

10 AUG 1981

MYCOTAXON

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

Volume XIII

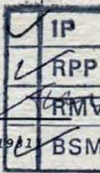
July-September 1981

No. 2

CONTENTS

| | | |
|--|-----------------|-----|
| The genus <i>Pilophorus</i> | H. MARTIN JAHNS | 289 |
| New dematiaceous hyphomycetes from tropical rain forest litter. S. ONOFRI, D. LUNGHINI, A. RAMBELLI AND L. LUSTRATI | | 331 |
| <i>Cochliobolus ravenelii</i> sp. nov. and <i>C. tripogonis</i> sp. nov. J. L. ALCORN | | 339 |
| A psychotropic fungus in Nepal. ROBERT F. SCHROEDER AND GASTÓN GUZMÁN | | 346 |
| Ascus structure and function in <i>Cochliobolus</i> species. J. L. ALCORN | | 349 |
| A preliminary discomycete flora of Macaronesia: Part 6, Geoglossaceae..... RICHARD P. KORF | | 361 |
| The psilopezoid fungi. VII. A new species of <i>Psilopezia</i> from France..... DONALD H. PFISTER AND FRANÇOISE CANDOUSSAU | | 367 |
| Notes on soil fungi isolated from a 15-year-old aspen stand in interior Alaska..... LOLA K. OLIVER AND KEITH VAN CLEVE | | 369 |
| <i>Coprinus</i> sect. <i>Herbicolas</i> from Canada, notes on extralimital taxa, and the taxonomic position of a low temperature basidiomycete forage crop pathogen from western Canada. S. A. REDHEAD AND J. A. TRAQUAIR | | 373 |
| <i>Sclerotinia bresadolae</i> Rick, a taxonomic synonym of <i>Ciborinia</i> <i>candolleana</i> (Lév.) Whetzel..... LINDA M. KOHN | | 405 |
| <i>Halystiomyces</i> , a new dematiaceous genus from Arizona's Sonoran Desert..... EMORY G. SIMMONS | | 407 |
| <i>Osoriomyces</i> , a new genus of the Laboulbeniales from Taiwan. KATSUYUKI TERADA | | 412 |
| The genus <i>Codinaea</i> . Three new species from the Americas. ADRIANNA D. HEWINGS AND J. L. CRANE | | 419 |
| A new species of <i>Dacryopinax</i> from Brazil..... B. LOWY | | 428 |
| Notice: Third International Mycological Congress..... | | 431 |

[MYCOTAXON for April-June 1981 (13: 1-287) was issued May 11, 1981]



ISSN 0093-4666

MYXNAE 13(2) 289-431 (1981)

Library of Congress Catalogue Card Number 74-7903

Published quarterly by MYCOTAXON, Ltd., P.O. Box 264, Ithaca NY 14850. For subscription details, availability in microfilm and microfiche, and availability of articles as tear sheets, see back cover

THE GENUS PILOPHORUS

H. MARTIN JAHNS

Botanisches Institut der Universität Frankfurt, Germany

Summary

All species of *Pilophorus* are examined and four species are excluded from the genus. The remaining 10 species are described and their geographical distribution is demonstrated on maps. Characteristics used for the separation of species are discussed and an artificial key is given.

Introduction

Formerly the genus *Pilophorus* was placed in the Cladoniaceae (Zahlbruckner, 1926), while today the genus is thought to be related to the genus *Stereocaulon* (Jahns, 1970a; Henssen and Jahns, 1973). In an earlier paper I attempted to delimit some species within the genus (Jahns, 1970b), but the choice of the species investigated at that time was arbitrary, resulting from the context of my ontogenetic work, so that no claim for completeness could be made. Furthermore, the investigations of most species were based on relatively limited material, so that conclusions about variation of characteristics and geographical distribution were not reliable. For these reasons it seemed desirable to complete the earlier observations and to extend the work to all species described by other authors and at the same time to include more specimens. This is the aim of the present work. Most of the specimens available from the major herbaria were used in this investigation (more than 1000 specimens). A complete list of their geographical distribution is not included as it would ask to much space. For all practical purposes it seemed to be sufficient to characterize the occurring species, to mention their most important synonyms, to distinguish them from each other and to demonstrate their distribution on maps. The exact places of origin are given for specimens found outside the main area of distribution. For a complete list of literature and synonyms see Zahlbruckner (1927b, 1939).

Material and methods

The material investigated was received on loan from the following herbaria: Herbarium University of Michigan, Ann Arbor (MICH); Herbarium of the University of Georgia, Athens (GA); University of Texas Herbarium, Austin (TEX); Universitetets Botaniske Museum, Bergen (BG); Herbarium University of California, Berkeley (UC); Botanisches

Museum, Berlin (B); Botanisches Institut, Bern (BERN); Museum of Natural History, Budapest (BP); Farlow Herbarium of Cryptogamic Botany, Harvard University, Cambridge (FH); Commonwealth Scientific & Industrial Research Organization, Division of Plant Industry, Canberra (CANB); Chicago Natural History Museum, Chicago (F); University of Alaska, College (ALA); Botanical Museum and Herbarium, Copenhagen (C); National Botanic Gardens, Dublin (DUB); Forschungsinstitut und Naturmuseum Senckenberg, Frankfurt (FR); Conservatoire et Jardin botaniques, Geneva (G); Botaniska Trädgård, Göteborg (GB); Department of Botany, Dalhousie University, Halifax (DAL); Botanical Museum, Helsinki (H); Botanical Institute of Hiroshima University, Hiroshima (HIRI); Botanisches Institut der Universität, Kiel (KIEL); Rijksherbarium, Leiden (L); Herbarium of the Department of Systematics and Plant Geography of the Botanical Institute of the Academy of Sciences of the USSR, Leningrad (LE); Institute of Botany, Faculty of Science, Lisboa (LISU); British Museum, Natural History, London (BM); Botanical Museum and Herbarium, Lund (LD); Herbarium of the University of Wisconsin, Madison (WIS); Botanisches Institut, Marburg (MB); Herbarium A. Henssen, Marburg (Hsn); Botanische Staatssammlung, München (M); Herbarium of Yale University, Osborn Botanical Laboratory, New Haven (YU); New York Botanical Garden, New York (NY); Hattori Botanical Laboratory, Nichinan (NICH); Botanisk Museum, Oslo (O); National Museum of Canada, Natural History Branch, Ottawa (CAN); Oulun Museo, Oulu (OULU); Orto Botanico, Padova (PAD); Muséum National d'histoire Naturelle, Laboratoire de Cryptogamie, Paris (PC); Botanical Department of the National Museum, Praha (PR); Division of Botany, National Herbarium, Pretoria (PRE); University of Washington, Herbarium, Botany Department, Seattle (WZU); Botanical Department, Naturhistoriska Riksmuseet, Stockholm (S); Botanical Department of Tromsø Museum, Tromsø (TROM); Botanical Department, Museum of the Royal Norwegian Society for Science and Letters, Trondheim (TRH); Botanical Institute of the University, Turku (TUR); Institute of Systematic Botany, University of Uppsala, Uppsala (UPS); US National Museum, Department of Botany, Washington (US); Naturhistorisches Museum, Wien (W); Botanischer Garten und Museum der Universität, Zürich (Z).

The specimens were mainly investigated with a stereo-microscope and some typical material was cut with a freeze-microtome.

The genus *Pilophorus* and its subdivision

In my earlier work I explained in detail why in my opinion the correct name of the genus and the correct epithet are "*Pilophorus* Th.Fr.". Further discussion of this question followed from Culberson (1970), who favored the name "*Pilophoron* (Tuck.)Th.Fr." and from Hawksworth, James and Laundon (1972), who agreed with my interpretation. Closely related to this problem is the question of the type species, which in my opinion should remain *P. robustus* Th.Fr. (Jahns, 1970b).

In the last hundred years not only has the number of species subsummed under this genus fluctuated considerably, but attempts have also been made to subdivide the genus. An extreme proposal was the classification of Tuckerman (1882) who considered *P. cereolus* to be the only species of the genus - designating all other species earlier described as subspecies of *P. cereolus*.

Stitzenberger (1862) included the genus *Helocarpon* Th.Fr.

as a subgenus in the genus *Pilophorus*. He referred implicitly to the description of Th. Fries (1861), who mentions for *Helocarpon crassipes* short black, stalked fruitbodies. Fries himself obviously did not consider a relation between the two genera described - *Pilophorus* and *Helocarpon* - but later declared *Helocarpon* to be a synonym for *Lecidea* (Th. Fries, 1874). Having examined the type material of *Lecidea crassipes*, I can confirm that there is no anatomical or morphological similarity with any species of *Pilophorus*.

A different subdivision of the genus was proposed by Satô (1940). When giving the description of the new species *P. nigricaulis* he believed there were principal differences between this species and all other representatives of the genus. He therefore suggested a division of the genus into a section *Nigricaulis*, including *P. nigricaulis*, and a section *Eupilophorus*, including all remaining species. It was explained earlier (Jahns, 1970a) that this subdivision cannot be accepted, as Satô based his description of the new section on a far too rigid partition of tissues and on pigmentation of the stalk tissue which, with variable intensity, can be found in other species too.

On the whole there seems to be no justification for any subdivision of the genus.

The importance of different characteristics for the separation of species

For the separation of the species the same criteria were used as described in the first paper dealing with part of the genus (Jahns, 1970b). However, it is now possible to give a more accurate definition of the range of variation and to judge the value of the different characteristics more rigidly.

Thallus horizontalis

The thallus horizontalis is always crustose and is generally grey or grey-green in color when dry. It consists of minute granules (fig. 1-3) or of flat or inflated scales (fig. 8). Small granules or scales may be pressed together, forming distinct areolae (fig. 7). In some species, especially in older material, the thallus horizontalis may be almost absent. The shape of the horizontal thallus is clearly specific and relatively constant for each species. Therefore it may be used as a distinguishing characteristic, but on its own it is not sufficient for the separation of the species. Principally the external morphology may be characteristic for each species but a certain degree of variation in shape is induced by factors like substrate, etc. Thus intermediate forms and transitions between the habits of different species may occur. Furthermore, variations in shape of the horizontal thallus among different species are difficult to explain, so that this characteristic is of restricted value for use in artificial keys.

Thallus verticalis and growth form

The thallus verticalis of *Pilophorus* is a pseudopodetium similar to the one found in the genus *Stereocaulon*. The position of the apothecia is always terminal. The pseudopodetia may be simple or branched. Their size varies within certain limits but offers a useful aid for the description of the species. In nearly all species a few fertile specimens occur where pseudopodetia are absent and the apothecia are sessile on the thallus horizontalis. The habit of the pseudopodetia offers one of the best means of distinction for taxonomic use. Most common are simple, unbranched and pin-shaped pseudopodetia, which occur in *P. cereolus*, *P. strumaticus*, *P. nigricaulis*, *P. fibula* and *P. curtulum* (fig. 3,6, 7,8,10). If the pseudopodetia of these species bear more than one fruitbody, an indistinct terminal branching may be simulated. In contrast to these pin-shaped species, *P. robustus* and *P. acicularis* have high, branched pseudopodetia which grow in dense clusters (fig. 1,9). An intermediate growth form between these two types is represented by *P. vegae*, *P. awasthianum* and *P. clavatus*. Their pseudopodetia are of middle height and somewhat branched and, at least in *P. vegae* and *P. awasthianum*, may grow in more or less distinct clusters (fig. 2,11). Quite typical for all species is their manner of branching, which is umbellate in *P. robustus* (fig.9), and forked in *P. acicularis*, *P. vegae* and *P. awasthianum*.

The pseudopodetia are usually covered with an algal layer which is not continuous and often resembles the granules and areolae of the thallus horizontalis. Older stalks may be partially bare. In *P. nigricaulis* the stalk is covered with conspicuous peltate scales, which are closely pressed together (fig. 8,17).

Soredia

In all species of *Pilophorus* the pseudopodetia are covered with an algal layer which is never continuous but composed of more or less dispersed areolae. A true cortex is only poorly developed and usually completely absent, so that the pseudopodetia in some species have a granular appearance. True soredia only occur in *P. cereolus*, where they give a distinct powdery look to the stalk (fig. 3).

Cephalodia

Cephalodia are characteristic for all species of the genus *Pilophorus*. However, two species which have been included in this genus (*P. conglomeratum* and *P. staufferi*) lack cephalodia. This, among other reasons, justifies in my opinion the exclusion of these species from the genus *Pilophorus*.

The cephalodia of *Pilophorus* are sacculate and exhibit no special wall structure. In the three tallest species, *P. robustus*, *P. acicularis* and *P. vegae*, some cephalodia occur on the pseudopodetia (fig. 1,9,11), but in all other species they are only to be found on the thallus horizontalis. Their shape is irregular, the surface smooth or granular, and they are light brown to deep brown-black in color.

The cephalodia either contain algae of the *Nostoc* or of the *Stigonema* type. In the species investigated I found *Stigonema* in *P. strumaticus*, *P. fibula*, *P. curtulum* and *P. nigricaulis*, while in *P. robustus* and *P. awasthianum* I found only *Nostoc*. In *P. acicularis* I observed only *Nostoc*, but Kurokawa and Shibuichi (1970) found *Stigonema* in this species. This contradiction may not result from a misobservation, because in *P. cereolus*, *P. clavatus* and *P. vegae* I found some cephalodia with *Stigonema* while others contained *Nostoc*. However, in general, all cephalodia of one specimen contain the same alga. Exceptions are rare. Cephalodia of *P. vegae* contain *Nostoc* and *Stigonema* and possibly algae of the *Gloeo-capsa* type as well.

Nostoc bearing cephalodia often have a habit distinct from those with *Stigonema*. They are always characterized by a smooth surface, while cephalodia with *Stigonema* as phycobionts show a granular surface, at least in their younger stages of development. This phenomenon is explained by the development of the cephalodium which was described elsewhere (Jahns, 1972).

It is not impossible that from those species which seem to contain only one algal species in their cephalodia, specimens with other phycobionts will be found in the future. The occurrence of specific blue-green algae in the cephalodia is therefore not a useful taxonomic characteristic.

Pycnidia, ascospores, fruitbody development

Pycnidia occur abundantly in all species of the genus *Pilophorus*. They are either located on sterile pseudopodetia or on the thallus horizontalis. The conidiophores are unbranched and the conidia sickle-shaped. The size of the conidia does not differ significantly in the different species, so that this characteristic is unimportant for the taxonomy of the genus. The same holds for the ellipsoid ascospores.

The development of the fruitbodies is very uniform too (Jahns, 1970a). Some specimens of *P. clavatus* form an exception. Numerous young apothecial primordia are located in bundles on short stalks (fig. 4). In the further course of development the primordia fuse and, with the growth of the generative tissue, form the typical elongated fruitbody of the species (fig. 5,16).

Anatomy and morphology of the apothecium

The outer shape and inner structure of the apothecium belong to the best characteristics for the separation of the species. In most species the mature apothecia are almost globose and quite often several apothecia are laterally fused (fig. 1,9,10). An exception is the fruitbody of *P. clavatus*, where the hymenium extends a considerable distance down the pseudopodetial stalk so that the apothecium assumes a triangular outline in longitudinal section (fig. 5,16). Smaller variations of the spherical structure are found in *P. awasthianum* and *P. nigricaulis*, which both tend towards slightly triangular-shaped fruitbodies (fig. 2,8).

However, it is possible that the samples of *P. awasthianum* that I examined were not fully developed and mature.

A longitudinal section reveals that the spherical shape of the apothecia is not uniformly formed. Apart from true globose apothecia, fruitbodies may be flattened with a margin of the hymenium that may hang down for a considerable distance before curving upwards again to fuse with the stalk (fig. 14).

Anatomically, three major characteristics are of importance: the boundary-texture, the pigment-boundary and the columella. The boundary between the vegetative tissue and the generative tissue of the fruitbody, which is always easily recognized, may follow different patterns. It forms a thin horizontal zone in the lower periphery of the fruitbody in most species (fig. 14), whereas in *P. robustus* and *P. strumaticus* the vegetative tissue extends upwards into the generative tissue of the apothecium (fig. 12) forming a cone-like columella.

The boundary between the vegetative and generative tissues may be emphasized by two conspicuous structures. In the transition zone the generative tissue may form a boundary-texture built from closely interwoven, short-celled hyphae (fig. 13). Often the junction of vegetative and generative tissue is characterized by a deposit of black-brown pigment (fig. 15), which is referred to as the pigment-boundary. The pigment-boundary bears little relationship to the boundary texture and may or may not be superimposed. Black pigment is often concentrated in the subhymenial layers (fig. 14,15) as well as in the pseudopodial tissue (for example in *P. nigricaulis*, *P. vegae* and *P. strumaticus*).

The columella, the boundary-texture and the pigment-boundary are characteristics which help to separate the species very accurately. These characteristics may occur singly or combined.

Secondary products

Small amounts of several specimens were investigated by TLC. The results obtained agree in general with those published by Krog (1968) and Kurokawa and Shibuichi (1970). All species contain atranorin and zeorin. Stictic acid was found in *P. nigricaulis* and *P. vegae*. Furthermore, Kurokawa and Shibuichi found caperatic acid in *P. clavatus* and constrictic acid in *P. nigricaulis* as well as six other non-identified substances in different species of the genus. These observations could not be substantiated in detail.

In this study the chemical characteristics will not be considered for taxonomy, as obviously only those substances that are common to all species occur in sufficient amounts. In order to avoid seriously damaging the usually limited material of the herbarial specimens it is sometimes impossible to demonstrate the presence even of atranorin and zeorin. Therefore, it is almost impossible to obtain an exact and reliable picture of the distribution of these substances with the methods described.

Substrate

The species of this genus grow exclusively on silicate stone. As an exception single colonies may extend to rigidly pressed soil covering the stone. One specimen of *P. acicularis* from USA, Washington (near Lake Cushman, Mason Co., S. East Olympias (F)) was found growing on dead wood. The numerous other specimens from the same region suggest extremely favorable climatic conditions which enable the lichen to colonize the unfamiliar substrate.

Distribution

The species of the genus *Pilophorus* occur exclusively in the northern hemisphere. *P. conglomeratum*, *P. colensoi* and *P. staufferi* described from Australia, New Zealand and New Caledonia are no longer included in the genus *Pilophorus*. In the literature it is still maintained that *P. acicularis* occurs in Australia and Africa (Cape of Good Hope). These statements refer exclusively to a note from Nylander (1860) who claims to have seen the material in the Hooker herbarium, but these specimens disappeared later. In the year 1860 the separation of the species was not well defined, so that it may well have been *P. conglomeratum*. In any case I consider this information too doubtful to include in the distribution maps.

The distribution maps of the individual species are based almost exclusively on specimens which I have personally investigated. Only in a few cases have I included notes from other workers (Krog, 1968; Ammann and Ammann, 1969; Kurokawa and Shibuichi, 1970), as I am certain that the definition of species by these authors agrees with my own views.

The individual points in the distribution maps often include material from a relatively large area. The number of specimens examined is given for each point. However, in many cases these numbers are almost certainly slightly higher than the number of findings proper, as it was impossible always to recognize identical specimens from the same gathering which had been distributed and preserved in different herbaria. In those cases where a single finding is represented by numerous specimens distributed as an exsiccate it is only recorded as a single point. The exact places of origin are indicated in detail only when either very few such places are known or when those places are outside the main area of distribution. Places which are listed in the description of the species are marked by a point, others not individually listed are marked by a square on the maps. Findings taken from other authors are marked by a triangle.

In general the following large-scale distribution was established: One group of species (*P. acicularis*, *P. nigricaulis*, *P. clavatus*) occurs around the northern Pacific Ocean. In the same area two more species are found which, however, are restricted to only part of this area (*P. cartilum* in China and Japan, *P. vegae* in Alaska and the Bering Strait area). One species (*P. avasthianum*) is restricted to the Himalayas and another (*P. fibula*) to the eastern

parts of the USA. One species (*P. strumaticus*) occurs only in those parts of Europe which have an oceanic climate. Very typical is the distribution of *P. robustus*, which is found circumpolarly in the most northern areas and in high mountains. *P. cereolus* shows the most irregular distribution. This species is most abundant in Scandinavia but occurs in single specimens in middle and central Europe, in Siberia and in the eastern part of North America.

Artificial key to the species

- | | | |
|-----|---|----|
| 1a | Lichen with pseudopodetia and developed apothecia | 2 |
| 1b | Lichen without pseudopodetia or pseudopodetia without apothecia, sometimes with pycnidia or black primordia of apothecia. | 15 |
| 2a | Thallus horizontalis and pseudopodetia clearly sorediate. Pseudopodetia pin-shaped, unbranched, at most 1 cm high. Apothecia without columella (fig. 3). <i>P. cereolus</i> | |
| 2b | Surface not sorediate, at the most slightly granulose. | 3 |
| 3a | Pseudopodetia with continuous white cortex. Ecorticate parts of the pseudopodetia and their central part always black. Pseudopodetia 0.5-1.5 cm high, usually dichotomously branched. Large cephalodia on short branches. Apothecia unknown. Alaska, Bering Strait. (fig. 11) <i>P. vegas</i> | |
| 3b | Lichen with other characteristics. | 4 |
| 4a | Pseudopodetia smaller than 5 mm. | 5 |
| 4b | Pseudopodetia higher than 5 mm. | 11 |
| 5a | Apothecia cylindrical or triangular in longitudinal section, at least twice as high as broad (fig. 16). Pseudopodetia pin-shaped, unbranched. Apothecia often slightly bifurcate at the apices (fig. 5). <i>P. clavatus</i> | |
| 5b | Apothecia globose, sometimes several globose apothecia are fused. | 6 |
| 6a | Pseudopodetia very thin (0.2-1.0 mm broad, 5 mm high), more or less branched, partly ecorticate and black (fig. 2). Himalayas. <i>P. axasthianum</i> | |
| 6b | Pseudopodetia broader, pin-shaped, unbranched. | 7 |
| 7a | Scales of the thallus horizontalis and of the pseudopodetial cortex peltate (fig. 17), white, pressed together, with an inflated appearance. Inner parts of the pseudopodetium with dark pigment. Apothecia with boundary-texture, globose or sometimes pointed (fig. 8). <i>P. nigricaulis</i> | |
| 7b | Lichen with other characteristics. | 8 |
| 8a | Thallus horizontalis formed by granules or minute scales. Granules or scales fused into broader, closely arranged areolae (fig. 6,7). | 9 |
| 8b | Granules or scales of the thallus horizontalis scattered. | 10 |
| 9a | Apothecia always with boundary-texture and pigment-boundary. Pseudopodetia usually not higher than 1 mm (at most 2 mm) (fig. 7). Eastern North America. <i>P. fibula</i> | |
| 9b | Apothecia always with boundary-texture, only very old specimens with pigment-boundary. Pseudopodetia 1-3 mm high (fig. 6). Japan and China. <i>P. curtulum</i> | |
| 10a | Apothecia without columella, with boundary-texture and in old specimens with pigment-boundary (fig. 6). Japan and China. <i>P. curtulum</i> | |

- 10b Apothecia with columella, without boundary-texture and pigment-boundary (fig. 10,12). Europe. *P. strumaticus*
- 11a Apothecia cylindrical or triangular in longitudinal section, at least twice as high as broad (fig. 16). Pseudopodetia pin-shaped, unbranched. Apothecia often slightly bifurcate at the apices (fig. 5). *P. clavatus* 12
- 11b Lichen with other characteristics.
- 12a Scales of the thallus horizontalis and of the pseudopodetial cortex peltate (fig. 17), white, pressed together, with an inflated appearance. Inner parts of the pseudopodetium with dark pigment. Apothecia with boundary-texture, globose or sometimes pointed (fig. 8). *P. nigricaulis*
- 12b Lichen with other characteristics. 13
- 13a Pseudopodetia very thin (0.2-1.0 mm broad, 5-15 mm high), more or less branched, partly ecorticate and black (fig. 2). Himalayas. *P. awasthianum*
- 13b Lichen with other characteristics. 14
- 14a Pseudopodetia umbellately branched towards the apices. Apothecia numerous, often fused at the margins, with large columella (fig. 9,12). *P. robustus*
- 14b Pseudopodetia dichotomously branched, in combed tufts, smaller plants unbranched. Apothecia without columella (fig. 1). *P. acicularis*
- 15a Pseudopodetia with pycnidia or with primordia of apothecia present. 16
- 15b Only thallus horizontalis present. 21
- 16a Thallus horizontalis and pseudopodetia sorediate. Pseudopodetia pin-like, often broadest in the middle (fig. 3). *P. cereolus*
- 16b Lichen not sorediate. 17
- 17a Pseudopodetia very thin (0.2-1.0 mm broad, 5-15 mm high), more or less branched, partly ecorticate and black (fig. 2). Himalayas. *P. awasthianum*
- 17b Pseudopodetia broader. 18
- 18a Pseudopodetia with continuous white cortex. Ecorticate parts of the pseudopodetia and their central part always black. Pseudopodetia 0.5-1.5 cm high, usually dichotomously branched. Large cephalodia on short branches. Apothecia unknown (fig. 11). Alaska, Bering Strait. *P. vegae*
- 18b Lichen with other characteristics. 19
- 19a Thallus horizontalis persistent, formed by closely connected areolae. Sterile pseudopodetia 1-2 mm high, terminated by a pointed pycnidia. *P. clavatus*
- 19b Thallus horizontalis formed by scattered granules, evanescent in older specimens. 20
- 20a Pseudopodetia at least indistinctly umbellately branched in their upper part. With numerous pycnidia or primordia of apothecia. *P. robustus*
- 20b Pseudopodetia slender, unbranched or dichotomously branched. *P. acicularis*
- 21a Thallus horizontalis not sorediate, sometimes granular. 22
- 21b Thallus horizontalis sorediate. *P. cereolus*
- 22a Thallus horizontalis formed by white, peltate, inflated scales or granules. Japan, west coast of North America. *P. nigricaulis*
- 22b Lichen with other characteristics. 23

- 23a Thallus horizontalis persistent, formed by closely connected areolae. 24
- 23b Thallus horizontalis persistent or evanescent, formed by more or less scattered granules or scales. Determination only from distribution (see maps). *P. robustus*, *P. strumaticus*, *P. acicularis*, *P. vegae*, *P. awasthianum*, *P. curtulum*
- 24a Areolae thin, not distinctly formed by individual granules. *P. clavatus*
- 24b Areolae thick, composed of small granules. 25
- 25a Distribution in Japan and China. *P. curtulum*
- 25b Distribution in the eastern North America. *P. fibula*

Description of the species

Pilophorus acicularis (Ach.) Th.Fr., De *Stereocaulis* et *Pilophoris* Comm.: 41 (1857).

Baeomyces acicularis Ach., Meth. Lich.: 328 (1803). Type collection: North America, Hall (UPS, isotype).

Genomyce acicularis Ach., Lich. Univ.: 567 (1810).

Thallus horizontalis small granular, evanescent in older thalli, grey when dry. Pseudopodetia (0.5-) 3 cm high, 1 mm diameter. Mostly simple or dichotomously branched, stalks curved so as to appear as if combed; rarely erect, pin-like and 1 cm high (fig. 1). In some specimens richly branched in the upper part of the pseudopodetia, thus

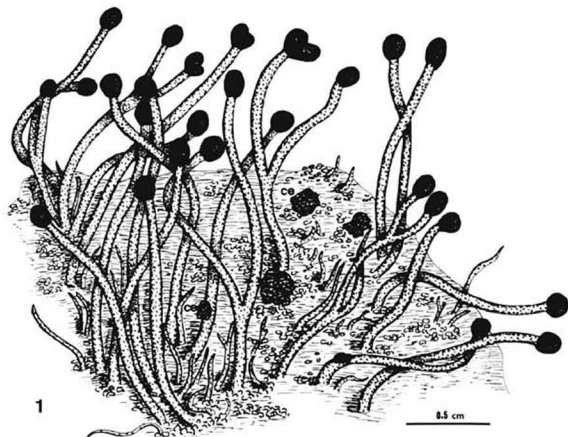


fig. 1 *P. acicularis* (ce - cephalodium)

faintly resembling *P. robustus*. Internally the pseudopodetia are solid when young, becoming hollow with age, composed of long, thin, strongly gelatinized hyphae with narrow lumina (0.5 μ m). The lower part of older pseudopodetia becomes blackened internally. Algal layer not continuous, in more or less distinct granules, entirely absent from some parts of the surface.

Pycnidia occur in the tips of small sterile pseudopodetia or in the tips of small lateral branches of older pseudopodetia. Conidiophores 30 μ m long, unbranched, with terminal sickle-shaped conidia, 6 x 1 μ m.

Apothecia abundant, one or several on the apices of the pseudopodetia, black, hemispherical or indistinctly triangular, up to 1.5 mm diameter. There is no columella.

Hymenium up to 240 μ m high, two-thirds pigmented, lower part sterile, consisting only of paraphyses. Excipulum absent. Asci eight-spored. Spores rounded when young, becoming spindle-shaped when mature, 21.0-29.5 x 4.5-5.5 μ m. Generative tissue formed of closely interwoven hyphae with short, broad cells with large lumina. The generative tissue is pigmented black-brown, the color being most intense below the paraphyses, becoming less so towards the stalk region.

Phycobiont green, *Pleurococcus* type, cells c. 9 μ m diameter.

Cephalodia on the thallus horizontalis are brown and hemispherical and contain *Nostoc*. Kurokawa and Shibuichi (1970) found cephalodia containing *Stigonema*. Small cephalodia also occur on the pseudopodetia (fig. 1).

Growing on silicate stone, seldom on decaying wood (one specimen).

Remarks

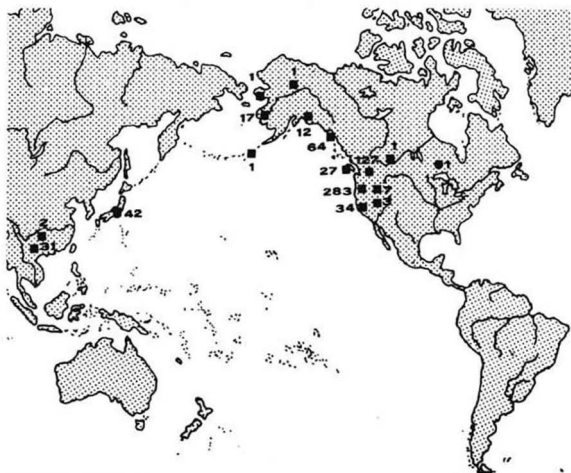
The correct citation for the species is *P. acicularis* (Ach.) Th.Fr. (1857, p.41) and not *P. acioularis* (Ach.) Nyl. (1857, p.96) as explained earlier (Jahns, 1970b).

P. acicularis can be separated from the smaller species by its tall pseudopodetia. It may be confused with *P. robustus*, especially in material from Alaska where both species occur together. But usually the type of branching is different (umbellate in *P. robustus*, dichotomous in *P. acicularis*) and the lack of a columella in longitudinal sections of the fruitbodies of *P. acicularis* always makes distinction easy.

Th. Fries (1889, p.765) described *P. acicularis* var. *conjugens* Th.Fr. from Vancouver Island, which is said to resemble *P. robustus*. I have seen the original material and can see no difference from numerous other specimens which are not worthy of varietal status.

Distribution (map 1)

P. acicularis is probably the most abundant species of the genus. Most specimens were found on the west coast of North America, with a focal point in British Columbia and Washington. The species is widely spread in Japan too. In general this species seems to prefer an oceanic climate without extremely low temperatures, at least in comparison with other species of the genus. This assumption is supported by the fact that this species is found more southerly (34 findings in California) than all other



map 1 *P. acicularis* - distribution (places listed ● and not listed ■ in the description of the species)

species and only two specimens were found in northern Alaska where, for example, *P. robustus* and *P. vegae* occur more often. East of the Rocky Mountains *P. acicularis* is rare too. It is very difficult to give any estimate on the occurrence of the species in China. Although there are only three places known to me where the species has been found, at least one gathering was large enough for the distribution of numerous specimens as an exsiccate (Krypt. Vind. Exs. 2842). Therefore, it may be suggested that *P. acicularis* is not rare in China, but simply has not been collected.

Places outside the main distribution area (map 1, marked by a circle):

Canada, Ontario, Belleville (CAN).

Pilophorus awasthianum Räs., Arch. Soc. Zool. Bot. Fenn. Vanamo 5:28-29 (1950). Type collection: India orientalis, Himalaya orientalis, Darjeeling, 3500 m (H, holotype).

Thallus horizontalis persistent or evanescent, consisting of loosely scattered granules, c. 0.1 mm diameter, grey when dry. Pseudopodetia simple or branched, small and very thin, 0.5-1.5 cm high and 0.2-1.0 mm broad. Pseudopodetia partly covered by an algal layer consisting of small granules, but for the most part the stalks

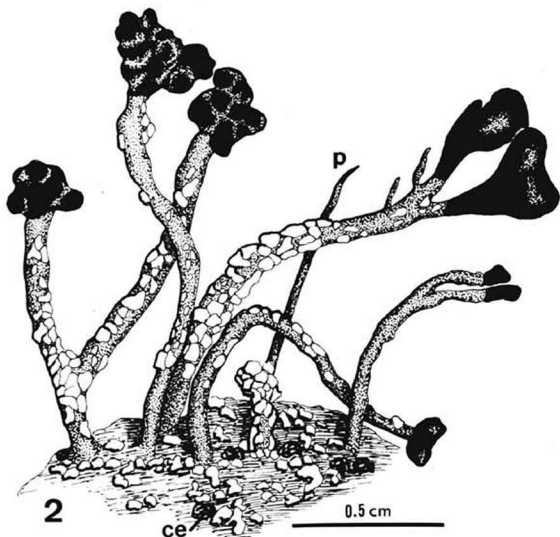


fig. 2 *P. awasthianum* (ce - cephalodium, p - pycnidium)

are bare. The ecorticated parts are blackened, the algal layer grey. Internal part of pseudopodetia solid, formed by strongly gelatinized hyphae.

Pycnidia apical on short pseudopodetia.

Apothecia apical on mature pseudopodetia, sometimes simple and globose but mostly aggregated, consisting of several subglobose bodies (fig. 2). Apothecia 1.5-2.0 mm in diameter. In mature specimens apothecium and pseudopodetium are separated by a pigment-boundary, while boundary-texture and columella are absent. Hymenium c. 100 μ m high, excipulum absent. Asci eight-spored, spores spindle-shaped, c. 20 x 7 μ m.

Phycobiont green, *Pleurococcus* type, cells c. 10 μ m in diameter.

Cephalodia contain *Nostoc*, black, globose, sessile on the thallus horizontalis, c. 0.1 mm diameter.

Growing on silicate rock and earth.

Remarks

P. awasthianum differs from all other species by the small, branched and very thin pseudopodetia and by the strongly aggregated apothecia. As there are only two

known specimens so far, the range of variation of the different characteristics is unknown.

Distribution (map 2)

The species is only known from the Himalayas. I have seen the following specimens:

India, Darjeeling district, E. Himalayas, Awasthi, 1948 (H, holotype); India Sandakhpu, Awasthi, 1950 (UPS).



map 2 *P. awasthianum* - distribution

Pilophorus cereolus (Ach.) Th.Fr., Lich. Scand. 1, 1: 55 (1871).
Lichen cereolus Ach., Lich. Suec. Prodr.: 89 (1798); Meth. Lich.:
 316 (1803). Type collection: Sweden, Fackelälf, E. Acharius
 (H, holotype).

Thallus horizontalis persistent, consisting of loosely aggregated, sorediate granules, c. 0.1 mm diameter, grey-green when dry. Pseudopodetia pin-like, usually up to 5 mm (occasionally up to 1 cm) high, 1.5 mm broad, sorediate. Sterile stalks or those

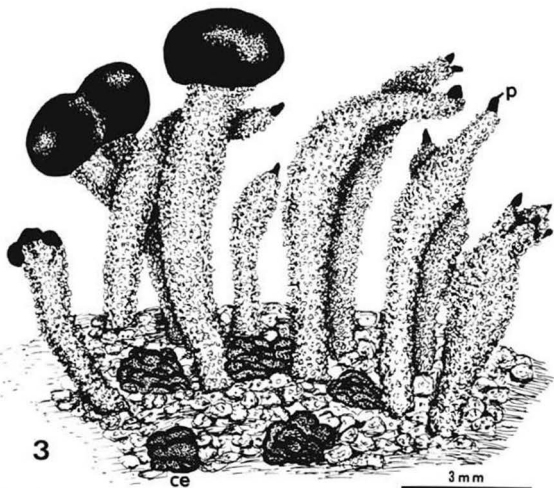


fig. 3 *P. cereolus* (ce - cephalodium, p - pycnidium)

bearing only pycnidia are usually broadest in the middle and irregularly curved (fig. 3). In some specimens, especially in the few American samples, the upper part of the pseudopodium is slightly branched, each branch bearing a pycnidium or a primordium of a fruit-body. Internally the stalks are compact, composed of strongly gelatinized hyphae with narrow lumina. The phycobiont layer is granular sorediate.

Pycnidia bottle-shaped, abundant, several often produced at the apex of a pseudopodium. Conidiophores c. 25 μm long, unbranched, with terminal conidia. Conidia sickle-shaped, 5 x 1 μm .

Apothecia scarce, solitary or seldom two on one stalk, spherical, black and terminal, up to 1.5 mm diameter. In longitudinal sections the apothecium is spherical and without a columella. The boundary between the generative and vegetative tissue remains horizontal with the lower margin of the apothecium. In old apothecia a strongly colored pigment-boundary is situated at this juncture. An indistinct boundary-texture may sometimes be developed. Hymenium c. 80 μm high, almost unpigmented. Excipulum absent. Asci eight-spored. Spores rounded when young, becoming spindle-shaped when mature, 14.5-21 x 5.5-6.5 μm . The regions just below the paraphyses and in the pigment-boundary are deep black-brown, towards the center of the apothecium the color grades to pale brown.

Phycobiont green, *Pleurococcus* type, cells c. 9 μm diameter.

Cephalodia brown, clustered, sessile on the thallus horizontalis, c. 1-2 mm in diameter. Their surface is usually wrinkled. The cephalodia contain *Nostoc* or sometimes *Stigonema*.

Growing on silicate stone.

Remarks

P. cereolus is distinguished from all the other species by the sorediate thallus horizontalis and pseudopodetia. Without this characteristic fruiting specimens of *P. cereolus* could be mistaken for *P. strumaticus*, *P. fibula*, *P. curtulum* or *P. nigricaulis*, as all these species are of about the same height and pin-like in appearance. The pseudopodetia of *P. vegae* sometimes have a granular cortex, which could be considered as sorediate, but the habit of the species distinctly differs from *P. cereolus* (fig. 3 and 11). Another important characteristic for the distinction of the small, pin-like species is the longitudinal section of the fruitbodies (fig. 12-15).

