MYCOTAXON

AN INTERNATIONAL JOURNAL DESIGNED TO EXPEDITE PUBLICATION OF RESEARCH ON TAXONOMY & NOMENCLATURE OF FUNGI & LICHENS

Volume XXXV July-September 1989 No. ~~1~~ 2

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ISSN 0093-4666 MYXNAE 35 (2) 201-512 (1989)

Published quarterly by MYCOTAXON, LTD., P. O. Box 264, Ithaca, NY 14851.
For subscription details, availability on microfilm and microfiche, and availability of articles as tear sheets, see back cover.

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[MYCOTAXON for April-June 1989 (35(1): 1-200) was issued May 26, 1989.]

MYCOTAXON

AN INTERNATIONAL JOURNAL DESIGNED TO EXPEDITE PUBLICATION
OF RESEARCH ON TAXONOMY & NOMENCLATURE OF FUNGI & LICHENS

VOLUME XXXV, 1989

COMPLETE IN TWO QUARTERLY ISSUES,

CONSISTING OF v + 512 PAGES INCLUDING FIGURES

CO-EDITORS

Published by
MYCOTAXON, LTD., P.O. BOX 264
ITHACA, NY 14851, USA

Printed in the United States of America

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No. 1. April-June, 1989

No. 2. July-September, 1989

MYCOTAXON

Vol. XXXV, No. 2, pp. 201-204 July-September 1989

A NEW ASCOSPOROGENOUS YEAST GENUS: YAMADAZYMA GEN. NOV.

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Summary

The genus *Pichia* is very heterogeneous as to the coenzyme Q system: 67 species are characterized by a coenzyme Q7, 4 species by a coenzyme Q8 and 20 by a coenzyme Q9. We propose the new ascoporogenous genus *Yamadazyma* for those species equipped with the coenzyme Q_9 and with hat-shaped ascospores.

Since Hansen established the genus *Pichia* in 1904, the definition of this taxon has changed considerably in order to accommodate the ever increasing number of new species assigned to it. This genus was very heterogeneous and the ascospores appeared spheroïdal, hat-shaped or Saturn-shaped.

Kurtzman and Smiley (1974) transferred two round-spored species to the genus *Debaryomyces* because their ascospores appeared roughened and typical of *Debaryomyces* by scanning electron microscopy; furthermore, these species were Q9-equipped as all species of the genus *Debaryomyces* (Yamada and Kondo, 1972; Yamada et al., 1976). Kurtzman et al. (1980) transferred three other round-spored species to the genus *Issatchenkia*, because their ascospores appeared roughened; they were Q7-equipped (Yamada et al., 1973). Only four round-spored species remained in the genus *Pichia* (Kurtzman, 1984); these species were Q9-equipped and we have suggested to transfer them to the genus *Debaryomyces* subject to investigating their ascospores by scanning electron microscopy (Billon-Grand, 1988).

The species with Saturn-shaped ascospores were proposed by Kurtzman (1984) for transference to the genus *Williopsis* Zender, as Von Arx et al. (1977) did for the Saturn-spored *Hansenula* species.

Among the 85 *Pichia* species with hat-shaped ascospores, 65 species are characterized by a coenzyme Q7, 4 species by a coenzyme Q8 and 16 species by a coenzyme Q9 (Yamada et al., 1973, Billon-Grand, 1985). In order to clarify the taxonomy of the genus *Pichia*, we propose a new ascosporogenous yeast genus for the 16 species equipped with the CoQ_9 system and with hat-shaped ascospores: the genus *Yamadazyma*, gen. nov.

This genus is named in honour of Professor Yuzo Yamada, Shizuoka University, Department of Agricultural Chemistry, Applied Microbiology Laboratory, Shizuoka, Japan, in recognition of his contribution to yeast taxonomy, especially his studies of the coenzyme Q system of asporogenous and ascosporogenous yeasts.

Latin diagnosis:

Cellulae globosae vel cylindricae per gemmationem multilateralem propagant. Pseudohyphae praesentes. Ascosporae pileiformes, 1 to 4 in quoque asco. Ascosporae maturae ex ascis liberantur. Fermentatio adest. Ad crescentiam vitaminae externae necessariae sunt. Systema coenzymatis Q9 adest.

Species typica: *Yamadazyma philogaea* (Van der Walt et Johannsen) Billon-Grand.

Cells are globose to cylindrical, reproducing by multilateral budding. Pseudophyphae are present. Ascospores are hat-shaped, 1 to 4 per ascus. Mature spores are easily released from the ascus, except for one species. Fermentation is usually present. Growth in vitamin free medium is usually negative. The coenzyme Q system is Q9.

The type species is: *Yamadazyma philogaea* (Van der Walt et Johannsen) Billon-Grand, comb. nov. (basionym: *Pichia philogaea* Van der Walt et Johannsen, Antonie van Leeuwenhoek, **41**: 173, 1975); type strain: CBS 6696.

The 15 other species of the new genus *Yamadazyma* are:

-*Yamadazyma acaciae* (Van der Walt) Billon-Grand, comb. nov. (basionym: *Pichia acaciae* Van der Walt, Antonie van Leeuwenhoek, **32**: 159, 1966); type strain: CBS 5656.

-*Yamadazyma besseyi* (Kurtzman et Wickerham) Billon-Grand, comb. nov. (basionym: *Pichia besseyi* Kurtzman et Wickerham, Antonie van Leeuwenhoek, **38**: 50, 1972); type strain: CBS 6343.

-*Yamadazyma castillae* (Santa Maria et Garcia Aser) Billon-Grand, comb. nov. (basionym: *Pichia castillae* Santa Maria et Garcia Aser, Bol. I.N.I.A., **62**: 53, 1970); type strain: CBS 6053.

-*Yamadazyma farinosa* (Lindner) Billon-Grand, comb. nov. (basionym: *Saccharomyces farinosus* Lindner, Wochenschr. Brau., 153, 1894); type strain: CBS 185.

-*Yamadazyma guilliermondii* (Wickerham) Billon-Grand, comb. nov. (basionym: *Pichia guilliermondii* Wickerham, J. Bacteriol., **92**: 1269, 1966); type strain: CBS 2031.

-*Yamadazyma haplophila* (Shifrine et Phaff) Billon-Grand, comb. nov. (basionym: *Pichia haplophila* Shifrine et Phaff, Mycologia, **48**: 45, 1956); type strain: CBS 2028.

-*Yamadazyma inositovora* (Golubev, Blagodatskaya, Suetin et Trotsenko) Billon-Grand, comb. nov. (basionym: *Pichia inositovora* Golubev, Blagodatskaya, Suetin et Trotsenko, Inter. J. System. Bacteriol., **31**: 91, 1981); type strain: CBS 8006.

-*Yamadazyma media* (Boidin, Pignal, Lehodey, Vey et Abadie) Billon-Grand, comb. nov. (basionym: *Pichia media* Boidin, Pignal, Lehodey, Vey et Abadie, Bull. Soc. Mycol. France, **80**: 438, 1966); type strain: CBS 5521.

-*Yamadazyma mexicana* (Miranda, Holzschu, Phaff et Starmer) Billon-Grand, comb. nov. (basionym: *Pichia mexicana* Miranda, Holzschu, Phaff et Starmer, Inter. J. System. Bacteriol., **32**: 103, 1982); type strain: CBS 7066.

-*Yamadazyma nakazawae* (Kodama) Billon-Grand, comb. nov. (basionym: *Pichia nakazawae* Kodama, J. Ferment. Technol., **53**: 626, 1975); type strain: CBS 6700.

-*Yamadazyma ohmeri* (Etchells et Bell) Billon-Grand, comb. nov. (basionym: *Endomycopsis ohmeri* Etchells et Bell, Food Technol., **4**: 81, 1950); type strain: CBS 5367.

-*Yamadazyma scolyti* (Phaff et Yoneyama) Billon-Grand, comb. nov. (basionym: *Endomycopsis scolyti* Phaff et Yoneyama, Antonie van Leeuwenhoek, **27**: 201, 1961); type strain: CBS 4802.

-*Yamadazyma segobiensis* (Santa Maria et Garcia Aser) Billon-Grand, comb. nov. (basionym: *Pichia segobiensis* Santa Maria et Garcia Aser, Bol. I.N.I.A., **5**: 49, 1977); type strain: CBS 6857.

-*Yamadazyma spartinae* (Ahearn, Yarrow et Meyers) Billon-Grand, comb. nov. (basionym: *Pichia spartinae* Ahearn, Yarrow et Meyers, Antonie van Leeuwenhoek, **36**: 505, 1970); type strain: CBS 6059.

-*Yamadazyma stipitis* (Pignal) Billon-Grand, comb. nov. (basionym: *Pichia stipitis* Pignal, Bull. Soc. Linéenne Lyon, 4: 168, 1967); type strain: CBS 5773.

The genus *Yamadazyma* is placed in the family *Endomycetaceae*.

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MYCOTAXON

Vol. XXXV, No. 2, pp. 205-210 July-September 1989

LEPTOSPHAERIA PIMPINELLAE AND ITS PHOMA ANAMORPH

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On a trip to Israel in 1987, R. Lowen collected a *Leptosphaeria* on blackened stems of *Pimpinella anisum* L. that does not fit any published descriptions (Holm, 1957; Müller, 1950; Shoemaker, 1984). A *Phoma* anamorph was derived from cultures of single ascospores and was also subsequently found on the host. The holomorph is described and illustrated.

Leptosphaeria pimpinellae Lowen & Sivanesan sp. nov. (Figs. 1,2)

Anamorph: *Phoma* sp.

Ascomata dispersa vel aggregata, aliquando confluentibus, immersa, saepe superficialia, atra, globosa, basali compressa, 300-400 μm lata, usque 500 μm alta, cum pilis sparsis dispersus, sine colore. Rostrum pleurumque uni et centralis, raro binis, 60-60 μm altis, sine periphyses. Ostiolum apicali, 25-70 μm latis. Paries ascomati brunneis,textura angularis, 50-75 μm latis, ex cellulis interno scleroplectenchymatis, externo pseudoparenchymatis compositus. Pseudoparaphyses numerosae, filiformes, septatae, sine colore, ramosae, 1.5 μm lata. Asci bitunicati, clavati, brevipedicellati, octospori, 90-120 X 14-16 μm. Ascosporae biseriatae vel multiseriatae in asco, fusiformes, 5-6(-10) transversaliter septatae, in medio constrictae aliquando ceterus septa, pallide brunneae, guttulatae, laeves, rectus vel leviter curvata, 50-65 X 5.5-6.5 μm, cum appendiculatae globosus, terminalis, gelatinoso, raro strato tenui gelatinoso totam sporam cingens. Conidiomata pycnidia, ascomata similis, parva, usque 300 μm diam, roseus contentu. Conidia brevicylindrica, aseptata, biguttulata, sine colore, 4-4.5 X 1.2-1.8 μm.

Holotype: Israel: Mt. Carmel, Beit Oren Forest, wadi near Kibbutz Oren. On dead, blackened, still standing stems of Pimpinella anisum L., 9 Dec 1987, R. Lowen 523-88, NY; Isotype IMI 328948.

Ascomata scattered to gregarious, sometimes confluent, immersed, becoming superficial, black, globose with a flattened base, 300-400 µm wide, up to 500 µm high, with sparse, scattered colorless hairs. Beak usually one and central, rarely two, approximately 60 x 60 µm high, without periphyses. Ostiole apical, 25-70 µm wide. Peridium surface brown, textura angularis, in longitudinal section 50-75 µm thick, of six to nine layers of scleroplectenchymatous cells toward the outside and pseudoparenchymatous cells toward the inside. Pseudoparaphyses numerous, septate, colorless, branched, up to 1.5 µm thick. Asci bitunicate, clavate, short-stalked, 8-spored, 120 x 14-16 µm. Ascospores biseriate to multiseriate in the ascus, fusiform, transversely 5-6(-10) septate, constricted in mid septum, occasionally in other septa, pale brown, guttulate, smooth, straight to slightly curved, 50-65 x 5.5-6.5 µm, with a globose, terminal, mucilaginous appendage at each end, rarely surrounded by a thin mucilaginous sheath. Conidiomata pycnidial, similar to ascomata, up to 300 µm diam, contents pink. Conidia short cylindrical, aseptate, biguttulate, colorless, 4-5.5 x 1.2-1.8 µm, formed on phialidic conidiogenous cells 6-12 X 3 µm at the base, tapering to 1 µm at the apex, apex flared, arising from cells lining the cavity of the pycnidium.

Culture study: Cultures were grown on CMD (cornmeal dextrose agar, Difco) and OM (oat meal agar, Smith and Onions, 1983) in diffuse daylight at 20°C. Ascospores germinating from one or both end cells, sometimes from the other cells, remaining viable after being frozen at 0°C for 24 h. Mycelium immersed, forming black, rhizoidal branching strands on CMD, much white aerial mycelia on OM, leading edge irregular, reverse black. Irregular conidiomata forming in one week at sites of mycelial aggregation, oozing copious pink slime containing conidia. Conidiomata becoming more regular after 6 weeks in culture, often 125-250 µm diam.

Leptosphaeria planiuscula (Reiss.) Ces. & De Not. is the closest species to L. pimpinellae with terminal appendaged ascospores but the ascospores are 5-septate,

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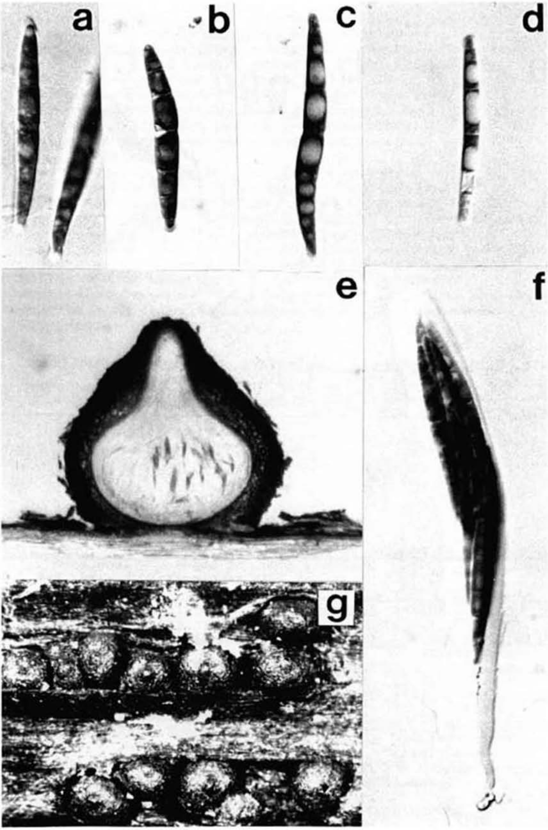
Fig. 1. Leptosphaeria pimpinellae, teleomorph. a-d. ascospores (X 1000); e. section of ascoma (X 100); f. ascus (X 1000); g. ascomata on host (X 25).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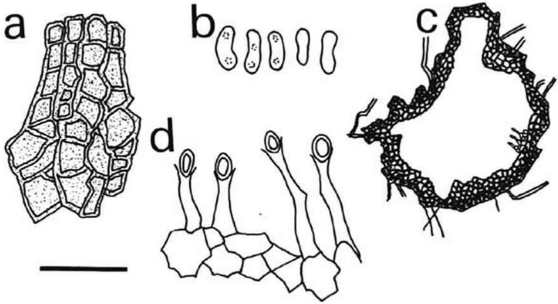

Fig. 2. *Leptosphaeria pimpinellae*, anamorph. a. cells on surface of peridium; b. conidia; c. section of conidioma; d. conidiophores with developing conidia. Bar a,b,d = 10 µm; c = 100 µm.

Table 1.
Comparison of species of *Leptosphaeria* on members of Umbelliferae

Species	Host	No. of septa in ascospore	Ascospore size (µm)
L.cornuta E.Müller (1953)	*Laserpitium*	4(-5)	35-45 X 5
L.foeniculacea Fabre (1883)	*Foeniculum*	4(-5)	40 X 6
L.foeniculi Gonz. (1924)	*Foeniculum*	4(-5)	18-24 X 5-7
L.ladina E.Müller (1950)*	*Laserpitium*	6-8	40-60 X 6-8
L. libanotis (Fuckel)Neissl in Kunze (1876)	*Angelica, Daucus, Seseli*	3	18-22 X 5.5-7
L.pimpinellae Lowen & Sivan.(1989)	*Pimpinella*	5-6(-10)	50-60 X 5.5-6.5
L.sileris Bres. (1926)	*Laserpitium*	3-5	36-50 X 4-5
L.simmonsii Sacc. (1920)	*Heracleum*	3	35-40 X 4.5

**Nodulosphaeria ladina* (Müller) Holm (1957) asci distinctly 4-spored (Shoemaker, 1984), and an anamorphic state is lacking. Many species of *Leptosphaeria* with *Phoma* anamorphs have been described (Sivanesan, 1984). Among these *L. acuta* (Fuckel) P. Karst. appears to be the most similar to *L. pimpinellae* in the ascospore and conidial morphology. Terminal appendages and sheaths, however, are not found on the ascospores. Although conidial morphological differences are insignificant between these two species, similar minor differences are also generally true between many species of *Phoma* which have been distinguished mainly on host basis. Furthermore *L. acuta* is restricted to species of the host genus *Urtica*. The host *Pimpinella* is a member of the family Umbelliferae. About eight species of *Leptosphaeria* (see table 1) have been described on other members of this family. All species except *L. ladina* E. Müller (1950) have typically 3- or 4- or rarely 5-septate ascospores. The ascospores in *L. ladina* are 6-8-septate with terminal appendages but the third cell is conspicuously enlarged.

We wish to thank C.T. Rogerson for his helpful comments and M.E. Barr Bigelow and R.A. Shoemaker for serving as pre-submission reviewers.

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Vol. XXXV, No. 2, pp. 211-218 July-September 1989

ASCOSPHAERA TENAX SPECIES NOVA AND A VARIANT OF *ASCOSPHAERA AGGREGATA*

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SUMMARY

Ascosphaera tenax sp. nov. with tough and leathery spore cysts is described. The fungus was found feeding saprophytically in association with *Megachile willughbiella*. Further, some atypical chalkbrood symptoms on *M. rotundata* larvae are found to be caused by a variant of *A. aggregata*.

INTRODUCTION

Eighteen years ago, nesting cells of the leafcutter bee *Megachile willughbiella* Kirby were collected from a rotten door rail at Søllested, Lolland (Holm & Skou, 1972), and infection with *Microascus exsertus* Skou (≡ *Pithoascus exsertus* (Skou) v. Arx, 1973) (Skou, 1973) was found during experimental rearing of the bees. Nesting cells of *M. willughbiella* with *M. exsertus* were found again in October 1984 in a rotten garden seat at Lindenborg, Zealand and in August 1985 in a dry-rotten tree stump at Nekselø (a small island close to the northwestern coast of Zealand). At these sites, an undescribed *Ascosphaera* species was found together with *M. exsertus* (Fig. 1a) (Skou, 1986).

Further, Nørgaard Holm received in March 1987 and in February 1988 collections of dead larvae of the alfalfa leafcutter bee *M. rotundata* (Fabr.) from J. Jakobsen, Tilley, Alberta, Canada, who had obtained the collections from "The Cocoon Testing Laboratory" in Brooks, Alberta, Canada. The larvae were sorted in boxes in regard to their symptoms. J. Jakobsen, Alterba, and Professor W.P. Stephen, Oregon (pers. comms), have recorded mortalities as high as 17% and 30%, respectively, due to chalkbrood diseases in populations of *M. rotundata* in southern Alberta. However, these diseases seem to be uncommon in the leafcutter bee populations of the bee producers in general according to Richards (1985) and Fairey & Lieverse (1987).

The results of examination of these collections are presented below.

MATERIALS AND METHODS

The material examined comprised a small sample of *Megachile willughbiella* Kirby cocoons from Lindenborg (1984) and a larger one from Nekselø (1985) infected with an undescribed *Ascosphera* species. Further, two collections of hundreds of dead larvae of the alfalfa leafcutter bee *M. rotundata* (Fabr.) were obtained from "The Cocoon Testing Laboratory", Brooks, Albertą, Canada, by J. Jakobsen (1987, 1988). *M. rotundata* larvae from the Department of Crop Science, Tåstrup, were used for an infection test with spores from the Canadian larvae.

A small test was set up using *M. rotundata* larvae reared on sterilized pollen diet (Nelson et al., 1972) with aureomycin. Ca. 100 mg diet was placed in each of 30 microwells (γ-ray sterilized Nunclon Delta SI box with 8 x 12 microwells). Spore cysts from the Canadian larvae were separated after removal of the larval skin, crushed and mixed with 1 ml of the diet. A drop of the resulting spore suspension was placed on top of the diet in each of 25 of the microwells. An egg or a newly hatched larva was transferred unsterilized to all 30 microwells.

Test for growth of the fungi were made on common media and on the special sugar rich media used for species of *Ascosphaera* (Skou, 1988).

The measurements were made with an ocular screw micrometer.

RESULTS

Ascosphaera tenax **Skou *et* Holm sp. nov.**

Etymology: 'tenax' = tough. This epithet refers to the inner membrane of the spore cysts which are tough and leathery as opposed the vitreous fragile consistency of the inner membrane in the other described species.

Descriptio: *Sporocystae nigrae vel brunneae, globosae, 33 - 67 - 105 µm magnae, 86 pro 100 inter 40 et 90 µm. Membrana externa hyalina, gelatinosa, sine colore et membrana interna translucenti brunnea, levis, tenax et coriacea, 1.5 µm crassa. Globuli sporarum sphaerici, 7.7 - 11.9 - 15.4 µm magni, 89.5 pro 100 inter 9.0 et 14.0 µm. Ascosporae unicellulares, naviculares vel subfalcatae et diametienti parum triangulatae, 0.6 - 0.7 - 0.9 x 1.9 - 2.7 - 3.5 µm magnae; ratione longitudinis pro latitudine ita 3.9. Status anamorphosis non observatus.*

Habitat in chrysalibus, cibaria et faecibus Megachilis willughbiellae Kirby *et Megachilis rotundatae* (Fabr.).

Holotypus anno 1985 in chrysalibus Megachilis willughbiellae in insula Nekselø, Dania lectus, in Museo et Herbario Hauniensi (C) depositus.

Description: The spore cysts are lustrous black or infrequently dark brown, globose, 33 - 67 - 105 µm with 86% between 40 and 90 µm (Fig. 1b). The outer membrane hyaline, gelatinous and colourless. The inner membrane dark brown in translucent light, smooth, tough and leathery, 1.5 µm thick and structureless in fraction (Fig. 1e and 1f). Spore balls globose, 7.7 - 11.9 - 15.4 µm with 89.5% between 9.0 and 14.0 µm (Fig. 1c). Ascospores one-celled, boat-shaped or sub-falciform when seen from the side, tending to be triangular in cross section - almost like a piece of orange, 0.6 - 0.7 - 0.9 x 1.9 - 2.7 - 3.5 µm with little variation (Fig. 1d and 1e). Length-to-width ratio: 3.9. Anamorph state not observed.

Habitat in cocoons, provisions and faecal pellets of *Megachile willughbiella* and *M. rotundata*.

Holotype in cocoons of *Megachile willughbiella* from Nekselø island, Denmark 1985 is deposited in the Botanical Museum and Herbarium, Copenhagen, Denmark (C).

Materials examined: Leaf cells with cocoons of *M. willughbiella* were collected from excavated tunnels in a rotten garden seat at Lindenborg and a dry-rotten tree stump at Nekselø. A number of cocoons from these sites were examined (Tab. 1).

Table 1. Distribution of fungi in cocoons of *Megachile willughbiella* from Nekselø (40) and Lindenborg (4)*.

Number of cocoons	*Ascosphaera tenax*	*Microascus exsertus*	*Eurotium* sp. (*Aspergillus* sp.)
5	+		
11	+	+	
1	+	+	+
26		+	
1	+		+
44	18	38	2

* Further, three cocoons with dead bees and two empty cocoons were without fungi.

Further, *A. tenax* was found in a few cases in cocoons of *M. rotundata* in the summer of 1988 at the Department of Crop Science, Tåstrup.

It seems characteristic that some unbroken spore cysts are empty. The pressure necessary in order to open the tough and leathery spore cysts may crush the spore balls or make them flatten out as the spores are kept together by a mucous substance.

A. tenax was found feeding saprophytically in cocoons with living larvae or infrequently on dead larvae where they most likely just grow *post mortem*. It seems more likely that *M. exsertus* may have killed the larvae.

The mycelium is intermingled with the rough silky web of the cocoons where there also are many spore cysts. Spore cysts now and then form a whole tapestry on the inner side of the cocoons, obviously without doing any harm to the larva inside. Fewer spore cysts occur on the outside of the cocoons but they are common on the pollen and faecal pellets beneath the inside of the leaf cap.

Hitherto, no growth on artificial media.

The Canadian collections

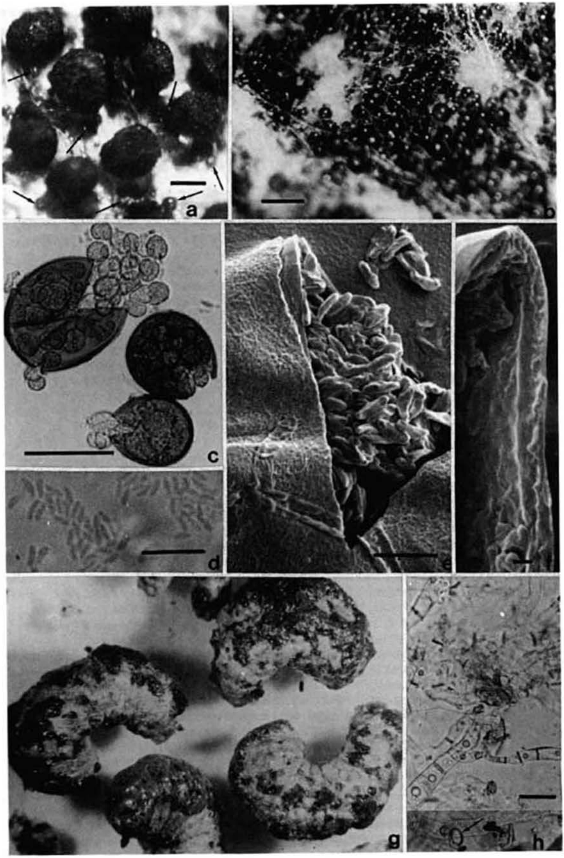
The larvae of *M. rotundata* from the two Canadian collections may be separated in four categories on the basis of their symptoms. The larvae vary in size but most of those in the first three categories are considered to be in the last instar whereas many of those in the fourth category are dead at an earlier state of development:

Category 1. Larvae with the ragged appearence of attack with *A. aggregata* Skou due to rupture of the brittle cellophane-like skin covering the closely aggregated black spore cysts all over the body (Skou, 1975; Fairey et al., 1985). All the spore cysts are filled with spores resulting in an enormous spore production from each dead larva.

Category 2. Beige to tan larvae with small and larger black boils caused by groups of spore cysts (Fig. 1g). The larval skin over these boils may or may not be cellophane-like. Most of the spore cysts appear angular in cross section and are conical like those of the first category but contrary to them, they are easily separable and have one or more depressions caused by pressure from the adjacent spore cysts. Most of the spore cysts with depressions are empty or almost empty for which reason the spore production with this type of attack is much less than in the case of the common attack with *A. aggregata*.

A small infection test was set up as described under Material and Methods. The symptoms described above developed on five of the 25 larvae in the microwells with diet infested with spores from category 2 larvae and none devel-

Figure 1a-f. *Ascosphaera tenax*. **a**: Spore cysts between perithecia of *Microascus exsertus* (arrows pointing on examples), x 35 bar = 200 µm. **b**: Spore cysts on pollen, x 45 bar = 200 µm. **c**: Broken spore cyst with spore balls, x 350 bar = 50 µm. **d**: Ascospores, x 1250 bar = 10 µm. **e**: SEM micrograph of a broken spore cyst, x 2500 bar = 5 µm. Note the two wall membranes with the tough and leathery appearence and the boat-shaped, triangular ascospores. **f**: SEM micrograph of the 1.5 µm thick inner membrane, x 4000 bar = 1 µm. **g**: Larvae of *Megachile rotundata* with boils caused by the variant of *Ascosphaera aggregata*, x 7. **h**: Non-sporulating *Ascosphaera*-mycelium from a larva of *M. rotundata*, x 300 bar = 25 µm. Note the conspicuous septa that persist after colapse of the mycelium - often as a ring, see arrow.


a
b
c
d
e
f
g
h

oped the common symptoms of attack with *A. aggregata*. *A. atra* Skou & Hackett developed on the diet in one well and some of the other wells were overgrown with yeast.

Comparison of the size of the ascospores from this test and the Canadian collection from 1988 with that of *A. aggregata* showed no significant difference whereas the comparison showed that a part of the Canadian collection from 1987 had ascospores with a somewhat larger diameter.

Larvae with this variant of *A. aggregata* are deposited at the Botanical Museum and Herbarium, Copenhagen (C).

Catagory 3. Beige to brown larvae without any spore cysts. An examination showed that they are filled with mycelium with the characteristic very conspicuous persistent septa of most of the *Ascosphaera* species (Fig. 1h) (Skou, 1988).

Category 4. Black or almost black larvae - a colour that is often obtained by larvae dead for various reasons. Many of these larvae appear sticky as if they have been immersed in a semi-liquid provision. Little mycelium was found with the microscopic examination of these larvae. When mycelium was present, it did not clearly show the *Ascosphaera*-type of septa and surface sterilized cut larvae plated on agar medium gave only *Aspergillus, Penicillium, Rhizopus* and yeast species (cf. Richards, 1985).

DISCUSSION

There is no direct contact between the sites of collection as Lindenborg and Nekselø lay 103 and 110 km apart, respectively, from the site of origin (Søllested, Lolland) of *M. exsertus* (Skou, 1973), and about one third of this is across the sea. Further, the distance between these two sites is 43 km. This might indicate that the fungi frequently occur in association with *M. willughbiella*. Besides, it was ascertained that the bees have nested in the dry-rotten tree stump for years, where *A. tenax* and *M. exsertus* have had good possibilities to accumulate.

It is clear that *A. tenax* grow on pollen and faecal pellets but the intermingling of mycelium and cocoon web, and the large number of spore cysts on the inside of the cocoon - obviously without affecting the bee larva - is hard to understand unless the fungus thrive also on the probably proteinaceous web of the cocoon.

One may wonder how the well protected spores come out of the leathery spore cysts. They may come out and spread when the bee make its way out of the cocoon.

The symptoms described for category 2 of the Canadian collections seem not to have been mentioned in the literature unless it is the "mottled appearence" and "mottled cream and black" mentioned by Vandenberg & Stephen (1982) and Richards (1985), respectively. It may be that these symptoms also occur on a figure in the paper of Stephen & Undurraga (1978, Fig. 1).

The small infection test made by us only indicate that the symptoms on the larvae and the appearence of the fungus may be reproduced. More investigations are necessary to clarify if it may be a special strain or a variety of *A. aggregata* in question or if the reason may be something else.

It is common to find a few empty spore cysts in *Ascosphaera* species in nature, but we have never seen anything like that occurring in category 2 of the Canadian collections.

The occurrence of spore cysts with somewhat thicker spores in the Canadian 1987-collection is in accordance with that found in another Canadian collection (Youssef et al., 1985). It might be a question of young spores as proposed by Liu (1987) for *A. apis* (Maassen & Claussen) Olive & Spiltoir but the spores cannot lie about and later unite into spore balls as he asserted. The spores are from the beginning joined together and surrounded by an evanescent membrane (cf. McManus & Youssef, 1984; Skou, 1988) and not without an apparent membrane as maintained by Richards (1985) and Liu (1987).

As noted by Richards (1985), it is inadequate to diagnose different *Ascosphaera* species on the mycelial growth or hyphal characteristics but the conspicuous persistent septa make their mycelia different from that of many other fungi (Fig. 1h) (Skou, 1988).

A. atra, that occurred in the infection test, most likely have been carried along with the Canadian collections (cf. Richards, 1985) though this species is found also in Denmark.

The authors are indebted to Dr Georg Kovács for assistance with the Latin text and to J.B. Bilde-Sørensen and Helmer Nilsson for preparation and operating the SEM microscope.

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MYCOTAXON

Vol. XXXV, No. 2, pp. 219-227 July-September 1989

SCUTELLOSPORA BIORNATA: A NEW SPECIES IN THE ENDOGONACEAE FROM THE LLANOS ORIENTALES OF COLOMBIA

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SUMMARY

Scutellospora biornata, a mycorrhizal fungus, was isolated from associations with native grasses. Two ornamented walls distinguish it from other species in the genus. Novelties related to the germination shield are discussed as well as the deformation of the laminated wall caused by common mountants.

RESUMEN

Scutellospora biornata, un hongo micorrizógeno que fué encontrado en asociación con gramíneas, tiene esporas con dos paredes ornamentadas que lo distingue de otras especies del género. En la descripción se incluyen aspectos nuevos relacionados con el escudo germinativo. También se discute la deformación de la pared laminada de las esporas en medios de montaje.

INTRODUCTION

Spores from vesicular-arbuscular mycorrhizal associations with native grasses were isolated over a period of years at the Centro Nacional de Investigaciones Agropecuarias (ICA-CIAT) at Carimagua, Meta. Several new species were previously described from this location (Schenck et al., 1984; Schenck et al., 1986). A Scutellospora species having two ornamented walls is described in this paper.

Refer to Spain et al. (1989), for the use of the terms sporogenous cell and sporophore.

DESCRIPTION

Scutellospora *biornata* Spain, Sieverding & Toro sp. nov. Figures 1-3.

Sporae singillatim in solo ennatae, globosae, (120-) 260-450 (-493) µm diam., flavae vel badiae. Paries sporae e stratis quinque vel sex (primum ad sextum) congregatis in turmis duobus. Turma externa cum stratis tribus (primum ad tertium): stratum primum brunneolo-flavum, solidum, 0.5-1 µm crassum cum ornamentatione e papillis rotundatis (0.5-) 1-3 µm diam. usque ad 2 µm longis; stratum secundum hyalinum lamellatum, (5-) 6-10 µm crassum; stratum tertium membranosum, hyalinum, 0.5-1 µm, cum ornamentatione simile strati primi. Turma interna hyalina cum stratis duobus vel tribus (quartum ad sextum). Stratum quartum membranosum, <0.5 µm crassum, saepe absens; stratum quintum membranosum, <0.5-1 µm crassum; sextum solidum, 1-2 µm crassum. Stratum secundum in solutione cum lactophenolio tumescens. In solutione Melzeri, stratum secundum purpureum colorans, stratum sextum pallide ruber. Cellula sporogenea fusca, (30-) 50-60 (-65) µm diam. Cellulae auxiliares generatim napiformes in fasciculo; cellula auxiliaris cum nudis. Germinatio sporae propria generis: plicatum spatium fuscum, inter stratum quintum et sextum efformatum, (113-) 188-238 X (113-) 188-275 µm diam. Usque ad 20 loci tuborum germinalerum, separati inter se per fissuras nigro-brunneas.

SPORES: borne singly in soil; globose, (120)260-450(-493) µm diam. or sub-globose 282-384 X 341-415 µm (measured in water); translucent, yellowish-brown to brown.

SPORE WALL STRUCTURE (spores ruptured and measured in water, Figs. 1A-E; 2): 6 walls, 8-15 µm thick, in two groups. Group A, 6-12 µm thick, of 3 walls: wall 1 unit wall, 0.5-1 µm thick, brown, ornamented on outer surface with noncontiguous blunt tapering projections from (0.5-)1-3 µm diam. at base up to 2 µm long, fused to wall 2. Wall 2 hyaline to sub-hyaline (up to 15 laminae), (5-)6-10 µm thick, adherent to wall 3. Wall 3, hyaline, membranous, 0.5-1.0 µm thick, ornamented on inside with blunt projections, 0.5-1 µm diam. to 2.0 µm long, generally smaller and more dense than projections on wall 1. Group B, 2-3 µm thick, of hyaline walls 4,5 & 6. Wall 4 membranous, <0.5 µm thick, rarely present; wall 5, membranous <0.5-1 µm thick, less elastic than adherent pliable unit wall 6, 1-2 µm thick.

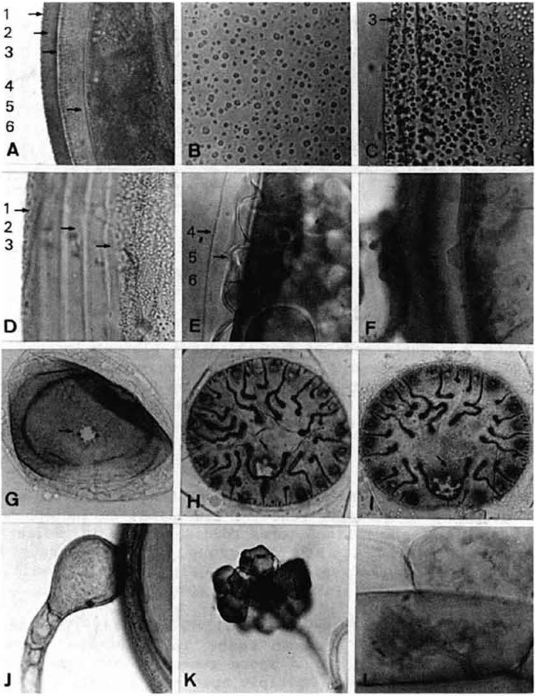
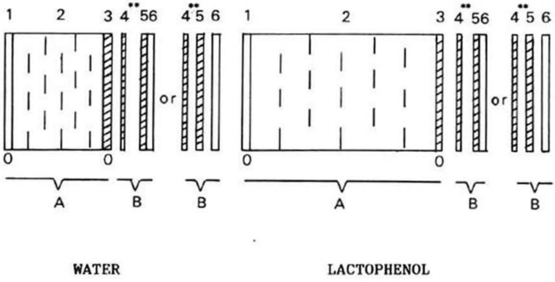


Figure 1. *Scutellospora biornata*. A) Wall groups A (1-3) & B (4-6) in water 200X. B) Wall 1 ornamentation, 1000X. C) Wall 3 ornamentation 1000X. D) Group A (1-3) in lactophenol; laminated wall 2 grossly expanded, 400X. E) Group B (4-6), Melzer's reagent, 1000X. F) Remnant on wall 6 of connection with sporogenous cell, 1000X. G) Aperture in wall 6 for formation of germination shield, Melzer's reagent, 200X. H) Germination shield: 'Y' configuration around aperture, 400X. I) Germination shield: 'U' configuration around aperture, 400X. J) Sporogenous cell of sporophore, 200X. K) Knobby auxiliary cells, 400X. L) Arbuscule in cortical cell of *Puereria phaseoloides*, 1000X.



** Rarely present

Figure 2. Murographs of Scutellospora biornata spores in water and lactophenol. Six walls in two groups: walls 1 & 3, group A, ornamented; wall 4**, group B, rarely present. Laminated wall 2, group A, deformed by reaction to lactophenol.

REACTION TO MOUNTANTS AND MELZER'S REAGENT: laminated wall 2, group A, is strongly reactive (swelling) to lactophenol (Figs. 1D; 2) and PVL and turns reddish-purple in Melzer's reagent. Walls 4, 5 & 6, group B, can separate in lactophenol and Melzer's reagent (Figs. 1E; 2); wall 6 turns light to deep pink.

GERMINATION SHIELD (Figs. 1G-I; 3): brown, (113-)188-238 X (113-)188-275 µm, cresent shape in x-section, formed between walls 5 and 6. A spore generally has one shield although two can form. Multiple apertures in wall 6 may be present (internal or external to the developed shield). Greatest pigment concentration around germ tube initials, aperture, Y & U configurations and other fissures. Germ tube initials, numbering (6)12-20 ($\bar{x}$ 17), 6-7 µm diam., generally separated from each other by a long fissure.

GERMINATION TUBE, light brown, coenocytic, 15-20 µm diam. proximate to shield narrowing to 9-14 µm diam., wall 1-1.5 µm thick. A single germ tube usually emerges at germination.

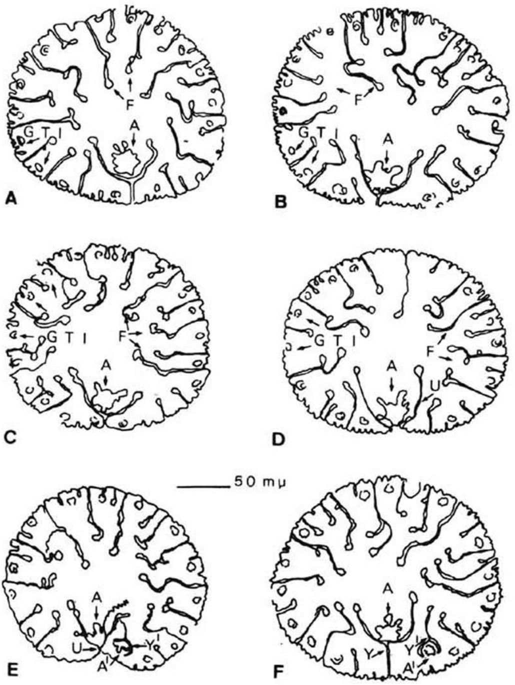


Figure 3. Scutellospora biornata germination shields, plan view (camera lucida drawings). A-F) Germ tube initials (GTI) generally separated by long fissures (F). A-C & F) 'Y' (Y) configuration around aperture (A). D & E) 'U' (U) configuration around aperture (A). E & F) Aborted shield with a small aperture (A') and rudimental 'Y' (Y') configuration within developed shield.

SPOROGENOUS CELL: apical cell of the sporophore, brown, (30-)50-60(-65) µm diam.; 1-3 walls totalling 2-4 µm thick; spore initial site generally apical (Fig. 1J); hyphal branches (pegs) may be present. Projections, somewhat larger than the ornamentation on the outer surface of the spore, may be present on the innermost wall.

SPOROPHORE: brown, septate below the sporogenous cell (Fig. 1J), 15-28 µm diam. narrowing to (7.5-) 10-13 µm in diam. with 1-2 walls up to 2.5 µm thick. Hyphal branches may form below the sporogenous cell.

AUXILIARY CELLS: brown, knobby and generally napiform, 32-48 X 37-48 µm diam., formed in clusters of 10-20 on coiled, thin walled, <1 µm thick, coenocytic hypha 3-5(-8.75) µm diam. (Fig. 1K).

ARBUSCULES and coiled hyphae form in cortical cells of infected roots (Fig. 1L).

TYPE: Colombia, Cali, Centro Internacional de Agricultura Tropical (CIAT), pot culture C-9; holotype GOET; isotypes COL, FLAS, OSC. Viable spores deposited in INVAM.

ETYMOLOGY: biornata, Latin, referring to the two ornamented spore walls.

DISTRIBUTION: Scutellospora biornata was first recovered from a sward of native grasses growing in a loamy sand at Hato Alegria, Carimagua, Meta, in the Llanos of Colombia. The soils, Oxisols with pH 4.8, have the following textural and chemical characteristics: sand 68%, silt 23%, clay 9%; exchangeable cations expressed in meq/100 g: Al 0.8, Ca 0.12, Mg 0.06. K 0.04; Al sat'n 82%; P 2.1 mg/kg soil (Bray II) and S 17 mg/kg soil.

MYCORRHIZAL ASSOCIATIONS KNOWN: Andropogon gayanus Kunth, Brachiaria decumbens Stapf, Manihot esculenta Crantz, Pueraria phaseoloides Benth & Zea mays L. and unidentified native grasses.

DISCUSSION

Scutellospora biornata spores can be readily separated from other pigmented Scutellospora species with ornamentation by the presence of a second ornamented wall.

Wall features of some spores in the Endogonaceae can be modified significantly by mountants and fixatives (Morton, 1986). Sward (1981) and others have recognized the need for a fixative and/or mountant which will preserve the integrity of the walls; that need is particularly evident with this spore. Lactophenol and PVL cause gross swelling (to a thickness of 55 µm) of laminated wall 2 (Figs. 1D; 2); apparently phenol is the reactive substance (Morton, 1986). Some or all of the laminae become diaphanous having little, if any, discernible structure; small rod-shape refractive areas are present in the distended wall. The laminae separate slightly at the rupture site in water, however, the wall character is not visibly altered. There was no distension of the laminated wall of spores fixed in FAA and mounted in lactophenol. The reaction time of the laminated wall (wall 2, group A) to Melzer's reagent is delayed. The reaction begins at the rupture sites and progresses slowly due to the non-reactive, tightly adherent, walls 1 and 3.

Wall 1 is fused to the adjacent laminae; observations of developing spores indicate that the initially smooth, subhyaline wall 1, continuous with the outer wall of the sporogenous cell, becomes ornamented and pigmented; areas, generally small, free of any ornamentation can occur. Wall 4, an extremely thin membranous wall in group B, observed in water, lactophenol and Melzer's, is rarely present. Walls 5 & 6 have the appearence of a coriaceous wall, a single wall wrinkled externally (Walker, 1986). Wall 5, less elastic than wall 6, wrinkles as it adheres somewhat loosly when the wall group is ruptured; occasionally walls 5 & 6 partially separate in water. Alhough pliable, wall 6, which readily ruptures but does not collapse, is described as a unit wall. A remnant of the connection to the sporogenous cell has been observed on wall 6 (Fig. 1F).

Walker & Sanders (1986) indicated that germination shields may have taxonomic value at the species level. The germination shield of _S. biornata_ is complex compared to the simple shields of _S. heterogama_ and _S. calospora_ and is formed between walls 5 & 6 of group B, rather than being constrained by the inner and outer wall groups as described by Walker and Sanders (1986). It may develop near the sporogenous cell or be unrelated to it. Usually a single aperture develops in wall 6; cytoplasm, apparently confined by the plasmalemma, is extruded through the aperture which appears as a tear having a very irregular periphery (Figs. 1G; 3A-F); pigment is concentrated around the perimeter. Fissures form a 'U' (Figs. 1I; 3D, E) around the aperture when the shield develops in such a way that the aperture is on the perimeter; shields thus formed are generally less round on the side of the aperture. Fissures form a 'Y' (Figs. 1H; 3A-C, F) when the aperture is sub-marginal to the developed shield. The 'U' and the 'Y' configurations occur with similar frequency. The germ tube initials are generally separated from each other by a long fissure. One or two medium long and numerous short fissures are usually present within these divisions. The mode of development of the fissures is not understood. Walker and Sanders (1986) infer that the "wishbone ('Y') formation occurs when the "...extruding membrane folds back on itself." Until ruptured by an emerging germ tube, the numerous germ tube initials are covered by the outermost ornamented wall. Walls 5 & 6 become rigid and inseparable from the shield; the rigidity and occasionally some pigment may extend slightly beyond the shield.

Two shields of average size have been observed within a single spore; they may overlap slightly or be completely separate. Multiple (up to six have been observed) small apertures, internal and/or external to the shield, may develop in addition to the large aperture. Shield development can be aborted; occasionally a small aperture has a rudimental 'Y' configuration formed around it (Fig. 3E & F); more often there is no evidence that cytoplasm was extruded through the small apertures.

Rare sporophore novelties pertain to the sporogenous cell. One sporogenous cell was bifurcate with no spore development; two sporogenous cells had an attached developed spore and an incipient spore.

ACKNOWLEDGEMENTS

We wish to thank Norman C. Schenck for reviewing the manuscript and providing critical commentary. The senior author wishes to acknowledge the encouragement given by James M. Spain and the gift of equipment by Aleene Williams Lance. The study of this spore was carried out at the Centro Nacional de Investigaciónes Agropequaria (CNIA) and Centro Internacional de Agricultura Tropical (CIAT) in Colombia and at the Centro de Pesquisa Agropequaria dos Cerrado (CPAC) in Brasil.

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MYCOTAXON

Vol. XXXV, No. 2, pp. 229-236 July-September 1989

TYPE STUDIES IN THE POLYPORACEAE - 21. SPECIES DESCRIBED BY C.G. LLOYD IN **CYCLOMYCES, DAEDALEA, FAVOLUS, FOMES** AND **HEXAGONIA**

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ABSTRACT. 94 species described by C.G. Lloyd in **Cyclomyces, Daedalea, Favolus, Fomes** and **Hexagonia** have been reviewed and the type specimens examined. 75 names are synonyms of existing names, 13 are accepted, the types for 3 names are sterile and three types are lost. 4 species are described and the following new combinations are proposed: **Ganoderma sculpturatum, Perenniporia malvena, Phellinus pusillus, Phellinus sublamaensis** and **Trametes sinensis**.

KEYWORDS. Basidiomycetes, Polyporaceae, C.G. Lloyd.

INTRODUCTION. C. G. Lloyd was an eccentric businessman with an avid interest in mycology. He published a long series of Mycological Notes which later was bound in 7 volumes. The pagination of the volumes is erratic, of driving unaware librarians against the wall.

After his death, his collection with all types was given to the Smithsonian Institution which later transferred it to the National Fungus Collection in Beltsville, Maryland (BPI). Lloyd described an incredible number of new species in many groups and Stevenson and Cash (1936) have published an Index to all his new names and combinations. In the Index there are references to place of publication, Lloyd collection number and all pertinent data concerning the types. To save space, this information is not repeated here although the country from where the species was described is given after an abbreviated reference to where the name was published. L.M.W. means Lloyd Mycological writings and the next digit refers to the volume of the bound version followed with a reference to the pertinent page and year.

In this paper the species are treated in the same way as in the Stevenson and Cash Index, i.e. alphabetically according to specific epithet within each genus in which they originally were described.

This paper is the first in a series treating Lloyd`s polypores. The remaining species will be treated similarly in separate papers.

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 seems to exist.

CYCLOMYCES

albida, C. L.M.W. 6:1007, 1920. Philippine Islands.
= Lenzites vespacea (Pers.) Ryv.
isabellina, C. L.M.W. 7:1270, 1924. Philippine Islands.
= Lenzites stereoides (Fr.) Ryv.

DAEDALEA

boseii, D. L.M.W. 7:1109, 1922. India.
= Lenzites acuta Berk.
fuscospora, D. Lloyd in Van der Byl. S. Afr. J. Sci. 21:308,1924.Zimbabwe.
= Inonotus ochroporus (Van der Byl) Pegler
There is a detailed description in Reid (1973:147-48), where he suggests that the type may represent an Inonotus species. I. ochroporus does have setae, but they often are very difficult to observe (see Ryvarden & Johansen 1980:125) and that may be why they were not observed by Reid nor in the tiny fragment which was at my disposal. I have collected I. ochroporus at Victoria Falls, Zambia/Zimbabwe, the type locality of Lloyds species. The macromorphology with the duplex consistency of the context, the hyphal system and the spores are all identical in the two species. Until a new convincing collection has been made of Lloyds setae-less species, it is treated as stated above.
fusco-stratosa, D. L.M.W. 7:1270, 1924.Brazil.
= Daedalea sprucei Berk.
glabra, D. L.M.W. 7:1270, 1924.Philippine Islands.
= Lenzites acuta Berk.
maculata, D. L.M.W. 7:1155,1922 Philippine Islands.
= Lenzites stereoides (Fr.) Ryv. as suggested by Lloyd.
mollicula, D. L.M.W. 7:1146, 1922. Japan.
= Trametes elegans (Spreng.:Fr.) Fr.
reflexa, D. L.M.W. 7:1155, 1922.Philippine Islands.
= Accepted in Daedalea.
Basidiocarp pileate, 4 cm wide and long, upper surface coarsely fibrous ochraceous to pale cinnamon brown, hymenophore poroid to labyrinthine, 1-3 pores per mm, cinnamon brown, tubes up to 3 mm deep, context cinnamon, 1 mm thick, no cuticle on pileus.
Hyphal system dimitic. Generative hyphae hyaline, 2-3 um wide and with clamps , skeletal hyphae abundant, pale yellowish to pale brown, thick-walled, 3-6 um wide, pointing into the hymenium as a distinct catahymenium, basidia and spores not seen.
Although the type is sterile, and the type of rot are not known, the species should be easy to recognize in the field because of the fibrous to partly shredded upper surface and the irregular hymenophore. Daedalea may not be the best genus when a fertile collection is found and the rot is known, but for the time being, Lloyds original disposition is accepted.
ridleyi, D. L.M.W. 6:930, 1920. Singapore.
= Lenzites acuta Berk.The type is sterile and seemingly treated with some chemical making it much darker than normally seen in this species.
roseola, D. L.M.W. 7:1145, 1922.Malaysia.

= Trametes elegans (Spreng.:Fr.) Fr.
sinensis, D. L.M.W. 7:1112, 1922.China.
=**Trametes sinensis** (Lloyd) Ryv. comb. nov. Basionym as cited above. This is a prior name for Trametes radiata Burt 1932, also described from China.
Basidiocarp pileate, applanate to triquetrous, woody when dry, up to 8 cm long and 4 cm wide and up to 3 cm thick at the base, upper surface at first finely velutinate, soon glabrous and with age tuberculate to irregularly warted, azonate, pale ochraceous to pale grey, pore surface white to pale cream, pores angular, thin- walled, 1-2 per mm, dentate in the dissepiments like in some American forms of Piptoporus betulinus (Fr.) Karst.,tubes up to 2,5 cm deep, concolorous with pore surface, context dense, cream to pale olivaceous grey, radially zonate, up to 0,5 cm thick at the base.
Hyphal system trimitic, generative hyphae with clamps, 2-4 um wide. skeletal hyphae abundant, hyaline, thick-walled to almost solid, 3-6 um wide, binding hyphae solid, hyaline tortuous, 3-4 um wide, basidia clavate, only seen sterile,15-20um long, basidiospores not seen.
Specimens only seen from China. Trametes ljubarskyii, Pil. described from Vladivostok is rather similar, but easily separated by smaller and round pores (3-4 per mm).(For a description of this species, see David 1966). Trametes lactinea Berk. known from tropical Asia has a matted velutinate and even surface and more rounded pores. Spore prints and cultural work is desirable in this group of species to settle their true relationship.
Trametes sinensis is easy to recognize in the field because of the angular dentate pores and the cream to pale ochraceous glabrous upper surface with distinct warts and scrupose tuberances. Its triquetrous shape seems also to be a constant feature.
stratosa, D. L.M.W. 7:1147, 1922.Brazil.
= Daedalea actinophila (Mont.) Rajchenb.
umbrina, D. L.M.W. 4:10, 1914. Brazil.
= Daedalea sprucei Berk.
ungulata, D. L.M.W. 4(60):15, 1915. Japan.
= Gloeophyllum sepiarium (Fr.) Karst.

FAVOLUS

africanus, F. L.M.W. 7:1194, 1923. Uganda.
= The type has not been found.
bengala, F. L.M.W. 7:1147, 1922.India.
= cfr. Trametes sp, but the type is sterile and no formal transfer is proposed. Basidiocarp dimidiate, 3 cm long and 2 cm wide, upper surface smooth and glabrous, pale dirty gray and faintly zonate,pore surface pale grey, pores angular, 1-1,5 mm in diameter, tubes up to 5 mm deep, concolorous, context thin and pale ochraceous.
Hyphal system trimitic, generative hyphae hyaline, 2-3 um wide and with clamps, skeletal hyphae hyaline, solid. 3-4 um wide, binding hyphae solid, tortuous,2-3 um wide, basidia and spores not seen.
Superficially, this species looks like Trametes bresadolae

Ryv. (for a description, see Ryvarden 1988:313) but this species has a distinct duplex consistency. A fertile collection and knowledge about the rot are necessary to settle the position of this species. Indian mycologists should be aware of it.

caespitosus, F. L.M.W. 5:821, 1919. USA.
= Polyporus tenuiculus (Beauv.) Fr. as already suggested by Lloyd.
dussii, F. L.M.W. 7:1194, 1923. Guadeloupe.
= Trametes villosa (Fr.) Kreisel
glandulosus, F. L.M.W. 7:1156, 1922. Philippine Islands.
= Polyporus philippinensis Berk.
grammocephalus, F. L.M.W. 7:1271, 1924. Fiji.
= Polyporus philippinensis Berk.
kauffmanii, F. L.M.W. 5:614, 1916.USA.
= Polyporus alveolaris (DC,:Fr.) Bond. & Sing.
lagunae, F. L.M.W. 7:1157, 1922.Philippine Islands.
= Polyporus philippinensis Berk.
leeuwenii, F. L.M.W. 6:1079, 1921.Indonesia.
= Echinochaete brachyporus (Mont.) Ryv.
lutescens, F. L.M.W. 7:1272, 1924.Honduras.
= Polyporus tenuiculus (Beauv.) Fr.
mollis, F. L.M.W. 7:1330, 1924.Brazil.
= Polyporus tenuiculus (Beauv.) Fr.
parviporus, F. L.M.W. 7:1146, 1922.Ecuador.
= The type is lost.
peponinus, F. L.M.W. 5(66):16, 1917.USA.
= Polyporus alveolaris (DC.:Fr.) Bond. & Sing.
roseus, F. L.M.W. 7:1157, 1922. Singapore.
= Polyporus tenuiculus (Beauv.) Fr.
samoensis, F. L.M.W. 7:1194, 1923. Samoa.
= Polyporus philippinensis Berk.
scabro-lineatus, F. L.M.W. 7:1157, 1922.Philippine Islands.
= Polyporus philippinensis Berk.
trigonus, F. L.M.W. 7:1332, 1924. Brazil.
= Polyporus craterellus Berk. & Curt.
whetstonei, F. L.M.W. 5:615, 1916. USA.
= Polyporus alveolaris (DC.:Fr.) Bond. & Sing.

FOMES

agglutinatus, F. L.M.W. 7:1156, 1922.Philippine Islands.
= Loweporus fusco-purpureus (Pers.) Ryv.
albotextus, F. L.M.W. 7:1332, 1924. South Africa.
= **Ischnoderma albo-textus** (Lloyd) Reid
For a description, see Reid 1974: 225.
angularis, F. L.M.W. 4:586, 1915.Japan.
= Phellinus sp. sterile.
annularis, F. L.M.W. 4(40):6, 1912.South Africa.
= Ganoderma australe (Fr.) Pat.
borealis, F. L.M.W. 4:247, 1915. Canada.
= Phellinus igniarius (L.:Fr.) Quél.
clelandii, F. L.M.W. 4(60):11, 1915.Australia.
= **Perenniporia clelandii** (Lloyd) Ryv.
For a description, see Cunningham 1965:145.
cuneatus, F. L.M.W. 4:217, 1915. Australia.
= Australoporus tasmanicus (Berk.) Buchanan & Ryv.

densus, F. L.M.W. 4:245, 1915.France.
= Phellinus conchatus (Pers.:Fr.) Quél. according to Lloyd in the description. The type is lost.
durissimus, F. L.M.W. 6:943, 1920.Angola.
= Phellinus fastuosus (Lév.) Ryv.
gilvus, F. L.M.W. 4(42):6, 1912.Argentina.
= Phellinus gilvus (Schw.) Pat.
glaucoporus, F. L.M.W. 4:251, 1915.Madagascar.
= Loweporus inflexibilis (Berk.) Ryv.
gossweileri, F. L.M.W. 6:940, 1920. Angola.
= Daedalea sprucei Berk.
graffii, F. L.M.W. 4:272, 1915. Philippine Islands.
= Amauroderma bataanense Murr.
hawaiensis, F. L.M.W. 4:260, 1915. USA.
= Phellinus senex (Nees & Mont) Imaz.
intertextus, F. L.M.W. 7:1111, 1922.Brazil.
= Loweporus roseo-albus (Jungh.) Ryv.
koningsbergii, F. L.M.W. 4:270, 1915. Indonesia.
= Ganoderma australe (Fr.) Pat.
latistipitatus, F. L.M.W. 6:1062, 1921. Japan.
= Coltricia vallata (Berk.) Teng
longinquus, F. L.M.W. 7:1335, 1925.Japan.
= Phellinus sp., sterile and without setae.
longosporus, F. L.M.W. 6:940, 1920.Angola.
= The type is sterile and Lloyd suggested in his description that this is a form of Ganoderma applanatum (Pers.) Pat. and the hyphal system and colour of the type suggest clearly that he was right.
magnosporus, F. L.M.W. 6:1014, 1920. Philippine Islands.
= Phellinus höhnelii (Bres.) Pat.
malvenus, F. L.M.W. 4:282, 1915. Samoa.
= **Perenniporia malvena** (Lloyd) Ryv. comb. nov. Basionym as cited above.
Basidiocarp effused-reflexed, pileus up to 5 cm long and 1 cm wide and distinctly sloping, upper surface black, glabrous and sulcate and with a distinct crust, margin rounded and brown, pore surface pale olivaceous brown, pores round, 6-7 per. mm, partly elongated in the most decurrent parts of the pore surface, tubes pale brown and old pores stuffed with white mycelium, context pale tobacco brown and 1 mm thick.
Hyphal system dimitic, generative hyphae with clamps, hyaline, 3-4 um wide, skeletal hyphae 1,5-4 um wide, thick-walled and strongly dextrinoid, basidia not seen, basidiospores truncate to ellipsoid, thick-walled and dextrinoid,4,5-5 x 3,5-4 um.
The dextrinoid spores and skeletal hyphae clearly put this species in Perenniporia. The black encrusted pileus is similar to that found in P. truncatospora (Lloyd) Ryv. (described from Japan), but this species has larger spores, i.e. 6,5-8 x 5-6 um).
mirabilis, F. L.M.W. 3(33): 3, 1911. Singapore.
= Ganoderma fusco-pallens (Bres.) Humphrey
nontostus, F. L.M.W. 4(48):7, 1913. Madagascar.
= Fomitopsis avellanae (Bres.) Ryv.
olivaceus, F. L.M.W. 5(65):14, 1917. Japan.

= Perenniporia tephropora (Mont.) Ryv.
oroflavus, F. L.M.W. 4:265, 1915. USA.
= Ganoderma annularis (Fr.) Gilbn. USA, Calif. Berkeley, Leg. S.B. Parish, Lloyd no 13958 selected here as lectotype.
oroniger, F. L.M.W. 7:1330, 1924. Malaysia.
= Phellinus pachyphloeus (Pat.) Pat.
ostricoloris, F. L.M.W. 4:257, 1915. Zaire.
= Phellinus linteus (Berk. & Curt.) Teng
perlevis, F. L.M.W. 4:39, 1912.Brazil.
= **Pyrofomes perlevis** (Lloyd.) Ryv. For a description, see Ryvarden and Johansen (1980: 533)
petchii,F. L.M.W. 4:268,1915. Sri Lanka.
= The type is lost, but from the description is is evident that it represents a Ganoderma species in the G. lucidum group. Lloyd interpreted it as a "form of Polyporus lucidus". With the present chaotic state in the laccate Ganoderma species, there is no possibilty to reach any conclusion as to its true identity.
polyzonus, F. L.M.W. 4:269, 1915.Indonesia.
= Ganoderma australe (Fr.) Pat.
pseudoaustralis, F. L.M.W. 4:269, 1915. Philippine Islands.
= Ganoderma australe (Fr.) Pat.
pseudopetchii,F. L.M.W.7:1202, 1923. Indonesia.
= **Fomitopsis pseudopetchii** (Lloyd) Ryv. For a description, see Ryvarden & Johansen 1980:339.
psila, F. L.M.W. 4:233, 1915.Brazil.
= Hexagonia hydnoides (Fr.) Fidalgo, as suggested by Lloyd in the description.
pusillus, F. L.M.W. 4(49):13, 1914.Japan.
= **Phellinus pusillus** (Lloyd) Ryv. comb. nov. Basionym as cited above.
Basidiocarp minute, pendant and conical, 5-8 mm high and wide, dorsally attached with expanding pileus, upper surface glabrous, black and sulcate, pore surface pale brown, pores tiny, 8-9 per mm, tubes stratified, in the type three layers are distinct, context very thin, rusty brown,2-300 um thick. Hyphal system dimitic, generative hyphae 2-3 um wide, hyaline and with simple septa, skeletal hyphae running more or less parallel in the context, and tubes, thick-walled, pale yellowish, 2-4 um wide,setae not seen, basidia not seen, basidiospores globose 5-6 um in diameter, thick-walled and strongly dextrinoid. Collected on Zelkova acuminata (Ulmaceae).
This species belongs to the Phellinus robustus complex because of its globose dextrinoid spores and lack of setae. Its minute dorsally attached basidiocarps are rather unique in the genus and this and possibly the host may be diagnostic.
Japanese mycologist should be aware of the species and see whether it is restricted to Zelkova only.
reviviscens, F. Lloyd in Rick, Broteria ser. Bot. 21:7,1924.Brazil.
= Navisporus sulcatus (Lloyd) Ryv.
rhaponticus, F. L.M.W. 4(44):11, 1913.Japan.
= Phellinus robustus (Karst.) Bourd. & Galz.
rheicolor, F. L.M.W. 4:245, 1915.Argentina.

= Phellinus rhabarbarinus (Berk.) Cunn.
roseotubulus, F. L.M.W. 5(67):14, 1918.Angola.
= Loweporus fusco-purpureus (Pers.) Ryv.
sanfordii, F. L.M.W. 4:258, 1915. Sri Lanka.
= **Phellinus sanfordii** (Loyd.) Ryv. For description, see Ryvarden & Johansen (1980:212).
sanjanii, F. L.M.W. 6:885, 1919.USA.
= Phellinus rimosus (Berk.) Pilat
sculpturatus, F. L.M.W. 4:39, 1912.Madagascar.
= **Ganoderma sculpturatum** (Lloyd) Ryv. comb. nov. Basionym as cited above. For a description, see Ryvarden & Johansen (1980:91) as G. neurosporum Furt. The species is common in Central Africa and easy to recognize by the sculptured context which inspired Lloyd to the name.
setulosus, F. L.M.W. 4:243, 1915. Sri Lanka.
= **Phellinus setulosus** (Lloyd) Imaz. For description, see Ryvarden & Johansen (1980:217).
sublamaensis, F. L.M.W. 7:1128, 1922.Philippine Islands.
= **Phellinus sublamaensis** (Lloyd) Ryv. comb. nov. Basionym as cited above. This is a prior name for Phellinus noxius (Corner) Cunn. For a description, see Ryvarden & Johansen (1980:212).
tepperii, F. L.M.W. 4:256, 1915.Australia.
= Phellinus rimosus (Berk.) Pilat
yasudai, F. L.M.W. 4:272, 1915.Japan.
= Phellinus robustus (Karst.) Bourd. & Galz.

HEXAGONIA
angulata, H. L.M.W. 6:1003, 1920.Malaysia.
= Hexagonia tenuis (Hook.) Fr.
atra, H. L.M.W. 7:1156, 1922.Philippine Islands.
= Hexagonia hirta (Fr.) Fr.
burchelli, H. L.M.W. 3:44,1910. Sri Lanka.
= Hexagonia tenuis (Hook.) Fr.
calignosa, H. L.M.W. 7:1156, 1922.Philippine Islands.
= Hexagonia tenuis (Hook.) Fr.
crassispora, H. L.M.W. 5:714, 1917.Ghana.
= Hexagonia speciosa Fr.
dermatiphora, H. L.M.W. 3:501, 1911.Zaire.
= Accepted in the genus. For a description, see Ryvarden & Johansen (1980:212).
ferruginosa, H. L.M.W. 6:1016, 1920. Philippine Islands.
= Gloeophyllum imponens (Ces.) Imaz.
flavofusca, H. L.M.W. 7:1156, 1922. Philippine Islands.
= Lenzites acuta Berk.
lignosa, H. L.M.W. 6:884, 1919. Mauritius.
= Coriolopsis asper (Jungh.) Teng
lineata, H. L.M.W. 7:1194, 1923. Zaire.
= Hexagonia dermatiphora Lloyd
mirabilis, H. L.M.W. 3:37, 1910. Samoa.
= Pseudofavolus cucullatus (Mont.) Pat.
murina, H. L.M.W. 7:1242, 1924. Indonesia.
= Lenzites acuta Berk.
olivacea, H. L.M.W. 4:53, 1914. Australia.
= Lenzites vespacea (Pers.) Ryv.

= Hexagonia hirta (Fr.) Fr.
scruposa, H. L.M.W. 7:1155, 1922. Philippine Islands.
= Daedalea sulcata (Berk.) Ryv.
smallii, H. L.M.W. 5:748, 1917. Uganda.
= Hexagonia dermatiphora (Lloyd) Ryv.
umbrosa, H. L.M.W. 6:957, 1920. Singapore.
= Hexagonia tenuis (Hook.) Fr.
velutino-glabra, H. L.M.W. 7:1193, 1923. Angola.
= Coriolopsis floccosa (Jungh.) Ryv.

ACKNOWLEDGEMENTS

Dr. J. Ginns, Biosystmatics Research Institute in Ottawa has read the manuscript and kindly suggested improvements for which I am very grateful.

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MYCOTAXON

Vol. XXXV, No. 2, pp. 237-242 July-September 1989

ECHINOPLACA FURCATA, A NEW SPECIES OF FOLIICOLOUS LICHEN (GOMPHILLACEAE) FROM RWANDA

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Summary. - *Echinoplaca furcata* Sérusiaux is described as new from Rwanda (Central-East Africa) where it is epiphyllous in montane rain forest. It is easily distinguished by its repeatedly and irregularly branched cilia growing on the prothallus and by the presence of needle-shaped crystals on the surface, emanating from the disintegrating excipulum.

Generic concepts in the lichen family Gomphillaceae W. Watson ex Hafellner have been recently revised by Vězda & Poelt (1987) who recognize ten genera : *Gomphillus* Nyl., *Actinoplaca* Müll. Arg., *Aulaxina* Fée, *Bullatina* Vězda & Poelt, *Calenia* Müll. Arg., *Caleniopsis* Vězda & Poelt, *Echinoplaca* Fée, *Gyalectidium* Müll. Arg., *Gyalideopsis* Vězda and *Tricharia* Fée. Since their survey of accepted taxa in these genera, thirty-one additional species have already been described (Kalb & Vězda 1988, Sérusiaux & De Sloover 1986, Vězda & Hafellner 1988); this clearly demonstrates how widespread, diverse and poorly known the family is, especially in tropical areas.

Much work remains to be carried out in this family, even at the generic level. Indeed there is little doubt that the following genera belong to it : *Epilithia* Nyl., *Microlynchus* Funk, *Microspatha* P. Karsten and *Szczawinskia* Funk (Funk 1973 and 1983; Seifert 1985).

The aim of this paper is thus rather modest as it deals with just a single new foliicolous species of *Echinoplaca* found in Rwanda (Central-East Africa).

