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TYPE STUDIES IN THE POLYPORACEAE - 18*

SPECIES DESCRIBED BY G.H. CUNNINGHAM.

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ABSTRACT: Thirty-two species described by G.H. Cunningham in the Polyporaceae have been reviewed and the type specimens examined. The names of 7 species are accepted in the genera in which Cunningham placed them, 9 are treated as synonyms of existing names, and the remainder are considered to belong in other genera. One species is validated with the name *Perenniporia oviforma*. *Australoporus* gen. nov. is described, based on *Polyporus tasmanicus* as type. Fourteen new combinations are proposed: *Inonotus albertinii*, *Rigidoporus aureofulvus*, *Ceriporiopsis coprosmae*, *Phellinus kamahi*, *Fomitopsis maire*, *Oligoporus manuka*, *Schizopora nothofagi*, *Skeletocutis novaezelandiae*, *Ceriporia otakou*, *Antrodiella rata*, *Ischnoderma rosulata*, *Oxyporus spiculifer*, *Australoporus tasmanicus*, and *Ceriporia totara*. In addition, two combinations not directly related to species described by G.H. Cunningham, *Inonotus duostratosus* and *Rigidoporus laetus*, are proposed.

* Previous paper in series: Ryvarden, L. 1985: Type studies in the Polyporaceae 17. Species described by W.A. Murrill. *Mycotaxon* 23: 169-198.

KEYWORDS: Basidiomycetes, G.H. Cunningham, New Zealand fungi, Polyporaceae.

INTRODUCTION: The New Zealand mycologist G.H. Cunningham (1892-1962) published 15 papers on the polypore fungi, beginning in 1927 and culminating in a book which appeared posthumously (Cunningham, 1965). His book remains the only comprehensive account of the Polyporaceae in Australasia. In all, Cunningham validly published the names of 31 new species. One species was described without a Latin description. He and his colleagues collected mainly in New Zealand, and all but three of his species are based on holotype material collected there.

The herbarium, Plant Diseases Division (PDD) contains all of Cunningham's holotypes and most of his other collections. Isotypes of some species are held at Kew (K).

In this paper, the species are treated in alphabetical order by specific epithet. The basionym is cited for each name and it is followed by the collection data for the holotype. The accepted name for each species is indicated in bold. As well as the holotype, authenticated specimens of each species have been examined where available. Spore measurements were made from material mounted in 3% potassium hydroxide.

Cunningham published all of his species in two New Zealand journals and these are abbreviated as follows:

DSIR Bull.: *New Zealand Department of Scientific and Industrial Research Bulletin.*
PDD Bull.: *Department of Scientific and Industrial Research, Plant Diseases Division Bulletin.*

PORIA AROHA G.H. Cunn. (fig. 1)
PDD Bull. 72: 39 (1947). Holotype: PDD 5254 - New Zealand, Mt Te Aroha, Nov. 1946, G.H. Cunningham, on *Beilschmiedia tawa* (A. Cunn.) Benth. & Hook. f. ex Kirk.

= *Flaviporus aroha* (G.H. Cunn.) G.H. Cunn., *DSIR Bull.* 164: 150 (1965).
= *Polyporus tasmanicus* Berk., *Flora Tasmanica* 2: 254 (1860).

= *Fomes tasmanicus* (Berk.) Cooke, *Grevillea* 14: 19 (1885).
= *Fomitopsis tasmanica* (Berk.) G.H. Cunn., *PDD Bull.* 81: 20 (1949).
= *Heterobasidion tasmanicum* (Berk.) G.H. Cunn., *DSIR Bull.* 164: 148 (1965).
= *Fomes cuneatus* Lloyd, *Lloyd's Mycol. Writ.* 4, *Syn. Gen. Fomes*: 217 (1915).
= *Fomitopsis cuneata* (Lloyd) G.H. Cunn., *PDD Bull.* 81: 20 (1949).
= *Polyporus suaderis* Lloyd, *Lloyd's Mycol. Writ.* 5: 859 (1919).

Cunningham (1965) transferred the species to *Flaviporus* Murr., while stating that apart from the presence of 'metuloids' the species could belong in *Heterobasidion* Bref. sensu Cunn. Comparison of the type specimens of *Poria aroha*, *Polyporus tasmanicus* Berk. (K), *Fomes cuneatus* Lloyd (K), and *Polyporus suaderis* Lloyd (K) show that all are conspecific, with *P. tasmanicus* being the oldest name.

Macroscopically, the species varies from resupinate to distinctly pileate. The perennial, narrowly concentrically sulcate and zonate, often ungulate pileus and the pale pink to orange pore surface, when fresh, are diagnostic characters.

In the descriptions of both *H. tasmanicum* and *Flaviporus aroha*, Cunningham (1965) mistakenly reported generative hyphae to be simple septate when, in fact, they have clamps. He also omitted to report that skeletal hyphae are strongly dextrinoid, becoming red-brown in Melzer's reagent. Skeletal hyphae often protrude into the hymenium, and at pore mouths the ends of skeletal hyphae are finely encrusted. The thick-walled metuloids described for *F. aroha* were found to be thin-walled, sometimes collapsed, apically encrusted cystidioles. They are more abundant in fertile specimens and may be scarce or absent in old specimens with a poorly preserved hymenium. Spores are elongate ellipsoid, smooth- and thin-walled, nonamyloid, nondextrinoid, and hyaline in the tubes. Those observed on the pileus surface however are light brown and often larger than those in the tubes. Average spore measurements are 8.5-13 x 3.5-6.5 µm.

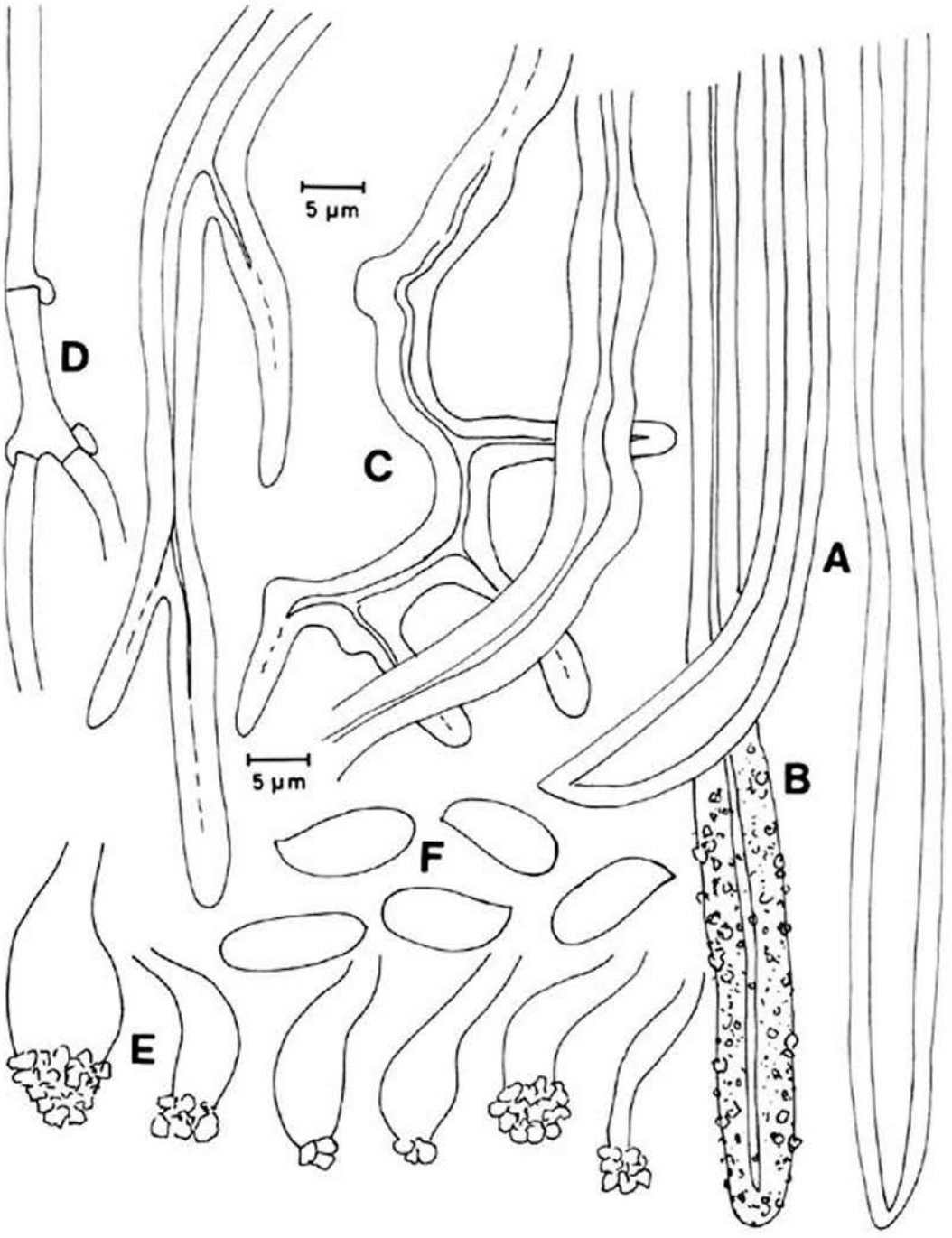

Fig. 1. *Australoporus tasmanicus*. A,C, skeletal hyphae from the context; B, encrusted skeletal hypha from the dissepiments; D, generative hyphae; E, ventricose cystidia from the hymenium; F, spores. From the type of *Poria aroha* (PDD 5254).

The unusual combination of characters found in *P. tasmanicus* means that the species cannot be accommodated in any of the four genera to which Cunningham assigned it. Indeed, we have found no suitable genus for this species.

Dextrinoid skeletal hyphae are found in species of *Perenniporia* Murr., but this genus has distinctly truncate, thick-walled spores with a variable dextrinoid reaction and lacks encrusted skeletal hyphae. *Navisporus* Ryv. is a close relative, having dextrinoid skeletal hyphae and navicular to cylindrical spores of similar size to those in *Polyporus tasmanicus*. However, skeletal hyphae are smooth and no encrusted cystidioles are known in the two species so far described in the genus. Furthermore, the species are brown in colour and have a loose consistency, very different from the hard, light-coloured fruit-bodies of *P. tasmanicus*. *Junghuhnia* Corda is characterised by a dimitic hyphal system of a similar type to that found in *P. tasmanicus*. Cystidia are present, but are developed from the skeletal hyphae and are encrusted at the apex. Thin-walled, ventricose cystidia have not been observed in this genus and the skeletal hyphae are not dextrinoid.

Since this species cannot be accommodated in any known genus without changing the concepts of that genus, we propose a new genus for *P. tasmanicus*.

Australoporus P.K. Buchanan & Ryvarden gen. nov.

Fructificatio resupinata ad pileata, annua ad perennia, pileus sulcatus, umbrosus, zonatus, pori facies alba ad cremea, systema hypharum dimiticum, hyphae generatoriae fibulatae, hyphae skeletales dextrinoideae, leviter encrustatae in ore pori, cystidia tenuitunicata, ventricosa ad cylindrica, incrustata, sporae cylindricae, hyalinae, tenuitunicatae, non-amyloidae et non-dextrinoideae.
Type species: **Australoporus tasmanicus** (Berk.) P.K. Buchanan & Ryvarden comb. nov.
Basionym: *Polyporus tasmanicus* Berk., *Flora Tasmanica* 2: 254 (1860).

Fruit-body resupinate to pileate, annual to perennnial, pileus sulcate, brown and zonate, pore surface white to cream to pale orange, tubes concolorous, context light-coloured, hyphal system dimitic, generative hyphae with clamps, skeletal hyphae thick-walled, dextrinoid, in the pore mouths finely encrusted over a considerable

length, basidia clavate and 4-sterigmate, cystidia present in the hymenium, hyaline, ventricose to cylindrical, thin-walled, apically encrusted, spores cylindrical, hyaline, smooth, thin-walled, non-amyloid, and non-dextrinoid.

FOMES AWHITU G.H. Cunn.
PDD Bull. 79: 16 (1948). Holotype: PDD 4496 - New Zealand, Auckland, Awhitu Peninsula, Apr. 1946, G.H. Cunningham, on *Beilschmiedia tarairi* (A. Cunn.) Benth. & Hook. f. ex Kirk.

= **Loweporus roseo-albus** (Jungh.) Ryv. & Johans., *A preliminary polypore flora of East Africa*, p. 415 (1980).
= *Phellinus endapalus* (Berk.) G.H. Cunn., *DSIR Bull.* 164: 237 (1965).

COLTRICIA CARTILAGINEA G.H. Cunn. (fig. 2)
DSIR Bull. 164: 262 (1965). Holotype: PDD 3869 - New Zealand, Wellington, Tararua Ranges, Ohau River, Jan. 1933, E.E. Chamberlain, on unknown host.

= **Rigidoporus aureofulvus** (Lloyd) P.K. Buchanan & Ryvarden comb. nov.
Basionym: *Polyporus aureofulvus* Lloyd, *Lloyd's Mycol. Writ.* 7: 1108 (1922).
= *Coltricia aureofulva* (Lloyd) G.H. Cunn., *PDD Bull.* 77: 9 (1948).

There is a good description of macroscopic characters in Cunningham (1965: 197), but the illustration (fig. 36, p. 197) is simplistic. The spores are smooth, not verruculose as indicated by Cunningham who was probably misled by the asperulate mould spores present in the type specimen. The basidiospores although mostly collapsed and difficult to observe are broadly ellipsoid to subglobose, very thin-walled, 5-6.3 x 4.2-5.5 µm, with a large oil droplet. According to Cunningham's illustration it should be very easy to observe septa on the generative hyphae. However, the context and trama are dominated by strongly agglutinated, thick-walled, skeletal-like hyphae and it took considerable time to find a single clearly differentiated septum.

The holotype, and only collection of *C. cartilaginea*, is a young specimen of *Coltricia aureofulva* (holotype PDD 175; several other PDD collections also examined). In Cunningham (1965: 191) the two species are mainly separated on the mistaken difference in spore wall ornamentation. Spores of *C. aureofulva* are hyaline, smooth, subglobose, nonamyloid, (4.7-)5-6.5(-7.3) x (3.7-)4.5-5.5(-6) µm. Septa of generative hyphae were most readily observed in the trama. Pilei in the holotype of *C. cartilaginea* are smaller than those typical of *C. aureofulva*.

C. aureofulva does not belong in *Coltricia* S.F. Gray, a member of the Hymenochaetaceae, as it does not share the brown hyphal colour nor the black xanthochroic reaction with KOH common to species in the genus. The orange colour, type of consistency, spores, and simple septate generative hyphae indicate that the species belongs in *Rigidoporus* Murr. The distinct reddening of hyphae in KOH reminds one of *Pycnoporellus* Murr. emend. Kotl. & Pouz. but other characters such as pore size, spore shape, and absence of cystidia do not conform to this genus.

Coltricia laeta (Cooke) G.H. Cunn. is closely related to *C. aureofulva* with similar fruit-body colour, red colour of hyphae in KOH, and similar spores. It differs in its larger and more robust form, larger pores, and wider, thinner-

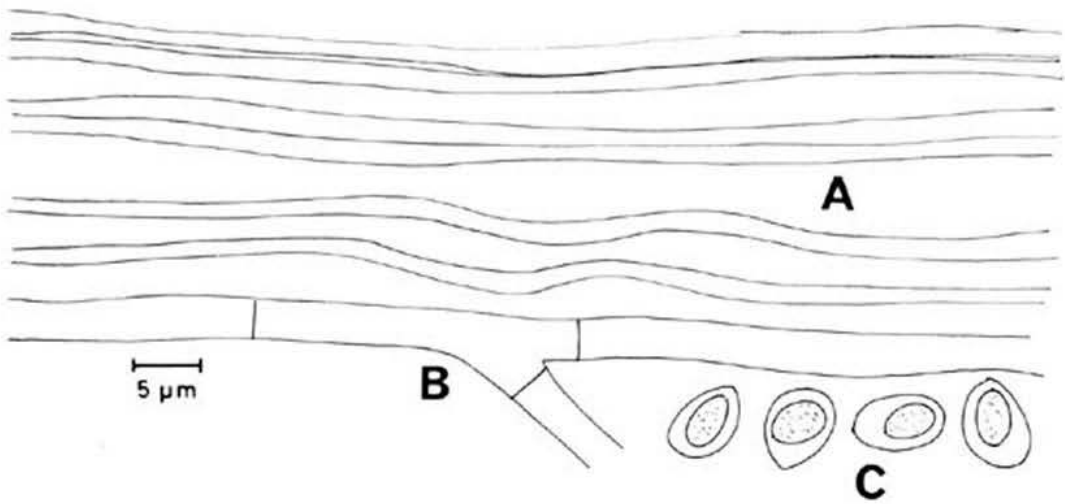

Fig. 2. *Rigidoporus aureofulvus*. A, skeletal-like hyphae from the context; B, simple septate generative hypha; C, spores. From the type of *Coltricia cartilaginea* (PDD 3869).

walled, more frequently simple septate hyphae. As with *C. aureofulva*, we consider that this species belongs in *Rigidoporus*, as:

Rigidoporus laetus (Cooke) P.K. Buchanan & Ryvarden comb. nov.
Basionym: *Polyporus laetus* Cooke, *Grevillea* 12: 16 (1883).

GLOEOPHYLLUM CONCENTRICUM G.H. Cunn. (fig. 3)
DSIR Bull. 164: 263 (1965). Holotype: PDD 12262 - Australia, Queensland, Cape York Peninsula, Lower Archer River, Mar. 1933, L. & G. Thomson, on unknown host.

Accepted as **Gloeophyllum concentricum.**

The colour, irregular hymenophore, trimitic hyphal system, and spore characters of this species conform well to the genus *Gloeophyllum* P. Karst. Although many species in the genus have cystidia, there are some like *G. concentricum* which lack them.

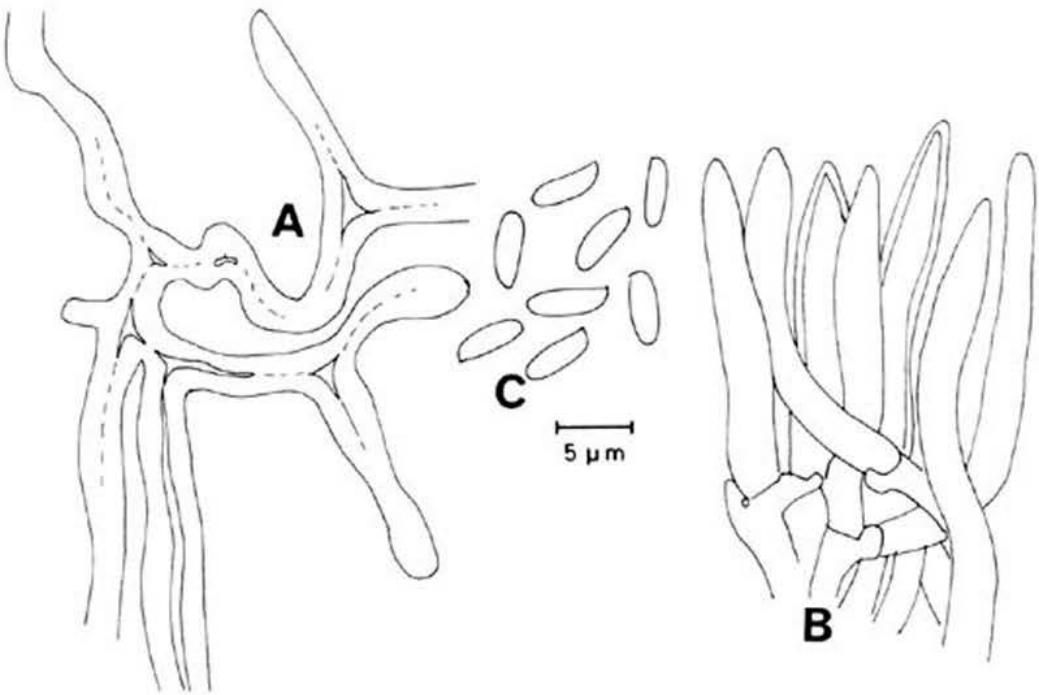

Fig. 3. *Gloeophyllum concentricum.* A, vegetative hyphae from the context; B, sterile hymenium with pointed elements; C, spores. From the type (PDD 12262).

The protologue description is adequate except for the shape and size of spores, described by Cunningham as elliptical, 3-3.5 x 1-1.5 µm. Spores from the type, and only collection of this fungus in herb. PDD, measure 4.2-6 x 1.5-1.8 µm and are better described as cylindrical, straight or weakly curved. The concentric arrangement of lamellae is a highly characteristic feature of this species.

PORIA COPROSMAE G.H. Cunn. (fig. 4)
Dept. Sci. Industr. Res., Pl. Dis. Div. Bull. 72: 38 (1947). Holotype: PDD 5252 - New Zealand, Westland, Lake Mapourika, Nov. 1946, J.M. Dingley, on *Coprosma* sp.

= **Ceriporiopsis coprosmae** (G.H. Cunn.) P.K. Buchanan & Ryvarden comb. nov.

Cunningham (1965: 130) placed the name in synonymy under *Tyromyces chioneus* (Fr.) P. Karst. However, it is obvious from Cunningham's description that his concept of *T. chioneus* is different from the Friesian concept. Cunningham described spores as 2.5-3.5 x 0.5 µm which agree with our measurements from the type of 2.8-3.3 x 0.4-0.5 µm. This is much smaller than in Fries' species, 3.5-4.5 x 1.5-2 µm (Ryvarden, 1978). Furthermore, the Friesian species is never resupinate.

Cunningham (1947, 1965) described the hyphal system of *C. coprosmae* as dimitic, but careful examination of the thick-walled 'binding' hyphae shows the occasional clamp. The hyphal system is monomitic with walls of generative hyphae varying from thin to irregularly thickened, to very thick or even solid.

Ceriporiopsis Dom. includes species with resupinate, light-coloured fruit-bodies with a monomitic hyphal system and clamps at the septa. No prominent sterile hymenial organs, such as cystidia, are known in the genus, and all species cause a white rot. These characters are found in *C. coprosmae* and we include it in *Ceriporiopsis* as defined in Gilbertson & Ryvarden (1986). Niemelä (1985) has separated species like *Polyporus pannocinctus* Rom. and *Poria subvermispora* Pilát in the genus *Gelatoporia* Niem. because in both these species gelatinized hyphal layers are present

in the fruit-body. Such structures or zones are not present in *C. coprosmae*.

Cunningham (1965: 131) stated that his *Tyromyces chioneus* was described by Overholts (1953) as *Polyporus semipileatus* Peck. This is a misunderstanding. *P. semipileatus* is a synonym of *P. niveus* Jungh. and is currently either placed in *Incrustoporia* Dom. or *Skeletocutis* Pouz. because of the characteristically encrusted hyphae, especially in the

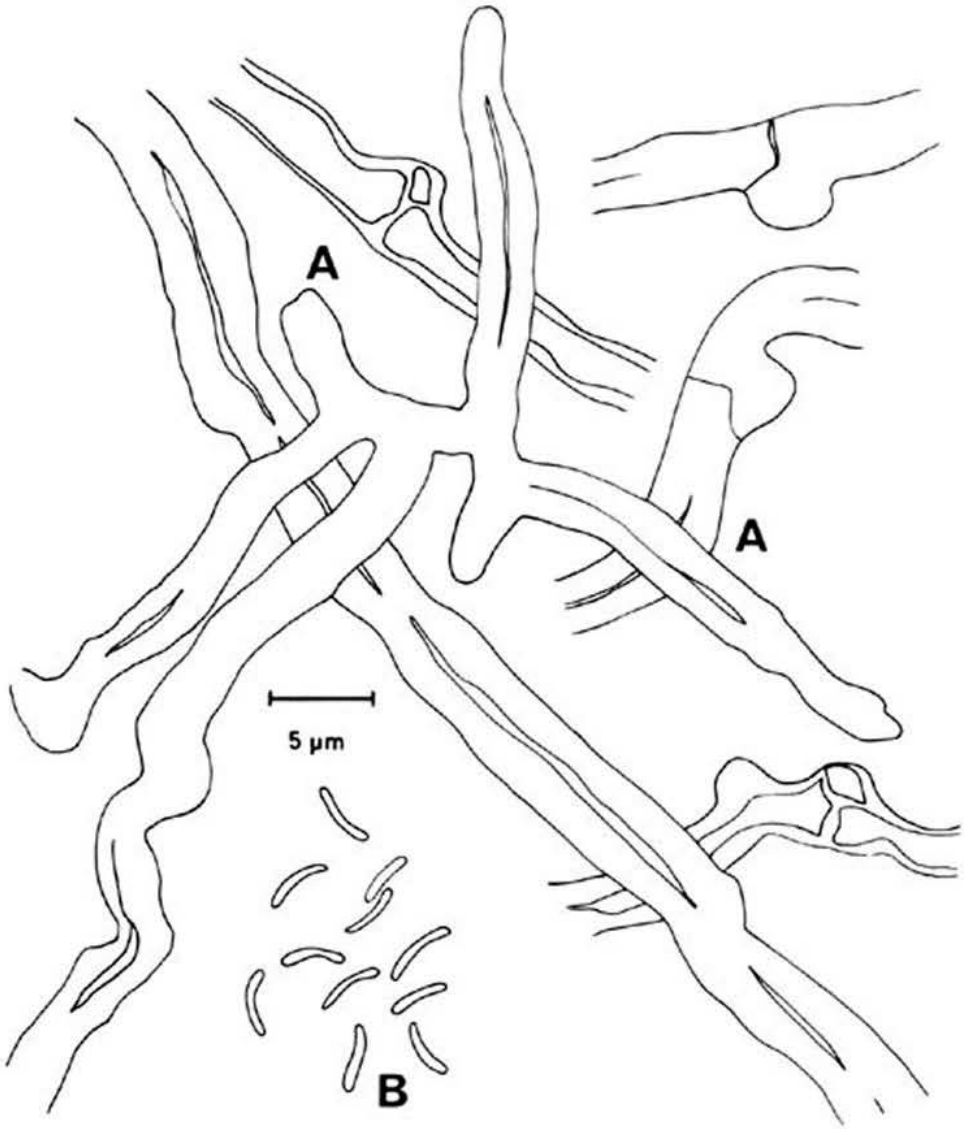

Fig. 4. *Ceriporiopsis coprosmae*. A, generative hyphae with walls varying from slightly and irregularly thickened to more or less solid; B, spores. From the type of *Poria coprosmae* (PDD 5252).

dissepiments. Furthermore, the species is dimitic or semi-trimitic with some branched solid hyphae which have sometimes been described as binding hyphae. Encrusted hyphae of the kind found in *Incrustoporia* are absent in *C. coprosmae*.

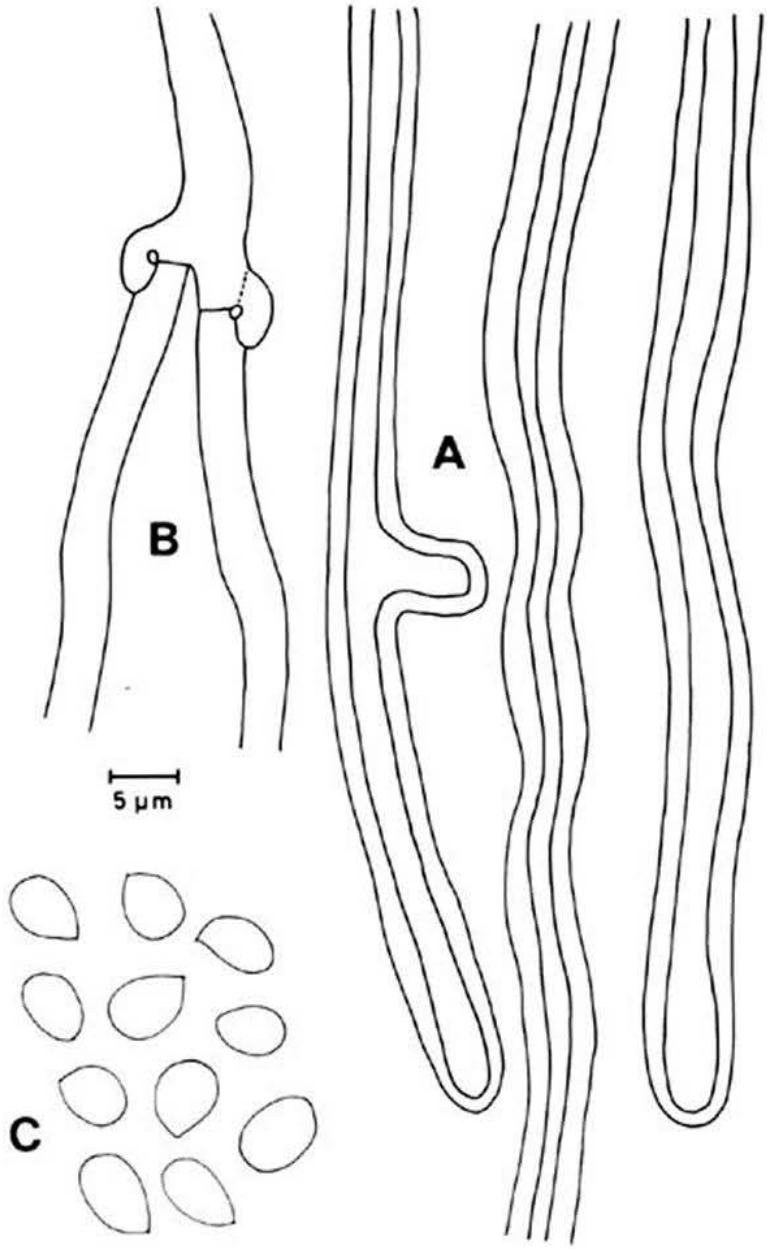

Fig. 5. *Tyromyces falcatus*. A, skeletal hyphae from the context; B, generative hyphae; C, spores. From the type (PDD 15612).

PORIA CORDYLINA G.H. Cunn.
PDD Bull. 72: 39 (1947). Holotype: PDD 5248 - New Zealand, Hamilton, Claudelands Reserve, Nov. 1946, G.H. Cunningham, on *Cordyline australis* Hook. f.

= **Aporpium caryae** (Schw.) Teix. & Rog., *Mycologia* 47: 410 (1955).

TYROMYCES FALCATUS G.H. Cunn. (fig. 5)
DSIR Bull. 164: 262 (1965). Holotype: PDD 15612 - New Zealand, Westland, Ahaura, Orwell Creek, Apr. 1955, J.M. Dingley, on *Nothofagus fusca* (Hook. f.) Oerst.

Accepted as **Tyromyces falcatus.**

The description by Cunningham of macroscopic characters is satisfactory, but there are misleading statements about the microscopic characters. The septa of the generative hyphae are not simple, but have large, conspicuous clamps. The basidiocarp is composed of mostly unbranched hyphae with very thick walls. These vegetative hyphae were described by Cunningham as binding hyphae but appear in the illustration (Cunningham, 1965: fig. 28) as skeletal hyphae. We interpret them as skeletal hyphae with scattered side-branches, the side-branches not being as common or regular as described by Cunningham. The thick hyphal walls often appear to be multilayered and are refractive in KOH. *T. falcatus* has a harder texture than most other species in *Tyromyces*.

INONOTUS HISPIDANS G.H. Cunn. (fig. 6)
DSIR Bull. 164: 263 (1965). Holotype: PDD 19911 - Australia, Queensland, Magnetic Island, Jun. 1954, J. Hunt, on unknown host.

= **Inonotus albertinii** (Lloyd) P.K. Buchanan & Ryvarden comb. nov.
Basionym: *Polyporus albertinii* Lloyd, *Lloyd's Mycol. Writ.* 3, *Syn. Stip. Stereums*: 160 (1912).

This is the same as *Polyporus albertinii* as indicated by Reid (1967: 164). There is a detailed description in Reid (1963: 277) where he transferred the species to *Phaeolus*

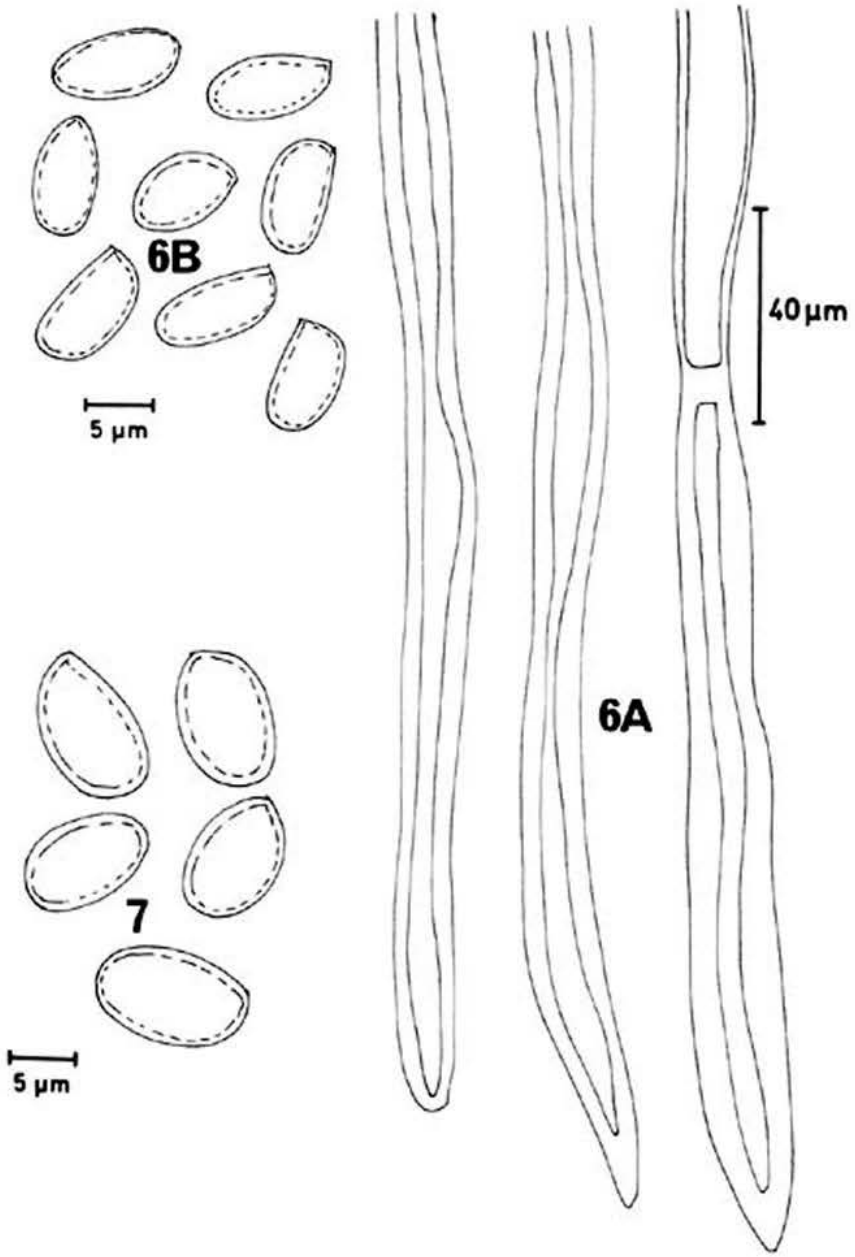

Fig. 6. *Inonotus albertinii*. A, setal hyphae from the trama; B, spores. From the type of *Inonotus hispidans* (PDD 19911).

Fig. 7. *Inonotus duostratosus*. Spores. From the type (BPI).

Pat. That genus is typified by *P. schweinitzii* (Fr.) Pat., and characterised by a brown fruit-body similar to that seen in *Inonotus* species. However, *P. schweinitzii* lacks setae and has instead oil-filled cystidia of a type unknown in the Hymenochaetaceae. Furthermore, it causes a brown rot in the wood, while all members of Hymenochaetaceae give a white rot. We feel that these characters alone are sufficient to exclude *Phaeolus* from the Hymenochaetaceae.

Polyporus albertinii is characterized by setal hyphae of the type seen in many representatives of the Hymenochaetaceae and we are in no doubt that the species belongs in *Inonotus* because of its monomitic hyphal system with wide, brown, simple septate hyphae.

A closely related species is *Polyporus duostratosus* Lloyd from Malaysia (holotype BPI). It is mainly separated from *P. albertinii* by larger pores and spores and clearly belongs in the same genus:

Inonotus duostratosus (Lloyd) P.K. Buchanan & Ryvarden comb. nov. (fig. 7).
Basionym: *Polyporus duostratosus* Lloyd, *Lloyd's Mycol. Writ.* 7: 1317 (1924).

PORIA HUNUA G.H. Cunn.
PDD Bull. 72: 39 (1947). Holotype: PDD 5279 - New Zealand, Auckland, Hunua Ranges, Upper Wairoa Valley, Sep. 1946, J.M. Dingley, on *Beilschmiedia tawa* (A. Cunn.) Benth. & Hook. f. ex Kirk.

= **Antrodiella hunua** (G.H. Cunn.) Ryv. & Johans., *A preliminary polypore flora of East Africa*, p. 257 (1980).

The description of Cunningham (1965: 55) is satisfactory. The species was transferred to *Antrodiella* Ryv. & Johans. by Ryvarden & Johansen (1980) because of the dense basidiocarp, dimitic hyphal system, and small spores.

FUSCOPORIA KAMAHI G.H. Cunn. (fig. 8)
New Zealand Dept. Sci. Industr. Res. Bull. 164: 263 (1965).
Holotype: PDD 5850; isotype PDD 5849 - New Zealand, Bay of Plenty, Mamaku Forest, 9 Nov. 1947, G.H. Cunningham, on *Weinmannia racemosa* Linn. f.

= **Phellinus kamahi** (G.H. Cunn.) P.K. Buchanan & Ryvarden comb. nov.

This species belongs in *Phellinus* Quél., and is similar in colour and pore size to *P. punctatiformis* (Murr.) Ryv. However, the spores of *P. kamahi* are larger, 5-7(-8.5) x 2.5-3 µm, although Cunningham (1965) described them as being 4-6 x 1.5-2 µm. A conspicuous feature of *P. kamahi* is the coarse crystals encrusting generative hyphae at or near the pore mouths. Cystidioles, present in the hymenium, are hyaline, thin-walled, lageniform and often have elongated, tapering necks.

LARICIFOMES MAIRE G.H. Cunn. (fig. 9)
New Zealand Dept. Sci. Industr. Res. Bull. 164: 262 (1965).
Holotype: PDD 38093 - New Zealand, Auckland, Waitakere Ranges, Anawhata Road, Aug. 1947, J.M. Dingley, on *Nestegis cunninghamii* (Hook. f.) L. Johnson.

= **Fomitopsis maire** (G.H. Cunn.) P.K. Buchanan & Ryvarden comb. nov.

All collections in PDD are sterile except one (PDD 11098) in which spores are cylindrical, 5-7.5 x 2-2.7 µm. Cunningham (1965) described the spores as ellipsoid, 8-10 x 5-6 µm.

We prefer to place the species in *Fomitopsis* P. Karst. because of the perennial basidiocarp with a crust, slightly coloured context, hyaline, nonamyloid, cylindrical spores, and brown rot in the host. These are all characters of *F. pinicola* (Sw.: Fr.) P. Karst., the type species of *Fomitopsis*.

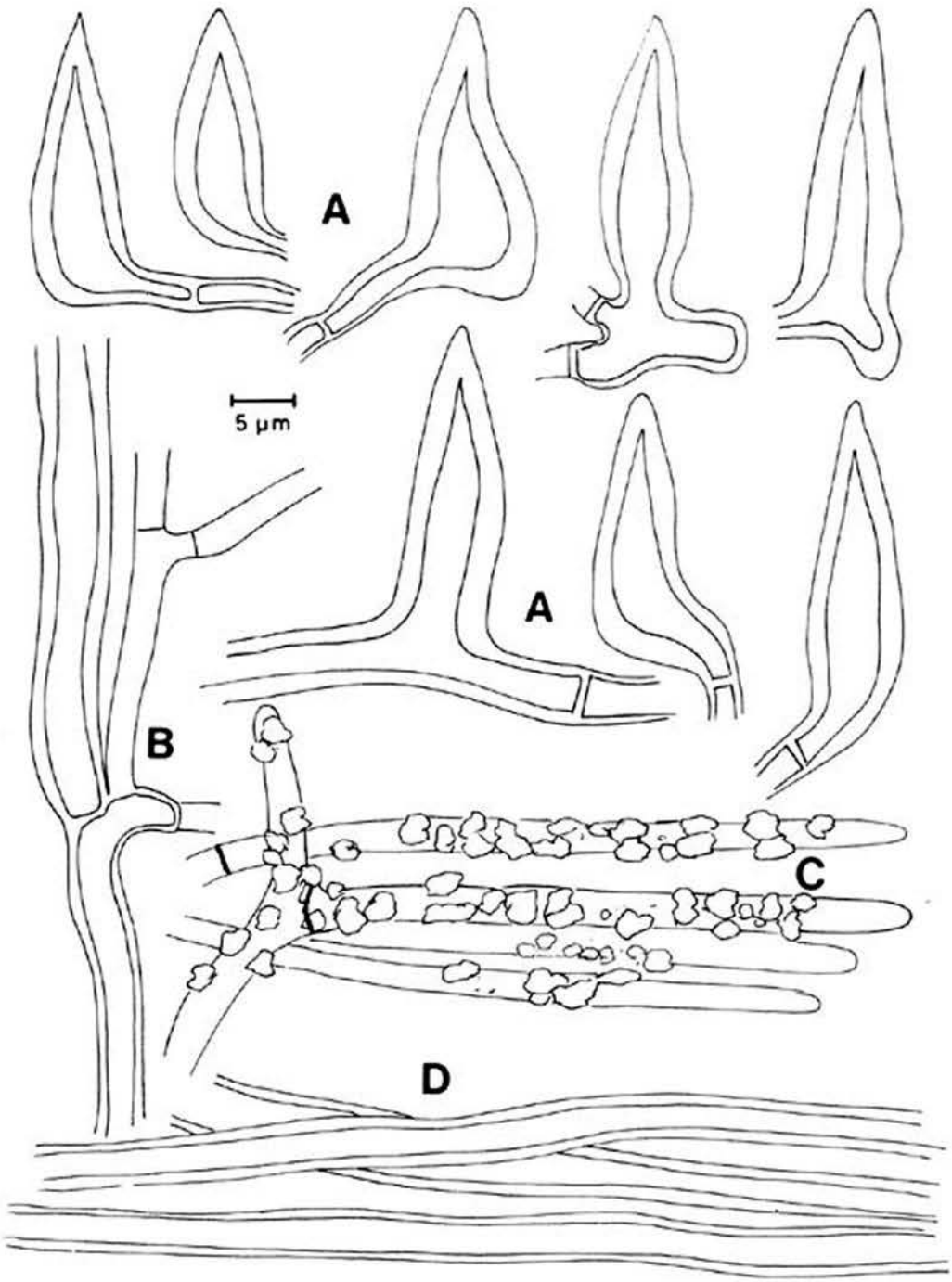

Fig. 8. *Phellinus kamahi*. A, setae; B, generative hyphae with part of skeletal hyphae; C, encrusted hyphae from the dissepiments; D, skeletal hyphae. From the type of *Fuscoporia kamahi* (PDD 5850).

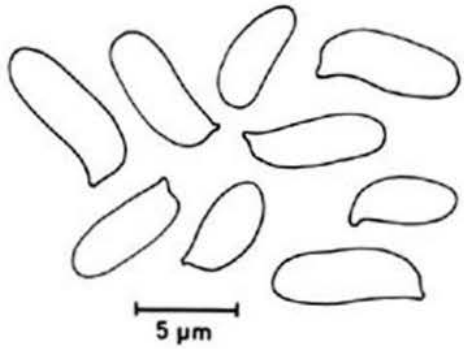

Fig. 9. *Fomitopsis maire*. Spores. From PDD 11098.

PORIA MANUKA G.H. Cunn. (fig. 10)
Dept. Sci. Industr. Res., Pl. Dis. Div. Bull. 72: 38 (1947). Holotype: PDD 4122 - New Zealand, Taupo, Mt Tongariro, Jan. 1940, G.H. Cunningham, on *Leptospermum scoparium* J.R. & G. Forst.

= **Oligoporus manuka** (G.H. Cunn.) P.K. Buchanan & Ryvarden comb. nov.

This species belongs in *Oligoporus* Bref. because of the resupinate basidiocarp, monomitic hyphal system with clamps at the septa, and the brown rot. Spores of *O. manuka* are cylindrical to allantoid and 6-7.5 x 2-2.5 µm, which is larger than the measurements given by Cunningham (1947, 1965) of 5-6 x 1.5-2 µm.

FUSCOPORIA NOTHOFAGI G.H. Cunn. (fig. 11)
DSIR Bull. 164: 263 (1965). Holotype: PDD 6613; isotype PDD 6614 - New Zealand, Taupo, Mt Ruapehu, Ohakune Track, 12 Dec. 1947, G.B. Rawlings, on *Nothofagus solandri* (Hook. f.) Oerst. var. *cliffortioides* (Hook. f.) Poole.

= **Phellinus nothofagi** (G.H. Cunn.) Ryv., *Norw. J. Bot.* 19: 235 (1972).

The species is characterised by strongly coloured spores, and it is restricted to *Nothofagus*.

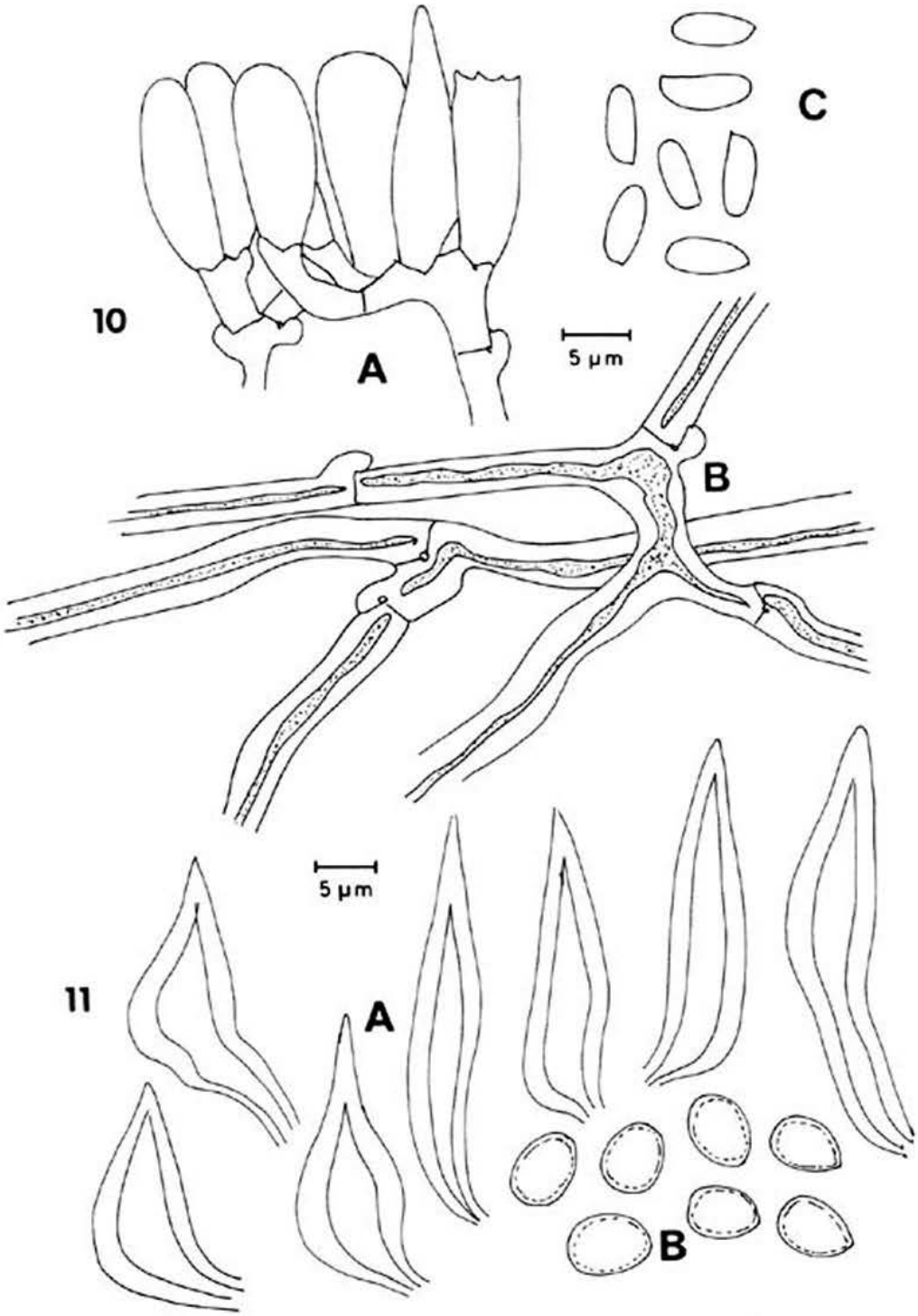

Fig. 10. *Oligoporus manuka*. A, part of hymenium; B, generative hyphae; C, spores. From the type of *Poria manuka* (PDD 4122).

Fig. 11. *Phellinus nothofagi*. A, setae; B, spores. From the type of *Fuscoporia nothofagi* (PDD 6613).

INONOTUS NOTHOFAGI G.H. Cunn. (fig. 12)
DSIR Bull. 78: 1 (1948). Holotype: PDD 5795 - New Zealand, Wellington, Days Bay, Aug. 1947, G.B. Rawlings, on *Nothofagus solandri* (Hook. f.) Oerst.

Accepted as **Inonotus nothofagi.**

As stated by Cunningham (1965), this species is related to *I. radiatus* (Sow.: Fr.) P. Karst. of the Northern Hemisphere, but is easily separated by the coloured spores

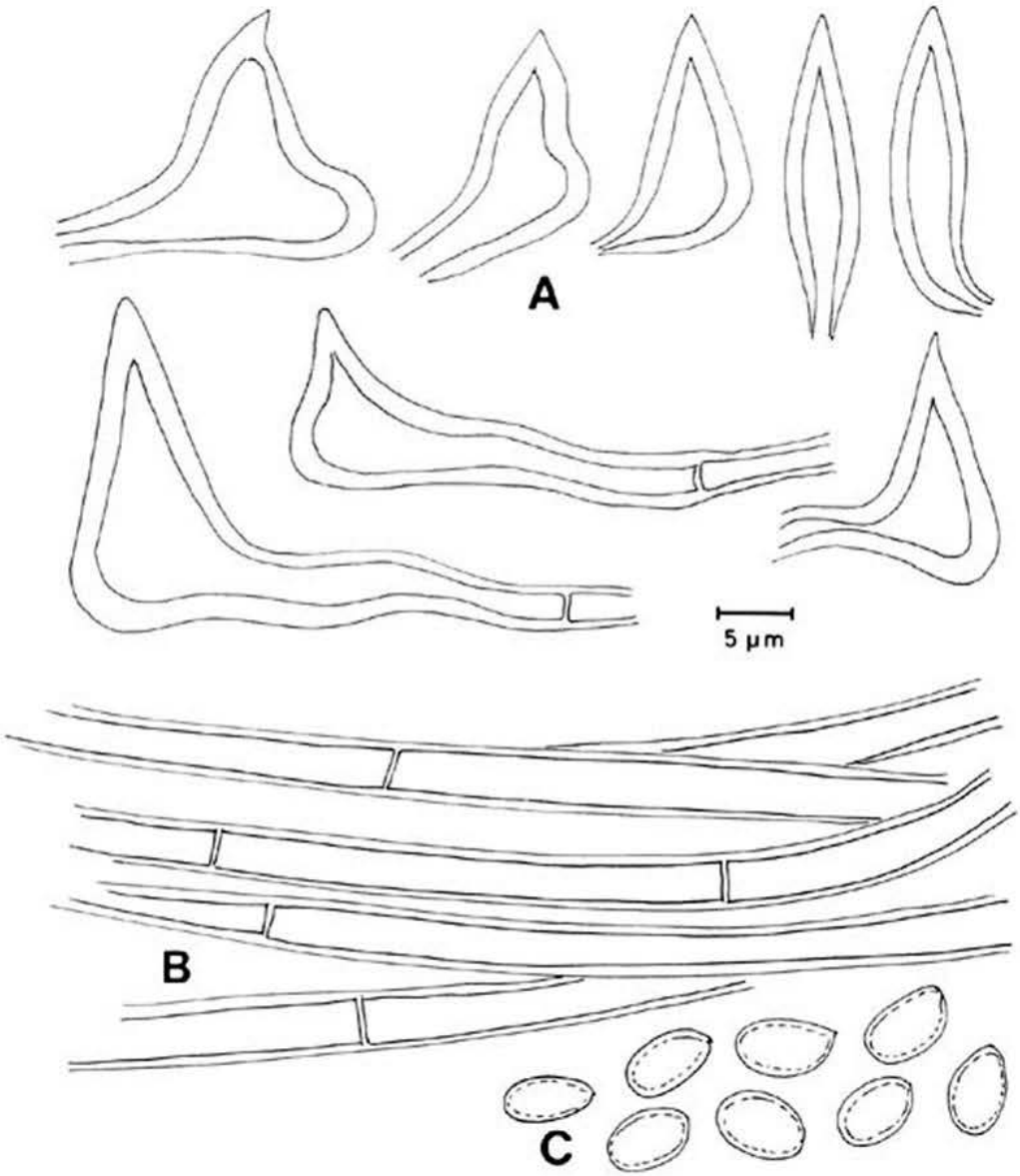

Fig. 12. *Inonotus nothofagi.* A, setae; B, generative hyphae; C, spores. From the type (PDD 5795).

and straight setae. It is confined to *Nothofagus*. Cunningham (1965) included collections on *Quercus* from India under *I. nothofagi* but these were later redetermined as *I. diverticulosepta* Pegler (Pegler, 1967).

PORIA NOTHOFAGI G.H. Cunn. (fig. 13)
New Zealand Dept. Sci. Industr. Res. Bull. 164: 261 (1965). Holotype: PDD 5275 - New Zealand, Taupo, Mt Tongariro, Waihohonu River, Jan. 1947, J.D. Atkinson, on *Nothofagus solandri* (Hook. f.) Oerst. var. *cliffortioides* (Hook. f.) Poole.

= **Schizopora nothofagi** (G.H. Cunn.) P.K. Buchanan & Ryvarden comb. nov.

This characteristic species belongs in *Schizopora* Velen. emend. Donk and is readily separated from the widespread *S. paradoxa* (Schrad.: Fr.) Donk by its cylindrical to suballantoid spores and distinctly monomitic hyphal system. Otherwise, the two species have in common hyaline cystidioles, bulbous hyphal ends, clamped, *Hyphodontia*-like hyphae, and coarse encrustation of hyphae in the dissepiments. Spores of *S. nothofagi* measure 6-8(-10) x 2-3 µm, which is larger than the measurements given by Cunningham (1965) of 5-6.5 x 1.5-2 µm.

PORIA NOVAEZELANDIAE G.H. Cunn. (fig. 14)
Dept. Sci. Industr. Res., Pl. Dis. Div. Bull. 72: 40 (1947). Holotype: PDD 5322 - New Zealand, Bay of Plenty, Mt Te Aroha, Nov. 1946, G.H. Cunningham, on *Metrosideros* sp.

= **Skeletocutis novaezelandiae** (G.H. Cunn.) P.K. Buchanan & Ryvarden comb. nov.
= *Chaetoporus novaezelandiae* (G.H. Cunn.) G.H. Cunn., *DSIR Bull.* 164: 71 (1965).

The species was transferred to *Chaetoporus* P. Karst. by Cunningham (1965) because he interpreted the encrusted skeletal hyphae as true cystidia. We concur with Rajchenberg (1983: 505), however that the skeletal hyphae do not form true cystidia. The finely encrusted hyphae are of the type characteristic of the genus *Skeletocutis* Kotl.

& Pouz. Other characters of *S. novaezelandiae*, such as the dimitic hyphal system with clamped generative hyphae, small pores, and small, nonamyloid spores, are also typical of *Skeletocutis*.

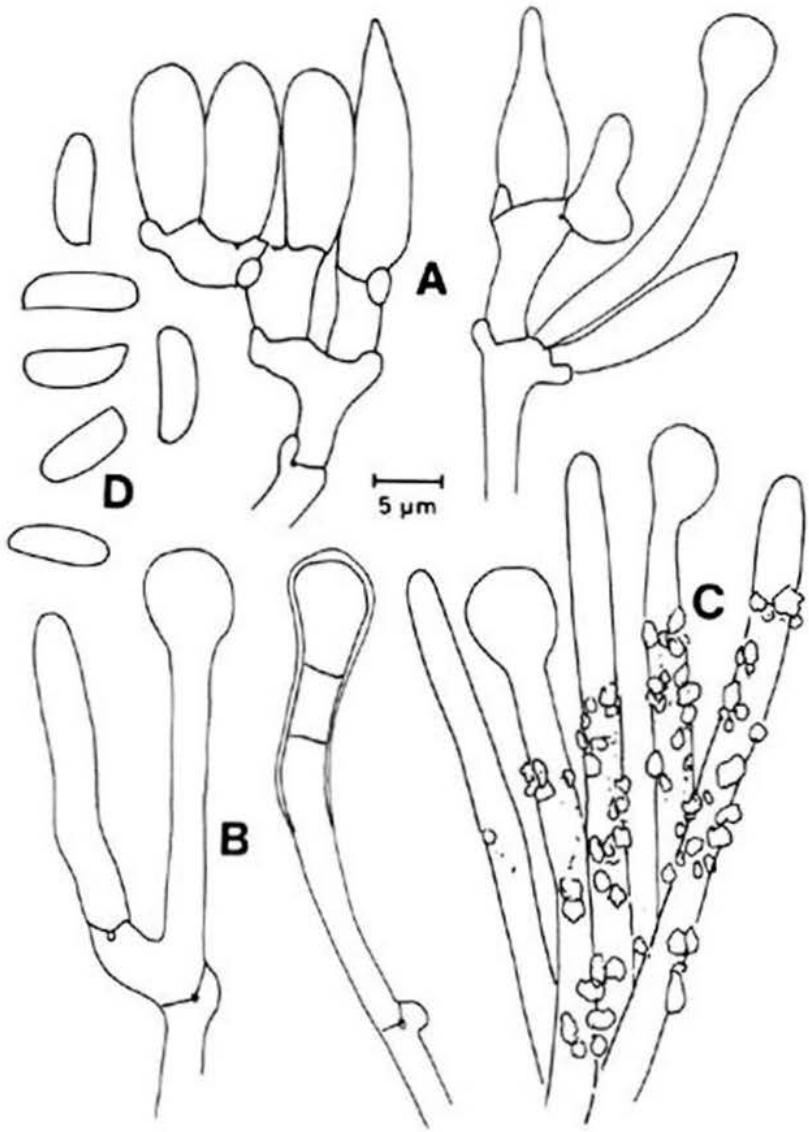

Fig. 13. *Schizopora nothofagi*. A, basidial clusters with cystidioles; B, bulbous hyphae; C, encrusted hyphae from the dissepiments; D, spores. From the type of *Poria nothofagi* (PDD 5275).

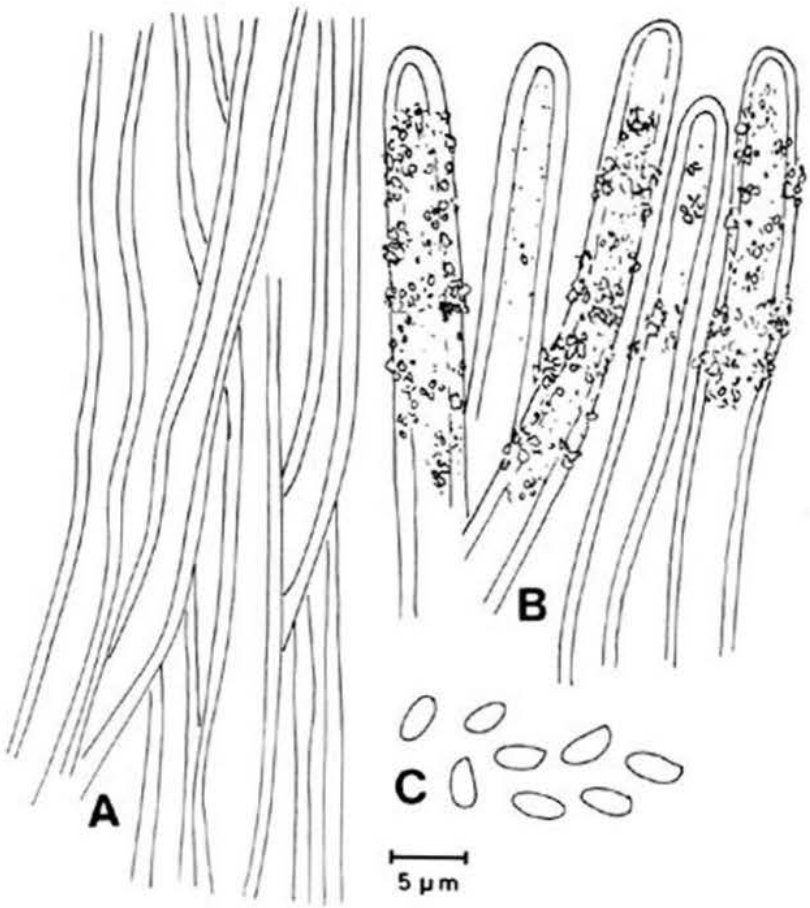

Fig. 14. *Skeletocutis novaezelandiae*. A, skeletal hyphae; B, encrusted skeletal hyphae from the dissepiments; C, spores. From the type of *Poria novaezelandiae* (PDD 5322).

PORIA OTAKOU G.H. Cunn. (fig. 15)
Dept. Sci. Industr. Res., Pl. Dis. Div. Bull. 72: 38 (1947). Holotype: PDD 4182 - New Zealand, Otago Lakes, Kinloch, Jan. 1942, G.H. Cunningham, on *Nothofagus fusca* (Hook. f.) Oerst.

= **Ceriporia otakou** (G.H. Cunn.) P.K. Buchanan & Ryvarden comb. nov.

The species belongs in *Ceriporia* Donk because of the resupinate basidiocarp, monomitic hyphal system with simple septate hyphae, absence of cystidia, and smooth, thin-walled, nonamyloid spores, 3.5-5 x 2-3 µm.

PORIA OVIFORMA G.H. Cunn. not validly published; no Latin description.
PDD Bull. 72: 35 (1947).

This species has a variable fruit-body that can be resupinate, effused-reflexed, or distinctly pileate. Cunningham (1947) first placed the species in *Poria* Pers., but later, to include the pileate habit, he recombined the name in *Polyporus* Mich.: Fr. (Cunningham, 1948a) and then in *Tyromyces* (Cunningham, 1965).

Contrary to the statement of Cunningham (1965), the spores of this species are dextrinoid. The species belongs in *Perenniporia* Murr. because of this reaction, the thick-walled, ovoid, truncate spores, and the dimitic hyphal system. It is related to *P. medulla-panis* (Jacq.: Fr.) Donk, but is readily separated by the distinctly dextrinoid

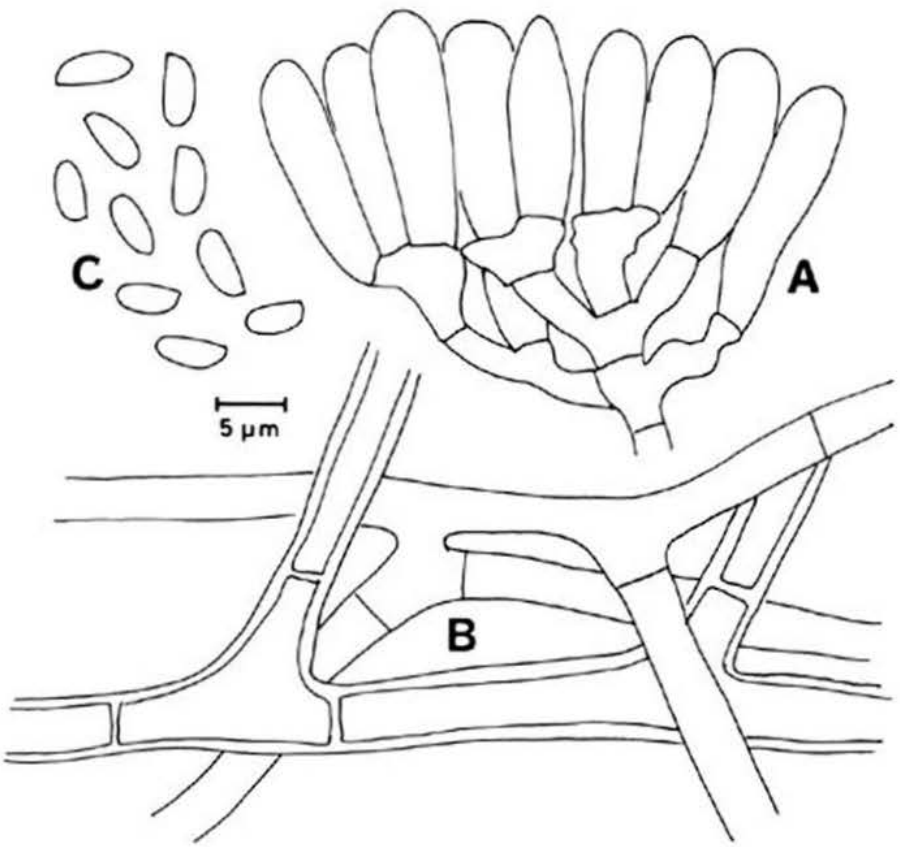

Fig. 15. *Ceriporia otakou*. A, part of hymenium; B, generative hyphae; C, spores. From the type of *Poria otakou* (PDD 4182).

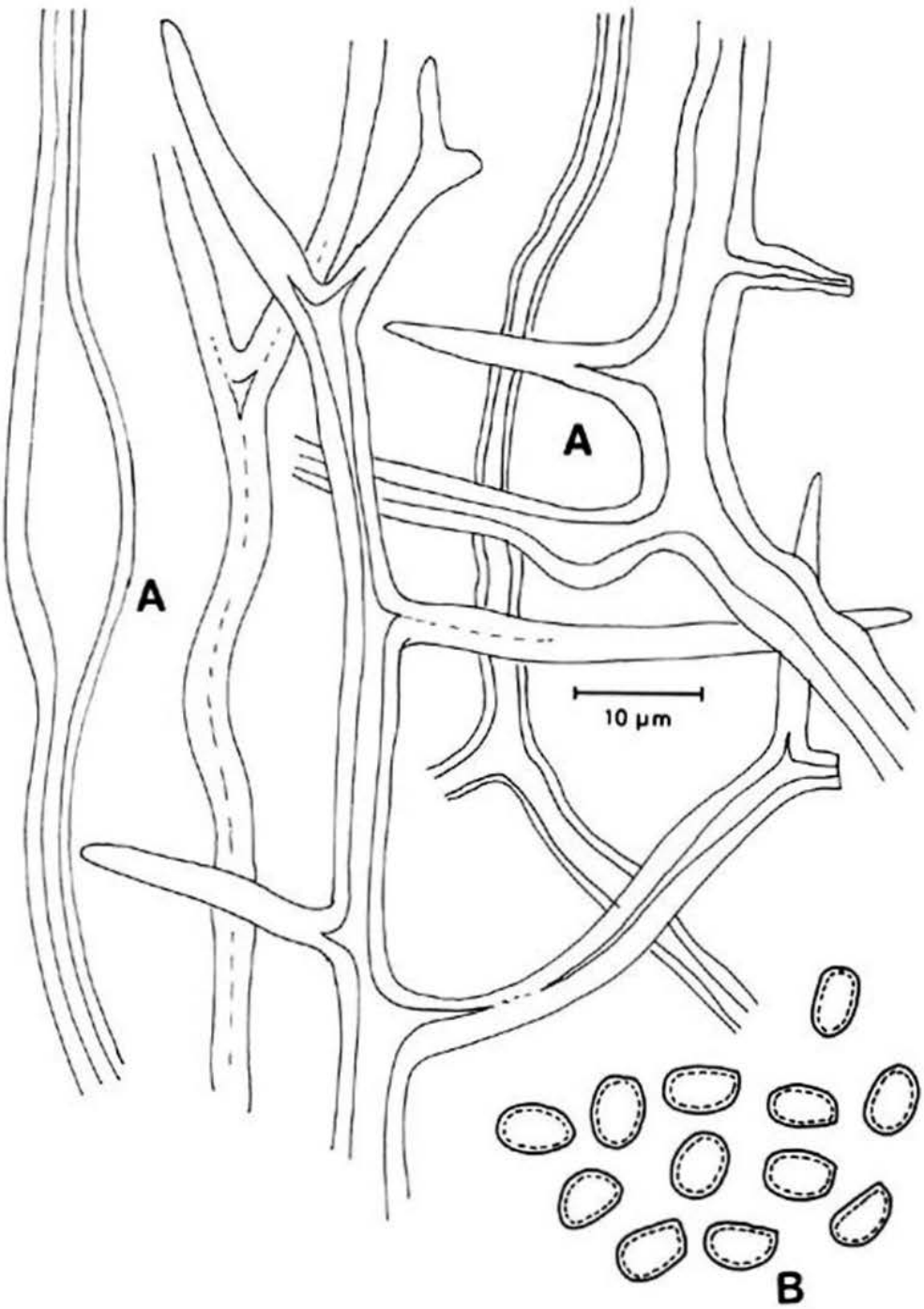

Fig. 16. *Perenniporia oviforma*. A, skeletal hyphae; B, spores. From the type of *Poria oviforma* (PDD 4435).

spores, measuring 5-7 x 3.5-5.5 µm, and the much more frequently branched vegetative hyphae. Some hyphae are so branched that they can be characterised as binding hyphae of the Bovista type. However, there are transitions to more narrow, slightly flexuous and solid vegetative hyphae of the type common in *P. medulla-panis*.

The following name is proposed:

Perenniporia oviforma G.H. Cunningham ex P.K. Buchanan & Ryvarden sp. nov. (fig. 16).

Fructificatio resupinata ad pileata, annua ad interdum biennia, pars reflexa angusta, alba vel ochracea, poria facies cremea vel ochracea, pori rotundi vel angulati, 4-5 per mm. System hypharum dimiticum, hyphae generatoriae hyalinae, fibulatae, hyphae vegetativae crassitunicatae, indextrinoideae, interdum ramosae ad instar hypharum ligantium, sporae ovoideae, truncatae, crassitunicatae, laeves, hyalinae, dextrinoideae, 5-7 x 3.5-5.5 µm.
Typus: New Zealand, Auckland, Swanson, Waitakere Ranges, 18 Nov. 1945, J.M. Dingley, on *Neopanax arboreum* (PDD 4435).

PORIA PIRONGIA G.H. Cunn.
PDD Bull. 72: 39 (1947). Holotype: PDD 4406 - New Zealand, Waikato, Mt Pirongia, 28 Dec. 1945, J.M. Dingley, on *Hedycarya arborea* J.R. & G. Forst.

= **Pachykytospora papyracea** (Schw.) Ryv., *Norw. J. Bot.* 19: 233 (1972).

As reported by Cunningham (1965) under *Poria papyracea* (Schw.) Cooke, this is the same as *Pachykytospora papyracea* although the hyphae are somewhat more branched in the New Zealand specimens than in specimens from North America.

PORIA RATA G.H. Cunn.
Dept. Sci. Industr. Res., Pl. Dis. Div. Bull. 72: 40 (1947). Holotype: PDD 3868 - New Zealand, Rangitikei, Ruahine Ranges, Ngatimoti (?), 27 Jan. 1933, J.G. Gibbs, on *Metrosideros robusta* A. Cunn.

= **Antrodiella rata** (G.H. Cunn.) P.K. Buchanan & Ryvarden comb. nov.

This is a species of *Antrodiella* Ryv. & Johans. because of the dense basidiocarp, dimitic hyphal system, small spores, and minute pores with a resinous appearance. It is separated from other species in the genus by the black lines between successive strata of the tubes and by the thickness of the basidiocarp (to 2.5 cm thick). In some collections, scattered, dark-brown, granular deposits are present on walls of the skeletal hyphae. The spores are slightly larger and the pores smaller than those of *A. semisupina* (Berk. & Curt.) Ryv., the type species.

POLYPORUS ROSULARIS G.H. Cunn.
PDD Bull. 74: 36 (1948). Holotype: PDD 3914 - New Zealand, Gisborne, Lake Waikaremoana, Waikareiti Track, Jan. 1933, J.G. Gibbs, on *Nothofagus* sp.

= **Grifola rosularis** (G.H. Cunn.) G.H. Cunn., *DSIR Bull.* 164: 90 (1965).

Cunningham (1965: 90) provided a good description of the species and transferred it to *Grifola* S.F. Gray because fruit-bodies usually consist of a cluster of imbricate pilei joined by a tuberous base. *G. frondosa* (Fr.) S.F. Gray, the type species, is similar to *G. rosularis* in having the same type of hyphal system and spores, although both spores and pores of *G. frondosa* are larger.

G. rosularis could be considered to belong in *Tyromyces*, which includes many species with imbricate basidiocarps, a monomitic hyphal system, and subglobose to ellipsoid, nonamyloid, nondextrinoid spores; *T. pubescens* (Fr.) Pilát is a representative example of this group. However, almost all *Tyromyces* species produce applanate basidiocarps on dead wood rather than semistipitate basidiocarps arising from a common base. Thus we maintain the species in *Grifola*.

POLYPORUS ROSULATUS G.H. Cunn. (fig. 17)
Dept. Sci. Industr. Res., Pl. Dis. Div. Bull. 74: 36 (1948). Holotype: PDD 5691 - New Zealand, Taupo, Kaingaroa State Forest, May 1946, G.B. Rawlings, on *Pinus radiata* D. Don.

= **Ischnoderma rosulata** (G.H. Cunn.) P.K. Buchanan & Ryvarden comb. nov.
= *Grifola rosulata* (G.H. Cunn.) G.H. Cunn., *DSIR Bull.* 164: 93 (1965).

Cunningham (1965) placed this species in *Grifola* because of the numerous pilei arising from a common base. However, this species has a brown to blackish, very thin cuticle at the pileus surface, sometimes covered in part by a brown adpressed tomentum. Hyphae of the tomentum are brown, wide, and thick-walled with large, conspicuous clamps; hyphae of the context are similar but paler coloured or more typically hyaline. In these characters the species is similar to *Ischnoderma resinosum* (Fr.) P. Karst. Spores of *I. rosulata* are ellipsoid and are smaller than the cylindrical spores of *I. resinosum*. We consider that *Ischnoderma* P. Karst. is a more suitable genus than *Grifola*.

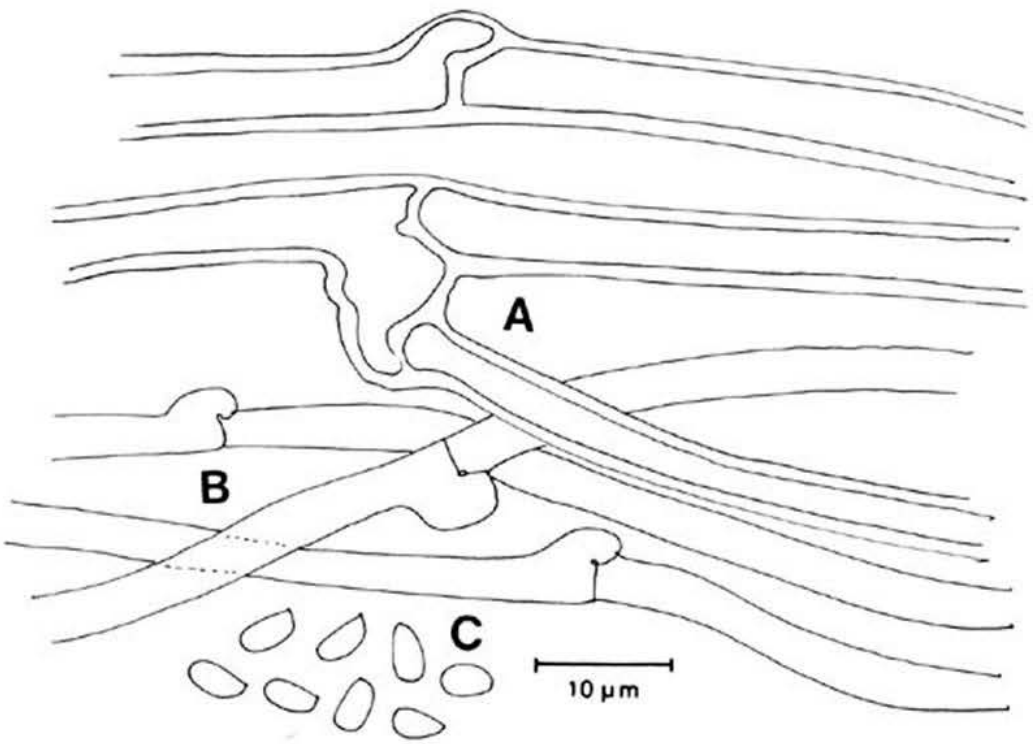

Fig. 17. *Ischnoderma rosulata*. A, generative hyphae from the context; B, generative hyphae from the trama; C, spores. From the type of *Polyporus rosulatus* (PDD 5691).