Tuckerman, in his later works (e.g. Tuckerman, 1882, p.235) considered all other species to be varieties of *P. cereolus*. As a result, many subsequent authors have attributed all species of the genus to this species. As pointed out by James (1965, p.139) "*P. cereolus*" as used



map 3 *P. cereolus* - world distribution (places listed ● and not listed ■ in the description of the species)

by British authors refers mostly to *P. strimonicus* and not to the present species. In the same way "*P. cereolus*" as used by many American authors refers to *P. acicularis*.

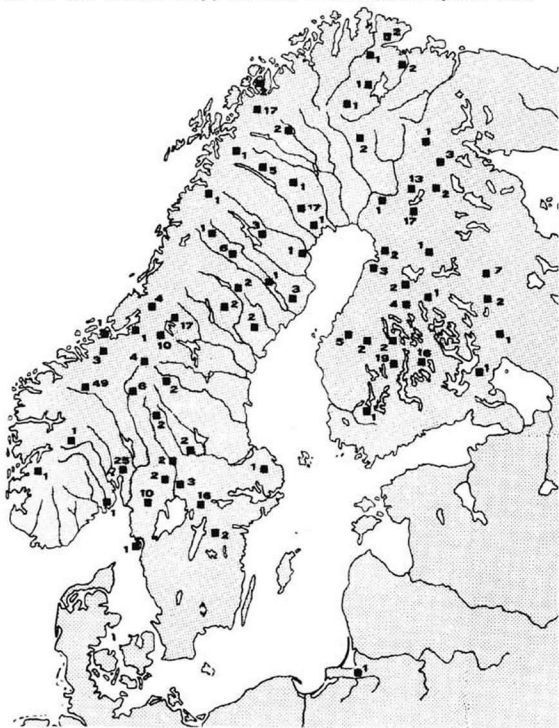
Räsänen (1946, p.2) described *P. cereolus* var. *cephalodiformis* Räs., which he said is to be distinguished by the smaller pseudopodetia and the abundant, markedly tuberculate cephalodia. The syntype material of this variety was distributed in Lich. Fenn. Exs. as no. 960. The samples are in no way different from a multitude of other poorly-developed specimens and should be considered merely as juvenile specimens which are not worthy of varietal status.



map 4 *P. cereolus* - distribution in Europe (places listed ● and not listed ■ in the description of the species)

Distribution (map 3-5)

P. cereolus is the most abundant species of the genus in Europe. Most samples were collected in Scandinavia where its occurrence overlaps with the distribution of *P. robustus* and *P. strumaticus*. However, *P. strumaticus* is restricted to the oceanic climate of the Norwegian and Swedish west coasts, and *P. robustus* occurs in the Norwegian highlands and in the Arctic only, whereas *P. cereolus* is spread over



map 5 *P. cereolus* - distribution in Scandinavia (places listed ● and not listed ■ in the description of the species)

Scandinavia, including Finland. The absence of *P. cereolus* in Great Britain suggests that this species, unlike *P. strunaticus*, dislikes an oceanic climate. This agrees with the observations made by Ammann and Ammann (1969).

Outside Scandinavia *P. cereolus* shows an interesting distribution (maps 3-4). These rare but widely-spread findings are listed further on. While a specimen from northern Poland links up reasonably well with Scandinavia, the occurrence in Siberia appears somewhat isolated. However, the material from Siberia is well developed and was most certainly very abundant as samples of this material can be found in many herbaria. A somewhat bigger group of findings originates from the Carpathes and the Tatra (Czechoslovakia), partly distributed as an exsiccate (Lojka, Lich. Hung. 179).

In the Alps this lichen is apparently far less abundant than might be expected from the older literature. Although I have not seen all material mentioned in older publications it seems that most samples belong to *Stereocaulon*, especially *Stereocaulon pileatum*, which is small and sorediate and looks somewhat similar to *P. cereolus*. Numerous specimens originate from the Oberpfalz in southern Germany. These and material from South Tyrol have been distributed as exsiccatae (Arnold, Lichenes exs. 823, 1088), but apparently it has been found only in a few places. The lichen seems to be absent from the rest of Germany and the more western countries.

The literature does not give any clue to the distribution of *P. cereolus* in North America as *P. cereolus*, *P. acicularis* and *P. fibula* were completely confused until recently. In particular, *P. acicularis* was designated as *P. cereolus* in many cases. Krog (1968) remarks, that she has not seen any authentic specimen of *P. cereolus* from western North America. She mentions one single specimen which she has not seen herself, but which from the description could have been *P. cereolus*. I had the chance to see this sample and it proved to be *P. acicularis* too. We may, therefore, conclude that *P. cereolus* does not occur in the western parts of North America. In the eastern part of the continent there are three places where true *P. cereolus* has been found. One of which (Grand Marais) was described by Fink (1910) who, however, thought it to be identical with the *P. cereolus* described by Tuckerman and which in fact was *P. acicularis*. The American material is not fully developed and slightly different from the European material. Nevertheless, it seems to be the same species and its distribution in North America is linked to the main distribution area in Europe by findings from Newfoundland, Greenland and the Azores.

Places outside the main distribution area (map 3-5, marked by a circle):

Canada, Newfoundland, upper Humber River (H); Canada, Newfoundland, New Harbour, Trinity Bay (M); Canada, Minnesota, Grand Marais, along the northern shore of Lake Superior (4 specimens MICH, 1 specimen US); Canada, Minnesota, Cook County, 8 miles SW of Grand Marais

on US Route 61, Cascade River State Park, along Cascade River (CAN); USA, New York State, Adirondack Region, Chapel Pond, near St. Huberts (MICH); Greenland, Diskofjord, Kuanersuit suvdlat (C); Azores, Santa Maria, Pico Alto (James and Hensen unpublished) (MB); Germany, Oberpfalz, above Spielberg near Nabeck west of Schwandorf (11 specimens BM, C, H, KIEL, M, O, PR); Germany, Oberpfalz, Schutzengelsteinbruch, Eldensteiner Forst (M); Austria, Tyrol, Silz, Intal (2 specimens M); Italy, South Tyrol, Margola near Predazzo (25 specimens B, BM, BP, FH, H, LD, M, O, S, W); Italy, South Tyrol, between Bellamonte and Paneveggio (4 specimens BM, BP, M, W); CSSR, Presov, Ő. Szatala (BP; CSSR, alpes Dzurowa prope pagum Teplicska, com. Lipto (W); CSSR, Slovakia, Nizke Tatry, in valle rivi Svidovy (PR); CSSR, Slovakia, Nizke Tatry, in valle rivi Svarinsky (PR); CSSR, in sylvia Stefkofka prope Bresztova, com Arva (16 specimens B, BG, BP, FH, G, H, LD, M, O, PR, S, US, W); Poland, prope Labiau (H); USSR, Dudinka, Yenisey, lat. bor. 69°35' (7 specimens FH, H, O, S, UPS).

Pilophorus clavatus Th.Fr., Bot. Notiser, 1888: 214 (1888). Type collection: Canada, British Columbia, Vancouver Island, Mt. Mark, 1887, Macoun (UPS, holotype).

P. acicularis f. *hallii* Tuck., Proc. Am. Acad. Arts Sci. 12: 177 (1877). Type collection: USA, Oregon, Hall (UPS, isotype).

P. cereolus var. *hallii* (Tuck.) Tuck., Syn. N. American Lich.: 235 (1882).

P. hallii (Tuck.) Vain., Bot. Mag., Tokyo 35: 59 (1921).

P. japonicum Zahlbr. (nomen nudum), Catal. Lich. 4: 432 (1926); Bot. Mag., Tokyo 41: 337 (1927).

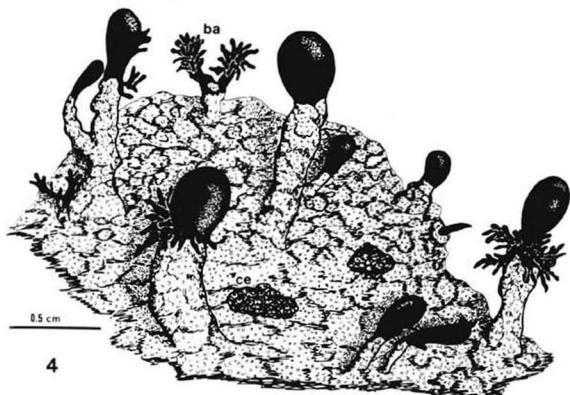


fig. 4 *P. clavatus*, with young fruitbodies (ba - bush-like primordia of apothecia, ce - cephalodium)

Thallus horizontalis thin, granular persistent. Granules often aggregated, forming scales. Granules minute, 0.1 mm diameter, grey-green when dry. Pseudopodetia up to 2 cm high, c. 0.3 mm thick (fig. 5). Internally the central area of the stalk is massive and consists of thin, strongly gelatinized hyphae with thin lumina (0.5 μ m). Algal layer not continuous, formed by more or less indiscrete granules, the stalk usually being naked just below the apothecium. Central lower part of the stalks sometimes blackened.

Pycnidia bottle-shaped, apical on short pseudopodetia, about 1 mm high, often bearing thalline scales which form a collar halfway up the stalk. Conidiophores unbranched, 25 μ m long, with terminal conidia, 5.0 x 0.5 μ m.

Apothecia black, occurring singly at the apex of each pseudopodetium, often spreading some distance down the stalk. The apothecia are triangular in longitudinal section (fig. 16), about 2 (-5) mm high, 1 mm broad at the upper end, tapering to 0.4 mm at the base, often they are more or less bifurcated at the apices (fig. 5). Apothecium sometimes formed by fusion of several primordia growing on bush-like branched pseudopodetia (fig. 4). No columella, boundary-texture, or pigment-boundary is formed between the vegetative and generative tissue. Hymenium c. 200 μ m high. Asci eight-spored. Spores rounded when young, becoming spindle-shaped when old, 23.5-26.5 x 5.0-6.0 μ m. Hymenium greenish, and the generative tissue uniformly pigmented, black-brown.

Phycobiont green, *Pleurococcus* type, cells c. 8 μ m diameter.

Cephalodia brown-black, irregular, lumpy, about 0.5 mm diameter with a velvety surface. Growing on the thallus horizontalis. They contain *Stigonema* and sometimes *Nostoc*.

Plants growing on silicate rock.

Remarks

In most specimens the triangular outline of the apothecia is sufficient to distinguish *P. clavatus* from all other species. *P. clavatus* could only possibly be confused with small specimens of *P. acicularis* bearing slightly triangular apothecia. In this case the two species may be separated by their persistent or evanescent thallus horizontalis respectively.

It was explained earlier (Jahns, 1970b) that *P. hallii* is a synonym for *P. clavatus* and that the name *P. clavatus*

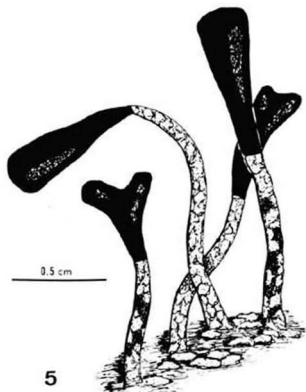


fig. 5 *P. clavatus*

Th.Fr. (1888) has priority at the species level over *P. hallii* (Tuck.) Vain. (1921). *P. japonicum* Zahlbr. is a nomen nudum. Zahlbruckner knew it to be a synonym of *P. hallii* but nevertheless preferred his new name.

Distribution (map 6)

The distribution of *P. clavatus* is essentially identical with the occurrence of *P. acicularis*. Both species are found on the coasts of the northern Pacific Ocean, *P. clavatus* apparently being relatively more abundant than *P. acicularis* in Japan. Surprisingly *P. clavatus* has not yet been found in Northern Alaska but was present on the Asiatic side of the Bering Strait. Kurokawa and Shibuichi (1970) have examined material from Formosa and their observation is included in map 6 (triangle), they also mention the species in Korea but don't seem to have examined the material themselves.



map 6 *P. clavatus* - distribution (■ places not listed in the description of the species, ▲ specimens not examined)

Pilophorus curtulum Kurok. and Shib., Journ. Jap Bot. 45, 3: 78 (1970). Type collection: Mt. Ontake, Prov. Hida, Japan (TNS, holotype; FH, O, isotypes).

Thallus horizontalis persistent, consisting of minute granules, 0.1 mm diameter, usually aggregated forming small squamules, 1.5 mm

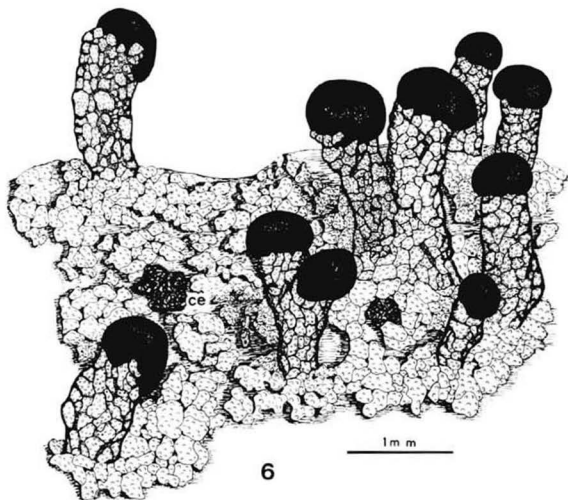


fig. 6 *P. curtulum* (ce - cephalodium)

diameter (fig. 6). Sometimes granules scattered and hardly aggregated. Thallus grey-green when dry. Pseudopodetia pin-like, 1-3 mm high, 0.5-1.0 mm broad. Mostly covered by a continuous algal layer consisting of small granules. Only sometimes ecorticate. Internally the stalks are compact, composed of strongly gelatinized hyphae. Central part of older pseudopodetia colored by deposition of dark pigment.

Pycnidia sessile on the thallus horizontalis.

Apothecia apical on the pseudopodetia, nearly always single, but sometimes two apothecia developed from two primordia have partly merged. Sometimes apothecia sessile on the thallus horizontalis. Apothecia about 1 mm in diameter. In longitudinal sections the apothecium is spherical and without columella. Pseudopodetium and apothecium are separated by a boundary-texture which is formed in the young primordium. In older specimens the boundary-texture is masked by a pigment-boundary. Hymenium c. 150 μ m high, almost unpigmented. Excipulum absent, asci eight-spored. Spores rounded when young, becoming spindle-shaped when mature, c. 7 x 22 μ m.

Phycobiont green, *Pleurococcus* type.

Cephalodia contain *Stigonema*, they form dark-brown flattened discs between the squamules of the thallus horizontalis.

Growing on silicate rock.

Remarks

This species resembles *P. fibula*. The thallus horizontalis of *P. curtulum* seems to be a bit thinner and less areolated, and the pseudopodetium is somewhat higher and more granulated than in *P. fibula*; but probably the only good reason for keeping the two species separated is their disjunct distribution. *P. curtulum* is only known from Japan and China, while *P. fibula* is endemic to north-east America.

Distribution (map 7)

This lichen has been found in Japan several times. I have seen samples from 10 places. From China I have seen two samples:

China, Yünnan, bor.occid. (O); China, Yünnan, bor.occid.: In montis Waha prope pagum Yungning regione frigide temperata infra casulam Maoniubi, alt. 3800-4030, Handel-Mazetti (Diar.Nr.1286) (W).



map 7 *P. curtulum* - distribution (places listed ● and not listed ■ in the description of the species)

Pilophorus fibula (Tuck.) Th.Fr., De *Stereocaulis* et *Pilophoris*
Comm.: 42 (1857).

Stereocaulon fibula Tuck., Proc. Am. Acad. Arts Sci. 1: 238 (1847).

Type collection: USA, New Hampshire, White Mts., 1844, Tuckerman (FH-Tuckerman, holotype).

Thallus horizontalis squamulose, squamules large, up to 2 mm dia-

meter, composed of small granules, persistent, grey-green. Pseudopodetia seldom exceeding 1 mm high, sometimes totally absent so that the apothecia are sessile (fig. 7). Stalk massive, composed of gelatinized thin hyphae with small lumina ($0.5 \mu\text{m}$). Algal layer more or less areolate, not continuous.

Pycnidia single, in small diminutive pseudopodetia. Conidiophores c. $30 \mu\text{m}$ long, unbranched, with terminal sickle-shaped conidia, $6 \times 1 \mu\text{m}$.

Apothecia black, hemispherical, 1 mm in diameter. A pigment-boundary and boundary-texture lies between the generative and vegetative tissues. There is no columella. Hymenium up to $120 \mu\text{m}$ high, lower-third pigmented. Lower edge of apothecium sterile, consisting only of paraphyses. Excipulum absent. Asci eight-spored. Spores rounded when young, becoming spindle-shaped when old, $17.0\text{-}23.0 \times 5.5\text{-}6.5 \mu\text{m}$. A dark-brown pigmented layer occurs under the paraphyses, which becomes paler towards the center of the apothecium.

Phycobiont green, *Pleurococcus* type, cells c. $6 \mu\text{m}$ diameter.

Cephalodia contain *Stigonema*, they form brown, flattened granular discs, c. 1 mm diameter between the scales of the thallus horizontalis (fig. 7).

Growing on silicate stone.

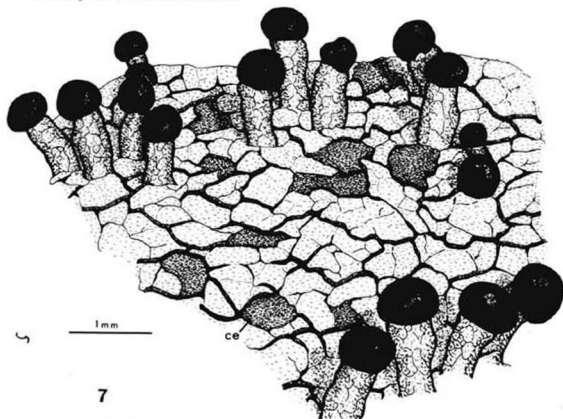


fig. 7 *P. fibula* (ce - cephalodium)

Remarks

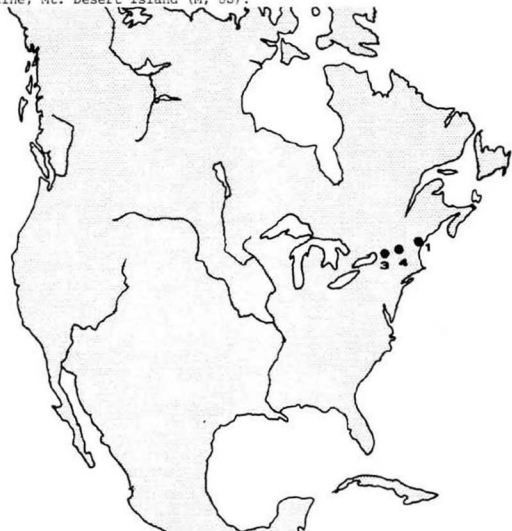
Since the first description of *Stereocaulon fibula* by Tuckerman in 1847 this specific epithet has tended to be applied to widely differing small or depauperate specimens of the genus. But *P. strumaticus* and *P. cereolus* differ distinctly from *P. fibula* by the occurrence of a columella

in the apothecium or of soredia respectively. Most difficult to distinguish from *P. fibula* is *P. curtulum*, as the differences between the two species are only gradual. The thallus horizontalis of *P. curtulum* is usually but not always less squamulose and less persistent. Moreover, only very old apothecia of *P. curtulum* are separated from the stalk by a pigment-boundary in addition to the boundary-texture which is always present.

Distribution (map 8)

P. fibula occurs only in north-east America and appears to be restricted mainly to the area of the White Mountains. Only two samples originate from the coast. I have seen material from the following places:

USA, New Hampshire, Mont. Alb. (BM, FH, M, MICH, W); USA, New Hampshire, Roche entrance to Ilume, Franconia (F, US); USA, New Hampshire, montibus Nord Anglio (PC); USA, New Hampshire, Warren (US); USA, New York, rock on trail up Mt. MacDetyse near Lake Placid (MICH); USA, New York, Adirondacks, Mt. Marcy (S); USA, New York, Adirondacks, Indian Falls, near Mt. Marcy, near Lake Placid (FH); USA, Maine, Mt. Desert Island (M, US).



map 8 *P. fibula* - distribution (● places listed in the description)

Pilophorus nigricaulis Satō, Journ. Jap. Bot. 16: 173 (1940) fig.7.

Type collection: Japan, Honsyū, Mt. Tyōkai (Tokyo, holotype).

Pilophoron cereolus (non Th.Fr.) Satō, Journ. Jap. Bot. 9: 214 (1933).

Thallus horizontalis persistent, white or light grey, granular. Granules c. 2 mm broad and c. 1 mm high, subglobose, aggregated or scattered on the substrate. Most granules slightly peltate. Pseudopodetia pin-like, 1-6 mm high, 1 mm diameter. Internally the stalks are compact, composed of strongly gelatinized hyphae, colored black by the deposition of dark pigment-granules. The pseudopodetia are covered by subglobose granules, showing the same color, morphology and structure as the granules of the thallus horizontalis (fig. 17). In some specimens a few stalks are branched.

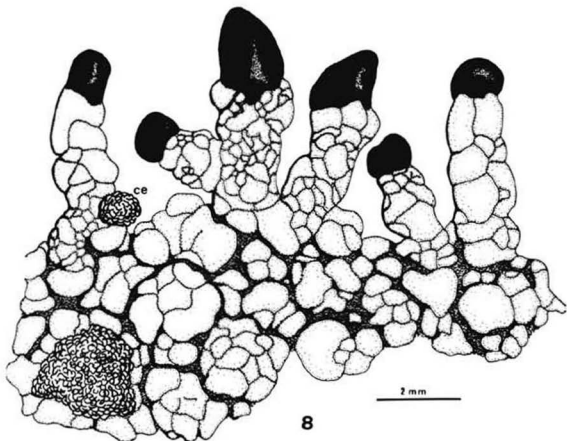


fig. 8 *P. nigricaulis* (ce - cephalodium)

Pycnidia apical on short pseudopodetia or sessile on the thallus horizontalis. Conidiophores long, slightly branched with terminal sickle-shaped conidia, c. $10 \times 1 \mu\text{m}$.

Apothecia terminal on mature pseudopodetia or sometimes sessile on the thallus horizontalis, 1.0-2.5 mm diameter. Apothecial margin downturned as far as the point of attachment to the stalk. Apothecia subglobose or slightly conical (fig. 8). No columella is present. Apothecium and pseudopodetium separated by a broad boundary-texture. No pigment-boundary is present. Hymenium c. $180 \mu\text{m}$ high, subhymenium $120 \mu\text{m}$. Excipulum absent. Asci eight-spored. Spores rounded when young, becoming spindle-shaped when mature, c. $18 \times 7 \mu\text{m}$.

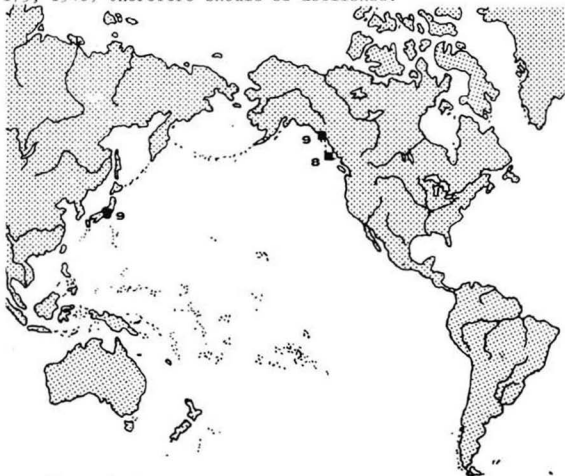
Phycobiont green, *Pleurococcus* type, cells c. $10 \mu\text{m}$ diameter.

Cephalodia on the thallus horizontalis, thick, brown to black,

with wrinkled surface, c. 0.5 mm diameter, containing *Stigonema*.
Growing on silicate rock.

Remarks

P. nigricaulis is distinguished from other species by the white color and the thick, subglobose to peltate structure of the thallus horizontalis and of the algal layer of the pseudopodetium. With these characteristics the species is easily distinguished from *P. curtulum*, which is also short stalked and occurs in the same area. On the other hand, the dark color of the central part of the pseudopodetium, from which the species takes its name, is not unique to the species. The stalks of *P. vegae*, *P. avasthianum*, *P. curtulum*, *P. strumaticus* and *P. clavatus* are also more or less blackened within. As Kurokawa and Shibuichi (1970) pointed out, in *P. curtulum* the color of the axis seems to vary with environmental factors. The same applies to the other species with blackened axes, where colorless and hyaline specimens can always be found. The blackened axis appears to have no consistent taxonomic value and therefore this criterion should not be used to divide the genus *Pilophorus* into sections as done by Satô (1940). The taxa *Pilophoron* section *Eupilophoron* Satô (Journ. Jap. Bot. 16: 175, 1940) and *Pilophoron* section *Nigricaulia* Satô (Journ. Jap. Bot. 16: 175, 1940) therefore should be abolished.



map. 9 *P. nigricaulis* - distribution

In figure 8 of his paper Satô (1940) gives a scheme of the transverse section of pseudopodetium and apothecium of his two sections. This figure is misleading in several respects. The species of his section *Eupilophoron* are shown to be hollow, which is not true for most species of *Pilophorus*. Only in *P. acicularis* and *P. robustus* do old pseudopodetia sometimes become hollow. The section of *Nigricaulia* shows a black central column of the pseudopodetium, which passes directly into the central part of the apothecium. In reality the apothecium and the pseudopodetium are not only of different ontogenetic origin, but are also distinctly separated by the boundary-texture. Furthermore, the pigment is not restricted to the axis of the pseudopodetium, but the phyllocladia and the thallus horizontalis are also pigmented.

Distribution (map 9)

The distribution of *P. nigricaulis* corresponds with the occurrence of *P. acicularis* and *P. clavatus*, but the species is much rarer. Until now *P. nigricaulis* has been found in two areas only: Japan and the west coast of America.

Pilophorus robustus Th.Fr., De *Stereocaulis et Pilophoris* Comm.: 41 (1857). Type collection: Norway, Hedmark, Østerdal, Amot, Austa-elv, 1837, Blytt (UPS, holotype).

Pilophoron polycarpum Tuck., Am. Journ. Arts Sci. 2, 15: 427 (1858). Type collection: Bering Straits (FH).

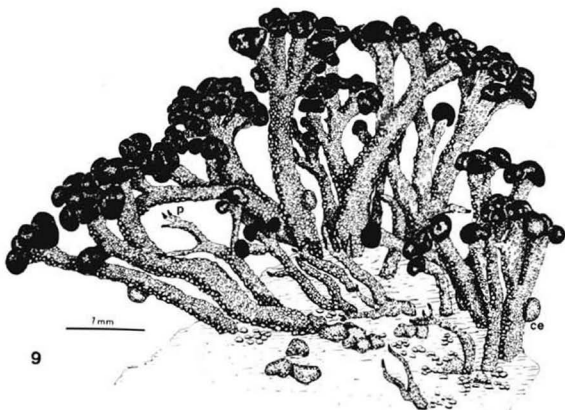
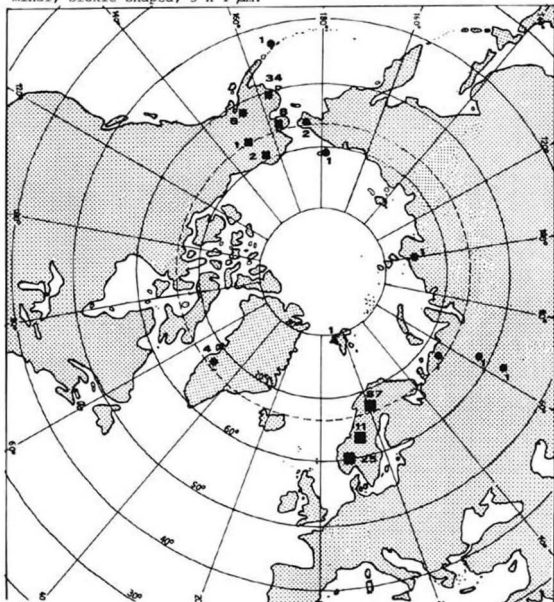


fig. 9 *P. robustus* (ce - cephalodium, p - pycnidium)

Thallus horizontalis granular or pulverulent, or indistinctly squamulose, evanescent in older specimens, grey-green when dry. Granules about 1 mm diameter. Pseudopodetia stout, massive, seldom becoming hollow when old, irregularly or umbellately branched in the upper part, normally 1.0-2.5 cm high, but sometimes up to 5 cm high and 3 mm broad (fig. 9). Hyphae of stalk strongly gelatinized with very small lumina (c. $0.5 \mu\text{m}$), cells at least $10 \mu\text{m}$ in length, orientated more or less parallel to the longitudinal axis of the pseudopodetium. Algal layer not homogenous, separated in loose granules. Old pseudopodetia becoming more or less decorticate. Cortex-granules c. 0.2 mm diameter.

Pycnidia bottle-shaped, apical on the tips of short lateral branches or at the tip of smaller young pseudopodetia (fig. 9). Conidiophores c. $10 \mu\text{m}$ long, unbranched with elongate cells. Conidia terminal, sickle-shaped, $5 \times 1 \mu\text{m}$.



map 10 *P. robustus* - world distribution (places listed ● and not listed ■ in the description. ▲ specimens not examined)

Apothecia numerous, crowded at the apices of the pseudopodietal branches, usually c. 2.5 mm (from 0.5 to 4 mm) broad, 1.5 mm high, globose. Margins of crowded apothecia sometimes grown together secondarily. Margin of the hymenium extending downwards below the point of attachment to the stalk, curving inward and upward before reaching the pseudopodietal surface. Vegetative tissue forming a large columella within the apothecium (fig. 12). In young specimens only a small columella is present. Boundary-texture and pigment-boundary absent. Hymenium c. 200 μ m high, lower-half pigmented.



map 11 *P. robustus* - distribution in Scandinavia

Asci eight-spored. Spores simple, rounded when young, spindle-shaped when mature, $18.0-24.0 \times 4.0-6.5 \mu\text{m}$. In one specimen some apothecia without pseudopodetia sessile on the thallus horizontalis.

Phycobiont green, *Pleurococcus* type, cells c. $9 \mu\text{m}$ diameter.

Cephalodia large, brown to orange, lumpy, 1.0-1.5 mm diameter, situated on the thallus horizontalis and on lower parts of older pseudopodetia (fig. 9), with *Nostoc*.

Growing on silicate rock and small stones.

Remarks

Pilophorus robustus can be separated from all the other species by the relatively tall, umbellately branched pseudopodetia, the evanescent thallus horizontalis, and the large and well-developed columella in the apothecium. In some specimens the very young and small pseudopodetia resemble *P. cereolus*, but the latter is always sorediate. In some cases certain specimens of *P. robustus* and *P. acicularis* might be confused, especially in material collected in Alaska, where both species occur together. This error is possible if the pseudopodetia of *P. acicularis* are richly branched in their upper part and thereby resemble the umbellately branched thalli of *P. robustus*. But the two species can always be distinguished from the occurrence of a columella in the apothecium of *P. robustus*.

Unusually small or very large specimens are quite frequently encountered in this species. Some specimens from different parts of the world are barely 1 cm high and have pseudopodetia of less than 1 mm in diameter. Others may have pseudopodetia up to 5 cm high and 6 mm broad at the base. Among these large specimens is *P. robustus* f. *magnus* Savicz (1941), but the type-material is in no way unique among the specimens examined. It is very interesting that unstalked apothecia which grew directly from the thallus

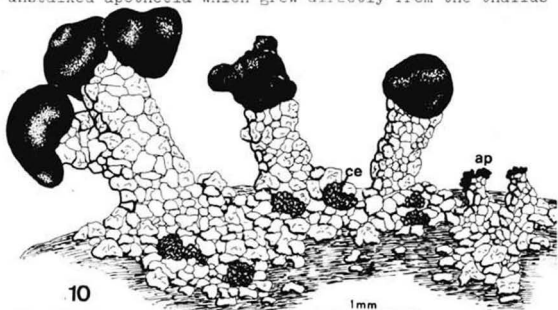


fig. 10 *P. strenaticus* (ap - primordium of apothecium, ce - cephalodium)

horizontalis were found. This is quite common in species with small pseudopodetia such as *P. fibula*, but is rather unusual in the larger species.

Distribution (map 10-11)

P. robustus shows a distinct arctic, circumpolar distribution. In Scandinavia where most samples were found the species is almost exclusively restricted to the high mountains as was already established by Ammann and Ammann (1969); but here too, its clear dominance in northern regions is obvious. A second center of distribution is Alaska and the Tschuktschen Peninsula. These two main areas are connected by specimens collected in Siberia, Spitsbergen and Greenland. I have not seen the material from Spitsbergen myself, but the information was given by Krog. Specimens found outside Scandinavia and Alaska:

Spitsbergen, Svenskeøya, Kong Karlsland, E.Dahl, 1936; Greenland, Laksefjord (C); Greenland, Laksefjord, Proven District (C); Greenland, Diskofjord, Kuanersuit (C); Greenland, Disko, Nordfjord, Kugssinerssuaq (C, 2 specimens); USA, Alaska, Aleutian Islands, Amchitka Island (WIS); USSR, Tschuktschen Peninsula (2 specimens LE, M); USSR, Arakamchechen Is., Tschuktschen Peninsula (BM, FH, PC, US); USSR, Wrangel Island (3 specimens LE); USSR, Taimyr Peninsula (3 specimens LE; GB, 2 specimens S); USSR, Laja River, Bolchese-melskaja (LE); USSR, Tobolsk (LE); USSR, Beresow, near Tobolsk (LE, O).

Pilophorus strumaticus Nyl. ex Cromb., Monogr. Lich. Brit.: 115

(1894). Type collection: Great Britain, S. Aberdeenshire, Braemar, Morrone, 1869, Crombie (BM, lectotype).

P. robustus f. *distans* Hult., Bih. K. svenska Vetensk. Akad. Handl. 26: 17 (1900). Type collection: Sweden, Dalsland, Hattefjäll, prope Vagsäter, 1870, Hulting (GB, lectotype; UPS, lectoparatype (1895)).

P. distans (Hult.) Magn., Bot. Notiser 108: 298 (1955).

Thallus persistent, minutely granular or nearly squamulose; granules 0.1 mm diameter, often becoming confluent to form aggregations c. 1 mm in size, grey when dry. Pseudopodetia pin-like, up to 2 mm high, 0.5 mm diameter (fig. 10). Internal hyphae strongly gelatinized, cell lumina 0.5 μ m wide, hyphae of upper part usually grey-brown. Pseudopodetia mostly covered by a layer of algae in continuous granules or squamules.

Pycnidia apical on short pseudopodetia, up to 0.5 mm high, often surrounded by a collar of granules or cortical scales. Conidiophores c. 45 μ m long, unbranched with terminal sickle-shaped conidia 6 x 1 μ m in size.

Each mature pseudopodetium nearly always bears a single hemispherical apothecium, c. 1 mm diameter. In some cases two separate apothecia develop at the tip of the pseudopodetium but later merge together. Apothecial margin turned down as far as the point of attachment to the stalk. The boundary between the generative and vegetative tissue arches upwards to form a small columella at the center of the apothecium (fig. 12). The boundary-texture and pigment-boundary between the generative and vegetative tissue are absent in mature apothecia. The development of apothecial primordia, which have a pigment-boundary is very characteristic for the spe-

cies (Jahns, 1970a).

Hymenium c. 230 μm high, lower part pigmented, margin sterile, consisting only of paraphyses. Excipulum absent. Asci eight-spored. Spores rounded when young, becoming spindle-shaped when mature, 14.0-19.0 x 6.5-8.5 μm . The brown-black pigment is densest directly below the paraphyses and tends to become less intense towards the columella.

Phycobiont green, *Pleurococcus* type, cells c. 8 μm diameter.

Cephalodia brown, granular, surface irregular and lumpy, containing *Stigonema*. The development of the cephalodia was described elsewhere (Jahns, 1972).

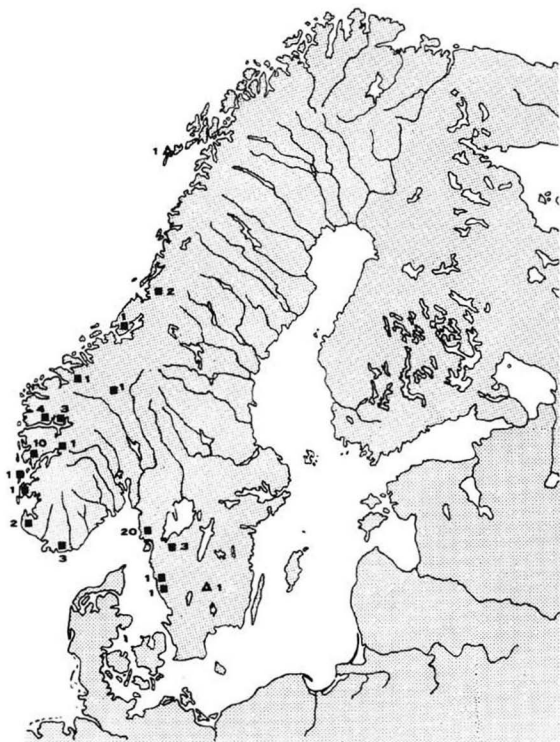
Growing on silicate stone.



map 12 *P. strumaticus* - distribution in Great Britain

Remarks

The distinct columella in the apothecium is characteristic of mature specimens of this species, distinguishing them from the other small species. *P. robustus* the only other species with a columella, has a distinctly different habit.



map 13 *P. stromaticus* - distribution in Scandinavia (■ places not listed in the description, ▲ specimens not examined)

The name *P. stromaticus* was first used by Crombie (1875, p. 140), but as no description was appended it was a nomen nudum there.

Distribution (map 12-13)

P. stromaticus has been found in western Scandinavia and in Great Britain. In contrast to *P. robustus* and *P. cereolus*, this species obviously prefers an oceanic climate and extends far less to the east and north of Scandinavia than the other two species. Similar observations were made by Ammann and Ammann (1969). Two of their locations have been included in map 13 (marked by a triangle), without having been examined by me.

Pilophorus vegae Krog, Norsk Polarinstitutts Skrifter, 144: 56-57, Oslo (1968), fig. 14. Type collection: Alaska, Bering Sea district, Nunivak Island, Roberts Mt., 1700 ft, Krog (O, holotype).