Echinoplaca furcata **Sérusiaux sp. nov.** Fig. 1.

Thallus epiphyllus, dispersus, viridulus vel cinereo-viridis, cum albis verrucis e crystallis compositis, hyphophoris instructus; hyphophori 0.4(-0.5) mm longi, albidi vel pallido brunnei, setiformes, arcuati, cum conidica massa. Prothallus pilis instructus; pili 0.6-0.8 mm longi, albidi vel pallide brunnei, simplices vel irregulariter ramosissimi.

Apothecia orbicularia, 0.3-0.5(-0.7) mm lata, aurantiaco-brunnea; excipulum crystallis albis acicularibus mox obtectum, demum fatiscens et crystallinescens.

Hymenium 45-55 µm altum cum luteo-brunneo epihymenio; paraphyses ramosae anastomosantesque; asci 1-spori, saccati; sporae ellipsoideae usque fere sphaericae, murales, (26-)28-42 x (38-)40-52 µm.

Alga cellulis globosis viridibus, 10-12 µm diam., ad familiam Chlorococcacearum verosimiliter pertinens.

Thallus epiphyllous, up to 1.2 cm large, made up of orbicular to irregular patches not exceeding 0.4 mm in diam., greenish to grey-green, or almost pure white when covered with crystals, rather shiny, covering irregular clusters of angular crystals which give it a verrucose appearance (verrucae paler than the thallus, 0.2-0.5 mm in diam.), with a large (up to 0.6 cm wide) translucid prothallus between and around the patches. Corticiform layer of hyaline interwoven hyphae.

Cilia numerous over the prothallus, 0.6-0.8 mm long, simple and tapered towards their tip or repeatedly and irregularly branched, sometimes forming a mat of entangled threads around the thallus patches, whitish to pale brown, usually dirty because of accumulations of various fragments (incl. plants diaspores, and pollen grains).

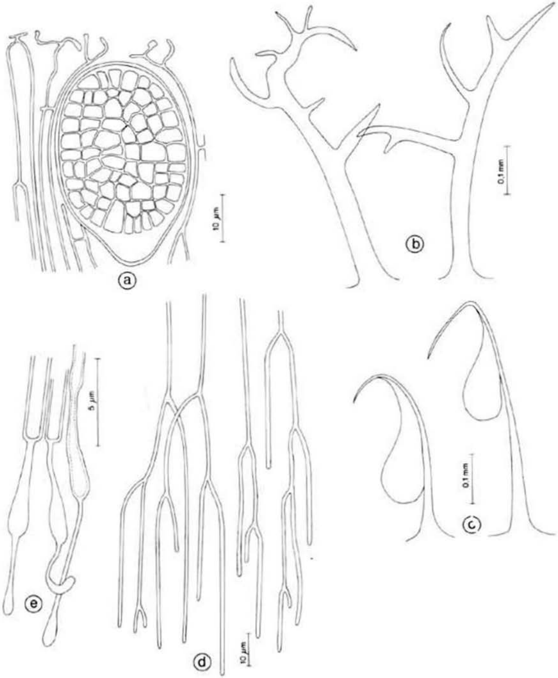

Fig. 1. *Echinoplaca furcata* Sérusiaux, holotype.
a - Hymenium, including an ascus with immature spore. b - Cilia. c - Hyphophores. d - Detail of the conidial mass (squash in water). e - Detail of the racket-like cells at the ends of hyphae present in the conidial mass.

Hyphophores absent on most specimens examined but numerous when present, growing only on thallus patches, 0.4(-0.5) mm long, whitish to pale brown, looking like long cilia, curved downwards near their tip, carrying a single conidial mass which is tear-shaped and stuck to the axis. Conidial mass hanging on the hyphophore tip by a few thick hyphae, made of long-branched thick hyphae (wall up to 1.5 μm when mounted in a KOH solution, cells reaching 15-20 μm long) carrying racket-like cells assumed to be the conidiophores, conidiogenous cells and conidia.

Apothecia numerous, orbicular, 0.3-0.5(-0.7) mm in diam., sometimes confluent, adnate on the thallus surface and expanding laterally over it (algal cells can thus be seen under most of the apothecium), sometimes developing over crystals clusters of 0.1-0.3 mm in diam.; disc orange brown. Margin soon covered by large amounts of white needle-shaped crystals (needles up to 150-200 μm long, easily seen under the dissecting microscope), coming out of the disintegrating excipulum, eventually invading the thallus and apothecia surface, breaking up into pieces and aggregating into angular clusters.

Excipulum formed by branched hyphae embedded in a pale brown gelatinous mass, easily observed in young apothecia but eventually disrupted by the formation of crystals; hypothecium hyaline, less than 10 μm high; hymenium 45-55 μm high with a distinct epihymenium mainly composed of crystals and a yellowish-brown gelatinous mass; paraphyses 1 μm thick, branched and anastomosed; asci 1-spored, saccate; spores ellipsoid to almost spherical, muriform, (26-)28-42 x (38-)40-52 μm.

Photobiont most probably belonging to the Chlorococcaceae, with green, globose cells (10-12 μm in diam.).

Material examined :

Rwanda, afromontane district, Nyungwe forest, near Kamiranzovu, 1950 m elev., dense rain forest on hydromorphic soil, on living leaves of *Beilschmiedia* (Lauraceae), Sept. 1971, coll. G. Bouxin 1119 (LG-holotypus). Ibid., Nyungwe forest, at Ruwankuba, 2000 m elev., dense rain forest on hydromorphic soil, on living leaves of *Ocotea* (Lauraceae), Feb. 1971, coll. G. Bouxin 1314 (LG). Ibid., Rugege Forest, Ruwankuba, 1950 m elev., riverine forest with *Sysygium guineense*, on living leaves of *Marattia fraxinea* (Marattiaceae), Dec. 1971, coll. J. Lambinon 71/1062 (LG). Ibid., Rugege Forest, hill between Muzimu Mt and Bigugu, ahead of river Kalundra, 2350 m elev., dense rain forest, on living leaves of *Schefflera myriantha* (Araliaceae), March 1972, coll. J. Lambinon 72/958 (LG).

Echinoplaca furcata is easily distinguished from all other representatives of the Gomphillaceae by its repeatedly and irregularly branched cilia growing only on the prothallus. To my knowledge, no other species presents these criteria. Cilia growing on the prothallus are rare in the genus *Echinoplaca* : only *E. atrofusca* R. Sant. has pale brown simple hairs on its prothallus.

E. furcata has an apothecium anatomy and hyphophores typical of the genus and there is thus no doubt about its generic position.

Echinoplaca furcata is also easily separated from other *Echinoplaca* species with 1-spored asci (*E. epiphylla* Fée and *E. similis* Kalb & Vězda) by the presence of long needle-shaped white crystals, at least on the excipulum outer surface. These crystals are not an artefact as in the four above cited collections, they are restricted to *E. furcata*, and are not present on associated species, including other representatives of the Gomphillaceae.

Acknowledgements

I am much indebted to Dr G. Bouxin and Prof. J. Lambinon who placed their valuable collections at my disposal. Prof. J. Lambinon and Dr B.J. Coppins are also to be thanked for their advice in improving the manuscript.

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MYCOTAXON

Vol. XXXV, No. 2, pp. 243-276 July-September 1989

PHYTOPHTHORA NICOTIANAE (P. PARASITICA)

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ABSTRACT

A comparative study of 35 isolates of Phytophthora nicotianae (P. parasitica) from different plant hosts was conducted under uniform conditions and the results failed to distinguish them into two morphological varieties as established by Waterhouse (1963). Phytophthora nicotianae and P. parasitica are conspecific but based on the International Botanical Nomenclature, the epithet nicotianae must be retained over parasitica which it antedates, despite the ambiguity and incompleteness of the original description of P. nicotianae.

INTRODUCTION

Phytophthora nicotianae Breda de Haan was first described by Breda de Haan (1896) causing seed-bed diseases of tobacco in Java. He did not provide a formal diagnosis and his description was incomplete. His failure to isolate the fungus on pure culture and his description and drawing of paragynous antheridia have been confusing and misleading to many researchers. Thus Lodewijks (1909) did not identify the tobacco Phytophthora as P. nicotianae partly because it could be grown readily in culture. Dastur (1913) distinguished P. parasitica Dastur on castor oil plant as a new species different from all other species of Phytophthora (including P. nicotianae) except P. colocasiae in the development of amphigynous antheridia. Similarly, Rosenbaum (1917) placed P. nicotianae in Cactorum Group characterized by predominantly paragynous antheridia to distinguish it from P. parasitica in Phaseoli Group with amphigynous antheridia while Lafferty & Pethybridge (1922) considered *P. nicotianae* a unique species within the genus in having exclusively paragynous antheridia. The erection of *P. parasitica* var. *rhei* Godf. on rhubarb (Godfrey, 1923) and *P. tabacci* Saw. on tobacco (Sawada, 1927) to distinguish from *P. nicotianae* was also partly due to their amphigynous antheridia, in contrast to the paragynous antheridia in the original description of *P. nicotianae*.

Leonian (1925) first questioned the taxonomic status of *P. nicotianae*. The isolate of *P. nicotianae* he received initially from Holland resembled two of Dastur's authentic isolates of *P. parasitica*, morphologically and physiologically. Tisdale & Kelly (1926) compared the black shank *Phytophthora* from tobacco in Florida with isolates of *P. nicotianae* and *P. parasitica* and found them very similar in morphology, but chose to treat it as a biological strain of *P. nicotianae* on account of their common pathogenicity towards tobacco. Ashby (1928) pointed out that Breda de Haan probably was not dealing with the same fungus all the time and the oospores he described for *P. nicotianae* actually belonged to a *Pythium* species. Consequently, he eliminated *P. nicotianae* as an independent species and included it in *P. parasitica* and the species description of the latter was amended. In his monograph on *Phytophthora*, Tucker (1931) accepted Ashby's species concept of *P. parasitica* and considered it synonymous with *P. melongenae* Saw., *P. allii* Saw. (Sawada, 1915), *P. terrestris* Sherb. (Sherbakoff, 1917), and *P. parasitica* var. *rhei*, but he rejected the intraspecific subdivision based on oospore size as proposed by Ashby (1928). Instead, he treated *P. nicotianae* as a variety of *P. parasitica*: *P. parasitica* var. *nicotianae*, synonymous with *P. tabacci* based on their specific pathogenicity to tobacco. Tucker's taxonomic treatment of *P. parasitica* was promptly and widely accepted by other workers until Waterhouse (1963) proposed that whereas *P. parasitica* was not specifically different from *P. nicotianae*, the latter antedated the former and should have priority. She further distinguished *P. nicotianae* into two morphological varieties: (1) *P. nicotianae* var. *parasitica*, synonymous with *P. formosana* Saw., *P. lycopersici* Saw, (Sawada, 1943), *P. ricini* Saw. (Sawada, 1942), *P. parasitica*, *P. parasitica* var. *piperina* Dast. (Dastur, 1935) and *P. tabacci*, (2) *P. nicotianae* var. *nicotianae*, synonymous with *P. allii*, *P. melongenae*, *P. parasitica* var. *rhei* and *P. terrestris*. However, researchers experienced great difficulty in differentiating these two varieties because many isolates had overlapping characteristics (Shepherd, 1976; Tsao & Sisemore, 1978; Caccilo & de San Lio, 1988). While authors began to adopt Waterhouse's species concept of P. nicotianae, many still preferred Tucker's treatment of P. parasitica. Consequently, there was considerable confusion in the literature. Erwin (1983) rightly pointed out that all tobacco isolates identified as P. parasitica var. nicotianae might not be synonymous with P. nicotianae var. nicotianae whereas all non-tobacco isolates, referred to as P. parasitica might not be synonymous with P. nicotianae var. parasitica, and he urged that the nomenclature of this group be re-redefined. The purpose of this study was to compare a wide variety of isolates of P. nicotianae (P. parasitica) from different hosts to determine if they can be distinguished into two morphological varieties and which epithet should be used for the species.

MATERIALS AND METHODS

Isolates and media: Specific information on the isolate of P. nicotianae (P. parasitica) used is given in Table 1. All isolates were obtained from the American Type Culture Collection (ATCC), Rockville, Maryland. Unfortunately, P. nicotianae never had a type culture and apparently, the type culture of P. parasitica is no longer in existence. Unless otherwise stated, clarified V-8 juice agar medium (Ribeiro, 1978) supplemented with sitosterol (30 mg/l) was used for culture.

Morphology: Colony characteristics on CV8, and Difco cornmeal agar (CMA) were compared after incubating in darkness at 20 C for 7 days. The colony diameters on CV8 were measured at right angle through the inoculum and the width of primary hyphae measured under light microscope. The minimal and maximal temperatures for growth were tested by growing them on CV8 and CMA at 10 C and 35 C. Sporangia were produced by incubating small mycelial agar discs of CV8 in freshly collected stream water sterilized by filtration through 0.45 μm pore size millipore membrane discs and incubating under light at 20 C. Production of sex organs in single cultures was followed by examining them periodically under microscope through the bottom of the petri dish. If the isolate failed to produce sex organs readily in single culture, it was paired with the appropriate mating types of P. nicotianae (ATCC 38606, A_2 and ATCC 38607, A_1). In case of a successful mating, the ability of the isolate to produce sex organs by selfing was confirmed by pairing it with the compatible strain across a polycarbonate membrane to prevent physical contact between the cultures (Ko, 1978). They were examined for sex organs after 2-3 wk incubation in dark at 20 C.

RESULTS

Colony morphology: On CV8, isolates of P. nicotianae (P. parasitica) ranged from uniform, diaphanously fluffy to irregularly rosette, tufted and submerged. With age, the plates turned brownish. The hyphae ranged from uniformly wide (approximately 5 µm) to very uneven (2-18 µm). In old agar plates and water cultures, spherical to irregular hyphal swellings up to 20 µm diameter were commonly produced, singly, in chains or clusters. Often the swellings looked "spiked" in possessing several radiating hyphae growing from them. On Difco CM, the colonies were primarily submerged with more conspicuously irregular and tufted mycelial growths.

The average daily growth rate of the isolates on V8C was 2-8 mm per day at 20 C and they all grew at 35 C. The ability to grow at 10 C varied with the isolates (Table 2).

Sporangium: Sporangia were produced on CV8 agar plates by all isolates, but more abundantly and more promptly in water, usually within 24-48 hr. They were distinctly papillate with hemispherical apical thickenings, spherical to broadly ovoid or obpyriform with round bases. The overall mean dimensions of sporangia (Table 2) for all isolates were 47±5 µm long and 35±4 wide, with an overall mean L/B ratio of 1.4±0.1. Occasionally, the sporangial apex prolonged into a beak or the sporangium had two apices. Beaked sporangia were especially common for isolates ATCC 13612, 22598, 38606, and 38607 when they were paired with the appropriate mating types, separated by a polycarbonate membrane. Under these conditions, elongated sporangia resembling the "abnormal sporangium-like structures" reported by Thompson & Hine (1972) and the vesicular sporangia (Dastur, 1913; Sawada 1927; Richardson, 1941; Vanderweyen 1983) were also formed although they could sometimes be found in water as well. They were tubular or lobulate, septate or non-septate with the terminal segment filled with cytoplasm and often capped with apical papilla. These were interpreted as externally proliferating sporangia under unfavorable conditions when the sporangium failed to mature normally but continued to grow and develop, resulting in an elongated or multiple-sporangium like structure. Sometimes, the sporangium could germinate directly to give rise to another sporangium or a chain of several sporangia.

The sporangia were borne terminally, singly or sympodially on slender sporangiophores (2-3 µm) or produced intercalarily by undifferentiated hyphae. In some cases, the sporangia either possessed short hyphal appendages in the basal portion or they were subtended by several hyphae. Sporangia were primarily non-deciduous although a low percentage of detached sporangia either with short occluded pedicels (<5 µm) or of uneven length could be found in some isolates, e.g. ATCC 26009, 36997, 46293, 46294, 56602, and 64535.

Encysted zoospores germinated by one or more germ tubes. Occasionally, instead of subsequently developing into a branching hypha, the germ tube was terminated by a microsporangium (Thompson & Allen, 1976). The production of microsporangia by germinating cysts was especially common for zoospores which were trapped and encysted within the sporangia as described by Drechsler (1930). However, repeated emergence of zoospores directly from cysts were seen only rarely in isolate ATCC 46293.

<u>Chlamydospores</u>: All isolates with the exception of ATCC 15409 and 46063 produced chlamydospores in varying amounts in 2-week old agar plates. Some isolates like ATCC 22597, 38607, 36997, 60439 and 64534 produced chlamydospores promptly and abundantly in water within 48 hr. The size of chlamydospores varied considerably with the overall mean diameter for all the isolates (Table 3) measuring 33±4 µm and the maximum about 60-70 µm. They were oval to spherical, terminal or intercalary with the chlamydospore wall 1-2 (-3) µm thick. Except for isolate ATCC 46063, they all eventually developed straw-colored to brown pigmentation with time on V8C. Isolate ATCC 64536 probably had degenerated because it produced sparsely, small poorly developed "chlamydospores" on agar plates and abnormal, elongated sporangia in water.

Sex organs: All isolates behaved heterothallically (Savage *et al*., 1968) producing sex organs abundantly by mating with the appropriate partners. Whereas sex organs were not produced in single cultures except occasionally upon aging (Tsao *et al*., 1980) isolate ATCC 15407 was unique in forming sex organs readily by itself. Self-fertile isolates of *P. parasitica* (*P. nicotianae*) have been reported previously (Apple, 1959; Haasis & Nelson, 1963; Suzui *et al*., 1978). Changes in mating type (Ko, 1981; Arentz, 1986) were not observed except in ATCC 60439 which proved to belong to A_1 mating type instead of being homothallic as determined initially (Sansome, 1980). Since it was impossible to determine exactly which partner(s) actually produced the sex organs in paired cultures on agar plates, measurements were taken from selfed sex organs produced by each partner when paired across a membrane (Table 3). Unfortunately, some isolates though mated readily in paired cultures on agar plates, never selfed on membrane or in old plates, suggesting the existence of hybridization in these crosses as demonstrated convincingly in *P. infestans* (Shattock *et al*., 1986). As observed previously in *P. cinnamomi* (Ho & Zentmyer 1977) and *P. cryptogea* (Ho & Jong, 1986), the oogonia formed as a result of crossing in dual cultures were slightly smaller than those formed by selfing. For instance, the oogonia formed in the cross between ATCC 38606 (A2) and ATCC 38607 (A1) averaged 24±2 μm in contrast to those formed by selfing (28±2) when the mating strains were physically separated by a membrane.

When mature, the oogonia turned brown, often with a conspicuous layer of amorphous deposits on the surface (Ho, 1979). The overall mean diameter of the oogonia and oospores for all isolates (Table 3) were 29±2 μm and 23±2 μm, respectively. Oogonia were invariably spherical although distorted oogonia as observed by Sansome (1985) were found in ATCC 15408. In certain isolates, e.g., ATCC 38606, 46732 and 64535, pigmented oogonium-like structures similar to those described by Bell & Haasis (1967) were found, devoid of contents and antheridia. They were especially common when paired on membrane and were considered as aborted oogonia which were prevented from fertilization by the membrane. Antheridia were short, non-pigmented and unicellular, measuring 10±1 μm long and 12±1 μm wide for all isolates. Eccentric oogonial stalk within the antheridium as described by Waterhouse (1963, 1974) was found rarely and randomly.

DISCUSSION

Ever since Breda de Haan (1896) erected *P. nicotianae* for the fungus on tobacco seedlings in Java, the species has been questioned by many workers. Firstly, he never isolated and described the fungus in pure culture and secondly, his description and figuring of paragynous antheridia confused and misled later researchers. Often, workers referred their *Phytophthora* isolates from tobacco as *P. nicotianae* without being certain that their isolates were the same as the one seen by Breda de Haan because all of them could be easily cultured and produced only amphigynous antheridia.

Breda de Haan's description of the sexual organs in *P. nicotianae* can be interpreted in two ways. The paragynous antheridia as described and figured by him indeed pertained to *P. nicotianae*. At least, Nolla (1928) included paragynous-like antheridia in his drawing of black shank *Phytophthora* of tobacco from Puerto Rico. On the other hand, Ashby (1928) pointed out that the oospores in Breda de Haan's specimen probably belonged to *Pythium* which attacked tobacco seedlings causing indistinguishable symptoms in Java at the same time. Meurs (1934) further suggested that the contaminant could be *Pythium deliense* Meurs based on the similarity in the fertilization process. No oogonial measurement was provided by Breda de Haan but Waterhouse (1970) stated that "from the magnifications given with the figures the measurements of the oogonia can be calculated as 28x25 µm, 20x16.6 µm, and 23.3x21.6 µm,and the oospore 16.6 µm diam." However, our measurements showed that the oogonia were approximately 23x20, 17x15 and 19x15 µm and the oospore 15 µm diam, agreeing more with Tucker's mentioning of "oogonia 19 µm in diameter" for *P. nicotianae* (Tucker, 1931). Oogonia of that small size are unknown in literature for isolates from tobacco. On the other hand, Meurs (1934) described the oogonia of *Pythium deliense* as "varying from 15-23.1 µm in diameter, mostly 16.1-20.0 µm, average 18.2 .... oospores average 14.8 µm". Thus, it seems highly probable that Breda de Haan's description of *P. nicotianae* was based on two fungi belonging to different genera. If so, the epithet probably could have been rejected in accordance with Article 70 of the International Code of Botanical Nomenclature (Stafleau, *et al*., 1972). However, this article has been deleted from the most recent Code (Voss *et al*., 1983).

With the notable exception of Rosenbaum (1917) who was probably working on an isolate wrongly identified as *P. parasitica* (Godfrey, 1923; Ashby, 1928) the great majority of researchers agreed that the isolates from tobacco known as *P. nicotianae* could not be specifically distinguished from isolates of *P. parasitica* from other hosts, but they were sharply divided in the use of the epithets. Dastur's detailed original and Ashby's succinct amended account of *P. parasitica* allowed the researchers to identify their isolates readily as belonging to this species without any lingering doubts. On the other hand, unless and until separate rules are adopted for fungi as suggested by Brasier (1983), the International code of Botanical Nomenclature must be observed to ensure uniformity in fungal nomenclature. Based on the principle of priority as contained in Article 11, it is mandatory to retain the epithet *nicotianae* over *parasitica* which it antedates. Article 51 further stipulates that "an alteration of the diagnostic characters or of the circumscription of a taxon does not warrant a change in its name". Thus, in spite of the ambiguity of the antheridial configuration of *P. nicotianae*, the epithet cannot be rejected. Although Gallegly (1983) pointed out the anamoly that "*nicotianae* implies host specificity and *parasitica* implies a braod host range", Article 62 prohibits the rejection of a legitimate epithet merely because it is "inappropriate or disagreeable, or because another is preferable, or better known, or because it has lost its original meaning". The lack of formal description does not invalidate the name *nicotianae* which was published before Jan 1, 1908 and thus accepted as valid in accordance with Article 44. However, in view of the long established usage of the name *P. parasitica* and the fact that it is a species of major economic importance attacking a wide variety of plants world-wide, plant pathologists can conceivably conserve the epithet *parasitica* under Article 14, but a formal proposal has to be submitted and approved by the International Botanical Congress.

Waterhouse's creation of two morphological varieties within the species *P. nicotianae* further compounded the nomenclatural problem of this group, because many workers found it very difficult, if impossible, to differentiate these two varieties. According to Waterhouse (1963), *P. nicotianae* var. *nicotianae* is characterized by uniformly fluffy colony with minimal growth temperature above 10 C, uniform hyphae, spiked hyphal swellings, abundant chlamydospores not turning brown, non-deciduous, beaked sporangia and eccentric oogonial stalk whereas P. nicotianae var. parasitica produces irregular rosette colonies with minimal growth temperature at or below 10 C, irregular hyphae, pigmented chlamydospores forming tardily with thicker wall, deciduous, smaller, non-beaked sporangia and smaller oogonia. Our findings based on the comparative morphological study of 35 isolates of P. nicotinae (P. parasitica) failed to separate them into two distinct varieties. In our study, the cultural appearance varied from appressed, distinctly tufted and irregular to uniformly fluffy and the hyphae also ranged from uniform to highly uneven. There was no correlation between growth pattern and the mating type or the host from which the isolate originated. Apple (1957) and Shepherd (1976) noted that even among isolates from tobacco, both smooth, fast growing colonies (mating type A1) and irregular, slow growing colonies of submerged arbuscular mycelium (mating type A2) could be found. Variabilities in colony morphology and hyphal characteristics were also found among the dissociants from rhubarb isolate (Leonian 1926, 1934). The production of spiked hyphal swellings and the ability to grow at 10 C were too variable to be of much significance in intraspecific classification. Spiked swellings occurred occasionally in some isolates in our study and in literature. The minimal temperatures for growth for isolates referrable as P. nicotianae var. nicotianae and P. nicotianae var. parasitica were 5-15 and 5-13 C respectively in literature. Even Waterhouse later accepted 5-12 C as the minimal growth temperature for both varieties (Waterhouse, 1974).

The ability to produce chlamydospores seemed to vary with the isolate rather than a stable diagnostic character of the taxon. There was no significant differences in the chlamydospore diameter or wall thickness. The overall means of chlamydospore diameters for isolates referrable as P. nicotianae var. nicotianae and P. nicotianae var. parasitica were 31±5 µm and 32±4 µm respectively based on literature and 33±4 µm and 34±8 µm respectively based on our measurements. Although Waterhouse (1963) distinguished the chlamydospores of P. nicotianae var. nicotianae measuring 20-40 µm from P. nicotianae var. parasitica" up to 60 µm, she later cited 22-30 µm for the chlamydospore diameter of the latter (1974) implying little or no difference in chlamydospore size between these two varieties. She also separated the two varieties based on the timing of chlamydospore formation and the pigmentation as well as the thickness of chlamydospore wall. We found that the timing was a variable character and in nearly all isolates, the chlamydospores wall measured 1-2 µm thick, eventually turning yellowish brown. This observation was also commonly made by authors working on isolates of *P. nicotianae* (*P. parasitica*) in the past. Waterhouse considered the sporangia of *P. nicotianae* var. *nicotianae* distinct in having the basal part nearly spherical with the apical third or quarter narrowed and prolonged into a 'beak'. Beaked sporangia were found in some isolates identified as "*P. nicotianae* var. *nicotianae*" or "*P. nicotianae* var. *parasitica*" and they were more commonly produced under less than favorable conditions, for example, on membranes in pairing experiments. The hyphal appendages of sporangia proved to be a poor diagnostic character. We also failed to confirm Waterhouse's distinction between the two varieties based on the caducity of sporangia. In present study, the sporangia in all isolates were primarily non-deciduous although in some isolates, a low percentage of sporangia were found dropping off in water with a short occuled pedicel (<5 µm long). Thus, our observations agreed with those reported earlier by Al-Hedarthy & Tsao (1979) and Trichelo & Aragaki (1982) regarding the noncaducity of the sporangia of *P. parasitica*. Whereas most authors did not comment on the caducity of sporangia Tucker (1931) concluded that although in most isolates of *P. parasitica* the sporangia fell away without a persistent pedicel, this was a variable character.

In Waterhouse's key of 1963, *P. nicotianae* var. *nicotianae* was distinguished from *P. nicotianae* var. *parasitica* in producing larger sporangia with mean length over 40 µm. However, in our study, many isolates produced sporangia over 40 µm (Table 2). When the frequency distribution of mean sporangial lengths of all isolates studied here were plotted, the graph clearly showed continuous variation with no gap to suggest possible intraspecific differentiation (Fig. 1). Similar result was obtained using published data in literature, with the median length of sporangia 40-42 µm instead of 43-45 µm in our study. The slight discrepancy could be attributable to the different methods of sporangial production and measurement. In any case, it is simply impossible to distinguish the two varities based on the sporangial length being over or under 40 µm.

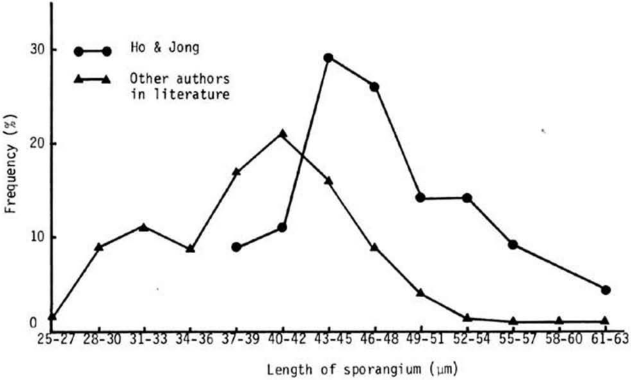

Fig. 1. Mean sporangial lengths of *Phytophthora nicotianae*

Waterhouse (1963) considered the oogonia of P. nicotianae var. nicotianae larger than those of P. nicotianae var. parasitica (28-30 vs 24-26 μm). The frequency distributions of oogonial diameters of isolates of P. nicotianae (P. parasitica) studied here and by previous workers (Fig. 2) again show continuous variations without any conspicuous break in the curves to justify the separation of two varieties.

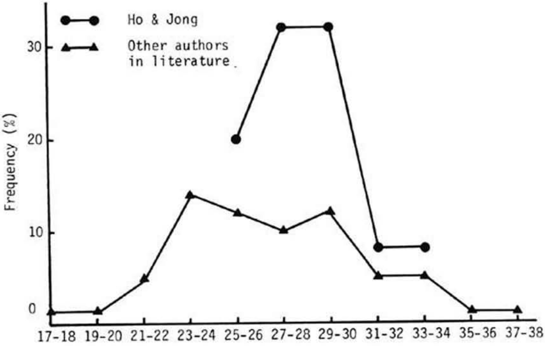

Fig. 2. Mean oogonium diameters of Phytophthora nicotianae

According to Waterhouse (1974), the oospores of P. nicotianae var. nicotianae measured over 20 μm whereas P. nicotianae var. parasitica produced oospores under 20 μm. The median diameters of oospores for all isolates of P. nicotianae (P. parasitica) studied by us was 21-22 μm and 19-20 μm based on published data and the frequency distributions showed continuous variations (Fig. 3). Thus the oospore diameter being greater or smaller than 20 μm is clearly of little diagnostic value. Furthermore, the overall mean values for the oogonial and oospore diameters for isolates referrable as P. nicotianae var. nicotianae were 29±3 and 23±3 μm respectively in our study; 27±4 and 21±4 μm based on literature, while isolates referrable as P. nicotianae var. parasitica

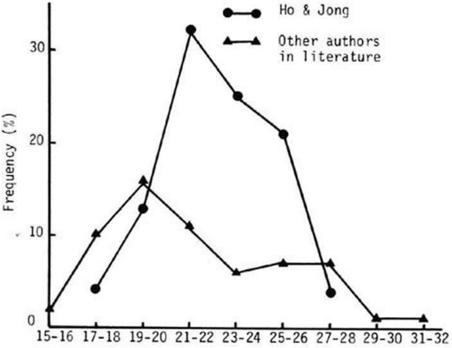

Fig. 3. Mean oospore diameters of *Phytophthora nicotianae*

produced oogonia and oospores averaging 29±2 and 23±2 μm diam in our study and 27±4 μm and 22±4 μm diam based on published data. These measurements strongly suggest that they should belong to the same taxon.

Waterhouse (1963, 1974) claimed that the oogonial stalk of *P. nicotianae* var. *nicotianae* was very eccentric, appearing to be not amphigynous at first sight. In all our isolates studied, we never had any difficulty in determining the antheridial type to be amphigynous because the oogonial stalks were predominantly central in position. Eccentric oogonial stalks were seldom observed and was not mentioned in literature.

In summary, our findings were in agreement with those of Tsao & Sisemore (1978) who reported a high degree of variability among the isolates from citrus, tomato and tobacco and questioned the separation of the species into two varieties. In fact, the difficulty or impossibility to differentiate these two varieties is apparent from the considerable overlapping in diagnostic characters as recorded in literature (Tables 4 & 5).

Waterhouse's disposition of similar taxa described earlier was also confusing. She (1974) stated that *P. nicotianae* var. *nicotianae* included Ashby's "*macrospora*" group with larger oospores and *P. nicotianae* var. *parasitica* corresponded to "*microspora*" group with smaller oospores. However, Waterhouse (1963) considered *P. formosana*, *P. lycopersici* and *P. ricini* synonymous with *P. nicotianae* var. *parasitica*, even though they all possessed larger oospores (19-25, 22-27 and 24-26 µm, respectively in original descriptions). On the other hand, *P. melongenae*, *P. allii* and *P. terrestris* were treated as synonymous with *P. nicotinae* var. *nicotianae* despite their smaller oospores (17-21, 17 and 18-21 µm, respectively in original descriptions). Her treatment of *P. parasitica* var. *piperina* was puzzling. It was listed as synonymous with *P. nicotianae* var. *parasitica* in the key but considered the same as *P. nicotianae* var. *nicotianae* in the text (Waterhouse, 1963).

The differentiation of the species into two less than distinct morphological varieties often cast doubt on the true identity of the pathogen. Thus, *Phytophthora* species on tobacco, tomato, eggplant, peperomia and agave were identified by different workers in different parts of the world as *P. nicotianae* var. *nicotianae*, *P. nicotianae* var. *parasitica* or both (Waterhouse & Waterston, 1964 a,b; Tamori, 1974; Holliday, 1980; Humphrey Jones, 1980; Shenoi *et al*., 1985; Flett, 1986). Liu (1977) reported both varieties on citrus, papaya, tomato, peppers and orchids in Malaysia. Although Weststeijn (1973) named the tomato *Phytophthora* in Holland as *P. nicotianae* var. *nicotianae* he admitted that it was probably the same as *P. parasitica* reported on tomato by workers in other countries. The confusion over these two varieties of *P. nicotianae* led some authors to disregard them completely (Zhuang, 1981; Krober, 1985; Gerrettson-Cornell, 1985; Cacciola & di San Lio, 1988). It is also our opinion that the separation of the species into two morphological varieties is not warranted. Furthermore, the serological study of Morton & Dukes (1967), the nutritional studies of Mehrotra (1951) and Roncadori (1965), the enzyme study of McIntyre & Hanlin (1978), the protein pattern analysis of Erselius & de Vallavieille (1984) and the immunoelectrophoresis work of Cristinzio *et al*. (1983) have all failed to support the separation of two varieties of *P. nicotianae* (*P. parasitica*). It is difficult to understand why Waterhouse (Gallegly, 1983) stated that *P. nicotianae* var. *nicotianae* and *P. nicotianae* var. *parasitica* could be treated even as two separate species if she (1963) considered *P. parasitica* specifically not different from *P. nicotianae* in the first place. Gallegly's suggestion (1983) of naming two different species based on host specificity is not acceptable according to the Code.

Isolates of *P. nicotianae* (*P. parasitica*) supposedly specific to certain plant hosts were sometimes further assigned subspecific epithets. Thus Kale & Prasad (1957) reported that *P. parasitica* var. *sesami* was specific to sesame. The tobacco black shank fungus has been referred as *P. parasitica* var. *nicotianae* (Tucker, 1931), *P. parasitica* f. sp. *nicotianae* (Herr & Sutton, 1984) and *P. nicotianae* f. sp. *nicotianae* (Erselius & Vallavielle, 1984). Ponchet *et al.*, 1972) used the name *P. nicotianae* f. sp. *parasitica* to refer to the isolates from carnation. While the specificity of *P. parasitica* var. *sesami* and *P. nicotianae* f. sp. *parasitica* was never confirmed, exceptions to the supposedly specific pathogenicity of black shank fungus on tobacco have been encountered (Tisdale & Kelly, 1926; Nolla, 1928; Ashby, 1928; Bell & Haasis, 1967; Munnecke & Bricker, 1976; Jain *et al.*, 1982). Thus, it seems unwise, as far as taxonomy is concerned, to distinguish isolates of *P. nicotianae* further based on specific pathogenicity although tobacco pathologists would prefer for communication purposes, a separate name for the tobacco black shank pathogen (Erwin, 1983).

Acknowledgements

This work was supported in part by a grant-in-aid from the Whitehall Foundation to H.H. Ho and NSF Grant BSR 8413523 to S.C. Jong. The authors thank Li Luo for her invaluable technical assistance and Elmer E. Davis for reviewing the manuscript.

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Table 1. Isolates of *Phytophthora nicotianae* (*P. parasitica*) used

ATCC	Host	Origin	Source
13611	Tobacco	USA	Apple
13612	Tobacco	USA	Apple
13614	Citrus	USA	Klotz A33/1A
15407	Unknown	Unknown	Gallegly M211
15408	Lemon	USA	Gallegly M34
15409	Tobacco	USA	Apple 1143
14310	Tobacco	USA	Gallegly M25
22597	Tobacco	USA	Apple 1156-3-1-9
22598	Tobacco	USA	Apple 1156-3-1-1
26009	Papaya	USA	Ko P-174
26510	Tobacco	USA	Flowers m-229
28302	*Citrus sinensis*	USA	Whiteside PR196
36996	*Gypsophila paniculata*	USA	Engelhard 4093
36997	*Poinsetta pulcherrima*	USA	Engelhard 4146
38212	*Brassaia actinophylla*	USA	Alfierri PTCC 859
38606	Citrus soil	USA	Zentmyer P731
38607	Citrus soil	USA	Zentmyer P991
38812	Strawberry	Japan	Suzui S11
42911	Cocoa	Sao Thome	Erselius 261
46060	Tobacco	USA	Lucas D-Barrow-1
46061	Tobacco	USA	Flowers 228
46062	Tobacco	USA	Bardinelli 3-15R
46063	Tobacco	USA	Bardinelli 3-15T
46293	Rhododendron	USA	Benson 316
46294	Azalea	USA	Benson 327
46732	*Fremontia californica*	USA	Zentmyer P1063
48004	Grapevine	S. Africa	Marais 61
48640	Tobacco	USA	Warner
52638	*Cornus florida*	USA	El-Gholl 080-2886
56197	*Musa* sp.	S. Africa	Thompson 3886
56602	*Piper nigrum*	China	Yu P15a
60439	*Lycopersicum esculentum*	England	CMI 35087
63534	Tomato	USA	CBS 109.17[b]
64535	*Solanum melongena*	Taiwan	CBS 301.29[c]
64536	Tobacco	Taiwan	CBS 305.29[d]

ATCC - Identified by American Type Culture Collection accession number
CBS - Centraalbureau voor Schimmelcultures, Baarn, Netherlands
CMI - Commonwealth Mycological Institute, Kew, Surrey, England

[a] Received as *P. palmivora*

[b] Received as *P. terrestris* (Type)

[c] Received as *P. melongenae* (Authentic)

[d] Received as *P. tabacci* (Authentic)

Table 2. Growth, cultural, hyphal and sporangial characteristics of *Phytophthora nicotianae* (*P. parasitica*)

ATCC	Growth at 10C	Culture Appearance	Hyphae	Spiked Swellings	Sporangium(a) Beaked Apex	Length (µm)	Breadth (µm)	L/B
13611	--	irregular,fluffy	uneven	+/-	--	40±3(b)	33±2	1.2±0.1
13612	--	distinctly tufted	very uneven	+/-	++	47±6	32±10	1.5±0.1
13614	+	uniformly fluffy	uniform	+/-	+/-	55±8	40±4	1.4±0
15407	--	uniformly fluffy	uniform	+	--	49±5	39±5	1.3±0
15408	--	tufted	uneven	++	+/-	49±6	38±5	1.3±0
15409	--	tufted, slighlty fluffy	uneven	--	--	43±6	31±4	1.4±0.2
15410	--	uniformly fluffy	slightly uneven	+/-	+/-	45±8	29±4	1.5±0.2
22597	++	irregular, fluffy	uniform	--	--	50±6	34±4	1.4±0.4
22598	--	irregular, fluffy	uneven	--	+/-	38±6	25±2	1.5±0.3
26009	--	irregular, fluffy	uneven	+/-	--	54±3	41±2	1.3±0
26510	--	tufted, fluffy	uneven	+/-	--	45±5	32±3	1.4±0.2
28302	--	irregular, slightly fluffy	uniform	+	--	44±4	34±3	1.3±0
36996	+/-	tufted	slightly uneven	++	--	47±5	37±5	1.3±0
36997	+/-	irregular, fluffy	slightly uneven	+	--	48±5	37±5	1.3±0
38212	--	slightly rosette, not fluffy	uniform	--	--	44±5	29±4	1.5±0
38606	--	tufted, slightly fluffy	uneven	++	+/-	40±6	25±3	1.6±0
38607	--	tufted slightly fluffy	uneven	+	+	42±4	31±2	1.4±0
38812	+/-	uniformly fluffy	uniform	+/-	--	52±7	42±4	1.2±0
42911	+	irregular, fluffy	uneven	--	--	48±5	38±2	1.3±0
46060	--	fluffy	uneven	--	--	52±7	40±5	1.3±0.1
46061	--	tufted, fairly fluffy	very uneven	--	--	47±6	37±4	1.3±0.1

Table 2. (cont'd.)

ATCC	Growth at 10C	Culture Appearance	Hyphae	Spiked Swellings	Sporangium(a) Beaked Apex	Length (μm)	Breadth (μm)	L/B
46062	--	tufted, not fluffy	uneven	--	+/-	44±4	32±3	1.4±0.1
46063	--	irregular, slightly fluffy	uneven	++	--	44±4	34±4	1.3±0.1
46293	+/-	uniformly fluffy	uniform	--	--	44±6	37±4	1.2±0
46294	+/-	tufted, mod. fluffy	slightly uneven	--	--	50±3	39±2	1.3±0.1
46732	--	uniformly fluffy	uniform	+	+/-	42±5	30±4	1.5±0.3
48004	--	tufted	slightly uneven	+/-	--	54±7	40±4	1.4±0.1
48640	++	tufted, not fluffy	uneven	+/-	+/-	43±4	31±3	1.4±0.2
52638	--	tufted	uniform	--	+/-	47±5	34±3	1.4±0.1
56197	++	uniformly fluffy	slightly uneven	+	--	52±6	38±4	1.4±0.1
56602	++	uniformly fluffy	uneven	+	--	38±6	28±5	1.4±0.1
60439	--	Uniformly fluffy	uniform	+	--	43±5	34±3	1.2±0.1
64534	--	tufted, fluffy	uneven	+	--	46±4	41±3	1.1±0.1
64535	--	irregular, tufted	uniform	--	--	50±5	34±3	1.5±0.2
64536	++	uniformly fluffy	uneven	--	+/-	63±6	35±3	1.8±0.2

(a) Produced from mycelial agar discs in water

(b) Mean ± standard error, based on 50 measurements

Table 3. Characteristics of sex organs and chlamydospores of *Phytophthora nicotianae* (*P. parasitica*)

ATCC	Mating Type	Oongium(a) Diam (µm)	Oospore Diam(µm)	Antheridium Length(µm)	Antheridium Breadth(µm)	Chlamydospore Diam(µm)
13611	A2		(No selfed sex organs produced)			37±6
13612	A2	27±3(b)	21±2	9±1	11±2	36±5
13614	A1	25±2	18±2	10±2	11±1	31±4
15407	A2/H	29±2	25±2	11±2	12±1	41±6
15408	A1	27±3	21±2	11±2	12±2	33±7
15409	A1		(No selfed sex organs produced)			25±5
15410	A2	26±3	21±3	12±2	14±2	26±6
22597	A1	30±2	25±2	9±2	12±2	37±5
22598	A1	28±3	23±3	11±2	12±2	31±4
26009	A1	30±2	24±1	8±2	13±1	36±9
26510	A1	28±2	23±2	9±2	13±1	35±5
28302	A2		(No selfed sex organs produced)			32±4
36996	A2	30±1	25±1	9±1	10±1	32±6
36997	A2	30±2	23±2	10±1	12±1	38±8
38212	A2		(No selfed sex organs produced)			30±2
38606	A2	28±2	21±2	10±2	13±2	37±4
38607	A1	28±2	22±2	10±2	11±2	31±5
38812	A2		(No selfed sex organs produced)			33±5
42911	A1	27±2	22±2	10±2	12±1	31±4
46060	A1	29±2	23±2	10±2	14±2	39±7
46061	A2		(No selfed sex organs produced)			34±5
46062	A2		(No selfed sex organs produced)			32±5
46063	A1	27±2	21±5	9±1	12±1	30±6
46293	A2		(No selfed sex organs produced)			34±10
46294	A2	29±1	24±2	9±2	13±1	36±6
46732	A2	26±2	20±1	12±2	13±2	35±6
48004	A1	32±2	26±2	12±2	15±2	33±7
48640	A2		(No selfed sex organs produced)			32±4
52638	A2	30±2	25±2	9±2	12±1	34±7
56197	A2		(No selfed sex organs produced)			36±8
56602	A1	26±2	20±2	12±1	12±1	36±7
60439	A1		(No selfed sex organs produced)			37±7
64534	A2	33±3	28±2	12±1	13±1	31±6
64535	A2	33±3	(aborted)	11±3	13±1	30±6
64536	A2	32	22	10	7	27±10

(a) selfed on membrane X *nicotianae* 38607 (A1) or 38606 (A2)

(b) mean ± standard error based on 50 measurements

Table 4. Characteristics of "*Phytophthora nicotianae* var. *parasitica*" *sensu* Waterhouse (103) recorded chronologically in literature

		Host of	Sporangium			Oogonium	Oospore	Antheridium		Chlamydospore	
Ref.	Synonyms	isolate	Length(µm)	Breadth(µm)	L/B	Diam(µm)	Diam(µm)	Length(µm)	Width(µm)	Diam(µm)	Wall(µm)
103			38(<40)	30	≤1.4(D)	24-26		10	12	<60	3-4(P)
16	*parasitica*	*Ricinus communis*	25-30	20-40		24	19			20-60	P
		Sesamum indicum									
75	*parasitica*	Castor bean	44	23	1.8					31	
5	*parasitica*	Coconut palm	37-40	28-30	1.3-1.4	23	19			36	P
						22	17				
						25	18				
						26	19				
						24	17				
94	*parasitica*	Pineapple	31	26	1.2					27	
53	*parasitica*	Tomato				18					
		Banana				18					
		Cotton				18					
80	*tabacci*	Tobacco	16-58	12-45		26-30	21-24			21-25	1.5-2
6	*parasitica*	Coconut				24	18				
	sec.	Pineapple				24	17				
	microspora	Cotton					28				
							28				
							22				
52	*parasitica*	*Ricinus communis*	40	30	1.3						
	parasitica	Rhubarb	41	30	1.4						
	var. *rhei*		40	31	1.3						
			27	26	1.0						
98	*parasitica*	*Ananas ananas*	50	35	1.4						
		Bryophyllum pinnatum	37	28	1.3						

Table 4. (cont'd.)

Ref.	Synonyms	Host of isolate	Sporangium Length(µm)	Sporangium Breadth(µm)	L/B	Oogonium Diam(µm)	Oospore Diam(µm)	Antheridium Length(µm)	Antheridium Width(µm)	Chlamydospore Diam(µm)	Chlamydospore Wall(µm)
			33	23	1.5						
		Capsicum annuum	41	31	1.3						
			29	21	1.4						
		Catharanthus roseus	37	28	1.3						
			37	29	1.3						
		Citrus sp.	34	24	1.4						
			62	46	1.3						
		Cocos nucifera	60	30	2.0						
		Gossypium barbadense	40	32	1.3						
			43	29	1.5						
			43	32	1.3						
		Grammatophyllum sp.	37	25	1.5						
		Hibiscus sabdariffa	43	26	1.3						
			44	33	1.3						
			42	31	1.4						
		Lilium regale	41	29	1.4						
			49	38	1.3						
			43	32	1.3						
		Lilium sp.	41	30	1.4						
		Lysopersicon lycopersici	42	33	1.3						
			51	38	1.3						
			37	29	1.3						
			37	30	1.2						
			44	33	1.3						
			46	33	1.4						
			40	29	1.4						

Table 4. (cont'd.)

Ref.	Synonyms	Host of isolate	Sporangium Length(μm)	Sporangium Breadth(μm)	L/B	Oogonium Diam(μm)	Oospore Diam(μm)	Antheridium Length(μm)	Antheridium Width(μm)	Chlamydospore Diam(μm)	Chlamydospore Wall(μm)
		Manihot sp.	35	25	1.4						
		Musa textilis	27	19	1.4						
		Pollia sp.	39	30	1.3						
		Rheum rhaponticum	28	18	1.6						
			42	31	1.3						
		Ricinus communis	32	25	1.3						
			50	40	1.3						
		Solanum melongena	34	24	1.4						
			47	34	1.4						
			41	31	1.3						
			41	30	1.4						
			38	29	1.3						
			42	29	1.9						
		Solanum tuberosum	31	22	1.4						
			35	25	1.4						
		Theobroma cacao	33	25	1.3						
		Vigna sp.	44	34	1.3						
58	*parasitica*	*Piper betle*				38	31	12	14	29	P
						35	28	12	14	33	P
		Ricinus communis	42	27	1.6						
			40	28	1.4						
			41	27	1.5						
17	*parasitica* var. *piperina*	*Piper betle*	36-56	31-36		33	26				
7	*parasitica*	Citrus & Cotton	48	38	1.2	23	19				
47	*parasitica*	Black locust	45	38	1.2					30	P

Table 4. (cont'd.)

Ref.	Synonyms	Host of isolate	Sporangium Length(µm)	Sporangium Breadth(µm)	L/B	Oogonium Diam(µm)	Oospore Diam(µm)	Antheridium Length(µm)	Antheridium Width(µm)	Chlamydospore Diam(µm)	Chlamydospore Wall(µm)
81	formosana	Castor bean	36	28	1.3	24-30	19-25	7-13	10-15		
			39	28	1.4						
82	lycopersici	Tomato	37	28	1.3	26-33	22-27			23-29	
			36	26	1.4						
81	ricini	Ricinus communis	38	25	1.6	26-32	24-26			32-40	
102	parasitica	Orange	40	28	1.4	32	28			30	P
			48	35	1.4	30				30	P
73	parasitica	Tomato	41	30	1.4	50(a)	33(a)	None(a)		31	P
										31	P
61	parasitica	Belladonna	38	31	1.2	23	20				
18	parasitica	Potato	20-63	15-48		31	26			18-43	P
24	parasitica		43	25	1.6	30	27	9	12	34	
43	parasitica	Tomato	47	31	1.5					30	
			45	37	1.2					32	
			41	28	1.5					36	
			29	24	1.2					29	
			38	31	1.2					37	
			42	36	1.2	28				36	
			48	46	1.0					28	
			29	26	1.1					41	
			43	37	1.2					35	
			39	33	1.2					30	
			39	36	1.1					36	
			33	31	1.1					39	
		Eggplant	37	29	1.3	26				30	
			33	29	1.1	25-28				40	

Table 4. (cont'd.)

		Host of	Sporangium			Oogonium	Oospore	Antheridium		Chlamydospore	
Ref.	Synonyms	isolate	Length(μm)	Breadth(μm)	L/B	Diam(μm)	Diam(μm)	Length(μm)	Width(μm)	Diam(μm)	Wall(μm)
			31	30	1.0	22-28				28	
			29	26	1.1					37	
			36	28	1.3	31				30	
			37	31	1.2					36	
			37	31	1.2					29	
			29	27	1.1					28	
			35	29	1.2					31	
			33	28	1.2	22				30	
			33	28	1.2	28				35	
		Sesamun	30	30	1.0					34	
			23	20	1.2					28	
			35	32	1.1					30	
			47	41	1.1					41	
			30	26	1.2					27	
			32	30	1.1	32				30	
			32	26	1.2					29	
			29	24	1.2					38	
			39	33	1.2					41	
			28	25	1.1					25	
			32	22	1.5					38	
			29	29	1.0	21				41	
		Pistachio	30	24	1.3	29				31	
			41	38	1.1					29	
106	parasitica	Tomato				18-30	12-25			20-60	
39	parasitica var. sesami	Sesamun	39	33	1.2						

Table 4. (cont'd.)

		Host of	Sporangium			Oogonium	Oospore	Antheridium		Chlamydospore	
Ref.	Synonyms	isolate	Length(µm)	Breadth(µm)	L/B	Diam(µm)	Diam(µm)	Length(µm)	Width(µm)	Diam(µm)	Wall(µm)
83	*parasitica*	*Bryophyllum*	41	32	1.3					33	
		Dianthus	49	38	1.3					29	
		Sesamum								28	
		Solanum melongena								30	
8	*parasitica*	Boxwood	42	31	1.3	24	19	12	14		
						24	19	14	12	32	
						26	22	14	13	29	
		Citrus & Ivy	38	28	1.4						
			36	27	1.3				30		
			43	32	1.3				32		
			38	29	1.3				29		
44	*parasitica*	Pistachio & Rosemary	34-56	26-45	1.2-1.4	23-24		11-12			
22		*Solanum tuberosum*	34	26	1.3	34	26	11	11	30	
		Ailanthus altissima	41	30	1.4	29		12	13	29	
		Dianthus caryophyllus	41	32	1.3	25	22	16	15	31	
		Malus sylvestris	35	27	1.3	27	21	12	12	31	
		L.esculentum	43	32	1.4						
		Sesamum indicum	40	30	1.4	27	21	13	12		
						29		13	12	29	
		Araucaria araucana	40	29	1.4	30		13	13	32	
		Solanum melongena	43	27	1.6						
		Citrus sp.	47	34	1.4	31	24	13	12		
			39	30	1.3						
		Washingtonia filifera	33	25	1.3	26	25	12	12	19	
		Nicotiana sp.	37	25	1.5	29		13	12	29	
48		Strawberry	40	29	1.4						

Table 4. (cont'd.)

Ref.	Synonyms	Host of isolate	Sporangium			Oogonium	Oospore	Antheridium		Chlamydospore	
			Length(µm)	Breadth(µm)	L/B	Diam(µm)	Diam(µm)	Length(µm)	Width(µm)	Diam(µm)	Wall(µm)
			38	28	1.3	23		12	12		
26		Peperomia	35	30	1.2					25-40	
99	*parasitica*		44-50	29-32	1.3-1.4	30	28	8	11	28	
66					<1.6	<28-40	<20-25			<25-35	
13	*parasitica*	*Phalaenopsis*	48	38	1.3	18		16	12	25-40	
9	*parasitica*	Citrus	38-50	30-40						<60	
56		Strawberry	43	35	1.2			13	14		
				45		39	1.2	13	14		
			44	35	1.3	27	18				
			44	36	1.2				14	14	
112	*nicotianae*	*Agave sisalana*	58	46	1.3(ND)	24	21	13	12	21	
		Piper nigrum	47	37	1.4(ND)					28-40	
		Rheum emodi	52	42	1.2(ND)					33-47	
		Ricinus communis	55	47	1.3(ND)					30-42	
		Solanum melongena	47	40	1.2(ND)					25-44	
			54	41	1.3(ND)					30-44	
		Stephania sinica	41	34	1.3(D)					22-46	
100		Citrus	43	34	1.6	28				28	
65	*nicotianae*	Golden-fruit palm	48	37	1.3	28	22	10	13	39	
45	*nicotianae*		44	33	1.3	32	27			30	
69		Lithospermum	40	32	1.2-1.4	27	23	11	12		
14		*Lilium*	49	32	1.5						
64		Sesame	45	32	1.4		19			32	P
4		Soil	38	30	1.3	26	12	9			

D = Deciduous; ND = Nondeciduous; P = Pigmented (yellowish to brown); *Sex organs questionable; (not included in analysis)

Table 5. Characteristics of "*Phytophthora* *nicotianae* var. *nicotianae*" *sensu* Waterhouse (103) recorded chronologically in literature

Ref	Synonyms	Host of isolate	Sporangium Length(µm)	Sporangium Breadth(µm)	L/B	Oogonium Diam(µm)	Oospore Diam(µm)	Antheridium Length(µm)	Antheridium Width(µm)	Chlamydospore Diam(µm)	Chlamydospore Wall(µm)
103			45(>40)	36	1.3(ND)	28-30	24	10-16	10	20-40	1.5 (NP)
11	*nicotianae*	Tobacco	36	25	1.4	19	15				
79	*melongenae*	Eggplant	42	34	1.3	18-23 x 20-24	17-21	10-14	12-16	25-42	P
79	*allii*	Onion	49	37	1.3	21	17	10-14	8-18	P	
87	*terrestris*	Tomato	43	31	1.4	22	20			34	
75	*nicotianae*	Tobacco	38	30	1.3					29	
5	*terrestris*	Tomato				24	19				
	parasitica	Tobacco	55	48	1.2	25	19				
40	*terrestris*	Tomato, eggplant, pepper	31	41	1.3		21			25	
28	*parasitica* var. *rhei*	Rhubarb	41	31	1.3		24			33	P
68	*melongenae*	Eggplant	35	28	1.2	24-32	16-24			29	NP/P
94	*nicotianae*	Tobacco	34	26	1.4					25	P
			38	29	1.3					23	P
			37	25	1.5						
53	*nicotianae*	Tobacco	46	33	1.4						
6	*terrestris*	Tomato				19					
						19				29	
						15					
	parasitica	Tobacco				30	26	8-10	12-14		
	sec. *macrospora*					33	26	9	15		
67	*nicotianae*	Tobacco	47	37	1.2					35	
			50	39	1.5					35	

Table 5. (cont'd.)

		Host of	Sporangium			Oogonium	Oospore	Antheridium		Chlamydospore	
Ref	Synonyms	isolate	Length(µm)	Breadth(µm)	L/B	Diam(µm)	Diam(µm)	Length(µm)	Width(µm)	Diam(µm)	Wall(µm)
			47	39	1.2					40	
			42	33	1.3					31	
52	*terrestris*	Tomato	41	32	1.3						
98	*parasitica*	Tobacco	35	25	1.4	29	25			29	
	var. *nicotianae*		41	32	1.3	29	25			24	
			40	29	1.4	26	21			21	
18	*parasitica* var. *piperina*	*Piper betle*	36-56	31-36		33	20				
43	*parasitica*	Tobacco	30	26	1.2	33-34				30	
			32	26	1.2					29	
			43	36	1.2					35	
			42	36	1.3					33	
38	*parasitica*	Tobacco					23				
3	*parasitica* var. *nicotianae*	Tobacco					24				
83	*parasitica* var. *nicotianae*	Tobacco								28	
	parasitica var. *rhei*	Rhubarb	45	34	1.3					35	
71	*parasitica* var. *macrospora*	*Annona squamosa*	40	19		21				28	
110		*Agave*			1.3 (ND)						
91		*Anacardium*	63	44	1.4 (ND)					35-37	
66					<1.6	28-40	20-30			25-35	
111		*Premontia*	39	31	1.3(ND)		28	22	11	35	1.5
36		Tomato	30-70	23-45	1.2-1.4		25-35		8-10	10-17	

Table 5. (cont'd.)

Ref	Synonyms	Host of isolate	Sporangium Length(µm)	Sporangium Breadth(µm)	L/B	Oogonium Diam(µm)	Oospore Diam(µm)	Antheridium Length(µm)	Antheridium Width(µm)	Chlamydospore Diam(µm)	Chlamydospore Wall(µm)
19		Tomato	36	26	1.4		25-28	23-27			
112	nicotianae	Tobacco	42	34	1.3					21-37	
37		Solanum melongena	42	31	1.4					23	
64		Sesame	45	32	1.4	19				32	
4		Soil	42	32	1.4	25		13	11		

P = Pigmented (yellowish to brown) NP = Non-pigmented

ND = Non-deciduous

MYCOTAXON

Vol. XXXV, No. 2, pp. 277-281 July-September 1989

CHAMONIXIA BISPORA SP. NOV. (BOLETALES) FROM CHINA

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ABSTRACT

An undescribed species, Chamonixia bispora sp. nov., from Guangdong, China, is described and illustrated, with detailed comparison with the other described species of the genus. This Chinese species is readily distinguished from the other species by a combination of the following characters: small short basidia bearing 2 spores (15-21 x 10-12 µm) with 3-4 longitudinal ridges, no columella, and peridium cyanescent when bruised or cut in the fresh state. A key to the Chinese species of Chamonixia is provided.

Key words: Chamonixia bispora sp. nov.; Boletales; taxonomy; China

During our investigation of Chinese hypogeous fungi, we came across an interesting collection deposited under the name of Gautieria graveolens Vittadini in the mycological herbarium of Guangdong Institute of Microbiology, Guangzhou. After careful studies, we found it to be a species belonging to the genus Chamonixia Rolland. A literature survey revealed that the genus has already been recorded with a single species, C. caespitosa Rolland, in China before (Eckblad & Ellingsen, 1984). This species was collected by H. Smith, a Swedish botanist who travelled to China three times to collect many specimens of higher plants and some higher fungi, in Sichuan in 1922. We have not examined the material which is deposited in UPS, but according to the authors' descriptions and the scanning electron microscopy of the spores, the present Chinese collection apparently differs from Smith's collection.

Since Rolland (1899) erected the genus Chamonixia typified by C. caespitosa, about a dozen species have been described in the genus (Rolland, 1899; Corner & Hawker, 1953; Smith & Singer, 1959; Beaton et al., 1985). It is distributed in Europe (Lange & Hawker, 1951; Kotlaba, 1971; Gross, 1974; Haeggstrom, 1987), North America (Dodge & Zeller, 1934; Smith & Singer, 1959), Australasia (Beaton et al., 1985; Corner & Hawker, 1953; Cribb, 1958; Cunningham, 1944) and China (Eckblad & Ellingsen, 1984). The genus is characterized by having almost globose whitish basidiomata with a peridium cyanescent when bruised or cut, and short clavate basidia bearing ellipsoidal spores with several longitudinal ridges (Beaton et al., 1985; Rolland, 1899; Smith and Singer, 1959). It is considered to belong to the Boletales (Jülich, 1981; Beaton et al., 1985). By comparisons with all published species of the genus, the present Chinese collection is apparently distinct and represents a species new to science.

The following descriptions are based on our observations and field notes accompanying the specimen. In our microscopic observations, the colours and measurements were obtained from material mounted in 5% KOH unless stated otherwise. For observations using the scanning electron microscope, material from a basidiome was rehydrated on a clean glass slide and stuck onto an adhesive layer on a small clean cover slip, then coated with gold and observed using a Hitachi S570 SEM.

KEY TO THE CHINESE SPECIES OF CHAMONIXIA

Columella percurrent; basidia 4-spored; spores with
8 or more longitudinal ridges .... *C. caespitosa*
Columella absent; basidia 2-spored; spores with
3-4 longitudinal ridges .... *C. bispora*

CHAMONIXIA BISPORA B.C.Zhang & Yu, sp. nov. Figs 1-4

Basidiomata subglobosa vel applanata, 1.1-2 cm lata; peridium album vel griseolo-brunneum, cyanescens ubi contusum; gleba brunneola vel fusca, cyanescens et viscida ubi secta, loculis minutis irregularibus composita; columella nulla. Sporae 15-21 x 10-12 µm, symmetricae, ellipsoideae vel breviter fusiformes, pallide brunneae, 3-4 costis praeditae. Basidia clavata vel subcylindrica, 2-sporigera. Trama hymenophoris 80-160 µm crassa, hyalina, gelatinosa. Peridiopellis hyphis parallelibus repentibus composita.

Ad terrum in sylvis frondosis.

Etymology: *bi* (Latin, two) and *spora* (Latin, spore), referring to each basidium bearing two spores.

Basidiomata epigeous, subglobose to flattened, 11-20 mm in the largest dimension, fleshy when fresh, drying firm, astipitate, with basal rhizomorphic attachment. Peridium very thin in section, white to pale greyish brown when fresh, becoming deep blue when bruised or in Melzer's reagent, drying pale greyish brown, ochraceous to medium brown, no colour change when stained in KOH. Gleba pale brown when young, brown to dark brown at maturity, becoming deep blue and sticky on cut surface when fresh, with numerous small chambers, 1-4 per mm, empty or filled with spores. Columella absent. Sterile base present, small. Tramal plates partly or fully gelatinized, 150-240 µm thick, composed of a broad hymenophoral trama and poorly developed subhymenial layers. Clamp connexions not seen. Spores symmetric, 15-21 x 10-12 µm including ridges, ellipsoidal to short-fusoid, obtuse at apex but occasionally acute, pale brown in KOH, brown to reddish brown in Melzer's reagent, with thickened wall about 1 µm, ornamented with 3-4 longitudinal ridges up to 2 µm high but usually lower, appearing as an irregular triangle or square profile when viewed from pole; hilar appendix conspicuous, 0.5-2 µm in length, often with terminal sterigmal appendages; with 1-2 droplets. Basidia clavate to subcylindrical, short, bearing 2 sterigmata, sometimes up to 5 µm high, readily collapsing. Subhymenial layers poorly developed, 10-20 µm thick, pseudoparenchymatous. Hymenophoral trama variable, 80-160 µm broad, composed of loosely interwoven

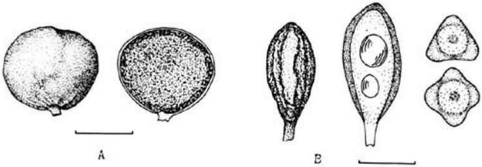
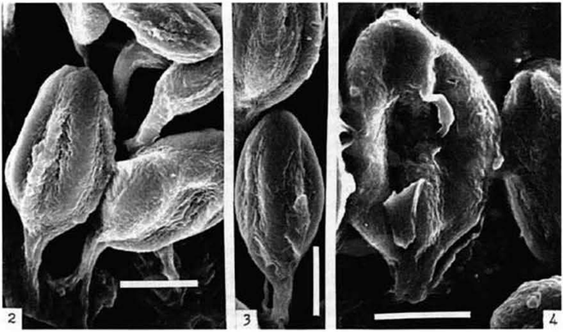


Fig.1. Basidiomata and basidiospores of <u>Chamonixia</u> <u>bispora</u>: A. Habit and section (bar=10 mm). B. spores of different views (bar=10 µm).



Figs 2-4. Basidiospores of <u>Chamonixia bispora</u> (SEM, holotype). (bar= 5 µm). Figs 2-3 showing spore shape and spore ornamentation. Fig.4 showing broken ridge of the spore.

hyaline hyphae 2-4 µm diam, gelatinized. Peridiopellis 160-240 µm thick, a repent epicutis, composed of thin walled parallel hyphae 2-3 µm diam.

HOLOTYPE: CHINA: Guangdong Prov., Dinghu Mountain Natural Reserve, near Qing Yun Temple, solitary on the ground in broad-leafed woods, leg. Wang You-zao, Zhen Wan-ling, Li Jian-qing, 13 X 1982 (GDIMH 5688). The type specimen is deposited in the Mycological Herbarium of Guangdong Institute of Microbiology, Guangzhou (GDIMH). Some basidiomata are partly eaten by insects.

This Chinese epigeous species possessing basidiomata with a whitish peridium cyanescent when bruised in the fresh state and short basidia bearing spores with longitudinal ridges, clearly belongs to the genus *Chamonixia*, although most species in this genus are hypogeous. *C. bispora*, characterized by having 2-spored small basidia, larger spores (15-21 x 10-12 µm) with 3-4 regular, longitudinal ridges, is readily distinguished from other species.

C. bispora is most similar to another species, *C. caespitosa*, which also occurs in China, in gross morphology and spore size. But the former differs from the latter in its absence of columella, 2-spored basidia and spore ornamentation (Eckblad & Ellingsen, 1984). *C. bispora* is also similar to *C. octorugosa* Corner & Hawker and *C. caespitosa* in spore size, but the latter has spores with 8 or more ridges and 4-spored basidia (Corner & Hawker, 1953). *C. bispora* differs from *C. mucosa* (Petri) Corner & Hawker, *C. pachydermis* (Zeller & Dodge) Beaton, Pegler & Young, and *C. vittatispora* Beaton, Pegler & Young in its larger spores and usually has fewer ridges on the spores, and 2-spored basidia (Beaton et al., 1985). There are three more species occurring in North America, which are distinct in their very irregular spore ornamentations (Smith & Singer, 1959), totally different from *C. bispora*. In *Chamonixia*, spore size and spore ornamentation are generally considered to be the main characters used to separate the species (Smith & Singer, 1959; Beaton et al., 1985).

Because of the similarity of spore ornamentations, *Chamonixia* is sometimes considered to be synonymous with *Gautieria* Vitt. (Dodge & Zeller, 1934; Cunningham, 1944; Cribb, 1958), but their longitidinal ridges are formed in different ways (Beaton et al., 1985). Our observations using SEM provide more evidence for their point of view. The ridges on spores of *C. bispora* are formed by an undulation of the episporial wall (i.e. outer layer), and are loosely connected with the inner walls and easily broken, exposing the inner walls (Fig. 4).

ACKNOWLEDGEMENT

We are grateful to Prof. Zheng Guo-yang and Mr. Li Tai-hui, Guangdong Institute of Microbiology, Guangzhou, for the loan of the specimen and their kind help to the senior author during his visit to the Institute, and to our colleague Dr. Zhuang Jian-yun for checking the Latin diagnosis. Our thanks are also due to Mr. Dong Guang-jun for his assistance during SEM observations, and to Ms Han Zhe-fang for inking the line drawings. Finally, we want to send our gratitude to Dr. W. Jülich, Rijksherbarium, Leiden, the Netherlands, who kindly read the manuscript and provided useful comments.

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中文摘要

本文描述采自广东的一新种双孢卡氏腹菌 *Chamonixia bispora* B.C.Zhang & Yu sp. nov.，并与该属已描述的种进行了详细的比较。双孢卡氏腹菌的主要特征为担子果白色至灰褐色，新鲜时受伤变蓝，无中轴；担子小而短，每个担子上着生两个孢子，孢子15-21 X 10-12μm，表面具 3—4 条纵肋。文中附有卡氏腹菌属中国种的检索表。

MYCOTAXON

Vol. XXXV, No. 2, pp. 283-285 July-September 1989

ASCOSPARASSIS HEINRICHERI FROM VENEZUELA: AN EXTENDED DISTRIBUTION.

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ABSTRACT

A brief review of the genus *Ascosparassis* (Pezizales) is given and a collections of the only known species, *A. heinricheri*, is reported for the first time from the Western Hemisphere. A photograph of *A. heinricheri* in fresh condition is provided.