IRPEX SPICULIFER G.H. Cunn. (fig. 18)
New Zealand Dept. Sci. Industr. Res. Bull. 164: 261 (1965).
Holotype: PDD 19144 - New Zealand, Buller, vic. Reefton, Staircase Creek, 29 Nov. 1952, S.D. Baker, on *Nothofagus fusca* (Hook. f.) Oerst.

= **Oxyporus spiculifer** (G.H. Cunn.) P.K. Buchanan & Ryvarden comb. nov.

Cunningham described this species in *Irpex* Fr. mainly because the pore mouths in mature specimens are partly split. However, this macroscopic feature is now considered to be of minor importance in delimiting genera. Many genera, such as *Antrodia* P. Karst., *Trametes* Fr., and *Spongipellis* Pat., include some species with a regular pore surface and others with a more or less dentate one. *Irpex* is typified by *I. lacteus* Fr. (see Maas Geesteranus, 1974), a distinctly hydnoid species with a dimitic hyphal system. The generative hyphae are simple septate and the cystidia develop from protruding skeletal hyphae which are encrusted over a considerable length. The cystidia in *O. spiculifer* are typically ventricose and apically encrusted, although some hyphae in the dissepiments are encrusted over longer segments. The cystidia and monomitic hyphal system of *O. spiculifer* indicate that it does not belong in *Irpex*.

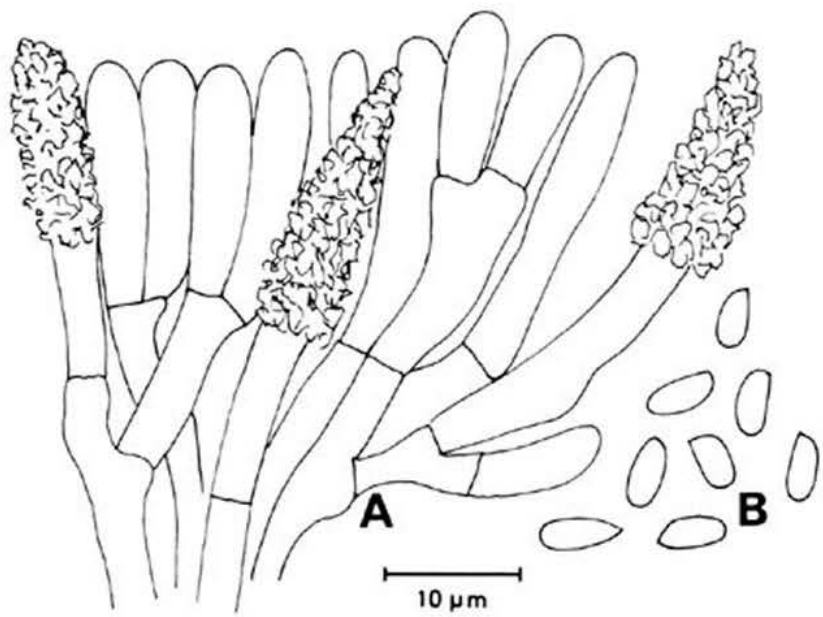

Fig. 18. *Oxyporus spiculifer*. A, part of the hymenium with cystidia; B, spores. From the type of *Irpex spiculifer* (PDD 19144).

Oxyporus Donk is characterised by a monomitic hyphal system with simple septate generative hyphae and mostly apically encrusted cystidia. *O. pellicula* (Jungh.) Ryv. from tropical Africa and Asia is similar in many respects to *O. spiculifer*, with a dentate, lacerate pore surface, but its spores are larger and more broadly ellipsoid. Spores of *O. spiculifer* measure 5-6.5 x 2.5-3 µm, larger than the dimensions given by Cunningham (1965) of 4-5 x 1.5-2 µm. From herbarium material, the type of rot appears to be white.

TYROMYCES STRAMENTICUS G.H. Cunn. (fig. 19)
DSIR Bull. 164: 262 (1965). Holotype: PDD 11038 - New Zealand, Taupo, Mt Ruapehu, Whakapapaiti Stream, Jan. 1951, J.M. Dingley, on *Nothofagus solandri* (Hook. f.) Oerst. var. *cliffortioides* (Hook. f.) Poole.

Accepted as **Tyromyces stramenticus.**

A good description is given in the protologue. Characteristic features of the species include the coarse bundles of agglutinated hyphae covering the pileus surface, the agglutinated hyphae of both context and dissepiments, lacerate pore mouths, and the small spores measuring 2.5-4 x 2-2.5 µm. The hyphal system is monomitic with the clamped generative hyphae only readily separable at the margin.

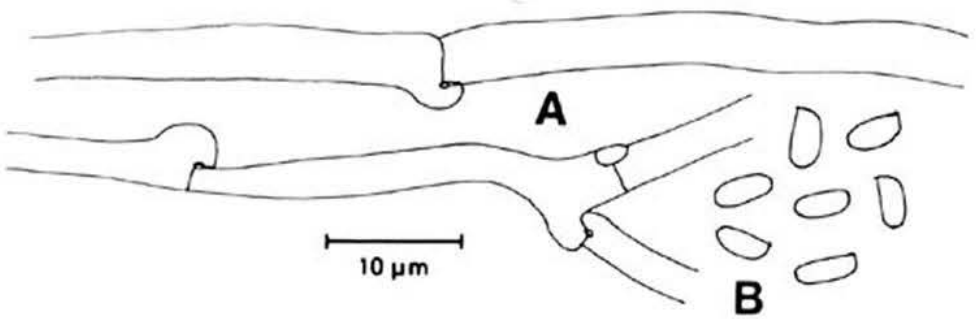

Fig. 19. *Tyromyces stramenticus*. A, generative hyphae; B, spores. From the type (PDD 11038).

COLTRICIA STRIGOSA G.H. Cunn.
PDD Bull. 77: 4 (1948). Holotype: PDD 4417 - New Zealand, Coromandel, Little Barrier Island, 3 Oct. 1945, J.M. Dingley, on rich humus on ground under *Leptospermum*.

Accepted as **Coltricia strigosa.**

This is a highly characteristic species in *Coltricia* with small, strigose basidiocarps and subglobose spores of variable size, measuring 4.5-7 x 4-6 µm. In Melzer's reagent, spores show a negative reaction, unlike those of some other *Coltricia* species which are weakly dextrinoid.

TRAMETES TAWA G.H. Cunn. (fig. 20)
PDD Bull. 80: 9 (1948). Holotype: PDD 4822 - New Zealand, Southland, Woodlaw State Forest, Nov. 1946, G.B. Rawlings, on unknown host.

= *Metuloidea tawa* (G.H. Cunn.) G.H. Cunn., *DSIR Bull.* 164: 250 (1965).
= **Junghuhnia rhinocephalus** (Berk.) Ryv., *Mycotaxon* 20: 353 (1984).
= *Trichaptum rhinocephalum* (Berk.) G.H. Cunn., *DSIR Bull.* 164: 102 (1965).

Junghuhnia rhinocephalus, a rather widespread species in Australia and New Zealand, is somewhat deviating in the genus *Junghuhnia* Corda since vegetative hyphae are light brown and the context is ochraceous to dark cinnamon. Most other species in the genus have hyaline hyphae and a white, ochraceous to yellowish context, although the context of *J. collabens* (Fr.) Ryv. is cocoa-brown. This variation in context and hyphal colour is accepted within the genus.

Cunningham (1965) described both *Trichaptum rhinocephalum* and *Trametes tawa* and considered them to be distinct species. He examined only the type collection of *J. rhinocephalus*, from Kew, and four small fragments apparently from this collection were retained (PDD 28062). Examination of these fragments reveals a mixed collection. Three fragments, which are sterile, correspond to *J. rhinocephalus*, while a fourth is of a different polypore species with a white context, hyaline hyphae, simple septate generative hyphae and subglobose spores, 5-5.5 x 4.5-5.5 µm. These characters appear in Cunningham's

description of *Trichaptum rhinocephalum*, indicating that he mistakenly based at least part of his description on the discordant element. *J. rhinocephalus* should have been described with a brown context, light brown vegetative hyphae, clamped generative hyphae, and ellipsoid spores measuring 3.5-4 x 2-2.5 µm.

A more accurate description of *J. rhinocephalus* was given by Cunningham (1965) for *Metuloidea taxa*, which he designated the type species of *Metuloidea* G.H. Cunn. This genus, mainly characterised by brown vegetative hyphae and encrusted cystidia, becomes a synonym of *Junghuhnia*.

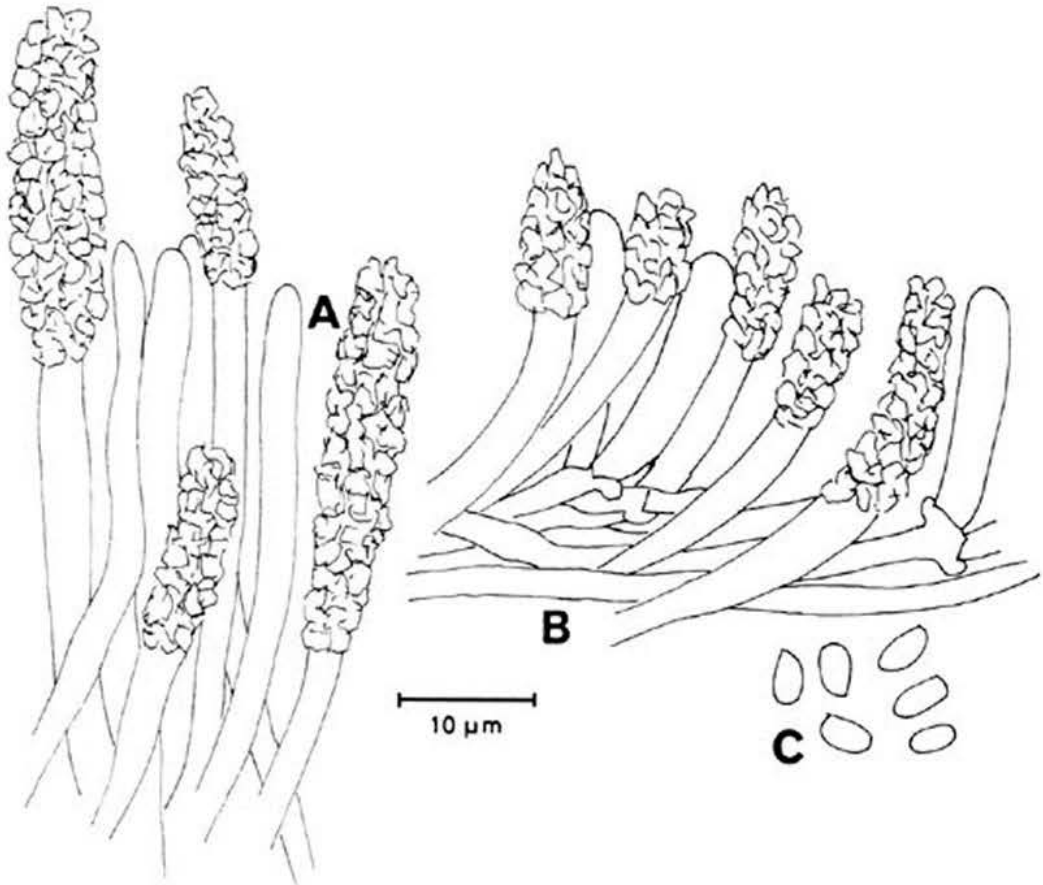

Fig. 20. *Junghuhnia rhinocephalus*. A, hyphae and cystidia from the dissepiments; B, sterile hymenium with cystidia. From the type (K). C, spores. From the type of *Trametes taxa* (PDD 4822).

FUSCOPORIA TAWHAI G.H. Cunn. (fig. 21)
PDD Bull. 73: 8 (1948). Holotype: PDD 5509 - New Zealand, Taupo, Mt Tongariro, headwaters of Pangarara River, Dec. 1946, G.H. Cunningham, on *Nothofagus solandri* (Hook. f.) Oerst. var. *cliffortioides* (Hook. f.) Poole.

= **Phellinus tawhai** (G.H. Cunn.) G.H. Cunn., *DSIR Bull.* 164: 229 (1965).

There is a good description in Cunningham (1965: 229). The hyaline, cylindrical spores from the type specimen measure 7-8.5 x 2-2.5 µm, somewhat larger than the dimensions given by Cunningham (1965). As noted by Cunningham, *Phellinus ferreus* (Pers.) Bourd. & Galz. is closely related but differs in being always adnate, never effused-reflexed nor with a black pileus surface as in pileate forms of *P. tawhai*.

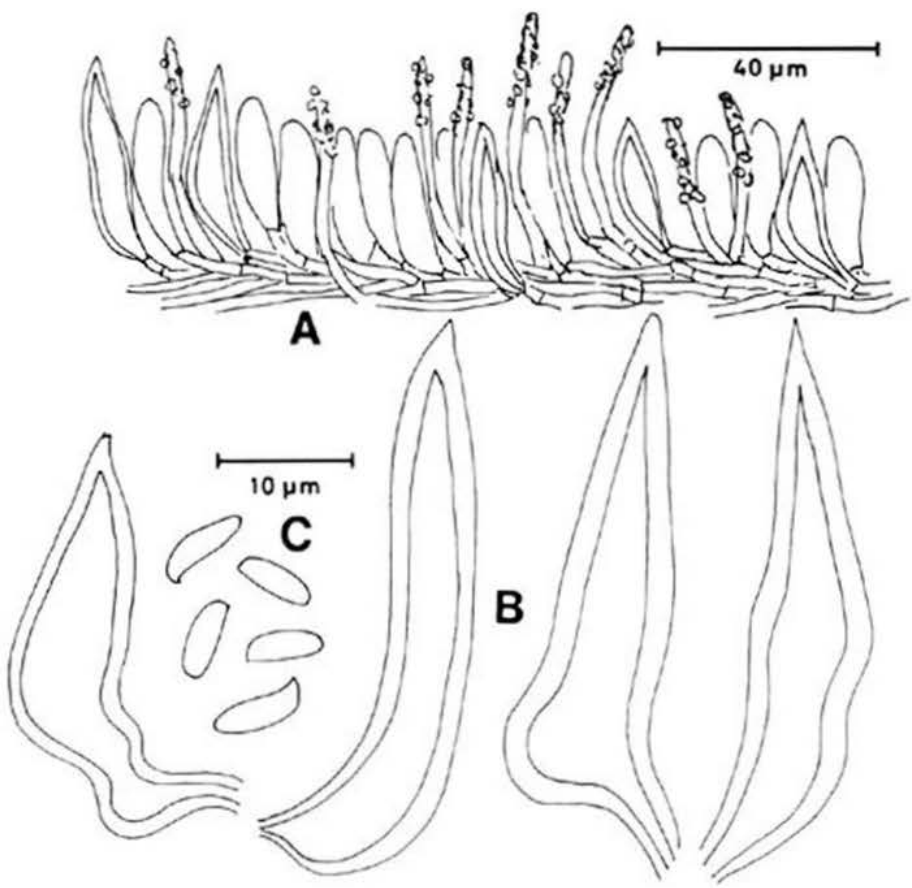

Fig. 21. *Phellinus tawhai*. A, section through the hymenium with setae and projecting encrusted hyphae; B, setae; C, spores. From the type of *Fuscoporia tawhai* (PDD 5509).

TYROMYCES TOATOA G.H. Cunn.
DSIR Bull. 164: 262 (1965). Holotype: PDD 7792 - New Zealand, Taupo, Mt Ruapehu, Whakapapa Stream, 19 Oct. 1949, J.M. Dingley, on *Phyllocladus alpinus* Hook. f.

Accepted as **Tyromyces toatoa.**

The dark surface and thin cuticle of the small, effused-reflexed pilei make the species easy to recognise and separate it from other species in the genus. Spores are suballantoid, 4-5 x 1.5-2 µm.

PORIA TOTARA G.H. Cunn. (fig. 22)
New Zealand Dept. Sci. Industr. Res. Bull. 164: 261 (1965). Holotype: PDD 6657 - New Zealand, Coromandel, Whitianga - Coromandel Road, Nov. 1947, G. Chamberlain, on *Podocarpus totara* G. Benn. ex D. Don.

= **Ceriporia totara** (G.H. Cunn.) P.K. Buchanan & Ryvarden comb. nov.

The description in Cunningham (1965) is accurate except he described the hyphal system as dimitic with clamped generative hyphae and binding hyphae. We found it to be dimitic with simple septate generative hyphae, 1.5-2.5 µm diam., with a thin to slightly thickened wall, and hyaline, thick-walled to solid, sparingly branched skeletal hyphae, 2-3.5 µm diam. Spores are oval to subglobose, apiculate, hyaline, and nonamyloid, measuring 2.5-3 x 1.7-2.5 µm. The cream to yellow pores are highly variable in appearance, from labyrinthine and up to 3 mm long, to more regular, angular, and 3-5(-7) per mm.

The species cannot be maintained in *Poria* because *Poria* Adanson is a nomen ambiguum and *Poria* Pers. a later homonym (Ryvarden, 1985). However, it is difficult to find a suitable genus for the species. Arguments can be made for different genera depending on the character(s) considered to be most important. If we consider that septation of the generative hyphae is important taxonomically at the generic level, then genera such as *Rigidoporus* Murr., *Ceriporia* Donk, and *Physisporinus* P. Karst. are possible alternatives.

Rigidoporus has a monomitic to pseudo-dimitic hyphal system, globose spores, small papillate cystidioles in the hymenium and, in some species, large encrusted cystidia. The type species and some related species are pileate and have a reddish pore surface when fresh, fading when dry. The pores are regular and small. The irregular pores, the yellowish to cream pore surface and lack of sterile hymenial elements are characters that separate *Poria totara* from *Rigidoporus* species. The skeletal hyphae of *P. totara* are also more densely arranged and narrower than hyphae typical of *Rigidoporus* where the rather wide, thick-walled, non-septate hyphae can be interpreted as either skeletal hyphae or as strongly sclerified generative hyphae with very rare septa.

Ceriporia includes resupinate, soft to hard, fragile species with a pore surface varying from white, cream, yellowish or reddish. Sterile hymenial organs are lacking and most species have cylindrical to oblong-ellipsoid spores. However, it has a monomitic hyphal system without a trace of thick-walled hyphae of any kind.

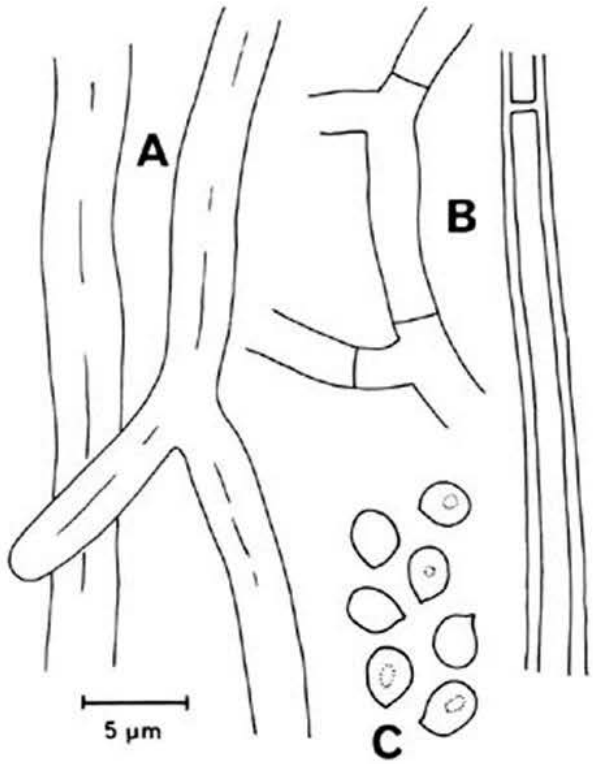

Fig. 22. *Ceriporia totara*. A, skeletal hyphae, sparingly branched; B, simple septate generative hyphae; C, spores. From the type of *Poria totara* (PDD 6657).

Physisporinus includes two resupinate species with large, globose spores. All hyphae are thin-walled and wide, and cystidial elements are lacking. The colour of the pore surface varies from whitish to red or black when dry and the pores are regular.

Septation of generative hyphae is commonly assumed to be very important in the Polyporaceae and very few genera include species with both types of septation. However, if we ignore the simple septa in *Poria totara*, other characters such as the type of fruit-body, the pores, colour, and dimitic hyphal system with dominance of skeletal hyphae suggest *Diplomitoporus* Dom. The spores of that genus are cylindrical to ellipsoid, while those of *P. totara* are subglobose. *Diplomitoporus* species cause a white rot as does *P. totara*, while species of *Antrodia* P. Karst., another candidate genus, all cause a brown rot.

Thus, whatever genus is considered, the inclusion of *P. totara* introduces a discordant element. Rather than create a new genus for this species, we feel it is more satisfactory to include it in an existing genus where only one new character is introduced. The choice then is between *Ceriporia* and *Diplomitoporus*. As we currently consider that septation is more important than the type of hyphal system, which recently has been shown to be complex with intergrading types, we conclude that *Ceriporia* is the best choice. *C. xylostromatioides* (Berk.) Ryv. has subglobose spores and a rather irregular hymenophore and is probably the most closely related species to *P. totara*. The main character separating these two species is the skeletal hyphae of the latter.

FOMES UNCATUS G.H. Cunn.
PDD Bull. 79: 3 (1948). Lectotype: PDD 5776 - New Zealand, Auckland, Riverhead, May 1947, G.B. Rawlings, on *Dysoxylum spectabile* (Forst. f.) Hook. f.

= **Phellinus wahlbergii** (Fr.) Reid, *Contr. Bolus Herb.* 7: 97 (1975).

Phellinus wahlbergii is characterised by hooked setae and subglobose, hyaline spores, 4-5.5 x 3.5-5 µm. Cunningham (1965: 222) mistakenly included *F. uncatus* as a synonym of *Phellinus setulosus* (Lloyd) Imaz. but the latter is

tropical, typically ungulate, and has large, ventricose, straight setae and larger spores. Australasian specimens included by Cunningham under *P. setulosus* and *P. zealandicus* (Cooke) G.H. Cunn. are considered to be conspecific with *P. wahlbergii*.

A single type collection for *F. uncatus* was not designated by Cunningham (1948b). Two collections, PDD 5776 and PDD 5777, have the same data as given in the protologue for the type, except for the date, May 1947 vs June 1947. An error in citation of the date in the protologue is suggested. PDD 5776 is herein designated the lectotype of *F. uncatus*; this specimen has a majority of setae with hooked apices whereas setae in PDD 5777 are mostly straight.

Cunningham (1948b, 1965) described the rot caused by this fungus as brown but as with all species of *Phellinus* the rot is white.

DENDROCHAETE VALLATA G.H. Cunn.
DSIR Bull. 164: 261 (1965). Holotype: PDD 19906 - Australia, northern Queensland, Stony Creek, Jan. 1954, W. Pont (no. 4334), on ground ? (probably growing from buried wood).

= **Laetiporus percicinus** (Berk. & Curt.) Gilbn., *Mycotaxon* 12: 385 (1981).

The type is a typical specimen of *Laetiporus percicinus*. The species is widespread in the tropics, although nowhere common. It was first recorded from Australia by Reid (1963: 289) as *Meripilus talpae* (Cooke) Reid. The specimen at Kew that Reid examined (W. Pont no. 4334) has the same collection data as the type of *D. vallata*.

PORIA WERAROENSIS G.H. Cunn.
PDD Bull. 72: 40 (1947). Holotype: PDD 1838 - New Zealand, Wellington, Weraroa, 12 Aug. 1919, G.H. Cunningham, on *Coprosma grandifolia* Hook. f.

Accepted as **'Poria' weraroensis.**

The holotype is badly eaten by insects, discoloured, and

sterile. Only one other collection is known. This collection (PDD 50957), in agreement with Cunningham's description of *P. weraroensis*, has discrete and coalescing, circular, resupinate colonies, individually 5-15 mm across and 1 mm thick, coloured pale yellow with a white margin. Pores are large, 1-2 per mm, with the hymenium lining the floor of the shallow tubes and extending up the vertical tube walls. The dimitic hyphal system consists of clamped generative hyphae and hyaline to pale yellow, nondextrinoid skeletal hyphae. Spores are hyaline, ellipsoid, 3.5-5 x 2.5-3 µm.

Both the type and PDD 50957 appear to be young and not fully developed. The irregular hymenophore varying from almost smooth through tuberculate to dentate or poroid in the centre of the small fruit-bodies strongly resembles species of *Schizopora*. However, the sterile elements typical of this genus are lacking in the fertile collection (PDD 50957), although the spores and the hyphal system come very close to that of *S. paradoxa* (Schrad.: Fr.) Donk, a widespread and variable species. The protruding skeletal hyphae in the dissepiments of *S. paradoxa* have a characteristic scattered, rather coarse encrustation. Some hyphae in *P. weraroensis* are encrusted, but they differ in appearance from those seen in *Schizopora*. The hymenium in young specimens of *Schizopora* often covers both the pore base and the side walls, underlining the relationship of this genus to many smooth and grandinioid species in the Corticiaceae.

The dimitic hyphal system and fertile pore bases suggest that *P. weraroensis* might belong in *Theleporus* Fr. but the species lacks the dendrohyphidia and the more regular pore surface seen in even young and small fruit-bodies of *Theleporus*.

More collections are needed before a proper evaluation of this species can be made.

ACKNOWLEDGEMENTS:
The authors are grateful to Dr J. Ginns, Dr T. Niemelä, and Mr H. Kotiranta for critical review of the manuscript.

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MYCOTAXON

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TOMENTELLAGO GEN. NOV. (THELEPHORACEAE, BASIDIOMYCETES)

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SUMMARY

Tomentellago gen. nov. is characterized by a resupinate, bluish-green, poroid basidiome with brown, ornamented basidiospores and a presence of thelephoric acid. This clearly places the genus in the Thelephoraceae of which the genus is the second poroid representative. Tomentellago aeruginascens sp. nov. from Colombia is described as the type species.

While collecting in Colombia in 1978, one of us (L.R.) collected a conspicuous, bluish, resupinate polypore. The colour was reminiscent of that found in the corticioid genera Lazulinospora (Burdsall & Larsen 1974) and Byssocorticium (Eriksson & Ryvarden 1976) which, however, have more or less smooth basidiocarps.
A microscopical examination of the Colombian polypore revealed ornamented brown spores which immediately raised the suspicion that the species belonged in the Thelephoraceae Chev., which is characterized by such spores.
Byssocorticium is characterized by smooth, thick-walled and cyanophilous spores, while Lazulinospora has finely ornamented hyaline spores, which are blue in 2 % KOH (Burdsall & Setliff 1974). Because the spores were hyaline and finely warted, both Larsen (1968) and Burdsall & Larsen (1974) concluded that Lazulinospora should be placed in Corticiaceae and suggested that Trechispora probably was the closest relative. The spores of the new species from Colombia also change colour in 2% KOH due to a pH shift, thus indicating a relationship to Lazulinospora.
The Thelephoraceae is characterized by variably shaped basidiocarps sharing ornamented brown spores, and thelephoric acid is present in most of the investigated species (Arpin & Fiasson 1971, Besl et al., 1975, Bresinsky & Rennschneid 1971).

To check the presence of thelephoric acid in the new species from Colombia, a small piece of the basidiocarp was extracted with pyridine. Also basidiocarps of Hydnellum suaveolens

(Scop.:Fr.) Karst., Boletopsis subsquamosa (Fr.) Kotl. & Pouz., and Thelephora palmata Scop.:Fr. were tested in the same way. The pyridine solution was then added a drop of concentrated ammonia. If thelephoric acid or analogous compounds are present, the solution will turn bright blue, and this was the case with all four species.
Thus, because of the thelephoric acid or very closely related compounds and the ornamented, pale brown spores, it was concluded that the species was best placed in the Thelephoraceae.

In the Thelephoraceae, Boletopsis has been the only poroid repre-sentative (see Pegler 1973). Boletopsis is characterized by a stipitate fruitbody with pale brown, somewhat angular spores and is probably mycorrhizal (see Gilbertson & Ryvarden 1986).
The new species from Colombia is resupinate, has large angular pores and is saphrophytic on dead wood. Its spores are distinctly tuberculate and not angular. In conclusion, it does not seem reasonable to place the new species in Boletopsis based on the presence of a poroid hymenophore and thelephoric acid when there are so many other divergent characters.

TOMENTELLAGO AERUGINASCENS gen. nov. et spec. nov.
Hjortst. & Ryv.
Fructificatio resupinata, adnata, mollis, plus minus aeruginosa; pori angulatis, irregularibus, circiter 0.25- mm latis. Systema hyphale monomiticum, hyphae sine fibulis, hyalinae vel plerumque viridescentes (KOH). Cystidia nulla. Basidia plus minus clavata, sinuosa, frequenter constricta et leviter pedunculata, 20-30 x 5-6 um, 4 sterigmatibus; Sporis subglobosis vel ellipsoidiis, verrucosis, in KOH hyalinis vel flavidae-dilute infuscatis, post demum caeruleis, 4.5-5.5 x 6-7 vel circuter 5.5 um diametro.
Holotypus: Colombia. Magdalena, Parque Nacional Tayrona, Estacion Canaveral, 0-30 m.a.s.l. June 14, 1978. L. Ryvarden No. 15911 (0). Isotypus: In Hjm. priv. herb. and col.
Fruitbody resupinate, adnate, soft, bluish-green when fresh, in the herbarium almost verdigris green but still with a somewhat bluish margin. Pores angular, irregular, 0.25-1 mm wide and 1-2 mm deep, uniform in colour or with the pore surface more pale. Hyphal system monomitic, hyphae thin- to moderately thick-walled, 3-4(-5) um wide, without clamps, hyaline or in KOH pale green after 1-5 minutes, most hyphae turn bluish in KOH and in Melzer's reagent.
Cystidia absent.
Basidia more or less sinuose, frequently constricted and slightly stalked, 20-30 x 5-6 um, with 4 sterigmata, but some basidia seen with only two sterigmata, with a clampless base.
Basidiospores verrucose, subglobose to ellipsoid, either about 5.5 um across or 4.5-5.5 x 6-7 um, thick-walled, more or less hyaline to pale yellow brown in H_2O, becoming bluish in both KOH and Melzer's reagent, yellowish brown in cotton blue.

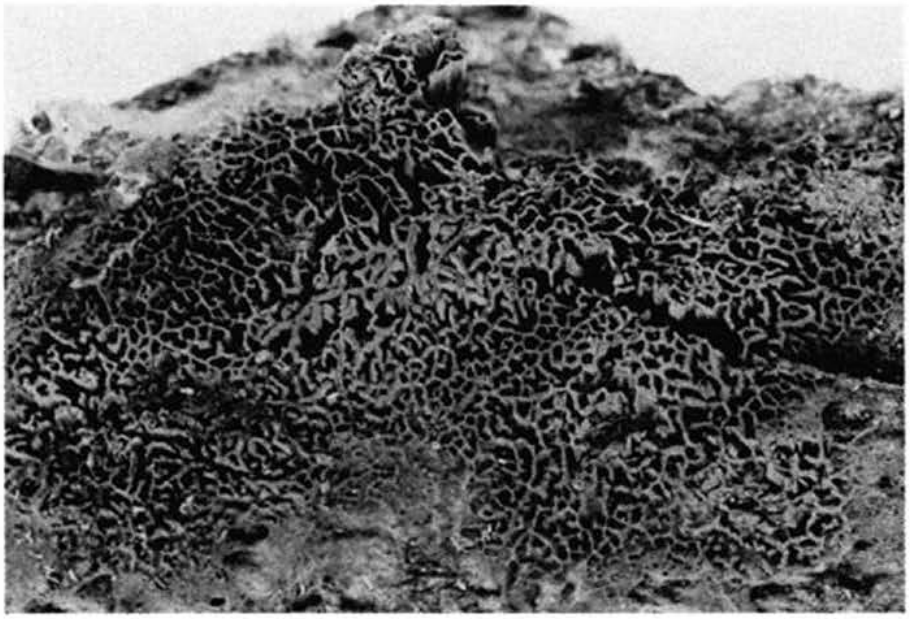

Fig. 1. Tomentellago aeruginascens, the holotype, ca. 2 x nat. size.

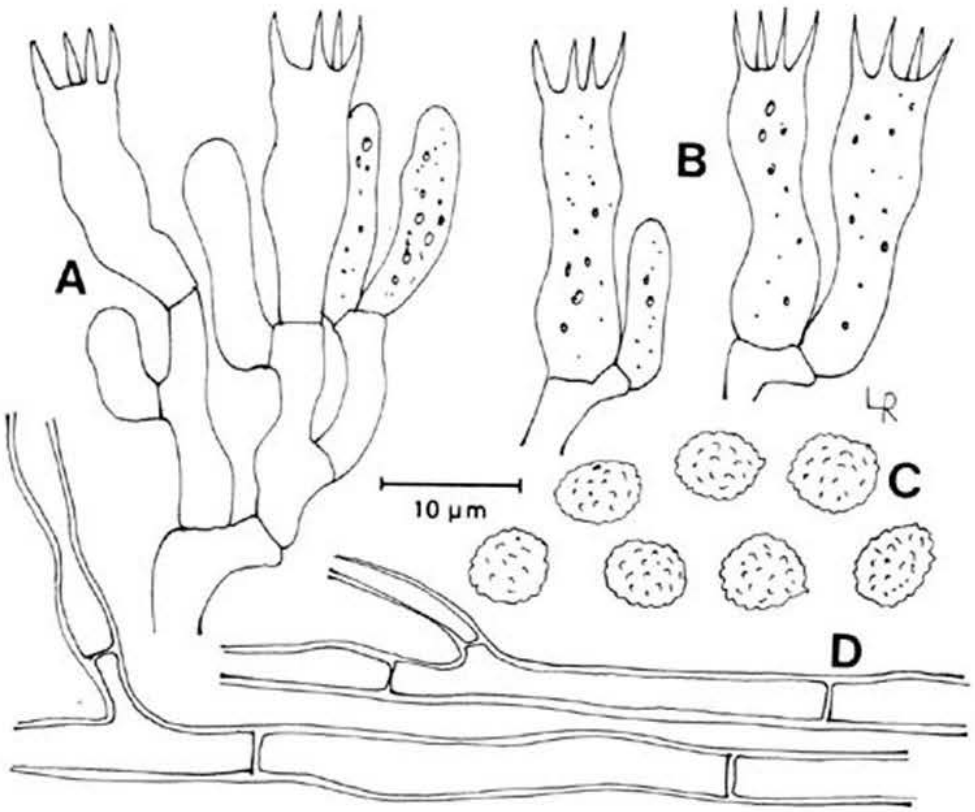

Fig. 2. Tomentellago aeruginascens A) Part of hymenium, B) Basidia, C) Spores, D) Hyphae from the subiculum. From the holotypus.

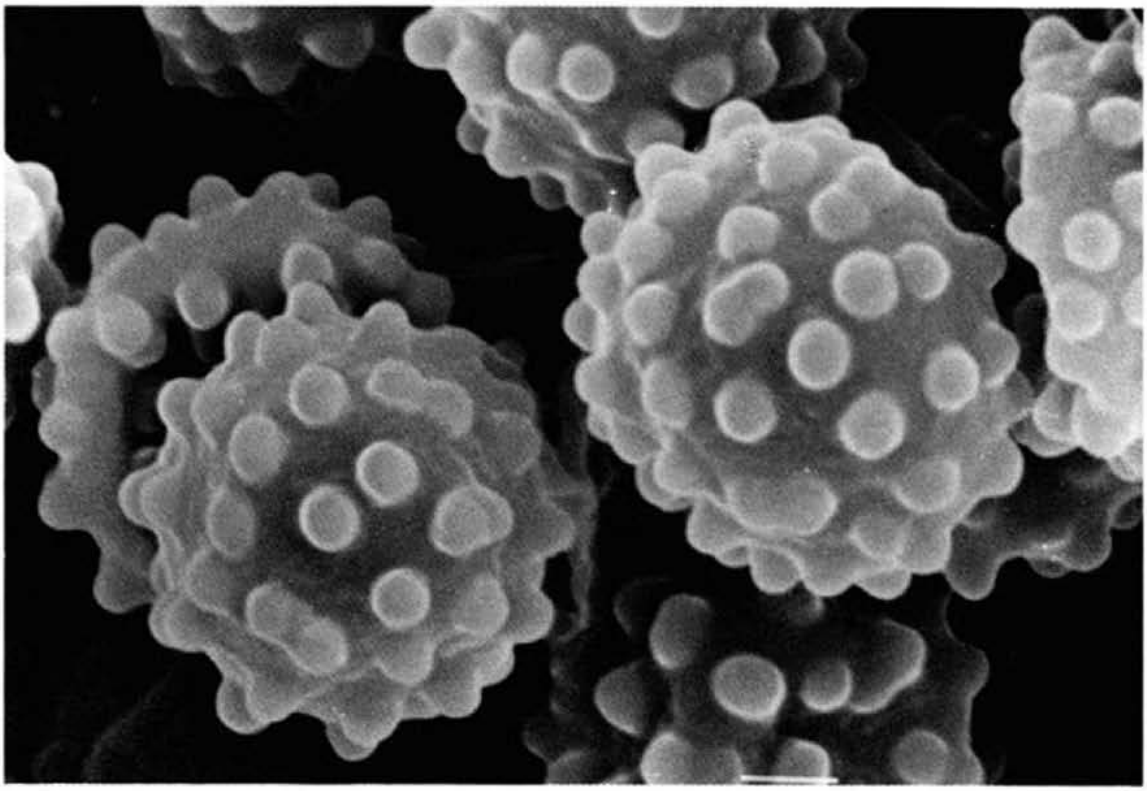

Fig. 3. Tomentellago aeruginascens, spores. Scale = 1 µm.

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TYPE STUDIES IN THE POLYPORACEAE 19

SPECIES DESCRIBED BY M.C. COOKE

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SUMMARY

Of the 142 polypores described by M.C. Cooke, 36 are accepted, 86 are taxonomic synonyms, 5 names are invalid, 10 are of uncertain status because of sterile and badly developed types while the type specimens were not found for 5 species. The following new combinations are proposed: **Albatrellus cochleariformis** (Cke) Ryv., **Antrodia porothelioides** (Cke) Ryv., **Coriolopsis burchellii** (Cke) Ryv., **Datronia brunneo-leuca** (Berk.) Ryv., **Leucophellinus hobsonii** (Cke) Ryv. and **Rigidoporus incurvus** (Cke) Ryv.

M.C. Cooke took over as a curator of the mycological collection in Kew Gardens after J.M. Berkeley. He apparently soon sorted out a number of polypores left by Berkeley with notes and preliminary names. As is evident from the following list, far too many of these names were published by Cooke. Many of the type specimens are in bad condition and represent forms of already described species. Cooke, like so many of his contemporary mycologists never collected themselves in the tropics. Thus, they never gained the necessary field knowledge so important to understand the morphological variation in a species.

All types of Cookes polypores are deposited in the herbarium of Royal Botanic Gardens, Kew (K), so this information is not repeated for each species.

The species are placed alphabetically according to specific epithet and the place of publication is in almost all cases cited as G and two digits indicating Grevillea, volume and page respectively. In the very few cases where Cooke did not publish in Grevillea, a full reference is given.

The type locality is indicated in all cases where it is known. When a species is accepted taxonomically, it is cited

in the appropriate genus with a reference to a recent description, or the species is described if no modern description exists.

acuta, Tram. Cke. G. 10:132, 1882, Richmond River (Australia).
= **Coriolopsis floccosa** (Jungh.) Ryv.

adelphica, Tram. Cke. G. 19:103, 1891, Madagascar
= **Hexagonia hirta** (Fr.) Fr.

aethiops, Pol. Cke. G. 9:99, 1881. Kala Nuddi (India).
= **Phellinus** sp. sterile

alabamae, Pol. Berk. & Cke. G. 6:130, 1878, Alabama, USA.
= **Pachykytospora alabamae** (Berk. & Cke.) Ryv. For a description, see Ryvarden & Johansen 1980:461.

albo-cincta, Poria Cke. & Massee
= **Porogramme albo-cincta** (Cke. & Massee) Lowe. For a description, see Ryvarden & Johansen 1980:48.

alutacea, Lenz. Cke. G. 10:121, 1882, Japan.
= **Lenzites acuta** Berk. as indicated by Bresadola on the sheet.

anax, Pol. Berk. ex Cke. G. 12:37, 1883. Ohio, USA.
= **Bondarzewia montana** (Quel.) Sing.

andamani, Daed. Berk. ex Cke. G. 19:93, 1891
= **Earliella scabrosa** (Pers.) Gilbn. & Ryv.

antrachopilus, Pol. Cke. G. 12:16, 1883. S.W. Australia
= **Tyromyces campylata** (Berk.) Ryv. as already indicated by Cunningham (1965:92).

arenosus, Pol. Cke. G. 13:2, 1884, Malaya.
= **Coriolopsis asper** (Jungh.) Teng.

argentatus, Pol. Cke. G. 15:20, 1886. Victoria, Australia.
= **Trametes cingulata** Berk.

argillaceus, Pol. Cke. G. 7:1, 1878. California, USA.
= **Aporpium caryae** (Schw.) Teix. & Rog.

astrostrigosus, Pol. Cke. G. 20:2, 1890, New Zealand.
= **Tyromyces astrostrigosus** (Cke.) Cunn. For a description see Cunningham 1965:120.

atrovinosa, Poria Cke. G. 10:131, 1882. Clarence River, Australia.
= **Phellinus** sp., the type is sterile.

auricoma, Poria Lév. ex Cke. G. 15:26, 1886. Marqusas.
= **Ceriporia mellea** (Berk.) Ryv.

badius, Fomes Berk. ex. Cke. G. 15:21, 1886. Arctic America.
= **Phellinus badius** (Berk. ex Cke.) Cunningh.
Without being aware of it, Cooke validated Berkley's illegitimate name **Polyporus badius** of 1843 (non **P. badius** Schw. 1823.) The type locality is certainly not correct, more probably the specimen came from Australia.

beaumontii, Pol. Cke. G. 15:26, 1886. Alabama, USA.
= **Antrodia** sp. sterile and without reaction in Melzer's reagent. Its identity is unknown.

bifasciatus, Lenz. Cke. G. 21:37, 1892. Victoria, Australia.
= **Gloeophyllum striatum** (Fr.) Murr.

binnendykei, Pol. Kurz. ex Cke. G. 15:19, 1886. Java.
= The type has not been found.

bireflexus, Pol. Cke. G. 10:101, 1882. Queensland, Australia.

= **Trametes** sp. cfr. **marianna** (Pers.) Ryv. The type is sterile and almost glabrous. Cunningham 1965:167, stated it to be **T. zonata** (Nees:Fr.) Pil., but in this species the pileus is tomentose to almost hirsute. No specimen of this boreal species has been seen from Australia.

breviporus, Pol. Cke G. 12:17, 1883. Endeavour River, Australia.
= **Phellinus gilvus** (Schw.) Pat.

burchellii, Tram. Berk. ex Cke. G. 19:102, 1891.
= **Coriolopsis burchelli** (Cke.) Ryv. comb. nov. Basionym: **Trametes burchellii** Cke. Grevillea 19:102, 1891.
Basidiocarp pileate, annual, up to 3 cm wide, 1 cm thick at the base, and apparently elongated and shelflike, type 3 cm long, tough and flexible, upper surface dark brown, finely tomentose at the margin, towards the base matted and finely scrupose to warted, azonate, margin sharp and bent downwards, pore surface dark brown, pores thin-walled and angular, 0.8-1.5 mm wide, tubes concolorous, up to 1 cm deep, , white on the inside walls, context dark brown, up to 2 mm depp, homogeneous.
Hyphal system trimitic, generative hyphae with clamps, 2-4 µm wide, skeletal hyphae dominating, 3-8 µm wide, thick-walled and pale brown, binding hypahe present in context, tortuous and richly branched, 2-4 µm wide, pale golden brown. Basidia and spores not seen.
This is a conspicuous species because of the snuff brown basidiocarp and the large angular, thin-walled pores. I have found no prior name for the taxon and no recent description that could cover this taxon. It is placed in **Coriolopsis** because of the trimitic hyphal system and the coloured skeletal hyphae.

caesio-glaucus, Pol. Cke. G. 10:121, 1882. Japan.
= **Trametes versicolor** (L.:Fr.) Pil. as already indicated on the sheet by Imazeki.

carneo-niger, Pol. Cke. G. 12:15, 1883. Daintree River,

Australia. = **Microporus affinis** (Fr.:Blume & Nees) Kunt.

carteri, Poria Cke. G. 15:25, 1886. India.
= **Phellinus carteri** (Cke.) Ryv. For a description, see Ryvarden & Johansen 1980:147.

caryophylleus, Fomes Cke. G. 15:21, 1886. Brazil.
= **Phellinus caryophylleus** (Cke.) Ryv. For a description, see Ryvarden & Johansen 1980:147.

caryophylleus, Polystictus Cke G. 15:22, 1886. Venezuela.
= **Microporellus obovatus** (Jungh.) Ryv.

cervicornis, Pol. Cke. G. 17:59, 1889. St. Lucia.
= **Antrodiella versicutis** (Berk. & Curt.) Ryv. The type is deeply split and represents an abarrent form.

cinncinati, Poria Cke. G. 15:27, 1886. Ohio, USA.
= **Irpex lacteus** Fr. Indicated already by Bresadola on the sheet.

cochleariformis, Pol. Cke. G. 14:12, 1885. Perak, Malaysia.
= **Albatrellus cochleariformis** (Cke.) Ryv. comb. nov.
Basionym: **Polyporus cochleariformis** Cke. Grevillea 14:12, 1885.
Basidiocarp annual, laterally stipitate, pileus semicircular, entire to deeply lobed or incised, up to 6 cm from stipe attach- ment to margin, probably fleshy when fresh, rigid and fragile when dry and apparently shrunken by drying, up to 3 mm thick, no special taste in dry condition.
Upper surface dark brown to almost black in parts, glabrous, dull and densely wrinkled when dry and with a very thin cuticle of adpressed hyphae, stipe concolorous, up to 3 mm in diameter, very dense and homogeneous, pore surface dark brown, partly decurrent on stipe, pores invisible to the naked eye, pore surface shiny when turned in the light, tubes dense, cartilaginous and dark brown, up to 2 mm deep, context paler than tubes, brown and fibrous, up to 1 mm deep.
Hyphal system monomitic, generative hyphae with simple septa, in the context strongly inflated, up to 35 µm wide with a wall thickness of up to 3 mm, straight to branched in right angles, in the stipe partly with straight, very thick-walled hyphae, up to 25 µm wide, mixed with frequently branched hyphae, all hyphae strongly agglutinated, in the trama richly branched and more difficult to tear apart, cystidia and basidia not observed, spores globose, thin-walled, hyaline and IKI-, 4-4.5 µm in diameter. No substrate indicated.
The species seems clearly to belong in **Albatrellus** because of the large inflated hyphae which characterize the genus and indicate that it is more related to **Agaricales** in a wide sense, than to the true polypores. The monomitic hyphal system and the round spores together with a fleshy, stipitate fruitbody are also features shared with other species in **Albatrellus.**
Albatrellus dispansus (Lloyd) Canf. & Gilbn. has similar spores, but has a basidiocarp with several pilei of a yellow colour and much larger pores (2-3 per mm). It is known from Japan and is connected to coniferous forests.

The colour, the tiny pores and the very wide, straight hyphae with scarce simple septa, characterize **A. cochleriformis.** Fresh collections are desirable to establish its colour in fresh condition.

concavus, Fomes Cke. G. 20:44, 1890. Queensland, Australia.
= **Fomitopsis concava** (Cke.) Cunn. There is a good description in Cunningham (1965:189).

concentricus, Pol. Cke. G. 9:13, 1880. Unknown type-locality.
= **Ganoderma applanatum** (Pers.) Pat.

contrarius, Fomes Cke. G. 15:21, 1886. Cuba.
= **Perenniporia contraria** (Cke.) Ryv. For a description, see Ryvarden and Johansen (1980:464).

corrugatus, Gloeoporus Cke. G. 19:105, 1886. India
= **Antrodiella** sp. sterile and badly contaminated, and its identity is unknown. Macroscopically it reminds of **A. liebmannii** (Fr.) Ryv. but the skeletal hyphae are more tortuous than seen in this species. The name should be dropped as a nomen ambiguum.

cornubovis, Pol. Cke. G. 13:2, 1884. Perak, Malaysia.
= **Nigrofomes melanodermus** (Mont.) Murr.

cristata, Tram. Cke. G. 10:132, 1882. North Australia.
= **Coriolopsis telfarii** (Kl.) Ryv.

cupreo-vinosus, Polyst. Cke. G. 15:23, 1886. Panuré, Brasil.
= **Trametes cupreo-roseus** (Berk.) Lloyd.

curreyanus, Pol. Cke. G. 15:20, 1886.
= **Bjerkandera adusta** (Fr.) Karst. Cunningham (1965:50) describes it as a species of its own, but the type is sterile and fresh specimens of the taxon described by Cunningham should be examined to find a proper generic place for this species. It may be that **Bjerkandera** is a proper genus if it really is different from **B. adusta.**

curreyii, Fomes Cke. G. 15:21, 1886. nomen novum for **Polyporus xerophyllaceus** Currey, non Berkeley.
= **Coriolopsis asper** (Jungh.) Ryv.

dictyoporus, Pol. Cke. G. 12:17, 1883. Queensland, Australia.
= **Macrohyporia dictyopora** (Cke). Ryv. For a description see Cunningham (1965:68).

dickinsii, Tram. Cke. G. 19:100, 1891. Japan.
= **Daedalea incana** (Lév.) Ryv.

ecklonii, Polyst. Cke. G. 15:23, 1886. South Africa.
= **Coriolopsis floccosa** (Jungh.) Ryv.

emericii, Pol. Cke. G. 10:96, 1882. Queensland, Australia.
= **Polyporus grammocephalus** Berk.

favoloides, Hexagonia Cke. G. 14:118, 1886. New Guinea.

= **Lenzites vespacea** (Pers.) Ryv.

fergussonii, Polyst. Cke. G. 15:23, 1886. Natal, South Africa.
= **Coriolopsis asper** (Jungh.) Ryv.

flabellum, Daed. Cke. G. 19:93, 1891. Rangoon, Burma.
= **Lenzites acuta** Berk.

flavipora, Poria Cke. G. 15:25, 1886.
= **Schizopora flavipora** (Cke) Ryv. For a description, see Ryvarden & Johansen (1980:553, as **S. trichiliae**) or David & Rajchenberg (1985:314 as **S. carneo-lutea**).

fumosogriseus, Pol. Cke. & Ellis G. 9:103, 1881. Pennsylvania, USA.
= **Bjerkandera adusta** (Fr.) Karst.

fuscomarginata, Poria Berk. & Cke. G. 15:24, 1886. Rhode Island, USA.
= **Perenniporia subacida** (Peck.) Donk as already indicated by Lowe (1966:109).

gallogrisea, Poria Cke. G. 15:25, 1886. India.
= **Antrodia** sp. sterile. Unknown identity.

gausapata, Tram. Cke. G. 19:102, 1891. USA.
= The type has not been found.

geogena, Poria Cke. G. 15:25, 1886. Venezuela.
= **Antrodia** sp. The type is sterile and badly contaminated.

geotropus, Pol. Cke. G. 13:32, 1884. Demarara, Brazil.
= **Rigidoporus ulmarius** (Fr.) Imaz.

gerardi, Polyst. Berk. & Cke. G. 15:24, 1886. Amazonas, Brazil.
= **Polyporus** s.str. The type is sterile.

glaucotus, Pol. Cke. G. 9:12, 1880. Japan.
= **Phellinus adamantinus** (Berk.) Ryv. as indicated already by Bresadola on the sheet.

glutinifer, Pol. Cke. G. 15:19, 1886. Mauritius.
= **Polyporus udus** Jungh. as indicated by J. Wright on the sheet.

guilfoylei, Lenz. Cke. G. 10:64, 1881. Queensland, Australia.
= **Lenzites acuta** Berk.

hartmannii, Pol. Cke. G. 12:14, 1883. Queensland, Australia.
= Accepted in the genus, see Cunningham 1965:79 for a description.
There are 5 collections on the sheet. Coll. Toivooma, Queensland (ink, Cooke's hand) is selected as lectotype.

heteromalla, Tram. Cke. G. 10:132, 1882. S. Wales, Australia.
= **Coriolopsis polyzona** (Pers.) Ryv.

hobsonii, Pol. Cke. G. 15:20, 1886. Bombay, India.
= **Leucophellinus hobsonii** (Cke.) Ryv. comb. nov. Basionym: **Polyporus hobsonii** Cke. Grevillea 15:20, 1886.
This is a prior name for **Leucophellinus mollissimus** (Pat.) Reid. Parmasto (1983) was of the opinion that this species also is represented in North Eastern Asia (described as **Leucophellinus irpicoides** (Pil.) Bond.). However, as already pointed out by Parmasto, the North-Eastern population has smaller spores than the tropical one, and for the time being I prefer to keep them as two species. The tropical specimens are almost always pileate, while those of North East Asia are almost always resupinate. For a description, see Ryvarden & Johansen 1980:453 as **Oxyporus mollissimus** (Pat.) Reid.

holomelanus, Fomes Cke. G. 15:51, 1886. Panuré, Brazil.
= **Polyporus atro-umbrinus** Berk.

holoxantha, Poria Berk. & Cooke. G. 15:26, 1886. Georgia, USA.
= **Perenniporia pulchella** (Schw.) Ryv. as indicated by Lowe (1966:111).

hyperborea, Poria Cke. G. 15:27, 1886. North America.
= Nomen nudum. There is one specimen in the Kew herbarium, which is a resupinate specimen of **Trichaptum biformis** (Fr. in Kl.) Ryv.

hypolateritia, Poria Cke. G. 15:24, 1886. India.
= **Tyromyces hypolateritia** (Cke.) Ryv. For a description see Ryvarden and Johansen 1980:608.

hypomelanus, Pol. G. 15:51, 1886. New Zealand.
= Accepted in the genus, for a description see Cunningham (1965: 136). The species is close to **Polyporus gayanus** Lév. which was described from the **Nothofagus**-forests in Chile. The two species may ultimately prove to be the same.

hyposclerus, Pol. Cke. G. 10:103, 1882. Australia.
= **Rigidoporus vinctus** (Berk.) Ryv.

hystriculus, Pol. Cke. G. 15:16, 1886. Melbourne, Australia.
= **Tyromyces pelliculosus** (Berk.) Cunn. as already cited by Cunningham (1965:124).

hystrix, Tram. Cke. G. 9:98, 1881. Mauritius.
= **Hexagonia hirta** Fr. as indicated by M.E.P.K. Fidalgo on the sheet.

illuda, Daeda. Cke. G. 21:37, 1892. Victoria, Australia.
= **Datronia brunneo-leuca** (Berk.) Ryv. comb. nov. Basionym: **Polyporus brunneo-leucus** Berk. Lond. J. Bot. 5:4, 1846. For a description, see Ryvarden & Johansen 1980:285.

incurvus, Pol. Cke. G. 13:2, 1884. Perak, Malaysia.
= **Rigidoporus incurvus** (Cke.) Ryv. comb. nov. Basionym: **Polyporus incurvus** Cke. Grevillea 13:2, 1884.
Basidiocarp laterally stipitate, pileus fanshaped, up to 3 cm

wide and 4 mm thick, woody hard when dry, upper surface dull, ochraceous with narrow pale gray zones, stipe 3 cm high, 3-4 mm in diam, ochraceous, glabrous, pore surface pale reddish brown, probably more pinkish when fresh, pore invisible to the naked eye, 7-8 per mm, tubes concolorous with pore surface, up to 3 mm deep and distinctly darker than the context, the latter fibrous, and ochraceous, up to 1 mm thick.
Hyphal system monomitic, generative hyphae with simple septa, in the context 4-8 µm wide with thick walls and scattered septa, in parts swollen to 30 µm and reminding of imbedded smooth cystidia, in the trama agglutinated, narrower and more thin-walled, no cystidia seen, mammilate cystidiols few and scattered, smooth, up to 25 x 8 µm, spores globose, thin-walled, hyaline, IKI-, 3-4 µm in diameter. Only the type has been seen.
R. biokoensis (Lloyd) Ryv. has a similar basidiocarp, but the spores are larger and cystidia are present in the hymenium. The simple-septate hyphae, the globose spores and the mammilate cystidiols clearly place **P. incurvus** in **Rigidoporus**. The pore surface has the same colour as in dried specimens of **R. lineatus** (Pers.) Ryv. and **R. microporus** (Fr.) Overeem and like these species, the pore surface of **R. incurvus** is probably orange to pink in fresh condition.

introstuppeus, Pol. Cke. G. 13:2, 1884. N.W. India.
= **Fomes fomentarius** (L.:Fr.) Kicks.

kurzianus, Polyst. Cke. G. 15:22, 1886. Java.
= **Trametes menziesii** (Berk.) Ryv.

laetus, Pol. Cke. G. 19:103, 1891. Victoria, Australia.
= **Rigidoporus laetus** (Cke.) Buch. & Ryv. For a description, see Cunningham (1965:196).

laevis, Hexagonia Cke. G. 19:103, 1891. Andaman Islands.
= **Daedalea sulcata** (Berk.) Ryv. For a description, see Mitra and Roy (1984).

laeteritius, Pol. Cke. G. 9:12, 1880. Rio de Janeiro, Brazil.
= **Pyrofomes laeteritius** (Cke.) Ryv. Norw. J. Bot. 19:236, 1972.
Basidiocarp perennial, woody, applanate, broadly attached, semicircular, up to 15 cm in diameter, 5 cm thick at the base, upper surface smooth and initially covered with a pale brown to brick red tomentum, apparently soon becoming glabrous exposing a darker reddish brown surface, slightly pitted and warted, but no distinct cuticle present, pore surface yellowish brown, pores round and thick-walled, almost invisible to the naked eye, 7-9 per mm, tubes concolorous, up to 3.5 mm deep and stratified, context up to 3 cm thick, brick red to orange brown, cherry red with KOH, changing to black at drying.
Hyphal system trimitic, generative hyphae hyaline and with clamps, 1-3 µm wide, very difficult to find in the type specimen, skeletal hyphae yellow to rusty brown, 2-6 µm wide, binding hyphae sparsely branched, yellowish, 2-3 µm wide,

cystidia and basidia not observed, spores thick-walled, globose to slightly truncate, hyaline to slightly thick-walled, IKI negative, 5-6 x 4.5-5.5 µm.
Known from Brazil, besides the type collection, specimens have also been seen from Amazonas (Herb. NY).

leucocreas, Pol. Cke. G. 8:55, 1879. New Zealand.
= **Piptoporus portentosus** (Berk.) Cunn. as already indicated by Cunningham 1965:106.

leucospongia, Pol. Cke. & Harkness. G. 11:106, 1883. California, USA.
= **Oligoporus leucospongia** (Cke. & Hark.) Gilbn. & Ryv. For a description, see Gilbertson & Ryvarden (1987:474).

lividus, Pol. Cke. G. 10:131, 1882. Clarence River, Australia.
= Illegitimate name, homonym of **P. lividus** Kalch. Grevillea 10:103, 1882.

luridus, Pol. Cke. G. 12:21, 1883. Name change for **Pol. lividus** Cke., non Kalch..
= **Perenniporia tephropora** (Mont.) Ryv.

makuensis, Polyst. Cke. G. 16:25, 1887. Makua, Mozambique.
= **Microporus vernicipes** (Berk.) Kunt.

malaiensis, Polyst. Cke. G. 14:13, 1885. Perak, Malaysia.
= **Phellinus discipes** (Berk.) Ryv.

membranacincta, Poria Cke. G. 15:26, 1886. Tasmania.
= **Tyromyces merulinus** (Berk.) Ryv.

microsticta, Daedalea Cke. G. 10:122, 1882. Rio de Janeiro, Brazil.
= Accepted in the genus. For a description, see Fidalgo & Fidalgo (1967:848).

muelleri, Daed. Cke. G. 19:93, 1891. Victoria, Australia.
= **Lenzites elegans** (Fr.) Pat.

mylittae, Pol. Cke. & Mass. G. 21:37, 1892. Victoria, Australia.
= Accepted in the genus. For a description, see Cunningham (1965:81).

neaniscus, Polyst. Cke. G. 15:24, 1886. Type locality unknown.
= **Trametes versicolor** (Fr.) Pil.

nebularis, Polyst. Cke. G. 15:23, 1886. Rio de Janeiro, Brazil.
= **Trichaptum sector** (Fr.) Kreisel.

nigrescens, Polyst. Cke. G. 20:90, 1892. Brazil.
= **Nigroporus vinosus** (Berk.) Murr.

nigrolaccatus, Pol. Cke. G. 9:97, 1881. Mauritius.

= **Ganoderma galagensis** (Mont.) Pat. Noted on the sheet by Bresadola.

nivea, Lenz. Cke. G. 15:94, 1887. Queensland, Australia.
= **Lenzites vespacea** (Pers.) Ryv.

oblinitus, Fomes Cke. G. 15:22, 1886. Mauritius.
= **Coriolopsis sanguinara** (Kl.) Ryv. based on the same type specimen as that of Klotzsch species.

obstinatus, Tram. Cke. G. 10:17, 1883. Endeavour River, Australia.
= **Trametes meyenii** (Kl.) Lloyd as already indicated by Cunningham (1965:168).

ochroflava, Tram. Cke. G. 9:12, 1880. Rio de Janeiro, Brazil.
Accepted in the genus.
Type: Brazil, Rio de Janeiro, Glaz. 11769.
Basidiocarp pileate, applanate, semicircular, dimidiate to partly sessile, woody, 10 cm long, 5 cm wide, 2 cm thick at the base, margin rounded, appr. 5-8 mm thick, upper surface pale brown to dark ochraceous today, tuberculate, glabrous, dull, slightly zoned at the margin, pore surface concolorous, margin wide and sterile, pores round to slightly angular, thick-walled, 4-5 per mm, hardly visible to the naked eye because of the thick pore-walls, tubes concolorous, up to 1 cm deep, context dense, dark ochraceous, up to 1.5 cm at the base.
Hyphal system trimitic, generative hyphae hyaline with clamps, 2-4 µm wide, very difficult to find in the type, skeletal hyphae dominant, 3-6 µm wide, thick-walled, but with distinct lumen, unbranched, slightly flexous, embedded and not easily separated, binding hyphae few and only fragments observed. No hymenium present, and no spores and basidia seen. This species is unknown to me, but should be easy to recognize in the field because of the even ochraceous colour which probably has darkened over the years compared with fresh condition. **Trametes elegans** (Fr.) Fr. in its poroid state may remind of this species, but has a white context and the pores are larger. The species seems to be correctly placed in **Trametes** with its trimitic hyphal system and as long as we do not know the type of rot.

omaena, Poria Cke. G. 15:26, 1886. Carolina, USA.
= The type is apparently lost.

palisserii, Pol. Cke. G. 10:98, 1882. Victoria, Australia.
= **Trametes cingulata** Berk.

parishii, Polyst. Cke. G. 15:51, 1886. Moulmein, India.
= **Earliella scabrosa** (Pers.) Gilbn. & Ryv.

perdurans, Pol. Kalch. & Cke. G. 9:1, 1880.
= The type is lost.

phlebiaformis, Poria Cke. G. 15:24, 1886. Cuba.
= **Hapalopilus phlebiaformis** (Cke.) Ryv. Mycotaxon 28:528, 1987. For a description, see Lowe 1966:125.

pinguedinea, Poria Cke. G. 15:25, 1886.
= Nomen nudum, illegitimate name.

placentaeformis, Polyst. Cke. G. 15:24, 1886. Canada.
Grevillea 15:24, 1886, Carlton, Br. North America.
The type collection is mixed and consists of two small, immature and badly developed specimens. The smallest one may be a young specimen of a **Coriolopsis** species because it has a brown context and a tomentose pileus with a trimitic hyphal system. The other specimen has a split hymenophore and may have been resupinate when fresh while the margin loosened and curled up during the drying. No hymenium is developed in either of the two specimens.
The name should be dropped as a nomen ambigum.

platyphyllus, Lenz. Cke. G. 13:1, 1884. Perak, Malaysia.
= **Lenzites acuta** Berk.

popanoides, Pol. Cke. G. 9:97, 1881. Mauritius.
= **Amylosporus campbellii** (Berk.) Ryv.

porothelioides, Poria Cke. G. 15:27, 1886. Venezuela.
= **Antrodia porothelioides** (Cke.) Ryv. comb. nov. Basionym: **Poria porothelioides** Cke. Grevillea 15:17, 1886.
Basidiocarp annual, detachable, resupinate, tough, up to 3 mm thick, margin whitish and with rhizomorphs, surface ochraceous today (white when fresh?), pores angular, rather thin-walled, 6-7 per mm, tubes concolorous, context tough and fibrous, white to wood-coloured, 1-2 mm thick.
Hyphal system dimitic, generative hyphae with clamps, difficult to observe in the type, 2-3 µm wide, skeletal hyphae dominating, rather narrow, 1.5-3 µm wide, IKI-, basidia 4-sterigmate, 12-15 x 4-5 µm, spores hyaline, thin-walled, IKI-, ellipsoid to subcylindrical, 5.5-6.5 x 2.5-3 µm. On deciduous wood.
This species reminds of **A. gossypia** (Speg.) Ryv. because of the rhizomorphs and relatively large ellipsoid spores. However, it is separated by its larger spores (4-5.5 µm long in **A. gossypia**) and smaller pores.

porriginosa, Poria Cke. G. 15:26, 1886. Bombay, India.
= No structure present, only a mycelial mat. Nomen dubium.

proteiformis, Polyst. Cke. G. 14:81, 1886. Australia.
= **Trametes marianna** (Pers.) Ryv. Namechange for **Pol. proteus** Kalch. 1882, non Berk. 1843.

proteiporus, Pol. Cke. G. 12:15, 1883. Inochomba, Queensland, Australia.
= **Abortiporus biennis** (Bull.:Fr.) Murr. as indicated by Cunningham (1965:82).

purpurea, Tram. Cke. G. 10:121, 1882. Japan.
= **Daedaleopsis purpurea** (Cke.) Imaz. & Aoshima. For a description, see Imazeki and Aoshima (1967:619).

purpureo-fuscus, Polyst. Cke. G. 15:24, 1886. South Carolina, USA.
= **Phellinus gilvus** (Schw.) Pat.

pyrrochreas, Fomes Cke. G. 14:11, 1885. New Guinea.
= **Pyrofomes albomarginata** (Lév.) Ryv. as already noted by Bresadola on the sheet.

regulicolor, Fomes Cke. G. 15:21, 1886. Cuba.
= **Amauroderma schomburgkii** (Berk.) Torr. as already noted by Bresadola on the sheet.

retriporus, Pol. Cke. G. 12:15, 1883. Australia.
= **Bondarzewia berkeleyi** (Fr.) Bond. & Sing.

rhinocerus, Fomes Cke. Trans. Bot. Soc. Edinburgh. 13:150, 1879.
= **Lignosus rhinocerus** (Cke.) Ryv. For description, see Ryvarden & Johansen (1980:408).

rigescens, Polyst. Cke. G. 14:12, 1885. Perak, Malaysia.
= **Antrodiella liebmannii** (Fr.) Ryv.

rufitincta, Poria Cke. G. 15:25, 1886. Cuba.
= **Phellinus rufitinctus** (Cke.) Ryv. For a description, see Ryvarden & Johansen (1980:210).

rufopictus, Polyst. Cke. G. 15:23, 1886. Cuba.
= **Rigidoporus lineatus** (Pers.) Ryv.

salleana, Poria Cke. G. 15:25, 1886. Cordova, Argentina.
= **Gloeoporus** cfr. **dichrous** (Fr.) Bres. The type is sterile and in a bad condition.

salpinctus, Pol. Cke. G. 8:142, 1880. New Zealand.
= **Coltricia salpinctus** (Cke.) Cunningh. For a description, see Cunningham (1965:194).

sepiater, Pol. Cke. G. 9:100, 1880. Rio de Janeiro, Brazil.
= **Rigidoporus microporus** (Fr.) Overeem.

setiger, Pol. Cke. G. 20:1, 1890. New Zealand.
= **Tyromyces setiger** (Cke.) Cunningh. For a description, see Cunningham (1965:120).

siennaecolor, Polyst. Cke. G. 15:22, 1886. Panuré, Brazil.
= **Antrodiella versicutis** (Berk. & Curt.) Ryv.

sinensis, Lenz. Cke. G. 17:75, 1889. China.
= **Daedaleopsis tricolor** (Fr.) Schroet.

socotrana, Tram. Cke, G. 11:39, 1882. Socotra, Tanzania.
= Accepted in the genus, for a description, see Ryvarden & Johansen (1980:584).

sordidus, Pol. Cke. G. 15:20, 1886. USA.
= Illegitimate name, homonym of **P. sordidus** Berk. in Fr. 1851. The type of the illegitimate name is a specimen of

Fomitopsis spraguei (Berk.) Gilbn. & Ryv.

spiculiferus, Pol. Cke. G. 15:20, 1886. Australia.
= **Fistulina spiculifera** (Cke.) Reid. For a description, see Reid (1963:280)

subaurantia, Poria Cke. G. 15:27, 1886. Carolina, USA.
= **Perenniporia subacida** (Peck) Donk, as already indicated on the sheet by Bresadola.

subcongener, Daed. Cke. G. 10:133, 1882. Australia.
= Nomen nudum and illegitimate.

subtenuis, Hexagonia Cke. G. 010:133, Australia.
= **Hexagonia tenuis** (Hook.) Fr.

subzonalis, Pol. Cke. G. 19:44, 1890. Australia.
= **Trametes menziesii** (Berk.) Ryv.

sulcatus, Pol. Cke. G. 13:32, 1884. Demarara, Brazil.
= **Perenniporia martius** (Berk.) Ryv.

talpae, Pol. Cke. G. 16:15, 1887. Minas Geras, Brazil.
= **Laetiporus percicinus** (Berk. & Curt.) Gilbn.

tegillaris, Poria Cke. G. 15:25, 1886. Carolina, USA.
= Unknown identity, the type is badly developed, sterile, and badly contaminated. Nomen dubium.

tenellus, Pol. Cooke & Ellis G. 7:81, 1878. New Jersey, USA.
= **Ceriporia tarda** (Berk.) Ginns.

tomentocincta, Poria Cke. G. 15:26, 1886. Carolina, USA.
= **Perenniporia pulchella** (Schw.) Ryv. as already stated by Bresadola on the sheet.

trizonatus, Pol. Cke. G. 12:17, 1883. Yarra, Australia.
= **Microporus affinis** (Blume & Nees:Fr.) Kunt.

description.

tumulosus, Pol. Cke. G. 17:55, 1889. Australia.
= Accepted in the genus. For a description, see Cunningham (1965:78).

veluticeps, Pol. Cke. G. 13:6, 1884. Mozambique.
= **Microporus concinnus** (Fr.) Kunt. as indicated by D.A. Reid on the sheet.

venezuelae, Pol. Cke. G. 15:20, 1886. Venezuela.
= **Fomitella supina** (Schwartz) Murr.

victoriae, Pol. Cke. G. 8:55, 1879. Victoria, Australia.
= **Phellinus wahlbergii** (Fr.) Reid.

zealandicus, Pol. Cke. G 8:55, 1879. New Zealand.
= **Phellinus wahlbergii** (Fr.) Reid.

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TAXONOMIC STUDIES IN THE GENUS *MYCOSPHAERELLA*. SOME SPECIES OF *MYCOSPHAERELLA* ON BRASSICACEAE IN CANADA

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Descriptions and illustrations of 4 species of *Mycosphaerella* (*M. brassicicola*, *M. cruciferarum*, *M. densa* and *M. tassiana*) occurring on Brassicaceae are provided. A key to the species and a host index are also given.

Le auteur décrive et illustre 4 espèces de *Mycosphaerella* (*M. brassicicola*, *M. cruciferarum*, *M. densa* and *M. tassiana*) venant sur les Brassicaceae. Un clef des espèces et un index des hôtes sont également présentés.

Introduction

The genus *Mycosphaerella* Johanson was established by Johanson (1884, p.163) as a new name for *Sphaerella* (Fr.) Rabenh., a later homonym of the algal genus *Sphaerella* Sommerfelt published in 1824. *Mycosphaerella* is based on *Sphaeria* subgenus *Sphaerella* Fr. (1849, p. 395), erected for several species of *Sphaeria* possessing immersed inconspicuous ascomata on dried leaves. Of the seven species listed by Fries, three of them, *Sphaeria maculaeformis* Pers.: Fr., *S. punctiformis* Pers.: Fr. and *S. recutita* Fr. are currently retained in *Mycosphaerella*. Although its nomenclatural status has long been a controversial subject as summarized by Holm (1975, p 482, 484-5), *Sphaerella*

sensu Fries is now generally accepted (Müller & von Arx 1962, p. 353; Barr 1972, p. 582; Holm 1975, pp. 485-6; Tomilin 1979, p. 7; Sivanesan 1984, p. 182) to have been used first at the generic level by Rabenhorst (1856). On some but not all packet labels of the exsiccatus specimen in Klotzchii Herb. vivum mycol., edition 2, cent. 3, no. 264, 1856 (fide Holm, p. 484-5) and in Bot. Zeit. 14:445. June 1856, Rabenhorst listed "*Sphaerella punctiformis* (Pers.)Fr. Summa. 396. var. *perexigua* Desmaz.", thus providing a direct reference to Fries' publication of subgenus *Sphaerella*. As pointed out by Holm (1975, p. 485), Rabenhorst incorrectly cited Fries as having published *Sphaerella* at the generic level but Rabenhorst is to be credited, albeit unintentionally, with the transfer to generic rank. Later, Fuckel (1870, p. 99) used *Sphaerella* (Fr.) at the generic level, characterizing the genus as having very small perithecia, 8-spored fasiculate asci and more or less oval, hyaline 2-celled ("..2 zellige,..") ascospores. He listed over fifty species mostly on living or dead leaves and included three of the seven species listed by Fries including *Sphaeria punctiformis* Pers.: Fr. *Sphaerella* (Fr.) Fuckel would be both a later homonym and obligate synonym of *Sphaerella* (Fr.) Rabenh. Cesati and de Notaris (1863, p. 236-8) meanwhile erected the genus *Sphaerella* Ces. & de Not. without any reference to *Sphaerella* (Fries) and did not include any of Fries' species. *Sphaerella* of Cesati and de Notaris comprises species with 1- or 2-septate or rarely non-septate ascospores. Auerswald (1869, pp. 1-20), although not citing the generic authority, used *Sphaerella* in the sense of Cesati & de Notaris. Saccardo accepted *Sphaerella* Ces. & de Not. in volume 1 of the Sylloge (1882, p. 476), pro parte, retaining in *Sphaerella* only species with one-septate ascospores. *Sphaerella* Ces. & de Not. is listed as a facultative synonym of *Mycosphaerella* in the seventh edition of Ainsworth & Bisby's Dictionary of the Fungi, (Hawksworth et al. 1983, p. 357) and as a synonym of the genus by von Arx (1949, p. 32), Müller & von Arx (1962, p. 353) and by Eriksson & Hawksworth (1986, p. 254). I would certainly agree that *Sphaerella* Ces. & de Not. in the restricted sense of Saccardo (1882) for species with 1-septate ascospores is a facultative synonym of *Mycosphaerella* Johans.