Thallus horizontalis crustaceus, consisting of loosely aggregated or nearly evanescent granules, c. 0.5 mm diameter, white when dry. Pseudopodetia simple or branched in the upper part. Branches either dichotomous or irregularly bush-like. Pseudopodetia 1.0-1.5 cm high and c. 3 mm broad. Younger parts covered with a continuous algal layer, consisting of minute granules or scales. Color of scales white, later becoming blackened at the base of the pseudopodetia. Basal part of old pseudopodetia often ecorticate. Central column of the young stalks hyaline, while the interior of older stalks is completely black.

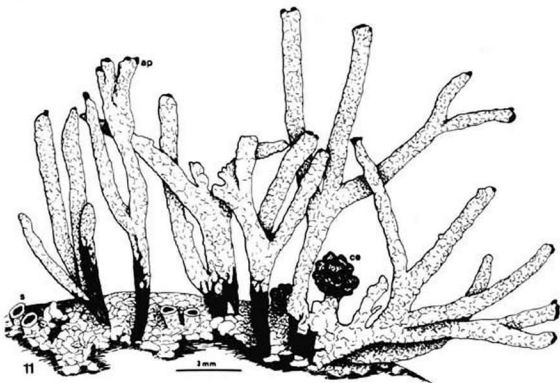


fig. 11 *P. vegae* (ap - primordium of apothecium, ce - cephalodium, s - broken stalk with pigmented center)

Pycnidia not observed.

Mature apothecia are absent in all specimens examined, but primordia of apothecia are found terminal at the tip of the stalks.

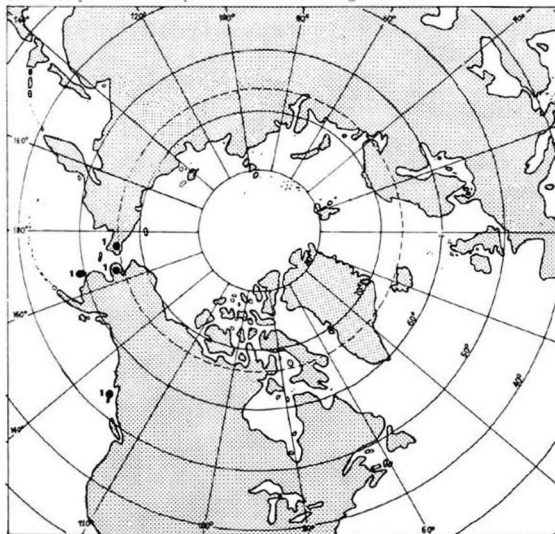
Phycobiont green, *Pleurocooccus* type.

Cephalodia stipitate on the pseudopodetia (fig. 11), containing *Nostoc* in the type-specimen and *Stigonema* in other specimens. Small cephalodia-like structures on the substrate contained algae of the *Gloeocephala* type, but it seems doubtful, whether they belong to this lichen.

Growing on silicate rock.

Remarks

P. vegae can be confused with *P. robustus* and *P. acicularis* occurring in the same region. The clearest characteristics of the species, which are lacking in *P. robustus* and *P. acicularis*, are the white color of the young pseudopodetia and the black pigment of the central column. *P. nigricaulis*, which also has a white cortex and a black central column is smaller and easily recognized by the globular or peltate shape of its cortex granules.



map 14 *P. vegae* - distribution (● places listed in the description of the species)

Distribution (map 14)

P. vegae is known from Alaska and the Bering Strait area only. I have seen the following specimens: USSR, Tschuktschorum, Bovidental, 64°45'N, 174°W (2 specimens LE, O); USA, Alaska, Bering Sea district, Nunivak Island, Roberts Mt., 1700 ft(O); USA, Alaska, Central Pacific Coast, Talkeetna Mts. (O); Canada, British Columbia, Queen Charlotte Islands, Moresby Island, Laing Point Mountain, SE of road into Peel inlet, c. 1 mile of Laing Point, 2000 ft (CAN).

Lichens to be excluded from the genus *Pilophorus*

Four species have been described as belonging to the genus *Pilophorus*, which must be placed elsewhere:

Pilophorus colensoi (Bab.) Knight, Trans. Proc. New Zealand 16: 400 (1884).

Stereocaulon colensoi Bab., in Hooker, Flora N.Z. 2: 294 (1867).

Type collection: New Zealand, Colenso 2746 (BM, holotype).

Corynophoron colensoi (Bab.) Nyl., Lich. Nov. Zeland.: 15 (1888).

Thallus horizontalis thin, granular and evanescent. Pseudopodetia up to 5 mm high, branched. Cortex of irregular scales. Cephalodia sacculate, on the pseudopodetia, containing *Stigonema*. Development of apothecia following the typical ontogeny of a *Stereocaulon* species (Jahns, 1970a).

Remarks

The helical ascogones are especially typical and quite different from the straight ones found in the genus *Pilophorus*. The species therefore belongs to the genus *Stereocaulon*, a view also taken by Th. Fries (1857) and by I.M. Lamb in a note attached to the type-specimen.

Räsänen (1932, p. 24) described *P. colensoi* var. *reagens* Räs. from Tierra del Fuego.

I have seen material from the following places:

New Zealand, Colenso 2746 (BM, holotype); Fuegia occid. supra Rupium (B); N-East of New Zealand (G).

Pilophorus conglomeratum F.Wils., Linn. Soc. Journ. Bot. 28: 372

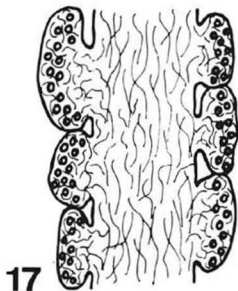
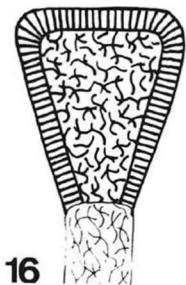
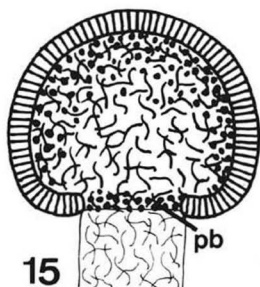
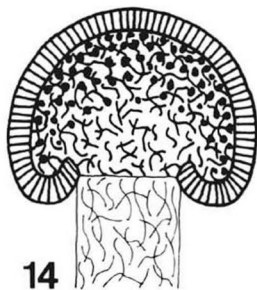
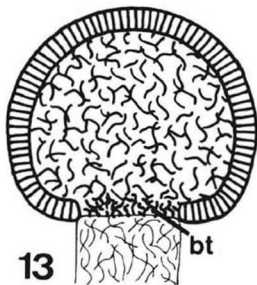
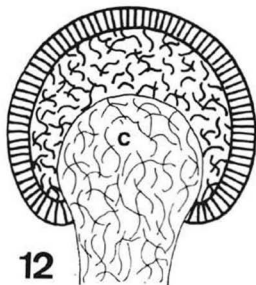
(1891). Type collection: Hab. supra truncum arboris smortuum muscosum in Black spur. Victoria, Australia (BM, holotype).

Pilophorus cariosum Hue, Nouv. Arch. Mus. 3, 10: 280 (1898).

Thallus horizontalis thin, grey-green, consisting of minute granules up to 0.1 mm in diameter. Thallus horizontalis persistent or evanescent. Thallus verticalis up to 2 cm high, pin-like, unbranched. In young specimens more or less smooth, covered with a thin layer of minute granules similar to those forming the thallus horizontalis. Thallus verticalis quickly becoming bare and divided by lengthwise-oriented furrows. In old specimens the stalk consists of numerous nearly-separated columns.

fig. 12-16 anatomy of apothecia (bt - boundary-texture, c - columella, pb - pigment-boundary)

fig. 17 *P. nigricaulis* with peltate scales, longitudinal section of the stalk



Several small apothecia crowded at the tip of the stalks, gradually merge into one large fruitbody. Spores $14 \times 3.5 \mu\text{m}$, spindle-shaped. Apothecia dark-brown. Cephalodia absent.

Remarks

The species somewhat resembles *P. robustus*, but the absence of cephalodia and the brown pigment of the apothecia are striking differences. The whole habit is slightly different from a *Pilophorus* and therefore the species should be excluded from the genus. Perhaps the lichen is related to *Baeomyces* or to one of the genera of the Cladoniaceae (e.g. *Heteromyces*, *Thysanothecium*) but the question can not be settled before more is known of its ontogeny.

I have seen material from the following places:

Tasmania, Hartz Mountain plateau, on rotten wood in forest, extremely damp and well shaded, alt. 3700 ft (BM); Central Western Tasmania, forest at western side of Mt. Arrowsmith near Franklin River, (BM); North Western Tasmania, Ball Room Forest Track, Dove Lake, near Cradle Mt. (BM); New Zealand, South Island, Fjordland, Eglinton Valley, Cascade Creek, alt. 1600 ft (BM); Victoria, Australia (BM, holotype).

Pilophorus staufferi Frey (nomen nudum), Bot. Jahrb. 86, 1-4: 242

(1967). Type collection: Neukaledonien, Monts des Koghis, Mt.

Bono, Gipfelgrat, 1070 m (BERN).

One's first impression of this species is that it is very much like *P. robustus*. The thallus verticalis is umbellately branched in the upper part, each branch bearing one to several apothecia. But on close inspection the lichen seems to be related to *P. conglomeratum*. The color of the apothecium is more brown than black, and the stalks show the same furrows as in *P. conglomeratum*. Cephalodia are also absent. The thallus horizontalis of *P. staufferi*, unlike the granulated thallus of *P. conglomeratum*, consists of small phylotidia about 1 mm in diameter. I think that *P. staufferi* and *P. conglomeratum* belong to the same genus; their exact taxonomic positions must be decided later.

Pilophorus pileatum (Mont.) Zahlbr. (nomen nudum), Catal. Lich.

10: 381 (1939).

Cladonia pileata Mont., Annal. Scienc. Nat. Bot. 3, 18: 310 (1852)

Type collection: Coquimbo in Chile.

I have seen no samples from this species, but the descriptions of Montagne (1852) and Vainio (1887) mention brown-black apothecia. Therefore it certainly does not belong to *Pilophorus*.

References

- Acharius, E. (1798) Lichenographiae Sueciae Prodromus. Lincopiae.
 Acharius, E. (1803) Methodus qua omnes detectos Lichenes. Stockholm.
 Acharius, E. (1810) Lichenographia universalis. Göttingen.
 Ammann, K. & B. Ammann (1969) Die fennoskandische Verbreitung von *Pilophorus* (Tuck.) Th.Fr., Stereocaulaceae. Herzogia 1:87-94.
 Crombie, J.M. (1875) Recent Additions to the British Lichen-flora. J.Bot.Lond. 13:140-142.

- Crombie, J.M. (1894) A Monograph of Lichens found in Britain. British Museum, London.
- Culberson, W.L. (1970) The Typification of the Lichen Genus *Pilophoron*. *Bryologist* 73:630-632.
- Fink, B. (1910) The Lichens of Minnesota. *Contr. U.S. nat. Herb.* 14, 1:1-269.
- Frey, E. (1967) Die lichenologischen Ergebnisse der Forschungsreisen des Dr. Hans Ulrich Stauffer. *Bot. Jahrb.* 86, 1-4:209-255.
- Fries, Th. (1857) *De Stereocaulis et Pilophoris Commentatio*. Uppsala.
- Fries, Th. (1861) *Lichenes Arctoi Europaeae Grönlandiaeque hactenus cogniti*. *Nova Acta Reg. Soc. Scient. Uppsal.* 3, 3:278.
- Fries, Th. (1871) *Lichenographia Scandinavica I*, Uppsala.
- Fries, Th. (1874) *Lichenographia Scandinavica II*, Uppsala.
- Fries, Th. (1888) *Nagra anmärkningar om Slägtet Pilophorus*. *Bot. Notiser* 1888: 212-214.
- Fries, Th. (1889) Einige Bemerkungen über die Gattung *Pilophorus*. *Bot. Centralblatt* 38:764-766.
- Hawksworth, D.L., P.W. James & J.R. Laundon (1972) The Nomenclature of *Pilophorus*. *Taxon* 21, 2/3:327-329.
- Henssen, A. & H.M. Jahns (1973) *Lichenes*. Stuttgart.
- Hooker, J. (1867) *Handbook of the New Zealand Flora II*. London.
- Hue, A.M. (1898) *Lichenes extra-europaei*. *Nouv. Arch. du Muséum* 3, 10:280
- Hulting, J. (1900) *Dalslands Lafvar*. *Bih. K. svenska Vetensk. Akad. Handl.* 26, 3/3:17.
- Jahns, H.M. (1970a) Untersuchungen zur Entwicklungsgeschichte der Cladoniaceen unter besonderer Berücksichtigung des *Podetium*-Problems. *Nova Hedwigia* 20:1-179.
- Jahns, H.M. (1970b) Remarks on the taxonomy of the European and North American Species of *Pilophorus* Th.Fr. *Lichenologist* 4:199-213.
- Jahns, H.M. (1972) Die Entwicklung von Flechten-Cephalodien aus *Stigonema*-Algen. *Ber. Dtsch. Bot. Ges.* 85, 10-12:615-622.
- James, P.W. (1965) A new Check-list of British Lichens. *Lichenologist* 3:95-153.
- Knight, C. (1884) On the *Lichenographia* of New Zealand. *Trans Proc. New Zealand* 16:400.
- Krog, H. (1968) The Macrolichens of Alaska. *Norsk Polarinst. Skrifter* 144:1-180.
- Kurokawa, S. & H. Shibuichi (1970) Notes on Japanese Species of *Pilophoron*. *Journ. Jap. Bot.* 45, 3:73-84.
- Magnusson, H. (1937) Förteckning över Scandinaviens växter, 4 Lavar.
- Magnusson, H. (1955) New or otherwise interesting Swedish Lichens XV. *Bot. Notiser* 108:298-299.
- Montagne, D.M. (1852) *Diagnoses phycologicae*. *Ann. Sci. Nat.* 3, 18: 302-319.
- Nylander, W. (1857) *Enumération générale des lichens*. *Mém. Soc. Sci. nat. Cherbourg* 5:85-146.
- Nylander, W. (1860) *Synopsis Methodica Lichenum I*. Paris.
- Nylander, W. (1888) *Lichenes Novae Zelandiae*, Paris.
- Räsänen, V. (1932) Zur Kenntnis der Flechtenflora Feuerlands. *Ann. Soc. Zool. Bot. Fenn. Vanamo* 2, 1:24.
- Räsänen, V. (1946) *Lichenes novi II*. *Ann. Soc. Zool. Bot. Fenn. Vanamo, Notul. Bot.* 21:1-7.
- Räsänen, V. (1950) *Lichenes novi VI*. *Ann. Soc. Zool. Bot. Fenn. Vanamo* 5:28-29.

- Satō, M.M. (1933) Notes on some Japanese Lichens determined by Dr. Edv. A. Wainio III. Journ. Jap. Bot. 9:211-214.
- Satō, M.M. (1940) East Asiatic Lichens III. Journ. Jap. Bot. 16: 173-177.
- Savicz, V.P. (1941) De nonnullis lichenibus URSS. Notul. syst. Inst. cryptog. Horti bot. Petropol. 5:7-9.
- Stitzenberger, E. (1862) Beitrag zur Flechtensystematik. Ber. über die Tätigkeit St. Gallisch. naturwis. Gesellsch.:124.
- Tuckerman, E. (1847) A synopsis of the Lichens of the Northern United States and British America. Proc. Am. Acad. Arts Sci. 1: 195-285.
- Tuckerman, E. (1858) Supplement to an Enumeration of North American Lichens. Am Journ. Arts Sci. 2, 25:422-430.
- Tuckerman, E. (1877) Observationes Lichenologicae 4. Proc. Am. Acad. Arts Sci. 12:177.
- Tuckerman, E. (1882) A Synopsis of North American Lichens. Boston.
- Vainio, E.A. (1887) Monographia Cladoniarum universalis.
- Vainio, E.A. (1921) Lichenes ab A. Yasuda in Japonica collecti, Continuatio 1. Bot. Mag. Tokyo 35:45-79.
- Wilson, F. (1891) On Lichens collected in the Colony of Victoria, Australia. Linn. Soc. Journ. Bot. 28:372.
- Zahlbruckner, A. (1926) Lichenes. In: Die natürlichen Pflanzenfamilien, 2. Aufl., Bd.8, hrsg. von Engler, A. & K. Prantl. Leipzig.
- Zahlbruckner, A. (1927a) Additamenta ad Lichenographiam Japoniae. Bot. Mag. Tokyo 41:313-364.
- Zahlbruckner, A. (1927b) Catalogus Lichenum Universalis 4. Leipzig.
- Zahlbruckner, A. (1939) Catalogus Lichenum Universalis 10. Leipzig.

NEW DEMATIACEOUS HYPHOMYCETES
FROM TROPICAL RAIN FOREST LITTER

S. ONOFRI, D. LUNGHINI, A. RAMBELLI and L. LUSTRATI

Cattedra di Micologia, Istituto dell'Orto Botanico, Università
di Roma, Largo Cristina di Svezia 24, 00165 Roma, Italy.

Summary

In this paper, a new genus, Chryseidea gen.nov. with the new species C.africana, and two new species, Beltrania onirica sp.nov. and Phaeo-trichoconis aurata sp.nov., from Tai National Park (Ivory Coast) forest litter, are described.

Among mycological investigations carried out by this Chair on the Tai project (M. A. B., Project n.1) to study the influence of human activities on the south-west forests in the Ivory Coast and with the purpose to improve the environmental knowledge and quality, three new species and a new genus of Dematiaceous Hyphomycetes are described. They were found on dead leaves collected on the soil surface in the Tai National Park forest. Every attempt at isolation in pure culture was unsuccessful. The following descriptions concern observations on natural media.

Exsiccata are available in the Mycological herbarium of the Rome Botanical Garden, (RO).

Chryseidea Onofri gen.nov.

Conidiophora macronematosa, synnematoso, erecta, simplicia, pigmentata, in apice semper sterilia. Cellulae conidiogenae a latere positae, determinatae, discretae, simplices, ampulliformes, apice denticulato, circiter in medio synnemati circumpositae. Conidia hyalina, falcata.

Sp. typ.: C.africana Onofri sp.nov.

Conidiophores macronematous, synnematos, straight, simple, pigmented, with apices always sterile. Conidiogenous cells lateral, determinate, discrete, simple, ampulliform, with a denticulate apex, surrounding the conidiogenous apparatus approximately in the mid part. Conidia hyaline and falcate.

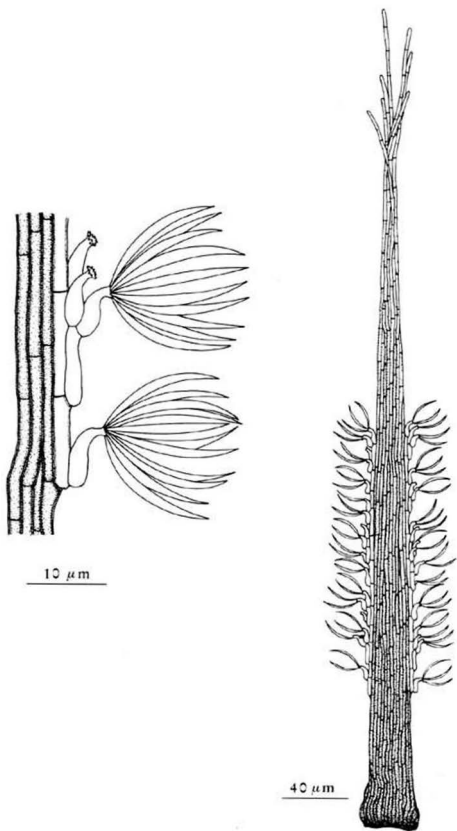


Fig. 1 - *Chryseidea africana* gen. et sp.nov.: a. conidiophore;
b. conidiogenous cells with conidia.

Chryseidea africana Onofri sp. nov.

Conidiophora macronematosa, synnematoso, solitaria, recta, simplicia, adtenuato et sterili apice, ex constantibus et rectis hyphis (2 μm crassis) composita, pallide brunnea, usque ad 560 μm longa et 42 μm ad basim crassa. Cellulae conidiogenae a latere positae, discretae, simplices, ampulliformes, cum apice saepe deflectens conidiorum forsitan pondere vel magna copia et denticulato ob subsequentes locorum qui conidia generant proliferationes; orientes ex hyphis laterali-bus, adherentibus et parallelis ab hyphis synnematis et orientibus pro-xime sub saeptis; ab circiter tertio altitudinis a basi usque ad dimidium synnema circumpositae, sufflavae; 7,8-11,2x2,3-2,7 μm . Conidia fal-cata, asaeptata, extremitatibus acuta, hyalina, omnia agglutinata; cir-cum conidiophora permanent in formam similia Chaetopsina fulva; 14,5-18,5x1,4-1,9 μm .

In foliis emortuis, Tai, Ora Eboris, holotypus: H. B. R. 116A, (RO).

Conidiophores macronematous, synnematoso, solitary, straight, simple, narrowing to the sterile apex, composed of straight and regu-lar hyphae, Ochraceous-Tawny in colour (Ridgway, 1912), up to 560 μm long and 42 μm thick at the base. Conidiogenous cells lateral, discrete, simple, ampulliform and denticulate from successive proli-ferations, with the apex frequently repent, presumably under the weight of conidial production; they originate from lateral hyphae that grow just under the septa of conidiophorous apparatus at about one third of the height from the base and extend up to half of the height of the conidiophorous apparatus, along which they grow side by side, Light-Buff in colour (Ridgway, 1912); 7,8-11,2x2,3-2,7 μm . Conidia 0-septate, falcate, with very sharp apices, hyaline, 14,5-18,5x1,4-1,9 μm ; they remain coiled at the apex of each conidiogenous cell in a compact mass surrounding the conidiophorous apparatus.

The microorganism described presents morphological characters different from others belonging to genera with synnematoso conidio-phorous apparatus. It differs in the position of the conidiogenous cells along the conidiophorous apparatus, in the resulting general structure (Chaetopsina like) and in spore shape. For these considerations we think necessary to propose the new genus, Chryseidea, and the spe-cies C. africana for our strain.

Beltrania onirica Lunghini sp. nov.

Coloniae effusae. Mycelium immersum. Setae erectae, simplices, le-ves, atrobrunneae, usque ad 506 μm longae et 4,6 μm ad basim crassae. Conidiophora macronematosa, mononematosa, simplicia aut rarius ra-mosa, saeptata, flexuosa, levia, non constanti crassitudine, pallide brunnea, 184-236x4,6 μm ; ab eadem basi setarum oriuntur. Cellulae conidiogenae integratae, terminales, polyblasticae, denticulatae, sym-

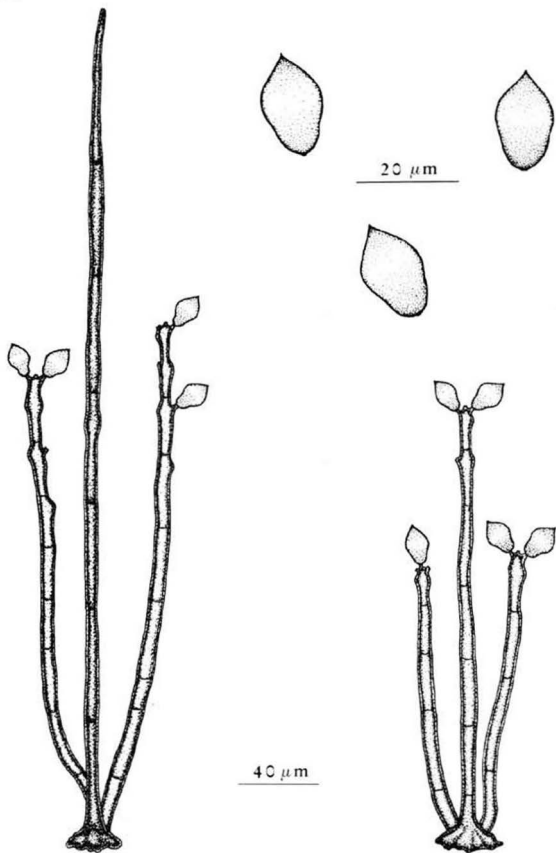


Fig. 2 - *Beltrania onirica* sp. nov.: a. conidiophores; b. conidiophores and seta; c. conidia.

podiales, locis qui conidia generant magno intervallo positis, pallide brunneae. Conidia levia, acrogena, protoplasmate granuloso, solitaria, conica-campanulata, zona supraaequatoriali subhyalina et tenui ornata, ad basim denticulata, ad apicem breviter appendiculata, pallide brunnea; 19-21x11,5-12,5 μm ; appendix circiter 2 μm longa.

In foliis emortuis, Tai, Ora Eboris, holotypus: H. B. R. 117A, (RO).

Colonies effuse. Mycelium immersed. Setae straight, simple, with thick and smooth walls; Argus Brown in colour (Ridgway, 1912); length up to 506 μm and 4,6 μm thick. Conidiophores macronematous, mononematous, simple or rarely branched, septate, slightly curved and irregularly thick, Deep Olive-Buff in colour (Ridgway, 1912), 184-236 x 4,6 μm ; originating from the base of the seta. Conidiogenous cells integrated, terminal, polyblastic, denticulate, elongating by sympodial proliferation, Deep Olive-Buff in colour (Ridgway, 1912). Conidia smooth, acrogenous, with granular protoplasm, solitary, conic-campanulate, with a thin, not easily observed transverse band, with a very short appendage at the apex and denticulate at the base, Deep Olive-Buff in colour (Ridgway, 1912); 19-21x11,5-12,5 μm ; appendage about 2 μm long.

The microorganism described presents characters different from those of related species. In particular it differs from Beltrania querna Harkness (Pirozynski, 1963) with conidia with a different shape and longer appendage; the conidial shape of our strain is very close to those of B. mangiferae Munjal et Kapoor (Pirozynski and Patil, 1970) and B. muelleri Rao et Mani Varghese, 1978, but these species are characterized by different conidiogenous cells. For these considerations we propose the new species B. onirica for our strain.

Phaeotrichoconis aurata Rambelli sp. nov.

Coloniae effusae. Mycelium immersum. Conidiophora macronematosa, mononematosa, solitaria, erecta, simplicia, saeptata, levia, brunnea-sufflava, usque ad 126 μm longa et 3,6-5 μm crassa (ad basim 8-10 μm). Cellulae conidiogenae polytreticae, integratae, sympodiales, cicatricibus conidialibus parum manifestis preditae. Conidia solitaria, sicca, acrogena, obclavata, 5-saeptata, ad basim trunca, ad apicem longo rostro praedita, levia, pallide brunnea-flava, protoplasmate omogeneo; 34,5-43,7x4,6-6,9 μm ; rostrum rectum, asaseptatum, hyalinum, usque ad 25 μm longum et usque ad 2 μm crassum.

In foliis emortuis, Tai, Ora Eboris, holotypus H. B. R. 118A, (RO).

Colonies effuse. Mycelium immersed. Conidiophores macronematous, mononematous, solitary, straight, simple, septate, with smooth walls, Buffy Brown in colour (Ridgway, 1912), up to 126 μm long and 3,6-5 μm thick (8-10 μm at the base). Conidiogenous cells polytretic, integrated, sympodial. Conidia solitary, dry, acrogenous, obclavate, transversely

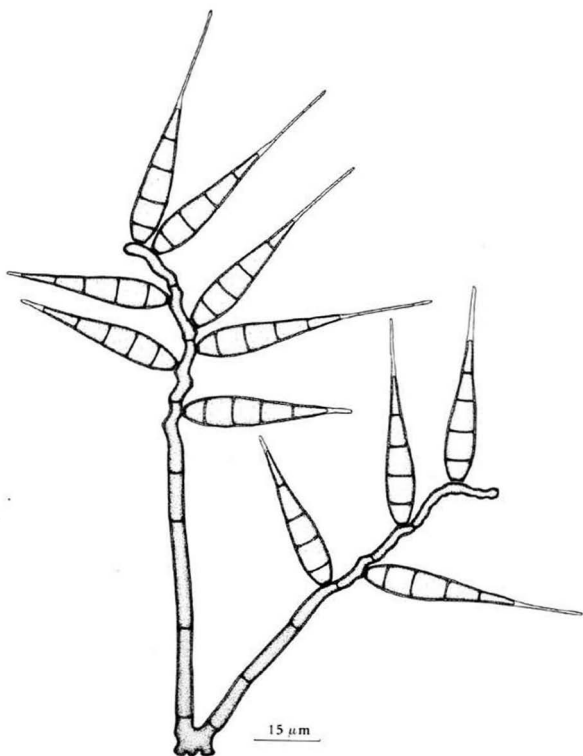


Fig. 3 - *Phaeotrichoconis aurata* sp. nov.: conidiophores with conidia.

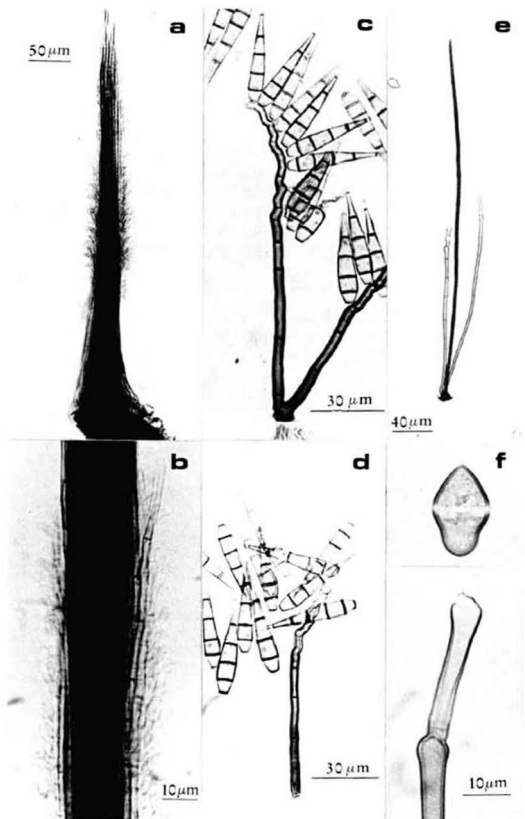


Fig. 4 - *Chryseidea africana*: a. and b.
Phaeotrichoconis aurata: c. and d.
Beltrania onirica: e. and f.

5-septate, rostrate, with a large scar at the base, smooth, Tilleul-Buff in colour (Ridgway, 1912), with homogeneous protoplasm, $34,5-43,7 \times 4,6-6,9 \mu\text{m}$; scar about $2,5-3 \mu\text{m}$ wide, beak straight, aseptate, hyaline, up to $25 \mu\text{m}$ long and $2 \mu\text{m}$ thick.

Ellis (1971) modified the original diagnosis of the type species *P. crotalariae* (Salam et Rao) Subramanian to include also species characterized by polytretic, integrated, terminal and sympodial conidiogenous cells. Our microorganism seems includable in the genus *Phaeotrichoconis* as modified by Ellis (1971), but differs from the two described species, *P. crotalariae* and *P. urariae* Bharadway, in several characters and mainly in the dimensions; for these reasons we propose for our strain the name *P. aurata* as a new species.

ACKNOWLEDGEMENTS

The Authors wish to thank the Minister of Scientific Research of the Ivory Coast, for the assistance he has given, Dr. P. M. Kirk of the C. M. I. for a slide of *P. crotalariae* kindly sent us and our colleagues, in particular Dr. A. M. Persiani, of the Laboratory of Mycology for their criticisms. We also thank Prof. O. Verona, Istituto di Microbiologia Agraria e Tecnica, Università di Pisa, Italy, for kindly reviewing the manuscript.

REFERENCES

- Bharadway, S.D. (1969). A new species of *Phaeotrichoconis* on *Ura-
ria picta* from Varanasi, India. *Indian Forester* 95(1): 24-26.
- Carmichael, J.W., W.B. Kendrick, I.L. Connors and L. Sigler (1980). *Genera of Hyphomycetes*. The University of Alberta Press, Edmon-
ton, Alberta, Canada.
- Ellis, M.B. (1971). *Dematiaceous Hyphomycetes*. Commonw. Mycolog.
Inst., Kew, England.
- Ellis, M.B. (1976). *More Dematiaceous Hyphomycetes*. Commonw. My-
colog. Inst., Kew, England.
- Matsushima, T. (1971). *Microfungi of the Solomon Islands and Pa-
pua-New Guinea*. Publ. by the Author, Kobe, Japan.
- Matsushima, T. (1975). *Icones microfungorum a Matsushima lectorum*.
Publ. by the Author, Kobe, Japan.
- Morris, E.F. (1963). *The synnematosus genera of the Fungi Imperfec-
ti*. Western Illinois Univ., Ser. Biological Sciences no. 3.
- Pirozynski, K.A. (1963). *Beltrania* and related genera. *Mycological
Papers*, 90.
- Pirozynski, K.A. and S.D. Patil (1970). Some setose Hyphomycetes
of leaf litter in south India. *Can. J. Bot.* 48: 567-581.
- Rao, V.G. and K.I. Mani Varghese (1978). Litter-Fungi: two unde-
scribed Hyphomycetes from India. *Nat. Acad. Sci. Letters* 1(2):
49-50.
- Ridgway, R. (1912). *Color standards and color nomenclature*. Wash-
ington, D.C.
- Subramanian, C.V. (1971). *Hyphomycetes, An account of Indian spe-
cies, except Cercosporae*. Indian Council of Agricultural Research,
New Delhi, India.

MYCOTAXON

Vol. XIII, No. 2, pp. 339-345

July-September 1981

COCHLIOBOLUS RAVENELII SP. NOV. AND *C. TRIPOGONIS* SP. NOV.

J. L. ALCORN

*Department of Primary Industries,
Indooroopilly, Queensland, 4068, Australia*

Abstract

Cochliobolus ravenelii sp. nov. and *C. tripogonis* sp. nov. are described from culture, as the teleomorphs for *Bipolaris ravenelii* and *B. tripogonis* comb. nov. respectively.

As part of a study of generic concepts in the complex of fungi assigned to *Drechslera* sens. lat., I have attempted to produce teleomorphs for species where no such connection was known. This has been done to test the hypothesis that conidial state characters allow prediction of teleomorph correlations, and that new associations will prove to be *Drechslera* sens. str. - *Pyrenophora*, *Bipolaris* - *Cochliobolus*, and *Exserohilum* - *Setosphaeria* (Luttrell 1977, 1978). Three new teleomorphs were described previously, two in *Cochliobolus* (Alcorn 1978a) and one in *Setosphaeria* (Alcorn 1978b), and those results support the predictive aspect of anamorph classification. Subsequently *Cochliobolus* states have been induced to form in cultures of other species. Two of these teleomorphs are described here as new.

COCHLIOBOLUS RAVENELII

Ascal states in *Cochliobolus* were found by McKenzie (1968) for two '*Helminthosporium*' species which infect *Sporobolus* inflorescences in Queensland. The work was reported in a thesis, and subsequently none of the data presented have been published. McKenzie did not assign specific epithets to the *Helminthosporium* collections

studied. I have examined specimens she deposited in BRIU and there is no doubt that one of the anamorphs connected with a teleomorph was *Bipolaris ravenelii* (Curt.) Shoem. Luttrell (1976) was unable to produce a perfect state for this species, and I made many unsuccessful pairings of cultures before a teleomorph developed. The methods used in the successful attempt are described briefly below.

Ten collections of *Sporobolus* spp. with infections of the inflorescence caused by *B. ravenelii* were made in south-eastern Queensland, in an area approximately 60 km north of Brisbane. Conidia from each of five panicles in each collection were streaked over water agar plates and allowed to germinate. Four germinated conidia from each plate were transferred to PDA, making a total of 20 transfers for each collection. Cultures were paired on Sach's agar (Hebert 1971), each plate being amended with maize leaf and barley grain. Three methods of pairing were employed:

- A. Bulkied conidial inoculum was prepared for each collection. Conidial suspensions from all isolates from a single collection were mixed and inoculated onto the plates.
- B. All possible pairings between collections were made, using the bulkied conidial inoculum from each.
- C. All possible pairings between collections, using one single-conidium isolate from each. Inoculum consisted of blocks from PDA cultures.

Ascocarps were obtained in only one pairing, namely with bulkied inoculum from collection 7957 (*Sporobolus fertilis* (Steudel) W.D. Clayton, Glasshouse Mountains, 24.v.1979) and collection 7963 (*S. elongatus* R. Br., Maleny, 24.v.1979). Four ascocarps were formed, each with a globose basal body and a long cylindrical neck. They were visible only because the necks projected above the dense hyphal mat investing the basal section. Ascocarps contained many ripe asci which released ascospores freely in water. Single-ascospore cultures were established. These cultures were paired in all possible combinations, but only one pairing resulted in the formation of ascocarps. None were formed in single-ascospore cultures, but all produced an anamorph on PDA indistinguishable from *B. ravenelii*.

In another test, small numbers of ascospores formed in pairings of cultures from collections 7976 (*S.?* *fertilis*, St. Lawrence, 24.vii.1979) and 7977 (*Sporobolus* sp., Clairview, 24.vii.1979), and 7976 and 7978 (*S. fertilis*, between Sarina and Mackay, 24.vii.1979). Some single-ascospore isolates from these ascocarps produced the teleomorph when paired, but not when grown alone under the same cultural conditions. Subsequently ascospores were formed in greater numbers when inflorescences and grain of *S. elongatus* were used as the plant substrate in Sach's agar plates, instead of maize leaf or barley grain.

Cochliobolus ravenelii sp. nov.

Figures 1 - 4

Ascocarpi atrobrunnei vel atrii, basi globosa 360-515 μm diam. et collo cylindrico 980-1800 μm alto, ad basim 95-135 μm diam., ad apicem 95-115 μm diam. Asci cylindrici, vestigiales bitunicati, 185-300 x 14-17.5 μm . Ascosporae hyalinae, filiformes, versus extrema angustatae, rectae vel torsivae, 5-14-septatae, 155-310 x 5-7.5 μm .

In inflorescentiis et granis *Sporoboli elongati* in agaro Sachii, vii. 1980, BRIP 13165, holotypus; BRIP 13027, 13028 paratypi.

Ascocarps dark brown to black with a globose body 360-515 μm diam. and a paler cylindrical neck 980-1800 x 95-135 μm at the base and 95-115 μm at the apex; occasionally with a cylindrical base up to 280 μm x 250 μm below the ascogenous section. Ascocarp body often covered densely by reddish brown hyphae, the beak glabrous or with a few short hairs (Fig. 1). Asci cylindrical, usually tapered slightly near the base but lacking a distinct pedicel, straight or curved, 185-300 x 14-17.5 μm , often with a blunt bifurcate foot 6-10 μm diam., vestigial bitunicate (Fig. 2). Ascospores filiform, straight or coiled helically in the ascus, slightly tapered to obtuse apex, more so to base, 5-14-septate, 155-310 x 5-7.5 μm (Fig. 3).