The purpose of this brief note is to report on a collection of *Ascosparassis heinricheri* (Bres.) by D. Pfister from Venezuela. The previous collections of this taxon have been made in Asia. The genus *Ascosparassis* was described by Kobayasi (1960), who based his description on a collection made by Shimizu from northern Honshu. He named the fungus *Ascosparassis shimizuensis* in honor of the collector and described it as a member of the Sclerotiniaceae, a family in the Leotiales. Kobayasi stated that the fungus "has the beautiful appearance resembling cauliflower or *Sparassis* with rosy tint." Korf (1963) studied additional collections of *A. shimizuensis* from Java and concluded that the fungus had operculate asci and referred it to the Pezizales placing it near *Otidea*. He (1973) later abandoned the genus *Ascosparassis* and placed the only species in *Otidea*. Based on the color, as judged by watercolor illustrations by van Overeem, Korf (1963) compared it with *Acervus aurantiacus* Kanouse, an orange fungus. In the course of tracing names of species referred to the genus *Midotis* and *Wynnea*, Pfister (1979) found an older name for this species, *Midotis heinricheri* Bres. (also from Java), and transferred the species to *Ascosparassis* which he recognized as a monotypic genus in the Pyronemataceae.

With reference to these few publications, the record of the genus and its single species is largely covered. Previous collections were from Indonesia and Japan (see Korf 1963) and at least one collection is known from China (Longtou Mts., Guizhon, Sept. 12, 1986, col. Liu Meihauai, det. Cao, Mycological Herbarium of Shanxi University no. 760 and FH).

Recently the junior author collected *Ascosparassis* in the north coastal mountains of Venezuela. This collection constitutes the first report of the species from the Americas. The collection (Estado Aragua, along road from Maracay to Choroni, on hardwood in soil, among bamboo, 20 July 1987, NY, FH, VIA, A) was photographed in the field. The photograph is reproduced here as figure 1. The collection agrees closely with the Asian material.

The diagnostic characteristics of the species are the sparassoid growth of the ascomata with numerous flattened upright branches; the small (4.5-5.5 x 3-4 μm) biguttulate ascospores; the broad hooked, curved and deformed paraphyses; and the thick outer excipulum made up of globose to angular cells giving rise to pustules on the outer surfaces. When fresh, the ascomata of the Venezuelan collection were 7-8 cm tall, orange, and had a chantarelle-like odor.

There are some variations in the descriptions of the species in the literature. In the first description of *A. shimizuensis*, it was said that the collection was pale rosy colored. All other collections seem to be yellow or yellowish. The isotype material of *A. heinricheri* (FH-Pat.) retains its yellow pigments even dried. It may also be noteworthy that both the holotype of *A. shimizuensis* and the Venezuelan collection were made among bamboo shrubs.

Acknowledgements

The junior author thanks Dra. Ninoska Pons (VIA) for logistical support in Maracay and support from NSF grant #BSR-860024. The authors wish to thank Dr. Richard P. Korf for reviewing the manuscript.

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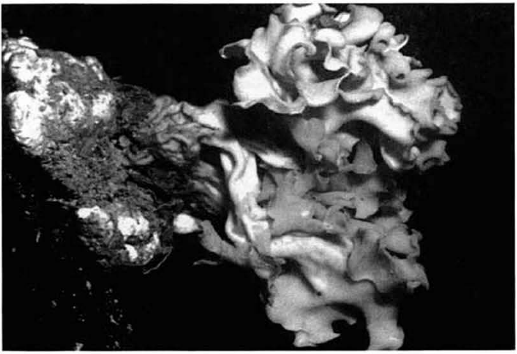

Figure 1. Ascosparassis heinricheri from Venezuela, natural size. Specimen in NY.

MYCOTAXON

Vol. XXXV, No. 2, pp. 287-296 July-September 1989

REDISPOSALS AND REDESCRIPTIONS IN THE MONOCHAETIA - SEIRIDIUM, PESTALOTIA - PESTALOTIOPSIS COMPLEXES. IX. ON THE STATUS OF PESTALOTIA EUPYRENA, PESTALOTIA GASTROLOBI AND PESTALOTIA VENETA.

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Pestalotia eupyrena and *Pestalotia gastrolobi* are redisposed in *Pestalotiopsis*. ***Seiridium venetum*** **comb. nov.** is proposed to accommodate *Pestalotia veneta*, and *Seiridium corni* is considered its synonym.

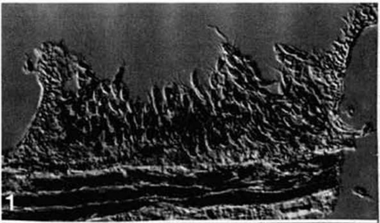
15. *Pestalotia eupyrena* Tassi
Boll. Lab. Ort. Bot. R. Univ. Siena 2: 105, 1899.
On pods of *Bossiaea ensata*, New Holland, Sydney, Australia; and

16. *Pestalotia gastrolobi* Tassi
Boll. Lab. Ort. Bot. R. Univ. Siena 3: 101, 1900.
On dead or withering legumes of *Gastrolobium boormanii*, New South Wales, Australia.

Guba (1961) accepted both fungi as good species of *Pestalotia* in the section 'quadriloculatae'. Study of the holotype specimens in SIENA, however, shows both taxa to be congeneric with *Pestalotiopsis maculans* (Corda) Nag Raj. They are transferred to *Pestalotiopsis*, redescribed and illustrated in Figs. 1-8 and 9-17 respectively. A key is given to all 3-septate species of *Pestalotiopsis* known to-date.

Pestalotiopsis eupyrena (Tassi) Nag Raj **comb. nov.** Figs. 1-9
≡ *Pestalotia eupyrena* Tassi, Boll. Lab. Ort. Bot. R. Univ. Siena 2: 105, 1899.

Fructicolous, occurring on the outer surface of the pod. *Conidiomata* stromatic, pycnidioid, scattered to gregarious, rarely confluent, innate erumpent, appearing as pulvinate or conoid, dark brown to black pustules, angular, orbicular or irregular in outline, broadly conical, 250-400 µm wide, 100-150 µm deep, unilocular, glabrous; basal stroma and lateral walls of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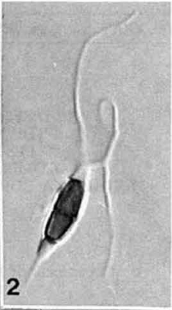
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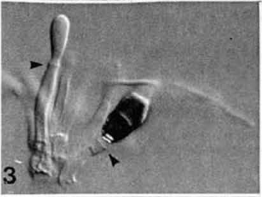
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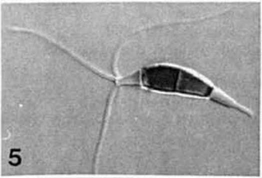
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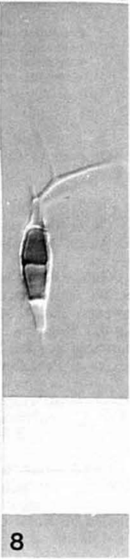
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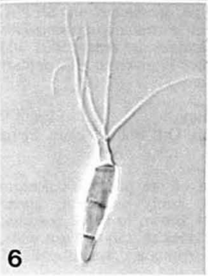
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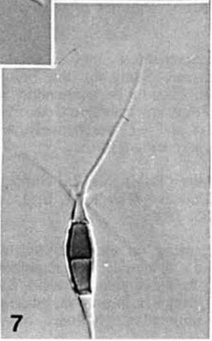
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Figures. 1-8. *Pestalotiopsis eupyrena* ex holotype in SIENA. Fig. 1. v.s. of a conidioma; Figs. 2, 4-8. Mature conidia; Fig. 3. Conidiogenous cells with developing conidia; Fig.1, X 165; Figs. 2-8 X 700.

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subhyaline 'textura angularis', 20-30 µm thick. *Conidiophores* lining the cavity of the conidioma, sparsely septate only at the base and up to 40 µm long, or reduced to conidiogenous cells, hyaline, smooth, invested in mucus. *Conidiogenous cells* phialidic, cylindrical to subcylindrical and 16-25 X 1.5-2 µm, or ampulliform to lageniform and 5.5-15 X 2.5-5 µm, with up to 4 percurrent proliferations. *Conidia* blastic-phialidic, elliptic-fusiform, 3-septate, 22-29 X 7-7.5(-8) [$\bar{x}$ = 25.5 X 7.2] µm, bearing appendages; basal cell obconic with a truncate base bearing minute marginal frills, subhyaline to hyaline, thin- and smooth-walled, 5(-6.5) µm long; median cells 2, doliiform, with thick walls, verrucose, brown and concolorous, together 12-17.5 [$\bar{x}$ = 14.8] µm long (second cell from the base 6-9.5 [$\bar{x}$ = 7.5] µm; third cell 6-8 [$\bar{x}$ = 7.3] µm); apical cell conical, subhyaline to hyaline, thin- and smooth-walled, 4-6 [$\bar{x}$ = 5] µm long; appendages tubular, attenuated, slender, flexuous; apical appendages 3-5, simple or branched, arising in an apical crest but each inserted at a different locus on the apical cell, 26-53 [$\bar{x}$ = 40] µm long; basal appendage usually present, single, unbranched, centric, 7-12 [$\bar{x}$ = 10] µm long; mean conidium length/width ratio = 3.5:1.

Habitat: On legumes of *Bossiaea ensata.*

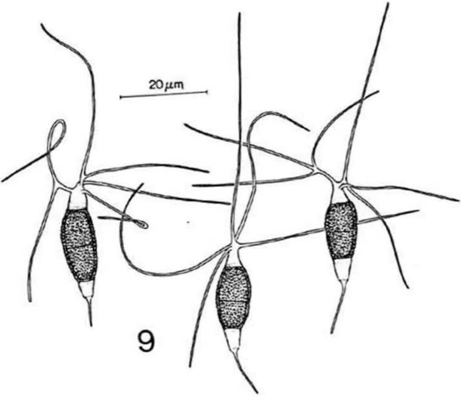
Specimen examined: SIENA [Holotype], New Holland, Sydney, New South Wales, Australia.

Known distribution: Australia.

Teleomorph: Unknown.

Pestalotiopsis gastrolobi (Tassi) Nag Raj **comb. nov.** Figs. 10-19
≡ *Pestalotia gastrolobi* Tassi, Boll. Lab. Ort. Bot. R. Univ. Siena 3: 101, 1900.

Fructicolous. *Conidiomata* stromatic, pycnidioid to acervuloid, scattered, rarely gregarious and confluent, intra-peridermal in origin, oval to orbicular in outline, subglobose to conical or cupulate in sectional view, 60-120 µm wide, 40-70 µm deep, unilocular, glabrous, dark brown to black, covered with black, pulverulent masses of conidia; dehiscing by a break in the overlying host tissue; basal stroma and lateral peridium 10-15 µm and a few cells thick, of a loose 'textura globulosa,' cells at the outer edge of the conidioma pale brown to brown, paler to hyaline in the inner area. *Conidiophores* arising all around the cavity of the conidioma, sparsely septate and branched only at the base and up to 40 µm long, or reduced to conidiogenous cells, hyaline, smooth, invested in mucus. *Conidiogenous cells* phialidic with minute periclinal thickenings in the collarette zone, ampulliform to lageniform and 6-10 X 2.5-3.5 [$\bar{x}$ = 8 X 3] µm, or cylindrical to subcylindrical and 15-21 X 1.5-2.5 [$\bar{x}$ = 17 X 1.7] µm, without percurrent proliferations. *Conidia* blastic-phialidic, fusiform to ellipsoid, 3-septate, 17-24 X (5-)6-7(-7.5) [$\bar{x}$ = 20 X 6.5] µm, bearing



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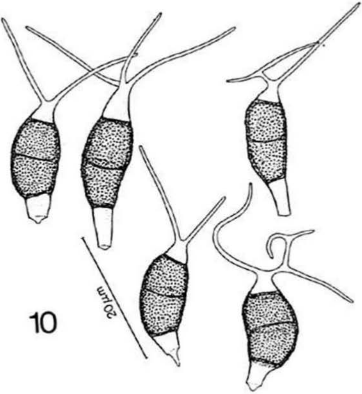

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Fig. 9. Mature conidia of *Pestalotiopsis eupyrena*; Fig. 10. Mature conidia of *Pestalotiopsis gastrolobi*.

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appendages; basal cell elongated obconic, subhyaline to hyaline, thin- and smooth-walled, 4-5.5(-6) [x̄ = 4.7] µm long; median cells 2, doliiform with thick, verrucose walls, honey brown and concolorous, ± equal, each cell 5-7 [x̄ = 6] µm long, together 10.5-14 [x̄ = 11.5] µm long; apical cell short conical, subhyaline to hyaline, with thin, smooth walls, 3-4.5 [x̄ = 3.7] µm long; appendages tubular, attenuated, coarse, flexuous; apical appendages 2-3, mostly simple, occasionally one of them irregularly branched, arising in an apical crest, but each inserted at a different locus on the apical cell, 7-22 [x̄ = 14] µm long; basal appendage mostly lacking, but when present, single, unbranched, centric, 1-1.5 µm long; mean conidium length/width ratio = 3:1.

Habitat: On dead or withering legumes of *Gastrolobium boormanii*.

Specimen examined: SIENA [Holotype], Sydney, New South Wales, Australia.

Known distribution: Australia.

Teleomorph: Unknown.

Key to 3-septate species of *Pestalotiopsis*.

A. Apical appendages 26-53 µm long; basal appendage usually present and up to 12 µm long; mean conidium length/width ratio = 3.5:1; second cell of conidium from base slightly longer than third cell . . . . *P. eupyrena*

A. Apical appendages up to 25 µm long; basal appendage mostly absent, but when present up to 4.5 µm long . . . . B

B. Median cells prominently verrucose, honey brown, together 11.5 µm long on average, equal in length; mean conidium length/width ratio = 3:1 . . . . *P. gastrolobi*

B. Median cells minutely verruculose, pale brown C

C. Conidia 7-9 µm wide; two median cells unequal, together 12-17 µm long; apical appendages 2-4, simple, or one occasionally branched, (-6.5)10-25 µm long; basal appendage, when present, up to 4.5 µm long . . . . *P. citrina*

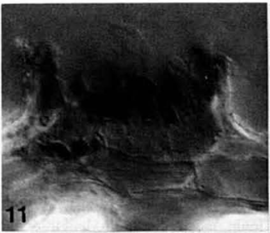
C. Conidia 5-6(-6.5) µm wide; two median cells ± equal, together 9-11 µm long; apical appendages usually 3, unbranched, 10-15(-17) µm long; basal appendage, when present, up to 3 µm long . . . . *P. besseyi*

17. *Pestalotia veneta* Saccardo

Michelia 1: 92, 1877.

On *Cornus sanguinea*, Selva, Italy, IX.1873.

Guba (1961) accepted Allescher's (1902) redisposal of the fungus as *Monochaetia veneta* and included three other collections under the binomial. He also accepted *Pestalotia corni* Allescher in *Pestalotia* in the section 'sexloculatae', although Allescher (1890) had reported that it approaches *Pestalotia veneta*. He does not mention having examined type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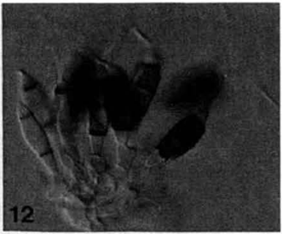
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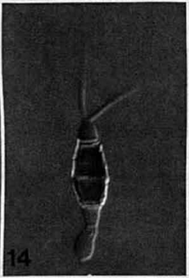
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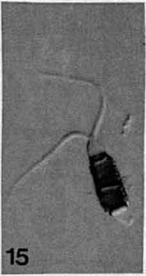
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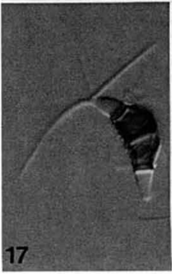
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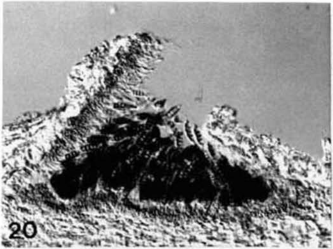
Figs. 11-19. *Pestalotiopsis gastrolobi* ex holotype in SIENA. Fig. 11. v.s. of a conidioma; Figs. 12 & 13, Conidiogenous cells with developing conidia; Figs. 14-19. Mature conidia. Fig. 11, X 420; Figs. 12, 15 & 16, X 700; Figs. 13, 14, 17-19, X 880.

specimens and his descriptions of the two species appear to be literal translations of the originals. Sutton (1969) published *Seiridium corni* (Allescher) Sutton, based on his study of a possible topotype specimen of *Pestalotia corni* in HBG. I had the opportunity to examine the holotype specimen of *P. veneta* in PAD, and other collections of *Seiridium corni* examined by Sutton (1969). As a result of these studies, I find that *P. veneta* and *S. corni* are conspecific and that both belong in *Seiridium* Nees : Fries. The fungus is redescribed with the correct nomenclator as follows:

Seiridium venetum (Saccardo) Nag Raj **comb. nov.** Figs. 20-30
≡ *Pestalotia veneta* Saccardo, Michelia 1: 92, 1877.
≡ *Monochaetia veneta* (Saccardo) Allescher in Rabenhorst, Krypt. Flora 1, Abt. 7: 668, 1902.
= *Pestalotia corni* Allescher, Bot. Centralbl. 42: 106, 1890.
≡ *Seiridium corni* (Allescher) Sutton, Can. J. Bot. 47: 2091, 1969.

Caulicolous, corticolous. *Conidiomata* stromatic, pycnidioid, scattered to gregarious, occasionally confluent, intraperidermal in origin, erumpent, appearing as conoid, black pustules, orbicular to oval in outline, ultimately crateriform in sectional view, 300-700 µm wide, 200-400 µm deep, unilocular with the locule irregularly divided, glabrous, dark brown; basal stroma and lateral tissue of an outer, loose, subhyaline 'textura intricata', and an inner more compact 'textura globulosa' to 'textura angularis' with an external layer of thick-walled, brown cells, and an internal layer of paler cells; basal stroma up to 30 µm thick, lateral tissue 50-60 µm thick; dehiscence by a split in the overlying host tissue. *Conidiophores* lining the cavity of the conidioma, septate, irregularly branched, hyaline, smooth-walled, 60-90 µm long, invested in mucus. *Conidiogenous cells* phialidic with minute periclinal thickenings in the collarette zone, cylindrical, occasionally lageniform, hyaline, smooth-walled, 7-25 X 1-2.5 [x̄ = 15.2 X 1.7] µm, with up to 2 percurrent proliferations, occasionally resulting in new conidiophores or conidiogenous cells at a higher level. *Conidia* blastic-phialidic, fusiform to ellipsoid, straight or somewhat bent, 5-septate, 18-28 X (6.5-)7-8.5 [x̄ = 23.5 X 7.7] µm, bearing appendages; basal cell obconic with a truncate base, mostly hyaline but subhyaline near the septum, smooth-walled, 3-3.5 [x̄ = 3.2] µm long; 4 median cells doliiform, unequal, brown, wall thick and smooth, together (12.5-)17-19(-21.5) [x̄ = 18] µm long (second cell from base (4-)5-6 [x̄ = 5.5] µm; third cell 3-4.5 [x̄ = 3.7] µm; fourth cell (2.5-)3-4 [x̄ = 3.5] µm; fifth cell (3-)5-7.5 [x̄ = 5.5] µm); apical cell narrow conical, mostly hyaline, subhyaline near the septum, smooth-walled, 2-4 [x̄ = 3] µm long; appendages tubular, attenuated, flexuous; apical appendage single, simple or branched, 3-36 [x̄ = 18] µm long; basal appendage single, simple or branched, centric, 2-7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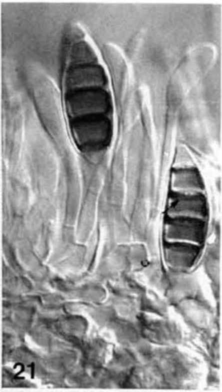
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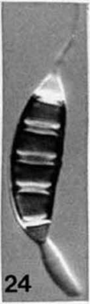
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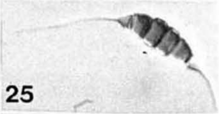
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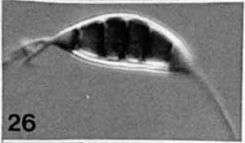
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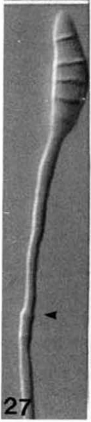
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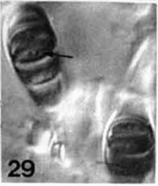
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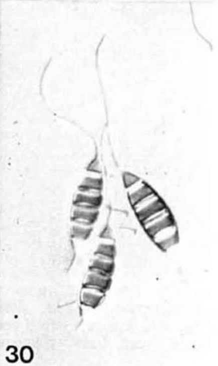
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Figs. 20-30. ***Seiridium venetum*** ex holotype in PAD. Fig. 20. v.s. of a conidioma; Fig. 21. Part of conidial hymenium; Figs. 22-24, 27. Conidiogenous cells with developing conidia; Figs. 25, 26, 29-30. Mature conidia; Fig. 28. Branched conidium appendage. (arrowheads in Figs. 22, 23 & 27 mark percurrent proliferations; arrows in Figs. 21 & 29 point to a septal pore); Fig. 20. X 165; Figs. 21, 24, 26-29, X 1100; Figs. 22 & 23, X 1760; Figs. 25 & 30, X 800.

[$\bar{x}$ = 4.5] µm long, occasionally absent; mean conidium length/width ratio = 3:1.

Habitat: On dead twigs of *Cornus alba, C. sanguinea, C. stolonifera*, and *Cornus* sp.

Specimens examined: 1. CFB - WINF (M) 6348, [slides ex HBG], on *C. alba*, München, Germany, X.1885, J.N.Schnabl; 2. CFB - WINF (M) 2333b, on *C.* sp., Seddon's corner, Man., Canada, 6.X.1965, B.C.Sutton, Jhant, J.J.Lawrence #299; 3. CFB - WINF (M) 4216, on *C.* sp., Dorothy Lake, Block 3, Whiteshell, Man., 8.VI.1966, B.C.Sutton, J.J.Lawrence #23; 4. CFB - WINF (M) 6744b, on *C.* sp., Montreal River Rd, nr. Molanosa, Sask., 23.V.1967, J.Beveridge #59; 5. CFB -WINF (M) 7249a, on *C.* sp., Forestry Rd., 1 mi. W of Hwy #10, Wasagaming, Man., Canada, 5.VII.1967, D.Shepherd #1191; 6. CFB - WINF (M) 7251a [collection data as in #5, D.Shepherd #1187]; 7. CFB - WINF (M) 8515, on *C.* sp., Candle lake, Sask., 28.VII.1967, B.C.Sutton #3618; 8. CFB - WINF (M) 10309a, on *C.* sp., Darwin, Man., 10.IX.1968, B.C.Sutton #3395; 9. CFB - WINF (M) 10380 [collection data as in #8, B.C.Sutton #3399]; 10. CFB - WINF (M) 12000a, on *C. stolonifera*, Iron Springs, Loon Lake, Sask., 17.IX.1968, B.B.McLeod; 11. PAD, on *C. sanguinea*, Selva, Italy, IX.1873 [type of *Pestalotia veneta* Saccardo].

Known distribution: Canada, Germany, Italy.

Teleomorph: Unknown.

The septal pores in conidia are clearly visible (Figs. 21 & 29). I have not been able to examine the collections of the fungus from France and England mentioned by Guba (1961).

Acknowledgments

I thank the curators at CFB - WINF, PAD, and SIENA for the loan of the specimens in their keeping. I am grateful to Prof. Bryce Kendrick, Dept. of Biology, University of Waterloo, and Dr. Amy Rossman, Systematic Botany & Mycology Laboratory, U.S. Department of Agriculture, Beltsville, Md., U.S.A. for critical reviews of this manuscript. I would like to thank the Canada Council, Ottawa for the award of a Killam Research Fellowship during the tenure of which part of this study was completed. Financial support from the Natural Sciences and Engineering Research Council of Canada in the form of an operating research grant to Prof. Kendrick is acknowledged.

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MYCOTAXON

Vol. XXXV, No. 2, pp. 297-312 July-September 1989

SOME NEW SPECIES AND NEW RECORDS OF DISCOMYCETES IN CHINA. III.

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ABSTRACT Five taxa are described as new: *Acervus epispartius* forma *albus*, *Coprobia magnifica*, *Otidea daliensis*, *Trichophaea pallidibrunnea*, and *Xeromedulla quercicola*. Eleven new records for China and name changes for four previously recorded Chinese discomycetes are listed.

NEW TAXA

1. **Acervus epispartius** forma **albus** Korf & W.-y. Zhuang, **forma nov.**

Ab Acervo epispartio *f.* epispartio *apotheciis totis albis differens.*

Apothecia deeply cupulate at first, almost applanate at maturity, when fresh hymenium white, with the faintest tinge of yellow-green, up to 1.4 cm in diam, with a very short stipe, arising from a fuzzy, downwardly tapering, pure white rhizomorph which branches at times and gives rise to more than one apothecium, less than 2 cm long, excipulum thin, white, clearly woolly, margin acute. Ectal excipulum of textura angularis, 45-65 µm thick, covered with hyaline hyphae, hyphae 7.5-10 µm wide, with blunt apices. Medullary excipulum of textura intricata, hyphae hyaline, 7-11 µm wide. Subhymenium of dense textura intricata. Hymenium 82-90 µm thick. Asci J– in Melzer's Reagent, 8-spored, ca 85 x 5.0-5.5 µm. Ascospores ellipsoid with blunt ends, uniseriate, slightly thick-walled when young, nonguttulate, 6.0-6.5 x 3.5-4.0 µm. Paraphyses filiform, not exceeding asci, 2.0-2.5 µm wide. On bare soil and duff.

Holotype: on bare soil and duff along path of Endangered Plant Collections, Xishuangbanna Botanical Garden, Mongla County, Yunnan, R.

P. Korf, M. Zang, K.-k. Chen, & W.-y. Zhuang (310), 25. X. 1988, HMAS 57686, CUP-CH 2534 (isotype).

Notes: The asci and ascospores fit *Acervus epispartius* (Korf, 1963; Pfister, 1975; Pfister & Bessette, 1985), but the white hymenium, pure white exciple, and pure white rhizomorphs do not fit that species (or any other *Acervus*) well. We treat it as a new form of the species.

2. **Coprobia magnifica** W.-y. Zhuang & Korf, **sp. nov.** Fig. 1.

Ab speciebus aliis Coprobiae *apotheciis magnis (9-16 mm diam), ascosporis horizontaliter striatis, et prominentibus hyphalibus capoillaribus unicellularibus clavatis ad marginem apothecialem praesentibus differens.*

Apothecia discoid, substipitate, hymenium dirty orange when fresh, (4-)9-16 mm in diam, receptacle surface concolorous with hymenium, faintly woolly especially at margin. Ectal excipulum of textura angularis, not clearly distinguished from medullary excipulum, the outermost cells with thicker walls than the inner ones, cells nearly isodiametric, ca 18-45 µm in diam, walls hyaline to subhyaline; receptacle surface undulate to pustulate at flanks, covered with thin-walled hyphae at very base of apothecium. Hyphal protrusions present at margin, clavate, with a blunt apex, one-celled, 25-50 µm long, walls subhyaline, cell contents subhyaline to pale brown; towards the flanks hyphal protrusions elongating to become hairs, 110-220 µm or longer, 6-10 µm wide, septate, not rigid, hyaline to subhyaline (or with a pale brown tint), hair walls not obviously thickened, arising from the outermost cells of ectal excipulum. Medullary excipulum of textura angularis, cell walls thin and hyaline. Asci J– in Melzer's Reagent, 8-spored, ca 175-200 x 9.5-11.0 µm. Ascospores ellipsoid, uniseriate, nonguttulate, with 13-14 horizontal striations on surface in cotton blue lactic acid, becoming somewhat shrunken when striations fully developed, some with a de Bary bubble (rarely two), very thick-walled when young, 12.5-16.6 x 7.5-10.0 µm. Paraphyses capitate, up to 8 µm diam at apex and ca 3 µm diam below. On cow dung.

Holotype: on cow dung, Ganhaizi, Lijiang, Yunnan, alt. 3170-3270 m, R. P. Korf, L.-s. Wang, & W.-y. Zhuang (339), 2. XI. 1988, HMAS 57687, CUP-CH 2531 (isotype).

Notes: Unlike most species of *Coprobia*, the ascospores are horizontally striate when mounted in cotton blue lactic acid. In no case did we see longitudinal striations. The perispore could not be loosened. The apothecia of this fungus are very large compared with the other species of the genus (Rifai, 1968; Thind & Kaushal, 1979; Moravec, 1984, 1987).

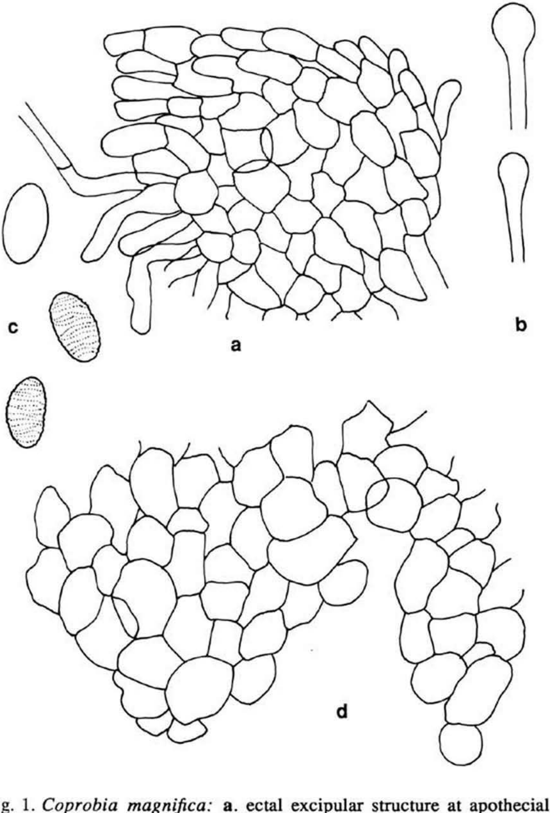

Fig. 1. *Coprobia magnifica:* **a**. ectal excipular structure at apothecial margin, **b**. two paraphysis apices, **c**. three ascospores, two with horizontal striations on surface, **d**. ectal excipular structure at flank; **a, d** x 412, **b, c** x 1030; from holotype.

3. **Otidea daliensis** W.-y. Zhuang & Korf, **sp. nov.** Fig. 2.

Ab speciebus aliis Otideae *characteribus consociatis apotheciorum parvorum (3-9 mm diam) discoideorum, ascosporis magnis (18-21 x 10-12 µm), et ascis magnis (172-205 x 15-17 µm) differens.*

Apothecia deeply cupulate, sometimes otideoid, pseudostipitate, 3-9 mm in diam, hymenium brown, in age dark brown, receptacle surface buff to light brown, margin somewhat darker, mealy to pustulate. Ectal excipulum of textura angularis, receptacle surface pustulate, ca. 50-85 µm thick excluding pustules; pustules of textura globulosa, ca 40-85 µm high, cells arranged in chains, isodiametric, loosely interconnected; ectal excipular cells ca 10-35 µm diam, walls yellow. Medullary excipulum of textura intricata, 150-255 µm thick, hyphae with pale brown contents, 3.0-3.5 µm wide, walls subhyaline. Hymenium ca 220 µm thick. Asci J– in Melzer's Reagent, 8-spored, ascus apices obviously lower than hymenium surface, 172-200 x 15-17 µm. Ascospores ellipsoid, mostly uniseriate, smooth-walled, biguttulate when young, 18-21 x 10-12 µm. Paraphyses strongly hooked at apex, multiseptate,often branched below, apical cells with yellow-brown cytoplasm, 3 µm wide. On bare soil.

Holotype: on bare soil under seedlings of *Plantago major* L., Hudiequan Park, Dali, Yunnan, alt. 2100 m, R. P. Korf, L.-s. Wang, & W.-y. Zhuang (395), 5. XI. 1988, HMAS 57688, CUP-CH 2532 (isotype).

Notes: This species, on microscopic characters surely an *Otidea,* is characterized by its unusually small apothecia and relatively large ascospores.

4. **Trichophaea pallidibrunnea** W.-y. Zhuang & Korf, **sp. nov.** Fig. 3.

Ab speciebus aliis Trichophaeae *pilis multum pallidioribus, cellulis excipularibus ectalibus pallidis, et ascis latis clavatis differens.*

Apothecia discoid to shallow cupulate, 2-4.5 mm in diam, sessile, hymenium light yellowish, buff to somewhat brown, margin thin and fringed. Ectal excipulum of textura angularis, ca 30-65 µm thick, cells hyaline to subhyaline, nearly isodiametric, 7-25(-45) µm in diam, axes of cells more or less perpendicular to outer surface, marginal cells in rows, at an angle to hymenium surface, ectal excipulum at margin much thicker than at flanks. Hairs pale brown, 4-12 or more in a fascicle, (0-)1-4 (or more) septa, tapering towards the apex, with round to pointed apex, relatively thick-walled, not as rigid as other species of *Trichophaea,* 50-230 µm long, short at margin and long at flanks, hyaline and flexuous at base, 4-8 µm at the widest part. Medullary excipulum of textura intricata, cells hyaline and thin-walled, at apothecial base not clearly distinguished

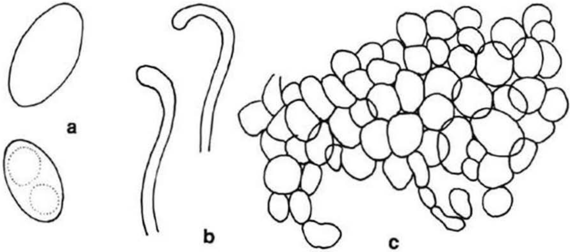

Fig. 2. *Otidea daliensis:* **a**. two ascospores, **b**. two paraphysis apices, **c**. structure of ectal excipulum; **a**, **b** x 1030, **c** x 412; from holotype.

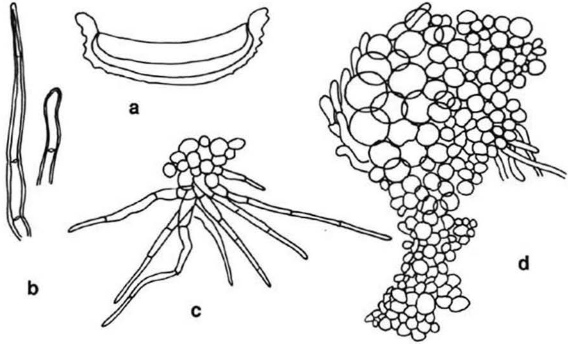

Fig. 3. *Trichophaea pallidibrunnea:* **a**. diagram of apothecium in section, from top to bottom showing hymenium, medullary excipulum, and ectal excipulum, **b**. two hairs, **c**. a fascicle of hairs, **d**. structure at apothecial margin and upper flank; **a** x 15, **b** x 412, **c**, **d** x 206; from holotype.

from ectal excipulum. Asci J– in Melzer's Reagent, subcylindrical when young and clavate at maturity, arising from crozier, 180-220 x 15-19 µm. Ascospores ellipsoid, smooth-walled, uniseriate to irregularly biseriate, uni- to biguttulate, 17.6-21.0 x 9.0-9.7 µm. Paraphyses filiform, 2.5-4.0 µm wide. On soil.

Holotype: on moist soil, Tanzhesi, Beijing, R. P. Korf & W.-y. Zhuang (184), 8. X. 1988, HMAS 57689.

Other specimen examined: on soil among small mosses around two-needle pine in temple ground, Tanzhesi, Beijing, R. P. Korf & W.-y. Zhuang (185), 8. X. 1988, HMAS 57690.

Notes: The apothecial color was too light for this to be recognized as a *Trichophaea* in the field. Under the microscope the hair color is the lightest known to us among species of this genus.

5. **Xeromedulla quercicola** Korf & W.-y. Zhuang, **sp. nov.** Fig. 4.

Ab X. tomentulosa *ascosporis lacrimiformibus, cellulis excipularibus lateralibus angulariubus vel laterculiformibus atque parietibus minus crassis praeditis, et pilis brevibus differens.*

Apothecia rather regularly spaced on lower surface of leaf, discoid, 0.4-0.5 mm in diam when rehydrated, short-stipitate, triangular or laterally appressed in shape when dry, faintly hairy on the receptacle surface, lemon-yellow when dry, ivory to semitranslucent when rehydrated. Ectal excipulum of textura oblita at margin and at flanks near margin, of textura angularis to textura globulosa at base and at flanks near base, ca 20-25 µm thick, cells isodiametric to brick-shaped, hyaline, glassy- and thick-walled, receptacle surface covered with a thin layer of gel especially at margin, tissues gelatinized at margin and upper flanks, hyphal ends protruding through gel and from the outermost cells of ectal excipulum. Hyphal protrusions banana-shaped at margin, curved to slightly undulate at flanks, 0-1-septate, more or less equal in width, 5-17 x 2.5-3.0 µm, surface granulate. Medullary excipulum of textura intricata, very thin and almost absent near margin, 3-15 µm thick at flanks, hyphae hyaline, thin-walled. Asci clavate, J+, pore walls with two blue dots in Melzer's Reagent, 8-spored, ca 30 x 3 µm. Ascospores teardrop-shaped, uniseriate, unicellular, 3-4 x 1 µm. Paraphyses filiform, slightly enlarged at apex, apices sometimes encrusted by amorphous substances, slightly longer than asci.

Holotype: on a fallen leaf of *Quercus,* Tanzhesi, Beijing, alt. 350 m, B.-c. Zhang (525), 16. X. 1988, HMAS 57691, CUP-CH 2535 (isotype).

Notes: The ectal excipulum of this species at margin and at flanks near the margin is of textura oblita and thus differs from that of the other two species in the genus (Zhuang & Korf, 1987). *Xeromedulla leptospora* and *X. tomentulosa* were reported from the Philippines while *X.*

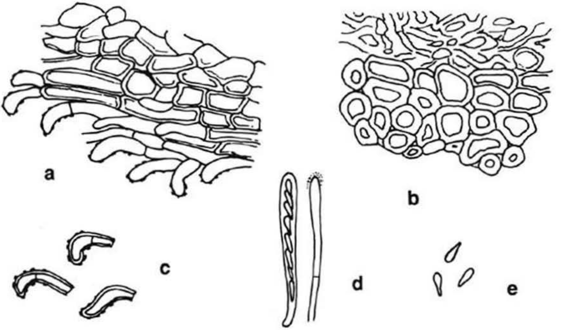

Fig. 4. *Xeromedulla quercicola:* **a**. ectal excipulum at flank near margin, **b**. ectal excipulum at flank near base, **c**. three hairs, **d**. an ascus and a paraphysis apex, **e**. three ascospores; all x 1030; from holotype.

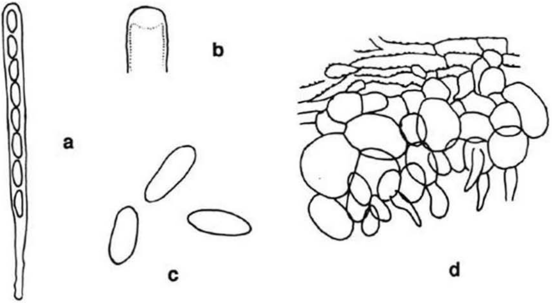

Fig. 5. *Moellerodiscus* sp.: **a**. an ascus, **b**. an ascus apex, **c**. three ascospores, **d**. excipular structure; **a, d** x 412, **b, c** x 1030; from HMAS 57694.

quercicola occurs in the temperate zone.

NEW RECORDS FOR CHINA

6. **Cordierites sprucei** Berk.

Diagnostic features: Apothecia discoid to infundibuliform, eccentrically stipitate, stipes arising from a common base or more or less branched, hymenium with a red-brown cast and receptacle black when fresh, hymenium dark purple brown, outside purplish black, receptacle surface slightly roughened, up to 8 mm in diam when dry. Tissues exuding dark purple pigmentation in aqueous KOH solution (ionomidotic reaction). Ectal excipulum of textura angularis to textura prismatica, receptacle covered with short hyphal protrusions. Medullary excipulum of textura intricata, hyphae parallel. Asci J– in Melzer's Reagent, subcylindrical. Ascospores ellipsoid, ca 4 x 2.2 µm.

Specimen examined: on rotting hard wood, in forest of *Quercus, Acer, Tilia,* and *Pinus,* Dayangcha, Baihe, Jilin, R. H. Petersen (1419), 7. VIII. 1988, HMAS 56494.

Notes: HMAS 56494 was collected in Jilin Province. The occurrence of this species is thus now known from South America, Africa, the Philippines, Northeast China, and the Soviet Union (Zhuang, 1988).

7. **Encoelia helvola** (Jungh.) Overeem

Diagnostic features: Apothecia discoid, gregarious, tough, often irregularly enrolled, up to 8 mm in diam, hymenium orange-tan, receptacle light tan, strongly pustulate, short-stipitate, stipes concolorous with receptacle or darker. Ectal excipulum of textura globulosa to textura angularis, receptacle surface strongly pustulate, ca 45-50 µm thick (excluding the pustules), cells isodiametric, hyaline, thick- and glassy-walled, pustules ca 40-80 µm high. Medullary excipulum of textura intricata, 230-250 µm thick at flanks, hyphae glassy- and relatively thick-walled. Hymenium ca 70 µm thick. Asci J– in Melzer's Reagent, ca 60-65 x 5-6 µm. Ascospores elongate ellipsoid, some faintly bent, uni- to biseriate, hyaline, biguttulate when young, nonguttulate at maturity, 6-8 x 2.0-2.5 µm. Paraphyses filiform, not enlarged at apex, ca 9 µm longer than ascus apices.

Specimen examined: on cankers at internodes of living bamboo plants, along path of the Endangered Plant Collections, Xishuangbanna Botanical Garden, Yunnan, R. P. Korf, M. Zang, K.-k. Chen, & W.-y. Zhuang (311), 25. X. 1988, HMAS 54037.

Notes: The morphology of the Chinese collection fits well the description and illustration provided by C. van Overeem (1926).

8. **Hymenoscyphus** cfr. **caudatus** (Karst.) Dennis, sensu Dumont & Carpenter Fig. 6a.

Diagnostic features: Apothecia discoid, short-stipitate, up to 1.8 mm in diam when dry, hymenium orange-yellow. Ectal excipulum of textura angularis, with a covering layer of elongate hyphae. Medullary excipulum of textura intricata. Hymenium ca 140 µm thick. Asci 8-spored, 10.5-11.5 µm wide, with a thick apex and a long apical pore, pore walls blue in Melzer's Reagent. Ascospores elongate-fusoid, often biseriate, multiguttulate, 23-27 x 4.5-5.5 µm. Paraphyses cylindrical, not exceeding asci.

Specimen examined: on roots of a grass, Tanzhesi, Beijing, R. P. Korf & W.-y. Zhuang (465), 8. X. 1988, HMAS 57692.

Notes: HMAS 57692 differs from the typical *Hymenoscyphus caudatus* in the larger apothecia, larger ascospores, and occurrence on roots of a grass instead of on leaves of dicotyledons. The description of the fungus given by Dumont and Carpenter (1982) records larger ascospores than that by Dennis (1978).

9. **Ionomidotis frondosa** (Kobayasi) Kob. & Korf

Diagnostic features: Apothecia ear-shaped, lobed, individuals ca 13 mm wide and 13 mm high when dry, several arising from a common base, hymenium black and receptacle surface wrinkled when dry, outside minutely pustulate, tissues ionomidotic. Ectal excipulum of textura angularis, ca 35-40(-50) µm thick, cells in gel, nearly isodiametric, cells darker in pustules than in inner layers. Medullary excipulum of textura intricata, ca 140 µm thick, tissues brownish. Subhymenium 38-43 µm thick, darker than medullary excipulum. Hymenium 43-45(-50) µm thick. Asci J– in Melzer's Reagent, ca 30-35 x 3.5-4.5 µm. Ascospores rod-shaped to allantoid, with 2-3 guttules, 4.5-5.5 x 1.1-1.4 µm. Paraphyses curved, straight, or circinate at apex, slightly enlarged at apex, up to 1.8 µm at the widest part.

Specimen examined: on wood, west of Sichuan, Z.-y. Yang, autumn of 1984, HMAS 57693.

Notes: This fungus has been reported as *Mollisia* sp., with a detailed description and illustration (Mao, 1987). The local people and the collector indicated that it is a poisonous "mushroom."

10. **Moellerodiscus** sp. (nov.) Fig. 5.

Apothecia on a very thin layer of black stroma, discoid, 1-3.5 mm in diam, stipe approximately equal to diam of disc, margin even, hymenium pinkish beige, receptacle slightly darker, stipe much darker at base, receptacle surface furfuraceous. Ectal excipulum of textura angularis to textura globulosa, ca 3-4 cell layers, 50-75 µm thick, cells subspherical to ovoid, walls hyaline, outermost cells giving rise to pointed to blunt very short protrusions which stain in cotton blue, 10-22 x 3.8-7.5 µm. Medullary excipulum of textura intricata, hyphae at flanks more or less parallel to outer surface, walls hyaline to subhyaline, mostly smooth but clearly marked in hyphae adjacent to the ectal excipulum. Subhymenium of textura intricata, hyphae subhyaline to slightly pigmented, ca 25-50 µm thick. Hymenium ca 170 µm thick. Asci subcylindrical, 8-spored, occasionally with only 4 spores mature (spores in 4-spored asci larger than normal), J+ in Melzer's Reagent (pore walls blue with two basal dots dark), 150-160 x 8-9 µm. Ascospores ellipsoid, uniseriate, biguttulate to multiguttulate when young, nonguttulate at maturity, 10-13(-14) x 4.5-5.3 µm. Paraphyses filiform, 2 µm wide, not exceeding asci.

In culture colony white, with some aerial hyphae at beginning, later producing many small, black, thin-layered stromata, stromata spherical, ellipsoid, or elongate to irregular in shape, centrally elevated, 2-5 mm in diam if spherical, or 2.5-6.5 x 3.5-12 mm, long stalk-like structures bearing a tiny, immature apothecium arising from the black stroma.

Specimen examined: on black, thin stroma along midrib of a skeletonized leaf of *Salix* sp. Heilongtan, Miyun County, Beijing, R. P. Korf & W.-y. Zhuang (468), 10. X. 1988, HMAS 57694.

Notes: This is a new taxon of *Moellerodiscus*. Since the collection is too poor to be a type, we record the fungus under *Moellerodiscus* sp. and await more ample collections.

11. **Orbilia curvatispora** Boud. Fig. 7.

Diagnostic features: Apothecia flat but centrally depressed, dirty orange when dry, convex when rehydrated, sessile with central attachment, 0.3-0.7 mm in diam, hymenium and receptacle smooth. Ectal excipulum of textura angularis, 35-43 µm thick. Medullary excipulum of textura intricata, 23-32 µm thick. Hymenium ca 36 µm thick. Asci J– in Melzer's Reagent, 30-43 x 3.0-3.5 µm. Ascospores elongate, curved or straight, one end sometimes faintly narrow, 9-13 x 0.7 µm. Paraphyses with a knob at apex.

Specimen examined: on a piece of bark, Sanming, Fujian, H.-z. Li, 18.VII. 1974, HMAS 57695.

Notes: We did not observe the obvious anchoring hyphae at the base of apothecia, which has been reported by some authors.

12. **Peziza** cfr. **saccardiana** Cooke Fig. 6b.

Diagnostic features: Apothecia cupulate to discoid, sessile, up to 20

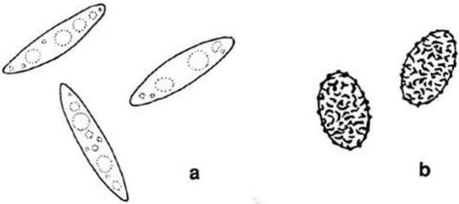

Fig. 6. Ascospores of two discomycetes: **a**. *Hymenoscyphus* cfr. *caudatus*, **b**. *Peziza* cfr.*saccardiana;* all x 1030; **a** from HMAS 57692, **b** from HMAS 57696.

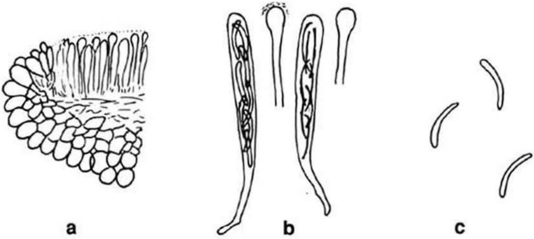

Fig. 7. *Orbilia curvatispora:* **a**. diagram of excipular structure at and near margin, **b**. asci and paraphysis apices, **c**. three ascospores; **a** x 350, **b**, **c** x 1030; from HMAS 57695.

mm in diam, hymenium and receptacle brown to dark brown. Ectal excipulum of textura angularis; medullary excipulum of textura angularis, with a few wide hyphoid cells, cells becoming smaller towards hymenium; subhymenium of dense textura angularis. Hymenium ca 235 µm thick. Asci J+ in Melzer's Reagent, 10-15 µm wide. Ascospores ellipsoid, uniguttulate to biguttulate, 15-17 x 8-9.5 µm (excluding markings), with markings on surface, warts spherical (0.5 µm in diam), or irregularly elongate to curved, 0.5-0.8 µm high.

Specimen examined: on soil under a two-needle pine, Tanzhesi, Beijing, R. P. Korf & W.-y. Zhuang (183), 8. X. 1988, HMAS 57696.

Notes: The size, guttulation, and marking shape of the ascospores of this fungus are similar to those of *Peziza saccardiana*.

13. **Scutellinia kerguelensis** (Berk. in Hook.) Kuntze

Diagnostic features: Apothecia discoid, sessile, (3-)4-6(-8) mm in diam when dry, hymenium light orange when fresh, margin with brown setae. Hairs brown, with 1(-3) rootlet(s), 153-330(-520) µm long, (15-)18-28(-38) µm wide. Ascospores ellipsoid, multiguttulate, 19-24 x 10.5-14.5 µm, with markings on surface, some markings interconnected; young spores thick-walled and with a non-stained, fine, longitudinal belt on one side when mounted in cotton blue lactic acid. Paraphyses enlarged to 6-9 µm wide at apex.

Specimen examined: on a trunk covered with a thin layer of sandy soil, Motuo, Xizang, alt. 3300 m, J.-y. Zhuang (XZ 28), 19. VIII. 1983, HMAS 57697.

Notes: According to Schumacher (1987) this species occurs in cool climates and high altitude. The Chinese collection (HMAS 57697) was found at the altitude of 3300 m in Motuo, Xizang (Tibet).

14. **Smardaea** cfr. **protea** Zhuang & Korf

Diagnostic features: apothecia discoid, substipitate to sessile, 3-6 mm in diam when fresh, hymenium dark purple, receptacle concolorous. Ectal excipulum of textura angularis to textura globulosa, ca 50 µm thick, cells isodiametric, 11.5-23 µm in diam. Medullary excipulum of textura intricata, 250-350 µm thick at flanks. Hymenium ca 360 µm thick. Asci J– in Melzer's Reagent, 15-18 µm wide. Ascospores long-ellipsoid, mostly biguttulate, 20-24 x 10.0-10.5 µm, with irregular warts on surface, markings angular, varying in size. Paraphyses filiform, 4-5 µm wide.

Specimen examined: on duff on moist soil, Songshan Natural Preserve, Beijing, X.-d. Zhu & W.-y. Zhuang (166), 13. IX. 1988, HMAS 57698.

Notes: Most apothecia of this collection are not fully mature.

Although the spore markings are loosely attached to the spore surface and the medullary excipulum is thicker, the general morphology of the Chinese fungus is very similar to the original description of *Smardaea protea* (Zhuang & Korf, 1986), known from Czechoslovakia.

15. **Tricharina gilva** (Boud. in Cooke) Eckblad

Diagnostic features: Apothecia discoid, sessile, 2-5 mm in diam when fresh, hymenium yellowish orange, receptacle lighter and covered with hyaline hairs. Hairs hyaline, with pointed apex and 3-4 septa, 126-200 x 9-14 μm. Ectal excipulum of textura angularis, cells up to 90 μm in diam. Asci J– in Melzer's Reagent, ca 153-165 x 11.5-12.5 μm. Ascospores ellipsoid with truncate ends, contents refractive, nonguttulate, 13.5-18.0 x 8.0-10.2 μm. Paraphyses slightly enlarged or not at apex, 3-5 μm wide at apex and 3-3.5 μm wide below.

Specimens examined: on soil in a flower pot, Zhongguancun, Beijing, J.-z. Zhou, early March, 1988, HMAS 57699; on soil, Zhongguancun, Beijing, X.-q. Zhang & S.-y. Ren, 4. X. 1988, HMAS 57700.

16. **Trichophaea gregaria** (Rehm) Boud. forma **gregaria**

Diagnostic features: Apothecia cupulate to hemispherical, rarely discoid, up to 5 mm in diam, hymenium pale buff to rosy buff, receptacle covered with brown hairs. Ectal excipulum of textura angularis, ca 75-80 μm thick at flanks; hairs arising from the outermost cells of ectal excipulum, very dense at margin and in fascicles at flanks. Setae brown, thick-walled, 2-6 septa, ca 82-306 μm long, very short at apothecial base. Medullary excipulum of textura intricata to textura angularis. Hymenium ca 255 μm thick. Asci usually 8-spored, 11-14(-17) μm wide. Ascospores ellipsoid, uniguttulate, mostly (17.5-)19.2-22.0 x 10-12 μm, some gigantic spores 23-28 x 15-16.5 μm; surface with minute warts, 0.2-0.4 μm in diam. Paraphyses slightly enlarged at apex.

Specimens examined: on mossy soil, Stone Forest, Lunan, Yunnan, R. P. Korf, K.-k. Chen, & W.-y. Zhuang, 19. X. 1988, HMAS 57709; on soil in forest around Huatingsi, Kunming, Yunnan, R. P. Korf, Z.-l. Yang, P.-g. Liu, & W.-y. Zhuang (432, 433), 9. XI. 1988, HMAS 57701, 57706.

PREVIOUSLY REPORTED SPECIES FOR WHICH DIFFERENT NAMES ARE REQUIRED

17. **Ascocoryne cylichnium** (Tul.) Korf

This species was previously recorded in China as *Coryne urnalis* (Nyl.) Sacc. (Tai, 1979). Korf (1971) listed the name as a synonym of

Ascocoryne cylichnium. The morphology of HMAS 57702 is very similar to the fungus Christiansen (1962) described as "*Coryne cylichnium* (Tul.) Boud. var. nov. on moss-grown stump," but neither a Latin diagnosis nor a varietal name was provided. The ascospores of the Chinese collection measured 23-28 x 4-5 µm.

Specimen examined: on wood covered with mosses in Nanjinghexi, Fujian, H.-z. Li (FJ 331), 5. VI. 1976, HMAS 57702.

18. **Calycina herbarum** (Pers. : Fr.) Gray

This is for the previously recorded *Helotium herbarum* (Pers.) Fr. (Tai, 1979). We agree with Baral and Krieglsteiner (1985) that a genus *Calycina,* based on this species, should be recognized in the Hyaloscyphaceae. In culture of our recent collection (HMAS 57703), we observed a *Phialophora*-like fungus which produced white, horn-like synnemata, light brown conidiogenous cells, and hyaline phialidic endoconidia. Further study is needed to confirm the connection between the conidial fungus and *Calycina herbarum.*

Specimen examined: on herbaceous stems, Heilongtan, Miyun County, Beijing, R. P. Korf & W.-y. Zhuang (471), 10. X. 1988, HMAS 57703.

19. **Microstoma** cfr. **floccosum** (Schw.) Rait.

The Chinese collection (HMAS 57704) is similar to *Microstoma floccosum,* but with larger ascospores than the typical material and smaller spores than the Japanese variety, *M. floccosum* var. *macrosporum* Otani. The junior author doubts whether this is *M. floccosum,* a species well known in North America. A detailed comparison between Asian materials and North American ones is needed to reach a final conclusion.

Specimen examined: on twigs, Milin, Xizang, alt. 3580 m, J.-y. Zhuang (XZ16), 24. VI. 1983, HMAS 57704.

20. **Trichophaea abundans** (Karst.) Boud.

"*Scutellinia abundans* Kuntze" has been recorded in China (Tai, 1979). This species was recently collected by us on burnt palm materials. But the correct generic name for the fungus should be *Trichophaea,* and Karsten is the author of the epithet. The anamorph, *Dichobotrys abundans* Hennebert, was produced easily on PDA medium and apothecia were found in the same culture 25 days after inoculation.

Specimen examined: on burnt palm materials, Xishuangbanna Botanical Garden, Yunnan, R. P. Korf, M. Zang, K.-k. Chen, & W.-y.

Zhuang (196), 21. X. 1988, HMAS 57705.

ACKNOWLEDGEMENTS

Financial aid from the Systematic Mycology and Lichenology Laboratory, Institute of Microbiology, Academia Sinica, which supported our trip to Yunnan Province where some of the specimens were collected, is deeply appreciated. We acknowledge gratefully all the collectors who made this study possible, Prof. William J. Dress of the Bailey Hortorium, Cornell University, who kindly provided the Latin diagnoses, and Prof. Donald H. Pfister, Farlow Herbarium, Harvard University, for serving as pre-submission reviewer.

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Vol. XXXV, No. 2, pp. 313-316 July-September 1989

ASCORHIZOCTONIA ASCOPHANOIDES SP. NOV.: ANAMORPH OF *TRICHARINA ASCOPHANOIDES*

CHIN S. YANG[1] and ROY KRISTIANSEN[2]

Tricharina ascophanoides (Boud.) Yang & Korf is a rare discomycete, and only a few specimens have been collected, preserved, and identified (Yang and Korf, 1985 b) since Boudier (1903) first described the species. Recently, three large collections were made in southern Norway by RK and positively identified by CSY with Yang and Korf's key (Yang and Korf, 1985 b) on the basis of their relatively thin-walled, hyaline to subhyaline marginal hairs in clusters, ellipsoid uniseriate to occasionally sub-biseriate ascospores, and obvious fine polar granules in the ascospores. The three collections were solitary or gregarious, growing on wet and/or burnt paperballs in a rubbish dump. These are deposited in TRH. This is the first record of *T. ascophanoides* in Fennoscandia.

During the monographic study of the genus *Tricharina* Eckblad, several species of the genus were cultured on agar medium and anamorphs were described (Yang and Korf, 1985 a). *Tricharina ascophanoides* was not one of the species yielding an anamorph at that time, because only a few old specimens were available. RK's collections were revived and ascospores were germinated following the procedures of Yang and Korf (1985 a). Here we report on our studies and descriptions of an isolate, designated as CSY 123, from the collection RK 82.146.

Spore germination of *T. ascophanoides* is similar to or identical to that of other species of *Tricharina* described by Yang and Korf (1985 a). Hyphal extensions from the apothecial pieces are visible to the naked eye 2-3 days following treatment. The initial germ tube emerges terminally or subterminally from one end of the ellipsoid ascospores. Most spores later develop another germ tube from the other end of the spore. The emerging germ tubes are fast growing, at first straight, rarely branched or fused with other nearby germ tubes.

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Growing hyphae from the germinating ascospores quickly form a culture when transferred to nutrient media. The culture is medium to fast growing (Table 1) and *Ascorhizoctonia*-like. A growth rate study identical to that conducted by Yang and Korf (1985 a) was performed, and the results are presented in Table 1. Four growth media, WA (1.2% water agar), MEA (2% malt extract agar), PDA (potato dextrose agar), and CMA (cornmeal agar), were used. All inoculated plates were incubated in the dark at room temperature (approximately 20-25 C). Growth rates were measured on the fourth day after the inoculation.

Table 1. Mycelial growth of *Ascorhizoctonia* anamorph of *T. ascophanoides* on four nutrient media as measured in radial diameter four days after inoculation.

	WA	CMA	MEA	PDA
CSY 123 ex RK 82.146	4.1-4.7X4.0-4.6 *	4.0-4.6X4.0-4.8	3.8-4.2X3.9-4.2	4.1-4.6X4.2-4.6

*Radial diameter in centimeters (range includes four plates).

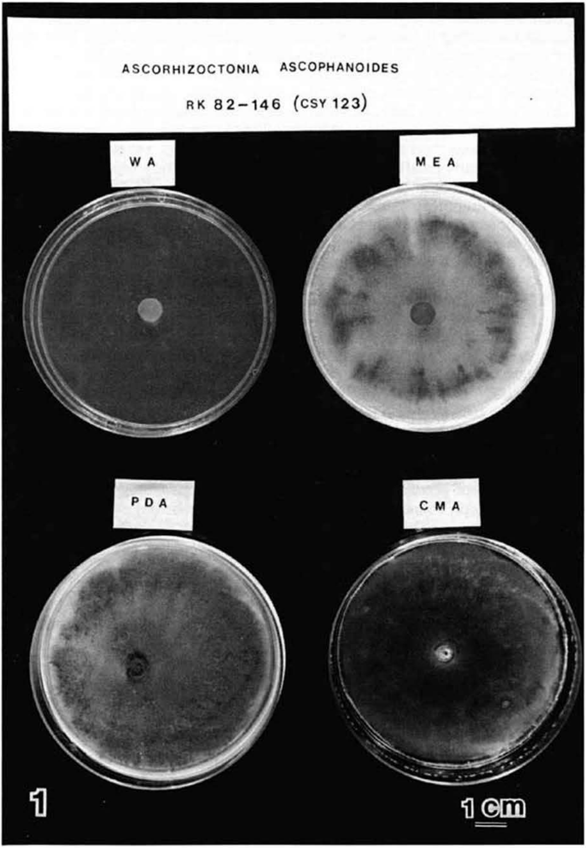
The culture was not as fast growing as other species of *Ascorhizoctonia* under the same conditions (Yang and Korf, 1985 a) and only on CMA did it produce obvious concentric bands in 4 days. The culture covered the 90 mm plates in 10-14 days. The culture produced chlamydospore-like aggregates on all media but they were much more abundant on MEA and PDA. The chlamydospore-like aggregates were in concentric bands on MEA and PDA, formed in the first 2-4 weeks, and might or might not merge together later on and become brownish to brown. The aggregates which formed on WA and CMA 2-3 weeks after inoculation were whitish initially and became brownish in or on the agar.

Because the anamorph of *Tricharina ascophanoides* has never been obtained and described before, we describe here the culture CSY 123 (ex RK 82.146) as a new species in the genus *Ascorhizoctonia.*

Ascorhizoctonia ascophanoides Yang *et* Kristiansen, sp. nov. Fig. 1.
Cultura generaliter valde similis culturae A. ochroleuca est, sed different zonis concentricis in CMA et MEA. A. ascophanoides (Tab. 1) leniter quam A. ochroleuca crescens (Tab. 3, Yang & Korf, 1985 a).
Holotypus: *Norvegia*, R. Kristiansen, TRH (ex RK 82.146, CSY 123)
Teleomorphosis: Tricharina ascophanoides (Boud.) Yang & Korf.

Mycelium covering 90 mm plates of water agar, malt extract agar, potato extract agar, and cornmeal agar in 2 weeks, no concentric bands formed on

Fig. 1. Colony morphology of Ascorhizoctonia ascophanoides on WA, CMA, MEA, and PDA. Scale = 1 cm.


ASCORHIZOCTONIA ASCOPHANOIDES
RK 82–146 (CSY 123)
WA
MEA
PDA
CMA
1
1 cm

WA, 1-2 bands formed on CMA, 3-5 bands on PDA or MEA. Concentric bands formed by chlamydospore-like aggregates present on aged PDA that may fuse together (Fig. 1), similar to those of *A. ochroleuca* Yang & Korf. Mycelium hyaline to yellowish on WA to grayish brown on PDA, mostly appressed and immersed with visible aerial hyphae, and producing chlamydospore-like (monilioid cell) aggregates in all media, fewer on WA. Hyphae cylindrical, simple septate, hyaline to pale brown, smooth, 2.0-10.0 µm broad, with right to almost right angle branching, containing oil globules usually smaller than 5.0 µm in diam; delimiting septum 3-5 µm into the branch or at or near the junction. Monilioid cells subhyaline to brownish, limoniform or subglobose, 16.2-32.0 µm broad, containing oil drops mostly 4.0-11.2 µm in diam, some as large as 15.0 µm .

Holotype: Dried culture derived from a specimen (RK 82.146) collected by R. Kristiansen in Norway in 1982, TRH. Isotypes in CUP, K, PRM, and S. Living cultures maintained at ATCC, CBS, DAOM, and IMI.

CSY 123 is in general very similar to that of *A. ochroleuca*, however it has concentric bands on CMA and MEA. The growth rate of *A. ascophanoides* (Table 1) was slower than that of *A. ochroleuca* (Table 3; Yang and Korf, 1985 a).
Holotype: Dried culture derived from an isolate (CSY 123) from specimens collected at TORP, just north of Fredrikstad, Norway, 3. VII. 1982 by R. Kristiansen, ex RK 82.146, deposited in TRH.

Mode of spore germination, growth pattern and morphology of the culture, and teleomorph connection suggest that the culture belongs to *Ascorhizoctonia*. This also reaffirms the placement of the teleomorph in the genus *Tricharina* and the segregation of *Tricharina* and *Wilcoxina* .

Acknowledgements:
The authors would like to express their sincere thanks to Mr. Jiří Moravec of Brno, Czechoslovakia for kindly arranging the Latin diagnosis and to Drs. Richard P. Korf and James W. Kimbrough for reviewing the manscript.

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MYCOTAXON

Vol. XXXV, No. 2, pp. 317-352 July-September 1989

STUDIES IN THE HYALOSCYPHACEAE V: SPECIES DESCRIBED BY C. H. PECK[1]

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ABSTRACT

Seventeen species of Hyaloscyphaceae (Order Leotiales) originally described by C. H. Peck are reevaluated or redescribed. The following new combinations are proposed: *Trichopeziza albotestacea* var. *agrostina* (Pk.) Haines [=*Peziza agrostina*, =*Albotricha longispora* Raitv.], *Cistellina chamaeleontina* (Pk.) Haines, *Perrotia distincta* (Pk.) Haines [=*Perrotia phragmiticola* (P. Henn. & Ploettn.) Dennis], *Lachnum luteodiscum* (Pk.) Haines [=*Lachnum albidoroseum* (Rehm) Nannf.], *Lachnum clavisporum* (Mout.) Haines, *Lachnum myricaceum* (Pk.) Haines, *Dasyscyphella sulphuricolor* (Pk.) Haines [=*Dasyscyphella cinnamomea* Raitv.] and *Amicodisca viridicoma* (Pk.) Haines. Descriptions and illustrations of *Solenopezia solenia* (Pk.) Sacc., *Lachnum sulphurellum* (Pk.) Raitv. [=*Lachnum cruciferum* (Phill.) Nannf.] and *Cistella grevillei* (Berk.) Massee [=*Peziza urticina* Pk.] are included as are notes on *Trichopeziza kalmiae* (Pk.) Sacc., *Trichopeziza leucophaea* (Pers.) Rehm [=*Lachnella bicolor* Pk.], *Lachnum capitatum* (Pk. in Thümen) Svrcek, *Trichopeziza relicina* (Fr.) Raitv. [=*Peziza longipila* Pk.], *Calycella subochracea* (Cke. & Pk.) Dennis and *Lachnella tiliae* (Pk.) Donk in Sing.

Early in his mycological career Charles Peck, best known for his work on fleshy fungi, described 17 species of discomycetes which are now, or have in the past been, included in the family Hyaloscyphaceae. Most of these have not been reevaluated in recent studies despite the fact that some of them should be in current usage. At the time of Peck's first publications, the fungi now treated in the

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[1] Contribution # 613 of the New York State Science Service.

Hyaloscyphaceae were all contained in one tribe of the genus Peziza. At the time of this writing the number of genera described in that family easily exceeds 100. The types of all seventeen of Peck's species have been reexamined are redescribed or discussed in the present work, and placed in the appropriate modern genera where appropriate.

Trichopeziza albotestacea (Desm.) Sacc. var. agrostina (Peck) Haines **stat. & comb. nov.** Figs. 1,2.

Basionym: Peziza agrostina Peck, Annual Rep. New York State Mus. 29: 55. 1878.

=Trichopeziza agrostina (Peck) Sacc., Syll. Fung. 8: 421. 1889.

=Lachnella agrostina (Peck) Seaver, North Amer. Cup-Fungi, p. 259. 1951.

=Albotricha longispora Raitv., Folia Crypt. Estonica 2: 14. 1973.

Apothecia up to 1.5 mm in diam. when fully expanded, scattered to crowded on grass culms, sometimes in great swarms on the substrate, goblet-shaped with disc concealed by hairs when immature or dry, salviform with white to light yellow disc fully exposed and flat when mature and moist, short stipitate, pink-buff becoming buff-yellow with age. **Ectal excipulum** of moderately thick-walled, hyaline to brown pigmented, nearly cuboid-celled, textura prismatica only 1-2 cells in thickness, cells 5-8 µm across, somtimes inflated to approach textura globulosa in the upper portions. **Medullary excipulum** of densely packed, thin-walled, hyaline, textura intricata composed of hyphae ca. 2-3 µm in diam. **Hairs** up to 180 µm long by 3.0-5.0 µm at the widest point about 1/3 up from the base, tapered to 2.5-3.0 µm at the base and 1.0-2.0 µm at the hemispherical apex, septate forming cells 10-20 µm long, roughened by adhering granules which dissolve in 3% KOH, then appearing completely smooth, or sometimes with small granulations remaining, without resin deposits at the apex, faintly yellow-pigmented, thick-walled, walls up to 1 µm, lumen often about 1/3 of hair width, there appears to be an inner wall thickening by deposit of hyaline matter, flexible, bending readily in mounted material. Some hairs have a minutely pitted surface. Marginal hairs short and clavate, thin-walled, smooth and hyaline. **Asci** (45-)45-55(-64) X 3.5.0-5.5 µm, cylindrical with slightly tapered base lacking croziers, and hemispherical apex with distinct J+ pore, 8-spored. **Spores** (7.0-)9-16(-18.5) X 1.3-2.0 µm (ave. of 35= 11.9 X 1.7 µm) non-septate. **Paraphyses** lanceolate 3.8-5.2 µm at their widest point, with acute apices when mature, superceeding the asci by up to 20 µm.

Type: U.S.A., Albany Co., West Albany, New York, on dead stems of Calamagrostis canadensis, Jun, year not stated, C. H. Peck (holotype NYS, isotype CUP-D as #104-14 & #82-130, isotype sent to NY in 1935). The holotype consists of 14 pcs of grass culm with ca 100 apothecia.

Hosts: On dead culms of previous years growth of large grasses. Calamagrostis canadensis; Panicum virgatum var. spissum; Phragmites australis (=P. communis); Phalaris arundinacea.