Because of the large number of *Mycosphaerella* and *Sphaerella* names in the literature no true world monograph of the genus *Mycosphaerella* exists at this time. Most of the recent comprehensive taxonomic works

are either regional treatments such as those by von Arx (1949) and Müller & von Arx (1962) on some European species and by Barr (1959, 1972) on the North American species or host limited treatments such as those by Holm and Holm (1979) on the Swedish species occurring on ferns and Evans (1984) on the species found on Pinus. Sivanesan's recent book (1984) deals with the species possessing well documented anamorphs. Tomilin's treatment (1979) of over 600 species or names arranged by host family perhaps comes closest to being a world monograph.

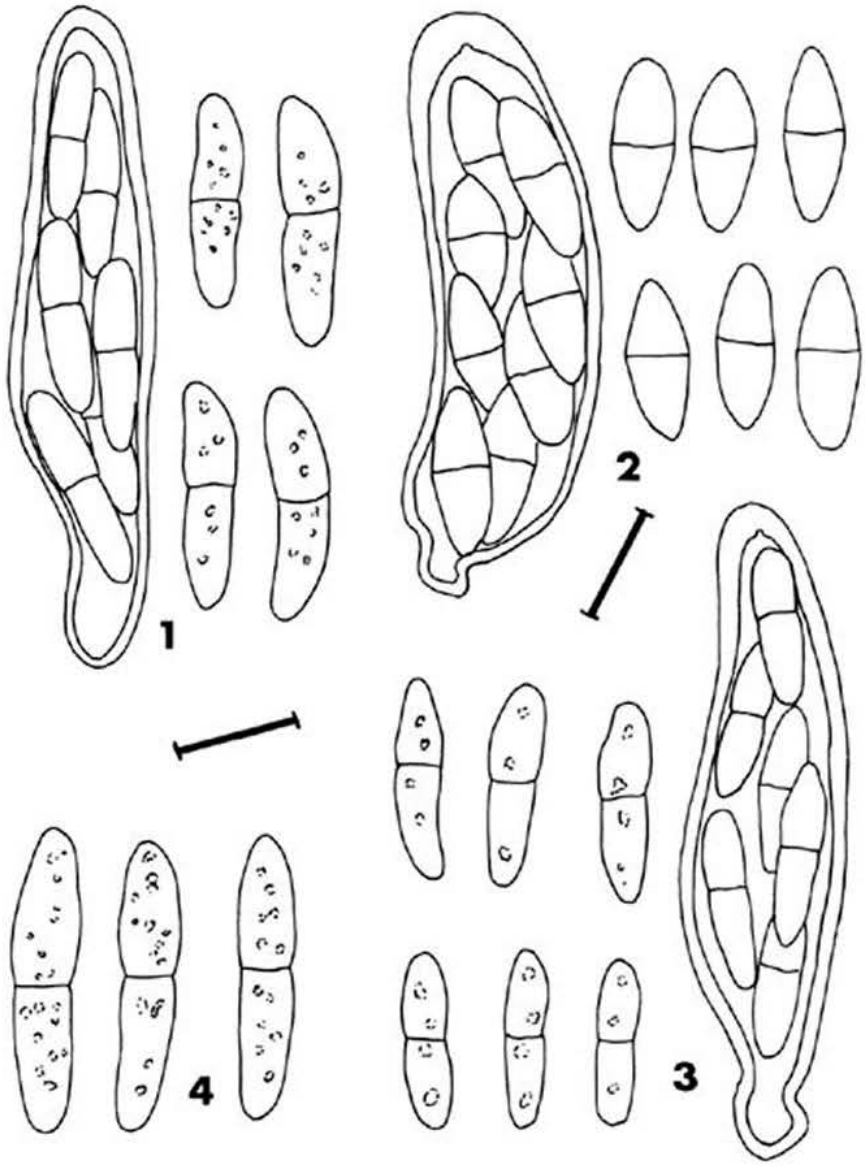
The present study is concerned with some species of *Mycosphaerella* occurring as saprophytes and/or pathogens on native and cultivated members of the the agriculturally important family Brassicaceae in Canada. The *Mycosphaerella* collections at the National Mycological Herbarium (DAOM) have been the principal source of material for this taxonomic study.

Key to the Species based on Fungus Morphology, Anamorphs

1. Asci saccate, few; ascospores up to 30µm long; anamorph a *Cladosporium* — *M. tassiana*
1. Asci elongate, numerous; ascospores less than 30µm long; anamorph other than *Cladosporium* or none — 2.

2. Ascomata and pycnidia in conspicuous pale spots on *Brassica* species; anamorph an *Asteromella* — *M. brassicicola*
2. Pale conspicuous spots absent; anamorphs apparently lacking or unconfirmed — 3.

3. Ascomata grouped in shiny black often stroma-like aggregations; ascospores 14-22x3-4.5µm, clavate, tapering to base — *M. densa*
3. Ascomata in dull blackened zones with abundant dark subepidermal hyphae; ascospores 13-15.5x3.5-5µm, fusoid to ellipsoid — *M. cruciferarum*



FIGURES 1-4, asci and ascospores. Fig. 1. *Mycosphaerella brassicicola*, DAOM 118312. Fig. 2. *Mycosphaerella cruciferarum*, DAOM 63458. Fig. 3. *Sphaerella densa*, ex type and *Mycosphaerella densa*, DAOM 70507. Fig. 4. *Dothidella sphaerelloides*, ex type. (scale = 10µm)

Species descriptions

Mycosphaerella brassicicola (Duby) Lindau, in Engler & Prantl, Die Naturl. Pflanzenf. 1(1):424. Feb. 1897. (FIGS. 1, 7-12)

=*Sphaeria brassicicola* Duby, Botanicon Gallicum 2:712. 1830, as *brassicaecola*, non *Sphaeria brassicicola* Berk. & Br., apud Berk., Outlines Br. Fungol. p. 401. 1860.

=*Sphaerella brassicicola* Ces. & de Not., Comment. Soc. critt. ital. 4:238. 1863, as *brassicaecola*.

=*Mycosphaerella brassicicola* (Duby) Oudem., Rév. Champ. Pays-Bas. 2:210. March 1897, as *brassicaecola*.

Anamorph: *Asteromella brassicae* (Chev.) Boerema & van Kesteren, Persoonia 3:18. 1964.

Ascomata mostly on leaves but also on stems and fruits, numerous, gregarious, immersed, becoming erumpent, globose to subglobose to somewhat flattened, 90-145µm wide X 90-125µm high, medium brown to dark brown, papillate, ostiole 16-20µm across. Ascoma wall 9-12µm thick, composed of 3-4 layers of medium to dark reddish brown angular pseudoparenchymatous cells, up to 6.5 X 4.5µm, increasingly paler to the inside. Pseudoparaphyses lacking. Asci bitunicate, numerous, elongate to clavate, 8-spored, 30-47(55) X 12-16µm. Ascospores hyaline, cylindrical, straight or curved, 16-25 X 3-4µm, septate in the middle, constricted or not constricted at septum, upper cell sometimes slightly broader than lower cell but generally uniform in width, ends rounded, hyaline, wall smooth, irregularly biseriate in the ascus.

Pycnidia globose to subglobose, sometimes flattened, 70-85(100)µm wide by 65-80µm high. Pycnidium wall 12-15µm thick, composed of 2-4 layers of angular reddish brown pseudoparenchymatous cells, ca 4-5µm diam. Pycnidiospores (spermatia) cylindrical, straight or curved, 3-5.5 X 1µm, hyaline.

Parasitic on leaves of *Brassica* species. Collections examined: On *Brassica oleracea* L. var. *botrytis* L. (cauliflower). CANADA: BRITISH COLUMBIA: Saanichton, Research Stat., DAOM 118311 (SBC 74), coll. W. Jones, March, 1934. On *Brassica oleracea* L. var. *capitata* L. (cabbage). CANADA: BRITISH COLUMBIA: Saanichton, DAOM 118309 (SBC 508), coll. W.J., July 1940; DAOM 118310 (SBC

648), coll. I. Mounce, 1 April 1942. Keating, DAOM 118312 (SBC 608), coll. W.J., July 1941. On *Brassica oleracea* L. var. *gongyloides*. NEW ZEALAND: Auckland City, Mt. Albert, DAOM 178265 (ex herb. PDD 34682), coll. B.H.C. McKenzie, 12 Feb. 1976. On *Brassica oleracea* L. var. cultivated. U.K.: NORTHERN IRELAND: Belfast, DAOM 2279, coll. H.T. Güssow, Aug. 1934. FRANCE: C. Roumeguère, F. gall. exsicc. 1602. On Brassica. FRANCE: Grand Quevilly, Rabenh., F. europ. 2754, coll. Letendre, 1882.

Three additional collections from the U.S.A., ex herb. TRTC, were examined: on *B. oleracea* var. *botrytis*, from Colma, California, coll. M.W. Gardner, 6 Dec. 1933; on *B. oleracea* var. *acephala* DC from Toledo, Oregon, coll. M.J. Conklin, 7 Jan. 1927; on *B. oleracea* var. *capitata* from Couperville, Washington, coll. F.D. Heald & L.M. Freeman, 21 July 1939. Unfortunately these collections, although apparently *M. brassicicola*, were immature. The California collection possesses a few ascospores but asci and ascospores were not seen in the other two collections. Barr (1953) cited several collections of *M. brassicicola* from herb. UBC; two or three of her citations are from Saanichton, British Columbia and are probably the ones examined in this study.

Mycosphaerella brassicicola produces a conspicuous pale grey-brown circular lesion up to 2 cm across, bounded by a narrow chlorotic zone (ring spot) on the outer leaves of *Brassica* species. Large numbers of spermatial pycnidia followed by ascomata are produced in the lesions mostly on the upper (outer) leaf surface although some fructifications are hypophyllous.

Punithalingam & Holliday (1969) provided a description and illustrations of *M. brassicicola* and references to the pathological literature. The life history of the fungus was described by Dring (1961) and Boerema & van Kesteren (1964) resolved the nomenclatural confusion, providing full synonymy for both teleomorph and anamorph.

Mycosphaerella cruciferarum (Fr.) Lindau, in Engler & Prantl, Die Naturl. Pflanzenf., Leipzig 1(1):424. 1897. (FIGS. 2, 13-15)

=*Sphaeria cruciferarum* Fr., Syst. Mycol. 2:315. 1823.

=*Sphaerella cruciferarum* (Fr.) Sacc., Michelia 2:315. 1881.

=*Sphaerella cruciferarum* (Fr.) v. Höhnel, Ber. Deut. Bot. Ges. 36:314. 1918.

Ascomata subepidermal in the stems, numerous, gregarious, immersed, becoming erumpent, connected by strands of medium brown hyphae radiating from individual ascomata, subglobose to somewhat depressed, 84-125µm wide by 70-100µm high, dark brown; ostiole 14-18µm across, neck conical or short cylindrical, 8-12µm high and ca 20µm wide, apex of ascoma distinctly flattened. Ascoma wall up to 10µm thick, composed of dark to light brown angular pseudoparenchymatous cells, 3-5µm broad. Pseudoparaphyses lacking. Asci bitunicate, thick-walled, elongate, ovoid to obclavate, numerous in a broad fascicle, 8-spored, 34-55 X 9-16µm. Ascospores hyaline, free ascospores appearing pale greenish, fusoid to ellipsoidal at maturity, straight or curved, 13-15.5 X 3.5-5µm, septate in the middle, not constricted at septum, becoming 2-3-septate at maturity, ends somewhat bluntly pointed, wall smooth, bi- to multiseriate in the ascus.

On old stems of various Brassicaceae. Collections examined: On *Draba alpina* L. CANADA: QUEBEC: McClelan Strait, DAOM 63458, coll. R.T. Wilce, 19 July 1955. On *Erysimum cheiranthoides* L. GERMAN DEMOCRATIC REPUBLIC: Brandenburg, Sydow, Mycoth. germ. 1231 in DAOM, coll. P. Vogel, 27 July 1913. On *Eutrema edwardsii* R.Br. CANADA: NORTHWEST TERR.: Baffin I., head of Clyde Inlet, DAOM 63422, coll. P. Dansereau, 27 June 1950.

Barr (1959) considered *Mycosphaerella cruciferarum* to be both common and widespread on Brassicaceae in temperate regions but also to occur in subarctic and arctic areas. The collections examined are characterized by an abundant subepidermal network of hyphae radiating from and connecting individual closely grouped ascomata. The dark ascomata and connecting mycelium are seen as blackened zones up to 1 mm across on the overwintered host twigs.

Mycosphaerella densa (Rostrup) Lind, in Rep. Sci. Res. Norweg. Exped. Nov. Zembl., 1921. 19:12. 1924. (FIGS. 3, 16-21)

=*Sphaerella densa* Rostrup, Botanisk Tidsskr. 14:225. 1885.

Ascomata predominantly epiphyllous but some occurring on lower leaf surface, grouped, rarely separate, connected

by masses of red-brown subepidermal hyphae, sometimes so closely grouped as to form shiny blackened stroma-like aggregations, immersed, subepidermal, erumpent, globose, subglobose, or elongate, (76)85-140µm wide by (78)95-150µm high, dark brown to blackish in mass; ostiole 10-25µm across, neck papillate or conical, often apically flattened. Ascoma wall 6.5-12µm thick and 2-3(4) cell layers, composed of medium reddish brown angular pseudoparenchymatous cells up to 11 x 5.5µm, wall cells paler to the inside but a darker red-brown around the neck; the latter when viewed from above, appearing as a darkened doughnut-like ring around each ostiole. Pseudoparaphyses lacking. Asci numerous, bitunicate, thick-walled, fasiculate, oblong to clavate, numerous, 8-spored, 36-54 X 9-11µm. Ascospores hyaline to greenish hyaline, obovoid to clavate, straight or curved, 14-22(24) X 3-4.5µm, septate in the middle, not constricted at septum, upper cell distinctly broader than lower cell, narrowing to the base, straight or curved below, upper end rounded to somewhat pointed, lower end rounded, wall smooth, cells faintly guttulate, biseriate in the ascus.

Saprophytic to parasitic on leaves, sometimes stems, of various plants including members of the Brassiciaceae. Collections examined (selected): On *Braya purpurascens* (R. Br.) Bunge. CANADA: NORTHWEST TERR.: Dist. Franklin, Baffin I., Clyde Inlet, DAOM 63476, coll. P. Dansereau, 2 July 1950. On *Cardamine bellidifolia* L. GREENLAND: Marchion Sound, ex herb. C, coll. J. Nygaard, 15 Aug. 1921. CANADA: NORTHWEST TERR.: Dist. Franklin, Somerset I., DAOM 70507, coll. D.B.O. Savile, 11 Aug. 1958. Cornwallis I. Resolute Bay, DAOM 70506, coll. D.B.O.S., J.A. Calder & I. Kokkonen, 13 Aug. 1959. Ellef Ringnes I., sw Isachsen, DAOM 75128, coll. D.B.O.S., 1 Aug. 1960. S of Isachsen, DAOM 83310, coll. D.B.O.S., 2 Aug. 1960. On *Cardamine pratensis* L. CANADA: NORTHWEST TERR.: Dist. Franklin, Bray I., DAOM 63069, coll. P.D., 10 Aug. 1950. On *Cochlearia officinalis* L. CANADA: NORTHWEST TERR.: Dist. Franklin, Ellef Ringnes I. sw Isachsen, DAOM 83311, coll. D.B.O.S., 19 July 1960. Victoria I., DAOM 88156, coll. W.D. Stretton & D.B.O.S., 29 Aug. 1960. On *Draba alpina* L. CANADA: NORTHWEST TERR.: Dist. Franklin, Ellef Ringes I., Isachsen, DAOM 75132, coll. D.B.O.S., 13 July 1960. On *Draba belli* Holm. Ellef Ringnes I., DAOM 75133, coll. D.B.O.S., 7-8 July 1960. On *Draba lactea* Adams. Dist. Franklin, Somerset I., DAOM 70509, coll. D.B.O.S., 9 Aug. 1958.

According to Barr (1959), *Mycosphaerella densa* is a very common species in arctic regions; it is well represented in DAOM by numerous collections from the Canadian arctic. *M. densa* is a very distinctive species, characterized by the shiny black, often stroma-like, aggregation of densely grouped ascomata on the leaves of host plants and by the basipetally tapering, straight to curved ascospores. The type collection of *Sphaerella densa* on *Arenaria*, coll. Reykjavik, Iceland, ex herb. C agrees quite well with the collections in DAOM cited above. Barr (1959) considered the type of *Dothidella sphaerelloides* Dearn., in herb. DAOM, to be conspecific with *M. densa*. I have some reservations and have not included *S. sphaerelloides* in the synonymy above. The type specimens of *densa* and *sphaerelloides* are alike in their ascoma and ascospore morphology although the ascospores of the latter are larger, the majority being 24-26.5µm long (Fig. 4). The mean ascospore length for the type of *S. densa* and the DAOM collections cited is 16-20µm.

No anamorph has been described for *M. densa* but in one collection, DAOM 70507, on leaves of *Cardamine*, a *Ramularia* species was present along with the ascomata. A brief description of the *Ramularia* is as follows. Dense fascicles of conidiophores arise from brownish substomatal stromata emerging through the stomates. The conidiophores are hyaline to brownish below, septate, up to approximately 40µm long by 3-4µm wide, bear prominent conidial scars, are geniculate and proliferate sympodially and produce the conidia in chains. The conidia are hyaline, cylindrical, tapering slightly at the ends, smooth, 20-45 x 2-3µm, 0-2-septate, bear thickened or refractive broadly flattened scars, 1-1.5µm across at one or both ends. The conidium apex is rounded in the absence of a scar. The association of the two morphs in this collection suggests that the *Ramularia* may be the anamorph of *M. densa*. This remains to be confirmed.

Mycosphaerella tassiana (de Not.) Johans., Ofver. Forh. Kongl. Vet.-Akad. 1884(9):167. 1884 var. *tassiana*. (FIGS. 5, 22-27)

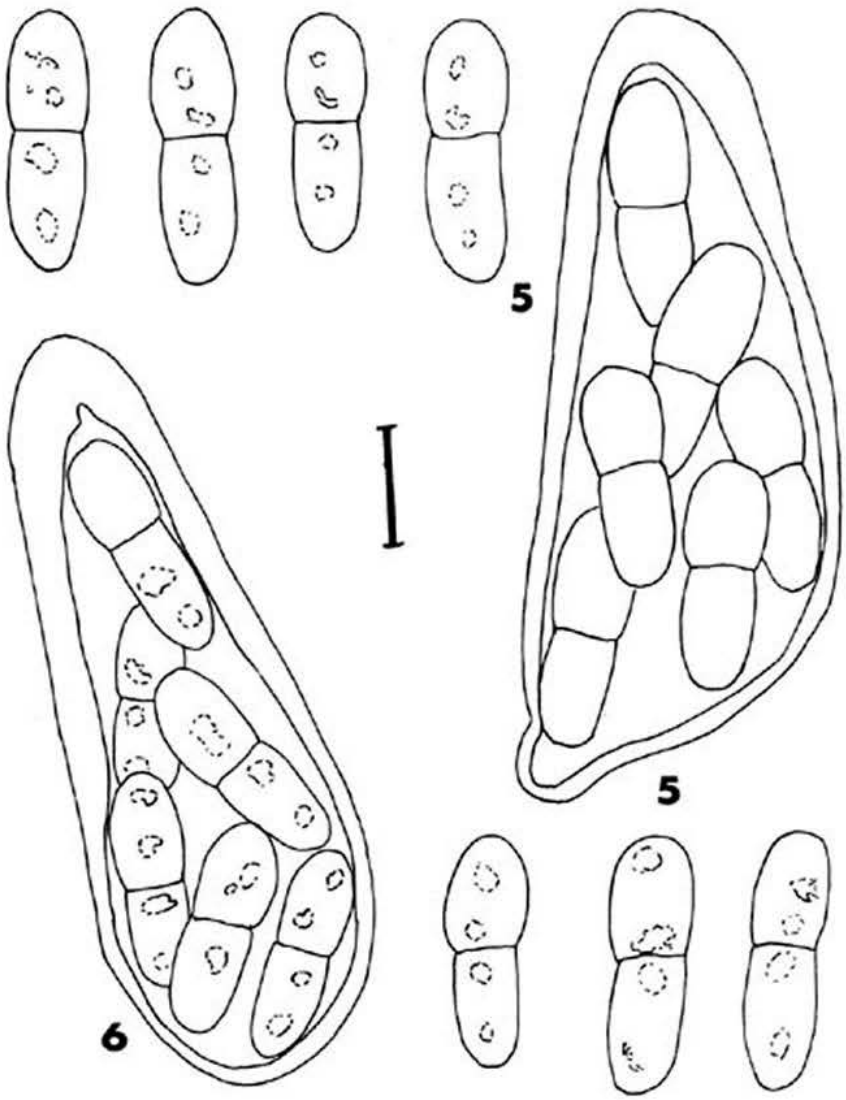
=*Sphaerella tassiana* de Not., Sfer. ital. p. 87. 1863.

Anamorph: *Cladosporium herbarum* (Pers.) Link: S.F. Gray, Nat. Arr. Br. Pl. 1:556. 1821.

Ascomata subepidermal in the stems or leaves, scattered or grouped, immersed, globose to subglobose to conical, 75-155µm wide by 100-155µm high (including neck), dark brown to blackish; neck papillate to conical, erumpent, 15-25µm high and up to 50µm across and apically flattened, ostiole 14-30(34)µm across. Ascoma wall up to 20µm thick, composed of 2-3(4) layers of dark to light brown angular to tangentially flattened pseudoparenchymatous cells, 5-16 X 3-7µm, darker to the outside, darkest around erumpent neck. Pseudoparaphyses lacking. Asci bitunicate, thick-walled, fasiculate, saccate to obclavate, relatively few in number, 8-spored, 45-88 X 15-29(32)µm. Ascospores hyaline to faintly greenish, obovate, straight, 17-31 X 4.5-9.5µm, septate at or near the middle, constricted or not constricted at septum, becoming 2-3-septate at maturity, upper cell often broader, cells usually distinctly biguttulate, sometimes pluriguttulate, ends rounded, wall smooth, uni- to biseriate above and multiseriate at the base of the ascus.

Anamorph colonies on natural substrate or on agar (DAOM 196249 ex CBS 121.49 on PDA & malt agar) olivaceous green to olivaceous brown, velvety; on agar, reverse olivaceous black. Conidiophores straight to flexuous or sometimes geniculate, proliferating sympodially, up to 250µm long (fasiculate and shorter in nature) and 3-6µm wide, with some terminal or intercalary swellings, 7-10µm across, at conidiogenous loci. Conidia in long, often branched chains, ellipsoidal to oblong, pale to medium brown or yellow brown, 5-20 x 3-6µm, 0-1 or more septate, ends rounded with protuberant scars at one or both ends, wall distinctly verruculose.

Saprophytic or weakly parasitic on stems of various plants including members of the Brassicaceae. Collections examined (selected): On *Braya purpurascens* (R. Br.) Bunge. CANADA: NORTHWEST TERR.: Dist. Franklin, Somerset I., DAOM 70713, coll. D.B.O. Savile, 22 July 1958 and Spence Bay, DAOM 70714, coll. D.B.O.S., 19 Aug. 1958. On *Cardamine bellidifolia* L. CANADA: NORTHWEST TERR.: Dist. Franklin, Ellesmere I., Hazen Camp, DAOM 92860, coll. D.B.O.S., 10 July 1962. On *Cochlearia officinalis* L. CANADA: NORTHWEST TERR.: Dist. Franklin, Ellef Ringnes I., DAOM 83445, coll. D.B.O.S., 19 July 1960. On *Draba alpina* L. CANADA: NORTHWEST TERR.: Dist. Franklin, Ellef Ringnes I., Isachsen, DAOM 75142, coll. D.B.O.S., 13 July 1960. On *Draba arabisana* (?). CANADA: NEWFOUNDLAND: Labrador, Akak, DAOM 63514, coll. R.T. Wilce (no. 221), 6 Aug. 1954. On *Draba groenlandica* Ekman. CANADA:



FIGURES 5-6, asci and ascospores. Fig. 5. *Mycosphaerella tassiana* var. *tassiana*, DAOM 92860. Fig. 6. *Mycosphaerella tassiana* var. *arctica*, DAOM 70688. (scale = 10μm)

NORTHWEST TERR., Dist. Franklin, Somerset I., DAOM 70716, coll. D.B.O.S., 13 Aug. 1958. On *Draba lactea* (?). CANADA: NORTHWEST TERR.: Dist. Franklin, Baffin I., Clyde Inlet, DAOM 63421, coll. P. Dansereau, 30 June 1950. On *Lesquerella arctica* (?). CANADA: NORTHWEST TERR., Dist. Franklin, Baffin I., Clyde Inlet, DAOM 62882, coll. P. D., 23 June 1950. On *Parrya arctica* R. Br. CANADA: NORTHWEST TERR.: Dist. Franklin, Victoria I., Cambridge Bay, DAOM 70719, coll. J.A. Calder, D.B.O.S., & I. Kukkonen, 12 August 1959; Victoria I., DAOM 88193 and 88194, coll. W.D. Stretton, 18 Aug. 1960.

Mycosphaerella tassiana is a saprophyte or occasionally a weak parasite which is very common throughout Canada especially in northern regions and at higher altitudes. From the label data available from DAOM collections, this species including all its described varieties (Barr, 1959) is recorded from approximately 60 genera representing about 20 families of dicotlydons and 4 families of monocotyledons. While most of these plant families are represented by only a single genus as a substrate/host, *M. tassiana* occurs more widely in a few families, notably Poaceae, Brassicaceae, Caryophyllaceae, Asteraceae, Rosaceae and Cyperaceae.

Petrie & Vanterpool (1978) reported on a species of *Mycosphaerella* common on overwintered stubble of 'rape' (*Brassica napus* L.), weedy Brassicaceae, Asteraceae and Chenopodiaceae from Saskatchewan and Alberta. The fungus proved to be the ubiquitous *M. tassiana* var. *tassiana* and not as originally thought, *M. brassicicola*, the cause of 'ring spot' of *Brassica* species.

Von Arx (1949) gave an extensive distribution, listing substrate/host species on which *M. tassiana* occurs not only in Europe and also in parts of Asia and the United States. A long list of synonyms of the teleomorph was given by von Arx (1949) while de Vries (1952) provided synonyms of the anamorph. The literature on the association of *Mycosphaerella* (*Sphaerella*) with *Cladosporium* has been summarized in detail by von Arx (1949, 1950, 1983), de Vries (1952) and Barr (1958) and will not dealt with here. Von Arx's taxonomic and nomenclatural studies (1949, 1950) provided convincing proof of the connection between *M. tassiana* and *C. herbarum* by the production of the anamorph from single ascospore cultures. However, *M. tassiana* and its *Cladosporium herbarum* anamorph would appear to be infrequently associated in nature. In the collections examined, the anamorph was rarely encountered.

In one collection, DAOM 70716, the teleomorph is associated with a *Cladosporium* possessing mostly 1-septate, verrucose conidia, 18-20 x 8-10µm which are closer to *Cladosporium macrocarpum* Preuss sensu de Vries (1952) than to *C. herbarum*. The two *Cladosporiums* intergrade and are distinguished principally by the larger, perhaps more verrucose conidia of *macrocarpum*. Barr (1958, p. 510) commented on the variability of the anamorph of *M. tassiana*, saying that "Different strains of the imperfect stage of *M. tassiana* may be considered either *C. herbarum* or *C. macrocarpum*,.... It seems probable that the two species could be united under *C. herbarum*, the earlier name."

Mycosphaerella tassiana var. *arctica* (Rostr.) Barr, Contr. Inst. Bot. Univ. Montréal 73:24. 1959. (FIGS. 6, 28, 29)
=*Laestadia arctica* Rostrup, Medd. om Gronland 3:547. 1888.

Saprophytic on old stems and leaves of various plants including members of the Brassicaceae. Collections examined (selected): On *Arabis arenicola* (Richards) Grel. CANADA: NORTHWEST TERR.: Dist. Franklin, Baffin I., Spence Bay, DAOM 63064, coll. P. Dansereau, 14 July 1950. QUEBEC: Fort Chimo, DAOM 70668, coll. D.B.O. Savile, J.A. Calder & I. Kukkonen, 17 Aug. 1959. On *Cochlearia groenlandica* L. CANADA: NORTHWEST TERR.: Dist. Franklin, Baffin I., head of Clyde Inlet, DAOM 63057, coll. P. D., 14 June 1950. On *Draba alpina* L. CANADA: QUEBEC: McClelan Strait, DAOM 63458, coll. R. Wilce, 19 July 1955. On *Eutrema edwardsii* R. Br. CANADA: NORTHWEST TERR.: Dist. Franklin, Baffin I., head Clyde Inlet, DAOM 63422, coll. P. D., 27 June 1950.

Barr characterized variety *arctica* as having the ascomata united by abundant dark brown mycelium into large compound stromata evident as blackened areas on the plant tissues. The asci and ascospores of *arctica* are indistinguishable from those of the type variety. Barr discussed the taxonomic status and distribution of variety *arctica* and provided an extensive synonomy. She considered it to be as common as the type variety in arctic and alpine regions of Canada. Variety *arctica* occurs on overwintered stems and leaves of many herbaceous monocotyledons and dicotyledons although on the basis of DAOM specimens, it is much less common on Brassicaceae

than the type variety.

Host Index

Arabis arenicola	*M. tassiana*
Brassica oleracea v. *botrytis*	*M. brassicicola*
Brassica oleracea v. *capitata*	*M. brassicicola*
Brassica oleracea v. *gongyloides* (N.Z.)	*M. brassicicola*
Braya purpurascens	*M. tassiana*
	M. densa
Cardamine bellidifolia	*M. tassiana*
	M. densa
Cardamine pratensis	*m. densa*
Cochlearia groenlandica	*M. tassiana*
Cochlearia officinalis	*M. tassiana*
	M. densa
Draba alpina	*M. cruciferarum*
	M. densa
	M. tassiana
Draba belli	*M. densa*
Draba groenlandica	*M. tassiana*
Draba lactea?	*M. densa*
	M. tassiana
Erysium cheiranthoides (G.D.R.)	*M. cruciferarum*
Eutrema edwardsii	*M. cruciferarum*
	M. tassiana
Lesquerella arctica?	*M. tassiana*
Parrya arctica	*M. tassiana*

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(on following pages)

FIGURES 7-12. *Mycosphaerella brassicicola*. Fig. 7. Leaf lesion bearing ascomata and pycnidia, DAOM 118312, (X 6.5). Fig. 8. Vertical sections of immature, DAOM 118311 and mature, DAOM 118310, ascomata (X 325). Fig. 9. Ascoma peridium, surface view, DAOM 118312 (X 325). Fig. 10. Pycnidium, vertical section, DAOM 2279 (X 325). Fig. 11. Portion of pycnidium with spermatia (conidia), DAOM 2279 (X 1050). Fig. 12. Asci, ascospores, DAOM 118312 (X 1050). FIGURES 13-14. *Mycosphaerella cruciferarum*. Fig. 13. Ascomata, surface view, Mycoth. germ. 1231 (X 100). Fig. 14. Ascoma, vertical section, Mycoth. germ 1231, (X 325).

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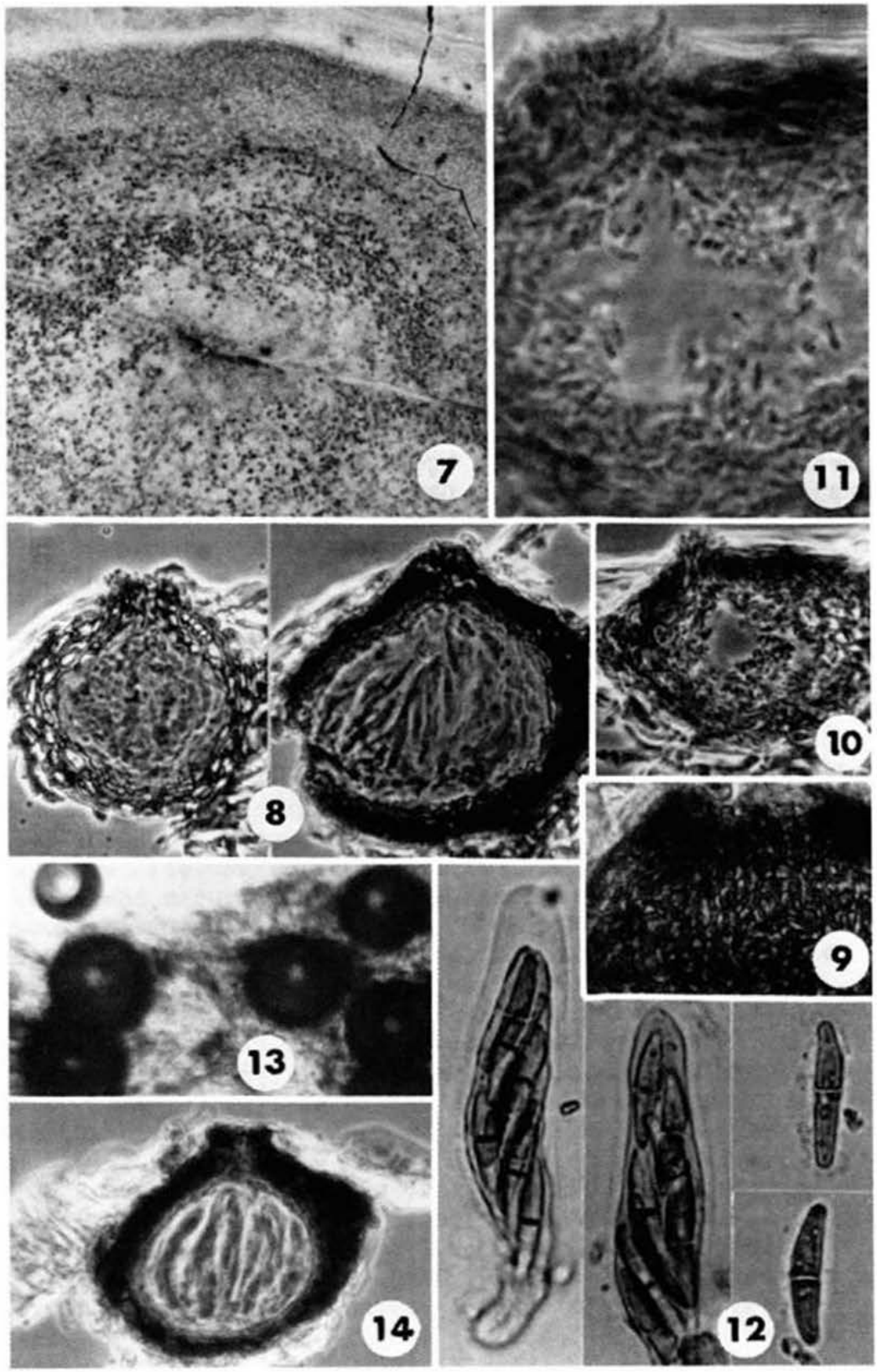
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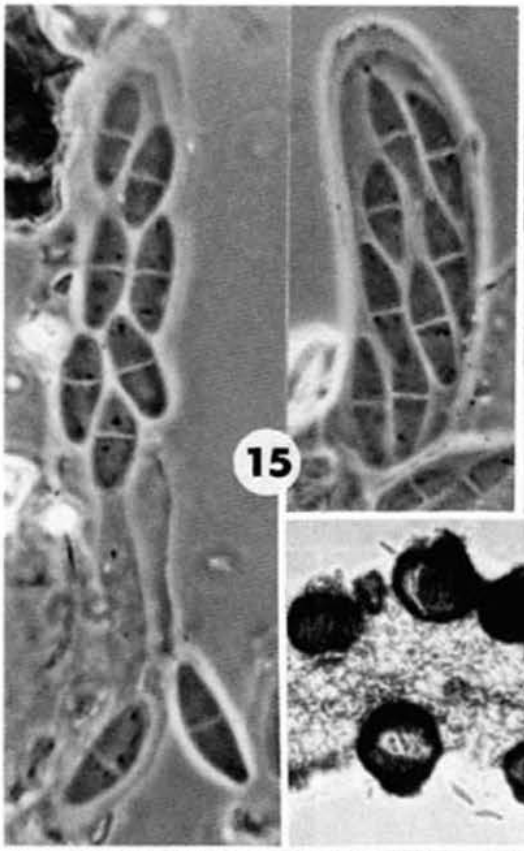
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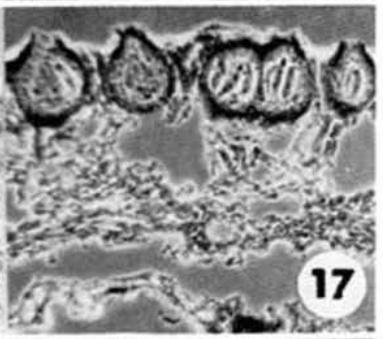
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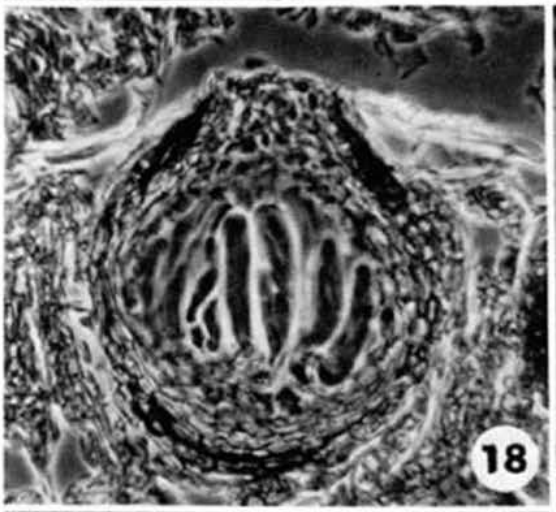
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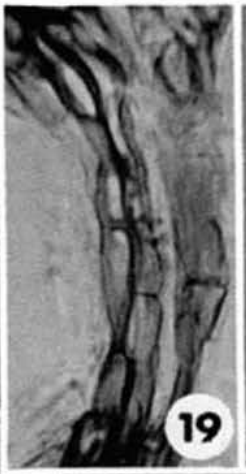
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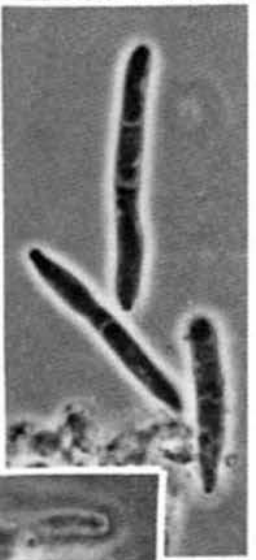

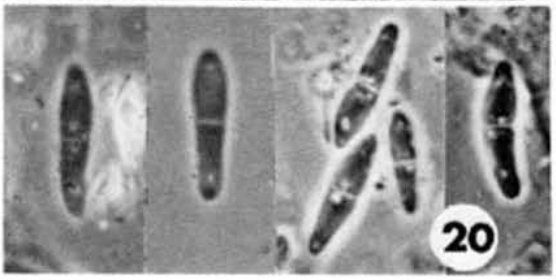
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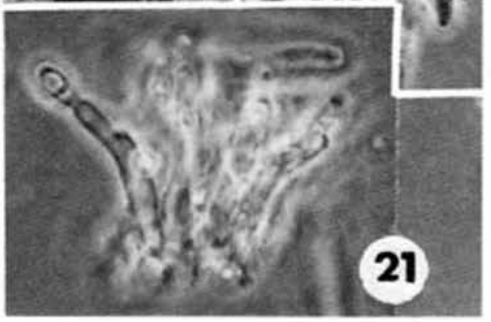
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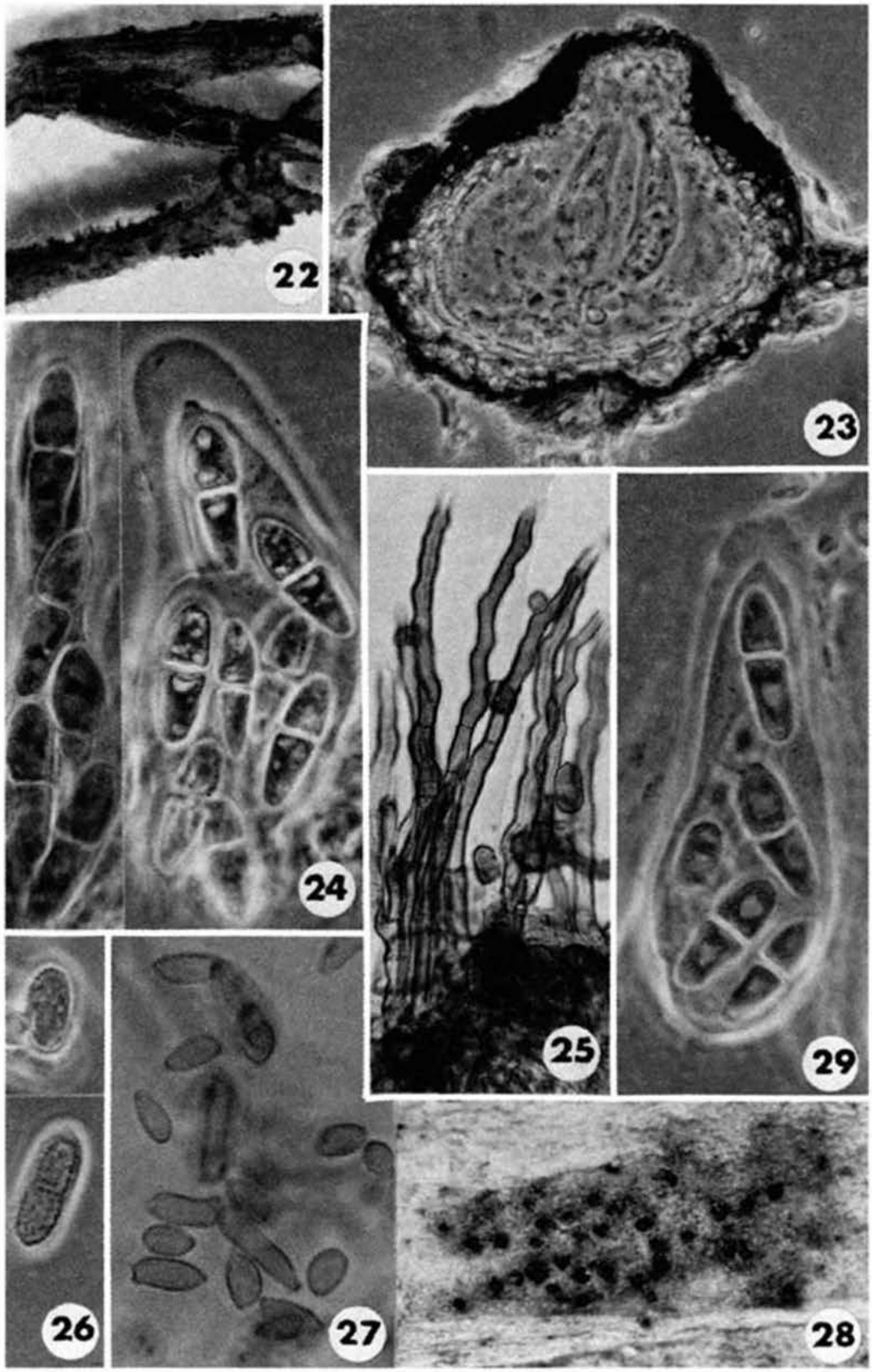
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FIRST RECORD OF GALERINA NANA (CORTINARIALES) FROM AUSTRALIA

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Abstract

Galerina nana is recorded for the first time from Australia. Collections from South Australia and Victoria are described. Both bi- and tetra-sporic races are represented.

Galerina nana was originally described from Florence Botanic Garden, Italy, by Petri (1903). It has subsequently been reported from Europe (France, Denmark, the British Isles, U.S.S.R.), North America (U.S.A.), the Caribbean (Jamaica), South America (Argentina, Bolivia, Chile), Africa (Kenya) (Singer & Digilio, 1952; Singer, 1969; Smith & Singer, 1964; Dennis, Orton & Hora, 1974 and references therein; Pegler, 1977) and India (Natarajan & Raman, 1983). The only Australasian record of this species is a collection from Little Barrier Island, New Zealand (Horak, 1983). The following description is based upon specimens collected in south-eastern Australia.

Galerina nana (Petri)Kühn., Encyc. Mycol. 7:219, fig. 73, 1935, - Figs 1 & 2.

Naucoria nana Petri, N. Giorn. bot. ital. 10:357, 1903.
N. montana Murr., Mycologia 4:78, 1912.
Galerula velenovskyi Kühn., Bull. Soc. Mycol. Fr. 50:74, 1934 = *Inocybe whitei* (Berk. & Br.)Sacc. sensu Velenovsky.
Galera nana (Petri)J. Lange, Dansk. Bot. Arkiv. 9(6):44, 1938.

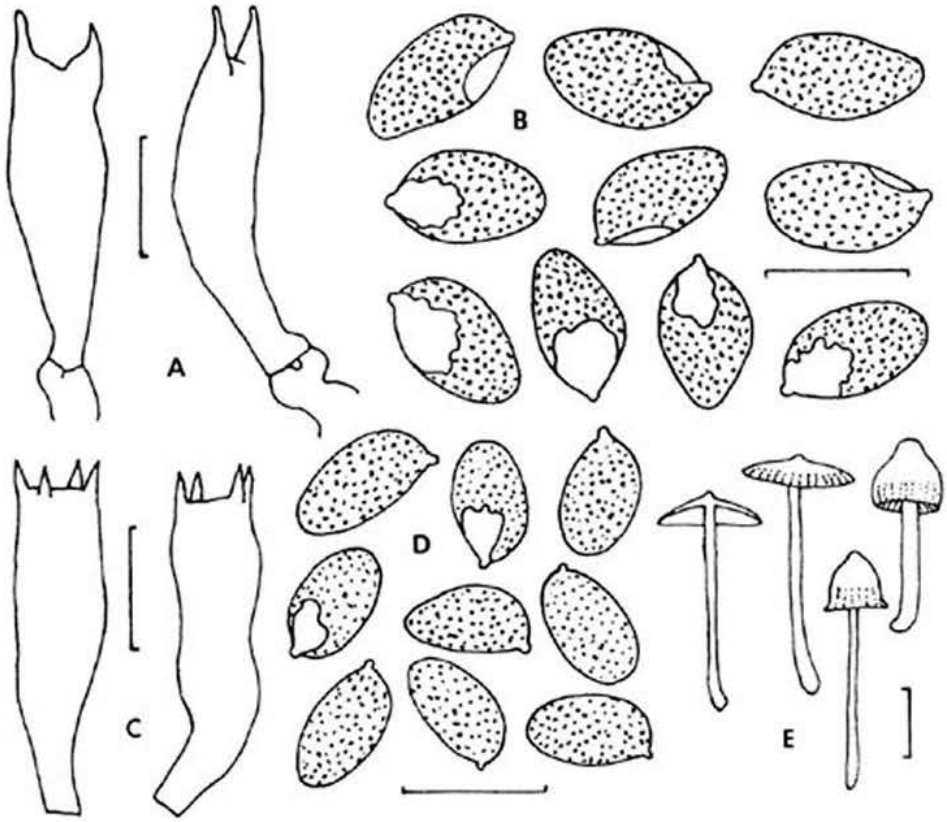

Fig 1. Galerina nana. - A. Bi-sporic basidia. - B. Basidiospores from bi-sporic basidia. - C. Tetra-sporic basidia. - D. Basidiospores from tetra-sporic basidia. - E. Habit. Bars (A - D) = 10 µm. Bar (E) = 1 cm.

PILEUS up to 22 mm diam., and to 8 mm high, ovate-conical becoming convex to broadly convex or campanulate, approaching plane with age, mamillate or occasionally obscurely umbonate, margin incurved then decurved, undulating with age, translucent-striate, hygrophanous, smooth, moist, mostly yellow-brown, (6D8[1]; 5YR 4/4[2], 7.5YR 4/6), centrally dark reddish-brown (5YR 3/3), paler yellow between the striae (7.5YR 6/8), yellow when dry (5B4; 10YR 8/6). PARTIAL VEIL a cortina of white fibrils present on very immature specimens, with older specimens showing remnants around the margin, quickly disappearing with age. LAMELLAE adnate or adnate with a small decurrent tooth, ascending to horizontal, subdistant, generally with two series of lamellulae, to 3 mm deep, thin, sides pruinose, edges minutely denticulate, brownish-yellow (5C67; 10YR 6/6). STIPE 19 - 45 mm long, 1 - 3 mm diam.,

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[1]Colours recorded from Kornerup, A. & Wanscher, J.H. (1981). Methuen Handbook of Colour, 3rd edn. Eyre Methuen, London.

[2]Colours recorded from Munsell Soil Colour Charts, Baltimore (1975).

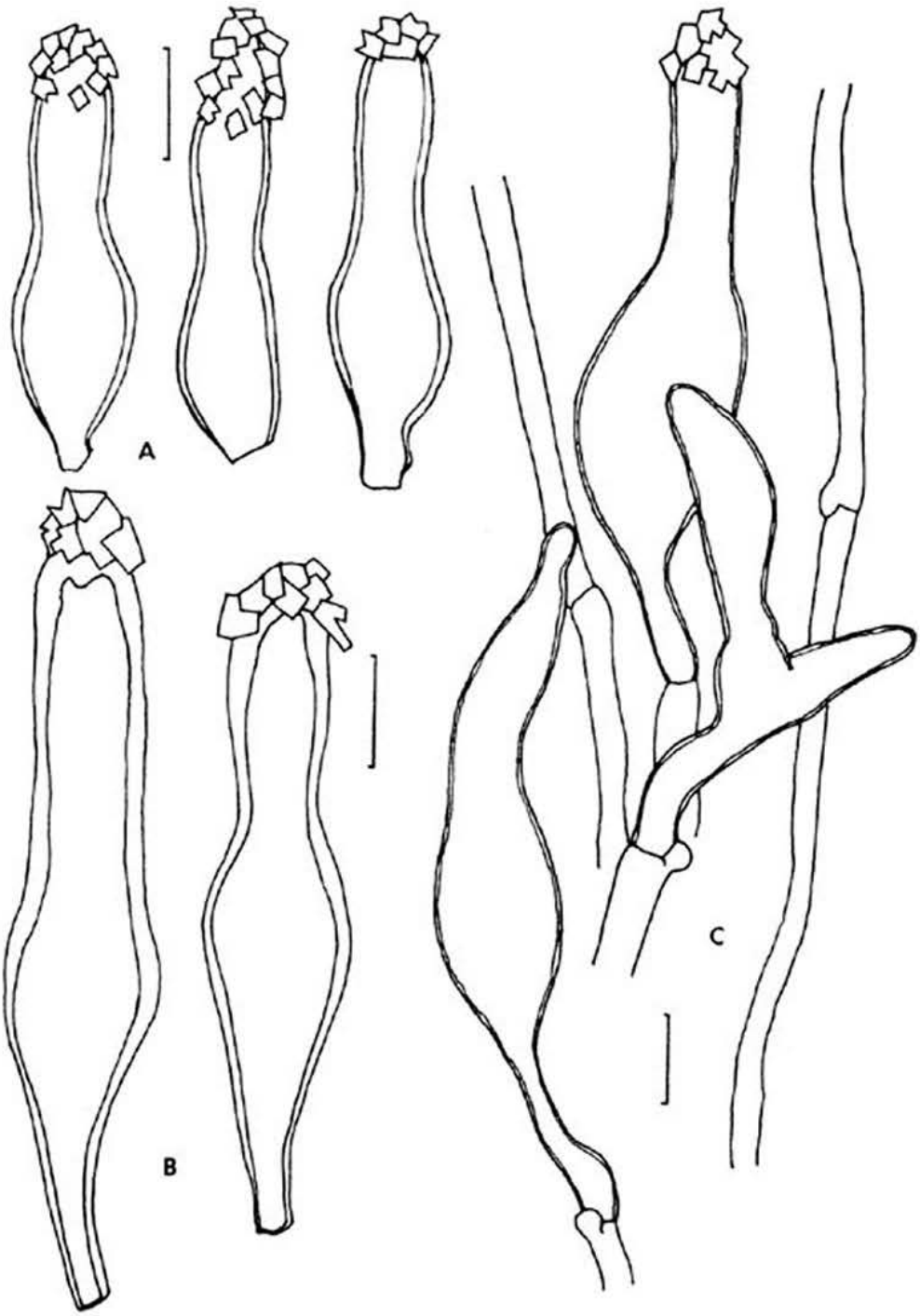

Fig. 2. Galerina nana. - A. Cheilocystidia. - B. Pleurocystidia. - C. Cystidia from partial veil. Bars = 10 µm.

cylindric above, base sub-bulbous, apex pruinose, the remainder sparsely longitudinally white fibrillose, partial veil zone obscure, fistulose, yellow at apex, red-brown below, to black basally, basal mycelium white tomentose.

ODOUR not distinctive. SPORE PRINT rich rust-colour (7.5YR 4/6).

BASIDIOSPORES [88/4][3], 8.5 - 12.4 ($\bar{x}$ = 10.6) x 4.9 - 7.2 ($\bar{x}$ = 6.2) µm, L/B[4] = 1.7 from predominantly two-spored collections and [51/4], 7.3 - 9.8 (- 11.0) ($\bar{x}$ = 8.6) x 4.9 - 6.1 (- 6.7) ($\bar{x}$ = 5.2) µm, L/B = 1.7 from predominantly four-spored collections, ovate-amygdaliform or amygdaliform, verrucose, suprahilar plage present, thick-walled, brown in 10% NH_4OH. BASIDIA [29/2], 24.5 - 32.0 ($\bar{x}$ = 28.3) x 6.4 - 8.8 ($\bar{x}$ = 7.2) µm, with sterigmata up to 9.6 µm long, either predominantly two- or four-spored within a collection, clavate. CHEILOCYSTIDIA [42/3], 34.4 - 71.2 ($\bar{x}$ = 48.4) x 8.5 - 13.7 ($\bar{x}$ = 11.5) µm, metuloid, fusoid-ventricose, pedicellate, apices generally heavily encrusted with crystals, thick-walled, walls up to 1.8 µm thick, pale yellowish in 5% KOH. PLEUROCYSTIDIA [53/4], 43.9 - 73.2 ($\bar{x}$ = 58.6) x 9.5 - 18.3 ($\bar{x}$ = 13.3) µm, similar to cheilocystidia. CAULOCYSTIDIA [11/1], 58.0 - 108.0 ($\bar{x}$ = 76.6) x 8.0 - 14.4 ($\bar{x}$ = 11.9) µm, similar to hymenial cystidia. HYMENOPHORAL TRAMA subregular, hyphae 2.5 - 15.0 µm diam., with encrusting pigment. PILEAL SURFACE an epicutis of filamentous, more or less gelatinized hyphae, 2.5 - 6.0 µm diam., hyphae of hypodermium broader, with golden-brown encrusting pigment. PARTIAL VEIL consisting of filamentous, occasionally encrusted hyphae, 2.0 - 4.8 µm diam., terminal cells often differentiated into cystidia similar to those in the hymenium. CLAMP CONNECTIONS present in all tissues.

HABIT, HABITAT and PHENOLOGY:- gregarious, on the ground or on wood fragments, preferring poorly drained sites, in woodland or forest under Eucalyptus (E. ovata Labill., E. obliqua L'Hérit, E. radiata Sieber ex DC., E. sieberi L.A.S. Johnson, E. regnans F. Muell.) or Leptospermum phylicoides (A. Cunn. ex Schauer)Cheel, often occurring in recently burnt areas, and then amongst Marchantia and Funaria; fruiting throughout the year, mostly from April to May.

MATERIAL:- SOUTH AUSTRALIA: Mt Lofty Botanic Garden, below "Carmino", 9.v.1984, AD 9936, C.A. Grgurinovic & R.J. Chinnock. VICTORIA: Courtney's Road Reserve, Belgrave, ix.1983, AD 12170, T.W. May M423; 6.xi.1983, AD 12169, T.W. M. M461; 15.v.1984, AD 12168, T.W. M. B155. Sherbrooke Falls, 20.i.1985, AD 12167, T.W. M. B188. Yalmy Rd, East Gippsland, iv.1984, AD 11804, T.W. M. B146. Anglesea, ix.1983, AD 11948, B.A. Fuhrer & T.W. M. B83. Old Lilydale-Healesville Railway, 18.v.1985, AD 12166, T.W. M. B338.

Galerina nana is readily recognised by its encrusted metuloidal cystidia and its verrucose spores which possess a plage. It can be distinguished macroscopically by the small size of the basidiomata, the mamillate pileus and the

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[3] [88/4], 88 measurements from 4 collections (see Bas, 1969:290).

[4] L/B, length-breadth ratio.

exannulate stipe.

Basidiomata of G. nana are frequently found after fire in Australia, where they occur with typical post-fire species such as Coprinus angulatus Peck, Gerronema postii (Fr.)Sing., Pholiota carbonaria A.H. Smith and Polyporus mylittae Cooke & Massee. However, the species has not been recorded as occurring after fire elsewhere and its basidiomata have also been collected in unburnt sites in south-eastern Australia. This fruiting of G. nana after fire may be due to an ability to grow in disturbed areas, such as on bare ground, as much as any specific physical or chemical changes in the environment caused by fire.

Both bi-sporic and tetra-sporic races have been found in Australia. There does not appear to be any difference between races in distribution, habitat, or time of fruiting. Both races occurred with equal frequency on burnt and unburnt sites. At one locality both of these races were collected at different times of the year.

The addition of Australia to the range of G. nana raises the question of the geographic origin of the species. Galerina nana has been found in both the northern and southern hemispheres, but is regarded as an exotic in Europe and North America. Petri (1904) suggested that the type collection (from the Florence Botanic Garden) had been introduced with exotic plants. Smith & Singer (1964) considered, that although widely distributed in Europe and North America, G. nana was uncommon in, and not native to these areas. Horak (1983) also recorded G. nana from Europe as growing in artificial habitats, with only rare occurrences in natural forests.

Horak (1983) listed G. nana as having a circum-pacific distribution (New Zealand - South America). However, the natural distribution has been recorded as extending to Central America (Smith & Singer, 1964), Africa (Pegler, 1977) and India (Natarajan & Raman, 1983) and the species has now been found in native Eucalyptus forests in Australia. New Zealand, South America, Africa, India and Australia originated from the fragmentation of Gondwana. A number of fungal species have a distribution pattern which can be explained by a Gondwanan origin. This is especially so for mycorrhizal agarics associated with Nothofagus Blume, which is itself of Gondwanan origin (Horak, 1983; Watling, 1985; White, 1986). The natural distribution of G. nana can also be interpreted as a result of its occurrence in Gondwana prior to the formation of the southern continents.

Some fungal species or genera of Gondwanan origin have extended their range to the northern hemisphere - most species of Rozites Karst. are found in the southern hemisphere, with one species known from Europe and one from India (Horak, 1983) and Panellus longinquus (Berk.)Sing. is found in South America, New Zealand and Australia, but also has a subspecies occuring in North America (Libonati-Barnes &

Redhead, 1984). Similarly, the presence of G. nana in the Caribbean (Jamaica) may have resulted from migration from South America. It is possible that the other northern hemisphere occurrences of G. nana are also the result of range extension by migration rather than introduction. However, rarity of the species and its frequent occurrence in greenhouses and gardens (Singer & Smith, 1964), suggests introduction rather than migration.

ACKNOWLEDGEMENTS

The authors would like to thank the Department of Conservation, Forests and Lands, Victoria for permission to collect in areas under its control, Mr B.A. Fuhrer for providing collections of Galerina nana, Miss T. Eadsforth for typing the manuscript and Dr R. Watling for reviewing the manuscript.

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LOST AND FOUND: A DISCOMYCETE PILGRIMAGE

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Two European species referable to the genus *Strossmayeria* Schulzer and one referable to the genus *Unguiculariopsis* Höhnel were believed to be "lost," because their type specimens were presumed no longer in existence. In September, 1987, a two-week collecting trip by the three of us was undertaken to search for holotypes, and, failing that, to recollect the fungi in their type localities to allow for the designation of topotypic neotypes for these names.

LECANIDION ALBUM CROUAN & CROUAN, A *STROSSMAYERIA*

Our first journey was to Concarneau, in the province of Finistère (Brittany), where the Crouan brothers' herbarium is located at the Laboratoire de Biologie Marine du Collège de France. An earlier visit in 1983 to this herbarium by the senior author, specifically searching for the type specimen of *Lecanidion album* Crouan & Crouan (**1867**), had met with no success (Iturriaga, **1984**). The herbarium is housed without much order in many boxes, drawers, and cabinets in the laboratory's library, and we felt it was still possible that the type specimen may have been misfiled or overlooked on that first visit. We were joined in our search by our colleague, Mme. Françoise Candoussau, of Pau, France (a Cooperating Scientist of the Cornell Plant Pathology Herbarium). Through the kindness of M. Yves Le Gal, the Sous-Directeur of the laboratory, we were afforded the chance to go through the complete herbarium at our leisure. To our delight, after but a few hours of searching, the holotype specimen of this species was discovered in a drawer in which the senior author had failed to look during his first visit to Concarneau. One of us (T.I.) has now examined that holotype specimen, and confirms that it is a species of *Strossmayeria*, as had been presumed. Moreover, we found an annotation slip within the packet, filed by Steven Carpenter, indicating that he had seen the specimen on a visit to Concarneau in 1979, and that in his opinion this provides an older epithet for *S. basitricha* Sacc. At this time the one of us working on *Strossmayeria*, (T.I.), has not concluded that that synonymy is necessarily correct.

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PITHYELLA HAMATA CHENANTAIS, AN *UNGUICULARIOPSIS*

We had been informed by Mme. Baudouin, Conservateur du Muséum d'Histoire Naturelle, Nantes, France, that the discomycete portion of the herbarium of the late J.-E. Chenantais had apparently been destroyed during World War II, and that only the pyrenomycetes have survived and are deposited in that herbarium (NM). We determined, nevertheless, to search through the Chenantais herbarium, since the fungus we sought occurs upon the hysterothecia of a "pyrenomycete," *Rhytidhysteron hysterinum*. We thus journeyed to Nantes, where we were able to examine the entire contents of four boxes of pyrenomycetes, all that remains of the Chenantais herbarium. We did discover one packet of the host "pyrenomycete," collected apparently at the same time as was the collection upon which *Pithyella hamata* Chenantais (**1918**) had been described, but unfortunately, no apothecia of the fungicolous discomycete were found. Within the boxes we did discover Chenantais's accession book for discomycetes and myxomycetes, and found an entry for a new species of *Pithyella* that he collected in 1907 that is unquestionably the data for the species he described in 1918 as *P. hamata*.

Our colleage, Françoise Candoussau, had earlier also corresponded for us in our search for the type specimen of this species, and had discovered that originally the Chenantais herbarium had been under the care of Dr. Maurice Chassain, of St.-Julien-de-Concelles. We were able, then, to visit with Dr. Chassain in his home, where he showed us portions of his vast collection of many thousand colored transparencies and SEM photographs of myxomycetes, and a copy of his book illustrating a few of these (Chassain, **1979**). He confirmed what he had already written to Mme. Candoussau earlier, that he had been responsible for giving the pyrenomycete portion of Chenantais's herbarium to the museum in Nantes. There had also been one box containing myxomycete and discomycete specimens that he had simply discarded as "useless" for study. He did retain an index volume from the Chenantais herbarium, listing all the collections. When we pointedly asked him about voucher specimens for the many beautiful colored and SEM photographs he published in his book, and for the thousands of unpublished ones, he indicated that he did not believe in keeping specimens of myxomycetes, as they "preserve poorly." We had, thus, no choice but to try to find a neotype to replace the discarded holotype of Chenantais's species.

We had earlier contacted the Office de Tourisme in Ruffec, in the province of Charente, where Chenantais had collected his species at a site called La Roche, and had been sent a detailed map showing this spot. Similarly Mme. Candoussau had contacted her old friend, Dr. Etienne Chollet, a doctor of veterinary medicine and botanist of Ruffec, who knew the area well. He sent her detailed directions and maps not only to La Roche, a farm belonging to old clients of his, but to other localities in the Ruffec area where he knew the higher plant, *Buxus sempervirens*, grows [on which the *Rhytidhysteron* and the fungicolous *"Pithyella" (Unguiculariopsis)* occur]. The four of us proceeded to examine the only remaining stands of boxwood

at La Roche, but even though we did discover the *Rhytidhysteron*, no trace of the *Unguicolariopsis* was found in this exceptionally dry location. The following day, however, a few kilometers to the north, following Dr. Chollet's directions, we obtained an ample collection of Chenantais's species in a boxwood thicket near a stream, in a much moister locality, and this collection will serve as a neotype for his species name. It is planned to divide the neotype collection and to distribute it in the exsiccati set, Discomycetes Exsiccati. The one of us now working on a monograph of *Unguicolariopsis*, (W.-y. Z.), currently considers this a taxon valid at the subspecific level.

PEZIZA HETEROMORPHA SCHULZER, A *STROSSMAYERIA*

Our next journey was to Yugoslavia, to attempt to find a neotype for the fungus that Schulzer had twice described as new from the same specimen, once as *Peziza heteromorpha* Schulzer (**1878**) and later as a new genus (and species!), *Strossmayeria rackii* Schulzer (**1881**). These are obligate synonyms, and both names are typified by a specimen believed to be lost (Iturriaga, **1984**). Since the authority on Schulzer's manuscripts and few known specimens is Dr. Milica Tortić (**1970**), now retired from the University of Zagreb, the authors stopped there to see the Schulzer manuscript, and to talk with her. She confirmed that there are only a few Schulzer specimens known, mostly of polypores, and that the Schulzer herbarium has not survived. Schulzer had described the fungus "im Walde Vidor bei Vinkovce" and "in silva Vidor prope Vinkovce," and had collected it in August and September. The senior author had enlisted the aid of Dr. Tortić and of two former Cornellians from Yugoslavia, Dr. Jelena Lević and Mr. Ivan Buturac, to find out if there was still a Vidor Forest near 'Vinkovce' (Vinkovci). Through their concerted efforts we were placed in contact with the forestry personnel responsible for the Vinkovci area. While there is no area known locally as "Vidor Forest," there is a Vidor Creek within a few kilometers of Vinkovci, and this is part of a managed forest system. Our efforts to find the Schulzer species in the woods near Vidor Creek were rewarded beyond our highest hopes: we obtained nearly 40 separate collections of the species in two days of collecting, mainly in *Fraxinus* groves. The great majority of the collections are on wood of *Fraxinus*, the original substrate, and also bear the *Pseudospiropes* anamorph. Two of these are large enough collections to divide and issue in Discomycetes Exsiccati. One will serve as the neotype of Schulzer's species name(s).

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A COMPUTER PROGRAM FOR THE RAPID IDENTIFICATION OF LICHEN SUBSTANCES

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ABSTRACT: A computer program for the identification of lichen substances based on thin layer chromatographic R_F values, the colour of the developed t.l.c. spots under visible and ultraviolet light, as well as the results of lichen spot test results is described. The program accepts R_F data from six standard solvent systems and a range of possible colours. A list of possible answers is generated within a user defined error range of both colours and R_F values. The program is designed for an Apple Macintosh computer with a 512K memory and is quick and very easy to use.

Introduction

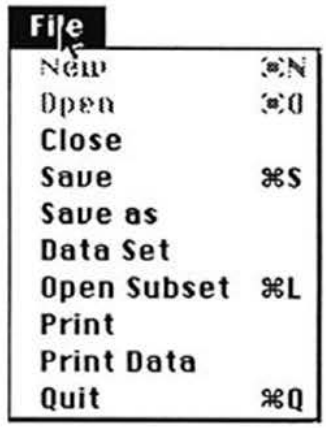
The application of chemical discriminators to lichen taxonomy began inadvertently when thalline colour was accepted as a valid generic or specific character. Hence the grey genus *Physcia* (containing the colourless substance atranorin in the cortex) was segregated from the superficially similar yellow-orange genus *Xanthoria* (containing cortical parietin, an orange anthraquinone pigment). Similarly *Parmeliopsis ambigua* (Wulfen.) Nyl. (with a yellow thallus due to the presence of usnic acid) was separated from *P. hyperopta* (Ach.) Arn. (grey with atranorin). Nevertheless most lichen substances are colourless and can be detected only by indirect means. The first chemical tests conducted on lichen thalli for taxonomic purposes were carried out by Nylander in the 1860s (Nylander 1866). He detected the presence of various lichen substances by spotting chemical reagents directly on the lichen thallus (spot tests) to produce characteristic colour changes: iodine solution (I; blue with certain polysaccharides), potassium hydroxide solution (K; distinctive colours with quinones, some depsides and depsidones) and calcium hypochlorite solution (C; pink or red with some depsides). Further test reagents followed; KC (K solution followed by C) and CK (with reverse addition). Nylander utilised the characteristic medullary and cortical reactions as a specific character, but the origin of these characteristic colour reactions remained unknown. The first serious chemical investigations were conducted by Zopf, culminating in his publication of 'Die Flechtenstoffe' in 1907 (Zopf 1907) with the description of over 150 lichen compounds. However the ultimate structural elucidation of many common lichen metabolites was due to the meticulous pioneering work of Asahina and co-workers in Japan in the 1930s (see Asahina & Shibata 1954). This laid the foundation for futher research on the compounds in recent times. Asahina also developed an additional spot test reagent (Pd, *p*-phenylenediamine solution) and a microcrystallization technique for more definitive recognition of individual lichen acids.

Subsequently the techniques of paper chromatography and particularly thin layer chromatography (TLC) have vastly improved the speed and certainty of recognition of lichen substances by means which are simple to use and relatively inexpensive. Standardised methodology and further refinements of analytical TLC procedures for

detecting and comparing lichen metabolites have been reported by C.F. Culberson and colleagues (Culberson 1972; Culberson & Ammann, 1979; Culberson, Culberson & Johnson 1981; Culberson & Johnson 1982). Further, two dimensional TLC has considerably improved R_F discrimination of structurally similar compounds and has enabled the identification of minor constituents present in complex mixtures (Culberson & Johnson 1976). More recently still, high performance liquid chromatography (HPLC) also has been employed as an effective analytical tool for the separation and identification of lichen substances. A added advantage of this technique is that it yields quantitative information about the components present in the total lichen extracts. At present a disadvantage of the HPLC system is the expense of the equipment and purified solvents, making it beyond the reach of more modest institutions and routine chemotaxonomic investigations. Consequently TLC remains the most readily accessible and widely used method for identifying lichen metabolites routinely. As chemical investigations now form an integral part of all serious taxonomic studies on lichen-forming fungi, inevitably even the more experienced lichenologist encounters TLC spots that are unfamiliar and difficult to identify.

In an effort to make the bulk of literature information on standardised TLC R_F values and spot colour characteristics more readily accessible, and to keep such a library of information current as more and more lichen metabolites are identified and characterised, we have prepared a data bank suitable for storing such information. The data is manipulated on the computer by a search program which operates on experimentally observed R_F values and TLC spot characteristics to search the data bank and generate a list of possible identities for the observed spot. The program provides powerful editing and reporting features. A standard set of colours is provided in an effort to reduce the differences in colour interpretation. Both the colour and R_F error of the unknown spot can be changed at will, as can the data stored in the data bank upon which the search is conducted. Furthermore additional information can be incorporated readily into the data set by the operator. The program is menu driven and Figure 1 shows the programs menu options.

Figure 1. The Menu Options available in the Program



The File Menu

- The New option is used to enter new input data.
- Open is used to recall saved input data from disk.
- Close is used to clear input data.
- Save and Save as allow the storage of input data on disk.
- Data Set allows the user to generate entirely new and different data files (subsets).
- Open Subset retrieves a data file from the disk in order to conduct a subset search.
- The Print option prints the current input data or answer set depending on which is active.
- Print Data outputs the the current data set or subset.
- Quit exits the program.

The Edit Menu

- Cut
- Copy
- Paste

Macintosh Clipboard functions.

The Data Menu

- Copy special enables the user to transfer input data or answers from a search to other Macintosh programs.
- Add data allows the user to extend the data base.
- Alter record allows the user to edit the data base.
- Add to subset adds records to the current subset.
- New Subset allows the user to create and save a subset of the data base.

The Search Menu

- Format allows the user to change the search parameters.
- Report generates the answer set from the input data.
- Character allows the user to enter the spot test data (i.e. K, C, KC or Pd) for the lichen that contains the unknown(s) being searched.

The Data Set

The data set operates primarily on R_F values obtained by TLC on silica gel in any number of six standard solvent systems (A, B, B', C, E, G); the characteristics of the TLC spot, i.e. whether the spot is coloured in visible (natural) light or visible under short wavelength ultraviolet light; the colour of the spot in visible and long wavelength ultraviolet light after spraying with 10% sulfuric acid and charring; or the colour after spraying with Archer's solution (Archer 1978). Information from simple thalline spot tests can also be incorporated and analysed to assist in the identification of the compounds. Mass spectrometric data also can be used if available. Often the presence of a particular metabolite may be inferred from the co-occurrence of a closely related biosequential or accessory metabolites found in the same lichen. Biosequentially related compounds are listed for each entry. However it is not necessary to have all such information about an unknown spot - the search program will operate on as little information as a single R_F value. Qualifying information simply reduces the number of possible answers generated.

Listed along with the name of each lichen substance is the following information (where available):

1) The Rf values of the compound in six standard solvent systems:

   A, toluene/ dioxane/ acetic acid (180 : 45 : 5)

   B, hexane/ diethyl ether/ formic acid (130 : 80 : 20)

   B', hexane/ methyl *tert*-butlyl ether/ formic acid (140 : 72 : 18)

   C, toluene/ acetic acid (170 : 30)

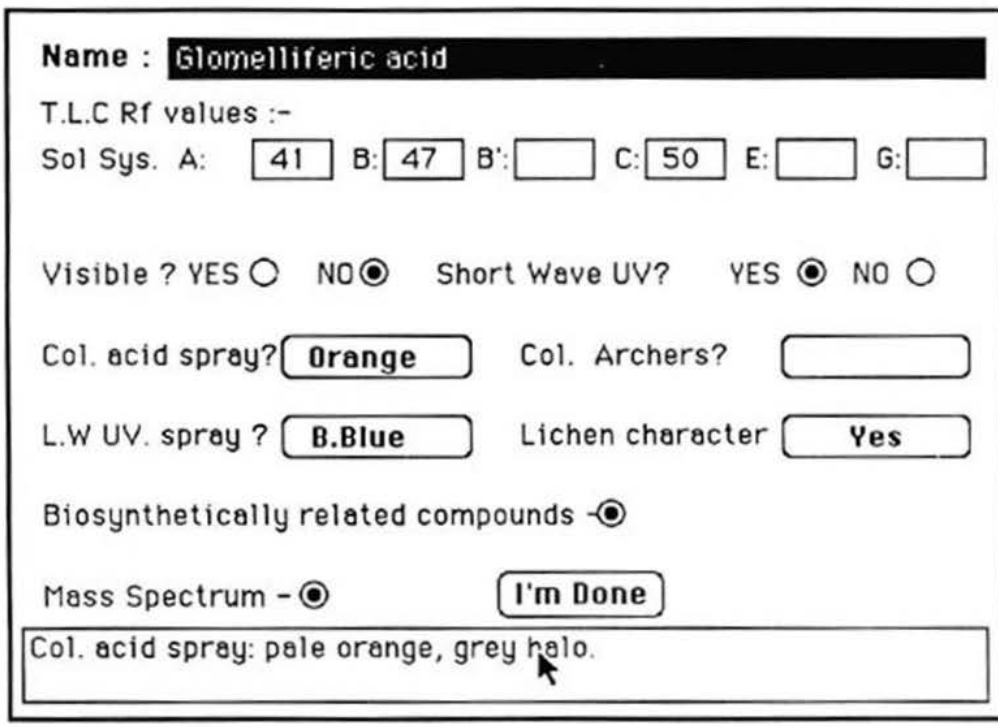
   E, hexane/ ethyl acetate (75 : 25)

   G, toluene/ ethyl acetate/ formic acid (139 : 83 : 8).