In some asci the degree of ascospore coiling is only very slight, while in others it is more pronounced. Sometimes ascospores are tightly coiled in the apical part for 20-25 μm , and loosely in the remainder. Ascospore diameter at the apex is about 4 μm , and at the base 2.5 μm . Conidia from two collections which gave rise to inter-ferile cultures of *B. ravenelii* are illustrated in Figure 4.

Cochliobolus ravenelii is quite distinct from *C. sporoboli* Castellani, which occurs on *Sporobolus* leaves (Castellani 1951). *C. sporoboli* has smaller, short-beaked ascomata, smaller asci, and shorter 4-6-septate ascospores.

COCHLIOBOLUS TRIPOGONIS

Drechslera tripogonis A.S. Patil & V.G. Rao was described from India, infecting the inflorescences of *Tripogon jacquemontii* Stapf (Patil & Rao 1972). Subsequently I collected a similar fungus on *T. loliiformis* (F. Muell.) C.E. Hubbard in Australia (Yetman, New South Wales, 12.v. 1977, J.L.A. 77158). Comparison with the type specimen (IMI 161251) showed that the fungus on this host was conspecific with *D. tripogonis*. No other collections have been made, although *T. loliiformis* has been examined at three other sites in Queensland (Bunya Mountains, Cooroy, Peregian Beach). Herbarium specimens of this species in BRI, from many different localities in eastern Australia, were also searched. No infections of the inflorescence were detected.

Single-conidium isolates from the collection on *T. loliiformis* were paired. A teleomorph referable to the genus *Cochliobolus* developed in these paired cultures. Single-ascospore isolates sometimes formed ascomata when paired, but never when grown alone. The anamorph formed by single-ascospore cultures is indistinguishable from that produced by the original single-conidium isolates.

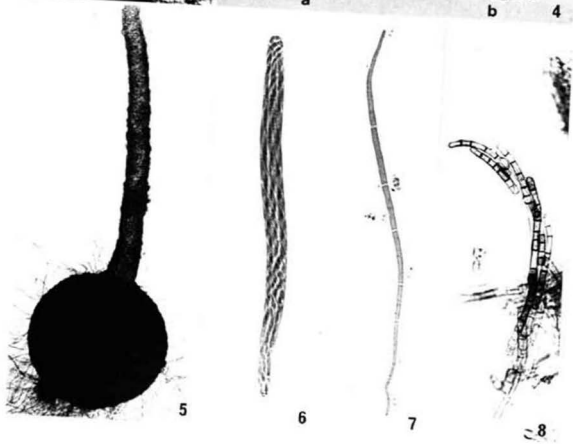
Cochliobolus tripogonis sp. nov.

Figures 5 - 8

Ascocarpi atri, basi globosa 300-590 μm diam. et collo cylindrico 880-2000 x 50-150 μm . Asci cylindrici, vestigiales bitunicati, 170-310 x 12.5-18.5 μm . Ascosporae hyalinae, filiformes, versus extrema angustatae, torsivae, 4-9-septatae, 175-275 x 4-6 μm .

Figs. 1 - 4 *Cochliobolus ravenelii* (1) Ascocarp x50 (2) Asci x200 (3) Ascospores x320 (4) Conidia from collections 7957(a) and 7963(b), x320. Isolates from these collections formed the teleomorph of *C. ravenelii* when paired.

Figs. 5 - 8 *Cochliobolus tripogonis* (5) Ascocarp x50 (6) Ascus x320 (7) Ascospore x320 (8) Ascosporic chlamydospores x320.



In foliis *Zea mays* in agaro Sachii, ix. 1977, BRIP 12375, holotypus; BRIP 12273 paratypus.

Ascocarps black, with a globose basal part 300-590 μm diam. bearing a long, straight or slightly curved cylindrical neck 880-2000 x 50-150 μm (Fig. 5). Conidiophores are not formed on ascocarp body or neck. Asci cylindrical, vestigial bitunicate, slightly tapered near the base, 170-310 x 12.5-18.5 μm (Fig. 6). Ascospores filiform, hyaline, helically coiled in the ascus and completely filling it, commonly somewhat loosely coiled in the median section and more tightly in the extremities, gradually tapered to approximately half the maximum width at each end, 4-7-septate, 175-275 x 4-6 μm (Fig. 7).

Single cells of some ascospores become dark brown and thick walled, while retaining their original shape (Fig. 8). These darker cells are regarded as ascosporic chlamydospores. I am unaware of any other reports of this phenomenon in *Cochliobolus* species.

In additional testing, inflorescences of *T. loliiformis* on Sach's agar were used as the substrate in an attempt to produce greater numbers of ascocarps. Ascomata were formed on the rachis and florets, but no more abundantly than previously. In some, a basal pedicel 30-150 μm high and 30-58 μm diam. was present below the swollen fertile section of the ascocarp.

The teleomorph of *C. tripogonis* is distinct from that of most other *Cochliobolus* species because of the very long ascocarp neck. Species such as *C. cymbopogonis* J.A. Hall & Sivanesan, *C. hawaiiensis* Alcorn, and *C. ravenelii*, which also have ascomata with long necks, can be distinguished by other morphological characteristics of teleomorph and anamorph.

Evidence supporting recognition of *Bipolaris* as a genus distinct from *Drechslera* will be presented elsewhere. Part of that evidence relates to *D. tripogonis*, for which a new combination is necessary.

Bipolaris tripogonis (A.S. Patil & V.G. Rao) comb. nov.
Drechslera tripogonis A.S. Patil & V.G. Rao, 1972,
Trans. Br. mycol. Soc. 59: 340.

Single-ascospore cultures representing opposite mating types of both *Cochliobolus* species have been deposited in the culture collection of the Commonwealth Mycological Institute (IMI 255652 and 255653, *C. ravenelii*; IMI 235294 and 235295, *C. tripogonis*).

ACKNOWLEDGEMENTS

I am grateful to Dr R.F.N. Langdon (BRIU) and Dr B.C. Sutton (IMI) for lending specimens in their keeping, and to Mr R.G. O'Brien for assistance in obtaining some of the *Bipolaris ravenelii* collections.

REFERENCES

- Alcorn, J.L. 1978a. Two new *Cochliobolus* species. *Trans. Br. mycol. Soc.* 70: 61-65.
- Alcorn, J.L. 1978b. *Setosphaeria monoceras* sp. nov., ascigerous state of *Exserohilum monoceras*. *Mycotaxon* 7: 411-414.
- Castellani, E. 1951. Una nuova specie di *Cochliobolus*. *Mycopath. Mycol. appl.* 6: 52-57.
- Hebert, T.T. 1971. The perfect stage of *Pyricularia grisea*. *Phytopathology* 61: 83-87.
- Luttrell, E.S. 1976. Ovarian infection of *Sporobolus poiretii* by *Bipolaris ravenelii*. *Phytopathology* 66: 260-268.
- Luttrell, E.S. 1977. Correlations between conidial and ascigerous state characters in *Pyrenophora*, *Cochliobolus* and *Setosphaeria*. *Rev. Mycol.* 41: 271-279.
- Luttrell, E.S. 1978. Biosystematics of *Helminthosporium*: impact on agriculture. In *Biosystematics in Agriculture*. Beltsville Symposia in Agricultural Research 2, ed. J.A. Romberger, R.H. Foote, L.V. Knutson & P.L. Lentz, pp. 193-209. Allanheld, Osmon & Co., Montclair, New Jersey.
- McKenzie, F. 1968. A study of false smut disease of *Sporobolus* spp. M. Sc. Thesis, University of Queensland, Brisbane.
- Patil, A.S. & Rao, V.G. 1972. A new species of *Drechslera* from India. *Trans. Br. mycol. Soc.* 59: 339-341.

A PSYCHOTROPIC FUNGUS IN NEPAL

by

Robert F. Schroeder
Continuing Education
University of Washington
Seattle, Washington

and

Gastón Guzmán
Escuela Nacional de Ciencias Biológicas
Instituto Politécnico Nacional
México, D.F.

SUMMARY

The presence of a Psilocybe species in Nepal which is close to P. cubensis (Earle) Sing. or P. subcubensis Guzmán and of known psychoactive properties is discussed. This is the first report of a bluing Psilocybe in the mainland Asia. Speculations on probable early cultural use of this and other Psilocybe in South Asia is also presented.

During 1978 and 1979 Schroeder have been working as an applied anthropologist for Rockefeller Foundation in agricultural development in Nepal. On a field trip to Pokhara in early 1978 he became aware of a bluing species of fungus. Collections of the species were made in the Pokhara valley over a two year period. Although actual specimens were not sent to Guzmán, for customs problems, the Nepal species was positively identified by him as either Psilocybe cubensis (Earle) Sing., or Psilocybe subcubensis Guzmán on the basis of a set of color photos of the collections made by Schroeder. These two species are both bluing and psychoactive; both exist in Mexico, and both are used by Mexican Indians. They differ in that P. cubensis has larger spores, and P. subcubensis has smaller spores, as discussed Guzmán (1978). On the other hand, P. cubensis is more common in subtropical regions, whereas P. subcubensis occurs commonly in tropical regions.

This appears to be the first documented report of a psychoactive Psilocybe species in mainland Asia, except the reports from Sri Lanka (Ceylon) by Berkeley and Broome in the last Century, which refer to three species of Psilocybe (These were recently studied by Guzmán in preparation of a

monograph on the Psilocybe). Other species of Psilocybe have been reported by Singer & Smith (1958) from Java and by Imazeki & Hongo (1957, 1969) from Japan. Recently Guzmán & Horak (1978) described six probable hallucinogenic species from New Guinea, New Caledonia and New Zealand, and Guzmán & Watling (1978) reported four bluing species from Australia and Tasmania. Guzmán (in Guzmán & Vergeer, 1978) reported on Agrocybe tibetensis (Mass.) Guzmán, a species described by Masee as Psilocybe from Tibet in 1906.

The valley in which the Nepal mushrooms were found lies at an elevation of about 2500 feet and is free of frost. The area has a monsoon climate with an average rainfall of about 140 in. per year. Specimens were most commonly found in abandoned fields or fallow fields where cattle and water buffalo were grazed, and in maize fields that had been fertilized with compost. The mushrooms were often growing on partially decomposed cow dung, and were found throughout the year. Peak fruiting occurred following the pre-monsoon rains in May and June, and the mushrooms were least abundant during the winter months.

There is no known local use for the mushroom, nor are psychoactive Psilocybe species known to be used elsewhere in South Asia. Western experimenters who have ingested the Pokhara species report experiences similar to those occurring with better known species of Psilocybe. Doseage is relatively high with some individuals ingesting forty or more mushrooms.

Wasson and Wasson (1957) described the use of Amanita muscaria in Siberian religious ceremonies. Later, Wasson (1972) proposed that Amanita muscaria was used by Indo Aryan peoples in the soma ritual, which was central to the development of Hinduism. We agree with Wasson that soma was a fungus. In light of the discovery of an active Psilocybe species in Nepal, however, we suggest that this species, or another yet to be discovered Psilocybe species, is the most likely candidate for the soma of the Vedas. If this is so, and the soma of the Vedas is both widely distributed and totally unknown in modern South Asia, interesting anthropological questions arise.

ACKNOWLEDGEMENTS

The authors are grateful to Dr. Arthur L. Welden of Tulane University for reviewing the manuscript. Guzmán express his thanks to CONACyT for support his researches.

LITERATURE CITED

- GUZMAN, G., 1978. The species of Psilocybe known from Central and South America. Mycotaxon 7: 225-255.
- _____ and R. WATLING, 1978. Studies in Australian Agarics and Boletes I: Some species of Psilocybe. Not. Roy. Bot. Gard. Edinb. 36: 199-210.
- _____ and E. HORAK, 1978. New species of Psilocybe from Papua New Guinea, New Caledonia and New Zealand. Sydowia 31: 44-54
- _____ and P.P. VERGEER, 1978. Index of taxa in the genus Psilocybe. Mycotaxon 6: 464-476.
- IMAZEKI, R. and T. HONGO, 1957. Coloured illustration of fungi of Japan. Hoikusha Publ., Osaka. Vol. I.
- _____ and _____, 1969. Ibid. Vol. II.
- SINGER, R., and A.H. SMITH, 1958. Mycological investigations on Teonanácatl, the Mexican hallucinogenic mushroom, II. Mycologia 50: 262-303.
- WASSON, V.P. and R.G. WASSON, 1957. Mushrooms, Russia and History. Pantheon Books, New York.
- WASSON, R.G. 1972. Soma. Divine Mushroom of Immortality Harcourt, Brace, Jovanovich, Inc. New York.

MYCOTAXON

Vol. XIII, No. 2, pp. 349-360

July-September 1981

ASCUS STRUCTURE AND FUNCTION IN *COCHLIOBOLUS* SPECIES

J. L. ALCORN

*Department of Primary Industries,
Indooroopilly, Queensland, 4068, Australia*

ABSTRACT

Observations by other authors on the structure of asci and mechanism of ascospore release in *Cochliobolus cymbopogonis* are confirmed. Similar structural and functional attributes of asci are found in other *Cochliobolus* species, including the generic type *C. heterostrophus*.

INTRODUCTION

Recently El Shafie and Webster (1980) reported their observations on ascus structure and ascospore liberation in *Cochliobolus cymbopogonis* J.A. Hall & Sivanesan. This novel method of spore release was discovered independently by the writer (Alcorn 1980), and previously unpublished material is presented here.

REVIEW OF LITERATURE

Luttrell (1965) included *Cochliobolus* in the Loculoascomycetes, but noted that asci in this genus appeared to be unitunicate. The ascus in *C. nodulosus* Luttrell and *C. homomorphus* Luttrell & Rogerson had previously been described as unitunicate by Luttrell (1957) and Luttrell and Rogerson (1959) respectively. *Cochliobolus* was again classified as a loculoascomycete by Luttrell (1973), but his illustration of an ascus from the teleomorph of *Bipolaris micropus* (Drechs.) Shoem. does not suggest a typical bitunicate structure. In contrast, Shoemaker (1955) reported that asci of *C. sativus* (Ito & Kurib.) Drechs. ex Dastur are bitunicate. This was visible in young asci with immature

spores, where a canal filled with cytoplasm penetrated the endotunica at the apex, but was not visible in mature asci. Bitunicate asci have also been reported for *C. bicolor* Paul & Parbery (Paul & Parbery 1966), *C. miakei* Hino & Katumoto (Hino & Katumoto 1966), *C. palmivora* Rao & Chaudhury (Rao & Chaudhury 1964), and *C. sitharamii* Reddy (Reddy 1976). Other species of *Cochliobolus* have been recorded as having unitunicate asci. In addition to *C. homomorphus* and *C. nodulosus*, they include *C. carbonum* Nelson (Nelson 1959), *C. cynodontis* Nelson (Nelson 1964a), *C. geniculatus* Nelson (Nelson 1964c), *C. intermedius* Nelson (Nelson 1960b), *C. lunatus* Nelson & Haasis (Nelson & Haasis 1964), *C. spicifer* Nelson (Nelson 1964b), and *C. victoriae* Nelson (Nelson 1960a).

The primary character used in assigning fungi to the Loculoascomycetes is the bitunicate ascus (Luttrell 1955, 1973). Bitunicate asci have a double-layered wall, consisting of an ectoascus and an endoascus. The layers normally are separable, and function in ascospore discharge. The ectoascus is thin and inextensible, while the endoascus is thick and extensible. Just prior to spore release the ectoascus splits at the apex, and the endoascus expands apically, increasing the ascus length by two or three times. Spores are discharged through an apical pore in the endoascus. Although many loculoascomycetes follow this pattern of ascus dehiscence, variations have been recorded. In some species, a circumcissile split occurs in the ectoascus below the tip, allowing the apical section to be thrown off as a thimble-shaped cap. This phenomenon has been observed in *Sporormia*, *Leptosphaeria*, *Lecanidion*, and *Stomiopeltis* (Luttrell 1951).

Bitunicate asci of many species have an indentation at the apex of the endoascus, forming a short extension of the lumen filled with cytoplasm (Luttrell 1973). This was noted in *C. sativus* by Shoemaker (1955), but is not evident in other authors' illustrations or descriptions of various *Cochliobolus* species. Characters correlated with the presence of bitunicate asci are ascostromatic ascocarps and pseudoparaphyses, and Luttrell (1965, 1973) may have relied on these when assigning *Cochliobolus* to the Loculoascomycetes. Barr (1979) included *Cochliobolus* in the new family Pyrenophoraceae, together with *Pyrenophora*, *Setosphaeria*, and *Pseudocochliobolus*. She gave no data concerning ascus structure other than to state that asci of fungi in this family are bitunicate.

Drechsler (1925) reported that spore discharge in *Cochliobolus heterostrophus* (Drechs.) Drechs. was preceded by a 'swelling of the ascus and circumcissile rupture in the apical portion of the ascus wall'. In this species ascospores discharge simultaneously, with sufficient force for them to clear the ascus in water mounts (Drechsler 1925). Drechsler did not describe or illustrate a cap comprising the section of the ascus above the split, but his description of rupturing could indicate that a cap was formed. Shoemaker (1955) reported that asci of *C. sativus* mounted in water commonly dehisced by a circumcissile apical rupturing, but that they also occasionally broke open at the centre and base. He obtained no evidence of an endotunica functioning in spore discharge, nor was a residual endotunica detected in asci which had released spores. Luttrell (1957) found that in water mounts, asci of *C. nodulosus* split across the apex and the ascospores oozed out, uncoiling as they emerged. A similar description of spore release was given by Luttrell and Rogerson (1959) for *C. homomorphus*. Discharge of ascospores through a split in the ascus wall has also been reported for *C. carbonum* (Nelson 1959), *C. cynodontis* (Nelson 1964a), *C. geniculatus* (Nelson 1964c), *C. intermedius* (Nelson 1960b), *C. lunatus* (Nelson & Haasis 1964), *C. spicifer* (Nelson 1964b), *C. victoriae* (Nelson 1960a), and *C. sitharamii* (Reddy 1976). Dastur (1942) recorded that ascospores of *C. tritici* Dastur escaped through an opening formed at the ascus apex by dissolution of the wall.

Hall and Sivanesan (1972) coined the term 'vestigial bitunicate' to describe ascus structure in *C. cymbopogonis*. With regard to the ascus in this species, they wrote that it was 'typically bitunicate but on rupture no extension of the inner wall has been observed'. Dehiscence was not further described but apparently it occurred in the ascocarp, because one of their illustrations shows ascospores emerging from the ostiole in loosely coiled groups. Hall and Sivanesan examined the type collections of *C. nodulosus* and *C. homomorphus* and reported that these species also had vestigial bitunicate asci. El Shafie and Webster (1980) found that asci of *C. cymbopogonis* and *C. kusanoi* (Nisik.) Drechs. ex Dastur are partially bitunicate, with the endotunica represented by an apical cap which functions in ascospore liberation. My studies of this phenomenon included species not examined by El Shafie and Webster, and this additional information is presented here.

OBSERVATIONS

Asci from living material in cultures were examined. Mountants and stains used in examining ascus wall structure included water, lactofuchsin, ammoniacal erythrosin, Lugol's iodine, KOH-phloxine, ammoniacal Congo red, and aqueous azure A. For studies of ascospore discharge, ascocarps were crushed lightly in a drop of water to expel asci. In addition, some ascocarps were suspended individually in water on excavated slides.

The ascus in *Cochliobolus heterostrophus*

This species is the generic type (Drechsler 1934). In most preparations, the ascus apex did not exhibit a bitunicate structure. There was commonly a thin unstained wall 1-2 μm thick enclosing the deeply stained cytoplasm. Even when ascospores did not push completely into the apex, there was generally no evidence of an apical indentation. Only two asci with a structure resembling an apical cytoplasmic channel were seen, one in KOH-phloxine and the other in azure A. The complex apical apparatus which occurs in unitunicate asci was not seen in this species.

The observations of Drechsler (1925) on ascospore discharge in *C. heterostrophus* could not be confirmed. In water preparations of crushed ascocarps, no discharge of spores from asci still attached basally to centrum tissue was detected. In asci lying free in the mount, spore discharge from the apex was not observed. Some ascospores escaped through the base of the ascus, the spores emerging singly through a narrow aperture at the base of the pedicel.

When unbroken ascocarps were immersed in water, ascospore discharge occurred after one hour at approximately 25°C. The released ascospores sometimes were coiled together, suggesting that each ascus released its contents as a unit under these conditions. Empty asci with a split at the apex were observed still attached to the base of the locule when these ascomata were crushed. In the same slides there were short, hyaline thimble-like structures measuring ca. 30 x 12 μm , with a rounded apex and a truncate base. After pressure was applied to the coverslip, a third type of structure was sometimes seen. It consisted of the apical portion of an ascus, freed by a circumcissile rupture of the wall. The released apical portion was double-walled. In

some instances the inner wall of this structure became partly everted when the apical section of the ascus was forced off. The inner wall was still attached to the outer wall near the base of the detached structure (Fig. 2). Two small dark spots were visible at the apex of the inner wall.

The ascus in other *Cochliobolus* species

Stained preparations revealed no evidence of typical bitunicate ascus structure in *C. cymbopogonis*, *C. hawaiiensis* Alcorn, *C. kusanoi*, *C. ravenelii* Alcorn, and *C. tripogonis* Alcorn, but ascospore discharge in water mounts was seen for each species.

My observations on spore discharge in *C. cymbopogonis* agree with those of El Shafie and Webster (1980). Ascospore release begins within 20 seconds when ascocarps are crushed in water. The spores are released as a group, emerging rapidly through the apex of the ascus (Fig. 3). Each ascospore bundle has a hyaline, cylindrical, thimble-like structure over the apical portion. The term 'endoascal caps' is used below to refer to these structures.

The endoascal cap generally separates from each ascospore group as soon as spores are clear of the ascus. Straightening of the reflexed ascospore tips, and expansion of the ascospore sheaths and any matrix left in the cap, may be involved in this process. Occasionally the cap remains ensheathing the ascospore tips after discharge. Asci which have discharged spores commonly have an irregular apical split through which the spores were forced. In many, the split was more or less 'V' shaped and gave the ascus apex a bilabiate appearance. A broader, less regular rupture occurred in others, leaving a wide aperture. The torn wall sometimes was recurved at the margin of the opening. Occasionally the split occurred in a lateral position just below the rounded apex of the ascus, but this could be an artefact caused by pressure when applying the coverslip.

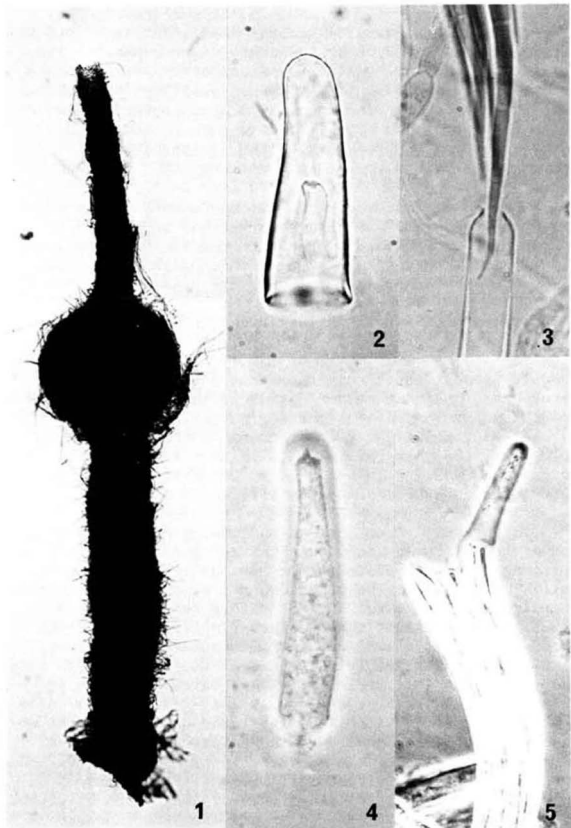
The endoascal caps carried out of the asci by the emerging spores are cylindrical, or slightly widened towards the base, hyaline, 75-100 x 15-20 μm with a smooth rounded apex and an irregular base which gives the appearance of having been torn away from a supporting structure. For comparison, intact mature asci of *C. cymbopogonis* measure 206-340 x 17.5-20 μm . Each cap has a wall up to 5 μm thick

at the apex, becoming progressively thinner towards the base where it is almost indistinguishable. The lumen contains cytoplasm. At the apex of the cap there is sometimes a configuration similar to that seen at the apex of a typical bitunicate ascus, that is, a cytoplasm-filled pore projecting into the apical wall (Fig. 4). Preparations stained in lactofuchsin still had endoascal caps visible after three months, whereas the mucilaginous ascospore sheaths dissolved rapidly in this medium. The wall of each cap had narrowed to approximately half the thickness seen in water mounts, especially at the apex. Persistence of these structures in lactofuchsin strongly suggests that they are not mucilaginous in composition.

Asci undergo a reduction in length and width after spore release. Thirty-five asci which had discharged ascospores measured 185-258 μm (mean 220 μm). The same number of apparently mature asci still containing spores measured 206-330 μm long (mean 271 μm). Width of empty asci was 14-17.5 μm , and of mature asci 17.5-20 μm . Measurements of ascus length before and after spore discharge were obtained individually for five asci. The lengths were 299 μm (before) - 206 μm (after), 288-216 μm , 263-196 μm , 330-242 μm , and 319-237 μm .

Mature ascomata of *C. cymbopogonis* liberate ascospores in the absence of free water. In Petri dish cultures, long straw-coloured cirri up to 6 mm long and 80-150 μm thick were formed when spores exuded from the ostiole. These cirri contained ascospores, but no asci, lying parallel to the long axis of the cirrus. The spores were straight except at the tip, where many were curved to more or less uncinata. Recently formed cirri disintegrated rapidly when mounted in water, but this capacity was lost

Fig. 1. Ascocarp of *Coehliobolus cymbopogonis*, from culture of IMI 130402 on Sach's agar + maize leaf (x60). Fig. 2. Broken ascus tip of *C. heterostrophus* showing partly everted endoascal wall and darkened tip of endoascus (x650). Fig. 3. Ascus of *C. cymbopogonis* with apical split through which the endoascal cap and ascospores are discharged (x650). Fig. 4. Endoascal cap of *C. cymbopogonis* (x800). Fig. 5. Ascospore bundle and endoascal cap of *C. tripogonis* (x400).



in older, dried cirri. In addition to ascospores, the cirri contained numerous endoascal caps identical to those produced when asci dehisce in water. Ascocarps with long cirri still had asci containing ascospores in the globose ascogenous section. Empty asci with split apices were also present in the ascogenous locule of ascomata from which ascospores had been liberated. Spore release probably occurs in this part of the ascocarp, the ascospores being pushed up the long neck as other asci dehisce.

A discharge mechanism similar to that described above for *C. cymbopogonis* was also observed in *C. hawaiiensis*, *C. kusanoi*, *C. ravenelii*, and *C. tripogonis*. The endoascal caps in these species are similar in appearance to those of *C. cymbopogonis* (Fig. 5).

An hypothesis to explain ascus structure and function in *Cochliobolus* species

It is postulated that the ascus in *Cochliobolus* is bitunicate, and that the endoascus is thickened only in the upper portion. It is further suggested that the mechanical strength of the endoascus in the lower part is not great, and that this results in the wall of the endoascus rupturing in a circumcissile manner under the force exerted by escaping ascospores.

The presumed events up to and including spore discharge are as follows. As ascospores mature, the ascus is stretched to accommodate them. Eventually the ectoascus splits at the tip. The endoascus may expand as in a normal bitunicate ascus at this stage. It is considered more likely, however, that the endoascus is forced out of the ectoascus by the expanding ascospore bundle and ruptures at a point approximately one third of the ascus length from the apex. The endoascal cap is then carried away as a sheath over the tips of the ascospores. An alternative to this hypothesis would be that the lower portion of the endoascus is firmly bonded to the ectoascus, and cannot expand to accommodate the increase in pressure which precedes ascospore release. If present, the endoascus in this lower region is too thin to be distinguished by light microscopy. It might also be argued that the endoascus is not complete, being present only in the upper third of the ascus. This seems a less plausible explanation, because it would require the endoascus to be attached to the ectoascus in a narrow region in the upper part. If both

walls were present in young, shorter asci, basauxic growth of the ectoascus would have to occur to bring about the condition of mature asci. Transmission electron microscopy possibly would help resolve these uncertainties concerning ascus structure.

Note on ascocarp morphology in *C. cymbopogonis*

The reports of Hall and Sivanesan (1972) and El Shafie and Webster (1980) indicate that ascomata of *C. cymbopogonis* are sessile, with a rounded ascogenous basal portion and a long cylindrical neck. When grown on Sach's agar + leaf of *Zea mays* L., the type culture of this species (IMI 130402) produces ascomata in abundance. Erect, cylindrical black stromata first develop on the leaf pieces, especially along the major veins. The ascomata differentiate singly at the apex of each stroma, so that at maturity each ascoma has a cylindrical sterile base (Fig. 1). These bases measure 500-1400(-1700) x 175-260 μm . On water agar + wheat straw, ascocarps are less numerous and most are sessile. Presence of a sterile stromatic base was one of the characters used by Tsuda, Ueyama, and Nishihara (1977) to distinguish the new genus *Pseudocochliobolus*. Clearly this facet of teleomorph morphology in *C. cymbopogonis* is conditioned by substrate. If this also applied in other species, it would be unsuitable for use as a generic criterion.

DISCUSSION

It is not clear whether the type species of *Cochliobolus* was studied by either Luttrell (1965, 1973) or Barr (1979), but both authors assigned this genus to the Loculoascomycetes. Barr stated that asci are bitunicate in the family Pyrenophoraceae, in which she included *Cochliobolus*. Luttrell (1965) believed that asci are unitunicate in *Cochliobolus*, while Hall and Sivanesan (1972) proposed the term 'vestigial bitunicate' to describe ascus structure in this genus. The data presented here and by El Shafie and Webster (1980) support the contention that *Cochliobolus* should be classified in the Loculoascomycetes, and offer some explanation for the differences of opinion concerning ascus structure in the genus. It is suggested that the term 'vestigial bitunicate' used by Hall and Sivanesan should be retained, because it seems that the endoascus plays no active role in spore discharge from the

ascus. In this respect my interpretation of ascospore release in *Cochliobolus* differs from that of El Shafie and Webster (1980). They referred to a protrusion of the endoascus enclosing the spores, followed by spore release. I believe the endoascus plays a much more passive role, and that it is forced out of the ectoascus by the expanding ascospore mass. However the process occurs rapidly and individual steps cannot be distinguished.

Unitunicate asci may have an outer, denser layer which is not structurally different from the inner wall layer (Griffiths 1973). One of the interpretations of ascus structure in *C. cymbopogonis* and similar species raises the possibility of fusion of walls in the lower part of the ascus. If transmission electron microscopy shows this to be correct, then the ascus in *Cochliobolus* may represent an intermediate form between unitunicate and bitunicate types.

Five of the *Cochliobolus* species in which ascospore discharge was observed have narrow cylindrical asci. Fresh material of other species such as *C. sativus* and *C. victoriae*, in which asci are much broader, should be examined to ascertain whether the discharge mechanism is the same. It is also important that ascus structure in *Cochliobolus* be observed by transmission electron microscopy, to relate ultrastructural detail to form and function as interpreted after examination by light microscopy.

ACKNOWLEDGEMENT

I thank Dr. A.H.S. Onions for the type culture of *C. cymbopogonis*, and Mr. A.E. El Shafie for a culture of *C. kusanoi*.

REFERENCES

- Alcorn, J.L. 1980. Generic concepts in *Drechslera* sens. lat. and correlated teleomorphs. Ph.D. Thesis, University of Queensland, Brisbane.
- Barr, M.E. 1979. A classification of Loculoascomycetes. *Mycologia* 71: 935-957.
- Dastur, J.F. 1942. Notes on some fungi isolated from 'black point' affected wheat kernels in the central provinces. *Ind. J. agric. Sci.* 12: 731-742.

- Drechsler, C. 1925. Leafspot of maize caused by *Ophiobolus heterostrophus*, n. sp., the ascigerous stage of a *Helminthosporium* exhibiting bipolar germination. *J. agric. Res.* 31: 701-726.
- Drechsler, C. 1934. Phytopathological and taxonomic aspects of *Ophiobolus*, *Pyrenophora*, *Helminthosporium*, and a new genus, *Cochliobolus*. *Phytopathology* 24: 953-983.
- El Shafie, A.E. & Webster, J. 1980. Ascospore liberation in *Cochliobolus cymbopogonis*. *Trans. Br. mycol. Soc.* 75: 141-146.
- Griffiths, H.B. 1973. Fine structure of seven unitunicate pyrenomycete asci. *Trans. Br. mycol. Soc.* 60: 261-271.
- Hall, J.A. & Sivanesan, A. 1972. *Cochliobolus* state of *Curvularia cymbopogonis*. *Trans. Br. mycol. Soc.* 59: 314-317.
- Hino, I. & Katumoto, K. 1966. Notes on bambusicolous fungi (2). *J. Jap. Bot.* 41: 292-297.
- Luttrell, E.S. 1951. Taxonomy of the Pyrenomycetes. *Univ. Missouri Studies* 24(3): 1-120.
- Luttrell, E.S. 1955. The ascostromatic Ascomycetes. *Mycologia* 47: 511-532.
- Luttrell, E.S. 1957. *Helminthosporium nodulosum* and related species. *Phytopathology* 47: 540-548.
- Luttrell, E.S. 1965. Classification of the Loculoascomycetes. *Phytopathology* 55: 828-833.
- Luttrell, E.S. 1973. Loculoascomycetes. In *The Fungi, an Advanced Treatise*, Vol. IVA, ed. G.C. Ainsworth, F.K. Sparrow & A.S. Sussman, pp. 135-219. Academic Press, New York.
- Luttrell, E.S. & Rogerson, C.T. 1959. Homothallism in an undescribed species of *Cochliobolus* and in *Cochliobolus kusanoi*. *Mycologia* 51: 195-202.
- Nelson, R.R. 1959. *Cochliobolus carbonum*, the perfect stage of *Helminthosporium carbonum*. *Phytopathology* 49: 807-810.
- Nelson, R.R. 1960a. *Cochliobolus victoriae*, the perfect stage of *Helminthosporium victoriae*. *Phytopathology* 50: 774-775.

- Nelson, R.R. 1960b. *Cochliobolus intermedius*, the perfect stage of *Curvularia intermedia*. Mycologia 52: 775-778.
- Nelson, R.R. 1964a. The perfect stage of *Helminthosporium cynodontis*. Mycologia 56: 64-69.
- Nelson, R.R. 1964b. The perfect stage of *Helminthosporium spiciferum*. Mycologia 56: 196-201.
- Nelson, R.R. 1964c. The perfect stage of *Curvularia geniculata*. Mycologia 56: 777-779.
- Nelson, R.R. & Haasis, F.A. 1964. The perfect stage of *Curvularia lunata*. Mycologia 56: 316-317.
- Paul, A.R. & Parbery, D.G. 1966. The perfect state of *Helminthosporium bicolor*. Trans. Br. mycol. Soc. 49: 385-386.
- Rao, P.N. & Chaudhury, R. 1964. A new species of *Cochliobolus* from Hyderabad - India. Mycopath. Mycol. appl. 23: 36-38.
- Reddy, S.M. 1976. A new species of *Cochliobolus*. Indian Phytopath. 29: 199-201.
- Shoemaker, R.A. 1955. Biology, cytology, and taxonomy of *Cochliobolus sativus*. Can. J. Bot. 33: 562-576.
- Tsuda, M., Ueyama, A. & Nishihara, N. 1977. *Pseudocochliobolus nisikadoi*, the perfect state of *Helminthosporium coicis*. Mycologia 69: 1109-1120.

**A PRELIMINARY DISCOMYCETE FLORA OF MACARONESIA:
PART 6, GEOGLOSSACEAE***

RICHARD P. KORF

Plant Pathology Herbarium, Cornell University
Ithaca, New York 14853 USA

"Was never eare, did heare that tong."

Edmund Spenser

AN ELEGIE, OR FRIENDS PASSION, FOR HIS ASTROPHILL, Line 110

**Order HELOTIALES
Suborder HYMENOSCYPHINEAE
Family GEOGLOSSACEAE Corda 1838**

KEY TO THE KNOWN MACARONESIAN GENERA

- 1. Ascospores brown at maturity2
- 1'. Ascospores hyaline at maturity4
 - 2(1). Hymenial setae present. **Trichoglossum**
 - 2'(1). Hymenial setae absent3
- 3(2'). Paraphyses restricted to hymenium, not running
down stipe; stipe dry. **Geoglossum**
- 3'(2'). Paraphyses running down the stipe; stipe glu-
tinous. **Gloeoglossum**
- 4(1'). Ascoclavula black or blackish. **Thuemenidium**
- 4'(1'). Ascoclavula paler, not blackish. **Microglossum**

GEOGLOSSUM Gillet 1879

One known Macaronesian species

* The parts of this flora will appear in irregular order. Reprints of individual parts will not be available for distribution.

1. *Geoglossum umbratile* Saccardo, *Michelia* 1: 444. 1878, var. *umbratile*

MISAPPLIED NAME: *Geoglossum nigratum* (Pers. : Fr.) Cke.

RECENT TAXONOMIC TREATMENTS:

Benkert (1976), Maas Geesteranus (1965), Mains (1954), Nannfeldt (1942).

PREVIOUS MACARONESIAN RECORDS:

None.

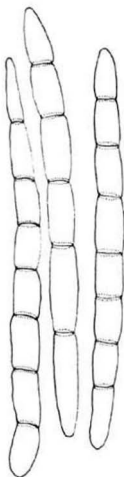
TYPE LOCALITY: Italy.

KNOWN MACARONESIAN DISTRIBUTION
CANARY ISLANDS.

Tenerife. CUP-MM 21 (OSC, TFC, to be issued in Korf & Gruff, *Disc. Exs.*), 1272 (TFC), 1279 (TFC), 1308 (TFC).

SUBSTRATA: On soil in ditches and on roadside banks.

