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LEOTIACEAE II. A PRELIMINARY SURVEY OF THE NEOTROPICAL SPECIES REFERRED TO HELOTIUM AND HYMENOSCYPHUS

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SUMMARY

The seventy-two species referred to *Helotium* or *Hymenoscyphus* and reported from the neotropics are re-examined and their current taxonomic status evaluated. A taxonomic key is provided for all accepted species, and members of the Sclerotiniaceae and *Hymenoscyphus* are fully described and illustrated; suggestions are made as to where the remainder of the species could be placed. The seventy-two species are distributed as follows: 17, no types or voucher specimens to confirm reports; Sclerotiniaceae - 24, distributed in the genera *Moellerodiscus* 5, *Lambertella* 8, *Lanzia* 7, *Poculum* 4; Leotiaceae - 26, with *Hymenoscyphus* 15, *Bisporella* 6, *Chlorencoelia* 2, *Chlorociboria* 1, *Encoelia* 1, *Phaeohelotium* 1; Orbiliaceae - *Orbilia* with 2; Operculate Discomycetes 2; 1 lichen. Several new combinations are made in both the Leotiaceae and Sclerotiniaceae, while several are placed into taxonomic synonymy.

For almost a decade and a half, I have been conducting extensive field explorations in the neotropics. Although our group has collected many groups of fungi comprehensively, we have concentrated on Inoperculate and Operculate Discomycetes found on a variety of substrata. We have gathered several hundred collections of these small fungi, and our recent emphasis has been attempting to identify the more common members of the Leotiaceae and Sclerotiniaceae. Until fairly recently, the most updated work on the fungi from this region has been by R. W. G. Dennis, who has published several scattered papers on these Discomycetes.

The chore of naming current collections is particularly difficult, since no real comprehensive treatment exists for most groups of fungi from tropical regions. Dennis's (1970) work on the fungus flora of Venezuela is an important treatment, but its scope is limited. Nevertheless, his work is still the best place to begin when attempting to identify many tropical species. Our work is further complicated because the necessary generic monographs are lacking, and even in temperate groups generic and species concepts are still vague and confusing. Identification of tropical collections of the

Helotium-Hymenoscyphus complex is an excellent example where identification is difficult; the naming of members of the Sclerotiniaceae in the neotropics in many cases is almost impossible since many species were described in other genera, and the names are hidden in genera such as *Helotium*.

Although Dennis (1964) provided an important contribution to understanding *Hymenoscyphus*, many species were placed into the genus when no type collections existed; and as is pointed out here, species were placed in the genus when in reality they are members of the Sclerotiniaceae. Recently, we have begun to report the findings of some of our field work and have been attempting to update synonymies and give descriptions and illustrations of many of the more common neotropical species (Carpenter & Dumont, 1978; Carpenter, 1981; Dumont & Carpenter, 1981; Dumont, 1981; and Haines, 1980).

The purpose of this paper is to present the findings of a preliminary survey of the species of *Helotium-Hymenoscyphus* reported from the neotropics. This study is by no means complete; it is hoped that with the aid of the taxonomic key, the descriptions and illustrations of members of *Helotium-Hymenoscyphus* and of the Sclerotiniaceae at least some of the more common species from the neotropics can now be identified and named correctly. It is further hoped that a better understanding of the genus *Hymenoscyphus* in the neotropics will begin to emerge as subsequent workers use this treatment and contribute further information to it.

The methods and terminology used here are the same as those reported by Dumont (1971). For those species which do not belong in *Helotium-Hymenoscyphus* or Sclerotiniaceae, no attempt has been made to redescribe them. Rather suggestions are made as to where the species may be better placed. No attempt is made to present full nomenclatural or taxonomic synonymies for any species. However, with those species referred to *Hymenoscyphus* or Sclerotiniaceae, the basionym will be cited. Those wishing further information are encouraged to refer to the literature cited for each species.

The following key includes the species considered. The names given are those which I accept for each taxon, and the names under that name in parentheses are those under which that taxon was actually published or reported. Since special emphasis in my recent studies have been in the Sclerotiniaceae and *Hymenoscyphus* (Leotiaceae), several of the species are keyed out only to genus, e.g., *Orbilia* spp.

Key to species reported as
Helotium or Hymenoscyphus from
the neotropics

1. Asci inoperculate..2.
   2. Apothecia subsessile to sessile, waxy; receptacle thin, composed of large, thin-walled, globose cells; the paraphyses knobbed; asci small; ascospores tiny..............................*Orbilia* spp.
   (See *Helotium blumenaviense*, *H. disseminatum*)
   2. Without the above combination of characters....................3.
      3. Substratal stroma present.................(Sclerotiniaceae)4.

4. Ectal excipulum composed of globose to angular cells...(*Moellerodiscus*)5.
  5. Apothecia in 2% KOH releasing a reddish purple dye; ascospores 5-7 x1.5-2.5µm...*M. fuscobrunneus*
  5. Apothecia not emitting a reddish purple dye in 2% KOH...........6.
    6. Paraphyses with internal light brown to dark brown pigment; ascospores 6-8(-10)x2-3.5(-4)µm..................*M. conocarpi*
    6. Paraphyses without internal brown pigment; ascospores (4-)5-7 (-9)x1.5-2.5µm.....................................*M. lentus*
    (See *Helotium cecropiae*, *H. phlebophorum*, *H. uleanum*)
4. Ectal excipulum composed of hyphae (textura prismatica to porrecta) imbedded in a gel or not...7.
  7. Ascospores less than 20µm long.................................8.
    8. Paraphyses pigmented; ascospores pigmented, (6-)7-8(-10)x (2.5-)3-3.5(-4)µm...................*Lambertella spadiceo-atra*
    (Also see *Helotium chromo-flavum*)
    8. Paraphyses without pigment.................................9.
      9. Outer surface of apothecium clothed with tightly interwoven, narrow hairs forming a mat with the details of the individual hairs difficult to observe; ascospores lightly pigmented, (9-)10-11(-12)x4-5µm................*L. lasseri*
      9. Outer surface not clothed with hairs, if hairs present not interwoven, the individual hairs easily observed.......10.
        10. Ascospores less than 10µm long...................11.
          11. Ascospores 5-6(-11)x2-2.5µm, lightly pigmented.. ....*L. microspora*
          (See *Helotium atrosubiculatum*, *H. caracassense*, *H. singeri*, *H. vile*)
          11. Ascospores 5-6x2-3µm, not pigmented............ ....*Lanzia livida*
        10. Ascospores 10µm or more long.....................12.
          12. Ectal excipulum composed of hyphae imbedded in a gel...13.
            13. Ascospores biguttulate, 10-12x2-3µm; ectal excipulum composed of long, narrow hyphae (textura porrecta); on culms of bamboo..... ....*Poculum bambusae*
            13. Ascospores multiguttulate, (9-)11-13x3-4µm; ectal excipulum composed of hyphae made up of brick-shaped cells (textura prismatica); on leaves.........................*P. titubans*
          12. Ectal excipulum composed of hyphae not imbedded in a gelatinous matrix; ascospores (12-)13-15 (-16)x(4-)5-6(-7)µm................*L. albo-atra*
  7. Ascospores more than 20µm long.................................14.
    14. Ectal excipulum composed of hyphae, lacking a gelatinous matrix; apically free marginal cells slightly to greatly inflated and expanded; ascospores (20-)24-36(-60)x(2.5-)3-6(-8) µm...*L. rufocornea*
    (See also *Helotium flavo-aurantium*, *H. fuscopurpureum*, *H. miniatum*, *H. subserotinum*)
3. Substratal stroma absent.............................(Leotiaceae)15.
  15. Ectal excipulum composed of globose to angular cells..........16.
    16. Ectal excipulum composed of loosely arranged globose to angular cells, not giving rise to tomentum hyphae oriented perpendicularly to the surface of the receptacle........... ....*Encoelia* sp.