Range: Probably common throughout the Eastern U.S.A., but so far only known from New York.

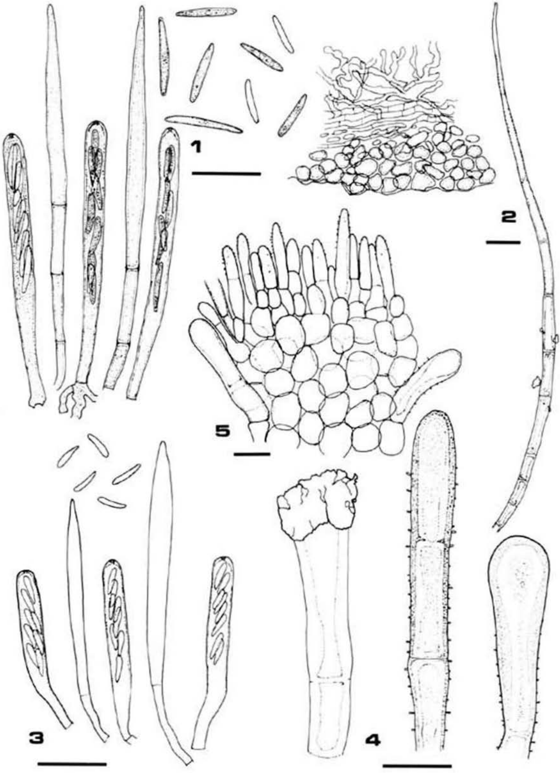
Specimens examined: U.S.A., New York, (see type); Suffolk Co., Wading River, on Panicum virgatum, Sep (no year given), C.H.Peck, as Trichopeziza agrostina (NYS, duplicate in CUP-D as 104-15); Albany Co., Bethlehem, Henry Hudson Park near W bank of Hudson River, on Panicum virgatum var spissum, 27 May 1970, Haines #1288 and S.J.Smith (holotype of Albotricha longispora NYS, isotype TAA); same as above but 11 May 1970, Haines 1128 (NYS); Herkimer Co., Cedarville Swamp ca. 1 mi S. of Cedarville, on Calamagrostis canadensis, 4 Jul 1970, Haines, S.J.Smith & C.T.Rogerson 1384 (NYS); Essex Co., Adirondack region, town of North Elba, North Meadow, on Calamagrostis canadensis, 23 Jul 1970, Haines 1438 & S.J.Smith (NYS); Essex Co., Adirondack region, Wilmington Notch, outlet of Malcolm Pond, on Calamagrostis canadensis, 23 Jul 1970, Haines 1448 & S.J.Smith (NYS); Warren Co., Adirondack region, Town of Warrensburg, Pack Experimental Forest, 8 Jun 1972, Haines 2050 (NYS); Cayuga Co., Montezuma game refuge, on Phragmites australis, 15 Jun 1972, Haines 2110 (NYS); Warren Co., Town of Warrensburg, in power line right-of-way, 2 mi N of Warrensburg, on Calamagrostis canadensis, 6 Jul 1972, Haines 2293 (NYS); Essex Co., Adirondack region, Keene Valley, on Gramineae, 12 Jul 1972 Haines 2321 (NYS); Essex Co., Adirondack region, meadow E of Wilmington, on Phalaris arundinaceae, 13 Jul 1972, Haines 2335 (NYS); Genesee Co., Bergen Swamp, on Phragmites australis, 18 Jul 1972, Haines 2356 (NYS); Albany Co., Albany Pine Bush, on Gramineae, 20 Jun 1978, Haines 3298 (NYS); Albany Co., town of Bethlehem, Henry Hudson Park near the W bank of the Hudson River, on Phragmites australis, 27 Jun 1978, Haines 3318 (NYS); same as previous collection but on Phragmites australis, 20 Jul 1979, Haines 3368 (NYS); Rensselaer Co., Rensselaer, under the E approach to the I 90 Bridge, on Phragmites australis, 24 Jul 1979, Haines 3376 (NYS); same as previous but on Panicum virgatum, Haines 3413 (NYS); Rensselaer Co., town of Sandlake, Taborton, on Gramineae, 22 May 1980, Haines 3426 & K.Conway, (NYS); Rensselaer Co., ca 5 mi E of Poestenkill, 22 May 1980, Haines 3455 (NYS); Washington Co., Eldridge Swamp ca 2 mi NE of Cambridge, Haines 3520 (NYS); Renselaer Co., Rensselaer, near the E approach to the I 90 bridge, on Phragmites australis, 10 Jul 1980, Haines 3756 (NYS); Albany Co., Albany riverfront, on Phragmites australis, 10 Jun 1986, Haines 3799 (NYS); Schenectady Co., along the old Erie Canal towpath ca 2 mi SE of Rotterdam Jct., on Phalaris arundinacea, 10 Jul 1986, Haines 3827 (NYS); Essex Co., Adirondack region, town of North Elba, South Meadow, on Calamagrostis canadensis, 16 Jul 1986, Haines 3852 (NYS); New Jersey, Newfield, on Andropogon, Jun 1889, J.B.Ellis, (as Ellis & Everhart, North American Fungi 2630) (NYS); Kansas, Manhattan, on Phragmites australis, Jun 1887, W.A.Kellerman (as Ellis & Everhart, North American Fungi #2038) (NYS).

Discussion. The variety, agrostina, is similar in macroscopic appearance to the type variety, but it differs by having spores measuring 7-18.5 µm instead of 6-9 µm as in authentic Desmazieres material of P.albotestacea ex M.A.Curtis herbarium now at NYS. All of the North American collections originally identified as Trichopeziza albotestacea (Desm.) Sacc. at the New York State Museum have spores longer than those of the type variety. This fact and the existance of Desmazieres' earlier species was apparently unkown to Peck as he described Peziza agrostina. Likewise, Raitviir was apparently unaware of Peck's P. agrostina when he described his Albotricha longispora from a modern collection made no more than 10 mi from Peck's type locality. The species, Trichopeziza albotestacea is readily distinquishable from other species of discomycetes on gramineae by its long, pink-buff hairs and cream-yellow disc.

The authors placement of this taxon in the genus Trichopeziza is based on the decision that the species is not congeneric with Albotricha acutipila (Karst.) Raitv., the type of Albotricha which has smooth, thin-walled hairs tapered to a fine point and thin-walled cells in the ectal exciple. Instead, it appears to be congeneric with Trichopeziza sulphurea, the type of Trichopeziza, which has slightly thick-walled hairs with loose granules, hemispherical apices and thick-walled cells in the ectal exciple. This opinion is not shared by Dr. Raitviir who wishes to retain P. agrostina as a species distinct from P. albotestacea and to retain both in the genus Albotricha. The name Belonidium which has, until recently, been used for this group of species has been replaced by Fuckel's name Trichopeziza for all but the type species, B. aeruginosum, which is referable to the genus Lachnum (Raitviir 1987).

Lachnella bicolor Peck, New York State Mus. Bull.
54:157. 1902.
non =Lachnella bicolor (Pat. & Demange) Locquin,
Bull. Soc. Mycol. France 68: 166. 1952.
nec =Lachnella bicolor (Bull.: Fr.) Phill., Brit.
Discomyc. p.249. 1889.

This unfortunate epithet was a latter homonym of the very common Lachnella bicolor (Bull.: Fr.) Phill. = Lachnum bicolor (Bull.: Fr.) Karst. when published, and at the same time a taxonomic synonym of the equally common Trichopeziza leucophaea (Per.) Rehm. Peck's name has apparently never been transferred and only a single specimen bearing that name is in the Peck herbarium. That specimen, marked "type" matches the type description and is on Phytolacca decandra collected near Snyder's Corners, Rensselaer Co., NY, 9 Aug 1900. However, the same species, now identified as Trichopeziza leucophaea, is represented by more than 20 additional specimens in the NYS herbarium. Several of these were made by Peck himself. One of the problems in the identification of this fungus is that the hairs change from bright yellow to grey-white with reddish brown resinous bodies. The number, size and location of this resinous matter determines the color of the dried specimen. In addition to the colored excipular hairs, Peck's type collection has hyaline hairs near the base which also attach to the substrate. This is a common , but not consistant, feature found in this taxon. It is this feature which led Peck to believe that this was a new species and to call it bicolor for the two colors of hairs. The basal mycelium is not to be confused with a subiculum in which the apothecium is seated entirely on a mat of hyphae as opposed to this instance in which the hyphae surround the apothecial base which is attached to the substrate.



Figs. 1–5. Trichopeziza albotestacea var. agrostina (Holotype). 1. Spores, asci and paraphyses. 2. Hairs and apothecial section. Lachnum capitatum (Lectotype). 3. Asci, paraphyses and ascospores. 4. Hairs. 5. Excipular margin.

Lachnum capitatum (Peck ex Thümen) Svrcek, Ces. Mykol. 39: 214. 1985. (as L. capitatum Peck) Figs. 3-5, 26.
Basionym: Peziza capitata Peck ex Thümen, Mycoth. Univ., Cent. IX, No. 813. 1877. (diagnosis on label)
=Trichopeziza capitata (Peck ex Thümen) Sacc., Syll. Fung. 8: 417. 1889.
=Dasyscypha capitata (Peck ex Thümen) LeGal, Rev. Mycol. N. S. 4: 29. 1939.
=Incrucipulum capitatum (Peck ex Thümen) Baral & Krieglst., Beih. Z. Mykol. 6: 72. 1985.
=Dasyscypha scintillans Massee, Brit. Fung. Fl. 4: 328. 1895.

This taxon is distinctive in having short, white, thick-walled, crystal-capped hairs and in being found on leaves of Quercus. It is one of Peck's best known hyaloscyphaceous species. It has been redescribed and illustrated by numerous authors (LeGal 1939, Kanouse 1947, Dennis 1949, Ellis & Ellis 1985), but it appears that the type specimen and authorship have been misinterpereted. Peck first collected this species in 1876 in Bethlehem, NY not far from Albany and made a complete description for publication in his annual report for that year. The publication, however, was delayed and did not get distributed until September of 1878 (Petersen 1980). In the interim, in 1877, he made a second, larger collection in Albany and sent it with his notes to F. Thümen for inclusion in his exsiccati, Mycotheca Universalis. Thümen's printing and distribution was much faster and the first publication of the species with a complete description appeared in 1877 on the cover of Mycotheca Universalis #813, at least 8 months before Peck's. This has a greater implication than just the date and author citation. Thümens packet and description refer to Peck's 1877, Albany collection, not the one he intended in his own publication to be the type. Fortunately the two specimens are conspecific, but since the "type" is now an exsiccatum which is divided into many portions and distributed throughout the world, lectotypification is necessary. I chose that portion of Mycotheca Universalis #813 deposited at NYS as Lectotype of Peziza capitata Peck ex Thümen. The lectotype specimen contains a single, complete, unbroken leaf with several hundred slightly immature apothecia.

Specimens examined: U. S. A., NY, Albany, on leaves of

Quercus alba L., 1877, C.H.Peck distributed as Thümen, Mycotheca Universalis #813 (lectotype NYS, duplicate not sent to Thümen isotype NYS); Albany Co., Bethlehem, on leaves of Quercus alba, Jun 1876, Peck (the specimen originally intended by Peck to be the type NYS); Rensselaer Co., Sandlake, on leaves of Q. prinus L., Jun, Peck (NYS); Catskill Mts., on leaves of Q. rubra, Peck (NYS); Albany Co., Albany Pine Bush region, on leaves of Q. ilicifolia Wang, Jun 20, 1978, Haines 3292 (NYS); Same as previous collection but on leaves of Q. alba, Haines 3292 (NYS); NJ, Newfield, on "oak leaves, Sep 1876 (as" Peziza cephalotricha Ell. mss") (NYS); Ohio, Lancaster, Fairfield Co., Jun 20, 1883, W. A. Kellerman 329 (NYS).

Cistellina chamaeleontina (Peck) Haines **comb. nov.** Fig 6.
Basionym; Peziza chamaeleontina Peck, Annual Rep. New York State Mus. 30: 60. 1878.
=Dasyscypha chamaeleontina (Peck) Sacc., Syll. Fung. 8: 1889.
=Atractobolus chamaeleontinus (Peck) O. Kuntze, Rev. Gen. Plant. 3: 445. 1898.

Apothecia .10 - .25 mm in diam., cup-shaped with a short cylindrical stipe ca .1 mm long, scattered on exposed, rotted wood of the host, white, changing to yellow then pinkish or red when bruised (according to Peck), now transluscent orange-yellow in dried material, covered with very short, yellow hairs. **Ectal excipulum** very thin, composed of parallel hyphae laying at a close angle to the surface, forming textura primatica with swollen cells up to 10 X 5 µm. Ends of the hyphae protrude to form rudimentary hairs. **Hairs** up to 30 X 2 - 3 µm, clavate, sparsely roughened on the apical half, smooth below, often slightly curved, non-septate, thin-walled. **Asci** 20 - 40 X 3 - 4 µm, cylindric-clavate, often subtended by a crozier, with a short, tapering, cylindrical apical pore ca 1 µm in diam. which stains bright blue in IKI (1% IK) without KOH pretreatment, no red reaction observed. **Spores** 4.0 - 5.5 X 1.3 - 2.3 µm, ovate to ovate ellipsoid (pyriform in strongly osmotic mounts), non-septate, with 1 or more inclusions at each end, occasionally enveloped in what appears to be a thin, hyaline gel layer about .3 µm thick. **Paraphyses** up to 2.5 µm thick, very slightly longer than the asci, slightly tapered to a blunt apex.

Type: U.S.A., NY, Rensselaer Co., Sand Lake, on decorticated wood of Hemlock (Tsuga canadensis), Nov (year not stated), C. H. Peck. The specimen consists of about 18 carved chips of wood with a total of more than 100 apothecia. (holotype NYS, Isotype in CUP-D).

Hosts: On the underside of a decorticated log of Tsuga canadensis.

Range: Known only from two New York collections made about 150 mi apart. It is such an inconspicuous fungus that it could easily be overlooked, and it could prove to be more widespread.

Specimens examined: U.S.A, NY (see type); Tompkins Co., Enfield, on wood, 19 Oct 1894, E.J.Durand (CUP-D); Tompkins Co., Fall Creek near Ithaca, 23 Oct 1894 (CUP-D)

Discussion: This appears to be a good species closely related to Cistellina hymeniophila (Karst.) Svrcek (=Peziza stereicola Cooke). It is recognized by its small, nearly smooth, orange yellow when dry, distinctly stipitate apothecia, its ectal exciple composed of parallel hyphae lying at a low angle to the surface and its small ovate spores. Peck recorded, a tendency for it to change from white to yellow and "pink rhubarb" or red when bruised. These features set it apart from other small discomycetes known to the author. It differs from C. hymeniophila by its lignicolous rather than fungicolous habitat. The genus Cistellina was proposed for Cistella-like fungi in which the exciple is composed of parallel hyphae.

Lachnella citrina Peck, Annual Rep. New York State Mus. 46: 35. 1893. Figs. 9-11.

Apothecia up to .6 mm across when dry, cyathiform, short stipitate, buff to orange buff, thickly covered with buff-yellow hairs which curve upward along the cup, and which turn olive-grey in older specimens. Some apothecia are almost white as noted by Peck in his original description. The olive pigment changes to red droplets then disperses and the excipulum becomes transparent when placed in 3%KOH. Disc slightly darker, concealed by marginal hairs in dried specimens. **Ectal excipulum** hyaline textura prismatica composed of thin-walled cells. **Hairs** up to 100 µm long by 2.5 - 3.0 µm wide, irregularly cylindrical or slightly tapered to a hemispherical tip, 0-, 1- or 2-septate, slightly thick-walled, walls up to ca. 1

µm thick, faintly yellow-pigmented, coarsely roughened with tightly adhering, uniform-sized granules ca .5 µm. **Asci** 55- 65 X 6.0-7.5 µm, cylindrical with hemispherical tip and tapered base lacking crozier, no pore detected with or without stains, 8-spored. **Spores** 7-12 X 2.5-3.0 µm, ellipsoid-fusiform, slightly more tapered in the lower half, non-septate. **Paraphyses** filiform, 1.0-1.5 µm in diam., not superceeding the asci in the hymenium.

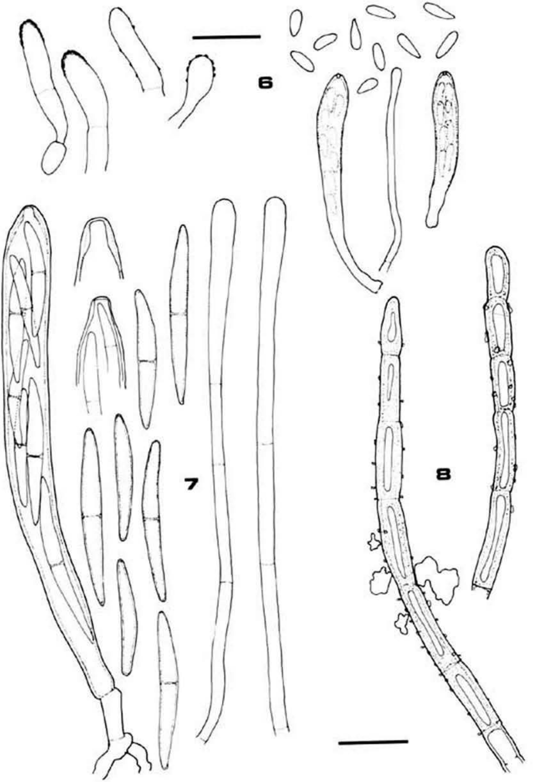
Type: U.S.A., NY, Ulster Co., Shokan, on bark of living chestnut tree, Sep 1892, C.H.Peck (holotype NYS, isotype CUP-D 82-43). The holotype consists of 7 pcs of chestnut park with over 100 apothecia.

Host: Known from the bark of living or recently killed American chestnut (Castanea americana) and Quercus and Acer spp.

Range: Known only from three widespread locations in New York.

Specimens examined: U. S. A. New York, (see type); Bolton Landing, Warren Co., 23 Aug, probably 1901, C. H. Peck (NYS); Coy Glen, near Ithaca, Thomkins Co., on living chestnut, Nov 20, 1894, E. J. Durand 631 as Dasyscypha turbinulata (NYS, CUP-F, CUP-D as 82-35); Coy Glen, on living chestnut, 9 Mar 1901, E.J.Durand (CUP-D 82-36; Coy Glen, on living chestnut, 11 Dec 1901 (CUP-D 82-47); West Shore of Cayuga Lake, on chestnut, 12 Oct 1901, E.J.Durand (CUP-D); New Jersey, Newfield, on bark of living Quercus coccinia, 1887, M. B. Ellis (NY); Pennsylvania, Bethlehem, Oct 1880, M. B. Ellis & H. W. Harkness, also distributed as North American Fungi #564, Ellis Collection (NY); North Carolina, Blowing rock, bark of living chestnut, Aug 1901, E.J.Durand 1226 (CUP-D 82-34, CUP-F).

As Rehm (1907) points out, Peck's Lachnella citrina is the same as Schweinitz's earlier Peziza turbinulata, a fortunate occurrence, since the specific epithet "citrina" is preoccupied in many hyaloscyphaceous genera. No holotype for P. turbinulata could be located in the Schweinitz collections at Philadelphia by Seaver according to notes at the New York Botanical Garden, but a later collection from the type locality and host fits the description well and was used to represent the species. It has apparently not been collected since around the turn of the century a fact which may be tied to the decline of its american chestnut host. Even though it is a small,



Figs. 6–8. Cistellina chamaeleontina (Holotype). 6. Hairs, asci, paraphyses and ascospores. Perrotia distincta (Holotype). 7. Asci, ascus tips, ascospores and paraphyses. 8. Hairs.

inconspicuous fungus, its olive-grey coloration when dried, and the absence of a pore at the ascus tip makes it distinctive and unlikely to be overlooked for long. The same, distinctive lack of pore that makes it easy to recognize, makes it difficult to place taxonomically. Within the Hyaloscyphaceae, Perrotia is similar in having pore-free asci, but it differs from P. flammea (Alb. & Schw.) Boud., the type of Perrotia, in exciple and hair characters, it bears a closer resemblance to P. populina (Seaver) Dennis. Raitviir (pers. comm.) has suggested that it needs a new genus, but for the present no new taxon will be described.

Seaver (1951) suggested a possible synonomy of this species with Lachnella albolutea (Pers.) Karst., but this most commonly refers to a species with a distinct ascus pore, smooth hairs and sessile apothecieum.

Perrotia distincta (Peck) Haines **comb. nov.** Figs. 7,8,28.

Basionym: Peziza distincta Peck, Annual Rep. New York State Museum 30: 60. Sep 1878.
=Trichopeziza distincta (Peck) Sacc., Syll. Fung.8: 421. 1889.
=Patellaria aureococcinea Berk. & Curt. in Ellis, N. Amer. Fungi, Cent I, #63. 1978. (nomen nudum).
=Helotiella aureococcinea Massee, J. Linn. Soc. 35: 108. 1901. (First valid publication).
=Solenopeziza aureococcinea (Massee) Rehm, Ann. Mycol. 2: 352. 1904.
=Dasyscypha phragmiticola P. Henn. & Ploettn. Verh. Bot. Brand. 41: 97. 1899.
=Lachnellula phragmiticola (P. Henn. & Ploettn.) Boud., Hist. Classif. Discom. Europe p. 124. 1907.
=Lachnella phragmiticola (P. Henn. & Ploettn.) W. Kirschst., Ann. Mycol. 34: 182. 1936.
=Perrotia phragmiticola (P. Henn. & Ploettn.) Dennis, Kew Bull. 17: 357. 1963.

Apothecia up to 1.5 mm in diam. when fully expanded, scattered or gregarious on substrate, salviform when moist, cyathiform when dry or with the margins infolding to become hysteriform, narrowed to a central point of attachment below, not distinctly stipitate, sometimes with a small weft of anchoring hyphae, black and nearly smooth externally, covered at the margin with buff to ochraceous-buff to yellow hairs, darkening slightly when dry. Disc pink to orange-vermillion when fresh, darkening to orange-ochraceous on drying, exposed even in dried specimens. **Ectal excipulum** of two distinct layers. The outer layer which gives rise to the hairs is of 1-3 cells thickness composed of dark red-brown (golden brown with transmitted light), thick-walled, subglobose or irregular cells 5-10 µm in diam., forming textura globulosa to epidermoidea. The cells of the inner layer are similar but are hyaline and even thicker-walled so that the lumen is confined to a small central cavity so that the tissue looks like the sclerenchyma of higher plants. **Medullary excipulum** of thick-walled, textura intricata. **Hairs** up to 150 µm long by 3-5 µm in diam., irregularly cylindrical, or tapering slightly toward the tip in the longer examples, with hemispherical tips which may be slightly enlarged in shorter examples, rarely branched near the base, septate with septa forming cells 7-15 µm long, thick-walled with the walls up to 2 µm thick and the lumen sometimes reduced to a narrow channel, golden brown with transmitted light, sometimes with nearly hyaline tips, smooth but with occasional lumps of yellow to brown resinous-appearing matter adhering to the surface especially near the tips, up to 2 µm in diam. **Asci** (55-)60-75(-90) X 5-7 µm, cylindrical with conical apices and tapered bases, usually subtended by croziers, without a trace of apical pore or plug, not reactive with Melzers' reagent or IKI, with or without KOH pretreatment, 8-spored. **Spores** (16-)18-22(-25) X 2-3 µm, elliptic-fusiform, straight or slightly curved, becoming 1-septate while still in the ascus, very slightly enlarged in the upper half, otherwise symmetrical about the polar axis, hyaline. **Paraphyses** up to 3 µm wide at the widest point, cylindrical 1-2 µm below expanded to clavate upper portion with a blunt apex, 2-3 µm wide, septate below, superceeding the asci by up to 10 µm in the hymenial arangement.

Type: U.S.A., NY, Albany Co., Center (now known as Karner in the Albany Pine Bush region), on dead culms of Andropogon furcatus, Oct. 1876, C. H. Peck [holotype in NYS; Isotype in CUP-D as #5696 (90-63) is a small collection in good condition. A second isotype was sent to NY in 1935]. The holotype consists of 30 plus pcs of grass culm with more than 200 apothecia.

Hosts: Andropogon furcatus; Phagmites communis; Panicum virgatum var. spissum. Occurring on last years culms, late in the growing season (Oct. and Nov.) in North America.

Range: Apparently widespread in temperate regions in Europe, the British Isles and North America, but not commonly collected, perhaps because of its late sesonal occurence and relative rarity.

Specimens examined: German Democratic Republic, near Rathenow, Nov 1889, Plottner (type of Dasyscypha phragmiticola (K); U.S.A., NY, (see holotype); South Carolina, on Andropogon, M.A.Curtis, (NYS ex Curtis herbarium, presumed isotype material of Patellaria aureococcinea); England, Norfolk, on Phragmites, Oct 1978, A.Moore (as Perrotia phragmiticola, K); Surrey, Black Pond, Eshe Common, 3 Nov 1985, B.Spooner (as Perrotia phragmiticola, K); Isle of Arran, Kildoron, on Phragmites, 24 Sep 1981, R.W.G.Dennis (as Perrotia phragmiticola, K); U.S.A., Kansas, Rooks Co., 22 Oct 1892, E.Bartholomew #3001 (CUP-D, #90-62); Louisiana, Lafayette, on Andropogon, 12 Nov 1889, Langlois #2253 (CUP-D 8255, 90-64); New Jersey, Newfield, on Andropogon, Oct, J.B.Ellis (NYS; also as Ellis, North American Fungi #63); New York, Albany Co., Cedar Hill near the W bank of the Hudson River, on Panicum virgatum var spissum, 3 Nov 1969, Haines 1114 & S.J.Smith (NYS); Albany Co., Albany Pine Bush, on Gramineae, 18 Oct 1977, Haines 3273 (NYS); Bronx Co., Bronx, on grounds of the New York Botanical Garden, on Andropogon virginicus, 23 Nov 1985, C.T.Rogerson 85-119 (NY, NYS); Orange Co., Harriman State Park, vicinity Raymond Torrey Monument, on Phragmites australis 6 Nov 1979, C.T.Rogerson (NY, NYS); Suffolk Co., Long Island, Riverhead, Sweezy Pond, on Panicum virgatum var spissum, 6 Oct 1971, S.J.Smith #47460, C.T.Rogerson & E.C.Ogden (NYS).

Discussion: As indicated by Peck's name for this fungus, it is very distinctive, but apparently somewhat rare. It is distinct in having a pinkish disc surrounded by yellow to brown hairs. The colors of both the hairs and the disc are variable and prone to change on drying and during the lifespan of the apothecia under natual conditions. Microscopically it is distinct in having nearly smooth, thick-walled hairs and in lacking an apical ascus pore. The ascus tip is similar to that found in Perrotia populina (Seaver) Dennis (Haines & McKnight 1977). Synonymy with P. phragmiticola is based on comparisons of type material and is reported here for the first time. Synonymy with Solenopeziza aureococcinea has been reported before and it would create a problem as to which species has priority as they were both used in 1878, but the latter was published as a nomen nudum without diagnosis as #63 in the first century of J. B. Ellis's North American Fungi. The diagnosis was finally provided by Massee in 1901, thereby clearly giving Peck's species priority. One has only to look at the list of genera in which this species has been placed to see that it has been a conundrum for those who have known it. Its subglobose, pigmented outer excipular cells, thick-walled hairs, clavate paraphyses and lack of a pore plug make Perrotia a clear choice at this state of our taxonomic knowledge.

Pezicula kalmiae (Peck) Sacc., Syll. Fung. 8: 314. 1889.
Basionym: Peziza kalmiae Peck, Annual Rep. New York State Mus. 25: 99. 1873.
=Dermatea kalmiae (Peck) Ellis & Everh., North American Fungi #147. 1879.
=Trichopeziza kalmiae (Peck) Sacc., Syll. Fung. 8: 411. 1889.

Type: U.S.A., NY, Rensselaer Co., Sandlake, on old stroma of the fungus Phyllachora kalmiae (Peck) Petrak which was growing on the small branch tips of Kalmia angustifolia, C.H.Peck, no date, (holotype NYS, isotype CUP-D 104-48). The holotype consists of one branching twig and one small fragment both mounted on small portions of herbarium sheet. Together they bear ca 30 apothecia.

Hosts: The fungus Phyllachora kalmiae on Kalmia angustifolia

Range: Known, with certainty, only from New York and Maine.

Specimens examined: USA, New York (see type); Maine, Kittery Point, on Kalmia, R. Thaxter (CUP-D 104-49).

Discussion: The type has an exciple composed of brown, small-celled textura angularis and ovate ascospores ca. 8.0 X 3.5 µm. It is definitely not hyaloscyphaceous and appears to be a member of the Dermatiaceae. The specimen distributed as Ellis' North American Fungi #147 was misidentified and was subsequently made the type of a new species, Gorgoniceps kalmiae, by Rehm (1904).

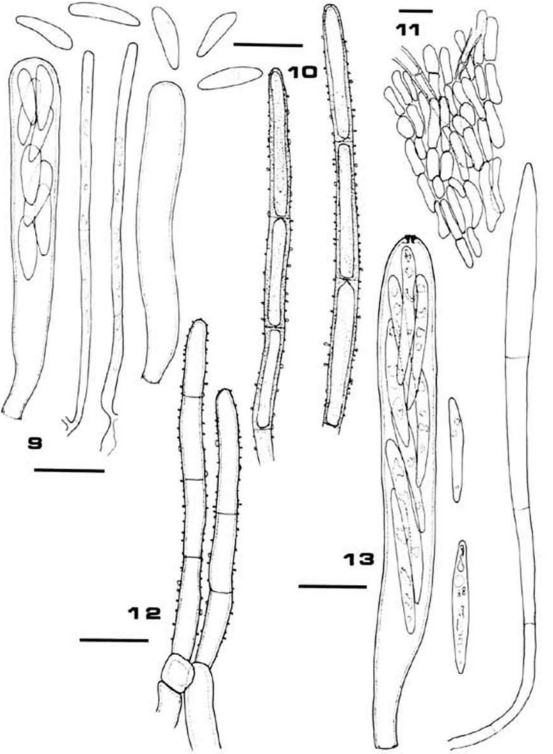
Peziza longipila Peck, Annual Rep. New York State Mus. 32: 46. 1879.

=Trichopezizella relicina (Fr.) Raitv., Scripta Mycol. 1: 60. 1970.

This species and its synonymy with T. relicina has been fully discussed previously by the author (Haines 1974). Although this species is relatively common in some areas, it is apparently rare in the territory known to Charles Peck and his type specimen of P. longipila remains today as the sole example known to the author from New York state. In addition to "normal" apothecia, the type collection contains several similar fruiting bodies in which the hymenium is replaced by what can be assumed to be the anamorphic state. This phenomenon is not uncommon in members of the Hyaloscyphaceae, but, unfortunately in this case the collection is very small (about a dozen poorly preserved apothecia) and the anamorph, which appears to have a phialidic type of conidial production, is immature. Spooner (1987) synonymizes Trichopeziella Raitv. with Lasiobelonium Ellis & Everh., on the basis that the smooth haired-species of the former intergrade with the rough-haired species of the latter. The present author maintains that the two are separable on the basis of hair granulation and the intensity of hair pigmentation, and retains both genera.

Lachnum luteodiscum (Peck) Haines **comb. nov.** Figs. 12,13.
Basionym: Peziza luteodisca Peck, Annual Rep. New York State Mus. 33: 31. 1881.
=Dasyscypha luteodisca (Peck) Sacc. Syll. Fung. 8: 449. 1889.
=Atractobolus luteodiscus (Peck) O. Kuntze, Rev. Gen. Plant. 3: 445. 1898.
=Pezizella albidorosea Rehm in Rabenh., Kryptogamenfl. 1(3): 682. 1896.
=Mollisiella albidorosea (Rehm) Boud., Hist. Classif. Discom. Europe p. 142. 1907.
=Dyslachnum albidoroseum (Rehm) Hohn., Mitt. Bot. Lab. Techn. Hochsch., Wien 3: 71. 1926.
=Lachnum albidoroseum (Rehm) Nannf., Ann. Mycol., Berl. 34: 397. 1936.
=Dasyscyphus albidoroseus (Rehm) Dennis, Comm. Mycol. Inst., Mycol. Pap. 32: 30. 1949.

Apothecia up to 1 mm in diam. when fully expanded, scattered on substrate, buff white, covered with short, white to rose-colored hairs, short stipitate, stipe ca. 0.1 mm in diam., shorter than the diameter of the disc, disc



Figs. 9-13. Lachnella citrina (Holotype). 9. Asci, paraphyses and ascospores. 10. Hairs. 11. Excipular surface. Lachnum luteodiscum (Holotype). 12. Hairs. 13. ascus, ascospores and paraphyses.

circular, flat, orange-buff to orange chrome drying to scarlet vermillion, exposed even in dried specimens. **Excipulum** not differentiated into definable layers, composed of short, slightly inflated-celled, hyline <u>textura prismatica</u>. **Hairs** of two types, excipular and marginal. The excipular hairs up to 60 µm long by 3-4 µm wide, cylindrical, with hemispherical tips, arising from a short chain of enlarged excipular cells, flexuous, hyaline or very slightly rose-colored in some specimens, sparingly septate, thin-walled, evenly and copiously roughened with coarse, hyaline granules ca. 0.7 µm in diam. which appear to be slightly taller than broad. The marginal hairs, which arise from the ends of the cells making up the margin, up to 70 µm by 2.5-3.5 µm, cylindrical or sometimes slightly tapered to 2-3 µm rounded tip, hyaline to buff, closely septate forming cells ca. 15 µm long, almost smooth, but some with a few adhering granules, very similar to paraphyses in some instances. **Asci** 55-70 X 6-8 µm, cylindrical with tapered base and slightly conical apex, lacking croziers, with distinct pore visible without staining, blue reaction in IKI with or without KOH pretreatment, 8-spored. **Spores** (12.5-)15-19(-20) X 2.5-4.0 µm, elliptical-fusoid, slightly tapered in the lower half, with rounded tips, straight or very slightly curved, usually non-septate, but occasionally with a single, median septum. **Paraphyses** lanceolate, 2.0-3.5 µm diam. at the widest point about one forth down from the tip, filiform with enlarged, clavate tip, superceeding the asci by less than 10 µm in the hymenial arrangement.

Type: U.S.A., NY, Manlius, on dead stems of <u>Scirpus validus</u>, Aug. 1879, C. H. Peck (holotype at NYS contains ample substrate, but only a few dozen apothecia and those are interspersed with <u>Mollisia</u> sp.; isotypes sent to NY in 1935 and CUP-D).

Hosts: <u>Scirpus</u> <u>lacustris</u>; <u>S</u>. <u>acutus</u>; <u>S</u>. <u>validus</u>; <u>Juncus</u> <u>effusus</u>; On the bases of overwintered flower stalks.

Range: Apparently widespread, but not common in the Northeastern U. S. A. and in Europe and the British Isles.

Specimens examined: U. S. A., NY, (see type); Genesee Co., Bergen Swamp, on <u>Scirpus</u> <u>acutus</u>, 14 Sep 1964, C. T. Rogerson, S. J. Smith & R. DeGroot (NY; and as JHH 1475 NYS); Bergen Swamp, on <u>Scirpus</u> <u>acutus</u>, 19 Jul 1972, Haines 2397 & 2379, S.J.Smith & C.T.Rogerson (NYS); New Jersey, Iona, on Juncus effusus, Aug, Carrie & Emma Bradley, leg. J. B. Ellis as "Peziza (Dasy.) paraphysata Ell" (NYS); A portion of what is apparently the same colection was also issued as J. B. Ellis, North American Fungi #441 as "Peziza luteodisca, Pk., in literis" (NYS).

Discussion: This is a very distinctive, but not commonly collected species, a fact which has led to its being decribed as new by several authors. As far as this author is aware, Peck was first to do so, with J. B. Ellis ready to describe it again as "Peziza paraphysata", even before Pecks name was in print. Fortunately the two authors were in correspondence and the situation was resolved with Ellis shelving his name in favor of Pecks prior to its valid publication.

Dasyscypha clavispora Mouton is a similar, large-spored species on grasses and rushes. Authentic material from Moutons herbarium was examined and compared with Pecks L. luteodiscum. Moutons species differs in having more distinctly clavate spores, cylindrical, non-lanceolate paraphyses 1.5-2.0 µm wide and finely granulate hairs. Its hair and apothecium color is difficult to determine from the scanty authentic material remaining. Dennis (1962) has reported D. clavisporus from Britain, but it has not yet been reported from outside of Europe. Despite its filiform paraphyses, it is a Lachnum in all other respects and its transfer to that genus is made here.

Lachnum clavisporum (Mouton) Haines, **comb. nov.**

Basionym: Dasyscypha clavispora Mouton, Bull Soc. Roy. Bot. Belgique 36: 18. 1897.

Only one collection labelled D. clavispora remains among the Mouton material at Bruxelles (BR), and that is reduced to one mounted and one unmounted apothecium. This packet, now mounted on a sheet marked "TYPE" with a recent label, states that the substrate is "Agrostis" which apparently corresponds with its contents. This host information does not, however, correspond with that in the protologue which names Molinia and Juncus conglomeratus as its substrate. Regardless of whether this specimen is the type or not, it appears to be the only authentic material left, and it is used here to base the transfer of this species.

Lachnum myricacea (Peck) Haines **comb. nov.** Figs. 18,19.

Basionym: Peziza myricacea Peck, Annual Rep. New York State Mus. 30: 59. 1878. (As Peziza

(Dasyscypha) myricacea)
=Trichopeziza myricacea (Pk.) Sacc., Syll. Fung. 8:409. 1889.

Apothecia up to 1.0 mm in diam., widely scattered on substrate, deeply cup-shaped, covered externally with matted, flexuous, light brown hairs which show no trace of resin secretions at low magnification, nor undergo any color change when immersed in 3% KOH. Disc concave, white to very "pale luteus", covered by infolded cup margin and hairs when dry. Stipitate with a naked stipe much shorter that the diameter of the disc. **Ectal excipulum** of Textura prismatica composed of hyaline cells ca. 3 X 10 µm. **Hairs** up to 250 µm long by 3.5-5.0 µm wide, cylindrical, flexuous, with hemispherical, unswollen, concolorous tips, without resin or crystal accretions, often branched, kinked or swollen near the base, light brown with transmitted light, unchanged and without pigment release in 3% KOH, septate, with thin outer walls, and what appears to be a thicker, hyaline inner wall, roughened externally with moderately coarse granules 0.2-0.8 µm in diam. that sometimes become dislodged after immersion in 3% KOH followed by Melzer's soln. Short, irregular, light brown, one-celled hairs are interspersed among the longer ones. **Asci** (39-)45-55 X 4-5 µm, cylindrical, with apical pore blue in IKI croziers not observed, 8-spored. **Spores** (6.0-)6.5-8.0(-10.0) X 1.1-1.8(-2.5) µm, unequally fusiform, slightly more tapered in the lower half, usually straight. **Paraphyses** up to 5 µm across at the widest point, definitely lanceolate with acute apices, superceeding the asci by up to 25 µm in the hymenial configuration.

Type: U.S.A., NY, Adirondack Mts., on dead stems and branches of Myrica gale, Aug. 1876, C. H. Peck (holotype NYS; isotypes sent to NY & CUP-D). The holotype contains an ample amount of substrate but very few apothecia, and those are in poor condition, a fact noted by Seaver (1951). This may be due to the scattered occurance of the fruiting bodies in nature and their propensity for becoming dislodged from their substrate in old specimens.

Host: Myrica gale L. Known only from the fallen, bark covered twigs and stems of this species.

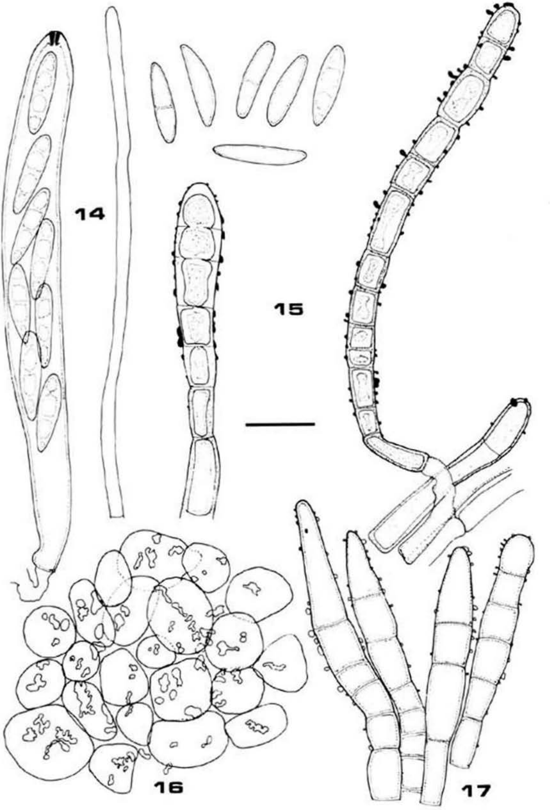
Range: So far known only from the Adirondack Mountains of New York, but it should be sought elsewhere in the range of Myrica gale.

Specimens examined: U.S.A., New York, (see type); Essex Co., Adirondack region, Lake Sallie (Lake Sally?), on Myrica gale, Aug, C.H.Peck (CUP-D 82-122, #9060); Grassy Pond, on Myrica gale, Probably Jun 1884, C.H.Peck (NYS); Essex Co., Adirondack region, Newcomb, on Myrica gale, 22 Jun 1923, H. D. House (NYS); Franklin Co., Adirondack region, Stoney Creek Ponds, Corey's, on Myrica gale, 5 Jun 1988, Haines #4038 (NYS); same as preceeding but 18 Jun 1988 Haines #4072 (NYS).

Discussion: This species is seldom encountered and its type collection is in poor condition so it is therefore, not well known. The six collections examined here are now enough to give a good concept of the species. It is a perfectly good Lachnum related to Lachnum clandestinum (Bull.) Fkl., but differs from that species by its its longer, hairs which lack resin secretions at the tips, its shorter stipe and restricted substrate. It is a species which has apparently not been illustrated or redescribed since its original publication. There is a single subsequent report of it in the literature (Jackson 1935) of a collection made by C. L. Shear near Inlet, NY in the Adirondack region in 1934. It was not reexamined, but there is no reason to doubt the report. A New Jersey collection by J.B.Ellis, Nov 1878, at NYS which bears the name Trichopeziza myricacea is misnamed.

Solenopezia solenia (Peck) Sacc. Syll. Fung. 8: 477. 1889. Figs. 14-17,29.
Basionym: Peziza solenia Peck, Bull. Buff. Soc. Nat. Sci. 1: 70. Jun 1873.
=Lachnella solenia (Peck) Seaver, N. Amer. Cup-fungi (inoperculates). p. 260. 1951.
=Dasyscyphus solenia (Peck) Dennis, Kew Bull. 17: 364. 1963.
=Belonidium solenia (Peck) Raitv., Scripta mycol. 1: 50. 1970.

Apothecia up to 0.5 mm diam., scattered to densely gregarius on substrate, often amongst other fungi, very deep cup-shaped, urceolate or soleniform, often slightly constricted at the mouth, height usually equal to or longer than diam., shape not changing significatly on drying, sessile, narrowed at the base to a small point of attachment, externally dark brown to almost black, sometimes with a purple tint, with a white fringe of hairs at the margin. Disc deeply concave, white to cream. Ectal



Figs. 14-17. Solenopezia solenia (Holotype). 14. ascus, paraphysis and ascospores. 15. Excipular hairs. 16. excipular surface. 17. Marginal hairs.

Excipulum thin, ranging from textua angularis near the base to short-celled textura prismatica near the margin, composed of brown, slightly thick-walled, cells, roughened on the exposed surface. **Medullary excipulum** hyaline Textura prismatica composed of thin-walled, elongate cells. **Hairs** of two types, excipular and marginal, excipular hairs up to 100 µm long, usually 40-60 µm, clavate, 3.0-4.5 µm below, expanding to 4.5-6.0 µm above, usually curved, closely septate with septa forming very short cells which are often no longer than they are wide in the swollen, upper portion of the hair, outer walls slightly constricted at the septa, thick-walled with what appears to be an inner wall layer up to 2.5 µm thick which reduces the cell lumen to less than half the hair width, brown below becoming hyaline in the swollen upper portion, with pigmented contents which may release a violaceous pigment in 3% KOH, externally smooth or with a very few concolorous granules. Marginal hairs usually ca. 40µm X 4-6 µm, cylindric clavate, closely septate, thin-walled, hyaline, externally covered in the lower portion with minute, regular granules up to 1 µm diam, the upper portions nearly smooth but with irregularly-shaped particles up to 2 µm diam. **Asci** (62-)70-85(-95) X 7.0-9.5 µm, cylindrical with slightly conical apex, tapered at the base, usually subtended by a crozier, pore clearly evident even in unstained material, blue in IKI, 8-spored, spores filling the entire ascus to within a few µm of the basal septum when mature. **Spores** (12.5-)14-17 X 3.0-3.5 µm, fusiform elliptic, slightly broader in the upper portion, straight or slightly curved, usually non-septate but occasionally 1-3-septate, containing 2-4 spherical inclusions, hyaline, smooth. **Paraphyses** 2-3 µm in diam., cylindrical with narrowly clavate tips, not superceeding the asci by more than a few microns.

Type: U.S.A., NY, Schuyler Co., Watkins Glen, "on dead stems of Eupatorium ageratoides in damp, shaded places" Sep 1871, C.H.Peck (holotype NYS; isotypes sent to NY, K & CUP-D). The holotype consists of about 20 pcs on stem with a total of more than 150 apothecia. The packet also contains 2 small drawings by Peck of microscopic detail

Hosts: Eupatorium maculatum L.(=E. purpureum var. maculatum); E. rugosum Houtt.(=E. ageratoides L.f.). Peck (1878) states that had only seen the fungus on E. ageratoides and never on E. maculatum, but it has subsequently been collected several times on the latter species. Apothecia found on previous years' stems lying in moist areas.

Range: So far known only from a few collections from widespread regions of New York.

Specimens examined: U.S.A., New York, (see type); Ulster Co., Big Indian, "Catskill Mts.", on *E. ageratoides*, C.H.Peck, Sep 1877 (NYS) also distributed as J.B.Ellis, North Amer. Fungi #384 (NYS), as F.de Thümen, Mycoth. Univ. 1114 (NYS) and in Clinton Herbarium sheet 44893 (BUF); Essex Co., Newcomb, on *E. purpureum*, H.D.House, 1115, 14 Sep 1925 (as *Dasyscypha leucostoma* Rehm) (NYS); Herkimer Co., swamp 1 mi S of Cedarville, on *Eupatorium maculatum*, 10 Sep 1970, Haines 1509, S.J.Smith & K.P.Dumont (NYS); Herkimer Co., cedar grove 1 mi S of Jordanville, on *Eupatorium maculatum*, 10 Sep 1970, Haines 1517, S.J.Smith & K.P.Dumont (NYS); Schuyler Co., Hendershot Gulf near Alpine, on *Eupatorium maculatum*, 19 Sep 1970, Haines 1551 on Peck Foray (NYS); Schuyler Co., Arnot Forest Camp SW of Ithaca, on *Eupatorium*, 20 Sep 1970, Haines 1563 on Peck Foray (NYS); W.R.Gerard (no collection data, but probably Poughkeepsie, New York ca. 1860) on *Eupatorium* sp. CUP-D 81-40 as *Peziza eupatorii* Schw.; USSR, Sakhalin Island, Kuznetsovo, 12 Sep 1979, A. Kollom (TAA 112768).

Discussion: Despite the fact that only a few collections of the fungus are known, it is a well known and well accepted taxon. The collection from Sakhalin Island, which was kinkly sent to the author by Dr. Raitviir, is geographically far removed from the other specimens known to the author, but it is identical in all other respects to the New York Material. The species has been described and illustrated by Peck (1873, 1878), Seaver (1951), Dennis (1963) and Raitviir (1973). Saccardo included it along with seven others in a new genus, *Solenopezia*. The genus was apparently based on the sessile nature of the fruiting bodies and their two-celled spores. Those characters are not enough to hold Saccardo's species together, but after Nannfeldt (1932) redefined the genus and lectotypified it with *S. solenia*, it has been accepted by most workers at least as a monotypic genus.

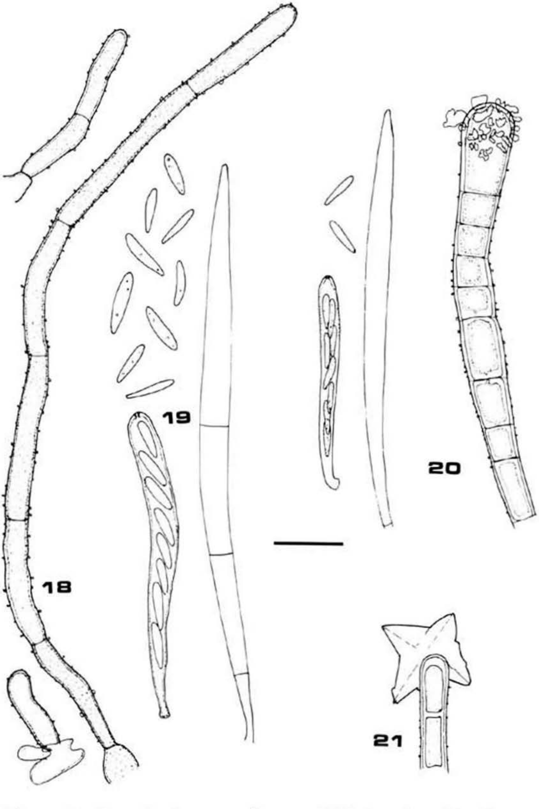
Calycella subochracea (Cooke & Peck) Dennis, Kew Bull. 17: 366. 1963.
Basionym: *Peziza subochracea* Cooke & Peck, Grevillea 1: 6. 1872 (as *Peziza* (Dasyscypha) *subochracea*).
=*Trichopeziza subochracea* (Cooke & Peck) Sacc.,

Syll. Fung. 8:408. 1889.
=Lachnella subochracea (Cooke & Peck) Seaver, N. Amer. Cup-fungi (inoperculates) p. 251. 1951.
=Dasyscyphus subochraceus (Cooke & Peck) Thind & Singh, J. Indian Bot. Soc. 40: 304. 1961.

Type: U.S.A., NY, "Adirondack Mts." on dead stems of Rubus odoratus, Aug., C. H. Peck (holotype K, sent from Peck to Cooke 25 Aug 1871 as #93; isotype NYS without number; duplicate sent to NY in 1935; also in CUP-D). The isotype collection at NYS contains about 20 sections of cane and several hundred apothecia in good, mature condition.

Discussion: The type of this species was reexamined and illustrated by Dennis (1963) and was found to be, not Hyaloscyphaceous, but a typical Calycella as that genus was interpereted at that time. Spooner (pers. comm.) has pointed out that this probably belongs in the genus Bisporella, but no transfer will be made at this time. Reports from India appear to be erroneous. The collection on which the first Indian report and transfer of the species to Dasyscyphus was based is not conspecific with the type and has subsequently been described as a new species of Dasyscyphus, D. thindii Sharma, Bibl. Mycol. 91: 115. 1983. [=Lachnum thindii (Sharma) Sharma]. Only two authentic collections are kown, the second, aside from the type, being another Peck gathering from Lower Ausable, Adirondack Mts., Jul (NYS).

Lachnum sulphurellum (Peck) Raitv., Folia Crypt. Estonica 20: 2. 1986. Figs. 20,21,27.
Basionym: Peziza sulphurella Peck, Annual Rep. New York State Mus.30: 59. Sep 1878 [as Peziza (Dasyscypha) sulphurella] .
=Atractobolus sulphurellus (Peck) O. Kuntze, Rev. Gen. Plant. 3: 445. 1898.
=Incrucipulum sulphurellum (Peck) Baral & Krieglesteiner, Beih. z. Mykol. 6: 72. 1985.
=Peziza crucifera Phill., Gard. Chron. N. S. 10: 378. Sep 28, 1878.
=Dasyscypha crucifera (Phill.) Sacc. Syll. Fung. 8: 440. 1889.
=Atractobolus cruciferus (Phill.) O. Kuntze, Rev. Gen. Plant. 3: 445. 1898.
=Lachnum cruciferum (Phill.) Nannf., Trans. Brit.



Figs. 18-21. *Lachnum myricacea* (Holotype). 18. Long and short hairs. 19. Ascus, ascospores and paraphysis. *Lachnum sulphurellum* (Holotype). 20. Ascus, ascospores, paraphysis and hair. 21. crystal.

Mycol. Soc. 20: 194. 1936.

Apothecia up to 0.4 mm diam., scattered on the substrate, shallow cup-shaped, covered with hairs, with flat, concolorous disc when mature and moist, closing to deep cup-shaped with disc mostly obscured by infolding margin when dry, pale yellow throughout when fresh, becoming white with an orange ochraceous disc when dried, stipitate. Stipe equal to diam. of disc, concolorous, covered with crystal-capped hairs which may be seen with a good quality hand lens. **Ectal Excipulum** hyaline <u>textura prismatica</u>, of slightly thick-walled, inflated brick-shaped or cuboid cells up to 9 X 12 µm. Individual cells are more distict when viewed in squash mounts than in most Hyaloscyphaceae. **Hairs** up to 120 µm long, usually 50-80 X 4-7 µm, cylindrical or slightly tapered toward the base, sometimes with swollen apex, rigid, straight, thick-walled with thick septa forming comparatively short cells 5-10 µm long, covered with very fine granules throughout or occasionally almost smooth, often capped with conspicuous, regular, flattened, easily crushed tetrahedral crystals ca. 10 µm across, which do not dissolve quickly in 3% KOH. Thinner-walled, strongly granulate hairs lacking crystals are also present in most specimens. **Asci** 30-35 X 3-4 µm, cylindrical with a short tapered base without conspicuous croziers and a hemispherical apex with a small pore plug which turns dark blue in IKI without KOH pretreatment, 8-spored. **Spores** (6-)7-8(-8.5) X 1.2-1.8 (-2.0) µm, narrowly fusiform, slightly larger in the upper portion, straight, non-septate. **Paraphyses** 3.0-5.5 by up to 30 µm longer than the asci in the hymenium, definitely lanceolate with sharp tips.

Type: U.S.A., New York, Adirondack region, Essex Co., dead stems of <u>Myrica gale</u>. From here there is a small descrepancy in the exact locality. Pecks' notebook for 1876 gives the locality as "Lake Jimmy", but the only original specimen which is labeled as the type gives "Lake Sallie" (an apparent misspelling of Lake Sally) as the locality. This is a minor point since the two lakes are less than a mile apart in Essex county in the central Adirondacks. Both lakes were listed in his collecting intinerary only once, and that was for August of 1876. The type collection is now in two portions with the same label information. It was common practise for Peck to split his larger collections into "herbarium material" and "study material" and most of the collections were reassembled by subsequent curators. The two portions will be treated here as the same collection. The portion in the packet contains Pecks original label and about 20 small twig fragments. The other portion, now in a later box with a later label, contains 7 larger stem fragments. Both collections contain numerous apothecia, but most of them are past maturity and do not revive well in microscopic preparations. Another small portion is in the Durand herbarium CUP-D, and there is a record of another portion being sent to Phillips.

Host: Twigs of _Myrica gale_ which retain their bark and leaves.

Range: Known from Canada, U.S.A., British Isles and Sweden. It is possibly throughout the range of its host.

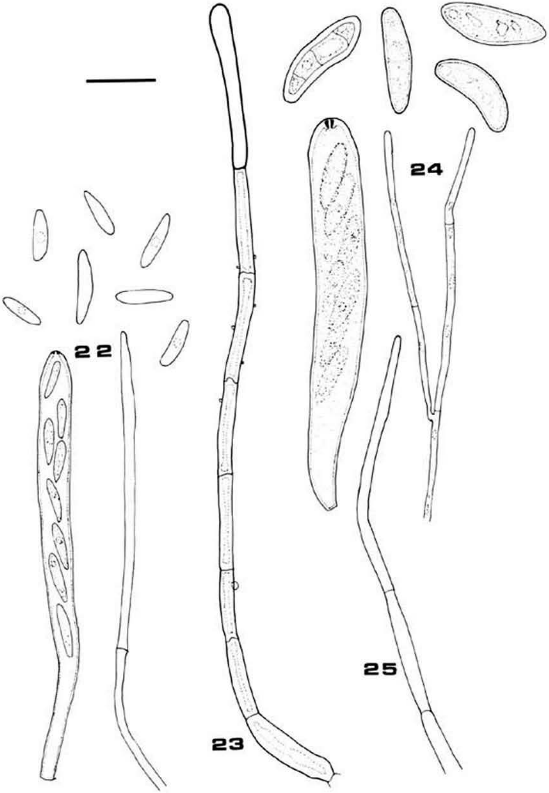
Specimens Examined: British Isles, North Wales, on _Myrica gale_, W.Phillips, (apparent isotype, NYS); U.S.A., NY, (see type); Warren Co., Bolton Landing, Skye Farm Camps, Sherman Pond, on _Myrica gale_, 25 Aug 1971, Haines 1829, S.J.Smith & G.Samuels (NYS); Warren Co., Pack Experimental Forest, on _Myrica gale_, 25 Sep 1971, Haines 1927, Peck Foray (NYS); Warren Co., Pack Experimental Forest, on _Myrica gale_, 6 Jul 1972 Haines 2288 & 2300 (NYS); Franklin Co., Lake Clear Girl Scout Camp, on _Myrica gale_, 15 Aug 1974 Haines 2720 & R.Fogel (NYS); Warren Co., Pack Experimental Forest, on _Myrica gale_, 22 Jun 1978, Haines 3317 (NYS); Hamilton Co., bog 1 mi S of Speculator, on _Myrica gale_, 2 Jul 1980, J.H. & Emily Haines 3490 (NYS); Warren Co., Pack Experimental Forest, on _Myrica gale_, 11 Sep 1982, Haines 3563 Peck Foray (NYS); Hamilton Co., town of Long Lake, Southern Raquette Lake, Silver Beach, on _Myrica gale_, 7 Sep 1986, Haines 3920 & 3934 Peck Foray (NYS); Franklin Co., near outlet of Stony Creek Pond, Corey's, on _Myrica gale_, 3 Jul 1988 Haines #4059 (NYS); same as preceeding but 18 Jul 1988 Haines #4070 (NYS); Essex Co., town of North Elba, W bank of Chubb River near the start of the Northville-Placid trail, on _Myrica gale_, 18 Jul 1988, Haines 4081 (NYS); Warren Co., Burnt Pond, elevation ca. 950 ft., on _Myrica gale_, 9 Jul 1971, S.J.Smith 46427, E.C.Ogden & P.Walker (NYS).

Discussion: This species is, so far, known only from _Myrica gale_ and is immediately recognizeable by its short-celled, thick-walled hairs tipped with tetrahedral crystals of calcium oxalate. It has some features in common with _Lachnum bicolor_, and the genus _Incrucipulum_ Baral is available for those who choose to recognize it as distinct from _Lachnum_.

The history of this taxon is confusing, and the puzzle of who published it first remains to this day. It was first collected by Peck, August 1876 and was included in his notebook and report for that year. The next mention of the species is another entry in his notebook when he included a specimen of "Peziza sulphurella Pk." in a package sent to William Phillips on January 23, 1877. A few months later in June 1878, Phillips collected the same species on the same substrate, Myrica gale, in North Wales but gave it a new name, Peziza (Dasyscypha) crucifera Phillips and sent a short note describing it as new to the Gardeners Chronicle, all while Peck's species was in the slow process of publication with his annual report. Peck's report was finally published sometime in September of 1878 (Petersen 1980), and Phillips note on September 28 of 1878. In all likelihood, Pecks Peziza sulphurella has priority and it will be treated that way here.

Dasyscyphella sulphuricolor (Peck), Haines, **comb. nov.**
Figs. 22,23.
Basionym: Dasyscypha sulphuricolor Peck, New York State Mus. Bull. 157: 25. 1912.
=Dasyscyphella cinnamomea Raitv. Eesti NSV Tead. Akad., Biol. 26: 31. 1977.

Apothecia up to 2.5 mm diam., scattered on substrate, shallow cup-shaped to salviform, short stipitate, covered with sulphur yellow hairs when fresh, becoming buff with dark adhering matter when dry, margins infolding when dry, but not so much as to cover the disc. Disc apricot-colored when dry. **Excipulum** textura angularis composed of thin-walled, inflated cells up to 10 X 25 µm. **Hairs** up to 125 µm long by 2.0-3.0 µm, of the "nivea" type, slightly enlarged, often refractive and smooth above, narrowed and coarsely granulate in the middle and wider, septate and fine granulate at the base, hyaline but exuding a faint vinaceous pigment in 3% KOH. **Asci** 55-75 X 4.5-5.5 µm, cylindrical, with slightly tapered base lacking conspicuous croziers and a hemispherical apex with a pore. **Spores** (8-) 9-11 (-12.5) X 2.0-2.8 µm, fusiform-ellipsoid, curved, occasionally 1-septate, often slightly thick-walled. **Paraphyses** definitely filiform with rounded tips, 1.5-2.5 µm diam., not superceeding the asci in length, occasionally branched.



Figs. 22-25. Dasyscyphella sulphuricolor (Holotype). 22. Ascus, ascospores and paraphysis. 23. Hair. Amicodisca viridicoma (Holotype). 24. Ascus, ascospores and paraphysis. 25. Hair.

Type: U.S.A., New York, Oneida Co., Remsen, on decaying wood of black ash, Fraxinus nigra Marsh., Aug. 1911, C. H. Peck (holotype NYS). The holotype collection consists of ca 20 carved off chips of wood, and more than 200 mature apothecia, many of which are dislodged and lying loose in the box.

Host: Fraxinus, and possibly other partially decayed hardwoods. In the specimens examined by the author, the wood is decorticated and decayed away in cavities with sound wood underneath.

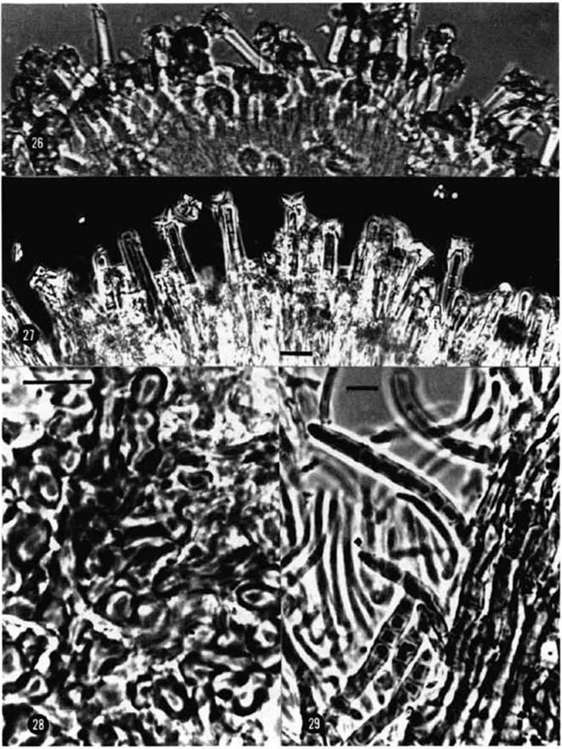
Range: So far, known only from New York and Pennsylvania.

Specimens Examined: U.S.A., New York, (see type); Pennsylvania, West Chester, E.H.J.& G. #390 (holotype of Dasyscyphella cinnamomea NY; isotype CUP-D).

Discussion: This large species of Dasyscyphella is distinguished by its yellow color when fresh which turns grey-buff with adhering dark resin particles when dry, comparatively large spores and asci and filiform paraphyses. Examination of the type of the recently described D. cinnamomea Raitv. has shown the two to be identical. It differs from D. dryina (Karst.) Raitv. in its shorter stipe, stouter cup and in having dark resin granules adhering to the hairs when dry, and from D. nivea in its larger spores and total lack of yellow-orange pigment when dry.

Lachnella tiliae (Peck) Donk apud Singer, Lilloa 22: 245. 1951.
Basionym: Peziza tiliae Peck, Annual Rep. New York State Mus. 24: 96. 1872.
=Trichopeziza tiliae (Peck) Sacc., Syll. Fung. 8: 428. 1889.
=Cyphella tiliae (Peck) Cooke, Grevillea 20: 9. 1891.

As M. C. Cooke pointed out, this fungus is not a discomycete as Peck thought, but a basidiomycete. Peck did not describe any microscopic details, but he compared the fungus to Peziza bicolor. It is fully described and illustrated by Reid (1963). It is, perhaps, ironic that Peck made the same mistake on the very same page of his annual report when he described a new genus and species,



Figs. 26-29. 26. *Lachnum capitatum*, holotype, apothecial margin with hairs tipped with irregular crystal masses. 27. *Lachnum sulphurellum*, JHH 4081, apothecial margin with hairs tipped with tetrahedral crystals. 28. *Perrotia distincta*, holotype, excipular surface. 29. *Solenopezia solenia*, holotype, excipular surface with hairs. Bar equals 10µm.

Nodularia balsamicola, with asci when his specimen was referable to the basidiomycete genus *Aleurodiscus*. The holotype of *Peziza tiliae* is at NYS and is labeled as being collected in Knowersville. Knowersville is a small town West of Albany, NY now known as Altamont and despite the fact that it is described as being in the Helderberg Mountains, it is at a relatively low elevation. There is a record of a duplicate collection being sent to M. C. Cooke as specimen #366 on 28 Jan 1875.

Cistella grevillei (Berk.) P. Raschle, Nova Hedwigia 30: 659. 1978.
Basionym: *Peziza grevillei* Berk., Engl. Flora 5(II): 198. 1837.
=*Peziza urticina* Peck, Annual Rep. New York State Mus. 32: 46. 1880.

Apothecia up to .4 mm diam., cup-shaped, becoming spherical with the disc completely obscured by the infolding margin when dry, narrowed to a small base, exterior of cup partially covered with hairs which appear as white meally patches, faint, vertical striations appear with shrinkage on some dried specimens, whitish when fresh, darkening to yellow-buff when dry. **Excipulum** distinct, thin-walled, hyaline *textura angularis*. **Hairs** up to 40 μm long by 3-7 μm, clavate, with enlarged apical cell, thin-walled, 1-3 septate, roughened with fine granulations on the apical cell only. **Asci** 45-50 X 4.5-5.5 μm, cylindrical with a short, tapered base often subtended by a crozier, and a slightly tapered apex with a minute but distinct pore, 8-spored. **Spores** 11.0- 12.5 X 2.0-2.5 μm, elongate-ellipsoid, non-septate, hyaline. **Paraphyses** almost cylindrical with a slightly lanceolate, blunt tip up to 2.0 μm wide and up to 10 μm longer than the asci in the hymenium.

Type: U.S.A., New York, Catskill Mountains, probably Ulster County as that is the only Catskill county mentioned in list of counties Peck visited in 1878, dead stems of nettle, *Urtica canadensis* [=*Laportea canadensis* (L.) Gaud. ex Freyc.], Jul 1878, C. H. Peck (NYS); Isotype at CUP-D. There is a record of a portion being sent to NY in 1935. The holotype collection consists of ca 30 pcs of herbaceous stem. In total there are several hundreds of apothecia.

Host: Usually found on Umbelliferae and Urticaceae, known from *Heracleum*; *Urtica*; *Laportea*; also *Adenostyles*.

Range: Common in Europe, Western U.S.A., also reported from India, Middle Asia and Canada, rare in the Eastern U.S.A.

Specimens Examined: U.S.A., New York, (see type); Washington, Gray's Harbor Co., Gray's Harbor City, on Heracleum lanatum 12 June 1966 JHH 395 (NYS); King Co., Seattle, Denny Park, on Urtica lyallii 17 May 1967 JHH 476.

Discussion: Peck's P. urticina is a later synonym for Berkeley's P. grevillei, a species which is apparently rare in the Eastern U.S.A. Peck's specimen is the only one I have seen from that region. It is distinquished from other discomycetes on herbaceous stems by its watery, light grey appearance when fresh and its short, granulate hairs. The generic disposition of this species has been difficult. It has most of the characters of Lachnum, but in a reduced form. Its stipe is reduced to a narrow point of attachment, its paraphyses are nearly cylindrical but retain a blunt lanceolate tip and its hairs are short, clavate and rough only in the apical cell. It fits in Cistella when that genus is accepted in the broad sense, but if Clavidisculum is accepted as distinct it can be placed there.

Amicodisca viridicoma (Peck) Haines **comb. nov.** Figs. 24,25.

Basionym: Peziza viridicoma Peck, Annual Rep. New York State Mus. 31: 46. 1879. [As Peziza (Dasyscyphae) viridicoma] =Lachnella viridicoma (Peck) Seaver, North American cup-fungi, p. 267. 1951.

=Trichopeziza viridicoma (Peck) Sacc., Syll. fung. 8: 414. 1889.

Apothecia up to .4 mm in diam., scattered to gregarious on undifferentiated, decorticated wood surfaces, shallow to deep cup-shaped, sessile, externally black, covered, with greenish-yellow hairs which become olive-brown when dried, releasing faint olive yellow pigment in KOH. **Excipulum** of hyaline, yellowish or slightly olivaceous textura prismatica to angularis, composed of thin-walled cells up to 12 µm in the greatest dimension. **Hairs** up to 100 µm long by 2.0-3.5 µm in diam at the base tapering to about 1 µm at the tip, straight, thin-walled, hyaline or yellowish, septate, smooth or with a few loosely attached granules, **Asci** 55-65(-75) X 7.5-11(-14)µm, clavate-cylindrical with a narrow base lacking croziers and a conical apex containing a large, conspicuous J+ pore ca. 1.5 µm in diam., 8-spored. **Spores** 12-16(-17.5) X 3-5 µm, clavate-ellipsoid, curved, occasionally 1-3-septate, usually with two large refractive inclusions, turning greenish brown with age after release from the ascus. **Paraphyses** filiform, 1.0-1.5 µm in diam., not superceeding the asci in length, occasionally branched, hyaline, very thin-walled, flexuous.

Type: U.S.A., New York, Rensselaer Co., Town of Sandlake, on unidentified, partially decayed wood, August (no year recorded), C.H.Peck (NYS) holotype; Portion of type at CUP-D. The holotype consists of 3 pcs of decayed wood attached to small portions of herbarium sheet. Only the largest of the three now has any obvious fungus material. It has about 50 apothecia.

Hosts: On partially decayed wood of Betula, Alnus rugosa and unidentified hardwoods.