2) Whether the TLC spot is coloured in visible (natural) light or visible under short wavelength ultraviolet light.
3) The colour of the TLC spot in visible (natural) and long wavelength ultraviolet light after spraying with H_2SO_4 and charring
4) The colour of the TLC spot after spraying with Archer's solution
5) The results of thalline spot tests with K, C, KC, Pd
6) Four major peaks in the mass spectrum
7) Up to ten biosynthetically related compounds
8) Notes, a one hundred long character message containing additional information regarding the charcateristics of the particular substance, individual tests, confirmatory tests for distinguishing closely related compounds with which it might be confused, etc.

The data set can be expanded or edited with the program using the Add data or Alter record options. Figure 2 shows the screen display when altering a record. Adding a record displays the same screen except the user is given the option to continue adding records.

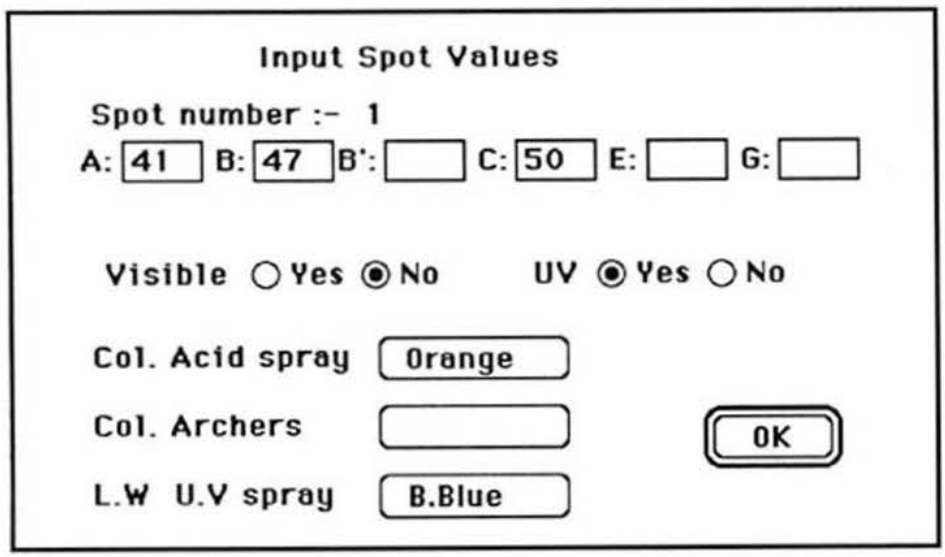
Figure 2. The Screen Display when Altering an Entry in the Data Base.



Searching the Data Base

The program requires at least one R_F value to conduct a search (Figure 3 shows the input screen). A subset of the total data set is generated from the first R_F value. Additional information such as another R_F value for the same spot in a different solvent system, or the colour after spraying with sulfuric acid is used to eliminate unlikely entries from this subset. The searching algorithm uses all the information stored in the data set except the biosynthetically related compounds, the mass spectral data, and the notes. A search is conducted by first entering the data for the unknown substance (see Figure 3) and then selecting Report from the Search Menu. The R_F error, colour errors and the input data that is used in the search is controlled by selecting Format (Figure 4) from the Search Menu. The input values for the unknown can be stored on disc for recall at a later time (Save or Save as options from the File Menu).

Figure 3. The Input Screen Display



Often a particular lichen genus being studied may contain a much more limited number of compounds. In such cases a subset of the data set can be generated to allow more rapid and specific searching.

The Output

After selecting Report from the Search Menu all the possible answers are displayed below the input (experimentally observed) values for the spot. In addition, for each answer the accepted R_F values and the spot colours are displayed on the screen (Figure 5). The user can then select to display the notes, the mass spectral data or the biosynthetically related compounds for each of the answers generated. Furthermore the program can print the answers generated, the input values or the entire data set.

Figure 4. Format of Search; Screen Display

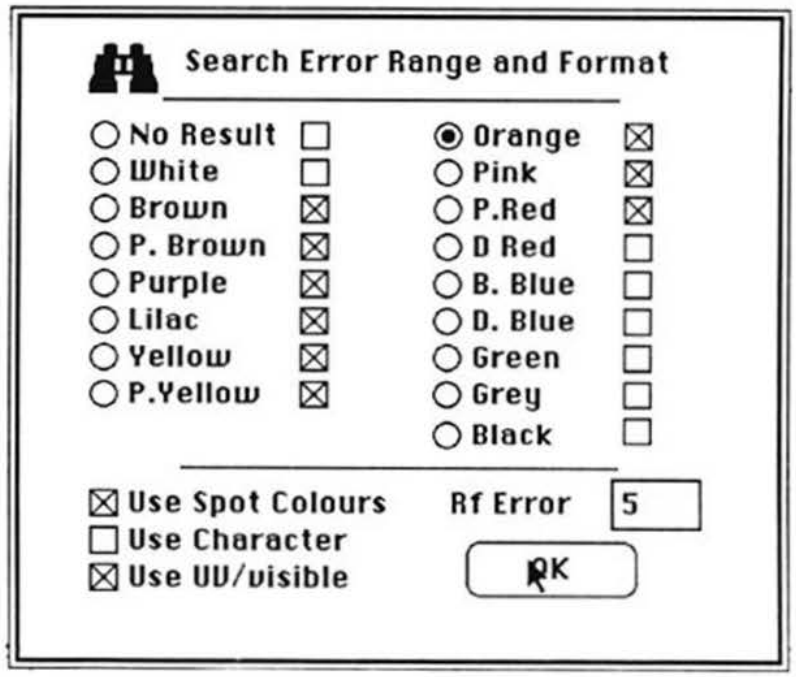
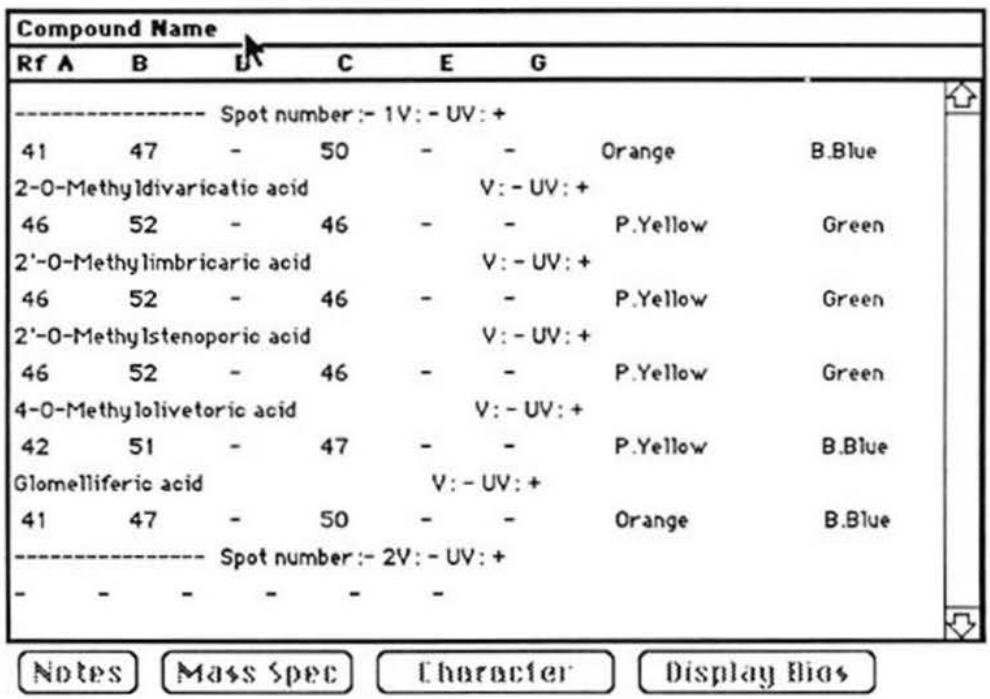


Figure 5. Report of Search; Screen Display



Performance of the Program

An acetone extract of the lichen *Hypotrachyna immaculata* (Nyl.) Hale shows six major spots on TLC in solvent system C. The observed R_F values in the three solvent systems A, B and C and spot colours are shown in Table 1.

Table 1. TLC Data for Extract from *Hypotrachyna immaculata*

Spot No.	RF values			Visible	UV active	Colours	
	A	B	C			H_2SO_4	Spray+UV
1	15	36	10	+	+	green	green
2	25	35	18	-	+	orange	purple
3	32	35	31	-	+	green	green
4	37	43	40	-	+	grey	purple
5	40	73	42	-	+	brown	purple
6	75	78	79	-	+	orange	orange

Spot number 3 was chosen as a suitable example to demonstrate of the searching potential of the program. Table 2 shows the results in terms of the number of answers generated for a variety of search conditions. The data set currently contains 430 entries. Using this data set the program produces 124 possible compounds when a single R_F value is entered and the R_F error is set at 10 (i.e. ± 10%, giving an overall 20% range in error). This rather large number of answers is readily reduced to 70 by entering the visibility under natural and short wave ultraviolet light. The fact that spot 3 is not visible in natural light eliminates all pigments, but is visible under ultraviolet light eliminates all the terpenes and aliphatic acids.

Table 2. Data types versus the number of answers generated for a test compound

Input data	Number of Answers	Error(±%)
Rf C	124	10
Rf C, Vis, UV,	70	10
Rf C, Vis, UV, spot colours	8	10
Rf C, Vis, UV, spot colours	6	5
Rf C, Vis, UV, spot colours	3	3
Rf C, Rf A	53	10
Rf C, Rf A , Vis, UV,	43	10
Rf C, Rf B , Vis, UV, spot colours	4	10
Rf C, Rf A, Rf B, Vis, UV, spot colous	2	10
Rf C, Rf A , Vis, UV, spot colours	1	5

The number of answers is further reduced to 8 after entering the colours of the spot after spraying and charring (Table 3). Already an acceptable number of answers have been obtained with the data from just a single spot. If the R_F error is reduced to ±5% (i.e. R_F range of 26 - 36), an accuracy readily achieved by most workers, only 6 answers are found. When an the R_F value for this compound in a second solvent system is entered at this level of the search a unique answer is obtained, namely lividic acid.

Table 3. The Answer Set Generated With One R_F Value and ±10% Error

A	B	R_F's B'	C	E	G	H_2SO_4	Colours Archers	Char-UV
--Spot number		**1**						
-1	-1	-1	31	-1	-1	Green		Purple
Norlobaridone								
50	36	36	21	-1	-1	Green	Lilac	B.Blue
Normiriquidic acid								
31	-1	41	21	-1	-1	B.Blue		P.Yellow
Lividic acid								
32	35	37	31	-1	-1	Green		Purple
Conloxodin								
50	36	31	32	-1	-1	Green		B.Blue
Loxodin								
58	40	40	35	-1	-1	Green		B.Blue
Methyl 3-α-hydroxy-4-O-methylbarbatate								
43	36	-1	35	-1	-1	Yellow		Green
α-Collatolic acid								
40	32	35	35	-1	-1	P.Yellow		D.Blue
Picrolichenic acid								
38	39	45	36	-1	-1	P.Yellow		Purple

Table 4 illustrates the answer set generated when all the data from Table 1 is used. Although unique answers are generated for spots number 1, 2, 3 and 5, three possible answers were generated for spot number 4, namely picrolichenic acid, 4-O-methylphysodic acid and baeomycesic acid. Baeomycesic acid and picrolichenic acid can be eliminated on spot colours (although this is best done only after co-chromatography with authentic materials) as well as on biosynthetic grounds. Thus the compounds biosynthetically related to oxyphysodic acid include physodic acid, lividic acid, colensoic acid, 4-O-methylphysodic acid, vittatolic acid, hydroxycolensoic acid and methoxycolensoic acid (as indicated by the program in Figure 6). Since other co-occurring compounds present in *Hypotrachyna immaculata* have already been identified as physodic acid, lividic acid and colensoic acid - compounds which are known to be biosynthetically related to oxyphysodic acid - it seems most probable that spot 4 is due to 4-O-methylphysodic acid. As lividic acid and its cogenors are relatively common in the genus *Hypotrachyna* they could be incorporated in a subset to be searched when determining further unknowns in specimens of this genus.

Figure 6. Compounds Biosequentially Related to Oxyphysodic Acid; Screen Display

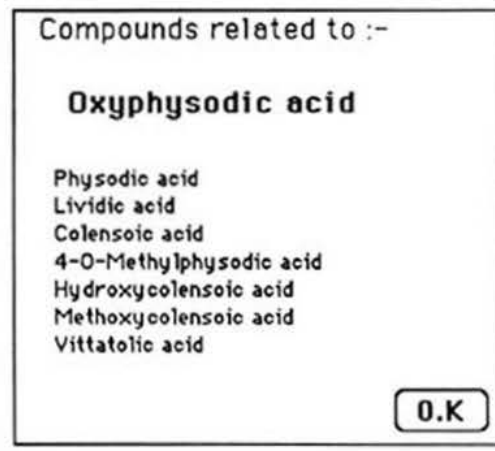


Table 4. The Answer Set Generated with the Data in Table 1, and an Error ±5%

A	B	R_F's B'	C	E	G	H_2SO_4	Colours Archers	Char-UV
---- Spot number 1								
15	36	-1	10	-1	-1	Green		Purple
Oxyphysodic acid								
15	36	-1	10	-1	-1	Green		Purple
---- Spot number 2								
25	35	-1	18	-1	-1	Orange		Purple
Physodic acid								
25	35	35	18	-1	-1	Orange		Purple
---- Spot number 3								
32	35	-1	31	-1	-1	Green		Purple
Lividic acid								
32	35	37	31	-1	-1	Green		Purple
---- Spot number 4								
37	43	-1	40	-1	-1	Grey		Purple
Picrolichenic acid								
38	39	45	36	-1	-1	P.Yellow		Purple
4-O-methylphysodic acid								
37	43	45	40	-1	-1	Grey		Purple
Baeomycesic acid								
39	40	41	42	-1	-1	Grey		Orange
---- Spot number 5								
40	73	-1	42	-1	-1	Brown		Purple
Colensoic acid								
40	73	68	42	-1	-1	Orange		Purple
--- Spot number 6								
75	78	-1	79	-1	-1	Orange		Orange
Dechloropannarin								
76	73	-1	75	55	-1	Orange		Orange
Atranorin								
75	78	73	79	57	-1	Orange	Orange	Orange
Chloroatranorin								
76	79	-1	80	26	-1	Orange	Orange	Orange

Indeed a real advantage of the program stems from the ease of establishing and utilizing subsets of data, since the overall search efficiency and the probability of generating unique answers can be considerably improved by subset searching. In the particular example above, a subset containing all compounds reported to occur in the genus *Hypotrachyna* can readily be constructed. When a search is conducted on this subset, unique answers are obtained for spots 1 to 5 with fewer input R_F values and less qualifying colour data.

Conclusion

We have developed a computer program which allows the rapid identification of lichen metabolites based on TLC R_F and other data. The program allows the user to search a large data base of information for over 400 lichen substances. Other information such as a list of biosynthetically related compounds can be used to eliminate unlikely answers. As an illustration the metabolites found to occur in the lichen *Hypotrochyna immaculata* are identified using the program. The program is used routinely in the identification of lichen metabolites in our laboratory and more importantly ,it will provide lichenologists with the ability to rapidly and readily identify metabolites for taxonomic and phytochemical studies. The program is uniquely easy to use.

Appendix A. Program Details

The program was written for an Apple Macintosh Computer (512K). The data set is stored as large random access file. A double inversion of data is used to give the program speed in the generation of answer sets. The record numbers in the data set are stored in six arrays (collectively known as the index file), there being a separate array for each solvent system. The arrays are indexed by the R_F value of the compounds, the elements of the arrays each contain a list of all the record numbers which have an R_F of that value for that solvent. Hence when a R_F value is input for searching the first answer set is generated by starting at the R_F - error index of the appropriate array for that solvent and then working up the array until the R_F + error index is reached. All the record numbers so obtained point to all the possible answers. When or if futher information is input the program then checks the subset generated from the first R_F value for consistency - any impossible answers are discarded. A subset of the data set is generated by simply by constructing a new index file.

A futher array stores the names of each compound, listed in alphabetical order, with the appropriate record number. This array is used to allow ready location of record names when it becomes necessary to alter a record or when entering further biosynthetically related compounds.

The program makes full use of the unique user friendliness of the Apple Macintosh Computer, fully supporting the windowing and menu environment. Very little typing is required to operate the program as most commands are issued with the Macintosh mouse (a graphic input device). Hence the program is very rapid and easy to operate.

A copy of the program and a users manual is available from the authors at a cost of $350.00 (US).

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GLYPHOPELTIS EBURINA AND XANTHOPSORELLA LLIMONAE ARE GLYPHOPELTIS LIGUSTICA, COMB. NOV.

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SUMMARY

The lichens **Glyphopeltis eburina** Brusse and **Xanthopsorella llimonae** Hertel et al. are reduced to synonymy with **G. ligustica** (B. de Lesd.) Timdal, comb. nov. (Lecideaceae). The species is reported as new to Macaronesia (Madeira).

The squamiform lichen **Psora ligustica** B. de Lesd. was described by Bouly de Lesdain (1935) from a single collection made by C. Sbarbaro in Liguria, Italy. This locality is still the only reported site for the species. Schneider (1980) placed it in **Lecidea** Ach., but gave no discussion of its affinities. Timdal (1984) found the species anatomically very similar to **Psora** Hoffm., but still excluded it from this genus because of the lack of anthraquinones and calcium oxalate in the apothecium, the green epithecium, the dark brown hypothecium, and the peltate squamules.

Later, Brusse (1985) described **Glyphopeltis** Brusse, a new monotypic genus with the new species **G. eburina** Brusse, from South Africa. When borrowing the holotype and one additional specimen from PRE, I found the species to be conspecific with **P. ligustica.**

Recently, Hertel et al. (in Nimis & Poelt 1987) described **Xanthopsorella llimonae** Hertel, Egea & Poelt from Spain and Sardinia. This is apparently the same species as **Psora llimonae** Hertel & Egea ined. mentioned by Llimona & Egea (1985: 438, 444). When borrowing an isotype from M, also this species turned out to be a later synonym of **P. ligustica. Xanthopsorella** Kalb & Hafellner (syn. **Xanthopsora** G. Schneider & W. Weber) is a North American, monotypic genus differing from **P. ligustica** mainly in having a different type of ascus, non-amyloid hymenial gelatine, different type of upper cortex, and containing anthraquinoid pigments in the thallus (Timdal 1984). **Psora ligustica** contains atranorin and usually bourgeanic acid (TLC); the report of no compounds by Timdal (1984) was probably due to insufficient extraction from the poor material then available.

Although **P. ligustica** is anatomically very similar to **Psora**, I still prefer to keep the species excluded from this genus and accept the genus **Glyphopeltis.**

GLYPHOPELTIS LIGUSTICA (B. de Lesd.) Timdal, **comb. nov.**

Psora ligustica B. de Lesd., Bull. Soc. bot. Fr. 82: 315 (1935). **Lecidea ligustica** (B. de Lesd.) G. Schneider, Biblioth. Lichenol. 13: 203 (1980, "1979"). - Type: Italy, Liguria orientalis, Framma, March 1935, Sbarbaro s.n. (LD, UPS; isotypes).

Glyphopeltis eburina Brusse, Lichenologist 17: 267 (1985). - Type: South Africa, Cape Province, 8 km NE of Granaatboskolk farmstead, alt. 910-1060 m, Brusse 1061 (PRE; holotype).

Xanthopsorella llimonae Hertel, Egea & Poelt in Nimis & Poelt, Stud. geobot. 7, Suppl. 1: 242 (1987). - Type: Spain, Prov. Murcia, Sierra de Enmedio, Puerto Lumbreras, alt. 500 m, Egea 628 (M; isotype).

The species is now known from Italy (Liguria and Sardinia), Spain (Granada, Murcia and Zaragoza), Portugal (Madeira), and South Africa (Bouly de Lesdain 1935, Brusse 1985, Nimis & Poelt 1987, and specimens cited below). The two localities I have examined in the field (Granada and Madeira) were both exposed, steep faces of rock where it grew together with **Peltula euploca** (Ach.) Pisut. Association with this lichen is also noted in Spain (Llimona & Egea 1985), Italy (Nimis & Poelt 1987), and on the label of one of the South African specimens examined (Brusse 4947, O).

Additional specimens examined: Spain, Granada, Sierra Nevada, near Valor, alt. 920 m, Hestmark & Timdal 5670 (O). **Portugal**, Madeira, Ribeira Brava, cliff E of the town, alt. 70 m, Krog & Timdal 5347 (O). **South Africa**, Cape Province, Vanrhynsdorp, 2 mi N of Nieuwe Rust, Almborn 4936 (LD); 10 km NE of Clanwilliam, Pakhuis Pass, alt. 550 m, Brusse 4947 (O); Orange Free State, Clarens, van der Plank 1898 (PRE).

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XYLARIA (SPHAERIALES, XYLARIACEAE) FROM CERRO DE LA NEBLINA, VENEZUELA

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ABSTRACT

A treatment of genus Xylaria from Cerro de la Neblina, Venezuela is presented here. Forty-one taxa are treated. The following new taxa are proposed: X. asperata sp. nov., X. griseo-olivacea sp. nov., X. kretzschmarioidea sp. nov., X. nodulosa var. microspora var. nov., X. platypoda var. microspora var. nov., and X. plumbea sp. nov. The following new combination is made: X. platypoda var. patouillardii comb. nov. Nine collections were not named owing to their small size or poor condition. Some of these undoubtedly represent new taxa. All taxa -- named and unnamed -- are included in keys and many are illustrated.

Cerro de la Neblina is an isolated mesa-capped mountain or tepui located on the border of Venezuela and Brazil. Owing to its unique ecosystem a series of multinational and multidisciplinary expeditions have been

carried out there. Various aspects of the tepui and details of several expeditions were described by Jackson (1985). Collections used in this study were made by Samuels and Teresita Iturriaga in 1984 and Rossman in 1985. Collections were identified and, when possible, cultured by Rogers and Callan.

The primary objective of this paper is to allow the identification of Xylaria from this intensively investigated area. Additional objectives include increased understanding of the distribution and biology of Xylaria in general and of neotropical Xylaria in particular.

Xylaria is a taxonomically difficult genus which probably reaches the zenith of its complexity in the American tropics. Most of our knowledge of the genus has come from sporadic and fragmentary collections made by collectors interested primarily in other organisms. Fortunately, these collections have been deposited in the herbaria of the world. R. W. G. Dennis has made outstanding contributions to the cataloguing and identification of Venezuelan fungi, including Xylaria (1956, 1957, 1970). His publications are indispensable in identifying Xylaria. Other useful works include those of Rick (1935) and Theissen (1909) from Brazil. As would be expected, intensive collecting in the vicinity of Cerro de la Neblina has revealed both taxa that have been widely collected in the American tropics and taxa that have heretofore been undescribed. Dennis (1970) presented keys for 47 taxa of Xylaria from Venezuela and adjacent countries. About 18 of these taxa are represented in this paper and several others will be covered elsewhere as Hypoxylon or Penzigia. Nonetheless, roughly half of the taxa covered herein were not listed by Dennis. On the other hand, at least half of the taxa keyed out by Dennis are not represented in this paper. Our experience in other parts of South America is similar. Only additional intensive collecting and taxonomic studies will clarify the numbers of Xylaria taxa and their distributions based upon host, climatic, and other variables.

MATERIALS AND METHODS

Attempts were made to culture most of the fungi described herein. Comparatively few cultures were initiated owing to condition of specimens and probably also to ascospore germination requirements which were not met in our laboratory. In any case, all reported cultures

were initiated from ascospores; cultural conditions and media are as reported in individual descriptions.

Holotype and other specimens were placed in VEN. Isotype and other material of Rossman were deposited at BPI. Isotype and other material of Samuels were deposited in NY. Material of Iturriaga was placed in VEN and some duplicates in NY. Portions of some collections that were further divisible were retained by JDR; these will ultimately be accessioned in WSP.

SPECIES WITH LARGE STROMATA ON WOOD
(Stromata usually 5 mm or greater in diameter)

1. Stromatal surfaces more or less smooth, usually tan, orange, white, or grey until blackening with extreme age 2
1. Stromatal surfaces more or less roughened with perithecial contours, coarse ostiolar papillae, warts, wrinkles, or all of the above, usually more or less black at maturity . . . 9

2. Fertile part oblong-ellipsoidal, ca. 3 cm X 1 cm diameter, often with fringe of digitate conidial processes immediately below and/or above, blackish with white patches, on hirsute stipe 5 cm X 1 mm diameter. Ascospores 31-35 X 8-9 µm, with abrupt pinched ends and long spiralling germ slit . . . . . X. comosa
2. Combination of characters differing from above 3

3. Stromata usually subglobose, ca. 1.5 cm diameter, dull grey, on short stipe. Ascospores 23.5-29.5 X (6-)6.5-7.5 µm, with short straight or oblique germ slit . . . . . X. obovata
3. Stromata usually clavate to cylindrical 4

4. Fertile part clavate with short stipe, 3 cm X 1 cm diameter, copper-colored at first. Ostioles finely papillate. Ascospores 9 X 3.5-4.5 µm. . . . . X. cubensis
4. Fertile part variously shaped. Ascospores much longer 5

5. Ascospores usually not longer than 25 µm. 6
5. Ascospores usually longer than 25 µm. 7

6. Fertile part cylindrical, ca. 5 cm X 5 mm diameter, on rooting base to 17 cm long, grey with yellowish tones. Ostioles punctate. Ascospores 19-23.5 X 7-8 µm, with long germ slit. . . . . X. cf. lutea

6. Fertile part fusiform, 3-5 cm X 0.4-1.2 cm diameter, on short stipe, tan to light orange to orange-red. Usually becoming hollow before maturity. Ostioles punctate. Ascospores (13-)17.5-25 X 6-7.5 µm, with slit short, oblique . . . . . X. telfairii (For similar fungus with ascospores showing longer germ slit see X. aff. telfairii R 2199. See also X. enterogena)

7. Fertile part cylindrical to somewhat clavate, 4 mm diameter, on short to long stipe, up to 11 cm total length; with large wrinkles, otherwise smooth, dull black. Ostioles discoid. Ascospores (26.5-)29-34 X 5-6(-8) µm, with short germ slit . . . . . X. cf. aenea

7. Fertile part clavate on short to long stipe, not usually exceeding 5 cm total height, smooth, light grey to whitish, becoming hollow. Ostioles punctate. 8

8. Ascospores 26.5-32 X 7.5-9 µm, with abrupt acute ends, with slit straight to oblique and less than spore-length . . . . . X. dealbata

8. Ascospores 23-30 X 5-6 µm, with rounded ends, with short germ slit. . . . . X. cf. kegeliana

9. Fertile part clavate, on short stipe, 4 cm X 7 mm diameter, wrinkled and contorted, dull black. Ostioles discoid. Ascospores 7.5-9 X 3.5-4.5 µm . . . . . Xylaria sp. (R 1965)

9. Fertile parts various. Ascospores much longer. 10

10. Fertile part cylindrical to clavate, on short or long stipe, up to 5 cm total length X 7 mm diameter, usually wrinkled and somewhat corky, dull black. Ascospores 16-23.5(-25) X (5-)6-7.5 µm, with short oblique to spiralling germ slit. . . . . X. scruposa

10. Fertile part variously shaped. Ascospores usually longer than 23.5 µm 11

11. Fertile part conical, subglobose, or irregular, sessile, 4 cm X 7 mm diameter, with prominent perithecial contours, white with black ostioles and orangish base. Ascospores 26.5-32.5 X 9.5-10.5(-13.5) µm . . . . . X. platypoda var. microspora

11. Fertile part variously shaped, more or less stipitate, not predominantly white at maturity 12

12. Fertile part globoid to wedge-shaped, 5 mm diameter, on branched stipes up to 7 cm long, with corky surface, dull blackish with brown tones. Ostioles strongly discoid. Kretzschmarioid in general aspect. Ascospores 25-32 X 7.5-9 µm, with short, oblique germ slit . . . . . X. kretzschmarioidea

12. Stromata not notably kretzschmarioid and character combinations otherwise different 13

13. Fertile part cylindrical to irregular, grading into stipe, 9 cm total length X 3-4 mm diameter, nodulose, with tomentum overall, dull black. Ascospores 23.5-28 X 7.5-9 µm, with pinched ends, with long spiral germ slit . . . . . X. nodulosa var. microspora

13. Fertile parts various, not notably nodulose 14

14. Fertile part extremely variable -- fragariform, hemispherical, globoid, clavate -- sessile to stipitate, 0.4 cm-3 cm X 0.3-1 cm diameter, highly roughened with warts, wrinkles, and corkiness, dull black. Ascospores (20-)22-28(-30) X 7.5-9.5(-10.5) µm, with short, oblique to spiralling germ slit . . . . . X. anisopleura

14. Fertile part clavate to irregular, 1-2.5 cm diameter, on long abrupt stipe, 5-6 cm total length, smooth except for major wrinkles, dull black. Ascospores 23.5-31 X 6.5-7.5 µm, with short, oblique to spiralling germ slit . . . . . X. schweinitzii

SPECIES WITH SMALL STROMATA ON WOOD
(Stromata usually less than 5 mm in diameter)

1. Stromatal surfaces more or less smooth, usually tan, orange, white, or grey until blackening with age. 2
1. Stromatal surfaces more or less roughened with perithecial contours, coarse ostiolar papillae, warts, wrinkles, or all of the above, usually more or less black at maturity 11

2. Fertile part globose. 3
2. Fertile part cylindrical, conical, clavate, or irregular. 4

3. Fertile part 5 mm diameter, on narrow stipe 5 mm long, grey. Ascospores 29.5-37(-40) X (12-)13-15(-16) µm. . . . . *Xylaria* sp. (S 1836)
3. Fertile part 2-3 mm diameter, on narrow stipe up to 5 mm long, grey-olive. Ascospores 23.5-31 X 9.5-11 µm, with pinched ends . . . . . *X. griseo-olivacea*

4. Ascospores usually 17.5 µm or longer 5
4. Ascospores usually not longer than 17.5 µm 7

5. Fertile part cylindrical with acute apex, 1-3 mm diameter, on narrow stipe, up to 4 cm total length, blackish with brown peeling layer. Ascospores 19-22 X 7.5-9 µm . . . . . *X. apiculata*
5. Fertile part clavate on short stipe. Ascospores averaging smaller. 6

6. Fertile part up to 6 cm X 1 cm diameter, but mostly smaller, yellow-white. Ostioles punctate. Ascospores (15-)16-21 X 6-7.5 µm, with short, oblique germ slit . . . . . *X. enterogena* (Closely allied to *X. telfairii*)
6. Fertile part 2.5 cm X 3 mm diameter, rusty orange. Ostioles more or less papillate. Ascospores 17.5-22 X 6.5-7.5 µm, with long spiralling germ slit . . . . . *Xylaria* sp. (R 2264)

7. Fertile part cylindrical to long conical, ca. 2 mm diameter, on narrow, short or long stipe, up to 2 cm total length, black with grey peeling layer. Ascospores 14.5-17.5 X 6-6.5 µm, with short germ slit . . . . . X. arbuscula
(A closely related fungus has a white peeling layer and ascospores (11.5-)12.5-13.5(-15) X 5-6 µm, with long germ slit. See R 2297).

7. Fertile part cylindrical, clavate, or irregular. Ascospores not longer than 15 µm 8

8. Fertile part clavate, 3 mm diameter, on narrow stipe, up to 3 cm total length, lustrous grey with black ostioles. Ostioles more or less papillate. Ascospores (10.5-)11-14(-15) X 3.5-4.5 µm . . . . . X. plumbea

8. Fertile part variously shaped. Ascospores not longer than 12 µm 9

9. Fertile part cylindrical to clavate, 2.5 cm X 1-6 mm diameter, white with black ostioles, on short black stipe. Texture soft. Ostioles punctate. Ascospores (8-)9-10.5(-12) X 3.5-4.5(-5) µm. . . . . X. microceras

9. Fertile part cylindrical to clavate. Texture hard to very hard 10

10. Fertile part clavate, 2 cm X 4 mm diameter, on short stipe, white becoming cinereus. Texture very hard. Ostioles punctate. Ascospores 9-10.5 X 3.5-4.5 µm . . . . . X. cf. pallida

10. Fertile part more or less cylindrical, often undulate from perithecial contours, 4 cm X 3 mm diameter, on short stipe, blackish with remnants of brownish peeling layer. Texture woody. Ascospores 9-10.5 X 3.5-4.5 µm. Ostioles punctate to slightly papillate . . . . . X. multiplex

11. Fertile part bearing more or less immersed perithecia 12

11. Fertile part composed of individual perithecia or aggregations of more or less naked perithecia 14

12. Fertile part cylindrical to irregular, to 6 cm X 2-3 mm diameter, with short stipe, wrinkled circumferentially, blackish. Ascospores 13-15 X 4.5-5 µm . . . . . X. berkeleyi

12. Fertile part not wrinkled circumferentially. Ascospores seldom longer than 9 µm 13

13. Fertile part cylindrical, 5 cm X 5 mm diameter, with short stipe, wrinkled and sometimes showing perithecial contours, dull black. Texture hard. Ascospores 6.5-9 X 3.5-4.5 µm . . . . . Xylaria sp. (R 2072)

13. Fertile part cylindrical to clavate, 4 mm diameter, with narrow, short to long stipe, to 5 cm total length, black. Texture cheesy to woody. Ostioles discoid. Ascospores 7.5-9 X 4.5 µm. . . . . X. feejeensis

14. Ascospores not longer than 12.5 µm. 15

14. Ascospores not shorter than 17.5 µm. 16

15. Fertile branches bearing more or less naked perithecia on upper parts, 5 cm X 1-1.5 mm diameter, hairy overall, blackish. Ostioles slightly papillate. Ascospores (10.5-)12-12.5 X 4.5-5 µm. . . . . X. cf. trichopoda

15. Fertile part cylindrical, branched or unbranched, 1-2 mm diameter, with short or long stipe, 0.5 cm-2 cm total length, with more or less naked perithecia, cream with orange near base and becoming black. Ostioles papillate. Ascospores 9.5-10.5 (-12) X 3.5-4.5 µm. . . . . X. coccophora (For similar fungi with immersed perithecia see S 1168 and S 1455)

16. Fertile part a rachis 30 cm X 1 mm diameter tapering to hair-breadth bearing naked individual perithecia at intervals, black. Ascospores 17.5-20 X 6.5-7.5 µm . . . . . Xylaria sp. (S 1364) NOTE: Also occurs on leaves.

16. Fertile part much shorter. Ascospores longer 17

17. Fertile part a rachis 6 cm X less than 1 mm diameter bearing aggregations of naked perithecia at intervals, black. Ascospores 22-25.5 X 6-7.5 µm . . . . . *Xylaria* sp. (S 1330)
17. Fertile part a rachis up to 1 cm X 2-3 mm diameter bearing more or less naked perithecia, with short stalk and sterile apiculus, black. Ascospores 22-26.5 X 6.5-7.5(-9.5) µm . . . . . *X.* aff. *theissenii*

SPECIES ON LEAVES, PETIOLES, AND FRUITS

1. Fertile parts of stromata conical, cylindrical, flattened, or subglobose. Perithecia immersed or contours distinct. 2
1. Fertile parts of stromata composed of aggregations of more or less naked perithecia 7

2. Stromata on fruits (pods). 3
2. Stromata on leaves and petioles. 5

3. Fertile part branched and flattened, without well-defined stipe, bearing perithecia with evident contours, tomentose overall, up to 5 cm, reddish brown to blackish. Ascospores 8-9.5 X 3-4 µm . . . . . *X. culleniae*
3. Fertile part as above, but up to 8 cm long. Ascospores larger 4

4. Ascospores 13-15(-17.5) X (3-)4-4.5(-5) µm, brown, with germ slit evident. . . . . *X.* cf. *ianthino-velutina*
4. Ascospores 13-15(-17.5) X 3.5-4.5 µm, yellowish to brownish, the germ slit not always evident. . . . . *X.* aff. *magnoliae*

5. Fertile part subglobose, ca. 2 mm diameter, tan, on thin stipe up to 1.5 cm, white. Ascospores 11-13 X 7.5-9 µm, nearly black . . . . . *Xylaria* sp. (S 1353)
5. Fertile part other than subglobose. 6

6. Fertile part cylindrical, highly geniculate from insertion of strongly papillate perithecia, at least 1.5 cm X 0.5-0.75 mm diameter, brown. Ascospores 13.5-15 X 7.5-8 µm. . . . . *Xylaria* sp. (R 1741)

6. Fertile part cylindrical, more or less regular, 1-1.5 cm X 2 mm diameter, on thin hairy stipe 4 cm or longer, black with peeling brown layer. Ascospores 14.5-16 X 6.5-7.5 µm. . . . . X. cf. brachiata

7. Fertile parts sporadic clusters of more or less naked perithecia with intervening peg-like processes (coremia) on fine rachis up to 2 cm, black. Ascospores (9-)10.5-12 X 6.5-8(-9) µm. . . . . X. asperata

7. Fertile part cylindrical with flattened areas bearing more or less naked perithecia, the whole 1 cm long X 1 mm, black. Ascospores 9-10.5 X 5-6 µm . . . . . Xylaria sp. (R 2023)

Xylaria cf. aenea Mont., Ann. Sci. Nat. Bot. (ser. 4) 3:100. 1855. Figs. 1,2,6,33,36

Stromata cylindrical to clavate, up to 6 cm X 4 mm-1 cm diam, on short to long stipes up to 5 cm long, externally dull black, but probably once brown; internally white. Texture hard. Surface smooth except for few or many small wrinkles. Perithecia ca. 1 mm diam. Ostioles umbilicate, often discoid. Asci eight-spored, the spores usually arranged in a biseriate manner, cylindric-clavate, very long-stipitate, 320-330 µm total length X 13-17 µm broad, the spore-bearing part 140-150 µm long, with apical ring bluing in Melzer's iodine reagent, urn-shaped, 4.5 µm high X 3 µm broad. Ascospores brown, unicellular or often bearing a cellular (primary) appendage at one end, inequilateral, fusoid or navicular, smooth, (26.5-)29-34 X 5-6(-8) µm, with germ slit straight to somewhat oblique, much less than spore-length.

SPECIMENS EXAMINED: R1955, R2003, R2004, R2068, R2470, R2515

NOTES: Our concept of this species is based on Dennis' description (1956). Our stromata are more slender than those described by Dennis and often have longer stipes. Dennis (1956) illustrated a specimen from Venezuela [Fendler 253 (K)]. JDR has examined this specimen which, although more robust than our material, has the same type of fusoid or navicular ascospore with a short slit. A photograph by J. H. Miller (in the possession of JDR) of

stromata and ascospores of X. aenea (presumably from C. G. Lloyd material) likewise is of a robust specimen with ascospores identical to those depicted by Dennis and described herein. Indeed, Miller's photographs even show the biseriate arrangement of ascospores in an ascus. We thus feel justified in considering the cited collections to represent X. aenea.

Dennis (1956) illustrated and described X. rickii Theissen, a fungus that seems very much like our X. aenea in the size and morphology of stromata. Dennis (1956) remarked on the short germ slits in ascospores of this species. He gave ascospores as 18-25 X 5-7 µm, but noted that an annotation on the packet gave them as 25-32 X 6-8 µm. If, indeed, X. rickii has ascospores of this latter range its relationship to X. aenea might be closer than usually suspected. We have not seen material of X. rickii.

Xylaria anisopleura (Mont.) Fr., Nova Acta Regiae Soc. Sci. Upsal. (ser. 3) 1, p. 127. 1851.

Figs. 28,29,64

Stromata extremely variable in shape, cylindrical to clavate to globoid when upright to fragariform or hemispheric when hypoxyloid with short narrowed stipes or with narrow connective, 4 mm to 3 cm high X 3 mm to 1 cm diam; externally dark brown to brownish black, internally white. Texture cheesy or woody to hard. Surface rough from warts, wrinkles, corkiness, and, sometimes, ostioles. Perithecia 0.5-1 mm diam. Ostioles discoid, prominent or obscure. Asci eight-spored, cylindrical, stipitate, 250-260 µm total length X 8 µm broad, the spore-bearing part 160-180 µm, with apical ring bluing in Melzer's iodine reagent, more or less urn-shaped, 7.5-9 µm high X 4.5-5 µm broad. Ascospores brown to dark brown, unicellular, ellipsoid-inequilateral, smooth, (20-)22-28(-30) X 7.5-9.5(-10.5) µm, with germ slit much shorter than spore-length oriented oblique to spore axis or spiralling.

Colonies on oatmeal agar at ca. 20 C under 12 h fluorescent light covering 9 cm diam Petri dish in 3 wk, with mycelium at first velvety, white, zonate, with plumose, deeply lobed margins, later with thin layer of olive grey hyphae deposited predominately around developing stromata, surface becoming furrowed in a radiating pattern. Reverse at first pale orange, then brown. Stromata cylindrical, unbranched to branched several times at point of contact with Petri dish lid,

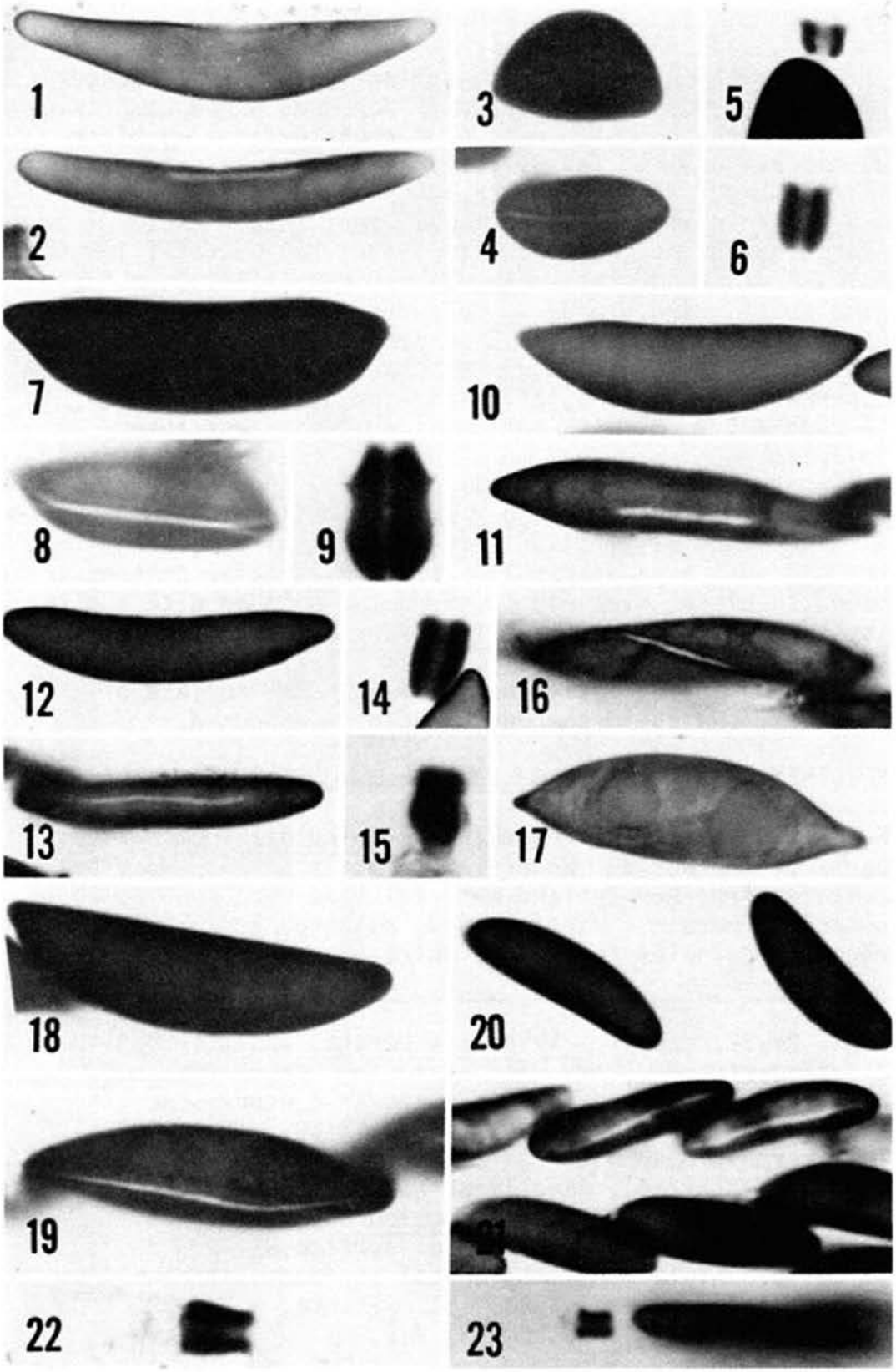
developing abundantly over surface of colony, especially at periphery of zones and edge of Petri dish, ca. 1-1.5 cm high X 1-2 mm diam, at first white, but soon covered with orange exudation droplets before turning dark olive grey. Orange pigment not evident in other areas of the colony, disappearing as colony matures. No conidiogenous structures produced.

SPECIMENS EXAMINED: R2192 (cultured), R2483, R2517, S1210, S1346, S1432, S1568, S1839

NOTES: Xylaria anisopleura -- along with with X. scruposa and X. schweinitzii -- is a member of the difficult X. polymorpha complex. Members of this complex can be separated, in part, by cultural characteristics, as will be shown in a future paper. Our culture did not yield the anamorph, but a culture of BEC from Puerto Rico produces conidia on conidiophore palisades on stromatal surfaces. Conidia measure (8-)9(-10) X (3.5-)4 mm.

Figs. 1-23. 1-2. Xylaria cf. aenea (R1955). Ascospores, that in Fig. 2 showing germ slit, X 1600. 3-5. X. asperata (R1773). 3,4. Ascospores, that in Fig. 4 showing germ slit, X 1900. 5. Ascus apical ring, X 1900. 6. X. cf. aenea (R1955). Ascus apical ring, X 1900. 7-9. X. griseo-olivacea. 7,8. Ascospores, that in Fig. 8 showing germ slit, X 1600. 9. Ascus apical ring, X 1600. 10,11. X. kretzschmarioidea. Ascospores, that in Fig. 11 showing germ slit, X 1500. 12,13. X. cf. kegeliana (S1451). Ascospores, that in Fig. 13 showing germ slit, X 1600. 14. X. kretzschmarioidea. Ascus apical ring, X 1600. 15. X. cf. kegeliana (S1451). Ascus apical ring, X 1600. 16,17. X. nodulosa var. microspora. Ascospores, that in Fig. 16 showing portion of spiralling germ slit, X 1700. 18,19. X. platypoda var. microspora. Ascospores, that in Fig. 19 showing germ slit, X 1600. 20,21. X. plumbea. Ascospores, several in Fig. 21 showing germ slit, X 2200. 22. X. platypoda var. microspora. Ascus apical ring, X 1600. 23. X. plumbea. Ascus apical ring, X 1500.

Figs. 5,6,9,14,15,22,23 from material mounted in Melzer's iodine reagent. Other figures from material mounted in water. All photographs by brightfield microscopy.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Xylaria apiculata Cooke, Grevillea 8:66. 1879.

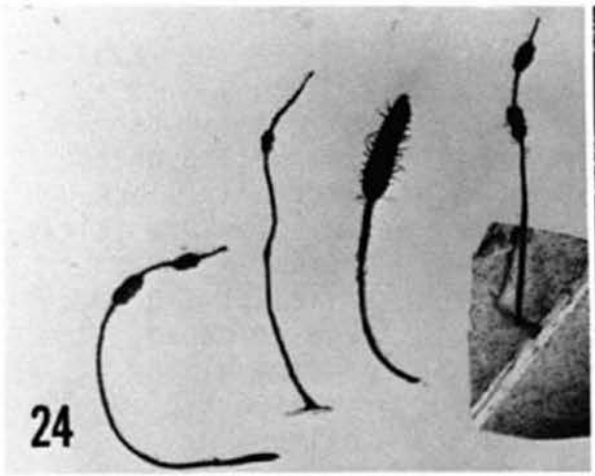
Stromata cylindrical to cylindric-conic with acute apices, 2-3 mm diam, on abruptly narrowed stipe comprising 1/3-2/3 total height, up to 4 cm high; externally black with brown peeling layer, internally white. Texture fairly hard. Surface smooth; stipe hairy. Perithecia 0.4-0.5 mm diam. Ostioles finely papillate. Asci eight-spored, cylindrical, stipitate, 165 µm total length X 10-11 µm broad, the spore-bearing part 115-120 µm long, with apical ring bluing in Melzer's iodine reagent, urn-shaped, 6 µm high X 4.5 µm broad. Ascospores brown, unicellular or with a tiny cellular appendage (primary appendage) at one end, ellipsoid-inequilateral, smooth, 19-22 X 7.5-9 µm, with germ slit somewhat less than full-length.

Colonies on oatmeal agar at ca. 20 C under 12 h fluorescent light covering 9 cm diam Petri dish in 2 wk, with mycelium at first velvety, white, uniform, becoming covered with a greyish felty layer which later deepens to brownish black, overlaid in irregular patches with a thin layer of white mycelium. Stromata rudimentary, pulvinate to irregularly cylindrical, 1-5 mm tall X 1-2 mm diam, developing infrequently and scattered over surface of colonies. No conidiogenous structures produced.

SPECIMEN EXAMINED: R2043 (cultured)

NOTES: Our material resembles X. apiculata from various parts of the world. Rogers and Samuels (1986) described cultures from New Zealand material that were much as that described herein. Martin (1970) cultured X. apiculata and reported colonies to be pure white.

Figs. 24-32. 24-27. Xylaria asperata. 24. (R2224). Maturing stromata, one with anamorphic processes, X 2. 25. (R1758). Stromata with anamorphic processes. The swollen areas will bear perithecia, X 10. 26. (R2224). Teleomorphic head with remnants of anamorphic processes, X 6.5. 27. (R2224). Swollen area bearing mature perithecia, X 24. 28,29. X. anisopleura (R1986). 28. Stromata, X 4.5. 29. Stromatal surface, X 20. 30,31. X. cf. brachiata. 30. Stromatal surface with conspicuous perithecial contours, X 24. 31. Stroma, X 2. 32. X. coccophora (R1794). Stromata, X 5.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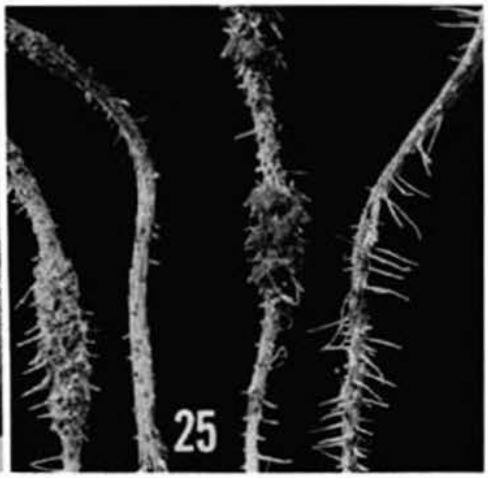
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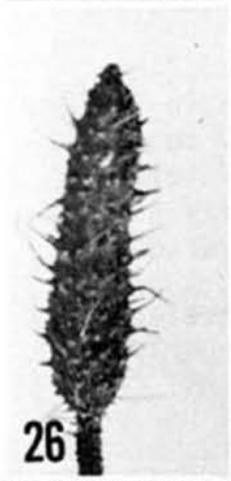
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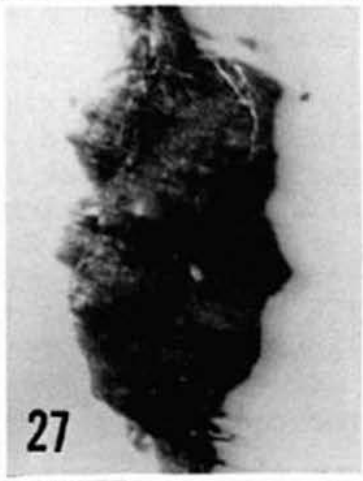
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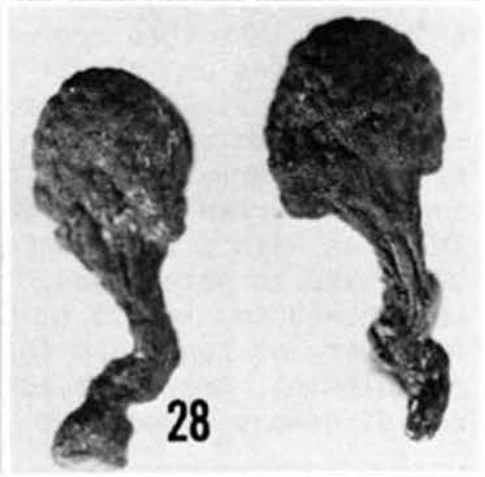
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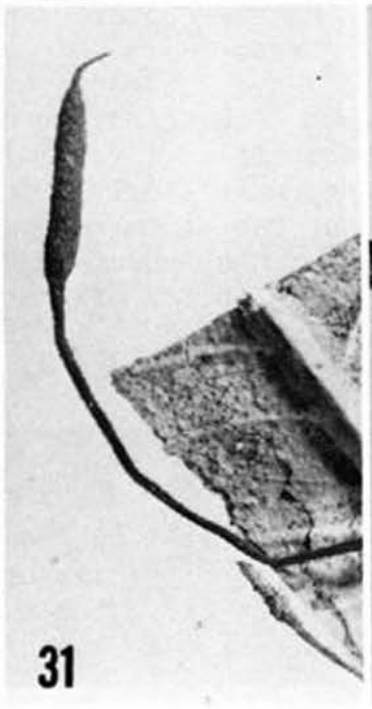
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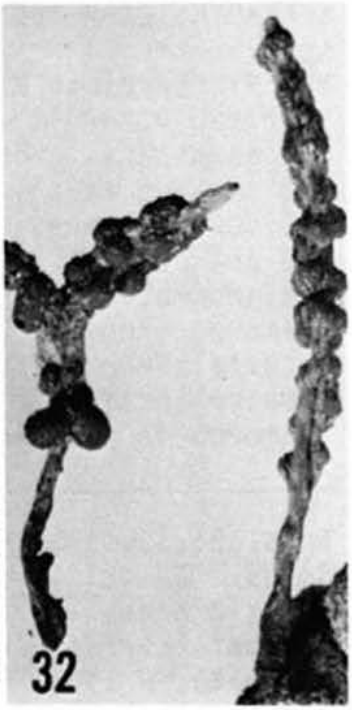
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Xylaria arbuscula Sacc., Michelia 1:249. 1878.

Fig. 67

Stromata cylindrical to long-conical with acute apices, 2-3 mm diam, on narrowed stipe comprising up to 1/2 of total height, up to 2 cm high; externally black with grey peeling layer, internally white. Texture fairly hard. Surface smooth; stipe hairy. Perithecia 0.4 mm diam. Ostioles slightly papillate. Asci eight-spored, cylindrical, 160-200 µm total length X 7-8 µm broad, the spore-bearing part 94-97 µm, with apical ring bluing in Melzer's iodine reagent, urn-shaped, 3 µm high X 2 µm broad. Ascospores brown, unicellular, ellipsoid-inequilateral, smooth, 14.5-17.5 X 6-6.5 µm, with germ slit much less than spore-length.

Colonies on oatmeal agar at ca. 20 C under 12 h fluorescent light covering 9 cm diam Petri dish in 2-3 wk, with mycelium at first whitish, velvety, widely zonate, becoming overlaid with a greyish brown layer of felty mycelium darkening to brownish black and patchily covered in areas with a thin white mycelial layer. Reverse uncolored to pale brown. Stromata cylindrical, unbranched, up to 3.5 cm high X 1-2 mm diam, developing at periphery of zones and in large numbers at the periphery of colonies, greyish black with whitish interiors. No conidiogenous structures produced.

SPECIMENS EXAMINED: R2309 (cultured) R2297 (not typical)

NOTES: Specimen R2309 seems typical of the species. Specimen R2297 is much like the other described herein, but ascospores average smaller, (11.5-)12.5-13.5(-15) X 5-6 µm, and have long, undulate to spiralling germ slits.

Our cultures produced stromata, but did not produce the anamorph. They somewhat resemble cultures from New Zealand material which produced neither stromata nor the anamorph (Rogers & Samuels, 1986). Martin (1970) cultured material from Africa and reported only sterile stromata. Some collections of X. arbuscula from Brazil produce the anamorph in palisades on stromata and in tufts on the

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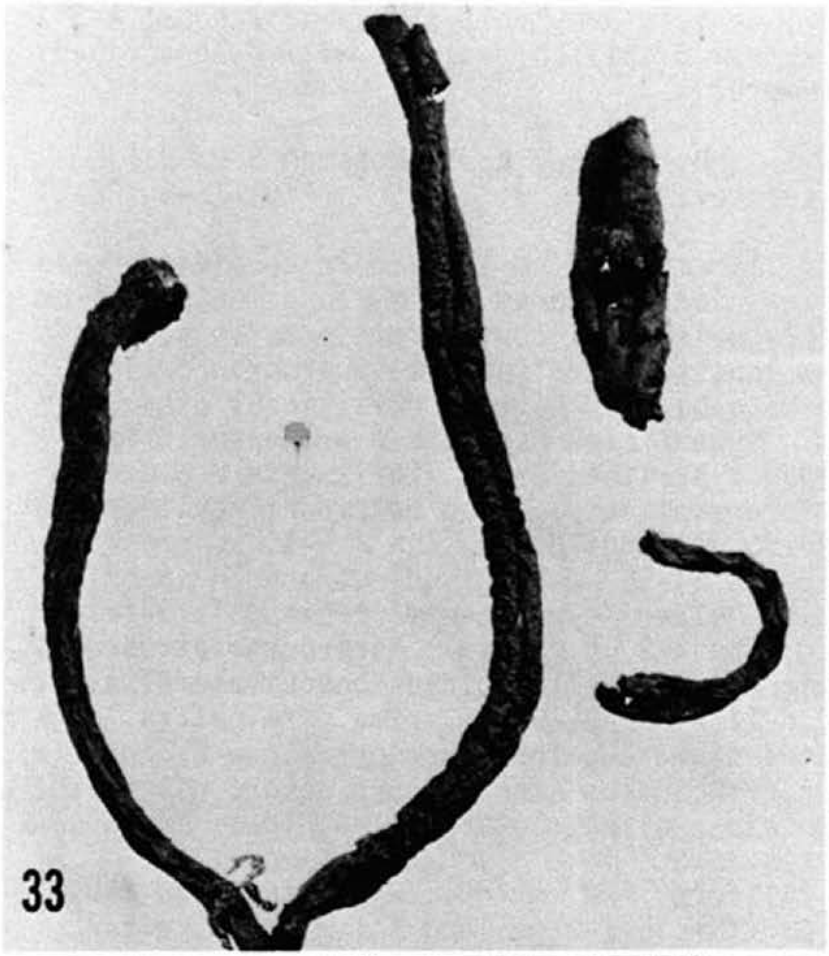
Figs. 33-37. 33. X. cf. aenea (R2064). Stromata, X 0.8. 34,35. X. griseo-olivacea. 34. Stromata, X 1.5. 35. Fertile head, X 15.5. 36. X. cf. aenea (R2064). Stromata surface, X 16. 37. X. ianthino-velutina. Stromata, X 1.6.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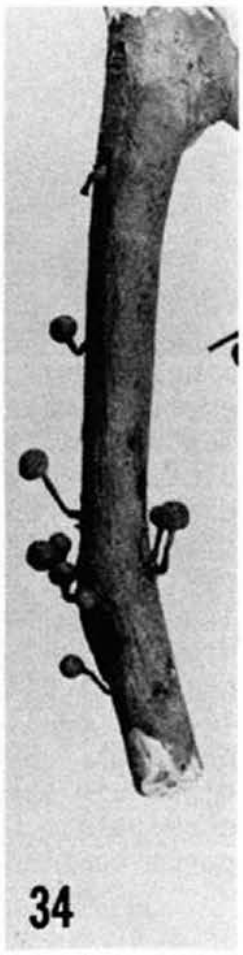
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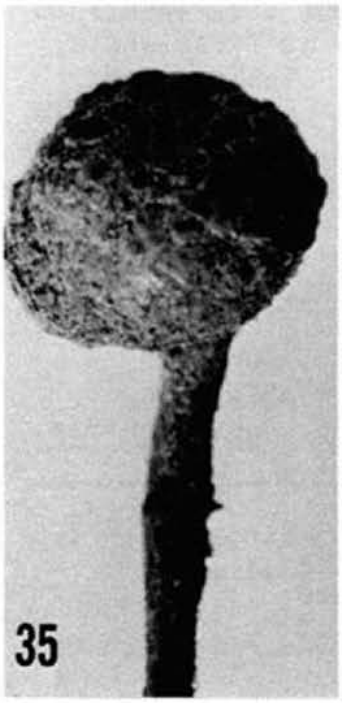
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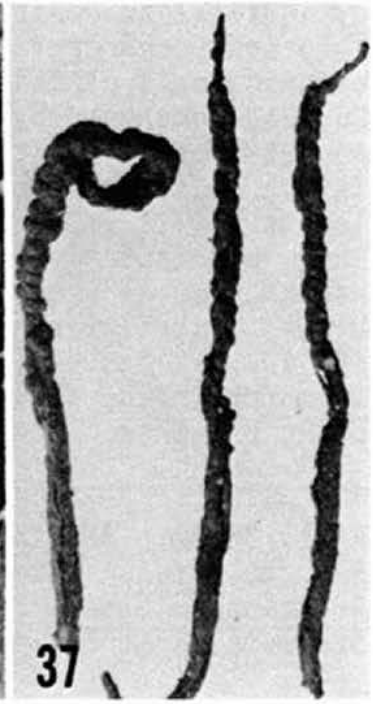
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colony surface. Conidia are typically xylariaceous, 4-5 X 2 µm. Cultures from Brazilian material will be described in detail elsewhere.

Xylaria asperata J. D. Rogers, A. Y. Rossman & G. J. Samuels, sp. nov. Figs. 3-5, 24-27

Stromata filiformia 1-2 cm longa, ornata a dispersis aggregatis peritheciorum nudorum 1-2 mm longitudine X 1 mm diametro, et cylindricis vel conicis projecturis conidicis minus quam 1 mm longitudine dispersim super principalem axem; extus prima alba, tum nigrescentia, intus alba. Textura mollis. Superficies asperata a projecturis conidicis et aggregatis peritheciorum. Perithecia 0.3-0.4 mm diametro. Ostiola papillata. Asci octospori, cylindrici, stipitati, 120-150 µm longitudine tota X 9-11 µm crassi, partibus sporiferis 84-90 µm longitudine, annulo apicali in liquore iodato Melzeri cyanescente, rectangulari vel urceolato, 3 µm alto X 3 µm crasso. Ascosporae atrobrunneae, unicellulares, late ellipsoideo-inaequilaterales, leves, (9-)10.5-12 X 6.5-8(-9) µm, rima germinativa longa praedita. Status conidicus forma projecturarum (? coremia) dispersim super principalem axem. Conidiophora non clare observata. Conidia hyalina, levia, ellipsoidea, basibus parum complanatis.

Stromata filiform, 1-2 cm long, with scattered clusters of naked perithecia 1-2 mm long X 1 mm diam, with cylindrical to conical conidial projections less than 1 mm long scattered over main axis; externally at first white, becoming dull blackish; internally white. Texture soft. Surface roughened by conidial projections and perithecial aggregations. Perithecia 0.3-0.4 mm diam. Ostioles papillate. Asci eight-spored, cylindrical, 120-150 µm total length X 9-11 µm broad, the spore-bearing part 84-90 µm long, with apical ring bluing in Melzer's iodine reagent, rectangular to urn-shaped, 3 µm X 3 µm. Ascospores dark brown, unicellular, broad ellipsoid-inequilateral, smooth, (9-)10.5-12 X 6.5-8(-9) µm, with germ slit spore-length. Anamorph in the form of pegs (? coremia) scattered over principal axis. Conidiophores not clearly seen. Conidia

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Figs. 38-42. 38. Xylaria cf. kegeliana. Stromata, X 1. 39. X. lutea. Stromatal surface, X 16. 40,41. X. kretzschmarioidea. 40. Fertile heads, X 3. 41. Stromata, X 1.75. 42. X. lutea. Stromata, X 1.2.

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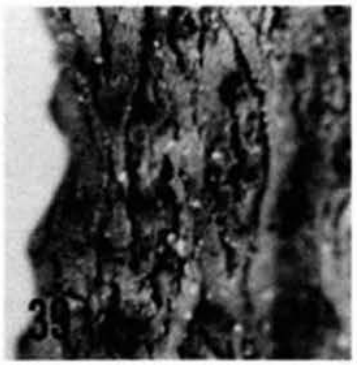

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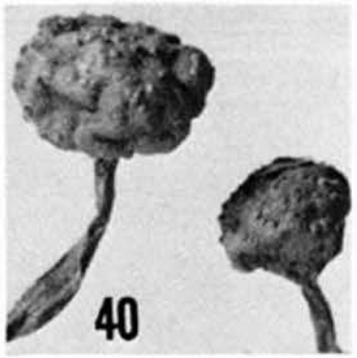

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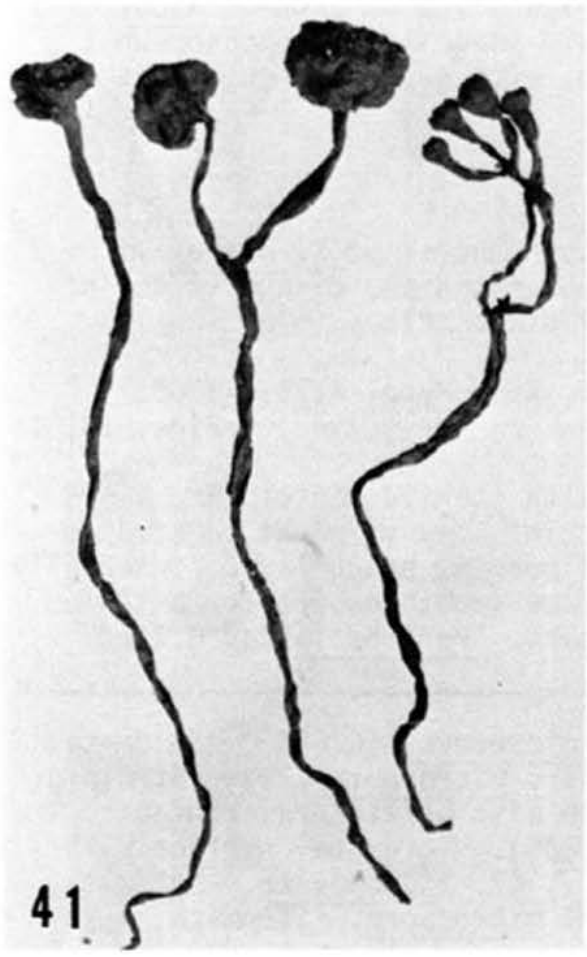

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hyaline, smooth, ellipsoid, 4-6 X 1.5-2 µm, with slightly flattened bases.

SPECIMENS EXAMINED: R2224 (Holotype, VEN; Isotypes, BPI, JDR), R2380 (immature), R2394, S1410

NOTES: This fungus is most striking in the production of coremia on the rachis and the retention of these structures -- at least for some time -- on mature teleomorphic stromata. The affinities of this fungus are probably with X. comosa and X. tentaculata.

Xylaria berkeleyi Mont. apud Cooke, Grevillea 11:85. 1883.

Stromata cylindric-irregular on short stipe, up to 6 cm high X 2-3 mm diam, externally black, internally white. Texture hard. Surface roughened by circumferential wrinkles. Perithecia 0.5 mm diam. Ostioles obscure. Asci not intact; apical ring bluing in Melzer's iodine reagent, urn-shaped, 3 µm high X 1.5 µm broad. Ascospores brown, unicellular, ellipsoid-inequilateral to somewhat allantoid, 13-15 X 4.5-5 µm, with germ slit much less than full-length.

SPECIMEN EXAMINED: S1264

NOTES: Our material fits our concept of X. berkeleyi well. The wrinkles oriented around the circumference of the stroma are particularly diagnostic.

Xylaria cf. brachiata Sacc., Ann. Mycol 4:75. 1906. Figs. 30,31

Stromata cylindrical with sterile acute apex, 1-1.5 cm long X 2 mm diam, with thin hairy stipe at least 4 cm long; externally black with peeling brown layer, internally white. Texture soft. Surface smooth except for ostioles, peeling layer, and stipe hairs. Perithecia ca. 0.2 mm

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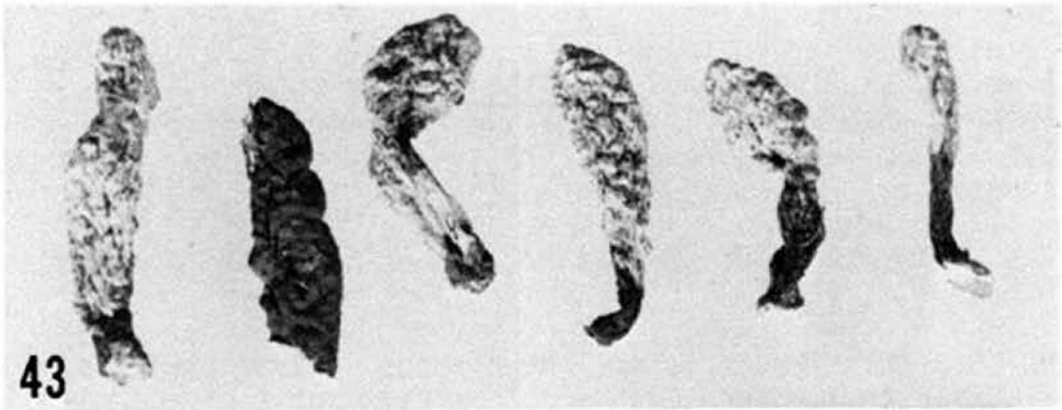
Figs. 43-48. 43. Xylaria microceras (R2085). Stromata, X 2. 44,45. X. nodulosa var. microspora. 44. Stromata, X 1. 45. Stromatal surface with perithecial contours, X 16. 46. X. microceras (R2085). Stromatal surface with wrinkles and ostioles, X 24. 47. X. obovata. Stromata, X 1. 48. X. platypoda var. microspora. Stromata, X 2.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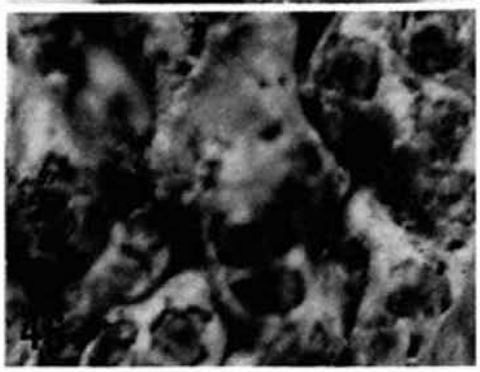


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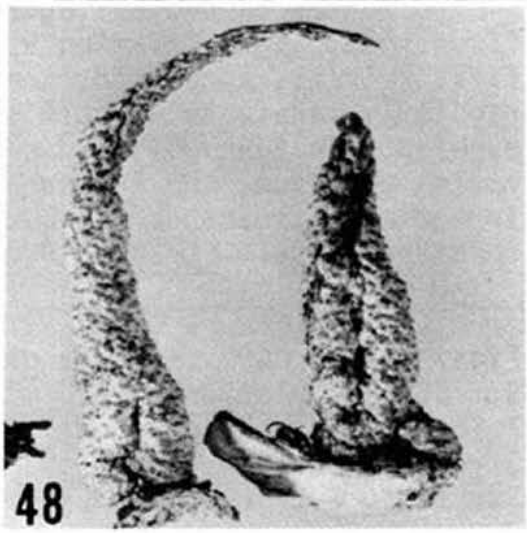
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diam. Ostioles discoid. Asci poor in this material, with apical ring bluing in Melzer's iodine reagent, urn-shaped, 4 µm high X 3 µm broad. Ascospores dark brown, unicellular, broad ellipsoid-inequilateral, smooth, 14.5-16 X 6.5-7.5 µm, with germ slit straight or undulating, spore-length.

SPECIMENS EXAMINED: R2233, R2284. R2232 might represent immature material.

NOTES: This fungus is not known to us. It might be assignable to X. brachiata Sacc. We have not seen authentic material of that species. Dennis (1957) considers X. brachiata to be synonymous with X. mellisii (Berk.) Cooke [as Xylosphaera mellisii (Berk.) Dennis].

Xylaria coccophora Mont., Ann. Sci. Nat. Bot. (sér. 4) 3:109. 1855. Figs. 32,65

Stromata cylindrical, simple or with a few branches, with acute apices, with short or long stipes, 5 mm - 2 cm high X 1-2 mm diam; externally cream-colored often with areas of bright orange; internally white. Texture soft. Surface smooth except for perithecial contours. Perithecia 0.5-0.7 mm diam. Ostioles more or less papillate. Asci eight-spored, cylindrical, stipitate, 160 µm total length X 6-7 µm broad, the spore-bearing part 75-85 µm, with apical ring bluing in Melzer's iodine reagent, urn-shaped, 2-3 µm high X 2-3 µm broad. Ascospores brown, unicellular, ellipsoid-inequilateral, smooth, 9.5-10.5(-12) X 3.5-4.5 µm, with germ slit slightly or considerably less than full-length.