(See *Helotium lobatum*)

16. Ectal excipulum if composed of angular to globose cells, then not loosely arranged, rather tightly compact and giving rise to tomentum hyphae oriented perpendicularly to the surface of the apothecium....................................*Chlorencoelia* sp.
(See *Helotium gedeanum*)

15. Ectal excipulum composed of hyphae organized into a textura prismatica, porrecta, or intricata, no globose or angular cells present or if present then only at the base of the receptacle and/or stipe......17.

17. Apothecia aeruginous green, growing on wood and the wood stained green..............................*Chlorociboria aeruginascens*
(See *Helotium aeruginosum*)

17. Apothecia not aeruginous green, substrate not stained green..18.

18. Apothecia sessile to subsessile, yellow; ectal excipulum composed of waxy, undulating hyphae oriented more or less perpendicularly or at very high angles to the surface of the apothecium and without globose cells....(*Bisporella*)19.

19. Asci J-; ascospores 0 to 1-septate, 9-14x3-5µm........ ....*Bisporella citrina*
(See also *Helotium crocinum*)

19. Asci J+; ascospores 1-septate, 8-10x1.5-2µm........... ....*B. discedens*
(See also *Helotium nigripes*, *H. pezizoideum*, *H. hyphicola*)

18. Without the above combination of characters.............20.

20. Ectal excipulum composed of hyphae extending perpendicularly to the surface of the apothecium, interwoven, frequently losing hyphal orientation, globose cells present and giving rise to tomentum hyphae oriented perpendicularly to the surface of the apothecium ....*Chlorencoelia* sp.
(See *Helotium gedeanum*)

20. Ectal excipulum if with any of the above characters, then without the clavate, tomentum hyphae............ ....(*Hymenoscyphus*)21.

21. Apothecia subsessile, substipitate, turbinate; stipe (or substipe) and base of receptacle of apothecium on the outside composed of textura angularis to textura globulosa.................... ....(*Hymenoscyphus epiphyllus* group)22.

22. Apothecia occurring on wood.............23.

23. Apothecia strongly cupulate to umbilicate; ascospores (13-)15-18(-20)x(3-)4-5µm; apically free cells of the ectal excipulum cylindric, clavate, subcapitate.....................*H. umbilicatus*

23. Apothecia flat or only slightly concave, not umbilicate; ascospores (16-)18-22(-24)x(4-)5-6(-8)µm; without modified apically free cells on the ectal excipulum..........*Phaeohelotium luteum*

22. Apothecia occurring on leaves, turbinate, not umbilicate; ascospores 15-18x3.5-5µm.... ....*H. epiphyllus*

21. Apothecia stipitate; stipe (or substipe, if present) composed of textura prismatica to porrecta (if any globose cells present in stipe or recep-

tacle use first choice).....................*H. caudatus* group 24.

24. Ascospores more or less equilateral, (4-)5-7(-9)x1.5-2(-2.5) µm; apothecia large, irregular in outline, umbilicate....... ....*H. leucopsis* (See also *Helotium cupreum*, *H. irregulare*)

24. Ascospores generally inequilateral frequently flattened on one side; apothecia not so constructed...................25.

25. Ascospores with a large "nuclear staining area" visible in phloxine, cotton blue and analine blue dyes, rarely 1-septate, (22-)26-30(-35)x4-5(-6)µm; ascus apex papillate, tropical................*Hymenoscyphus sclerogenus* (See also *Helotium camerunense*, *H. cantareirense*)

25. Ascospores without "nuclear staining area"..........26.

26. Ascospores regularly septate (more than 50% in any mount)..27.

27. Ascospores 1-septate, (17-)18-22(-24)x4-5(-6) µm; apothecia without hairs at the base of the stipe.............*Hymenoscyphus musicola*

27. Ascospores 3-septate, (20-)24-30(-35)x4-5(-6) µm; apothecia with abundant hairs at the base of the stipe..................*H. lasiopodius*

26. Ascospores aseptate............................28.

28. Ascospores with a basal cilium (16-)18-22 (-26)x2-3µm........................*H. scutula*

28. Ascospores without a basal cilium.........29.

29. Ascospores hooked apically...........30.

30. Ascospores strongly and obviously hooked, (16-)18-23(-30)x2-3(-4.5) µm, tapering gradually to the base. ....*H. serotinus* (Also see *Helotium calyculus*)

30. Ascospores if hooked, only slightly and a few per mount, (14-)16-23 (-26)x4-5µm, abruptly pointed at the basal end...................... ....*Hymenoscyphus caudatus*

29. Ascospores not hooked apically.......31.

31. Ascospores (11-)12-15(-16)x(2.5-)3-4µm with internal, oily resinous contents..................*H. cereus*

31. Ascospores (14-)16-23(-26)x4-5(-6) µm without internal, oily resinous contents................*H. caudatus* (See also *Helotium calyculus*)

1. Asci operculate.................(See *Helotium buccina*, *H. rhytidodes*)

1. *Helotium aeruginosum* (Oed. per Purton) Gray, Nat. Arr. Brit. Pl. p. 661. 1821.

NOTES. As Dixon (1975) pointed out, this is a species referred to *Chlorociboria*, but also has been placed in *Chlorosplenium*. There has been considerable confusion concerning the identification of this species and its closest relative, *C. aeruginascens*; for separating features and neotropical distribution, see Dixon (1975). The species has been reported from the neotropics by several authors under *Helotium*, such as

Montagne (1853), Berkeley (1896), etc. I agree with the species placement in *Chlorociboria* and will not treat it further.

2. *Helotium albo-atrum* P. Hennings, Hedwigia 41: 24. 1902. FIG. 1.

Stroma — Substratal, variable, visible on the host as single black lines extending irregularly along the surface of the host leaf or imbedded in the host; the black lines composed of rind cells with differentially pigmented walls, epidermoid to irregular in face view, also visible in section at the base of the stipe of the apothecium; not known in culture.

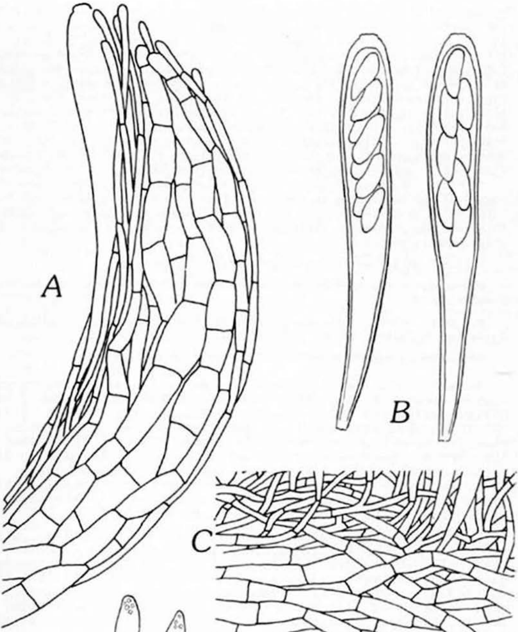
Macroconidial state — Unknown, presumed absent.

Microconidial state — Unknown.

Apothecial morphology — Apothecia variable, gregarious, arising in association with black lines on the host, stipitate, to ca 1.0mm high, generally disc diam less than height of fruitbody, when fresh disc flat, drying flat, rehydrating flat. Hymenium when fresh white, drying black, rehydrating lighter and dark brown to almost black; margin when fresh, dry, or rehydrated concolorous with the hymenium; receptacle when fresh white, drying black, rehydrating dark; stipe cylindrical, ca 0.5mm long, ca 0.2 mm wide, broader above and tapering below to the base, black when fresh, dry, or rehydrated.

