) representing intermediate forms between *Talaromyces* and *Byssochlamys*. In *T. emersonii* the ascomata consist of clusters of asci surrounded by inconspicuous, very scanty wefts of branched, yellow, thin hyphae, thus approximating to the structure of the ascomata of *Byssochlamys*. However, the asci are produced in chains and the conidial state belongs in *Penicillium*. The perfect state of *T. leycettanus* agrees with that of a *Talaromyces* since the ascomata are surrounded by a definite network of pale yellow hyphae while the asci are produced in chains. However, the imperfect state, though described as a *Penicillium*, shows much closer relationship with the imperfect genus *Paecilomyces* and thus must be transferred to that genus, as **Paecilomyces leycettanus** (Evans & Stolk) Stolk, Samson & Evans, *comb. nov.* (basionymum, *Penicillium leycettanum* Evans & Stolk *in* Trans. Br. mycol. Soc. **56**: 45. 1971). This means either bringing a *Paecilomyces* conidial state into *Talaromyces* or including a species with ascomata surrounded by conspicuous peridial hyphae in *Byssochlamys*.

Whereas *Byssochlamys* is a natural genus, *Talaromyces*, from its origin has been a heterogeneous genus. The structure of the ascomatal covering differs markedly in the different species of *Talaromyces*. In some species (e.g. *T. thermophilus*) the ascomata are bounded by rather closely knit hyphae, simulating a true peridium, whereas in others (e.g. *T. emersonii*) the covering is very scanty. Thus, as far as the structure of the 'wall' is concerned, the ascomata of *Talaromyces* merge via *T. emersonii* into those of *Byssochlamys*.

In most species of *Talaromyces* asci are borne in chains. However, in two species, *T. avellaneus* (Thom & Turesson) Benjamin and *T. striatus* (Raper & Fennell) Benjamin, they develop singly from croziers as in *Byssochlamys*. According to Emmons (*1935*) the asci of *T. luteus* also develop singly from croziers. However, our examination of two strains of this species, showed short chains of asci to be present.

The conidial states of different species of *Talaromyces* also vary considerably. In *T. leycettanus* the imperfect state belongs in *Paecilomyces* and though the conidial states of all other described species are to be classified in *Penicillium*, they belong to quite different series of that genus.

Thus we conclude that neither the complexity of the covering of the ascomata, in both genera consisting of the same type of hyphae, nor the nature of the conidial state can be considered to be satisfactory characters in distinguishing *Talaromyces* from *Byssochlamys*. Instead, we prefer to separate the two genera on the disposition of the asci. This entails the exclusion of the crozier-producing species *T. avellaneus* and *T. striatus* from *Talaromyces* and the introduction of the new genus *Hamigera* to include these two species.

Hamigera Stolk & Samson, *gen. nov.*

Ascomata mollia, globosa vel subglobosa, superficialia, discreta vel confluentia, pariete e hyphis intertextis constante, ex ascogoniis spiralibus oriuntur, anteridiis absentibus. Asci evanescentes, plerumque octospori, subglobosi vel ellipsoidei vel clavati, pedicellati, singuli

ex hamis oriuntur. Ascosporae continuae, plerumque ellipsoideae, varie ornamentatae, subflavae.

STATUS CONIDIALIS.—*Penicillium* Link ex Fr.

SPECIES TYPICA.—*Hamigera avellanea* (Thom & Turesson) Stolk & Samson.

Ascomata soft, globose to subglobose, superficial, discrete and confluent. Coverings composed of interwoven hyphae. Ascomatal initials consisting of coiled ascogonia without antheridia. Asci evanescent, mostly 8-spored, subglobose to ellipsoid to clavate, stalked, formed singly from croziers. Ascospores continuous, mostly ellipsoid showing different ornamentations, yellowish.

CONIDIAL STATE.—*Penicillium* Link ex Fr.

TYPE SPECIES.—*Hamigera avellanea* (Thom & Turesson) Stolk & Samson.

The two species now combined in the new genus *Hamigera* agree in the structure of their initials and ascomata and in the development of their asci. They differ markedly from one another in the ornamentation of their ascospores and in their conidial states. The brown imperfect state of *H. avellanea* does not fit in any of Raper & Thom's series of *Penicillium* (Raper & Thom, *1949*), while *P. striatum* can best be classified in the Divaricata.

For these reasons, the classification of these species in two different new genera may be justified. However, as no other species which may be related to either of the above species has been encountered as yet, we prefer to place them together in one new genus, *Hamigera*. This decision is supported by the fact that species which differ in respect of their conidial states and ornamentation of their ascospores are also included in the genus *Talaromyces*. Further emphasis of these differences might ultimately lead to the splitting of the genus *Talaromyces* into different genera but we do not regard this as desirable at present.

Ascomatal initials consist of coiled ascogonia, each borne as a branch from a vegetative hypha. They are usually surrounded by thin, twisted branching hyphae which are developing into the 'wall' of the ascoma. After having produced about 2 to 3 (4) coils, the ascogonia may grow straight for a short distance and then develop new coils.

Most of the straight segments disintegrate while the coiled parts become septate and produce either croziers directly or develop crozier-producing ascogenous hyphae. These secondary coils occur in both species, but are more common in *H. avellanea* than in *H. striata*.

Asci are borne singly on short branches. They develop from the penultimate cell of a crozier; occasionally penultimate cells grow out to form a continuation of the ascogenous hypha, developing secondary croziers etc., resulting in the formation of large clusters of asci.

Hamigera belongs in the Eurotiaceae and, because of the development of the asci, is closely related to the genera *Byssochlamys* Westling and *Thermoascus* Miehe. It differs from *Byssochlamys* primarily in the structure of the ascomatal initials. Moreover, the 'wall' of the ascomata is much denser in *Hamigera* than in *Byssochlamys*, where the covering may be entirely lacking. In addition, *Hamigera* is characterized by a *Penicil-*

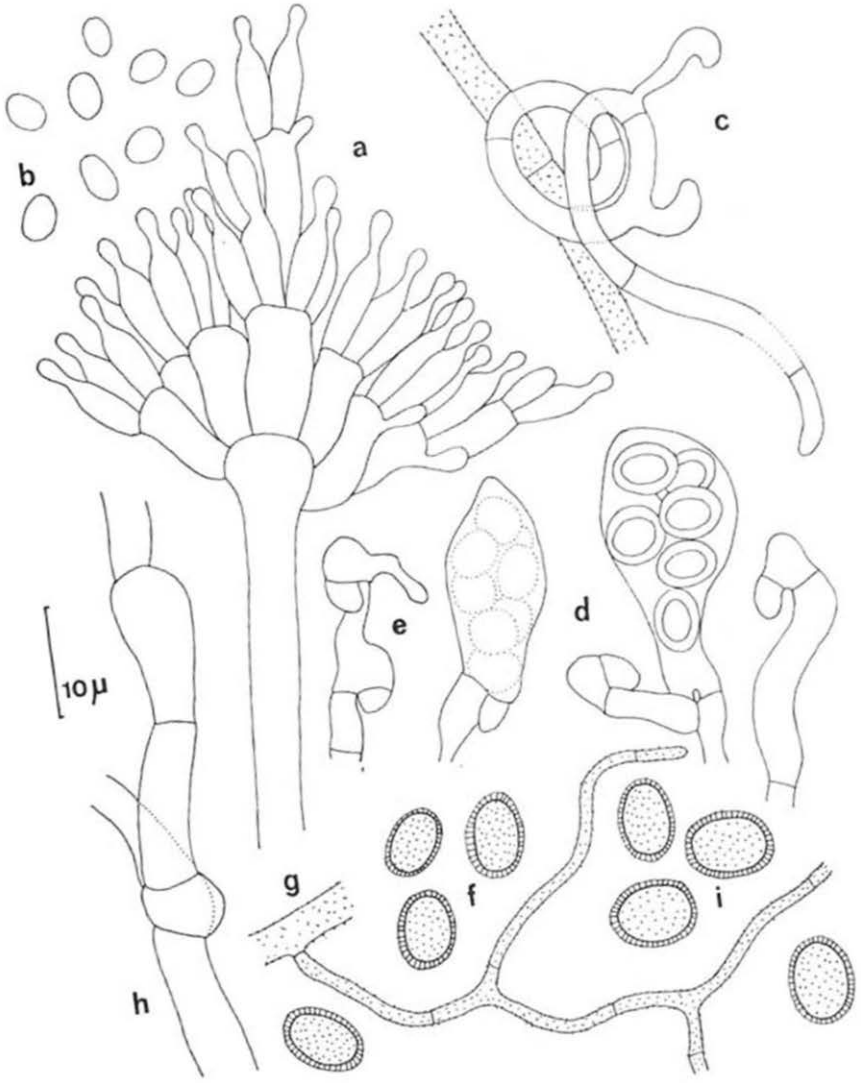

Fig. 1

lium conidial state while in *Byssochlamys* a *Paecilomyces* conidial state is present.

In both *Thermoascus* and *Hamigera*, asci are produced from croziers and ascomatal initials are identical. Moreover, in two species of *Thermoascus*, *T. crustaceus* (Apinis & Chesters) Stolk (*1965*) and *T. thermophilus* (Sopp) von Arx (*1970*), phialides occur. The two genera differ mainly from one another in the nature of their ascomatal-walls: those of *Hamigera* consisting of a loose weft of interwoven hyphae, while those of *Thermoascus* are brown, pseudoparenchymatous and composed of one or more layers of somewhat thick-walled polygonal cells. The ascomata of *Thermoascus* are often aggregated in large brown or red-brown crusts. The ascospores of *Hamigera* are yellow, those of *Thermoascus* are hyaline becoming brown in age. Moreover, the three species of *Thermoascus* are thermophilic.

Separation between *Hamigera* and *Talaromyces* is based on the development of the asci.

Hamigera differs from *Arachniotus*, as represented by its type species *A. ruber* (van Tieghem) Schroeter, primarily in producing a quite different conidial state, since in *Arachniotus* only arthrospore- of aleuriospore-bearing structures occur (Kuehn, *1957*, *1958*; Apinis, *1964*). Originally the two species of *Hamigera*, though described inclusive of their perfect states, were placed in the imperfect genus *Penicillium*. In accordance with Art. 59 of the International Code of Botanical Nomenclature of 1966 the perfect states of the two species are now described as new species of the genus *Hamigera*.

Hamigera avellanea Stolk & Samson, *sp. nov.*—Fig. 1

Penicillium avellaneum Thom & Turesson *in* Mycologia **7**: 284. 1915. — *Talaromyces avellaneus* (Thom & Turesson) Benjamin *in* Mycologia **47**: 682. 1955.

STATUS CONIDIALIS.—*Penicillium avellaneum* Thom & Turesson *in* Mycologia **7**: 284. 1915.

SPECIAL LITERATURE.—Raper & Thom (*1949*: 597).

Ascomata flava, globosa vel subglobosa, 100–300 μ diametro, XX diebus maturantia, reticulo hypharum laxe intertextarum flavarum incrustatarum, circa 1,5 μ crassarum circumdata. Asci ellipsoidei vel clavati, 18–24 × 10–12 μ, sex- vel octospori. Ascosporae flavae, ellipsoideae, 6–8 × 4–6,5 μ, crassitunicatae; paries translucens flavus fere 0,5 μ crassus, in plano medio adspectum radiatim striatum praebet, in superficie punctatus. Status conidicus *Penicillium avellaneum* Thom & Turesson.

TYPUS status perfecti CBS 295.48 = NRRL 1938, isolatus e terra, San Antonio, Texas, 1943.

Colonies on malt agar spreading broadly, attaining a diameter of about 7 cm within 10 days at 25° C, composed of a basal felt with numerous yellow ascomata, more or less obscured in the central area by a dense, layer of penicilli, giving the surface of the colonies a brown appearance, ranging from Avellaneous to Wood Brown (Ridgway, *1912*, Pl. 40; Rayner, *1970*, 17′′′b, 17′′′), the margins of colonies

FIG. 1. *Hamigera avellanea*, CBS 295.48. — a. Penicillus. — b. Conidia. — c. Ascomatal initial developing as a branch from a yellow-encrusted aerial hypha. — d. Ascus production from croziers. — e. Penultimate cell of a crozier growing out to form a secondary crozier. — f. Ascospores. — g. Young hypha surrounding the initials and developing into the ascomatal covering. — h. Submerged hypha, CBS 343.68. — i. Ascospores.

showing bright yellow colours because of developing ascomata and yellow mycelium near Citron Yellow (Ridgway, Pl. 16; Rayner 23'b). Reverse purple red near Diamine Brown (Ridgway, Pl. 13; Rayner, 3'm).

Production of ascomata is more pronounced on oatmeal agar, on which medium the surface of the colonies may be predominantly yellow, the brown colour of the conidial state being less conspicuous than on malt agar, at least in fresh isolates. Reverse purple.

Vegetative hyphae hyaline to reddish coloured, about 2–4 μ in diameter, submerged hyphae, often very wide showing conspicuous inflations up to 8 μ in diameter.

Ascomata yellow, globose or nearly so, 100–300 μ in diameter, ripening within 3 weeks. Coverings consisting of a loosely interwoven network of yellow-encrusted hyphae, about 1.5 μ in diameter, invested in yellow-encrusted, somewhat twisted, branching, radiating hyphae.

Initials consist of large loosely coiled ascogonia, developing in about 10 days inside small, loose tufts of narrow branched, twisted, yellow-encrusted hyphae which later develop into the ascomatal 'walls'. Asci ellipsoid, sometimes slightly clavate, 18–24 × 10–12 μ, 6–8-spored. Ascospores yellow, ellipsoid, thick-walled, surrounded by a transparent yellow wall about 0.5 μ in diameter, which in transverse section shows radiate striations, the surface appearing punctate, with overall dimensions, 6–8 × 4–6.5 μ.

Conidiophores arising from both submerged and aerial hyphae, up to 400 μ in length by 3–5 μ in diameter, hyaline, septate, smooth-walled, inflated at their apices up to 8–8.5 μ in diameter. Penicilli very large, compact, each consisting of a crowded verticil of 5–12 metulae, sometimes with secondary metulae, each metula bearing a verticil of phialides; all elements of the penicillus are hyaline and smooth-walled. Rami lacking. Metulae developing successively on the inflated apex of the conidiophore, rarely occurring also on its subterminal portion, sometimes somewhat irregularly disposed, 9–15 × 3.5—4.5 μ, slightly inflated apically. Phialides 8–11 × 2–3 μ, occurring in verticils of about 5, cylindrical, sometimes slightly swollen, narrowing abruptly at the apex to form small conidium-bearing tips, about 1.5 μ long. Conidia hyaline to pale brownish, ovoid to slightly ellipsoid 3–4.5 × 2–3 μ, smooth, forming tangled chains.

The species is slightly thermotolerant, minimum temperature about 10°, optimum 30–35°, maximum about 45° C.

CULTURES EXAMINED.—

CBS 295.48 = NRRL 1938, type strain, isolated from soil from San Antonio, Texas, September, 1943.

CBS 189.67, isolated as an air contaminant by H. D. Ackermann, Berlin, in 1967. This culture is now predominantly conidial, only occasionally producing a few small ascomata.

CBS 343.68 = NHL 6081 and CBS 344.68 = NHL 6088, isolated by Udagawa & Takada from soil in Japan, 1966.