Range: Known from the Northeastern U.S. and Japan. It is probably much more widespread but it has not been recognized or collected from elsewhere.

Specimens examined: U.S.A., New York (see type); Rensselaer Co., Grafton State Park, on Betula, 12 Jun 1980, Haines #3438 (NYS); Hamilton Co., Adirondack region, town of Long Lake, Raquette Lake, Camp Pine Knot, on Alnus rugosa, 28 Jul 1987, Haines #3967, T.Baroni & mycology class (NYS); JAPAN, Honshu, Gumma Pref., along the North shore of Lake Marunima, on decorticated log, R. P. Korf, Fungi of Japan, 7 Oct 1957 (CUP).

Discussion: This pretty little discomycete is distinquished by its yellow-green hairs, dark exciple, large asci and spores and narrow paraphyses. It has rarely been collected and has apparently not been redescribed since its original publication in 1877. Until the recent publication of Amicodisca by Svrcek (1987) there seemed to be no genus in which this species fitted comfortably.

Acknowledgments

The author wishes to give heartfelt thanks to Dr. Brian Spooner, Dr. Ain Raitviir and Prof. Richard P. Korf for their careful and thoughtful reviews and comments, and each of whom prevented me from making foolish errors, and to Dr. Gordon C. Tucker for his technical assistance with the preparation of the manuscript. The author also wishes to thank the curators of CUP, NY and BR for the loan of specimens that made the comparative part of this study possible.

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MYCOTAXON

Vol. XXXV, No. 2, pp. 353-356 July-September 1989

A NEW TRICHOCLADIUM ISOLATED FROM SUBMERGED WOOD TEST BLOCKS IN A FRESHWATER STREAM

by

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Summary: Trichocladium angelicum, a new dematiaceous hyphomycetes, is described in pure culture from submerged wood test blocks in a freshwater stream. Differences between T. angelicum and T. achrasporum are discussed.

Trichocladium angelicum sp. nov. (Figs. 1-2)

Coloniae supra agarum maltosum (1%) atrae, compactae, lentissime crescentes, restrictae; mycelium aerium sparsum, gossypinum, griseum; chlamydosporae brunneae, 7-12 µm in diam., catenatae vel irregulariter aggregatae. **Sporulatio** atypica in culturis agarosis, sed typica in culturis subaquaticis, post 5-6 dies, sub vel summa aqua. **Conidiophora** ex hyphis vetustis vel novis ecrescentia, subhyalina usque ad griseo-brunnea, micro- usque ad semimacronematosa et mononematosa, apicalia vel lateralia, usque ad 75 x 3.5-5.5 µm. **Cellulae conidiogenae** apicales vel laterales, mono- vel polyblasticae, 4-17 x 2.5-5.5 µm. **Conidia** solitaria, raro bina, acrogena, raro pleurogena, crassitunicata, glabra; cellula basalis hyalina, obconico-truncata, 3-12 x 2.5-4.5 µm; cellula ceterae (3-5) inflatae, subhyalinae et vacuolatae, typice auctae ad apicem versus; cellula apicalis globosa vel ellipsoidea; conidia (cum cellula basali) 25-47 x 7.5-12 µm. Disjunctio rhexolytica. Germinatio in agaro maltoso cum antibioticis tardissima, filamentum germinale e base conidii ecrescens, sed saepe mox periit.

Etym: named in grateful honour of Dr. Mª Angeles Puig, of this University.

Colony (1% MA) black, compact, growth restricted and very slow (0.8 cm diam./3 months), aerial mycelium sparse, cottony, greyish, chlamydospores brown, 7-12 µm diam., catenate or in irregular groups. **Sporulation** atypical on agar, but abundant and typical when colony pieces are submerged in sterile distilled standing water for 5-6 days, underwater and at the surface. **Conidiophores** directly on old hyphae on the cut surfaces or on new fast-growing hyphae, subhyaline to greyish-brown, micro- to semimacronematous and then mononematous, apical or lateral, up to 75 x 3.5-5.5

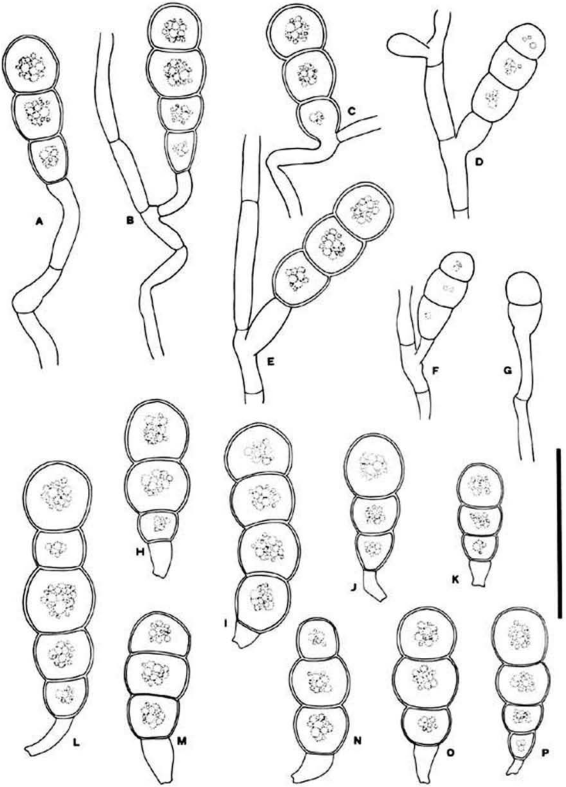

Fig. 1.- Trichocladium angelicum in pure culture (holotype). A-G, conidiophores. H-P, detached conidia. Bar = 30 µm.

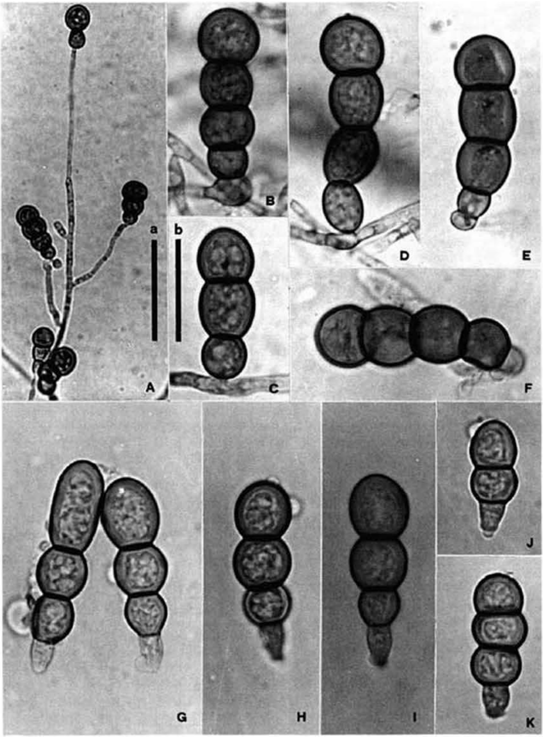

Fig. 2.- Trichocladium angelicum. A-F, conidiophores and detached conidia from pure culture (holotype). G-K, detached conidia on naturally colonized wood. (Lactofuchsin mounts). A, according to scale "a" = 50 µm. Rest, according to scale "b" = 20 µm.

µm. **Conidiogenous cells** apical or lateral, mono- or polyblastic, 4-17 x 2.5-5.5 µm. **Conidia** solitary, rarely paired, acrogenous, rarely pleurogenous, walls thick and smooth, basal cell (remains of separating cell) hyaline, obconico-truncate, 3-12 x 2.5-4.5 µm; the remaining 3-5 cells swollen, subhyaline and highly vacuolate, typically larger towards the apex, apical cell regularly globose to ellipsoid; conidia (including basal cell) 25-47 x 7.5-12 µm. **Secession** rhexolytic. **Germination** after failing or on malt-agar with antibiotics very slow, germ tube basal, growing through scar, reaching 75 µm in 5 days, then often interrupting growth.

Type: monoconidial isolate from submerged *Populus* wood for six months in the River Vinalopó (Bañeres, Alicante, Spain), A. Roldán, March 1988 (MA FUNGI 21517) holotype ex MUB: AR 9875 isotype.

Although repeatedly isolated, only one culture was established, due to poor conidial germination. Both conidiogenesis and conidial morphology of this fungus fit those of *Trichocladium* Harz. The nearest species is *Trichocladium achrasporum* (Meyers & Moore) Dixon in Shearer & Crane (1971), a marine fungus first described as *Culcitalna achraspora* Meyers & Moore (1960), which produces sporodochia on wood. Kohlmeyer & Kohlmeyer (1979) accept its reallocation in *Trichocladium* because the degree of conidiophore aggregation is not quite that of a sporodochium. They describe the conidia as obpyriform and strongly pigmented. Ellis (1976) retains *Culcitalna* Meyers & Moore and illustrates conidia similar to ours, but much darker. Its teleomorph is the marine ascomycete *Halosphaeria mediosetigera* Cribb & Cribb (Shearer & Crane, 1977).

Trichocladium angelicum differs from *T. achrasporum* in having longer conidia (which are pyriform in the latter), with strong septal constrictions and lacking dark pigmentation. Furthermore, the two fungi are known from very different habitats, the type locality of *T. angelicum* being a hard water mountain stream (800 msm.).

We should like to thank Dr. E. Descals for English translation and Dr. L. Marvanová for kindly providing the latin diagnosis. We are also indebted to Dr. P.M. Kirk for his comments on the identity of *T. angelicum*.

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MYCOTAXON

Vol. XXXV, No. 2, pp. 357-361 July-September 1989

SCUTELLOSPORA SCUTATA SP. NOV., A NEWLY DESCRIBED ENDOMYCORRHIZAL FUNGUS FROM BRAZIL

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SUMMARY

A new species in the genus *Scutellospora* is described and illustrated. The fungus was isolated from Cerradão xeromorphic forest in Brazil, and has formed mycorrhizas with arbuscules and hyphal coils, but without vesicles, in pot culture with corn, sorghum, *Cajanus*, and *Brachiaria*.

INTRODUCTION

Investigations into the Endogonaceae of the Cerrado Region of Brazil have been carried out in order to isolate mycorrhizal fungi that may be useful in tropical agricultural systems by increasing nutrient uptake of crop plants (Diederichs, unpublished). Among spores found in soil samples collected from the root zone of wild pineapple, *Ananus comosus* (L.) Merr., was an undescribed member of the genus *Scutellospora*, which was successfully established in pot culture with *Zea mays* L., *Cajanus cajan* (L.) Millsp., *Sorghum bicolor* (L.) Moench., and *Brachiaria decumbens* (Stapf.). The species has unusually large spores and a prominent germination shield. Because of the latter feature, it is given the name *Scutellospora scutata* sp. nov. Descriptions of color (Anon. 1969) are from fresh spores immersed in water and viewed with tungsten lighting under a dissecting microscope at up to 50X magnification. Other details are described from spores mounted under a compound microscope at magnifications of up to 2000X with bright field illumination or Nomarski differential interference contrast. Wall structure descriptions follow the standardizations of Walker (1983, 1986) and Morton (1986).

SCUTELLOSPORA SCUTATA Walker et Diederichs sp. nov. (Figures 1 & 2)

Sporae in solo singillatim lateraliter vel raro terminaliter in cellula brunnea bulbiforme suspensoriforme efformatae, globosae, subglobosae vel raro ovoideae, 350-667 x 350-713 µm, juventute hyalinae at que diaphanae, postea opaceae, sordidae albidae vel olivaceo-bubalinae.

Tunica sporarum sex in turmis duabus (A et B) vel tribus (A, B et C). Turma A tunica 1 externa, hyalina, laevi, 0.2-0.8 µm crassa, ad tunicam 2 interiorum sordide albidam vel olivaceo-bubalinam, 3.4-16.7 µm crassam arcte adherenti. Ubi tunicae sporarum in turmis duabus, turma B tunicis quator (3-6); tunica 3 coriacea, 2.3-8.4 µm crassa, cum tunica 4 tenui, membranacea, 0.2-0.8 µm crassa laxe consociata; tunica 5 coriacea, 2.2-8.2 µm crassa, ad tunicam 6 amorpham, 0.2-0.5 µm crassam arcte adhaerens. Ubi tunicae sporarum in turmis tribus, turma B tunicis 3 (coriacea) et 4 (membranacea), turma C tunicis 5 (coriacea) et 6 (amorpha).

Scutum germinationis complexum, ovale vel cordatum, castaneum, multilobatum, 240-323 x 208-302 µm. Cellula suspensoriformis 92-125 x 47-100 µm. Cellulae auxiliares porphyriae, laeves vel nodosae, 17-55 x 15-45 µm, 4-25 arcte fasciculatae in hypha tortuosa, brunnea, 5-12.5 µm crassa.

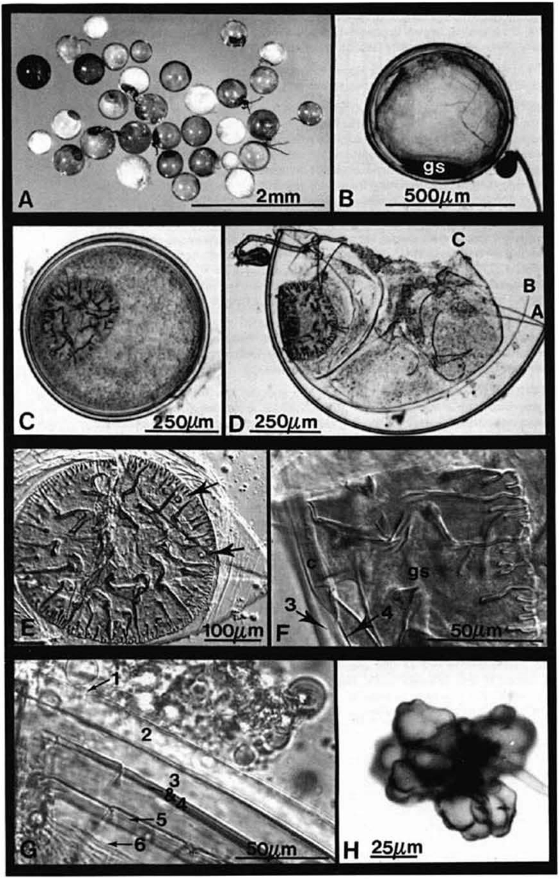
SPORES borne singly in the soil laterally (rarely subterminally) on a brown pyriform suspensor-like cell, globose to subglobose (rarely ovoid), 350-667 x 350-713 µm [mean (n = 53) 532 x 530 µm,] hyaline and transparent with vacuolar contents when young, later becoming opaque, dirty white to olivaceous buff.

Spore wall structure (Fig. 2) of six walls (1-6) in two or three groups (A & B or A, B & C). *Group A* with a hyaline, smooth, outermost unit wall (1), 0.2-0.8 µm thick, tightly adherent to a dirty-white to olivaceous buff laminated wall (2), 3.4-16.7 µm thick. When in two groups, *Group B* consisting of four walls (3-6). Wall 3 coriaceous, 2.3-8.4 µm thick, loosely associated with a thin membranous wall (4), 0.2-0.8 µm thick. Wall 5, coriaceous, 2.2-8.2 µm thick tightly adherent to an amorphous wall (6), 0.2-0.5 µm thick when not heavily crushed in an acidic mountant. When in three groups, *Group B* of the loosely associated walls 3 (coriaceous) and 4 (membranous) and *Group C* of the tightly adherent walls 5 (coriaceous) and 6 (amorphous).

Germination shield complex, circular to oval or heart-shaped, chestnut-brown, multi-lobed, 240-323 x 208-302 µm, present in wall Group B of almost all mature spores. Germination shield in lateral view appearing to form compartments between wall groups.

Suspensor-like cell (92-125 x 47-100) µm) produced terminally on an often recurved, sparsely septate, brown subtending hypha up to 400 µm long; wall of suspensor-like cell 1-5 µm thick distally, thickening to 3-12 µm near the spore base; bearing one or more stout, peg-like hyphal protrusions 2.5-17.5 µm long and 2.5-15 µm broad.

Figure 1 *Scutellospora scutata*. A. Intact spores at low magnification. The conspicuous germination shields are evident on most specimens. B. An intact spore showing germination shields (gs) in side view. The spore is attached laterally to the suspensor-like cell in this specimen. C. In this specimen, which has lost its suspensor-like cell, the germination shield can be seen at the left. D. The three wall groups (A, B and C) can be distinguished in this crushed spore. E. Plan view of the germination shield on wall 6, illustrating the complex infolding at the edges. Several germ tube initials can be seen, two of which are arrowed. F. Details of a germination shield (gs) showing walls 4, 5 and 6 (numbered). The appearance in lateral view where the shield curves around the perimeter of the spore gives the impression of compartmentalization (Hall 1977). G. Detail of the six walls revealed by crushing the spores. Walls 3 and 4 are tightly adherent and cannot be distinguished individually at this magnification. H. A cluster of the auxiliary cells produced by this fungus.


A
2mm
B
gs
500μm
C
250μm
D
250μm
C
B
A
E
100μm
F
c
gs
3
4
50μm
G
1
2
3
& 4
5
6
50μm
H
25μm

Auxiliary cells formed in the soil, red-brown, 17-55 x 15-45 µm, borne in tight clusters of 4-25 on coiled, brown hyphae 5-12.5 µm wide; smooth to knobby. Forming endogonaceous endomycorrhizae with arbuscules.

ETYMOLOGY: Latin, *Scutata*, armed with a shield. Referring to the prominent brown germination shield present on spores in this species.

DISTRIBUTION AND HABITAT: known from the root zone of *Ananus comosus* in the Ecological Area of the Cerradão Forest, Centro de Pesquisa Agropecuaria dos Cerrados (CPAC), Brasilia DF, Brazil. The soil type covering about 11 per cent of the Cerrado ecosystem is a dark red latosol (Haplustox) (Goedert & Lobato 1980). The vegetation of the Cerrado ecosystem can be defined as subhumid wooded savanna, although there is large variation from pure grassland to closed tree canopy (Eiten 1972). The latter is called 'Cerradão' in Brazil.

The vegetation is closely related to soil characteristics, for example some native tree species are able to grow despite the accumulation of large amounts of aluminum in their leaves (Haridasan 1982). The topsoil is up to 20 cm deep, with pH (KCl) 4 (pH in water, 4.5), organic content 1.8-2.5 per cent, extractable P 1.0 mg kg^{-1}, and exchangeable Al, Ca, Mg, and K of 1.45, 0.53, 0.15, and 0.10 mg kg^{-1}, respectively. The soil has a very high Al saturation of 67 per cent, a free Fe_2O_3 content of 9.6 per cent, and a clay content (<2 µm) of 60 per cent.

Scutellospora scutata is associated in the field with *Gigaspora gigantea* (Nicol. & Gerd.) Gerd. & Trappe, *S. verrucosa* (Koske & Walker) Walker & Sanders, *Entrophospora* spp., *Glomus* spp. and *Acaulospora* spp.

MYCORRHIZAL ASSOCIATIONS: the species has formed arbuscular mycorrhizae with *Z. mays*, *S. bicolor*, *C. cajan*, and *B. decumbens* in pot culture. It is found in the field with endogonaceously endomycorrhizal *A. comosus* and associated tropical vegetation.

COLLECTIONS EXAMINED: HOLOTYPE: BRAZIL - Centro de Pesquisa Agropecuaria dos Cerrados. Walker 997 (OSC, isotypes FH, K). From pot culture with *Zea mays*. Field collections of spores from the Cerrado Region have also been examined.

DISCUSSION

This species can be distinguished from all other members of the genus by the combination of the large size, color, smooth outer wall, and prominent brown germination shields of its spores. The only other described species with spores of similar size and possessing a similar germination shield, is *S. nigra* (Redhead) Walker & Sanders, a species with dark brown to black spores which have an outer wall pitted by rounded pores (Nicolson & Schenck 1979, Koske, Miller & Walker 1983).

The suspensor-like cell of this species readily becomes detached during spore extraction to leave a sessile spore. Under such circumstances, the spores could be misidentified as belonging to a species of *Acaulospora*. Great care should therefore be taken when examining collections of this or similar species in the genera *Gigaspora* or *Scutellospora*.

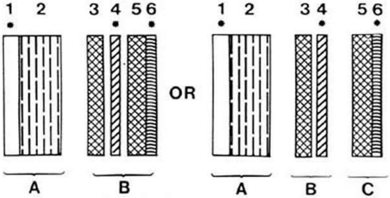


Figure 2. Murograph (after Walker 1983) of *Scutellospora scutata*. Unit walls are unshaded. Shading is by vertical alternating dashed lines for laminated walls, 45° hatching in one direction for the membranous wall, 45° hatching in both directions for the coriaceous walls. The amorphous wall is indicated by segments of parallel circles. Walls marked with an asterisk can be difficult to see.

ACKNOWLEDGMENTS

We wish to thank Dr. J. M. Trappe, Oregon State University, and Dr. J. B. Morton, West Virginia University, for reviewing the manuscript. Dr Trappe kindly prepared the Latin diagnosis. Thanks are also due to S. Swan (Forestry Commission) for typing the manuscript and L. Hanson (Forestry Commission) for typesetting the camera-ready copy.

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MYCOTAXON

Vol. XXXV, No. 2, pp. 363-369 July-September 1989

AMANITA RISTICHII: A NEW SPECIES FROM NEW ENGLAND WITH BASIDIA DOMINANTLY 2-SPORED

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Summary

Amanita ristichii is described as new from southern Maine and New Hampshire. Worldwide, this is the fourth taxon of section *Vaginatae* to be described as having dominantly bisterigmate basidia. Two other species (*A. pachysperma* Atkinson and *A. virginiana* (Murrill) Murrill) were also described from the eastern United States. *Amanita submembranacea* var. *bispora* Reid was described from the United Kingdom.

Amanita ristichii Tulloss sp. nov. Holotypus: Maine, Oxford Co., Oxford, T. Herman 7-15-85-SSR1 (NY).[1]

Etymology: Named in honor of Dr. Samuel S. Ristich, Cumberland Center, Maine—entomologist, mycologist, lover of nature, and enthusiastic teacher.

Pileus albus, impolitus, 25 - 64 *mm in mensura diametrica; margine striata, nonappendiculata; materies volvica absentes. Lamellae condensae, in massa albae vel roseae; lamellulae abundantes. Stipes* 37 - 89 × 3 - 9 *mm, albus; annulus superus vel subsuperus, tenuis, albus, interdum evanescens; volva membranacea, alba,* 12 - 25 *alta, interdum limbis acutis. Dimidium vel duo trientes basidiarum bisterigmaticarum; fibulae praesentes. Sporae:* (9.2-) 10.2 - 14.2 (-17.0) × (6.6-) 7.0 - 9.0 (-12.8) *µm, subellipsoideae vel ellipsoideae vel elongatae, nonamyloideae.*

Belonging to section *Vaginatae*, *Amanita ristichii* (Fig. 1) is a rather small, delicate, white mushroom with a slender stipe exhibiting a superior to subsuperior annulus. The pileus usually has no remnants of the universal veil upon it and has a striate, nonappendiculate margin. The stipe base is contained by a saccate, persistent, membranous universal veil which is separated into several lobes. The lamellae are usually quite notably pinkish or pale orangish, although in one of six specimens

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[1]
FH - Farlow Library and Herbarium, Harvard University, Cambridge, Massachusetts, U.S.A.
NY - Herbarium of The New York Botanical Garden, Bronx, U.S.A.

All collections with no herbarium location cited are in the author's private herbarium. The author's collection numbers are composed of three numbers (month, day, year) and a string of characters which serve to distinguish fungi collected on a given day.

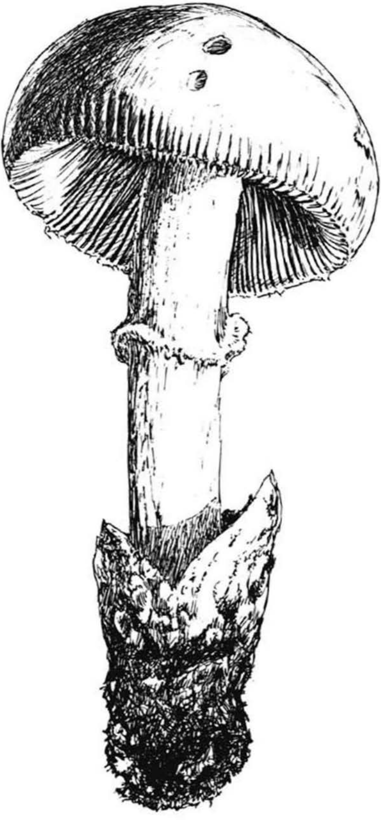

Fig. 1 *Amanita ristichii*. S. S. Ristich 7-11-84-SSR1 [×3].

examined, they were whitish. The microscopic characters that are particularly notable are the dominantly bisterigmate basidia and the rather large spores. At present, the taxon is known only from the southern parts of the states of Maine and New Hampshire, U.S.A.

PILEUS: 25 - 64 mm diam, hemispheric at first, becoming convex then planoconvex, sometimes with slight umbo, white, surface dull to slightly shiny, subviscid; margin striate (.2R - .3R), nonappendiculate; context whitish, 3± mm thick at stipe; lacking remnants of universal veil. LAMELLAE: close, about 3 mm or more broad, free to narrowly adnate, pinkish or (occasionally) whitish in mass, drying pinkish to pale orange ($5A3^2$ or $5YR\ 8/4^3$), occasionally anastomosing; lamellulae plentiful, subtruncate. STIPE: 37 - 89 × 3 - 9 mm, narrowing upwards, white, browning from handling, longitudinally striate, pulverulent above annulus, somewhat fibrillose below; context whitish, hollow with some cottony stuffing in 1 - 2 mm diam central cylinder; partial veil superior to subsuperior, white, delicate, finely striate above, sometimes disappearing or, if not, becoming appressed to stipe and browning at margin in age; universal veil membranous, persistent, saccate, breaking into several, sometimes pointed limbs about 1 mm thick, white to whitish, flaring in upper one-half to two-thirds or collapsed against the stipe, with tallest limb reaching 12 - 25 mm from stipe base; limbus internus positioned in upper third of interior surface of limb. Odor and taste not recorded.

PILEIPELLIS: 50 - 60 μm thick, composed of undifferentiated, filamentous hyphae and occasional oleiferous hyphae (sometimes in fascicles) randomly to subradially arranged, interweaving, gelatinizing throughout, but especially strongly in upper 10 μm; penetrated in lower portion by upturned tips of hyphae (filamentous or inflated) from pileus trama. PILEUS CONTEXT: a tangle of interwoven, branching, undifferentiated, filamentous hyphae <1 - 10.8 μm diam; slightly inflated hyphae to 19.6 μm diam; occasional oleiferous hyphae 1.7 - 4.5 μm diam; inflated cells to 135 × 45.5 μm, elongate clavate to bacilliform, somewhat difficult to reinflate. LAMELLA TRAMA: bilateral; branching undifferentiated filamentous hyphae 1.5 - 5.6 μm diam; somewhat inflated hyphae to 14.7 μm diam, with occasional, conspicuous clamps; inflated cells to 115 × 26 μm in chains; branching, oleiferous hyphae present 2.5 - 13.3 μm diam. SUBHYMENIUM: small cellular, subglobose to pyriform elements in short chains clustered at the end of the broadest diam hyphae which arise in the central stratum. BASIDIA: 42.5 - 60 × 8.5 - 12.5 μm, clavate to narrowly clavate, about half to two-thirds 2-spored, also 1-, 3-, and 4-spored, a number aborted or stunted (measurements of such not included in dimensions cited), thin-walled, apparently rapidly collapsing after release of spores; some basidioles branching; sterigmata to 3.5 μm long; clamps frequent. UNIVERSAL VEIL: throughout dominated by sublongitudinally oriented hyphae; outer surface consisting of interwoven to sublongitudinally arranged branching undifferentiated filamentous hyphae 1.7 - 5.6 μm diam, gelatinizing; inner surface composed of longitudinally oriented hyphae to 14 μm

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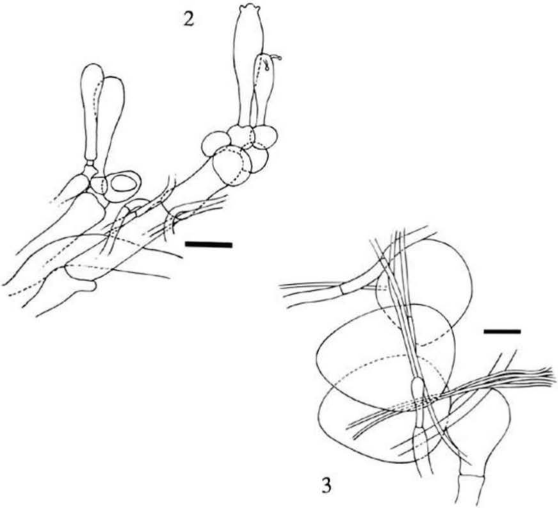
[2] This color code is from Kornerup & Wanscher (1978).

[3] This color code is from Munsell Color (1975).

diam in a rather easily separable layer, less than five hyphal diams thick, somewhat gelatinizing; inflated cells confined to interior, terminal, broadly ellipsoid to cylindrical, up to 77 × 63 µm; oleiferous hyphae throughout 4.9 - 7.7 µm diam; tissues densest on inner and outer surfaces, else rather uniform in cross-sectional mount; in some specimens, all tissues somewhat difficult to reinflate except oleiferous hyphae. STIPE CONTEXT: acrophysalidic; branching, filamentous, undifferentiated hyphae, 1.0 - 4.2 µm diam; acrophysalides narrow elongate to 400 × 42 µm; oleiferous hyphae present 3.5 - 8.4 µm diam. PARTIAL VEIL: dominated by branching undifferentiated filamentous hyphae 1.4 - 7.7 µm diam, partially gelatinizing and difficult to reinflate; branching oleiferous hyphae 2.1 - 5.9 µm diam, densely tangled locally; inflated cells difficult to reinflate, apparently subglobose to broadly ellipsoid to ovoid to elongate to clavate, up to 81 × 49 µm. All tissues pale yellow in NH_4OH.



Figs. 2-3 *Amanita ristichii*. 2. Portion of hymenium and subhymenium of holotype. 3. Internal layer of universal veil from stipe base of holotype. The bars in Figs. 2 & 3 represent 20 µm.

BASIDIOSPORES: [165 measured from 6 specimens] (9.2-) 10.2 - 14.2 (-17.0) × (6.6-) 7.0 - 9.0 (-12.8) µm, (average length per specimen = 11.5 - 12.4 µm; average length (overall) = 12.1 µm; average breadth per specimen = 7.8 - 8.5 µm; average breadth (overall) = 8.1 µm; Q = (1.22-) 1.33 - 1.70 (-1.84); average Q per specimen = 1.42 - 1.57; average Q (overall) = 1.50), inamyloid, thin-walled, hyaline, broadly ellipsoid to ellipsoid to elongate, occasionally expanded at or near one end; contents guttulate; apiculus sublateral, cylindric, 1 µm diam; white in deposit.

Habitat and distribution: Known only from southern Maine and New Hampshire. Found in July in sandy soil, solitary. In Maine, collections were made under *Tsuga canadensis* (L.) Carr. and *Acer rubrum* L. in the flood plain of a river or under *T. canadensis* and *Pinus strobus* L. as dominant trees in mixed woods. The New Hampshire collection was made under *Pinus sp.*

Collections examined: **UNITED STATES OF AMERICA**, MAINE, Androscoggin County, Sabbatus, S. S. Ristich 7-23-84-SSRA; Cumberland County, Windham, flood plain of Pleasant River, S. S. Ristich 7-11-84-SSR1, 7-13-88-SSRA, 7-13-88-SSRB, 7-30-88-SSR1; Oxford County, Oxford, T. Herman 7-15-85-SSR1 (holotype, NY); NEW HAMPSHIRE, Carroll Co., Chocorua, 28.vii.1906 L. C. C. Krieger Kr. 224 (FH).

DISCUSSION

After examination of the literature regarding 113 taxa belonging to *Amanita* section *Vaginatae*, I have found only one reference to a taxon described from outside of North America having basidia dominantly bisterigmate. Worldwide, I found a total of 56 species described in the literature as having 4-spored basidia; 3 (three) are described as having dominantly 2-spored basidia—*A. pachysperma* Atkinson (1918) and *A. virginiana* (Murrill) Murrill (1914) in North America and *A. submembranacea* var. *bispora* Reid (1987) from the United Kingdom.

C. Bas, Rijksherbarium, Leiden, The Netherlands, has observed (personal communication) that the presence of some bisterigmate basidia is not uncommon in many taxa of *Amanita*. In a number of taxa, it is not uncommon to find such basidia in specimens in which sporulation is just beginning. Dominance of bisterigmate basidia in mature basidiocarps is a character likely to be of taxonomic significance in sorting out section *Vaginatae*. Both of the previously described North American species with bisterigmate basidia are apparently rarely collected (Jenkins, 1986).

Described from sandy ground in woods, Watauga County, North Carolina, *A. pachysperma* is similar to *A. ristichii* in habit and in spore size and shape. Jenkins (1982) studied the type of *A. pachysperma*. Jenkins (1986) reports average Q of *A. pachysperma* = 1.45. It is described as being the color of "*Amanita cinerea* Bres." ("*livido-grigiastro traente al cenerino*" (Bresadola, 1881: 75)); and it differs markedly from *A. ristichii* in microscopic characters. For example, the acrophysalides of the stipe tissue of *A. pachysperma* are half the length of those of *A. ristichii*; also, the former has a ramose subhymenium and smaller basidia which lack clamps (Jenkins, 1986).

A study of the type of *Amanita virginiana* was reported in (Jenkins, 1979). It has a grayish pileus; its spores, basidia, and stipe acrophysalides are all of differing dimensions than those of *A. ristichii*; and its basidia lack clamps.

Amanita submembranacea var. *bispora* is very much larger than *A. ristichii*, has an exannulate stipe, a deeply colored pileus, and mostly globose to subglobose spores (Reid, 1987).

Krieger preserved Kr. 224 as a voucher from which he had painted an excellent watercolor (also in FH) showing Kr. 224 whole and in longitudinal section. The specimen is in poor condition, but large spores and acrophysalidic stipe context are to be seen. The watercolor leaves little doubt as to the identity of the collection; it represents very clearly all major macroscopic characters except the presence of an internal limb in the volva. The specimen is accompanied by three pages of discursive description by Krieger and a note in the handwriting of W. D. Farlow which summarizes some of Krieger's description and adds notes on the spores including the observation that "some spores were monstrous, as large as 6 div. × 4 1/2 div." Krieger's notes are the source of my information about the anastomosing of lamellae and striation of the upper surface of the annulus. He also mentions previously having collected the entity in 1904 in Chocorua; however, I have not located a 1904 collection. Because the few spores I found in Kr. 224 were on the stipe and, in some cases, were damaged, I have not included their measurements in the data on basidiospores, above. The eight spores measured fell into the following range: $12.0 - 15.0 \times 6.5 - 9.4$ µm.

In the field, *A. ristichii* might be confused with *Amanita alba* ss. auct. amer. (=*A. vaginata* var. *alba* ss. auct. amer.) as described in North American field guides and floristic studies (e.g., see Miller & Farr (1975) and Thiers (1982)). *Amanita ristichii* can be distinguished by many characters including the size and shape of its spores, the more robust universal veil, pale orange or pinkish gills drying a similar color, annulate stipe, and bisterigmate basidia.

In correpondence I have used the designation "species N1" for the taxon here named *Amanita ristichii.*

ACKNOWLEDGMENTS

I thank Dr. David T. Jenkins, Department of Biology, University of Alabama at Birmingham, for his review of this paper. I am very grateful to Dr. Jean R. Boise and Mr. Gennaro Concavio for their assistance at FH. I gratefully acknowledge the following assistance in the preparation of this paper: Mr. Neal Macdonald, Princeton, New Jersey, provided the illustrations. Mr. David C. Tulloss, Princeton, New Jersey, assisted with numerical computations. All Maine specimens were communicated to me by Dr. Samuel S. Ristich, Cumberland Center, Maine. Proofreading of final layout was done with the assistance of Ms. Mary A. King, Roosevelt, New Jersey.

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MYCOTAXON

Vol. XXXV, No. 2, pp. 371-377 July-September 1989

SCYTALIDIUM VACCINII SP. NOV., AN ERICOID ENDOPHYTE OF VACCINIUM ANGUSTIFOLIUM ROOTS.

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SUMMARY

Scytalidium vaccinii n. sp., a slow-growing dematiaceous hyphomycete isolated from cortical root cells of a mature blueberry plant, is illustrated and described. Its growth and nutritive requirements are presented and its mycorrhizal potential compared with other known ericoid mycorrhizal fungi.

RESUME

Scytalidium vaccinii n. sp., un hyphomycete dématié à croissance lente isolé des cellules corticales de racines de bleuets est illustré et décrit. Des données de croissance et de nutrition sont présentées et le potentiel mycorhizien comparé à celui d'autres symbiotes connus.

INTRODUCTION

The known causal organisms of ericoid mycorrhizae are slow-growing fungi giving dark-pigmented cultures. The sterile strains of Mycelium radicis myrtillis (Freisleben, 1936) and the dark sterile colonies described by Singh (1974) remain unidentified. The Helotiaceous Hymenoscyphus ericae (Read) Korf & Kernan (= Pezizella ericae Read, (1974)), and hyphomycetes of the genus Oidiodendron (Couture & al. 1983; Dalpé, 1986) are proven mycorrhizal symbionts of ericaceous hosts. In an attempt to evaluate benefit from different strains of H. ericae to young blueberry plantlets (Smagula & Litten, 1989), an authenticated isolate from England was compared with two isolates from roots of *Vaccinium angustifolium* Ait. of Maine. One of the Maine isolates was identified as *H. ericae*, but the other, although resembling *H. ericae* in growth rate and colony characteristics, differs in producing an arthroconidial anamorph which is described below as a new species of *Scytalidium*. This fungus is particularly active in the colonisation of the cortical root cells of blueberry plants and is the first species of *Scytalidium* known to form ericoid mycorrhizae.

MATERIAL AND METHODS

The specimen of *Vaccinium angustifolium* was obtained from a long established commercial blueberry field in Washington County, Maine. Cortical root cells were separated by maceration of hair roots of a mature plant (Pearson and Read, 1973), plated on water agar, and the outgrowing colonies transfered after 48 days to modified Melin-Norkrans medium (MMN) (Marx, 1969). Subsequent transfers to MMN were made after 35 and 104 days. The fungus was then grown and maintained on potato dextrose agar (PDA), malt agar (MA) (Difco), Corn Meal Agar (CMA), and on the synthetic medium of Mitchell and Read (1981) enriched with 0.5% of sucrose. Material for microscopic examination was obtained from these media and from tap water agar (TWA); slide cultures were made using Pablum cereal agar without antibiotics (CER) and oatmeal-salts agar (OAT) (Padhye et al., 1973). The mycorrhizal status of the fungus was then tested on axenic *V. angustifolium* seedlings (Dalpé, 1986). Root systems were stained with Malachite Green and Fuchsin, acid (Alexander, 1980) and their colonization levels estimated by the percentage of cortical root cells filled by hyphal coils. Optimum temperature, pH, vitamin, nitrogen and carbohydrate requirements for growth were studied. Cellulolytic activity was evaluated by the method of Yeoh et al. (1985). Fluorescence under ultraviolet was observed with an Optiphot Nikon microscope equipped with an episcopic-fluorescence attachment "EF"/"EFA", excitation and auxiliary filter UV 330-380 and an absorption filter 420 K.

DESCRIPTION OF THE FUNGUS

Scytalidium vaccinii Dalpé, Litten et Sigler sp. nov. Figs.1-7

Coloniae in PDA et MA, lente ad 20°C crescentes, densae, brunneae ad olivaceae-brunneae supra et infra, anguste hyalinae ad albae ad marginem, superficiei coactae, aerio mycelio albo ad cineraceo, filis hyphorum brunneis ad fumosis ad centrum. Coloniae in MA, azonateae; coloniae in PDA, plus minusve radiatim sulcatae, crassae, vix zonatae ad marginem, venetae prope marginem ad 10° vel temperaturam inferiorem. Crescentia nulla ad 40°C temperaturam. Mycelium aerium et immersum. Vegetativae hyphae, laeves, 2-3 um latae, subhyalinae ad brunneolae, ramosae, septatae, inflatis cellulis. Fertiles hyphae laeves, hyalinae ad subhyalinae, septatae, schizolitice secedentibus arthroconidis. Arthroconidia hyalina ad subhyalina, cylindracea, 0(1)-septata, 5.5-11 x 1.5-2.5 um in CER et OAT; arthroconidia subhyalina ad flavo--brunnea ad olivaceo-brunnea, cylindracea ad oblongo-elliptica, pandurata vel doliformia, laevia, guttulata 7-14(16) x (2)3-4(5) in TWA, PDA et MA. Conidia ubi catenata valde flexuosa, raro armilla relicta ad disjunctionem. Teleomorphosis ignotus.

Scytalidium vaccinii Dalpé, Litten et Sigler sp. nov. Figs 1-7

Colonies on PDA and MA growing slowly at 20°C (22 mm on MA, 25 mm on PDA after 15 days of incubation), with dense, brown to olive-brown, front and reverse, narrow hyaline to white margin, felted surface, white to gray aerial mycelium, brown to gray-brown hyphal strands developing toward the centre of older colonies. Colonies on MA, flat, without zonation; colonies on PDA, more or less radially folded, thick and scarcely zonated toward the margin, bluish-green near the margin at 10°C or lower temperatures. No growth at 40°C. Mycelium aerial and immersed. Vegetative hyphae smooth, 2-3 um wide, subhyaline to pale brown, branched, sparsely to regularly septate, sometimes slightly constricted at the septa, and often with individual cells rather variable in shape and slightly swollen; hyphae sometimes aggregating into strands. Fertile hyphae scarcely differentiated from vegetative hyphae, smooth, hyaline to subhyaline, with septa more closely spaced, fragmenting by schizolytic dehiscence to form arthroconidia. As with other arthroconidial fungi, arthroconidia vary in width depending on the width of the parent hypha. Arthroconidia most abundant and uniform on CER and OAT, hyaline to subhyaline, cylindrical, 0(1)-septate, measuring 5.5 - 11 x 1.5 - 2.5 um. On TWA, PDA and MA, arthroconidia subhyaline to yellow-brown or olive-brown, and more variable in width, measuring 7-14(16) x (2)3-4(5) um, and in shape, cylindrical to oblong-elliptical, panduriform or doliiform, smooth, guttulate. Conidia often remaining connected in zig-zag chains, rarely with a small frill of wall remaining at disjunction. Teleomorph unknown.

Holotype: Dried agar culture isolated from the cortical root cells of *Vaccinium angustifolium*, "Blueberry barrens", Washington County, Maine 30 Apr. 1986. Deposited in DAOM #196925. Microscope slides of mycelium and colonized roots of *Vaccinium angustifolium* are filed as DAOM 210088. Living subcultures deposited in CCFC as DAOM 196925 and in UAMH as 5828.

Scytalidium vaccinii growth requirements

Optimal temperature for growth of *S. vaccinii* was 20°C at a pH of 5.5. No growth occurred below 5° C and a pH of 4.5, or over 40°C and a pH of 8.0. The strain developed a turquoise pigmentation at the colony margin when exposed to 10°C or lower temperatures. This pigmentation faded gradually to an olive-brown tint in cultures grown at higher temperatures. Growth was supported by several nutritive media such as PDA, MA, CMA, and the synthetic Mitchell & Read (1981) medium enriched with 5% sucrose. In the Mitchell & Read medium free of sucrose, the strain completely lost its pigmentation; with the same medium, both organic and inorganic nitrogen sources such as NaNO3, NH4NO3, glutamine, asparagine and methionine were utilized and no vitamin deficiency was observed. *S. vaccinii* shows strong cellulolytic activity. Growth was inhibited by benomyl at 0.01% and by chloramphenicol at 100 p.p.m.

Vaccinium angustifolium root colonization

Under axenic culture conditions *S. vaccinii* produced typical hyphal coils comparable in morphology to those of other known ericoid mycorrhizal fungi (Fig.8). Young roots of seedlings were first surrounded by a loose weft of pale pigmented hyphae. As the roots extended, extraradical mycelium became scantier and root cortical cells were gradually colonized. Root penetration was first observed after two weeks of incubation. Colonization level attained its maximum six weeks later: a mean of 42% of the cortical cells were filled with hyphal coils detectable by both root staining and ultra-violet autofluorescence (Fig.9). Under the same growing conditions in the same incubation time (Dalpé, 1986), the level of root colonization of blueberry seedlings was 9% with *Oidiodendron rhodogenum*, 21% with *O. griseum*, and 25% with *Hymenoscyphus ericae* (unpublished data). Similar tests with two strains of *Scytalidium lignicola* Pesante (DAOM 57215; 117429) and an unidentified *Scytalidium* species (DAOM 198535 = UAMH 6045) did not result in mycorrhizal infection.

DISCUSSION

Since Pesante (1957) described the hyphomycete genus *Scytalidium* typified by *S. lignicola*, twelve additional species and a synanamorph of the coelomycete *Hendersonula toruloidea* Nattrass have been added. Although several species are regularly associated with plant material, this is the first species shown to form a mycorrhizal association.

Hendersonula toruloidea is a fairly widespread pathogen of stone and other fruit trees (Punithalingam & Waterston, 1970) in tropical and subtropical areas. In recent years, it has become well-known as a recalcitrant agent of dermatomycosis and onychomycosis in individuals from the areas of the world where the fungus is a common plant pathogen. While the majority of isolates of *H. toruloidea* can be readily differentiated from *S. vaccinii* by their black colonies with aerial strands of broad hyphae (up to 10 um wide), rapid growth rate and production of characteristic pycnidia, our new species is similar in growth rate and colony characteristics to clinical isolates recorded as Form 3 by Moore (1988).

Moore distinguished three forms of *H. toruloidea* on growth rates, growth temperature, production of pycnidia, and hyphal and arthroconidial characteristics. Since the Form 3 group produced no pycnidia, Moore was unable to make a definitive identification of them as *H. toruloidea*, but the morphology of the *Scytalidium* arthroconidia and the clinical origin of the isolates suggested a close affinity. Form 3 isolates are not yet known from plant material; Moore has suggested that the slow-growing forms may represent an evolution of a more represent an evolution of a more aggressive human pathogen with an anthropophilic mode of transmission. Two Canadian isolates of *H. toruloidea* from human infection (UAMH 5396 and 6290), examined by the

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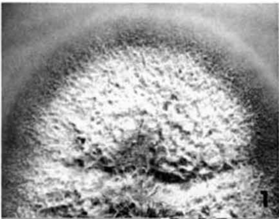
Fig.1. *Scytalidium vaccinii*. Colony on PDA. Fig.2. Hyphal strand (scale = 16um). Fig.3-4. Hyphae with swollen cells from TWA (scale = 16 um). Fig.5-6. Unbranched and branched fertile hyphae from CER dividing by schizolytic dehiscence to form arthroconidia remaining connected in zig-zag chains (scale = 20um). Fig.7. Chains of mature arthroconidia from TWA (scale = 20um). Fig.8-9. Colonized root sections of *Vaccinium angustifolium* seedlings (scale = 16um). Fig.8. Trypan Blue (0.2% in lactoglycerol). Fig.9: Ultraviolet fluorescence.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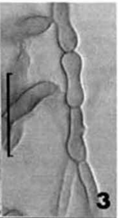
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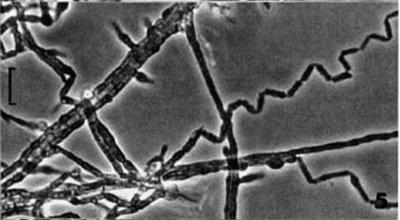
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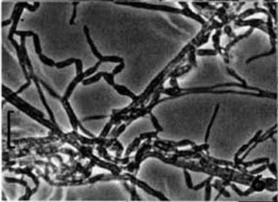
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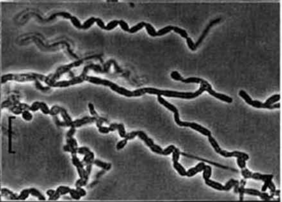
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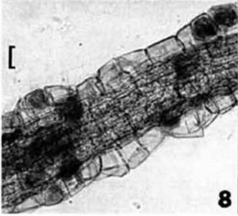
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junior author, demonstrate the features characteristic of Form 3. They grow more slowly, produce no pycnidia, and the hyphae are narrower (2-5 um broad) and bear distinctive excrescences on the surface. In addition, hyphal coils and loops are common and portions of the hyphae may be surrounded by brown slime. The arthroconidia of the *Scytalidium* morph are more variable in width, mostly 3-4 um wide but often rounding up at maturity to a width of 6 um, dark brown, and often 1-septate. *S. vaccinii* differs in having smooth hyphae, arthroconidia which are hyaline to subhyaline or yellow-brown and narrower. A few hyphal loops were seen in slide culture preparations on CER.

Scytalidium fulvum Morgan-Jones & al (1984), isolated from cysts of *Heterodera glycines* Ichinohe from soybean field soil in Alabama, is also slow-growing but the colonies are dark grey and the conidia are larger.

Several isolates of microfungi have previously been reported from roots of Ericaceae (Doak, 1928; Freisleben, 1936; Bain, 1937; Singh, 1974). Most of them were not taxonomically identified but the majority were described as non-sporulating, slow-growing dark-pigmented mycelia. *S. vaccinii* shows some similarities with the dark-sterile (DS) forms previously described by Singh (1974) related to the slow growth rate, the same olive to olive brown tint of colony pigmentation and the presence of aerial pigmented fascicles. However, the presence of aseptate arthroconidia in our strain directly affiliated it to the genus *Scytalidium*.

Colonies of *S. vaccinii* are easily confused with *Hymenoscyphus ericae* ones. Cultures of both species have a white margin with a brown to olive brown central colony and aerial pigmented hyphal strands (Vegh & Gianinazzi-Pearson, 1979). Microscopically, *H. ericae* filaments differ from those of *S. vaccinii* in that hyphae of the former are divided into numerous segments highly variable in form, length, and width (5.5-25-60) X 2-5.5 um) quite different from arthroconidia of *S. vaccinii*.

The *S. vaccinii* isolate invaded roots of *V. angustifolium* seedlings more aggressively than did other known ericoid mycorrhizal fungi. The benefit to the plant of inoculation with *S. vaccinii* has not been demonstrated under nursery procedures (Smagula & Litten, 1989). In view of the acceleration of root development found by Pons et al. (1982) in plantlets of *Vaccinium myrtillus* L. and *Calluna vulgaris* (L.) Hull by inoculation with *H. ericae*, further studies are under way to compare inoculations with *H. ericae* and *S. vaccinii* in promoting rooting and growth of *V. angustifolium* tissue-culture explants in sterilized and unsterilized conditions.

ACKNOWLEDGEMENTS

Thanks to E.J. McLaughlin for the host collection, P. Boothby for laboratory assistance,J.M. Smagula, S.J. Hughes, and K.A. Pirozynski for valuable advice, and J. Cayouette for the revision of the Latin diagnosis. The junior author gratefully acknowledges the technical assistance of Mrs. A. Flis and an operating grant A3755 from the Natural Sciences and Engineering Research Council of Canada.

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MYCOTAXON

Vol. XXXV, No. 2, pp. 379-394 July-September 1989

THE LICHEN FLORA OF QAANAAQ (THULE), NORTHWESTERN GREENLAND

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SUMMARY

The present investigation of occurrence of lichens around Qaanaaq in northwestern Greenland is based on a study of more than 800 collections of 144 species of macro- and microlichens collected by the author in the summer of 1986. Six species are additions to the known lichen flora of Greenland, viz. Absconditella delutula (Nyl.) Coppins & Kilias, Bryonora rhypariza (Nyl.) Poelt, Buellia pulverulenta (Anzi) Jatta, Caloplaca psoricida E.S. Hansen, Poelt & Søchting, Catapyrenium squamulosum (Ach.) O. Breuss and Cladonia alaskana A. Evans. Beyond this, range extensions are given for 55 species. The most important epigeic and epilithic lichen communities are surveyed. The paper also comprises information on topography, geology and climate of the Qaanaaq area.

INTRODUCTION

Until recently northwestern Greenland has been in lack of lichenological investigations, mainly because of difficult of access. Some small collections of lichens made by, e.g., P. Freuchen, M.P. Porsild and W.S. Benninghoff & H.C. Robbins are, however, available from the start and the middle of the twentieth century.

The collection work as regards lichens was intensified in the Thule District in the seventies, first by A. Züst, who collected 50 taxa of lichens on the Carey Islands (76°44'N, 73°11'W)(Thomson 1978) and then by L. de Bonneval and B. Fredskild, who collected 77 taxa of macro- and microlichens in four areas situated in northwestern Greenland including Qaanaaq. The last-mentioned collections were determined by the present author (E.S. Hansen 1980). The total number of taxa of lichens known from this part of Greenland now amounted to about 100.

In the summer of 1981 L. Hansson collected 63 species of

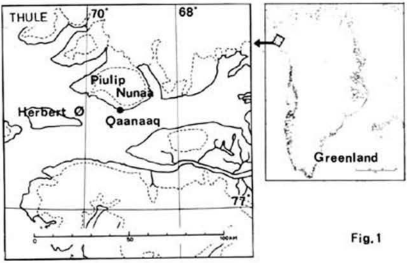

Fig.1

Fig. 1. Location of Qaanaaq (Thule) in Greenland.

lichens at Qaanaaq and three localities to the south of Qaanaaq (E.S.Hansen 1983). Her collections added 15 species to the known lichen flora of northwestern Greenland and gave us new knowledge about the vegetation of Iterdlak (76°19'N, 69°15'W) and Narssârssuk (76°26'N, 69°12'W).

The present author visited Qaanaaq in the summer of 1986 with the purpose of investigating the lichen flora of the surroundings of Qaanaaq. The population moved from the settlement Uummannaq at Thule Air Base to Qaanaaq in 1953. The environment appears to be only slightly influenced by the inhabitants of Qaanaaq (E.S. Hansen 1987). With this paper it is the intention to give a survey of the lichen flora and vegetation of the Qaanaaq area. The collected lichen material is deposited at the Botanical Museum, University of Copenhagen.

TOPOGRAPHY, GEOLOGY AND CLIMATE

Qaanaaq (77°29'N, 69°12'W) is situated near the south point of Piulip Nunaa peninsula that is partly covered by a central icecap (Fig. 1). The maximum elevation of this icecap, from which several glaciers, e.g., Qaanaaq Gletscher, radiate, is unknown. An altitude of 578 m a.s.l. has, however, been measured at a site located exactly to the north of Qaanaaq and close to the icecap. The mountainous ground slopes down from the icecap towards the inlet Inglefield Bredning (Kangerdlugssuaq) under formation of more or less distinct terraces and large talus slopes. Glacial streams form broad deltas on the marine foreland. The town Qaanaaq is founded on this foreland. The shortest distance between the icecap and the coastline is about 2 km, only.

The geological conditions of the Thule area are strongly influenced by late Proterozoic sedimentary rocks of the Wolstenholme Formation (Escher & Stuart Watt 1976) that overlies the Archaean-Proterozoic crystalline basement. The Wolstenholme Formation, which together with the Dundas Formation and the Narssârssuk Formation constitute the Thule Group, consists of four units: 1. a basal, multicoloured one with ferruginous sandstone, shale and different volcanic rocks. 2. a white to pink unit of quartzite with conglomerate. 3. a red unit of ferruginous sandstone, siltstone, shale and conglomerate. 4. a brownish yellow to yellow unit of sandstone, quartzite and quartz pebble conglomerate. The above-mentioned rocks are intruded and cut by dolerite sills and dykes. Weathering and frost erosion of the rocks has resulted in stones and boulders that cover the ground almost totally in many places around Qaanaaq. Visible layers of sandstone and shale appear, however, to the east and to the west of the town. Large, ice transported, gneissic boulders occur rather frequently in the marine foreland. Their degree of hardness is greater than that of the sandstones, and they carry another type of lichen flora.

Table 1. Mean temperatures (°C), precipitation (mm) and snow depth (cm) of the months in Qaanaaq (measurements made by the Danish Meteorological Institute 1964-1980; snow depth 1964-1977).

	J	F	M	A	M	J	J	A	S	O	N	D	Year
Mean temperatures	-21.8	-22.7	-22.7	-16.4	-5.2	1.3	4.3	4.6	-1.3	-7.8	-15.5	-20.8	-10.5
Precipitation	5.3	6.9	3.7	5.3	5.0	7.5	25.1	21.3	13.1	6.6	4.5	3.0	91.7
Snow depth	23.8	26.2	28.9	32.1	24.0	3.1	0	0	2.9	11.7	18.1	20.8	16.1

Qaanaaq has a high arctic and somewhat continental climate according to meteorological data available from the weather station situated in the northern part of the town (cf. Table 1). The mean temperature of the warmest month, August, is 4.6°C, while the mean temperature of the coldest months, February and March, is -22.7°C. The annual temperature amplitude is 27.3°C. Extremely low temperatures occur commonly during the winter. The average annual precipitation at Qaanaaq is 91.7 mm, most of it falling as snow. The amount of precipitation is greatest in July and August. The snow depth is greatest in April. In July and August the snow disappears totally from the ground in the lowlands. Formation of fog is frequent during the summer. The polar night lasts for a period of three and a half months (Oct. 28-Febr. 15).

LIST OF SPECIES

In the following an outline will be given of the lichens found in the Qaanaaq area except some additional, critical lichens that await further determination. The species (and a single subspecies) are listed alphabetically within the families. These are arranged according to the outline of the Ascomycetes presented by Eriksson & Hawksworth (1988). Nomenclature follows Santesson (1984) with subsequent changes given by, e.g. Hertel & Rambold (1987) and Rogers & Hafellner (1988). An asterisk in front of the name indicates that the species is an addition to the known lichen flora of northwestern Greenland (73°N-80°N), two asterisks that the species is new to the whole Greenland. Presence of apothecia or perithecia are indicated by "c.ap." and "c.pe", respectively. "st." means that the specimens found are sterile.

Class Ascomycetes

Acarosporaceae
- Acarospora chlorophana (Wahlenb. in Ach.) Massal. (c.ap.)
- * Acarospora sinopica (Wahlenb. in Ach.) Koerb. (c.ap.)
- * Acarospora smaragdula (Wahlenb. in Ach.) Massal. (c.ap.)
- Sporastatia testudinea (Ach.) Massal. (c.ap.)

Alectoriaceae
- Alectoria nigricans (Ach.) Nyl. (st.)
- Alectoria ochroleuca (Hoffm.) Massal. (st.)

Arthrorhaphidaceae
- * Arthrorhaphis citrinella (Ach.) Poelt (st.)

Baeomycetaceae
- * Baeomyces placophyllus Ach. (st.)
- * Baeomyces roseus Pers. (st.)

Candelariaceae
- Candelariella athallina (Wedd.) Du Rietz (c.ap.)
- Candelariella aurella (Hoffm.) Zahlbr. (c.ap.)
- Candelariella placodizans (Nyl.) H.Magn. (c.ap.)
- Candelariella vitellina (Hoffm.) Müll. Arg. (c.ap.)
- Candelariella xanthostigma (Ach.) Lettau (st.)

Cladoniaceae
- ** Cladonia alaskana A. Evans (st.)
- Cladonia amaurocraea (Flk.) Schaer. (st.)
- Cladonia arbuscula (Wallr.) Flotow ssp. mitis (Sandst.) Rouss (st.)
- * Cladonia cariosa (Ach.) Spreng. (c.ap.)
- Cladonia cenotea (Ach.) Schaer. (st.)
- Cladonia chlorophaea (Flk. ex Sommerf.) Spreng. s.lat. (st.)
- Cladonia coccifera (L.) Willd. (c.ap.)
- * Cladonia cornuta (L.) Hoffm. (ssp. groenlandica (E.Dahl) Ahti)(st.)
- * Cladonia ecmocyna Leight (st.)
- * Cladonia fimbriata (L.) Fr. (st.)
- Cladonia gracilis (L.) Willd. (st.)
- * Cladonia luteoalba A. Wils. & Wheld. (st.)

* Cladonia macroceras (Flk.) Ahti (st.)
Cladonia macrophylla (Schaer.) Stenham. (st.)
Cladonia pleurota (Flk.) Schaer. (st.)
Cladonia pyxidata (L.) Hoffm. (st.)
* Cladonia squamosa (Scop.) Hoffm. (st.)
Cladonia stricta (Nyl.) Nyl. (st.)

Collemataceae

* Leciophysma finmarkicum Th. Fr. (c.ap.)

Coniocybaceae

* Coniocybe furfuracea (L.) Ach. (c.ap.)

Hymeneliaceae

* Tremolecia atrata (Ach.) Hertel (c.ap.)

Lecanoraceae

* Bryonora castanea (Hepp) Poelt (c.ap)
** Bryonora rhypariza (Nyl.) Poelt (c.ap.)
* Lecanora atrosulphurea (Wahlenb.) Ach. (c.ap.)
* Lecanora badia (Pers.) Ach. (c.ap.)
* Lecanora behringii Nyl. (c.ap.)
* Lecanora contractula Nyl. (c.ap.)
Lecanora epibryon (Ach.) Ach. (c.ap.)
* Lecanora geophila (Th. Fr.) Poelt (st.)
* Lecanora intricata (Ach.) Ach. (c.ap.)
* Lecanora marginata (Schaer.) Hertel & Rambold (c.ap.)
Lecanora polytropa (Hoffm.) Rabenh. (c.ap.)
* Miriquidica nigroleprosa (Vain.) Hertel & Rambold (c.ap.)
Rhizoplaca melanophthalma (DC. in Lam. & DC.) Leuckert & Poelt (c.ap.)

Lecideaceae

Lecidea atrobrunnea (DC. in Lam. & DC.) Schaer. (c.ap.)
Lecidea auriculata Th. Fr. (c.ap.)

Ophioparmaceae

Ophioparma ventosa (L.) Norman (c.ap.)

Pannariaceae

* Pannaria pezizoides (Web.) Trevis. (c.ap.)
Psoroma hypnorum (Vahl) S.F. Gray (c.ap.)

Parmeliaceae

Bryocaulon divergens (Ach.) Kärnef. (st.)
* Bryoria nitidula (Th. Fr.) Brodo & Hawksw. (st.)
Cetraria cucullata (Bell.) Ach. (c.ap.)
Cetraria delisei (Bory ex Schaer.) Nyl. (st.)
Cetraria islandica (L.) Ach. (st.)
Cetraria nigricans Nyl. (st.)
Cetraria nigricascens (Nyl.) Elenkin (st.)
Cetrareia nivalis (L.) Ach. (st.)
Coelocaulon muricatum (Ach.) Kärnef. (st.)
Dactylina arctica (Hook.) Nyl. (st.)
Dactylina ramulosa (Hook.) Tuck. (st.)
Hypogymnia austerodes (Nyl.) Räs. (st.)
Hypogymnia oroarctica Krog (st.)
* Hypogymnia physodes (L.) Nyl. (st.)
* Hypogymnia subobscura (Vain.) Poelt (st.)
Parmelia alpicola Th. Fr. (st.)
Parmelia disjuncta Erichs. (st.)
* Parmelia incurva (Pers.) Fr. (st.)
Parmelia infumata Nyl. (st.)
Parmelia omphalodes (L.) Ach. (st.)

Parmelia saxatilis (L.) Ach. (st.)
Parmelia sulcata Tayl. (st.)
Pseudephebe minuscula (Nyl. ex Arn.) Brodo & Hawksw. (st.)
Pseudephebe pubescens (L.) Choisy (st.)

Peltigeraceae
* Peltigera didactyla (With.) Laundon (st.)
* Peltigera lepidophora (Nyl.) Bitter (st.)
Peltigera leucophlebia (Nyl.) Gyeln. (st.)
Peltigera malacea (Ach.) Funck (st.)
* Peltigera neckeri Müll. Arg. (st.)
Peltigera rufescens (Weis.) Humb. (st.)
Solorina bispora Nyl. (c.ap.)
Solorina crocea (L.) Ach. (c.ap.)

Pertusariaceae
Ochrolechia frigida (Sw.) Lynge (c.ap.)
Ochrolechia grimmiae Lynge (c.ap.)
* Ochrolechia upsaliensis (L.) Massal. (c.ap.)
Pertusaria dactylina (Ach.) Nyl. (st.)
Pertusaria oculata (Dicks.) Th. Fr.(st.)

Physciaceae
** Buellia pulverulenta (Anzi) Jatta (c.ap.)
* Dimelaena oreina (Ach.) Norm. (c.ap.)
Phaeophyscia sciastra (Ach.) Moberg (st.)
Physcia caesia (Hoffm.) Fürnrohr (st.)
Physcia dubia (Hoffm.) Lettau (st.)
Physconia muscigena (Ach.) Poelt (c.ap.)
* Rinodina roscida (Sommerf.) Arn. (c.ap.)
Rinodina turfacea (Wahlenb.) Koerb. (c.ap.)

Placynthiaceae
* Placynthium asperellum (Ach.) Trevis. (st.)

Porpidiaceae
Porpidia pseudomelinodes Schwab (st.)

Psoraceae
* Lecidoma demissum (Rutstr.) G. Schneider & Hertel (c.ap.)
* Psora rubiformis (Ach.) Hook. (c.ap.)

Rhizocarpaceae
Orphniospora moriopsis (Massal.) Hawksw. (c.ap.)
Rhizocarpon geminatum Koerb. (c.ap.)
Rhizocarpon geographicum (L.) DC. (c.ap.)
* Rhizocarpon grande (Flk. ex Flot.) Arn. (c.ap.)
* Rhizocarpon pusillum Runem. (c.ap.)
* Rhizocarpon renneri Poelt (c.ap.)

Sphaerophoraceae
Sphaerophorus fragilis (L.) Pers. (st.)
Sphaerophorus globosus (Huds.) Vain. (st.)

Stereocaulaceae
Stereocaulon alpinun Laur. (c.ap.)
Stereocaulon arenarium (Sav.) Lamb. (c.ap.)
Stereocaulon rivulorum H. Magn. (c.ap.)

Stictidaceae
** Absconditella delutula (Nyl.) Coppins & Kilias (c.ap.)

Teloschistaceae
* Caloplaca alcarum Poelt (c.ap.)
* Caloplaca ammiospila (Ach.) Oliv. (c.ap.)
* Caloplaca celata Th. Fr. (c.ap.)

Caloplaca cerina (Ehrh.) Th. Fr. (c.ap.)
* Caloplaca epiphyta Lynge (c.ap.)
* Caloplaca epithallina Lynge (c.ap.)
* Caloplaca jungermanniae (Vahl) Th. Fr. (c.ap.)
* Caloplaca lithophila H. Magn. (c.ap.)
** Caloplaca psoricida E.S. Hansen, Poelt & Søchting (c.ap.)
* Caloplaca saxifragarum Poelt (c.ap.)
* Caloplaca tetraspora (Nyl.) Oliv. (c.ap.)
Caloplaca tiroliensis Zahlbr. (c.ap.)
Xanthoria candelaria (L.) Th. Fr. (st.)
Xanthoria elegans (Link) Th. Fr. (c.ap.)
* Xanthoria sorediata (Vain.) Poelt (st.)

<u>Trapeliaceae</u>
* Trapeliopsis granulosa (Hoffm.) Lumbsch (st.)

<u>Umbilicariaceae</u>
Umbilicaria arctica (Ach.) Nyl. (c.ap.)
Umbilicaria cylindrica (L.) Del. ex Duby (c.ap.)
Umbilicaria decussata (Vill.) Zahlbr. (c.ap.)
Umbilicaria hyperborea (Ach.) Hoffm. (c.ap.)
Umbilicaria lyngei Schol. (st.)
Umbilicaria proboscidea (L). Schrad. (c.ap.)
Umbilicaria torrefacta (Lightf.) Schrad. (c.ap.)
Umbilicaria virginis Schaer. (c.ap.)

<u>Verrucariaceae</u>
* Catapyrenium cinereum (Pers.) Koerb. (c.pe).
* Catapyrenium daedaleum (Krempelh.) B. Stein (c.pe.)
** Catapyrenium squamulosum (Ach.) O. Breuss (c.pe.)

Class Basidiomycetes

<u>Tricholomataceae</u>
Omphalina hudsoniana (Jenn.) Bigelow

Lichenes Imperfecti

* Cystocoleus ebenus (Dillw.) Thwaites
Lepraria neglecta Vain.
Thamnolia vermicularis (Sw.) Schaer.

TYPES OF VEGETATION RICH IN LICHENS

Very few ecological investigations have previously been carried out along with plant sociological research in northwestern Greenland. The floristic constitution of some important communities has been described by the present author (E.S. Hansen 1980, 1983). The following survey of the lichen vegetation and habitats around Qaanaaq is also purely descriptive, but it contains additional information on a number of ecological factors such as type of soil and rock, snow cover and influence of manuring.

A. EPIGEIC VEGETATION

Vaccinium uliginosum-Dryas integrifolia-Carex rupestris Sociation

This type of heath vegetation covers large patches on south- and southeast exposed slopes to the north of Qaanaaq, particularly in areas that are early free of a protecting snow cover and therefore relatively dry during summer. The layer of soil is often very thin. The soil is a mixture of clayey and sandy weathering material and some organic material. It has a slightly acid reaction. Salix arctica, Silene acaulis and Hierochloë alpina occur more or less constantly in this sociation.

The sociation is comparatively rich in lichens (max. 20 taxa), Cetraria cucullata being the most abundant species. Thamnolia vermicularis and Coelocaulon muricatum are additional important lichens also occurring in more dry types of dwarf shrub heaths and in fell-fields in other parts of Greenland (Gelting 1955; E.S. Hansen 1978a & b). It is of interest that Cetraria nivalis is of minor importance, only. Gelting (1955) found that it is a constant species in a Dryas integrifolia community analysed by him on Disko. The occurrence of Psora rubiformis and other eutrophic lichens in the corresponding heath type at Qaanaaq show that the soil is comparatively rich in nutrition.

Alectoria nigricans, Bryoria chalybeiformis and Cetraria cucullata are the dominant lichens in a Vaccinium uliginosum-Carex rupestris heath near the above-mentioned patches. It is very rich in crustaceous species, e.g. Caloplaca ammiospila, Ochrolechia upsaliensis and Pertusaria dactylina, but generally these lichens cover very small areas, only.

Dead tufts of Dryas often carry a rich vegetation of Caloplacas, e.g. C. cerina, C. tiroliensis and C. ammiospila. Caloplaca jungermanniae and Leciophysma finmarkicum were found growing on dead fragments of Silene acaulis.