Colonies on oatmeal agar at ca. 20 C and under 12 h fluorescent light covering 9 cm Petri dish in 3 wk, at first velvety, appressed, some with plumose margins, irregularly zonate to uniform, becoming covered with blackish mycelium, in turn overlaid with white, or in some isolates, yellow mycelium, the latter bearing aggregates of pigmented irregular excrescences on hyphal surfaces. Reverse pale reddish-orange. Stromata narrowly cylindrical, up to 2 cm

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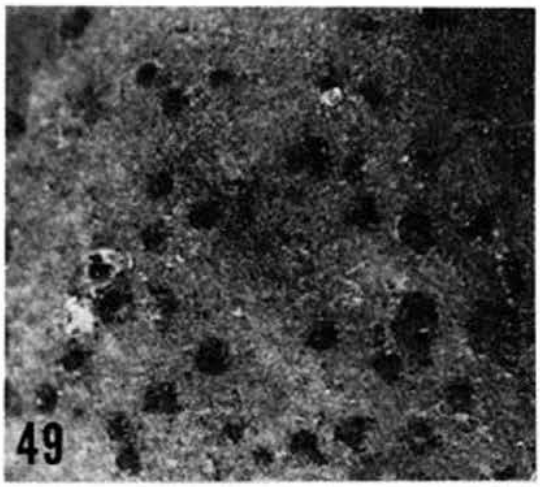
Figs. 49-53. 49. Xylaria obovata. Stromatal surface, X 9. 50. X. platypoda var. microspora. Stromatal surface, X 16. 51,52. X. plumbea. 51. Stromata, X 1.6. 52. Stromatal surface, X 24. 53. X. scruposa (R1882). Stromata, X 2.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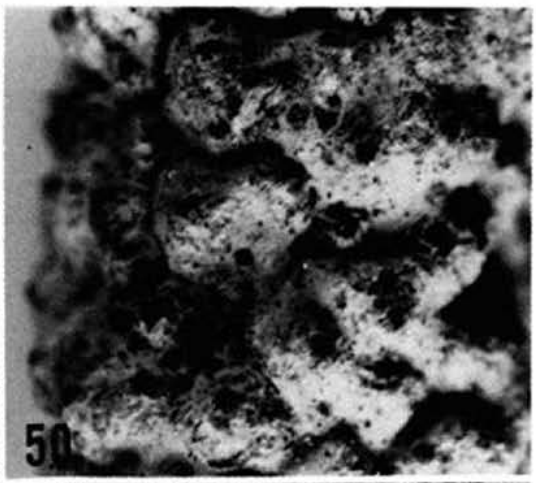
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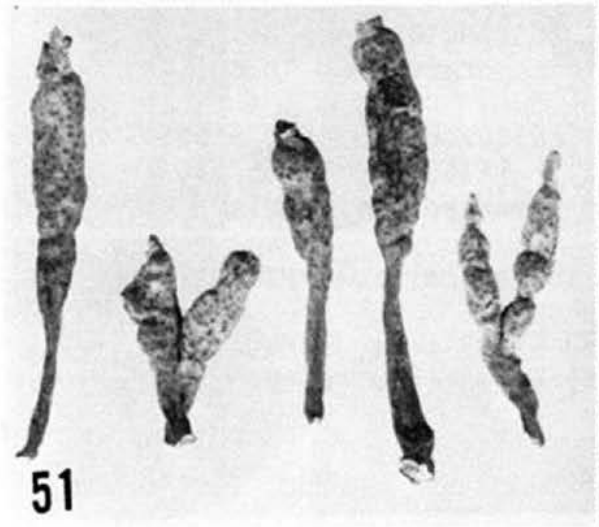
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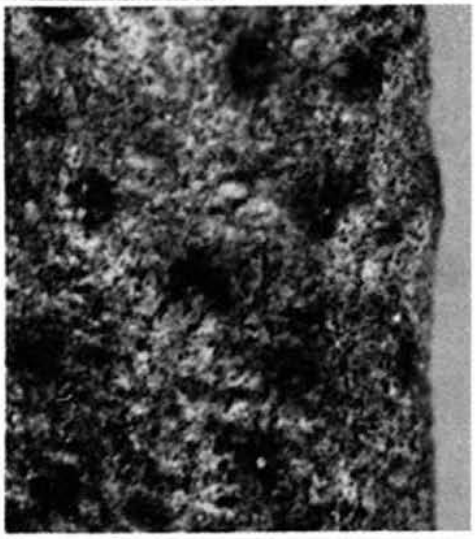

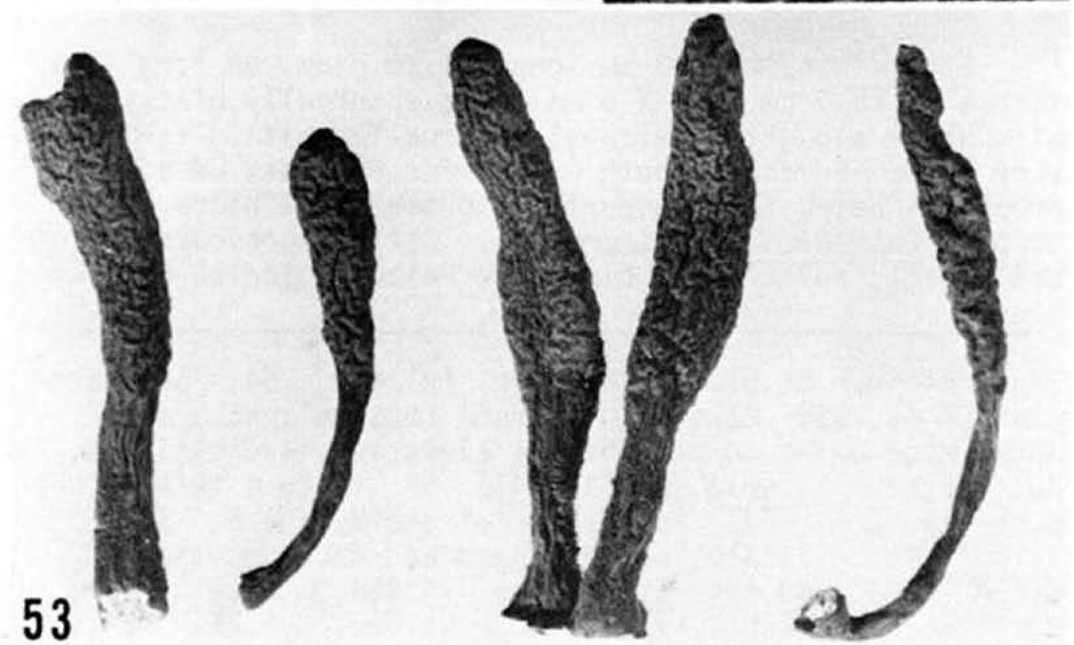
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tall X .5-1 mm diam, to clavate or flabelliform, 0.5-1 cm tall X 3-4 mm diam, produced on surface and periphery of colony, at first white, then covered except for growing tips with thin black layer and a second white to yellow layer of more or less parallel hyphae. Conidium-bearing regions on basal surfaces of stromata and on small, pulvinate protrusions on agar, but not seen on areas bearing yellow hyphae. Conidiophores upright in palisades, sparingly branched near base, white to pale brownish in mass, smooth-walled. Conidiogenous cell terminal, cylindrical, 20-30 X 4-6 µm, bearing denticular conidial secession scars. Conidia produced holoblastically in sympodial sequence. Conidia hyaline, smooth, narrow ellipsoid, guttulate, with flattened to slightly flared bases indicating former points of attachment to condiogenous cell, (7-)8-9 (-10) X (2.5-)3-4 µm. Conidia germinating in culture.

SPECIMENS EXAMINED: R1794 (cultured), S1484, S1525 (cultured), S1618 (cultured). S1168 and S1455 are somewhat atypical in having immersed perithecia.

NOTES: Except where noted above, our collections seem entirely typical of X. coccophora.

Cultures from S1525 and S1618 were as described. Specimen R1794 yielded a white floccose culture devoid of the anamorph.

Xylaria comosa (Mont.) Fr., Summa Veg. Scand. Sect. Post., p. 381. 1849.

Stromata oblong, 3 cm long X 1 cm diam, on long thin stipes up to 5 cm long X 1 mm diam; externally blackish with white sloughing patches; internally white. Texture very hard. Surface smooth except for remnants of conidial processes below fertile part and dense short hairs on stipe. Perithecia ca. 1 mm diam. Ostioles obscure. Asci not intact; apical ring bluing in Melzer's iodine reagent,

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Figs. 54-60. 54,55. Xylaria sp. (R1741). 54. Stroma on leaf, X 6. 55. Portion of stroma showing geniculate appearance owing to perithecial elevations and ostioles, X 20. 56,57. Xylaria sp. (R2264). 56. Mature teleomorphic stromata, X 6. 57. Anamorphic stromata, X 1.5. 58. Xylaria sp. (S1353). Fertile head and short portion of stipe, X 24. 59,60. Xylaria sp. (S1364). 59. Perithecia on rachis, X 24. 60. Stroma, X 1.75.


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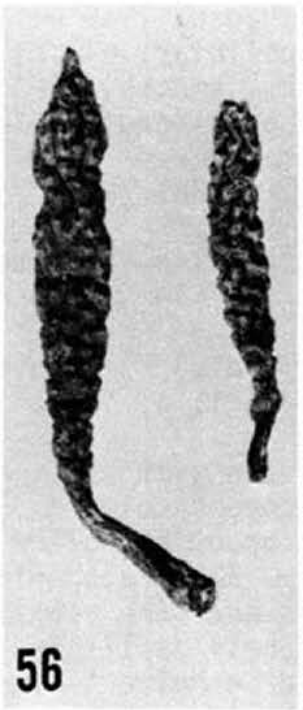
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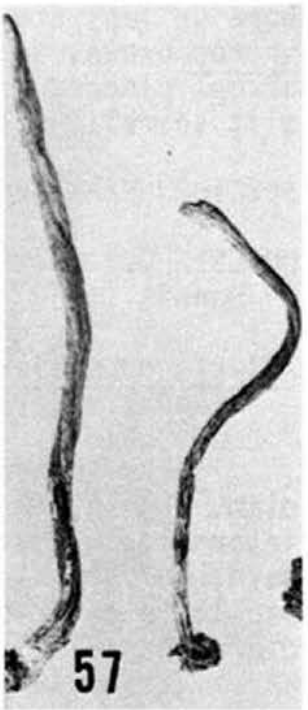
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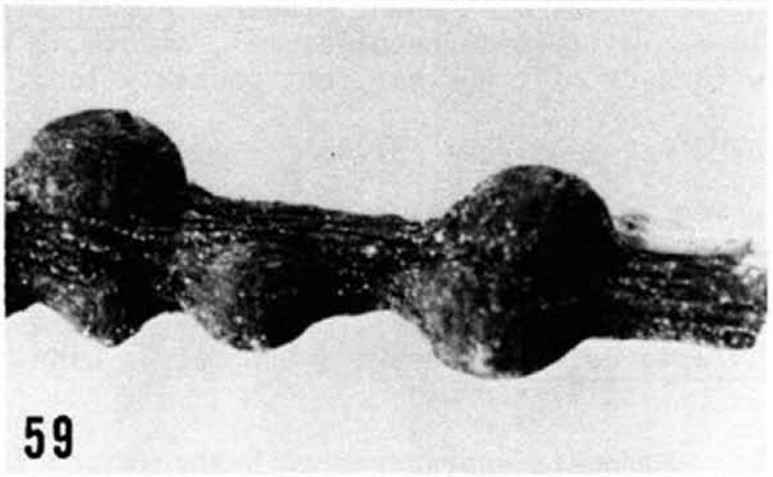
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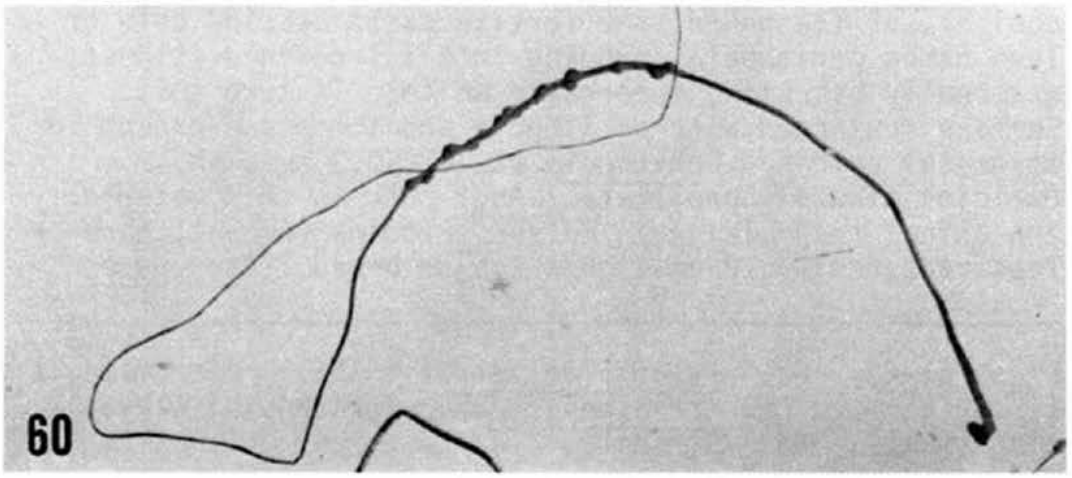
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more or less urn-shaped, 10.5 µm high X 7.5 broad. Ascospores brown, unicellular, ellipsoid-inequilateral with abrupt pinched ends, smooth, 31-35 X 8-9 µm, with germ slit spiralling, spore-length.

SPECIMEN EXAMINED: S1801

NOTES: Our material is much as described and illustrated by Dennis (1956).

Xylaria cubensis (Mont.) Fr., Nova Acta Regiae Soc. Sci. Upsal. (ser. 3) 1, p. 126. 1851.

Stromata clavate with short stipe, 3 cm high X 1 cm diam, externally copper-colored, becoming blackened; internally white, becoming hollow and inrolled. Texture hard, but fragile. Surface smooth except for finely papillate ostioles and fine cracking. Perithecia 0.4 mm diam. Ostioles finely papillate. Asci not intact. Ascus apical ring bluing in Melzer's iodine reagent, rectangular or inverted hat-shaped, minute. Ascospores brown, unicellular, ellipsoid-inequilateral, smooth, 9 X 3.5-4.5 µm, with germ slit unclear, but probably long.

SPECIMEN EXAMINED: R1785

NOTES: Our material seems typical for the species. Rogers (1984) has discussed X. cubensis and its Xylocoremium J. D. Rogers anamorph.

Xylaria culleniae Berk. & Broome, J. Linn. Soc. Bot. 14:119. 1875.

Stromata unbranched or branched, cylindrical, long conical, or flattened, the fertile parts bearing more or less naked perithecia, grading into ill-defined stipes; externally blackish, internally white. Texture soft. Surface roughened with perithecia and tomentose except for stromatal apices. Perithecia ca. 0.2-0.3 mm diam. Ostioles minutely papillate. Asci poor in this material, the apical ring bluing in Melzer's iodine reagent, more or less rectangular, 2 µm high X 1.5 µm broad. Ascospores

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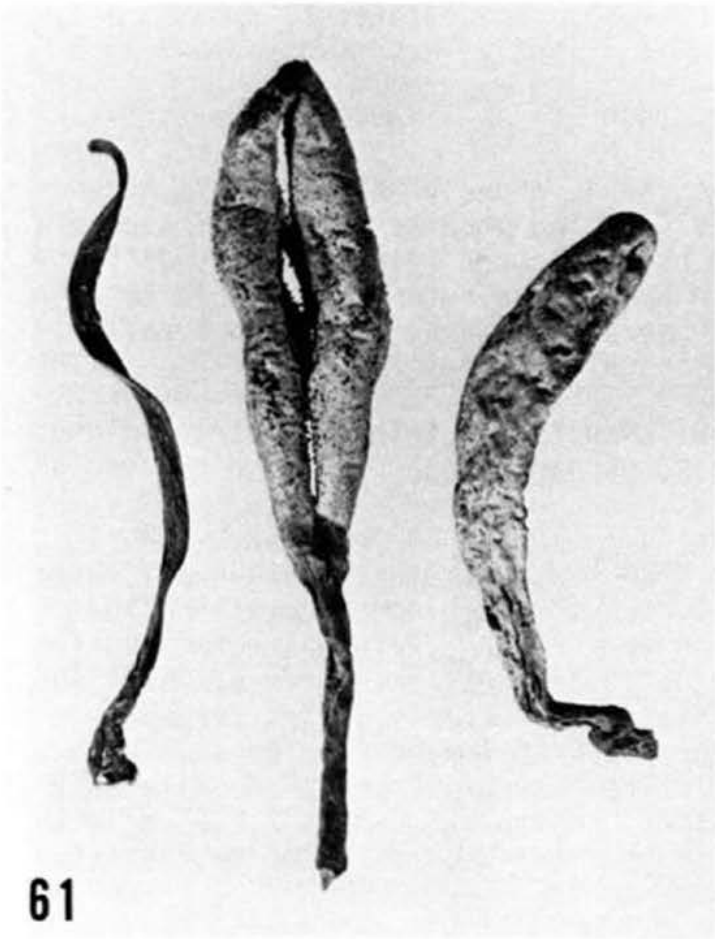
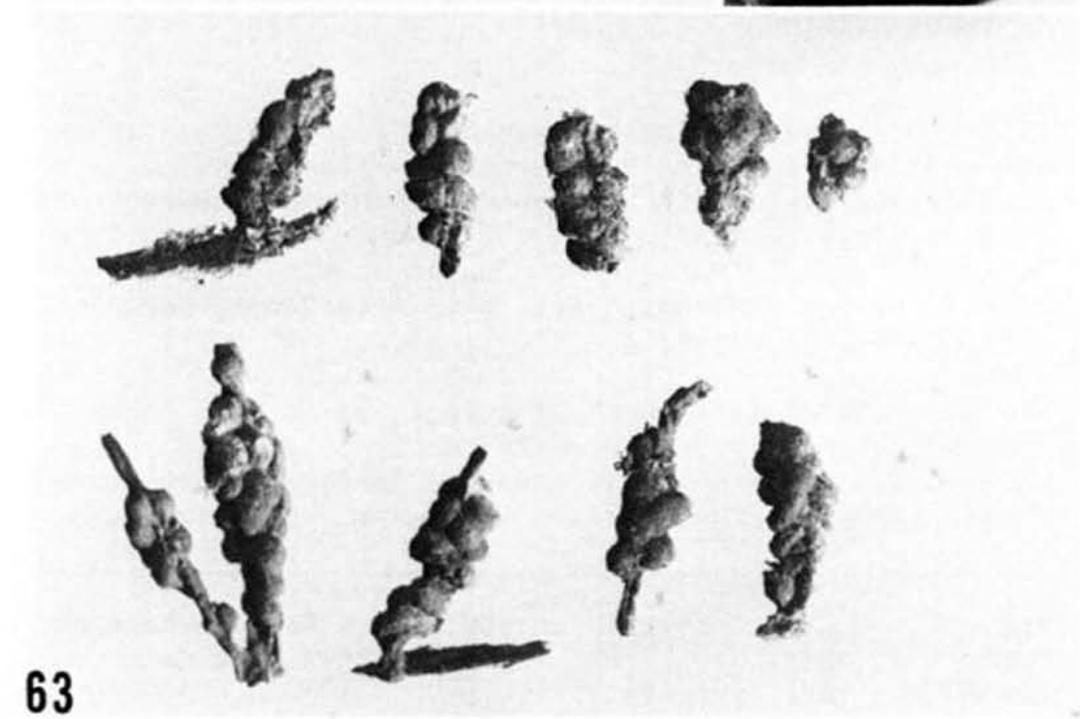
Figs. 61-63. 61. Xylaria telfairii (S1561). Stromata, X 1. 62,63. X. cf. theissenii. 62. Perithecial elevations, X 24. 63. Stromata, X 4.



61

62



63

brown, unicellular, ellipsoid-inequilateral, smooth, 8-9.5 X 3-4 µm, with germ slit slightly less than spore-length.

SPECIMEN EXAMINED: S1159

NOTES: Xylaria culleniae is closely related to X. ianthino-velutina and detailed studies may show it to be a small-spored variety of the latter (Dennis, 1956; Joly, 1968; Rogers, 1979). We were unfortunately unable to culture our fungus. See also remarks herein on X. aff. magnoliae and X. cf. ianthino-velutina.

Xylaria dealbata Berk. & Curt., J. Acad. Nat. Sci. Philadelphia, N.S. 2:284. 1853.

Stromata clavate, 4 cm long X 5-7 mm diam, with narrowed stipe up to 5 cm long, externally egg-shell white to greyish; internally tan to blackish, becoming hollow and inrolled. Texture very hard. Surface smooth. Perithecia 0.7 mm diam. Ostioles punctate, obscure. Asci not intact; apical ring bluing in Melzer's iodine reagent, more or less urn-shaped, 6.5 µm long X 4 µm broad. Ascospores nearly black, unicellular, ellipsoid-inequilateral with abrupt acute apices, smooth, 26.5-32 X 7.5-9 µm, with slit less than full-length, oriented parallel to the axis of the spore or oblique to it.

SPECIMENS EXAMINED: I740, R2143, S1183, S1425, S1468, S1818, S1926

NOTES: Our material seems typical of X. dealbata. It has been well-described and illustrated by Dennis (1956). The putative conidial state has been described by Rogers, Callan & Samuels (1987).

Xylaria enterogena (Mont.) Fr., Nova Acta Regiae Soc. Sci. Upsal. (ser. 3) 1, p. 127. 1851.

Stromata clavate on short stipes, up to 6 cm high X 1 cm diam; externally yellow-white, internally white, becoming brownish. Texture fairly hard. Surface smooth, more or less laccate. Perithecia 0.5 mm diam. Ostioles punct-

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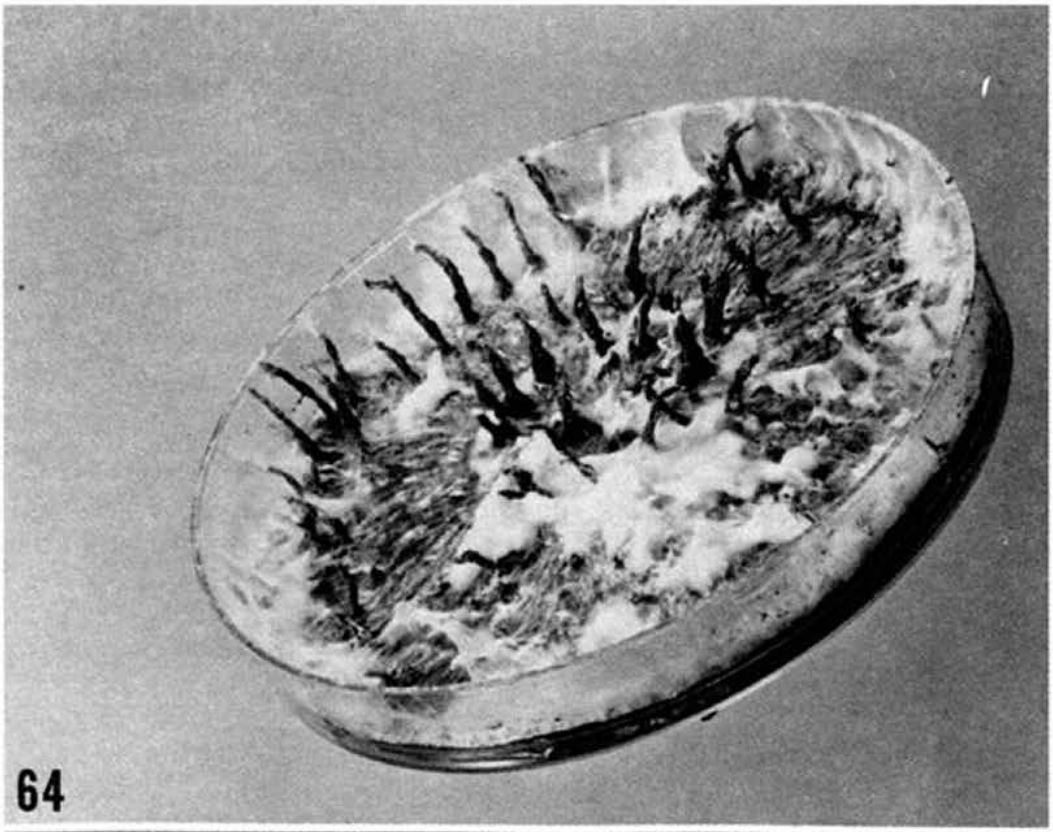
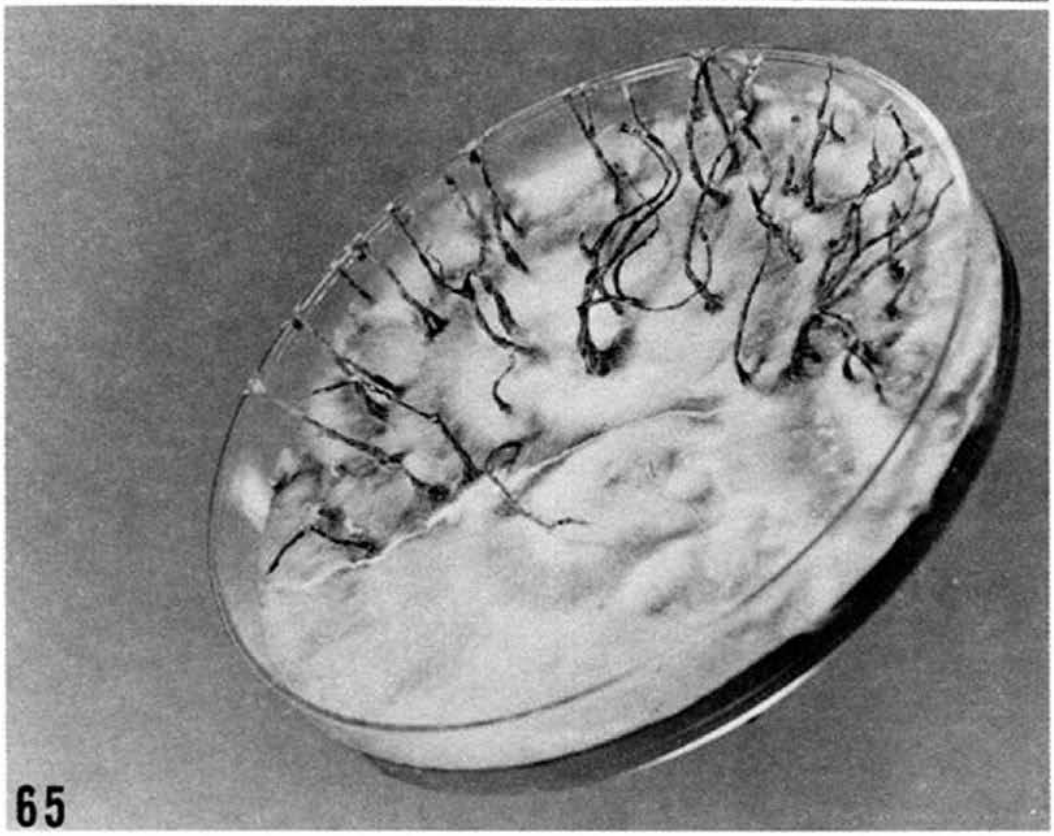
Figs. 64, 65. 64. Xylaria anisopleura. Culture bearing immature stromata, X 1. 65. X. coccophora. Culture bearing immature stromata, X 1.



64



65

ate. Asci not intact; apical ring bluing in Melzer's iodine reagent, urn-shaped, 4.5 µm high X 3 µm broad. Ascospores brown, unicellular, ellipsoid-inequilateral to crescentic with rounded apices, smooth, (15-)16-21 X 6-7.5 µm, with germ slit short, oriented oblique to axis of spore.

SPECIMENS EXAMINED: I127, R2425, S1450, S1458, S1698

NOTES: Dennis (1956) considered X. enterogena to be a small state of X. telfairii. We consider X. enterogena to be a separate species, albeit closely related to X. telfairii. It differs from X. telfairii primarily in its yellow-white color, its smaller stature, and its smaller (average) ascospores with rounded ends. Cultural features of X. enterogena and X. telfairii are very similar (unpublished data).

Xylaria feejeensis (Berk.) Fr., Nova Acta Regiae Soc. Sci. Upsal. (ser. 3) 1, p. 128. 1851.

Stromata cylindric-clavate on stipe comprising 1/3-1/2 total height, 5 cm high X 4 mm diam, externally black, internally white. Texture cheesy. Surface roughened by small wrinkles and ostioles. Perithecia 0.3 mm diam. Ostioles discoid. Asci not intact; apical ring bluing in Melzer's iodine reagent, inverted hat-shaped, minute. Ascospores brown, unicellular, ellipsoid-inequilateral, smooth, 7.5-9 X 4.5 µm, with germ slit full-length.

SPECIMENS EXAMINED: S1521, S1768

NOTES: This collection fits our concept of the species. The species seems present in the tropics worldwide. Dennis (1956) should be consulted for synonymy.

Xylaria griseo-olivacea J. D. Rogers & A. Y. Rossman, sp. nov. Figs. 7-9, 34,35

Stromata globosa 2-3 mm diametro, stipitibus perangustis 2-5 mm altis, extus griseo-olivacea, intus alba; stipites nigri. Textura fragilis. Partes fertiles pulverulentae; stipitibus hispidis. Perithecia 1 mm vel

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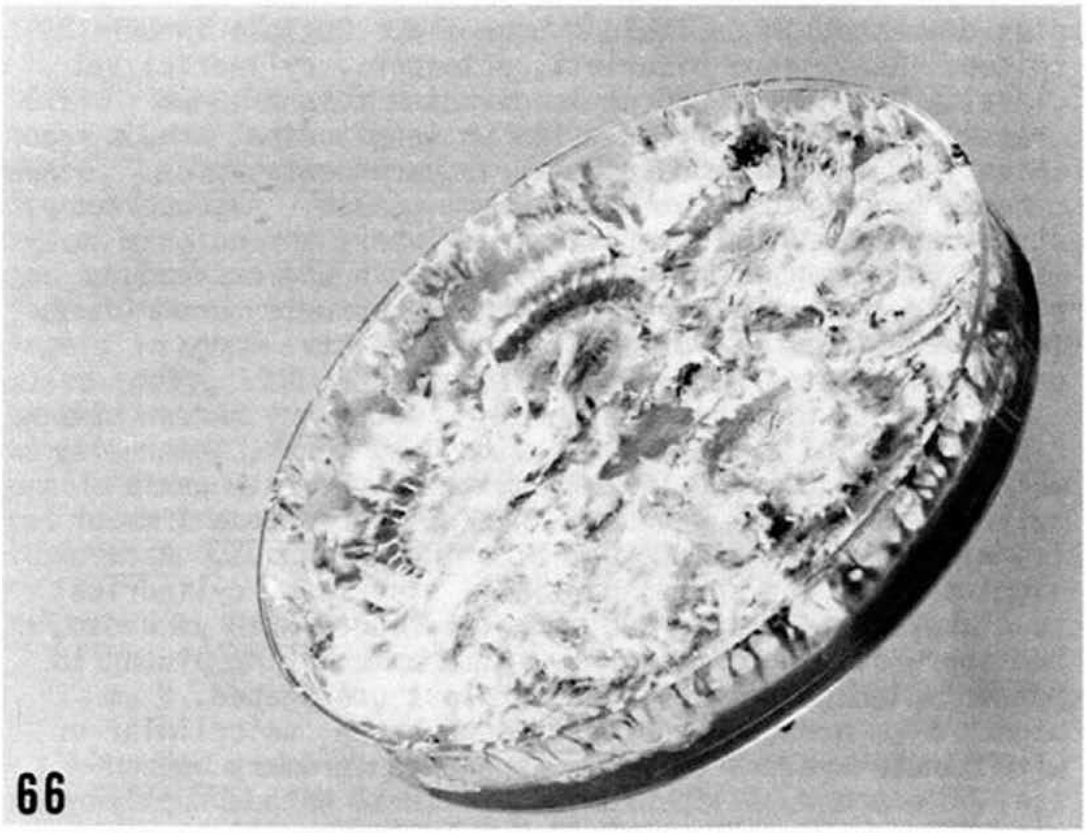
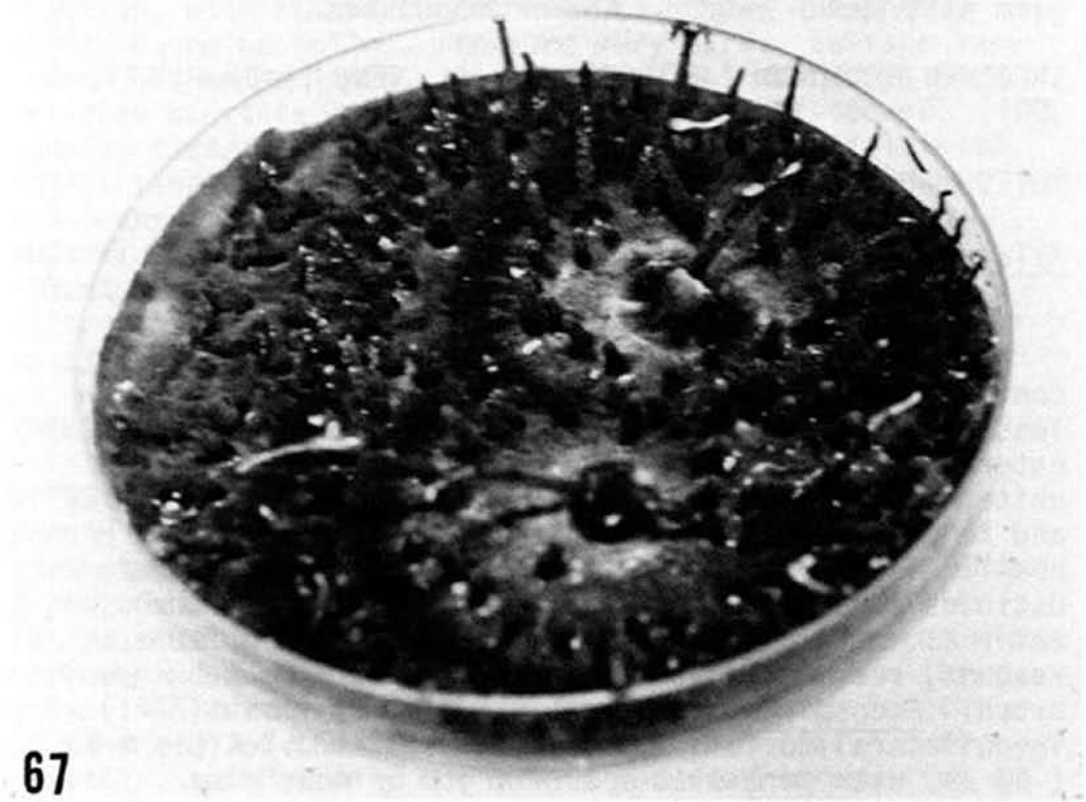
Figs. 66,67. 66. Xylaria scruposa. Culture, X 1. 67. X. arbuscula. Culture, X 1.1.



66



67

plus diametro, in capitulo quoque 1-3. Ostiola inconspicua. Asci saepe biseriati, octospori, cylindrici vel clavati, stipitati, 200 µm longitudine tota X 19 µm crassi, partibus sporiferis 145 µm longitudine, annulo apicali in liquore iodato Melzeri cyanescente, plus minusve urceolato, 9 µm alto X 6 µm crasso. Ascosporae atrobrunneae, unicellulares vel cellulari appendicula minuta hyalina (appendicula primaria) in uno extremo, ellipsoideo-inaequilaterales extremis abrupte constrictis, leves, 23.5-31 X 9.5-11 µm, rima germinativa longa praedita. Status anamorphosis ignotus.

Stromata globose, 2-3 mm diam, with very narrow stipes 2-5 mm high, externally olive with grey tones, internally white; stipes black. Texture brittle. Fertile parts pulverulent, stipes with short hair. Perithecia 1 mm or (+) diam, 1-3 per head. Ostioles inconspicuous. Asci eight-spored, the spores partially biseriate, cylindrical to clavate, stipitate, 200 µm total length X 19 µm broad, the spore-bearing part 145 µm, with apical ring bluing in Melzer's iodine reagent, more or less urn-shaped, 9 µm high X 6 µm broad. Ascospores dark brown, unicellular or with minute hyaline cellular appendage (primary appendage) on one end, ellipsoid-inequilateral with abruptly pinched ends, smooth, 23.5-31 X 9.5-11 µm, with straight germ slit spore-length. Anamorph unknown.

SPECIMEN EXAMINED: R1736 (Holotype, VEN; Isotype, BPI, JDR).

NOTES: This is a strikingly beautiful fungus.

Xylaria cf. ianthino-velutina (Mont.) Fr., Nova Acta Regiae Soc. Sci. Upsal. (ser. 3) 1, p. 128. Fig. 37

Stromata unbranched or branched, cylindrical, long conical, or flattened, the fertile parts bearing more or less naked perithecia, grading into ill-defined stipes; externally dark reddish brown to blackish, internally white. Texture soft. Surface roughened with perithecia and tomentose except for stromatal apices which usually bear traces of anamorph. Perithecia ca. 0.5 mm diam. Ostioles more or less papillate. Asci poor in this material, with apical ring bluing in Melzer's iodine reagent, rectangular to urn-shaped, 3 µm high X 1.5 µm broad. Ascospores brown, unicellular, ellipsoid-inequilateral to fusoid, smooth, 13-15(-17.5) X (3-)4-4.5 (-5) µm, with germ slit spore-length or nearly so.

SPECIMENS EXAMINED: R1766, R1772, S1173, S1189, S1530

NOTES: This fungus occurs on tough fruits, including those of the legume genus Elizabetha. As far as we are aware, X. ianthino-velutina usually (? always) occurs on legume fruits. Although the fungus in question greatly resembles X. ianthino-velutina, its spores average longer and tend to be more fusoid (Dennis, 1956; Rogers, 1979). Indeed, its spores resemble those of X. magnoliae J. D. Rogers in shape, but are darker and have definite germ slits (Joly, 1968; Rogers, 1979). Moreover, X. magnoliae is confined to Magnolia fruits in North America, as far as we are aware (Rogers, 1979). Unfortunately, we have been unable to culture the present fungus. Xylaria magnoliae has been cultured (Chacko & Rogers, 1981). See also remarks on X. aff. magnoliae and X. culleniae herein.

Xylaria cf. kegeliana (Lév.) Fr., Nova Acta Regiae Soc. Sci. Upsal. (ser. 3) 1, p. 125. 1851.
Figs. 12,13,15,38

Stromata clavate, 1-4 cm X 4-10 mm diam, on abruptly narrowed stipes up to 1.5 cm, externally dull grey with tan tones and sometimes mottled with white, becoming dull blackish, with stipes concolorous to black; internally white, becoming hollow. Texture very hard. Surface very smooth with fine lines. Perithecia 0.5-1 mm or (+) diam. Ostioles punctate, inconspicuous. Asci eight-spored, usually biseriate, poor condition in this material, with apical ring bluing in Melzer's iodine reagent, somewhat urn-shaped, 4.5-6 µm high X 3 µm diam. Ascospores brown, unicellular, inequilateral, fusoid to navicular or allantoid, with rounded apices, smooth, 23-30 X 5-6 µm, with germ slit much less than spore-length, oriented with axis of spore or oblique to it.

SPECIMENS EXAMINED: S1427, S1451

NOTES: Our concept of this species is very tentative. Dennis (1956) depicts it from type material as having stromata with acute apices and ascospores with acute ends. A photograph of Cuban material by the late J. H. Miller (in possession of JDR) shows stromata with ascospores with narrowed rounded apices and long spiralling germ slits. Joly (1968) remarked on the narrow aspect (high length: width ratio) of the ascospores of type material. Unfortunately, neither Joly nor Dennis recorded information on

germ slit morphology or ascus tips. Dennis (1956) noted that, in color and spores, X. kegeliana resembles X. dealbata. Our material resembles X. dealbata in color, but the ascospores of our material differ in having rounded rather than pointed ends. Indeed, the ascospores of our fungus greatly resemble those of X. aenea and those depicted by Miller for Cuban material of X. kegeliana. Our material does not otherwise resemble X. aenea and ascospore germ slits of our material are short and straight to oblique with no tendency to spiral. Other tropical collections and cultures should eventually clarify this problem.

Xylaria kretzschmarioidea J. D. Rogers & A. Y. Rossman, sp. nov. Figs. 10,11,14,40,41

Capitula stromatum globosa vel cuneata vel irregularia usque ad 5 mm diametrum, stipitibus perangustis teretibus vel complanatis et tortis, ramosis vel haud ramosis circa 7 cm longitudine; extus memnonia, intus alba. Textura dura. Superficies plus minusve suberosa. Perithecia 1 mm diametro. Ostiola fortiter discoidea. Asci octospori, cylindrici, longe stipitati, 250-325 µm longitudine tota X 9 µm crassi, partibus sporiferis 140-170 µm longitudine, annulo apicali in liquore iodato Melzeri cyanescente, doliiformi vel plus minusve urceolato, 7 µm alto X 4 µm crasso. Ascosporae brunneae, unicellulares, ellipsoideo-inaequilaterales vel naviculares, extremis acutis, leves, 25-32 X 7.5-9 µm, rima germinativa brevi obliqua. Status anamorphosis ignotus.

Stromatal heads globoid, wedge-shaped, or irregular up to 5 mm diam, with thin, terete or flattened and twisted, unbranched or branched stipes up to 7 cm long; externally dull blackish with brown tones, internally white. Texture hard. Surface more or less corky. Perithecia 1 mm diam. Ostioles strongly discoid. Asci eight-spored, cylindrical, long-stipitate, 250-325 µm total length X 9 µm, the spore-bearing part 140-170 µm, with apical ring bluing in Melzer's iodine reagent, barrel-shaped to somewhat urn-shaped, 7 µm high X 4 µm broad. Ascospores brown, unicellular, ellipsoid- inequilateral to navicular, with acute ends, smooth, 25-32 X 7.5-9 µm, with short oblique germ slit.

SPECIMEN EXAMINED: R2010 (Holotype, VEN; Isotype, BPI, JDR).

NOTES: This fungus superficially resembles a long-stalked Kretzschmaria, but with firm persistent interior flesh. It probably does not become hollow like many Kretzschmaria species.

Xylaria cf. lutea Beeli, Bull. Soc. Roy. Bot. Belg. 58:204. 1926. Figs. 39,42

Stromata cylindrical, up to 5 cm X 4 mm diam, terete or flattened, on branches of rooting stipes up to 17 cm long, externally grey with yellowish tones, becoming black; internally white. Texture hard. Surface smooth except for tiny wrinkles and shredding yellow layer. Perithecia 0.7 mm diam. Ostioles umbilicate, sometimes slightly raised. Asci eight-spored, cylindrical, poor condition in this material, with apical ring bluing in Melzer's iodine reagent, rectangular, 4.5 µm high X 3 µm broad. Ascospores dark brown, unicellular, ellipsoid-inequilateral, smooth, 19-23.5 X 7-8 µm, with germ slit slightly less than spore-length.

Conidia borne on apices of mature stromata, probably covering entire juvenile stromata, hyaline, smooth, long ellipsoid with flattened bases indicating former points of attachment to condiogenous cell, 7-9 X 2-3 µm.

SPECIMEN EXAMINED: S1542

NOTES: This species was originally described from Africa. Dennis' description (1961)(as Xylosphaera) fits it well. We have not seen type material.

Xylaria sp. aff. magnoliae J. D. Rogers, Can. J. Bot. 57: 941. 1979.

Stromata unbranched or branched, cylindrical, long conical, or flattened, the fertile parts bearing more or less naked perithecia, grading into ill-defined stipes, externally reddish brown to blackish, internally white. Texture soft. Surface roughened with perithecia and tomentose except for stromatal apices which usually bear traces of anamorph. Perithecia ca. 0.5 mm diam. Ostioles more or less papillate. Asci eight-spored, the spores arranged in partially biseriate manner, cylindric-clavate, stipitate, 120-140 µm total length X 9 µm broad, the spore-bearing part 75 µm long, with apical ring bluing in Melzer's iodine reagent, more or less rectangular, 3 µm high X 1.5 µm wide. Ascospores yellowish to brownish,

unicellular, fusoid-inequilateral, smooth, 13-15(-17.5) X 3.5-4.5 µm, with germ slit often difficult to discern, straight to undulate, nearly spore-length.

SPECIMEN EXAMINED: R1740

NOTES: This fungus bears a striking resemblance to those referred to X. cf. ianthino-velutina herein, differing primarily in the pale ascospores. It resembles X. magnoliae J. D. Rogers in ascospore size, but the latter is confined to Magnolia in North America as far as we are aware (Rogers, 1979). Moreover, the ascospore germ slit of X. magnoliae is obscure, whereas that of the present fungus can usually be seen. It is probable that this fungus is a variant of X. cf. ianthino-velutina described herein. Unfortunately, we were unable to culture this fungus and, moreover, have never cultured typical X. ianthino-velutina. Cultural comparisons might help elucidate this problem. See also remarks on X. cf. ianthino-velutina and X. culleniae herein.

Xylaria microceras (Mont.) Fr., Nova Acta Regiae Soc. Sci. Upsal. (ser. 3) 1, p. 128. 1851. Figs. 43,46

Stromata cylindrical to clavate on short stipes, up to 2.5 cm high X 1-6 mm diam; externally at first white with black stipes and ostioles, becoming black overall; internally white. Texture fairly hard. Surface with fine wrinkles. Perithecia 0.2 mm diam. Ostioles more or less punctate. Asci eight-spored, cylindrical, stipitate, 125-130 µm total length X 6 µm broad, the spore-bearing part 55 µm, with apical ring bluing in Melzer's iodine reagent, inverted hat-shaped, 2 µm high X 1.5 µm wide. Ascospores brown, unicellular, ellipsoid-inequilateral, smooth, (8-) 9-10.5(-12) X 3.5-4.5(-5) µm, with germ slit full-length or nearly so.

Colonies on oatmeal agar at ca. 20 C and under 12 h fluorescent light covering 9 cm diam Petri dish in 2 wk, with mycelium at first white, faintly zonate towards center, becoming covered with plumose patterns of brownish-grey hyphae. Reverse brownish-black. No stromata or conidiogenous structures produced.

SPECIMENS EXAMINED: R2085 (cultured), R2164

NOTES: Our specimens seem typical for the species.

Xylaria multiplex (Kunze) Fr., Nova Acta Regiae Soc. Sci. Upsal. (ser. 3) 1, p. 127. 1851; sensu Dennis, Kew Bull. 1956: 416. 1956.

Stromata cylindrical-clavate on short stipes with pannose bases, up to 4 cm high X 3 mm diam, externally blackish with remnants of brown peeling layer; internally whitish to tan. Texture hard. Surface undulate to nodulose from perithecial contours, otherwise smooth. Perithecia 0.3-0.5 µm diam. Ostioles more or less punctate. Asci not intact; apical ring bluing in Melzer's iodine reagent, inverted hat-shaped, 2 µm high X 1.5 µm broad. Ascospores brown, unicellular, ellipsoid-inequilateral, smooth, 9-10.5 X 3.5-4.5 µm, with germ slit slightly less than full-length.

SPECIMENS EXAMINED: I104, I115, I501, S1257

NOTES: Our material is much as described by Dennis (1956), whose concept of the species we accept. Saccardo (1882) described the species as having much larger ascospores.

Xylaria nodulosa Lloyd var. microspora J. D. Rogers & G. J. Samuels, var. nov. Figs. 16,17,44,45
Typical variety, Mycol. Notes 6:1007. 1920.

A varietate typica differt in ascosporis 23.5-28 X 7.5-9 µm.

Differs from the typical variety in size of ascospores 23.5-28 X 7.5-9 µm.

Stromata long cylindrical-irregular, up to 9 cm X 3-4 mm, grading into an ill-defined stipe, externally dull black, internally white. Texture hard. Surface roughened with perithecial contours and clothed in hair. Perithecia ca. 1 mm diam. Ostioles slightly papillate. Asci apparently eight-spored, more or less cylindrical, poor condition in this material, with apical rings bluing in Melzer's iodine reagent, rectangular to urn-shaped, 6-6.5 µm high X 2-3 µm broad. Ascospores light brown, unicellular or with a hyaline cellular appendage (primary appendage) at one end, ellipsoid-inequilateral with abrupt pinched ends, smooth, 23.5-28 X 7.5-9 µm, with long spiral germ slit.

SPECIMEN EXAMINED: S1206 (Holotype, VEN; Isotype, NY, JDR).

NOTES: This seems to fit X. nodulosa Lloyd well except

for smaller ascospores, i.e., the range above versus 32-38 X 8-9 µm. We have thus erected a small-spored variety. Miller's photograph (in my possession) of the Lloyd type indicates that it has long undulating ascospore germ slits. Our material has long spiralling germ slits.

Xylaria obovata (Berk.) Fr., Nova Acta Regiae Soc. Sci. Upsal. (ser. 3)1, p. 127. 1851. Figs. 47,49

Stromata more or less globose, ca. 1.5 cm diam, on short narrowed stipe; externally dull grey becoming black; internally white becoming hollow. Texture very hard. Surface smooth. Perithecia ca. 1 mm diam. Ostioles punctate. Asci not observed. Ascospores brown, unicellular, ellipsoid-inequilateral, smooth, 23.5-29.5 X (6-) 6.5-7.5 µm, with slit short, oriented parallel to axis of spore or oblique to it.

SPECIMEN EXAMINED: S1507

NOTES: Our material is much as described by Dennis (1956), except that ascospores average somewhat longer, i.e. see above vs. 20-26 X 6-8.5 µm.

Xylaria cf. pallida Berk. & Cooke, J. Linn. Soc. Bot 15:395. 1876.

Stromata clavate on narrowed short stipes, up to 4 cm X 4 mm diam, externally at first white, then grey; internally white. Texture very hard. Surface smooth. Perithecia 0.3-0.5 mm. Ostioles punctate, inconspicuous. Asci eight-spored, cylindrical, poor condition in this material, with apical ring bluing in Melzer's iodine reagent, urn-shaped, 3 µm high X 1.5 µm broad. Ascospores brown, unicellular, ellipsoid-inequilateral, smooth, 9-10.5 X 3.5-4.5 µm, with germ slit slightly less than spore-length.

SPECIMEN EXAMINED: S1165

NOTES: This fungus greatly resembles type material at (K). Our material was moldy and intact mature asci were lacking. This fungus has been known only from the type collection. Ascospores of our material are smaller than described by Dennis (1956), 10.5-12 X 4.5-5 µm.

Xylaria platypoda (Lév.) Fr. var. microspora J. D. Rogers & A. Y. Rossman, var. nov.

Figs. 18,19,22,48,50

Typical variety, Nova. Acta Regiae Soc. Sci. Upsal. (ser. 3)1, p. 127. 1851.

A varietate typica differt in ascosporis 26.5-32.5 X 9.5-10.5(-13.5) µm.

Differs from the typical variety in size of ascospores 26.5-32.5 X 9.5-10.5(-13.5) µm.

Stromata conic, up to 4 cm high X 7 mm diam, or subglobose or irregular, sessile, externally white with black ostioles and traces of orange at bases, internally white. Texture rather hard. Surface roughened by perithecial contours. Perithecia 1 mm or greater diam. Ostioles barely raised. Asci eight-spored, the spores sometimes arranged in partially biseriate manner, cylindrical to clavate, long-stipitate, 290-300 µm total length X 12-13 µm when spores uniseriate, X 15-20 when spores biseriate, the spore-bearing part 160-192 µm, with apical ring bluing in Melzer's iodine reagent, urn-shaped, 5 µm high X 4.5 µm broad. Ascospores dark brown, often with tiny hyaline cell (primary appendage) at one end, ellipsoid-inequilateral to navicular, smooth, 26.5-32.5 X 9.5-10.5(-13.5) µm, with germ slit somewhat less than spore-length.

SPECIMEN EXAMINED: R2079 (Holotype, VEN; Isotype, NY, JDR).

NOTES: This fungus looks much like X. platypoda, but spores are much smaller than given by Dennis (1956), i.e., 36-50 X 12-15 µm. Joly (1968) erected var. patouillardii [as Xylosphaera platypoda (Lév.) Dennis var. patouillardii Joly] on material from Viet-Nam with slightly smaller ascospores and immersed, nonmammiform perithecia. Because Xylaria is conserved against Xylosphaera the following new combination is made: Xylaria platypoda (Lév.) Fr. var patouillardii (Joly) J. D. Rogers. Basionym: Xylosphaera platypoda (Lév.) Dennis var. patouillardii Joly, Rev. Mycologie 33:162. 1968.

Xylaria plumbea J. D. Rogers & G. J. Samuels, sp. nov.

Figs. 20,21,23,51,52

Stromata clavata, apicibus rotundatis vel acutis,

stipitibus perangustis circa 1/3-1/2 longitudine toto, usque ad 3 cm X 3 mm diametrum, extus plumbea ostiolis nigris, intus alba. Textura durissima. Superficies levis praeter ostiola. Perithecia 0.4-0.5 diametro. Ostiola elevata, umbilicata vel aliquantum papillata. Asci octospori, cylindrici, longe stipitati, 145-160 µm longitudine tota X 5 µm crassi, partibus sporiferis 72-82 µm, annulo apicali in liquore iodato Melzeri immerso cyanescente, inverse petasiformi, 2 µm alto X 1.5 µm crasso. Ascosporae brunneae, unicellulares, longe ellipsoideo-inequilaterales vel naviculares vel allantoideae, leves, (10.5-)11-14(-15) X 3.5-4.5 µm, rima germinativa minus quam longitudine spora. Status anamorphosis ignotus.

Stromata clavate with rounded or acute apices, with narrowed stipes about 1/3 - 1/2 total length, up to 3 cm X 3 mm diam, externally lustrous grey with black ostioles, internally white. Texture very hard. Surface smooth except for ostioles. Perithecia 0.4-0.5 mm diam. Ostioles raised, umbilicate to somewhat papillate. Asci eight-spored, cylindrical, long-stipitate, 145-160 µm total length X 5 µm broad, the spore-bearing part 72-82 µm, with apical ring bluing in Melzer's iodine reagent, inverted hat-shaped, 2 µm high X 1.5 µm broad. Ascospores brown, unicellular, long ellipsoid-inequilateral to navicular or allantoid, smooth, (10.5-)11-14(-15) X 3.5-4.5 µm, with straight germ slit somewhat less than spore-length.

SPECIMEN EXAMINED: S1814 (Holotype, VEN; Isotype, NY, JDR).

NOTES: This fungus was unknown to us. The stromatal surface is somewhat reminiscent of X. dealbata, but the color is more lustrous.

Xylaria schweinitzii Berk. & Curt., J. Acad, Nat. Sci. Philadelphia, N.S. 2:284. 1853.

Stromata clavate to highly irregular on abrupt narrowed stipe comprising 1/3-1/2 the total length, 5-6 cm high X 1-2.5 cm diam, externally dull black, internally white. Texture cheesy. Surface smooth or somewhat wrinkled. Perithecia ca. 1 mm diam. Ostioles discoid, tiny. Asci not intact; apical ring bluing in Melzer's iodine reagent, urn-shaped, 4.5-6 µm high X 3.5 µm broad. Ascospores brown, unicellular, ellipsoid-inequilateral to navicular, smooth, 23.5-31 X 6.5-7.5 µm, with slit much

shorter than spore-length, oriented oblique to spore axis or spiralling.

Colonies on oatmeal agar at ca. 20 C under 12 h fluorescent light covering 9 cm diam Petri dish in 2-3 wk, at first velvety with large floccose sectors, white, uniform to faintly zonate, some with plumose margins, becoming tan to grey towards center then darkening to olive-black. Reverse tan with blackish centers. Stromata rudimentary, tuft-like, 1-5 mm tall X 1-2 mm diam, developing over surface but predominately at periphery of colonies, whitish, some becoming covered with a tan to dark grey layer. No conidiogenous structures produced.

SPECIMENS EXAMINED: S1158, S1310 (culture), S1704 (culture)

NOTES: Xylaria schweinitzii is a member of the X. polymorpha complex, along with X. anisopleura and X. scruposa. See notes on these latter two species herein. Xylaria schweinitzii and its anamorph have been discussed by Rogers & Callan (1986), but Venezuelan colonies yielded no anamorph.

Xylaria scruposa (Fr.) Fr., Nova Acta Regiae Soc. Sci. Upsal. (ser. 3) 1, p. 127. 1851; sensu Dennis, Kew Bull. 1956:436. 1956. Figs. 53,66

Stromata extremely variable, cylindrical to clavate, on short or long narrowed stipes, 3-5 cm total height X 2-7 mm diam; externally dull black, often with brown tones; internally white. Texture cheesy to hard. Surface often rugose with small wrinkles, sometimes corky. Perithecia 0.5-0.7 mm diam. Ostioles discoid, evident or obscure. Asci eight-spored, cylindrical, stipitate, 215-230 µm total length X 8-10 µm broad, the spore-bearing part 130-142 µm, with apical ring bluing in Melzer's iodine reagent, more or less urn shaped, 4.5-6 µm high X 3-4.5 µm broad. Ascospores brown, unicellular, ellipsoid-inequilateral, smooth, 16-23.5(-25) X (5-)6-7.5 µm, with germ slit shorter than spore-length, spiralling or oriented oblique to axis of spore.

Colonies on oatmeal agar at ca. 20C under 12 h fluorescent light covering 9 cm diam Petri dish in 2-3 wk, mycelium initially velvety with small floccose patches, zonate, white, then turning dusky rose, darkening to brownish grey towards center. Reverse pale brown. Stromata consisting of loosely compacted hyphal strands

with expanded, cottony apices, 4-10 mm high X 2-4 mm diam at base, developing at periphery of colonies, white. No conidiogenous structures produced.

SPECIMENS EXAMINED: I462, R1897, R1982, R2057, R2059, R2405, R2538, S1211, S1229, S1918 (cultured).

NOTES: Xylaria scruposa is a complex taxon that seems particularly abundant in the American tropics. There are a number of nomenclatural problems with it, as discussed by Dennis (1956, 1958). Our concept of the species generally is that of Dennis. We consider it to be a member of the X. polymorpha (Pers.: Fr.) Grev. complex with ascospores that average smaller than those of X. schweinitzii and X. anisopleura, but grading into them.

Xylaria sp. (R1741) Figs. 54,55

Stromata cylindrical with sterile apex, geniculate from conspicuous widely-spaced ostioles, grading into stipes, 1.5 cm total length X 0.5-1 mm diam; externally brown, internally white. Texture soft. Smooth except for ostioles. Perithecia 0.1-0.2 mm diam. Ostioles strongly papillate. Asci eight-spored, cylindrical, 130 µm total length X 11 µm broad, the spore-bearing part 98 µm long, with apical ring bluing in Melzer's iodine reagent, somewhat urn-shaped, 7 µm high X 6 µm broad. Ascospores dark brown, unicellular, ellipsoid-inequilateral, smooth, 13.5-15 X 7.5-8 µm, with germ slit spore-length.

SPECIMEN EXAMINED: R1741

NOTES: This fungus might represent a new taxon, but our collection is too small to describe as such. It seems to resemble X. lima v. Höhnel (Saccardo, 1913), a species that we have not examined.

Xylaria sp. (R1965)

Stromata cylindrical to clavate, unbranched or several from common base, up to 4 cm long X 7 mm diam, with short stipes, externally dull black, internally white. Texture hard. Surface wrinkled and contorted. Perithecia 0.3 mm diam. Ostioles discoid. Asci probably eight-spored, cylindrical, poor condition in this material, with apical ring bluing in Melzer's iodine reagent, rectangular, minute. Ascospores brown,

unicellular, ellipsoid-inequilateral, smooth, 7.5-9 X 3.5-4.5 µm, with long germ slit.

SPECIMEN EXAMINED: R1965

NOTES: This fungus was unknown to us. It might eventually be shown to be a new species.

Xylaria sp. (R2023)

Stroma cylindrical with flattened areas and scattered naked perithecia, 1 cm long X 1 mm diam; externally black, internally white. Texture soft. Surface smooth except for perithecia. Perithecia 0.2 mm diam. Ostioles barely papillate. Asci eight-spored, cylindrical, 100-105 µm total length X 6-7 diam, with spore-bearing part 65-70 µm long, with apical ring bluing in Melzer's iodine reagent, more or less rectangular, 2 X 2 µm. Ascospores brown, unicellular, broad ellipsoid-inequilateral, smooth, 9-10.5 X 5-6 µm, with germ slit spore-length.

SPECIMEN EXAMINED: R2023

NOTES: This fungus was unknown to us. It is represented by only one stroma.

Xylaria sp. (R2072)

Stromata more or less cylindrical, on short stipes, up to 5 cm X 5 mm diam, externally dull black, but perhaps initially brown; internally white. Texture hard. Surface smooth except for major wrinkles, occasional perithecial elevations, and ostioles. Perithecia up to 1 mm diam. Ostioles papillate. Asci eight-spored, cylindrical, stipitate, 160 µm total length X 6 µm broad, the spore-bearing part 52 µm, with apical ring bluing in Melzer's iodine reagent, inverted hat-shaped, minute. Ascospores dark brown, unicellular, ellipsoid-inequilateral, smooth, 6.5-9 X 3.5-4.5 µm, with long, ill-defined germ slit.

SPECIMEN EXAMINED: R2072

NOTES: This fungus might represent a diminutive form of X. cubensis. Cultures of X. cubensis are highly characteristic (Rogers, 1984), but we were unable to culture this material. It resembles the description of X. variegata Sydow (H. & P. Sydow, 1907) in many respects and

might be only a somewhat robust representative of that species.

Xylaria sp. (R2264) Figs. 56,57

Stromata clavate with acute apex, on short stipes, 2.5 cm high X 3 mm broad, externally rusty orange with black ostioles, internally yellow immediately beneath surface and white below. Texture rather soft. Surface finely wrinkled. Perithecia 0.5 mm diam. Ostioles barely papillate. Asci eight-spored, poor condition in this material, with apical ring bluing in Melzer's iodine solution, more or less urn-shaped, 4.5 µm high X 3 µm broad. Ascospores dark brown, unicellular, ellipsoid-inequilateral to navicular, smooth, 17.5-22 X 6.5-7.5 µm, with spiralling germ slit less than spore-length.

SPECIMEN EXAMINED: R 2264

NOTES: This fungus greatly resembles X. phosphorea Berk., but has much longer ascospores. Elongated anamorphic clubs were found associated with teleomorphs. Dennis (1956) remarked on a similar association in the case of X. phosphorea from Brazil. This fungus is probably to be considered as a large-spored variety of X. phosphorea, but the small size of the collection and the poor condition of asci constrain us from formally describing it.

Xylaria sp. (S1330)

Stromata upright, each stroma composed of rachis up to 6 cm X 0.5-1 mm bearing areas of naked perithecia, externally black, internally white. Texture rather soft. Surface roughened in perithecial areas. Perithecia 0.4-0.5 mm diam. Ostioles papillate. Asci eight-spored, poor condition in this collection, with apical ring bluing in Melzer's iodine reagent, urn-shaped, 6 µm high X 3 µm broad. Ascospores brown, unicellular, long ellipsoid-inequilateral to navicular, smooth, 22-25.5 X 6-7.5 µm, with germ slit straight to undulating, spore-length.

SPECIMEN EXAMINED: S1330

NOTES: Although the fungus is probably undescribed, this collection is too small to be the basis of a new species.

Xylaria sp. (S1353) Fig. 58

Stromata subglobose, ca. 2 mm diam, with narrow stipe up to 1.5 cm tall; externally, heads tan and stipes white; internally white. Texture soft. Surface smooth except for ostiolar papillae. Perithecia 0.3 mm diam. Ostioles papillate. Asci not present in this material. Ascospores nearly black, unicellular, very broad oval to nearly globose, inequilateral, smooth, 11-13 X 7.5-9 µm, with germ slit straight to undulate, spore-length.

SPECIMEN EXAMINED: S1353

NOTES: This fungus might represent a new taxon but our collection lacks asci and is too small to describe as new.

Xylaria sp. (S1364) Figs. 59,60

Stromata prostrate to partially upright, each stroma consisting of a rachis up to 30 cm long X 1 mm diam at attachment point to hair-like at apex, with individual naked perithecia scattered in areas up to 2 cm long at irregular intervals; externally black, internally white. Texture fairly hard. Surface smooth except for perithecial contours. Perithecia ca. 1 mm diam. Ostioles papillate. Asci eight-spored, cylindrical, poor condition in this material with ascus apical ring bluing in Melzer's iodine reagent, urn-shaped, 4.5 µm high X 3 µm broad. Ascospores dark brown, unicellular, strongly inequilateral, with abruptly narrowed or acute ends, smooth, 17.5-20 X 6.5-7.5 µm, with germ slit slightly less than spore-length.

SPECIMEN EXAMINED: S1364

NOTES: This fungus seems allied to X. juruensis P. Henn. and X. melanura (Lév.) Sacc. Ascospores are too large for the former fungus and too small for the latter. Moreover, the rachis is longer than reported for these species, as far as we are aware.

Xylaria sp. (S1836)

Stromata globose, up to 5 mm diam, on short stipes up to 5 mm long, externally ashen grey, internally white; stipe black. Texture very hard. Fertile parts smooth except for raised ostioles. Perithecia 1 mm or (+) diam. Ostioles umbilicate, raised. Asci eight-spored, cylindrical, stipitate, poor condition in this material, with

apical ring bluing in Melzer's iodine reagent, coffin-shaped, 14.5 µm high X 6 µm broad. Ascospores brown, unicellular, ellipsoid-inequilateral, smooth, 29.5-37(-40) X (12-)13-15(-16) µm, with straight to undulating germ slit spore-length.

SPECIMEN EXAMINED: S1836

NOTES: This fungus was unknown to us. The small collection, the absence of intact mature asci, and the fact that stromata are moldy keep us from describing it as a new species.

Xylaria telfairii (Berk.) Fr., Nova Acta Regiae Soc. Sci. Upsal. (ser. 3) 1, p. 127. 1851. Fig. 61

Stromata clavate to cigar-shaped (fusoid) on narrowed stipe 1/4-1/3 the length of the fertile part, up to 5 cm total length X up to 1.2 cm diam; externally tan to light orange to reddish brown, internally white but becoming hollow and inrolled, often before maturation of perithecia. Texture hard to very hard. Surface smooth. Perithecia 0.5-0.7 mm diam. Ostioles umbilicate. Asci not intact; apical ring bluing in Melzer's iodine reagent, more or less urn-shaped, at least 4.5 µm high X 3 µm broad. Ascospores brown, unicellular, smooth, ellipsoid-inequilateral, (13-)17.5-25 X 6-7.5 µm, with germ slit short, oriented oblique to axis of spore.

SPECIMENS EXAMINED: R1979, R2096, R2145, R2199, S1355, S1562, S1706

NOTES: Most of our material is typical of X. telfairii, as discussed and illustrated by Dennis (1956). One collection -- R2199 -- differs from typical X. telfairii in having germ slits that are nearly spore-length. (See also discussion of X. enterogena elsewhere herein.)

Xylaria cf. theissenii Lloyd, Mycol. Notes 48, Mycol. Writ. 5:677. 1917. Figs. 62,63

Stromata clavate, up to 1 cm long X 3 mm diam, with short stipe and sterile acute apiculus, bearing more or less naked perithecia; externally black, internally white. Texture somewhat woody. Perithecia ca. 1 mm diam. Ostioles obscure. Asci not intact, with detached apical rings bluing in Melzer's iodine reagent, urn-shaped, 6 µm

high X 3.5 µm broad. Ascospores dark brown, unicellular, ellipsoid-inequilateral, smooth, 22-26.5 X 6.5-7.5(-9.5) µm, with germ slit spore-length or slightly less than spore-length.

SPECIMEN EXAMINED: I594

NOTES: This fungus looks much like X. theissenii Lloyd, but lacks the long stalk of this species. It might prove to be only a morphological variant of that species.

Xylaria cf. trichopoda Penz. & Sacc., Icones fungorum javanicorum. p. 31. 1904.

Stromata consisting of a main axis with branches up to 5 cm X 1-1.5 mm diam bearing more or less naked perithecia on upper parts and extending beyond fertile region as sharp apices; externally blackish, internally white. Texture soft. Surface overall densely tomentose, the fertile parts roughened by perithecial contours. Perithecia 0.3-0.4 mm diam. Ostioles barely papillate. Asci eight-spored, cylindrical, poor condition in this material, with apical ring bluing in Melzer's iodine reagent, rectangular to inverted hat-shaped, 2 µm high X 2 µm broad. Ascospores brown, unicellular, ellipsoid-inequilateral, smooth, (10.5-)12-12.5 X 4.5-5 µm, with germ slit slightly less than spore-length.

SPECIMEN EXAMINED: S1342

NOTES: This fungus seems much like X. trichopoda, described originally from Java. The ascospores of our material average somewhat smaller than those from Java material, i.e., 11.5-14.5 X 5-6 µm as given by Dennis (1958) and 12-13.5 X 5 µm as given by Penzig and Saccardo (1904).

DATA ON CITED COLLECTIONS

Teresita Iturriaga (I) collections. All collections from VENEZUELA, Territorio Federal Amazonas.

Cerro de la Neblina base camp on Rio Mawarinuma, elev. 140 m, 00°50'N, 66°10'W: I104, 25-28 Nov 1984, on trunk; I115, 25-28 Nov 1984, on trunk; I127, 25-28 Nov 1984, on trunk; I407, 1-4 Dec 1984, on trunk; I462, 1-4 Dec 1984, on palm trunk; I501, 1-4 Dec 1984, on trunk.

Cerro de la Neblina massif, "Camp 7," elev. 1770-1850 m. Forested quebradas with Euterpe along river: I594, 29 Nov-1 Dec 1984, on wood.

A. Y. Rossman (R) collections. All collections from VENEZUELA, Territorio Federal Amazonas.

San Carlos de Rio Negro, near airport, on IVIC plot, 5 Jan 1985: R1736, on dead branch; R1740, on legume pod (Elizabetha sp.); R1741, on leaves.

Cerro de la Neblina base camp, on Rio Mawarinuma, left bank, elev. 140 m, 00°50'40"N, 65°58'10"W: R1766, 27 Jan 1985, on pod of legume (Elizabetha sp.); R1772, on pod of legume (Elizabetha); R1785, 27 Jan 1985, on log; R1794, 28 Jan 1985, on log; R2380, 27 Jan 1985, on decaying leaf of Alusiaceae; R2394, 27 Jan 1985, on thin leaf; R2405, 27 Jan 1985, on wood; R2425, 28 Jan 1985, on wood; R1955, 05 Feb 1985, on log; R1965, 04 Feb 1985, on log; R1979, 05 Feb 1985, on log; R1982, 06 Feb 1985, on log; R1986, 06 Feb 1985, on wood; R1987, 03 Feb 1985, on log; R2003, 06 Feb 1985, on wood; R2004, 06 Feb 1985, on wood; R2009, 11 Feb 1985, on wood; R2010, 11 Feb 1985, on tree fern stump; R2023, 11 Feb 1985, on leathery leaf; R2035, 11 Feb 1985, on wood; R2043, 12 Feb 1985, on log; R2057, 11 Feb 1985, on wood; R2059, 12 Feb 1985, on log; R2064, 12 Feb 1985, on wood; R2068, 11 Feb 1985, on wood; R2072, 11 Feb 1985, on log; R2079, 03 Feb 1985, on wood; R2085, 12 Feb 1985, on log; R2096, 11 Feb 1985, on wood; R2143, 18 Feb 1985, on log; R2145, 18 Feb 1985, on log; R2155, 18 Feb 1985, on log surrounded by termite nest; R2164, 18 Feb 1985, on small dead twigs; R2192, 20 Feb 1985, on wood, R2199, 21 Feb 1985, on wood; R2224, 24 Feb 1985, on leaf.

Cerro de la Neblina, 6.2 km NNE Pico Phelps, elev. 1390-1515, 00°51'45"N, 65°58'52"W: R2233, 24 Feb 1985, on Clusia sp.; R2264, 24 Feb 1985, on Clusia sp.; R2296, 23 Feb 1985, on dead twig; R2309, 23 Feb 1985, on wood.

Cerro de la Neblina, 51 km NE Pico Phelps, elev. 1730-1850, 00°50'40"N, 65°58'10"W: R1979, 05 Feb 1985, on log; R2470, 02 Feb 1985, on log; R2483, 03 Feb 1985, on palm trunk; R2515, 03 Feb 1985, on log; R2517, 03 Feb 1985, on dead limb; R2538, 03 Feb 1985, on wood.

G. J. Samuels, et al. (S) collections. All collections from VENEZUELA, Territorio Federal Amazonas.

Rio Negro, San Carlos de Rio Negro, dry forest on sand, elev. 140 m: S1353, 9 Apr 1984, on decaying leaf of Clusia sp.

Cerro de la Neblina base camp, on Rio Mawarinuma, elev. 140 m, 00°50'40"N, 65°58'10"W: S1158, 10 Apr 1984,

on wood; S1159, 10 Apr 1984, on ?legume fruit; S1165, 10 Apr 1984, on wood; S1168, 10 Apr 1984, on wood; S1173, 10 Apr 1984, on Clusia fruit; S1183, 10 Apr 1984, on wood; S1355 19 Apr 1984, on wood; S1410, 20 Apr 1984, on Ficus leaves; S1425, 20 Apr 1984, on wood; S1427, 20 Apr 1984, on wood; S1432, 20 Apr 1984, on wood; S1450, 20 Apr 1984, on wood; S1451, 20 Apr 1984, on wood, S1455, 20 Apr 1984, on wood; S1458, 20 Apr 1984, on wood, S1468, 21 Apr 1984, on wood; S1484, 21 Apr 1984, on wood; S1530, 22, 23 Apr 1984, on ?legume fruit; S1542, 22, 23 Apr 1984, on log; S1562, 22, 23 Apr 1984, on wood, S1568, 22, 23 Apr 1984, on log; S1918, 1984; S1926, 7 May 1984, on dead tree.

Cerro de la Neblina, "Camp 5", valley N base of Pico Phelps, elev. 1000-1250 m, 00°49'N, 66°0'W, cloud forest: S1189, 12 Apr 1984, on ?legume fruit; S1206, 12 Apr 1984, on wood; S1207, 12 Apr 1984, on wood; S1210, 12 Apr 1984, on wood; S1211, 12 Apr 1984, on wood; S1229, 12 Apr 1984, on wood; S1330, 12 Apr 1984, on petiole of Cercropia; S1342, 12 Apr 1984, on soil; S1346, 12 Apr 1984, on bark.

Same data as above, except elev. 1350 m: S1257, 13,14 Apr 1984, on wood; S1264, 13,14 Apr 1984, on wood; S1310, 13,14 Apr 1984, on wood.

Cerro de la Neblina, "Camp 6", ridge at Venezuela-Brazil divide, ca. 3.5 km W of Pico Zoloaga, 26 km ENE of base camp, elev. ca. 2000 m, 00°53'N, 65°15'W, intermittent cloud forest with Clusia spp. and Melastomaceae and bromeliad ground cover: S1364, 15, 16 Apr 1984, on leaves, wood.

Cerro de la Neblina, ca. 0.5 km walk on trail leading S of base camp, elev. ca. 140 m, periodically inundated forest: S1507, 22 Apr 1984, on wood; S1521, 22 Apr 1984, on wood.

Cerro de la Neblina, "Puerto Chimo," ca. 5 km upstream from base camp, elev. 300-500 m, dry upland forest: S1618, 25 Apr 1984, on wood.

Cerro de la Neblina, vic. base camp, trail leading upstream along tributary of Rio Mawarinuma, elev. 140 m, periodically inundated forest: S1698, 28 Apr 1984, on wood; S1704, 28 Apr 1984, on wood; S1706, 28 Apr 1984, on wood.

Cerro de la Neblina, vic base camp, ca. 3 km upstream on Rio Mawarinuma, elev. ca. 140 m, periodically inundated forest of Phenakospermum, palms, and bamboo: S1768, 1,2 May 1984, on wood; S1801, 1,2 May 1984, on forest litter.

Cerro de la Neblina, on trail leading E from Rio Mawarinuma opposite base camp, elev. ca. 140 m, periodically inundated forest grading into dry upland

forest: S1814, 3 May 1984, on wood; S1818, 3 May 1984, on wood.

Cerro de la Neblina, vic base camp, study plot 5 min SE base camp, elev. ca. 140 m, moist forest dominated by legume trees: S1836, 4 May 1984, on wood; S1839, 4 May 1984, on wood.

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THREE NEW SPECIES OF *PARMELIA* (LICHENES) FROM SOUTHERN AFRICA

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ABSTRACT

Three new species of *Parmelia* (Lichenes, Parmeliaceae) are described from southern Africa. They are: *Parmelia asilaris* Brusse, *P. lurida* Brusse and *P. spissa* Brusse. Their chemistries and affinities are discussed.

PARMELIA ASILARIS Brusse, *sp. nov.*

Thallus foliosus, saxicola, ad 8 cm diametro, sat vel arcte adnatus. *Lobi* elongati, 0,5–3,5 mm lati, 100–250 µm crassi. *Thallus superne* leviter cinereus, nitidus, isidiis sorediisque destitutus. *Cortex superior* 10–13 µm crassus. *Stratum gonidiale* 20–50 µm crassum, algis *Trebouxiis*, 4,5–16 µm diametris. *Medulla* alba, 65–180 µm crassa. *Cortex inferior* 6,5–8 µm crassus. *Thallus inferne* piceus. *Rhizinae* simplices, 45–70 µm crassae. *Apothecia* ad 5 mm diametris. *Hypothecium* hyalinum, 15–40 µm crassum. *Subhymenium* hyalinum, 5–10 µm crassum. *Hymenium* hyalinum, 45–55 µm altum, J+ caeruleum. *Asci* clavati, tholis J+ caeruleis (fig. 1). *Ascosporae* octonae, hyalinae, simplices, ellipsoideae, 8–10,5 x 4,5–6 µm. *Pycnidia* globosa, 100–150 µm profunda, 100–120 µm lata. *Pycnidiosporae* aciculares, hyalinae, rectae, 4,5–7,5 x 0,8 µm. *Thallus* atranorinum, acidum stictícum et acidum constictícum continens.