The ascospores of CBS 343.68 and CBS 344.68 are slightly larger than those of CBS 295.48 and CBS 189.67, but all are within the given range of sizes. The temperature relationships are somewhat variable too, maximum temperatures of CBS 295.48 and CBS 189.67 are slightly higher than those of CBS 343.68 and CBS 344.68. Strains of this species, e.g. CBS 189.67, when maintained in culture may soon loose their capacity to produce ascomata.

Classification of the imperfect state in the scheme of the genus *Penicillium* as suggested by Raper & Thom (*1949*) is difficult. On account of the structure of the

perfect state Raper & Thom place it in the Biverticillata-Symmetrica, but they add "Upon the basis of the conidial structures alone, one might be tempted to assign this species to the Brevi-Compacta series'. Smith (*1963*) places it in the Asymmetrica-Velutina, without, however, assigning it to any of its series. According to Udagawa *& al.* (*1967*) the conidial state should be related to many species of *Aspergillus*, especially to *A. carneus* (van Tieghem) Blochwitz. They consider *P. avellaneum* as an intermediate form between *Penicillium* and *Aspergillus*. The 'Hülle-cells' they described refer to the strongly inflated cells of the submerged mycelium. These lack the morphological characters of Hülle-cells.

In our opinion the imperfect state of *H. avellanea* belongs in *Penicillium* since the metulae develop successively on the apex of the conidiophore and not simultaneously as in *Aspergillus*. Also, its conidiophores lack footcells. However, it can not be classified satisfactorily in any of Raper & Thom's series of *Penicillium*. Therefore we propose to erect a new series of *Penicillium*, the *P. avellaneum* series to accomodate *P. avellaneum* and the closely related imperfect species *P. ingelheimense* van Beyma (*1942*). These two species differ from one another mainly in the shape of their conidia and the sizes of their conidiophores and penicilli. Moreover, *P. ingelheimense* does not produce the purple red pigment which characterizes *P. avellaneum*.

Hamigera striata Stolk & Samson, *sp. nov.*—Fig. 2

Penicillium striatum Raper & Fennell *in* Mycologia **40**: 521. 1948. — *Talaromyces striatus* (Raper & Fennell) Benjamin *in* Mycologia **47**: 682. 1955.

STATUS CONIDIALIS.—*Penicillium striatum* Raper & Fennell *in* Mycologia **40**: 521. 1948.

SPECIAL LITERATURE.—Raper & Thom (*1949*: 603).

Diagnosis latina in 'Mycologia' **40**: 521. 1948, continetur.

TYPUS novae speciei status perfectus culturae CBS 377.48.

Colonies on malt agar spreading broadly, attaining a diameter of 6 cm within 10 days at 25° C, thin, largely composed of a dense layer of ascomata occurring at the agar surface, showing creamish shades near Pale Pinkish Buff (Ridgway, Pl. 29; Rayner, 17''f), becoming brown in age ranging from Chamois to Tawny-Olive (Ridgway, Pl. 30, 29; Rayner, 19''b, 17''i); in the centre overgrown by a thin network of uncoloured mycelium, bearing very few penicilli, not affecting the colony appearance. Reverse of colonies brown, near Warm Sepia (Ridgway, Pl. 29; Rayner, 13''m).

Colonies on Czapek agar growing very restrictedly, about 1.5–2 cm in 10 days. Colonies on oatmeal- and cornmeal-agar growing more rapidly, producing ascomata abundantly, reverses ranging from brownish to conspicuous purple near Anthracene Purple (Ridgway, Pl. 44, Rayner, 69'''k).

Vegetative hyphae hyaline, 1.5–5 μ in diameter, submerged hyphae occasionally showing inflations up to 8 μ in diameter.

Ascomata brownish, globose to subglobose, 100–160 μ in diameter, ripening within 10 days. Coverings consisting of a somewhat closely knit network of hyaline to slightly brownish hyphae surrounded by long, slightly twisted, branching, radiating hyphae about 1–2 μ in diameter.

Initials consisting of coiled ascogonia, developing mostly simultaneously with the surrounding hyphae in 6 days old cultures. Asci, subglobose to ellipsoid, occa-

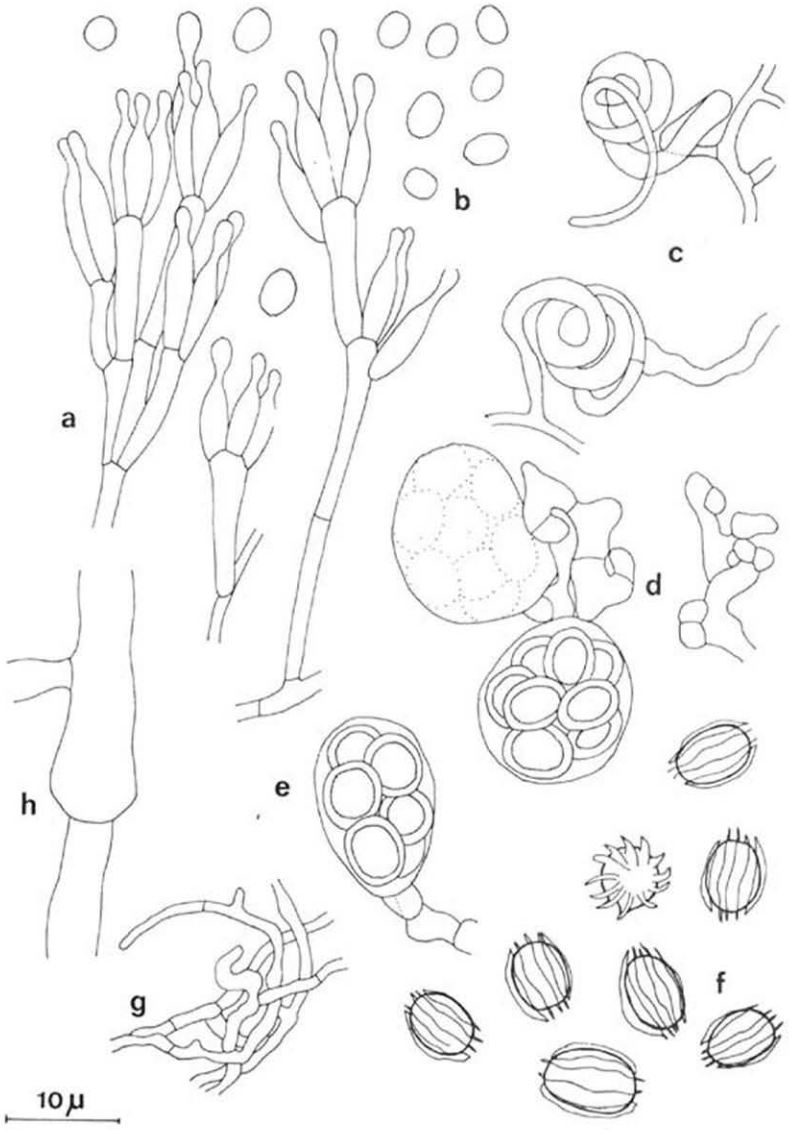

FIG. 2. *Hamigera striata*, CBS 377.48. — a. Different types of penicilli. — b. Conidia. — c. Ascomatal initials. — d. Ascus production. — e. Ascus. — f. Ascospores. — g. Part of ascomatal covering. — h. Submerged hypha.

sionally slightly clavate, mostly 8-spored, 17–23 × 12–14 μ. Ascospores pale yellow, ellipsoid, bearing 8 to 12 longitudinal, nearly hyaline, wavy frills about 1 μ wide, usually converging at the two ends; 7.5–9.5 × 5.5–7 μ, frills included.

Conidial state very scantily produced on all media tested, the best development on Czapek with 20 % sucrose, though still scarce. Conidiophores mostly arising from aerial hyphae, occasionally from submerged hyphae, usually short, 15–50 × 1.5–3 μ, smooth-walled. Penicilli irregular in pattern, ranging from monoverticillate to biverticillate and then consisting of rami bearing metulae with phialides; all elements of the penicillus smooth-walled. Rami occurring rarely, 1 to 2 in addition to the main axis, 9–12 × 2–2.5 μ. Metulae 8–14 × 2–3 μ in verticils of 2 to 3, Phialides 8–12 × 2–3 μ, occurring in clusters of 2 to 5, cylindrical, sometimes slightly swollen, tapering abruptly to conspicuous conidium-bearing tips, about 2 μ in length. Conidia hyaline, subglobose to ellipsoid, 3–4,5 × 2–3.5 μ, smooth, forming divergent chains.

Because of the shape of the phialides the conidial state can best be placed in the Asymmetrica-Divaricata.

Minimum temperature about 5°, optimum 25–30°, maximum temperature about 38° C.

CULTURE EXAMINED.—

CBS 377.48 = NRRL 717, type strain, isolated in 1938 by Williams, Cameron & Williams (*1941*) from canned blue-berries.

Though the ascospores of *H. striata* differ markedly from those of *H. avellanea* in their ornamentation, they have one character in common. In both species the young developing ascospore is surrounded by a, probably gelatinous, layer. When ripening, the ascospores become larger and consequently the 'gelatinous' wall splits. In the ascospores of *H. avellanea* this surrounding layer develops radiate fissures appearing as the described radiate striations, while in *H. striata* this layer splits into longitudinal frills as in *Emericellopsis*.

BYSSOCHLAMYS Westling

Byssochlamys Westling *in* Svensk bot. Tidskr. **3**: 134. 1909.

Ascomata discrete and confluent. Covering lacking or very scanty, composed of loose wefts of hyaline, thin, twisted, hyphae. Ascomatal initials consisting of ascogonia coiled around swollen antheridia. Asci 8-spored, globose to subglobose, stalked, formed singly from croziers. Ascospores continuous, ellipsoid, smooth, pale-yellowish.

CONIDIAL STATE—*Paecilomyces* Bainier.

TYPE SPECIES—*Byssochlamys nivea* Westling.

Benjamin (*1957*) discussed the systematic position of *Byssochlamys*. Although he recognized the close relationship of *Byssochlamys* with other genera of the Eurotiaceae he followed the suggestion of Kuehn (*1955*), including *Byssochlamys* in the Gymnoascaceae on account of the production of the asci from croziers. The species of *Byssochlamys* are, however, characterized by the penicillate conidial apparatus of the *Paecilomyces*-type, and the genus appears to be better placed near the new genus *Hamigera* in the Eurotiaceae. It differs from this genus in the structure of the ascomatal initials, the conidial state and the nature of the covering of the ascomata.

The ascomatal initials of *Byssochlamys* consist of ascogonia, which are coiled around swollen, mostly club-shaped antheridia. The initials become septate and

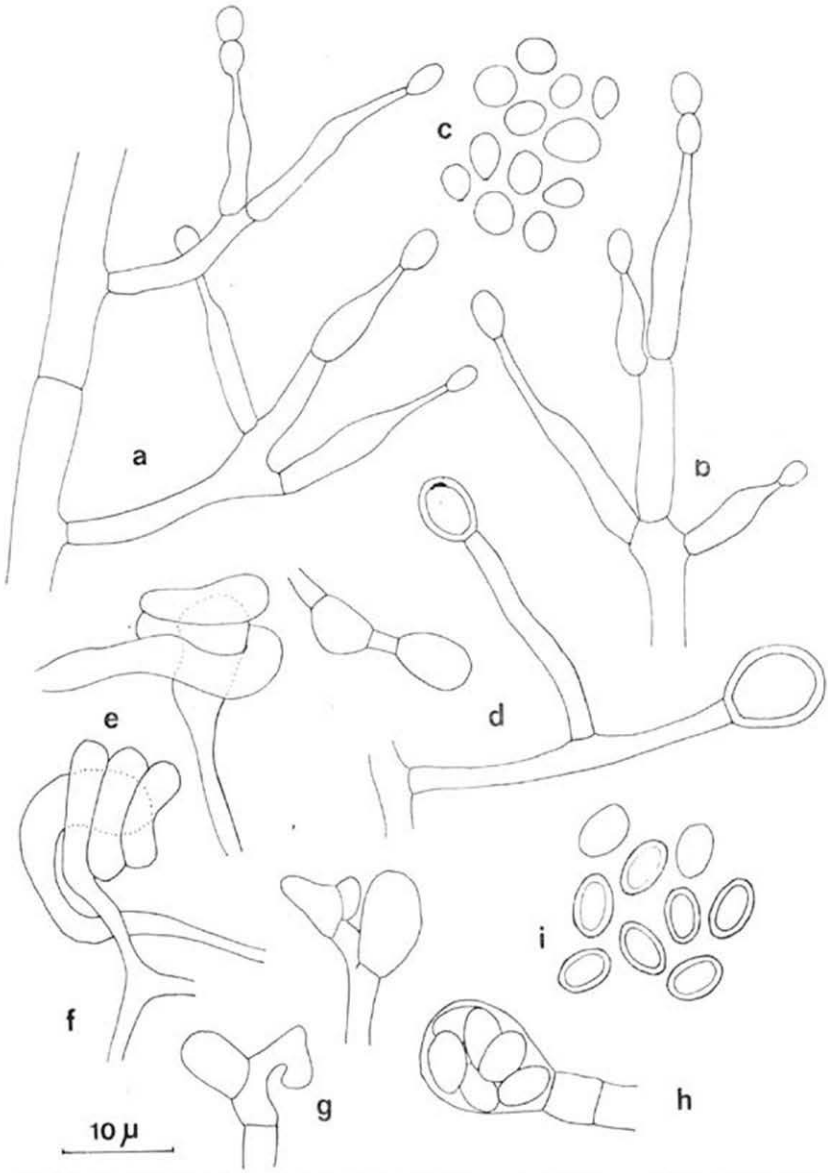

FIG. 3. *Byssochlamys nivea*. — a, b. Sporing structures. — c. Conidia. — d. Chlamydospores. — e, f. Ascomatal initials. — g. Ascus production. — h. Ascus. — i. Ascospores.

develop the crozier-producing ascogenous hyphae. As in *Hamigera* the penultimate cell may be converted directly into an ascus or may grow out to form secondary croziers.

The genera *Thermoascus* and *Byssochlamys* differ primarily in the structure of the ascomatal covering. The development of the asci in *Byssochlamys* is distinct from that seen in *Talaromyces*, where asci are produced in chains. The separation between *Byssochlamys* and *Arachniotus* is based on the differences in conidial state.

The three species of *Byssochlamys* can be distinguished easily from one another by differences in the size of the ascospores and the conidia, and the presence or absence of chlamydospores.

BYSSOCHLAMYS NIVEA Westling—Fig. 3

Byssochlamys nivea Westling *in* Svensk bot. Tidskr. **3**: 134. 1909.
? *Byssochlamys musticola* Naumoff & Kiryalova *in* Trudy bot. Inst. Akad. SSSR **3**: 362. 1935.
Arachniotus trisporus Hotson *in* Mycologia **28**: 500–501. 1936.
Byssochlamys trisporus (Hotson) Cain *in* Can. J. Bot. **34**: 140. 1956.
Gymnoascus sudans Vailionis in Vyauto Didz. Univ. mat. gamos Fak. Darb. **11**: 115. 1936.
Byssochlamys nivea Westling var. *langucullariae* Ram *in* Nova Hedwigia **16**: 311. 1968.
STATUS CONIDIALIS.—*Paecilomyces niveus* Stolk & Samson, *stat. nov.*
? *Spicaria musticola* Naumoff & Kiryalova *in* Trudy bot. Inst. Akad. SSSR **3**: 363. 1935.