Apothecial anatomy — Asci 8-spored, ca 100-120x9-11μm, probably produced from croziers, long-cylindric to broadly clavate, gradually tapering toward the base and there becoming expanded to form a small foot, wall ca 1μm thick, enlarged or not at the rounded to truncate apex and there ca 1-2μm thick; pore J+, the walls outlined blue in Melzer's Reagent. Ascospores (12-)13-15(-16)x(4-)5-6(-7)μm, generally obliquely uniseriate or irregularly biseriate, hyaline, smooth, aseptate, ellipsoid to ovoid, ends rounded or rarely pointed below, in outline more or less equilateral, anterior end slightly broader; guttule details difficult to interpret owing to condition of material, but with 2 large polar guttules or guttulate areas ca 3μm wide visible in most spores. Paraphyses not well preserved, details obscured, reported by Hennings and Rick to be filiform, expanded at the apex and there 3-3.5μm wide, internally hyaline to yellowish. Subhymenium details uninterpretable owing to poor preservation of apothecium. Medullary excipulum poorly developed, non-refractive, pigmented light yellow to yellow-brown, composed predominantly of parallel hyphae originating in the stipe, but becoming slightly interwoven in the narrow flanks and just below the base of the asci, the individual hyphae light yellow-brown to brown, 3-7μm wide, the walls thin to thick, non-refractive, generally light yellow-brown to dark brown, smooth or roughened. Ectal excipulum poorly preserved, differentiation into inner ectal and outer ectal excipula doubtful, the entire area non-refractive, light brown to intensely dark brown, ca 15-20μm broad toward the margin and to ca 40μm broad towards the stipe, consisting predominantly of textura prismatica, with the individual

FIG. 1. *Lanzia albo-atra*, Möller 657, freehand drawings, x 1,000. A. Median longitudinal section of apothecium through margin. B. Two asci each containing 8 ascospores. C. Median longitudinal section of apothecium at approximately midpoint between margin and stipe. D. 8 ascospores drawn after discharge from the ascus.


A
B
C
D

hyphae generally collapsing, extending at a low angle to the surface of the apothecium, the individual cells toward the margin 8-22x4-8(-10)µm and 15-28x9-12(-14)µm toward the stipe, the walls thin to slightly thick, light to dark brown, smooth or roughened. Outer covering layer present, 1-2 layers of hyphae and 2-5µm wide, the individual hyphae extending parallel to the surface of the apothecium, overlapping, frequently terminating before the margin and the apically free cells unmodified, the individual cells light brown, dark brown to intensely pigmented, the walls non-refractive, thin to thick, pigmented brown, frequently roughened. Hairs absent. Margin details difficult to interpret owing to condition of apothecium, apparently constructed similarly to the flank below, the individual cells smaller, entire layer intensely pigmented. Stipe of rather uniform construction, to the outside the outermost 2-3 layers intensely pigmented and roughened, to the inside the pigmentation present, but less intense, individual hyphae 4-6µm wide, with walls thin to rarely slightly thickened and generally roughened; rind cells visible at the base of the stipe. Hairs absent.

Habitat: On fallen leaves of unidentified dicot plant.

Etymology of the specific epithet: refers to the white receptacle and black stipe.

Holotype: Helotium albo-atrum - Brazil, near Blumenau, Sta. Catharina, unidentified leaves, 15 Jul 1892, A. Möller 657 (ex S).

Specimens examined: known only from the type collection.

NOTES. *Helotium albo-atrum* was described as occurring on leaves from south Brazil by Hennings (1902) and was based on a Möller collection 657. Dennis, at least twice (Dennis, 1954 & 1960) compared this species with other species of *Hymenoscyphus* from the neotropics, but indicated (Dennis, 1954) that the type was presumed lost at Berlin. He did not mention the species in his last treatment of the genus (Dennis, 1964). I have examined a portion of Möller 657 deposited at S from the Sydow herbarium and conclude that it is a part of the type collection as the data agrees with the protologue.

I have observed a black line stroma on the host leaf in association with apothecia of this species and have observed rind cells at the base of the stipe and conclude that the species should be referred to the Sclerotiniaceae. With the production of a substratal stroma, and presence of an ectal excipulum composed of textura prismatica lacking a gelatinous matrix, the species could be referred to either *Lanzia* or to *Lambertella*. Since there is no pigmentation in the ascospores, the species is referred to *Lanzia*. I know of no earlier name for the species and thus make the formal transfer to *Lanzia* as follows:

Lanzia albo-atra (Hennings) Dumont, comb. nov.

Basionym: Helotium albo-atrum P. Hennings, Hedwigia 41: 24. 1902.

Lanzia albo-atra appears to be most closely related to *Lanzia luteovirescens*. In *L. luteovirescens* the ascospores are 12-16.5x5-7µm (White, 1942) and have large guttules which fill most of the spore, while in the type of *L. albo-atra* the ascospores have small polar guttulate areas. In *L. luteovirescens* the apothecia are yellowish with a green cast, while in *L.*

albo-atra the receptacle when fresh is white and the stipe black, and when dry the entire fruitbody is black. The sterile tissue of *L. albo-atra* is pigmented yellow-brown to dark brown, while in *L. luteovirescens* the sterile tissue is hyaline or very faintly yellowish and lacks the distinctive coloration of *L. albo-atra*.

3. *Helotium ambiguum* Rick, Brotéria, Sér. Bot. 25: 109. 1931.

NOTES. *Helotium ambiguum* was described by Rick from south Brazil as occurring on wood, but he did not cite any collection in the original description. Dennis (1954, 1960a, 1970) did not treat the species. I have been unable to locate any material on this species at K, S, NY, CUP, BPI, M, B, and the Rick Herbarium (PACA) and must assume that the type collection no longer exists.

From the brief four and one half line description, it is difficult to tell much about the fungus. The ascospores were said to be 7x3µm, and the substrate wood. There are few named neotropical Leotiaceae or Sclerotiniaceae with spore measurements that short occurring on wood. Two such species are *Hymenoscyphus leucopse* (Berk. & Curt.) Dennis and *Helotium microspermum* with ascospores 3.5-4x1.5-2µm. Until type material is found for this species, I am unable to treat this species further.

4. *Helotium angelense* Starbäck, Ark. Bot. 2(5): 4. 1904.

NOTES. *Helotium angelense* was described by Starbäck from south Brazil on leaves. I have been unable to locate authentic material of this species and am, therefore, uncertain of its relationships. According to the original description, the apothecia are yellow, black at the base, which is suggestive of the Sclerotiniaceae, and has ascospores 12-15x3-4µm. Should material of this species be located, it should be compared with several species such as *Hymenoscyphus caudatus*, *Lanzia albo-atra*, *Helotium titubans*, *Hymenoscyphus cereus* and *Helotium crocatum*. Until authentic material is located, I cannot consider the species further.

5. *Helotium atrosubiculatum* Seaver & Waterston, Mycologia 32: 397. 1940.

NOTES. *Helotium atrosubiculatum* Seaver & Waterston was described on leaves of *Archontophoenix alexandrae* Wenden & Drude from Bermuda. Dumont (1974) placed the species into taxonomic synonymy with *Lambertella microspora* (Seaver) Dumont; and for a full description and illustrations, see Dumont (1971), under the name *Lambertella pallidispora* Dumont. I continue to accept this placement of the species into synonymy with *L. microspora* and will not treat the species further here.