TYPUS: SOUTH AFRICA, Cape Province, Mountain Zebra National Park near Cradock, Bankberg mountains, on dolerite outcrop on E slope, near ascending road from rest camp to Rooiplaat, alt. 1280 m. *F. Brusse 4680*, 29.i.1986 (PRE, holo-; LD, iso -). Fig. 3.

Thallus foliose, saxicolous, to 8 cm across, moderately to tightly adnate. *Lobes* elongate, 0,5–3,5 mm broad, 100–250 µm thick. *Upper surface* light grey, nitid, not isidiate and not sorediate. *Upper cortex* 10–13 µm thick. *Algal layer* 20–50 µm thick, algae *Trebouxia*, 4,5–16 µm diam. *Medulla* white, 65–180 µm thick. *Lower cortex* 6,5–8 µm thick. *Lower surface* black. *Rhizines* simple, 45–70 µm thick. *Apothecia* to 5 mm diam. *Hypothecium* hyaline, 15–40 µm thick. *Subhymenium* hyaline, 5–10 µm thick. *Hymenium* hyaline, 45–55 µm high, J+ blue. *Asci* clavate, eight-spored, tholus J+ blue (fig. 1). *Ascospores* hyaline, simple, ellipsoid, 8–10,5 x 4,5–6 µm. *Pycnidia* globose,

100–150 µm deep, 100–120 µm wide. *Pycnidiospores* hyaline, straight needles, 4,5–7,5 x 0,8 µm. *Chemistry*: Atranorin in the cortex, stictic and constictic acids in the medulla.

This new species is most similar to *Parmelia (Canoparmelia) inhaminensis* Dodge, with the same combination of characters commonly used in *Parmelia*. However, *P. inhaminensis* is a corticolous lichen of tropical areas in Africa, perhaps restricted to low lying coastal areas, whereas *P. asilaris* occurs in an arid temperate area on rock, where winters get relatively cold. Although several corticolous species (i.e. *Canoparmelias*, see Elix, Johnston & Verdon (1986)) are known to grow on rock, they are then fairly loosely adnate, because they are actually growing on the plant debris that has accumulated under them, if not present over the rest of the rock. *P. asilaris* is moderately tightly adnate on rock, and is not growing over plant debris.

The ascospores of *Parmelia asilaris* are somewhat smaller (8–10,5 x 4,5–6 µm) than those of *P. inhaminensis* (10–12 x 5–8 µm), and the pycnidiospores are somewhat shorter too (4,5–7,5 µm long in *P. asilaris* as opposed to about 12 µm long in *P. inhaminensis*. Hale 1976). *P. asilaris* resembles the common Cape *Paraparmelia*, *Parmelia molybdiza* Nyl., but the medulla is K+ yellow instead of C+ red.

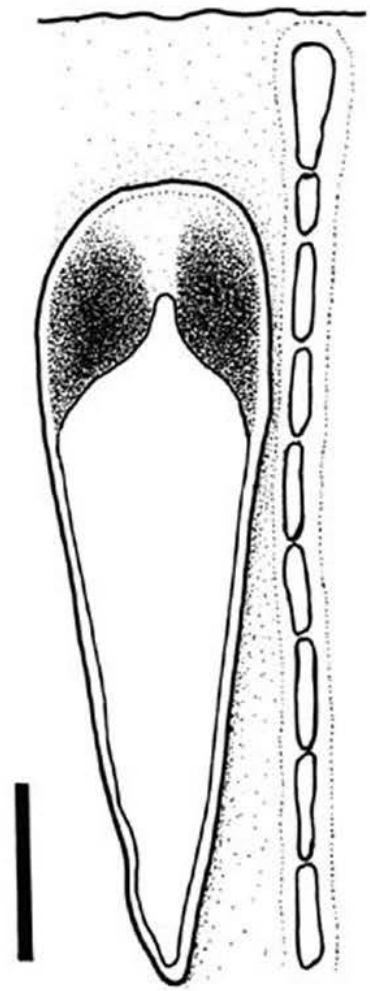

Fig. 1. *Parmelia asilaris* Brusse, ascus and paraphysis. *F. Brusse 4680*, holotype. Bar = 10 µm.

The isidiate counterpart of *P. asilaris* may be *P. ischnoides* Kurok., which is still only known from the Cape peninsula, with somewhat narrower lobes than *P. asilaris*.

The typification of the genus *Parmelia* remains problematical, because the genus was first satisfactorily typified by *P. conspersa* Ach. by Clements & Shear in 1931. This typification must be followed (Art. 8, Voss 1983) keeping in mind that the type is not necessarily the most typical or representative element of a taxon (Art. 7.2), and that sections of genera have no priority outside of their own rank (Art. 11), and therefore cannot be used to determine the types of genera. This latter procedure was used by Berry (1941) to choose *P. saxatilis* (L.) Ach. as type. This was later followed by the Special Committee for Lichens of the Paris Congress (Ahlner 1954), for reasons not given, but presumably because of the intention to conserve *Parmelia* against *Lichen*. In my opinion, the name *Lichen* was unsatisfactorily typified by the Special Committee

for Lichens of the Paris Congress (Ahlner 1954), as *Lichen saxatilis*, because it contradicts a previously satisfactorily determined type, *Parmelia conspersa* Ach. (Clements & Shear 1931), when conserved against *Parmelia*. *Lichen* should be typified by an original species, which when rejected against it's genus, should not interfere with the earliest satisfactory typification, already extant.

Although all editions of the Botanical Code of Nomenclature since the Paris Code (Lanjouw 1956), list *Lichen* as rejected against *Parmelia*, this is in fact in error. Article 15 of the Code requires that each name proposed for conservation, be ratified three (3) times — firstly, by a Special Committee for the taxonomic group concerned; secondly, a General Committee; and lastly, a general assembly of an International Botanical Congress, respectively. Most of the lichen names currently listed as conserved, were only approved by the Special Committee for Lichens of the Paris Congress (Ahlner 1954). This committee processed the longer list of proposals submitted to the Cambridge Congress by Zahlbruckner (Briquet 1930, 1935) which was passed-on to the Amsterdam Congress (Camp *et al.* 1947). This list, which included a superfluous proposal to conserve *Parmelia* against *Imbricaria* (not *Lichen*), was not acted on by these congresses, and is not mentioned at all in the Stockholm Code (Lanjouw 1952). There is no evidence, that the list processed by the Special Committee for Lichens of the Paris Code (Ahlner 1954), went any further at that Congress (*Taxon* **3**: 233 (1954); *Taxon* **4**: 162–164 (1955)), and I have been unable to trace any indication of this at any later Congress. *Parmelia* Ach. is therefore not really conserved against *Lichen* L., as it presently stands in the Code.

Parmelia, typified by *P. conspersa* Ach. (Clements & Shear 1931), can be used for a far larger number of species than it could were it typified by *P. saxatilis*, which would then leave the literature as little altered as possible.

To my mind the *Parmelia saxatilis* group may be more closely allied to the Cetrarioid lichens, because of the presence of a syncortex rather that an epicortex (Modenesi & Vanzo 1986), but this work is very preliminary at present. If the present family Parmeliaceae is split further in the future, then the *P. saxatilis* group might belong to the Cetrariaceae (Schaerer 1850, Cooke & Hawksworth 1970), rather than a more restricted Parmeliaceae. It would be more preferable to retain most of the species, previously placed in *Parmelia*, in a future more restricted Parmeliaceae.

The use of the name *Parmelia* for the *P. saxatilis* group, is therefore unacceptable to me, and I continue to use *Parmelia* in a broad sense, until more pertinent morphological data becomes available, and until the nomenclature is clarified.

At present *P. asilaris* is known only from the type locality, the Bankberg near Cradock, in a game reserve created to preserve the Mountain Zebra (*Equus zebra* L. subsp. *zebra*).

PARMELIA LURIDA Brusse, *sp. nov.*

Thallus foliosus, saxicola, appressus, ad 2 cm diametro. *Lobi* elongati vel sublineares, 0,1–1,2 mm lati, 95–140 μm crassi. *Thallus superne* luteolus vel pallide helvolus, emaculatus, nitidus, isidiis sorediisque nullis. *Cortex superior* 10–15 μm crassus. *Stratum gonidiale* 12–40 μm crassum, algis *Trebouxiis*, 4,0–16,5 μm diametris. *Medulla* alba, 45–90 μm crassa. *Cortex inferior* 6–13 μm crassus. *Thallus inferne* piceus. *Rhizinae* sparsae, 80–100 μm crassae. *Apothecia* et *Pycnidia* non visa. *Thallus* materias ignotas continens.

TYPUS: SOUTH AFRICA, Cape Province, 19 km S of Prince Albert, summit of Swartberg Pass, wind blown SE gulleys, on S faces of TMS rocks in more exposed positions, alt. 1650 m, *F. Brusse 4889*, 7. ii. 1986 (PRE, holo-). Fig. 4.

Thallus foliose, saxicolous, appressed, to 2 cm across. *Lobes* elongate to sublinear, 0,1–1,2 mm broad, 95–140 µm thick. *Upper surface* pale yellowish, emaculate, nitid, non-isidiate and non-sorediate. *Upper cortex* 10–15 µm thick. *Algal layer* 12–40 µm thick, algae *Trebouxia*, 4,0–16,5 µm diam. *Medulla* white, 45–90 µm thick. *Lower cortex* 6–13 µm thick. *Lower surface* black. *Rhizines* sparse, 80–100 µm thick. *Apothecia* and *Pycnidia* not seen. *Chemistry*: an unidentified pale yellow substance in the cortex, and another colourless one in the medulla.

Parmelia lurida is one of the few species that do not contain either usnic acid, lichexanthone, or atranorin/chloroatranorin in the cortex. This new species is related to *P. chapadensis* Lynge from the Mato Grosso of Brazil, but has a black lower surface, instead of a pale brown one, as in *P. chapadensis* (Hale 1976, Lynge 1914). The unidentified substance in the medulla is colourless, KC+ rose, and fluoresces white in longwave ultraviolet light, whereas that in *P. chapadensis* is P+ red (Hale 1976). The cortical pigment appears as a dark spot on TLC plates in longwave ultra-violet light, reacts similarly to usnic acid with 10% sulphuric acid and heat, but is paler yellow and has slightly different R_f values than usnic acid on TLC plates, run according to the method of Culberson (1972) and Culberson & Johnson (1982).

Parmelia lurida is presently known only from the type locality at high altitude in the Swartberg range, near Oudtshoorn.

PARMELIA SPISSA Brusse, *sp. nov.*

Thallus subcrustosus, basalticola, ad 4 cm diametro. *Lobi* elongati, ad 4 mm longi, 0,3–1,2 mm lati, 140–330 µm crassi. *Thallus superne* flavo-viridis, emaculatus, ad apicem loborum versus pruinosus, isidiis sorediisque nullis. *Cortex superior* 13–30 µm crassus, paraplectenchymatus, cellulis 3–6 µm diametris. *Stratum gonidiale* 45–60 µm crassum, algis *Trebouxiis*, 4–15 µm diametris. *Medulla* alba, 50–240 µm crassa. *Cortex inferior* 5–20 µm crassus. *Thallus inferne* pallidus. *Rhizinae* non bene evolutae. *Apothecia* sessilia vel adnata, ad 1,5 mm diametris. *Hypothecium* hyalinum, 45–65 µm crassum. *Subhymenium* hyalinum, 4,5–6,5 µm crassum. *Hymenium* hyalinum, 45–55 µm altum, J+ caeruleum. *Asci* clavati, tholis J+ caeruleis (fig. 2). *Ascosporae* octonae, simplices, hyalinae, ellipsoideae, 8–10,5 x 4,5–6 µm. *Pycnidia* globosa, 160–230 µm profunda, 120–140 µm lata. *Pycnidiosporae* hyalinae, rigidae, aciculares, 7,5–11,5 x 0,8 µm. *Thallus* acidum usnicum, acidum evernicum et acidum lecanoricum continens.

TYPUS: SOUTH AFRICA, Natal, 31 km S of Phuthaditjhaba (Witsieshoek), Monts-aux-Sources, summit plateau of Western Buttress, on S faces of basalt rocks in dry exposed positions, on gentle S slope, alt. 3080 m, *F. Brusse 4524*, 21. i. 1986 (PRE, holo-; LD, iso-). Fig. 5.

Thallus subcrustose, basalticolous, to 4 cm across. *Lobes* elongate, to 4 mm long, 0,3–1,2 mm broad, 140–330 µm thick. *Upper surface* yellow-green, emaculate, pruinose towards lobe ends, non-isidiate and non-sorediate. *Upper cortex* 13–30 µm thick, paraplectenchymatous, cells 3–6 µm diam. *Algal layer* 45–60 µm thick, algae *Trebouxia*, 4–15 µm diam. *Medulla* white, 50–240 µm thick. *Lower cortex* 5–20 µm thick. *Lower surface* pale. *Rhizines* not well developed. *Apothecia* sessile to adnate, to 1,5 mm diam.

Hypothecium hyaline, 45–65 µm thick. *Subhymenium* hyaline, 4,5–6,5 µm thick. *Hymenium* hyaline, 45–55 µm high, J+ blue. *Asci* clavate, eight-spored, tholus J+ blue (fig. 2). *Ascospores* simple, hyaline, ellipsoid, 8–10,5 x 4,5–6,0 µm. *Pycnidia* globose, 160–230 µm deep, 120–140 µm wide. *Pycnidiospores* hyaline, rigid needles, 7,5–11,5 x 0,8 µm. *Chemistry*: Usnic acid in the cortex, evernic and lecanoric acids in the medulla.

This new species was at first thought to be *Parmelia scitula* Brusse (1984), but a careful study of the chemistry revealed the additional presence of evernic acid in the medulla. The lobes become much thicker in *P. spissa* (to 330 µm), than in *P. scitula* (to 150 µm), and *P. spissa* is so far known only from high altitude basalt in the Drakensberg, whereas *P. scitula* occurs in the southern Cape mountains to southern Natal at moderate altitudes. The quantitative measurements of the two species vary somewhat from each other, but it is not yet known if this is really significant, as relatively few specimens of each species have been examined. The upper cortex of *P. spissa* is, however, more dense and paraplectenchymatous, than the fairly loose palisade plectenchyma, normal for most of the genus *Parmelia* except the *P. saxatilis* group, the brown Parmeliae, and the *P. reticulata* group.

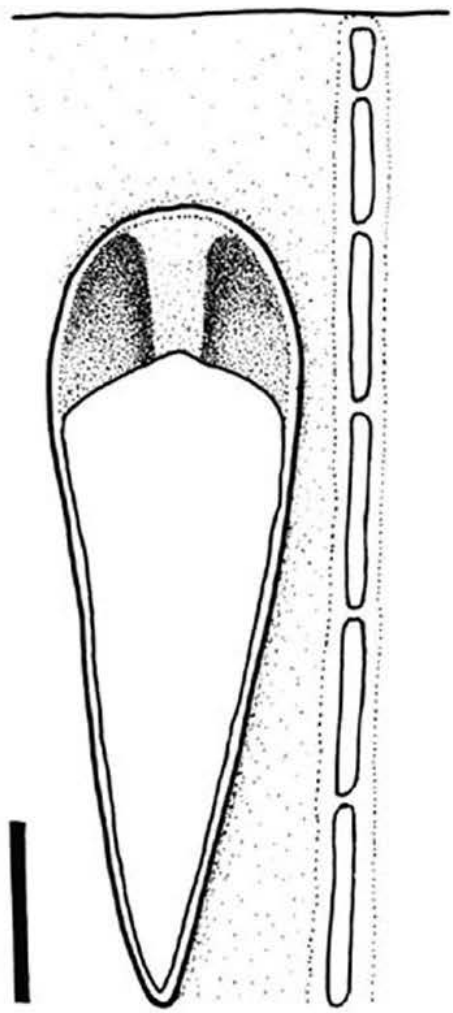

Fig. 2. *Parmelia spissa* Brusse, ascus and paraphysis. *F. Brusse 4524*, holotype. Bar = 10 µm.

This new species is presently known from the type locality, the summit plateau of the Western Buttress of Mont-aux-Sources, in the Royal Natal Park, and from Naudé's Nek further south.

SOUTH AFRICA, Natal — 2828 (Bethlehem): Mont aux Sources, near Hut, alt. 9,900', lithophytic on basalt boulders, exposed, succeeding crustose species, frequent (–DD), *E. Schelpe 1293*, 17. ii. 1946 (NU).

Cape—3028 (Matatiele): 65 km N of Maclear, summit of Naudé's Nek, basalt summit plateau near SE cliff edge, on basalt rocks in full sun, alt. 2500 m (–CA). *F. Brusse 4592*, 26.ii.1986 (BM, COLO, LD, PRE).

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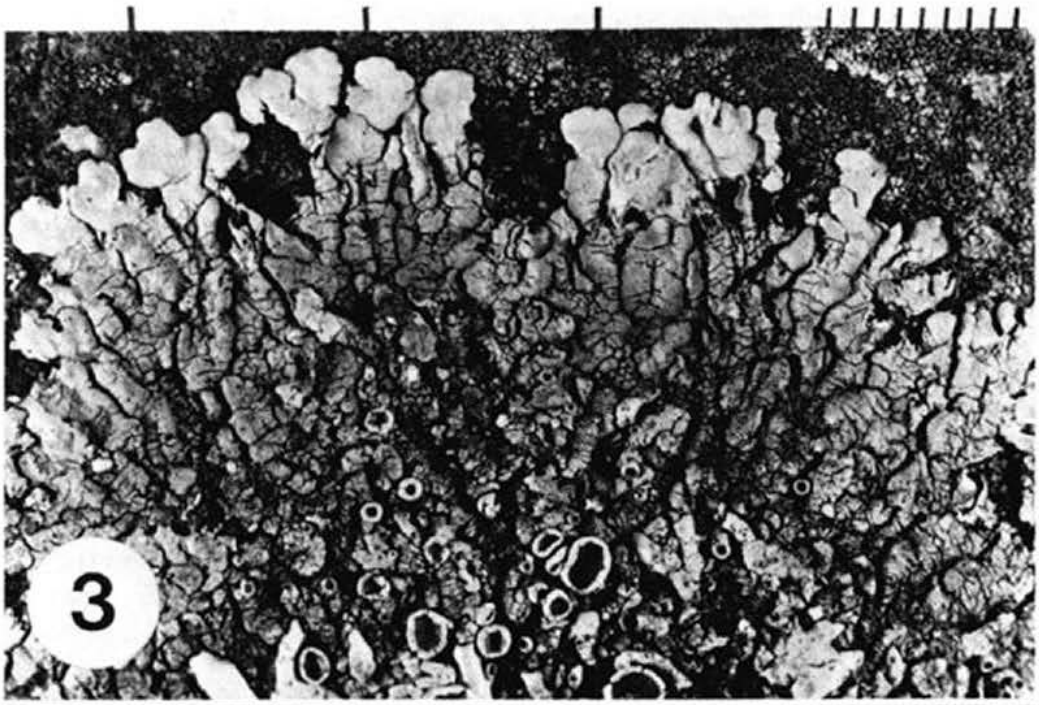
FIGURE 3. *Parmelia asilaris* Brusse, habit. *F. Brusse 4680*, holotype. Scale in mm.

FIGURE 4. *Parmelia lurida* Brusse, habit. *F. Brusse 4889*, holotype. Scale in mm.

FIGURE 5. *Parmelia spissa* Brusse, habit. *F. Brusse 4524*, holotype. Scale in mm.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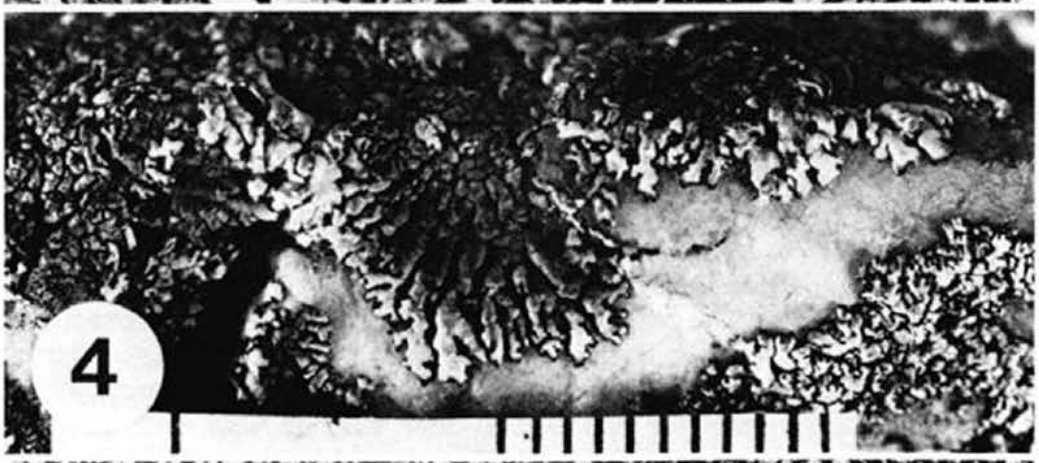
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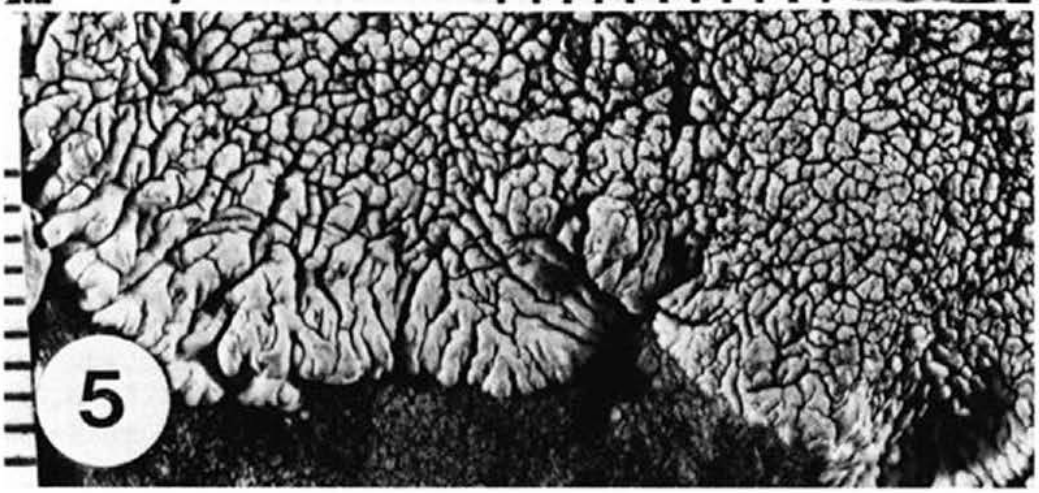
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CIRRENALIA BASIMINUTA: A NEW LIGNICOLOUS MARINE DEUTEROMYCETE FROM THE TROPICS

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During our examination of mangrove and submerged wood for marine fungi an underscribed species of *Cirrenalia* was encountered. Ten *Cirrenalia* species have been described; five from the marine environment (*C. fusca, C. macrocephala, C. pseudomacrocephala, C. pygmea, C. tropicalis*) and five from terrestrial habitats (*C. donnae, C. lignicola, C. indica, C. japonica, C. palmicola*)(Goos, 1985). The new fungus was collected on mangrove wood from Goa and from test blocks submerged in the sea at Kuwait (Zainal and Jones, 1984, 1986).

CIRRENALIA BASIMINUTA Raghu-Kumar et Zainal sp. nov. (Figs. 1-10).

Hyphae 2.4-5.0µm diametro, septatae, hyalinae vel pallido-brunneae. *Conidiophora* terminalia, monoblastica, 8.2-28.1 x 1.4-2.5µm. *Conidia* acrogena, solitaria, helicoidea, semicontorta, 29-41µm alta, 18-34µm diametro, 3-4 (-5) septata, constricta ad septa. Cellula apicalis 9.4-16.2 x 9.0-13.7µm, subglobosa, cellula ad basim attenuata, 4.9-17µm longa, 2.5-7.0µm diametro.

Substratum: lignum immersum *Rhizophorae mucronatae* et *Pini sylvestris*.

Holotypus: in laminis vitreis et culturis ex ligno immerso *Pini sylvestris*, IMI. 318783.

Isotypus: cultura ex *Rhizophora mucronata* (2/10/86).

CIRRENALIA BASIMINUTA Raghu-Kumar et Zainal

Hyphae: 2.4-5.5µm in diameter, septate, hyaline to pale brown. *Conidiophores* terminal, integrated, monoblastic and determinate, 8.2-28.1 x 1.4-2.5µm. *Conidia* borne acrogenously, rarely borne laterally, and directly on conidiophore, solitary, helicoid, semi-contorted, 29-41µm high and 18-34µm in diameter. *Conidia* 3-4 (5) septate, constricted at the septa. Cells increasing in size from base to apex. Apical cell 9.4-16.2 x 9.0-13.7µm subglobose basal cell cylindrical and tapering, 4.9-17.1µm long and 2.5-7.0µm wide at the widest part. Pigmentation of the cells increasing from base to apex, the apical cell light brown with a reddish tinge.

Holotype: Slides and cultures isolated from submerged test block at Doha, Kuwait, January 1984, IMI. 318783.

Isotype: Cirrenalia basiminuta culture isolated from *Rhizophora mucronata* Lank. 2nd October 1983 from mangroves at Orda, Goa, India.

Etymology: from the latin *basim*-base, and *minuta* - small referring to the small basal cell of the condium.

Conidial measurements of Kuwait material on wood blocks were 13.6 (15.8) 17µm high and 14-18µm diameter while the basal cell is the smallest, 10-14µm long and 5-7µm wide. The conidia from the culture material (Goa) being slightly larger.

The conidium initial arises as an apical, club-shaped swelling of the conidiogenous cell which is then cut off by the septum. This cell increases in size and the rest of the septa are then formed. The young conidium enlarges the apical cell attains its characteristic shape and darkens in colour and is usually the darkest.

C. basiminuta most closely resembles *C. pseudomacrocephala;* however, the latter has conidia that are less constricted, darker and usually have more septa (3-6). *C. fusca* has a more reniform or ellipsoidal apical cell and is thus quite

distinct from *C. basiminuta*. *C. pygmea* has very dark brown conidia and a characteristic apical cell which is much larger than that of *C. basiminuta*. *C. basiminuta* differs from all the other marine *Cirrenalia* species in conidial dimensions, septation, degree of coiling and constriction at the septa and the conidia are paler in colour (see Table 1 after Kohlmeyer and Kohlmeyer, 1979; Goos, 1985). Also the basal cell is quite characteristic and is peg-like in appearance.

The genera *Zalerion* and *Cirrenalia* are similar in morphology. The latter has conidia that are brown to fuscous in colour (fuscous in *Zalerion*), the apical cell diameter is greater than the other cells and the conidia are less coiled than those of *Zalerion*. This raises the question of the placement of the terrestrial species, because these have apical cells that are generally the same diameter as the remaining cells and are many times more septate (up to 12 septa).

Teleomorphs have not been found for any species of *Cirrenalia*. Nakagiri (1984) demonstrated that *Lulworthia uniseptata* is the teleomorph of *Zalerion maritimum*.

There seems to be a blurring of the taxonomic criteria for the separation of these genera; particularly with the inclusion of species such as *C. donnae* and *C. lignicola* (Sutton, 1973; Kirk, 1981). Sutton (1973) broadened the generic description because he believed that a distinctive feature of *Cirrenalia* is that the "apex of the conidiogenous cells and basal cell of the conidium are both at the centre of the helix formed by the conidial filament, whereas in other helicosporous fungi such as *Helicosporium* and *Helicoma* they are formed on the periphery of the helix". Sutton (1973) has ignored the most distinctive feature of the genus, namely that the diameter and pigmentation of the conidia increase from the base to the apex of the conidium (Meyers and Moore, 1960; Kohlmeyer and Kohlmeyer, 1979).

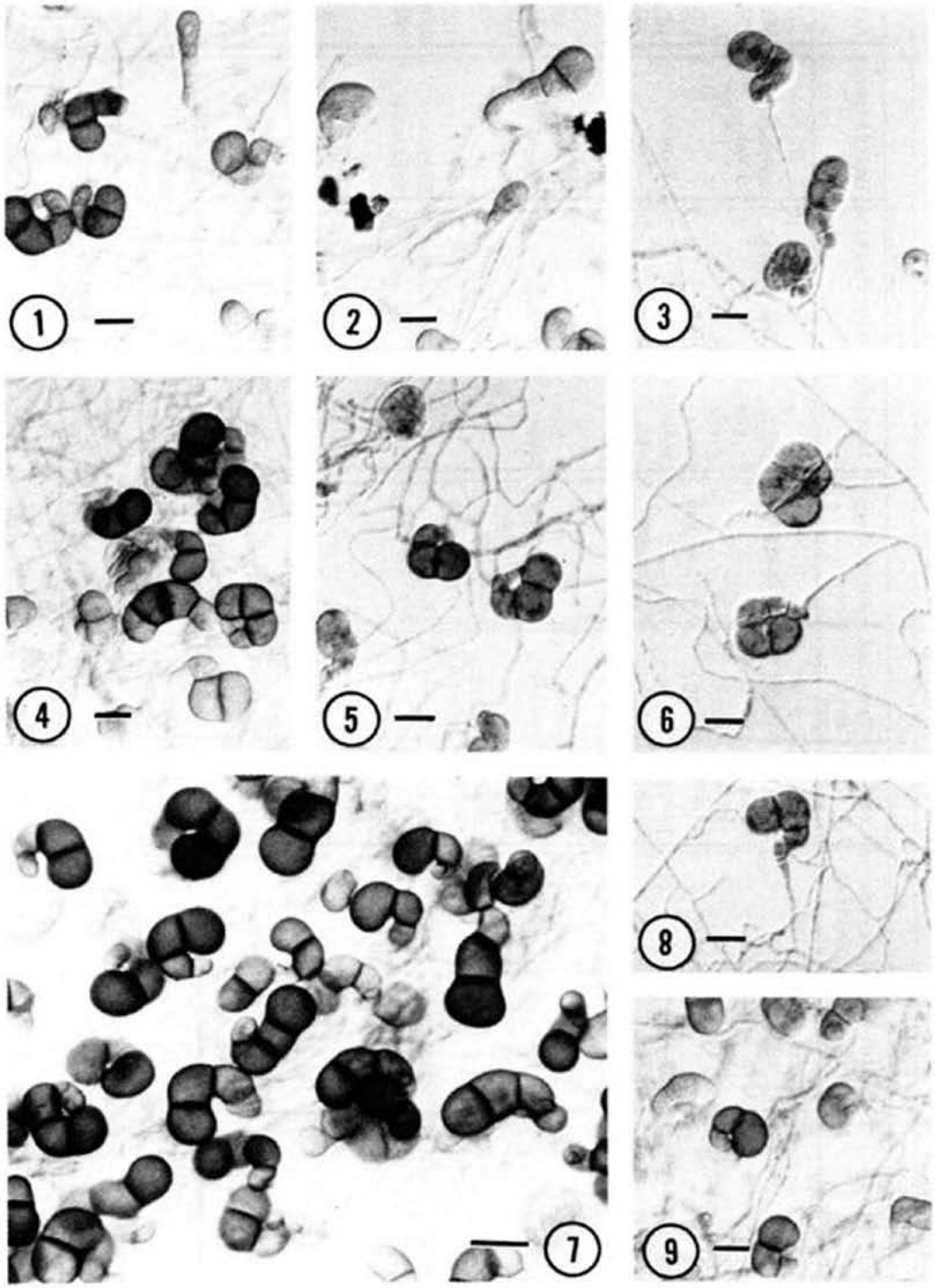
We concur with the views of Goos (1985) that the genus *Cirrenalia* is a heterogenous assemblage of species. For this reason we would exclude: *C. donnae*, *C. lignicola*, *C. japonica (?)* and *C. palmicola* from *Cirrenalia*. However, for the present, the terrestrial species are best left in *Cirrenalia*, until further studies are undertaken.

TABLE I. CONIDIAL MEASUREMENTS (μ) OF *CIRRENALIA* SPECIES

Species	Conidiophore size	Degree of Coiling	Conidia	Terminal cell	Morphology	Septation	Distribution	Conidiophore	Reference
Marine *C. fusca* Schmidt.	up to 23(33) x 3-6	1 1/2	20-36 high	13-33 high	reniform to ellipsoidal sausage-shaped	2-4	Temperate	Micro-nematous	Schmidt 1969
C. macrocephala (Kohlm.) Meyers & Moore	3.5-25 x 2-5	1/4-1	12-35 high 12-23.5 diam. reddish brown	5.5-13.5 high 6.5-17 diam.	subglobose	2-7	Cosmopolitan	semi-macro-nematous	Kohlmeyer & Kohlmeyer 1979
C. pseudomacrocephala Kohlm.	23-30 x 3-5	1 1/4	27.5-38.5 diam. brown	16.5-18.5 high 16.5-20 diam.	subglobose to ellipsoidal	3-6	Tropical?	semi-macro-nematous	Kohlmeyer & Kohlmeyer 1979
C. pygmea Kohlm.	lacking	1/2-1	25.5-31 28.5-34 black shiny	16.5-23 diam.	reniform	3-4	Tropical	-----	Kohlmeyer & Kohlmeyer 1979
C. tropicalis Kohlm.	25-42 x 2.5-5.5	1-1 1/2	20-38.5 diam. brown	9-15 high 10-20 diam.	subglobose to ellipsoidal	6-12 slightly constricted at septa	Tropical	macro-nematous	Kohlmeyer & Kohlmeyer 1979
C. basiminuta	8.2-28.0 x 1.4-2.5	1/2	29-41 high 18-34 diam. pale brown	9.4-16.2 x 9.0-13.7	subglobose	3-5	Tropical?	-----	

TABLE I. Cont'd

Species	Conidiophore size	Degree of Coiling	Conidia	Terminal cell	Morphology	Septation	Distribution	Conidiophore	Reference
Terrestrial									
C. donnae Sutton	up to 35 x 3-6	1	20-25.5 diam. reddish brown	10 wide	Globose	7-11	Temperate	Sporodochial	Sutton 1973
C. indica Rao & Reddy	6-9 x 3-6	1/4-1/2	10-15 diam. subhyaline/dark brown	-----	Large variable in shape	-----	-----	-----	Rao & Reddy 1978
C. japonica Sugiyama	63 x 2.5 x 6	1/2-1	18-28 diam. reddish brown	-----	Rounded slightly swollen	4-9	?	Fasciculate	Sugiyama 1981
C. lignicola Kirk	Indeterminate	1 1/2-2	15-20 diam. olive aceous brown	-----	Rounded	up to 12	Temperate	Micronematous	Kirk 1981
C. palmicola Matsushima	-? x 1-2.5	1-3	5-8 x 40-100 dark brown	-----	Rounded	10-30	Tropical	Micronematous	Matsushima 1980



Figs. 1-9. Light micrographs of *Cirrenalia basiminuta*. Stages in the development of conidia. Bar lines = 10µm.

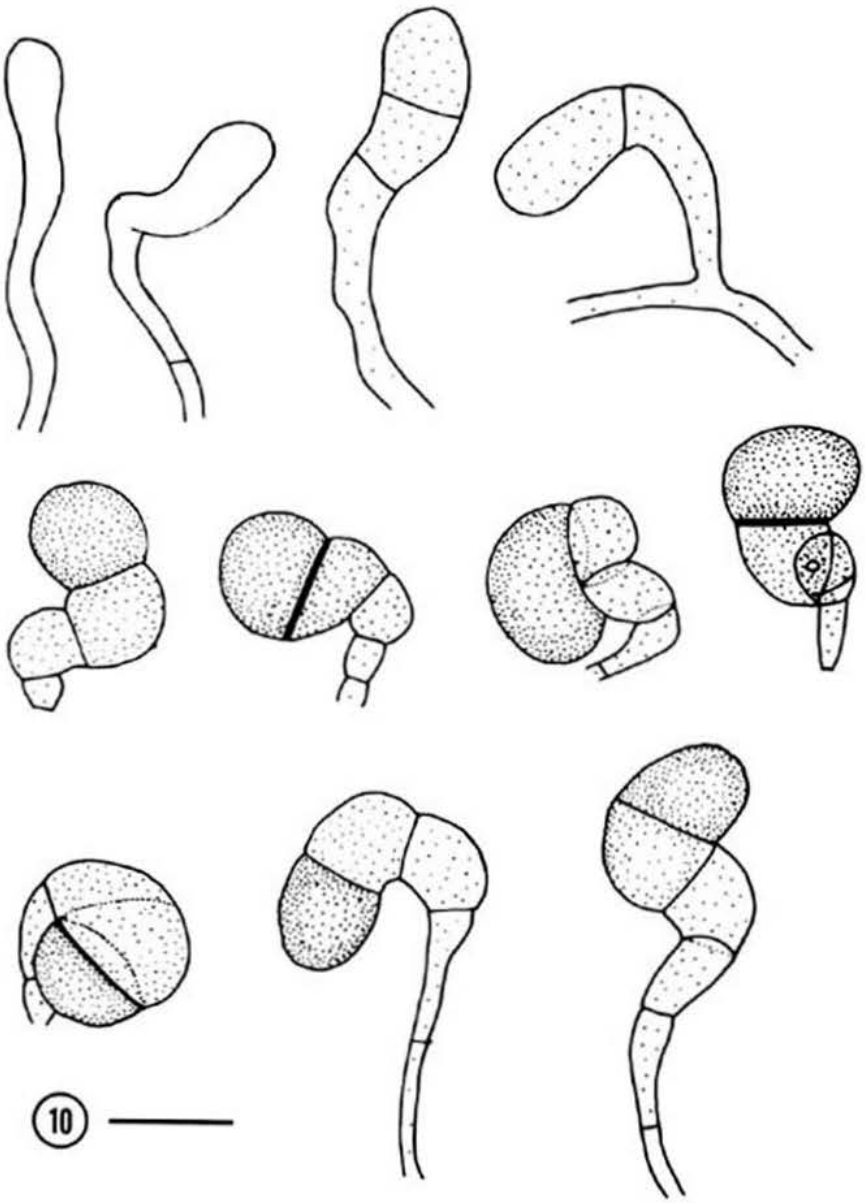


Fig. 10. Line drawings of conidial development in *Cirrenalia basiminuta*. Bar line = 10μm.

ACKNOWLEDGEMENTS

We are grateful to Dr. and Mrs. A.R. Loveless for the Latin diagnosis, to C. Derrick for photographic assistance, to the Kuwait University Research Council for funds for Professor E.B. Gareth Jones to work on the marine fungi of Kuwait, to Professor J. Kohlmeyer for advice and to Professor R.Goos for reviewing the manuscript.

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MYCOTAXON

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MICROSPHAERA BULBOSA NOM. NOV.

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Wang (1987) described Bulbomicrosphaera magnoliae gen. & spec. nov. The new species differs from Microsphaera by the bulbous base of the cleistothecial appendages. Otherwise it agrees fully with Microsphaera. I have revised the type material of this new species (HMAS 50013). The introduction of Bulbomicrosphaera is undoubtedly referred to the generic concept of Uncinula/Bulbouncinula. Recently I have discussed the generic concept of the Erysiphales in detail (Braun 1987). Bulbouncinula is recognized on account of the second type of appendages. The mere existence of the bulbous swellings of the cleistothecial appendages is not sufficient to introduce a new genus. There are some Uncinula as well as Microsphaera species with enlarged, coloured basal cells (e.g. Uncinula bischofiae Wei; Microsphaera magnifica U. Braun, on Magnolia in North America and Japan). B. magnoliae does not possess any other distinguishing characteristics, except the bulbous swellings of the cleistothecial appendages. Therefore, I reduce Bulbomicrosphaera to the synonymy of Microsphaera. Because of M. magnoliae Sawada, it is not possible to transfer B. magnoliae to Microsphaera.

Microsphaera bulbosa U. Braun nom. nov.

Bas.: Bulbomicrosphaera magnoliae A. Q. Wang, Acta Mycol. Sinica 6(2), p.74 (1987).

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JAPANESE SPECIES OF *ASCOSPHAERA*

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SUMMARY

Seven new species of *Ascosphaera* were uncovered by examination of collected bamboo canes with nesting cells and cocoons of the mason bee, *Osmia cornifrons*, from the Nagano region in Japan where more than 30 years extensive use of this species for pollination of apple trees constitutes the basis for accumulation of fungi living in association with the bees. Further, the investigations revealed osmophily or xerophily as the rule rather than the exception in *Ascosphaerales*. Some species required as much as three mol l^{-1} glucose in the media for formation of ripe spore cysts or fairly normal mycelial growth with little collapse.

INTRODUCTION

Already more than 30 years ago, the fruit growers in the Nagano region in Japan had serious problems with pollination of fruit trees because honey bees and wild bees suffered damage from the application of insecticides. This led to an extensive use of hand pollination in order to maintain a constant apple production, and to a search for bees especially suitable for pollination purposes under the prevailing conditions. The best species for use in the apple orchards was found to be the mason bee *Osmia cornifrons* (Radoszkowski) which since has been of increasing importance (Maeta & Kitamura, 1964; Kitamura & Maeta, 1969). The increased populations and number of nesting sites with high amounts of bees gave problems with different kinds of enemies - not least of fungi (Maeta & Kitamura, 1965; Maeta, 1978). The fungi were found on the larval, prepupal, and pupal stages and the percentage seemed to vary from year to year, from one region to another, and from bee species to bee species. The largest amount of fungi on *O. cornifrons*, 24.6% of the nest cells collected, was found in apple orchards at Suzaka City in 1964 (Maeta, 1978). The fungi were not identified.

During the 30th International Apicultural Congress in Nagoya, Japan, in 1985, Dr. Yasuo Maeta kindly invited the

author to participate in an excursion to the large apple orchards around Nagano City (cf. Ebato, 1980) in order to see how the fruit growers used *O. cornifrons*.

By use of a simple magnifying glass (x 6) it became immediately clear that the nest cells might contain *Ascosphaera* species new to science. The identification of some of the species are presented below.

Previously *A. apis* (Massen:Claussen) Olive et Spiltoir have been found in Japan (Udagawa & Horie, 1974; Furuya et al., 1981; Furuya, 1982).

MATERIALS AND METHODS

The examined material comprised samples of bamboo canes collected in three apple orchards close to Nagano City. The canes were used as nests for the mason bee, *Osmia cornifrons* (Radoszkowski), and for this aim each cane had an inner diameter of 6 mm and was cut in 15-20 cm pieces. The samples of bamboo canes were taken from bundles placed under the roof of houses or from small huts placed at intervals in the orchards (cf. Kitamura & Maeta, 1969).

When the bamboo canes were split up for examination, it was observed that all three samples were more or less heavily infested with species of mites. They were killed by two three-day exposures to "Vapona" strips (18.6% dichlorovos = o,o-dimethyl o-(2,2-dichlorvinyl) phosphate) after removal of the cocoons with living bees (270 individuals) from sample 3.

The rather small sample 1 was found to be ransacked by mites and larvae of a beetle species, and a direct microscopical examination uncovered only an *Aspergillus* species. This was why this sample was discarded. In the large samples 2 and 3, *Ascosphaera* species occurred almost anywhere in most of the bamboo canes - though to a lesser extent in connection with cocoons with living bees. The provision of a nectar and pollen mixture was in some cases left uneaten, interwoven with mycelium, and mixed with a large number of spore cysts of an *Ascosphaera* species.

Further, Dr. S.N. Holm handed one thousand cocoons of *O. cornifrons* over to the author for examination. In the autumn of 1985 he had received about 5000 cocoons from Dr. E. Takahashi in order to test if this bee would be usable under Danish conditions. After overwintering in the same way as other bees, they were all found dead. The examination unveiled that nearly all of them had died at the fully developed imago stage and with only accidentally occurring fungi that could not provide any reason for the deaths. Only less than one per cent had died at the larval stage after spinning the cocoon, probably already in Japan. These larvae were interwoven by mycelium of an *Ascosphaera* species but without any spore cysts. These were situated on the inner side of the cocoons where they formed a tapestry of closely aggregated spore cysts analogous to

that of *A. aggregata* Skou under the larval integument (Skou, 1975), or now and then occurring singly.

Finally, a small sample was received from Dr. Yasuo Maeta who had collected it at Mt. Hoshigami, Shimane Prefecture, Japan, in November 1985.

As far as possible, spore cysts were picked up one by one for examination, macerated and spread on the honey-pollen medium or on MEA with 30% glucose (Skou, 1975; Skou & King, 1984). As soon as growth occurred, the mycelia were transferred to a fresh medium in order to get rid of contaminants and to separate the different *Ascosphaera* species. Per cent glucose denotes w/v glucose monohydrate and MEA with 30% and 60% glucose then equals 1.60 and 3.12 mol l^{-1}, respectively. The fungi were grown in growth chamber at 21°C. Other growth conditions are given under each described species.

Aureomycin was added to all media as a standard in order to avoid bacterial growth.

All comparisons of the species were based on measurements made with an ocular screw micrometer and the results from the ascomata (spore cysts) and their content were based on at least 200 measurings each.

THE SPECIES

1. *Ascosphaera parasitica* Skou sp. nov.

Etymology: The epithet '*parasitica*' is given because the fungus is found growing and sporulating only inside the cocoons of *Osmia cornifrons* (Radoszkowski).

Descriptio: *Ascosphaera parasitica species nova. Mycelium parcum, in superficie larvarum mortuarum. Sporocystae nigrescentes, intus crysalibus dense congestae, ob compressae formis variis vel solitares formis globosis, 143 - 281 - 456 µm magnae, 94 pro 100 inter 200 et 400 µm. Membrana externa hyalina, gelatinosa, palleo brunnea vel flava et membrana interna nigrofusca vel inpellucera, levis, vitro instar fragili constituta. Globuli sporarum sphaerici, 11 - 18.1 - 29 µm magnae, 89.5 pro 100 inter 13 et 23 µm. Ascosporae unicellulares, ellipsoideae vel fusiformes, 1.2 - 1.8 - 2.3 x 4.3 - 6.7 - 8.8 µm magnae, 81 pro 100 inter 1.5 et 2.0 µm latitudine et 94 pro 100 inter 5 et 8 µm longitudine; ratione longitudinis pro latitudinis ita 3.7. Status anamorphosis non observatus.*

Habitat in chrysalibus Osmiae cornifrontis (Radoszkowski) *parasitica.*

Holotypus anno 1986 in chrysalibus Osmiae cornifrontis in regione Nagano, Japonia lectus, in Museo et Herbario Botanico Hauniensi (C) deposito.

Description: Mycelium sparse on the surface of dead larvae. Spore cysts black, tinged with grey in reflected light, either closely aggregated in a tapestry on the inner site of the cocoons and variable in form or singly and globose, 143 - 281 - 456 µm with 94% between 200 and 400 µm. The outer membrane hyaline, gelatinous and pale

brown to yellow, the inner membrane dark brown to opaque, smooth, vitreous and brittle. Spore balls globose, 11 - 18.1 - 29 µm with 89.5% between 13 and 23 µm. Ascospores one-celled, elliptical to fusiform, hyaline and colourless, 1.2 - 1.8 - 2.3 x 4.3 - 6.7 - 8.8 µm, 81% with a breadth between 1.5 and 2.0 µm and 94% with a length between 5 and 8 µm. Length-to-width ratio: 3.7 (Fig. 1). Anamorph state not observed.

Habitat in cocoons of *Osmia cornifrons*.

Holotype in cocoons of *Osmia cornifrons* received from E. Takahashi, Nagano, Japan, in 1985. Deposited in the Botanical Museum and Herbarium, Copenhagen, Denmark (C).

Material examined: About a thousand of the cocoons received from E. Takahashi. The fungus occurred in less than one per cent of this material.

Hitherto no growth on artificial media.

The manner of occurrence suggests that the fungus is parasitic, hence the epithet *parasitica*. Probably the fungus is also pathogenic, but this is not proven.

2. *Ascosphaera verrucosa* Skou sp. nov.

Etymology: '*verrucosa*' = wart-like. The term refers to the sculptured ascospores.

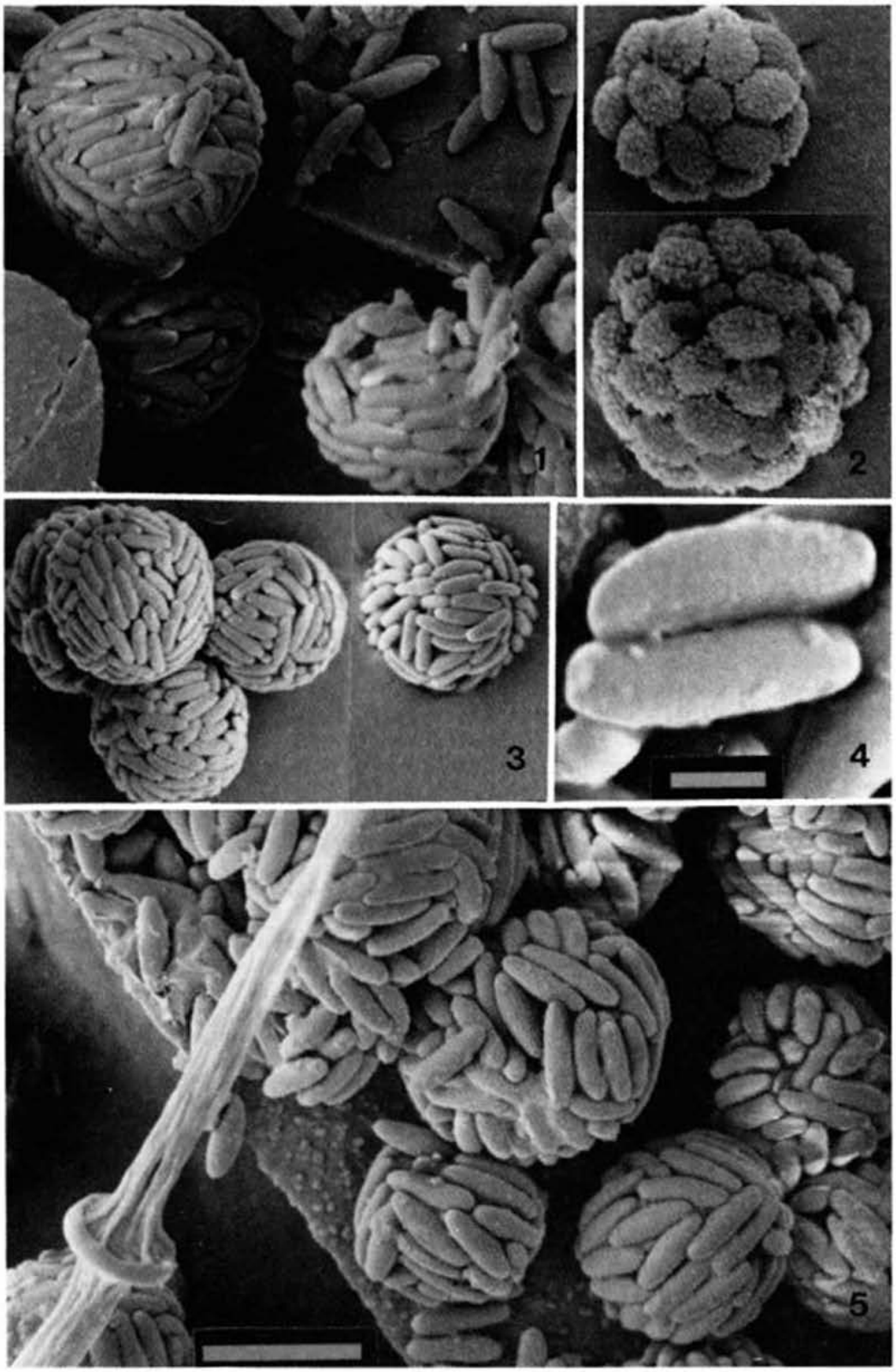
Descriptio: *Ascosphaera verrucosa species nova. Mycelium niveus et sporocystae coracinae intertexta inter mixtura nectaris et pollinis. Sporocystae globosae, 56 - 101 - 140 µm magnae, 92.5 pro 100 inter 70 et 130 µm. Membrana externa hyalina, gelatinosa, nullo colore et membrana interna translucenti spadicea, vitro instar fragili constituta. Globuli sporarum sphaerici, 12 - 16.8 - 24 µm magnae, 82.5 pro 100 inter 14 et 20 µm. Ascosporae unicellulares, verrucosae, ellipsoideae vel subglobosae, superficialis ceracea instar verrucosa, tendentia decidua, 3 - 4.3 - 6 x 4 - 5.8 - 7 µm magnae, 96 pro 100 inter 3.5 et 5.5 µm latitudine et 94 pro 100 inter 5.0 et 6.5 µm longitudine; ratione longitudinis pro latitudinis ita 1.4. Status anamorphosis non observatus.*

Habitat in cibaria Osmiae cornifrontis (Radoszkowski).

Holotypus anno 1985 in cibaria Osmiae cornifrontis (Radoszkowski), *in regione, Nagano, Japonia lectus, in Museo et Herbario Botanico Hauniensi (C) deposito.*

Description: The snow-white mycelium and the lustrous ravenblack spore cysts occur interwoven in the provision mixture of nectar and pollen collected by *Osmia cornifrons*. Spore cysts globose, 56 - 101 - 140 µm with 92.5% between 70 and 130 µm. The outer membrane hyaline, gelatinous and colourless. The inner membrane date-brown in translucent light, vitreous and brittle and with variously

Figures 1-5. Spore balls and ascospores of *Ascosphaera* species. 1: *A. parasitica*, 2: *A. verrucosa*, 3 and 4: *A. celerrima*, 5: *A. cinnamomea*. Figure 4: x 12,000 and bar = 1 µm. The others: x 2,000 and bar = 10 µm.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sized dark spots that tend to be reticulate. Spore balls globose, 12 - 16.8 - 24 µm with 82.5% between 14 and 20 µm. Ascospores one-celled, elliptical to subglobose and verrucose from numerous wax-like, ethanol-soluble grains, 3 - 4.3 - 6 x 4 - 5.8 - 7 µm, 96% with a breadth between 3.5 and 5.5 µm and 94% with a length between 5.0 and 6.5 µm. Length-to-width ratio: 1.4 (Fig. 2). Anamorph state not observed.

Habitat in provisions of *Osmia cornifrons*.

Holotype in provisions of *Osmia cornifrons* collected at Nagano region, Japan, in 1985. Deposited in the Botanical Museum and Herbarium, Copenhagen, Denmark (C).

Material examined: Two samples collected in the Nagano region and a sample collected by Dr. Y. Maeta at Mt. Hoshigami, Shimane Prefecture, Japan.

Hitherto no growth on artificial media.

3. *Ascosphaera celerrima* Skou sp. nov.

Etymology: '*celerrima*', from '*celer*' = quick, rapid and the superlative suffix '*-rima*'. The term refers to the very fast growth of the fungus.

Descriptio: *Ascosphaera celerrima species nova. Mycelium 5 - 8.2 - 14 µm, album, abundans et celeriter crescens. Sporocystae nigrae, globosae, magnitudine maxime variabili, 45 - 191 - 428 µm magnae, 87 pro 100 inter 75 et 350 µm. Membrana externa hyalina, tenuis, gelatinosa, nullo colore et membrana interna brunnea, levis, vitro instar fragili constituta. Globuli sporarum sphaerici 8 - 12.5 - 18 µm magnae, 86 pro 100 inter 10 et 15 µm. Ascosporae unicellulares, oblongae vel fusiformes, 1.1 - 1.5 - 2.4 x 3 - 4.2 - 6 µm magnae, variatione parva; ratione longitudinis pro latitudinis ita 2.7. Status anamorphosis non observatus.*

Habitat in nidis Osmiae cornifrontis (Radoszkowski) *in canna bambusae.*

Holotypus anno 1985 in nido Osmiae cornifrontis (Radoszkowski) *in regione Nagano, Japonia, lectus, in Dania cultus, vivis prolibus in vivario Neerlandico Baarnensi sub numeris CBS 390.87 traditis et mycelio sporifero sicco typifico in Museo et Herbario Botanico Hauniensi (C) deposito.*

Description: Mycelium, 5 - 8.2 - 14 µm, white, abundant, and very fast growing at 21°C and ambient room temperature. Spore cysts black, globose, extremely variable in size, 45 - 191 - 428 µm with 87% between 75 and 350 µm. The outer membrane thin, hyaline, gelatinous and colourless. The inner membrane brown, smooth, vitreous and brittle. Spore balls globose, 8 - 12.5 - 18 µm with 86% between 10 and 15 µm. Ascospores one-celled, oblong or fusiforme, 1.1 - 1.5 - 2.4 x 3 - 4.2 - 6 µm with little variation. Length-to-width ratio: 2.7 (Figs 3 and 4). Anamorph state not observed.

Habitat in nests of *Osmia cornifrons*.

Holotype anno 1985 collected in nests of *Osmia cornifrons* (Radoszkowski) in bamboo canes in the Nagano region, Japan. Culture No. J21 deposited at CBS, Baarn, The Netherlands, with accession No. CBS 390.87. A dried culture of No. J21 is chosen as holotype and deposited at the Botanical Museum and Herbarium, Copenhagen, Denmark (C).

Material examined: From nesting cells in bamboo canes at the nesting site 3 where the large spore cysts were picked up one by one. The fungus was easily purified because of its very fast growth though the presence of *Penicillium* spp. proved destructive to it.

The fungus grows best on MEA with yeast extract and 30% glucose (Skou & King, 1984) or on honey-pollen medium (Skou, 1972).

4. *Ascosphaera cinnamomea* Skou sp. nov.

Etymology: '*cinnamomea*' from '*cinnamomum*' = cinnamon, a bright brown colour. The term refers to the mycelium which changes from white to bright brown during the time of ripening of the spore cysts.

Descriptio: *Ascosphaera cinnamomea species nova. Mycelium 8 - 9.8 - 14 µm crassum, initio album postea ad cinnamomum mutans. Septa intactae in mycelio collapso similia cumuli ossium scelati. Sporocystae brunneae, globosae, 123 - 226 - 350 µm magnae, 82 pro 100 inter 150 et 300 µm. Membrana externa hyalina, gelatinosa, nullo colore et membrana interna brunnea, levis vel maculata dispar, vitro instar fragili constituta. Globuli sporarum sphaerici, 10 - 16.2 - 23 µm magnae, 87.5 pro 100 inter 13 et 20 µm. Ascosporae unicellulares, lanceolatae, apicibus obtusis, 1.7 - 2.1 - 2.5 x 6 - 7.9 - 9 µm, variatione parva; ratione longitudinis pro latitudinis ita 3.8. Status anamorphosis non observatus.*

Habitat in nidis Osmiae cornifrontis (Radoszkowski) *in canna bambusae.*

Holotypus anno 1985 in nido Osmiae cornifrontis (Radoszkowski) *in regione Nagano, Japonia, lectus, in Dania cultus, vivis prolibus in vivario Neerlandico Baarnensi sub numeris CBS 375.87 traditis et mycelio sporifero sicco typifico in Museo et Herbario Botanico Hauniensi (C) deposito.*

Description: Mycelium, 8 - 9.8 - 14 µm diam., initially white but changing to cinnamon during formation and ripening of the spore cysts. At this time it has a pronounced collapsing tendency and develops a cinnamon-coloured liquid cell content, and with the septa left unchanged, indicating why the mycelium gets a bony appearance. Spore cysts brown, globose, 123 - 226 - 350 µm with 82% between 150 and 300 µm. The outer membrane hyaline, gelatinous and colourless (Fig. 12). The inner membrane brown, smooth or with a varying number of dark spots, vitreous and brittle. Spore balls globose, 10 - 16.2 - 23 µm with 87.5% between 13 and 20 µm. Ascospores one-celled, lanceolate with more or less obtuse to

fusiforme apices, 1.7 - 2.1 - 2.5 x 6 - 7.9 - 9 µm with little variation. Length-to-width ratio: 3.8 (Fig. 5). Anamorph state not observed.

Habitat in nests of *Osmia cornifrons*.

Holotype collected in 1985 in nests of *Osmia cornifrons* (Radoszkowski) in bamboo canes in the Nagano region, Japan. Culture No. J61 deposited at CBS, Baarn, The Netherlands, with accession No. CBS 375.87. A dried culture of No. J61 is chosen as holotype and deposited at the Botanical Museum and Herbarium, Copenhagen, Denmark (C).

Material examined: From nesting cells in bamboo canes at nesting site 3 where the cinnamon-coloured mycelium and the brown spore cysts occurred sparsely here and there.

The fungus grows best on MEA with yeast extract and 30% glucose (Skou & King, 1984) or on honey-pollen medium (Skou, 1972).

5. *Ascosphaera fusiformis* Skou sp. nov.

Etymology: '*fusiformis*'; '*fusi-*' from '*fusus*' = spindle and '*-formis*' from '*forma*' = shape. These terms refer to the spindle-shaped ascospores.

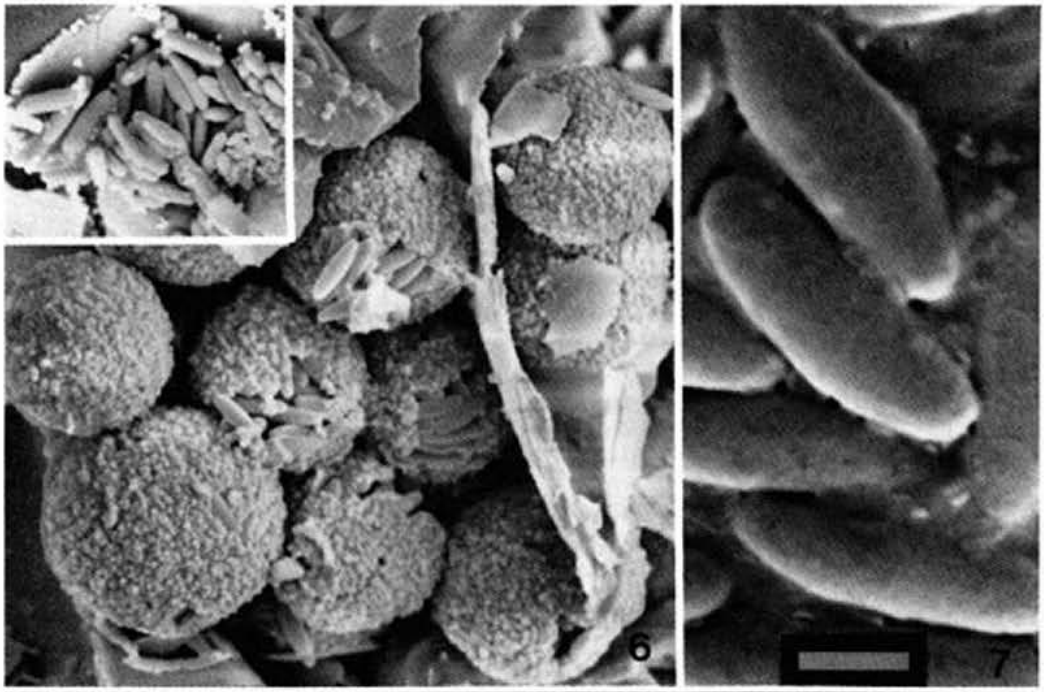
Descriptio: *Ascosphaera fusiformis species nova. Mycelium 2.5 - 3.7 - 5.0 µm crassum, album, dense et humiliter in coloniis non sporiferentibus et mycelium parcum in coloniis sporiferentibus. Diameter coloniae limitatus. Sporocystae nigrae, globosae, 28 - 65 - 132 µm magnae, 89 pro 100 inter 35 et 100 µm. Membrana externa hyalina, gelatinosa, nullo colore et membrana interna translucenti brunnea, levis cum granis numerosis laxis, parvis et fuscis, vitro instar fragili constituta. Globuli sporarum sphaerici, pallides brunnei, 7 - 11.5 - 16 µm magnae, 83 pro 100 inter 9 et 14 µm. Ascosporae unicellulares, fusiformes, 0.6 - 1.0 - 1.6 x 2.9 - 3.9 - 5.1 µm magnae, variatione parva. Ratione longitudinis pro latitudinis ita 4.0. Status anamorphosis non observatus.*

Habitat in nidis Osmiae cornifrontis (Radoszkowski) *in canna bambusae.*

Holotypus anno 1985 in nido Osmiae cornifrontis (Radoszkowski) *in regione Nagano, Japonia, lectus, in Dania cultus, vivis prolibus in vivario Neerlandico Baarnensi sub numeris CBS 373.87 traditis et mycelio sporifero sicco typifico in Museo et Herbario Botanico Hauniensi (C) deposito.*

Description: Mycelium 2.5 - 3.7 - 5.0 µm in diam., white, dense and low-growing in colonies without spore cysts, whereas the mycelium appears sparse in colonies which are black or almost black due to a huge number of spore cysts. Colony diameter may be rather limited. Spore cysts black,

Figures 6-9. Spore balls and ascospores of *Ascosphaera* species. 6 and 7: *A. fusiformis*, 8: *A. naganensis*, 9: *A. xerophila*. Figure 7: x 12,000 and bar = 1 µm. *The others: x 2,000 and bar = 10 µm.*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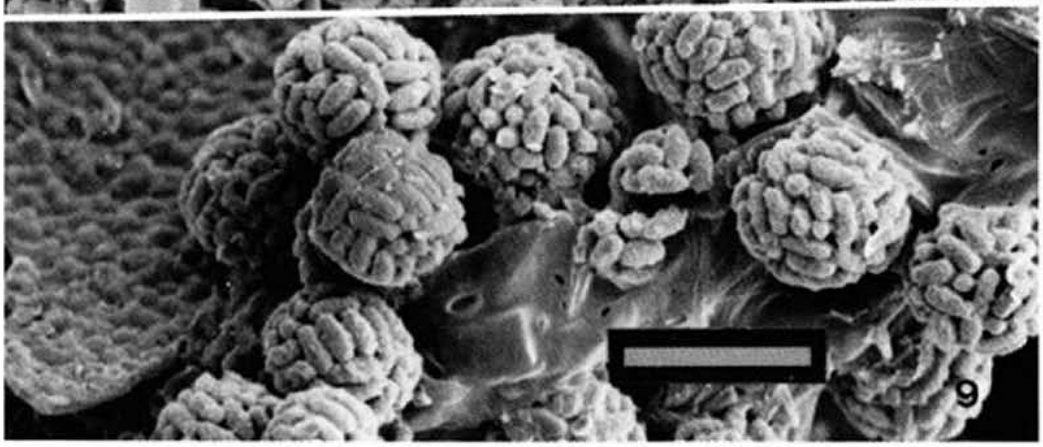
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globose and 28 - 65 - 132 µm in diam. with 98% between 35 and 100 µm. The outer membrane hyaline, gelatinous and colourless. The inner membrane brown in translucent light, smooth with numerous small, loose, dark grains, vitreous and brittle. Spore balls pale brown with an unusually persistent unit membrane (Fig. 6), 7 - 11.5 - 16 µm in diam. with 83% between 9 and 14 µm. Ascospores one-celled, spindle-shaped, and 0.6 - 1.0 - 1.6 x 2.9 - 3.9 - 5.1 µm with little variation. Length-to-width ratio: 4.0 (Figs 6 and 7). Anamorph state not observed.

Habitat in nests of *Osmia cornifrons*.

Holotype anno 1985 collected in nests of *Osmia cornifrons* (Radoszkowski) in bamboo canes in Nagano region, Japan. Culture No. J1 deposited at CBS, Baarn, The Netherlands, with accession No. CBS 373.87. A dried culture of No. J1 is chosen as holotype and deposited at the Botanical Museum and Herbarium, Copenhagen, Denmark (C).

Material examined: From nesting cells in bamboo canes at nesting site 2 where it occurred in a few cases between other species.

The fungus grows best on MEA with yeast extract (Skou, 1972) and on 30% glucose (Skou & King, 1984) or on the honey-pollen medium.

6. *Ascosphaera naganensis* Skou sp. nov.

Etymology: '*naganensis*' from Nagano. The epithet is given in memory of the visit to Nagano City and the surroundings, and because this species was that most often collected.

Descriptio: *Ascosphaera naganensis species nova. Mycelium album, 5 - 8 - 11 (15) µm crassum cum tendentia conformationis vacuolarum et collapsus, dichotoma ramificatio inconspicua vel dispar. Cellulae nutritoriae et hyphae masculinae abundanter, frequenter formationem sporocystarum incipientes. Sporocystae nigrescentes, 44 - 123 - 330 µm magnae, 93 pro 100 inter 50 et 200 µm, hic interdum vacuae. Membrana externa hyalina, gelatinosa, nullo colore et membrana interna translucenti brunnea, subtiliter maculata, vitro instar fragili constituta. Globuli sporarum sphaerici, 7 - 10.2 - 13 µm magnae, 86 pro 100 inter 8 et 12 µm. Ascosporae unicellulares oblongae, apicibus obtusis, 1.0 - 1.2 - 1.6 x 2.7 - 3.7 - 4.3 µm magnae, variatione parva. Ratione longitudinis pro latitudinis ita 3.0. Status anamorphosis non observatus.*

Habitat in nidis Osmiae cornifrontis (Radoszkowski) *in canna bambusae.*

Holotypus anno 1985 in nido Osmiae cornifrontis (Radoszkowski) *in regione Nagano, Japonia, lectus, in Dania cultus, vivis prolibus in vivario Neerlandico Baarnensi sub numeris CBS 374.87 traditis et mycelio sporifero sicco typifico in Museo et Herbario Botanico Hauniensi (C) deposito.*

Description: Mycelium white, 5 - 8 - 11 (15) µm in diam. with a tendency to vacuolation and collapse and with less distinct dichotomous ramification than in other species.

Copulative hyphae, '*antheridia*' and '*pronutriocytes*', abundantly present, meet frequently and initiate formation of spore cysts. Spore cysts black with a little tinge of gray, 44 - 123 - 330 µm with 93% between 50 and 200 µm. Now and then many spore cysts are empty which may possibly be due to an early cessation of growth. Empty spore cysts remain transparent. The outer membrane hyaline, gelatinous and colourless. The inner membrane brown in transmitted light, very finely spotted, vitreous and brittle. Spore balls, 7 - 10.2 - 13 µm with 86% between 8 and 12 µm. Ascospores one-celled, oblong with obtuse apices, 1.0 - 1.2 - 1.6 x 2.7 - 3.7 - 4.3 µm with little variation. Length-to-width ratio: 3.0 (Figs 8 and 10). Anamorph state not observed.

Habitat in nests of *Osmia cornifrons*.

Holotype anno 1985 collected in nests of *Osmia cornifrons* (Radoszkowski) in bamboo canes in Nagano region, Japan. Culture No. J2 deposited at CBS, Baarn, The Netherlands, with accession No. CBS 374.87. A dried culture of No. J2 is chosen as holotype and deposited at the Botanical Museum and Herbarium, Copenhagen, Denmark (C).

Material examined: From nesting cells in bamboo canes at nesting sites 2 and 3 where *A. naganensis* was the most frequently isolated species. It grows fairly well on MEA with yeast extract and 30% glucose but the isolates have a more or less pronounced tendency to vacuolation and collapse of the hyphae and formation of empty spore cysts. Growth is less on the honey-pollen medium (Skou, 1972).

The isolates of *A. naganensis* have all the same general habit and the spore cysts and spore balls are alike, whereas there were found some variation in the length of the ascospores from one isolate to another. Though these differences might be significant, I find it unwise to give them species rank.

7. *Ascosphaera xerophila* Skou sp. nov.

Etymology: '*Xerophila*', from '*xero*' = dry and '*phila*' = loving. The terms refer to the fact that the fungus needs media with very low water activity for formation of fully developed ascomata, the spore cysts.

Descriptio: *Ascosphaera xerophila species nova. Mycelium 2.5 - 3.9 - 6.5 µm crassum, album et gossypinum sub conditione optima, tarde crescens. Sporocystae nigrae, globosae, 44 - 128.6 - 308 µm magnae, 78 pro 100 inter 75 et 200 µm. Membrana externa hyalina, tenuis, gelatinosa, nullo colore et membrana interna nigra, crassa, vitro instar fragili constituta. Globuli sporarum sphaerici 5.5 - 9.7- 13.0 µm magnae, 91 pro 100 inter 8 et 12 µm. Ascosporae unicellulares, ellipticae 1.0 - 1.3 - 1.8 x 2.2 - 2.9 - 3.8 µm magnae, variatione parva; ratione longitudinis pro latitudinis ita 2.2. Status anamorphosis non observatus.*

Habitat in nidis Osmiae cornifrontis (Radoszkowski) *in canna bambusae.*

Holotypus anno 1985 in nido Osmiae cornifrontis (Radoszkowski), *in regione Nagano, Japonia, lectus, in Dania cultus, vivis prolibus in vivario Neerlandico Baarnensi sub numeris CBS 376.87 traditis et mycelio sporifero sicco typifico in Museo et Herbario Botanico Hauniensi (C) deposito.*

Description: Mycelium 2.5 - 3.9 - 6.5 µm, white, cottony and slow growing at the best found growth conditions. Spore cysts black, globose 44 - 128.6 - 308 µm with 78% between 75 and 200 µm. The outer membrane thin, hyaline, gelatinous and colourless. The inner membrane black, unusually thick, vitreous and brittle. Spore balls globose, 5.5 - 9.7 - 13.0 µm with 91% between 8 and 12 µm. Ascospores one-celled, elliptical 1.0 - 1.3 - 1.8 x 2.2 - 2.9 - 3.8 µm with little variation. Length-to-width ratio: 2.2 (Figs 9 and 11). Anamorph state not observed.

Habitat in nests of *Osmia cornifrons*.

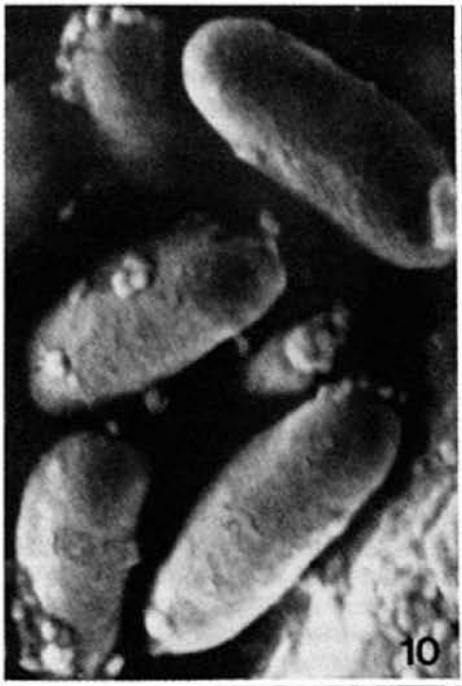
Holotype collected in 1985 in nests of *Osmia cornifrons* (Radoszkowski) in bamboo canes in the Nagano region, Japan. Culture No. J19 deposited at CBS, Baarn, The Netherlands, with accession No. CBS 376.87. A dried culture is chosen as holotype and deposited at the Botanical Museum and Herbarium, Copenhagen, Denmark (C).

Material examined: *A. xerophila* was isolated once only from nesting site 3. It showed a weak mycelial growth on MEA. The growth further increased on MEA with yeast extract and 20% glucose where after some time there came a dark shade on the colony for the reason that many of the young nutriocytes turned brownish, but spore cysts were never seen on this medium. The same picture was seen on honey-pollen medium (Skou, 1972) and on MEA with yeast extract and 30% glucose though with the difference that there came a slow development of spore cysts on the latter medium after some transfers to fresh medium. Addition of 60% glucose gave a fairly good cottony growth with many slowly ripening spore cysts. There was no growth or abnormal growth on several other media tried.