Cassiope tetragona Sociation

Cassiope tetragona forms a very dense type of vegetation in places with a prolonged snow cover, i.e., on east exposed slopes and in depressions on south and west exposed slopes. The soil has an upper, peaty layer that gradually changes into clay, sand and stones with a marked higher pH. Salix herbacea, S. arctica, Silene acaulis and Luzula confusa were found growing in this sociation, but in very small quantities, only.

Among the cryptogams Racomitrium lanuginosum and Cetraria nivalis are constant elements of the Cassiope heaths near Qaanaaq. About a dozen species of lichens are able to colonize the soil and dead plant fragments in these heaths, but Lepraria neglecta is the only lichen that covers larger, mossy patches. Arthrorhaphis citrinella, Candelariella placodizans and Lecanora geophila (Fig. 2) are pioneer plants on open soil among the dwarf shrubs.

Baeomyces placophyllus and B. roseus occur in a similar way along tracks on the slopes and in the lowlands. Cetraria cucullata is of minor importance in these Cassiope heaths that otherwise are rich in macrolichens commonly occurring in Greenland dwarf shrub heaths, e.g., Cladonia arbuscula ssp. mitis, C. amaurocraea, Cetraria nivalis and C. islandica (Fredskild 1961, E.S. Hansen 1979 a & b). A single growth of Cladonia luteoalba was found in an open Cassiope vegetation on the slope above Qaanaaq. Crustaceous lichens such as Lecidoma demissum, Ochrolechia frigida and Pertusaria dactylina cover small areas, only.

An open Cassiope tetragona-Vaccinium uliginosum heath is developed in places with a comparatively good drainage. Accordingly the soil is more dry in the summer period than in the other types of Cassiope vegetation. The peaty surface layer is rather thin. The underlying soil has a slight acid reaction. The Cassiope-Vaccinium heath is very rich in lichens (up to c. 20 species), some of which (e.g., Caloplaca ammiospila and Peltigera lepidophora) indicate that the soil is circumneutral, at least locally. The floristic composition of the heath is comparable with that of the above-mentioned Cassiope heath, but it is more rich in pioneer lichens and mosses. The mosses are often covered by crustaceous lichens such as Bryonora castanea and Psoroma hypnorum. Stereocaulon arenarium is an occasional component of the community.

An interesting variant of the Cassiope heath occurs in horizontal patches on some of the terraces above Qaanaaq. Here melting snow is found even in July. The soil is very moist during summer. Cetraria nigricascens is a constant component of these heath patches and sometimes is found in great abundance (E.S. Hansen 1986b). It also occurs on the east exposed slopes near Qaanaaq. After C. nigricascens was reported from Greenland (Melville Bugt) by the present author (E.S. Hansen 1981), it has been collected at Scoresbysund in Central East Greenland. There is an additional report from Peary Land (E.S. Hansen 1984). Accordingly the species belongs to the group of lichens that have a northern, high arctic distribution in Greenland. In addition it belongs to the Beringian element in the arctic (Thomson 1984). It is no matter for surprise that the moist Cassiope heaths with C. nigricascens are rich in plants otherwise known from snowbeds in other parts of Greenland, e.g., Salix herbacea and Cetraria delisei. At Qaanaaq Stereocaulon alpinum appears to have a particular preference for the Cassiope heaths. However, macrolichens are of minor importance in these very northern snowbeds. Thus Solorina crocea is comparatively rare in the Qaanaaq area.

Empetrum hermaphroditum-Vaccinium uliginosum Sociation

Empetrum hermaphroditum is a rare species in the Qaanaaq area. The plant only covers small areas at lower altitudes on the slopes. The soil is of the same type as that in the other Vaccinium communities. Macrolichens such as Cladonia arbuscula ssp. mitis, C. pyxidata, C. coccifera and Cetraria cucullata occur more or less abundantly in the sociation. Crustaceous lichens appear to be more rare than in the above-mentioned sociations.

Racomitrium lanuginosum-Cladonia alaskana Sociation

Racomitrium lanuginosum forms tussocks covering several square metres of ground in some places in the lowlands around Qaanaaq. A number of lichens occur scattered upon these tussocks, e.g., Dactylina arctica, Sphaerophorus globosus and Ochrolechia grimmiae. Cladonia alaskana (Fig. 3) grows in protected niches among sandstone boulders together with Racomitrium lanuginosum and lichens such as Bryoria nitidula, Cladonia cenotea, C. cornuta and C. squamosa. Omphalina hudsoniana belongs to this sociation, too. Like Cetraria nigricascens, Cladonia alaskana shows a wide amphi-Beringian range (E.S. Hansen 1989). The great waterholding capacity of Racomitrium probably determines the abundant occurrence of Cladonia stricta in the moss tussocks. Otherwise C. stricta is a dominant species on moist soil along the watercourses that carry melting water from the local accumulations of ice.

Mossy cliff rich in Peltigeras and other lichens

A few metres from the coast line somewhat to the east of Qaanaaq a low mossy cliff with scattered Dryas plants was studied. Four species or Peltigera occur on the cliff, viz. Peltigera didactyla, P. neckeri, P. rufescens and P. leucophlebia. Psoroma hypnorum, Caloplaca cerina, Lecanora epibryon and Physconia muscigena grow on and among mosses, too. Absconditella delutula (Fig. 4) that is an addition to the known lichen flora of Greenland was found growing on dead fragments of Dryas together with Caloplaca tetraspora, C. tiroliensis and Rinodina turfacea. Coniocybe furfuracea occurs in a small, somewhat moist and shady depression together with Cystocoleus ebenus, while Hypogymnia subobscura, Ochrolechia upsaliensis, Lecanora geophila and Candelarialla placodizans grow on more dry soil on the cliff.

B. EPILITHIC LICHEN VEGETATION

Umbilicaria hyperborea-Pseudephebe minuscula-Sporastatia testudinea Sociation

This sociation that is unique by its distinct dominance of Umbilicaria hyperborea has a wide distribution in the Qaanaaq area and occurs on garnet gneiss, quartz-pebble conglomerate and sandstone.

Ice transported boulders composed of garnet-hornblende or garnet-biotite gneiss occur scattered in the lowlands around Qaanaaq. The vertical surfaces of the blocks are partly covered by species such as Umbilicaria hyperborea, U. proboscidea, Pseudephebe minuscula, Parmelia disjuncta and the following microlichens: Sporastatia testudinea, Rhizocarpon geographicum, R. geminatum and Lecanora polytropa. The boulders act as resting-places for various birds and accordingly their tops are often covered by ornithocoprophilous lichens (see later).

The sociation is more common than the other epilithic sociations on sedimentary rocks in the Qaanaaq area. It is found on sandstone blocks both in the lowlands and at higher altitudes (up to c. 500 m a.s.l.). It consists of the above-mentioned species that grow on all types of surfaces of the sandstone boulders, even the apical faces. As many sandstones in the area are ferruginous, it sometimes can happen that Tremolecia atrata joins in the association. Umbilicaria lyngei, U. torrefacta, U. cylindrica, Parmelia incurva, Hypogymnia oroarctica, Ophioparma ventosa, Candelariella vitellina, Lecanora intricata and L. atrosulphurea are additional species found on these sandstone rocks. A somewhat reduced edition of the sociation occurs on scattered boulders composed of quartz-pebble conglomerate.

Acarospora chlorophana Sociation

Acarospora chlorophana occurs sparsely on southeast exposed slopes north of Qaanaaq. Here it was found growing on blocks of ferruginous sandstone of reddish brown colour and more rarely on pale sandstone (max. alt. 560 m a.s.l.). It was not found on the gneissic boulders. The plants consist of a few, scattered areoles with the characteristic bright lemon colour. Apothecia are present.

Creveld (1981) describes a Norwegian community with Acarospora chlorophana occurring on strongly overhanging faces of boulders and rocks and even in deep vertical crevices. In the same way most of the Greenland populations of A. chlorophana have a distinct preference for overhangs, rocky caves and crevices (E.S. Hansen 1982). However, the species is always found growing on exposed rocks in the Qaanaaq area. This partly can be explained by the fact that the polar night lasts for 3 1/2 months in this part of Greenland. Creveld (1981) found that A. chlorophana occurs regularly in the Umbilicaria-Sporastatia association in southern Norway, but the species is not present in the above-mentioned Umbilicaria hyperborea-Pseudephebe minuscula-Sporastatia testudinea sociation. The occurrence of A. chlorophana on substrates rich in iron has previously been reported by Wirth (1987).

Parmelia incurva Sociation

This association typically occurs in protected and somewhat moist places with a snow cover of long duration such as rocks near snowbeds and watercourses. Parmelia incurva sometimes grows together with Porpidia pseudomelinodes on boulders close to small streams with melting water. The species is particularly abundant on sandstone rocks in block fields in the lowlands. It has a distinct preference for the top and the subapical faces of the boulders. Parmelia incurva is always sterile and poor in soralia in the Qaanaaq area.

Acarospora sinopica Sociation

Although rocks with iron containing minerals occur abundantly around Qaanaaq, the content of Fe-oxides is rarely high enough to allow the Acarospora sinopica sociation to grow on them. It was found on some small, dark reddish brown blocks in a marsh somewhat to the east of Qaanaaq. Acarospora sinopica is of greatest importance, but species such as Tremolecia atrata, Umbilicaria hyperborea, Pseudephebe minuscula and Sporastatia testudinea also occur on the stones. Creveld (1981) states for some Norwegian rocks with Fe-minerals that they are mainly inhabited by Sporastatia-Pseudephebe communities. This also applies to a large part of the sandstone rocks of Qaanaaq. Rocks with a well-developed vegetation of species such as Acarospora sinopica, Lecidea atrofulva and L. silacea have been studied in South East Greenland by the present author (E.S. Hansen 1986a).

Dimelaena oreina Sociation

The sociation occurs on the previously mentioned gneissic boulders rich in garnet situated in the flat lowland near the inlet. The boulders have been transported by ice and have a comparatively smooth, but very hard surface. They are up to 1.5 m high and are more or less manured by birds. Dimelaena oreina is dominant on the apical and subapical surfaces of the boulders, where pH is higher than at the lower surfaces. The sociation is also considered ornithocoprophilous or nitrophilous in Central Europe (Klement 1950, 1955), whereas the Norwegian associations with Dimelaena oreina studied by Creveld (1981) do not show this characteristic. She found it to be restricted to steep and overhanging rock faces with southern exposure. In North Greenland (Thule, Peary Land) Dimelaena oreina has a distinct preference for the top and the subapical surfaces of the rocks and boulders, but occasionally it occurs on steep faces, too.

Xanthoria elegans, Umbilicaria decussata, U. hyperborea, Sporastatia testudinea, Pseudephebe minuscula, Candelariella vitellina and species of Physcia are additional important members of the sociation. Grey and yellow species of Rhizocarpon occur less frequently. The rare Greenland species Rhizocarpon renneri was found growing parasitically on Dimelaena oreina on one of the gneissic boulders at Qaanaaq.

Xanthoria elegans-Physcia caesia Sociation

This very conspicuous sociation has a wide distribution in the Qaanaaq area and occurs in all other parts of Greenland, too (Daniëls 1975; E.S.Hansen 1978 a & b, 1982; Salomonsen 1979; Moberg & E.S. Hansen 1986). It is found on both gneissic rocks and sandstones of different types and with varied exposure and slope. The species belonging to the sociation occur abundantly on the top of boulders, where birds, e.g. snowbuntings, like to rest, but are also

Fig.2

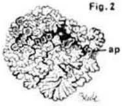

Fig.3

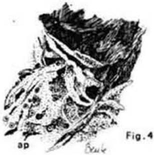

Fig.4

Fig.5

Fig.6

Fig. 2. Lecanora geophila (Th. Fr.) Poelt (x2). Fig. 3. Cladonia alaskana A. Evans (x2.5). Fig. 4. Absconditella delutula (Nyl.) Coppins & Kilias (x1.5). Fig. 5. Caloplaca alcarum Poelt (x8.5). Fig. 6. Buellia pulverulenta (Anzi) Jatta (x4.5). ap = apothecia.

found growing in great abundance on the rocks in places, where the dogs of Qaanaaq are kept, when they are not on sledge journeys.

Xanthoria elegans and Physcia caesia appear to be the most characteristic of the nitrophilous species on the above-mentioned rocks, followed by Umbilicaria decussata, Parmelia infumata, Physcia dubia, Rhizocarpon geminatum and Lecidea atrobrunnea. Species such as Sporastatia testudinea, Pseudephebe minuscula and Candelariella vitellina are constant elements of the sociation. The two parasitic species of Caloplaca, C. alcarum (Fig. 5) and C. epithallina that grow on the thalli of Lecanora contractula and Rhizoplaca melanophthalma, respectively, occur on boulders close to Qaanaaq. Presumably the occurrence of both of these species on these boulders indirectly is influenced by nitrogenous matters from dog droppings.

Xanthoria candelaria-Physcia dubia Sociation

While the preceding sociation can be found near the houses of Qaanaaq, the community dominated by Xanthoria candelaria and Physcia dubia occurs at some distance from the town. It occurs predominantly on the apical surface of boulders influenced by guano from, e.g. snowbuntings. The number of thalli of Xanthoria candelaria on such boulders can be very high. In extreme cases the species covers the whole top surface leaving only small patches for other lichens. Physcia dubia is sometimes replaced by P. caesia on the rocks that are composed either of sandstone or gneiss. Parmelia sulcata, Rhizoplaca melanophthalma and Lecanora badia are additional lichens of the community. In a few cases Xanthoria sorediata was found on the lower part of boulders otherwise overgrown by members of the Xanthoria candelaria-Physcia dubia sociation. Physcia dubia was found to be infested with Buellia pulverulenta (Fig. 6).

C. LICHENS GROWING ON BONES AND WOOD

Old bones of seal, narwhale and other marine mammals occur scattered on the ground in the lowlands around Qaanaaq. They are often covered by lichens, e.g. Physcia caesia, Caloplaca tiroliensis, C. cerina, Candelariella aurella and Lecanora behringii. Psoroma hypnorum was found growing over mosses on a bone.

Old wood is also a substrate for species such as Caloplaca tiroliensis and C. cerina (E.S. Hansen, Poelt & Søchting 1987).

ACKNOWLEDGEMENTS

The present project was accomplished thanks to financial support from the Danish Natural Science Research Council and great help from Kalaallit Ninerfiat (KNI) at Qaanaaq and from other friends in the Thule District. I also wish to thank my many colleagues that have taken an interest in the project and have helped with identification of the lichen material and the collections of rocks. Bente Pedersen made the drawings, Ole Lansø typed the manuscript. Ove Eriksson provided helpful suggestions of the manuscript. The assistance of all of these is gratefully acknowledged.

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MYCOTAXON

Vol. XXXV, No. 2, pp. 395-397 July-September 1989

AZBUKINIA GEN. NOV.

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During studies on the pyrenomycetes of the soviet Far East by the author, some new species and genera were found, and one of the most exciting findings is the fungus recorded by Jaczewski (1913) as *Chailletia ferruginea* (Fuckel) Jacz. Unfortunately, the genus *Chailletia* Jacz. is invalid because of its thrice-repeated usage for various kinds of organisms (Hawksworth et al., 1983). So, a new genus is described here:

Azbukinia Lar. Vass., gen. nov.

Syn.: *Chailletia* Jacz., Opred. gribov (The handbook of fungi) 1: 233. 1913, nom. nud.; non *Chailletia* DC., Ann. Mus. Natl. Hist. Nat. 17: 153. 1811; non *Chailletia* Fuckel, Fungi Rhen. 6: 557. 1863; non *Chailletia* Karsten, Mycol. Fenn. 1: 21, 241. 1871.

Stromata eutypoidea, ligno decorticato insidentia vel verruciformiter elevata, effusa, confluentia vel irregulariter efformata, nigrescentia. Ostiola prominentia, distincte sulcata. Perithecia ligno immersa, ovoidea vel compressa, collo longi. Asci unitunicati, cylindrici, fasciculati, paraphysati, apparatu apicali nonamyloideo. Ascosporae uniseriales, ellipsoideae, incoloratae, dictyoseptatae.

Type species: *Azbukinia ferruginea* (Fuckel) Lar. Vass.

Azbukinia ferruginea (Fuckel) Lar. Vass., comb. nov.

Syn.: *Melanops ferruginea* Fuckel, Jahrb. Nassauischen Ver. Naturk. 27-28: 40. 1873.- *Botryosphaeria ferruginea* (Fuckel) Sacc. Syll. Fung. 1: 465. 1882. - *Chailletia* *ferruginea* (Fuckel) Jacz. Opred. gribov, 1: 233. 1913.

Stromata eutypoid, effuse or limited, sometimes very prominent and robust, black. Perithecia immersed, 500-600 µm diam, with sulcate ostioles and elongate beaks projecting beyond surface of stroma. Asci unitunicate, cylindrical, in fascicle, with numerous paraphyses and nonamyloid apical ring, 130-150 x 10-12 µm. Ascospores uniseriate, ellipsoid, 3-(4-)septate and one vertical septum, without constrictions, hyaline, 16-20 x 7-9 µm.

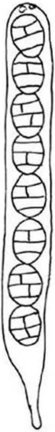
In woody plants, USSR, Primorski region, reservation "Kedrovaja Padj," October 1987, Lar. N. Vasilyeva.

The original description and illustration (Fuckel, 1873) indicated that the ascospores were one celled and contained four to six guttules. Winter (1887) made the observation that the fungus is dictyosporous. He provided no other disposition for the species, which he listed under *Botryosphaeria* as doubtful or to be excluded.

Jaczewski (1913) placed this fungus in the family Valsaceae among a very heterogeneous complex of genera (*Mamiania* Ces. et de Not., *Valsa* Fr., *Anthostoma* Nits., *Physalosporina* Woronich., *Botryosphaeria* Ces. et de Not., *Chailletia* Jacz., *Melogramma* Fr., *Kalmusia* Niessl, *Endothia* Fr., *Diaporthe* Nits., *Hercospora* Tul., *Rhynchostoma* Karst., *Myrmaecium* Nits.), which actually belong in Valsaceae, Gnomoniaceae, Diatrypaceae, Dothideaceae or Hypocreaceae.

The perithecial centrum of the fungus (i.e., fasciculate asci with paraphyses) is characteristic of the family Diatrypaceae in my new treatment (Vasilyeva, 1987, 1988) which includes all ascospore types (in contrast to more widely accepted "allantosporous concept," cfr. Eriksson and Hawksworth, 1986, pp. 218-219) and exhibits the complete parallelism to the family Valsaceae both in ascosporic and stromatal characters.

It should be noted that the genus *Azbukinia* falls on that place in the table of generic distribution in Diatrypaceae (Vasilyeva, 1987, p. 39) which was unoccupied before, i.e., it corresponds to the expected generic combination of dictyospores and eutypoid (or diatrypoid) stromata. The fulfilled predictions are the indicators of the natural system and of the robustness of its theoretical grounds.



Azbukinia ferruginea: Stroma and ascus with ascospores.

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MYCOTAXON

Vol. XXXV, No. 2, pp. 399-404 July-September 1989

TWO NEW SPECIES IN PARMELIACEAE (LICHENIZED ASCOMYCOTINA) AND NEW RECORDS FOR ARGENTINA

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ABSTRACT: The Argentinian species *Punctelia jujensis* Adler and *Parmotrema pseudobreviciliatum* Adler, Elix & Hale, are described as new. The former is known only from Jujuy Province and the latter, from Buenos Aires Province in Argentina, and also from Brazil. In addition four new species previously unrecorded for Argentina are reported.

METHODS: Thalline chemistry was determined by thin layer chromatography (Culberson & Ammann, 1979), high performance liquid chromatography (Lumbsch & Elix, 1985) and comparison with authentic samples.

PUNCTELIA JUJENSIS Adler sp. nov. Fig.1

Thallus foliaceus adnatus, cinereus, ca 10 cm latus, sine propagulis; lobis subrotundatis 3-7 mm latis. Superficies pseudocyphellatus, pseudocyphellis punctiformibus minutis (< 0.2 mm latis) sparsis. Facies infera castanea vel nigricans, rhizinis longis, simplicibus, eborineis vel hyalinis, raro concoloribus. Pycnidia inmersa, conidiis filiformibus, 9-15 µm longis. Apothecia ignota. Atranorinum et acidum gyrophoricum continens.

Type: **Argentina**, Jujuy Province, Yala River (65°25'W, 24°07'S,1500m); on roadside *Populus* sp. cortex, M.T.Adler, II-1986, BAFC 35.388-holotype, ANUC-isotype.

Thallus foliose, adnate, corticolous, light to dark grey, with chestnut to yellow tinge. Lobes apically subrotund, 3-7 mm wide. Upper surface plane to broadly undulate, rugose in the center, with punctiform, sparse, minute (< 0.2 mm diam.), evenly scattered pseudocyphellae; without isidia, soredia, squamules or lobulae. Medulla white. Lower surface chestnut to black except for an ivory marginal zone below the apices of the lobes. Rhizines long, simple, ivory, hyaline or concolorous with the lower surface. Pycnidia immersed, mainly submarginal, with filiform conidia 9-15µm long. Apothecia not known.
Chemistry: Cortex K+ yellow (atranorin), medulla K-, C+ pink and KC+ pink (gyrophoric acid).

Currently seven species of *Punctelia* with filiform conidia have been recognized, five of which lack vegetative propagules. Krog(1982) accepted three of the five such species: *P. hypoleucites* (Nyl.) Krog (pale underside, lecanoric acid); *P. microsticta* (Müll. Arg.) Krog (black underside, unknown fatty acids, spores less than 20 µm long); and *P. negata* (Nyl.) Krog (black underside, unknown fatty acids, spores more than 20 µm long). More recently Galloway and Elix (1984) added *P. subalbicans* (Stirt.) Galloway & Elix (pale underside, lecanoric acid as in *P. hypoleucites*, but differing mainly in distribution of pseudocyphellae; laminal in *P. hypoleucites*, marginal in *P. subalbicans*). Recently Elix and Johnston (1988) described also *P. nebulata*, which has pale underside and lacks medullary substances.

Two further species have vegetative diaspores: *P. colombiana* Sér. (Sérusiaux, 1984; isidiate, black underside, gyrophoric acid); and *P. novozelandica* Elix & Johnston (1988); lobulate and isidiate, black underside, lecanoric acid).

The new species, *P. jujensis*, belongs to the first group which lack vegetative propagules. It is distinguished by the presence of gyrophoric acid in the medulla in combination with a chestnut to black lower surface. This new species probably represents the non-isidiate morph of *P. colombiana*. This species is reported here for the first time from Argentina (see further). It was frequently collected on rocks of Buenos Aires, Córdoba and Jujuy Provinces.

PARMOTREMA PSEUDOBREVICILIATUM Adler, Elix & Hale sp.nov. Fig.2

Species cum thallo et substantiis principalibus (atranorinum et acidum alectoronicum) ut in *Parmotrema breviciliatum* (Hale) Hale sed ab hac specie conidiis filiformibus 8-11 µm longis differt.

Type: **Argentina**, Buenos Aires Province, on granite rock, near Cerro "El Centinela", Partido de Tandil (59°09'W, 37°20'S, 350 m). M.T.Adler I-1987; BAFC 35.901-holotype; ANUC, US-isotypes.

Thallus saxicolous, grey to greenish grey, ca 5-15 cm diam. or mat-forming. Lobes 4-10 mm wide, with rounded apices, sometimes crenate or deeply incised, especially towards the center, where they sometimes form isidioid (cylindrical to triangular, 1-3 mm wide) lobules (not present in all specimens); margin moderately ciliate with slender cilia up to 2.5 mm long. Upper surface broadly undulate, emaculate or slightly maculate in older parts, occassionally forming verrucose isidia-like granules. Medulla white. Lower surface black with a pale tan marginal zone at the apices of the lobes; this marginal zone is ivory, white or mottled when the lobes are fertile. Mature apothecia infrequent, cupuliform, stipitate, with an imperforate brown disc up to 1 cm diam.; margin ornate with isidioid lobules; ascospores 10-14 X 13-18 µm. Pycnidia immersed, conidia filiform 8-11 µm long.

hemistry: Cortex K+ yellow (atranorin); medulla K-, C-, KC+ purple turning orange; alectoronic acid (major), α-collatolic acid (major), unknown substance related to alectoronic acid (minor) and a unknown pink pigment (variable from major to trace).

Parmotrema pseudobreviciliatum appears to be closely related to *P. breviciliatum* (Hale) Hale (1965 and 1974; holotype at US!). Both are saxicolous, similar in morphology and chemistry and occasionally form laminal, isidia-like structures. Nevertheless the two species differ in type and length of conidia: in *P. breviciliatum* they are sublageniform and 6-8 µm long while in *P. pseudobreviciliatum* they are slender, filiform and 8-11 µm long.

P. pseudobreviciliatum is also closely related to the corticolous Indian endemic *Parmotrema vartakii* Hale, which lacks both ∝-collatolic acid and the unknown associated with alectoronic acid, which are major and minor substances respectively in *P. pseudobreviciliatum*.

So far this new species is known from Argentina, where it grows on rocks both in protected sites (near small streams) and in more exposed situations, and from Brazil (Hale, pers. comunication).

Specimens examined: **Argentina.** Buenos Aires Province; on rock, near Arroyo "Los Helechos", Sierra de La Ventana, Partido de Tornquist, M.T.Adler, V-1986 (BAFC 35.787); on granite, near Cerro "El Centinela", Partido de Tandil, M.T.Adler, I-1987 (BAFC 35.935, 35.938); on granite, near "La Cascada", Partido de Tandil, M.T.Adler, I-1987 (BAFC 35.933, 35.934, 35.936, 35.942).

NEW RECORDS FOR ARGENTINA

Flavoparmelia haysomii (Gyel. & Fóriss) Hale

Buenos Aires Province. Olavarría, Partido de Olavarría, on rock, mixed with *Flavoparmelia papillosa*, M.T. Adler, III-1986 (BAFC 35.695). Sierra de La Ventana, Partido de Tornquist, Parque Provincial E. Tornquist, on rock mixed with *F. papillosa*, M.T. Adler, V-1986 (BAFC 35.699).

Paraparmelia rupicola (Lynge) Elix & Johnston

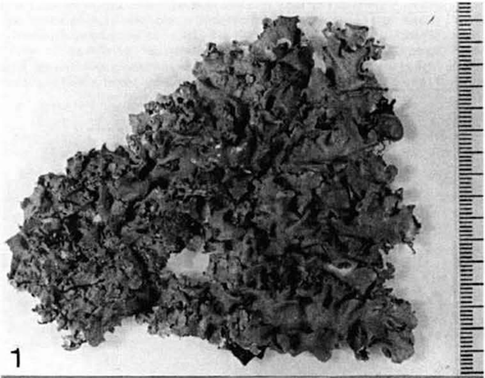
Buenos Aires Province. Sierra de La Ventana, on rock, M.T.Adler V-1986 (BAFC 35.795); Tandil, near Cerro "El Centinela", on rock, M.T. Adler, I-1987 (BAFC 36.012); Tandil, "La Cascada", on rock, M.T. Adler I-1987 (BAFC 36.009, 36.010, 36.011).

Punctelia colombiana Sérusiaux

Buenos Aires Province. Sierra de La Ventana, Arroyo "Los Helechos", on rock, M.T. Adler, V-1986 (BAFC 35.801, 35.802); Tandil, "La Cascada", on rocks, M.T. Adler, I-1987 (BAFC 36.393, 35.915); Tandil, "La Movediza", on rock, M.T. Adler, I-1987 (BAFC 35.919).

Córdoba Province. Near Copina, on soil deposited on rocks, M.T.Adler, X-1985 (BAFC 36.396); Los Gigantes, on soil deposited on rocks, M.T. Adler, X-1985 (BAFC 36.395).

Jujuy Province. Near Laguna Yala, on soil deposited on rocks, *M.T. Adler, II-1986 (BAFC 36.397, 36.398, 36.400, 36.401); near* Laguna Yala, on *Alnus jorulensis* cortex, M.T. Adler, II-1986 (BAFC



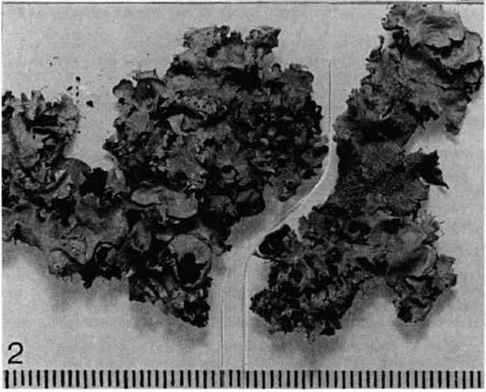


Fig.1- Holotype of *Punctelia jujensis* (BAFC 36.388).

Fig.2- Part of holotype of *Parmotrema pseudobreviciliatum* (BAFC 35.936).

36.402).

Some collections from Jujuy Province, show a typical mixture of both coralloid and small dorsiventral isidia (as in the type at S!). However most collections, especially from Córdoba and Buenos Aires Provinces, have only the small, simple isidia.

Punctelia semansiana (Culb. & Culb.) Krog

Buenos Aires Province. Sierra de La Ventana, Abra de La Ventana at Cerro Bahía Blanca's base, on soil and musci, M.T. Adler, V-1986 (BAFC 35.805 (determination, M.T. Adler, confirmed by J.A. Elix), 35.808); Tandil, "La Movediza", on rock, M.T. Adler, I-1987 (BAFC 35.910, 35.914); Tandil, "La Cascada", on rocks, M.T. Adler, I-1987 (BAFC 35.911, 35.912, 35.913).

Salta Province. Cuesta del Obispo, near Escoipe, part on soil and musci and part on rock, M.T. Adler, II-1986 (BAFC 35.945, det. by M.T. Adler, confirmation, J.A. Elix).

Part of the Argentinian collections studied had the lobes more incised than the holotype (at DUKE!), sometimes plenty of lobules.

ACKNOWLEDGEMENTS

I wish to thank Drs. J.A. Elix, M.E. Hale Jr. and J.E. Wright for critically reading the manuscript and for valuable assistance and suggestions; Mr. D. verdon for checking the Latin diagnosis; Dra. I. Gamundi de Amos for the organization of the trip to Sierra de La Ventana; Lic. M.A. Bernabé, Prof. H.H. de Ormazábal and Mr. Alvaro Zamacona for assistance in field work; the Herbaria US, S and DUKE for the loan of types and critical collections; and the Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET) of Argentina, for making this work possible through a post-graduate fellowship to M.T. Adler.

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MYCOTAXON

Vol. XXXV, No. 2, pp. 405-406 July-September 1989

SOME NAME CHANGES NECESSITATED BY THE REDEFINITION OF THE GENUS CANDIDA

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In a recent publication Weijman *et al.* (1988) further amended the description of the genus *Candida* and removed some basidiomycetous species to the genera *Rhodotorula* and *Cryptococcus.* However they did not completely purge *Candida* of all its basidiomycetous species, i.e. all those which give a positive result in the diazonium blue B and urea tests, have a fine structure characteristic of basidiomycetous yeasts and whose polysaccharides contain either xylose, fucose or rhamnose.

Four species were overlooked, namely: *Candida buffonii, C. dulciaminis, C. lignophila,* and *C. huempii.* Moreover, although Weijman *et al.* (1988) placed *Apiotrichum* in synonymy with *Cryptococcus* they failed to rename the species *A. futronensis* and *A. nothofagi.* The purpose of this short communication is to remedy these ommissions.

The diagnostic properties of *Cryptococcus* and *Rhodotorula* according to Weijman *et al.* (1988) are given in Table 1, together with results for inositol growth, galacturonate growth, and starch production reported by Barnett *et al.* (1987, 1989), as well as of the polysaccharide analyses found in this study. The carbohydrates were analyzed according to Weijman & Golubev (1987). The cell walls are multilayered and therefore characteristic of basidiomycetous yeasts (W. Batenburg-v.d. Vegte, pers.comm.).

Table 1

	Growth		Starch	Polysaccharide		
	inositol	galacturonate	production	xylose	fucose	rhamnose
Cryptococcus	+ or -	+	+	+	+ or -	-
Rhodotorula	-	+ or -	-	-	+ or -	+ or -
Candida buffonii (CBS 7150)	-	-	-	-	+	+
C. dulciaminis (CBS 7288)	-	+	-	-	+	+
C. huempii (CBS 8186)	-	+	+	+	+	-
C. lignophila (CBS 7109)	-	+	-	-	+	+
Apiotrichum futronensis (CBS 8163)	-	-	-	-	+	+
A. nothofagi (CBS 8166)	-	-	-	-	+	+

From this table it can be clearly seen that *Candida huempii* must be reassigned to *Cryptococcus* and the rest of the species to *Rhodotorula*, as follows:

Cryptococcus huempii (Ramírez & González) Roeijmans, van Eijk & Yarrow nov. comb.
Basionym: *Candida huempii* Ramírez & González, 1984, Mycopathologia 88: 167.
Rhodotorula buffonii (Ramírez) Roeijmans, van Eijk & Yarrow nov. comb.
Basionym: *Torulopsis buffonii* Ramírez, 1957, Microbiol. Españ. 10: 238.
Rhodotorula dulciaminis (Tokuoka et al.) Roeijmans, van Eijk & Yarrow nov. comb.
Basionym: *Candida dulciaminis* Tokuoka, Ishitani, Goto & Komagata, 1987, J. Gen. Appl. Microbiol. 33: 5.
Rhodotorula lignophila (Dill *et al.*) Roeijmans, van Eijk & Yarrow nov. comb.
Basionym: *Candida lignophila* Dill, Ramírez & González, 1984, Antonie van Leeuwenhoek 50: 220.
Rhodotorula futronensis (Ramírez & González) Roeijmans, van Eijk & Yarrow nov. comb.
Basionym: *Apiotrichum futronensis* Ramírez & González, 1984, Mycopathologia 88: 74.
Rhodotorula nothofagi (Ramírez & González) Roeijmans, van Eijk & Yarrow nov. comb.
Basionym: *Apiotrichum nothofagi* Ramírez & González, 1984, Mycopathologia 88: 76.

ACKNOWLEDGEMENTS

Dr. A.C.M. Weijman performed the presubmission review, and we are sincerely grateful for his time and expertise.

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MYCOTAXON

Vol. XXXV, No. 2, pp. 407-416 July-September 1989

A CONTRIBUTION TO THE GENERIC DEFINITION OF FUSARIUM

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Abstract

In *Fusarium* distinction is usually made between macroconidia and microconidia, though a differentiation between conidia of the aerial mycelium and sporodochial conidia (always pluricellular and foot-celled) is more appropriate. Classification of the microconidial or aerial forms of sporulation is possible in *Fusarium* if the generic diagnosis is slightly broadened, while none of the other presently used amerosporous genera is suited to accommodate them.

A polythetic definition of the genus is proposed that takes care of numerous variations. The crucial point is the potential of every *Fusarium* to produce fusiform, septate, "sporodochial" phialoconidia, though they need not be present in every specimen or culture. With this definition it is possible to recognize isolates that form exclusively microconidia as *Fusarium* and it is also admissible to combine taxa based on such conidia in *Fusarium*.

Hennebert (1987) outlined the problems involved in the definition and naming of pleoanamorphic genera in either a pseudobotanical or an anatomical way. He reached the conclusion that what is used in practice is some kind of compromise between the two; it is impossible to state in general rules, to what extent the anatomical system can be pursued.

Fusarium with its different forms of sporulation is an outstanding example to illustrate all the inherent problems. An unmistakable definition of the genus, covering all border-line cases, is one of the major tasks of the I.S.P.P. Committee for *Fusarium* nomenclature. Only with such a definition will it be possible to avoid further conflicts about the nomenclature of microconidial forms, which still hamper the communication among experts.

Among all hyphomycete genera, *Fusarium* is one of the best known and extensively studied cases, with regard to natural affinities of sections and teleomorph connections (Samson & Gams, 1984). Since Wollenweber and Reinking (1935) the genus has a rather natural circumscription. Gams & Gerlagh (1968), included the anamorph of *Plectosphaerella* that does not really fit in this complex of related fungi and will have to be excluded. Among previously reported teleomorphs, *Calonectria* has been eliminated with the conclusion by Rossman (1983), that *C. rigidiuscula* is best classified as *Nectria rigidiuscula* Berk. & Br.. The genera *Micronectriella*, *Cryphosphaeria* and other teleomorph names (ultimately *Monographella*, Müller, 1977) have been discarded for *Fusarium* by the now widely accepted conclusion that *F. nivale* with its annellidic conidiogenesis (Gams & Müller, 1980) is to be accommodated in *Microdochium* (or *Gerlachia*), because of the classification of the teleomorph in the Hyponectriaceae (Samuels & Hallett, 1983). Other species transferred by von Arx (1984) from *Fusarium* to *Microdochium* may better remain in *Fusarium*, as their conidiogenesis is regularly phialidic. The genus *Fusarium* then will contain only anamorphs of two complex ascomycete genera of the Nectriaceae, *Gibberella* and *Nectria*.

This situation provides strong arguments for the desirability to reach a delimitation of the genus according to natural affinities rather than according to a schematic anatomical criterion of conidial shape and conidiogenesis. The salient feature of the genus is septate, fusiform, pedicellate macroconidia with phialidic (monophialidic or sympodial-polyphialidic) conidiogenesis, but other forms of conidia and modes of conidiogenesis also occur. The occurrence of sporodochia, for some time used to distinguish *Fusarium* from *Fusisporium* Link, had been obsolete as a generic criterion since Wollenweber's work (Wollenweber and Reinking, 1935), but see below.

According to the present circumscription, the genus also comprises species that form non-septate and 1- to 2-septate **microconidia**. Since the division of conidia into pluriseptate macroconidia and microconidia is usually not possible along a sharp borderline, it might be more precise to distinguish between conidia (non-pedicellate) borne in the aerial mycelium on non-aggregated conidiophores ("**conidia of the aerial mycelium**") and of conidia borne on the surface of the substrate on aggregated conidiophores: pionnotes, sporodochia, synnemata, acervuli ("**sporodochial conidia**"). The latter are pedicellate and are consistently of phialidic origin; the former may have both phialidic and polyphialidic conidiogenesis (Booth, 1971). When these conidia are produced singly, Booth (l.c.) called them polyblastic, Gams (1973) preferred to speak of phialides with solitary conidia rather than true blastoconidia, because after formation of a single conidium an internal wall thickening becomes visible that occludes the opening of the conidiogenous cell. If this hypothesis is true, there is no conceptual discontinuity between the phialidic and monoconidial conidiogenesis (at least in *Fusarium*). Electron-microscopic examination of the situation has still to be done. For brevity's sake, we shall continue to call them polyblastic here. But the same fungi under certain circumstances also produce phialidic (sporodochial) conidia and then there is no doubt about their inclusion in *Fusarium*. In culture, wild-type isolates of *Fusarium* always produce phialidic pedicellate conidia under certain conditions. The only species that fail to do so are *F. camptoceras* and *F. ventricosum* and their inclusion in the genus remains problematic. In the Berlin collection there are only two isolates of each species and possibly, if the conditions are varied, they also may form sporodochia.

Matsushima (1971) defined the genus *Pseudofusarium* because of polyblastically formed conidia, but in 1980 he no longer recognized this genus as distinct from *Fusarium*. We agree with this conclusion. *F. semitectum* (now *F. pallidoroseum* (Cooke) Saccardo, fide Booth & Sutton, 1984), forms, by preference, fusiform conidia on polyblastic conidiogenous cells in the aerial mycelium and it has therefore repeatedly caused problems of generic classification. But under special conditions it also produces typical *Fusarium* conidia in culture, establishing its classification in this genus. Within the same species there are isolates (also in *F. poae* and others) which prefer to produce conidia in the aerial mycelium only, and others which produce the sporodochial conidia readily.

It is very necessary to use the morphology of the aerial conidia and their conidiophores to identify many *Fusarium* species.

-- If only sporodochial conidia of *F. tricinctum* are available, it is not certain whether this is *F. tricinctum* or *F. reticulatum* or *F. acuminatum*.

-- No species of the section *Liseola* can be identified if aerial conidia are absent.

are absent.
-- One important difference between sections *Elegans* and *Martiella* is the length of the conidiophores of the aerial mycelium: short in *Elegans*, and long in *Martiella*.

The crucial question to be asked here is, whether it is necessary and meaningful to coin additional generic names for these synanamorphs present alongside the septate, phialidic, sporodochial conidia. If a choice for the anatomical system sensu Hennebert is made, a complicated nomenclature will ensue, such as "*Pseudofusarium* synanamorph of *F. chlamydosporum*", etc. Some new generic names will have to be coined, because *Cephalosporium* (even in its broadest sense) is no longer available and the microconidial forms of sporulation of the *Eupionnotes, Spicarioides, Sporotrichiella, Liseola, Martiella* and *Elegans* fusaria definitely do not belong to *Acremonium* as circumscribed by Gams (1971). Admittedly, the circumscription of *Acremonium* is still very heterogeneous and far from ideal, but a further extension to include microconidial fusaria would only make matters worse. Moreover, for the pluriseptate conidia of the aerial mycelium (sections *Roseum* and *Arthrosporiella; F. bullatum, F. stilboides* and *F. sporotrichioides*), the genus *Fusisporium* would have to be reintroduced, and also the species *Fusarium ventricosum*, which Wollenweber and Reinking (1935) placed in *Fusarium* because of its teleomorph, would have to be called *Fusisporium ventricosum*, a step backward to a pre-Wollenweber system.

The alternative is to reach a polythetic definition of *Fusarium*, that may be rather complex and worded like "...if only microconidia occur, then ...". Nevertheless, a reasonably experienced worker should be able to recognize an atypically developed *Fusarium* as such, as long as there is positive evidence that no other similar anamorph can be confused with it. Gams (1982, 1984) argued in particular for uniting synanamorphs of one fungus with the same conidiogenesis in the same genus whenever possible. Minter (1987) expressed a similar idea: "The plastic nature of fungal development makes it essential that conidiogenesis is not studied separately: it can only be understood in the context of the whole fungus". Conidial septation is now often considered dissatisfactory as a generic criterion and 0- to 3-septate species are recognized in, e.g., *Arthrobotrys* (Schenck et al., 1977; van Oorschot, 1985). In some *Fusarium* species there is a continuous range from 1-celled to 4- or more-celled conidia; in others the delimitation between macro- and microconidia is sharper.

The best way to reach a meaningful decision between the two alternatives, anatomical or botanical nomenclature, that will be acceptable to the *Fusarium* experts, is to analyze some cases. We discuss here two examples that may point to the direction of the anatomical system:

Seemüller (1968) was not prepared to accept a microconidial fungus as a *Fusarium* of the section *Sporotrichiella* unless it produced at least some macroconidia. But we often identify *Fusarium* species of the *Sporotrichiella* section on the basis of the microconidia alone (especially *F. poae* and *F. tricinctum*). Problems may arise with *F. sporotrichioides* and *F. chlamydosporum*, but actually the "macroconidia" are not indispensable. In both cases the chlamydospores are important (otherwise confusion with *Microdochium* or similar fungi might be possible), and in *F. sporotrichioides* also the conidiophores, on which the pyriform conidia are borne.

In the sections *Elegans* and *Liseola* often specimens or isolates are found that exclusively contain microconidia. As mentioned above, no adequate generic name is available to cover the microconidia. It is, however, possible to recognize such fungi in their true identity. Admittedly, Gams (1971) made a mistake in this respect in overlooking the identity of *Cephalosporium indicum* Petch with *F. moniliforme*. This error was corrected by Nirenberg (1976). But what we wish to emphasize is that there are hardly any fungi known that can be confused with exclusively microconidial *Elegans* or *Liseola* fusaria. Therefore we plead again for recognizing these exclusively microconidial cases as *Fusarium* and nothing else. Otherwise, if the anatomical system were binding, a microconidial specimen of *Fusarium moniliforme*, for example, would always have to be referred to as *Verticillium* (or *Paecilomyces*?) *verticillioides* synanam. of *F. moniliforme*. We do not see any advantage in this.

A crucial deliberation for the present case is the following: the level of species is the basic element of biological classification. In the philosophy of taxonomy the species are regarded as the "individuals" (Ghiselin, 1974; Hull, 1976) which do not have properties that define them (unlike all higher taxonomic categories, called "classes" in this philosophical approach); they simply exist. Therefore a type specimen of a species represents the species in question, no matter how small and fragmentary it is. It is impossible to postulate any criteria to which a type must suffice in order to be recognized as such. This is of course the basic philosophy of the botanical system, as it is applied in the nomenclature of fungal teleomorphs. The anatomical system for anamorphs and synanamorphs is a concession to practical needs; additional names for anamorphs and synanamorphs are permitted but by no means imposed by Article 59 of the ICBN. It must not become a dogma for its own sake that hampers taxonomic insight. Even if we adopt the anatomical idea (not the principle), we must ask the question: to what extent must we dissect morphs?

The only criterion to apply in *Fusarium* is that the type of a species must contain a *Fusarium* and not a fungus of another genus. This depends on the breadth of the generic definition.

Therefore a **polythetic generic definition** is offered here that takes into account all marginal cases. It may read approximately as follows:

Colonies growing moderately (3-5 cm diam in 1 week at 20°C) to rather fast (6-10 cm diam), consisting of hyaline or brightly coloured vegetative hyphae > 1.5 μm wide; aerial mycelium, if present, of characteristic floccose felty appearance. Pigmentation ranging from white to pale pink to intensely red, orange, purple, blue or blue-green, and seldom olive-green or brown, particularly in colony reverse (but never with olivaceous-brown or black wall pigments in the submerged hyphae). Hyaline or bright-coloured to brownish chlamydospores often produced in terminal, lateral or intercalary position, in the latter case often forming chains; conidial cells may also become transformed into chlamydospores. Sclerotial bodies of irregular shape, beige, ochre, brown or blackish, occurring in some species. Sporulation scattered in the aerial mycelium or aggregated in synnemata, sporodochia (sometimes appearing acervular on the host, Sutton, 1986) or forming extended slimy masses (pionnotes). Their conidiophores are complex branched structures, ending in numerous, more or less cylindrical or slightly tapering phialides. They bear fusiform, more or less curved conidia, which are none- to pluriseptate, with a tapering, more or less pointed apical cell, and a more or less differentiated (foot-shaped, see Sutton 1986) basal cell. Conidiophores of the aerial mycelium are far less complex, sometimes consisting of a single conidiogenous cell only (sect. *Elegans*), sometimes consisting of a supporting cell besides the conidiogenous cell (sections *Sporotrichiella* p.p., *Eupionnotes*, and *Martiella* p.p.), sometimes with branching or proliferating supporting cells (sections *Liseola, Spicarioides, Roseum, Martiella* p.p., *Arthrosporiella*, and *Sporotrichiella* p.p.; *F. stilboides*), seldom differentiated by verticillate (sections *Martiella* p.p. and *Liseola* p.p.) or somewhat penicillate (*F. decemcellulare*) arrangement, or polyphialidic (several conidia arising from each denticle) or exclusively polyblastic (one conidium formed from each denticle) conidiogenesis (*F. chlamydosporum, F. pallidoroseum, F. camptoceras*). They bear either mostly one-celled, smaller conidia (microconidia), similar in width to the macroconidia, mostly ellipsoidal, slightly curved, sometimes also fusiform, clavate, pyriform or subglobose, with a rounded or truncate base, normally formed in slimy heads, in a few species also in basipetal chains, or fusiform pluriseptate conidia (macroconidia) without a foot-shaped basal cell.

The crucial point in this definition is the **potential** of every *Fusarium* to produce fusiform, septate "sporodochial" (in the broadest sense, see above) phialoconidia. But they need not be present in every specimen or culture.

If in some isolates conidia occur exclusively in the aerial mycelium, they can be recognized as *Fusarium* by the following combinations of characteristics:

-- Conidia fusiform, mostly 1-celled, borne on densely sympodially proliferating conidiogenous cells (polyblastic); intercalary chlamydospores abundant
  -- colonies intensely red *F. chlamydosporum* var. *chlamydosporum*
  -- colonies beige to brown *F. chlamydosporum* var. *fuscum*

-- Conidia ellipsoidal, mostly 1-celled, more or less curved, sometimes pyriform ones present, borne on mostly unbranched, short conidiophores; colonies beige to pink to violet; terminal, lateral or intercalary chlamydospores present sect. *Elegans*

-- Conidia ellipsoidal, in some species 1-celled, in others 1-4-celled, borne on unbranched or branched long conidiophores; colonies beige, pink to vinaceous or blue; terminal, lateral or intercalary chlamydospores present sect. *Martiella*

-- Conidia clavate, elongate-ovoid or pyriform, mostly 1-celled, borne on more or less branched conidiophores in slimy heads or chains; colonies beige, pink to pale purple or vinaceous; chlamydospores absent sect. *Liseola*

-- Conidia napiform, mostly 1-celled, borne on sparsely branched conidiophores with inflated phialides; chlamydospores absent *F. poae*

-- Conidia citriform, mostly 1-celled, borne on sparsely branched conidiophores with slender cylindric phialides; true chlamydospores absent *F. tricinctum*

-- Conidia fusiform, septate, borne on branched conidiophores with polyblastic conidiogenous cells

  -- Colonies beige to brown; conidia 1- to mostly 3-septate, almost straight; chlamydospores present or absent *F. pallidoroseum* var. *pallidoroseum*
  -- Colonies beige to brown or olivaceous-brown; conidia 1- to mostly 5-septate, almost straight; chlamydospores present or absent *F. pallidoroseum* var. *majus*
  -- Colonies beige to brown; conidia mostly 5-septate, slightly curved; chlamydospores absent *F. camptoceras*
  -- Colonies beige to cherry red, conidia 1- to 5-septate, almost straight; chlamydospores absent *F. avenaceum*
  -- As above, pyriform conidia also occurring *F. arthrosporioides*

-- Conidia fusiform, mostly 1-3-septate, borne on proliferating long conidiophores; colonies white, isabelline to beige; chlamydospores terminal or intercalary *F. ventricosum*

With this refined generic definition it will be possible to assign atypically developed isolates to the correct genus. It will also be possible to recognize type specimens that exclusively contain microconidia as representing species of *Fusarium* (provided a confusion with fungi outside the genus can be ruled out). Only if it is impossible to decide about the specific identity of a certain protologue and type specimen can a name be declared as doubtful.

Many fusaria can only be identified correctly in culture, if and where they are able to produce all their morphological characteristics ("Hochkultur" of the wild type), such as aerial mycelium with conidiophores and conidia, large conidia produced on aggregated conidiophores, and chlamydospores. Growth patterns, colour and sclerotial bodies give only hints. Faced with the problem of identifying a *Fusarium* to species, if we had the choice to do it either on the basis of the aerial conidiophores and conidia only, or on the "macroconidia" only, we would choose the first option; it generally is safer.

The present definition may thus serve to settle debates concerning the nomenclature in the section *Liseola* (Nirenberg, 1976; versus Neish & Leggett, 1981; Kuhlman, 1982), where the oldest available names of three recognized species are based on microconidial material.

F. verticillioides - *Oospora verticillioides* Sacc.
F. sacchari - *Cephalosporium sacchari* Butler
F. proliferatum - *Cephalosporium proliferatum* Matsushima

The advantages of accepting these names based on microconidial material for *Liseola* fusaria have been emphasized by Nirenberg (1976) and Gams (1982, 1984). If *F. sacchari* is not recognized for the taxon under consideration, then this fungus can certainly not be called *F. subglutinans* (Nelson et al., 1983), because at least one other included name is older at specific rank: *F. neoceras* Wollenw. & Reinking.

In this text related genera, particularly *Cylindrocarpon*, have not been touched, but similar problems apply to them.

We hope to have shown here that the acceptance of microconidial forms in *Fusarium* and the recognition of microconidial type specimens for species of *Fusarium* are in line with current *Fusarium* taxonomy and contribute to a natural delimitation of the genus; they are acceptable according to the rules of nomenclature and contribute to the clarification of some nomenclatural problems.

Acknowledgement

This paper was discussed during the 6th International Fusarium Workshop at Tsukuba, Japan, in 1988, and was generally well received. We thank the discussants, particularly Dr W. F. O. Marasas, for their comments, which have contributed to sharpening our views. Prof. R. P. Korf kindly further improved the text.

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MYCOTAXON

Vol. XXXV, No. 2, pp. 417-428 July-September 1989

CHECKLIST OF WESTERN AUSTRALIAN LICHENS

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ABSTRACT : A checklist of 380 lichen species and 16 infra-species taxa has been compiled from an examination of specimens and herbarium records in Australia, British Museum (Natural History) London , and the Conservatoire et Jardin Botaniques (Geneva). Nine genera requiring taxonomic studies are included without species listings.

Introduction

The earliest collection of lichens from Western Australia was made by Robert Brown in 1801 when he was botanist aboard the "Investigator". Collections were made on the mainland adjacent to the Great Australian Bight. Although a list of lichens was published as an appendix to Flinder's journal "Voyage to Terra Australis", their exact localities remain vague.

In 1817, Charles Gaudichaud-Beaupré accompanying Admiral Henri Louis Freycinet on the "L'Uranie" arrived in Shark Bay on September 12, 1818 (Bassett 1962). From the entrance to Shark Bay they moved 40 miles or so across the water to Dampier Bay and the "L'Uranie" laid anchor on September 13. The Bay formed the head of the Peron Peninsula and harboured hostile aborigines, so much so, that when Gaudichaud called for travelling companions to embark on a short plant collecting trip, he had to go botanizing alone. The lichen collections, on return to France, were determined by Christian Hendrik Persoon and the Shark Bay specimen was identified as *Lecidea ochroleuca* Pers.

With the establishment of the Swan River Colony in 1829, botanical exploration expanded and collections made in the hinterland. All previous collections had been along the coastline. With the growth of the settlement, a greater interest in the country was developed in England and Europe, which resulted in European botanists visiting the country for the purpose of investigating the flora and introducing its plants into cultivation.

In 1838, the German botanist Ludwig Preiss visited the Colony and remained until 1842. During this period, Preiss collected thoroughly around Perth, Fremantle, Rottnest Island, Geographe Bay, Busselton, King George's Sound and Cape Riche. He explored the country as far as Cunderdin in the district known as "Quangen Plains". On his return to Germany, the lichen collections were identified by Elias Fries who published an account in "Plantae Preissianae sive enumeratio plantarum" Volume 2. Of the 23 lichens identified, *Usnea pulvinata* Fr. and *Cladonia scutellata* Fr. were described as new. The latter species was collected "ad caudicem Macrozamia preissii". It is now correctly named as *Thysanothecium scutellatum* (Fr.)D.Galloway.

At about the time Preiss was collecting in Western Australia, one of the early settlers, James Drummond made large collections and botanically investigated until then, unknown country. Correspondence with Sir William Hooker added to Drummond's interest and he published several plant names in the Kew Journal (Erickson 1969). Unlike Preiss, who he accompanied for a time, Drummond was not particular as to the collecting localities of his plants, contenting with the note "Swan River". This may be taken to represent the country between the south coast and the Victoria district, including east Mount Barren and the Murchison. In addition to his letters to Sir William Hooker, Drummond contributed several interesting articles to the local newspaper containing systematic, ecological and economic references. Although Drummond was unimpressed with the Porongurup Range near Albany for collecting phanerogams, he was enthusiatic about the cryptogams of the region. This is recorded in a letter to Mr. G. Leake published in "The Inquirer" dated December 6, 1848.

> " The Perangarup (sic) are clothed with mosses and jangermannia (sic) and lichens as rank and luxuraint as I have seen in the moist, rich valleys in the south of Ireland."

Although principally concerned with flowering plants, Drummond had a keen eye for lichens. An observation made on a lichen now correctly known as *Cladia ferdinandii* occurs in a letter to the editor of "The Inquirer" published on May 11, 1842.

> " The beautiful lichen nearly allied to the reindeer moss, with a stem perforated like lace, grows near to Halfway House on the York road."

In 1867, Ferdinand von Müller visited Western Australia on invitation of the Government. He did not contribute much to the State as a collector, but did stimulate in the people he met an interest in the Australian flora, and encouraged private collections among the early settlers. Few of these settlers collected lichens for Ferdinand von Müller.

The desert regions were explored by Ernest Giles and important collections were also made by Richard Helms on the Elder Expedition. The specimens were forwarded to Ferdinand von Müller and in turn the lichens forwarded to Jean Müller in Geneva. The identifications were published in the journal Hedwigia in 1892.

The late P. Bibby of the National Herbarium, Victoria was the first person in Australia to conduct critical taxonomic research on lichens and hepatics. Gordon Smith, then lecturer in Botany at the University of Western Australia, collected lichens and curated the collections in the Botany Department Herbarium (UWA). In 1955, they collaborated on a paper compiling a list of 17 species for Western Australia. However, the authors did emphasize that the list was not comprehensive for the State. Later, Smith (1962), made a study of the flora of the granite outcrops in the Porogurups and listed 12 lichens for that area. E.R.L. Johnson and A.M.Baird (1970) of the same Department studied the vegetation at Forrest on the Nullabor Plain in 1930 and 1955. From their collections, 12 lichens were identified by Dr. R.W.Rogers.

Following Bibby's death, Rex Filson actively continued taxonomic work on lichens and identified Western Australian specimens. Research on coastal limestone lichens was conducted by Sammy (1970) and together with Smith 13 species were recorded for this specialised habitat near Perth (Sammy and Smith 1972). During 1982, R.M. and D.H.S. Richardson collected and partly identified 194 species of lichens from Western Australia. This collection, together with the personal herbarium of N.Sammy, forms the foundation of the lichen specimens at the Western Australian Herbarium (PERTH).

Checklist for Lichen Flora

In the checklist, the lichen genera and species are listed alphabetically. Where the type specimen has been described from Western Australia, the name is shown in bold print. Genera inlcuded without species listing indicate the requirement for taxonomic studies to be undertaken.

Acarospora cervina (Ach.)Mass
Acarospora citrina (Taylor)Zahlbr. & Rech.
Acarospora ferdinandii (Müll.Arg.)Hue
Acarospora negligens H.Magn.
Acarospora novaehollandiae H.Magn.
Acarospora sinopica (Wahlenb.)Mass.
Anema
Arthonia
Arthopyrenia lapponica Anzi
Arthothelium interveniens (Nyl.)Müll.Arg.
Aspicilia calcarea (L.)Mudd
Aspicilia calcarea (L.)Mudd var. caesioalba (le Prev.)Hazsl.
Blastenia
Bacidia microphyllina (Tuck.)Riddle
Bacidia aff. subuletorum (Schreb.)Lett.
Buellia cretacea Müll.Arg.
Buellia desertorum Müll.Arg.
Buellia disciformis (Fr.)Mudd
Buellia epigaea (Hoffm.)Tuck.
Buellia farinulenta Müll.Arg.
Buellia glomerulans (Müll.Arg.)Zahlbr.
Buellia inturgescens Müll.Arg.
Buellia marginulata (Müll.Arg.)Zahlbr.
Buellia punctata (Hoffm.)Mass.
Buellia retrovertens Tuck.
Buellia spuria (Schaerer)Anzi
Buellia stellulata (Taylor)Mudd.
Buellia stigmaea Tuck.
Buellia subalbula (Nyl.)Müll.Arg.
Buellia subcoronata (Müll.Arg.)Malme
Buellia subdisciformis (Leighton)Vainio
Calicium abietinum Pers.
Calicium glaucellum Ach.
Calicium robustellum Nyl.
Calicium salicinum Pers.
Calicium subquercinum Asah.
Calicium tricolor F.Wilson
Calicium victorianum (F.Wilson)Tibell ssp. victorianum
Calicium victorianum (F.Wilson)Tibell ssp. desidiosum Tibell
Caloplaca aurantiaca (Lightf.)Th.Fr.
Caloplaca cerina (Ehrh.)Th.Fr.
Caloplaca cinnabarina (Ach.)Zahlbr.
Caloplaca citrina (Hoffm.)Th.Fr.
Caloplaca erythrosticta (Taylor)Zahlbr.
Caloplaca ferruginea (Hudson)Th.Fr.
Caloplaca flavorubescens (Hudson)Laundon
Caloplaca granularis (Muell.Arg.)Zahlbr.
Caloplaca holocarpa (Hoffm.)Wade
Caloplaca irrubescens (Nyl.)Zahlbr.

Caloplaca lactea (Massal.)Zahlbr.
Caloplaca lateritia (Taylor)Zahlbr.
Caloplaca marina (Wedd.)Zahlbr.
Caloplaca murorum (Ach.)Th.Fr.
Caloplaca murorum var. areolata (Müll.Arg.)Zahlbr.
Caloplaca murorum var. miniata (Hoffm.)Th.Fr.
Caloplaca murorum var. obliterata (Pers.)Jatta
Caloplaca saxicola (Hoffm.)Nordin
Candelaria concolor (Dickson)J.Stein.
Candelaria spraguei (Tuck.)Zahlbr.
Candelaria xanthostigmoides (Müll.Arg.)R.W.Rogers
Candelariella antenaria Räs.
Candelariella vitellina (Ehrh.)Müll.Arg.
Candelariella xanthostigma (Ach.)Lettau
Canoparmelia macrospora Elix & Johnston
Canoparmelia pruinata (Müll.Arg.)Elix & Johnston
Catapyrenium compactum (Massal.)R.Sant.
Catapyrenium lachneum (Ach.) R.Sant.
Catillaria atropurpurea (Schaerer)Th.Fr.
Catillaria chalybeia (Borr.)Massal.
Catillaria lenticularis (Ach.)Th.Fr.
Chaenotheca brunneola (Ach.)Müll.Arg.
Chaenotheca carthusiae (Harm.)Lettau
Chaenotheca chrysocephala (Turn. ex Ach.)Th.Fr.
Chaenotheca ferruginea (Turn. ex Sm.)Migula
Chaenotheca melanophaea (Ach.)Zw.
Chaenothecopsis debilis (Turn. & Borr. ex Sm.)Tibell
Chaenothecopsis pusilla (Ach.)A.Schmidt
Chondropsis semiviridis (F.Müll. ex Nyl.)Nyl.
Chrysothrix candelaris (L.)Laudon
Cladia aggregata (Sw.)Nyl.
Cladia corallaizon F.Wilson ex R.Filson
Cladia ferdinandii (Müll.Arg.)R.Filson
Cladia schizopora (Nyl.)Nyl.
Cladia sullivanii (Müll.Arg.)Martin
Cladina confusa (R.Sant.)Follman & Ahti
Cladonia amaurocraea (Flörke)Schaerer
Cladonia angustata Nyl.
Cladonia borbonica (Delise)Nyl.
Cladonia capitata (Michaux)Sprengel
Cladonia capitellata (J.D.Hook &Tayl.)Church.Babingt.
Cladonia calyciformis Nuno
Cladonia carassensis Vainio
Cladonia cariosa (Ach.)Sprengel
Cladonia cervicornis (Vainio)Kernst.
Cladonia cervicornis subsp. verticillata (Hoffm.)Ahti
Cladonia chlorophaea (Flörke)Sprengel
Cladonia coniocraea (Flörke)Sprengel
Cladonia degenerans (Flörke)Sprengel
Cladonia enantia Nyl.
Cladonia fimbriata (L.)Fr.
Cladonia foliacea (Hudson)Schaerer
Cladonia foliacea var. firma (Nyl.)Vainio
Cladonia furcata (Hudson)Schrader
Cladonia krempelhuberi Vainio
Cladonia macilenta Hoffm.

Cladonia merochlorophaea Asah.
Cladonia ochrochlora Flörke
Cladonia pleurota (Flörke)Schaerer
Cladonia polydactyla (Flörke)Krempelh.
Cladonia praetermissa A.W.Archer
Cladonia phyllophora Hoffm.
Cladonia pyxidata (L.)Hoffm.
Cladonia ramulosa (With.)Laundon
Cladonai rigida (J.D.Hooker & Taylor) Hampe
Cladonia southlandica Martin
Cladonia subcervicornis (Vainio)Kernst.
Cladonia sulcata var. wilsonii (Archer)Archer
Cladonia tesellata Ahti & Kashiwadani
Cladonia theophila Asah.
Coccocarpia erythroxili (Sprengel)Swinscow & Krog
Coelocaulon aculeatum (Schreber)Gyel.
Collema coccophorum Tuck.
Collema glaucopthalmum Nyl.
Cyphelium trachylioides (Nyl.ex Deichm. Branth & Rostr.)Erichs. in Keissler
Degelia duplomarginata Arvidsson & Galloway
Diploicia canescens (Dickson)Massal
Diploschistes gypsaceus (Ach.)Zahlbr.
Diploschistes hensseniae Lumbsch & Elix
Diploschistes ocellatus (Vill.)Norm.
Diploschistes scruposus (Schreb.)Norm
Diplotomma alboatrum (Hoffm)Flotow
Dirinaria aegialita (Ach.)Moore
Dirinaria applanata (Fée)Awasthi
Dirinaria batavica Awasthi
Dirinaria picta (Sw.)Clem. & Schaerer
Endocarpon helmsianum Muell.Arg.
Ephebe lanata (L.)Vainio
Eremastrella crystallifera (Taylor)G.Schneider
Flavoparmelia diffractaica Elix & Johnston
Flavoparmelia proeuplecta Elix & Johnston
Flavoparmelia ferax (Müll.Arg.)Hale
Flavoparmelia rutidota (Müll.Arg.)Hale
Flavoparmelia scabrosina Elix & Johnston
Flavoparmelia secalonica Elix & Johnston
Fulgensia bracteata (Hoffm.)Jatta
Fulgensia subbracteata (Nyl.)Poelt
Fuscidea cyathoides (Ach.)V.Wirth & Vezda
Graphis afzelii Ach.
Graphis scripta (Wigg.)Ach.
Haematomma eremaeum R.W.Rogers
Haematomma pruinosum R.W.Rogers
Haematomma puniceum (Ach.)Mass.
Heppia acarosporoides Müll.Arg.
Heterodea beaugleholei R. Filson
Heterodea muelleri (Hampe)Nyl.
Heterodermia dendritica (Pers.)Poelt
Heterodermia japonica (Sato)Swinscow & Krog
Heterodermia obscurata (Nyl.)Trev.
Heterodermia speciosa (Wulfen)Trevisan
Hypocoenomyce australis Timdal
Hypocoenomyce scalaris (Ach.)Choisy
Hypogymnia pulchrilobata (Bitter)Elix

Hypogymnia pulverata (Nyl. ex Crombie)Elix
Hypogymnia subphysodes (Krempelh.)Filson var. austerodioides Elix
Hypogymnia subphysodes (Krempelh.)Filson var. subphysodes
Lecania erysibe (Ach.)Mudd
Lecanora caesiorubella Ach.
Lecanora caesiorubella Ach. ssp. glaucomodes (Nyl.)Imshaug & Brodo
Lecanora campestris (Schaerer)Hue
Lecanora expallens Ach.
Lecanora muralis (Schreb.)Rabenh.
Lecanora pallida (Schreb.)Rabenh.
Lecanora rupicola (L.)Zahlbr.
Lecanora sphaerospora Müll.Arg.
Lecidea contigua (Hoffm.)Fr.
Lecidea glauca Tayl.
Lecidea laeta Stirt.
Lecidea limitata (Scop.)Gray
Lecidea multiflora Tayl.
Lecidea ochroleuca Pers.
Lecidea planata Müll.Arg.
Lecidea templetonii T.Tayl.
Lecidea varians Ach.
Leproloma membranacea (Dickson)Laundon
Leptogium brebissonii Mont.
Leptogium menziesii (Sm.)Ach.
Leptogium phyllocarpum (Pers.)Mont.
Leptotrema
Letrouitia domingensis (Pers.)Hafellner & Bellemere
Lichina minutissima A.Henssen
Lichenothelia scopularia (Nyl.)D. Hawksworth
Menegazzia caesiopruinosa P.James
Menegazzia platytrema (Muell.Arg.)R.Sant.
Microcalicium conversum Tibell
Microthelia micula (Flotow)Körb.
Mycocalicium albonigrum (Nyl.)Tibell
Mycocalicium subtile (Pers.)Szat.
Mycocalicium victoriae (C.Knight ex F.Wilson)Tibell
Mycoporum quercus (Massal.)Müll.Arg.
Neofuscelia imitatrix (Tayl.)Esslinger
Neofuscelia incantata (Esslinger)Esslinger
Neofuscelia loxodella (Esslinger)Esslinger
Neofuscelia pulla (Ach.)Esslinger
Neofuscelia verrucella (Esslinger)Esslinger
Ocellularia
Ochrolechia pallescens (L.)Mass.
Ochrolechia parella (L.)Mass.
Ochrolechia pseudotartarea (Vainio)Verseghy
Ochrolechia subathallina H.Magn.
Ochrolechia subpallescens Verseghy
Pannaria elatior Stirt.
Pannaria pityrea (DC.)Degel.
Pannaria rubiginosa (Thunb. ex Ach.)Delise
Pannoparmelia angustata (Pers.)Zahlbr.
Pannoparmelia wilsonii (Ras.)Galloway
Paraparmelia sammyii Elix & Johnston
Paraparmelia sargentii Elix & Johnston
Parmelina conlabrosa (Hale)Elix & Johnston
Parmelina endoleuca (Tayl.)Hale

Parmelina labrosa (Zahlbr.)Elix & Johnston
Parmelina quercina (Willd.)Hale
Parmentaria microspora Muell.Arg.
Parmotrema cooperi (J.Stein & Zahlbr.)Serusiaux
Parmotrema dilatatum (Vainio)Hale
Parmotrema chinense (Osbeck)Hale & Ahti
Parmotrema praesorediosum (Nyl.)Hale
Parmotrema reticulatum (Tayl.)Choisy
Parmotrema subrugatum (Kremplh.)Hale
Parmotrema subsumptum (Nyl.)Hale
Parmotrema tinctorum (Nyl.)Hale
Peccania
Peltigera dolichorhiza (Nyl.)Nyl.
Peltigera spuria var. erumpens (Ach.)DC. ex Lam. & DC.
Peltula australiensis (Müll.Arg.)R.Filson
Peltula euploca (Ach.)Poelt ex Ozenda & Clauz.
Peltula omphaliza (Nyl.)Wetmore
Peltula placodizans (Zahlbr.)Wetmore
Pertusaria flavicans Lamy
Pertusaria hymenea (Ach.)Schaerer
Pertusaria leioplaca (Ach.)DC.
Pertusaria leioplacella Nyl.
Pertusaria pertusa (L.)Tuck.
Pertusaria pustulata (Ach.)Duby
Phaeographina
Phaeographis
Phaeophyscia endococcinoides (Poelt)Esslinger
Phaeophyscia orbicularis (Necker)Morburg
Phaeotrema
Physcia aipolia (Ehrh. ex Humb.)Fürnr.
Physcia alba (Fée)Müll.Arg.
Physcia albicans (Pers.)Thomson
Physcia caesia (Hoffm.)Furnr.
Physcia stellaris (L.)Nyl.
Physcia tribacia (Ach.)Nyl.
Physcia virella (Ach.)Flagey
Physconia pulverulenta (Hoffm.)Poelt
Placopsis perugosa (Nyl.)Nyl.
Pleurotrema pyrenuloides Müll.Arg.
Polysporina simplex (Davies)Vezda
Porocyphus lichenelloides A.Henssen
Porpidia macrocarpa (DC.)Hertel & Schwab.
Pseudocyphellaria aurata (Sm.)Vainio
Pseudocyphellaria billardierei (Delise)Räsänen
Pseudocyphellaria crocata (L.)Vainio
Pseudocyphellaria neglecta (Müll.Arg.)H.Magn.
Pseudocyphellaria richardii (Mont.)Mass.
Psora decipiens (Hedwig.)Hoffm.
Psoroma sphinctrinum (Mont.)Nyl.
Punctelia subalbicans (Stirt.)Galloway & Elix
Punctelia subrudecta (Nyl.)Krog
Pyxine coccifera (Fée) Nyl.
Pyxine cocoes (Sw.)Nyl.
Pyxine petricola Nyl.
Pyxine subcinerea Stirt.
Ramalea cochleata Müll.Arg.
Ramalina australiensis Nyl.