Paecilomyces niveus Stolk & Samson, *stat. nov.*

Conidiophora levia, ad 300 μ longa, 2–3 μ crassa, phialides binas vel ternas vel singulas ferunt. Phialides 12,5–20 μ longae, basi cylindrica 2–3,5 μ crassa, subito in collum exiguum, 2,5–7,5 μ longum, 0,7–1,5 μ crassum attenuatae. Conidia hyalina vel dilute flava, globosa vel late ellipsoidea, basi plerumque truncata, 3–5,7 × 2,2–4 μ, levia, catenis siccis divergentibus connexa. Chlamydosporae crassitunicatae, flavo-brunneae vel brunneae, globosae, ovoideae vel pyriformes, ad 10 μ diametro, leves vel asperulae.

TYPUS CBS 100.11.

Colonies on malt agar, spreading broadly, attaining a diameter of 9 cm in 7 to 14 days at 30° C, composed of a basal felt with white ascomata, occasionally in localized sectors, obscured by a floccose to funiculose overgrowth, which gives a creamish colour to the surface of the colonies, near Cartridge Buff (Ridgway, Pl. 30; Rayner, 19″f). Other, predominantly conidial strains, show buff shades between Olive-Buff (Ridgway, Pl. 40; Rayner, 21‴d) and Deep Olive-Buff (Ridgway, Pl. 40; Rayner, 21‴b). Reverse in pale brown to yellow shades. Odour slight or unpronounced. No exudate. Vegetative hyphae, hyaline, 0.5–4.5 μ in diameter, submerged hyphae mostly thick-walled, up to 8 μ in diameter.

Ascomata, white, up to 350 μ in diameter, ripening in 7 to 10 days at 30° C. Covering lacking or very scanty, composed of loose wefts of hyaline, thin hyphae with a diameter of 0.5–1 μ. Asci, globose to subglobose, 8.5–11 μ in diameter. Ascospores, pale-yellowish, ellipsoid, thick-walled, 4–5.5 × 2.5–3.5 μ smooth.

Conidiophores rare, septate, smooth, up to 300 μ in length and 2–3 μ in diameter; when present, bearing phialides in groups of two or three. Usually single phialides are borne directly on the trailing hyphae. Phialides 12.5–20 × 2–3.5 μ, with a cylindrical basal portion, tapering abruptly to a long thin neck, 2.5–7.5 in length and 0.7–1.5 in diameter, smooth. Conidia, hyaline to pale yellowish, globose to broadly ellipsoid, usually with a flattened base, 3–5.7 × 2.2–4 μ, smooth, in dry divergent chains.

Chlamydospores usually abundantly produced, singly or in short chains, thick-

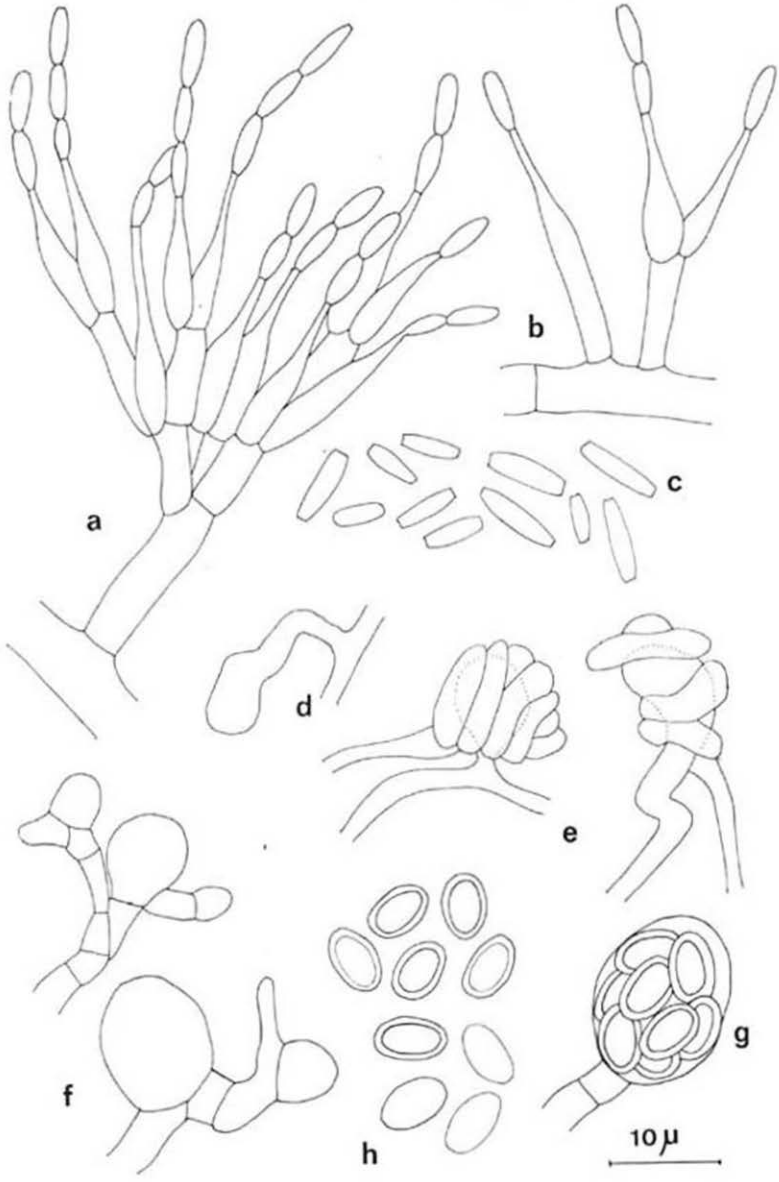

Fig. 4

walled, yellow-brown to brown, globose, ovoid to pyriform, up to 10 μ in diameter, smooth to slightly roughened.

Minimum temperature about 10°, optimum 30–35°, maximum 40° C.

CULTURES EXAMINED:—

CBS 100.11 = ATCC 22260 = type of *B. nivea*, received from R. Westling.

CBS 133.37, received as type of *Arachniotus trisporus* Hotson by J. W. Hotson.

CBS 134.37, sent by L. Vailionis as *Gymnoascus sudans* n. sp., isolated from nutrient solution in which *Betula verrucosa* twigs were cultivated.

CBS 140.65, isolated from applejuice in Wädenswill and sent by E. Müller, Zurich.

CBS 136.67, soil-isolation in glasshouse by G. J. Bollen, Wageningen.

CBS 607.71 A = NRRL 5253, sent as *Byssochlamys* spec. by D. I. Fennell, isolation from soil.

CBS 607.71 B = NRRL 5254, sent as *Byssochlamys* spec. by D. I. Fennell, (received from G. F. Orr).

CBS 899.70 = C 769, isolated from moist barley grain as strain D 5/3 in 1965, received from J. Lacey, Rothamsted Experimental Station, Harpenden, Great Britain.

CBS 900.70 = C 901, isolated from moist barley grain as strain H 214D in 1965, received from J. Lacey, Rothamsted Experimental Station, Harpenden, Great Britain.

CBS 901.70 = C 1454, isolated from silage by M. R. M. Clark in 1969, received from J. Lacey, Rothamsted Experimental Station, Harpenden, Great Britain.

CBS 608.71 = F 5, isolated from mummified plums from orchard floor, received from D. F. Splittstoesser, Cornell University, New York, State Agricultural Experimental Station, Geneva, New York 14456, U.S.A.

CBS 606.71 = BKMF 1486, received as *Byssochlamys musticola*, isolated from oat grain by Tatarenko, Kharkov (1953), no type culture.

CBS 373.70 = IMUFPe 2195 = type culture of *Byssochlamys nivea* var. *languculariae* Ram, isolated from wood sample of *Langucularia racemosa* Gaertn. in Brazil.

Byssochlamys musticola was placed as a synonym of *B. nivea* by Brown & G. Smith (1957). Strain CBS 606.71, which does not represent the type culture, but was received as *B. musticola* from the Institute of Microbiology of Moscow, fits the description of this species. The ascospores and the globose to broadly ellipsoid conidia are slightly larger, but they fall within the given measurements of *B. nivea*. For these reasons *B. musticola* may be considered to be a possible synonym of *B. nivea*.

The type culture of *B. nivea* Westling var. *languculariae* Ram is predominantly conidial with a few white ascomata, which gives an avellaneous colour to the surface of the colony near Vinaceous Buff (Ridgway, Pl. 40; Rayner, 17'''d) or Avellanous (Ridgway, Pl. 40; Rayner, 17'''b). It differs only slightly from the other examined strains of *B. nivea* in producing smaller conidia and ascospores and is therefore regarded as a synonym of *B. nivea*.

BYSSOCHLAMYS FULVA Olliver & G. Smith—Fig. 4

Byssochlamys fulva Olliver & G. Smith *in* J. Bot., London **72**: 197. 1933.

STATUS CONIDIALIS.—*Paecilomyces fulvus* Stolk & Samson, *stat. nov.*

FIG. 4. *Byssochlamys fulva*. — a, b. Sporing structures. — c. Conidia. — d. Antheridum. — e. Ascomatal initials — f. Ascus production. — g. Ascus. — h. Ascospores.

Paecilomyces fulvus Stolk & Samson, *stat. nov.*

Conidiophora levia, ad 150 μ longa, 3–5 μ crassa, phialides binas vel ternas metulis brevibus innatas vel singulas ferunt. Phialides 12,5–17 μ longae, basi cylindrica 2,5–3,5 μ crassa, subito in collum exiguum, 3–8,5 μ longum, 1–1,2 μ crassum attenuatae, pariete sursum inspissato. Conidia dilute flava, plerumque cylindrica, utrinque truncata, 4–8,7 × 1,5–5 μ, levia, catenis siccis divergentibus vel intricatis connexa.

TYPUS CBS 132.33.

Colonies on malt agar, spreading broadly, attaining a diameter of 9 cm in 7 to 14 days at 30° C, composed of a basal felt with white ascomata, occasionally in localized sectors, obscured by the velvety, occasionally floccose overgrowth of the conidial state, which gives a fulvous colour to the surface of the colonies near Olive-Buff (Ridgway, Pl. 40; Rayner, 21''' d) or Deep Olive-Buff (Ridgway, Pl. 40; Rayner, 21'''b). Reverse in pale brown to yellow shades. Odour slight, sweet aromatic. No exudate. Vegetative hyphae, 0.5–5 μ in diameter; submerged hyphae, usually thick-walled up to 10 μ in diameter.

Ascomata white, up to 150 μ in diameter, ripening in 7 to 10 days at 30° C. Covering lacking or very scanty, composed of loose wefts of hyaline, thin hyphae of about 1 μ in diameter. Asci, globose to subglobose, 9–12.5 μ in diameter. Ascospores pale-yellowish, ellipsoid, thick-walled, 5.2–6.5 × 3.2–4 μ in diameter, smooth.

Conidiophores septate, smooth, up to 150 μ in length with the phialides borne in groups of two or three on short metulae. Single phialides also borne directly on the aerial hyphae. Phialides 12.5–17 × 2.5–3.5 μ, with cylindrical basal portion, tapering abruptly to a long thin neck 3–8.5 μ in length and 1–1.2 μ in diameter, with the apex thickened, smooth.

Conidia yellowish, usually cylindrical with both ends flattened, 4–8.7 × 1.5–5 μ, in dry divergent or tangled chains.

Chlamydospores absent.

Temperature minimum about 10°, optimum 30–35°, maximum 45° C.

CULTURES EXAMINED.—

CBS 132.33 = IMI 58.421 = Type from G. Smith, isolated from bottled fruits. This strain is only conidial, producing occasionally some ascomatal initials.

CBS 146.48 = IMI 40.021 = ATCC 10099 = NRRL 1125 = probably identical with the type strain; isolated from bottled fruit and used for the production of byssochlamic acid and mannitol; only conidial.

CBS 135.62, isolated from fruitjuice and sent by H. Lüthi, Wädenswill, Switserland.

CBS 604.71 = NRRL 2975, received as the type culture of *Paecilomyces todicus*, sent by D. I. Fennell; Patent strain on the production of an antiviral antibiotic (U.S. Patent nos. 3, 303, 094).

CBS 605.71 = strain H-80, isolated from mechanically harvested grapes and sent by D. F. Splittstoesser, Geneva, New York, U.S.A.

Byssochlamys fulva can easily loose its capacity to produce ripe ascospores in pure culture e.g. the type strain CBS 132.33 is only represented by its conidial state. Olliver & G. Smith (*1933*) and Brown & G. Smith (*1957*) suggest that this conidial state represents the same fungus as *Paecilomyces variotii* Bainier. Our studies show however that the typical cylindrical conidia and the absence of chlamydospores distinguishes *Paecilomyces fulvus* from *P. variotii*.

BYSSOCHLAMYS ZOLLERNIAE Ram

Byssochlamys zollerniae Ram *in* Nova Hedwigia **16**: 312. 1968.

The description of this species is only based on the single type strain CBS 374.70.

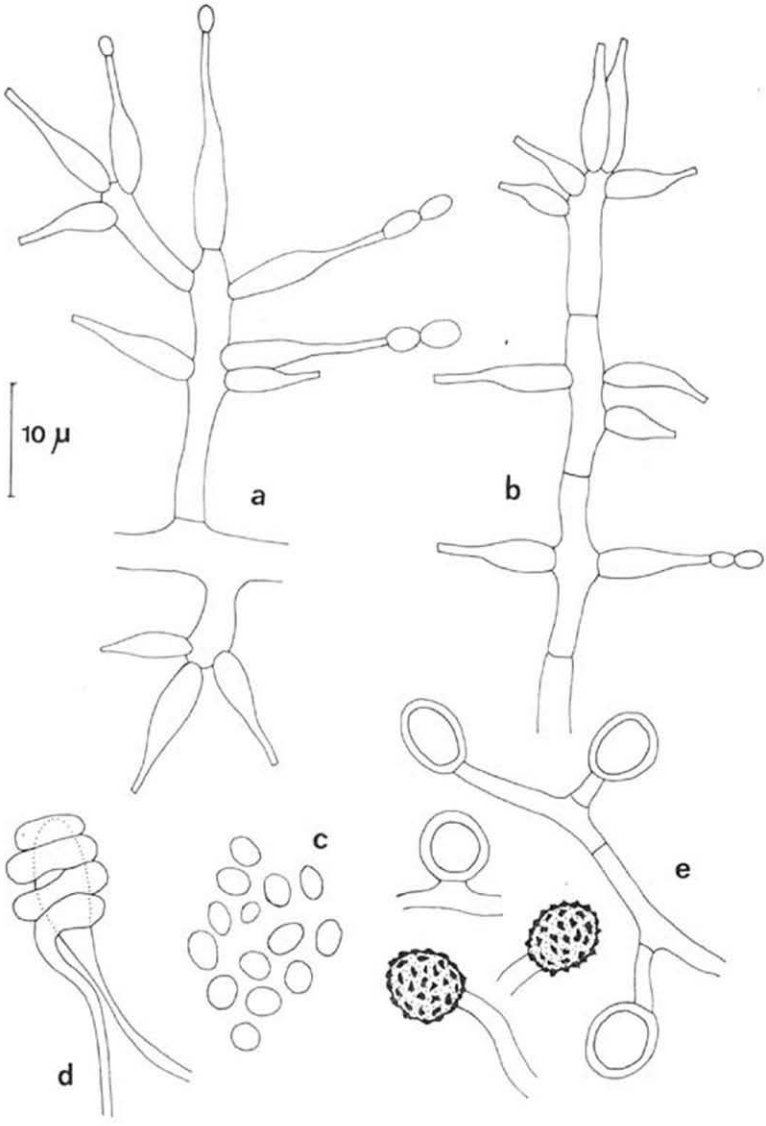

FIG. 5. *Paecilomyces zollerniae*, CBS 374.70. — a, b. Sporing structures. — c. Conidia. — d. Ascomatal initial. — e. Chlamydospores.