8. Other species

Eremascus albus Eidam, *Aspergillus* spp., mainly *A. repens* (Corda) de Bary and *A. amstelodami* (Mangin) Thom (cf. Holm & Skou, 1972), and *Wallemia sebi* (Fr.) v. Arx (syn. *Sporendonema epizoum* (Corda) Cif. & Red.) often occurred together with species of *Ascosphaeraceae*, *E. albus* especially in connection with the pollen mould *Bettsia alvei*

Figures 10-13. Spore cyst membrane, spore balls and ascospores of *Ascosphaera* species. 10: *A. naganensis*, 11: *A. xerophila*, 12: The gelatinous outer spore cyst membrane of *A. cinnamomea*, 13: *A. apis*. Figures 10 and 11: x 12,000 and bar = 1 µm; 12: x 1,000 and bar = 10 µm; 13: x 2,000 and bar = 10 µm.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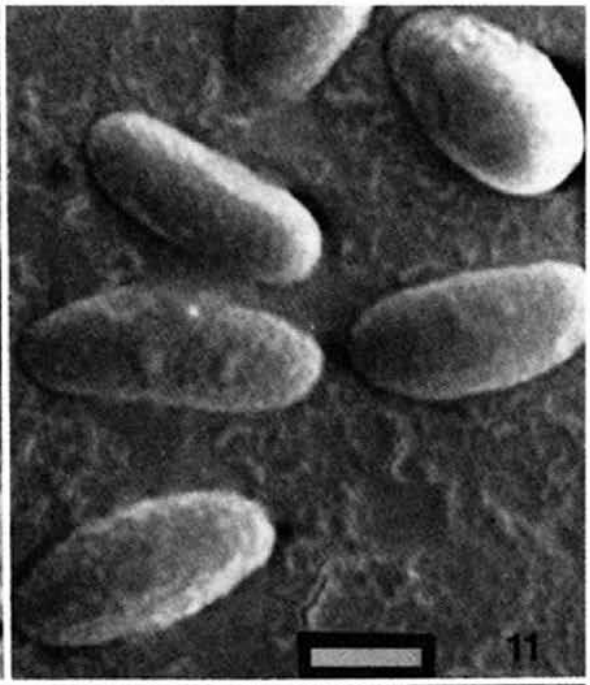
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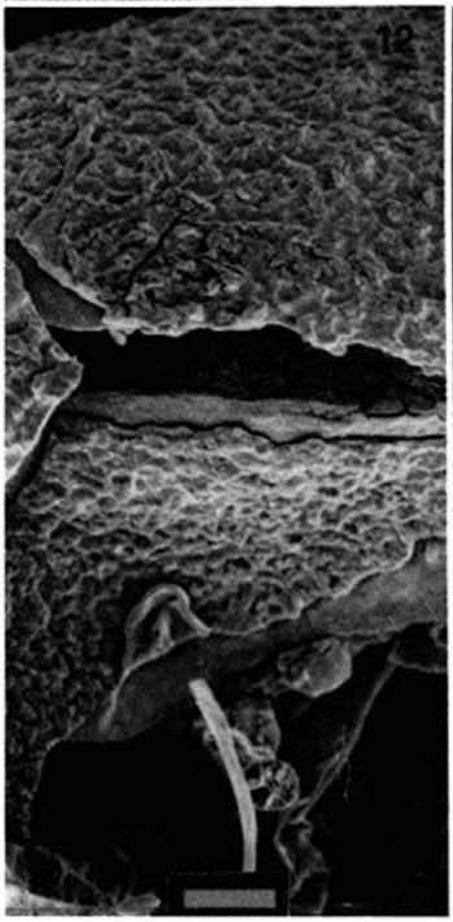
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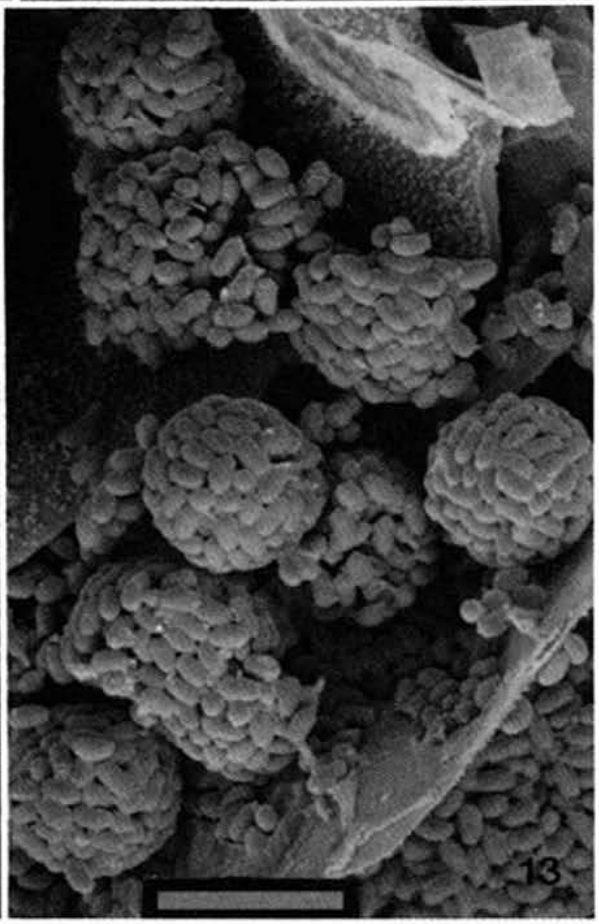
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(Betts) Skou. These fungi were characterized as xerophilic (Pitt & Christian, 1968; Pitt, 1975), including *Chrysosporium fastidium* Pitt (syn. of *C. farinicola* (Burnside) Skou, the anamorph of *B. alvei* (cf. Oorschot, 1980)). Further, the studies of *A. osmophila* Skou & King (1984) drew the attention to osmophily within this group of fungi and led to growth and identification of most of the above-described species.

In several cases the hyphae of isolated mycelia stuck together, vacuolated and collapsed at various early stages of the life cycle. Investigations on the effect of the glucose concentration revealed evidence that these phenomena were connected with the tendency of explosion or lysis of the cells so their content leaked out fast or more slowly. When the glucose concentration was increased the frequencies of these peculiar tendencies were either reduced, delayed or absent, and the growth rate increased.

Addition of 60% glucose not only made it possible to get normal growth of *A. xerophila*; it also initiated formation of spore cysts in some other - in all probability - *Ascosphaera* mycelia difficult to grow. However, these spore cysts later collapsed. Two of these mycelia were grown on this medium (MEA with yeast extract and 60% glucose, cf. Material and Methods) over concentrated $CaCl_2$ and $Mg(NO_3)_2$ solutions in desiccators with air circulation by aquarium pumps giving water activities (a_w) of approximately 0.45 and 0.80, respectively where

$$a_w = \frac{p}{p_o}$$

(p = water pressure over the medium and p_o = water pressure over pure water).

These conditions resulted in good growth of the mycelia in which the hyphae did not stick together. Later the agar medium dried out, obviously with only a slow collapse of the mycelia.

These results established that some *Ascosphaera* species have very extreme requirements which it may be almost impossible to fulfil under artificial conditions.

Finally in this context, several isolations resulted in growth of osmophilic *Chrysosporium* species that have morphological characters and nutritional requirements in common with *C. farinicola* (Pitt, 1966; Skou, 1975, 1986; Oorschot, 1980).

DISCUSSION

It has been said that I mainly base the differences between species on the size of the ascospores (*e.g.* Youssef et al., 1985). This is correct in the sense that they constitute the most constant character, but I find it necessesary to base the species on the sum of characters that are "stable enough" to differentiate on species level (*i.e.* the Adansonian principles, cf. Cowan, 1978). Even growth habit and hyphae may be used in this connection. The aerial mycelium shows in all species a repeatedly dichotomous ramification of the hyphae with angles of 45° to

60°. Together with the roughness of the hyphae it normally makes it easy to recognize these species from contaminants, especially *A. osmophila* (Skou & King, 1984), *A. celerrima*, and *A. cinnamomea*. Only in *A. naganensis* is the dichotomous ramification inconspicous which may be connected with the tendency to vacuolate. In *A. osmophila* (Skou & King, 1984) and *A. cinnamomea* (Fig. 5) the septa remain unchanged and stiff when the mycelium collapse. In the latter, this may make the collapsed mycelium looks like a heap of skeletal bones.

The size of spore cysts is the most variable character. An especially large variation was first mentioned on *A. major* (Prökschl & Zobl) Skou (Skou, 1972), later for *A. asterophora* Skou where the size is strongly dependent on the number of spore balls inside that vary from one to about 150 (Skou, 1982), and now for *A. celerrima* where the size of spore cysts varies by a factor of ten.

The presence of the outer spore cyst membrane is usually noted. An impression of its softness and gelatinous character appears from Fig. 12. In most cases this membrane is colourless but in *A. parasitica* it has a hint of yellow or brown. A similar colouring has been seen in an hitherto undescribed, uncultured species. At present I dare not say anything about the stability of this character.

The unit membrane surrounding the young spore balls is evanescent and difficult to observe in most cases, but in *A. fusiformis* it is unusually persistent (Fig. 6). It need not, however, be a good species character as it was formerly observed on an isolate of *A. major* (Skou, 1972).

The size of the spore balls is usually a good character for differentiation between species but Figs 8 and 9 show that it is not always so. A close up of the ascospores, however, shows a clear difference in their shape (Figs 10 and 11). Further, SEM micrographs unveiled a pronounced difference of the internal structure of the vitreous inner membranes of the spore cysts of *A. naganensis* and *A. xerophila* (cf. Skou, 1988). A picture of spore balls and ascospores of the type species *A. apis* is inserted for comparison (Fig. 13).

Ascosphaera verrucosa was found only in nesting cells where the collected provision - mainly pollen - was left uneaten. The yellow pollen mixed with the lustrous raven-black spore cysts was a beautiful sight under the stereo microscope. The reason for the uneaten provision and the absence of egg or larva might be the presence of *A. verrucosa*. Analogous cases are not uncommon in connection with other bees, and neither in those cases were any decisive explanations found (Skou, 1986).

In all cases the ascospores are held together in the spore balls by a substance that hitherto is circumscribed as a mucous substance. The amounts of it are normally so minute that they are visible only in the SEM microscope. It was observed, however, under the examination of *A. verrucosa* that it was grains of such a substance that gave

the spores the warty appearence in the light microscope and that the substance is soluble in ethanol. Further, the SEM microscopy disclosed that the substance may lie as a more or less rough, crumbled layer on the inner side of the vitreous inner membrane of the spore cysts (Figs 5, 8 and 13). For these reasons, the substance may be regarded as wax-like rather than mucous or slimy, and it may in reality be such a substance which causes at least some of the structures on the inner membranes mentioned in the descriptions of the various species. Therefore this character must not be given too much taxonomical importance though it obviously differs from one species to another.

When *A. osmophila* was examined years ago we believed that its osmophilic growth requirements were an exception among the *Ascosphaera* species (Skou & King, 1984) but the present investigations of the Japanese species and tests of the other species have shown that osmophily may be the rule rather than the exception. On the other hand, the hyphae of some species may, *e.g. A. xerophila* and mycelia of undescribed species mentioned above, take up so much water that the cells explode even at rather high glucose concentrations in the media. It seems therefore more likely to be a question of reduced water activity in the media (cf. Brown, 1976) and hence of xerophily instead (Pitt & Christian, 1968; Pitt, 1975; Samson et al., 1984; and Skou, unpublished), though humidity might be of importance for the infectivity of *A. apis* and *A. proliperda* Skou (Gilliam, 1986, Youssef et al., 1985).

Very recently Dr. S. Udagawa drew the author's attention to Japanese works (Furuya et al., 1981; Furuya, 1982) that show optimal growth of *A. apis* on 10-20% and of *A. atra, A. major* and *A. proliperda* on 20-30% glucose. This is in close accordance with the author's unpublished observations.

A frequency of varying size of empty spore cysts may occur in any *Ascosphaera* species and in *Bettsia alvei* and probably also in undescribed *Bettsia* species so they grow only in the *Chrysosporium* state (see above; cf. Oorschot, 1980). An explanation cannot be given, but in species as *A. naganensis* and *A. xerophila* it may be a question of fulfilling nutritional or environmental requirements. In *A. xerophila* the development of spore cysts may stop already at the nutriocyte state. The reason for this might be a failure of fertilization due to a too high water activity. It may be mentioned in this connection that the molarity of about three in the medium which gave normal growth of *A. xerophila* is the same which gave optimal growth of *Sporendonema epizoum* (*i.e. Wallemia sebi*) (cf. Ormerod, 1967).

It is known that transfer of *Ascosphaera* species to fresh media easily results in sterile growth because only one of the sexes is carried along. It is especially easy if the transfer is made so early that the very delicate nutriocytes or young spore cysts are disturbed. It is further observed in the case of *A. celerrima* that very

fast growth also may increase the possibility of getting sterile growth.

The initial growth of *A. cinnamomea* is white but the whole fungal growth except the ascospores becomes cinnamon coloured towards the ripening of the spore cysts that are darker brown. At that time, the mycelium is rather rough with a pronounced tendency to collapse. It is unknown if the colour and the collapse have anything with each other to do but the mycelium is obviously not dead as it grows out on transfer.

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MORE DETAILS IN SUPPORT OF THE CLASS *ASCOSPHAEROMYCETES*

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SUMMARY

The investigations recognized additional characters to the uniqueness of the ontogenesis and physiology that support Barr's (1983) proposal to give *Ascosphaerales* class rank. The hyphae show pronounced dichotomous branching and have thick-walled, uniperforate, persistent septa. The inner part of the double-layered acellular spore cyst membrane shows unique internal structures that were different on species level. The unit membrane of the spore balls may be considerably persistent. The taxa seem confined to the bee family of *Hymenoptera* and is generally osmophilic or xerophilic.

INTRODUCTION

The *Plectomycetes* class of *Ascomycotina* is so broadly defined that a varying and generally increasing number of orders were included in the course of time though their ontogenesis may be different in several cases (cf. *e.g.* Luttrell, 1951; Malloch, 1979, 1981; Benny & Kimbrough, 1980; Hawksworth et al., 1983).

Hawksworth et al. (1983) reviewed proposed classifications of fungi and gave their own proposal which omit classes within *Ascomycotina* due to difficulties in determining which features should be used in the recognition of higher categories in this very large group of fungi. Consequently the *Plectomycetes* class disappeared.

It may be wise to stop at the level of orders in *Ascomycotina* for a while, but it can hardly remain there. In her presidental address to the Mycological Society of America, Margaret E. Barr (1983) presented a concept of *Ascomycotina* (*Ascomycota*) which might contribute toward bringing the classification of these fungi forward anew. In this concept, Barr (1983) proposed to give *Ascosphaerales* class rank and referred only to the papers of Skou (1972, 1982b). For years, the author has considered if it should stay without further argumentation. In the light of recent-

ly observed properties, the author decided to present a series of details that may support Barr's (1983) proposal.

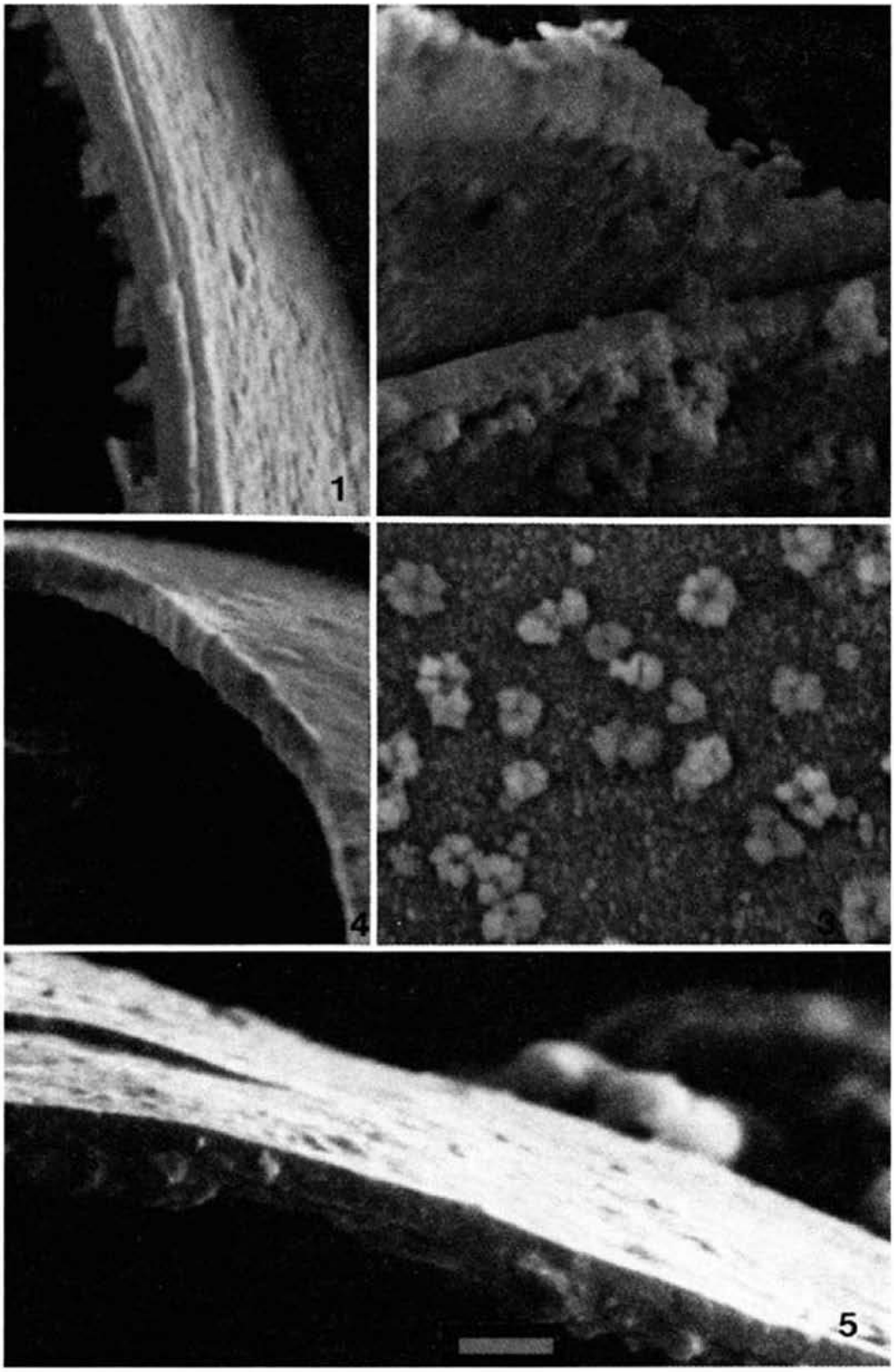
MYCELIA AND ASCOMATA

Hyphae, mycelia and growth habit vary with the species. The hyphae are thin in some species and very thick in others. Those of the aerial mycelia show distinct dichotomous branching (Skou, 1988) with little apical dominance (cf. Robertson, 1965). The dichotomous branching is infrequently inconspicuous when the mycelium has a tendency to vacuolate. The septa are thick-walled, uniperforate and unusually persistent after collapse of the mycelia, especially in *A. osmophila* Skou & King (1984) and *A. cinnamomea* Skou (1988). This phenomenon has also been observed by Kimbrough (1984). The mycelia are generally white, but become bright brown in *A. cinnamomea*. The mycelial habit is either tight and low or cottony in most cases.

The distinct difference between male and female mycelium (of which the latter form nutriocytes that become ascogonia after fertilization, inflate and end up as the spore cysts) have led to the term morphological heterothallism (Olive, 1958). This makes the ascomata ontogenetically fundamentally different from those of cleistothecial fungi, *i.e. Plectomycetes*. For this reason, the diagnosis of *Ascosphaerales* should not be broadened to include fungi with a different ontogeny (Skou, 1982a) as did Benny & Kimbrough (1980) and which has been adopted recently by Eriksson & Hawksworth (1986). The term spore cyst is explained by Skou (1982b). Homothallism has been demonstrated only for *A. atra* Skou & Hackett (1979).

The acellular, membranous spore cyst wall consists of two layers. The outer is gelatinous and usually colourless, and the inner vitreous, fragile and brown to black. SEM microscopy has unveiled new details of the internal structure of the inner membrane. The surface of fractures appears with at least four different shapes. (1) structureless in *A. apis* (Massen:Claussen) Olive & Spiltoir, *A. atra*, *A. asterophora* Skou (1982a), *A. verrucosa* Skou (1988) (Figs 1, 2, 4, 6, 7), and *A. osmophila* (Skou & King, 1984), (2) fibrous in *A. naganensis* Skou (1988) (Fig. 5), (3) transversly striated in *A. fusiformis* Skou, *A. celerrima* Skou, *A. cinnamomea*, and *A. parasitica* Skou (1988) (Figs 8-11), and (4) structureless double-layered - apparently tenoned together - in *A. xerophila* Skou (1988) (Fig. 12). The thickness of this membrane varies from about 0.3 µm in *A. fusiformis* to about 2.3 µm in *A. xerophila*.

Figures 1, 2, 4, and 5. Fractures of the inner spore cyst membrane of *Ascosphaera* species, 1: *A. apis*, 2: *A. atra*, 4: *A. asterophora*, 5: *A. naganensis*. Figures 2 and 3: Wax-like substance on the inner spore cyst membrane of *A. atra*. x 12,000, bar = 1 µm.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ASCI VERSUS SPORE BALLS

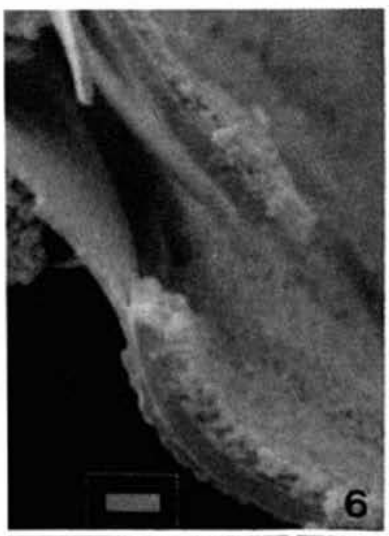
The comprehensive investigations of Varitchak (1933) and Spiltoir (1955) clearly revealed that these fungi belong to *Ascomycotina* but it has since been discussed as to which group of fungi they are related most closely. In this context, much attention has been drawn to evanescence of the asci. It is questionable, however, whether anyone has in reality seen a membrane (tunica) around the ascospores formed after the third nuclear division. Varitchak (1933) found none but said that in spite of this "les oeufs" were separated from the rest of the plasm and that they immediately were transformed to "agglomerations" of spores. Spiltoir (1955) found that the ascus wall either became exceedingly thin or was in the process of disintegration so the outline of the individual asci was soon lost. It may be on this basis that Gäumann (1964) connected *Ascosphaerales* with his subclass of "prototunicaten Ascomyceten" and others connected them with *Plectomycetes*, but in these fungi, the ascospores lie free in the ascomata after deliquescence of the ascus membrane (cf. *e.g.* Luttrell, 1951; Malloch, 1981). Kimbrough (1984) may have seen the membrane as he wrote that intrahyphal cells with compatible nuclei branch, cells disarticulate, and free-floating asci develop within the enlarging ascogonium.

The prototunicate asci of Gäumann (1964) may be regarded to be a fact as did Müller & Loeffler (1982) and Barr (1983) because it is difficult to imagine separation without a membrane but it is quite as difficult to imagine how free-lying, "undressed" ascospores (asci) in a considerable and relatively constant number for each species unite in spore balls within a unit membrane. If the prototunica is to be regarded a primary membrane, then the unit, limiting membrane of the spore balls should be regarded as secondary.

In *Bettsia alvei* (Betts) Skou (1972), the ascospores seem free as in *Plectomycetes* but detailed analyses of the early stages are not made. In *Ascosphaera*, the ascospores occur always in spore balls that are surrounded by an evanescent membrane which in some cases may be considerably persistent, *e.g* in *A. major* (Prökschl & Zobl) Skou (1972) and *A. fusiformis* (Skou, 1988) (Fig. 13). The ascospores in the spore balls of *A. asterophora* (Skou, 1982a) are arranged in one peripheral layer and radiate from an empty centrum. Also in *A. osmophila* (Skou & King, 1984) the spore balls seem hollow.

These characters may raise the question whether the spore balls could be many-spored asci formed by successive divisions from the early 8-spored stage.

Figures 6-12. Fractures of the inner spore cyst membrane of *Ascosphaera* species. 6 and 7: *A. verrucosa*, 8: *A. fusiformis*, 9: *A. celerrima*, 10: *A. cinnamomea*, 11: *A. parasitica*, 12: *A. xerophila*. Figure 6: x 6,000, bar = 1 µm. Figures 7-12: x 12,000, bar = 1 µm.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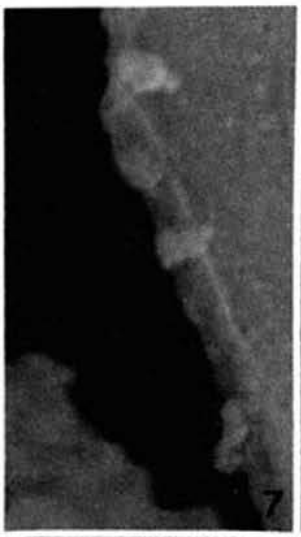
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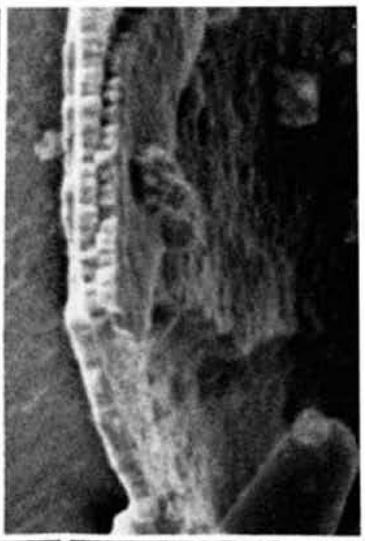

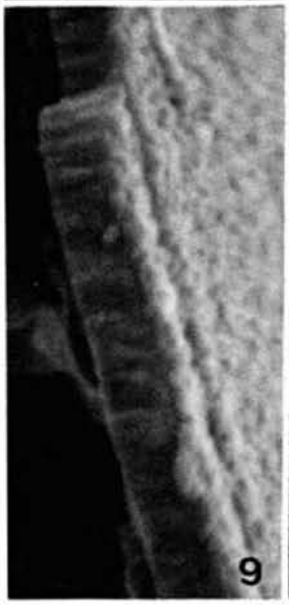
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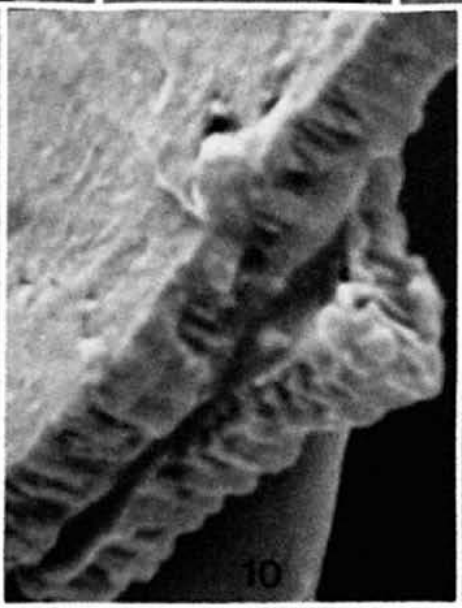
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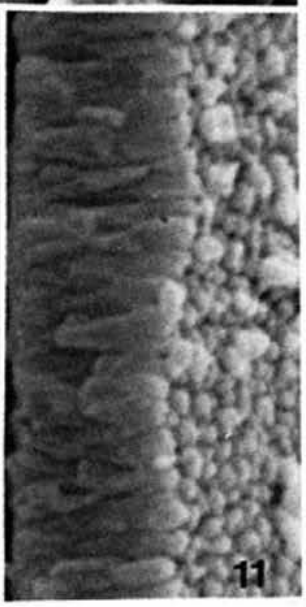
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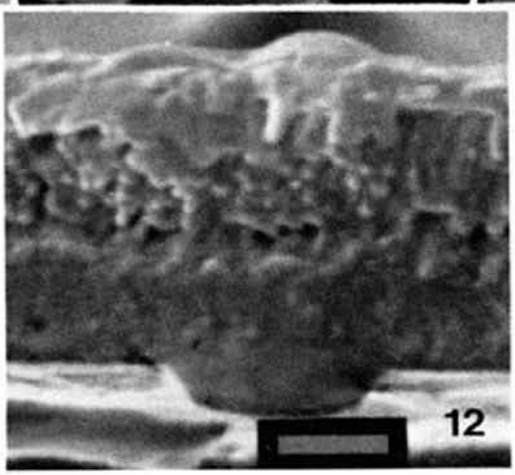
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The ascospores stick together more or less strongly by a substance which hitherto has been regarded as mucous or slimy, but as it may be soluble in absolute ethanol (Skou, 1988) it is more likely to be of a wax-like or lipidic nature. Besides more or less tightly covering the spores, the SEM microscopy showed that the substance occurs as crumbs both on the spores, *e.g.* on *A. verrucosa* (Skou, 1988), and on the inner side of the spore cyst membrane where it may contribute to the membrane structure when it is examined in translucent light. The size of the crumbs may vary from one species to another and be characteristically structured (Figs 2 and 3). This substance may contribute further to the spreading of these fungi as it may enhance the load of spores sticking to the fur of the bees (Vandenberg et al., 1980).

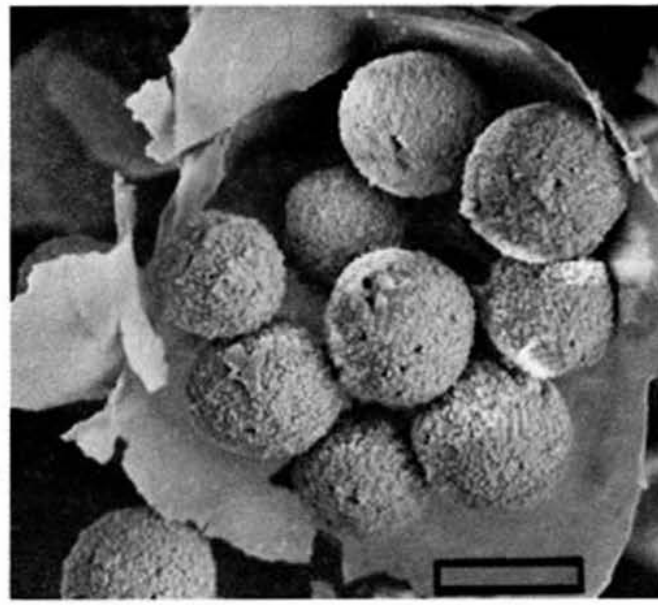

Figure 13. Broken spore cyst of *Ascosphaera fusiformis* with spore balls covered with the unit membrane. x 1,500, bar = 10 µm.

ASSOCIATION AND PHYSIOLOGY

The association of *Ascosphaerales* seems to be strictly confined to the bee family (*Apidae* in *Hymenoptera*). Only *A. atra* and *Chrysosporium farinicola* (Burnside) Skou were observed outside this habitat (Skou, 1986, 1988). Some of the species are pathogenic, especially *A. apis* and *A. proliperda* Skou (1972), that cause chalkbrood in honey bees and different solitary bees, respectively, and *A. aggregata* Skou (1975) which causes ragged brood (also named chalkbrood in U.S.A.) in several species of solitary bees (Skou, 1986). Others - perhaps the main part of the species - are saprophytes that thrive on the nectar and pollen collected by the bees.

Only little work has been done on the physiology of these fungi. It has not yet been possible to grow some of the species on artificial media. Several species may grow on the common fungal media but the fact is that the main part of them prefer up to 30-40% glucose in the medium - in some cases even up to 60% (w/v glucose monohydrate; the concentration of the media then equals 1.60 and 3.12 mol l^{-1} for 30% and 60% glucose, respectively) - and in addition dry air (Skou, 1988 and unpublished). This suggests *Ascosphaerales* to be osmophilic or xerophilic in general. This seems supported by Maghrabi & Kish (1985a, b) who grew the fungi in desiccators.

The protein and isoenzyme patterns were characterized by Maghrabi & Kish (1985a, b, 1986) for several of these fungi. Naturally, they found greater intraspecific similarities than interspecific ones. Most surprising was their finding that the pattern that appears when the mating types were grown together in *A. apis* and *A. asterophora*, respectively, differed clearly from the pattern when the mating types were grown separately.

It is an interesting idea to calculate the relative genetical distance between the species on the basis of such biochemical characters; however, they can hardly be used in the classical taxonomy according to the Code of Botanical Nomenclature. The value of these methods and results lies in their use in connection with for example infection experiments to ensure that the isolate recovered is the same as that used as inoculum.

The author wishes to thank Mr. J. Lindbo and Mr. J.B. Bilde-Sørensen for preparing specimens and for operating the SEM microscope.

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TYPE STUDIES AND NOMENCLATURAL CONSIDERATIONS IN THE GENUS SPARASSIS

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SUMMARY

Type specimens and authentic specimens of eight putative species of Sparassis were examined. Two species are recognized; S. crispa and S. spathulata. Synonymy is proposed.

INTRODUCTION

In a study of the cultural and morphological characters of Sparassis radicata Weir and related species, Martin and Gilbertson (1976) showed that the fungus known as S. radicata in North America was actually conspecific with S. crispa Wulf.: Fr., and what has long been known as S. crispa in eastern North America must be called by a

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[1]Maintained at Madison, WI, in cooperation with the University of Wisconsin.

different name. They carried their study no further with respect to species circumscriptions and nomenclatural considerations in the genus Sparassis.

More recently, Kreisel (1983) studied Sparassis specimens named S. laminosa, S. nemecii, and S. brevipes from Europe and concluded that they represent one species that should be called S. brevipes. However, no authentic or type specimens were cited as having been examined.

In this work, we have examined the 8 available type or authentic specimens of the 11 described species of Sparassis and Stereum caroliniense Cke. et Rav. in an attempt to resolve taxonomic and nomenclatural problems in the genus.

Type or authentic specimens of the following were studied: S. crispa, S. herbstii Peck, S. laminosa Fr., S. nemecii Pilát, S. radicata Weir, S. spathulata Schw.: Fr., S. tremelloides Berk., and S. simplex D. A. Reid and Stereum caroliniense. Neither type nor authentic specimens of Sparassis brevipes Krombh., S. foliacea St. Amans, and S. kazachstanicus Schwarzman were available for study.

MATERIALS AND METHODS

We examined specimens microscopically with a Ziess WL microscope as hand sections and/or as squash mounts in a drop of 2% KOH mixed with a drop of 1% aqueous phloxine, with Melzer's reagent (Ainsworth, 1971) to determine amyloidity or dextrinoidity (if no reaction, indicated as Melzer's -) and with lactophenol aniline blue (Ainsworth, 1971) to detect cyanophily. Herbarium abbreviations are taken from Holmgren and Keuken (1974).

NOTES ON TYPE SPECIMENS

Sparassis brevipes Krombh., Nat. Abbild. Besch. Schw., t. 22, fig. 4. 1834.

The type specimen is not extant according to information from PR.

We believe that the name S. brevipes should be considered a nomen dubium because only pictures and a description are available to serve as type. Until an appropriate type specimen of S. brevipes is found, the Krombholz concept cannot be known with certainty, but having concluded that S. spathulata is probably the oldest name for S. brevipes, more precise typification of S. brevipes is obviated.

Stereum caroliniense Cke. et Rav., J. Mycol. 1:130. 1885.
United States: No. 4104 (Holotype) sent to Ravenel by Dr. Thos. F. Wood of Wilmington, North Carolina, Aug. 1885 (K).
This specimen is conspecific with Sparassis spathulata.

Sparassis crispa Wulf.: Fr., Syst. Mycol. 1:464. 1821.
There is no Wulfen specimen available in UPS. Only one specimen of Fries' at UPS is labeled S. crispa. It was collected by Th. M. Fries in 1869, so it was not available to Fries when he sanctioned S. crispa. We are now attempting to decide on an appropriate specimen to serve as neotype. When those studies are complete, S. crispa will be neotypified.

In the interim, the Fries specimen will represent the present concept of S. crispa. It possesses small, pale to cream-colored and azonate, flabellae extending from the central core of the basidiocarp. Hyphae system monomitic. Tramal hyphae 4-15 µm diam, thin- to somewhat thick-walled, mostly clamped, with scattered broad refractive hyphae up to 15 µm diam; basidiospores broadly ellipsoid, sometimes flattened adaxially, thin-walled, hyaline, 5.5-6 µm diam, with a large central guttule.

Specimens examined: As S. crispa--Sweden: Uppsala, Kungsparken, 1869. Th. M. Fries (UPS). As S. radicata--Holotype, U.S.A.: Idaho; Priest River, Sept. 1916, on roots of Douglas-fir [Pseudotsuga menziesii], Weir 9822; Sept. 29, 1966, on P. menziesii, OKM 4817 (both CFMR) - Oregon; Detroit Nov. 1, 1909, on P. menziesii, FP 1758 (CFMR).

Many authors list basidiospore lengths of 5-7 µm or 6-7 µm. Our study of collections from North America, Europe, and Japan confirms a range of 5-6.5 µm, excluding the apiculus. We were unable to find longer spores. This is important because S. spathulata basidiospores are 6-8 (-9) µm long with a mean of 7 µm. It is possible, therefore, to separate the two species on spore length alone in poorly preserved specimens.

Excellent illustrations of S. crispa basidiocarps are found in Dähncke and Dähncke (1979) and Jahn (1979), and under S. radicata in Martin and Gilbertson (1976) and Miller (1972). However, only Martin and Gilbertson (1976) pictures the radicating base, characteristic of this species. It is not a characteristic feature of S. spathulata.

Sparassis foliacea St. Amans, Fl. Agen., p. 541, t. 11. 1821.

A type specimen for this name cannot be located.

Sparassis herbstii Peck, Bull. Torrey Bot. Club 22:207. 1895.

The type specimen (NYS) agrees well with the neotype specimen of S. spathulata (PH).

Specimen examined: U.S.A.: Pennsylvania, Trexlertown, Wm. Herbst, no number or date (Holotype, NYS).

Sparassis kazachstanicus Schwarzman, Flora Spor. rast. Kaz. 4:154. 1964.

The type specimen of S. kazachstanicus was not made available for study, and we have not been able to interpret the description to represent one of the two species recognized in this work. Its true identity must await examination of the type. The same situation exists with the genus Sparassiella Schwarzman and its type S. longistipitata Schwarzman, which appears similar to Sparassis spp.

Sparassis laminosa Fr., Antechn. Sverige Atl. Svamp, ed. I, p. 57. 1836.

The specimens cited have both the macro- and micromorphology of S. spathulata. To date, we know of no specimen that could be used as neotype. However, the Polish specimen is probably a good representative of the Friesian concept. It is in good condition and was determined by Fries.

Specimens examined: Czechoslovakia: Moravia, ad terram apud Fagus et Abies, 51870, 13 VIII 59 (PR); ad basim Abietis, 611164, 3 VIII 63 (PR); Hradec prope Opava, ad radicis trunci emortui Abietis albae, 710448, 5 IX 1969 (PR). All annotated as S. nemecii by Pouzar. Poland: Silesia, Kretschmar, no number, no date (UPS).

Sparassis nemecii Pilát et Vesely, Ann. Mycol. 31:56. 1933.

The type and several specimens examined under this name possess the large thick, zonate flabellae typical of S. spathulata. Micromorphology is also that of S. spathulata. In addition, the junior author observed the species fruiting in Czechoslovakia and noted it to be identical to S. spathulata in the United States.

Specimens examined: Czechoslovakia: sub Fago, Jánskí Lázné, Montes Corcontici, 1932-X, 168606 (Holotype, PR). See also specimens cited under S. laminosa.

Sparassis radicata Weir, Phytopathology 7:166. 1917.

As indicated by Martin and Gilbertson (1976) in their description of the type specimen, it is conspecific with S. crispa. Their Arizona isolates of S. radicata were genetically compatible with European isolates of S. crispa. We agree with Gilbertson (1981) that S. radicata is a synonym of S. crispa.

Specimens examined: United States: Idaho, Priest River, on roots of Douglas-fir [Pseudotsuga menziesii (Mirb.) Franco], Weir 9822 (Holotype, CFMR). See S. crispa, also.

Sparassis simplex Reid, Trans. Brit. Mycol. Soc. 41:439. 1958.

This species is based on a poorly developed specimen with only a single flabelliform basidiocarp. The macro- and micromorphology agree with those of S. spathulata. The junior author has observed this type of fruiting of S. spathulata in the southeastern United States. We consider S. simplex to be a synonym of S. spathulata.

Specimen examined: England: Box Hill, Surrey, on Pinus debris under Calluna, P.K.C. Austwick, no number, 2. Oct. 1955 (Holotype, K).

Sparassis spathulata Schw.: Fr., Elench. Fung., p. 227. 1828. ≡ Merisma spathulatum Schw., Schr. Nat. Ges. Leipzig 1:110. 1822.

The neotype specimen possesses flabellae up to 2 cm broad, concentrically zonate, varying from pale yellow to light brown, and brittle on drying.

Hyphal system monomitic; context hyphae of two types: 1). (1)4-10(-12) µm diam, hyaline, smooth, simple septate with walls up to 2.5 µm thick; and 2). (2-)6-15(-20) µm diam, thin-walled to firm-walled, smooth, simple septate, with refractive contents staining strongly in phloxine and Melzer's reagent; subhymenium hyphae thin-walled, hyaline, smooth, compact, agglutinated, nodose-septate or simple-septate; hymenium poorly preserved; cystidia not evident; basidia not found; basidiospores ellipsoid to somewhat adaxially flattened, 6-7.5(-9) x 4-5.5 µm, hyaline, thin-walled, smooth, Melzer's -, acyanophilous.

Specimens examined: As S. spathulata: United States: Pennsylvania, no location, no date, Schweinitz s.n. (K); Maryland, FP 103936, on Pinus virginiana Mill., Laurel (CFMR); North Carolina, Salem, L. v. S [chweinitz] (PH) (neotype, here designated); Salem-Beth[lehem] [PA], 1005-2 Syn. Fung., Epic. 3 (PH); South Carolina, M. A. Curtis, herb. E. Fries (UPS); ad terram, autumno, legit Ravenel, herb. E. Fries (UPS): as Stereum caroliniense, holotype (K): as Sparassis crispa: Maryland, Laurel, on Pinus, JL 240, and under Quercus, JL 221; Beltsville, FP 103936 (CFMR); South Carolina, Patrick, on Pinus, FP 105840 (CFMR): as Sparassis herbstii, holotype (NYS): as Sparassis laminosa: Poland, Silesia (UPS); Czechoslovakia, 51870 (PR); 611164 (PR); 710448 (PR): as Sparassis nemecii holotype (PR): as Sparassis simplex holotype (K).

The specimens cited agree well with the proposed neotype. Miller (1972) illustrated S. spathulata as S. crispa. Jahn (1979) also illustrated S. spathulata (called S. laminosa) in Europe. The macroscopic characteristics agree well with S. spathulata observed by the junior author in Europe.

Sparassis tremelloides Berk., Grevillea 2:6. 1873.

The specimen examined possesses longitudinally septate basidia and appears to be an immature specimen of Tremella reticulata (Berk.) Farlow. No basidiospores were found. Information on the packet agrees with that in the original description. Therefore, this specimen is being designated neotype.

Specimen examined: South Carolina, M. A. Curtis 1380. Neotype, ex K, isotype in FH.

CONCLUSION

This study revealed two species of Sparassis in North America and Europe; S. crispa and S. spathulata. The organism which has been commonly called Sparassis crispa in North America should be called S. spathulata. All the other Sparassis epithets that we recognize and Stereum caroliniense can be placed in synonymy with either S. crispa or S. spathulata. Our conclusions regarding the synonymy of S. spathulata are based entirely on morphological considerations. In Europe, the names S. nemecii and S. laminosa, ones we believe are synonyms of S. spathulata, are deeply rooted and will probably continue to be used. Confrontations of single spore isolates from specimens representing these concepts with those from specimens of S. spathulata are needed to support or refute our interpretation of the morphological data.

Until it is thus refuted, we believe the synonymy for Sparassis species is as follows:

Sparassis crispa	Sparassis spathulata
= Sparassis radicata	= Stereum caroliniense
	= Sparassis herbstii
	= Sparassis laminosa
	= Sparassis nemecii
	= Sparassis simplex

S. brevipes, S. foliacea, and Elvella ramosa Schaeffer, the earliest name that probably applies to S. crispa, can only be interpreted from descriptions. For reasons of priority or devalidation in Fries sanctioning work (1821), none of these names is a competing epithet.

ACKNOWLEDGMENTS

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CODING OF STRAIN FEATURES FOR COMPUTER-AIDED IDENTIFICATION OF YEASTS

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ABSTRACT

The RKC system of coding microbiological data for computers has been extended to include features specifically to aid in coding data for identification of yeasts. By combining the features listed here with those of the more general coding system (7), a set of strain descriptors including inventory and history, can be generated for overall storage and retrieval of yeast strain data.

BACKGROUND AND DISCUSSION

The yeasts are a diverse group of eukaryotic microorganisms. There are about 60 genera and 500 species now recognized (1). To identify a particular strain of yeast to the species level, morphological and growth characteristics are important as are tolerance to inhibitory substances, requirements for certain growth factors, and the ability of the organism to ferment or utilize various carbon and nitrogen sources. These plus other available phenotypic characters can mean that at least 50 observations of phenotypic behavior may be necessary to be certain of the species identity of a given yeast strain.

Morphological and physiological characteristics of currently recognized species of yeast are described in Kreger-van Rij (1). Barnett et al. (2) also provide lists of groups of yeasts and charts of their physiological reactions. The reference works often eliminate the need for searching the open literature to make comparisons of results and observations with an unknown strain. These references (1, 2) provide the basis for the features listed here for use in identifying yeasts. However, manual searching of even these works for matching phenotypes can prove laborious. Computer-aided identification can improve the efficiency and accuracy of identification. The list of characteristics presented herein is designed for such use.

The RKC Coding System has been developed with cooperation from many individuals, government research and regulatory laboratories, international committees and working groups, and special research projects and is maintained by the Microbial Systematics Section, National Institute of Dental Research, National Institutes of Health, Bethesda, MD 20892 USA. Originally, characteristics for bacterial strains only were included (3), but in 1980, protozoan descriptions were added (4). Descriptive items for selected groups of medically important fungi were also added (5). The range of coding possibilities was further broadened to include algal descriptive items in 1983 using a 1977 publication (6). The expanded and revised RKC Coding System has been recently published in book form under the auspices of the Committee on Data for Science and Technology (CODATA) (7).

Since many bacterial and yeast characteristics overlap, many of the original features from the bacteria were used for this yeast coding set. However, because of the unique applications to yeast biology, several new features had to be added and assigned new numbers.

In the RKC coding system, the descriptors are grouped in sections such as Individual Cell Morphology (section 3), Individual Vegetative Cell Size (section 4), Branching, Hyphae and Production of Asexual and Sexual Spores (section 8), Mode of Cell Division (section 14), Vegetative Cell Temperature (section 17), Metabolic Reactions (section 24), and Carbohydrate Metabolism (section 25). Some of the features listed in one group may be cross-listed under another heading. For example, the statement "The organism is heterothallic." is in section 8 under Production of Sexual Spores and in section 14 under Mode of Cell Division (albeit with the same code number).

A characteristic can be judged positive (1), negative (0), or no information (blank). If the organism has, for example, pleomorphic cells and some of the cells are oval and others are apiculate then all three descriptors: 003023-pleomorphic cells are characteristic, 003146-cells are ovate (egg-shaped), and 003028-cells are apiculate, are scored as positive. If a descriptor is not found in the Code list, then one can be added by assigning it a temporary number between 98,000 and 99,999.

With reference to the yeasts, there are several descriptive terms that, mycologically, all mean the same thing. In particular, the terms spore and conidia both refer to a propagative unit produced by a fungus. In this set of descriptors, the term conidia is used to describe how or where it is produced. Blastospores, arthrospores, and ascospores are produced blastically, arthrically, and in an ascus, respectively.

A computer managed set of data coded by use of descriptors such as those described in this communication could enable the investigator to enter the data on the new strain and use the computer to aid in the identification process by use of keys, matrices, or probability calculations. Even when computer analysis does not give a definitive identification, the results reduce the number of species that have to be considered and will optionally suggest additional tests that can be performed to improve the identification. If more than one organism is suggested, research into specific literature on those particular ones can be done. This has proven to be less time consuming and more accurate than doing the whole process manually.

Information on various yeast strains, like the bacteria, can be numerous and matching an unknown yeast to a known one may prove to be difficult and time consuming. There are many morphological and physiological observations to be compared. Like most other technologies, this information can be computerized, alleviating time and accuracy problems. Using the RKC Coding System developed initially for bacteria, data on yeasts have been added for storage, retrieval, and analysis.

INDIVIDUAL CELL MORPHOLOGY

003001: Cells are spherical (all perpendicular axes have ratios between 6:5 and 1:1).
003004: Cells are elliptic (ellipsoidal).
003007: Cells are triangular.
003027: Cells are ogival.
003028: Cells are apiculate.
003156: Cells are lunate (arcuate, bow-shaped, crescent-shaped).
003146: Cells are ovate (egg-shaped).
003180: Cells are oblong.
003008: Cells are rod-shaped (cylindrical).
003183: Cells are cylindrical giant cells.
003005: Cells are pyriform (pear-shaped).
003181: Cells are tetrahedral.
003182: Cells are rhombohedral.
003023: Pleomorphic cells are characteristic.

INDIVIDUAL VEGETATIVE CELL SIZE

004003: Longest axis of each cell is 1.1 - 2.0 µm.
004004: Longest axis of each cell is 2.1 - 3.0 µm.
004005: Longest axis of each cell is 3.1 - 4.0 µm.
004006: Longest axis of each cell is 4.1 - 5.0 µm.
004007: Longest axis of each cell is 5.1 - 10 µm.
004008: Longest axis of each cell is 11 - 15 µm.
004009: Longest axis of each cell is 16 - 100 µm.
004013: Shortest axis of each cell is 1.1 - 2.0 µm.
004014: Shortest axis of each cell is 2.1 - 3.0 µm.
004015: Shortest axis of each cell is 3.1 - 4.0 µm.

004016: Shortest axis of each cell is 4.1 - 5.0 µm.
004017: Shortest axis of each cell is 5.1 - 10 µm.
004018: Shortest axis of each cell is 11 - 15 µm.
004019: Shortest axis of each cell is 16 - 100 µm.

INTRACELLULAR AND EXTRACELLULAR DEPOSITIONS

005009: Cell contains lipid globules.
005024: The number of isoprene units in the side chain of coenzyme Q (ubiquinone) is 6.
005025: The number of isoprene units in the side chain of coenzyme Q (ubiquinone) is 7.
005026: The number of isoprene units in the side chain of coenzyme Q (ubiquinone) is 8.
005027: The number of isoprene units in the side chain of coenzyme Q (ubiquinone) is 9.
005028: The number of isoprene units in the side chain of coenzyme Q (ubiquinone) is 10.

MISCELLANEOUS SPORES, CONIDIA, AND HYPHAE

008662: True mycelium is produced.
008663: Pseudomycelium is produced.
008342: Hyphae are septate.
008344: Hyphae are nodose-septate (clamp connections present).
008345: Clamp connections are single.
008346: Clamp connections are multiple.
008667: Septa have plasmodesmata.
008668: Septa have single micropores.
008669: Septate hyphae have dolipores.
008670: Dolipore has a primitive cap.
008671: Dolipore has a vesicular cap.
008672: Dolipore has a tapped edge.
008673: Dolipore has a well developed cap.
008753: Dolipore is plugged.
008674: Hyphae are dikaryotic.
008675: Hyphae are monokaryotic.
006001: Endospores are produced (any refractile intracellular body capable of germination into a new vegetative cell).
008020: Fragmentation results in exogenous arthrospores.
008030: Conidia are produced.
008521: Conidia are cylindrical (sausage-shaped).
008522: Conidia are clavate.
008523: Conidia are oval.
008676: Conidia are needle-shaped.
008442: Conidiophores are produced.
008677: Conidia are formed on conidiophores in sympodulae.
008678: Conidia are terminal.
008383: Conidial surface is smooth.
008363: Chlamydospores are present.
008398: Ballistospores are produced.
008679: Ballistospores are asymmetrical.
008456: Blastospores are produced.
008680: Blastospores have long filamentous appendages.

008681: Blastese-like structures are formed.
008617: Sexual reproduction occurs.
008618: Organism is homothallic (male and female on same mycelium).
008619: Organism is heterothallic (male and female on separate mycelia exhibit interfertility).
008634: Asci are produced.
008682: Ascus is the mother cell.
008683: Asci are formed by mother-daughter cell conjugation.
008684: Asci are formed by conjugation of two cells.
008685: Asci are formed by conjugation of two hyphae.
008686: Asci are formed directly by diploid cells.
008687: Asci are formed exclusively on the hyphae.
008688: Asci develop from swollen hyphal cells.
008689: Asci are formed on diploid hyphae.
008690: Asci are sac-like protrusions transformed from vegetative cells.
008691: Asci have small vegetative apical cells attached.
008692: Asci have abortive conjugation tubes.
008693: Asci occur on ascophores.
008694: Asci occur in chains.
008695: Asci occur in brush-like arrangements.
008755: Asci are in groups at ends of hyphae.
008756: Asci are in groups at septa.
008636: Asci are round (spherical, globose).
008754: Asci are oval.
008696: Asci are banana-shaped.
008697: Asci are elongated.
008698: Asci are cylindrical.
008699: Asci are spindle-shaped.
008700: Asci are clavate.
008701: Asci are sphaeropedunculate.
008702: Asci are ellipsoidopedunulate.
008703: Asci are dehiscent (evanescent).
008704: Asci are persistent.
008705: Ascospores are produced.
008706: One ascospore is produced.
008707: Two ascospores are produced.
008708: Three ascospores are produced.
008640: Four ascospores are produced.
008709: Five ascospores are produced.
008710: Six ascospores are produced.
008711: Seven ascospores are produced.
008641: Eight ascospores are produced.
008712: More than eight ascospores are produced.
008638: Ascospores are oval.
008639: Ascospores are round.
008713: Ascospores are fusiform.
008714: Ascospores are helical.
008715: Ascospores are hat-shaped.
008716: Ascospores are spherical with tangential rims (saturn-shaped).
008717: Ascospores are hemispherical.
008718: Ascospores are crescentiform.
008719: Ascospores are reniform.

008720: Ascospores are oblong with obtuse ends.
008721: Ascospores are prolate spherical.
008722: Ascospores are prolate ellipsoidal.
008723: Ascospores are needle-shaped.
008724: Ascospores are attenuated at both ends.
008725: Ascospores are clavate.
008726: Ascospores have smooth walls.
008727: Ascospores have warty walls.
008728: Ascospores have spiny surfaces.
008729: Ascospores are rugose.
008730: Ascospores are hyaline.
008731: Ascospores are brown.
008732: Ascospore is thickened at both poles and gives the appearance of appendages.
008733: Ascospores have whip-like appendages.
008734: Ascospores have ridges that run over the poles.
008735: Ascospores contain lipid or oil globules.
008736: Ascospores are liberated (at maturity or otherwise).
008737: Ascospores tend to agglutinate when liberated.
008738: Basidia are formed.
008739: Basidia are formed in synnemata.
008740: Basidia are formed on loose hyphae.
008741: Basidiocarps (fruiting bodies) are formed.
007073: Basidiospores are present.
008742: Basidiospores are produced in chains.
008743: Basidiospores are smooth.
008744: Basidiospores are rough.
008656: Probasidium is formed.
008657: Probasidium is septate.
008658: Sporidia are formed.
008659: Sporidia are lateral.
008660: Sporidia are terminal.
008655: Teliospores are formed.
008745: Teliospores are highly angular.
008746: Teliospores are spherical.
008747: Teliospores are cleft.
008748: Teliospores are dioboate.
008749: Teliospores are diclavate.
008750: Teliospores do not germinate.
008751: Germ tubes are formed.
011001: Capsule is present.

MODE OF CELL DIVISION

014003: Cells reproduce by budding directly from mother cell.
014004: Daughter cells bud on tubular outgrowths from mother cells.
014012: One or more daughter cells can form at one pole or both poles of the cell.
014018: Conjugation occurs.
014037: Cell has mating type.
014050: Cells undergo fission.
014051: Multilateral budding is present.

014052: Organism has a unifactorial incompatibility mating system.
014053: Organism has a bifactorial mating system.
014054: Organism has a biallelic mating control system.
014055: Organism has a multiple mating control system.

ARRANGEMENT

015001: Cells occur singly.
015002: Cells occur in pairs.
015004: Cells occur in chains.
015005: Cells are arranged in irregular aggregates.
015007: Cells are arranged in cubical packets (three-dimensional).

COLONY CHARACTERISTICS ON SOLID MEDIA

016008: Agar macrocolony margin is entire.
016009: Agar macrocolony margin is erose.
016010: Agar macrocolony margin is filamentous (rhizoid).
016011: Agar macrocolony margin is irregular.
016362: Agar macrocolony margin is undulate.
016361: Agar macrocolony margin is lobate.
016189: Agar macrocolony is convex.
016017: Agar macrocolony is raised but not convex.
016022: Colony consistency is butyrous (soft, buttery).
016023: Colony consistency is viscid (mucoid).
016027: Colony surface is glistening.
016028: Colony surface is dull (matte).
016029: Colony surface is powdery, dry.
016030: Colony surface is smooth.
016031: Colony surface is rough.
016491: Colony surface is wrinkled.

PIGMENTS AND ODORS

020001: Colonies are pure (paper) white on solid medium.
020002: Colonies are gray on solid medium.
020108: Colonies are cream colored.
020008: Pigments are produced only in the light (photochromogenicity).
020038: Nondiffusible red pigments are produced.
020043: Nondiffusible golden (yellow) pigments are produced.
020021: Diffusible yellow pigments are produced.
020045: Cells contain carotenoid pigments.
020107: Pulcherrimin (noncarotenoid, Bordeaux-red pigment) is produced.
020062: Detectable odor is present.
020063: Detected odor is fragrant (e.g., fruity, wintergreen).
020064: Detected odor is musty.
020079: Detected odor is putrefactive.
020106: Detected odor is alcoholic (e.g., ethanol).

GROWTH CHARACTERISTICS IN LIQUID MEDIA

016041: Cells form an easily dispersible sediment in liquid culture.
016043: Floccular growth occurs in liquid culture.
016044: Ring growth on the wall of the tube occurs in liquid culture.
016045: Culture grows on walls of container without clouding the medium.

pH LIMITS OF GROWTH

016057: Growth takes place at an initial pH of 4.0.
016172: Growth takes place at an initial pH of 4.5.
016375: Growth takes place at an initial pH of 4.8.
016056: Growth takes place at an initial pH of 5.0.
016193: Growth takes place at an initial pH of 5.5.
016288: Growth takes place at an initial pH of 5.7.
016055: Growth takes place at an initial pH of 6.0.
016376: Growth takes place at an initial pH of 6.5.
016054: Growth takes place at an initial pH of 7.0.
016377: Growth takes place at an initial pH of 7.5.
016352: Growth takes place at an initial pH of 8.5.
016053: Growth takes place at an initial pH of 9.0.
016165: Growth takes place at an initial pH of 9.6.

VEGETATIVE CELL TEMPERATURE RELATIONSHIPS

017012: Growth occurs at 10 C.
017013: Growth occurs at 15 C.
017037: Growth occurs at 20 C.
017070: Growth occurs at 24 C.
017014: Growth occurs at 25 C.
017071: Growth occurs at 26 C.
017033: Growth occurs at 30 C.
017015: Growth occurs at 37 C.
017017: Growth occurs at 45 C.

CULTURAL CONDITIONS, INHIBITORS, NUTRITION, GROWTH, LIFE CYCLES

016059: Growth occurs from loop inoculum spread on surface of solid media incubated in air.
016485: Added gaseous carbon dioxide is required for growth.
016489: Growth occurs in media overlaid with corn or olive oil.
016212: At least one vitamin (growth factor) is required for growth.
029057: P-Aminobenzoic acid is required for growth.
016107: Biotin is required for growth.
016108: Folic acid is required for growth.
016110: Niacin (nicotinic acid) is required for growth.
016111: Pantothenic acid is required for growth.
016112: Pyridoxal or pyridoxamine is required for growth.

016114: Thiamine is required for growth.
016484: Meso-inositol is required for growth.
018028: Added NaCl is required for growth.
018026: Growth occurs in the presence of 0.1% NaCl (1 ppt).
018003: Growth occurs in the presence of 0.5% NaCl (5 ppt).
018024: Growth occurs in the presence of 1% NaCl (10 ppt).
018025: Growth occurs in the presence of 1.5% NaCl (15 ppt).
018019: Growth occurs in the presence of 2% NaCl (20 ppt).
018004: Growth occurs in the presence of 3% NaCl (30 ppt).
018005: Growth occurs in the presence of 4% NaCl (40 ppt).
018006: Growth occurs in the presence of 5% NaCl (50 ppt).
018021: Growth occurs in the presence of 6% NaCl (60 ppt).
018020: Growth occurs in the presence of 6.5% NaCl (65 ppt).
018007: Growth occurs in the presence of 7% NaCl (70 ppt).
018022: Growth occurs in the presence of 7.5% NaCl (75 ppt).
018023: Growth occurs in the presence of 8% NaCl (80 ppt).
018008: Growth occurs in the presence of 10% NaCl (100 ppt).
018009: Growth occurs in the presence of 15% NaCl (150 ppt).
018010: Growth occurs in the presence of 20% NaCl (200 ppt).
018011: Growth occurs in the presence of 25% NaCl (250 ppt).
018027: Growth occurs in the presence of 32% NaCl (320 ppt).
018032: Growth occurs in the presence of 50% glucose.
018034: Growth occurs in the presence of 60% glucose.
016486: Organism grows in media containing 1% acetic acid.
016487: Growth occurs on canavanine glycine bromthymol blue (CGB) agar.
016488: Canavanine glycine bromthymol blue agar (CGB) turns blue in 2 to 5 d.
016137: Ammonium salts can serve as the sole source of nitrogen for growth.
016138: Nitrate can serve as the sole source of nitrogen for growth.
016139: Nitrite can serve as the sole source of nitrogen for growth.
030141: Cadaverine can be used as the sole source of nitrogen.
030508: Imidazole (1,3-diaza-2,4-cyclopentadiene) can be used as the sole source of nitrogen.
033006: Strains may be successfully lyophilized.

METABOLIC REACTIONS

024009: Gelatin is hydrolyzed (liquefied).
025367: Arbutin is hydrolyzed.
034143: Urease (3.5.1.5) is produced.
024016: Acetic acid is produced from D-glucose.
024190: Tetrazolium dyes are reduced.
024252: Extracellular starch-like materials are produced.

024353: Acetic acid is produced from complex basal medium.
024463: Diazonium Blue B (DBB) dye turns red when applied directly to agar or broth medium.

CARBOHYDRATE METABOLISM - ACID PRODUCTION

025194: Acid is produced from D-galactose.
025195: Acid is produced from D-glucose.
025207: Acid is produced from α-methyl-D-glucoside.
025211: Acid is produced from cellobiose.
025212: Acid is produced from lactose.
025213: Acid is produced from maltose.
025214: Acid is produced from melibiose.
025215: Acid is produced from sucrose.
025216: Acid is produced from trehalose.
025217: Acid is produced from D-melezitose.
025218: Acid is produced from raffinose.
025225: Acid is produced from inulin.
025226: Acid is produced from starch.

CARBOHYDRATE METABOLISM - GAS PRODUCTION

025252: Gas is produced from D-galactose.
025253: Gas is produced from D-glucose.
025265: Gas is produced from α-methyl-D-glucoside.
025269: Gas is produced from cellobiose.
025270: Gas is produced from lactose.
025271: Gas is produced from maltose.
025272: Gas is produced from melibiose.
025273: Gas is produced from sucrose.
025274: Gas is produced from trehalose.
025275: Gas is produced from D-melezitose.
025276: Gas is produced from raffinose.
025283: Gas is produced from inulin.
025284: Gas is produced from starch.

CARBOHYDRATES AS SOLE SOURCE OF CARBON

025296: D-Arabinose can be used as the sole source of carbon.
025297: L-Arabinose can be used as the sole source of carbon.
025300: D-Ribose can be used as the sole source of carbon.
025302: D-Xylose can be used as the sole source of carbon.
025307: L-Rhamnose can be used as the sole source of carbon.
025310: D-Galactose can be used as the sole source of carbon.
025311: D-Glucose can be used as the sole source of carbon.
025313: L-Sorbose can be used as the sole source of carbon.
025323: α-methyl-D-glucoside can be used as the sole source of carbon.
025326: Salicin can be used as the sole source of carbon.
025327: Cellobiose can be used as the sole source of carbon.
025328: Lactose can be used as the sole source of carbon.

025329: Maltose can be used as the sole source of carbon.
025330: Melibiose can be used as the sole source of carbon.
025331: Sucrose can be used as the sole source of carbon.
025332: Trehalose can be used as the sole source of carbon.
025333: D-Melezitose can be used as the sole source of carbon.
025334: Raffinose can be used as the sole source of carbon.
025341: Inulin can be used as the sole source of carbon.
025342: Starch can be used as the sole source of carbon.

ALCOHOLS AS SOLE SOURCE OF CARBON

026515: Ethanol can be used as the sole source of carbon.
026518: Methanol can be used as the sole source of carbon.
026555: 1,2,3-Propanetriol (glycerol) can be used as the sole source of carbon.
026556: Erythritol can be used as the sole source of carbon.
026559: Adonitol can be used as the sole source of carbon.
026563: L-Arabitol can be used as the sole source of carbon.
026565: Meso-xylitol can be used as the sole source of carbon.
026567: Dulcitol can be used as the sole source of carbon.
026575: D-Mannitol can be used as the sole source of carbon.
026578: D-Sorbitol can be used as the sole source of carbon.
026589: Meso-inositol can be used as the sole source of carbon.

ACIDS AND AMINO ACIDS AS SOLE SOURCE OF CARBON

028134: Succinic acid can be used as the sole source of carbon.
028164: DL-Lactic acid can be used as the sole source of carbon.
028173: Citric acid can be used as the sole source of carbon.
028175: 2-Ketogluconic acid can be used as the sole source of carbon.
028208: D-Gluconic acid can be used as the sole source of carbon.
028209: Glucuronic acid can be used as the sole source of carbon.
028699: 5-Ketogluconic acid can be used as the sole source of carbon.
029115: L-Arginine can be used as the sole source of carbon.
029126: Glycine can be used as the sole source of carbon.
029143: L-Proline can be used as the sole source of carbon.
029153: L-Valine can be used as the sole source of carbon.
030102: Glucosamine can be used as the sole source of carbon.

AMINO ACIDS AND AMINES AS SOLE SOURCE OF NITROGEN

029188: L-Lysine can be used as the sole source of nitrogen.
029172: Creatine can be used as the sole source of nitrogen.
029641: Creatinine can be used as the sole source of nitrogen.
030142: Ethylamine can be used as the sole source of nitrogen.

NUCLEUS

037090: Cells are diploid (2N or twice the basic (haploid) number set of chromosomes).
037091: Cells are haploid (N or single basic set of chromosomes).
037104: Cells are triploid.
037105: Cells are tetraploid.
037106: Cells are hexaploid.
037107: Cells are polyploid.

CYCLOHEXIMIDE (ACTIDIONE) SUSCEPTIBILITY

040389: Organism is susceptible to cycloheximide (Actidione) concentration in medium of 0.01 µg/ml.
040390: Organism exhibits intermediate resistance to cycloheximide (Actidione) concentration in medium of 0.01 µg/ml.
040391: Organism is susceptible to cycloheximide (Actidione) concentration in medium of 0.05 µg/ml.
040392: Organism exhibits intermediate resistance to cycloheximide (Actidione) concentration in medium of 0.05 µg/ml.
040393: Organism is susceptible to cycloheximide (Actidione) concentration in medium of 0.1 µg/ml.
040394: Organism exhibits intermediate resistance to cycloheximide (Actidione) concentration in medium of 0.1 µg/ml.
040395: Organism is susceptible to cycloheximide (Actidione) concentration in medium of 1 µg/ml.
040396: Organism exhibits intermediate resistance to cycloheximide (Actidione) concentration in medium of 1 µg/ml.
040399: Organism is susceptible to cycloheximide (Actidione) concentration in medium of 25 µg/ml.
040400: Organism exhibits intermediate resistance to cycloheximide (Actidione) concentration in medium of 25 µg/ml.
040401: Organism is susceptible to cycloheximide (Actidione) concentration in medium of 100 µg/ml.
040402: Organism exhibits intermediate resistance to cycloheximide (Actidione) concentration in medium of 100 µg/ml.

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PHYTOCONIS, THE CORRECT GENERIC NAME FOR THE BASIDIOLICHEN BOTRYDINA

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ABSTRACT

Application of recent changes in the International Code of Botanical Nomenclature necessitates the substitution of the generic name *Phytoconis* for *Botrydina*, and of the specific epithet *ericetorum* for *botryoides*.

INTRODUCTION

The systematics of a small group of lichenized basidiomycetes formerly placed in *Omphalina* was discussed at length by us (Redhead & Kuyper 1987). Guided by strict interpretation of the 1983 edition of the International Code of Botanical Nomenclature (ICBN) adopted at Sidney, a large number of difficult nomenclatural problems were resolved. Subsequent to the publication of our article, new changes which affect these names were made to the ICBN at the XIV International Botanical Congress, June 1987, in Berlin. At this congress, article 63.1 (ICBN) was modified to state unequivocally that lectotypification is not retroactive (Art. 63 proposal B, Greuter and McNeill, 1987). One result is the generic name *Phytoconis* Bory de St. Vincent (1797) is not automatically typified by the later designated lectotype of *Byssus* L. as we suggested. We must now accept the lectotypification of *Phytoconis* with *Byssus botryoides* L. by Drouet and Daily (1956). It follows that *Botrydina* Brébisson (1839), also typified by *B. botryoides* is superfluous. The generic name *Botrydina* has been linked to literature on lichenized agarics for over 20 years. However its adoption for a distinct genus of agarics is new. Hence, rather than conserve *Botrydina* we propose adoption of the name *Phytoconis*.

A second change to ICBN (Art. 13 proposals B & C) approved in Berlin has conferred 'sanctioned status' to a few names treated in the Systema Mycologicum previously excluded from the 'sanctioned' list

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because they were based upon lichenized fungi. The commonest lichenized agaric, which we treated as *Botrydina botryoides*, was described by Fries (1821) under the name *Agaricus ericetorum* Pers. Persoon's (1796) name, *A. ericetorum*, was a nomen novum for *A. pseudoandrosaceus* Bull. as indicated by us (Redhead and Kuyper, 1987). In addition, we showed that *A. pseudoandrosaceus* and *Byssus botryoides* are conspecific. The correct name for this species now should be based on the sanctioned binomial, *A. ericetorum*, rather than on the earlier name *Byssus botryoides*.

RESULTS

The following new combinations are proposed as substitutes for those in *Botrydina* used by us in 1987:

Phytoconis aurantiaca (Redhead & Kuyper) comb. nov.
=*Botrydina aurantiaca* Redhead & Kuyper, Arctic and Alpine Mycology II, p. 334. 1987. Plenum Press, N.Y.

Phytoconis chromacea (Cleland) comb. nov.
=*Omphalia chromacea* Cleland, Toadstools and Mushrooms and Other Larger Fungi of South Australia 1: 86. 1934.

Phytoconis ericetorum (Persoon:Fries) comb. nov.
=*Agaricus ericetorum* Persoon, Obs. Mycol. 1: 50. 1796. E.M. Fries, Syst. Mycol. 1: 165. 1821.
=*Byssus botryoides* Linnaeus, Species Plantarum, p. 1169. 1753.
=*Botrydina vulgaris* Brébisson, Mém. Soc. Acad. Agricol. Indust. & Instruct. Falaise, p. 36. 1839.
=*Agaricus pseudoandrosaceus* Bulliard, Herbier de la France, pl. 276. 1786.

Phytoconis lobata (Redhead & Kuyper) comb. nov.
=*Botrydina lobata* Redhead & Kuyper, Arctic and Alpine Mycology II, p. 334. 1987. Plenum Press, N.Y.

Phytoconis luteovitellina (Pilát & Nannfeldt) comb. nov.
=*Omphalia luteovitellina* Pilát & Nannfeldt, Friesia 5: 22. 1954.

Phytoconis velutina (Quélet) comb. nov.
=*Omphalia velutina* Quélet, C.R. Ass. franç. Av. Sci. (Grenoble, 1885) 14: 445. 1886.

Phytoconis viridis (Acharius) comb. nov.
=*Endocarpon viride* Acharius, Lichenogr. Univers., p. 300. 1810.

In addition to the specimens cited in our earlier paper it should be noted that an isotype of *Omphalia chromacea* Cleland has been located at Beltsville (BPI) and examined: South Australia, Mt. Lofty, 1/7/22, J.B. Cleland No. 178, on bare damp ground.

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MYCOTAXON

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A NEW SPECIES OF PEZICULA ON LEAVES OF PHYLLOCLADUS ASPLENIIFOLIUS IN TASMANIA

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ABSTRACT

A new species of *Pezicula* occurring on leaves of *Phyllocladus aspleniifolius* from Tasmania, Australia is decribed as *Pezicula tasmanica.*

A beautiful inoperculate discomycete which was collected in Tasmania, Australia and associated with a pycnidial fungus on thick, almost woody leaves of *Phyllocladus aspleniifolius* was kindly sent to us by Mr. Peter R. Johnston of the Plant Diseases Division, Department of Scientific and Industrial Research, Auckland, New Zealand (PDD). Although the species of *Pezicula* usually occur on bark or wood of higher plants (Wollenweber, 1939; Dennis, 1974; Hawksworth & Sivanesan, 1976; Korf, 1978; Remler, 1980), the apothecial structure of this fungus is similar to that of *Pezicula*, and does not recall the anatomy of *Pseudopezicula* Korf, a leaf-inhabiting genus of the Peziculoideae known only on leaves of the Vitaceae. This fungus is characterized by very small apothecia, short and very broad asci, and its occurrence on leaves. We describe it as a new species of *Pezicula.*

Pezicula tasmanica Zhuang & Korf, **sp. nov.** (Figs. 1)

Ab Peziculae speciebus aliis apotheciis parvis, foliicola, ascis latis, 74.6-87.7 x 20.5-24.3 µm.

Apothecium closely associated with a pycnidial fungus, erumpent from leaf epidermis, solitary, or two in a group, turbinate, sessile to subsessile, 200-300 µm in diam, hymenium pruinose when dry, light buff, receptacle concolorous. Ectal excipulum of textura prismatica to textura angularis, marginal cells club-shaped with a swollen and rounded apex, cell walls hyaline to subhyaline. Medullary excipulum of densely arranged textura intricata to textura angularis, cell walls hyaline to subhyaline. Subhymenium indistinguishable. Asci inoperculate, 8-spored, clavate to club-shaped,

hemiamyloid, pore J+ (red) in Lugol's solution (IKI), J— in Melzer's reagent without KOH pretreatment, J+ (pore walls strongly blue) in Melzer's reagent with 2% aqueous KOH pretreatment, 74.6-87.7 x 20.5-24.3 µm. Ascospores irregularly uniseriate, ellipsoid to slightly reniform, unicellular, hyaline, becoming 3-septate and slightly pigmented when fully mature, 18.3-26.5 x 7.3-10.2 µm. Paraphyses filiform, slightly enlarged at apex, up to 3.5 µm at apex, 1.5-2.0 µm below, not exceeding asci.

Habitat: Mostly on the lower leaf surface of *Phyllocladus aspleniifolius*.

Holotype: associated with fruit bodies of a pycnidial fungus on leaves of *Phyllocladus aspleniifolius*, Pine Track, Tayatea Rd., Arthur River, Tasmania, Australia, P. K. Buchanan & A. Mills, 16. V. 1987, CUP 61818; PDD (isotype).