Notes: Mains (1954) and Nannfeldt (1942) use the name *G. nigratum*, and our Macaronesian collections were initially identified as *G. nigratum* var. *nigratum*, but Maas Geesteranus (1965) has shown that name applies correctly to a basidiomycete (Persoon originally described it as *Clavaria nigrita*, and it has been consistently misinterpreted since then).



G. umbratile
v. *umbratile*,
3 ascospores,
CUP-MM 1272,
x 1000.

GLOEOGLOSSUM Durand 1908

One known Macaronesian species

1. *Gloeoglossum glutinosum* (Pers. : Fr.) Durand, *Ann. Mycol.* 6: 419. 1908.

= *Geoglossum glutinosum* Pers., *Obs. Myc.* 1: 11. 1796, : Fries, *Syst. Myc.* 1: 489. 1821.

RECENT TAXONOMIC TREATMENTS:
Mains (1954), Nannfeldt (1942).

PREVIOUS MACARONESIAN RECORDS:
None.

TYPE LOCALITY: Europe.

KNOWN MACARONESIAN DISTRIBUTION
MADEIRA.

Madeira. CUP-MM 1566.

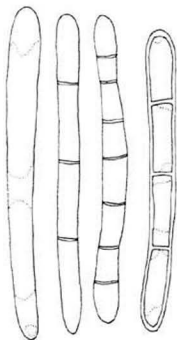
CANARY ISLANDS.

Gomera. CUP-MM 1168(O).

Tenerife. CUP-MM 1187(TFC).

SUBSTRATA: On soil.

Notes: Though most modern authors do not accept Durand's segregate genus, the glutinous stipe makes it an easy taxon to recognize even in the field.



Gl. glutinosum, 1
immature ascospore, 3 mature,
CUP-MM 1566,
x 1000.

MICROGLOSSUM Gillet 1879

One known Macaronesian species

- Microglossum olivaceum** (Pers. : Fr.) Gillet, Champ. France discomyc., livr. 1, p. 26. 1879.

RECENT TAXONOMIC TREATMENTS: Dennis (1978), Mains (1956), Nannfeldt (1942).

PREVIOUS MACARONESIAN RECORDS: None.

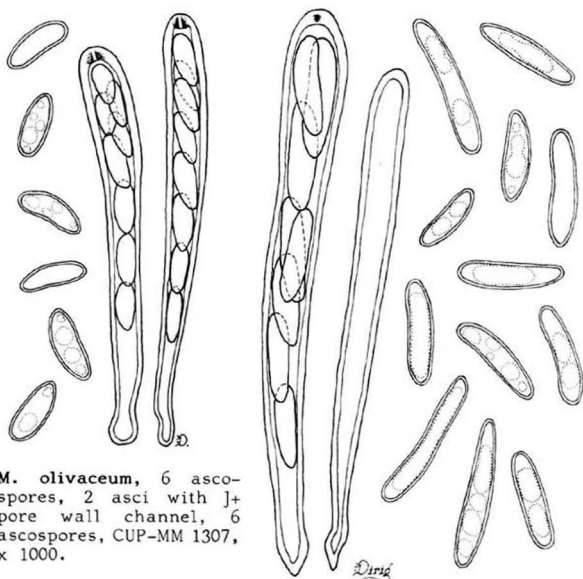
TYPE LOCALITY: Europe.

KNOWN MACARONESIAN DISTRIBUTION
CANARY ISLANDS.

Tenerife. CUP-MM 1307(TFC).

SUBSTRATA: On soil.

Notes: Mains (1956) included Thuemenidium (= Corynetes) in his very broad concept of the genus.



M. olivaceum, 6 ascospores, 2 asci with J+ pore wall channel, 6 ascospores, CUP-MM 1307, x 1000.

Th. atropurpureum, mature ascus with J+ pore wall channel, immature ascus, 12 ascospores, CUP-MM 1371, x 1000.

THUEMENIDIUM Kuntze 1891 emend. Maas Geesteranus 1964

One known Macaronesian species

1. **Thuemenedium atropurpureum** (Batsch : Fr.) Kuntze, Revis. gen. pl. 2: 875. 1891.

= Corynetes atropurpureus (Batsch : Fr.) Durand, Ann. Mycol. 6: 414. 1908.

= Microglossum atropurpureum (Batsch : Fr.) Karst., Acta Soc. Fauna Fl. Fenn. 2(6): 110. 1885.

RECENT TAXONOMIC TREATMENTS: Dennis (1978), Maas Geesteranus (1964), Mains (1956: Microglossum), Nannfeldt (1942: Corynetes).

PREVIOUS MACARONESIAN RECORDS: *Bañares Baudet & al. (1980), +Beltrán Tejera (1980), **Cool (1924), ***Cool (1925).

TYPE LOCALITY: Europe.

KNOWN MACARONESIAN DISTRIBUTION

* ** ***CANARY ISLANDS.

***Gomera.** *CUP-MM 1371(TFC[=TFC 770]).

** *****Tenerife.** CUP-MM 1136(O), ** ***1652(L).

SUBSTRATA: On soil.

Notes: Though the criterion of an amorphous, colored pseudoepithecium has been used to distinguish Thuemenidium, it is often absent. Mains (1956) I think correctly synonymized 3 species Durand (1908) distinguished in his monograph, Corynetes atropurpureus, C. purpurascens, and C. robustus, the last with an epithecium "lacking or inconspicuous," and with more robust ascoclavula, and somewhat longer spores. The collection from Gomera, reported by Bañares Baudet & al., was taken during one of our expeditions to Gomera, together with the staff of the Universidade de La Laguna. It has no trace of a colored pseudoepithecium, and thus matches C. robustus, and also has very large ascoclavula, but the ascospores are within the typical range of T. atropurpureum. A better criterion, perhaps, is the peculiar dual-hyphal structure in the stipe, evident in the Gomera collection as well, which was stressed by Maas Geesteranus (1964). Mains (1956) included this in Microglossum, while Maas Geesteranus points out that it may belong in Geoglossum, differing mainly only in the colorless (and non-septate) ascospores. Corynetes arenarius (Rostrup) Durand, from Greenland, is also a Thuemenidium, but C. globosus (Sommerf. : Fr.) Durand from Scandinavia, the Alps, Greenland, and probably Canada is a Sarcoleotia according to my studies, though treated in Corynetes by Nannfeldt (1942); Maas Geesteranus (1964) showed it could not be a Thuemenidium.

TRICHOGLOSSUM Boudier 1885

One known Macaronesian species

1. *Trichoglossum hirsutum* (Pers. : Fr.) Boud., Hist. classific. discomyc. Europe, p. 86. 1907, var. *hirsutum*

RECENT TAXONOMIC TREATMENTS:

Dennis (1978), Mains (1954), Nannfeldt (1932).

PREVIOUS MACARONESIAN RECORDS:

*Baagøe & al. (1972), ** Beltrán & Wildpret (1975), + Beltrán Tejera (1980).

TYPE LOCALITY: Europe.

KNOWN MACARONESIAN DISTRIBUTION

*MADEIRA.

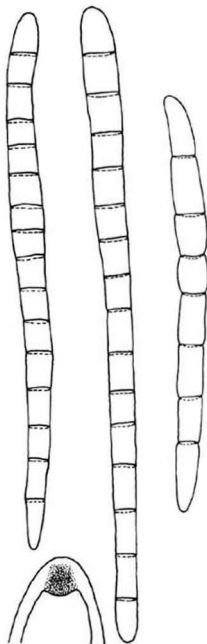
***Madeira.** CUP-MM 1492(TFC, OSC), 1495, 1538, 1574 (TFC), 1597, 2339, *2499 (C: as "sp."), *2501(C).

**CANARY ISLANDS.

La Palma. CUP-MM 668, 669 (TFC, OSC).

****Tenerife.** CUP-MM 1113(O), 1114(O), 1127(O), 1167(O), 1261(TFC), 1296, 1298(TFC, OSC, to be issued in Disc. Exs.), **2507(TFC), **2509(TFC).

SUBSTRATA: On bare soil and among mosses.



Tr. hirsutum var. *hirsutum*, 2 15-septate ascospores, ascus apex in iodine, CUP-MM 1113; 7-septate ascospore, CUP-MM 2507; all x 1000.

The Psilopezoid fungi. VII.

A new species of Psilopezia from France.

Donald H. Pfister

Farlow Reference Library and Herbarium of Cryptogamic Botany
Harvard University, Cambridge, MA

and

Françoise Candoussau

22, rue Hoö-Paris, 64000 Pau, France

Psilopezia nummularialis Pfister and F. Candoussau sp. nov.* Receptacles gregarious, 1-3 cm diam, sessile, convex, later convoluted, broadly attached to the substrate, surrounded by a white mycelium which is particularly evident in dried material. External surface lighter. Hymenium gazelle colored, a rich ochraceous, the pigment soluble. The flesh paler than the hymenium 1 to 2 mm thick toward the center, translucent, brownish when dried.

Outer excipulum of two indistinct layers; inner layer of + parallel, septate hyphae which become loosely intertwined, 9-10 μ m in diam on the inner position and 20-35 μ m toward the outer one or two cells of this inner layer. The outer layer, non-gelatinous, of interwoven hyphae about 12-15 μ m in diam with a few free hyphal tips which sparsely cover the outer surface.

Medullary excipulum of textura intricata of cells 10-15 μ m in diam.

Asci 8-spored, 400 x 18-22 μ m broad with evident croziers.

Paraphyses encrusted with brown amorphous material, branching and septate below 9-11 μ m.

HOLOTYPE: sur tronc de Salix pourri, a terre, endroit inonde periodically, avec Pachyella sp. et Climacodon pulcherrimus (Berk. & Curt.) Nikol. Forêt de Bugangue (Oloron) Pyrénées Atlantiques. F. Candoussau. 14.IX.1980. Holotype FH, Isotypes F.C. no. 3757 and CUP 59826.

Other collections made in October and November in the same locality are in FH and the collection of the junior author.

This species is close to Psilopezia nummularia Berk.

*Psilopezia nummularialis Pfister & F. Candoussau sp. nov.

Similis Psilopezia nummularia Berk. sed ascosporis 26-29 x 12-15 μ m, ascis 400 x 18-22 μ m et hymenii ochraceis.

Holotypus: sur tronc de Salix pourri, a terre, endroit inonde periodically, avec Pachyella sp. et Climacodon pulcherrimus (Berk. & Curt.) Nikol. Forêt de Bugangue (Oloron) Pyrénées Atlantiques. F. Candoussau. 17.IX.1980. Holotype FH; Isotypes F.C. no. 37571 and CUP 59826.



Figure 1. Apothecia of *Psilopezia nummularialis* scale = 2 cm.

which has been collected in Europe and is known in some of the literature under the name *Peziza atroviolacea* Bres., shown to be a later synonym (Pfister 1973). The two species can be distinguished as follows:

| | <u><i>P. nummularialis</i></u> | <u><i>P. nummularia</i></u> |
|-------------------------------|--------------------------------|-----------------------------|
| Hymenial color | ochraceous | olivaceous, or nearly black |
| Asci | 400 x 18-22 μ m | 275-300 x 20-27 μ m |
| Ascospores | 26-29 x 12-15 μ m | 29-40 x 14-20 μ m |
| Outer zone of outer excipulum | 10-17 μ m | up to 35 μ m |

In anatomical features *Psilopezia nummularialis* and *P. nummularia* are quite similar. It should be pointed out that a report by Beller (1972) of *Psilopezia nummularia* is in fact *Pachyella babingtonii* Berk. & Br.

The work of the senior author was supported in part by National Science Foundation Grant DEB 8023018. We thank E. Jarias for photographs.

Literature Cited

- Beller, J. 1972. *Psilopezia nummularia* Berkeley. Documents mycologiques. 3: 1-4.
- Pfister, D. H. 1973. The psilopezioïd fungi. III. The genus *Psilopezia* (Pezizales). 60: 355-365.

MYCOTAXON

Vol. XIII, No. 2, pp. 369-372

July-September 1981

NOTES ON SOIL FUNGI ISOLATED FROM A 15-YEAR-OLD ASPEN STAND IN INTERIOR ALASKA

LOLA K. OLIVER and KEITH VAN CLEVE

*Forest Soils Laboratory, University of Alaska
Fairbanks, Alaska 99701 USA*

SITE DESCRIPTION

The sampling site, a quaking aspen (*Populus tremuloides* Michx.) stand located 42 kilometers northeast of Fairbanks, Alaska, is an area between 150 and 210 meters above sea level and is situated at 146°50'W longitude and 64°54'N latitude. Soil is alluvial silt-loam of the Goldstream-Saulich series. The lowland site has a slope of between 3 and 7%. Mean annual precipitation and temperature for the Fairbanks vicinity are 28.7 cm and -3.4°C, respectively. A severe forest fire 15 years prior to sample collection destroyed virtually all surface vegetation on the study area. Nearly all trees and other plants now present in the area are less than 15 years of age. Present cover is suspected to have originated from surviving root stock and sprouts. Average tree height in the burn area is approximately five meters; diameters are eight centimeters or less, and ground vegetation is very sparse.

METHODS AND MATERIALS

Prior to sampling for soil fungi, factorial applications of N, P and K fertilizers were made to the sample plots as part of an on-going experiment dealing with organic matter production. The present study was limited to sampling from the nitrogen, phosphorus, potassium application and control plots of that experiment. Plots were fertilized in the fall prior to sampling and again in May of the same year at the rates of 112 kg/ha NH_4NO_3 for the nitrogen plots, 56 kg/ha P_2O_5 for the phosphorus plots and 112 kg/ha KCl for the potassium plots. Sampling began in late May and continued once a week for eight weeks. A 6.5 cm corer was used to collect three cores of surface material from each of two subplots in each of the three replicate fertilizer and control plots (eighteen cores for each treatment). Cores for each treatment were combined for fungal isolation. The litter layer of the site was present in too small a mass to be used alone for sample analysis. The fermentation and humus layers were indistinguishable; hence the entire organic layer of the cores was used. The depth of this total organic layer was never more than 3 cm but never less than 2 cm. Organic content of the layer was calculated by sample ignition in a muffle furnace at 700°C for four hours. It ranged from 41.4 to 81.7%. Soil pH ranged from 4.7 to 7.5 and was determined on a saturation paste using a glass

TABLE: FUNGI

| SPECIES | ALL AGARS | | | | | PDA | | | | | PDAR | | | | | PDARBS | | | | | SE | | | | |
|---|-----------|----|----|-----|-----|-----------|----|----|----|----|-----------|----|----|----|----|-----------|----|----|----|----|-----------|----|----|----|----|
| | Treatment | | | | | Treatment | | | | | Treatment | | | | | Treatment | | | | | Treatment | | | | |
| | N | Q | X | Y | U | N | Q | X | Y | U | N | Q | X | Y | U | N | Q | X | Y | U | N | Q | X | Y | U |
| * <i>Penicillium coppi</i> Zaleski | 50 | 54 | 60 | 109 | 273 | 20 | 16 | 20 | 34 | 90 | 10 | 15 | 17 | 27 | 69 | 12 | 14 | 16 | 24 | 66 | 8 | 9 | 7 | 24 | 48 |
| * <i>Penicillium pinaxorum</i> Christensen and Backus | 11 | 31 | 23 | 17 | 82 | 1 | 5 | 8 | 4 | 18 | 2 | 6 | 5 | 5 | 18 | 6 | 10 | 8 | 3 | 27 | 2 | 10 | 2 | 5 | 19 |
| * <i>Penicillium thomii</i> Maire | 28 | 24 | 14 | 10 | 76 | 11 | 15 | 5 | 1 | 32 | 8 | 4 | 4 | 4 | 20 | 1 | 3 | 4 | 8 | | 3 | 1 | 2 | 4 | 10 |
| *Unknown #1 | 25 | 18 | 7 | 3 | 53 | 2 | 2 | 1 | 1 | 6 | 5 | 4 | 1 | 2 | 12 | 7 | 6 | 3 | 16 | | 11 | 6 | 2 | 19 | |
| * <i>Penicillium</i> sp. #1 | 7 | 18 | 18 | 9 | 52 | 3 | 1 | 2 | 6 | 3 | 5 | 11 | 1 | 20 | | 2 | 4 | 2 | 1 | 9 | 2 | 6 | 4 | 5 | 17 |
| * <i>Montenozia vinacea</i> Dixon-Stewart | 3 | 14 | 14 | 4 | 35 | 2 | 5 | 7 | | | 2 | | | | | 2 | 1 | 4 | 2 | 7 | 2 | 10 | 5 | 2 | 19 |
| * <i>Penicillium</i> sp. #2 | 1 | 3 | 22 | 1 | 27 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | 1 | 3 | 1 | 20 | 2 | 1 | 20 | 2 | 21 |
| <i>Mucor varians</i> Povah | 14 | 2 | 6 | 1 | 23 | 4 | 1 | 1 | 6 | 1 | 1 | 1 | 3 | 5 | 8 | 1 | 1 | 3 | 5 | 8 | 2 | 1 | 1 | 1 | 11 |
| <i>Mycelia Sterilia</i> sp. #1 | 8 | 6 | 4 | 1 | 19 | | | | | | 2 | 2 | 3 | 7 | 6 | 4 | 1 | 1 | 12 | | | | | | |
| <i>Pezizaceum roseum</i> Link | 14 | | | | 15 | 4 | | | | 4 | 3 | | | 3 | 3 | 3 | | | 3 | 4 | | | | | 1 |
| <i>Trichoderma viride</i> Link ex Fries | 3 | 1 | 5 | 6 | 15 | | | | | 3 | 6 | 8 | 2 | | 2 | 1 | 1 | 2 | 1 | 5 | | | | | |
| <i>Mycelia Sterilia</i> sp. #2 | 5 | 6 | 2 | 1 | 14 | 2 | | | | 2 | 1 | 2 | 1 | 4 | 4 | 2 | 1 | 1 | 1 | 8 | | | | | |
| <i>Mycelia Sterilia</i> sp. #3 | 2 | 6 | 3 | 1 | 12 | 1 | 1 | 2 | 4 | | 1 | 1 | 1 | 1 | 1 | | | | | | 1 | 5 | 1 | 7 | |
| *Unknown #2 | 5 | 4 | 3 | 12 | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 3 | 7 | 2 | 1 | 3 | | | |
| <i>Montenozia gracilis</i> Linnenann | 4 | 2 | 3 | 3 | 12 | | | | | | 1 | 1 | 1 | 3 | | 2 | 3 | 5 | 3 | 1 | 4 | | | | |
| * <i>Montenozia faaballina</i> (Oudemans) Zycha | 1 | 2 | 1 | 4 | 8 | 1 | | | | 1 | 2 | 1 | 4 | 7 | | | | | | | | | | | |
| <i>Spaerogonema apiculata</i> Kalthbrenner | 2 | 2 | 5 | 9 | 1 | 1 | 1 | 2 | 4 | | 1 | 1 | 2 | 1 | 3 | 4 | | | | | 1 | 1 | 1 | 1 | |
| <i>Steptomyces</i> sp. | 4 | 1 | 2 | 7 | | | | | | | | | | | | | | | | | 4 | 1 | 2 | 7 | |
| * <i>Montenozia nazza</i> Linnenann | 4 | 2 | 6 | 3 | 1 | 4 | | | | | 1 | 2 | 3 | | | 2 | 2 | | | | 1 | 1 | 2 | | |
| <i>Penicillium obrythogenum</i> Thom | 1 | 2 | 2 | 5 | | | | | | | 1 | 2 | 3 | | | 2 | 2 | | | | | | | | |
| <i>Asiumyces</i> sp. | 3 | 1 | 4 | | | | | | | | | | | | | | | | | | 3 | 1 | 4 | | |
| <i>Penicillium brequistanii</i> Westling | 1 | 3 | 4 | | | 1 | 1 | | | 1 | 1 | 1 | 3 | | | 2 | 2 | | | | 1 | 1 | | | |
| <i>Penicillium rustrosum</i> Gilman and Abbott | 4 | 4 | | | | 1 | 1 | | | 3 | 3 | | | | | 2 | 2 | | | | 1 | 1 | | | |
| <i>Penicillium funiculosum</i> Thom | 2 | 1 | 3 | | | | | | | | 1 | 1 | 1 | 3 | | | | | | | | | | | |
| <i>Penicillium volutum</i> Westling | 1 | 1 | 1 | 3 | | | | | | | 2 | 1 | 3 | | | | | | | | | | | | |
| <i>Mycelia Sterilia</i> sp. #4 | 2 | | | 1 | 3 | | | | | | 2 | 1 | 3 | | | | | | | | | | | | |
| <i>Stachybotria atra</i> Corda | 1 | 1 | 1 | 3 | | 1 | 1 | 1 | 3 | | 1 | 1 | 1 | 3 | | 1 | 1 | 1 | 3 | | 1 | 1 | 2 | | |
| * <i>Montenozia alpina</i> Peyroud | 1 | 1 | 1 | 2 | | | | | | | | | | | | 1 | 2 | | | | | | | | |
| <i>Mucor fragilis</i> Baiter | 2 | | | 2 | | | | | | | | | | | | 2 | | | | | | | | | |

ISOLATED

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| <i>Penicillium oxyporphium</i> Dierckx | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 |
| <i>Mycelia Sterilia</i> sp. #5 | 1 | 1 | 2 | | | | | 1 | 1 |
| *Unknown #3 | 2 | 2 | 2 | 1 | 1 | | | 1 | 1 |
| * <i>Penicillium</i> sp. #3 | | | 2 | 2 | | | | 2 | 2 |
| <i>Paucarium amictectum</i> Berkeley and Ravenel | 1 | 1 | 1 | 1 | | | | | |
| <i>Monosporium minutissimum</i> Rivolta | | | 1 | 1 | | | | 1 | 1 |
| <i>Zygothyrium heterogamum</i> Vuillemin | | | 1 | 1 | 1 | 1 | | | |
| <i>Penicillium asperum</i> (Shear) Raper and Thom | 1 | | 1 | 1 | | | | | |
| <i>Penicillium kypauczakii</i> Zaleski | | | 1 | 1 | 1 | 1 | | | |
| <i>Mycelia Sterilia</i> sp. #6 | 1 | | 1 | | | | 1 | | |
| * <i>Chrysosporium parvum</i> (Link) Hughes | 1 | | 1 | 1 | | | | 1 | 1 |
| * <i>Gytopora</i> sp. #1 | | | 1 | 1 | | | | 1 | 1 |
| * <i>Gytopora</i> sp. #2 | | | 1 | 1 | | | | 1 | 1 |
| * <i>Coniothyrium</i> sp. | | | 1 | 1 | | | | 1 | 1 |

N = Nitrogen (NH₄NO₃)

PDA = Potato dextrose agar

P = Phosphorus (P₂O₅)

PDARB = Potato dextrose agar with rose bengal

K = Potassium (KCl)

PDARBS = Potato dextrose agar with rose bengal and streptomycin

C = Control

SE = Aspen soil extract agar

*Identified or confirmed by the staff of the Centraalbureau voor Schimmelcultures, Netherlands.

electrode pH meter. Above ground temperature for the study period ranged from -4°C to 28°C . Soil moisture content over the period of the study ranged from 12.4 to 176.6% (wet weight %).

Samples were plated in replicates onto four different agar media. A different agar was used each week. The agars used were: potato dextrose agar at pH 4.0 (PDA); potato dextrose agar with rose bengal added (PDARB); potato dextrose agar with rose bengal and streptomycin added (PDARBS); and aspen soil extract agar (SE). The dilutions from which the fungi were taken were 10^{-5} for all potato dextrose agars and 10^{-4} for the soil extract agar. Five colonies from each of five plates prepared for each area were isolated and cultured on potato dextrose agar pending fungal identification.

RESULTS

Species were identified using methods outlined by Raper and Thom (1946), Barnett (1960) and Gilman (1971). In all, 800 fungi were isolated. Duplicate species were discarded and by the end of the study 43 species had been isolated. Twenty of the more difficult species to identify were sent to Dr. J.A. Von Arx at the Centraalbureau voor Schimmelcultures in the Netherlands for identification. Those that his staff confirmed or identified are indicated by an asterisk in the accompanying table of fungi. Fungi not identified were given a number notation. Four of the *Mycelia Sterilia* species had noticeable clamp connections, indicating the presence of basidiomycetes.

ACKNOWLEDGEMENTS

We would like to thank Terrence A. Moore and Dr. Gary A. Laursen for their advice and criticism of this paper. The research was funded in part by the McIntire Stennis Cooperative Forest Research Program.

LITERATURE CITED

- BARNETT, H.L. 1960. *Illustrated Genera of Imperfect Fungi*. 2nd ed. Burgess Publishing Co., Minneapolis. 225 p.
- GILMAN, J.C. 1971. *A Manual of Soil Fungi*. 2nd ed. The Iowa State University Press, Ames. 450 p.
- RAPER, K.B. and C. THOM. 1946. *A Manual of the Penicillia*. Hafner Publishing Co., New York. 875 p.

MYCOTAXON

Vol. XIII, No. 2, pp. 373-404

July-September 1981

COPRINUS SECT. HERBICOLAE FROM CANADA, NOTES
ON EXTRALIMITAL TAXA, AND THE TAXONOMIC POSITION OF A
LOW TEMPERATURE BASIDIOMYCETE FORAGE CROP
PATHOGEN FROM WESTERN CANADA

S.A. REDHEAD

Biosystematics Research Institute, Research Branch,
Agriculture Canada, Wm. Saunders Bldg., C.E.F.,
Ottawa, Ontario, Canada K1A 0C6

&

J.A. TRAQUAIR

Agriculture Canada Research Station,
Lethbridge, Alberta, Canada, T1J 4B1

ABSTRACT

The pathogenic low temperature basidiomycete (LTB) affecting turf grass, forage legumes and winter cereals in western Canada is described as *C. psychromorbidus* sp. nov. A second western species is described as *C. maysoidisporus* sp. nov. *Coprinus* section *Herbicolae* is revised and a key to the accepted species given. The study of type specimens led to the conclusions that *Coprinus saichiae* Reid and *C. rhombisporus* Orton are synonyms of *C. friesii* Quél. *Coprinus brassicae* Peck, *C. melo* Favre and *C. suburticicola* Pil. & Svr. are synonyms of *C. urticicola* (Berk. & Br.) Buller. *Coprinus pseudofriesii* Pil. & Svr. and *C. xantholepis* Orton are synonyms of *C. phaeosporus* Karst., and *Coprinus amphibius* Anast. is a synonym of *C. kubickae* Pil. & Svr.

In addition, *Coprinus paleotropicus* sp. nov., *C. neotropicus* sp. nov. and *C. austrofriesii* sp. nov. are described for tropical collections previously reported as *C. urticicola*, *C. brassicae* and *C. friesii*.

A previously unidentifiable low-temperature basidiomycete (LTB) known to cause snow mold damage to turf grasses, winter cereals, forage legumes and native perennials (Broadfoot 1936, Broadfoot & Cormak 1941, Lebeau 1969) has been identified as a species of

Coprinus in the section *Herbicolae* (Traquair 1980). The specific identity of this *Coprinus* could not be ascertained from existing publications. Furthermore, although a re-evaluation of type materials for names published for species here considered in section *Herbicolae* revealed some inconsistencies, none of these species were conspecific with the pathogenic *Coprinus*. The fungus and a second species isolated with it are described as new. Descriptions of other species known to occur in Canada, a discussion on related taxa and a key to species accepted in section *Herbicolae* are also given. A description of the cultural characteristics of one species follows the taxonomic portion. Three tropical species are described as new and problematic species are discussed.

A key to *Coprinus* section *Herbicolae*

- A. Spores blackish to blackish brown and rapidly losing their colour and form in concentrated sulfuric acid solution or doing so within 1-5 minutes B
- A. Spores pale to dark brown or blackish brown, remaining relatively dark and intact in concentrated sulfuric acid solution for over 5 minutes D
 - B. Veil elements with hyaline thin walls; spores blackish brown, ovoid *C. kubickae*
 - B. Veil elements with hyaline moderately thin walls lightly incrustated with brown pigments; spores blackish, shaped like maize kernels C
- C. Spores 5.5-6.5 X 5.0-5.2 X 4.5-4.8 μ m; European *C. argenteus*
- C. Spores 7-9 X 6-7.6 X 5.1-5.3 μ m; North American *C. maysoi*
- D. Spores globose to subglobose, 4.5-5.0 X 4.5-4.8 μ m, apically rugulose *C. herinkii*
- D. Spores not globose, larger, smooth E
- E. Veil elements hyaline or subhyaline, in one species tending to become faintly yellowish with age or on drying F
- E. Veil elements prominently pigmented, brownish to golden brown I
- F. Veil elements thick-walled, over 0.5 μ m thick in places G

- F. Veil elements thin-walled, under
0.5 μ m thick H
- G. Spores 9.6-11.8 X 7.2-8 X 7-9 μ m;
S. American *C. austrofriesii*
- G. Spores 7.5-9.3 X 5.5-7.9 μ m;
N. Hemisphere *C. friesii*
- G. Spores 3.8-4.2 X 4.5-5.3 μ m;
N. American *C. burkii*
- H. Spores predominantly ovate in face
view, slightly compressed in profile,
6.1-8 X 4.5-5 X 5.8-6.7 μ m, walls
thickening; African *C. paleotropicus*
- H. Spores predominantly broadly ellipsoid
to near subglobose, 5.5-8 X 3.9-5.1 μ m,
walls relatively thin; N. Hemisphere *C. urticicola*
- H. Spores ellipsoid to ovoid,
8-9.5 X 6.5-7.5 μ m, walls relatively
thin; S. American *C. neotropicus*
- I. Veil element walls refractive, thickened,
often 0.5-1.0 μ m thick over long segments;
elements much branched, with some units like
matured deer antlers; golden in colour J
- I. Veil element walls thin to only slightly
thickened; elements moderately branched, at
most some units shaped like young blunt deer
antlers; brownish in colour L
- J. Spores obscurely to prominently angular
in face view, being an elongated hexagon *C. herbivorus*
- J. Spores ovate to elliptical in face view K
- K. Spores 5-7(-8) X 5-6 μ m, in face view, broadly
ovate, less so in profile; with a nearly lateral
eccentric apiculus on many; European *C. phaeosporus*
- K. Spores (6.4-)7.2-8.8(-9.6) X (4.2-)5-6(-7.3) μ m,
in face view, typically ovate to broadly elliptical,
varying in different isolates, some with nearly all
spores broadly ovate, in others with nearly all
elliptical; apiculus slightly eccentric to nearly
lateral; North American *C. psychromorbidus*

- K. Spores 9.5-11.5 X 6.5-7.0 μ m, in face view
ovate to elliptical; apiculus slightly
eccentric; Jamaican (on wood) *C. cinchonensis*
L. Spores 5.7-7 X 4.5-6 μ m;
South American *C. subtigrinellus*
L. Spores 8-10 X 6.8-7.1 μ m; European *C. tigrinellus*

SPECIES FOUND IN CANADA

**Coprinus friesii* Quélet (1872: 159, tab. 23, no. 5) Figs. 13,14,16,
29,34,44-47.

= *Coprinopsis friesii* (Quélet.) Karsten
(1881: 27)

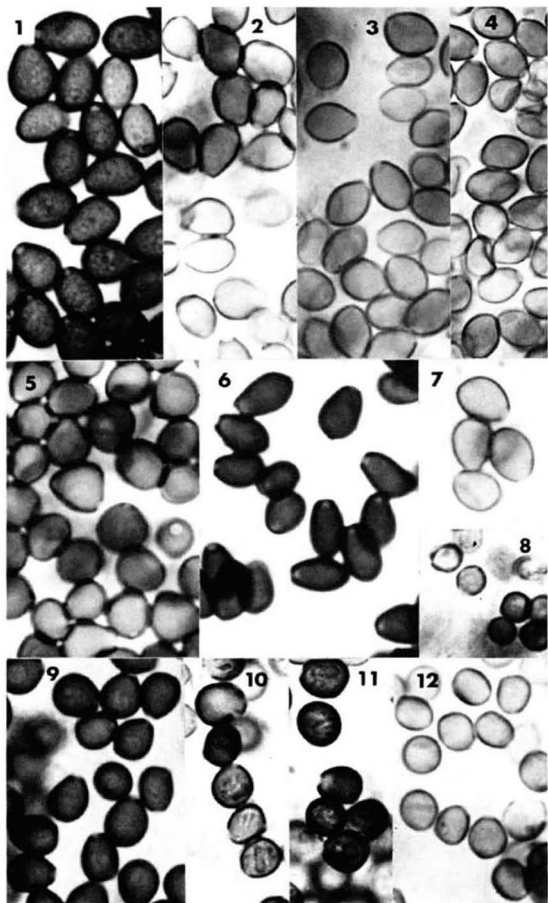
= *Coprinus saichiae* Reid (1958: 430)

= *Coprinus rhombisporus* Orton (1972: 145)

PILEUS 3-5 mm high unexpanded, narrowly paraboloid-conical, white to whitish, sometimes tinted faintly brownish towards the center, finely appressed floccose scaly towards the disc, becoming pale mouse grey and vaguely striate when fertile, expanding to plane, with edges becoming revolute. LAMELLAE ascending, nearly free, white, becoming greyish-sepia, crowded, somewhat deliquescing with age. STIPE 5-20 X 0.2-0.5 mm, subequal, white, nearly glabrous to minutely pulverulent, with a flattened basal disc fringed with tapering radiating mycelial strands.

PILEAR VEIL ELEMENTS: loosely interwoven, 2-4.5 μ m diam., somewhat duplex, lower elements with a poorly developed coralloid branching pattern, thin-walled, sometimes obscurely roughened, hyaline or faintly brownish, tending to deliquesce early, upper or outer elements normally well developed but sometimes nearly lacking, with a well developed thorny to antler-like branching pattern, thick-walled, having numerous elongated narrow branchlets which are solid or nearly so, smooth to vaguely roughened; veil elements loosely attached to the trama tissue which lacks a well developed pellis. PILEUS TRAMA: hyphae radiating, 3-5 μ m diam., little inflated, thin-walled, hyaline, smooth, with simple and clamped septa. LAMELLAR TRAMA: exceedingly thin; 2-3 hyphae thick, loosely interwoven, and often septate, nearly forming a pseudoparenchymatous layer, hyaline, thin-walled. PLEUROCYSTIDIA: scattered, numerous, 70-75 X 14-20 μ m, subcylindrical to fusoid, thin-walled, hyaline. CHEILOCYSTIDIA: polymorphic, a mixture of shorter pleurocystidia-like elements, swollen brachybasidium-like elements and thin-walled veil-like elements forming a mat over the lamellae edges. BASIDIA: dimorphic,

Figs. 1-12. Basidiospores. 1, *C. psychromorbidus* DAOM 175229. 2, *C. psychromorbidus* DAOM 179229. 3, *C. psychromorbidus* DAOM 175232. 4, *C. psychromorbidus* ex Dearness DAOM. 5, *C. psychromorbidus* DAOM 189345. 6, *C. psychromorbidus* DAOM 177600. 7, *C. psychromorbidus* DAOM 175226. 8, *C. herinkii* Type at PRM. 9, *C. pseudofriesii* Type at PRM. 10, 11, *C. xantholepis* Type at E. 12, *C. phaeosporus* Type at H. All ca. 1,200 X mag.



15-21 X 8.8-9.7 μ m, 4-spored, subglobose with a short to long tapering pedicel, spaced by swollen brachybasidia forming a rosette pattern. BASIDIOSPORES: 7.5-9.3 X 5.5-7.9 μ m, usually broadly ovate in face view, varying to broadly elliptical, inequilateral in profile with a less convex surface on the abaxial surface, thick-walled, smooth, brown vinaceous in mass, sienna in H₂O, with a well developed apical germ pore. STIPE HYPHAE: parallel, often inflated especially internally, 3-15 μ m diam., hyaline, thin-walled, smooth.

HABITAT and SUBSTRATES: On leaf litter of *Typha* and *Carex* (Ont.) or unspecified monocots (Que.) in wet fields or temporary pools.

COLLECTIONS EXAMINED: CANADA: Ontario: Ottawa, June 28, 1979, S.A.R. 3455 (DAOM 175138). Québec: Cantley, July 15, 1980, J. Ginns (DAOM 177601). ENGLAND: Hertfordshire, King's Langley, Sept. 23, 1955, R.A. Saich (K, type for *C. saichiae*); Norfolk, Surlingham, Wheatfen Broad, Aug. 3, 1968, P.D. Orton 3249 (E, type for *C. rhombisporus*). SWEDEN: Västergötland, Göteborg, St. Änggården, Aug. 2 & 3, 1937, T. Nathorst-Windahl 658 (DAOM, Lundell & Nannfeldt 2928 as *C. friesii*).

An authentic Quélet collection of *Coprinus friesii* could not be located at Paris (PC). The concept adopted here is that of Pilát & Svrček (1967), Lundell & Nannfeldt (1979), Kühner & Romagnesi (1953) and Romagnesi (1937), i.e. a species with thick-walled, hyaline to faintly yellowish, coralloid veil elements and broadly ovoid brownish spores 7.5-9.3 X 5.5-7.9 μ m.

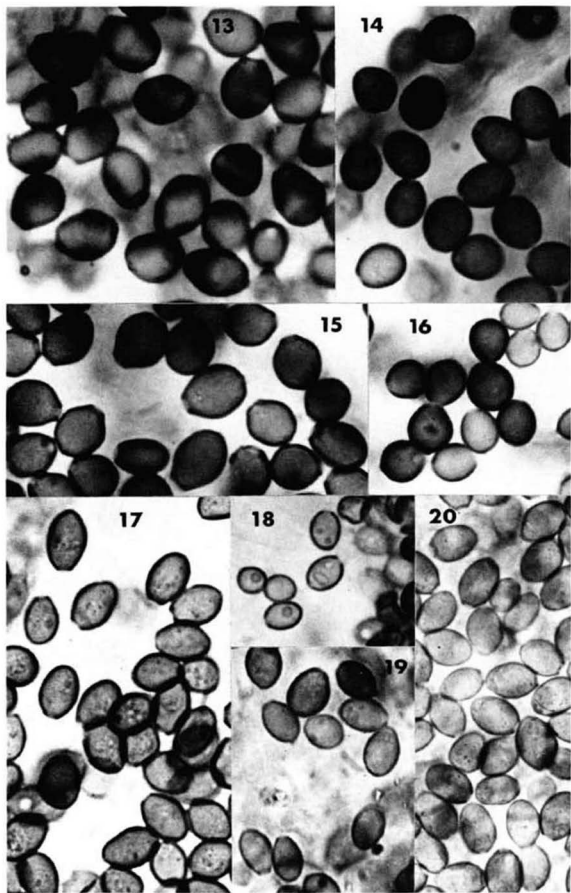
The types for both *Coprinus saichiae* (figs. 16, 47) and *C. rhombisporus* (figs. 13, 45) do not differ significantly from other collections of *C. friesii*. There is a slight variation in the colour of the veil elements, from hyaline to faintly yellowish, and in spore sizes but these are not unexpected considering the variations found in the better documented case of *C. psychromorbidus*. Nearly complete sterility or a nearly complete arrestment of full veil development as in DAOM 175138, make identifications difficult.