Ram (*1968*) described *B. zollerniae* with hyaline, oval to ellipsoid ascospores, measuring 3–4.5 × 2.5–3 μ. However, examination of the type culture showed, that it produces only the ascomatal initials but no ripe ascospores. The initials are of the *Byssochlamys* type, consisting of ascogonia coiled around swollen antheridia.

Until new isolations of this fungus are found, only the conidial state can be described.

Paecilomyces zollerniae Stolk & Samson, *stat. nov.*—Fig. 5.

Conidiophora levia, ad 150 μ longa, 2–3 μ crassa, e hyphis aeriis oriuntur, phialides binas vel ternas metulis brevibus innatas vel singulas ferunt. Phialides 8–20 μ longae, basi cylindrica 2–2,5 μ crassa, subito in collum exiguum, 2,5–7,5 μ longum, 0,7–1,0 μ crassum attenuatae. Conidia hyalina, globosa vel ellipsoidea, 2,5–4 × 1,5–3 μ, levia, catenis siccis divergentibus connexa. Chlamydosporae crassitunicatae, brunneae vel obscure brunneae, 5–10,5 μ diametro, plerumque globosa, primum leves, demum verrucosae.

TYPUS CBS 374.70.

Colonies on malt agar, spreading broadly, attaining a diameter of 8 cm in 14 days at 30° C, composed of a dense matted felt with floccose overgrowth, cottony, pure white at first, changing to Cream Buff (Ridgway, Pl. 30; Rayner, 19″d). Reverse in yellow to reddish shades. Odour slight. No exudate.

Vegetative hyphae, hyaline, thin 0.5–3 μ in diameter, submerged hyphae up to 5 μ in diameter.

Conidiophores, septate, smooth, up to 150 μ in length arising from the aerial hyphae bearing short metulae with the phialides in groups of two or three. Usually single phialides are borne directly on the trailing hyphae. Phialides 8–20 × 2–2.5 μ with a cylindrical basal portion tapering abruptly to a thin long neck, 2.5–7.5 μ in length and 0.7–1 μ in diameter, smooth.

Conidia, hyaline, globose to ellipsoid, 2.5–4 × 1.5–3 μ, smooth in dry divergent chains.

Chlamydospores abundantly produced, borne singly or in short chains, thick-walled, brown to dark-brown, 5–10.5 μ in diameter, usually globose, smooth when young, later becoming warty.

CULTURE EXAMINED.—

CBS 374.70 = IMUFPe 2190 = type culture of *B. zollerniae*, isolated from wood samples of *Zollernia illicifolia* Vog. and *Protium heptaphyllum* (Aubl.) March.

ACKNOWLEDGEMENTS

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MACROVENTURIA, A NEW GENUS OF THE VENTURIACEAE

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(With four Text-figures)

Macroventuria, a new genus of Venturiaceae, is discribed with two new species.

Amongst fungus cultures recently sent to the "Centraalbureau voor Schimmelcultures" for identification strains of two closely related ascomycetes belonging to the Pseudosphaeriales were encountered, with some characters pointing to the Venturiaceae as well as to the Mycosphaerellaceae and Pleosporaceae. The relatively large, nearly hyaline, two-celled ascospores suggest *Mycosphaerella* Johanson sect. *Didymellina* (von Arx, *1949*; Müller & von Arx, *1962*). On the other hand the perithecia are provided with well developed setae, a character recalling *Venturia* De-Not. sensu Saccardo (Saccardo, *1882*; von Arx, *1952*). In this character and in the permanently two-celled ascospores, the present strains differ from *Leptosphaerulina* McAlpine, a genus with characters that can be compared in pure culture, where relatively quick-ripening ascospores are formed. The saprophytic mode of life and the morphology are suggestive of a rather primitive organisation, like that of *Wettsteinina* Höhn. and *Pyrenophora* Fr. (Müller & von Arx, *1950*).

The genus *Venturia* contains a fairly large number of species. These are parasitic on higher plants and restricted to a single host or to a few closely related hosts (Menon, *1956*; Müller, *1957*; Nuesch, *1960*; Müller & von Arx, *1962*; Barr, *1968*). The present strains resemble *Venturia* by their setose perithecia but they differ in the restricted number of the relatively large asci, the almost hyaline, large ascospores and the saprophytic mode of life. They are considered to be primitive Venturiaceae and are described here as representatives of a new genus.

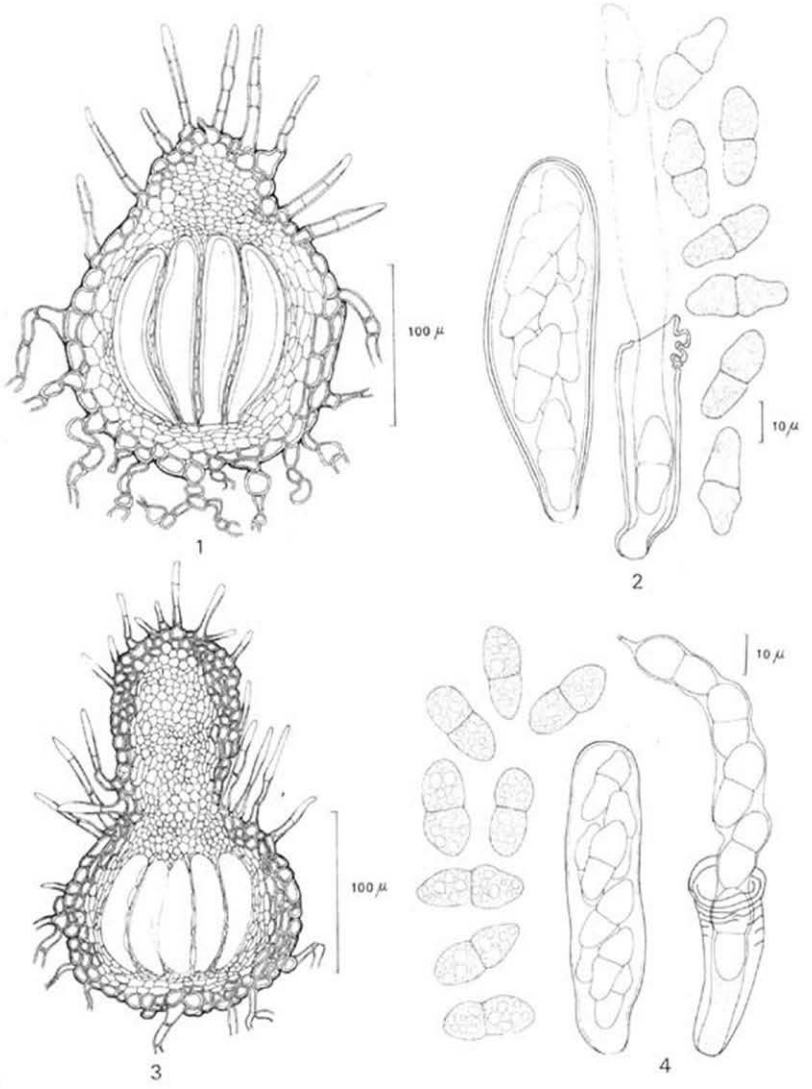
Macroventuria van der Aa, *gen. nov.*

Genus Venturiacearum, *Venturiae* affine, sed saprophyticum, peritheciis globosis papillatis erumpentibus, demum superficialibus, fuscis, sursum setulatis. Asci pauci, ellipsoidei vel sacciformes, bitunicati, octospori. Ascosporae fere hyalinae, ellipsoideae, bicellulares, semper plus quam 20 μ longae.

SPECIES TYPICA *Macroventuria wentii* van der Aa.

Genus belonging to the Venturiaceae, saprophytic, with perithecia spherical and papillate, erumpent, becoming superficial, dark, setose on the upper part. Asci in small number, ellipsoid or sack-like, bitunicate, 8-spored. Ascospores almost hyaline, ellipsoid, 2-celled, over 20 μ long.

TYPE SPECIES.—*Macroventuria wentii* van der Aa.



FIGS. 1–4. — 1–2, *Macroventuria wentii*. 1. Perithecium. 2. Asci and ascospores. — 3, 4 *Macroventuria anomochaeta*. 3. Perithecium. 4. Asci and ascospores.

Macroventuria wentii van der Aa, *spec. nov.*

Coloniae in vitro celeriter crescunt, e die decimo perithecia matura formant. Perithecia disseminata vel dense aggregata in strato stromatico, hyphis valde sinuosis, crassitunicatis, septatis, olivaceis, 6–9 μ diametro, enascentia.

Perithecia piriformia vel globosa, maturitate papilla prominente instructa, 135–180 × 105–160 μ, apice setis obtecta; setae crassitunicatae, olivaceae, sursum tenuitunicatae et fere hyalinae, cylindraceae vel attenuatae, sursum rotundatae, nonnumquam acuminatae, 40–90 × 5–7.5 μ. Paries peritheciorum 25–35 μ crassus, strato externo e cellulis brunneis, crassitunicatis, plerumque rotundatis constante, intus in nonnulla strata cellularum fere hyalinarum, tenuitunicatarum, angulatarum vel compressarum transeunte.

Asci cylindracei vel clavati, sursum late rotundati, nonnumquam brevipedicellati, bitunicati, tunica externa crassa, tunica interna tenui, octospori, 75–93 × 24–30 μ. Ascosporae una vel tribus seriebus dispositae, bicellulares, medio septatae et perspicue constrictae, utrinque sensim attenuatae ad finem rotundatum, granula parva hyalina vel viridula et nonnullas vacuolas majores transparentes continentes, 22–32 × 8–14 μ; paraphyses tam longae quam asci, vix 1–2 μ crassae.

TYPUS CBS 526.71, isolatus e stramento foliorum, Death Valley, Nevada, U.S.A. (*F. W. Went 229; H. van der Aa 2592*).

Colonies on oatmeal- or cornmeal-agar growing quickly, reaching a diameter of 4.5–5 cm within 10 days, dark olivaceous brown to almost black with a broad pale olivaceous border, without aerial mycelium or with sparse greyish to brownish aerial mycelium. Perithecia produced from the very beginning and ripening within 10 days, scattered over and in the agar, free or growing close together and in older cultures connected by a loose stromatic tissue.

Perithecia piriform or globose, with a prominent papilla, 135–180 μ, seldom more than 200 μ in diameter. Perithecial wall about 25–35 μ thick, composed of an outer layer of more or less thick-walled, rounded or somewhat angular, dark brown cells, on the inner side gradually passing into some layers of prismatic or rounded, often somewhat flattened, subhyaline to hyaline cells; on the outer side passing into the agar or into the aerial mycelium with brownish, strongly twisted, septate and thick-walled hyphae, 6–9 μ in diameter, locally with swollen, chlamydospore-like cells, 10–25 μ in diameter, in older cultures with irregular septation in all directions, probably representing new perithecial initials; at top, starting from base of papilla, set with characteristic setae. Setae pale olivaceous, with a sub-hyaline tip, cylindrical or tapering to the rounded or somewhat pointed tip, 0–11, often 4–7-septate, thick-walled except in upper part, mostly 40–90 μ long, 5–7.5 μ in diameter at the broadest part often to be found at the base, present from the very beginning of perithecial development and also occurring on upper side of undeveloped, chlamydospore-like perithecial initials.

Asci restricted in number, often 7–10 in one perithecium, arranged more or less parallel to one another, broadly cylindrical or club-shaped, the widest part somewhat below the middle, with or without a short, broad stalk, bitunicate, the outer membrane thick, the inner one thin, liberating from the top of the ascus at maturity and lengthening in the direction of the pore of the perithecium. Asci 75–93 × 24–30 μ, 8-spored, the spores in 1–3 series.

Ascospores 2-celled, the cells equal in size, often constricted at the septum, with one or both of the cells suddenly narrowing at the middle and tapering to the rounded ends, hyaline and filled with rather fine colourless or greenish granula surrounding some larger vacuoles, which may be brighter in colour, 22–32 × 8–14 μ.

Asci surrounded by very slender, septate paraphyses, composed of 6–10 μ long and 1–2 μ broad cells. These connect the small, thin-walled, hyaline, prismatic

or somewhat flattened cells at the base of the asci, with the tissue above the asci, where mainly prismatic, thin-walled hyaline cells occur, these merging indistinguishably on the outer side with the sub-hyaline inner wall-cells. At maturity a canal originates in the papilla by decay of the inner cells, a process favoured by the increase of pressure in the perithecium.

Living, lyophilized and dried cultures and permanent slides are deposited in the CBS collection and herbarium.

MATERIAL EXAMINED.—

CBS 526.71, isolated from dead litter (*F. W. Went 229; H. van der Aa 2592*) holotype.

CBS 877.70, isolated from young *Franseria* bur (*F. W. Went 136p; H. van der Aa 2209*).

CBS 527.71A, isolated from air (*F. W. Went 240; H. van der Aa 2593*).

CBS 527.71B, isolated from ant pellet (*F. W. Went 773; H van der Aa 2627*).

CBS 527.71C, isolated from floor of Veromessor nest (*F. W. Went 796; H. van der Aa 2628*).

CBS 527.71D, isolated from mycelium of *Veromessor* nest (*F. W. Went 814; H. van der Aa 2725*).

An isolation from male inflorescence of *Hymenoclea* (*F. W. Went 630; H. van der Aa 2619*) was intermixed with *Penicillium* and not kept.

All the collections mentioned were isolated by F. W. Went in 1970 and 1971, and originate from Death Valley, Nevada, U.S.A.

The present species differs clearly from *Macroventuria anomochaeta* in its lack of the characteristic arrangement of the setae in two series and in some details of perithecial and spore shape and sizes. Ascospore measurements show a rather wide range, but in a single perithecium differences in spore sizes are small. In strain CBS 527.71B for example some perithecia contain spores of about 27–28 × 10–12 μ. Others were found with all the spores over 30 μ long and 13–14 μ wide.