6. *Helotium atroviride* P. Hennings, Hedwigia 41: 25. 1902.

NOTES. *Helotium atroviride* was described on leaves by Hennings from two Möller collections, 31d and 409, from Brazil.

I only have been able to locate one collection, 409 and, thus designate this as the lectotype specimen for the species. The collection is rather poorly preserved and I here place it into tentative synonymy with "*Helotium crocatum*." See *H. crocatum* for full discussion. The type collection was filed under the epithet "*atro-virescens*."

Lectotype: Helotium atroviride - Brazil, Blumenau, Sta. Catharina, on unidentified leaves, Jan 1891, A. Möller 409 (ex S).

7. *Helotium aurantio-rubrum* Bresadola, Hedwigia 35: 295. 1896.

NOTES. *Helotium aurantio-rubrum* was described by Bresadola as occurring on wood from south Brazil and was based on a Möller collection 29b. As Dennis (1954) has pointed out, the holotype cannot be located and is presumed to be lost. From the original description, it is possible that the species is *Lanzia rufocornea*. Until the type is located or until a new one is designated, I can only place the species into tentative synonymy with *H. rufo-corneum*.

8. *Helotium bambusae* von Höhnel, Akad. Wiss. Wien, Math-Naturwiss. Kl., Denkschr. 83: 30. 1907.

NOTES. *Helotium bambusae* was described from Brazil as occurring on culms of bamboo. I have examined the presumed holotype deposited at FH, and it is very poorly preserved and appears to have been preserved in a liquid such as alcohol. Most of the anatomical details are either obscured or contorted, and it is for this reason that I have been unable to present a full description. Because so much of the apothecium studied appears badly preserved, I will only present only relevant information which will help in placing the species properly and in recognizing it in the future.

I have noted that the substrate is obviously blackened, and it appears that the fungus produces a substratal stroma, since rind cells were observed on the host and at the base of the stipe of the apothecium. The details of the hymenial elements are almost entirely obscured. The asci in the original description were said to be ca 120x6-6.5µm, and J+. I have seen several ascospores which appear to be normal, and they are 8-10x2-3µm, have two large polar guttules, are equilateral to slightly inequilateral and not flattened, have ends rounded to slightly pointed, and are aseptate and hyaline. There are paraphyses present which appear to be pigmented light brown, while others are probably hyaline, and they were said to be 3 µm wide in the original description.

The sterile tissue of the apothecium is extremely difficult to interpret. The entire internal tissue is pigmented light to dark brown, the individual hyphae are hyaline to intensely pigmented, and the walls are frequently roughened. The subhymenium and margin are more intensely pigmented than the remainder of the fruitbody. The ectal excipulum is highly refractive, especially in the stipe, and the narrow hyphae (ca 2-3µm wide) appear to be embedded in a gelatinous matrix. The subhymenium appears to be made up of narrow, vertically oriented, pigmented hyphae.

Because a substratal stroma is produced the species should be referred to the Sclerotiniaceae, and if my interpretation of the ectal excipulum is correct and a gelatinous matrix is present, then it should be referred to *Poculum*. *Helotium bambusae* could be confused with a foliicolous species of *Poculum*, *Helotium titubans*, which has ascospores (9-)11-13x3-4μm. In *H. bambusae* the ectal excipulum is composed of long-narrow cells and in *H. titubans* the cells are brick-shaped; the ascospores in *H. bambusae* are biguttulate, while in *H. titubans* they are multiguttulate. I know now of no other species of *Poculum* with which this species could be confused. I thus propose here the formal transfer to *Poculum* as follows:

Poculum bambusae (von Höhnel) Dumont, comb. nov.

Basionym: Helotium bambusae von Höhnel, Akad. Wiss. Wien, Math-Naturwiss. Kl., Denkschr. 83: 30. 1907.

Presumed holotype: Helotium bambusae - Brazil, São Paulo, Bertiago, near Santos, on culm of bamboo, 1901, F. von Höhnel, s.n. (ex FH, herb von Höhnel no. 5395).

9. *Helotium belisense* Kanouse, Mycologia 33: 465. 1941.

≡ *Lambertella belisense* (Kanouse) Dumont, Mycologia 66: 342. 1974.
≡ *Rutstroemia belisense* (Kanouse) Dennis, Persoonia 3: 36. 1964.

NOTES. *Helotium belisense* was described from British Honduras (now called Belize) as occurring on leaves of *Ilex* and was based on a Main 3606 collection. Dumont (1974) showed the species to be a *Lambertella* and an older name for *Lambertella boliviana* Dennis, a decision with which I still agree. For a full description, illustrations, and discussion, see Dumont (1971, 1974).

10. *Helotium blumenaviense* P. Hennings, Hedwigia 41: 24. 1902.

NOTES. *Helotium blumenaviense* was described from a downed palm frond and was based on Möller 347. I have examined the type deposited at S and conclude that the species is an *Orbilia*. I am not well enough acquainted with the neotropical species of *Orbilia* to propose a transfer to that genus, and will not treat it further here.

The ectal excipulum is composed of large globose to irregular cells with frequently thickened walls, the individual cells and asci are respectively ca 10-30μm and 24-30x3-4μm. The paraphyses and other details of the microanatomy cannot be interpreted owing to the poor preservation of the apothecium.

Holotype: Helotium blumenaviense - Brazil, Catharina, on palm, 17 Jan 1892, A. Möller 347 (ex S).

11. *Helotium buccina* (Persoon ex Persoon) Fries, Summa veg. Scand, p. 355. 1849.

NOTES. *Helotium baccina* was reported from Chile by Montagne (1853). I have examined the specimen from PC upon which this record was based and find it to be an operculate Discomycete doubtless referrable to the Sarcoscyphaceae. Thus, to my knowledge, *H. buccina* is still unknown from the neotropics.

Specimen examined: Chile, near Valdivia, on dead wood, M. Gay, sn, s.f. (ex PC).

12. *Helotium calyculus* (Sow. ex Fries) Fries, Summa veg. Scand. p. 355. 1849.

NOTES. *Helotium calyculus* was reported from Venezuela by Dennis (1960, 1970). As Dumont & Carpenter (1981) have pointed out, the type of *Peziza calyculus* appears to be the same as *Peziza firma* Persoon, and it is probable that the taxon previously referred to as *Helotium calyculus* will need a new name.

The Dennis report from Venezuela is based upon one of his own collections, Dennis 2452. I have examined the collection and have a somewhat different interpretation than Dennis. Dumont & Carpenter (1981) have discussed their neotropical collections of *Hymenoscyphus caudatus* and *H. serotinus* and have pointed out that both are very variable species and are probably very closely related. They further pointed out that broad-spored collections of *H. serotinus* approached those of *H. caudatus* and that narrow-spored collections of *H. caudatus* approached those of *H. serotinus*. They cited one collection which they felt was an intermediate between the two.

Dennis 2452 appears to fall into the *H. caudatus*-*H. serotinus* complex, but I cannot satisfactorily place it into either one or the other. The ascospores are 16-20x4-6µm, ellipsoid, frequently slightly hooked at the apex, taper to a small point at the base and cannot be distinguished from those of *H. caudatus*. However, the fruitbody of *H. caudatus* appears to be consistently tiny, less than 1mm high and wide, and generally light yellow to off white. The fruitbody of the Dennis collection appears to fall into the range of *H. serotinus*, which has apothecia up to 2mm diam and to 5mm high, varying in coloration from yellow to orange to dark brown. The apothecia of the Dennis collection are to 3mm wide, and ca 10mm high and dry brownish. Until I have more material similar to the Dennis collection, I must reserve judgement as to its final identification and placement, and conclude that it is an intermediate form.