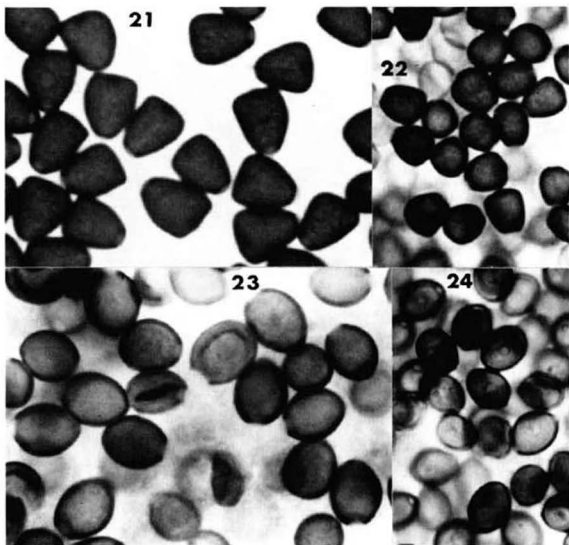
In Europe, *Coprinus friesii* has been found on senescent *Trifolium*, *Lupinus*, *Chenopodium*, *Arctium*, *Robinia*, *Carex* and various grasses (see references above, Orton & Watling 1979, and Lange 1915, 1939). It has also been reported from Morocco (Malençon & Bertault 1970) on *Phragmites* and *Juncus*, and from Japan (Imazeki & Hongo 1965). The report from Venezuela by Dennis (1961) is based on *C. austrofriesii* (q.v.).

**Coprinus kubickae* Pilát & Svrček (1967, Aug.: 142) Figs. 67,68
= *Coprinus amphibius* Anastasiou (1967, Nov.: 2213-4).

COLLECTION EXAMINED: CANADA: British Columbia: basidiocarps from a

Figs. 13-20. Basidiospores. 13, *C. rhombisporus* Type E. 14, *C. friesii* ex Lundell & Nannfeldt DAOM. 15, *C. herbivorus* Type at F. 16, *C. saichiae* Type at K. 17, *C. suburticicola* Type at PRM. 18, *C. urticicola* DAOM 175421. 19, *C. brassicae* Type at NYS. 20, *C. melo* Type at G. All ca. 1,200 X mag.





Figs. 21-24. Basidiospores. 21, *C. maysoidisporus* DAOM 175231. 22, *C. argenteus* Type at K. 23, *C. tigrinellus* Type at PC. 24, *C. subtigrinellus* Type at K. All ca. 1,200 X mag.

culture made from basidiocarps on wood, 4.5 mi. S of Clinton, by Hwy. 97, July 24, 1964, L. Broome & N. Corfman (Anastasiou A 261 = DAOM 128359, type *C. amphibius*).

An isolate of *Coprinus kubiackae* from turf grass in Saskatchewan was recently described by Redhead & Smith (1981). A subsequent study of the type of *C. amphibius* indicates that it is conspecific. Spore size (fig. 67), colouration, reaction in H_2SO_4 solution, and shape are identical. Veil tissues (fig. 68) are similar although the hyphae are less inflated on the average in the type of *C. amphibius*. The habitat differs as *C. amphibius* was described on wood in alkaline lakes whereas *C. kubiackae* is normally on herbaceous material. A wetland habitat and possibly a basic substrate is common to all collections known. This includes a collection from intertidal salt marsh plant debris, on both woody twigs and grass from Willapa Bay, Washington, U.S.A., Mar. 13, 1971, described by Van de Bogart (1975) under the

unpublished and provisional name, "*Coprinus willapaensis*" which appears to be *C. kubickae*.

**Coprinus maysoi-disporus* Redhead & Traquair,
sp. nov.

Figs. 21,28,30,
31-33,35,37,43.

Pileus 4.5-7.0 mm alt., conicus demum planus, candidus, squamatus; squamae bronneae, floccosae. Lamellae librae, candidae demum atrae, approximatae. Stipes 8-21 mm long., 0.5-1.0 mm crassus, candidus, glaber vel floccosus. Sporae 7-9 X 6-7.6 X 5.1-5.3µm, atrae, pellucidae, angulatae vel maysoi-disporiformis, laeves; apicem poro germinativo; tunica crassa. Pleurocystidia 78-94 X 32-37µm, fusiformis, hyalina. Hyphae veli, ramosae; tunica hyalina, incrustata fusce.

Holotypus: in solum prope Medicaginem sativam, DAOM 175231.

PILEUS paraboloid-conical, 4.5-7 mm high when unexpanded, whitish, with pale umber-coloured to pallid appressed floccose scales mostly in the central region, becoming convex and greyish with age, shallowly plicate-striate; edges eroding. LAMELLAE ascending, nearly free, white becoming fuscous black, crowded, deliquescing with age. STIPE 6-21 mm long, 0.5-1.0 mm wide, subequal, white, nearly glabrous to slightly fibrillose-floccose, with a slightly flattened swollen base.

PILEAR VEIL ELEMENTS: loosely interwoven, only slightly inflated 5-10µm diam., with a poorly developed coraloid branching pattern, thin-walled, hyaline or brownish in segments where incrustated, clamped, loosely attached to the trama tissue which lacks a well developed pellis. PILEUS TRAMA: hyphae radiating, often inflated with age, 6-18µm diam., thin-walled, hyaline, constricted at septa, smooth. LAMELLAR TRAMA: exceedingly thin, 2-3 hyphae thick; hyphae loosely interwoven, 2.7-5.5µm diam., hyaline, thin-walled, clamped. PLEUROCYSTIDIA: 79-94 X 31-37µm, broadly ellipsoid to ventricose, often forked or dimpled at the apex where embedded in the opposing hymenium, thin-walled, hyaline. CHEILOCYSTIDIA: polymorphic ranging from shorter versions of the pleurocystidia to brachybasidium-like, mixed with or attached to hyaline veil-like elements forming a matted cover on the lamellar edges. BASIDIA: dimorphic, 17-24 X 9.9-10.1µm, 4-spored, broadly ellipsoidal with a short to long narrow pedicel; brachybasidia flattened, swollen, forming a rosette around each basidium. BASIDIOSPORES: 7-9 X 6-7.6 X 5.1-5.3µm, subangular and broadly ovate to cordate or triangular in face view, slightly flattened and elliptic to ovate in profile, similar in shape to the kernels of *Zea mays*, thick-walled, fuscous black in mass, blackish but not opaque under the microscope in H₂O, readily dissolving in concentrated H₂SO₄, with a prominent apical germ pore. STIPE HYPHAE: 5-30µm diam., hyaline, with thin to pronounced smooth walls, more inflated internally.

HABITAT and SUBSTRATES: On soil or artificial soil adjacent to *Medicago sativa* taken from arid environments.

COLLECTIONS EXAMINED: CANADA: Alberta: nr. Brocket, Aug. 17, 1979, J.A.T. 1334b (DAOM 175233); Lethbridge, freezing tests in greenhouse

from outdoor plots, April 11, 1979, J.A.T. 1287b, (DAOM 175231, Typus). U.S.A.: Montana: Echo Lake, July 19, 1928, C.H. Kauffman (DAOM 89696).

Coprinus maysoioidisporus is distinguished by its blackish translucent characteristically-shaped spores and its coralloid, thin-walled, brownish, incrustated veil elements. Its large spore size is the only feature which readily distinguishes it from *C. argenteus*, a species known from one collection in the British Isles. Kauffman's collection was labelled "*Coprinus (triangulospora) n.sp.* Kauff. unpublished". No published record of this collection could be found.

Cultural data follows the taxonomic portion.

**Coprinus psychromorbidus* Redhead & Traquair
sp. nov.

Figs. 1-7, 25,
32, 36, 38-42.

Pileus 4-9 mm alt., 5-12 mm latus, conicus demum planus, candidus, squamatus; squamae brunneae, floccosae. Lamellae librae candidae demum atrobrunneae, approximatae, deliquescentes. Stipes 26-70 mm long, 1-3 mm crassus, candidus, glaber vel floccosus. Sporae (6.4-)7.2-8.8(-9.6) X (4.2)5-6(-7.3) μ m atrobrunneae, laeves, ellipsoideae vel ovoideae; apicem poro germinativo; tunica crassa. Pleurocystidia 65-100 X 15-20 μ m, fusiformia, hyalina. Hyphae veli, ramosae, flavobrunneae; tunica crassa. Holotypus: in apicalibus senescentibus *Medicago sativae*, DAOM 179229.

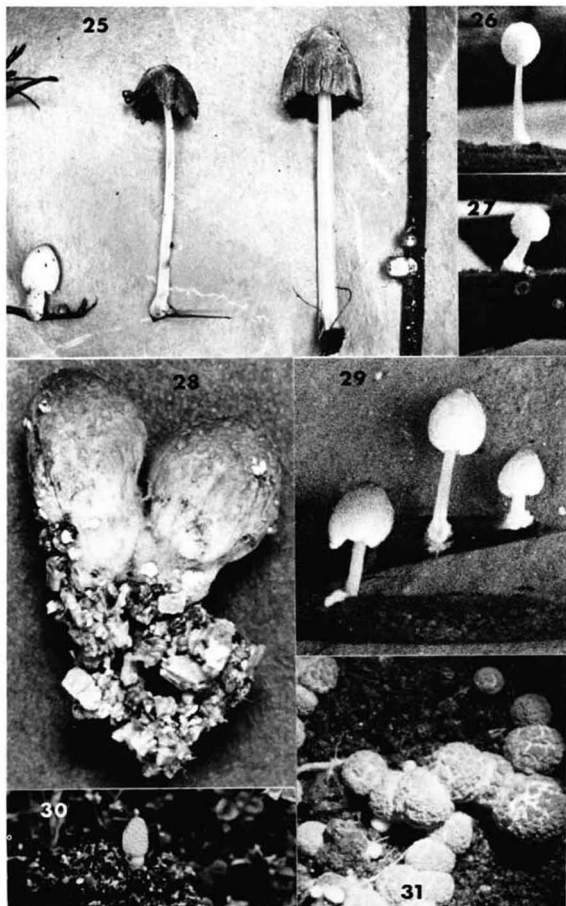
HABITAT and SUBSTRATES: On necrotic or senescent parts of *Medicago sativa* L. (Alta.), *Triticum aestivum* L. (Man.), *Urtica dioica* L. (Man.), *Elymus piperi* Bowden (B.C.), *Agrostis stolonifera* L. (Sask.), *Dianthus* sp. (Ont.) and other herbaceous plants usually in arid macro-environments.

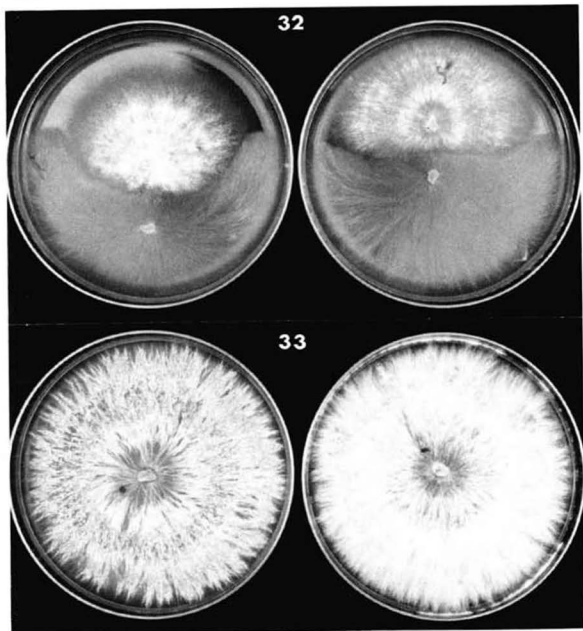
COLLECTIONS EXAMINED: CANADA: Alberta: nr. Brocket, Aug. 17, 1979, J.A.T. 1334a (DAOM 175232); Lethbridge, field plots, Sept. 20, 1979, J.A.T. 1341 (DAOM 175228), freezing test materials removed from field plots, April 11, 1979, J.A.T. 1286 (DAOM 175226), J.A.T. 1287 (DAOM 175230), April 17, 1979, J.A.T. 1291 (DAOM 175227), J.A.T. 1292 [Holotypus] (DAOM 179229), also culture from J.A.T. 1292 on horse manure (DAOM 177647). British Columbia: 2 km. N. of Vernon, Sept. 25, 1980, S.A.R. 4054 (DAOM 177600). Manitoba: Winnipeg, Aug. 3, 1937, coll. unknown (DAOM 189344, 189345). Saskatchewan: Saskatoon, in greenhouse material from outdoor plots, Mar. 12, 1981, J. Drew Smith (DAOM 179672). Ontario: London area, Sept. 8, 1926, "Emma" [Dearness] (DAOM).

A more detailed description of the basidiomes and cultures based on Alberta collections was presented by Traquair (1980).

Coprinus psychromorbidus is characterized by having thick-walled

Figs. 25-31. Basidiomes. 25, *C. psychromorbidus* DAOM 177600. 26, 27, *C. urticaicola* DAOM 175421. 28, 30, 31, *C. maysoioidisporus* DAOM 175231. 29, *C. friesii* DAOM 175138.





Figs. 32-33. Mycelia in petri plates. 32, *C. maysoideisporus* DAOM 175237 on upper halves versus *C. psychromorbidus* DAOM 175227 on lower halves. 33, *C. maysoideisporus* on PDA (left) and MA (right) 3 wks.

brownish antler-like veil elements and brown, thick-walled ovoid to ellipsoid spores, mostly $7.2-8.8 \times 5-6\mu\text{m}$. The size, shape and intensity of the melanization of the basidiospores is quite variable. In the Ontario collection the spores were nearly all ellipsoidal and relatively weakly pigmented, the Manitoba collections have spores with prominently domed adaxial surfaces and in some cases a second germ pore on this raised portion, the British Columbian collection had many misshaped spores, was partially sterile and in general had elongated ovoid spores. The collections from Alberta showed a range in shapes from broadly ovoid to ellipsoidal and in degrees of pigmentation. Cultures from all of the Alberta collections interbred (Traquair 1980). The variation in spore characteristics probably indicates

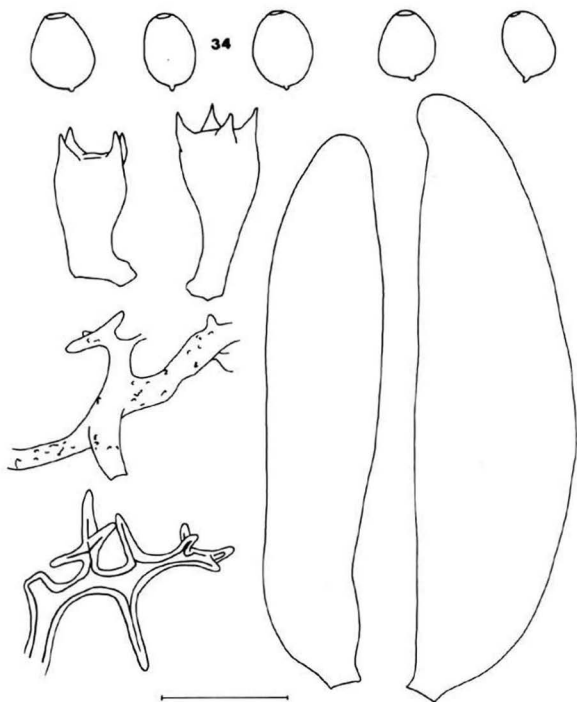


Fig. 34. *C. friesii*, basidiospores, basidia, pleurocystidia, veil elements from pileus, DAOM 177601. Scale = 15 μ m.

that the species has an unstable gene pool resulting in a high degree of plasticity.

The earliest known collection of *Coprinus psychromorbidus* was made by Mrs. Emma Dearness, the wife of Dr. John Dearness. The collection's label reads, "*Coprinus brassicae*... Emma D. found it on stems of garden pink 8th Sept. 1926," with no additional locality data given. This collection is considered to be from London, Ontario, John Dearness's hometown (Tamblin 1955) as Dearness collections at DAOM (Parmelee 1978) made at more distant localities are so labelled whereas collections made in the London area usually are not. In addition, J. Dearness, and presumably his wife, had been home in southern Ontario in September 1926 as is evident from his publications (Dearness 1972a,b) and other miscellaneous collections.

Coprinus psychromorbidus was next collected by W.F. Hanna (1939) who reported it as *C. urticicola*. He had earlier cited it as *C. phaeosporus* (Bisby et al. 1938). Hanna's material on wheat and on the nettle collected in July 1937, are not available for study. Two collections labelled *Coprinus brassicae* (a name Hanna considered synonymous with *C. urticicola*) made on herbaceous stems collected behind the Dominion Rust Research Laboratory, Winnipeg, in Aug. 1937 by an anonymous collector are *C. psychromorbidus*. Also, Hanna's (1939) description, line drawings and photographs of the collections on wheat indicate that he had *C. psychromorbidus* and not *C. urticicola* or any other species. Thus Hanna was the first to describe the species in culture and recognize that it might be of importance to agriculture although he could not demonstrate any pathogenicity.

Coprinus psychromorbidus was finally linked to snow mold damage when dikaryotic-monokaryotic matings were made between sterile isolates of the causal agent and single spore isolates from basidiocarps of the *Coprinus* from Alberta (Traquair 1980, 1981). The presence of one pathogenic species in section *Herbicolae* raises the possibilities that other species are pathogens. *Coprinus kubickae*, was found to be associated with superficial fairy rings on turf in Saskatchewan and is possibly the causal agent (Redhead and Smith 1981). Alternatively, the turf damage may have been caused by *C. psychromorbidus*, or *C. kubickae* in combination with *C. psychromorbidus* as the last species has also been isolated from the affected turf (see specimens examined).

Coprinus psychromorbidus appears to be closely allied to the European *C. phaeosporus* Karsten. Its spores are smaller, fall within a narrower range, and the shape is more constant probably as a result of the small size. *Coprinus psychromorbidus* and *C. phaeosporus* probably represent a vicarious species pair derived from a common ancestral circumpolar population. The main difference is spore size and that being highly variable for the former although not to the extent of overlapping. In the same way that *C. psychromorbidus* is a large-spored equivalent of *C. phaeosporus*, *C. maysoiisporus* is a large-spored equivalent of *C. argenteus*. These last two species otherwise being nearly identical in habit, habitat and morphology, also can be considered as a vicarious species pair. In the cases of *Coprinus friesii*, *C. urticicola* and *C. kubickae* which are all found on both continents, more stable gene pools must be involved.

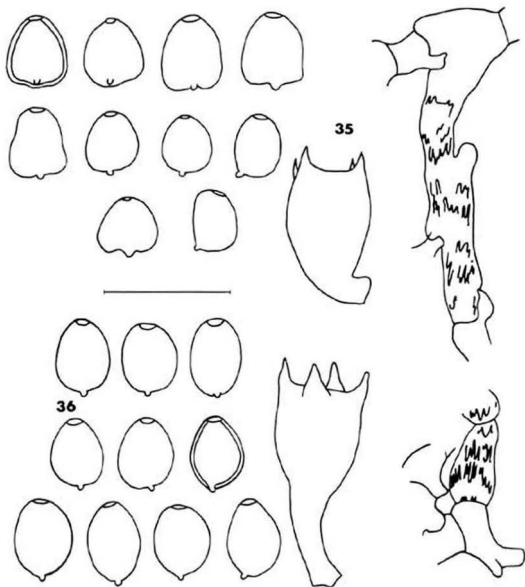


Fig. 35. *C. maysoiisporus*, basidiospores, basidia, veil elements from pileus, DAOM 175231. Fig. 36. *C. psychromorbidus* basidiospores, DAOM 179229. Scale = 15 μ m.

Other closely allied species are *C. herbivorus*, differing by angular spores, and *C. cinchonensis* (q.v.), differing by large spores.

- **Coprinus urticicola* (Berk. & Br.) Buller Figs. 17-19, 26,
(1917: 485) 27, 56-62, 69.
= *Agaricus urticicola* Berkeley & Broome
(1861: 376) ut "*urticascola*" (Art. 73.8, Stafleu *et al.* 1978).
= *Psathyra urticicola* (Berk. & Br.) Saccardo (1887: 107).
= *Coprinus brassicae* Peck (1890: 64)
= *Coprinus melo* Favre (1948: 215)
= *Coprinus suburticicola* Pilát & Svrček (1967: 140)

PILEUS 3-4 mm high unexpanded, paraboloid-conical to nearly hemispherical, white, nearly opaque, minutely pulverulent, becoming plane with revolute torn edges, greyish sepia with age. LAMELLAE nearly free, crowded, white, becoming greyish sepia with age, deliquescing slightly. STIPE 6-11 mm long, 0.1-0.4 mm wide, subequal, fistulose, white, minutely floccose to nearly glabrous, arising from a basal disc with a sparse fringe of tapering mycelial strands.

PILEAR VEIL ELEMENTS: loosely interwoven, with a poorly to moderately developed coralloid branching pattern, little inflated, 5-10 μ m diam., thin-walled, hyaline, sometimes with refractive hardened drop-like incrustations, simple-septate; loosely attached to the trama tissue which lacks a well developed pellis. PILEUS TRAMA: exceedingly thin; hyphae radiating, thin-walled, hyaline, 2-5 μ m diam., little inflated, simple-septate. LAMELLAR TRAMA: exceedingly thin, 2-3 hyphae thick; hyphae interwoven and often septate forming a nearly pseudoparenchymatous tissue, 2-5 μ m diam., hyaline, thin-walled. PLEUROCYSTIDIA: abundant, scattered, 65-88 X 16-24 μ m, fusoid to ventricose, thin-walled hyaline. CHEILOCYSTIDIA: polymorphic, varying from shorter pleurocystidia-like elements to swollen brachybasidium-like elements and veil-like elements binding the lamellae edges together. BASIDIA: dimorphic 13-22 X 6.5-7.0 μ m, 4-spored, subglobose to utriform, with a short to long narrow pedicel, simple-septate. BASIDIOSPORES: 5.5-8 X 3.9-5.1 μ m, narrowly to broadly ellipsoidal to obscurely ovoid, sometimes approaching subglobose in shorter spores, slightly inequilaterally flattened on the adaxial surface, smooth, thin to very slightly thick-walled, pale brown under the microscope, sepia in mass, with a prominent transverse to tangential apical germ pore. STIPE: hyphae parallel, more inflated internally, 14-15 μ m diam., thin-walled, hyaline, smooth.

HABITAT and SUBSTRATES: On *Carex* (Que.) or grass leaves in wet open fields.

COLLECTIONS EXAMINED: CANADA: Québec: Cantley, June 24, 1979, S.A.R. 3490 & J.H. Ginns (DAOM 175421), June 29, 1980, S.A.R. 3518 & J.H. Ginns (DAOM 177602). CZECHOSLOVAKIA: Horní Slovénice pr. Lomnice nad Lužnici, Bohemiae, July 14, 1962, M. Svrček & J. Kubička (PRM #567917, type for *C. suburticicola*). ENGLAND: Kew, July 24, 1957, D.A. Reid (DAOM 66599, ex K). ITALY: Athesis fl. (= Adige River), Sept. 1900, G. Bresadola (NY). SWITZERLAND: Jura vaudo's

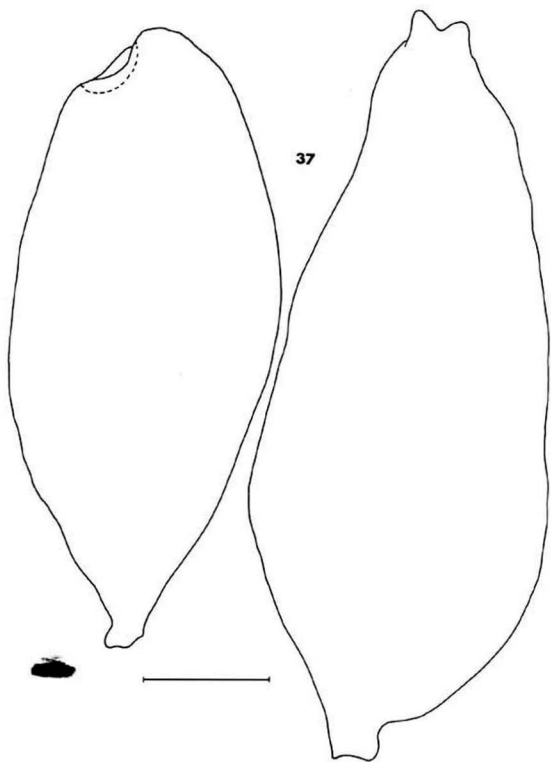


Fig. 37. *C. maysoidisporus*, pleurocystidia, DAOM 175231.
Scale = 15 μ m.

vallée de Joux, près du Sentier, Rièze la Côte, Aug. 28, 1939, J. Favre (G, type of *C. melo*). U.S.A.: New York, Albany Co., Menands, Aug. C.H. Peck (NYS, type for *C. brassicae*); Bronx, June 15, 1911, W.A. Murrill (NY).

The type of *Agaricus urticicola*, the basionym of *Coprinus urticicola*, was unavailable for study because of its fragmented nature. Orton (Dennis, Orton & Hora 1960: 222; Orton 1960: 410) illustrated and described the spores from the type as ellipsoidal, 6-8 X 4.5-5.5µm, with an apical germ pore. This is in rough agreement with Cooke's (1886) illustration from the type collection showing ellipsoidal to obscurely ovoid spores, 7 X 4µm. The combination of spores of this type and a pure white pileus for a European *Coprinus* in section *Herbicolae* indicates that the name should be applied to the species as accepted here.

The types of *Coprinus brassicae* (Figs. 19,58), *C. melo* (Figs. 20,57) and *C. suburticicola* (Figs. 17,59) all have hyaline, thin-walled coralloid veil elements and ellipsoid to obscurely ovoid brownish spores with a prominent apical germ pore. *Coprinus brassicae* is clearly synonymous with *C. urticicola*. Many of the spores of *C. suburticicola* are larger than typical *C. urticicola* but the ranges overlap too much to allow maintaining them as separate taxa. The position of the germ pore is also too variable. *Coprinus melo* differs mainly in the gross appearance of the pileus, having prominent rib-like folds suggesting a type of melon. The microscopic features are identical to typical *C. urticicola*. The type of *C. melo* would seem to be a growth form of *C. urticicola* possibly effected by the high altitude environment.

Coprinus urticicola has been reported on *Brassica oleraceae* L. and *Zea mays* L. in the U.S.A. (Peck 1980 & Murrill 1912, as *C. brassicae*) and on *Urtica dioica* L., *Carex*, *Juncus*, branches of *Picea abies* Karst. and various grasses including *Phalaris arundinacea* L. and *Agropyron* species in Europe (Pilát & Svrček 1967).

The report of *Coprinus urticicola* from Manitoba by Hanna (1939) was based on material of *C. psychromorbidus* (q.v.). Pegler's (1977) report from east Africa is based on *C. paletropicus* (q.v.) and the Venezuelan collection reported by Dennis (1961) is *C. neotropicus* (q.v.).

EXTRALIMITAL SPECIES

**Coprinus argenteus* Orton (1972: 139) Figs. 22,51.

COLLECTION EXAMINED: ENGLAND: Surrey, Mickleham, Juniper Hill, June 22, 1956, C. Kemball (K, type).

This is the European small spored equivalent of *C. maysoidisporus*. It has blackish but translucent spores readily dissolving in concentrated H₂SO₄. The spores are identical in shape to *C. maysoidisporus*, but are smaller, 5.5-6.5 X 5.0-5.2 X 4.5-4.8µm. The veil elements are moderately to poorly coralloid, essentially thin-walled and hyaline with patches of hyphae bearing a thin brownish incrustation.

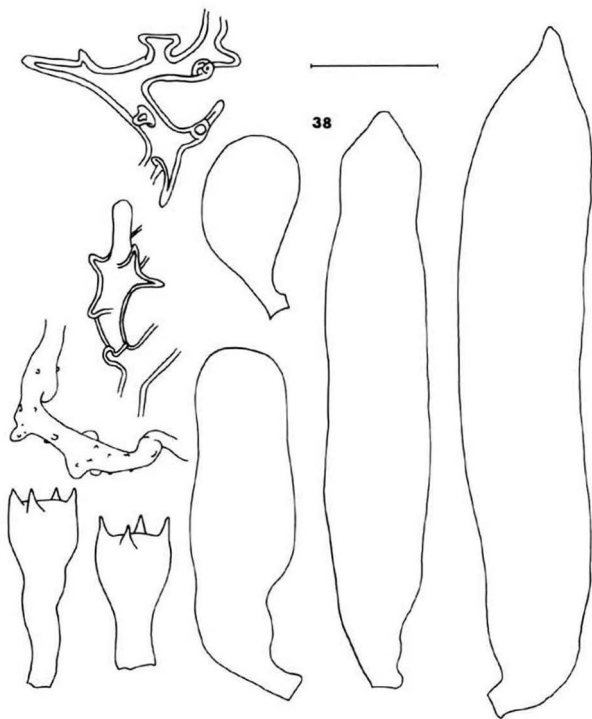


Fig. 38. *C. psychromorbidus* veil elements, cheilocystidia (center), pleurocystidia, basidia, DAOM 179229. Scale = 15 μ m.

The habitat is on grass in chalkland grasslands.

**Coprinus austrofriesii* Redhead & Pegler, sp. nov. Fig. 55.

Differt a Coprino friesio sporis ovoides 9.6-11.8 X 7.2-8 X 7-9µm.

Holotypus: in graminis, Julio 11, 1958, Los Palos Grandes (Caracas) Edo, Miranda, Venezuela, leg. R.W.G. Dennis 1495 (K).

Coprinus austrofriesii was reported from Venezuela as *C. friesii* by Dennis (1961: 120). Dennis evidently noted a difference between his collection and European materials as he suspected it would be segregated at the species level in time. It differs from *C. friesii* by the much larger spores. In other respects it resembles *C. friesii*. This is an important difference when compared to the consistency shown between European and North American collections of *C. friesii*.

**Coprinus burkii* Smith in Smith & Hesler (1946: 178).

The type of this species was not studied. This species is essentially *C. phaeosporus* (q.v.) but with hyaline veil elements which have thinner walls towards the extremes of the branches than in *C. phaeosporus*. The habitat is on fern petioles in Alabama.

**Coprinus cinchonensis* Murrill (1918: 85) Fig. 54.

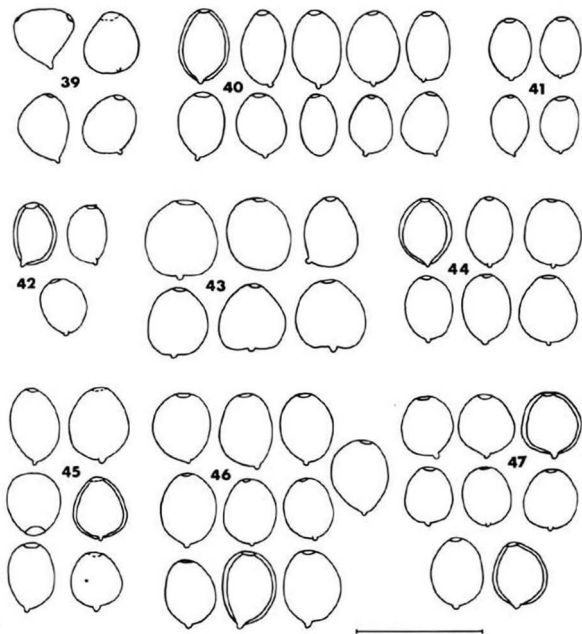
COLLECTION EXAMINED: JAMAICA: Cinchona, 4500-5200 ft. level, Dec.25-Jan. 8, 1908-9, W.A. & E.L. Murrill 579 (NY, type).

Very little is known about this species whose name is based on a single basidiome. The fact that it grew on a log may indicate that it is a peripheral species to the section *Herbicolae*, however, our and Smith's (1948) type studies showed that the microscopic features are very similar to the fungus described here as *C. psychromorbidus*. Murrill's species differs by having larger spores, 9-11 X 5-6 X 6-7.5µm and by the lignicolous habitat. The veil elements are slightly paler yellow than most *C. psychromorbidus* veil elements.

**Coprinus herbivorus* Singer (1973: 70) Figs. 15,49.

COLLECTION EXAMINED: ARGENTINA: Jujuy, Lagunas de Yala, Feb. 9, 1965, R. Singer T3929 (F1015235, type).

Singer (l.c.) gave a detailed description of this species. The angularity of the spores, the most characteristic feature of this species, varies from prominent to obscure. Veil elements with a prominent linear axis from which branched elements arise also characterize *C. herbivorus*.



Figs. 39-47. Basidiospores. 39, *C. psychromorbidus* DAOM 189345. 40, *C. psychromorbidus* DAOM 177600. 41, *C. psychromorbidus* ex Dearness DAOM. 42, *C. psychromorbidus* DAOM 175239. 43, *C. maysoidisporus* DAOM 89696. 44, *C. friesii* DAOM ex Lundell & Nannfeldt. 45, *C. rhombisporus* Type at E. 46, *C. friesii* DAOM 175188. 47, *C. saichiae* Type at K. Scale = 15 μ m.

**Coprinus herinkii* Pilát & Svrček (1967: 137) Figs. 8,66.

COLLECTION EXAMINED: CZECHOSLOVAKIA: southern Bohemia, Černoháj nr. Vodňany, Aug. 12, 1938, J. Herink (PRM 499770, type).

Only one collection of this species is known but it seems distinct enough to warrant recognition. The small subglobose spores with apical wrinkles and patches, if found to be a consistent character, will readily distinguish it from all other taxa.

**Coprinus neotropicus* Redhead & Pegler, sp. nov. Fig. 53.

Differt a *Coprino urticicolo* sporis ellipsoideis vel ovoideis 8-9.5 X 6.5-7.5µm.

Holotypus: in *Bambuseis*, *Iulio*, 4, 1958, El Avila, Dts. Federal, Venezuela, leg. R.W.G. Dennis 1136 (K).

Coprinus neotropicus was reported from Venezuela as *C. brassicae* by Dennis (1961: 118-119). As with *C. austrofriesii* (q.v.) he suspected that the collection would be segregated from the northern taxon. *Coprinus neotropicus* differs from *C. urticicola* by having larger spores. It is, in other respects, very similar to the latter species.

**Coprinus paleotropicus* Redhead & Pegler, sp. nov. Fig. 52.

Differt a *Coprino urticicola* sporis ovoideis, 6.1-8 X 4.5-5 X 5.8-6.7µm, tunicis, crassis.

Holotypus: in ligno, *Martio* 25, 1968, Nyanza Prov., Kericho reg., Kigumu fl., Kenya, leg. D. Pegler 234 (K). Paratypus: Pegler 368.

Coprinus paleotropicus is well described and illustrated as *C. urticicola* by Pegler (1977: 397-399). It differs from *C. urticicola* by having more prominently ovoid, thicker-walled spores and by the woody substrate.

**Coprinus phaeosporus* Karsten (1881: 9) Figs. 9-12,63-65.

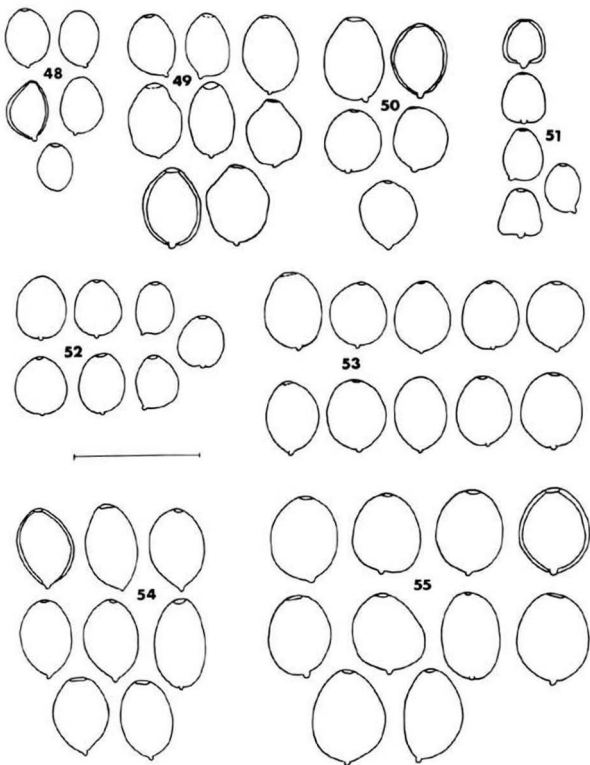
= *Coprinopsis phaeosporus* (Karsten) Karsten (1881b: 27)

= *Coprinus pseudofriesii* Pilát & Svrček (1967: 140-141)

= *Coprinus xantholepis* Orton (1972: 150)

COLLECTIONS EXAMINED: CZECHOSLOVAKIA: central Bohemia, Praha-Divoká, July 22, 1941, J.A. Herink 332/41 (PRM 626346, type of *C. pseudofriesii*). FINLAND: southern Tavastia, Tammela, Mustiala, Aug. 5, 1880, P.A. Karsten 1602 (H, lectotype of *C. phaeosporus*). SCOTLAND: Aberdeenshire, Loch Skene, Aug. 19, 1964, P.D. Orton (E, type of *C. xantholepis*).

The data for the collection which was designated as lectotype and illustrated by Horak (1968) agrees well with that of the protologue (Karsten 1881) and a subsequent description (Karsten 1881c), i.e. Mustiala, in terra stercoreatis, 5 Aug. 1880. The type



Figs. 48-55. Basidiospores. 48, *C. subtigrinellus* Type at K. 49, *C. herbivorus* Type at F. 50, *C. tigrinellus* Type at PC. 51, *C. argenteus* Type at K. 52, *C. paleotropicus* Type at K. 53, *C. neotropicus* Type at K. 54, *C. cinchonensis* Type at NY. 55, *C. austrofriesii* Type at K. Scale = 15 μ m.

consists of a number of basidiomes, some caespitose on grassy debris. As noted by Horak (1968) and Pilát & Svrček (1967), the spores (Figs. 12,65) from the extant basidiomes are smaller, $5.5-7 \times 5.5-6 \mu\text{m}$, and shaped differently from what Karsten had observed, i.e. $9-15 \times 5-9 \mu\text{m}$. This discrepancy is best explained, as suggested by Pilát & Svrček (l.c.), by assuming that Karsten had a mixed collection and what now remains, represents only one of the species represented in the original collection. Thus the species as lectotypified is one characterized by having veil elements with a well developed antler-like branching pattern, thick, golden to hyaline refractive walls, and brownish thick-walled spores which are broadly ovate in face view and slightly compressed, inequilateral and with a nearly lateral apiculus in profile.