Ramalina canariensis Steiner
Ramalina celastri (Sprengel)Krog & Swinscow subsp. celastri (Ach.)N.Stevens
Ramalina celastri (Sprengel) Krog & Swinscow subsp. ovalis (J.D.Hook. & Tayl.) N.Stevens
Ramalina fissa (Müll.Arg.)Vainio
Ramalina glaucescens Krempelh.
Ramalina inflata (J.D.Hook. & Tayl.)J.D.Hook. & Tayl. subsp. **australis** N.Stevens
Ramalina subfraxinea Nyl. var. subfraxinea Nyl.
Ramalina subfraxinea Nyl. var. norstictica N.Stevens
Rhizocarpon geographicum (L.)Lam & DC.
Rhizocarpon polycarpon (Hepp.)Th.Fr.
Rhizocarpon tinei (Tornab.)Runemark
Rinodina bischoffii (Hepp)Mass.
Rinodina thiomela (Nyl.)Müll.Arg.
Rinodinella halophila (Müll.Arg.)Mayrhofer
Rocella montagnei Bel.
Sarcogyne clavus (DC.)Kremph.
Sarcogyne privigna (Ach.)Massal.
Sarcogyne regularis Koerber
Siphula coriacea Taylor ex Nyl.
Siplonema paradoxum Born.
Solenopsora vulturiensis Massal.
Stereocaulon corticatulum Nyl.
Synalissa symphorea (Ach.)Nyl.
Teloschistes chrysopthalmus (L.)Th.Fr.
Teloschistes sieberianus (Laurer)Hillman
Tephromela atra (Hudson)Hafellner
Thelotrema lepadinum (Ach.)Ach.
Thysanothecium hookeri Mont. & Berk.
Thysanothecium scutellatum (Fr.)Galloway
Toninia australiensis (Müll.Arg.)Zahlbr.
Toninia caeruleonigricans (Lightf.)Th.Fr.
Toninia cumullata (Sommerf.)Th.Fr.
Trapelia coarctata (Turner)Choisy
Trapelia mooreana (Carrol)P.W.James
Umbilicaria polyphylla (L.)Baumg.
Usnea angulosa (Müll.Arg.)Mot.
Usnea arida Mot.
Usnea ceratina Ach.
Usnea consimilis Stirt.
Usnea inermis Mot.
Usnea pulvinata Fr.
Usnea scabrida Taylor
Usnea torulosa (Müll.Arg.)Zahlbr.
Usnea xanthopoga Nyl.
Verrucaria calciseda DC.
Verrucaria maura Wahlenb. ex Ach.
Verrucaria sphinctrina (Dufour)Ach.
Xanthoparmelia alternata Elix & Johnston
Xanthoparmelia amplexula (Stirton)Elix & Johnston
Xanthoparmelia antleriformis (Elix)Elix & Johnston
Xanthoparmelia arapilensis (Elix & P.Armstr.)R.Filson
Xanthoparmelia australasica D.Galloway
Xanthoparmelia bellatula (Kurok. & Filson) Elix & Johnston
Xanthoparmelia cheelii (Gyelnik)Hale
Xanthoparmelia concomitans Elix & Johnston

Xanthoparmelia congenis (B.Stein)Hale
Xanthoparmelia congesta (Kurok. & Filson)Elix & Johnston
Xanthoparmelia constipata (Kurok. & Filson)Elix & Johnston
Xanthoparmelia cravenii Elix & Johnston
Xanthoparmelia dayiana (Elix & P.Armstr.)Elix & Johnston
Xanthoparmelia dichotoma (Elix & P.Armstr.)Elix & Johnston
Xanthoparmelia digitiformis (Elix & P.Armstr.)R.Filson
Xanthoparmelia dissitifolia Kurok. ex Elix & Johnston
Xanthoparmelia donneri Elix & Johnston
Xanthoparmelia eilifii Elix & Johnston
Xanthoparmelia elixii R.Filson
Xanthoparmelia everardensis (Elix & Armstr.)Elix & Johnston
Xanthoparmelia exillima (Elix)Elix & Johnston
Xanthoparmelia filarszkyana (Gyel.)Hale
Xanthoparmelia filsonii Elix & Johnston
Xanthoparmelia flavescentireagens (Gyel.)D.Galloway
Xanthoparmelia flindersiana (Elix & Armstr.)Elix & Johnston
Xanthoparmelia fumigata (Kurok.)Elix & Johnston
Xanthoparmelia furcata (Müll.Arg.)Hale
Xanthoparmelia gerhardii Elix & Johnston
Xanthoparmelia glareosa (Kurok. & Filson) Elix & Johnston
Xanthoparmelia globulifera (Kurok. & Filson) Hale
Xanthoparmelia gongylodes Elix & Johnston
Xanthoparmelia hypoleia (Nyl.)Hale
Xanthoparmelia incerta (Kurok. & Filson) Elix & Johnston
Xanthoparmelia incrustata (Kurok. & Filson)Elix & Johnston
Xanthoparmelia isidiigera (Müll.Arg.)Elix & Johnston
Xanthoparmelia isidiosa (Müll.Arg.)Elix & Johnston
Xanthoparmelia lineola (Berry)Hale
Xanthoparmelia louisii Elix & Johnston
Xanthoparmelia metaclystoides (Kurok. & Filson)Elix & Johnston
Xanthoparmelia mexicana (Gyel.)Hale
Xanthoparmelia molliuscula (Ach.)Hale
Xanthoparmelia mougeotina (Nyl.)D.Galloway
Xanthoparmelia nana (Kurok.)Elix & Johnston
Xanthoparmelia nashii Elix & Johnston
Xanthoparmelia neorimalis (Elix & Armstr.)Elix & T.Nash
Xanthoparmelia neotinctina (Elix)Elix & Johnston
Xanthoparmelia norpumila Elix & Johnston
Xanthoparmelia notata (Kurok.)Hale
Xanthoparmelia oleosa (Elix & P. Armstr.) Elix & T.Nash
Xanthoparmelia parvoclystoides Elix & Johnston
Xanthoparmelia parvoincerta Elix & Johnston
Xanthoparmelia pertinax (Kurok. & Filson)Elix & Johnston
Xanthoparmelia praegnans (Elix & P.Armstr.)Elix & Johnston
Xanthoparmelia prodomokosii Elix & Johnston
Xanthoparmelia norpraegnans Elix & Johnston
Xanthoparmelia pumila (Kuork. & Filson)Elix & Johnston
Xanthoparmelia pustuliza (Elix)Elix & Johnston
Xanthoparmelia remanens (Elix)Elix & Johnston
Xanthoparmelia reptans (Kurok.)Elix & Johnston
Xanthoparmelia rupestris Elix & Johnston
Xanthoparmelia scabrosa (Taylor)Hale
Xanthoparmelia subcrustacea (Gyel.)Hale
Xanthoparmelia subdistorta (Kurok.)Hale
Xanthoparmelia subnuda (Kurok.)Hale
Xanthoparmelia substrigosa (Hale)Hale

Xanthoparmelia succedans Elix & Johnston
Xanthoparmelia taractica (Krempelh.)Hale
Xanthoparmelia tasmanica (J.D.Hook. & Tayl.)Hale
Xanthoparmelia tegeta Elix & Johnston
Xanthoparmelia terrestris (Kurok. & Filson)Elix & Johnston
Xanthoparmelia versicolor Hale
Xanthoparmelia weberi (Hale)Hale
Xanthoparmelia willisii (Kurok. & Filson) Elix & Johnston
Xanthoparmelia xanthomelaena (Müll.Arg.)Hale
Xanthoparmelia xanthosorediata (Elix) Elix & Johnston
Xanthoria candelaria var.laciniosa (Dufour)Arn.
Xanthoria ligulata (Körber)P.W.James
Xanthoria parietina (L.)Th.Fr.

Specimens Known Only From Type Locality

Acarospora negligens H.Magn.
Western Australia. R. Helms No. 94, on Elder Expedition. Syntype (G and MEL)

Buellia desertorum Müll.Arg.
"saxicola in Western Australia, in Victoria Desert", R.Helms No.51, on Elder Expedition. Holotype (G) Isotype (MEL)

Buellia glomerulans (Müll.Arg.)Zahlbr.
as *Catolechia glomerulans*, "ad terram sabulosam rubidam, prope Wallangering", R. Helms No. 55, on Elder Expedition. Holotype (G)

Caloplaca erythrosticta (Taylor)Zahlbr.
as *Lecanora erythrosticta*, "on bark, Swan River", James Drummond No. 78. Holotype (G) Isotype (BM)

Caloplaca lateritia (Taylor)Zahlbr.
as *Lecidea lateritia*, "on rocks, Swan River", James Drummond. Holotype (FH)

Haematomma pruinosum R.W.Rogers
Mount Manning, Western Australia, A.V.Milweski, 10.iv.1980. Holotype (PERTH)

Lecidea multiflora Taylor
"On bark, Swan River", James Drummond 1843. Holotype (FH) Isotype (BM)

Lecidea ochroleuca Pers.
"Dampier Bay, Peron Peninsula, Shark Bay", C. Gaudichad-Beaupré 1818.
Type not located.

Lichina minutissima A.Henssen
Kumarl to Lake King Road, 14 miles west of Kumarl, R.Filson, 9.x.1966.
Holotype (MEL) Isotype (MB)

Paraparmelia sammyii Elix & Johnston
Yillimining Rock, 20 km east of Narrogin, on road to Harrismith, J.Elix and M.Sargent. Holotype (CBG) Isotype (MEL)

Paraparmelia sargentii Elix & Johnston
Yillimining Rock, 20 km east of Narrogin, on road to Harrismith, J.Elix and M.Sargent. Holotype (CBG) Isotype (MEL)

Porocyphus lichenelloides A.Henssen
Rain Gauge Rock, Porongurups, G.G.Smith.
Holotype (MB) Isotype (MEL and UWA)

ACKNOWLEDGEMENTS

Dr. Jack Elix, Australian National University, Canberra , Dr. Gintaras Kantvilas of the Tasmanian Herbarium, Hobart and Dr. Neville Marchant, Western Australian Herbarium, Perth, critically read the manuscript suggesting improvements.

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MYCOTAXON

Vol. XXXV, No. 2, pp. 429-436 July-September 1989

MYXOMYCETES FROM CHINA. I

A checklist of Myxomycetes from China

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The earlier records of myxomycetes in China were reported by Nakazawa (1929), Skvortzow (1931), Emoto (1931,1933,1936), S. C. Teng (1933), and Z. H. Zhou (as C. H. Chow, 1937). In 1963, 142 species and varieties of Chinese myxomycetes were recorded by S. C. Teng in his book FUNGI OF CHINA, while in 1977, 164 species were recorded in TAXONOMIC MATERIALS OF MYXOMYCETES, a book compiled by Jilin Agricultural University and the Institute of Microbiology, Academia Sinica. Since then, more materials have been added (Z. H. Zhou & H. Z. Li, 1978,1983, 1985; Z. H. Zhou et al., 1981; Z. H. Zhou & Y. Li, 1983; Y. Li, 1981, 1983; H. Z. Li, 1988; Z. L. Liu, 1981; Y. F. Zhao, 1983; C. H. Liu, 1980, 1981, 1982, 1983; B. Ing, 1988; and C. L. Champion, 1980). During the last decade, many specimens in some regions of Northeast, Southwest, Southern, and Eastern China have been collected and identified by us. This paper is a compilation of all the known species of myxomycetes from China. Localities from which each species has been collected are indicated by numbers, which are marked with an asterisk when representing a new distribution for that species.

LOCALITIES

1. Beijing 2. Tianjin 3. Hebei 4. Shanxi 5. Nei Mongol 6. Liaoning 7. Jilin 8. Heilongjiang 9. Shanghai 10. Jiangsu 11. Zhejiang 12. Anhui 13. Fujian 14. Jiangxi 15. Shandong 16. Henan 17. Hubei 18. Hunan 19. Guangdong 20. Guangxi 21. Sichuan 22. Guizhou 23. Yunnan 24. Xizang 25. Shaanxi 26. Gansu 27. Qinghai 28. Ningxia 29. Xinjiang 30. Taiwan 31. Hainan 32. Hong Kong 33. Macao.

Species of Myxomycetes

Ceratiomyxales

Ceratiomyxa fruticulosa (Muell.) Macbr., common.

Echinosteliales

Clastoderma debaryanum Blytt., 7, *13, 19, 30.
Echinostelium minutum de Bary, 7, * 17 19, 30, 31, 32.

Liceales

Cribraria argillacea (Pers.) Pers., 7, *17, 30.
Cribraria atrofusca Martin & Lovejoy, 7. *13.
Cribraria aurantiaca Schrad., 3, 7. 13.
Cribraria confusa Nann.-Brem. & Yam. (=C. zhoui Y. Li), 7.
Cribraria dictyospora Martin & Lovejoy, 7.
Cribraria enodis Zhou Z. H. & Y. Li, 25.
Cribraria intricata Schrad., 6, 7. *13, *17, 30.
Cribraria languescens Rex., 7, 10, 13, 30.
Cribraria macrocarpa Schrad., 7, 30.
Cribraria martinii Nann.-Brem., 7.
Cribraria microcarpa (Schrad.) Pers., 7. 11, 12, 13. 17.
Cribraria minutissima Schw., 7, 13, *17, 30, 32.
Cribraria montana Nann.-Brem., 7.
Cribraria oregana H. C. Gilbert, 7.
Cribraria piriformis Schrad., 7, 13, 30.
Cribraria purpurea Schrad., 7.
Cribraria rufa (Roth) Rost., 7.
Cribraria splendens (Schrad.) Pers., 7, 12, *17.
Cribraria tenella Schrad., 1, 3, 7, 11, 13, 30, 31.
Cribraria violacea Rex., 7, 10, 13, *17, 21, 30, 32.
Cribraria vulgaris Schrad., 7, 21.
Dictydiaethelium plumbeum (Schum.) Rost., 7, 8, 12, *13, *17, 18, 23, 30, 31.
Dictydium cancellatum (Batsch.) Macbr., common.
Dictydium mirabile (Rost.) Mylan., 12, 24.
Licea biforis Morgan, 8, *13, *17.
Licea denudescens Keller & Brooks, 19.
Licea erectoides Nann,-Brem. & Yam., 32.
Licea kleistobolus Martin, 32.
Licea minima Fries, 7.
Licea operculata (Wingate) Martin, *13, *17. 30. 32.
Licea pedicellata (H. C. Gilbert) H. C. Gilbert, 32.
Licea scyphoides Brooks & Keller, 32.
Lindbladia tubulina Fries, 3, 7, *8, 11, 12.
Lycogala conicum Pers., 7, *13, 30.
Lycogala epidendrum (L.) Fries, common.
Lycogala exiguum Morgan, common.

Lycogala flavofuscum (Ehrenb.) Rost., *1, 3, 4,10, *29, 30.
Enteridium lycoperdon (Bull.) Farr, 3, *4, 7, *8, *13, 23, 26, 27, 29, 30.
Enteridium splendens (Morgan) Macbr., 3, *4, 7, *8, 20. 25, 26.
Tubifera casparyi (Rost.) Macbr., 7.
Tubifera ferruginosa (Batsch) J. F. Gmelin, *4, 6, 7, 11, 12, *13, *17, 21, 23, *25, 29, 30.
Tubifera microsperma (Berk. & Curt.) Martin, 7, *13, 30.

Trichiales
Arcyria annulifera Torrend, 30.
Arcyria carnea (G. Lister) G. Lister, 8, *13, 30.
Arcyria cinerea (Bull.) Pers., 3, 6, 7, 8, 10, 11, 12, 13, *14, *17, 18, 23, *24, *26, 30, 31, 32.
Arcyria denudata (L.) Wettst., common.
Arcyria ferruginea Santer., 7, *8, 26.
Arcyria glauca A. Lister, 3, 10, *13.
Arcyria globosa Schw., 12, *21.
Arcyria incarnata (Pers.) Pers., 3, 7, *13, *17, 19, 23, 30, 31.
Arcyria insignis Kalchbr. & Cooke, 6, 7, *13. 30.
Arcyria leiocarpa (Cooke) Martin & Alexop., 12.
Arcyria magna Rex., *1, 3, 7.
Arcyria major (G. Lister) Ing, 19, 20, 31, 33.
Arcyria nigella Emoto, 7.
Arcyria nutans (Bull.) Grev., *1, 10, *13, *17, *19, 30. *31.
Arcyria occidentalis (Macbr.) G. Lister, 3, *8, *17.
Arcyria oerstedtii Rost., *8, *13, 29.
Arcyria pomiformis (Leers) Rost., 6, 7, 10, 12, *13, 30.
Arcyria stipata (Schw.) A. Lister, *1, 3, 7, *17.
Arcyria versicolor Phill., 23.
Arcyria virescens G. Lister, 1, *13, 23.
Calomyxa metallica (Berk.) Nieuwl., *6, 30.
Hemitrichia calyculata (Speg.) Farr, 3, *6, 7, *8, *13, *15, *17, *19, *23, *25, 30.
Hemitrichia chrysospora (A. Lister) A. Lister, *6, 11, 12.
Hemitrichia clavata (Pers.) Rost., common.
Hemitrichia imperialis G. Lister, *1, 3, *6, 7.
Hemitrichia karstenii (Rost.) A. Lister, 12.
Hemitrichia serpula (Scop.) Rost., common.
Metatrichia vesparium (Batsch) Nann.-Brem., common.
Perichaena chrysosperma (Currey) A. Lister, 4, 7, 13, 30. 32.
Perichaena corticalis (Batsch) Rost., 7, 30.
Perichaena depressa Libert, 6, 7. 8, *13, *23, 30.
Perichaena minor (G. Lister) Hagelst.(=Hemitrichia minor Ing), 7, 32.

Perichaena vermicularis (Schw.) Rost., 7, 13, *23, 30.
Trichia botrytis (J. F. Gmel.) Pers., *5, *6, 7, 12, *13, *17, 21, 30.
Trichia contorta (Ditmar) Rost., 7, 8, *25, 26, 27, 29, 30.
Trichia decipiens (Pers.) Macbr., 3, *5, *6, 7, *8, *13, *17, 20. 21, *23.
Trichia favoginea (Batsch.) Pers., common.
Trichia floriformis (Schw.) G. Lister, *5, 7, 30.
Trichia lutescens (A. Lister) A. Lister, 3, 7.
Trichia scabra Rost., *5, 6, 7, *13, *17, 18. 23, 25, 27, 30.
Trichia subfusca Rex., 7.
Trichia varia (Pers.) Pers., 3, *5, *6, 7, 8, *13, *18, *25.
Trichia verrucosa Berk., 30, 31.

Physarales
Badhamia affinis Rost., 1, 3, 4, 6, 7, 13.
Badhamia capsulifera (Bull.) Berk., *17.
Badhamia macrocarpa (Ces.) Rost., 4, 5, 7, 8, 13, 17, 26.
Badhamia nitens Berk., 30.
Badhamia obovata (Peck.) S. T. Smith, *8.
Badhamia utricularis (Bull.) Berk., 4, 7, 11, 27.
Badhamiopsis ainoae (Yamashiro) Brooks & Keller, 7.
Craterium aureum (Schum.) Rost., 3, 7.
Craterium concinnum Rex., 7, 12.
Craterium leucocephalum (Pers.) Ditm., 1. 3, 6, 7, 12.
Craterium minutum (Leers) Fries, *1, 3, 7.
Craterium rubronodum G. Lister, 7.
Clenkowskia reticulata (Alb. & Schw.) Rost., 7, 23, 30.
Diderma asteroides (A. & G. Lister) G. Lister, 7, 25.
Diderma chondrioderma (de Bary & Rost.) G. Lister, 13, 30, 32.
Diderma cor-rubrum Macbr., 7.
Diderma effusum (Schw.) Morgan., 1, 3, 7, 11, 13, 32.
Diderma floriforme (Bull.) Pers., 26.
Diderma globosum Pers., 3, 7, 8.
Diderma hemisphaericum (Bull.) Hornem., 3, 7, 10, *13, 20.
Diderma lyallii (Massee) Macbr., 7.
Diderma Platyearpon Nann.-Brem., 30.
Diderma radiatum (L.) Morgan., 29.
Diderma spumarioides (Fries) Fries, 1, 3, 8, 10, 18, 26, 27.
Diderma testaceum (Schrad.) Pers., 4.
Didymium anellus Morgan, 7.
Didymium clavus (Alb. & Schw.) Rab., 10, 13.
Didymium crutaceum Fries, *8.
Didymium difforme (Pers.) S. F. Gray, 10, 32.

Didymium eximium Peck em. Nann.-Brem., 30, 31.
Didymium intermedium Schroet., 12.
Didymium iridis (Ditmar.) Fries, 7, 8, 12, 13.
Didymium leonium Berk. & Br., 8, 21.
Didymium melanospermum (Pers.) Macbr., 3, 7, 25.
Didymium minus (A. Lister) Morgan, 7, 10, 11, 12, *13, 20.
Didymium nigripes (Link) Fries, 1, 3, 6, 7, *8, 10, 12, 13, 18, 23, 25, 31.
Didymium ovoideum Nann.-Brem., 30.
Didymium proximum Berk. & Curt, 31.
(This segregate from *D. iridis* not previously separated in Asia.)
Didymium squamulosum (Alb. & Schw) Fries, common.
Didymium serpula Fries, 30.
Didymium vaccinum (Dur. & Mont.) Buchet, 7.
Didymium verrucosporum Welden, 30.
Erionema aureum Penzig., 12, 13.
Fuligo cinerea (Schw.) Morgan, *13, 30.
Fuligo intermedia Macbr., 30.
Fuligo licenti Buchet, 4.
Fuligo muscorum Alb. & Schw., 8.
Fuligo rufa Pers., 8.
Fuligo septica (L.) Wiggers, common.
Mucilago crustacea Wiggers, *1, 3, 4, 7, 26.
Paradiacheopsis cribrata Nann.-Brem., 19.
Physarella oblonga (Berk. & Curt.) Morgan, *1, 7, *13, *19.
Physarum alpinum (A. & G. Listr) G. Lister, 7.
Physarum bethelii Macbr., 19.
Physarum bivalve Pers., 3, 4, 7, 10, 11, 12, 13.
Physarum bogoriense Racib., 13, 27.
Physarum brunneolum (Phill.) Massee, 7.
Physarum cinereum (Batsch) Pers., *1, 3, 6, 7, *8, *13.
Physarum citrinum Schum., 13.
Physarum compressum Alb. & Schw., 3, 4, 6, 7, 8, 10, 13, 31.
Physarum contextum (Pers.) Pers., 7.
Physarum crateriforme Petch, 13, 30.
Physarum decipiens Curtis, 32.
Physarum diderma Rost., 1, 7, 11.
Physarum didermoides (Pers.) Rost., 4, 7, *8, *12, 23, 31.
Physarum flavicomum Berk., 1, 8, 10, 12, 13, 31.
Physarum galbeum Wingate, 7.
Physarum globuliferum (Bull.) Pers., 1, 3, 13, 31.
Physarum gyrosum Rost., 3, 4, 7, 10, 29.
Physarum javanicum Racib., 13.
Physarum lateritium (Berk. & Rav.) Morgan, 7.
Physarum leucopus Link., 3, 7, 10, 11, 12, 30.
Physarum leucophaeum Fries, 8, 13.

Physarum listeri Macbr., 3, 7.
Physarum luteolum Peck, 7, 13.
Physarum megalosporum Macbr., 10, 13.
Physarum melleum (Berk. & Br.) Massee, 10, 12, 13, 20, 21, 23.
Physarum nicaragense Macbr., 6, 7, 13, 30.
Physarum notabile Macbr., 7, 30.
Physarum nucleatum Rex, 13.
Physarum nutans Pers., 1, 3, 6, 7, 10, 13, 19, 21.
Physarum oblatum Macbr., 12, 13, 21, 23, 31, 32.
Physarum ovisporum G. Lister, 30.
Physarum penetrale Rex, *13.
Physarum pezizoideum (Jungh.) Pav. & Lag., 7, 13, 14, 20, 22, 23, 31.
Physarum polycephalum Schw., 1, 3, 8, 10, 31.
Physarum psittacinum Ditmar., 7, 13.
Physarum pusillum (Berk. & Curt.) G. Lister, 3, 4, 7, 8, 11, 13, 20, 21, 23.
Physarum puniceum Emoto, *1, 3, 6.
Physarum rigidum (G. Lister) G. Lister, 7, 13, 20. 31.
Physarum roseum Berk & Br., 13, 19.
Physarum sessile Brandza, 1, 3, 30, 32.
Physarum serpula Morgan, 8, 13, 30.
Physarum stellatum (Massee) Martin, 30.
Physarum straminipes A. Lister, 30.
Physarum sulphureum Alb. & Schw., 1, 3.
Physarum tenerum Rex, 7, 10, 13, 19, 31.
Physarum vernum Somm., 3, 4, 5, 7, 13.
Physarum virescens Ditmar., 13.
Physarum viride (Bull.) Pers., 1, 3, 7, 8, 11, 12, 13, 18, 20, 21, 23, 31.

Stemonitales

Amaurochaete atra (Alb. & Schw.) Rost., *13, 29.
Comatricha cylindrica (Bilgram.) Macbr., 11.
Comatricha dictyospora Celak., 12.
Comatricha elegans (Racib.) G. Lister, 12, 13.
Comatricha irregularis Rex, *1, 3, 25.
Comatricha laxa Rost., 7, 10, 12.
comatricha longa Peck, *1, 3, 10, *13, 23, 31.
Comatricha lurida A. Lister, 7.
Comatricha nigra (Pers.) Schroet., 6, 7, 10, 13, 20, 32.
Comatricha pulchella (C. Bab.) Rost., 10, *13.
Comatricha subcaespitosa Peck, 13.
Comatricha tenerrima (M. A. Curt.) G. Lister, 32.
Comatricha typhoides (Bull.) Rost., 3. 7. *8, 10. 13, 23, 25, 31.
Diachea bulbillosa (Berk. & Br.) A. Lister, 3, 6, 12.

Diachea leucopodia (Bull.) Rost., *1, 3, 4, 10, *13, 20, 21, 26.
Diachea splendens Peck, 6, 7.
Diachea subsessilis Peck, 20.
Diachea synspora H. Z. Li, 17.
Enerthenema papillatum (Pers.) Rost., 7. 32.
Lamproderma arcyrionema Rost., 7, *13, 19, 30, 31.
Lamproderma columbinum (Pers.) Rost., 7.
Lamproderma scintillans (Berk. & Br.) Morgan, 7, 10, 11, 14, 20.
Macbrideola cornea (G. Lister & Cran) Alexop., 30.
Stemonitis axifera (Bull.) Macbr., 9, 12, 13, 19, 24.
Stemonitis flavogenita Jahn, 12, 13, 30.
Stemonitis fusca Rost., common.
Stemonitis herbatica Peck, 3, 7, 8, 10, 12, 13, 23, 31.
Stemonitis hyperopta Meylan, 13.
Stemonitis microsperma B. Ing, 30.
Stemonitis nigrescens Rex, 7, 9, 12, 13.
Stemonitis pallida Wingate, 6, 7, 13, 23, 31.
Stemonitis smithii Macbr., 7., 8, 12, 13.
Stemonitis splendens Rost., Common
Stemonitis trechispora (Berk.) Macbr., 30.
Stemonitis uvifera Macbr., 30.
Stemonitis virginiensis Rex, 7, 13, 30.

ACKNOWLEDGMENTS

We express our appreciation to Dr. Zhuang Wen-Ying for her helpful suggestions. We are especially grateful to both Prof. Richard P. Korf and Prof. Steven L. Stephenson for their critical review of the manuscript.

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MYCOTAXON

Vol. XXXV, No. 2, pp. 437-447 July-September 1989

NEW SPECIES IN THE LICHEN FAMILY THELOTREMATACEAE FROM ASIA (ASCOMYCOTINA)

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Abstract: The following 16 species in the lichen family Thelotremataceae from southeast Asia are described as new: *Myriotrema craterellum* Nagarkar & Hale, *M. extendens* Nagarkar & Hale, *M. lunense* Nagarkar & Hale, *M. permaculatum* Nagarkar & Hale, *M. sembilanense* Nagarkar & Hale, *M. viride* Nagarkar & Hale, *Ocellularia bakoensis* Nagarkar & Hale, *O. deformis* Nagarkar & Hale, *O. flavomedullosa* Nagarkar & Hale, *O. gentingensis* Nagarkar & Hale, *O. inexpectata* Nagarkar & Hale, *O. kinabalensis* Nagarkar & Hale, *O. pruinata* Nagarkar & Hale,*O. tuberculata* Nagarkar & Hale, *Thelotrema fissuratum* Nagarkar & Hale, *T. verruculosum* Nagarkar & Hale. The following new combinations are made: *M. microphthalmum* (Müll. Arg.) Nagarkar & Hale, *Ocellularia auberianoides* (Nyl.) Nagarkar & Hale, Nagarkar & Hale, and *O. eurychades* (Krempelh.) Nagarkar & Hale.

Introduction

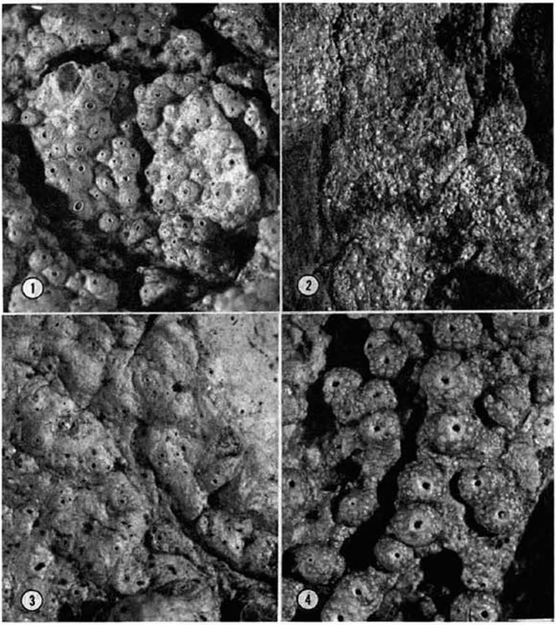
The following new species are based for the most part on specimens collected by the junior author in Malaysia, Sri Lanka, and the Philippines. Most of the localities were virgin dipterocarp logging areas, where the Thelotremataceae are exceptionally well developed. This habitat is rapidly disappearing throughout southeast Asia as large-scale commercial timbering for lauan used in vaneer manufacture continues unabated since the end of World War II. These forests are replaced by an impoverished secondary scrub, replanted with fast-growing *Albizzia falcata* or tung oil, or turned into pasture. Only rarely are conservation measures taken to preserve the continuity of the dipterocarp forest community, and consequently the Thelotremataceae flora is being lost forever.

The generic delimitation of the family is still unsettled. The old spore-based genera (*Ocellularia, Phaeotrema, Thelotrema,* and *Leptotrema*) served well for nearly 100 years but are now considered to be artificial. Hale (1981) introduced three exicpular-based genera (*Myriotrema, Ocellularia,* and *Thelotrema*) in a treatment of the large Sri Lankan flora. Spore characters were relegated a secondary role in the taxonomy. While extremely few lichenologists have tested the validity of this approach, our experience has convinced us that both *Myriotrema* and *Ocellularia* so delimited overlap in many areas and appear to be unacceptably heterogeneous. By comparison, *Thelotrema* is a relatively homogeneous group.

What is needed is a modern, comprehensive study of ascocarp ontogeny in the family, but this will not be made soon. In the meantime we will continue using excipular-based genera with the realization that this generic delimitation could well change significantly in the future.

Myriotrema craterellum Nagarkar & Hale, sp. nov.

Thallus (Fig. 1) corticola, laevis, apothecia numerosa, emergentia, basin constricta, 0.4 - 0.6



Figures 1-4. Holotypes of *Myriotrema* species: 1, *M. craterellum;* 2, *M. extendens*; 3, *M. lunense*; 4, *M. permaculatum*. Scale for all species equals 1 mm (See Fig. 4).

mm diametro, excipulo connato; pseudocolumella nigricans; ostiolum rotundatum; sporae fuscae, 8:nae, 4–6 × 12–16 μm, transversim 6-loculatae.

Holotype: Sabah, Near Mt. Silam, Kennedy Bay Lumber concession, logging area in virgin dipterocarp forest, elev. ca 150 m, *M. E. Hale* 34,610, 16 March 1965 (US).

Thallus corticolous, white, smooth, cracked with age, to 10 cm broad; cortex indistinct; apothecia numerous, closely aggregated, semi-emergent to emergent, becoming basally constricted, 0.4-0.6 mm in diameter; exciple fused, reddish brown, dark brownish black at the tips, with incorporated bark elements; pseudocolumella thin, 45-60 μm in diameter, fromed by clumping of paraphyses and dead spore cells, brown to dark brownish black; ostiole rotund with a slightly raised, thin, white ring, the pore 0.09–0.14 mm in diameter; hymenium 100–120 μm high; spores brown, 8/ascus, transversely 6-loculate, 4–6 × 12–16 μm.

Chemistry: Psoromic acid present.

Observations: *Ocellularia caledoniensis* (Hale) Hale with similar chemistry, spores and a weak columella, has larger apothecia (up to 1.4 mm in diameter) and a depressed pore without any ring.

Myriotrema extendens Nagarkar & Hale, sp. nov.

Thallus (Fig. 2) corticola, hypophloeodes, ca 8 cm latus; apothecia emergentia, 0.8–1.3 mm diametro, margine eroso, medulla lutea; columella nulla; ostiolum irregulare, o.15–0.3 mm latum; hymenium 120–150 μm; sporae 4– 8:nae, incolores, muriformes, 10–12 × 30–38 μm.

Holotype: Sri Lanka, Western Province, Kalutara District, near Hedigalla, Morapitiya logging area; elev. ca. 167 m; 11 Feb. 1976; *M. E. Hale* 47,192 (US).

Thallus greenish grey, minutely verruculose, continuous; cortex 15–18 μm; algal layer 20–24 μm, continuous; medulla up to 60 μm, with small to medium crystals; apothecia numerous, semi-emergent, 0.25–0.35 mm in diameter; exciple fused, sometimes splitting to seperate, yellowish to reddish brown; ostiole circular, with pore-area concolorous to tannish, rim white when exposed, pore 0.06–0.09 mm in diameter; hymenium 65–80 μm high; spores hyaline, transversely 4-loculate, 3–4 × 9–10 μm, I + blue, 8/ascus.

Chemistry: Psoromic acid present.

Observations: This species is close to *M. myriotremoides* (Nyl.) Hale in excipular structure, spore characters, and chemistry, but *M. myriotremoides* lacks a cortex, being typically hyphloeodal. *Myriotrema glaucophaenum* (Krempelh.) Hale has a distinctly corticate thallus, but lacks the typical brown excipular tissue.

Myriotrema lunense Nagarkar & Hale, sp. nov.

Thallus (Fig. 3) corticola, epiphloeodes, 8–10 cm latus; apothecia immersa, 0.4– 0.75 mm diametro, excipulo connato raro fissurato; pseudocolumella 40 μm diametro; ostiolum rotundatum, 0.06–0.1 mm diametro; hymenium 100 μm; sporae fuscae, 8:nae, 8–9 × 12–21 μm, 1–2 × 2-4-loculatae.

Holotype: Philippines, Mountain Province, Luzon, PECORP logging area ca 30 km S of Luna; virgin dipterocarp forest; elev ca 300 m; July 1964; *M. E. Hale* 25878 (US).

Thallus on bark, white mineral grey, smooth, continuous, 8–10 cm broad; cortex indistinct; algal layer 30 μm, continuous; medulla hypophloeodal, with medium crystals; apothecia immersed in bark or slightly raised, 0.4–0.75 mm; exciple fused, cracking to separate in a few apothecia, reddish brown, apically darkening, noncarbonized; a pseudocollumella (40 μm thick) sometimes developing by aggregation of the hymenial elements; pore flush to depressed, concolorous or becoming tannish, rarely with a slightly raised tannish ring 0.06–01 mm in diameter; hymenium 100 μm; spores brown, 12–21 × 8–9 μm, 1–2 × 2–4-loculate, 8/ascus.

Chemistry: No substances present.

Obervations: This species is close to *"Leptotrema" zollingeri* Mont. & v.d.Bosch (generic status not yet determined) from Java in morphology, but *L. zollingeri* contains "Praestans" unknowns and has a verruculose thallus.

Myriotrema permaculatum Nagarkar & Hale, sp. nov.

Thallus (Fig. 4) corticola, epiphloeodes, 3–4 cm latus; apothecia emergentia, 0.8–1.2 mm diametro; ostiolum depressum, albocinctum, 0.07–0.14 mm diametro; columella nulla; hymenium 300 μm; sporae 8:nae, obscurae, 12–15 × 15–27 μm, 1–2 × 3–4-loculatae.

Holotype: Philippines, Basilan Province, Basilan Lumber Co. logging area, about 25 km N of Upper Canas, virgin dipterocarp forest. Elev. ca 300 m. June 1964, *M. E. Hale* 24937 (US).

Thallus on bark, pale tannish grey, verruculose, continuous, 3–4 cm broad; cortex thin, 5–6 μm; algal layer 30 μm, interrupted by crystals; medulla 90–100 μm, with medium-sized crystals; apothecia many, closely disposed, emergent, ascidioid, rounded, 0.8–1.2 mm; exciple fused, reddish brown, with a few bark cells embedded; pore depressed, white rimmed, 0.07–0.14 mm; margin thick, 350–380 μm, largely crystal studded, externally white notched, the notches resembling pseudocyphellae; hymenium 300 μm; spores brown, broadly oval, 12–15 × 15–27 μm, 1–2 × 3–4-loculate, 8/ascus.

Chemistry: Protocetraric acid present.

Observations: *M. bahianum* (Ach.) Hale is close, but has wider pore (up to 0.3 mm), columnar aggregates in the hymenium and lacks the distinct white notches on the margin, charateristic of *M. permaculatum*.

Myriotrema sembilanense Nagarkar & Hale, sp. nov.

Thallus (Fig. 5) corticola, epiphloeodes, 6–8 cm latus; apothecia vix elevata, 0.2–0.3 mm diametro, excipulo connato; columella nulla; ostioum rotundatum, 0.05–0.06 mm diametro; hymenium 75 um; sporae incolores, 8:nae, 2–3 × 6–9 μm, transversim 4–6-loculate.

Holotype: Malaya, State of Negri Sembilan, Kuala Pilah logging area, ca. 8 km N of Seremban, Kuala Pilah road, ca. 10 km W of Kuala Pilah; felled trees in dipterocarp forest; elev. ca. 150 m; 17 Aug. 1983; M.E. Hale 63,050 (US).

Thallus greenish grey, smooth, shiny, minutely verruculose; cortex 12–15 μm, distinct; algal layer 17 μm, continuous; medulla 90–110 μm, with medium-sized crystals; apothecia numerous, slightly elevated, immersed in medulla, 0.2–0.3 mm in diameter; columella lacking; pale brown; pore flush, 0.05–0.06 mm in diameter, bounded by a whitish circular zone; hymenium 75 μm; spores hyaline, transversely 4–6-loculate, 2–3 × 6–9 μm, I + blue, 8/ascus.

Chemistry: Protocetraric acid present.

Additional specimen: Same locality as the type, *M. E. Hale* 63,040 (US).

Observations: This species has close resemblance with *M. immersum* (Eschw.) Hale which, however, has larger spores, 8–10 × 24–26 μm, and a columnar cortex.

Myriotrema viride Nagarkar & Hale, sp. nov.

Thallus (Fig. 6) corticola, epiphloeodes, 5–6 cm latus; apothecia vix elevata in medulla immersa, 0.2–0.3 mm diametro, excipulo connato; ostiolum rotundatum, 0.06–0.07mm diametro; hymenium 120 μm; sporae incolores, 8:nae, muriformes, 5–6 × 15–20 μm, 1–2 × 5–7-loculatae.

Holotype: Malaya, State of Selangor, Genting Hilands, old troop bivouac area below the hotels along main road, remnant mid-elevation rain forest; elev. ca. 1800 m; 16 Aug 1983; *M. E. Hale* 63,111 (US).

Thallus greenish grey, smooth, shiny, continuous; cortex distinct, 21–24 μm; algal layer continuous, 18 μm; medulla 70–80 μm, with medium-sized crystals; apothecia numerous, slightly elevated, immersed in the medulla, 0.2–0.3 mm in diameter; exciple fused, faint reddish brown; pore small, round to irregular, 0.6–0.7 mm in diameter; hymenium 120 μm high; spores hyaline, muriform, 1–2 × 5–7-loculate, 5–6 × 15–20 μm, I + blue, 8/ascus.

Chemistry: Protocetraric acid present.

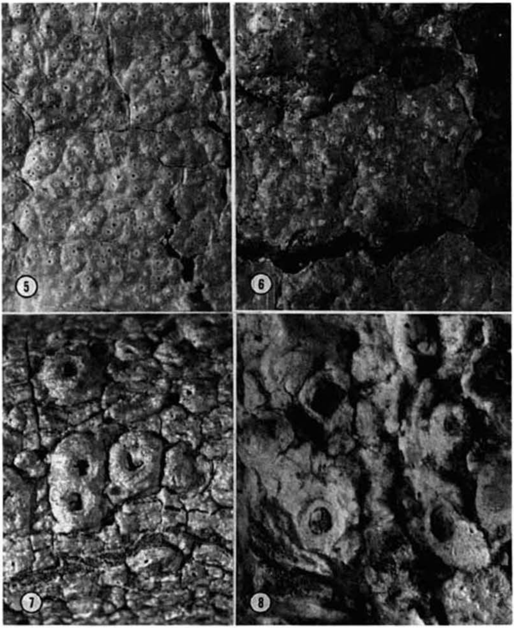
Observations: This species resembles *Myriotrema sembilanense* from Malaya, described above, in all characters except for the dark color, more elevated apothecia, and vertical spore septation. *Myriotrema microphthalmum* (Müll. Arg.) Nagarkar & Hale (comb. nov. Basionym: *Thelotrema microphthalmum* Müll. Arg., Bull. Herb. Boissier 3:314. 1895) from Australia is close but has a thin central columella (type in G!), 48–56 μm.

Ocellularia bakoensis Nagarkar & Hale, sp. nov.

Thallus (Fig. 7) corticola, epiphloeodes, ca 8 cm latus; apothecia emergentia, basin constricta, aetate 1–1.4 mm diametro; columella 400–440 μm diametro, centro fissurina; ostiolum 0.3–0.6 mm diametro; hymenium ad 140 μm; sporae incolores, 8:nae, 10–12 × 35–45 μm, transversim 10–12-loculatae.

Holotype: Sarawak, Bako National Park; Oak-dipterocarp forest; 10 Mar. 1965; *M. E. Hale* 29,834 (US).

Thallus pale greenish grey, smooth to minutely verruculose, regularly fissured, forming more or less rectangular blocks; cortex 30 μm, projecting up to 48 μm; algal layer 30 μm, partly interrupted by medium to large-sized crystals; medulla mostly hypophloeodal; apothecia solitary or rarely 2-



Figures 5-8. Holotypes of *Myriotrema* and *Ocellularia* species: 5, *M. sembilanense*; 6, *M. viride*; 7, *O. bakoensis*; 8, *O. deformis*. See Fig. 4 for scale.

fused, emergent, constricted at the base, rounded, (0.7) 1–1.4 mm in diameter; pore circular, 0.3–0.6 mm in diameter, concolorous or becoming dark brownish-black rimmed; exciple reddish brown, up to 320 µm thick, carbonized to the base at the inner edge; columella initially simple, wide, 400–440 µm in diameter, 140 µm high, becoming fissured in the center, with a heavily pruinose, divided tip visible through the pore, carbonized to the base; hymenium 140 µm high, confined to a narrow peripheral zone 90 µm wide; spores hyaline, transversely 10–12-loculate, 10–12 × 35–45 µm, I + blue, 8/ascus.

Chemistry: Psoromic acid present.

Additional specimens: Same locality as the type, *M. E. Hale* 29,810, 29,819 (US).

Observations: This species resembles *O. eurychades* (Krempelh.) Nagarkar & Hale (comb. nov. Basionym: *Thelotrema eurychades* Krempelh., Nuov. Giorn. Bot. Ital. 7:17. 1875), also from Sarawak, which, however, lacks psoromic acid, and has much thinner exciple, 40–50 µm thick. Specimen no. 29,810 has a more distinctly verrucose thallus.

Ocellularia deformis Nagarkar & Hale, sp. nov.

Thallus (Fig. 8) corticola, hypophloeodes, 4–6 cm latus; apothecia semi-emergentia, excipulo connato, interiore fuligineo; columella fuliginea, 400–720 µm diametro; ostiolum rotundatum vel elongatum, 0.3–0.45 mm diametro; hymenium 160 µm; sporae fuscae, 8:nae, 10–12 × 18–22 µm, transversim 4-loculatae.

Holotype: Sabah, Kinabalu National Park, on ridge between E. and W. Mesilau Rivers; elev. ca. 1800 m; Aug. 1964; *M. E. Hale* 28,377 (US).

Thallus whitish, smooth, minutely fissured with age; cortex lacking; algal layer 20–25 µm, continuous; medulla hypophloeodal with small crystals; apothecia semi-emergent, 0.8–1.4 mm in diameter; exciple fused, reddish brown, with yellowish brown bark layers present to the outer part, inner part thickly carbonized to the base; columella initially simple, wide, 400–720 µm in diameter, 200 µm high, carbonized to the base, fissuring and becoming partially actinoid, with the tips heavily white pruinose; ostiole initially circular, becoming elongate to boat-shaped or angular, with concolorous pore area and black rim, pore gaping, 0.3–0.45 mm in diameter; hymenium low, confined to the periphery, 160 µm high, 240 µm thick; spores brown, withered, transversely 4-loculate, 10–12 × 18–22 µm, 8/ascus.

Chemistry: No substances present.

Observations: In later stages, the apothecia are deformed to some extent, the ostiole becomes elongate to angular, the margin becomes erect, and the columella fissures to become partially actinoid. The species is related to *O. meiosperma* (Nyl.) Hale which has smaller, more immersed apothecia. A similar type of columella is observed in *O. bakoensis*, a new species from Sarawak described above.

Ocellularia flavomedullosa Nagarkar & Hale, sp. nov.

Thallus (Fig. 9) corticola, epiphloeodes, 3–5 cm latus; apothecia semi-emergentia, 0.25–0.35 mm diametro, excipulo connato; columella nulla; ostiolum 0.06–0.09 mm diametro; hymenium 65–80 µm; sporae incolores, 8:nae, 3–4 × 9–10 µm, transversim 4-loculatae.

Holotype: Philippines, Agusan Province, Mindanao, about 30 km SE of Butuan City, Nasipit Lumber Co., Florida logging area; virgin dipterocarp forest; elev. ca 200 m, Aug. 1964; *M. E. Hale* 25,240 (US).

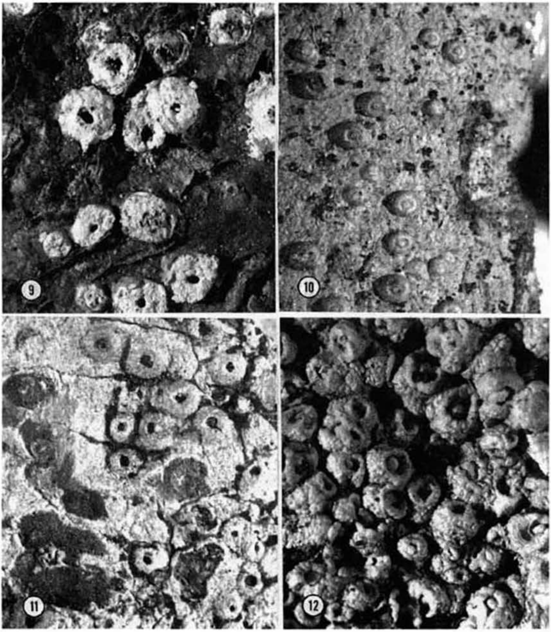
Thallus olivaceous greenish to tannish grey, smooth, continuous; cortex indistinct; algal layer ca. 15 µm, continuous; medulla completely hypophloeodal, with a few medium-sized crystals; apothecia numerous, emergent, basally constricted, 0.8–1.3 mm in diameter, solitary or 2 fused, with the top flaking off, exposing a marginal yellow medulla; exciple fused, black to the base, with bark cells; margin thick, 400–450 µm thick, filled with yellow powdery substance in medulla; ostiole left as a hole 0.15–0.3 mm across, circular to elongate; hymenium 120–150 µm high; spores hyaline, muriform, 10–12 × 30–38 µm, I+ blue, 4–8/ascus.

Chemistry: Two unknown PD+ substances present.

Observations: The apothecia with the top flaking off and exposed light yellow medulla of the margin appear as rounded yellow eruptions over the thallus. No comparable species are known in the genus.

Ocellularia gentingensis Nagarkar & Hale, sp. nov.

Thallus (Fig. 10) corticola, pro parte hypophloeodes, 2–8 cm latus; apothecia emergentia, 0.5–0.9



Figures 9-12. Holotypes of *Ocellularia* species: 9, *O. flavomedullosa*; 10, *O. gentingensis*; 11, *O. inexpectata*; 12, *O. kinabalensis*. See Fig. 4 for scale.

mm diametro, excipulo connato, fuliginio in parte superiore; columella nulla; ostiolum minutum, 0.05-0.08 mm diametro; hymenium 240 μm; sporae incolores, 4-8:nae, 9-12 × 54-96 μm, transversim 13-26-loculatae.

Holotype: Malaya, Trail above (N of) Casino, Genting Highlands, just N of Kuala Lumpur; elev. ca. 2000 m; 16 Aug. 1983; *M. E. Hale* 59,894 (US).

Thallus ashy grey, smooth, continuous; cortex indistinct; algal layer 25-30 μm, continuous; medulla mostly hypophloeodal, with a few crystals; apothecia emergent, ascidioid, rounded, 0.5-0.9 mm in diameter; exciple fused, reddish brown, carbonized in the upper part; pore minute, 0.05-0.08 mm in diameter, the pore area concolorous, the rim white when exposed, sometimes slightly raised but a distinct annulate ring not developed; margin thick, 120 μm; hymenium 240 μm; spores hyaline, transversely 13-26-loculate, 9-12 × 54-96 μm, at the average 60 μm long, I+ blue, 4-8/ascus.

Chemistry: Protocetraric acid and "amplior" unknown substances present.

Additional specimens: Same locality as the type, *M. E. Hale* 59,887 (US).

Observations: It is very close in external morphology and chemistry to *Myriotrema microstomum* (Müll. Arg.) Hale, a species from Japan which, however, has muriform spores and fumarprotocetraric acid in addition to protocetraric. *Ocellularia globosa* Hale from Sarawak has comparable anatomy and chemistry but with smaller spores, 8-10 × 30-50 μm, and a gaping pore up to 0.3 mm in diameter, through which the white pruinose disc is visible. It also has a more elaborate, fissurred white thallus.

Ocellularia inexpectata Nagarkar & Hale, sp. nov.

Thallus (Fig. 11) corticola, epiphloeodes, ca 5 cm latus; apothecia emergentia, plerumque basin constricta, 0.6-1 mm diametro, excipulo connato, fuligineo; columella fuliginea, 300-400 μm diametro; ostiolum rotundatum, 0.1-0.4 mm diametro; sporae fuscae, 8:nae, 9-10 × 22-24 μm, 6-8 × 1-2-loculatae.

Holotype: Sarawak, 30 km N of Sibu, Rasau logging area; in virgin peat dipterocarp forest: elev 1 m; 12 Mar. 1965; *M. E. Hale* 29,966 (US).

Thallus whitish mineral grey, minutely verruculose, fissured with age; cortex 10 μm, loose, indistinct; algal layer 15 μm, just above the bark surface, continuous or interrupted by crystals; medulla 20-25 μm, partly hypophloeodal, with medium-sized crystals; apothecia emergent, most basally constricted, 0.6-1 mm in diameter; exciple reddish brown, carbonized to the base; columella wide, 300-400 μm in diameter, 140 μm high, carbonized completely, with white pruinose tip visible through the pore, becoming actinoid; ostiole rounded, 0.1-0.4 mm in diameter, with concolorous pore area; margin verruculose, ca. 100 μm thick, with crystal-filled medulla; hymenium 120 μm high; spores brown, 6-8 × 1-2-loculate, 9-10 × 22-24 μm, I+ blue, 8/ascus.

Chemistry: "Praestans" unknown substances present.

Observations: Other *Ocellularia* species with an actinoid columella have much thicker thallii and different chemistry. *"Leptotrema" zollingeri*, the only other species in the genus with this chemistry, has small, immersed and ecolumellate apothecia.

Ocellularia kinabalensis Nagarkar & Hale, sp. nov.

Thallus (Fig. 12) corticola, epiphloeodes, 8-10 cm latus; apothecia congesta, emergentia, basin constricta, 0.6-1 mm diametro, excipulo connato, interiori fuligineo; columella fuliginea, 300-500 μm diametro; ostiolum rotundatum vel irregulariter elongatum, 0.2-0.35 μm diametro; hymenium 140- 180 μm; sporae fuscae, 8:nae, muriformes, 6-8 × 12-20 μm, 1 × 4-5-loculatae.

Holotype: Sabah, Kinabalu National Park, small ridge just above E. Mesilau River; elev. ca 1900 m; Aug. 1964; *M. E. Hale* 28,245 (US).

Thallus pale greenish grey, distinctly verrucose, continuous; cortex indistinct; algal layer 30-40 μm, continuous or partly interrupted by crystals; medulla 35-90 μm, with medium-sized crystals; apothecia numerous, densely crowded, emergent, constricted at the base, 0.6-1 mm in diameter; exciple fused, reddish brown, with an incomplete layer of the bark cells, inner side thickly carbonized to the base; columella wide, 300-500 μm in diameter, 150-200 μm high, carbonized to the base, with a dome shaped white top up to 400 μm high, protruding out of the pore; ostiole circular to becoming irregularly elongated, 0.2-0.35 mm in diameter, opening out as an erect ring, sometimes up to 0.8 mm in diameter; margin verrucose, 200-280 μm thick; hymenium 140-180 μm high, confined to the periphery, ca. 140 μm thick; spores brown, muriform, 1 × 4-5-loculate, 6-8 × 12-20 μm, 8/ascus.

Chemistry: Psoromic acid present.

Observations: The columella has a very thick dome-shaped top which protrudes out through the pore as in the case of *O. berkeleyana* (Mont.) Zahlbr.) but here it is undivided. *Ocellularia cubana* (Tuck.) Zahlbr., has emergent large apothecia, wide pore and psoromic acid in the thallus, but the spores are smaller, only up to 12 µm long, and the columella is much thinner without protruding. Other psoromic acid-containing species of *Ocellularia* in this group have an actinoid columella.

Ocellularia pruinata Nagarkar & Hale, sp. nov.

Thallus (Fig. 13) corticola, epiphloeodes, 4–5 cm latus; apothecia emergentia, basin constricta, 0.4–0.9 mm diametro, excipulo connato; columella aetate actinoidea, ad 400 µm diametro; ostiolum rotundatum, 0.2–0.5 mm diametro; sporae incolores, 8:nae, 3–4 × 9–15 µm, transversim 4-loculatae.

Holotype: Malaya, State of Negri Sembilan, Kuala Pilah logging area, ca 10 km W of Kuala Pilah, felled trees in dipterocarp forest; elev. ca. 150 m ; 17 Aug. 1983; *M. E. Hale* 63,041 (US).

Thallus greenish to tannish grey, verruculose, continuous; cortex pale yellow, loosely cellular, 9–12 µm; algal layer 18–20 µm, continuous; medulla variable, 24–45 µm thick, with small crystal inclusions; apothecia solitary, emergent basally constricted at maturity, 0.4–0.9 mm in diameter; exciple fused, brown; columella present, initially wide, upto 400 µm, unevenly thickened, at length becoming actinoid, with white pruinose tip, brown; margin entire, becoming erect; pore gaping, 0.2–0.5 mm in diameter, filled with white tips of the columella; hymenium 90 µm high; spores hyaline, transversely 4-loculate, 9–15 × 3–4 µm, I + blue, 8/ascus.

Chemistry: Protocetraric acid and two unknown substances present.

Observations: *O. mauritiana* Hale and *O. auberianoides* (Nyl.) Nagarkar & Hale (comb. nov. Basionym: *Thelotrema auberianoides* Nyl., Ann. Soc. Scient. Fenn. 7:451. 1863). have an actinoid columella and protocetraric acid. *O. mauritiana*, however, has much larger apothecia, 1.5–3 mm in diameter and a carbonized exciple, while *O. auberinoides* has an irregularly elongate pore, a thicker thallus (up to 200 µm) and 6–8-loculate spores.

Ocellularia tuberculata Nagarkar & Hale, sp. nov.

Thallus (Fig. 14) corticola, epiphloeodes, tuberculo-papillatus, 4–6 cm latus; apothecia emergentia, basin constricta, 0.7–1.2 mm diametro, excipulo connato, apice fuligineo; columella apice fuliginea, 130–160 µm diametro; ostiolum rotundatum, 0.1–0.2 mm diametro; hymenium 200 µm; sporae incolores, 8:nae, 6–8 × 21–27 µm, transversim 8-loculatae.

Holotype: Malaya, Trail above (N of) Casino, Genting Highlands, just N of Kuala Lumpur; on small trees in elfin forest; elev. ca. 2000 m; 16 Aug. 1983; *M. E. Hale* 59,880 (US).

Thallus greyish sepia, with isidioid white tipped tuberculate papillae 288–320 × 252–272 µm, fissured; cortex 12 –15 µm, cellular, dark colored; algal layer diffused in a 48 µm thick epiphloeodal part of the thallus; medulla mostly hypophloeodal, with medium-sized crystals in the papillae and the margin; apothecia emergent, constricted at the base, columellate, 0.07–1.2 mm in diameter; exciple reddish brown, apically carbonized; columella simple, formed by the aggregation of hymenial elements, black at the tip with white pruina, 130–160 µm in diameter; margin distinctly verrucose, 200–216 µm; hymenium 200 µm; spores hyaline, transversely 8-loculate, 6–8 × 21–27 µm, I + blue, 8/ascus.

Chemistry: Hypoprotocetraric acid, 4-*O*-demethylnotatic acid, with or without psoromic acid.

Additional specimen: Malaya, State of Negri Sembian, Kuala Pilah logging area, *M. E. Hale* 63,082.

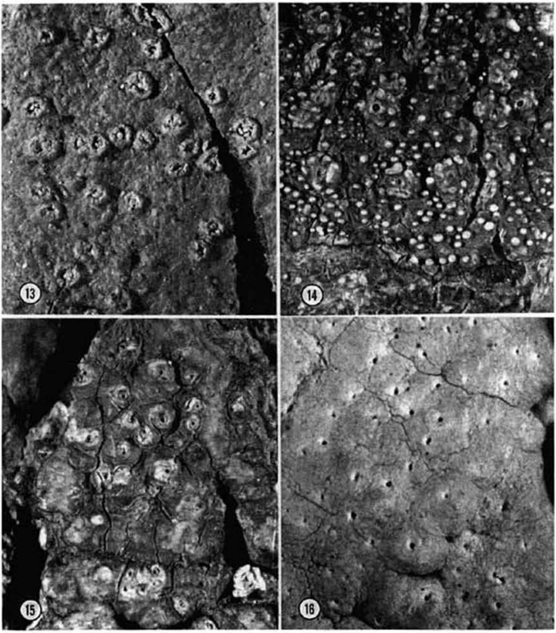
Observations: Conspicuous isidioid papillae and hypoprotocetraric acid make this a distinct species. *O. phaeotropa* (Krempel.) Müll. Arg. from Sarawak, with similar ascocarp structure and hypoprotocetraric acid in the thallus, lacks isidioid papillae. The type material has combination of hypoprotocetraric and psoromic acids, unusual for thelotremes.

Thelotrema fissuratum Nagarkar & Hale, sp. nov.

Thallus (Fig. 15) corticola, epiphloeodes, fissurina, 6–10 cm latus; apothecia semi-emergentia, 0.5–0.9 mm diametro, excipulo discreto; columella nulla; ostiolum rotundatum, albocinctum, 0.2–0.3 mm diametro; hymenium 145–155 µm; sporae incolores, 8:nae, 5–6 × 18–24 µm, transversim 8-loculatae.

Holotype: Malaya, State of Selanger, Genting Highlands; remnant mid-elevation rain forest; elev. ca 1800 m; 16 Aug. 1983; *M. E. Hale* 63,113 (US).

Thallus greenish olivaceous grey, smooth, shiny, deeply fissured; cortex thick, up to 45 µm,



Figures 13-16. Holotypes of *Ocellularia* and *Thelotrema* species: 13, *O. pruinata*; 14, *O. tuberculata*; 15, *T. fissuratum*; 16, *T. verruculosum*. See Fig. 4 for scale.

exfoliating, with aculeate hyphae; algal layer 24–30 μm, continuous; medulla 70–80 μm, with small dispersed crystals; apothecia semi-emergent, 0.5–0.9 mm in diameter; exciple free from the thalline wall, fissured to separate; pore area, rim and excipular tips white; pore 0.2–0.3 mm in diameter; hymenium 145–155μm high; spores hyaline, transversely 8-loculate, 5–6 × 18–24 μm, I + blue, 8/ascus.

Chemistry: Psoromic acid present.

Observations: Inner and outer excipular tissues are fused but due to cracking they are seperated from rest of the thallus. Hyphal tips of the inner exciple appear to be periphyses at the lower magnifications. The species has no close relatives in the genus.

Thelotrema verruculosum Nagarkar & Hale, sp. nov.

Thallus (Fig. 16) corticola, epiphloeodes, 6–8 cm latus; apothecia immersa, 0.25–0.4 mm diametro, excipulo connato; columella nulla; ostiolum profunde depressum, albocinctum, 0.1–0.2 mm diametro; hymenium 140–200 μm; sporae fuscae, 8:nae, 10–12 × 12–15 μm, 2 × 2–3-loculatae.

Holotype: Malaya, State of Negri Sembilan, Kuala Pilah logging area, ca 8 km N of Seremban-Kuala Pilah road, ca 10 km W of Kuala Pilah, on felled trees in dipterocarp forest; elev. ca 150 m; 17 Aug. 1983; *M. E. Hale* 63,057 (US).

Thallus whitish mineral grey, smooth to minutely verruculose, continuous; cortex ca. 10 μm; algal layer 30–35 μm, interrupted by crystals; medulla thick, up to 320 μm, with medium-sized crystals; apothecia numerous, immersed in the medulla, 0.25–0.4 mm in diameter; the exciple fused, reddish brown, darker towards inner edge, with long periphysoids; pore deeply depressed, white rimmed, 0.1–0.2 mm in diameter; hymenium 140–200 μm; spores brown, broadly oval, 2 × 2–3-loculate, 10–12 × 12–15 μm, 8/ascus.

Chemistry: No substances present.

Observations: Depressed pores, long periphysoids, and 2 × 2–3-loculate broadly oval spores distinguish this species. It has no close relatives in the genus.

MYCOTAXON

Vol. XXXV, No. 2, pp. 449-453 July-September 1989

PHYTOPHTHORA UNDULATA COMB.NOV.

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Phytophthora undulata (H.E. Petersen) M.W. Dick comb.nov.

Basionym	*Pythium undulatum* H.E. Petersen, *Botanisk Tidsskrift* **29**: 345 (1909).
Synonyms	*Pythiomorpha undulata* (H.E. Petersen) A.E. Apinis, *Acta Horti Botanici Universitatis Latviensis* **4**: 234 (1929). *Pythium undulatum* H.E. Petersen var. *litorale* Hohnk, *Veroffentlichungen des Instituts fur Meeresforschung in Bremerhaven* **2**: 81 (1953).

Type: IMI 308280 (NEOTYPE). Plaats-Niterink (1981) quotes a culture as the neotype. This does not satisfy the *International Code of Botanical Nomenclature* (Greuter *et al.*, 1988) and therefore slides of culture IMI 308280 have been deposited in Herb. IMI, Isoneotypes at Reading.

Pythium undulatum H.E. Petersen was first described from Denmark (Petersen, 1909). Apinis (1929) transferred the species to *Pythiomorpha* H.E. Petersen. The fungus is common in the northern hemisphere and has been studied on various occasions from N. America (Beneke & Schmitt, 1961; Dick, 1971 (Canada, B.C.); Drechsler, 1946; Goldie-Smith, 1952; Hamm *et al.*, 1988 (Alaska);

Matthews, 1931; Scott, 1960 (Haiti); Sparrow, 1932) Europe (Apinis, 1929; Beverwijk, 1948; Dissman, 1927; Dudka, 1970 (Ukraine); Goldie-Smith, 1952; Hohnk, 1953, 1956; Johnson, 1971 (Iceland); Lund, 1934; Perrott, 1960; Petersen, 1909, 1910; Wildeman, 1931; Zebrowska, 1976) and Asia (Khulbe & Bhargava, 1977, India). It does not appear to have been reported from the southern Hemisphere.

No sexual reproduction has ever been obtained, so the generic disposition of this taxon has rested on the morphology of the zoosporangium, which is acknowledged to be exceptional (Plaats-Niterink, 1981). The zoospore cyst diameter is also at the upper end of the range for *Pythium*. It is pertinent to note from the discussion in Plaats-Niterink (1981) that zoospores are known to be formed within the sporangium on occasion, and that it was this feature that Apinis (1929) used to justify the transfer of the species to *Pythiomorpha*. Goldie-Smith (1952: plate 24, fig. 10) gives unequivocal proof of this phenomenon and also points out that there is no discharge tube. *Pythiomorpha* is regarded as a synonym of *Phytophthora* (Blackwell, Waterhouse & Thompson, 1941). Beneke & Schmitt (1961) used the combination "*Phytophthora undulatum* (*Pythiomorpha undulata*)" without comment regarding the nomenclature.

Belkhiri & Dick (1987) cast some doubt on the position of *Pythium undulatum* within the genus *Pythium* because it failed to show the characteristic ribosomal DNA band in DNA preparations. Work on the comparative tolerance of a wide range of Oomycetes to hymexazol concentrations (Kato & Dick, in preparation) has shown that the responses of *Phytophthora undulata* were unlike those of *Pythium* species but did resemble those for several species of *Phytophthora*. Therefore it is now appropriate to make the new combination which was first intimated, on other grounds, by Apinis (1929). Unfortunately, Apinis (1929) used the genus *Pythiomorpha*. However, since the type species of *Pythiomorpha* (*P. gonapodyides* H.E. Petersen) was transferred to *Phytophthora* (*P. gonapodyides* (H.E. Petersen) C.J. Buisman) by Buisman (1927) and Blackwell *et al.* (1941) placed *Pythiomorpha* as a synonym of *Phytophthora* without mention of *Pythium undulatum* or *Pythiomorpha undulata*, a new combiantion is required.

Dick (Belkhiri & Dick, 1988; Dick *et al.*, 1989) has suggested that supra-specific taxa in both *Pythium* and *Phytophthora* may need reconsideration. Many more chemotaxonomic data will be required before morphological criteria can be suitably redefined to reflect relatedness. The change proposed here relates to *Pythium sensu lato* and *Phytophthora sensu lato*.

Phytophthora gonapodyides is another species of *Phytophthora* which has no known sexual reproduction and which shares with *P. undulata* an aquatic saprophytic habit. However, there are no data to suggest that these two species are closely related within *Phytophthora sensu lato*. Therefore, it would not be appropriate to revive the genus *Pythiomorpha*, which was originally erected for *P. gonapodyides* by Petersen (1909).

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MYCOTAXON

Vol. XXXV, No. 2, pp. 455-467 July-September 1989

CONCERNING ATKINSONELLA TEXENSIS, A PATHOGEN OF THE GRASS STIPA LEUCOTRICHA: DEVELOPMENTAL MORPHOLOGY AND MATING SYSTEM.

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ABSTRACT

Atkinsonella texensis (Diehl) Leuchtmann and Clay in ed., a member of the Balansieae host-specific to *Stipa leucotricha* Trin., is described and illustrated. The developmental morphology of the teleomorph and the preceding synanamorphs [microconidial *Acremonium*-like state and macroconidial *Ephelis* state] are considered. The fungus is shown, by experimental crosses, to be heterothallic. Comments are made on the similarity between the microconidial anamorph and that of *Epichloë typhina* (Fr.) Tul. [*Acremonium typhinum* Morgan-Jones & W. Gams].