Macroventuria anomochaeta van der Aa, *spec. nov.*

Coloniae in vitro tarde crescunt, post 4–6 hebdomades perithecia formant. Perithecia dense aggregata in crusta stromatica. Mycelium aerium obscure brunneum vel nigrum, nonnumquam absens. Perithecia piriformia, cylindrica vel globosa, papilla perspicua prominente instructa, 120–150 μ diametro, (140–260(–300) μ alta, quorum 75–150 μ papilla occupat; disparibus setis praedita, alterae collare inferius in margine perithecii formant, brunneae, rigidae, 2–6-septate, 60–120 μ longae, 3–5 μ crassae, basi nonnumquam usque ad 10 μ inflatae, sursum plerumque rotundatae, raro aliquam acuminatae, alterae in summa papilla, subhyalinae vel basi pallide brunneae, 1–4-septatae, 30–75 × 3–4 μ, basi ad 9 μ inflatae, sursum acuminatae vel rotundatae. Inter ambos zona nuda, raro setis formae intermediae obtecta. Prima forma etiam in hyphis vegetativis vel in stadiis juvenilibus peritheciorum adest. Paries peritheciorum 16–24 μ crassus, extus ex uno vel quattuor stratis cellularum crassitunicatarum, brunnearum, rotundarum vel prismaticarum, intus e nonnullis stratis cellularum tenuitunicatarum hyalinarum constat.

Asci pauci, fere paralleli, cylindracei vel sacciformes, bitunicati, apedicellati, apice late rotundati, octospori, 60–75 × 16–21 μ. Ascosporae una vel tribus seriebus dispositae, bicellulares, medio septatae et constrictae, utrinque attenuatae, vel una parte late rotundatae; plasma leve, raris granulis intermixtis pallide viride; 21–27 × 9–11 μ. Paraphyses paucae, nonnumquam maturitate dilapsae.

TYPUS CBS 525.71, isolatus e linteo tentorii exeso, in deserto Karroo, Africa meridionali (*M. C. Papendorf* 278).

Colonies on different media growing slowly, reaching a diameter of 1 cm in 10–12 days, the best growth being on oatmeal- or cornmeal-agar with sterile stems of lupin that stimulate production of perithecia. Aerial mycelium dark brown to almost black, lacking when grown in ultraviolet light, which seems to have a stimulating effect on the production of perithecia. Perithecia formed in 4–6 weeks old cultures, very abundant on lupin stems in agar, ripening within 10 days, dense but separate, or tightly packed together in a stroma-like crust.

Perithecia piriform, somewhat columnar or more often globose with a conspicuous papilla, 120–150 μ in diameter and 140–260 μ, seldom more than 300 μ high, the papilla measuring 75–150 μ. Perithecial wall mostly 16–24 μ thick on the outer side with 1–4 layers of thick-walled, rounded or prismatic, often flattened cells, 6–15 μ large, passing on the outer side of perithecium, especially at the base, into brownish, strongly interwoven hyphae, septate and often about 3–7 μ thick; on the inner side the wall passes into some layers of hyaline, prismatic or flattened, thin-walled cells, variable in diameter, above the asci more or less globose, very thin-walled and partly disappearing at maturity. Setae on perithecia of two types; lower ones on the upper part of the perithecial body and the lower part of the papilla, brownish, often very stiff, with 2–6, mostly 2–4 septa, 60–120 μ long, 3–5 μ in diameter, at the base sometimes swollen and up to 10 μ broad, somewhat tapering to the top and mostly rounded, but seldom pointed; second type of setae on the top of the papilla, sub-hyaline or only faintly brownish near the base, 30–75 × 3–4 μ, at the base up to 9 μ in diameter, with 1–4 septa; the two types of setae usually separated by a zone without setae, but sometimes with intermediate forms occurring on the side of the papilla; the first type may also occur on the mycelium or on the chlamydospore-like initials of the perithecia from the very beginning of their developement.

Asci restricted in number, arranged parallel or almost parallel to one another, cylindrical or sack-like, the widest part in the middle or just below the middle, almost without a stalk, rounded at their base, broadly rounded at the top, bitunicate, the inner tunica suddenly elongating at maturity, 60–75 × 16–21 μ, 8-spored, the spores in 1–3 series.

Ascospores 2-celled, the cells equal in size, constricted at the septum, tapering toward the ends or broadly rounded at one end and somewhat tapering toward the other end, the contents very thin, greenish granular, 21–27 × 9–11 μ.

Asci surrounded by very slender paraphyses, composed of 5–8 μ long and 1.5–3 μ broad cells, sometimes completely disappearing at maturity.

Living, lyophylized and dried cultures and permanent slides are deposited in the CBS collection and herbarium.

MATERIAL EXAMINED.—

CBS 525.71, isolated from almost decayed canvas, in Karroo Desert, S. Africa (*M. C. Papendorf 278; H. van der Aa 2427*).

ACKNOWLEDGEMENTS.—I wish to thank Prof. F. W. Went and Prof. M. C. Papendorf for permission to describe their cultures. I am also grateful to Mrs. M. Rumondor-Hüner for the great care with which she inked the drawings.

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TESTUDINACEAE, A NEW FAMILY OF ASCOMYCETES

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(With two Plates)

The Testudinaceae, a new family of the Pseudosphaeriales, is characterized by astomatous ascomata with a dark peridium which is often made up of plates, by bitunicate asci, and by dark, 2-celled ascospores, about 10 μ long. Keyed out are the genera *Testudina*, *Neotestudina*, *Lepidosphaeria*, *Argynna* and *Pseudophaeotrichum*.

In Zygomycetes, Ascomycetes, and Basidiomycetes phylogenetic relationships are known to exist between epigeous and hypogeous fungi. Epigeous fructifications which were gymnocarpous or hemiangiocarpous originally, became angiocarpous and spherical or tuberiform when the development took place subterraneously. At the same time the special spore dispersal mechanisms, associated with open sporocarps tend to disappear. The sporocarps remained closed for an extended period and spore dispersal was brought about by soil inhabiting animals and other agents.

Often such soil inhabiting fungi are closely related to fungi with epigeous fructifications. For example a number of hypogeous, gasteromycete-like Basidiomycetes are related to well-defined genera of Agaricales, Boletales, or Russulales.

Well known in this respect is the phylogentic relationship between the astrogastraceous series, comprising *Russula*, *Lactarius* and a number of genera with hypogeous or semihypogeous species (Heim, *1948*; Singer & Smith, *1960*).

In Ascomycetes the relationship between some operculate Discomycetes (Pezizales) and most of the genera of the Tuberales is often recognized as a classical model with all possible intermediates. Also well known is the relationship between many genera of Sphaeriales with ostiolate ascomata and genera with cleistothecia, hitherto mostly arranged in Plectascales or Eurotiales (compare Müller & von Arx, *1972*, in press). For example the genus *Heleococcum* is the angiocarpous relative of *Nectria*, *Chaetomidium* that of *Chaetomium*, *Zopfiella* that of *Podospora*, and *Microthecium* that of *Melanospora*. The two last-mentioned genera often are united, because most of the species of the one have related species in the other. Moreover, in pure culture the ascomata of a single strain may be ostiolate or astomatous, depending on environmental conditions. This phenomenon has been observed also for other genera of the Sordariaceae and the Melanosporaceae (including Chaetomiaceae and Microascaceae).

In the bitunicate Pyrenomycetes (Loculoascomycetidae) only two cases of relationship between ostiolate and astomatous genera are known. One concerns *Trichodelitschia*, which is ostiolate, and *Phaeotrichum*, which is astomatous (Cain, *1956*).

The other is the phylogenetic group comprising the genera *Sporormia*, *Preussia*, and *Westerdykella* (von Arx & Storm, *1967*). In *Sporormia* the ascomata are ostiolate, in the

two other genera astomatous. In *Sporormia* and in some species of *Preussia* the asci are cylindrical-clavate and bitunicate. In other species of *Preussia* and in *Westerdykella* the asci are obovate or nearly spherical and the two membranes of the ascus wall are no longer distinguishable. In *Sporormia* the asci are arranged in a hymenial layer and extend to the ostiolum, in *Westerdykella* the asci are arranged irregularly at different levels, and *Preussia* again is intermediate.

Remarkable is the species *Sporormia aemulans* (Rehm) v. Arx & Storm, where in one and the same strain the ascomata may be provided with a conical ostiolum or may be astomatous. In the latter instance, the upper part of the ascomata is flat or slightly umbilicate and the peridial wall is thinner than on the sides and the base. The formation of an ostiolum in the *Sporormia—Preussia* series can be influenced by the choice of medium and humidity when the ascomata are in an early state of development. In species considered to belong to *Westerdykella* the ascomata in every case are astomatous and spherical to tuberous.

A study of recently collected material showed that *Testudina terrestris* Bizz., hitherto placed in the Eurotiales, in fact has bitunicate asci and also is an astomatous member of the Pseudosphaeriales. The genus is related to some other astomatous Ascomycetes, described as type species of the genera *Neotestudina*, *Pseudophaeotrichum*, *Lepidosphaeria* and *Argynna*. Common characters are the dark cleistothecia, 2-celled, pigmented ascospores without germ pores or germ slits and the 'parenchymatic' initials. Related genera with ostiolate ascomata and elongated asci might be *Didymosphaeria* and *Herpotrichia* of the Pleosporaceae, but no intermediates are known. *Testudina* and the related genera can hardly be assigned to the Pleosporaceae, therefore the description of a new family of the Pseudosphaeriales becomes necessary:

Testudinaceae von Arx, *nov. fam.*

Ascomata e cellulis plerumque intercalaribus, inflatis, undique divisis oriuntur; cleistothecia tuberosa vel globosa, pariete in bracteas e cellulis crassitunicatis obscuris radiantibus compositas diviso; asci irregulares vel fasciculati, clavati, obovati vel fere globosi, pariete inspissato duplici vel tenui; ascosporae bicellulares, brunneae, plerumque crassitunicatae; paraphyses filamentosae, saepe absunt.

GENUS TYPICUM *Testudina* Bizz.

Colonies spreading, aerial mycelium abundant or scarce; composed of brown, thick-walled hyphae; initials of ascomata consisting mostly of intercalary swollen cells dividing in all directions; ascomata tuberiform or spherical, without ostiolum; peridial wall usually divided into plates, composed of elongated, radially arranged, thick-walled, dark cells; asci irregularly arranged or in fascicles borne on ascogenous hyphae, clavate, obovate or nearly spherical, with a thickened double or a thin single membrane; ascospores 2-celled, brown, glabrous or ornamented, mostly thick-walled; paraphyses absent or scarce, filamentous, often septate and ramose.

TYPE GENUS.—*Testudina* Bizz.

KEY TO THE GENERA

1. Ascomata with continuous peridium composed of flattened cells; asci obovate or spherical, with a thin membrane . . . . . *Pseudophaeotrichum*
1. Ascomata with peridium composed of plates of radiating cells; asci clavate or obovate, bitunicate 2
2. Ascospores ornamented 3
2. Ascospores glabrous 4
3. Asci obovate or broadly clavate; ascospores reticulate. . . . . *Testudina*
3. Asci clavate, with a long stalk; ascospores finely echinulate, darker near the septum *Lepidosphaeria*
4. Asci clavate, stalked; ascospores darker near the septum . . . . . *Argynna*
4. Asci obovate or nearly spherical; ascospores not darker near the septum. *Neotestudina*

1. TESTUDINA Bizz.

Testudina Bizz. *in* Atti Ist. veneto Sci. (Lett. Arti) VI **3**: 303. 1885.
Marchaliella Wint. *apud* Bommer & Rouss. *in* Bull. Soc. r. Bot. Belg. **29**: 243. 1891.

TYPE SPECIES.—*Testudina terrestris* Bizz.

The ascomata develop in a dark mycelial mat; they are spherical or tuberous, dark, and 400–600 μ in diameter. The 'plates' of the peridium are composed of thick-walled, brown cells, 4–7 μ long, 2–4 μ wide and arranged in radiating rows. The asci, borne on branched, hyaline ascogenous hyphae, are obovate, broadly clavate or nearly spherical, with a short stalk, 15–20 × 12–16 μ in size. The outer membrane is thin, the inner one is up to 2–3 μ thick at the apex. The reticulate, brown ascospores are composed of 2 rounded cells, and measure 9–10.5 × 4.5–5.5 μ (without ornamentation 8–9 × 4–5 μ). Plate 12.

The description is based on a freshly collected specimen, received from Dr. Roswitha Schneider (Berlin) and on some herbarium collections. In most of them the fungus had developed on twigs of conifers. Type specimens of *T. terrestris* and *M. zopfielloides* were not available.

In the collections studied the fungus develops in association with other fungi, e.g. *Fusarium* sp., *Acremonium* sp., and *Phialophora* sp., probably as a fungal parasite. Isolation in pure culture did not succeed, and only cultures of the last-mentioned genera developed on the agar plates.

2. NEOTESTUDINA Segretain & Destombes

Neotestudina Segretain & Destombes *in* C.r. hebd. Séanc. Acad. Sci. Paris **253**: 2577. 1961.

TYPE SPECIES.—*Neotestudina rosatii* Segretain & Destombes.

In the type strain (CBS 427.62), ascomata were observed only in cultures developed on oatmeal agar from revived lyophilized ascospores. The ascomata are black, 300–450 μ in diameter, and the peridial wall is divided into plates. The cells of the wall, arranged in rows, are brown, thick-walled, and measure 8–12 × 4–6 μ. The asci develop laterally on wide ascogenous hyphae; they are bitunicate, with a thick inner membrane, at the apex up to 2–3 μ, and measure 16–24 × 10–16 μ. The ascospores are irregular in shape, often broadly truncate, often rounded or attenuated at the ends, provided with a rather thick, smooth wall and measure 9–12 × 5–8 μ.

3. LEPIDOSPHAERIA Parguey-Leduc

Lepidosphaeria Parguey-Leduc *in* C.r. hebd. Séanc. Acad. Sci. Paris **270**: 2784. 1970.

TYPE SPECIES.—*Lepidosphaeria nicotiae* Parguey-Leduc.

The development of this fungus has been fully described by Parguey-Leduc (*1970*). In cultures of the type strain (CBS 559.71) on malt- and oatmeal-agar, only a few cleistothecia were observed on the dark, dense mycelial mat; these have a diameter of 230–500 μ; the peridial wall is subdivided into plates. The bitunicate asci are arranged in dense fascicles in a hymenium-like layer around the center of the ascoma on ascogenous hyphae; they are clavate, long stalked and measure (without stalk) 27–37 × 9–13 μ. The ascospores consist of 2 rounded cells; they measure 8–10 × 5–6.5 μ; the rather thick wall is finely echinulate, brownish, darker at maturity and nearly opaque along the septum.

4. ARGYNNA Morgan

Argynna Morgan *in* J. Cincinn. Soc. nat. Hist. **18**: 41. 1895.

TYPE SPECIES.—*Argynna polyhedron* (Schw.) Morgan

No specimen of this fungus could be studied, but it is fully described and illustrated by Martin (*1941*).

Its relationship with *Neotestudina* has also been recognized by D. Malloch (personal communication). The fungus seems to be closely related to *Lepidosphaeria nicotiae*, but differs in the ascospores which are smooth, asymmetrical, and attenuated at both ends.

5. PSEUDOPHAEOTRICHUM Aue & *al.*

Pseudophaeotrichum Aue & *al. in* Nova Hedwigia **17**: 84. 1969.

TYPE SPECIES.—*Pseudophaeotrichum sudanense* Aue & *al.*

Studied was the type strain (CBS 512.69). The fungus was described and illustrated fully by Aue & al. (1969). In culture on oatmeal agar the ascomata attain a diameter of 300–600 μ. The asci have a thin membrane and measure 17–24 × 15–20 μ; the ascospores are smooth, brown, attenuated at both ends, and measure 10–12 × 6–7.5 μ. Plate 13.