The name *Coprinus xantholepis* (Figs. 10,11,64) is based on a collection with essentially identical features to *C. phaeosporus* as is *C. pseudofriesii* (Figs. 9,63). There is a slight difference in the degree of pigmentation of the spores in the three types but not enough to segregate them into different taxa, especially when one considers the variation observed in compatible strains of the allied *C. psychromorbidus*. The report of *C. phaeosporus* from Manitoba (Bisby et al. 1938) is based on *C. psychromorbidus* (q.v.).

**Coprinus subtigrinellus* Dennis (1961: 122-123) Figs. 24,48.

COLLECTION EXAMINED: VENEZUELA: Caracas, Botanic Garden, June 30, 1958, R.W.G. Dennis 1124 (K, type).

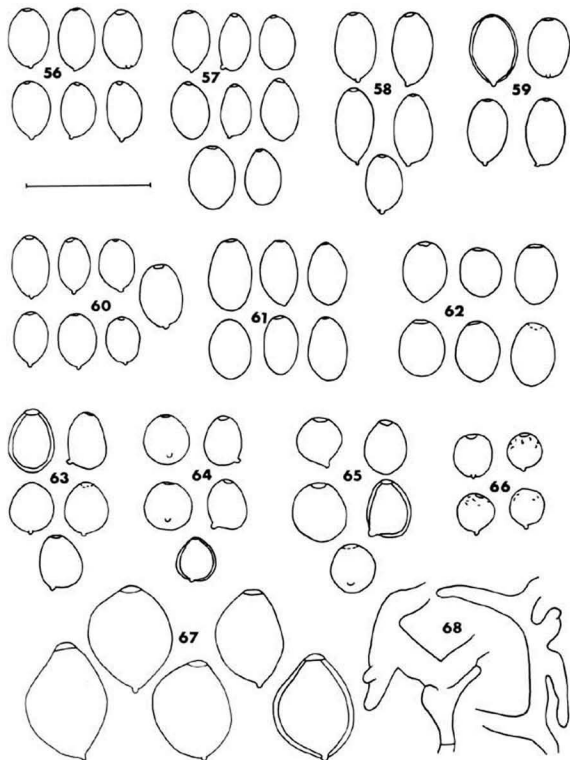
As indicated by the name, *C. subtigrinellus* is allied to *C. tigrinellus*, both having veil elements which are brownish, essentially thin walled and coralloid.

Coprinus subtigrinellus differs from *C. tigrinellus* in having smaller spores, $5.7-7 \times 4.5-6 \mu\text{m}$ vs. $8-10 \times 6.8-7.1 \mu\text{m}$. Otherwise they are very similar although the former is known from South America and the latter from Europe.

**Coprinus tigrinellus* Boudier (1885: 283) Figs. 23,50.

COLLECTIONS EXAMINED: FRANCE: Montmorency, July 1884, E. Boudier (Lectotype marked "Icones N. 409") plus two additional collections from 1884 and 1890 (PC).

The veil elements of *C. tigrinellus* are not as rounded as illustrated by Boudier (1905-1910) but more like that illustrated for *C. subtigrinellus* by Dennis (1961). The walls are relatively thin and vary from nearly hyaline in some segments to quite darkly melanized in others. They do not become thickened and refractive or golden as in *C. phaeosporus* or *C. psychromorbidus* and they are not roughened by incrustations to the extent that the veil is in *C. argenteus* or *C. maysoidisporus*.



Figs. 56-67. Basidiospores. 56, *C. urticicola* DAOM 66599. 57, *C. melo* Type at G. 58, *C. brassicae* Type at NYS. 59, *C. suburticicola* Type at PRM. 60, *C. urticicola* DAOM 175421. 61, *C. urticicola* NY ex Murrill. 62, *C. urticicola* NY ex Bresadola. 63, *C. pseudofriesii* Type at PRM. 64, *C. xantholepis* Type at E. 65, *C. phaeosporus* Type at H. 66, *C. herinkii* Type at PRM. 67, *C. amphibius* Type at DAOM. 68, Veil elements of *C. amphibius*. Scale = 15 μ m.

PROBLEMATIC NAMES

**Coprinus friesii* var. *microspora* J. Lange (1915: 42).

No type collection exists for this name and insufficient data was given in the original description to determine its taxonomic position.

**Coprinus microspermus* J. Lange (1939: 112), nom. invalid.

This is a nomen nudum, nomen provisionum and no voucher specimens exist. It is probably the same as *C. friesii* var. *microspora* but no connection was stated.

**Coprinus pallidisporus* J. Lange (1939: 112), nom invalid.

This is a nomen nudum, nomen provisionum and no voucher specimens exist.

**Coprinus platypus* Berkeley in Cooke (1888: 234; 1886: pl. 687B, [675B]).

The type of this species is deposited at Kew. It was described from a collection on palm leaves in conservatories in England and was considered as an alien species. Microscopic details from the type recorded by Dr. D.N. Pegler at Kew (pers. comm.) indicate that the spores are 7.5-9.5 X 6-7.5 μ m and the veil elements are branched in a manner similar to that for *C. friesii*. The elements have thick hyaline walls and are 1.5-4.5 μ m diam. Additional observations made by one of us (S.A.R.) on a lamellar fragment indicate the presence of pleurocystidia, an abundance of simple-septa, 4-spored basidia lacking clamps, and brownish slightly thickened walls on the spores. The shape of the spores is subglobose to broadly ellipsoidal.

This species keys out to *C. friesii* and is probably a synonym of that species but the total lack of clamp connections, and the more rounded spore shape without obvious ovoid forms as seen in all other collections of *C. friesii* raise a degree of doubt. Additional collections of *C. friesii* showing more of an intergradation with *C. platypus* should be studied before the latter name is permanently placed in synonymy.

**Coprinus phaeosporus* var. *solitarius* J. Lange (1939: 111), nom. invalid.

This is a nomen nudum and no voucher specimen exists. Pilat & Svrcek (1967) proposed the combination *Coprinus solitarius* (Lange) Pil. & Svr. based on Lange's variety. However, the combination is based on an invalid name and even though the latin description in Pilat & Svrcek's key couplet might suffice for validation, no type was designated as was required. The name thus remains invalid.

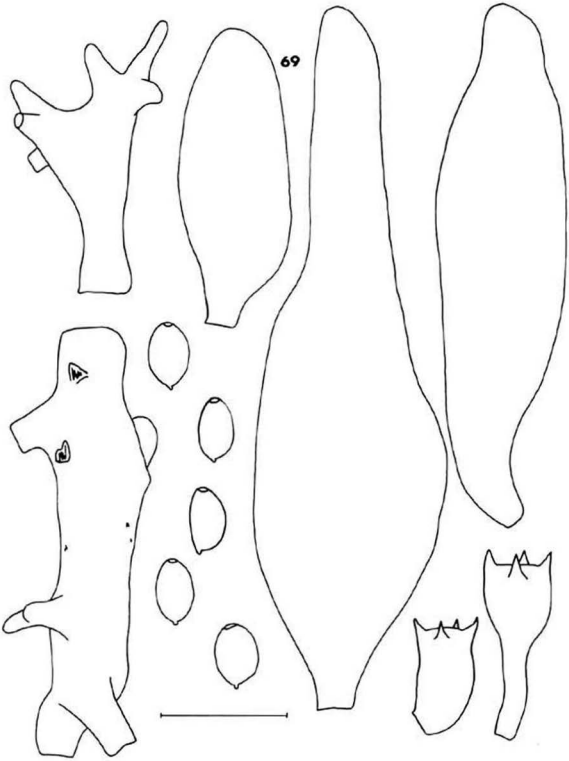


Fig. 69. *C. urticicola*, veil elements from pileus, cheilocystidium, pleurocystidia, basidiospores, basidia, DAQM 177602. Scale = 15 μ m.

**Coprinus picosporus* Locquin (1955: 13), *C. pusio* Locquin (1955: 16) and *C. romagnesi* Locquin (1955: 14).

These three species no doubt belong in *Coprinus* section *Herbicolae* but insufficient details were published and no types were designated to allow comparisons. In addition, Reid (1958) has noted that the spore sizes given in the text do not correspond with the measurements calculated from data from the illustrations. He suggested that if the magnification stated for the illustrations of spores were changed to 1000X from 2000X there would be consistent correlations. If this were done all three would be taxa distinct from others in section *Herbicolae*. However, if the magnifications given for the illustrations of spores is correct, i.e. 2000X then the spores would be 1/2 the size reported in the text. *Coprinus picosporus* would have spores 4.5-6 X 3.5-4.2 μ m. Based on spore shape and the thick-walled pigmented coralloid veil elements, *C. picosporus* would become a synonym of *C. phaeosporus*. *Coprinus romagnesi* would have spores 8-9.5 X 6.5-8.5 μ m and presuming that the veil elements were thick-walled (data not given), then *C. romagnesi* would be synonymous with *C. friesii*. *Coprinus pusio* would have spores 7-8 X 4.5-5 μ m. Presuming that Locquin's collection had a poorly developed veil, *C. pusio* would be synonymous with *C. urticicola*.

Until the characters to be associated with Locquin's three names can be determined, the use of the names is problematic. Lectotypifiable material may be present in Dr. Locquin's herbarium but this was unavailable during its transfer to the Laboratoire de Micropaléontologie, Paris (Locquin, pers. comm.).

CULTURAL STUDIES

The following information on cultures of *C. maysoidisporus* should be compared with that given for *C. psychromorbidus* (see Traquair 1980). The isolate (DAOM 175231) was obtained by streaking a spore suspension, obtained from a powdered dried basidiome, on potato dextrose agar. The procedures follow Nobles (1965).

Macroscopic description:

Growth moderate to rapid at 22°C, covering 9-cm petriplates in 2-3 wk (8.0 mm/da), with optimal temperature 25°C; advancing zone even to uneven, thin, appressed; aerial mycelium white, appressed to felt-like and somewhat patchy and plumose after 3-4 wk (Fig. 33), occasionally producing yellowish to pale brownish patches of densely matted hyphae after 4-5 wk; surface and submerged mycelium producing white, globose to irregular hyphal knots, 1-3 mm wide, which develop into brownish-black, smooth sclerotia at 6 wk; reverse unchanged in color; odor not distinctive; no evidence of fruiting on malt extract agar or potato dextrose agar.

Tests for extracellular oxidases with gallic acid were positive with no subsequent mycelial growth and were positive, changing color within 2 min with alcoholic gum guaiacum.

Tests for hydrogen cyanide with picric acid solution and PDA as growth medium (Lebeau and Hawn 1963) were negative after 45 da.

Microscopic description:

Hyphae hyaline, thin-walled, noninflated and with clamp connections unless otherwise noted; hyphae of the advancing zone 2.0-3.5 μm wide, occasionally branched; hyphae on the agar surface 2.0-4.5 (-5.0) μm wide, frequently branched and loosely interwoven after 2 wk, becoming more frequently branched and interwoven after 3-4 wk; submerged hyphae 2.5-4.0 (-10.0) μm wide, frequently branched, gnarled, contorted, with globose, elliptical, or irregular swellings and having thin to slightly thickened hyaline to yellowish refractile walls. Hyphal knots and sclerotia compactly interwoven, internal hyphae (medulla) of sclerotia pseudoparenchymatous, 4.0-12.0 μm wide, hyaline, thin-walled, inflated, containing granular or oily contents; outer hyphae (rind) of sclerotia plectenchymatous, 4.0-8.0 (-12.0) μm wide, yellowish to brown-walled, slightly thickened to thick-walled, cylindrical to irregularly inflated.

Sexuality studies:

Spores from basidiocarps of collection DAOM 175231 germinated in 4-12 h on potato dextrose agar. Hyphae of the monokaryotic, primary mycelium lacked clamp connections but otherwise resembled the dikaryotic, secondary mycelium.

Coprinus maysoidisporus like *Coprinus psychromorbidus*, is heterothallic and is probably bipolar. This pattern is indicated by the complete compatibility of 12 single spore isolates with the dikaryotic isolate in di-mon pairings. Such a result is consistent with findings for other bipolar basidiomycetes (Raper 1966). Tetrapolar species usually have 50% compatibility in intraspecific, intracollection di-mon matings.

The di-mon matings between *C. maysoidisporus* and *C. psychromorbidus* did not result in the dikaryotization of the monokaryotic mycelia, thus supporting the view that two species should be recognized. Monokaryotic mycelium of each species was not dikaryotized by the other *Coprinus* species but was dikaryotized by dikaryotic isolates of the same species. Moreover, colonies of different species failed to merge. The different colonies remained distinct and a confrontation or barrage zone of mounded hyphae developed at the interface between them.

Discussion on the cultural characteristics:

Coprinus maysoidisporus differs from *C. psychromorbidus* in colony morphology and optimal growth temperature. The former produces appressed mats whereas *C. psychromorbidus* produces woolly or cottony mats. Unlike the latter *Coprinus*, the former has a higher temperature optimum (i.e. 25°C) and grows very slowly if at all, at temperatures below 10°C. Furthermore, *C. maysoidisporus* does not produce HCN in culture as does *C. psychromorbidus* (Traquair 1980).

The hyphae of the two species are similar. Although allocyst-like and antler-like branches characteristic of the hyphae of *C. psychromorbidus* were not observed in *C. maysoidisporus*, it would be extremely difficult to distinguish cultures of the two species on the basis of hyphal anatomy.

Whether or not *C. maysoiopsis* is pathogenic is not known at present.

ACKNOWLEDGEMENTS

We thank the following curators and mycologists for their invaluable assistance by the loan of type and other materials: Drs. J. Haines (NYS), B. Spooner, D. Pegler and D. Reid (K), C. Rogerson (NY), D. Henderson and R. Watling (E), H. Harnaja (H), M. Svrček (PRM), O. Monthoux (G), S. Jovet and J. Mouchacca (PC), and P. Ponce de Leon (F). We also wish to thank Dr. J. Ginns for collecting fresh materials and commenting on the manuscript and Dr. M. Locquin for correspondence concerning his collections. J. Drew Smith kindly reviewed the manuscript, as did R. Watling, and provided the Saskatchewan collections of *C. psychromorbidus*. Dr. D. Pegler provided invaluable assistance at Kew. Mrs. M. Meredith typed the final manuscript.

LITERATURE CITED

- Anastasiou, C.J. 1967. Two species of *Coprinus* from alkali lakes. *Can. J. Bot.* 45: 2213-2222.
- Berkeley, M.J. & C.E. Broome. 1861. Notices of British Fungi. *Ann. Mag. Nat. Hist.*, ser. 3, 7: 373-382.
- Bisby, G.R., A.H.R. Buller, J. Dearness, W.P. Fraser, R.C. Russell & H.T. Gussow. 1938. The fungi of Manitoba and Saskatchewan. N.R.C.C., Ottawa.
- Boudier, E. 1885. Description de quelques espèces nouvelles de Champignons basidiosporés. *Bull. Soc. Bot. Fr.* 32: 282-285.
- _____. 1905-1910. *Icones Mycologicae*. Lib. Sci. Natur., Paris.
- Broadfoot, W.C. 1936. Experiments on the chemical control of snow-mould of turf in Alberta. *Sci. Agric.* 16: 615-618.
- Broadfoot, W.C. & M.W. Cormack. 1941. A low-temperature basidiomycete causing early spring killing of grasses and legumes in Alberta. *Phytopathology* 31: 1058-1059.
- Buller, A.H.R. 1917. Some critical remarks on the generic position of *Psathyra urticaeicola* Berk. et Broome, *Coprinus plicatilis* Fr., and *Psathyrella disseminata*. *Trans. Brit. Mycol. Soc.* 5: 482-489.
- Cooke, M.C. 1886. Illustrations of British Fungi (Hymenomycetes). No. XXXIX and No. XLIII. Williams and Norgate. London.
- _____. 1888. Handbook of British Fungi. [published with separate pagination in Grevillea]. *Agaricini* No. 513-949. *Grevillea* 16(80): ut 145-256.
- Dearness, J. 1927a. *Amanita* poisoning. *Mycologia* 19: 93-96.
- _____. 1927b. Fleshy fungi. *Mycologia* 19: 228-229.
- Dennis, R.W.G. 1961. Fungi Venezuelani. IV., *Kew Bull.* 15: 67-156.
- Dennis, R.W.G., P.D. Orton & F.B. Hora. 1960. New checklist of British agarics and boleti. *Trans. Brit. Mycol. Soc.* 43 (suppl.)
- Favre, J. 1948. Les associations fongiques des hauts-marais jurassiens et de quelques régions voisines. *Beit. Kryptogamenflora Schw.* 10(3): 1-228, I-IV pls.

- Hanna, W.F. 1939. *Coprinus urticaecola* on stems of Marquis wheat. *Mycologia* 31: 250-257.
- Horak, E. 1968. Synopsis generum Agaricalium (Die Gattungstypen der Agaricales). *Beit. Kryptogamenflora Schw.* 13: 1-741.
- Imazeki, R. & T. Hongo. 1965. Coloured illustrations of Fungi of Japan. Vol. II. Hoikusha Publ. Co., Osaka.
- Karsten, P.A. 1881a. Symbolae ad mycologiam Fennicam. VIII. *Meddel. af Soc. pro Fauna et Flora Fennica* 6: 7-13.
- _____. 1881b. Hymenomycetes Fennica. *Acta Soc. pro Fauna et flora Fennica.* II, 1: 1-40.
- _____. 1881c. Symbolae ad mycologiam Fennicam. IX. *Meddel. af Soc. pro Fauna et flora Fennica* 9: 39-56.
- Kühner, R. & H. Romagnesi. 1953. Flore analytique des champignons supérieurs. Masson et Cie, Paris.
- Lange, J.E. 1915. Studies in the agarics of Denmark. Pt. II. *Amanita, Lepiota, Coprinus.* *Dansk. Bot. Ark.* 2(3): 1-53.
- _____. 1939. Flora agaricina Danica. IV. *Danish Bot. Soc., Copenhagen.*
- Lebeau, J.B. 1969. Diseases affecting forage production in western Canada. p. 125-138. In K.F. Nielson, ed. *Proc. Can. Forage Crops Symp., Western Cooperative Fertilizers Ltd., Calgary.*
- Lebeau, J.B. & E.J. Hawn. 1963. Formation of hydrogen cyanide by the mycelial stage of a fairy ring fungus. *Phytopathol.* 53: 1395-1396.
- Locquin, M. 1955. Recherches sur les Coprins. *Bull. Soc. Mycol. Fr.* 71: 5-18.
- Lundell, S. & J.A. Nannfeldt. 1979. Fungi Exsiccati Suecici. Praesertim Upsalienses. Fasc. LVII-LX (Nr. 2801-3000). Reklam & Kalalogtryck, Uppsala.
- Malençon, G. & R. Bertault. 1970. Flore des Champignons supérieurs du Maroc. I. *Trav. Inst. scient. chérif. et Faculté des Sci., Rabat., ser. bot. biol. végét.* 32: 1-604.
- Murrill, W.A. 1912. Illustrations of Fungi - X. *Mycologia* 4: 1-6.
- _____. 1918. The Agaricaceae of tropical North America - VIII. *Mycologia* 10: 62-85.
- Nobles, M.K. 1965. Identification of cultures of wood-inhabiting Hymenomycetes. *Can. J. Bot.* 43: 1097-1139.
- Orton, P.D. 1960. New checklist of British agarics and boleti. Part III. Notes on genera and species in the list. *Trans. Brit. Mycol. Soc.* 43: 159-439.
- _____. 1972. Notes on British agarics: IV. *Notes Royal Bot. Gard., Edinburgh.* 32: 135-150.
- Orton, P.D. & R. Watling. 1979. British fungus flora. Agarics and Boleti. 2. Coprinaceae Part 1: *Coprinus.* *Roy. Bot. Gard. Edinburgh, Edinburgh.*
- Parmelee, J.A. 1978. The Dearness mycological collection. *Mycologia* 70: 509-526.
- Peck, C.H. 1890. Annual report of the state botanist (1889). *From the 43d report of the New York State Museum. Bot. ed.,* p. 1-48, 4 pls.
- Pegler, D.N. 1977. A preliminary agaric flora of east Africa. *Kew. Bull. addit. ser. VI.*
- Pilát, A. & M. Svrček. 1967. *Revisio specierum sectionis Herbicolarum Pil. et Svr. generis Coprinus* (Pers. ex) S.F. Gray. *Česka Mykol.* 21: 136-145.

- Quélet, M.L. 1872. Les champignons du Jura et des vosges. Mém. Soc. Emul. Montbéliard, ser. II, 5: (43-332).
- Raper, J.R. 1966. Genetics of sexuality in higher fungi. Ronald Press Co., New York. 283 p.
- Redhead, S.A. & J.D. Smith. 1981. A North American isolate of *Coprinus kubickae* associated with a superficial fairy ring. Can. J. Bot. 59: 410-414.
- Reid, D.A. 1958. New or interesting records of British hymenomycetes II. Trans. Brit. Mycol. Soc. 41: 419-445.
- Romagnesi, H. 1937. Florule mycologique des Bois de la Grange et de l'Etoile. Rev. Mycol. 2: 243-255.
- _____. 1951. Etude de quelques Coprins. Rev. Mycol. 16: 108-128.
- Saccardo, P.A. 1887. Sylloge Hymenomycetum I. Agaricineae. Patavia.
- Singer, R. 1973. Diagnoses fungorum novorum Agaricalium III. Beih. Sydowia 7: 1-106.
- Smith, A.H. 1948. Studies in the dark-spored agarics. Mycologia 40: 669-707.
- Smith, A.H. & L.R. Hesler. 1946. New and unusual dark-spored agarics from North America. J. Elisha Mitchell Sci. Soc. 62: 177-200.
- Stafleu, *et al.* 1978. International code of botanical nomenclature. Regnum Vegetabile 97: 1-457.
- Tamblyn, W.F. 1955. John Dearness. Mycologia 47: 909-915.
- Traquair, J.A. 1980. Conspicificity of an unidentified snow mold basidiomycete and a *Coprinus* species in the section Herbicolae. Can. J. Plant Path. 2: 105-115.
- _____. 1981. Discovery of a sporulating state for the LTB snow mold. Can. Agric. 26: 18-20.
- Van de Bogart, F. 1975. The genus *Coprinus* in Washington and adjacent western states. Ph.D. thesis, Univ. Wash.

NOTE ADDED WHEN IN PRESS

A few additional collections from Edinburgh (E) were examined which are of interest. *Coprinus herbivorus* is now known from Australia: Sydney, April 6, 1974, R. Watling Herb. No. 10892, on grass. Two paratypes of *C. rhombisporus* were examined. The earliest, Orton No. 962, July 18, 1956, consists of what appears to be a mixed collection of *C. friesii* with slightly abnormal spores (some slightly rhomboid) and *C. phaeosporus*. The second collection, Orton No. 4134, Aug. 10, 1971, is *C. friesii*.

SCLEROTINIA BRESADOLAE RICK, A TAXONOMIC SYNONYM
OF CIBORINIA CANDOLLEANA (LÉV.) WHETZEL

LINDA M. KOHN

Department of Botany, Clemson University
Clemson, SC 29631

Since type or authentic material of Sclerotinia bresadolae Rick (Inoperculate Discomycetes) was unavailable during the author's previous studies of the genus Sclerotinia, no conclusive disposition of the species could be made and the epithet was listed in "A monographic revision of the genus Sclerotinia" (Kohn, 1979), as "imperfectly known." Recently the holotype became available for study and disposition of the species as a taxonomic synonym of Ciborinia candolleana (Lév.) Whetzel can now be made.

Rick (1900) described the species from a collection made in Spring, 1899, on rotting buds of Quercus, many of which were infected by a gall-forming wasp, Dryoteras terminalis. He distinguished the new species from Sclerotinia candolleana Lév., which occurs on leaves of Quercus, primarily on the basis of what he felt was a unique substrate, buds transformed into galls. In addition, he cited the longer stipes and the hairs borne on apothecia and stipes as distinctive.

This species clearly fits within the accepted circumscription of Ciborinia Whetzel. Though hypertrophied due to insect infection, the host is foliar. The ectal excipulum of the apothecium is composed of large-celled textura globulosa. The loaf-shaped sclerotia incorporate host xylem vessels distinguishable by their spirally thickened walls; the medullary cells are dorsiventrally differentiated with the upper zone composed of textura globulosa with gelatinous walls, and the lower zone composed of textura oblita. No conidial anamorph has been observed for this species.

This species also fits within modern circumscriptions of

Ciborinia candolleana. Stipe length is within the range for that species as described by Batra (1960) and, according to Rick's comments on S. bresadolae, is no doubt due to a thick layer of litter covering the sclerotia of this particular population. Batra mentions "rhizoidal tufts present" on the stipe, and stout, rhizoidal hyphae are present at the base of the apothecium, often connecting directly to the sclerotium, in Rick's material. No other "Behaarung" that could account for Ricks description "stipite ... villosa, versus discum fere lanuginoso" is now evident, except for tufts of fine hyphae, originating either from germinating spores or from infection of apothecia by another fungus, seen in some older apothecia examined.

Because particular weight has been placed on host specificity in delimitation of species in Ciborinia, the occurrence of S. bresadolae on Quercus is important. If considered as meristematic leaf tissue, buds and galls are probably not significantly different from the leaves of Quercus, although Rick's specimen appears to represent a rare occurrence of C. candolleana on insect galls.

SPECIMEN EXAMINED: Rick, Majo 1889, "in gemmis Quercus transformatis infectione Dryoteratis terminalis." Holland. [S, ex herb. Bresadola; slide in CUP 59836].

ACKNOWLEDGEMENT

Appreciation is expressed to T. Schumacher, University of Oslo, for making this specimen available for study.

LITERATURE CITED

- BATRA, L. R. 1960. The species of Ciborinia pathogenic to Salix, Magnolia, and Quercus. Amer. J. Bot. **47**: 819-827.
- KOHN, L. M. 1979. A monographic revision of the genus Sclerotinia. Mycotaxon **9**: 365-444.
- RICK, J. 1900. Eine neue Sclerotinia-Art. Oesterr. Bot. Z. **50**: 121-122.

HALYSIOMYCES, A NEW DEMATIACEOUS GENUS
FROM ARIZONA'S SONORAN DESERT

EMORY G. SIMMONS

*Department of Botany, University of Massachusetts
Amherst, Massachusetts 01003*

Clumps and chains of dark-walled, nonsporulating fungus cells are extremely common inhabitants of practically any surface that offers a bit of nutrient. Substrate examples include discarded cellulosic products, painted surfaces, almost every scrap of plant debris overwintered in temperate climates, and the surfaces of living leaves and stems, especially in the tropics but also in temperate climates when aphid secretions and similar nutrients afford support.

Identification of such nonsporulating growths rarely is possible. But the simple expedient of holding a sample in a damp chamber for a day or so frequently induces sporulation and thus enhances the possibility of identification. Species of *Cladosporium*, *Aureobasidium*, and *Alternaria* commonly develop from such materials in temperate climates; other less easily characterized genera also may be found.

Discussed herewith is a species that, judging from its characters in culture, probably will be seen in nature primarily (if at all) as chains and clumps of dark, rounded, thick-walled cells. It grows readily as an isolate on weak potato-carrot agar, hay decoction agar, and 20% V-8 juice agar (hereafter as PCA, Hay, V-8; see Stevens 1974). It produces conidia abundantly and of a septate, catenulate kind that is believed to be remarkable for this heterogeneous group of dematiaceous molds. Inspiration to discuss this species has derived largely from staff publications of the Centraalbureau voor Schimmelcultures (Hermanides-Nijhof 1977; Hoog and Hermanides-Nijhof 1977) and of the University of Alberta Mold Herbarium and Culture Collection (Sigler, Tsuneda and Carmichael 1981), which treat several superficially similar genera.

HALYSIOMYCES Simmons, gen. nov. *Hyphomycetes*
 [Gr.: *halysion* + *mykes* = chain-fungus]

Hyphae atrobrunneae, torulosae, ramosae. Colonia atra ut radii discreti vel fila radiata arcte adpressa formata; plerumque in substrato agarō submersa, sed ad centrum aliquantum elevata, convoluta, cerebriformis; aspectu nitido sed nec uda nec mucosa. Hyphae aerae infrequentes. Conidia ex cellulis hypharum holoblastica, atra, transverse septata, singularia vel distaliter catenata.

Typus: Halysiomyces saxatilis Simmons, sp. nov.

Described from axenic culture. Hyphae dematiaceous, torulose, branching. Colony black, developing as discrete radii (on PCA and Hay) or as closely appressed radial elements; mostly submerged in agar substrate, but raised, convoluted, cerebriform in center; appearing shiny on V-8 but not wet or mucoid. Aerial hyphae rare. Conidia holoblastic from hyphal cells, dark, transversely septate, distally catenate.

Halysiomyces saxatilis Simmons, sp. nov.

[L.: *saxatilis* = found among rocks]

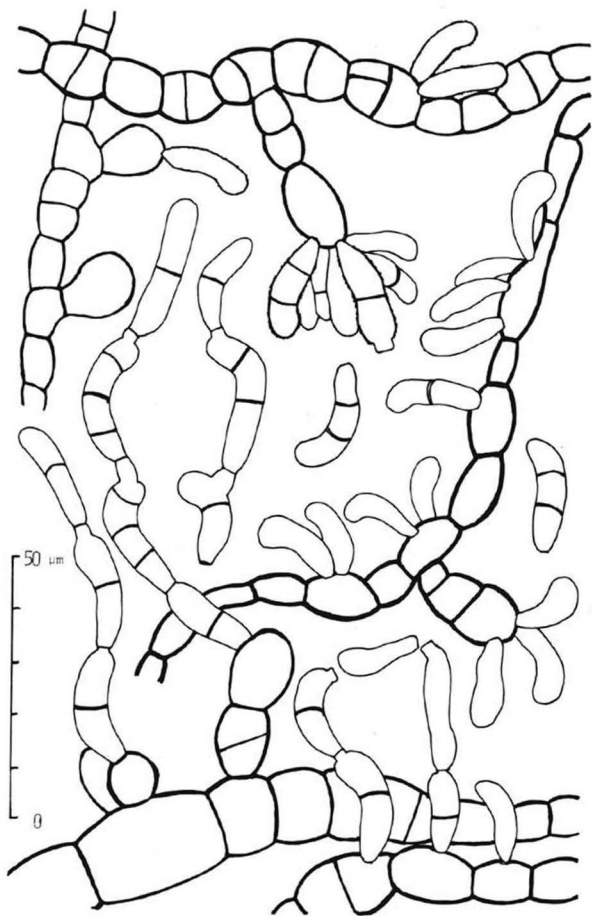
Ex culturis in agarō PCA descripta. Coloniae ut hyphae atrobrunneae, torulosae, ramosae, submersae, valde radiatae formatae. Centrum coloniae convolutum, aliquantum elevatum, hyphis aeriis paucis. Cellulae hypharum laeves, usque ad 6-16 μ m longae x 16-20 μ m latae ampliatae. Conidia ex cellulis hypharum radialium et ramulorum lateralium holoblastica, allantoideoclavata, minute aspera, brunnea, 1-3 transverse septata, circa 25 x 4 μ m, et solitaria et 2-4-catenulata acropeta.

Origo typi: ex aere deserti Sonora prope Phoenix, Arizona, U.S.A., m. Febr. 1980, a J. T. Staley et F. Palmer lecto.

Typus: partes ex Simmons 33-129 desiccatae et in BPI, DAOM, IMI, NY conservandae.

The isolate is described from cultures grown concurrently on PCA, Hay and V-8 juice agars. Radial growth is about 10mm in 7 da at 15-22°C in diurnal light/dark cycles.

Fig. 1. *Halysiomyces saxatilis*. Thick-walled radial and branch hyphae with solitary and catenate conidia produced as submerged elements in PCA.



Radiating torulose hyphae produced in PCA are distinct and somewhat sinuous; concentric rings of growth correlate with the light-dark regimen; the colony center is slightly raised above the agar surface and is closely convoluted under pressure of progressive septation, enlargement, and hardening of the toruloid elements. The macroscopic appearance on Hay agar is similar to that on PCA except that the radial pattern of growth is less striking than are the medusoid radii produced in PCA. The radial elements produced on V-8 agar are appressed so closely that the colony appears opaque; there is a larger, more obviously convoluted central area of development than is found on PCA; and the agar surface has a dull sheen which, on inspection at low magnification, proves to be light reflected from a network of jetblack, closely septate torulose hyphae resembling millipede integuments or doliiform beads in chains of indeterminate length. Colonies are dry, not mucoid or wet.

Linear hyphal growth is of brown tubular elements that gradually become septate and torulose-swollen at more or less regular intervals; most resultant cells are 10-20 μ m broad and shorter than wide; a longitudinal septum is laid down in relatively few hyphal cells. Lateral branches of one to many swollen brown cells are numerous throughout the length of the radial hyphae, but they do not obscure the predominantly radial appearance of most colonies. Otherwise undifferentiated cells of radial hyphae and of lateral branches may produce conidia, sometimes only one or two per conidiogenous cell but at other times clusters of 6-10.

Primary conidia are sessile, pale, minutely rough, and slightly enlarged toward the apex; they darken, produce a median transverse septum, and become inequilateral, usually with an abrupt bend near the distal end; at the 1-septum stage they commonly are 25 x 4 μ m, becoming only slightly, if at all, larger when second and third transverse septa are formed. Conidia may develop a subapical or truly lateral extension 2-3 μ m wide x 1-3 μ m long which functions as the site of production of a single holoblastic conidium. Chains of 2-4 or more conidia are produced in this manner; they are easily visible as they are held in position submerged in the agar substrate. Conidium ontogeny appears to be holoblastic in all cases. Conidium release appears to be by wall fracture, a small remnant of conidiogenous cell wall sometimes being visible alongside the bottom contour of a dislodged conidium.

Production of distinctive conidia submerged in agar substrates, as with this fungus, is a striking phenomenon; but, in my experience, it is not unique to this fungus, in

that some strains of *Stemphylium* and *Curvularia* have been observed to sporulate abundantly and with typical conidium morphology under such conditions.

Information from isolator J. T. Staley is that this fungus (typified from an air isolate) also has been found in culture plates prepared from swabbings of a material referred to as "rock varnish," which is found on rock surfaces in the cactus-creosote bush region of the Sonoran desert near Phoenix, Arizona, U.S.A.

- o o o -

Margaret E. Barr Bigelow and I had several fruitful discussions on the systematic placement of this isolate. J. W. Carmichael, after reviewing a draft of the manuscript, has commented on unique aspects of the species.

- o -

LITERATURE CITED

- Hermanides-Nijhof, E. J. 1977. *Aureobasidium* and allied genera. CBS Studies in Mycology, no. 15, p. 141-177.
- Hoog, G. S. de, and E. J. Hermanides-Nijhof. 1977. Survey of black yeasts and allied Hyphomycetes. CBS Studies in Mycology, no. 15, p. 178-222.
- Sigler, L., A. Tsuneda and J. W. Carmichael. 1981. *Phaeotheca* and *Phaeosclera*, two new genera of dematiaceous hyphomycetes and a redescription of *Sarcinomyces* Lindner. Mycotaxon 12(2): 449-467.
- Stevens, R. B. (ed.) 1974. Mycology Guidebook. Seattle. 703 p.

OSORIOMYCES, A NEW GENUS OF THE LABOULBENIALES
FROM TAIWAN

KATSUYUKI TERADA

*Botanical Institute, Faculty of Science,
Hiroshima University, Hiroshima 730, Japan*

SUMMARY

A new species of the Laboulbeniales parasitic on *Osorius formosae* Bernhauer (Coleoptera, Staphylinidae) is described as *Osoriomyces rhizophorus*. *Osoriomyces* is a new genus having an affinity with *Scelophoromyces*; it is characterized by a thallus consisting of a primary axis of superposed cells that terminates in a cluster of appendages; this axis bears sessile perithecia, as well as secondary axes on which short antheridial appendages and perithecia are borne laterally. Rhizoidlike appendages grow downward from a cluster of small cells just above the basal cell of the thallus. The outer walls of the perithecia consist of four vertical rows of four cells each. Although spermatia could not be detected, structures having the appearance of simple antheridia were observed.

During my investigation of the Laboulbeniales of Taiwan, a fungus was found that bore a resemblance to *Scelophoromyces osorianus* Thaxter, which had been collected on *Osorius* in Argentina (Thaxter, 1912, 1931). However, the perithecia of the Taiwanese thalli had very short stalk cells, giving the appearance of being sessile, and the thalli bore secondary axes. Consequently, the following new genus is being described. Both fungus and host specimens are deposited in the Herbarium of Hiroshima University, Hiroshima, Japan (HIRO).

Osoriomyces Terada, gen. nov.

Thallus ex axe primario et axibus secundariis constans.
Axis primarius ad apicem appendicem terminalem et secus

latera appendices laterales et prope basin rhizoidea gerens. Axes secundarii secus latera appendices laterales gerentes. Cellulae receptaculi praeter cellulas prope basin uniseriales. Perithecia sessilia in axe primario et axibus secundariis lateraliter prodientia. Parietes exteriores perithecii ex seriebus 4-cellularibus quattuor constantes. Antheridia simplicia in appendicibus lateralibus prodientia.

Thallus consisting of primary and secondary axes. Primary axis bearing primary appendage at its apex, lateral appendages along its sides, and rhizoidlike appendages near its base. Secondary axes bearing lateral appendages. Cells of receptacle (except for cells in the suprabasal portion of the primary axis) arranged in a uniseriate row. Sessile perithecia produced laterally on both the primary and secondary axes. Outer walls of perithecia consisting of four vertical rows of four cells each. Simple antheridia produced on lateral appendages.