13. *Helotium camerunense* P. Hennings, Bot. Jahrb. Syst. 22: 73. 1895.

NOTES. *Helotium camerunense* was described by Hennings from Africa from a Dusén collection. Dennis (1958) reported the species from Bolivia, based on three Singer collections, B620, B644, and B891/2; Rick (1931) described a variety *brasiliense* from Brazil.

I have examined the three Singer collections and conclude that they are *Hymenoscyphus sclerogenus* (Berkeley & Curtis)

Dennis as defined by Dumont & Carpenter (1981). I have attempted to locate the type of *Helotium camerunense* Hennings var. *brasiliense* Rick, but could not locate it at K, S. B, M, FH or BPI. I have found a collection of *Helotium camerunense* deposited at NY made by Rick and from the Bresadola herbarium. Since Rick did not actually designate a specific collection as the type, there remains some doubt as to whether or not this is the actual holotype of Rick's variety. It does agree with the protologue for the variety and I thus designate it as the neotype rather than as lectotype, since there is some doubt as to whether it is part of the holotype. This specimen is marked with the number "#27 = 71!" The collection agrees in all regards with *Helotium rufo-corneum*, and I thus place Rick's variety into synonymy with *H. rufo-corneum*, which has priority. For full description and illustrations of *Hymenoscyphus sclerogenus* see Dumont & Carpenter (1981) and for *Helotium rufo-corneum* see Dumont (1980).

I have been unable to locate the type specimen of *H. camerunense* at S, K, H, B, M, NY, FH, S, and from the brief original description cannot determine what the species actually is. From the description it could be *Hymenoscyphus lasiopodium*, *H. sclerogenus*, or *Lanzia rufocornea*. I am unprepared to designate a neotype specimen for the species and cannot treat it further here.

14. *Helotium cantareirense* (P. Hennings) Rick, Brotéria, Sér. Bot. 25: 116. 1931.

≡ *Lanzia cantareirensis* P. Hennings, Hedwigia 43: 208. 1904.

NOTES. *Lanzia cantareirensis* was originally described by Hennings from south Brazil as occurring on palm fibers. I have examined a portion of the holotype collection deposited at S and conclude that it falls within the concept of *Hymenoscyphus sclerogenus* as presented by Dumont & Carpenter (1981). I, thus, place *Helotium cantareirense* into synonymy with *Hymenoscyphus sclerogenus* and adopt the latter name as it has priority. For full descriptions and illustrations of *H. sclerogenus*, see Dumont & Carpenter (1981).

Holotype: Lanzia cantareirensis - Brazil, São Paulo, Serra da Cantareira, auf Palmenfasern, Mar 1903, Puttemans 869 (S).

15. *Helotium caracassense* Dennis, Kew Bull. 1954: 324. 1954.

NOTES. *Helotium caracassense* was described by Dennis (1954) from a single collection on leaves of an unidentified plant from Venezuela. After studying the type collection deposited at Kew, I conclude that it fits well into the concept of *Lambertella microspora* (Seaver) Dumont, which is a very common and variable fungus found throughout the tropics. For full description and illustrations, see Dumont (1971) under the name *L. pallidispora* Dumont.

Holotype: Helotium caracassense - Venezuela, Country Club, Río Chacaito, Caracas, on dead and decaying leaves, 18 Nov 1949, R. W. G. Dennis 370 (ex K).

16. *Helotium castaneum* P. Hennings, Hedwigia 36: 233. 1897.

≡ *Helotium subcastaneum* P. Hennings in Sacc. & Syd., Syll. Fung. 14: 764. 1899.

NOTES. *Helotium castaneum* was described from a Möller collection from Brazil on branches. Saccardo & Sydow (1899) showed the species to be a later homonym of *Helotium castaneum* Saccardo & Ellis in Saccardo (1882) and renamed the species *Helotium subcastaneum* Hennings in Saccardo & Sydow. I have been unable to locate the Hennings type in any of the herbaria surveyed. Neotropical species of the Leotiaceae or Sclerotiniaceae with small spores (those given in the original were said to be 4-5x2-3μm) are not common, and we conclude from the description that this species could be synonymous with *Helotium leucopse* or *H. microspermum*. We must, however, reserve final judgement until type or authentic material is located.

17. *Helotium caudatum* (Karsten) Velenovský, Monogr. Discom. Bohem. 1: 206. 1934.

≡ *Peziza caudata* Karsten, Fungi fenn. ex. 547. 1866.

NOTES. *Hymenoscyphus caudatus* (Karsten) Dennis was reported from the neotropics by Dumont & Carpenter (1981). For a full description, illustrations, and discussion of neotropical relatives, see that paper.

18. *Helotium cecropiae* P. Hennings, Hedwigia 41: 25. 1902.

NOTES. *Helotium cecropiae* was described from south Brazil on leaves. Dumont (1976) placed the species into taxonomic synonymy with *Helotium lentum* Berkeley & Broome (= *Moellerodiscus lentus*). For complete description, illustrations and discussions, see Dumont (1976). I agree with the placement of the species in *Moellerodiscus* and will not treat it further here. Dennis (1962) placed the species in *Ciboriopsis* as *C. lentus* (Berkeley & Broome) Dennis.

19. *Helotium cereum* (Rick) Dennis, Kew Bull. 14: 123. 1960. FIG. 2.

≡ *Ciboria cerea* Rick, Brotéria, Sér. Bot. 25: 119. 1931.
≡ *Hymenoscyphus cereus* (Rick) Dennis, Persoonia 3:76. 1964.

Apothecial morphology — Apothecia gregarious, stipitate, 1-2mm in diam, "6"mm high, when fresh waxy and pallid throughout, drying nearly black, rehydrating slightly lighter.

Apothecial anatomy — Asci 8-spored, 60-80x6-8μm, probably produced from tiny croziers, long cylindric-clavate, gradually tapering to the base and there becoming expanded to form a tiny foot, wall ca 1μm thick, enlarged at the papillate to subtruncate apex and there 2-3μm thick, pore weakly J+. Ascospores (11-)12-15(-16)x(2.5-)3-4μm, obliquely uniseriate to irregularly biseriate, hyaline, smooth, aseptate, ellipsoid to subfusoid, anterior ends rounded, posterior ends pointed, in outline inequilateral, flattened on one surface, anterior end broader, posterior end frequently becoming slightly drawn out; guttules probably present, internally

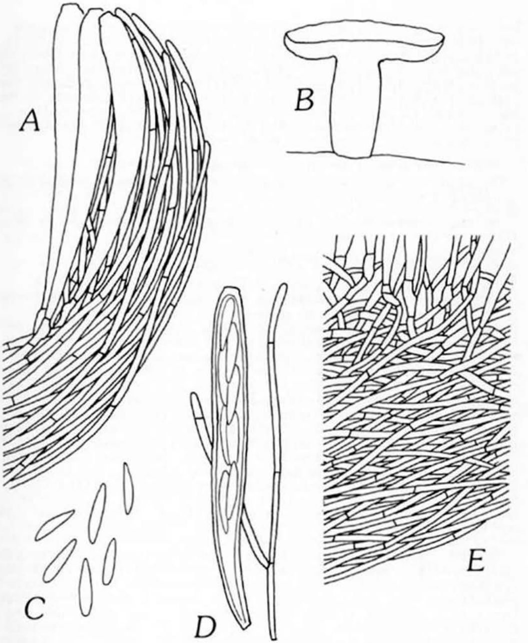


FIG. 2. *Hymenoscyphus cereus*, PACA 12645, freehand drawings. A. Median longitudinal section of apothecium through margin. B. Habit sketch of entire fruitbody on substrate. C. 6 ascospores drawn after discharge from the ascus. D. An ascus and paraphysis. E. Median longitudinal section of apothecium at approximately midpoint between margin and stipe. A, C, D, E x 1,000; B x ca 50.

with oily resinous material either filling the entire ascospore or becoming broken up and centralized in bipolar areas. Paraphyses equal to the asci, branched toward the base and septate, filiform becoming 2-3μm broad at the apex. Subhymenium not differentiated from the medullary excipulum.