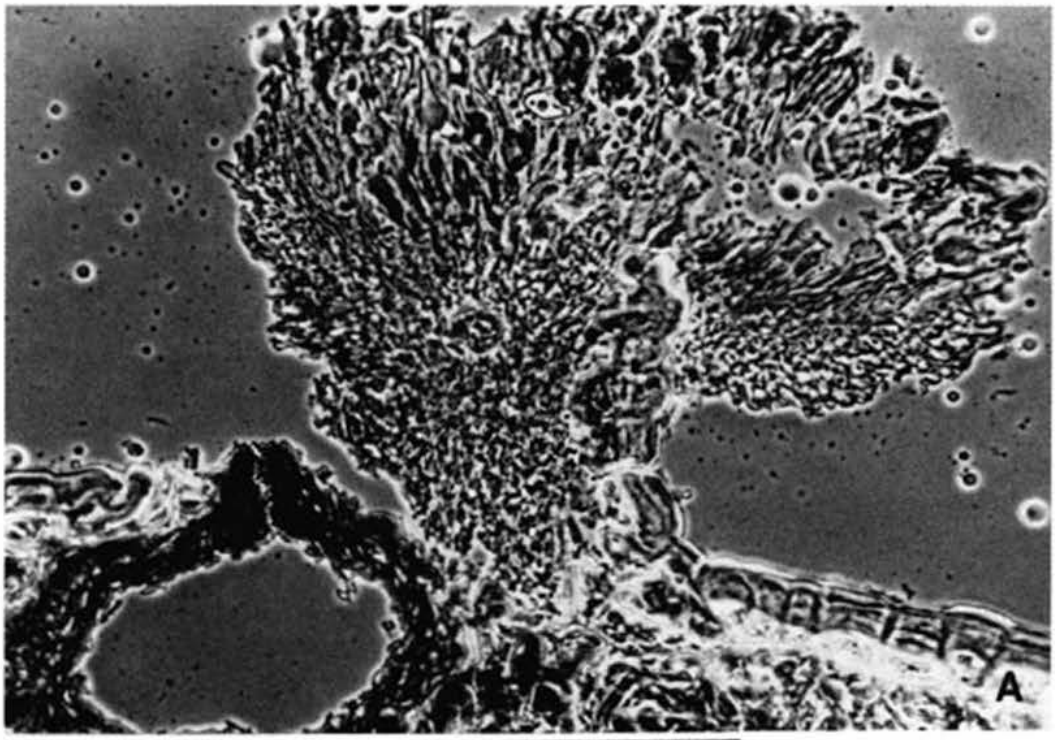
Notes: The presence of anamorphs of *Pezicula* species, ranging from acervulate to pycnidial, has been reported previously (Groves,1938, 1939, 1940, 1947; Wollenweber, 1939). Apothecia of the new species occurred directly on pycnidia which were in the leaves. The pycnidia had dark brown, well-developed walls but conidiogenous cells and conidia were very difficult to detect in sectioned preparations, perhaps because the pycnidia were overmature. Some ellipsoid, hyaline, catenulate conidia were found in squash mounts of a few pycnidia. Whether the *Pezicula* and the pycnidial fungus are mycoparasite and host, or whether they are teleomorph and anamorph (representing one holomorph) cannot be determined without cultural studies.

The substrate, leaves, is certainly unusual in *Pezicula*, characterized by occurrence on branches and stems of woody plants, *Rubus*, etc. The leaves of *Phyllocladus* are exceptionally tough and rigid.

ACKNOWLEDGEMENTS

We thank deeply Mr. P. R. Johnston (PDD) for providing this interesting fungus for our studies, Dr. W. J. Dress, Bailey Hortorium, Cornell University for correcting the Latin diagnosis, Dr. Linda M. Kohn, Department of Biology, University of Toronto-Erindale for serving as pre-submission reviewer, and Mr. K. E. Loeffler, the Department of Plant Pathology, Cornell University for preparing photographs.

Fig. 1. *Pezicula tasmanica*: A. photograph of a transverse section of an apothecium associated with a pycnidial fungus, B. photograph of a transverse section of an apothecium erumpent from leaf tissue, C. line drawing of a young ascus with ascospores, and hemiamyloid ascus apex; A, B x 240, C x 836; all from holotype.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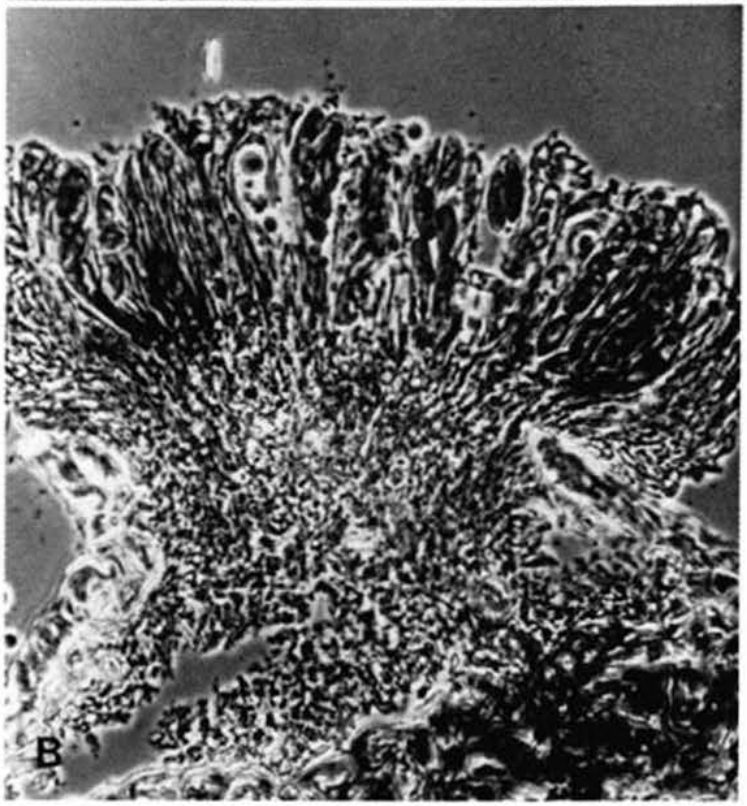
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C

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NOTES ON THE CULTURAL CHARACTERS, MORPHOLOGY AND DISTRIBUTION OF RIPARTITELLA BRASILIENSIS

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Summary

A description of Ripartitella brasiliensis (Tricholomataceae) is provided along with a description of its characters in culture. This species is a white-rot fungus found on hardwoods and has a tetrapolar mating system. It occurs throughout the tropics and subtropics.

In the following description, color comparisons in parentheses were made using Kelley (1965) or Kornerup and Wanscher (1978). Culture studies were performed on commercial BBL Malt Extract Agar and BBL Potato Dextrose Agar and cultures were incubated at 25 ° C. Culture morphology was determined following Nobles (1965) and Stalpers (1978). The species code given is that of Nobles (1965) and the key pattern of Davidson et al (1942). Procedures and chemical formulas for the spot tests are found in Stalpers (1978) and Marr (1979). All collections are deposited at NO unless otherwise noted.

Ripartitella brasiliensis (Speg.) Singer, Lilloa 22: 452. 1951.
≡Pleurotus brasiliensis Speg., Bol. Acad. Nac. Cienc. Cordoba 11: 20. 1889.
=Marasmius squamosidiscus Murr., Bull. Torrey Bot. Club 67: 151. 1940.
=Lentodium floridanum Murr., Mycologia 35: 426. 1943.
[=Ripartitella squamosidisca (Murr.) Sing., Lloydia 9: 128. 1946. nom. illeg.]
=Ripartitella squamosidisca (Murr.) Sing., Mycologia 39: 85. 1947.

=Collybia pseudoboryana Dennis, Trans. Brit. Mycol. Soc. 34: 453. 1951.
=Lepiota armillarioides Dennis, Kew Bull. 7: 486. 1952.

Figs. 1-8

Pileus 10-60 (70) mm wide, hemispheric to convex when young, expanding to broadly convex or nearly plane, the edge incurved when young, straight or wavy when mature, the edge appendiculate with fibrillar flaps for a short period after expansion begins, surface dry, matted-wooly and medium vinaceous-reddish brown (7D4-7E5, 58 m. Br.) overall on unopened or recently opened buttons, after expansion the center remaining matted-wooly and brown, elsewhere with tiny (0.5 mm), brownish fibrillar-squamular tufts, the squamules becoming distantly spaced and smaller toward the edge where finally nearly glabrous, glabrous in between the squamules, ground color whitish buff and not discoloring; context 1.5-3 mm thick, whitish buff, odor nondescript, taste slightly nondescript.

Lamellae 2-4 mm wide, more or less adnate, ivory white, not discoloring, entire, close; lamellulae numerous but not arranged in distinct tiers.

Stipe 15-50 mm long, 2-6 mm thick, equal, surface covered with small, distantly spaced, brownish, erumpent, fibrillar squamules up to a slightly fibrillar-annular zone near the apex, the squamules less evident in age, glabrous above, silky-fibrillose in between squamules, ground color whitish buff; context solid, whitish buff; often with a copious whitish, cottony mycelium at the base where attached to the substrate.

Veil fibrillar-membranous, brownish on the outer surface, remnants present as stated in pileus and stipe descriptions.

Chemical color reactions: 2.5% KOH no reaction, 10% NH_4OH pale grayish green on brownish areas of pileus (only one collection tested).

Spores white in deposit, 4.6-5.8 x 3.5-4.0 (4.6) µm, broadly elliptic to subspherical in profile and face view, finely echinulate, 1 or 2-guttulate, hyaline, inamyloid, acyanophilous. Basidia 18-24 x 5.8-6.9 µm, 4-sterigmate, clavate, hyaline. Hymenial cystidia found mainly on the

Fig. 1. Ripartitella brasiliensis (Ovrebo 1917). Carpophores, X .9.

sides, 37-45 µm long, 6.9-8.1 µm wide at widest point, 2.3-3.5 µm wide at neck where not capitate, lageniform with generally a narrow base, capitate with crystalline-like ornamentation extending 6-10 µm down from the apex, the ornamentation dissolving quickly in 2.5% KOH and then appearing smooth-walled overall, the ornamentation more or less remaining intact in Melzer's reagent or water, thin-walled, hyaline, inamyloid. Caulocystidia at stipe apex, 11.5-52 (69) x 3.5-5.8 µm, intercalary or arising from recurved surface hyphae, cylindric, smooth, thin-walled, hyaline, scattered or in clusters. Hyphae of lamellar trama 3.5-17 µm wide, more or less parallel, cylindric to slightly inflated, hyaline. Hyphae of subhymenium 2.3-2.9 µm wide, scarcely differentiated as a layer, cylindric, hyaline. Hyphae of pileus cuticle 3.5-9.2 µm wide, interwoven at the center, elsewhere radially aligned except where in clusters, incrusted with rusty brown incrustations less than 0.5 µm thick, with narrow hyphal outgrowths extending from some cells, cells in clusters generally short (9-16 µm long), somewhat more inflated and darker pigmented than the repent surface cells which are cylindric and longer (12-40 µm), rusty brown as a layer. Hyphae of pileus trama 4.6-17 µm wide, cylindric to slightly inflated, hyaline, the walls slightly refractive. Hyphae

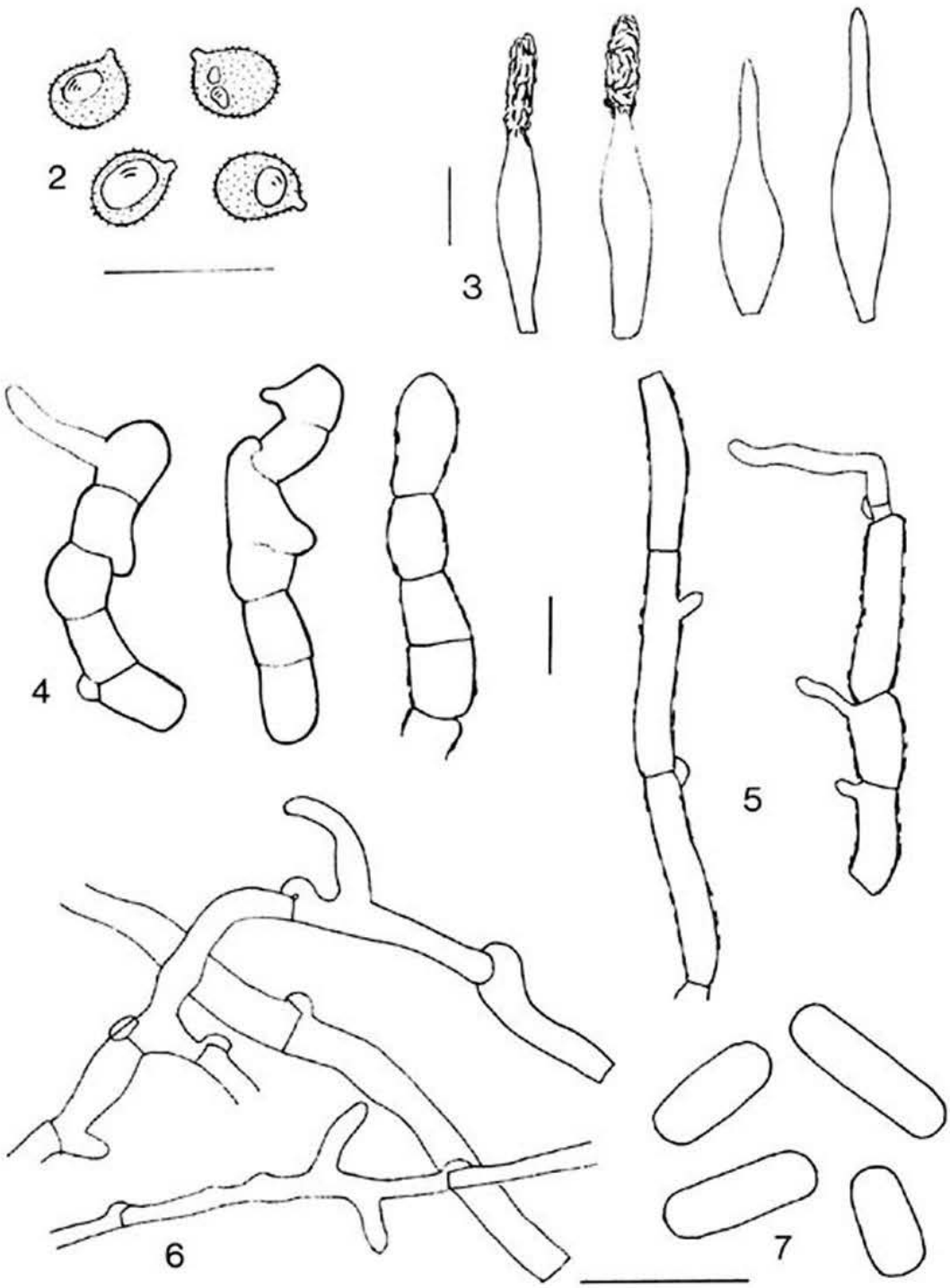
of stipe surface 3.5-8.1 µm wide, longitudinally aligned but in places forming clusters, cylindric, smooth and thin-walled or with brownish incrustations, the cells in the clusters most heavily pigmented, narrow hyphal outgrowths present on some cells. Hyphae of stipe trama 3.5-25 µm wide, parallel, compacted, cylindric to slightly inflated, hyaline, walls slightly refractive. Hyphae of veil 3.5-6.9 µm wide, cylindric, smooth and thin-walled or with brownish incrustations. Hyphae on stipe base 2.9-5.8 µm wide, cylindric, smooth, thin-walled, hyaline. Clamp connections present throughout the carpophore.

Densely gregarious on downed hardwood logs, frequently on Quercus, one collection found on well-rotted bracket fungus; July - December on U.S. Gulf Coast. Subtropical and tropical, the latter being both in lowland and montane regions.

Collections studied:

U.S.A.: Florida: Alachua Co.: Gainesville, 4 Jul 1943, W. A. Murrill, Univ. of Florida Campus, Gainesville, 9 Aug 1985, Halling 4504 (both NY), 8 Nov 1938, W. A. Murrill, F 19126, 6 Sep 1939, W. A. Murrill, F 19955, 14 Sep 1938, W. A. Murrill, F 32694; Santa Fe, 13 Jul 1938, W. A. Murrill, F 17876 (holotype, Lentodium floridanum); Grove Park, 15 Jul 1938, West, Arnold & Murrill, F 18262 (holotype, Marasmius squamosidiscus, FLAS & isotype, NY); Sanchez Hammock, 23 Jul 1938, West & Murrill, F 17959 & 8 Aug 1938, West & Murrill, F 18035; Juniper Springs, 6 Sep 1939, A. S. Rhoads, F 20084 (all FLAS except where noted). Leon Co.: Botany Place, Tallahassee, 10 Aug 1983, G. Wright 3065. Louisiana: St. Tammany Par.: Crawford's Landing, Slidell, 18 Jul 1985, Ovrebo 1803. Tangipahoa Par.: Zemmuray Gardens, near hwy 10, 16 Nov 1985, Ovrebo 1929. Mississippi: Perry Co.: Black Creek, 6 Dec 1986, Ovrebo 2574. Texas: Hardin Co.: Jack Gore Baygall Unit, Big Thicket Natural Preserve, 26 Oct 1985, Ovrebo 1917 & 1918 & 1 Aug 1982, Lewis 3239; Lance Rosier Unit, Big Thicket Natural Preserve, 10 Jul 1976, Lewis 380. Orange Co.: 455 Virginia Lane, Vidor, 6 Aug 1979, Lewis 1878.

Caribbean region: Martinique: Mahogany Plantation, 23 Jan 1982, J. P. Fiard 1505. Trinidad: Tucuche Trail on Naranja, 2 Oct 1949, Dennis 116 (holotype, Collybia pseudoboryana); Sangre Grande, 11 Oct 1949, Dennis 159 (holotype, Lepiota armillarioides) (all K).



Figs. 2-7. Ripartitella brasiliensis. 2. Basidiospores (Ovrebo 1803). 3. Hymenial cystidia (Ovrebo 1803). 4. Hyphae from clusters on pileus surface (Ovrebo 1829). 5. Repent surface hyphae (Ovrebo 1829). 6. Hyphae from culture (Ovrebo 1803). 7. Arthrospores from culture (Ovrebo 1803). Scale line = 10 µm.

South America: Bolivia: Beni, Vaca Diez, Riberalta, 30 March 1956, R. Singer B2339 (F). Brazil: Apiahy, May 1988, J. Puiggari 2886-2888 (holotype, Pleurotus brasiliensis, LPS). Colombia: Departamento Antioquia: Municipios Puerto Triunfo/Sonson, 1-2 km E of Rio Claro, 8 Nov 1986, Ovrebo 2453; Municipio San José: between San José de la Montaña & Labores, 26 Nov 1986, Ovrebo 2551 (both HUA, NY, NO).

Africa: Kenya: W. Prov.: Kakanuga Forest, 25-27 Jan 1973, L. Ryvarden. Tanzania: Tanga Prov.: Magamba Reserve, 23 April, 1968, D. N. Pegler T654 (both K).

Western Pacific: Bonin Islands: Chichijima Island: Nagatami, 26 Nov 1977, Hongo B-224 (K).

Culture characters:
Culture examined: Ovrebo 1803 (NO, CFMR)
Species code: 2.3.7.35.36.38.47.54.60; key pattern: A-P-S-1-4-5-10.

Growth characters: Growth slow on MEA, 2.5-4 mm per week, 16-26 mm radius after 6 weeks, growth on PDA 6.5-7.5 mm per week, 40-45 mm radius after 6 weeks, margin even, raised and downy, white; mat thin downy, white; reverse unchanged; no odor detected; not fruiting within 6 weeks; gum guaiac solution: +; 0.1 M α-naphthol: +; syringaldazine: + (last 2 for laccase); 0.1 M cresol: -; tyrosine: - (last two for tyrosinase); α-naphthol phosphate: + (phosphatase); gallic and tannic acid agars no growth and no reaction.

Microscopic characters: Submerged and aerial hyphae thin-walled, occasionally swollen slightly in places, hyaline, nodose septate, often branched, 2.3-6 µm wide; thallic arthrospores cylindric to doliform with rounded ends, 6.9-13 x 2.9-3.5 µm, smooth, thin-walled, abundant in aerial mat.

Mating studies: The fungus is heterothallic with tetrapolar incompatibility system. The distribution of mating types among the monosporous isolates is as follows: A_1B_1 = 1, 8; A_1B_2 = 11, 12, 15; A_2B_1 = 2, 3, 4, 5, 9; A_2B_2 = 6, 7, 10, 13, 17. Clamp connections were found at the mating zone of compatible crosses but none were found in the new growth at the periphery of the same culture. Tissue explants of clamped hyphae from the mating zone formed stable-clamped mycelium in newly grown cultures.

Observations: Ripartitella brasiliensis is easily recognized by its small stature, tiny brown squamules on the pileus and stipe, and by its fruiting habit which is generally densely gregarious. Distinctive microscopic characters are the echinulate spores, capitate cystidia and make-up of the pileus surface. The capitate material on the cystidia dissolves in a matter of minutes in 2.5% KOH and the entire cystidium then appears smooth. The capitate material remains intact in water or Melzer's reagent. The cystidia are always present but are abundant in some collections while rare in others. It is the latter that has caused some workers (Dennis, 1951; Horak, 1968; Pegler, 1977, 1983) to report that they are absent. As noted by Singer (1946) and Pegler (1977, 1983), the pileus surface is composed of two cell types: (1) repent surface hyphae composed of long and narrow cells which are generally incrusted (Fig. 5), and (2) squamular hyphae composed of short, cylindric to slightly inflated cells that are slightly thick-walled and smooth or incrusted (Fig. 4). Both cell types are also found on the stipe. Commonly, there are narrow hyphal outgrowths from both these cell types that are smooth and narrower than the cells from which they arise (Figs. 4 & 5). These narrow outgrowths represent new growth from what otherwise appear to be differentiated cells.

As seen from the synonomy, Ripartitella brasiliensis has been described as a new species in a number of genera. It most truly, however, resembles a Lepiota due to the aspect of the pileus surface and presence of a veil. The latter is easily separated by having free lamellae and smooth, dextrinoid spores. In contrast to Singer (1986), who places Ripartitella in the Agaricaceae, this author agrees with Pegler (1977) that the genus is properly placed in the Tricholomataceae.

Ripartitella brasiliensis is known to date from a number of locations throughout the tropics and subtropics (Fig. 8) from both lowland and montane habitats. Records to date reveal that it occurs on angiosperm dicotyledonous wood. It is associated with white rot decay. Further collecting may show that it is widely distributed throughout the tropical and subtropical belts.

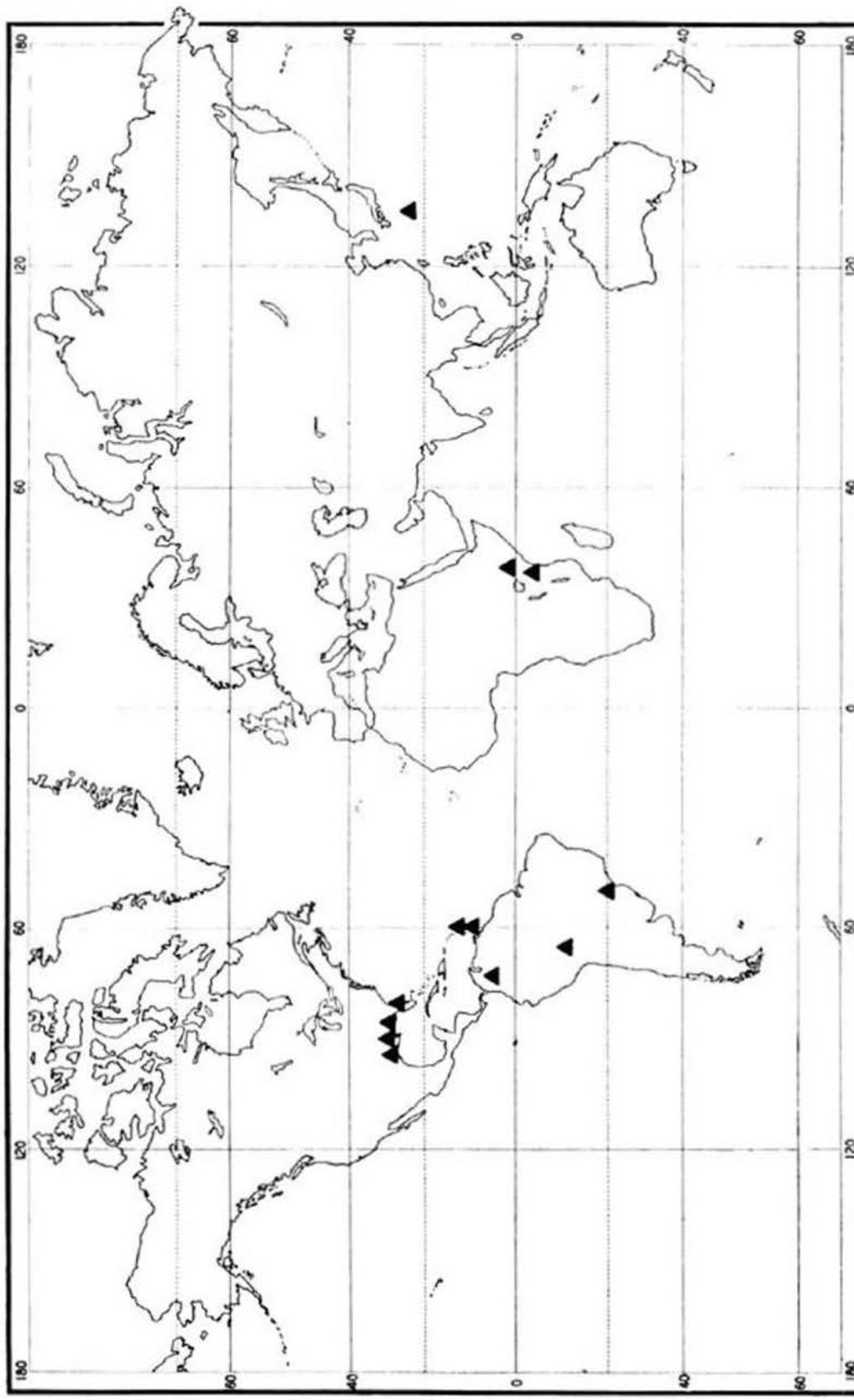


Fig. 8. Distribution of Ripartitella brasiliensis.

Acknowledgements

Thanks are extended to the following institutions and individuals for the loan of specimens: K, LPS, NY, F, FLAS, Greg Wright and David P. Lewis. Meredith Blackwell and Karen Nakasone assisted in the analysis of the culture characters. Field work in Colombia was made possible through an NSF grant (# BSR-860024) to Roy E. Halling.

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LAZUARDIA, A NEW GENUS FOR PEZIZA LOBATA

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ABSTRACT

The globose spored and bluish species *Peziza lobata* (with its synonyms *Peziza verruculosa* and *Barlaeina albocaerulescens*) is made the type of a new operculate genus *Lazuardia*. The combination *Lazuardia lobata* is proposed for this rare but widely distributed species and an illustrated description is presented as well.

The globose spored *Peziza lobata* Berk. & Curt. and its many synonyms seems to defy any attempt to place it in the existing genera of operculate cup fungi. A new genus solely proposed to accommodate this species would appear appropriate, but since the generic delimitations of Pezizales involving globose spored species have always been a source of disagreements among discomycetologists a brief explanatory justification would be required for establishing such a genus.

Based on a specimen from Cuba, *Wright 652*, this species was originally introduced into mycological literature by Berkeley (1868) with distinguishing characters which read "... hymenio rufo hic illic cribroso, subtus pallidioribus sporidiis globosis ...." Since field notes were not available until quite recently, the pigmentation and the appearance of this species in fresh conditions were unknown and consequently its true affinity has always been in doubt. It became dull orange and later on pale yellow when Seaver (1914, 1928) redescribed it, a typical field character of species of *Lamprospora* de Not. where Seaver classified this species. Using Seaver's treatise as a guide, Thind & Waraith (1971) reported an Indian collection of this species which was stated to have a pure white hymenial surface.

The same species was described again from Ceylon as *Peziza verruculosa* by Berkeley & Broome (1873) who diagnosed it only microscopically ("... ascis linearibus; sporidiis uniseriatis globosis fortiter verruculosis, paraphysibus linearibus intus globulis repletis ..."). For its macroscopic characters they

simply added "... caetera *P. hirtae* ..." Neither substrate, nor habitat, nor specimen were indicated but luckily Berkeley left an annotated specimen behind. The comparison with *Scutellinia hirta* was totally misleading -- obviously it led Saccardo (1889) to compile it as *Sphaerospora verruculosa*, but there is nothing to suggest their resemblance whatsoever. This matter was later cleared up by Petch (1916).

There was apparently some mix-up during the preparation of the description of *Peziza sarmentorum* Berk. & Br. var. *geophila* Berk. & Br., because although the spores were said to be "... 0.0008 long, 0.0004 wide ..." the type specimen indicated (*Ceylon Fungi 1055*) was found to have globose spores typical of the present species. The synonymy of *Peziza sarmentorum* var. *geophila* to *Peziza lobata* was already known to Cook (1877). This synonymy was accepted by Saccardo who did not specifically list *Peziza sarmentorum* var. *geophila* as a synonym of *Peziza lobata* but by citing the illustration published by Cook he did give the geographic distribution of the present species as Cuba and Ceylon. *Peziza sarmentorum* Berk. & Br. itself is a petiole-inhabiting helotioid species.

The true bluish pigmentation of the present species when fresh was first given by Penzig & Saccardo (1901) when they described and later (Penzig & Saccardo 1904) illustrated *Barlaeina albocaerulescens* Penz. & Sacc. based on a specimen collected by Max Fleischer in Java. Petch (1916) also observed that when fresh the field characters of the Ceylonese *Peziza verruculosa* were identical with the Javanese form so that he synonymized them. With regard to the Cuban collection Petch stated that "... if colour given for *B. lobata* in the published description is correct, the Ceylon species is immediately distinguishable ..." thus indicating his belief on the taxonomic importance of the pigmentation. In recording the specimen from Trinidad, Dennis (1954) noted in the caption of his illustration that the fresh colour of this species was still uncertain. Due to these inconclusive evidences and because only a casual examination was undertaken, it was only tentatively that in a former study (Rifai 1968) all the species involved were regarded to be identical.

A more recent new world collection from Trinidad made by Dr. D. A. Reid of the Herbarium of the Royal Botanic Gardens Kew in 1973 was available for further study and fortunately it was accompanied by ample field notes which record that when fresh the colour of the apothecia is "...white to bluish white inside, white to yellowish white outside...". With this new evidence and because microssopically there is nothing to distinguish them I am now convinced that *Peziza lobata*, *Peziza verruculosa*, *Peziza sarmentorum* var. *geophila* and *Barlaeina albocaerulescens* are the same species.

As has been indicated earlier (Rifai 1968) the presence of hairs on the surface of the receptacle

makes this species not wholly acceptable to the *Barlaeina - Marcelleina - Pulparia* complex where Saccardo and Petch would place it. Admittedly the hairs are delicate and hyaline so that their presence has escaped the detection of earlier workers, the only other mention of their existence being that of Thind & Waraith (1971). Their size and distribution pattern on the surface of the apothecia, however, is similar to those of other typical hairs found in the suborder Pezizineae, namely they are more numerous, longer but narrower towards the margin of the cup.

Similarly the classification of the present species in *Lamprospora* as has been done by Seaver (1914, 1928), Boedijn (1951), Dennis (1954) and more recently by Thind & Waraith (1971) is out of the question largely because of the marked differences in macroscopic habit of the apothecia, their consistency, excipular structure, anatomy of the apothecial margin as well as the disc pigmentation. Blue being rare in fungi, this character may have a more important diagnostic value than the presence of the hair. It is with this idea in mind that I make this bluish species the type species of a new genus which is proposed to be called *Lazuardia* Rifai.

Lazuardia Rifai, *gen. nov.*

Apothecia gregaria, mediocria, sessilia, denique discoidea, disco caerulescentes, extra tomentosa ex pilis hyalinis septatis composita. Excipulum ectale e cellulis angularibus (textura angularis), excipulum medullare ex hyphis septatis (textura intricata) compositum. Asci cylindracei, apice operculati jodo haud tincti, octospori. Ascospori uniseriati, hyalini, globosi, ornati, uniguttulati. Paraphyses septatae, rectae, filiformes. Species typica generis: *Peziza lobata* Berk. & Curt.

Lazuardia lobata (Berk. & Curt.) Rifai, *comb. nov.*

Peziza lobata Berk. & Curt. *apud* Berk. *in* J. Linn. Soc. (Bot.) 10: 365. 1868 (basionym). --*Barlaea lobata* (Berk. & Curt.) Sacc., Syll. Fung. 8: 117. 1889. --*Barlaeina lobata* (Berk. & Curt.) Sacc. & Trav. *in* Sacc., Syll. Fung. 19: 140. 1910. --*Lamprospora lobata* (Berk. & Curt.) Seaver *in* Mycologia 6: 22. 1914.

Peziza sarmentorum Berk. & Br. var. *geophila* Berk. & Br. *in* J. Linn. Soc. (Bot.) 14: 102. 1873.

Peziza verruculosa Berk. & Br. *in* J. Linn. Soc. (Bot.) 14: 105. pl. V, fig. 23. 1873; non *Peziza verruculosa* Berk. & Curt. *in* Proc. Amer. Acad. 4: 127. 1860. --*Sphaerospora verruculosa* (Berk. & Br.) Sacc., Syll. Fung. 8: 189. 1889. --*Barlaeina verruculosa* (Berk. & Br.) Petch *in* Ann. R. Bot. Gard. Perad. 6:

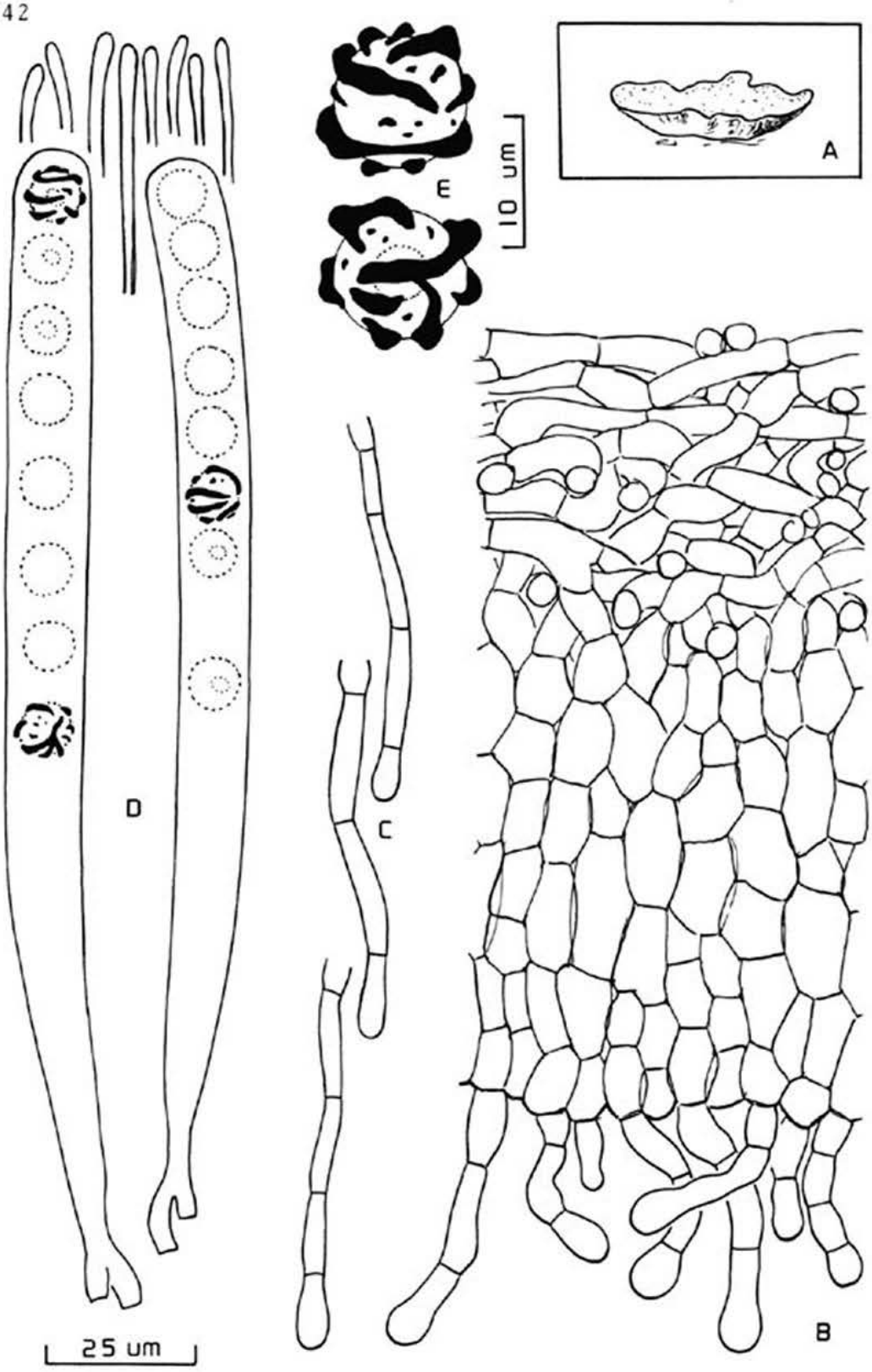

Fig. 1. *Lazuardia lobata*.--A. Habit sketch. B. Diagrammatic section of ectal and medullary excipulum. C. Hairs. D. Asci and paraphyses. E. Ascospores.

169. 1916 (ut *Barleina*). --*Lamprospora verruculosa* (Berk. & Br.) Boedijn *in* Sydowia 5: 211. 1951.
Barlaeina albocaerulescens Penz. & Sacc. *in* Malpighia 15: 202. 1901; Icon. Fung. Jav. :67, tab. V, fig. 4. 1904.

Apothecia scattered to gregarious, occasionally caespitose, sessile, up to 2.5 cm diam. Disc at first distinctly concave, later on wavy to almost flat, smooth, bluish white (?fading) to pure white. Receptacle when young deeply cupulate, becoming shallowly cup shaped in age, irregularly undulated or lobed at the margin, white to yellowish white, finely tomentose especially towards the edge, with a fleshy consistency. The tomentomes consist of delicate but well differentiated hairs which are hyaline, flexuous, smooth and thin walled, septate, subcylindrical but distinctly enlarged towards their apex, 4-8 um diam. and up to 75 um long, those near the margin of the cup longer but narrower than the rest. Ectal excipulum up to 120 um thick, of compacted prosenchymatous tissue to form a textura angularis pseudoparenchyma with polygonal elongated cells up to 36 um long by 18 um wide, arranged with their long axis at right angles to the surface of receptacle. Medullary excipulum well developed, made up of tightly interwoven, septate and branched hyaline hyphae (textura intricata), 4.5-8(-12) um in diam., slightly thinner walled compared to those of the ectal excipulum. Subhymenium of compacted isodiametric, rounded or polygonal cells, interspersed with short celled hyphal elements. Hymenial layer about 250 um thick. Asci cylindrical and clearly attenuate towards the base, 8-spored, up to 255 um long by 11-15 um diam., apex or walls not blued in Melzer's reagent. Ascospores uniseriate, globose, hyaline, uniguttulate, at first smooth but soon becoming ornamented with 4-6 irregularly orientated, wavy, rarely anastomosing broad band-like ridges of various length and uneven thickness up to 2.8 um high; without the ornamentation the ascospores measure 8.4-11.4 um in diam. Paraphyses straight, sparingly septate, slender, 1.5-2 um diam. and only slightly enlarged at the apex to about 2.8 um diam., projecting to about 30 um beyond the ascus tip.

Habitat and distribution: on the ground in Ceylon, India, Java, Sumatra, Cuba, Jamaica and Trinidad.

SPECIMENS EXAMINED: AMERICA. C u b a. On the ground, s. dat., *Wright 652* (K, type of *Peziza lobata* Berk. & Curt.); on the ground, s. dat., *Wright s.n.* (K, paratype of *Peziza lobata* Berk. & Curt.)-- T r i n i - d a d. On sandy soil in forest, Quinan, 4 November 1949, *R.E.D. Baker s.n.* (K); on (?burnt) soil with fragments of mica and schist, Mt. Benedict, Tunafuna, 31 August 1973, *D.A. Reid s.n.* (K). -- J a m a i c a. On earth in woods, 18 February 1928, *C.R. Orcutt 4226* (K).

ASIA. C e y l o n. On the ground, Peradeniya, December 1868, *s. coll. 1055* (K, type of *Peziza sarmentorum* Berk. & Br. var. *geophila* Berk. & Br.); on the ground, s.dat., s. coll. (K, type of *Peziza verruculosa* Berk. & Br.); on the ground, Gangarua, December 1913, *Petch 4100* (K); on the ground, Peradeniya, November 1914, *Petch 4337* (K). -- I n d i a. On soil under teak and pine, Kalimpong Rd from Tiste, Darjeeling, 22 July 1964, *K.S. Thind 352* (K). -- J a v a. On soil, Cibodas, Mt. Gede, 1897, *M. Fleischer 934* (BO 2680, type of *Barlaeina albocaerulescens* Penz. & Sacc.); on the ground, Bogor Botanic Gardens, April 1926, *Nongnong s.n.* (BO 1023). -- S u m a t r a. Batang Palupuh, 1000 m alt., July 1924, *E. Jacobson s.n.* (BO 9246).

I should like to thank the Keeper of the Herbarium of the Royal Botanic Gardens Kew for research facilities put at my disposal in 1978 and to Dr. R. P. Korf of Cornell University for kindly going through the manuscript.

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MYCOTAXON

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ARACHNOPEZIZA OCHRACEA COMB. NOV. AND A NEW SYNONYM OF POLYDESMIA PRUINOSA

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ARACHNOPEZIZA OCHRACEA

During type studies for her monograph of the genus *Strossmayeria* Schulzer, the senior author has examined the holotype specimen of *Belonidium ochraceum* Grelet & Crozals (**1929**), on deposit in Paris (PC). It is clearly neither a *Strossmayeria* nor a *Belonidium*, but proves to be a previously unrecognized species of *Arachnopeziza* Fuckel, a genus that has been a subject of the junior author's Ph.D. thesis and later studies (Korf, **1952, 1959, 1977, 1981**; Korf and Gruff, **1981**; Korf & Zhuang, **1985**).

The original description of *Belonidium ochraceum* fails to mention the presence of marginal hairs on the apothecia, and the presence of a scanty subiculum, which may account for its correct position being overlooked by all subsequent authors. The original description also disagrees in microscopic measurements of all features with those we obtained. It seems highly possible that Grelet used an incorrect calibration of his microscope when drawing up the description, as has previously been postulated by Korf (**1951**) in discussing the discrepancy in measurements between Grelet's description of *Arachnopeziza obtusipila* Grelet and its type specimen. By applying a correction factor of x0.75 to the published microscopic measurements, Korf was able to get better agreement between the type specimen and the description. The type specimens of *A. obtusipila* and of *B. ochraceum* were both collected by A. de Crozals in December, 1927, and we now assume both descriptions were drawn up, perhaps at the same time, with the postulated incorrect calibration. Table I illustrates application of this correction factor to the microscopic measurements reported by these authors in comparison with their published figures and with those we obtained from the type specimen. The appreciably longer ascus and ascospore measurements of the original description, in particular, are in far better agreement with the type specimen after application of the correction factor. We found no asci or ascospores approaching the lengths recorded originally.

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TABLE I

BELONIDIUM OCHRACEUM GRELET & CROZALS

	Grelet	Iturriaga & Korf	Grelet x 0.75
Ascus width	8-10µm	7.5-9.3µm	6.0-7.5µm
Ascus length	75-105µm	(65.4-)72.8-85.8µm	56.2-78.8µm
Spore width	3-4µm	(2.0-)2.6-3.7(-4.0)µm	2.25-3.0µm
General spore width	3µm	2.6-3.7µm	2.25µm
Spore length	16-27µm	(14.6-)16.8-21.3µm	12.0-20.2µm
General spore length	18-25µm	16.8-21.3µm	13.5-18.8µm
Paraphysis width	2.5-3µm	1.5-2.2µm	1.9-2.3µm

The type collection of *Belonidium ochraceum* is only in a fair state of preservation, with some molds overgrowing the specimen. The fungus fruits on the cut end of a wood chip, which the original authors assumed may be *Pinus*. The subiculum is scanty, and the hairs are rather short for a typical *Arachnopeziza*, and are only obvious at the margin, where they form a whitish fringe. It is clearly a species unknown to the junior author, and a formal transfer and an emended description is provided here.

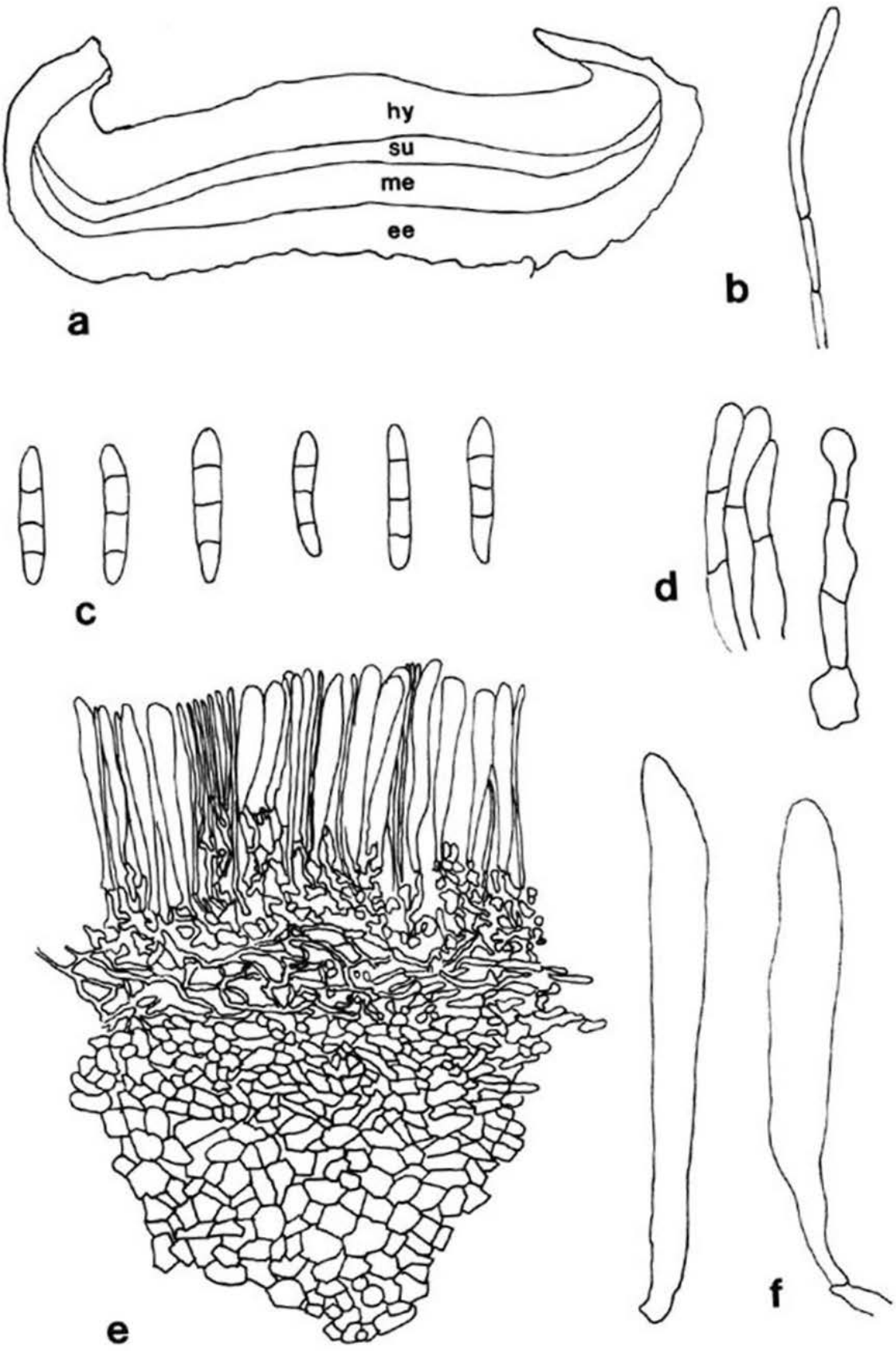
Arachnopeziza ochracea (Grelet & Crozals) Korf & Iturriaga, *comb. nov.* (FIG. 1)

≡ *Belonidium ochraceum* Grelet & Crozals, Bull. Soc. Mycol. France **44:** 274. 1929 (1928).

Apothecia cupulate, sessile, 1.0-1.5 mm diam, with a paler margin. *Disc* beige, granulose when dry. *Receptacle* reddish brown when dry, fringed with short hairs at the margin only. *Hairs* hyaline, several-septate, fairly thin-walled, tapering apically, apex rounded, (29.4-) 36.7-38.2 x (2.2-) 3.7 (-4.4)µm. *In section:* ectal excipulum of textura angularis, 36-75µm thick, cells (4.4-) 6.6-9.5 (-11.0) x 2.9-5.9 (-6.6)µm, hyaline except outermost cells near base may be yellowish, walls somewhat glassy; medullary excipulum of textura intricata, 37-47µm thick, hyphae 1.5-2.2(-2.9)µm wide; subhymenium not clearly distinguishable from medullary excipulum, up to 9.3µm deep. *Asci* 8-spored, clavate, but tapering toward the apex, provided with a J+ pore (with or without KOH-pretreatment), arising from repeating croziers, (65.4-) 72.8-85.8 x 7.5-9.3µm. *Ascospores* hyaline, biseriate, rarely triseriate, cylindric-fusiform, 3-septate at maturity, not constricted at the septa, (14.6-) 16.8-21.3 x (2.0-) 2.6-3.7 (-4.0)µm. *Paraphyses* equal in length to the asci, simple or rarely branched, 1.5-2.2µm wide.

CULTURAL CHARACTERS: Unknown.
HABITAT: Rotten wood, on cut surface, of *? Pinus*.
NAME: From Latin, *ochraceus* = color of apothecia when fresh.
TYPE LOCALITY: Toulon (Var), France.

FIG. 1. *Arachnopeziza ochracea*, drawn from holotype. a, diagrammatic transverse section of apothecium (hy = hymenium, su = subhymenium, me = medullary excipulum, ee = ectal excipulum); b, paraphysis apex; c, six ascospores; d, marginal hairs; e, portion of a transverse section; f, two asci. Magnifications: a, x 100; b, c, d, f, x 1000; e, x 400.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ILLUSTRATIONS: Grelet & Crozals, Bull. Soc. Mycol. France **44:** pl. 21, fig. 7; this paper, fig. 1.

EXSICCATI: None.

HOLOTYPE EXAMINED: *France:* A. de Crozals, sur bois pourri de pin (probablement), environs de Toulon (Var), Décembre 1927 (PC-Grelet).

POLYDESMIA PRUINOSA

The senior author's examination of the type specimen of *Belonium pyrenomycetum* Vel. has shown this to be a later synonym of the common pyrenomycete-inhabiting *Polydesmia pruinosa* (Jerd. *in* Berk. & Br.) Boud., as was already noted on the outer packet of the type specimen (PRM 149887). The outer and inner packets bear the date "VII.1928," while Velenovsky's (**1940**) original diagnosis gives the date as "julio 1935.' All the other data is in agreement. Since the junior author gave the date of publication of Boudier's combination as 1907 in his monograph (Korf, **1978**), we take this opportunity to point out the possibility that Boudier's earlier combination in 1904 may be considered valid by some authors despite the incorrect author citation. The problem also was noted in the junior author's compendium on names for the plates in Boudier's *Icones Mycologicae* (Korf, **1986**). The full, corrected synonymy of the species is:

POLYDESMIA PRUINOSA (Jerd. *in* Berk. & Br.) Boudier, Icon. mycol. Liste prélim. p. [4]. 1904 ('(Berk.) Boud.'); Hist. classific. discomyc. Europe p. 100. 1907 ('Berk. et Br.').

= *Helotium pruinosum* Jerd. *in* Berk. & Br., Ann. Mag. Nat. Hist., ser. 3, **18:** 127. 1866.

= *Pseudohelotium jerdonii* Sacc. (*'jerdoni'*), Syll. Fung. **8:** 296. 1889 [a name change, not *Ps. pruinosum* (Wallr.) Sacc. 1889].

= *Belonidium pruinosum* (Jerd. *in* Berk. & Br.) Rehm *in* Rabenh., Kryptogam.Fl. Deutschl., Oesterr. Schweiz, ed. 2, **1**(3) [Lief. 35]: 510. 1891; [Lief. 36]: 562. 1891.

= *Belonium pruinosum* (Jerd. *in* Berk. & Br.) Höhn. *in* Rehm, Ann. mycol. **10:** 536. 1912.

= *Belonium pyrenomycetum* Vel. (*'Pyrenomycetum'*), Novitates Mycol. p. 182. 1940 (1939).

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GANODERMA MEREDITHAE, A NEW SPECIES ON PINES IN THE SOUTHEASTERN UNITED STATES [1]

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SUMMARY

A new species, *Ganoderma meredithae*, is described from pines in the southeastern United States. It is distinguished from other species in the *G. lucidum* complex by its host specificity, often branched or lobed pilocystidia, plumose or feathery growth habit in culture, optimum growth temperature of 25-30 C with growth at 35 C, and lack of chlamydospores in culture.

In the course of research on North American species in the *Ganoderma lucidum* complex, we have obtained evidence for six distinct taxa. These are *G. lucidum* (W. Curt.: Fr.) Karst., *G. tsugae* Murr., *G. oregonense* Murr., *G. zonatum* Murr., *G. colossum* (Fr.) C.F. Baker, and a sixth species that is restricted to pines in the southern pine region (Adaskaveg and Gilbertson, 1986 a,b). For reasons detailed below, we have concluded that none of the names of described species of *Ganoderma* are applicable to this taxon and we therefore describe it as a new species.

Basidiocarp and cultural tissues were mounted in 4% KOH and phloxine or Melzer's reagent for microscopic examination. Drawings were made with a camera lucida on a Leitz Dialux microscope. Capitalized color names are from Ridgway (1912).

GANODERMA MEREDITHAE Adaskaveg and Gilbertson, sp. nov.

Fructificatio annua, sessili vel stipitata; superficies cremea vel luteo-bubalina ad initium, demum rubro-brunnea, crustosa vel laccata; pori 4-6 per mm; contextus pallido-bubalinus vel pallido purpureo-brunneus, cum zonae atropurpureo-brunnea, resinosa; systema hypharum dimiticum; hyphae generatoriae fibulatae; hyphae skeletales nonseptatae, crassitunicatae, cum ramos dendriticus; pilocystidia crassitunicatae, amyloidea, saepe ramosa vel lobata; basidia late clavata, 4-sterigmatibus, 22-26 X 13-16 µm; basidiosporae ellipsoideae, truncatae, pallido-brunnea, paries duplexis, cum columnae interparietis, 9.5-11.5 X 5.5-7.0 µm.

Holotypus: JEA 345, on *Pinus taeda* L., R. Summers, Pineville, Grant Parish, LA, Aug. 21, 1985; in herb. National Fungus Collections, Beltsville, MD.

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[1] - University of Arizona Agricultural Experiment Station Journal Article No. 4444

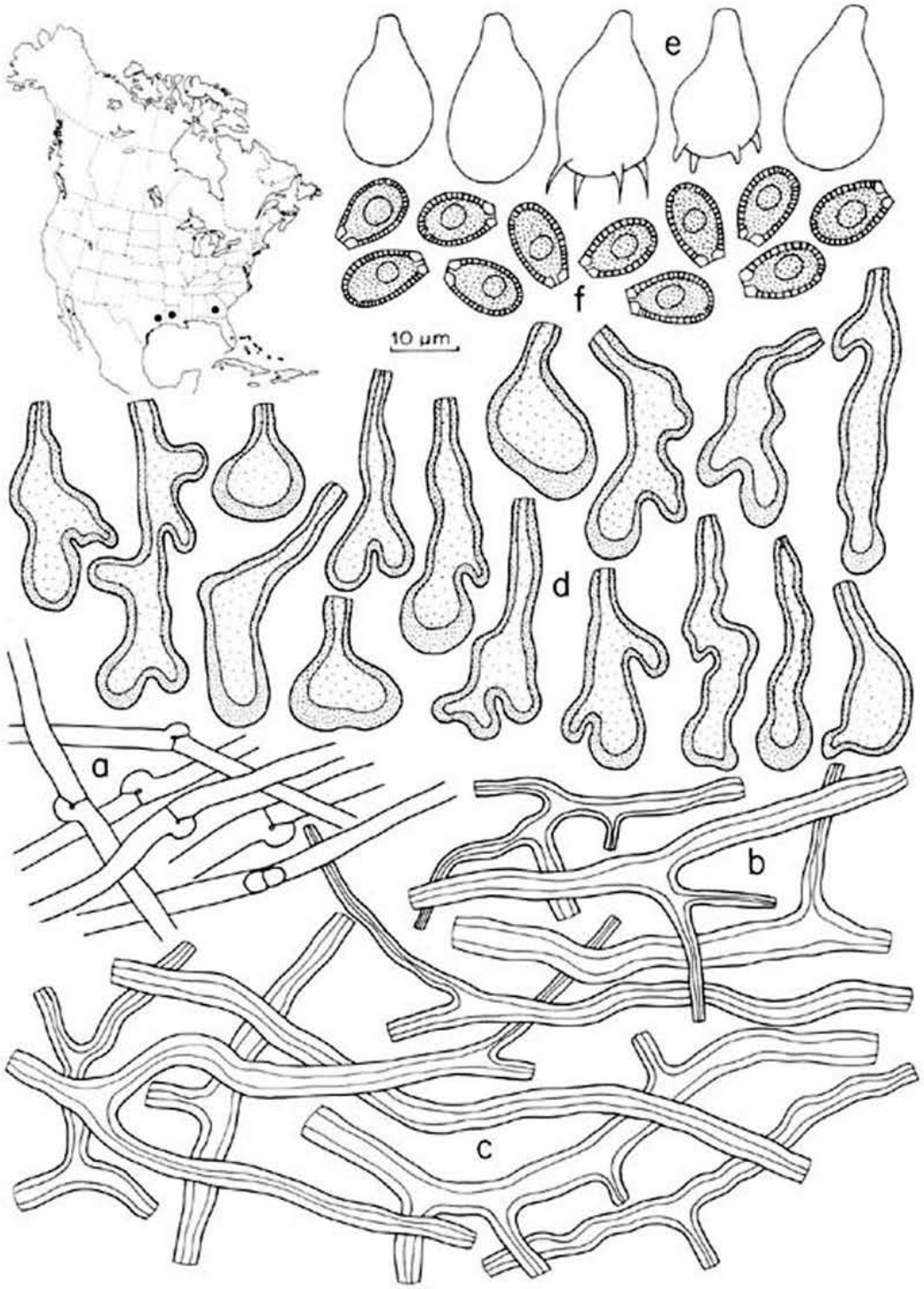

Fig. 1. Basidiocarp characteristics of *Ganoderma meredithae* (JEA 395, holotype). a, tramal generative hyphae; b, tramal skeletal hyphae; c, contextual skeletal hyphae; d, pilocystidia; e, basidia; f, basidiospores.

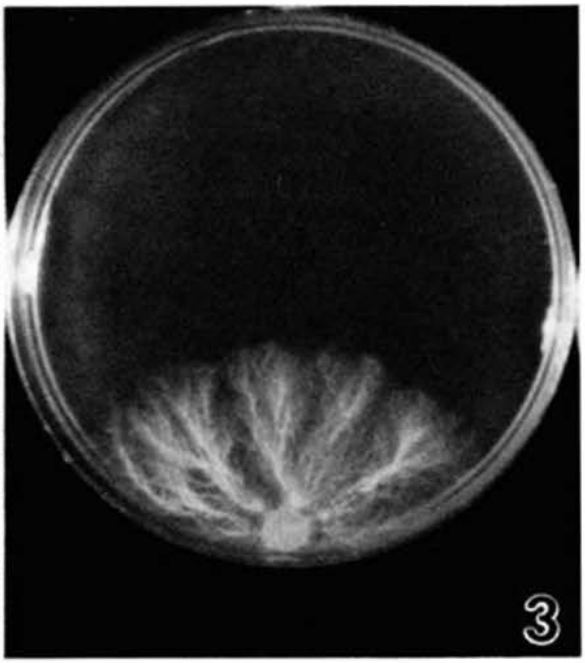

Fig. 2-3. *Ganoderma meredithae*. 2, basidiocarp at base of *Pinus taeda*; 3, one week-old culture on malt extract agar medium at 25 C (JEA 399).

Etymology: named for Dr. Meredith Blackwell of Louisiana State University, a student of Gulf Coast fungi.

Basidiocarps annual, sessile to centrally or laterally stipitate, developing at the base of living pines or on dead pines or stumps; pilei circular to dimidiate or reniform, up to 15 cm or more broad, upper surface cream colored to yellowish buff at first, becoming reddish brown, concentrically zonate and shallowly sulcate, glabrous, dull and crustose to shiny and laccate; pore surface creamy white at first, becoming pale vinaceous cream at maturity, pores circular to angular, 4-6 per mm, with thick, entire dissepiments that have a sugary appearance under a 30X lens; stipe central to lateral, up to 10 cm long and 3 cm thick, becoming dark maroon, shiny, and laccate, cut surfaces showing distinct dark zones of dense purplish brown tissue under an outer zone of uniformly pale buff tissue, in cross sections these dark zones appear as concentric rings; context light buff near the upper surface, grading to pale purplish brown toward the tubes, corky, usually with some darker resinous zones, up to 2 cm thick; tube layer light purplish brown, corky, up to 2 cm thick.

Hyphal system dimitic; contextual skeletal hyphae thick-walled, hyaline, nonseptate, faintly pigmented in mass, 2-6 µm in diam with frequent branching, tips often dendritically branched; contextual generative hyphae difficult to discern in mature specimens, thin-walled, hyaline, with clamps, 2.5-4.5 µm in diam; tramal hyphae similar, generative hyphae more obvious; pilocystidia forming a solid palisade on the pilear surface, moderately thick-walled, often much thicker-walled at the apex, strongly amyloid in Melzer's reagent, highly variable in shape from nearly spherical or reniform to clavate, often strongly branched or lobed, 17-50 X 6-15 µm.

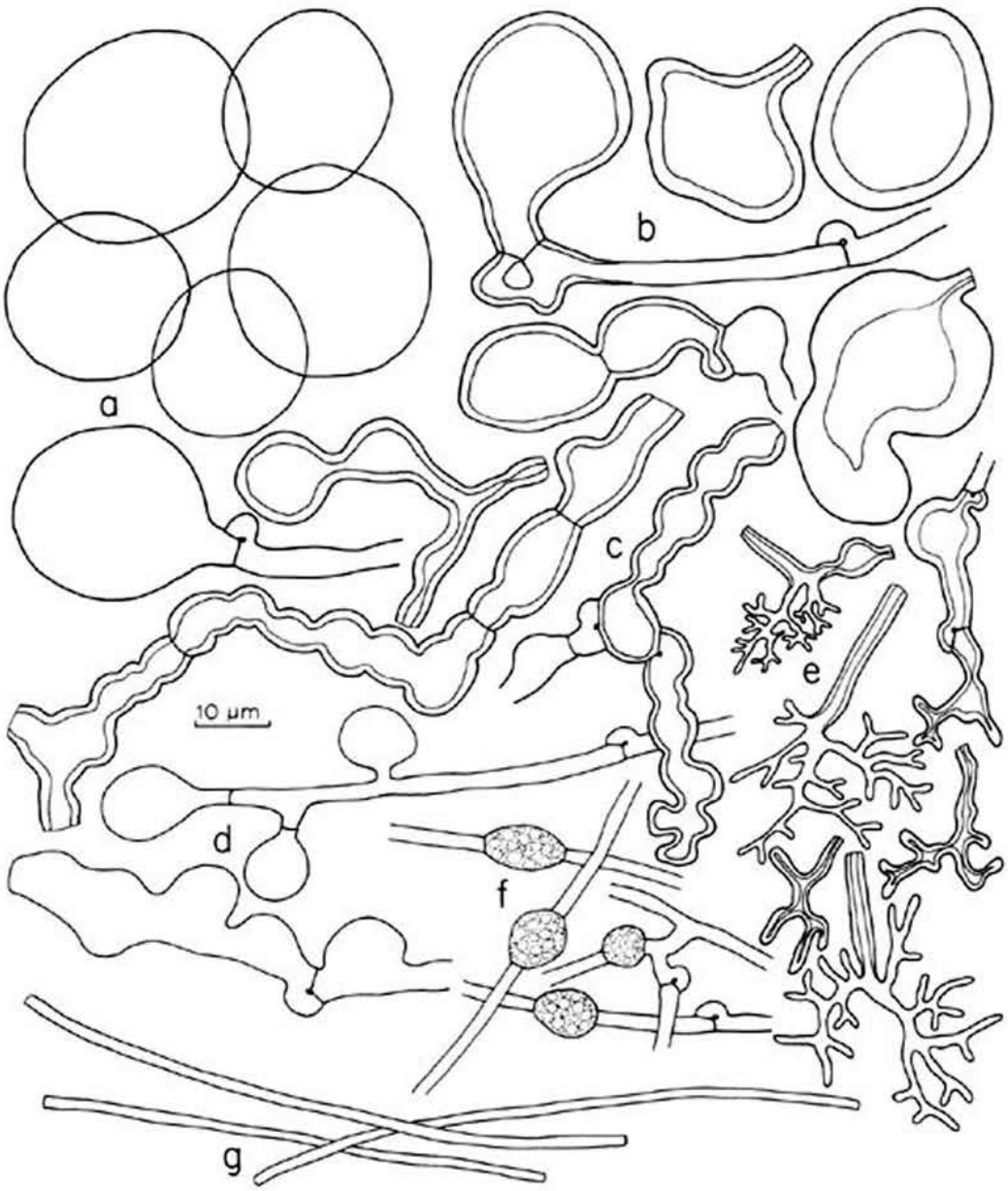

Fig. 4. Cultural characteristics of *Ganoderma meredithae* (JEA 395, holotype). a, thin-walled cuticular cells; b, thick-walled, amyloid cuticular cells; c, moniliform, amyloid, thick-walled hyphae; d, thin-walled hyphae with developing cuticular cells; e, staghorn hyphae; f, hyphal vesicles and generative hyphae; and g, fiber hyphae.

Cystidia or other sterile hymenial elements absent.

Basidia broadly clavate to subspherical, with a sharply narrowed base, 4-sterigmate, 22-26 X 13-16 µm.

Basidiospores ellipsoid, apex truncate with a germ pore, pale brown in KOH, wall two-layered with layers separated by inter-wall pillars, 9.5-11.5 X 5.5-7.0 µm.

Type of rot - White root and butt rot of living pines.

Substrata - Restricted to *Pinus*, causing a white root and butt rot of living trees and also continuing decay and fruiting on dead trees and stumps. Known from *Pinus taeda* L. (loblolly pine) and *Pinus glabra* Walt. (spruce pine).

Distribution - Apparently through the Gulf Coast region from east Texas to Georgia.

Specimens examined: JEA 395, R. Summers, on *Pinus taeda* L. (loblolly pine), USFS Stuart seed orchard, Pineville, Grant Parish, LA, Aug. 21, 1985 (Holotype); JEA 393, 394,397,399, same data; JEA 305, G.F. Joge, on *P. taeda* stump, Baton Rouge, East Baton Rouge Parish, LA, Nov. 20,1984; CMD 3, on *P. taeda* stump, Oct. 11, 1984; MB 2110, at base of living *P. glabra* Walt. (spruce pine), LSU campus, Baton Rouge, Oct. 26, 1984; MB 2249, on living *P. glabra*, LSU campus, Baton Rouge, July 10, 1985; MB 2086, on *P. taeda* stump, Baton Rouge, Sept. 21, 1984; JEA 345, C.M. Dugas, on *P. taeda* stump, Baton Rouge, July 17, 1985; E.W. Ross 279, on *Pinus* sp. stump, Athens, Clarke County, GA, July 27, 1969.

Cultural characteristics

Macroscopic: Growth moderate, malt extract agar (MEA) plates covered in 3-4 weeks; advancing zone bayed, aerial mycelium extending to limit of growth; mat white and remaining so for 3-4 weeks, with dense radiating and branching strands that give it a distinctly feathery or plumose appearance, eventually becoming Primuline Yellow-Xanthine Orange to Ochracheous Tawny, crustose and appressed, often becoming grooved or wrinkled; mycelium forming radiating, white, sinuous strands or cordons; reverse bleached and eventually darkening, becoming Burnt Sienna-Mahagony Red to Xanthine Orange under the mat; odor faintly fruity; on gallic acid medium reaction moderately strong to weak, growth 10-20 mm in 4 wk; on tannic acid medium reaction strong to moderately strong, growth 13-25 mm in 4 weeks; optimum temperature range 25-30 C on MEA, growth rate 3-5 mm/day; no growth above 35 C.

Microscopic: Hyphae of advancing zone hyaline, clamped, 2-5 (-7) µm in diam with thin walled, intercalary vesicles forming at irregular distances along hyphae; aerial mycelium with (1) some hyphae as in advancing zone; (2) fiber hyphae that are thick-walled, rarely branched, 1-2 µm in diam; (3) cuticular cells that are thin- to thick-walled, globose to irregular in shape, produced singly or in chains from swollen hyphae, variable in size, 15-23 (-25) X 6-14 µm, empty or filled with cytoplasm, thick-walled type strongly amyloid; (4) thick-walled, amyloid, moniliform hyphae in older cultures; (5) staghorn hyphae sporadically produced, not as abundant as those in cultures of *G. lucidum* and *G. tsugae*, apparently lacking in some cultures; hyphae of submerged mycelium as in advancing zone, crystals abundant to few; chlamydospores not produced.

Cultures examined: JEA 393,395,399; MB 2249.

Species code: 2,3,8,10,16,26,32,36,39,40,43,44,55 (Nobles, 1965).

Remarks: The cultural characteristics of *G. meredithae* do not fit those of any of the *Ganoderma* species described in detail by Nobles (1948).

DISCUSSION

Ganoderma collections from pine in the past have been referred to as *Ganoderma lucidum*, *G. curtisii* (Berk.) Murr. or *G. tsugae*. Our concept of *G. lucidum* is that it occurs only on hardwoods. It is consistently characterized in North America by production of distinctive chlamydospores in culture and an optimum temperature range of 30-35 C with some growth up to 42 C. *Ganoderma tsugae* occurs mainly on conifers and occasionally on birch in northern latitudes. It has an optimum growth temperature of 20-25 C and does not grow above 30 C. *Ganoderma tsugae* is a common species in the northeastern and northcentral United States and eastern Canada on *Tsuga* and in southwestern United States on *Abies*. These main hosts are associated with species of pine. However, *Ganoderma tsugae* has rarely been reported on pine in these regions. *Ganoderma meredithae* has an optimum growth temperature of 25-30 C, with growth up to 35 C, and produces plumose or feathery mats. Furthermore, *G. tsugae* and *G. meredithae* differ in morphology of pilocystidia and basidiospores (Adaskaveg and Gilbertson, 1988). It is not reasonable to consider the southern pine *Ganoderma* to be *G. tsugae*. *Ganoderma curtisii* has been recognized as distinct from *G. lucidum* by Overholts (1953) and others on the basis of having stipitate basidiocarps. However, it is established that *G. lucidum* and *G. meredithae* basidiocarps vary from stipitate to sessile and, at least with *G. lucidum*, cultures from sessile basidiocarps will produce stipitate ones (Adaskaveg and Gilbertson, 1986c). The neotype of *G. curtisii* at Kew has a part of the substratum adhering to it and we have identified this as hardwood bark, probably of oak. It is certainly not pine bark. Resinous zones considered by Steyaert (1980) to be an important character of *G. curtisii* are typical of *G. meredithae* but also occur in *G. lucidum*. The macro- and microscopic morphological characters of the neotype of *G. curtisii* fit our concept of *G. lucidum* and there is no reason to consider *G. curtisii* as anything other than a synonym of *G. lucidum* (Adaskaveg and Gilbertson, 1986c). Steyaert (1980) described *G. ravenelii* as a new species based on a portion of the former neotype of *G. curtisii*, considering that portion to have different spore and context morphology than the rest of the *G. curtisii* neotype. Our examination of the specimen designated as the holotype of *G. ravenelii* by Steyaert indicates that it does have spores that are more narrow than those of the *G. curtisii* neotype. Basidiospores of the *G. ravenelii* holotype are different from those of *G. meredithae* and are more like those of *G. zonatum*, a species found on palms from the southeastern United States (Adaskaveg and Gilbertson, 1986b). However, there is no information on the substratum of the *G. ravenelii* holotype. There is no reason to believe it was on pine and no reason to apply the name *G. ravenelii* to the pine *Ganoderma*. When all of the evidence from basidiocarp morphology, cultural characteristics, temperature relationships, substratum relationships, and geographical distribution are considered the only defensible and logical alternative is to consider the pine *Ganoderma* to be a species distinct from the other members of the *G. lucidum* complex in North America (Adaskaveg and Gilbertson, 1986a,b,c, 1988). Some species of *Ganoderma* on conifers (i.e., *G. carnosum* Pat., *G. atkinsonii* Jahn, Kotl. and Pouzar) from Europe and other regions unfortunately have not been characterized as to cultural morphology and it is not possible to draw any conclusions on the application of any of these names to North American *Ganoderma* species. Stalpers (1978) considers *G. valesiacum* Bourd. of Europe a

synonym of *G. tsugae*.

The distinguishing characteristics of *G. meredithae* are the restriction to pines, the frequently lobed or branched pilocystidia, the plumose or feathery mats produced in culture, the lack of chlamydospores, and the optimum growth temperatures of 25-30 C, intermediate between *G. lucidum* and *G. tsugae*. Its temperature relationships are similar to those of *G. zonatum* (Adaskaveg and Gilbertson, 1986a). However, *G. zonatum* differs in several respects including host specificity (on palms), distinctive, narrow basidiospores, and different cultural morphology.

ACKNOWLEDGMENTS

The authors would like to thank Dr. M. Blackwell for her collections and her enthusiastic interest in our studies of *Ganoderma* species; also R. Summers, G.F. Joge, C.M. Dugas, and E.W. Ross for their collections of *G. meredithae*.

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NOTICE:

IMC IV REGENSBURG 1990, PRELIMINARY ANNOUNCEMENT

Preliminary plans for the Fourth International Mycological Congress, to be held at the University of Regensburg, in West Germany, from 28 August to 3 September, 1990, have been announced.

The date also allows for an appropriate 200th anniversary commemoration of the death of Jakob Christian Schäffer, famous mycologist and citizen of Regensburg.

Participants will be housed in hotels in Regensburg. The city center is within walking distance of the university campus. Both pre-congress and post-congress forays, excursions, and sightseeing tours will be offered.

Further information may be obtained from:

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Universitätsstraße 31
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West Germany

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NOTICES:

BELTSVILLE SYMPOSIUM XIII
BIOTIC DIVERSITY AND GERMPLASM PRESERVATION : GLOBAL IMPERATIVES

A first announcement of this symposium to be held May 9-11, 1988 at Beltsville Maryland has been mailed. The program will include 26 invited papers, invited and contributed posters, and demonstrations of computer applications. To receive the second announcement address:

Mrs. J. Weirman
Room 127, Building 001
Beltsville Agricultural Research Center–West
Beltsville, MD 20705

ASPERGILLUS AND PENICILLIUM IDENTIFICATION WORKSHOP, 1988

A first circular on this workshop, organized by the Mycological Society of Japan, has been distributed. It is primarily a laboratory course, and will be held in the Sugadira Montane Research Center, University of Tsukuba, Sanada, Nagano Prefecture, Japan, from August 28–September 3, 1988, following the 5th International Congress of Plant Pathology to be held in Kyoto, August 20-28.

Participants will hear lectures and will examine and learn to identify some 100 common species of *Aspergillus, Penicillium,* and related teleomorphs.

Interested persons should immediately contact:

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