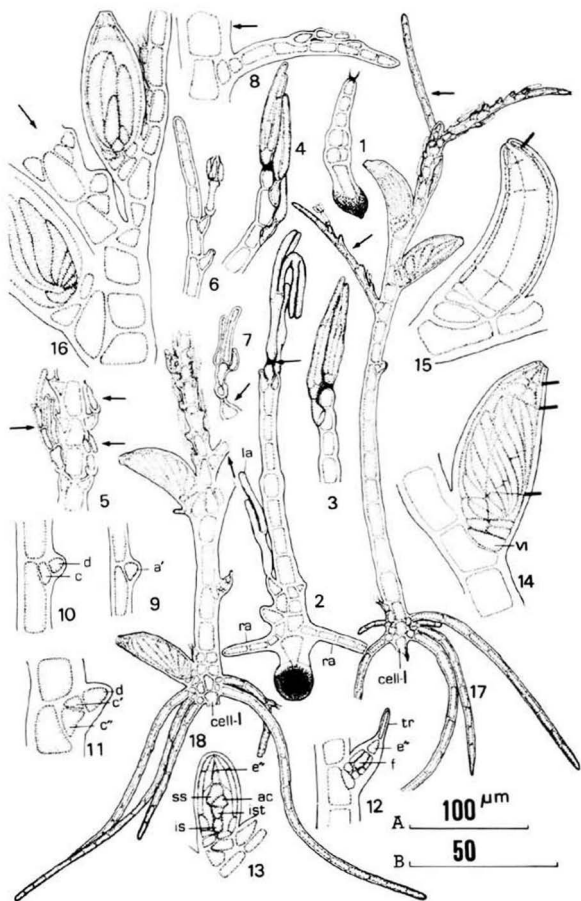
Type species: *Osoriomyces rhizophorus* Terada, on *Osorius formosae* Bernhauer from Taiwan.

Osoriomyces rhizophorus Terada, sp. nov. (Figs. 1-18)

Thallus hyalinus vel leviter luteolus, 320-540 μm longus, in receptaculi 2-5 perithecia gerens. Axis primarius ex 25-35 cellulis superpositis oblongis constans. Axes secundarii ex 8-13 cellulis superpositis oblongis constantes. Appendix terminalis ca. 50 μm longa, plerumque ramosa, gelatinosa, sparse septata, basi septo denigrato constricta. Appendices laterales 26-52 μm longae, simplices vel varie ramosae, gelatinosae, sparse septatae, sursum extensae. Rhizoidea 180-350 μm longa, simplicia, rigidula, clare septata, deorsum extensa. Antheridia ca. 9 μm longa, evanescentia, gelatinosa, solitaria vel fasciculata. Perithecia 60-79 x 24-36 μm , ovata, plerumque extrinsecus curvata, apice truncata.

Thallus hyaline or slightly yellowish, 320-540 μm long (from foot to constricted, dark septum at base of terminal appendage), bearing 2-5 perithecia on receptacle. Primary axis consisting of 25-35 superposed, oblong cells; cells just above cell I undergoing several longitudinal and transverse divisions to form group of cells. Secondary axes shorter and thinner than primary axis, on which they are irregularly arranged, each secondary axis consisting of 8-13 superposed, oblong cells. Terminal appendage ca. 50 μm

Figs. 1-18. *Osoriomyces rhizophorus*. 1. Sporeling with second and third cells divided longitudinally. 2. Young thallus, showing receptacle with two rhizoidlike appendages (ra), a lateral appendage (la), and a terminal cluster of appendages. Arrow indicates blackened septum. 3. Upper portion of primary axis, showing a cluster of appendages; only terminal one bears blackened septum at its base. 4. Upper portion of primary axis, showing a cluster of appendages; terminal one also bears blackened septum at its base. 5. Upper portion of primary axis, showing appendages produced on both sides of each receptacle cell. Left arrow indicates a subdichotomously branched appendage. Right arrows indicate antheridia with or without a one-celled stalk. 6. Upper portion of secondary axis, showing the initiation of an appendage below and a triangular, subsessile cell above bearing a one-celled antheridial branch with three apical antheridia. 7. Short trichotomous appendage. Arrow indicates triangular basal cell. 8. Secondary axis, showing a short, simple appendage. Arrow indicates primary axis. 9-11. Very early stages of perithecial development. Explanation is in text. 12. Young perithecium, showing the female organ, which consists of three cells - a terminal trichogyne (tr), a median trichophoric cell (e"), and a carpogenic cell (f). 13. Immature perithecium at 3-tier stage, showing a trichophoric cell (e"), a superior supporting cell (ss), an ascogenous cell (ac), a secondary inferior supporting cell (ist), and an inferior supporting cell (is). 14. Fully mature perithecium on primary axis, with appressed stalk cell (VI). Lines indicate septa in vertical row of outer wall cells. 15. Mature perithecium in which the fourth tier has divided in one row. Line indicates dividing point. 16. Slightly immature perithecium on secondary axis; primary axis (arrow) bends to left. 17. Thallus with two well-developed perithecia and two secondary axes (arrows). 18. Thallus with two mature perithecia and one young perithecium; five rhizoidlike appendages extend from suprabasal portion of primary axis; gelatinous lateral appendages arise from upper portion of primary axis; secondary axis (arrow) has broken. (Figs. 1-16: scale B; Figs. 17-18: scale A.)



long, usually branched, gelatinous, sparsely septate, constricted by blackish septum at its base. Lateral appendages 26-52 μm long, simple or variously branched, gelatinous, extending upward, arising from triangular, sessile cells formed at one or both upper corners of receptacle cells, these appendages sometimes producing one or more antheridia terminally. Simple rhizoidlike appendages 180-350 μm long, somewhat rigid, extending downward from more or less cubical cells in suprabasal cluster of receptacle cells. Antheridia ca. 9 μm long, evanescent, gelatinous, solitary or clustered, produced directly upon somewhat triangular basal cell or borne on short, one-celled branch. Perithecia 60-79 x 24-36 μm , ovate, usually curved outward and truncate at its apex.

Holotype: TAIWAN. Nantou Hsien, Chitou, at ca. 1300 m alt., No. 783, May 28, 1977, K. Terada leg., on elytra of *Osorius formosae* Bernhauer (Coleoptera, Staphylinidae).

Paratypes: TAIWAN. Nantou Hsien, Chitou, Nos. 782, 784, 786-790, data as for the holotype; Nantou Hsien, Tsuifeng, Nos. 791, 792, July 25, 1972, K. Terada leg., on various parts of body of *Osorius formosae* Bernhauer.

Osorius formosae occurs in mountainous regions of Taiwan, where it lives in rotten wood. It is often found with *Priochirus silvestrii* Bernhauer, host of *Monoicomyces leptochiri* Thaxter (Terada, unpublished). Eight fully mature specimens of *Osoriomyces* and more than ten immature ones were collected from thirteen specimens of *Osorius formosae*. Collection of additional specimens would be necessary for a thorough study of thallus development.

After spore germination, a series of horizontal divisions takes place that results in the formation of a uniseriate thallus having a darkened, constricted septum near its apex, which may break off early (Fig. 1). Vertical divisions soon occur in the lower cells of the thallus, resulting in the formation of a biseriolate lower receptacle (Fig. 1). The number of cells in the thallus increase so that in the thallus shown in Fig. 2, there are eight superposed cells separating the constricted, dark septum from the cluster of cells just above the basal cell. Rhizoidlike appendages (ra) extend outward just above the base of the thallus, whereas gelatinous, erect appendages (la) arise laterally at a higher level. The primary axis of the thallus terminates in a cluster of gelatinous appendages (Figs. 2-4) (it was not possible to determine the exact position of the spore septum, which separates the primary appendage

from the receptacle). By maturity, five or six simple, long, rhizoidlike appendages are present that extend downward from the suprabasal group of cells in the primary axis (Figs. 17, 18). Triangular, sessile cells are formed on one or both upper corners of the upper cells of the receptacle. Each of these cells produces a short, gelatinous branch. Secondary axes that arise from the upper part of the primary axis (two are indicated in Fig. 17) may deteriorate later (Fig. 18). The positions of the perithecia are variable; however, the lowermost one usually occurs on the suprabasal portion of the primary axis (Fig. 18).

In the material examined, one specimen bore gelatinous, unicellular, elongate structures directly on triangular, sessile cells (Fig. 5) or in clusters on a stalk cell produced by a sessile cell (Figs. 5, 6). Although spermata could not be detected, these structures are regarded as simple antheridia because they are very narrow apically. Consequently, *Osoriomyces* belongs to the Laboulbeniaceae. The antheridia seem to cease their function in a short time; possibly, they are converted into sterile appendages (Fig. 5, arrow at left; Figs. 7, 8).

During perithecial ontogeny in *Osoriomyces rhizophorus*, a single cell (a') that arises laterally from the receptacle (Fig. 9) soon divides obliquely into an upper (d) and a lower cell (c) (Fig. 10). The lower cell (c) divides into an upper cell (c') and a lower cell (c'') (Fig. 11), which undergo further divisions and finally form the perithecial walls. The upper cell (d) produces the female sexual organ, which initially consists of three superposed cells - a lower carpogenic cell (f), a median trichophoric cell (e''), and a terminal trichogyne (tr) (Fig. 12). Only one- or two-celled trichogynes were observed. By the time there are three tiers of outer wall cells, an ascogenous cell (ac) and three supporting cells (ss, ist, is) are present below the trichophoric cell (e'') within the perithecium (Fig. 13). This pattern of perithecial development is the same as that described in detail by Thaxter (1896) for *Stigmatomyces baeri* (Knoch) Peyritsch and other taxa.

By the time perithecial wall consists of four tiers of cells, asci have been formed (Fig. 16). The second tier of cells in the fully mature perithecia is 3-4 times taller than the lowest tier (Fig. 14). Sometimes the apical outer wall cell on the inner side of the perithecium (toward the thallus axis) divides (Fig. 15). The stalk cells and the basal cells are strongly appressed to the receptacle so that the perithecia are sessile in appearance (Figs. 14, 15).

The genus *Osoriomyces* cannot be allied with any genus of the Laboulbeniales except *Scelophoromyces* Thaxter (1912; in 1931, Thaxter altered the spelling of this genus to *Skelophoromyces*, but the earlier spelling should be used). *Osoriomyces* resembles *Scelophoromyces* in the following ways: 1) the primary axis consists of a variable number of superposed cells; 2) rhizoidlike appendages arise at right and left from the suprabasal portion of the primary axis; 3) lateral appendages extend upward from one or both upper corners of receptacle cells. On the other hand, remarkable differences exist between the two genera: 1) the perithecia of *Osoriomyces* are normally sessile and lateral, whereas in *Scelophoromyces*, they are long-stalked and never arise directly from any cell of the primary axis; 2) the primary axis of *Osoriomyces* is highly divided in the suprabasal portion, whereas in *Scelophoromyces*, the suprabasal portion is less divided or undivided; 3) lateral appendages of *Osoriomyces* are gelatinous and the protoplasts of their short, subsessile basal cells taper almost to a point apically, whereas in *Scelophoromyces*, they are rigid like the rhizoidlike appendages and the protoplasts of their basal cells are broad at the apex.

ACKNOWLEDGMENTS

I wish to thank Dr. I. I. Tavares, University of California, Berkeley, for reviewing the manuscript as well as for helpful suggestions and Mr. Y. Shibata, Tokyo, for identification of the host insects.

LITERATURE CITED

- Thaxter, R. 1896. Contribution towards a monograph of the Laboulbeniaceae. Mem. Amer. Acad. Arts Sci. 12: 187-429. Pls. I-XXVI.
- _____. 1912. New or critical Laboulbeniales from the Argentine. Proc. Amer. Acad. Arts Sci. 48: 153-223.
- _____. 1931. Contribution towards a monograph of the Laboulbeniaceae. Part V. Mem. Amer. Acad. Arts Sci. 16: 1-435. Pls. I-LX.

MYCOTAXON

Vol. XIII, No. 2, pp. 419-427

July-September 1981

THE GENUS CODINAEA. THREE NEW SPECIES FROM THE AMERICAS

ADRIANNA D. HEWINGS

Department of Plant Pathology, University of Illinois,
Urbana, IL 61801

J.L. CRANE

Illinois Natural History Survey and the Departments of
Botany and Plant Pathology, University of Illinois, Urbana,
IL 61801

Three new species of *Codinaea* Maire are described and illustrated from the U.S.A. and Venezuela. A key modified from Hughes and Kendrick (3) to include those species described since 1968 is also included.

Codinaea illinoensis Hewings & Crane sp. nov. Fig. 1.
A and B.

Coloniae effuse, pallide brunneae, demum fusco-brunnescentes. Mycelium in substrato immersum, e hyphis crasse tunicatis, ramosis, septatis, subhyalinis vel pallide brunneis compositum. Setae nullae. Conidiophori macronemati, mononemati, simplices, recti vel paulum arcuati, septati, hyalini vel pallide brunnei, tunicis crassis, levibus induti, singillatim e hyphis vel cellulis nodulosis orti. Cellulae conidiogenae monophialidicae, integratae, terminales, paulum lageniformes, apicem versus tenuiter, prope basim crasse tunicatae, 30-37 x 5.6-6.7 μ m. Collarula conspicua, infundibuliformia, expansa, marginem versus tenuiter tunicata, ad basim crasse tunicata, refringentia, 2.3-3.3 x 3.3-4.4 μ m. Phialoconidia hyalina, continua vel nonnumquam uniseptata, paulum arcuata, symmetrica, ad apicem attenuata in finem obtuse rotundatum setulam rudimentarium apiculatum exhibentem, ad basim attenuata, cicatrice obtusa notata, 14.4-18.9 x 3.3-4.4 μ m. Typus: ILLS 42169.

Colonies effuse, pale brown becoming dark brown. Mycelium immersed in the substrate, composed of thick-walled, branched, septate, subhyaline to pale brown hyphae. Setae absent. Conidiophores macronematous,

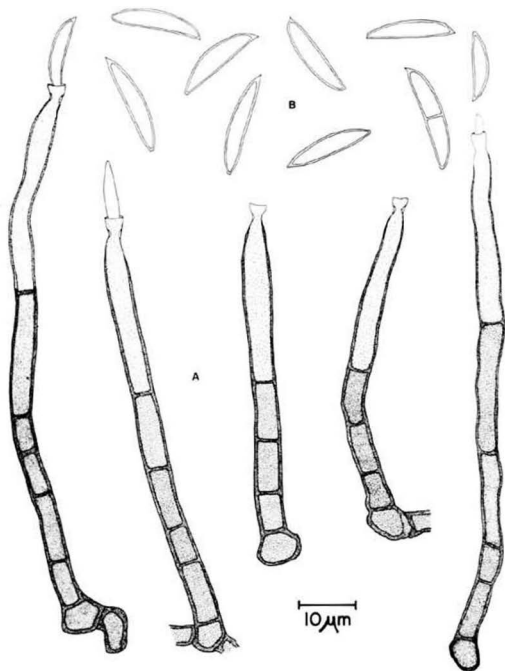


Fig. 1. *Codinaea illinoensis*, A. Conidiophores; B. Mature Conidia.

mononematous, simple, straight or slightly curved, septate, hyaline to light brown, thick-walled, smooth, arising singly from the hyphae or nodulose cells. Conidiogenous cells monophialidic, integrated, terminal, slightly lageniform, thin-walled at apex, thick-walled at base, 30-37 x 5.6-6.7 μm . Collarettes conspicuous, funnel-shaped, flaring, distally thin-walled, thick-walled and refringent at base, 2.3-3.3 x 3.3-4.4 μm . Phialoconidia hyaline, unicellular or occasionally 1-septate, slightly curved, symmetrical, tapering to a bluntly rounded distal end bearing a rudimentary apiculate setula, basal end tapering with a blunt scar.

Holotype: On decayed wood, cypress swamp, N.W. of Vienna, Johnson County, Illinois, 9 July 1969, J.L. Crane 98-69, ILLS 42169.

Codinaea lunulospora Hewings & Crane sp. nov. Fig.2, A-F

Coloniae effusae, pallide demum obscure brunneae. Mycelium in substrato immersum, e hyphis crasse tunicatis, ramosis, septatis, subhyalinis vel pallide brunneis compositum. Setae nullae. Conidiophori e basibus sculptis orti, macronemati, mononemati, simplices, recti, septati, obscure brunnei, crasse tunicati, leves, ad phialidis basim paulum attenuati. Cellulae conidiogenae phialidicae, integratae, terminales, lageniformes, ad apicem tenuiter tunicatae, hyalinae, crasse tunicatae, subhyalinae vel pallido brunneae ad basim. Collarula conspicua, infudibuliformis vel aliquantulum cylindrica, apicem versus tenuiter tunicata, sympodialiter semel vel bis instaurata, 3.6-4.5 x 1.8-2.7 μm , prope basim ad 1.4-1.8 μm attenuata. Phialoconidia hyalina, continua, lunata vel sigmoidea, symmetrica, 8.8-12.0 x 0.8-1.0 μm . Holotypus: Dumont-VE 4619 (NY). Isotypus: (VEN).

Colonies effuse, light brown becoming dark brown. Mycelium immersed in the substrate, composed of thick-walled, branched, septate, subhyaline to light brown hyphae. Setae absent. Conidiophores arising from sculptured bases, macronematous, mononematous, simple, straight, septate, dark brown, thick-walled, smooth, tapered slightly at base of phialide. Conidiogenous cells phialidic, integrated, terminal, lageniform, thin-walled and hyaline at apex, thick-walled, subhyaline or light brown at base. Collarettes conspicuous, funnel-shaped to somewhat cylindrical, distally thin-walled, developing sympodially with 1-2 successive proliferations, 3.6-4.5 x

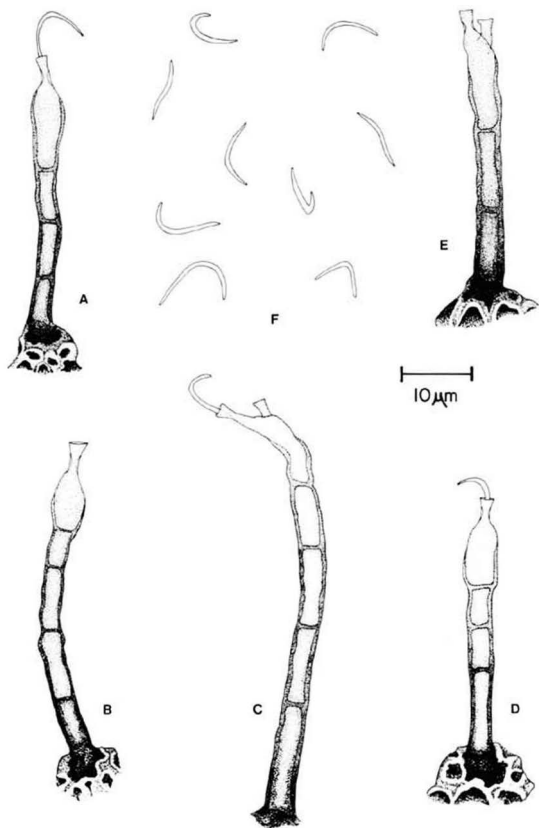


Fig. 2. *Codinaea lunulospora*, A-E. Conidiophores; F. Mature Conidia.

1.8-2.7 μm narrowing to 1.4-1.8 μm at base. Phialoconidia hyaline, unicellular, crescent-shaped or sigmoid, symmetrical, 8.8-12.0 x 0.8-1.0 μm .

Holotype: On unidentified herbaceous stem. Trail between Manacal and Los Pocitos, N.W. of Irapa, Edo Sucre, Venezuela, 10 July 1972. K.P. Dumont et al., Dumont VE-4619 (NY), Isotype: (VEN).

Codinaea matsushimae Hewings & Crane sp. nov. Fig. 3, A-D

Coloniae effusae, pallide brunneae, demum obscure brunneae. Mycelium in substrato immersum, e hyphis crasse tunicatis, ramosis, septatis, subhyalinis vel pallide brunneis compositum. Setae singillatim vel gregatim ortae, rectae, crasse tunicatae, leves, ad viciis septatae, ad basim obscure brunneae, ad apicem obtuse rotundatum pallide brunneae vel subhyalinae, usque 340 μm longae, e basi 6.7 μm lata ad apicem 4.4 μm lata attenuatae. Conidiophori e cellularum nodo setarum socio orti, macronemati, mononemati, simplices, recti vel paulum arcuati, septati, hyalini vel pallide brunnei, crasse tunicate, leves. Cellulae conidiogenae phialidicae, integratae, terminales, hyalinae, paulum lageniformes, ad apicem tenuiter, ad basim crasse tunicatae, 14-27 x 3.0-6.0 μm . Collarula conspicua, evanescent, ad marginem tenuiter, ad basim abrupte crasse tunicata, synpodialis, semel, bis, vel ter instaurata, 2.0-3.0 x 2.0-4.0 μm . Phialoconidia setulis ornata, hyalina, ter ver raro semel vel bis septata, paulum arcuata, symmetrica, ad apicem obtuse rotundatum et basim cicatrice notatum attenuata, 20-27 x 3.3-5.4 μm . Setulae alia ad apicem, alia juxtam cicatricem basalem affixae, 5.5-7.8 μm longa. Typus: ILLS 42170.

Colonies effuse, light brown becoming dark brown. Mycelium immersed in the substrate, composed of thick-walled, branched, septate, subhyaline to light brown hyphae. Setae arising singly or in groups, erect, thick-walled, smooth, up to 20-septate, dark brown at base, pale brown to subhyaline at bluntly rounded apex, up to 340 μm long, tapering from 6.7 μm wide at base to 4.4 μm at apex. Conidiophores arising singly from a knob of cells associated with setae, macronematous, mononematous, simple, straight to slightly curved, septate, hyaline to light brown, thick-walled, smooth. Conidiogenous cells phialidic, integrated, terminal, hyaline, slightly lageniform thin-walled at apex, thick-walled at base, 14-27 x 3.0-6.0 μm . Collarettes conspicuous becoming evanescent,

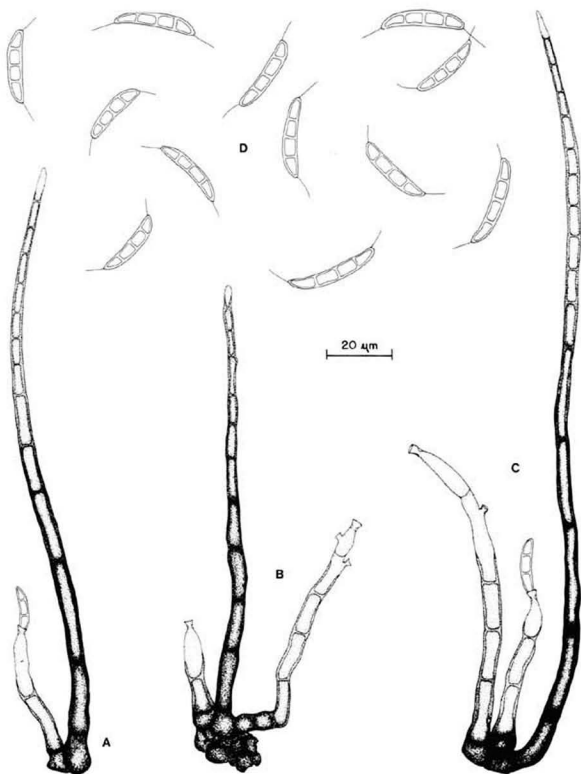


Fig. 3. *Codinaea matsushimae*, A-C. Conidiophores and setae; D. Mature Conidia.

distally thin-walled, abruptly thick-walled at base, sympodial with 1-3 proliferations, 2.0-3.0 x 2.0-4.0 μm . Phialoconidia with setulae, hyaline, 3-rarely 1 or 2-septate, slightly curved, symmetrical, tapering to a bluntly rounded distal end and a proximal basal scar, 20-27 x 3.3-5.4 μm . Setulae attached at distal end and to one side of basal scar, 5.5-7.8 μm long.

Type: On exocarp of Carya, Benson's Bluff, S.E. of Gorevill, Johnson County, Illinois, 4 April 1969, J.L. Crane 12-1-69, ILLS 42170. Other Material Examined: On decayed wood, Elvira Cypress Swamp (Deer Pond), Johnson County Illinois, 22 May 1969, J.L. Crane, 91-69, ILLS 42171.

Key to the Species of Codinaea Maire*

1. Conidiophores synnematos C. obesispora (3)
Conidiophores monenematous 2
2. Phialoconidia with setulae 3
Phialoconidia without setulae 22
3. Phialoconidia with a setula at each end 6
Phialoconidia with 1 apical setula 4
4. Setula definite, 13-15 μm long C. unisetula (7)
Setula apiculate 5
5. Phialoconidia 14-19 x 3.3-4.4 μm . C. illinoensis
Phialoconidia 20-30 x 4.0-5.5 μm ... C. apiculata (6)
6. Phialoconidia septate 7
Phialoconidia non-septate 12
7. Setulae < 3.0 μm long C. brevisetula (3)
Setulae > 3.0 μm long 8
8. Phialoconidia 3-septate C. matsushimae
Phialoconidia 1-septate 9
9. Setae present 10
Setae absent 11
10. Setae simple or branched, sterile or fertile;
conidia 14-17 x 1.8-2.7 μm
Chaetosphaeria dengleyae anam. Codinaea (3)
Setae simple, apex fertile;
conidia 13-20 x 2.5-3.5 μm C. novae-quineensis (5)
11. Conidiophores 1-3-septate; conidiogenous cells
usually terminal C. septata (11)
Conidiophores up to 20 septate; conidiogenous
cells usually intercalary C. eucalypti (11)

*Numbers in parentheses refer to literature cited.

| | | |
|-----|---|------------------------------|
| 12. | Setae present | 13 |
| | Setae absent | 19 |
| 13. | Setae fertile | 14 |
| | Setae sterile | 17 |
| 14. | Phialides from node-like hyphae | |
| | on setae | <u>C. gonytrichodes</u> (10) |
| | Phialides from base of setae | 15 |
| 15. | Setae < 250 μm long | <u>C. pakhalensis</u> (9) |
| | Setae > 250 μm long | 16 |
| 16. | Setae slightly geniculate at apex ... | <u>C. fertilis</u> (3) |
| | Setae straight, cylindrical to gradually | |
| | tapering at apex | <u>C. assamica</u> (3) |
| 17. | Setulae of unequal length | <u>C. aristata</u> (4) |
| | Setulae equal in length | 18 |
| 18. | Setulae 5-9 μm long | <u>C. britannica</u> (1) |
| | Setulae up to 1.0 μm long | |
| | <u>Chaetosphaeria pulchriseta</u> anam. <u>Codinaea</u> | (3) |
| 19. | Setulae < 6 μm long | 20 |
| | Setulae > 6 μm long | 21 |
| 20. | Phialoconidia 11-17 μm long | <u>C. parva</u> (3) |
| | Phialoconidia 17-23 μm long | <u>C. vulgaris</u> (3) |
| 21. | Phialoconidia with acute apex, | |
| | 23-28 μm long | <u>C. longispora</u> (3) |
| | Phialoconidia with bluntly pointed apex, | |
| | 14-19 μm long | <u>C. simplex</u> (3) |
| 22. | Phialoconidia septate | 23 |
| | Phialoconidia non-septate | 26 |
| 23. | Phialoconidia 3-septate | <u>C. apicalis</u> (3) |
| | Phialoconidia 1-septate | 24 |
| 24. | Conidiophores branched | |
| | and ornamented | <u>C. glauco-nigra</u> (3) |
| | Conidiophores simple and smooth | 25 |
| 25. | Phialoconidia 10-16 x 2.5-3.5 μm | <u>C. lunata</u> (6) |
| | Phialoconidia 20-24 x 2.0-2.8 μm | <u>C. setosa</u> (3) |
| 26. | Conidiophores branched | 27 |
| | Conidiophores simple | 28 |
| 27. | Phialoconidia 20-26 μm long | <u>C. hughesii</u> (1) |
| | Phialoconidia 10-15 μm long | |
| | <u>Chaetosphaeria callimorpha</u> anam. <u>Codinaea</u> | (3) |
| 28. | Phialoconidia strongly curved | 29 |
| | Phialoconidia straight or slightly curved | 30 |
| 29. | Phialoconidia sigmoid | <u>C. lunulospora</u> |
| | Phialoconidia botuliform | <u>C. botulispora</u> (3) |
| 30. | Phialoconidia cylindrical | <u>C. cylindrospora</u> (7) |
| | Phialoconidia tapering towards base | 31 |
| 31. | Phialoconidia abruptly tapered | |
| | at base | <u>C. clavulata</u> (2) |
| | Phialoconidia gradually tapered at base | |
| | <u>Chaetosphaeria talbotii</u> anam. <u>Codinaea</u> | (3) |

Literature Cited

1. Ellis, M.B. 1976. More dematiaceous Hyphomycetes. Commonwealth Mycological Institute, Kew, 507 pp.
2. Gams, W. and V. Holubova-Jechova. 1976. Chloridium and some other dematiaceous Hyphomycetes growing on decaying wood. Studies in Mycology No. 13, Baarn, 99 pp.
3. Hughes, S. J. and W. B. Kendrick. 1968. New Zealand fungi 12. Menispora, Codinaea, Menisporopsis. New Zealand J. Bot. 6: 323-375.
4. Maire, R. 1937. Fungi Catalaunici, Series alterna. Contribution a l'etude de la Flore Mycologique de la Catalogne. Publications Inst. bot. Barcelona 3: 128 pp.
5. Matsushima, T. 1971. Microfungi of the Solomon Islands and Papua-New Guinea. Pub. by author, Kobe, 78 p.
6. Matsushima, T. 1975. Icones Microfungorum a Matsushima Lectorum. Pub. by author, Kobe, 209 pp.
7. Morgan-Jones, G. and E. B. Ingram. 1976. Notes on Hyphomycetes XV. Two new species of Codinaea. Mycotaxon 4: 504-509.
8. Pirozynski, K. A. and S. D. Patil. 1970. Some setose Hyphomycetes of leaf litter in south India. Canad. J. Bot. 48: 567-581.
9. Reddy, S. M. and S. S. 1978. A new species of Codinaea Sydowia 30 (1-6): 186-188.
10. Shearer, C. A. and J. L. Crane. 1971. Fungi of the Chesapeake Bay and its tributaries. I. Patuxent River. Mycologia 63: 237-260.
11. Sutton, B. C. and C. S. Hodges. 1975. Eucalyptus microfungi: Codinaea and Zanclospora species from Brazil. Nova Hedwigia 26: 517-525.

A NEW SPECIES OF DACRYOPINAX FROM BRAZIL

B. Lowy

Botany Department, Louisiana State University
Baton Rouge, LA 70803Dacryopinax maxidorii Lowy, sp. nov.

Fructificatio in humido aurantiolutea, elastico-gelatinosa, pileata, 4.5 cm alta ad 5 cm lata; sicca cornea, ferrugineo-brunnea; caulis elongatus, firme radicans, conspicuus, crassi-venatus; in sicco dense albido-tomentosus; apicis alte ramosus, deinde polycephalus, lobuli flabelliforme ad 450 μ m crassis cum margine crenulata; hymenio glabrum, unilaterali, inferiori, pauci pilosa; probasidia cylindrata, aseptata, 30.0-36.5 X 4.5 μ m, metabasidia furcata, aseptata, bisterigmata; hyphae endosae, 2.0-3.0 μ m diam; basidiosporae leviter curvulo-cylindratae vel subovoideae, uniseptatae, in cumulo aurantiaco-lutea, (7.0-) 8.0-10.0 (11.5) X 4.5-5.0 μ m, per promycelium aut conidia germinantes; conidia subspherica, 1.5-2.5 μ m diam.

Fructification when fresh rubbery gelatinous, orange-yellow, stipitate, pileate, up to 4.5 cm in height, 5 cm broad (Fig. 1); drying horny, rusty brown; arising from a broad, elongated, firmly rooted, sterile stalk; thick veined, densely whitish-pilose when dry, with pilosity diminishing upward; deeply branched apically, frequently becoming polycephalic with broad, veined, flabelliform lobes \pm 450 μ m thick, often with crenate margins; hymenium unilateral, inferior, producing a dense palisade of basidia; abhymenium thinly covered with hyaline, cylindrical to slightly inflated, unbranched hairs, unicellular to sparsely septate, arising from a layer of irregularly inflated hyphae; probasidia cylindrical, unicellular, 30.0-36.5 X 4.0-4.5 μ m; occasional cylindrical, slender, unbranched dikaryophyses 20-25 X 2.5-3.0 μ m; metabasidia furcate, bisterigmate; hyphae without clamp connections,

2.0-3.0 μm diam; basidiospores slightly curved-cylindrical to subovoid with narrowed apices and prominent apiculus, with a single, thick, central septum, (7.0-) 8.0-10.0 (-11.5) X 4.5-5.0 μm , producing subspherical conidia 1.5-2.5 μm diam, or germinating by germ tube.

Holotype. Brazil. Lowy 190 BR (TYPE), km 405 Manaus-Porto Velho road, Amazonas, 16-IX-1980.

Leg. B. Lowy, D. Coelho. On unidentified log.

This species is named for Maxine and Doris Lowy, enthusiastic collectors of tremellaceous fungi.



Figure 1. Basidiocarps of Dacryopinax maxidorii with scale shown in millimeters.

In gross morphology the new species somewhat resembles D. indacocheae Lowy (1959), except for the latter's stubby stalk, thinner lobes, and brownish to earth-colored pigmentation. However, the long stalk, bright carotinoid pigmentation, and flabelliform lobes of the new species places it closer to D. martinii Lowy (1971). The basidiospores of these three species are predominantly 1-septate, but D. maxidorii shares with D. indacocheae somewhat curved-cylindrical spores with a single, thick septum whereas the spores of D. martinii are characteristically thin septate.

The following revised key includes the seven known species of Dacryopinax occurring in tropical America.

1. Basidiocarp slightly expanded apically; pileus simple or branched. 2
 2. Stipe tomentose; basidiospores becoming 1-septate. D. spathularia
 2. Stipe not tomentose; basidiospores becoming 3-septate. D. dennisii
1. Basidiocarp broadly expanded apically; pileus grossly lobed to flabelliform or polycephalic 3
 3. Long stipitate; pileus flabelliform. 4
 3. Short stipitate to substipitate; pileus not flabelliform. 5
 4. Abhymenium and stipe smooth; dried pileus thin, fragile. D. martinii
 4. Abhymenium and stipe pilose; dried pileus thick, robust. D. maxidorii
 5. Hymenium coarsely papillate, yellow when fresh. D. yungensis
 5. Hymenium smooth, not yellow when fresh 6
 6. Pileus spreading-orbiculate, undivided, drying dark brown to blackish. D. elegans
 6. Pileus foliose, deeply lobed, drying light brown. D. indacocheae

ACKNOWLEDGEMENTS

Thanks are due The New York Botanical Garden, the Instituto Nacional de Pesquisas da Amazonia (Manaus, Amazonas, Brasil), and Louisiana State University (Baton Rouge, LA), under whose sponsorship the field work was completed as part of the Projecto Flora Amazonica.

LITERATURE CITED

- Lowy, B. 1959. New or Noteworthy Tremellales from Bolivia. *Mycologia* 51: 840-850.
- _____. 1971. Tremellales. *Flora Neotropica*. Monograph 6, Hafner Publishing Company, Inc. New York.

CO-EDITORS OF MYCOTAXON

G. L. HENNEBERT

FRENCH LANGUAGE EDITOR
& BOOK REVIEW EDITOR

RICHARD P. KORF

ENGLISH LANGUAGE EDITOR
& MANAGING EDITOR

UCL, Place Croix du Sud 3
B-1348 Louvain-la-Neuve, Belgium

P.O. Box 264
Ithaca, NY 14850, USA

MYCOTAXON is a quarterly journal devoted to all phases of mycological and lichenological taxonomy and nomenclature. It seeks to publish all papers within 4 months of acceptance, using photo-offset lithography. All articles are reviewed by specialists prior to acceptance. Publication is open to all persons. Papers may be in French or English, summaries in any language.

SUBSCRIPTION INFORMATION

Each issue of MYCOTAXON may vary in number of pages. Each volume, beginning with volume 3, consists of at least 512 pages, and consists of an irregular number of quarterly issues depending upon the amount of copy received from authors. Subscriptions are on a per volume basis, not on an annual basis. If only one bill during each year is a requirement, please pay for 2 volumes, which will normally cover at least one year's issues. Personal subscriptions are available at a substantially reduced subscription rate for individuals who agree not to deposit their copies in another library than their own within 3 years of receipt. Prices for each volume, beginning with volume 3, are:

| | |
|-----------------------|------------|
| REGULAR (multiuser) | \$40.00 US |
| PERSONAL (individual) | \$17.50 US |

(Vols. 1 & 2 are available at half the above rates per volume)

(Complete runs, vol. 1 through the latest completed volume, are subject to a 10% discount for new subscribers; old subscribers who wish to complete their sets may also purchase the missing volumes at a 10% discount)

MYCOTAXON may also be obtained on a journal exchange basis. This may be arranged with journals, institutions, or individuals who have difficulty in obtaining foreign currencies. For details, write to a Co-Editor.

AVAILABILITY IN MICROFORM, AND TEAR SHEET SERVICES FOR ARTICLES

MYCOTAXON is also available in microfiche and microfilm from University Microfilms, 300 North Zeeb Road, Ann Arbor, MI 48106, from whom prices may be obtained.

Tear sheets of individual articles appearing in MYCOTAXON may be obtained through the Original Article Tear Sheet Service of The Institute for Scientific Information, 3501 Market Street, University City Science Center, Philadelphia, PA 19104, from whom prices may be obtained.

EDITORIAL SERVICES AND INFORMATION FOR PROSPECTIVE AUTHORS

Authors prepare their own camera-ready copy after having received comments from pre-submission reviewers. Detailed Instructions to Authors appeared in MYCOTAXON 1: 3-12, 1974, and 6: 370, 1977. A copy of each will be sent upon request to one of the Co-Editors.

We are able to provide prospective authors with two aids to publication. Both are sold at our cost, and are shipped postpaid from MYCOTAXON, LTD., P.O. Box 264, Ithaca, NY 14850 USA.

SPECIAL MANUSCRIPT PAPER is available in packages of 50 sheets, and is ruled in blue, non-photoreproducing ink for each of the two sizes of typeface called for in the instructions to authors (elite, pica). It is a convenience to typists, but certainly not an essential, since rectangles of the appropriate size can be prepared on any paper using a non-photoreproducing blue pencil. Each package of 50 sheets is sent postpaid for \$2.20 US.

BIOPATE is a special sheet of transfer letters for the use of authors in the preparation of plates and graphs for publication. It is manufactured for us by Prestype, and available in either black or white. Each sheet is approximately 30 X 39 cm., with a wide assortment of numbers, letters (including important Greek characters), symbols, etc. These are sent postpaid for \$4.95 US (black will be shipped unless white is specified).