Medullary excipulum not well developed, nearly absent in the flanks and undifferentiated from the outer ectal excipulum, entire region hyaline, individual hyphae 1-2µm wide. Ectal excipulum undifferentiated into inner and outer regions, very simple, grading into the medullary excipulum, details somewhat obscured, composed of a small-celled textura porrecta, the individual hyphae ca 2-3(-4)µm wide. Margin constructed similarly to the flanks below, slightly broader above than below, entire region hyaline. Stipe constructed as the lower portion of the receptacle, to the outside the hyphae occasionally pigmented light brown.

Habitat: On veins of leaves of Tiliaceae, perhaps *Luhea*.

Etymology of the specific epithet: refers to the waxy appearance of the apothecia in fresh condition.

Holotype (presumed): Ciboria cerea - Brazil, São Leopoldo, in foliis Tiliaceae "(Inhea)", Braun, 1929 s.n. (PACA 12645).

Illustrations: Dennis, Kew Bull. 14: 124, fig. 12. 1960.

NOTES. *Ciboria cerea* was originally described by Rick (1931) from Brazil as occurring on leaves. It was transferred first by Dennis (1960a) to *Helotium*, then to *Hymenoscyphus* (Dennis, 1964), a decision with which I concur. The species is most easily distinguished from all other species of neotropical *Hymenoscyphi* by the rather simple, homogeneous construction of the sterile tissue of the apothecium and by the resinous-oily material in the spores. The hyphae comprising the sterile tissue are 1-2(-3)µm wide and basically undifferentiated between the subhymenium, medullary excipulum and ectal excipulum. Since all of the tissue is a textura porrecta and lacks any globose or angular cells, it appears to be most closely related to the species in the *H. caudatus* group rather than the *H. epiphyllus* group, which has globose cells in the stipe and frequently in the lower portion of the flanks.

20. *Helotium chromo-flavum* Rick, Brotéria, Sér. Bot. 25: 114. 1931.

NOTES. *Helotium chromo-flavum* was described on leaves from south Brazil. Dennis (1960a) redescribed and illustrated the species, but declined to express an opinion on the taxonomic position of the species owing to the lack of adequate material for study. Dumont (1974) re-examined the type and found the species to be an older name for *Lambertella phaeoparaphysata* Dumont, and transferred the species to *Lambertella*. I have concluded from the present studies that still another name, *Helotium spadiceo-atrum*, is even older, and the actual transfer to *Lambertella* is made below. For a full description, illustrations and discussion on relationships, see Dumont (1971), as *L. phaeoparaphysata*.

21. *Helotium citrinum* (Hedwig ex Purton) Fries, Summa veg. Scand. p. 355. 1849.

NOTES. *Helotium citrinum* has been reported several times from throughout the neotropics, such as Montagne (1853) from Chile, Patouillard & Lagerheim (1893) from Ecuador, Duss (1903) from Guadeloupe, etc. It is very common in temperate regions and until recently it was generally referred to the genus *Calycella*, but according to Korf & Carpenter (1974) it must now be called *Bisporella*. Carpenter & Dumont (1978) have presented a review of the common neotropical species of *Bisporella*, and the species will not be treated further here.

22. *Helotium conocarpi* Seaver & Waterston, Mycologia 34: 517. 1942.

NOTES. *Helotium conocarpi* was originally described on leaves from Bermuda by Seaver & Waterston and transferred to *Moellerodiscus* by Dumont (1976). For a complete description and illustrations, see Dumont (1976). I agree with the placement of the species in *Moellerodiscus* and will not treat it further here.

23. *Helotium crocatum* (Montagne) Le Gal, Prod. Flore Mycol. Madagascar 4: 347. 1953. FIGS. 3, 4.

≡ *Peziza crocata* Montagne, Ann. Sci. Nat. Bot., Sér. 2, 13: 207. 1840.
≡ *Hymenoscyphus crocatus* (Montagne) Kuntze, Revis. gen. Pl. 3(3): 485. 1898.
≡ *Poculum crocatum* (Montagne) Dumont in Dumont & Pal, Mycologia 70: 85. 1978.

Stroma — Substratal, on the host petiole easily visible as blackened areas, forming a discontinuous rind with epidermoid to irregular cells as seen in face view; in section rind cells visible at base of stipe of apothecium; not known in culture.

Macroconidial state — Unknown, presumed absent.

Microconidial state — Unknown.

Apothecial morphology — Apothecia variable, scattered along the petiole of host leaf and arising in association with and from blackened areas, stipitate, 0.5-1.5mm in diam, to ca 1.0 high, disc when fresh, dry, and rehydrated flat; hymenium, receptacle, margin, and upper portion of stipe when fresh yellow, drying and rehydrating pallid to translucent; base of stipe blackened.

Apothecial anatomy — Asci 8-spored, ca 100-125x8-10µm, presence or absence of croziers not determined, long-cylindric, gradually tapering toward the base and there details obscured, wall 1-2µm thick, enlarged at the rounded to subtruncate apex and there 2-3(-4)µm thick; pore reaction in Melzer's Reagent not determined. Ascospores (20-)21-23(-25)x2.5-3.5(-4)µm, generally biseriate throughout or less commonly irregularly and obliquely uniseriate, hyaline, smooth, aseptate, ellipsoid to subfusoid, in outline inequilateral, flattened on one surface or curved and the anterior end broader and constricted in lower portion of spore, guttular condition uncertain, possibly with two polar guttulate areas composed of one large guttule or one broken into smaller ones; anterior end of spore frequently somewhat "flared." Paraphyses present, but details uninterpretable. Subhymenium apparently undifferentiated from medullary excipulum. Medullary excipulum poorly developed and differentiated from subhymenium, composed of narrow (to ca 2µm wide), more or less parallel hyphae originating in the stipe and nearly absent in the flanks. Ectal excipulum

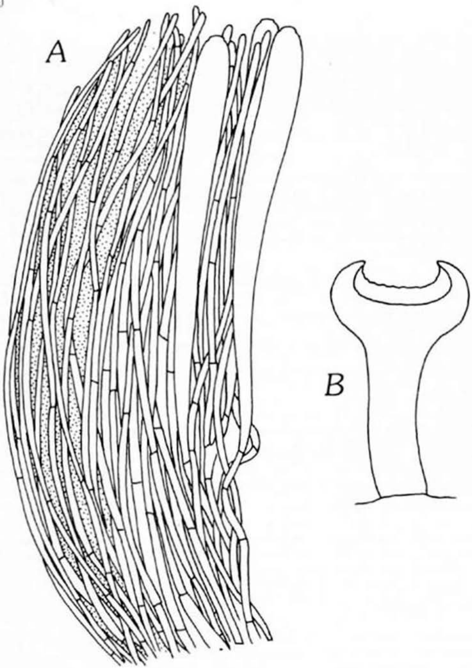


FIG. 3. *Poculum crocatum*, Leprieur 439 ex NY, freehand drawings. A. Median longitudinal section of apothecium through margin, x 1,000. B. Habit sketch of entire fruitbody on substrate, x ca 50.