Another cleistocarpous genus with two-celled ascospores is *Zopfia* Rabenh. (see Müller & von Arx, *1962*). *Zopfia rhizophila* Rabenh. and other species develop on roots. All species are easily recognized because of the very large ascospores. Whether this genus is a further angiocarpous member of the Pseudosphaeriales is still uncertain.

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EXPLANATION OF PLATES 12 AND 13

PLATE 12

Testudina terrestris, young and mature asci and ascospores. — 1800 ×.

PLATE 13

Pseudophaeotrichum sudanense, ascogenous hyphae with young asci and a mature ascus. — 1800 ×.

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ON ARACHNIOTUS AND RELATED GENERA OF THE GYMNOASCACEAE

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(With two Plates)

Fungal strains in the culture collection of the CBS under the generic names *Arachniotus* and *Pseudoarachniotus* were studied. The genera *Arachniotus* (including *Pseudoarachniotus*) with 6 species, *Narasimhella* with a single species, and *Amauroascus* with 7 species are accepted. For *Arachniotus glomeratus*, *Arachniotus striatisporus* and *Arachniotus lectardii* the new generic names *Arachnotheca*, *Byssoascus*, and *Eleutherascus* are proposed. A key is given for the genera of the Gymnoascaceae.

In recent publications on Gymnoascaceae the concepts of the generic distinctions are contradictory. Differences of opinion exist especially on the delimitation of *Arachniotus*, *Pseudoarachniotus*, *Amauroascus*, and *Narasimhella*. Some genera have been put into synonymy by one author and are accepted again by another. In a revision of British Gymnoascaceae, Apinis (*1964*) for instance reduced *Pseudoarachniotus* Kuehn (*1957*) to the synonymy of *Arachniotus* Schroeter (*1893*). On the other hand Orr & Kuehn (*1971*) found the type species of *Narasimhella* Thirum. & Mathur (*1965*) to be identical with a fungus described by Kuehn & Orr (*1963*) as *Pseudoarachniotus marginosporus*. Orr *& al.* (*1965*) included *Amauroascus* in *Arachniotus*.

To clarify the identity of the above mentioned genera, all cultures present in the CBS-collection under these names were compared. The study has shown that the genus *Arachniotus* sensu Apinis (*1964*) and sensu Orr *& al.* (*1965*) is an unnatural taxon containing a variety of fungi with different relationships. In addition to *Arachniotus* the genera *Narasimhella* and *Amauroascus* must be accepted. Certain species classified as *Arachniotus* belong to other genera of the Gymnoascaceae and the Eurotiaceae.

The strains were compared on YpSs- and hay-infusion agar after an incubation of 3–4 weeks at a temperature of 24° C in diffuse light. Species not developing well on these media were studied on agar-media containing oatmeal, malt or potato-carrot-extract. All of the species discussed in this paper are provided in the existing literature with suitable and complete descriptions. Therefore no new species descriptions are offered.

The following disposition is proposed:

1. ARACHNIOTUS Schroeter

Arachniotus Schroeter *in* Krypt.-Fl. Schles. **3** (2): 210. 1893.
Pseudoarachniotus Kuehn *in* Mycologia **49**: 694. 1957.
Waldemaria Batista *& al. in* Atas Inst. Micol. (Recife) **1**: 5. 1960.

TYPE SPECIES.—*Arachniotus ruber* (van Tieghem) Schroeter

Colonies on YpSs-agar velvety or lanose, often furrowed, becoming yellow, brownish or cinnamon; initials consisting of two similar gametangia coiling about each other; peridium absent; asci on short ascogenous hyphae, often localized in patches throughout the aerial mycelium, frequently forming short chains, spherical or nearly so, with a thin, rather persistent membrane, 4- or mostly 8-spored; ascospores lenticular or oblate, often with an equatorial rim or furrow, sometimes also with polar thickenings, yellow- or red-brown when mature, with a diameter of 4–8 μ; conidia mostly absent, but arthro- or aleurioconidia may be present.

1. ARACHNIOTUS RUBER (van Tieghem) Schroeter

Gymnoascus ruber van Tieghem *in* Bull. Soc. bot. Fr. **24**: 159. 1877. — *Arachniotus ruber* (van Tieghem) Schroeter *in* Krypt.-Fl. Schles. **3** (2): 211. 1893.

This species is readily recognized by its ascospores which have 2 equatorial rims bounding a furrow. They are reddish brown when mature and measure 5.5–7 × 4–5 μ. A detailed description of the fungus is given by Kuehn & Orr (*1964*). Plate 14 Fig. a.

STRAINS EXAMINED.—
CBS 194.64 = IMI 92.796 (neotype), received from G. F. Orr;
CBS 351.66 = IMI 100.913 = BDUN 265, received from A. E. Apinis;
CBS 112.69, isolated from soil, received from K. H. Domsch;
CBS 592.71, isolated from soil, received from J. H. van Emden.

2. ARACHNIOTUS CITRINUS Massee & Salmon

Arachniotus citrinus Massee & Salmon *in* Ann. Bot. **16**: 62. 1902. — *Pseudoarachniotus citrinus* (Massee & Salmon) Kuehn *in* Mycologia **49**: 699. 1957.
Arachniotus confluens (Sartory & Bainier) Apinis *in* Mycol. Pap. No. 96: 37. 1964.

This species can be recognized by its bright, mostly yellow, mycelial mat. The lenticular ascospores are spherical from above, rhomboidal or elliptical in side view; they have neither a rim nor a furrow and the wall is only slightly thickened in the equatorial region. The size of the ascospores is 6–7 × 4.5–5.5 μ.

STRAINS EXAMINED.—
CBS 114.54 = IMI 56.774, isolated from soil, USA, received from L. Ajello;
CBS 113.61 = IMI 63.905, received from J. Nicot;
CBS 352.66 = IMI 100.873 = BDUN 375, received from A. E. Apinis as neotype of *Arachniotus confluens*.

3. ARACHNIOTUS DANKALIENSIS (Castellani) van Beyma

Arachniotus dankaliensis (Castellani) van Beyma *in* Antonie van Leeuwenhoek **8**: 107. 1942.
Pseudoarachniotus roseus Kuehn *in* Mycologia **49**: 695, 1957.
Waldemaria pernambucensis Batista & *al. in* Atas Inst. Micol. (Recife) **1**: 6. 1960.
Pseudoarachniotus flavus Thirum. & Mathur *in* Mycopath. Mycol. appl. **40**: 97. 1970.
Pseudoarachniotus halophilus Pawar & al. *in* Mycopath. Mycol. appl. **40**: 100. 1970.
Pseudoarachniotus terrestris Thirum. & Mathur *in* Mycopath. Mycol. appl. **40**: 102. 1970.
Pseudoarachniotus thirumalacharii Mathur *in* Mycopath. Mycol. appl. **40**: 101. 1970.

In this species the colonies usually become light brownish in age. The oblate ascospores are provided with a fairly broad equatorial rim and also with polar thickenings. In all strains studied the ascospores are bright red-brown, have a diameter of 6–7.5 μ and are 4–5 μ wide. Other measurements given in the literature are erroneous. Plate 14 Fig. b.

STRAINS EXAMINED.—
CBS 117.38, isolated from a camel, type strain of *A. dankaliensis*;
CBS 130.60, isolated from a dog, Curaçao;
CBS 568.69, isolated from soil in Peshawar, Pakistan;
CBS 323.58 = IMI 76.605, H. H. Kuehn, type strain of *Pseudoarachniotus roseus*;
CBS 352.68, isolated from man, Curaçao;
CBS 369.65 = HACC-162, type strain of *Pseudoarachniotus flavus*;
CBS 382.65 = HACC-168, type strain of *Pseudoarachniotus halophilus*;
CBS 399.65 = HACC-157, type strain of *Pseudoarachniotus terrestris*;
CBS 294.66 = HACC-198, type strain of *Pseudoarachniotus thirumalacharii*.

4. **Arachniotus punctatus** (Dutta & Ghosh) von Arx, *comb. nov.*

Pseudoarachniotus punctatus Dutta & Ghosh *in* Mycologia **56**: 153. 1964 (basionymum).

This species is very similar to *Arachniotus dankaliensis*, but differs in having smaller ascospores, 5–6 μ in diameter, with a very prominent equatorial rim. The colonies have an orange colour and the agar medium is also coloured orange by an exudate.

STRAIN EXAMINED:
CBS 279.64, type strain, received from G. F. Orr.

5. ARACHNIOTUS FLAVOLUTEUS Kuehn & Orr

Arachniotus flavoluteus Kuehn & Orr *in* Mycologia **51**: 864. 1959.

This fungus is closely related to *Arachniotus dankaliensis*, but may be distinguished by the light colour and the often lanose appearance of the colonies. The spherical asci have a diameter of 11–15 μ and are often aggregated in dense clusters. The oblate ascospores have an equatorial rim or thickening, are brownish-yellow, and measure 5–6.5 μ.

STRAINS EXAMINED.—
CBS 627.71 = NRRL 1243, type strain, isolated from soil by C. W. Emmons.
CBS 519.68, isolated from man, Calcutta, India, received from G. F. Orr.
CBS 946.69, isolated from man, Curaçao.

6. **Arachniotus aurantiacus** (Kamyschko) von Arx, *comb. nov.*

Pseudoarachniotus aurantiacus Kamyschko *in* Nov. Sist. niz. Rast. **4**: 224. 1967 (basionymum).

In this slow-growing species the colonies also have an orange, cinnamon or golden-yellow colour. After 4 weeks coiled initials are developed. The asci are spherical and have a diameter of 8–12 μ. The ascospores are oblate, without a prominent equatorial rim, golden-yellowish when mature, 4–5.5 μ in diameter and 2.5–3.5 μ wide.

STRAINS EXAMINED:
CBS 603.67 = BKM F-1140, type strain, received from L. A. Beljakova.
CBS 950.69, as *Arachniotus hebridensis* received from G. F. Orr.

2. NARASIMHELLA Thirum. & Mathur

Narasimhella Thirum. & Mathur *in* Sydowia **19**: 184. 1966 ("1965").

TYPE SPECIES.—*Narasimhella poonensis* Thirum. & Mathur [= *N. hyalinospora* (Kuehn & *al.*) v. Arx].

Colonies on YpSs-agar becoming fasciculate or forming synnema- or sporodochium-like structures with yellow, cinnamon or greenish tints; initials of ascomata nearly ring-like, septate, often surrounding a central cell; asci mainly embedded in the upper parts of the sporodochia or synnemata, born in clusters on ascogenous hyphae, broadly clavate or obovate, with a thin membrane, mostly 8-spored; peridium absent; ascospores inequilateral lenticular, with a thin, fringy equatorial edge and with a wall often thicker at one side than at the other, hyaline or pale yellowish. The fringy appearance of the rim often suggests a spiny wall.

Narasimhella hyalinospora (Kuehn & al.) von Arx, *comb. nov.*

Pseudoarachniotus hyalinosporus Kuehn & *al. in* Mycopath. Mycol. appl. **14**: 215. 1961 (basionymum). — *Arachniotus hyalinosporus* (Kuehn & *al.*) Apinis *in* Mycol. Pap. No. 96: 41. 1964. *Pseudoarachniotus marginosporus* Kuehn & Orr *in* Mycopath. Mycol. appl. **19**: 257. 1963. — *Arachniotus marginosporus* (Kuehn & Orr) Udagawa *in* Trans. mycol. Soc. Jap. **10**: 103. 1970. *Narasimhella poonensis* Thirum. & Mathur *in* Sydowia **19**: 184. 1966 ('1965').

The identity of *Narasimhella poonensis* and *Pseudoarachniotus marginosporus* has been recognized by Orr & Kuehn (*1971*).

The genus *Narasimhella* is related to *Arachniotus*, but differs e.g. in the appearance of the colonies, the clavate asci borne from croziers; the almost hyaline ascospores, with an equatorial frill, measuring 4–5 μ in diameter. Plate 15.

STRAINS EXAMINED.—

CBS 115.54 = ATCC 15314, type strain of *Pseudoarachniotus marginosporus*;

CBS 469.63, CBS 470.63, CBS 471.63, CBS 566.63, all received from G. F. Orr as *Pseudoarachniotus hyalinosporus*;

CBS 393.71 = ATCC 16197 = HACC-171, type strain of *Narasimhella poonensis*, received from M. J. Thirumalachar and from ATCC.

3. AMAUROASCUS Schroeter

Amauroascus Schroeter *in* Krypt.-Fl. Schles. **3** (2): 211, 1893.

TYPE SPECIES.—*Amauroascus verrucosus* (Eidam) Schroeter.

Colonies on YpSs-agar lanose or felty, bright or white, composed of hyaline, often fasciculate hyphae; ascogenous parts often hemispherical, spherical, sporodochium-like or irregular, sometimes large, sometimes small, without a true peridium, but often covered by hyphae, often becoming dark, especially when the ascospores are pigmented; asci develop on ascogenous hyphae in clusters, they are broadly clavate or abovate, rarely spherical, mostly 8-spored; ascospores spherical or nearly so, wall thick, reticulate, or with spiny thickenings or an ornamented sheath, reddish or brownish when mature or remaining hyaline.

The genus *Amauroascus* can easily be distinguished from *Arachniotus* and *Narasimhella* by the spherical and ornamented ascospores. The development of the asci on croziers indicates a closer relationship with *Narasimhella* than with *Arachniotus*. The latter genus differs in colony appearance and in its spherical asci. *Chrysosporium*-like conidial states with aleurio- and arthroconidia occur in several species of *Amauroascus*.

1. AMAUROASCUS VERRUCOSUS (Eidam) Schroeter

Gymnoascus verrucosus Eidam *in* Jber. schles. Ges. **64**: 162. 1887. — *Amauroascus verrucosus* (Eidam) Schroeter *in* Krypt.-Fl. Schles. **3** (2) : 211. 1893. — *Arachniotus verrucosus* (Eidam) Kuehn & *al. in* Mycopath. Mycol. appl. **25**: 103. 1965.

In this species the hemispherical or sporodochium-like ascomata attain a diameter of 2–6 mm. The ascospores are spherical, thick-walled, verrucose-tuberculate brownish when mature and 6–8 μ in diameter. Plate 14 Fig. c.

STRAINS EXAMINED.—
CBS 227.69, isolated by G. A. de Vries;
CBS 181.70, received from G. F. Orr.

2. AMAUROASCUS NIGER Schroeter

Amauroascus niger Schroeter *in* Krypt.-Fl. Sches. **3**: (2): 211. 1893. — *Arachniotus niger* (Schroeter) Kuehn & *al. in* Mycopath. Mycol. appl. **25**: 106. 1965.

On YpSs-agar the fungus produces a white, lanose aerial mycelium and the medium is coloured red by an exudate. The ascomata are irregularly spherical or hemispherical, 0.5–2.5 mm broad and become brownish at maturity. The ascospores are spherical, brown, thick-walled, reticulate-spiny, and 4.5–6 μ in diameter.

STRAIN EXAMINED.—
CBS 144.61, isolated from soil in California, received from G. F. Orr (no. 0-315).