INTRODUCTION

In recent years, fungi belonging to the tribe Balansieae [Clavicipitaceae, Claviciptiales, Ascomycotina], associated with grasses, have been shown to have a significant impact on the ecology of their hosts and some have been found to cause frequent and severe toxicosis in cattle (Bacon *et al.*, 1975, 1986; Lyons *et al.*, 1986). Infected grasses are now thought to be resistant to numerous insect herbivores due to the production of toxic alkaloids by these fungi, or by the hosts in response to their presence (Funk *et al.*, 1983; Siegel *et al.*, 1985; Clay, 1986, 1988). The Balansieae was monographed by Diehl (1950), who adopted generic concepts reflective of anamorph characteristics as well as teleomorph morphology. The genus *Atkinsonella* Diehl was established to accommodate *A. hypoxylon* (Peck) Diehl [*Epichloë hypoxylon* Peck], on the basis of the presence in its life-cycle of a so-called typhodial anamorph [an adjective derived from the form-genus *Typhodium* Link, a name sometimes used, in the past, for the anamorph of *Epichloë* (Fr.) Tul.] in addition to the ephelidial anamorph [belonging to *Ephelis* Fr.] typical of the genera *Balansia* Speg. and *Myriogenospora* Atk. *Atkinsonella hypoxylon* had previously been classified in *Balansia* [as *B. hypoxylon* (Peck) Atk.] and in *Hypocrella* Sacc. [as *H.*

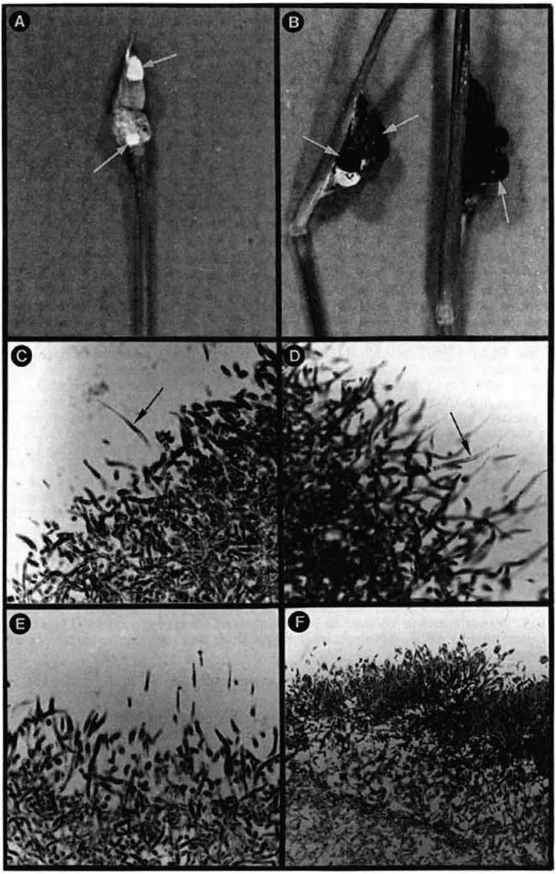
Alabama Agricultural Experiment Station Journal Series No. 18-892147P.

hypoxylon (Peck) Sacc.]. Binomial recombinations had also been made into *Dothichloë* Atk., *Hypocrea* Fr. and *Ophiodothis* Sacc. [*D. hypoxylon* (Peck) Atk., *H. hypoxylon* (Peck) Ell. & Everh., and *O. hypoxylon* (Peck) Sacc., respectively]. These, however, as recognized by Diehl (1950), were purely nomenclatural shuffles since each authority had misidentified the fungus on which they based their recombination decisions. In each instance, *Balansia henningsiana* (Moell.) Diehl [*Ophiodothis henningsiana* Moell.] had been erroneously determined as *Epichloë hypoxylon*. Both *Dothichloë* and *Ophiodothis* are now, incidentally, considered to be synonyms of *Balansia*. The binomial *Ephelis borealis* Ell. & Everh. was established for the ephelidial anamorph of *A. hypoxylon* (Ellis and Everhart, 1885).

The presence or absence of one or other of the two anamorphs helps characterize all genera of the Balansieae, namely *Atkinsonella*, *Balansia*, *Balansiopsis* Höhn., *Epichloë* and *Myriogenospora*. In *Epichloë*, only the microconidial, typhodial anamorph [now classified in *Acremonium* Link, sect. *Albo-lanosa* Morgan-Jones & W. Gams (Morgan-Jones and Gams, 1982; White and Morgan-Jones, 1987b)] is present, whereas in *Balansia* and *Myriogenospora* only the macroconidial, ephelidial state is produced (Rykard *et al.*, 1984). Diehl (1950) reported that no anamorph is produced in *Balansiopsis* but Rykard *et al.* (1984) documented the occurrence of small discoid cavities in the stroma of *Balansiopsis pilulaeformis* (Berk. & Curt.) Diehl, lining which are *Ephelis* conidiophores. So far as is known, however, an anamorph is lacking in *B. gaduae* (Rehm) Höhn. [*Ophiodothis gaduae* Rehm], the type species of *Balansiopsis*, and in *B. asclerotiaca* (P. Henn.) Diehl. In *Atkinsonella*, the typhodial anamorph is the first to be formed and originates from an ectostroma in the same manner as in *Epichloë*. Individual conidiogenous cells, in a loose palisade, each producing a single conidium holoblastically, have the subulate form characteristic of *Acremonium typhinum* Morgan-Jones & W. Gams [anamorph of *E. typhina* (Fr.) Tul., the type species of *Epichloë*]. The *Ephelis* state subsequently develops beneath the microconidial layer, occupying cavities within the stroma or becoming erumpent and sporodochium-like.

The generic name *Typhodium* is a *nomen dubium* because it cannot be satisfactorily typified. As pointed out by Diehl (1950), Link's meager description of it suggests a stage in stromatic development where immature perithecia are present. *Typhodium* is therefore probably a facultative synonym of *Epichloë* (Clements and Shear, 1931; Ainsworth, 1971; Rykard *et al.*, 1984) and is not available for the anamorph. Another form-genus, *Sphacelia* Lēv., [type species *S. segetum* Lēv., the anamorph of *Claviceps purpurea* (Fr.) Tul.] has also been taken up for the microconidial typhodial state following the naming of the anamorph of *Epichloë typhina* as *Sphacelia typhina* (Pers.) Sacc. and *Sphacelia typhina aeruginosa* Sacc. (Saccardo, 1881, 1882, respectively) [*Sphacelia typhina* Sacc.]. The binomial *S. typhina* is, however, also regarded as a *nomen dubium* since it is uncertain that Saccardo ever saw the true anamorph of *E. typhina*, as explained by Morgan-Jones and Gams (1982) and by

PLATE 1. *Atkinsonella texensis*. A, Primary conidial stroma showing white mycelial growth (indicated by arrows) where stromata of opposite mating type were rubbed; B, primary stromata, each bearing a number of black, pulvinate, more or less hemispherical ascostromata (indicated by arrows); C-E, sections through microconidial stromata (conidiogenous cells indicated by arrows) [X 4000]; section showing superficial, macroconidial, sporodochium-like *Ephelis* pustule [X 1000].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White and Morgan-Jones (1987b). Saccardo, in his 1882 account, may, in fact, have based his observations on discordant elements: a greenish [etym. : *aerugo*, the rust of copper] fungus overgrowing the stromata of *Epichloë*. The continued use of *Sphacelia* as a generic name for the anamorph of *Epichloë* is unfortunate for several additional reasons. The sphacelial anamorph of *C. purpurea* is appreciably different in morphology from that of *Epichloë*. In the former, short, obclavate conidiogenous cells, arranged in a dense, effuse palisade, are borne in convoluted labyrinthine chambers (Luttrell, 1980). Moreover, conidiogenesis in *Sphacelia segetum* is enteroblastic, a number of glutinous conidia being formed from each phialidic conidiogenous cell. In addition, the fact that *Sphacelia*, is the anamorph of *Claviceps*, which constitutes the tribe Clavicipiteae, should preclude its use for conidial *Epichloë*. By the same token, it is inappropriate to refer to the microconidial state of *Atkinsonella* as being sphacelial or belonging to *Sphacelia* as is sometimes done in the literature.

Diehl's (1950) treatment of the Balansieae focuses predominantly on morphological aspects observed by study of herbarium material and is incomplete in so far as details of development and life history are concerned. A modern treatment of species of Balansieae, including studies of biological aspects such as mating systems, stromal development, and infection mechanisms, would contribute significantly to our understanding of the group. When Diehl (1950) described *Atkinsonella hypoxylon*, a pathogen of species of the grass genus *Danthonia* DC., a separate variety, occurring on *Stipa leucotricha* Trin., was recognized and named *A. hypoxylon* var. *texensis*. The autonym *A. hypoxylon* var. *hypoxylon* was thereby created. Variety *texensis* had previously been reported by Heald and Wolf (1912) [as *Balansia hypoxylon*] to be the causal organism of a "Balansia blight" disease which destroyed the grass inflorescence. Variety *texensis* was said to differ (Diehl, 1950) in having larger stromata and ephelidial conidiomata. Following reevaluation of the characteristics of var. *texensis*, Leuchtmann and Clay (1989) concluded that this entity differs sufficiently from *A. hypoxylon* var. *hypoxylon* to warrant recognition as a separate species. In addition to stromal size disparity, differences were found in the morphology of the conidiomata of its *Ephelis* anamorph and in growth rates and colony characteristics *in vitro*. Inoculation experiments showed the two entities to be host specific to their respective grass genera and isoenzyme studies indicated appreciable genetic distance between the two. The present authors concur with the view that var. *texensis* should be elevated to species rank. We have had opportunity to examine fresh collections of *A. texensis* and to conduct an investigation of its mating system. The results of our studies of its developmental morphology and crossing experiments are reported herein.

MATERIALS AND METHODS

Stromata of *A. texensis*, in various stages of development, were collected at the Brackenridge Field Experiment Station, University of Texas at Austin. For histological studies, stromata were cut into disks, approximately 2 mm thick. These were fixed in FAA [5 parts formalin: 5 parts concentrate acetic acid: 90 parts 95% ethanol], dehydrated in a graded ethanol series and embedded in acrylic embedding medium [LR White]. Sections approximately 1 um thick were made using glass knives and stained in warm [50 C] 1% aqueous aniline blue stain followed by 1% aqueous toluidine blue.

To investigate the mating system of the fungus, crosses were made in the laboratory between randomly collected stromata. Culms of nine separate plants,

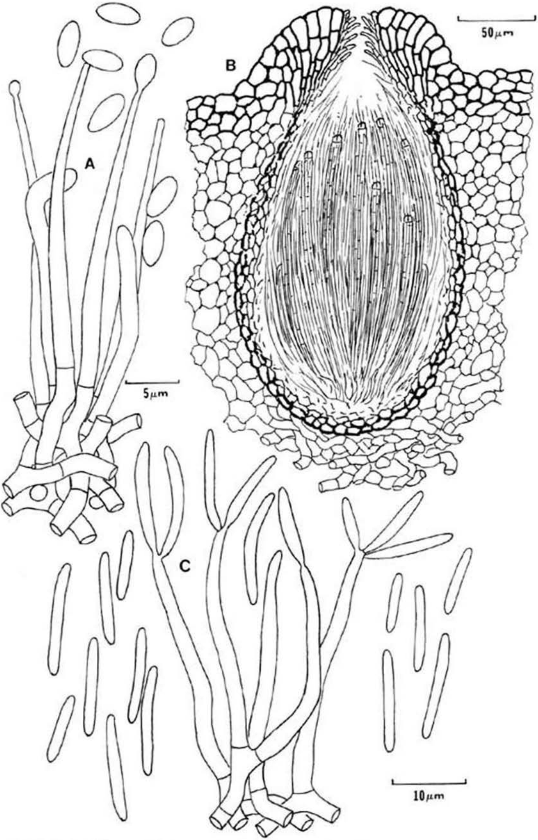


FIGURE 1.*Atkinsonella texensis*. A, *Acremonium*-like microconidial state and receptive hyphae; B, V.S. perithecium; C, *Ephelis* macroconidial state.

each with newly-formed stromata bearing microconidia, were selected. Each was cut 7 inches below the stroma using a sharp razor and placed separately into 50 ml test tubes containing distilled water. Stromata were then segregated into three groups [designated A, B, and C arbitrarily], each group consisting of three stromata [designated 1, 2, and 3]. To make crosses within each group, stromata were inoculated with both of the other stromata by bringing them into contact as follows: to inoculate stroma 1, stroma 2 was brushed against its top, and stroma 3 was brushed against its bottom; to inoculate stroma 2, stroma 1 was brushed against its top, while stroma 3 was brushed against its bottom; to inoculate stroma 3, stroma 1 was brushed against its top, and stroma 2 was brushed against its bottom. In this way, all possible crosses were made within each of the three groups of stromata. Stromata were then loosely wrapped in plastic bags to prevent drying and incubated at room temperature for one week, after which time each was examined for evidence of ascostromal initiation. Growth of a white raised mycelium over the surface of the inoculation site (Fig. 1) was taken as evidence that stromata brought into contact were of the opposite mating type and no response indicated the cross-inoculated stromata to belong to the same mating type.

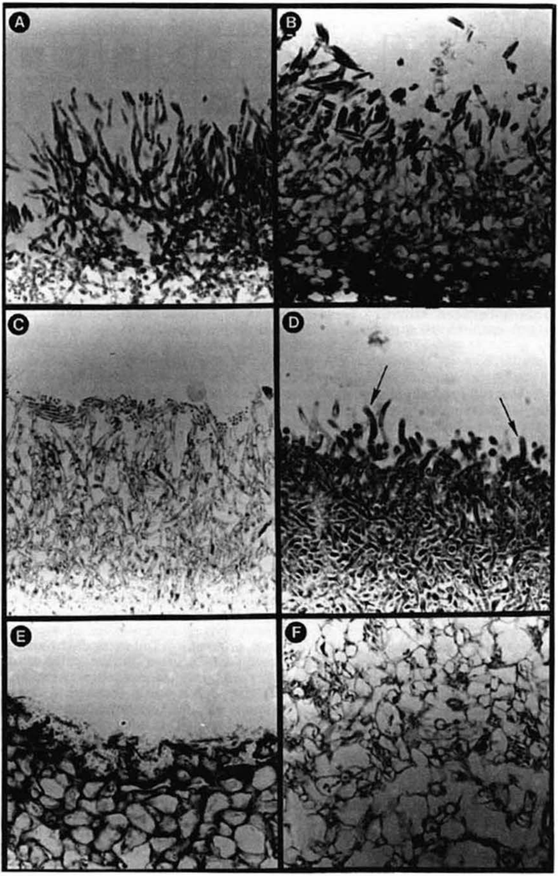
TAXONOMIC PART

Atkinsonella texensis (Diehl) Leuchtmann and Clay, *Mycologia* 80: 1989, *ineditatio* (Plates 1, 2 & 3, Figure 1).

≡ *Atkinsonella hypoxylon* (Peck) Diehl, var. *texensis* Diehl, *U.S.D.A. Agr. Monogr.* 4: 54, 1950.

Mycelium at first occurring epiphytically in the vicinity of upper leaf bases, then progressively enveloping culm and immature inflorescence, with some hyphae becoming intercellular and associating with phloem tissue, eventually consolidating to form a compact, initially prosenchymatous stroma. Stromata (Plate 1, A & B) surrounding and eventually enclosing inflorescence, but not the leaf, at first white, becoming gray to purple gray, more or less obclavate in shape, surface uneven with scattered pulvinate protrusions, at first linear within the leaf sheath, later becoming exposed and bent outwards towards its middle, away from the leaf, to give a boomerang-like configuration (Plate 1, B), 9-18 X 2-5 mm in size, attenuated distally. Surface stromal protrusions 1-1.5 mm in diameter reflective of underlying ovules and associated tissues or, when larger, of secondary ascostromal development. Microconidial conidiophores arising from hyphae at the exposed periphery of young stromata, more or less evenly distributed over the entire stromal surface arranged in a loose, effuse palisade, oriented perpendicular to the surface, simple or occasionally branched, usually somewhat flexuous, cylindrical, septate, hyaline, thin-walled. Microconidial conidiogenous cells (Plate 1, C-E) terminal, determinate, attenuating distally to give a subulate shape, straight or slightly curved, slender, bearing a single conidium and lacking terminal periclinal thickening, 18-25 µm long, 1-2 µm wide at the base. Microconidia holoblastic,

PLATE 2. *Atkinsonella texensis*. A & B, *Ephelis* conidiogenous cells and macroconidia [X 4000]; C, expanding stroma below ephelidial layer [X 2000]; D, consolidated stroma following fertilization, with some receptive hyphae [indicated by arrows] still apparent; [X 4000] E, section of ascostromal surface layer showing pseudoparenchymatous, melanized tissue; F, tissue toward center of ascostroma [X 4000].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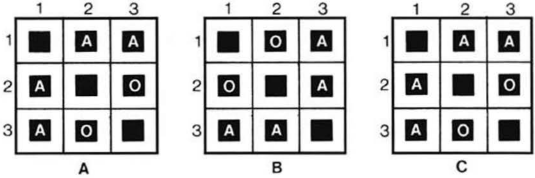


	1	2	3
1	■	A	A
2	A	■	O
3	A	O	■

A

	1	2	3
1	■	O	A
2	O	■	A
3	A	A	■

B

	1	2	3
1	■	A	A
2	A	■	O
3	A	O	■

C

FIGURE 2. A - C, Results of three separate sets of crosses [labelled A, B, and C] between randomly collected stromata [labelled 1, 2, and 3], (A = ascostromal initiation; O = no ascostromal initiation). A series of crosses: crosses between stromata 1 and 2, and 1 and 3 resulted in ascostromal initiation, while crosses between stromata 2 and 3 showed no reaction. B series of crosses: crosses between stromata 1 and 3, and 2 and 3 resulted in ascostromal initiation, while crosses between stromata 1 and 2 showed no reaction. C series of crosses: results were identical to those in the A series of crosses.

ellipsoidal or narrowly ovoid, hyaline, unicellular, smooth, thin-walled, 3-4.5 X 1-2 µm. Microconidial conidiophores interspersed with somewhat shorter, sterile, determinate hyphae, oriented in the same direction, whose obtuse tips are free and exposed. Macroconidial [*Ephelis*] conidiomata arising as cavities in the stromata and becoming erumpent from below the primary microconidial hymenium, or frequently originating superficially as scattered sporodochium-like pustules (Plate 1, F), white to gray in color, sometimes overlying young ascostroma. Macroconidial conidiophores arranged in a loose to dense palisade, cylindrical, septate, branched (Plate 2). Macroconidial conidiogenous cells cylindrical, straight or somewhat flexuous, attenuating gradually toward the apex, sympodial, 1-2.5 µm wide, varying in length, gently geniculate at the apex and bearing the macroconidia in verticil-like clusters. Macroconidia holoblastic, narrowly cylindrical to acicular, straight or very slightly curved, unicellular, smooth, thin-walled, 8-23 X 1-1.5 µm, appearing as glutinous, cream-colored masses extruding from stromal cavities or overlying the sporodochium-like conidiomata (Plate 2, B). Ascostromata hemispherical or somewhat flattened (Plate 3, A), pulvinate, arising as a number of separate entities from the primary conidial stroma, originating, following fertilization, by consolidation and subsequent expansion from just below the palisade of microconidial conidiogenous cells, becoming erumpent and exposed, when mature black in surface view, remaining pale within, 0.5-3 mm in diameter, 1-2 mm high, surface minutely papillate in the vicinity of slightly protruding perithecial necks. Ascostromal tissue at the exposed surface, and in a narrow zone below, pseudoparenchymatous, composed of thick-walled, melanized, inflated, more or less isodiametric cells (Plate 2, E); paler but also pseudoparenchymatous in the subtending portion containing perithecia; and looser, prosenchymatous toward the center and base, tending to disintegrate somewhat centrally as perithecia mature (Plate 2, F). Perithecia immersed, arranged in an irregular layer a short distance below the ascostromal surface (Plate 3, B), lageniform, with a short, thickened, periphysate neck, gregarious, not or very slightly compressed (Plate 3, D), 200-400 µm long, 100-200 µm wide. Perithecial wall well-defined, pseudoparenchymatous (Plate 3, E), generally composed of smaller, more elongate cells than the surrounding stromal tissue. Asci cylindrical with thickened apex pierced by a narrow, tubular pore (Plate 3, F), eight-spored, 120-250 X 4-6 µm. Ascospores filiform, hyaline, multiseptate, 100-190 X 1-1.5 µm.

On *Stipa leucotricha* Trin.; North America.

Collection examined: Brackenridge Field Experiment Station, Austin, Texas, May 1987, J.F. White Jr., AUA.

RESULTS AND DISCUSSION

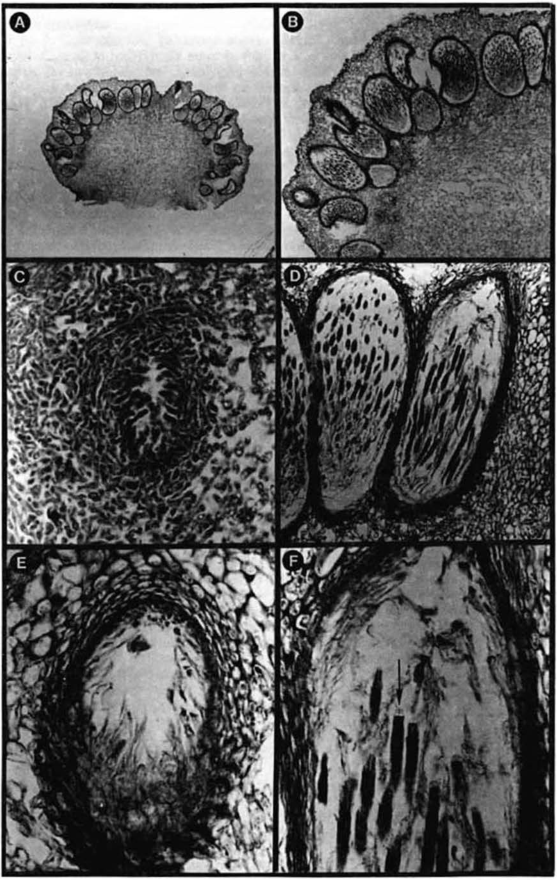
The results of crossing experiments (Fig. 2) suggest *Atkinsonella texensis* to be self-incompatible and heterothallic, with two mating types. For initiation of the sexual phase and elaboration of an ascostroma, a primary conidial stroma must be cross-inoculated with a microconidium of the opposite mating type. The microconidia, although they have capacity to germinate, function as spermatia. In nature, these are assumed to be wind-transmitted (Diehl, 1950). In *Epichloë typhina*, which is also heterothallic (White and Bultman, 1987), microconidia, serving as spermatia, are carried by insects between stromata (Bultman and White, 1987). Whether or not insects play a similar role in the case of *A. texensis* is presently unknown. The sterile, temporarily determinate, hyphae intermixed with microconidial conidiogenous cells probably function as trichogynes or receptive elements, as they are assumed to do in *E. typhina* (White and Morgan-Jones, 1987b). Such hyphae in *A. texensis* resemble those of *E. typhina* in frequently becoming curved subapically so as to assume, toward their tip, orientation more or less parallel to the stromal surface. Some of these initially sterile hyphal elements may, however, remain linear and give rise to further conidiogenous cells so that a succession of these are, in effect, produced. Following fertilization, hyphal growth is resumed laterally in-between and over the microconidial hymenium, mycelial proliferation giving rise to the pulvinate, compact, largely pseudoparenchymatous ascostroma. In our experimental crosses, abundant white mycelium developed at the sites of inoculation when compatible pairings were made. The abundance of such mycelium probably indicated multiple fertilization, resulting in stimulation of many hyphae to resume growth following dikaryotization. The provision of favorable environmental conditions also undoubtedly contributed to appreciable mycelial growth during the one-week incubation period. In nature, the ephelidial anamorph succeeds the microconidial state, forming predominantly as small, scattered pustules superimposed over the primary stroma or immature ascostroma, or originating within cavities in the loosely organized primary stroma. Stromata of *A. texensis* frequently become overgrown in nature by colonies of *Cladosporium* spp., giving them a greenish coloration. In this connection it is interesting to note that Sampson (1933) reported the perithecial layer in *Epichloë typhina* to dry following ascospore dispersal and to become moldy with *Cladosporium* sp.

A number of morphological differences exist between *Atkinsonella hypoxylon* and *A. texensis*. The stromata of the latter, as noted by Diehl (1950), tend to be larger and no leaf tissue is encompassed within them. The ephelidial conidiomata in *A. hypoxylon* are saucer-shaped or apothecioid, in contrast to those of *A. texensis* which are mostly sporodochium-like, and the macroconidia of the latter are appreciably shorter [those of *A. hypoxylon* measure 14-40 X 1-1.5 µm] (Leuchtmann and Clay, 1989; Morgan-Jones and White, personal observations). It should be noted, however, that ephelidial conidiomata tend to be quite variable. Ullasa (1969) described the *Ephelis* anamorph of *Balansia claviceps* Speg. [*Ephelis mexicana* Fr., the type species of *Ephelis* according to

Diehl (1950)] to have conidiomata that vary in outline, and their morphology to be dependent upon the nature and moisture content of the host tissue. Rykard *et al.* (1984) also considered *Ephelis* to be a variable genus, although typically having an apothecioid conidiomata. They noted that the conidiomata of *Atkinsonella hypoxylon* originate as pustular swellings containing a saucer-shaped locule overlaid by stromatic tissue. A layer of conidiophores lining the base of the locule is exposed by splitting of the overlying tissue which is pushed sideward to assume the form of an exciple. The microconidial conidiogenous cells in *A. texensis* are more slender and more aculeolate in overall shape than those of *A. hypoxylon*. In this respect, they resemble those of *Acremonium typhinum in vivo* (see White and Morgan-Jones, 1987b). Those of *A. hypoxylon* measure 2.5-3.5 µm wide at the base and attenuate abruptly distally to give a narrowly lageniform shape. Further documented differences between *A. hypoxylon* and *A. texensis* (Leuchtmann and Clay, 1989) include colony coloration, texture, and growth rate *in vitro*. Also, host inoculation studies by these authors showed the two species to be host-specific to their respective grass genera.

Cell wall relationships between microconidia and the conidiogenous cells from which they originate in *A. texensis* are, at present, uncertain, as in the case in *Acremonium typhinum* and in the other endophytic fungal anamorphs classified in *Acremonium* sect. *Albo-lanosa*. As indicated by White and Morgan-Jones (1987b), conidia in *A. typhinum* are thought to be possibly produced holoblastically, but ultrastructural studies are necessary in order to determine this. Likewise we are, therefore, referring to the process of microconidiogenesis in *A. texensis* as being holoblastic advisedly. The conidiogenous cells of the endophytes *Acremonium coenophialum* Morgan-Jones & W. Gams, *A. lolii* Latch, Christensen & Samuels and *A. typhinum*, as discussed by Latch *et al.* (1984) and White and Morgan-Jones (1987b), at least do not appear to be typical phialides. There is no periclinal thickening at the apex, which is not flared and has the appearance, under the light microscope, of being closed. In this respect, the conidiogenous cells seem to bear similarity to those of species of *Cladobotryum* Nees (see Gray and Morgan-Jones, 1980). Rykard *et al.* (1984) considered the conidiogenous cells of the anamorphs of *E. typhina* and *A. hypoxylon* [referred to as *Sphacelia* states] to be phialidic. The so-called typhodial, microconidial state in the *Atkinsonella* life-cycle is homologous with the *Acremonium* anamorph [*A. typhinum*] in *Epichloë typhina*. Moreover, the organization of the microconidial stromata and the morphology of the microconidial conidiogenous cells in the two are quite closely similar, indicating phylogenetic affinity. Because of this, the microconidial state in *A. texensis* can, at least provisionally, be referred to as being *Acremonium*-like, or as the *Acremonium* anamorph of *A. texensis*. In due course, following further studies of endophytic anamorphs belonging to this complex, it may well be appropriate to establish a separate form-genus in which to accommodate anamorphs currently classified in *Acremonium* sect. *Albo-lanosa* and the microconidial states of *A. hypoxylon* and *A. texensis*. In the meantime, as alluded to in the introduction, application of the generic name *Sphacelia* to the latter should be avoided. The microconidia of *Acremonium typhinum* and some

PLATE 3. *Atkinsonella texensis*. A & B, section of ascostroma bearing perithecia [A, X 200; B, X 800], C, early stage of perithecial formation in expanding ascostroma [X 4000]; D, V.S. perithecia [X 2000]; E, section of young perithecium showing anatomy of perithecial wall; F, asci with thickened apices (narrow, tubular pore indicated by arrow) [X 4000].


A
B
C
D
E
F

other endophytic members of sect. *Albo-lanosa*, such as *A. coenophialum* and *A. starrii* White & Morgan-Jones, differ from those of *A. texensis* in being inequilateral. This is not, however, considered to be significant at generic level since *Acremonium chisosum* White & Morgan-Jones, an endophyte of *Stipa eminens* Cav. not known to have an extant teleomorph, classified in sect. *Albo-lanosa* (White and Morgan-Jones, 1987c), has ovoid microconidia (see White and Morgan-Jones, 1987a), not dissimilar to those of *A. texensis*.

In perpetuating the use of the generic name *Atkinsonella*, Leuchtmann and Clay (1988a, 1988b, 1989) chose to disregard the view of Rykard *et al*. (1984) that there is little justification for maintaining it as a separate entity from *Balansia*. With the recognition of the second species, *A. texensis*, having the characteristic of possessing both microconidial *Acremonium*-like and macroconidial *Ephelis* anamorphs, we, likewise, accept, for the time being at least, the generic distinctions drawn by Diehl (1950). Similarly, we believe that *Balansiopsis* should be maintained until the peculiarities of its type species, *B. gaduae*, particularly whether or not it bears an *Ephelis* anamorph, can be fully reevaluated from fresh collections. Ideally, a new and comprehensive study of these fungi should be conducted before considering reamalgamation of some of the taxa presently separated at generic level.

ACKNOWLEDGMENT

We thank Dr. Dean A. Glawe, Department of Plant Pathology, University of Illinois, for his review of this paper.

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MYCOTAXON

Vol. XXXV, No. 2, pp. 469-476 July-September 1989

NEW SPECIES AND NEW RECORDS OF HYPOGYMNIA (LICHENIZED ASCOMYCOTINA)

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ABSTRACT : The species *Hypogymnia australica* Elix and *Hypogymnia tasmanica* Elix are described as new. The new combination *Hypogymnia pectinatula* (Zahlbr.) Elix is made; *H. pseudobitteriana* (Awas.) Awas. and *H. zeylanica* (R. Sant.) Awas. are reported for the first time from Papua New Guinea. The morphological and chemical variation of the Himalayan species *Hypogymnia delavayi* (Hue) Rassad. is discussed. An updated key to the Australasian species is given.

Introduction

In the 1979 revision of the lichen genus *Hypogymnia* in Australasia (Elix 1979) a total of eleven species and five varieties was accepted for the region. In the intervening decade many more collections of *Hypogymnia* from Australasia and throughout the world have been examined and a further two new species are described here, one from the Australian mainland and one from Tasmania. In addition, three further species are reported for the first time from the region and an updated key to the Australasian species is given.

Throughout the present work chemical constituents were identified by thin layer chromatography (Elix, Johnston & Parker 1987, 1988), high performance liquid chromatography (Lumbsch & Elix 1985) and by comparison with authentic samples.

Hypogymnia australica Elix sp. nov. Figure 1

Species cum thallo ut in *Hypogymnia enteromorphoides* sed ab hac specie parviore, lobis angustioribus, apotheciis dispersis, subtus eperforatis et acidum physodalicum et acidum protocetraricum deficiente differt.
Type. Australia. New South Wales. On *Leptospermum*, Great Dividing Range, 12.6 km east of Bungendore, 850 m, *J. A. Elix 2992*, 23.iii.1977; CBG-holotype.

Thallus foliose, corticolous, loosely adnate, pale grey to grey, to 7 cm in diameter. *Lobes* subcontiguous centrally, becoming linear-elongate, di- or trichotomously branched and lacking lateral contacts marginally, 1.0-2.5(-3.0) mm wide, evenly inflated and hollow throughout. *Upper surface* convex to ± flattened in older lobes, smooth, shiny, rarely black-margined, lacking isidia and soredia; medulla white within but blackened adjacent to the lobe cavity. *Lower surface* black, pale brown at the apices, strongly wrinkled, lacking perforations in the lower cortex. *Apothecia* common,

scattered, 1-5 mm in diameter, sessile to short-pedicellate, swollen basally when young; disc red-brown to dark brown, ± shiny, concave at first then undulate-distorted, margin involute at first, but becoming crenate; asci 8-spored, spores simple, colourless, ellipsoid, 5-8 x 3.5-4.5 μm. *Pycnidia* common, subspherical, immersed, black; conidia bifusiform, 5-6 x 1 μm.
Chemistry. Cortex K+ yellow; medulla K-, C-, KC+ rose, P- ; containing atranorin, chloroatranorin, physodic acid (major), oxyphysodic acid (minor), 2'-*O*-methylphysodic acid (minor) and alectoronic acid (trace).

This new species appears to be related to *Hypogymnia enteromorphoides* Elix as both species have similar inflated, extended, discrete marginal lobes and basally inflated apothecia. However these species differ chemically and in overall growth habit, thallus morphology and distribution of the apothecia. Thus the thallus of *H. australica* is smaller (5-7 cm) than that of *H. enteromorphoides* (8-15 cm), the lobes are narrower (1.0-3.0 cf. 3.0-7.0 mm wide) and more deeply divided, and the primary lobes are subcontiguous. The primary lobes are contiguous in *H. enteromorphoides*. *H. australica* also differs in lacking perforations in the lower cortex and having scattered apothecia. By contrast *H. enteromorphoides* commonly has perforations in the lower cortex and grouped apothecia.

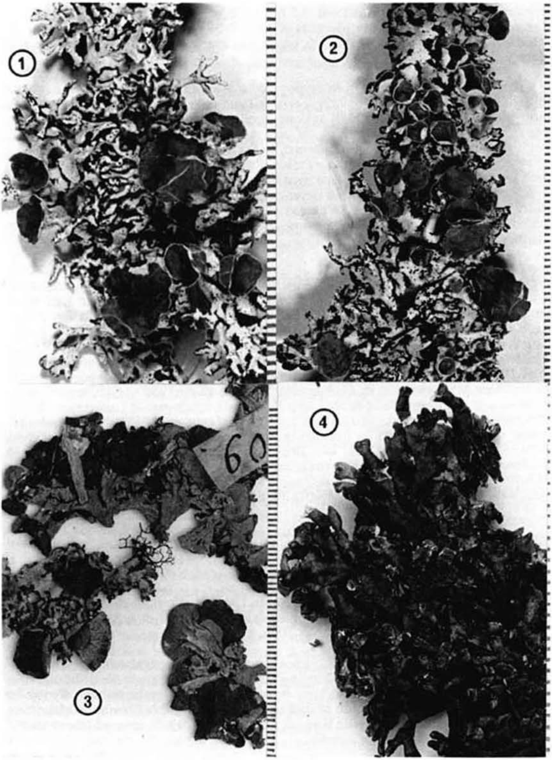
These species also differ chemically. The large majority of specimens of *H. enteromorphoides* react P+ and contain physodalic acid and protocetraric acid in addition to the physodic acid complex, while *H. australica* always reacts P- and contains only the physodic acid complex. These two species are very rarely sympatric : *H. australica* generally occurs east of the Great Dividing Range in central New South Wales; while *H. enteromorphoides* has a more extensive and southerly distribution in New South Wales (particularly the Snowy Mountains), Victoria and Tasmania.

Specimens Examined.
NEW SOUTH WALES. On *Eucalyptus* twigs, type locality, *J. A. Elix 2985*, 23.iii.1977 (MEL); on twigs of *Banksia, Hakea* and *Lambertia* shrubs, Peckmans Plateau, Katoomba, 980 m, *J. A. Elix 3199, 3202, 3620*, 24.iv.1977 (ANUC); on *Bursaria spinosa* twigs, along Reedy Creek, Marble Arch, 48 km south of Braidwood, 620 m, *J. A. Elix 4437*, 2.iii.1978 (ANUC); on *Leptospermum* shrubs in dry sclerophyll forest, north-east slopes of Mt. Canobolas, near Orange, 1320 m, *J. A. Elix 4625*, 1.iv.1978 (ANUC).

Hypogymnia tasmanica Elix sp. nov. Figure 2

Species cum thallo ut in *Hypogymnia turgidula* sed ab hac specie majore, lobis nigromarginatis et medulla nigricante differt.
Type. Australia. Tasmania. On *Banksia* in open woodland, along shore of Lake St. Clair, *J. A. Elix 5643*, 18.i.1979; CBG-holotype; MEL-isotype.

Thallus foliose, corticolous, loosely adnate, grey or grey with black margins, lines or patches, orbicular to 8 cm in diameter or irregularly spreading. *Lobes* contiguous to subcontiguous centrally or throughout the thallus, occasionally developing marginal linear, di- or trichotomously branched lobes which lack lateral contacts, 2.0-4.5 mm wide, evenly inflated and hollow throughout. *Upper surface* convex to ± flattened in older lobes, smooth, shiny, commonly black-margined, lacking isidia and soredia; medulla blackened adjacent to the lobe cavity. *Lower surface* black, pale brown at the apices, strongly wrinkled, eperforate. *Apothecia* common, scattered, 1-7 mm in diameter, short-pedicellate, not swollen basally; disc red-brown to dark brown, ± shiny, concave at first then undulate-distorted, margin entire, thin; asci 8-spored, spores simple, colourless, ellipsoid, 7-9 x 4.5-5.5 μm. *Pycnidia* common, subspherical,



Figures 1-4. Species of *Hypogymnia*. 1, *H. australica* (holotype in CBG); 2, *H. tasmanica* (holotype in CBG); 3, *H. delavayi* (holotype in PC); 4, *H. delavayi* (*Poelt N86-L698* in GZU). Scale in mm.

immersed, black; conidia bifusiform, 5.5-6.5 x 0.7 µm.
Chemistry. Cortex K+ yellow; medulla K-, C-, KC+ rose, P- ; containing atranorin, chloroatranorin, physodic acid (major), oxyphysodic acid (minor) and alectoronic acid (trace).

This new species is related to *Hypogymnia turgidula* (Bitter) Elix as both are corticolous in subalpine areas, have comparable thalli with inflated, contiguous lobes and short-pedicellate apothecia which are not swollen basally, plus identical medullary chemistry (physodic acid complex). *H. tasmanica* differs in developing black lines, bands or patches on the upper surface and by the medulla surrounding the lobe cavity being completely blackened. *H. turgidula* normally has a grey upper surface and a relatively thick, white medulla - the medulla adjacent to the lower surface becomes discoloured (brown) only rarely but never completely blackens. These two species are rarely sympatric in Tasmania. Whereas *H. turgidula* also occurs in New Zealand (common) and New South Wales (rare), *H. tasmanica* appears to be restricted to Tasmania.

Specimens Examined.
TASMANIA. On *Cassinia* sp., Nelson River, central Tasmania, 42°06'S, 145°43'E, 320 m, *G. C. Bratt 72/176*, 3.iv.1972 (HO); on dead wood, Tinder Box road, south-east Tasmania, 43°02'S, 147°18'E, 5 m, *G. C. Bratt & J. A. Cashin 3544*, 2.x.1966 (HO); on limbs of tree, Lake St. Clair, 760 m, 42°06'S, 145°43'E, 320 m, *D. Cannel (G.C. Bratt 70/587)*, 1970 (HO); on upper twigs of *Phyllocladus asplenifolius* in rainforest, Little Denison River Forestry Concession, 420 m, *G. Kantvilas 92/80*, 17.iv.1980 (ANUC); on *Nothofagus cunninghamii* in rainforest, 5-road, Florentine Valley, near Maydena, 450 m, *G. Kantvilas 269/80*, 12.vii.1980 (ANUC); on *Drimys lanceolata* in rainforest, Telopea road near Ben Nevis, south-east of Launceston, 870 m, *G. Kantvilas 559/80*, 5.xi.1980 (ANUC); on *Nothofagus cunninghamii* in rainforest, Sumac road, spur 2 - South Arthurs River Forestry area, 170 m, *G. Kantvilas 658/80*, 24.xi.1980, *G. Kantvilas 315/81*, 14.v.1981 (ANUC); on *Nothofagus cunninghamii* in rainforest, Savage River Pipeline road, south of Rapid River, 480 m, *G. Kantvilas 723/80*, 27.xi.1980 (ANUC); on *Adenopetalum biglandulosum* in rainforest, Mt. Mangana, South Bruny Island, *B. Muffet 3323/44*, 25.i.1977 (ANUC).

New Combination

Hypogymnia pectinatula (Zahlbr.) Elix, comb. nov.

Basionym: *Parmelia pectinatula* Zahlbr., *Annls. Cryptog. Exot.*, **1**, 208 (1928).
Holotype: Java, in montis Pangerango regione alpina, alt. 2985 m, leg. V. Schiffner, Iter Indicum 1893/1894, No. 3002, 9.v.1894 (W).

Specimens now assigned to this species previously were considered to be esorediate forms of *H. vittata*. However following field studies in Papua New Guinea this appeared highly unlikely. In particularly favourable sites, four morphologically similar but distinct, lobulate species could be distinguished: *H. vittata* (with terminal labriform soralia), *H. pseudobitteriana* (with laminal, pustulate soralia), *H. zeylanica* (with isidia) and *H. pectinatula* (no isidia or soredia).
Specimen Examined.
PAPUA NEW GUINEA. On a tussock in subalpine grassland with scattered shrubs, Mt. Giluwe, 4 km south-east of summit, Southern Highlands, 3650 m, *H. Streimann 24266*, 12.ix.1982 (CBG, LAE).

New Records

Hypogymnia pseudobitteriana (Awas.) Awas.
This species has been reported previously from India and the Philippines.
Specimens Examined.
PAPUA NEW GUINEA. On dead stump along border of montane forest, Onim Forestry Station, Iaro River, 14 km north-north-west of Ialibu, 6°09'S, 143°57'E, 2280 m, *J. A. Elix 13406 & H. Streimann*, 19.xii.1982 (ANUC); on trunk of *Lithocarpus* in well lit situation in forest, Mt. Gahavisuki near Goroka, Eastern Highlands, Grid ref. CP 23, 2200 m, *P. W. Lambley 644*, 8.vi.1986 (ANUC, UPNG); on tree trunk, *Nothofagus* - Podocarpaceae dominated ridge, Spreader Divide, 12 km north-west of Aseki, Morobe Province, 7°16'S, 146°06'E, 2000 m, *H. Streimann 11858 & E. Tamba*, 21.i.1981 (CBG, ANUC).

Hypogymnia zeylanica (R. Sant.) Awas. & Singh
This species has been reported previously from Sri Lanka and India.
Specimens Examined.
PAPUA NEW GUINEA. On *Podocarpus* in ridgetop forest, near Myola, Central Province, Grid ref. EK 8690, 2750 m, *P. W. Lambley 97/85*, 23.iv.1985 (ANUC, UPNG).

Notes

Hypogymnia delavayi (Hue) Rassad. Figures 3,4
in *Bot. Mater. Gerb. Bot. Inst. V.A. Komarova* **11**, 5 (1956).

Basionym: *Parmelia delavayi* Hue, in *Bull. Soc. Bot. Fr.* **60**, 21 (1887).
Lectotype: China, Yunnan. Au col de Hoang le in Keou prés le Capin-tze, 1800 m alt. Leg. *Abbé Delavay no. 1609*, 11.iii.1885 (PC!).

Previously this species has been poorly understood because of the broad range of morphotypes and chemotypes that it exhibits. It appears to fill the same ecological niches in the high Himalayas that *H. lugubris* (Pers.) Krog does in the alpine areas of the Southern Hemisphere (New Zealand, Tasmania and South America), and is probably related to that species. A full description of this species follows.

Thallus foliose, corticolous, saxicolous or terricolous, loosely adnate, pale grey or more commonly black-grey or completely blackened, orbicular to 8 cm in diameter or with irregularly spreading lobes. *Lobes* generally free, lacking lateral contacts or more rarely compacted and imbricate, linear, dichotomously to irregularly branched, 0.5-2.5 mm wide, evenly inflated and hollow throughout. *Upper surface* convex to ± flattened in older lobes, smooth, becoming blackened throughout and not sharply delimited from the lower cortex, lacking isidia and soredia; medulla white within but discoloured or blackened adjacent to the lobe cavity in the lower half of the lobes (rarely becoming completely blackened adjacent to the cavity). *Lower surface* black, strongly wrinkled, commonly with relatively large apical perforations. *Apothecia* very rare, 2-7 mm in diameter, sessile to short-pedicellate, base not swollen; disc brown, ± shiny, concave at first then funnel-shaped, margin entire at first but becoming crenate, the amphithecium deeply and distinctly wrinkled; asci 8-spored, spores simple, colourless, ellipsoid, 6-8 x 4-5 µm. *Pycnidia* common, subspherical, immersed, black; conidia weakly bifusiform, 4-6 x 1 µm.
Chemistry. Cortex K+ yellow; medulla K-, C-, KC+ rose, P- or P+ red ; containing atranorin, chloroatranorin, physodic acid (major), oxyphysodic acid (minor), 2'-*O*-methylphysodic acid (trace), alectoronic acid (trace), ± physodalic acid (major), ± protocetraric acid (minor).

Although this species resembles *H. lugubris* in many respects - substrate, growth habit, ecology, the rarity of apothecia, the separate, ± vagrant lobes, chemistry - it differs in having frequent perforations in the lower surface of the lobes and in lacking black lines, bands or patches on the upper surface. Instead the whole upper surface blackens (Figure 4). It seems highly likely that it was *H. delavayi* that Nuno referred to as *H. lugubris* v. *sikkimensis* (Nuno, 1964).

H. delavayi occurs on branches and twigs but more commonly on rocks and soil. The thallus is commonly blackened throughout, although occasional specimens (e.g. the lectotype, Figure 3) have a pale yellow-grey upper surface. The P+ chemotype (containing physodalic acid and the physodic acid complex) is more common than the P- chemotype (containing the physodic acid complex only). However these two chemotypes intergrade : physodalic acid may be absent, present in minor or trace quantities or even the major secondary metabolite present. Previously this species has been recorded only from Yunnan (China) and Nepal.

Specimens Examined.
NEPAL. On rocks, Khumbu Himal, near Ngozumpa Glaciers, mountains north of Chhugyuma, 5200-5600 m, *W. Brandstetter*, iv.1977 (GZU); on soil, Tsona, Langtang area, 4050 m, *G. & S. Miehe 3659c*, 18.vi.1986 (GZU); on soil, Jikeapsa, north-east of Kyangjin, 4450 m, Langtang area, *G. & S. Miehe 4352* (GZU); on soil and debris, Yala, Langtang area, 4960-5120 m, *G. & S. Miehe 4642, 4680c*, 3.vii.1986, *G. & S. Miehe 5290, 5297*, 12.vii.1986 (GZU); on *Rhododendron* twigs, Ganja-La, Langtang area, 4800 m, *G. & S. Miehe 6202b*, 23.vii.1986 (GZU); on soil, Surdscha Kunda, Langtang area, 4850 m, *G. & S. Miehe 8728, 8738b, 8766, 8886a*, 11-13.viii.1986 (GZU); on branch of shrubs, Langshisa Glacier, Langtang area, 4090 m, *G. & S. Miehe 11725a*, 15.ix.1986 (GZU); on SW exposed rock ledges, lateral moraines, Langshisa Glacier, Langtang area, 4530 m, *G. & S. Miehe 11835, 12017, 12022a*, 16.ix.1986 (GZU); on soil, terminal moraine of Langtang Glacier, 4990 m, *G. & S. Miehe 12407*, 20.ix.1986 (GZU); on soil, Karka Sawa, Langtang area, 4990 m, *G. & S. Miehe 12543*, 22.ix.1986 (GZU); on soil, Upper Langtang, west lateral moraine, Langtang area, 4880 m, *G. & S. Miehe 12834*, 26.ix.1986 (GZU); on juniper twigs, Pemdang Karpo, Langtang area, 4620 m, *G. & S. Miehe 13056b, 13056e*, 29.ix.1986 (GZU); on soil, above Pemdang Karpo, Langtang area, 5270 m, *G. & S. Miehe 13324*, 3.x.1986 (GZU); on soil in *Rhododendron* dwarf scrub, terminal moraine, Pemdang Karpo, Langtang area, 4660-5000 m, *G. & S. Miehe 13448*, 5.x.1986, *G. & S. Miehe 13602*, 7.x.1986 (GZU); on juniper branches in *Juniperus* 'Krummholz', Langshisa Glacier, S-flank, Langtang area, 4400 m, *G. & S. Miehe 13846*, 9.x.1986 (GZU); on juniper branches, Niang Tsoha, Langtang area, 4820 m, *G. & S. Miehe 14002*, 12.x.1986 (GZU); on huge rocks near Kyangjin, 3750 m, Langtang area, *J. Poelt N86-L248, N86-L258*, 8-10.ix.1987 (GZU); on soil, slopes north of Kyangjin, moraines of Langtang Lirung Glacier, Langtang area, *J. Poelt N86-L771*, 9.ix.1987 (GZU); on big rocks west of Kyangjin, north of Langtang Khola, Langtang area, 3750 m, *J. Poelt N86-L698*, 10.ix.1987 (GZU); over mosses, big rocks in low scrub, Langshisa, Langtang area, c. 4150 m, *J. Poelt N86-L667*, 15.ix.1987 (GZU); on soil, north exposed slopes above Langshisa Kharka and moraines of Shalbachun Glacier, Langtang area, c. 4400 m, *J. Poelt N86-L478*, 16.ix.1987 (GZU); on soil, north exposed slopes towards Langshisa Glacier, south-east of Langshisa Kharka, Langtang area, c. 4300 m, *J. Poelt N86-L303, N86-L7358*, 17.ix.1987 (GZU).

KEY TO THE SPECIES OF *HYPOGYMNIA* IN AUSTRALASIA

1. Thallus sorediate or isidiate..2
1. Thallus lacking soredia and isidia...7

2. Thallus isidiate .... *H. zeylanica*
2. Thallus sorediate..3

3. Medulla mainly solid.. *H. pulverata*
3. Medulla hollow for the most part..4

4. Lobes with conspicuous and regular lobulae 5
4. Lobes lacking conspicuous lobulae 6

5. Soralia terminal, labriform.. *H. vittata*
5. Soralia laminal, subpustulate.. *H. pseudobitteriana*

6. Lobes crowded, subcontiguous................. *H. subphysodes* v. *austerodioides*
6. Lobes elongated, lacking lateral contact.......... *H. subphysodes* v. *subphysodes*

7. Medulla solid..8
7. Medulla hollow 10

8. Lobes mainly contiguous .... *H. billardieri*
8. Lobes mainly separate...9

9. Thallus corticolous, lobes flattened, medulla P-......................... *H. mundata*
9. Thallus saxicolous, lobes subterete, medulla P+....................... *H. tubularis*

10. Lobes contiguous throughout.. 11
10. Marginal lobes separate, without extensive lateral contacts.........................13

11. Thallus saxicolous, blackened.. *H. kosciuskoensis*
11. Thallus corticolous, grey..12

12. Apothecia basally swollen, lobes 3-6 mm wide.................... *H. pulchrilobata*
12. Apothecia not basally swollen, lobes 1-3 mm wide..................... *H. turgidula*

13. Central lobes contiguous to subcontiguous...14
13. Central lobes lacking lateral contacts...17

14. Apothecia basally swollen, lobes 2-5 mm wide 15
14. Apothecia not basally swollen, lobes 1-3 mm wide.................................16

15. Lobes 2-3 mm wide, medulla P-.. *H.australica*
15. Lobes 3-5 mm wide, medulla P+ .... *H. enteromorphoides*

16. Medulla adjacent to cavity completely blackened....................... *H. tasmanica*
16. Medulla adjacent to cavity white or discoloured below................. *H. turgidula*

17. Lobes markedly lobulate.. *H. pectinatula*
17. Lobes elobulate...18

18. Thallus cartilaginous, medulla thick, ± solid........................... *H. tubularis*
18. Thallus brittle, medullary layer thin...19

19. Lobes sparsely branched, markedly elongate............... *H. lugubris* v. *lugubris*
19. Lobes moderately to densely branched, short...20

20. Lobes irregular, crowded, markedly imbricate, with sparse black
    markings and brown apices................................ *H. lugubris* v. *compactior*
20. Lobes loosely dichotomously branched, not imbricate and with
    prominent black markings................................ *H. lugubris* v. *sublugubris*

ACKNOWLEDGEMENTS

We thank Dr. D. D. Awasthi (LWU), Dr. M. E. Hale (US), Dr. G. Kantvilas (HO), Dr. H. Kashiwadani (TNS), Professor Dr. Josef Poelt (GZU) and Mr. H. Streimann (CBG) for their cooperation and assistance in making many critical collections available to us. We thank the following for the loan of material: CBG, CHR, PC, TNS, W, Mr. P.W. Lambley (UPNG), Drs. R. W. Rogers and G. N. Stevens (BRIU). We also wish to thank the staff of the Science Photographic Unit, ANU, for preparing the photographs, Mr. D. Verdon for checking the Latin descriptions, Ms. J. Johnston for suggestions to this manuscript and the Australian National University for generous financial support through the Faculties Research Fund.

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MYCOTAXON

Vol. XXXV, No. 2, pp. 477-480 July-September 1989

NORTHERN FRUITING OF *PISOLITHUS TINCTORIUS* (GASTEROMYCETES, SCLERODERMATALES)

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Pisolithus tinctorius (Pers.) Coker and Couch (Gasteromycetes, Sclerodermatales) is an ectomycorrhizal fungus which has received much attention in recent years due to its applications in forestry (Marx 1984). This fungus is found world-wide and forms ectomycorrhizae with a broad range of hosts, including most commercially important conifer and hardwood trees (Marx 1977).

Extensive reports on the distribution of *P. tinctorius* have appeared in the literature. Its world distribution was reviewed by Marx in 1977, and its distribution in the United States was reviewed by Grand in 1976. This species is considered to have a Mediterranean and warm-temperate distribution (Grand 1976, Marx 1977, Ing 1985).

Marx (1977) reports *P. tinctorius* as occurring in 38 states of the United States, with a predominantly central, southern and western range; one Michigan collection is cited. Grand (1976) reports *P. tinctorius* as occurring as far north as Washington (approx. 48°00'N) in the western United States, but in mid-continent only as far north as central Michigan (approx. 43°30'N). The northern-most collection of *P. tinctorius* in the University of Michigan herbarium is also from the central part of the state (Edgewood, Gratiot County), which coincides with the locality reported by Grand (1976).

In Canada, *P. tinctorius* has been reported as far north as Ontario's Sudbury District (46°40'N), on mine tailings, and from the Muskoka District (45°00'N) in an undisturbed forest (Malloch and Kuja 1979). *Pisolithus tinctorius* was reported for the first time from Ireland (Tipperary, 52°30'N) in 1984; the collector of which stating, "exceptional weather of the summer of 1984" was probably responsible for it fruiting there (Ing 1985).

Smith (1951) considered *P. tinctorius* rare in the Great Lakes region. Alan Parker (pers. comm.), collecting in northern Wisconsin (Eagle River, Vilas County, 46°10'N), found three specimens of *P. tinctorius* there in 1987. Though the author of the present paper has been collecting ectomycorrhizal gasteromycetes in the Upper

Peninsula of Michigan for the past five years, *P. tinctorius* has not been found prior to 1988, when five collections were made.

Table 1 lists the collections of *P. tinctorius* made in the Upper Peninsula of Michigan (from 46°05'N to 47°09'N) following the extremely hot, dry summer of 1988. Two collections were of single fruiting bodies, and one collection was of two fruiting bodies; more were not found at these sites even though an extensive search was conducted. These small collections were associated with mature *Quercus rubra* L.; mature *Pinus resinosa* Ait. were also present at one site. The other two collections were of numerous fruiting bodies, and were associated with *Betula papyrifera* Marsh. on mine spoils. Here, the barren, rocky sites were being colonized by clusters of young trees, estimated at from 5-20 yrs in age.

The hot, dry weather of 1988 resulted in severe drought in the Upper Peninsula of Michigan. Data from the National Weather Station at Houghton, Michigan (47°07'N) show that the mean daily temperature from April through September was from 1 to 3 degrees C above normal; April through July was drier than normal as well, receiving 1.68 to 5.38 cm less monthly rainfall (Anonymous 1988).

Table 1. Collections of *Pisolithus tinctorius* from the Upper Peninsula of Michigan in 1988.

Date	Location	Habitat	Associated Hosts	Notes
7 Sept.	Dollar Bay, Houghton Co. (47°08'N)	gravel roadside	*Quercus rubra* L.	single, unopened fruiting body 7 X 5 cm
9 Sept.	Houghton, Houghton Co. (47°07'N)	mine spoils	*Quercus rubra* L.	single, unopened fruiting body 6 X 4 cm
10 Sept.	Iron River, Iron Co. (46°05'N)	mine spoils	*Betula papyrifera* Marsh.	prolific fruiting, all stages, 2-8 X 2-10 cm
15 Sept.	Mason, Houghton Co. (47°09'N)	mine spoils	*Betula papyrifera* Marsh.	prolific fruiting, all stages, 2-8 X 2-10 cm
30 Sept.	Marquette, Marquette Co. (46°30'N)	sandy, lawn edge	*Quercus rubra* L. and *Pinus resinosa* Ait.	two fruiting bodies, one mature, 7 X 6 cm, one unopened 7 X 5 cm

The northern-most fruitings of *P. tinctorius* reported by Grand (1976) in the middle and eastern United States generally follow and lie below the 21.1 C (70 F) isotherm for July average daily temperatures (Anonymous 1983). The average daily temperature for July in Houghton, Michigan in 1988 was 21.6 C (Anonymous 1988). This is 2.9 degrees above normal and 0.5 degrees above the isotherm where *P. tinctorius* has previously been reported. Thus, conditions here were comparable to those where *P. tinctorius* normally fruits.

In physiological studies, Marx *et al.* (1970) found that mycelial growth of *P. tinctorius* was greatest at the relatively high temperature of 28 C, and that ectomycorrhizal development with *Pinus taeda* L. was greatest at 34 C. Furthermore, Marx (1977) found *P. tinctorius* more abundant in soils with high surface temperatures. In the Upper Peninsula of Michigan during the summer of 1988, higher than normal air temperatures, combined with lower than normal rainfall, probably resulted in higher than normal soil temperatures. These factors may contribute to the fruiting of ectomycorrhizal fungi with physiological characteristics like those of *P. tinctorius*.

Also studying the effects of growth temperature on ectomycorrhizal fungi, Cline *et al.* (1987) similarly found that *P. tinctorius* exhibited the greatest growth at the higher temperature treatments. In that study, *P. tinctorius* was the only fungus of four tested which demonstrated a relationship between growth performance and geographic origin. This suggests that *P. tinctorius* may be more sensitive to temperature than other ectomycorrhizal fungi. Northern isolates of *P. tinctorius* may be better suited for use in ectomycorrhizal inoculation of tree seedlings in regions where cooler conditions prevail.

Pure cultures of these five northern collections of *P. tinctorius* were obtained from fresh sporocarp tissue. This provides the opportunity to study their growth rates at various temperatures, and to compare them with isolates from more southerly locations. These studies, and those involving their effectiveness at forming ectomycorrhizae with hosts important to the forest industry in the northern Lake States, would be valuable research to conduct with these isolates.

That *P. tinctorius* was found fruiting in the Upper Peninsula of Michigan, north of where it normally fruits, has interesting implications for researchers isolating the fungus symbionts from ectomycorrhizae. It is unlikely that *P. tinctorius* colonized root systems of its hosts and fruited here all in a single season. It is more likely that this fungus was present as a root symbiont in previous years, but did not fruit here until weather conditions became favorable. If this is the case, then one could conceivably isolate ectomycorrhizal fungi from host root systems in regions beyond where they are known to occur from fruiting records.

ACKNOWLEDGEMENTS

Alan D. Parker, University of Wisconsin-Waukesha, Waukesha, Wisconsin 53188, reviewed the manuscript and provided information of *P. tinctorius* in the northern Lake States. Robert L. Shaffer, Herbarium, University of Michigan, Ann Arbor, Michigan 48109, supplied data regarding collections of *P. tinctorius* in Michigan.

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MYCOTAXON

Vol. XXXV, No. 2, pp. 481-483 July-September 1989

BOOK REVIEWS

by
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AGARIC FLORA OF SRI LANKA, by David N.PEGLER, , 519 pp., 104 fig., 125 x 24 cm, paperback, Kew Bulletin Additional Series XII, 1986. Her Majesty's Stationery Office, Room 2C03, St. Crispins, Duke Street, Norwich NR3 1PD, UK. ISBN 0 11 250004 8. £27.-

Virgin forests in tropical countries are subject to annihilation at such a dramatic speed, that tropical mycological flora can be said endangered. Organized extensive mycological explorations are urgently needed. Sri Lanka is one of these countries. Fortunately, collecting the agaricoid flora of Sri Lanka started more than 140 years ago. Gardner (1844) sent 1200 specimens, with water-colour illustrations, to Berkeley who described 305 of them as new species. Later, Thwaites's (1868-9) collections were published by Berkeley and Broome. After Beccari, Cesati and von Höhnel, Petch (1905-25) added a lot more, revised Berkeley & Broome's species, and described 79 others. Pegler himself visited the county in 1974.

The *Agaric Flora of Sri Lanka* is the third of a series of tropical fungus floras by Pegler, after East Africa, 1977 and Lesser Antilles, 1983. It covers 335 accepted species within 94 genera and 21 families. With the same consistent method, care and precision, the author has carried out his study mainly on type and authentic material preserved at Kew Herbarium.from Berkeley, Berkeley and Broome, and Petch. This flora is therefore also a taxonomic revision according to modern taxonomy, proposing more than 70 new combinations and 4 new names, but only one new species. Agaricoid taxa are described in Aphyllophorales, Cantharellales, Boletales, as well as in the Agaricales and Russulales. For all taxa a complete revised synonymy, an accurate description based on exsiccata, and some comments are provided. Most descriptions are illustrated by some line drawings of spores, cystidia, epicuticular elements or pileal hairs, and very fine habit sketches drawn from the available copies of the original water-colour paintings.

Such outstanding revision of today's knowledge of the tropical agaricoid flora of Sri Lanka is most welcome, as a new basis for further collecting and research in that country as well as in any other tropical area.

AN ANNOTATED CATALOG OF THE PYRENOMYCETES DESCRIBED BY CHARLES H. PECK, by Margaret E. BARR, Clark T. ROGERSON, Stanley J. SMITH and John H. HAINES, New York State Museum Bull. 459, 74 pp., 21 x 28 cm, Paperback, 1986. The University of the State of New York, The State Education Dept., Albany, N.Y. 12234, U.S.A. ISBN 1-55557-005-4.

Charles Horton Peck, botanist at the New York State Museum, at Albany, from 1867 to 1915, described a huge number of new species of fungi, but including

Ascomycetes in the years 1870-1888. One hundred of them were described with M.C. Cooke between 1871 and 1876.All specimens, including types, from Peck's herbarium, are preserved at the herbarium NYS.

The purpose of the catalog is to provide a comprehensive and updated listing of Peck's Ascomycetes classically termed Pyrenomycetes, including both euascomycetes and loculoascomycetes. Most of the type specimens were reexamined, to ascertain a revised position of the taxa where necessary. Entries are specific epithets in alphabetical order, followed by its original generic position and the correct citation Data on type specimens include the host and other collection data, and reference to duplicates either sent to Cooke (K) or deposited in NY or BPI herbarium. Currently accepted taxonomic positions of the taxa, with synonymies, are given and 23 new combinations are proposed, with full arguments, supported by illustrations. Such a paper provides a greatly needed tool that anyone ought to have when consulting old mycological literature. Similar research work is to be encouraged.

CHAMPIGNONS DU TONKIN, illustrations of fungi in the Farlow Reference Library with the mycological papers of N.T. PATOUILLARD, by Donald H. PFISTER, 20 pp., 132 fig. in 3 colour microfiches, 4 text microfiches, cloth hardcover, 22 x 28 cm, 1985. Meckler Publishing and Chadwyck-Healey Ltd, 11 Ferry Lane West, Westport, CT 06880, USA. ISBN 0-930466-95-0. US$145.00.

Many mycological thesauri are probably still hidden in botanical Museums that deserve publication. Patouillard's collection was one that Pfister revealed to the public. This publication includes the reproduction of 26 Patouillard's papers published from 1890 to 1928 on fungi collected by V. Demange in North Viet-Nam (Tonkin and Annam), Laos and Cambodia, and the colour reproduction on archival quality silver halide film of 172 plates of water-colour paintings of those fungi. Pfister, who is the author of "An annotated index to fungi described by N. Patouillard" (1977), introduces the publication with a short historical account about Patouillard, Demange, and other fungus collectors in South East Asia, and produces a list of the colour illustrations, with original taxonomic names and references to Patouillard's Herbarium and publications. A selected bibliography on fungi in Viet-Nam and adjacent areas is added.

ICONES MYCOLOGICAE, Tome V. Liste préliminaire et Explication des Planches, by Emile BOUDIER, with contributions by J. VAN BRUMMELEN, *Introduction,* R.P. KORF, H. CLEMENÇON, W. JÜLICH and V. DEMOULIN, *Revision des espèces,* XXX + 300 pp., 24 x 32 cm, leather hardcover, 1985. Editions Piantanida, Lausanne, Switzerland.

The fifth volume of the reprinted edition of Boudier's "Icones Mycologicae" reproduces in facsimile the original lists of the species illustrated in the plates and the explanation to each of them, in 6 series of one hundred at a time. The introduction to that re-edition consists of a historical account on Boudier and his work, as well as a table recording the distribution dates of the 30 successives sets of plates. The revision of the species, in charge of R.P. Korf, has been shared by H. Clemençon for the Agaricales, Russulales and Boletales (plates 1-82, 84-150), W. Jülich for the Aphyllophorales (83, 151-181), V. Demoulin for the Hymenogastrales (184-193), and R.P. Korf himself for the Ascomycotina, mostly Discomycetes and a few Pyrenomycetes, some Deuteromycotina and one Myxomycota (194-600). The revision provides, when possible, the currently valid name for each taxon illustrated by Boudier according the numerical order of the plates, with, in addition, diverse comments, taxonomic justifications, and bibliography. The names as revised, but not all those that are proposed by H. Clemençon, are in agreement with the Sydney International Code of Botanical Nomenclature. In the Ascomycetes, and particularly in the Discomycetes — the special field of Boudier and of Korf, Korf has taken much care in providing, beside the correct valid name in agreement with his taxonomic opinion, any other nomenclatural or taxonomic synonyms that in the opinion of other taxonomists might be alternate correct names. This open way of stating the present nomenclatural or taxonomic status of Boudier's taxa is intended to be useful to most and to enhance further investigations. An index of both original and revised names of the taxa ends the volume.

The reprinting of Boudier's "Icones Mycologicae" has been a difficult enterprise, initiated by R. Karger of the Société Mycologique de Chalon-sur-Saone, France, and successfully brought to the excellent final product that all subscribers have greatly appreciated. But what has made that reprint most accessible and useful to mycologists is that updating of Boudier's taxonomy by Korf and others as presented in this volume. Not only looking with admiration at the Boudier's colorful plates, but using them for scientific purposes is possible now, with great enjoyment.

AUTHOR INDEX, VOLUME THIRTY-FIVE

INDEX TO FUNGOUS AND LICHEN TAXA, VOLUME THIRTY-FIVE

This index contains the names of genera, infrageneric taxa, species, and infraspecific taxa. New names are in **boldface,** as are the page numbers on which such new taxa are proposed.

REVIEWERS, VOLUME THIRTY-FIVE

The Co-Editors express their appreciation to the following individuals who have, prior to acceptance for publication, reviewed one or more of the papers appearing in this volume:

P. A. BACKMAN
M. E. BARR BIGELOW
B. J. COPPINS
E. E. DAVIS
J. A. ELIX
O. ERIKSSON
J. GINNS
D. A. GLAWE
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S. L. STEPHENSEN
J. M. TRAPPE
A. C. M. WEIJMAN
J. E. WRIGHT

MYCOTAXON PUBLICATION DATES

Volume **34**(2)	(January-March 1989)	April 12, 1989
Volume **35**(1)	(April-June 1989)	May 26, 1989

ERRATA, VOLUME TWENTY-FOUR

Page	2	line	18	for	*Gymnascoideus*	read	*Gymnoascoideus*
	8		19	for	*Neoxenophylla*	read	*Neoxenophila*
	13		33	for	*Gymnoascella*	read	*Gymnascella*
	82		4	for	*Gymnascoideus*	read	*Gymnoascoideus*
	138		41	for	*stercorarius*	read	*stercoraria*
	190		28	for	*Narashimella*	read	*Narasimhella*
			28	*for*	1966	*read*	1965
			29	for	**20:**	read	**19:**
	208		5	for	**20:**	read	**19:**

ERRATUM, VOLUME TWENTY-SIX

Pages 120 and 121 were reversed; the Index to Taxa reflects the correct pagination.

ERRATUM, VOLUME THIRTY-TWO

Page	64	line	31	for	*mitschkei*	read	*nitschkei*

ERRATA

The guest co-editors of MYCOTAXON 34(1) wish to correct some editorial oversights. These oversights were the responsibility of the guest co-editors and **NOT** the fault of the respective authors.

•On p. 262, lines 30-32 should read:

A≠B≠: Clamp connections at most septa.
A≠B=: False clamps at most septa.
A=B≠, or A=B=: Simple septa throughout.

•On p. 273, to be inserted under *Lactarius*:

L. manzanitae Methven, Mycologia 77: 475. 1985. CALIFORNIA. Mendocino Co.: Jackson State Forest, under *Arctostaphylos*, 21 Nov 1982, *Desjardin 1775*.

L. riparius Methven, Mycologia 77: 476. 1985. CALIFORNIA. El Dorado Co.: Audrian Lake, under *Abies*, *Alnus*, and *Salix*, 3 Oct 1982, *Methven 1715*.

L. scrobiculatus var. *montanus* Methven, Mycologia 77: 478. 1985. CALIFORNIA. El Dorado Co.: Audrian Lake, under *Abies* and *Pinus*, 3 Oct 1982, *Methven 1716*.

•On p. 273, to be inserted under *Leccinum*:

L. arbuticola Thiers, Calif. Mushrooms: A field guide to the boletes, 126. 1975. CALIFORNIA. Nevada Co.: near Nevada City, scattered to gregarious under madrone, 11 Nov 1972, *Thiers 30514*.

•On p. 276, to be inserted between lines 27 and 28:

Lepiota thiersii Sundberg, Mycotaxon (this issue) 1989.

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