highly refractive, doubtfully distinguished into inner and outer ectal excipulum, to ca 35μm broad toward the margin and slightly broader toward the stipe, composed of hyphae extending parallel or at a low angle to the surface of the apothecium and imbedded in a gelatinous matrix, the individual hyphae (3-)4-6(-8)μm wide; outer covering layer doubtfully present, but occasionally with the outermost cells of the outer ectal excipulum be-

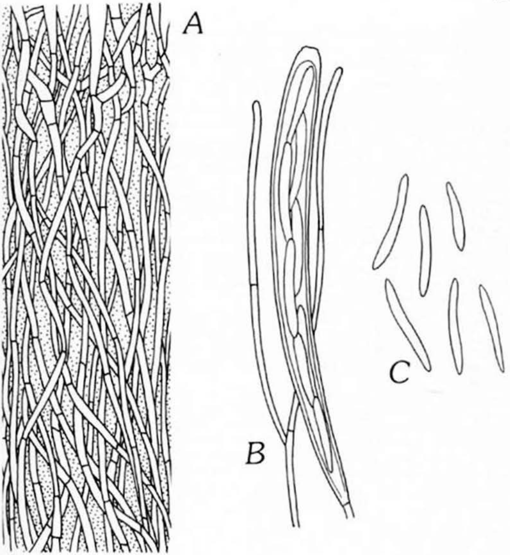


FIG. 4. *Poculum crocatum*, Leprieur 439, freehand drawings, x 1,000. A. Median longitudinal section of apothecium from base of asci through subhymenium, medullary excipulum, and ectal excipulum. B. An ascus with 8 ascospores and a paraphysis. C. 6 ascospores drawn after discharge from ascus.

coming lightly pigmented and slightly roughened. Margin constructed similarly to the ectal excipulum, but the hyphae narrower and the gel more prominent and more refractive than the tissue below, apical cells unmodified. Stipe with the outermost layer highly refractive and similar to the flank and to the inside the gel absent and with the hyphae 2-4μm wide; hairs not observed.

Habitat: On petiole of undetermined leaves.

Etymology of the specific epithet: refers to the yellow color of the apothecium in fresh condition.

Holotype: French Guiana, Sinnamarie, petioles of fallen leaves, Jan, Leprieur 439 (Montagne, Plantes cellulaires exotiques nouvelles Sér. II, no. 19, leg Leprieur. 439).

Illustration: Dennis, Kew Bull. 1954: 327, fig. 36. 1954.

NOTES. *Peziza crocata* was originally described on petioles of leaves from Surinam. Dennis (1954) reported the species from Jamaica, based on one of his own collections, (J72) which I have not seen, and later transferred the species to *Hymenoscyphus*. I have examined a portion of the original collection, Leprieur 439, deposited NY, and find it to be somewhat poorly preserved with many of the apothecia covered by an unidentified mold. Thus many of the microscopic features could not be studied adequately, and many of the observations are highly tentative and subject to change when additional material of the species is obtained and analyzed. Dennis (1954) in his study of the species reported the ascospores of the species to be 21-27x3µm, while I have found them to be (19-)21-23 (-25)x2.5-3.5(-4)µm.

As pointed out by Dumont and Pal (1978), a stroma is produced; the species is, therefore, referred to the Sclerotiniaceae, rather than the Helotiaceae (= Leotiaceae) as has been done generally. I agree that the species should be placed in *Poculum*.

Helotium atroviride Hennings was described on leaves from south Brazil. I have studied the lectotype collection (designated above) and conclude that it could possibly be a synonym of *Poculum crocatum*. However, as with the type of *P. crocatum*, I find the apothecia of *H. atroviride* to be somewhat poorly preserved and possibly slightly immature. In the original description, the apothecia were said to be "atroviridulo," but in the collection studied the apothecia were of a small, yellow, stipitate Discomycete. In the original description the ascospores were reported to be 15-21x3µm, but I have found only a very few approaching 20µm long. Also the ectal excipulum of *Poculum crocatum* is more obviously gelatinized than in the lectotype of *H. atroviride*, and the hyphae of *H. atroviride* are narrower than those of *P. crocatum*. Until more material of either is available, I am unable to understand the variation, and can only place *H. atroviride* into tentative synonymy with *P. crocatum*.

24. *Helotium crocinum* Berkeley & Curtis in Berkeley, J. Linn. Soc., Bot. 10: 369. 1869 ('1868').

NOTES. *Helotium crocinum* was described on twigs from Cuba and was based on a Wright collection, 374. I have examined a portion deposited in the Curtis collection at FH, and it is different from the one deposited at K. D. H. Pfister has ananotated the FH collection as a species of *Phillipsia*, with which I agree. The portion deposited at K was identified by Dennis (1954) as *Calycella citrina*, a decision with which I agree. The two portions of the Wright collection represent isotypes, and according to the International Code of Botanical Nomenclature, one must be selected as the lectotype. I designate the K portion of Wright 374 as the lectotype portion of *Helotium crocinum* Berkeley & Curtis as it agrees with the protologue, whereas the FH portion clearly represents another species not described in the protologue.

Dennis (1954) cited the basionym of this species as "*Peziza crocina* Berk. & Curt., J. Linn. Soc. Bot. 10: 369 (1868)." In the original description the species was actually cited "*H.* [*Helotium*] (*Calycella*) *crocinum* B. & C." For a full discussion of some neotropical species of *Calycella*, now referred to as *Bisporella*, see Carpenter & Dumont (1978).

Lectotype: Cuba, on twigs, C. Wright 374 (ex K, with the name "*Pez. crocina* B. & C." written on the packet).

25. *Helotium cupreum* Bresadola, Hedwigia 35: 295. 1896.

NOTES. *Helotium cupreum* was described on wood from Blumenau, Brazil, and was based on a Möller collection, 29c. Dennis (1954) indicated that he had not seen the type, and I have been unable to locate the type at the herbaria surveyed. I have, however, located another Möller collection, 54d, also collected on wood from Blumenau and identified by Bresadola as *Helotium cupreum*. The collection agrees with the protologue of *H. cupreum* and, I thus, designate Möller 54d, deposited at S, as the neotype collection. I have further compared the type specimen of *Helotium leucopse* with that collection and find them to represent the same species. Since *H. leucopse* has priority, I place *H. cupreum* into synonymy with it. For further discussion see *H. leucopse* below.

Illustration: Dennis, Kew Bull. 1954: 326, fig. 35 right. 1954.

Neotype: Helotium cupreum - Brazil, Blumenau, on wood, A. Möller 54d (ex S, slides deposited NY with Dumont number 3036).

Helotium cupreum was also reported from Brazil by Rick (1931), and there are five collections in his herbarium at PACA. One collection, Rick 13212, is marked "Typus," which it cannot be, since it was collected in 1905, and the species was described in 1896. Three collections 13217, 13218, 13226 are *Helotium leucopse*, while 13212 and 13219 represent a very distinct taxon, *Moellerodiscus musae* (Dennis) Dumont.

Additional specimens studied: Brazil: São Leopoldo, on wood, 1902, Rick (ex PACA 13212); São Leopoldo, on wood, 1904, Rick (ex PACA 13217); São Leopoldo, on wood, 1930, Rick (ex PACA 13218); São Leopoldo, on decorticated wood, Oct 1939, Rick (ex PACA 13219); São Leopoldo, decorticated wood, 1905, Rick (ex PACA 13226).

26. *Helotium discedens* Karsten, Hedwigia 28: 191. 1889.