3. **Amauroascus aureus** (Eidam) von Arx, *comb. nov.*

Gymnoascus aureus Eidam *in* Jber. schles. Ges. **64**: 161. 1887 (basionymum). — *Arachniotus aureus* (Eidam) Schroeter *in* Krypt.-Fl. Schles. **3** (2): 210. 1893.

The asci are borne in sporodochium-like or nearly spherical, lanose, white or yellow ascomata, 0.5–2 mm in diameter. They develop in clusters, are broadly clavate and 15–20 × 10-13 μ. The ascospores are spherical, thick-walled, bright yellowish, reticulate-spiny and 4–5.5 μ in diameter.

A detailed description is given by Kuehn & *al.* (*1964*).

STRAINS STUDIED.—
CBS 107.26, received from A. Nannizzi;
CBS 593.71 = NRRL A-12.184 (neotype), received from G. F. Orr.

4. **Amauroascus echinulatus** (Dutta & Ghosh) von Arx, *comb. nov.*

Pseudoarachniotus echinulatus Dutta & Ghosh *in* Mycologia **55**: 775. 1963 (basionymum).

The asci are formed in small, mostly irregular areas in the lanose or fasciculate mycelial mat. Spherical ascomata or sporodochium-like structures are absent. The ascospores are spherical, light brownish, thick-walled, warty to spiny, 4.5–5.5 μ in diameter. The aerial mycelium is composed of thin-walled, septate, 4–6 μ wide hyphae. Plate 15 Fig. d.

Strain studied.—
CBS 278.64 = ATCC 15317, type strain, received from G. F. Orr.

5. **Amauroascus reticulatus** (Kuehn & Goos) von Arx, *comb. nov.*

Pseudoarachniotus reticulatus Kuehn & Goos *in* Mycologia **52**: 40. 1960 (basionymum).

In this species the colonies have a felt-like appearance and are composed of hyaline, 1.5–2.5 μ broad, often fasciculate hyphae. The asci are borne in irregular, often small areas. The ascospores are spherical, golden-yellow, thick-walled, reticulate and 5–6 μ in diameter. Plate 14 Fig. e.

STRAIN EXAMINED.—

CBS 392.61 = IMI 84.358 = ATCC 14045, type strain, received from H. H. Kuehn.

6. **Amauroascus albicans** (Apinis) von Arx, *comb. nov.*

Arachniotus albicans Apinis *in* Mycol. Pap. No. 96: 45. 1964 (basionymum).

In this species the asci are formed in sporodochium-like, yellow-brownish, loose, 0.5–1.5 mm broad ascomata in small clusters on ascogenous hyphae. The ascospores are spherical, thick-walled, irregularly echinulate, hyaline and 3–4 μ in diameter.

STRAIN STUDIED.—

CBS 151.63 = IMI 100.875 = BDUN 262, type strain, received from A. E. Apinis.

7. **Amauroascus kuehnii** von Arx, *nom. nov.*

Arachniotus reticulatus Kuehn *in* Mycologia **49**: 57. 1957, non *Amauroascus reticulatus* (Kuehn & Goos) v. Arx.

No ascomata were observed in cultures of the type strain, only arthroconidia of the conidial state developed.

STRAIN EXAMINED.—

CBS 113.58, type strain, received from H. H. Kuehn.

4. **Arachnotheca** von Arx, *gen. nov.*

Ascogonia e cellula recta incrassata saepe clavata et antheridio dense convoluto constant; ascomata globosa, lanosa, fere hyalina, peridio e fere crassis hyphis anastomosantibus composito; asci globosi vel subglobosi, e hyphis ascogenis uncinatis oriuntur, tenui-tunicati, octospori; ascosporae globosae, hyalinae, parvae, fere crassi-tunicatae, strato mucido irregulariter sulcato praeditae. Conidia cylindrica, hyalina, e hypharum ramulis fragmentatis oriuntur modo generis *Geotrichi*.

SPECIES TYPICA *Arachniotus glomeratus* Müller & Pacha-Aue.

Ascogonium composed of a straight, thickened, often clavate cell, surrounded by a densely coiled antheridium; ascomata spherical, lanose, light, with a peridium composed of rather thick, anastomosing hyphal elements; asci spherical or nearly so, borne on croziers, thin-walled, 8-spored; ascospores spherical, hyaline, small, with a rather thick wall surrounded by an irregularly furrowed sheath. Conidia cylindrical, hyaline, born by fragmentation of hyphal branches (form genus *Geotrichum*).

TYPE SPECIES.—*Arachniotus glomeratus* Müller & Pacha-Aue.

Arachnotheca glomerata (Müller & Pacha-Aue) von Arx, *comb. nov.*

Arachniotus glomeratus Müller & Pacha-Aue *in* Nova Hedwigia **15**: 544. 1968 (basionymum).

In this fungus the ascomata are spherical, lanose, brightly greyish, 260–500 μ in diameter, with a peridium composed of hyaline, rather thin-walled, smooth, 15–30 μ long, 2–5 μ wide, often anastomosing hyphal cells. The asci are spherical, 8-spored, thin-walled and 9–12 μ in diameter. The ascospores are spherical, rather thick-

walled, surrounded by an irregularly furrowed sheath; they measure 4–5 μ in diameter, without sheath 3–3.5 μ. Hyaline, 1-celled arthroconidia are formed from aerial hyphae which measure 3–7 × 2–4 μ.

In this species the large initials with one clavate gametangium surrounded by a dense spiral of the other is noteworthy. Suitable media for cultivation are oatmeal- or cornmeal-agar.

Strain studied.—
CBS 348.71 = ETH-M7292, received from E. Müller.

The genus *Arachnotheca* is related to *Amauroascus*, but is easy to distinguish by the different kinds of ascomata initials, by the thick peridium and by the small ascospores, surrounded by a sheath. *Rollandina vriesii* Apinis (*in* Trans. Br. mycol. Soc. **55**: 501. 1970) may be a related species, but differs by having echinulate ascospores.

5. **Byssoascus** von Arx, *gen. nov.*

Ascomata globosa vel irregularia, parva, peridio inconspicuo e textura laxa hypharum tenuium composito circumdata. Asci acervati e hyphis ascogenis uncinatis oriuntur, late clavati vel obovati, tenui-tunicati, octospori. Ascosporae fusiformes, sulcis longitudinalibus striatae, maturitate stramineae. Conidia cylindrica, catenulata, e ramulis fragmentatis conidiophororum modo generis *Oidiodendri* oriuntur.

SPECIES TYPICA *Arachniotus striatisporus* Barron & Booth.

Ascomata spherical or irregular, small, with an inconspicuous peridium composed of a loose network of thin hyphae. Asci borne in clusters on ascogenous hyphae with croziers, broadly clavate or obovate, thin-walled, 8-spored. Ascospores fusiform, striate by longitudinal flutes, straw-coloured when mature. Conidia cylindrical, borne in chains by fragmentation of branching conidiophores (form genus *Oidiodendron*).

TYPE SPECIES.—*Arachniotus striatisporus* Barron & Booth.

Byssoascus striatisporus (Barron & Booth) von Arx, *comb. nov.*

Arachniotus striatisporus Barron & Booth *in* Can. J. Bot. **44**: 1060. 1966 (basionymum).

The genus *Byssoascus* can easily be distinguished from *Arachniotus*, *Narasimhella*, *Amauroascus* and all other genera of the Gymnoascaceae by its ascospores, which are fusiform and striate and not spherical or oblate. Also characteristic of the genus are the clavate asci borne on croziers and especially the *Oidiodendron* conidial state.

The fungus is not related to other Gymnoascaceae, its position in this family is only based on a superficial resemblance, but other related ascomycetes are unknown to the writer. The fungus does not develop well on YpSs-agar, but a suitable medium is oatmeal-agar.

STRAIN STUDIED.—
CBS 642.66, type strain, isolated from soil, Canada, received from G. L. Barron.

6. **Eleutherascus** von Arx, *gen. nov.*

Ascomata absunt; ascogonia in mycelio aerio, curvata vel contorta, ascos singulos vel paucos proferunt et saepe nonnulla filamenta; asci late clavati, obovati vel subglobosi, pariete

simplici, tenui, plerumque octospori; ascosporae globosae, maturitate dilute brunneae, pariete crasso, spinoso; conidia absunt.

SPECIES TYPICA *Arachniotus lectardii* Nicot.

Ascomata absent; initials borne in the aerial mycelium, curved or coiled, forming a single ascus or a small number of asci and often some filaments; asci broadly clavate, obovate or nearly spherical, with a single, thin membrane, mostly 8-spored; ascospores spherical, light brownish when mature, with a thick, spiny wall, about 12 μ in diameter; conidia absent.

TYPE SPECIES.—*Arachniotus lectardii* Nicot.

Eleutherascus lectardii (Nicot) von Arx, *comb. nov.*

Arachniotus lectardii Nicot *apud* Nicot & Durand *in* Bull. Soc. mycol. Fr. **85**: 319. 1969 (basionymum).

The development of the fungus has been described in detail by Nicot & Durand (*1969*) and by Durand (*1969*). The asci mostly develop in pairs on the ascogonia, dispersed in the aerial mycelium; they measure 38–50 × 30–40 μ and are provided with a thin, rather persistent membrane. The ascospores are spherical, light brownish, thick-walled, ornamented with 2–2.5 μ long spines and measure 10–13 μ in diameter (without the spines).

STRAIN STUDIED.—

CBS 626.71 = LC 2022, type strain, isolated from salty soil, Château-Salin, Moselle, France, by P. Lectard, 1968, received from J. Nicot.

The genus *Eleutherascus* is not related to *Arachniotus* or to other genera of the Gymnoascaceae. It can rather be regarded as a primitive discomycete without ascocarps; it may be related to *Ascodesmis*. Another probably related, as yet un described fungus is maintained in the CBS-collection as '*Amauroascus verrucosus*' (CBS 109.54).

SPECIES DESCRIBED AS ARACHNIOTUS BUT NOT BELONGING TO THE ABOVE DISCUSSED GENERA

1. *Arachniotus hebridensis* Apinis *in* Mycol. Pap. No. 96: 41. 1964.

The type strain (CBS 360.66 = BDUN 389), received from A. E. Apinis, was studied. Only aleuriospores of a *Chrysosporium*-like conidial state were observed. The original diagnosis and the figures do not give sufficient information on the relationship of the fungus.

2. *Arachniotus intermedius* Apinis *in* Mycol. Pap. No. 96: 45. 1964.

The type strain (CBS 152.65 = BDUN 267 = IMI 100.874) was studied. The fungus is quite a typical member of the Eurotiaceae, related to *Talaromyces*. Its phialidic conidial state, however, is more closely related to *Acremonium* or *Torulomyces* than to *Penicillium*.

3. *Arachniotus lanatus* Apinis *in* Mycol. Pap. No. 96: 39. 1964.

Rollandina lanata (Apinis) Apinis *in* Trans. Br. mycol. Soc. **55**: 501. 1970.

No cultures of this fungus were available. Its classification in the genus *Rollandina* is also doubtful. The type species of this genus is probably based on a sterile fungus parasitized by another and is unknown in pure culture. Both taxa may belong to *Nannizzia* Stockdale.

4. *Arachniotus purpureus* Müller & Pacha-Aue *in* Nova Hedwigia **15**: 552. 1968.

The type strain (CBS 475.71) was studied. The ascomata are true cleistothecia with a thin peridium composed of hyphae. The conidial state belongs to the Restrictum series of the form genus *Penicillium*. The fungus has to be transferred to *Talaromyces* (see Stolk & Samson, *1971*).

5. *Arachniotus trisporus* Hotson *in* Mycologia **28**: 500. 1936.

A study of the type strain (CBS 133.37) confirmed the identity of this fungus with *Byssochlamys nivea* Westling. The genus *Byssochlamys* Westling is related to *Talaromyces* Benjamin and *Hamigera* Stolk & Samson (Eurotiaceae) and is discussed in this context by Stolk & Samson (*1971*).

KEY TO THE GENERA OF THE GYMNOASCACEAE

1. Ascospores spherical, 10—13 μ in diameter, spiny, asci disoersed, borne singly, in pairs or in a small number on a coil . . . . . *Eleutherascus*
1. Ascospores smaller 2
2. Ascospores striate, fusiform . . . . . *Byssoascus*
2. Ascospores not striate, mostly not fusiform 3
3. Ascospores spherical or nearly so, ornamented. 4
3. Ascospores lenticular, oblate, ellipsoidal, fusiform or small and smooth if spherical . 7
4. Peridial hyphae absent or present, thin-walled, without prominent appendages of chlamydospores. 5
4. Peridial hyphae present, mostly thick-walled, with chlamydospores or appendages. 6
5. Initials consisting of 2 coils, peridium absent or thin, composed of loose, radiating hyphae, ascospores ornamented . . . . . *Amauroascus*
5. Initials composed of a clavate cell surrounded by a dense coil, peridium thick, composed of dense layers of hyphae, ascospores small, with a sheath . . . . . *Arachnotheca*
6. Peridial hyphae hyaline, forming coiled appendages and dark chlamydospores. *Apinisia*
6. Peridial hyphae thick-walled, with long appendages.. . . . . *Auxarthron*
7. Peridial hyphae absent or narrow and similar to those of the aerial mycelium . . 2
7. Peridial hyphae present, often wide or with appendages, ascomata spherical or nearly so. 9
8. Initials ring-like, asci clavate, borne in clusters, ascospores lenticular, nearly hyaline, sporodochium-like structures often present. . . . . *Narasimhella*
8. Initials consisting of 2 coils, asci spherical, often in short rows, ascospores lenticular or oblate, reddish or brownish, often with an equatorial rim or furrow, colonies mostly velvety, sporodochium-like structures absent . . . . . *Arachniotus*
9. Ascospores fusiform or nearly so, asci often with a short cylindrical stalk. *Pseudogymnoascus*
9. Ascospores not fusiform. 10
10. Ascomata small (15–120 μ in diameter), peridial hyphae provided with coiled or recurved appendages, ascospores small 11
10. Ascomata mostly larger. 12
11. Peridial hyphae with recurved appendages . . . . . *Spiromastix*
11. Peridial hyphae with closely coiled appendages.. . . . . *Ajellomyces*

12. Peridial hyphae brown, thick-walled or with dark appendages 13
12. Peridial hyphae light. 15
13. Cells of the appendages form recurved tooth-like protuberances on one side. *Ctenomyces*
13. Cells of the appendages not so 14
14. Ascomata light, appendages of one kind . . . . . *Gymnoascus*
14. Ascomata dark, peridial hyphae form short, spine-like branches as well as long, mostly uncinate appendages . . . . . *Myxotrichum*
15. Peridial hyphae composed of dumb-bell-shaped cells . . . . . *Arthroderma*
15. Peridial hyphae composed of a network of filaments. 16
16. Peridial appendages present (*Dermatophytes*) 17
16. Peridial appendages absent or scarce. 18
17. Peridial appendages short, blunt. . . . . *Neogymnomyces*
17. Peridial appendages coiled or straight, often forming aleurioconidia . . . *Nannizzia*
18. Peridial hyphae disarticulating. . . . . *Shanorella*
18. Peridial hyphae not disarticulating. . . . . Cf. *Arachniotus*

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Explanation of Plates 14 and 15

Plate 14

Ascospores of (a) *Arachniotus ruber*, (b) *Arachniotus dankalensis*, (c) *Amauroascus verrucosus*, (d) *Amauroascus echinulatus*, (e) *Amauroascus reticulatus*. — All 1800 ×.

Plate 15

Narasimhella hyalinospora, initials with asci and ascospores. — 1800 ×.

REVIEWS

A. H. Smith & L. R. Hesler. *The North American species of Pholiota.* (Hafner Publishing Company, 1968). Pp. 402, 519 text-figures, 90 plates presenting 115 black-and-white photographs. Price $ 22.50.

Drawing on long experience and numerous, well annotated collections Dr. A. H. Smith and Dr. L. R. Hesler have published another monograph on a group of North American agarics, viz. the genus *Pholiota* in a very wide sense, including *Flammula*, *Kuehneromyces*, *Pachylepyrium*, *Phaeolepiota*, some species of *Hypholoma* and a large part of *Phaeomarasmius*.

The general chapters in the first 36 pages deal with the history of the genus, the new classification proposed by the authors, the macroscopic, microscopic and chemical characters and the intergeneric relationships of *Pholiota*. The bulk of the book comprises a taxonomic treatment of the genus and includes extensive descriptions and drawings of the most important microscopis characters of 205 species arranged in 48 groups called stirpes, 16 sections and 7 subgenera. More than half of the species are new. The keys are scattered throughout the entire taxonomic section. This is a great inconvenience as they lead to names without page numbers, leaving the reader with the choice of either adding the page numbers to the keys himself or else repeatedly looking up the appropriate keys or descriptions in the index. The 115 black-and-white photographs are of excellent quality and very instructive.

The most interesting feature of the book is undoubtedly the authors' wide conception of the genus *Pholiota*. The fusion of *Pholiota* and *Flammula* had already been more or less generally accepted but the re-insertion of *Kuehneromyces* and *Phaeolepiota* in *Pholiota* and the transfer of *Pachylepyrium*, many species of *Phaeomarasmius* and some species of *Hypholoma* to *Pholiota* are new.

A first thought could be that for practical reasons the authors wished to publish a book covering all the North American *Pholiota*-like fungi, but the introductory chapters show that they regard *Pholiota* as they circumscribe it as a natural genus. I am convinced that many agaricologists will disagree with them on this point.

One of the disadvantages of a large genus conception as adopted here can be that the wider the conception the greater the variation of characters within the genus, rendering the gaps still separating it from related genera relatively less important. Subsequently such an enlarging of a genus can sometimes be stopped only artificially. In my opinion the authors have done just this by, for instance, considering the colour of the spore-print to be decisive for the distinction of *Pholiota* from *Hypholoma*. Consequently because of their brown spore-prints *H. elongatipes* (= *H. elongatum*) and *H. myosotis* are placed in Pholiota. Both species, however, strongly resemble *Hypholoma* in habit and colours and have a subcellular subpellis (hypoderm) in common with most of the other species of *Hypholoma*. This character is not discussed in the book.

In the brown-spored series of genera the difficult delimitation of *Pholiota* against *Galerina* is another result of the "inflation" of *Pholiota*. Actually smooth-spored species of *Galerina* section *Porospora* fit perfectly in the authors' description of *Pholiota*. At the foot of page 31 however it is stated that "the important feature between the two genera [viz. *Pholiota* and *Galerina*] is the shift in emphasis of the important characters." Is this way of separating two genera perhaps not a bit too subjective? Further, would the same reasoning applied to *Phaeomarasmius* not have led to maintenance of the latter genus in its wide sense? In this connection it is interesting to observe that the species of *Pholiota* stirps *Aurea* (in which *Phaeolepiota aurea* is placed beside species of *Phaeomarasmius* with isodiametric cells on the cap) do not seem to fit in

the genus description on p. 37. But this may have something to do with the terminology for the covering layers of the cap.

In the genus *Pholiota* it is certainly very difficult to distinguish between the remnants of the universal veil on the cap and the surface layer(s) of the cap itself. This question demands clearly defined terminology. In the present book it is difficult to understand what is meant by cuticle, cutis, epicutis, hypoderm and subcutis. In many cases, both in the introduction and the descriptions the first three and the last two terms seem to be interchangeable. It becomes still more complicated when it develops that terms like epicutis (p. 55) and cutis (pp. 58, 171) are sometimes used for an outer layer that is almost certainly formed by the universal veil (see under *Phaeolepiota* and *Flocculina* in Reijnders' book of 1963 on the development of the agaric fruitbody) and that does not belong to the "cuticle" proper.

For the European mycologist it is disappointing that the extent of European knowledge of "*Pholiota*" species is somewhat poorly presented. The common *P. gummosa* cannot be named as this is clasified as a species without chrysocystidia. *Pholiota henningsii* is not mentioned in the book; when this species is keyed out however one arrives at *P. paludosella*, a species so similar that it could be identical, but in that case the name *P. henningsii* would have priority. The new species *P. pseudosiparia* is very similar to *Naucoria wieslandri* as conceived by Kühner & Romagnesi but that name does not occur in the book.

It would be a pity if too much criticism were to overshadow my admiration for this impressive piece of work. It is unquestionably a milestone in the study of the brown-spored agarics and it adds greatly to our knowledge of that group. It deserves a place on the bookshelf of every student of agarics.

C. BAS

P. H. B. TALBOT. *Principles of fungal taxonomy*. (The MacMillan Press Ltd, 22 April 1971). Pp. 274, 86 figures. Price £ 3.00, paper edition £ 1.50.

Compared with many other textbooks, "Principles of fungal taxonomy" is a thin volume, comprising little more than 270 pages. It had to be thin, for its aim was "to give a concise account of fungi, suitable for a short undergraduate course in mycology." As a consequence, descriptions of orders and families have been abridged to the utmost, while the number of genera treated are limited to a minimum. Author names have been omitted. Illustrations are comparatively few, but among them are some rarely if ever seen in other textbooks (Figs. 12, 13).

There are thirteen chapters. Subjects of a more general nature, like fungal morphology and reproduction, are dealt with in Chapters 1–7, while Chapters 8–12 are concerned with the descriptions of the slime-moulds and the various subdivisions of the Eumycota.

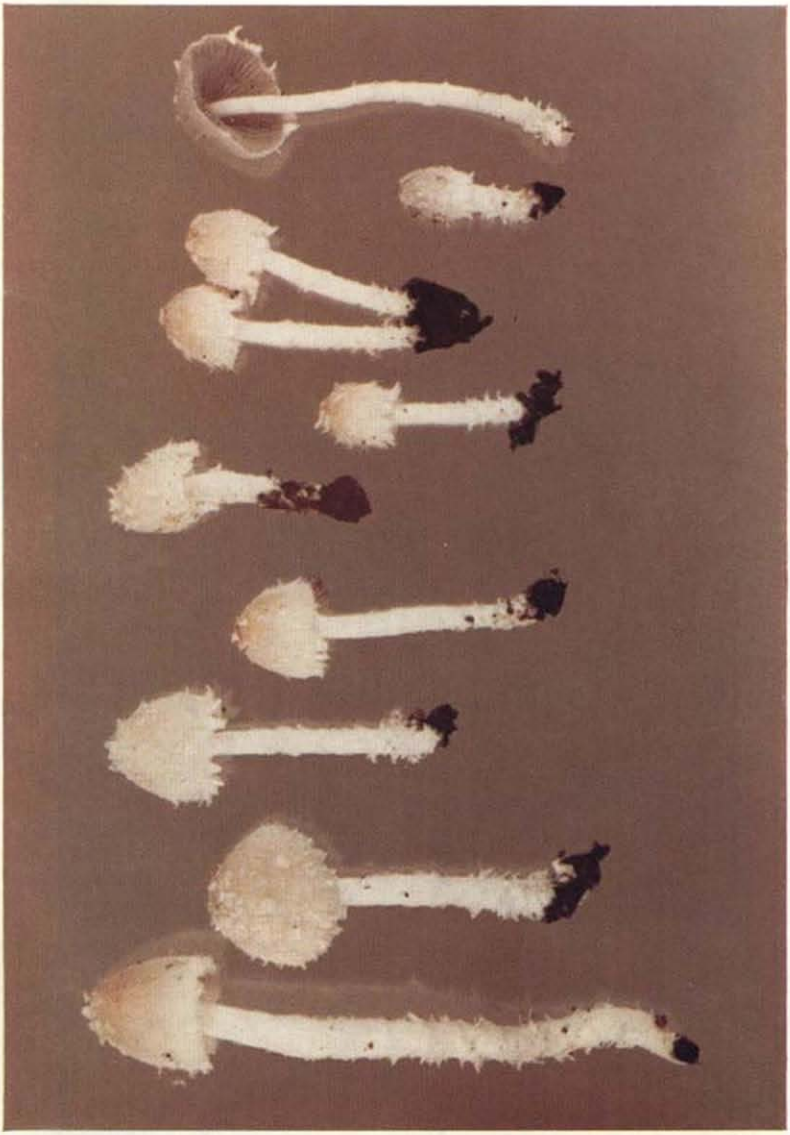
The outstanding feature of the present book is that the descriptions of the major taxa are preceded by a detailed treatise of general structures and processes.

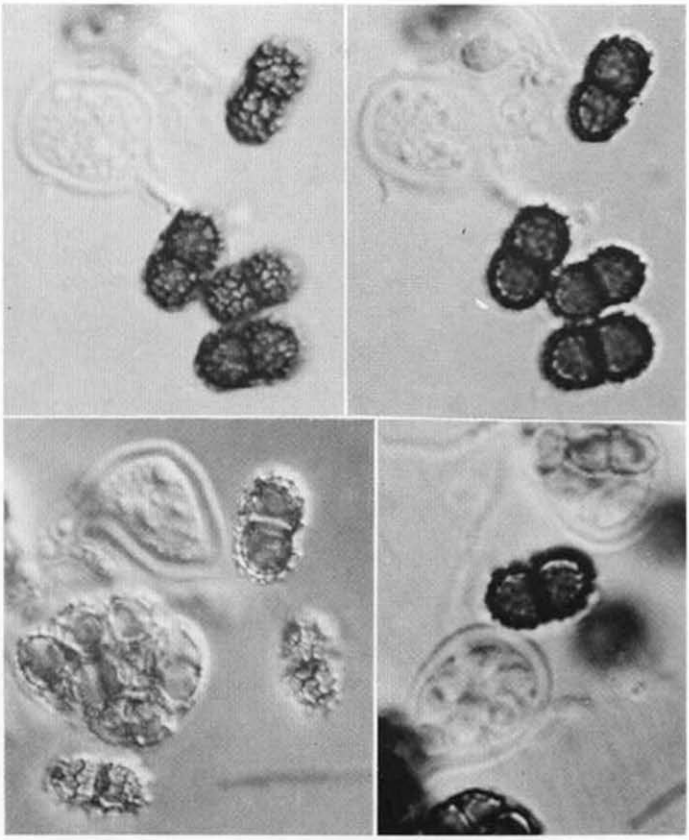
Chapter 2, introducing the concepts "systematics, taxonomy and nomenclature," is an exceedingly useful account that is recommended for re-reading from time to time.

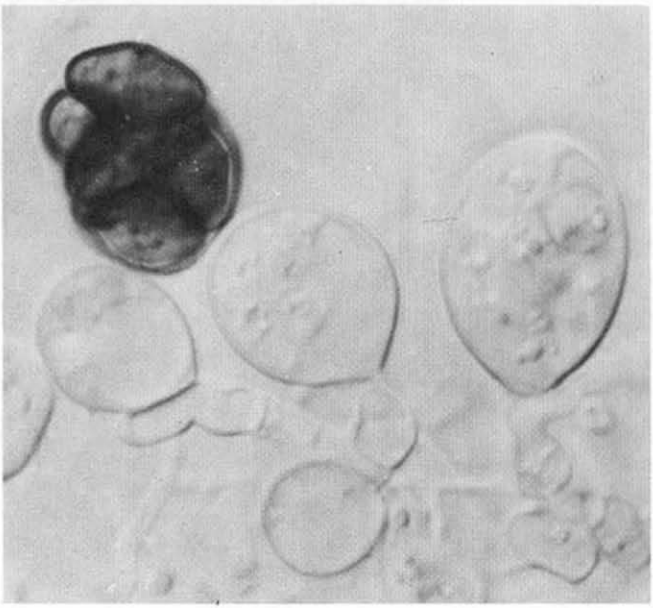
A minor error may be pointed out. The author states of the indusium of *Dictyophora* (p. 237) that "there is a lacy network suspended from the margin of the pileus." The truth is that the indusium is a veil attached to the top of the stipe under the cap and extends below the latter for some distance.

The moderate price of the paper edition is an asset.

R. A. MAAS GEESTERANUS







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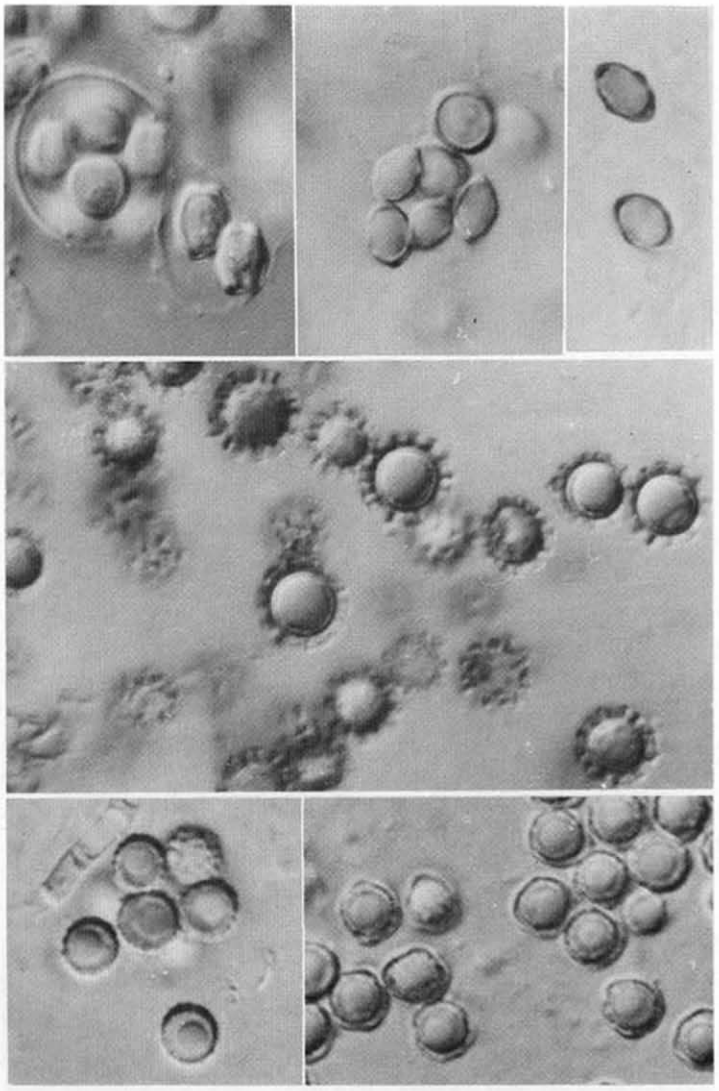

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