NOTES. *Helotium discedens* was described on wood from Minas Geraes, Brazil, and was transferred to *Calycella* by Dennis (1954). Carpenter (1975) partially redescribed the species and transferred it to *Bisporella* as *B. discedens* (Karsten) Carpenter. He further gave an expanded synonymy and reported the species from Brazil, Guadeloupe, Haiti, Dominica, Philippines, Colombia, Venezuela, etc. Carpenter & Dumont (1978) have further discussed the species and its relatives in tropical America and have indicated that it is one of the most common species of Inoperculate Discomycetes encountered in the neotropics.

I have recently examined European specimens identified as *Bisporella sulfurina* deposited at PC and find them to be the same species which we were calling *B. discedens* from tropical America. I have been unable to locate the type of *B. sulfurina* and cannot place *B. discedens* into synonymy with it until a type has been located or a neotype designated. I must reserve final judgement until later, and here only suggest possible synonymy.

Illustrations: Carpenter, Mycotaxon 2: 125, fig. 1. 1975.

Specimens studied of B. discedens: see Carpenter & Dumont (1978).

Additional specimens studied and identified as Bisporella (Calycella) sulfurina: France: Dept. Saone & Loire, decorticated dead branches, date not given, J. Guillemin (ex PC, det. L. Quélet); Dept. Seine & Maire, branches of *Ulmus*, date not given, Mlle Decary (ex PC, det. Boudier); Dept. Loire & Cher, wood, Oct 1932, A. Buisson (ex PC, det. L. Quélet); Dept. Var, branches of *Quercus coccifera*, Dec 1925, A. de Crozals (ex PC, det. Quélet).

27. *Helotium discula* Ferdinandsen & Winge, Bot. Tidsskr. 30: 211. 1910.

NOTES. *Helotium discula* was described from Venezuela on wood. Dennis (1954) has indicated that he could not locate the type and that the fungus could be a lichen or at least a member of the Lecanorales. I have not been able to locate the type or authentic material of this species and from the description agree with Dennis.

28. *Helotium disseminatum* P. Hennings, Hedwigia 41: 25. 1902.

NOTES. *Helotium disseminatum* was described from Brazil on palm leaves. I have examined a portion of the type deposited at S and find it to be no *Helotium* at all, rather a species of *Orbilia*. The ectal excipulum is composed of large, angular to globose cells, and the asci are ca 30x2-3μm and generally flattened at the apex. The paraphyses appear to be expanded at the apex and there to 4μm wide. I have been unable to make out the details of the ascospores, which in the original description were said to be 5-7x1-1.5μm. I choose not to make a transfer of the species to *Orbilia* until the other neotropical species of the genus are better understood.

Holotype: Helotium disseminatum - Brazil, Sta. Catharina, Blumenau, A. Möller, palm leaves, 1892 (ex S).

29. *Helotium epiphyllum* (Persoon ex Persoon) Fries, Summa veg. Scand. p. 356. 1849. FIGS. 5, 6.

≡ *Peziza epiphylla* Persoon, Ann. Bot. (Usteri) 11: 30. 1794.
≡ *Peziza epiphylla* Persoon ex Persoon, Mycol. Eur. 1: 295. 1822.

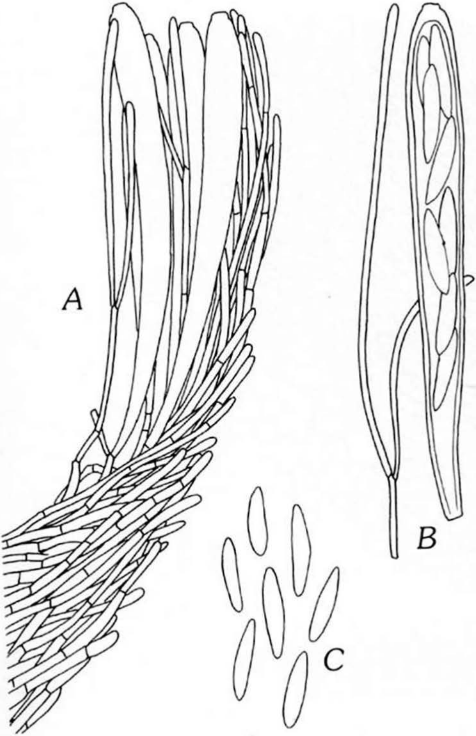


FIG. 5. *Hymenoscyphus epiphyllus*, CUP-ME 146, freehand drawings, x 1,000. A. Median longitudinal section of apothecium through margin. B. An ascus with 8 ascospores and a paraphysis. C. 7 ascospores drawn after discharge from ascus.

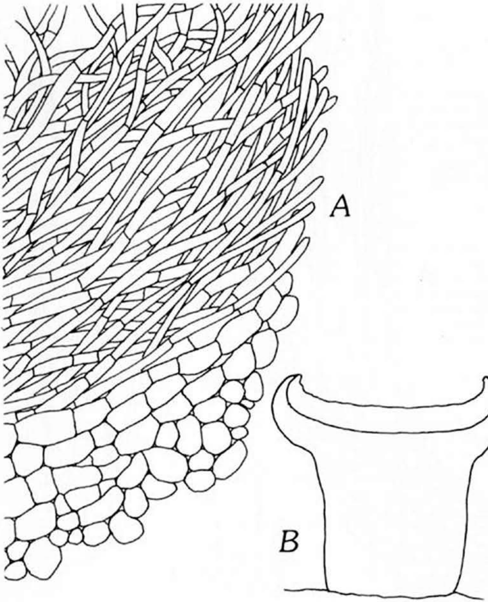


FIG. 6. *Hymenoscyphus epiphyllus*, CUP-ME 146, freehand drawings. A. Median longitudinal section of apothecium at a point in the flank just above the juncture of the receptacle and stipe, x 1,000. B. Habit sketch of entire fruitbody on substrate, x ca 50.

NOTES. *Helotium epiphyllum* is a common, subsessile, yellow to orange-yellow Inoperculate Discomycete found frequently throughout Europe and North America. I have attempted to locate the type of the species in the Persoon collection, but specimens identified as *Peziza epiphylla* contain no apothecial material, only sclerotia (which could be mistaken for subturbinate apothecia) of an undetermined fungus. I am thus following here the concepts of White (1943) and Dennis (1956), and I have not studied the species extensively and am uncertain of its morphological, anatomical variation and geographical distribution.

Helotium epiphyllum was reported from Guadeloupe by Duss (1903) and from Ecuador by Patouillard & Lagerheim (1895). I have been unable to locate the material upon which the Guadeloupe report was based, but have studied the Ecuadorian collection. The preservation of the material is such that exact identification is not possible, but I have observed in the ectal excipulum chains of globose cells which is suggestive of *Moellerodiscus*. The small ascospores, ca 4-5x1.5-2μm are reminiscent of *M. lentus*, a common neotropical species. For a complete discussion and illustration of *M. lentus*, see Dumont (1976).

I have studied two collections deposited in the Rick herbarium at PACA, 13207 and 13225, which were identified as *H. epiphyllum*, but neither represents this species. The ectal excipulum appears to be constructed similarly to *H. epiphyllum*, but the ascospores are too small, (7-)8-11(-13)x3-4μm. An additional collection (13220) identified as *H. epiphyllum* represents the same taxon. A fourth collection (13221) is somewhat poorly preserved, but may be the same taxon. The species is currently unknown to me, but is surely closely related to *H. epiphyllum*. Thus the collections upon which the previous reports of *H. epiphyllum* from the neotropics were based either cannot be located or represent still additional species. I have been unable to verify the occurrence of *H. epiphyllum* in the neotropics.

I have examined two collections (CUP-ME 144 & 146) from Mexico which may represent *H. epiphyllum*. These two collections are somewhat different from the limited concept of the species which I now have. My collections occur on pine needles and on leaves of *Quercus* sp. The apothecia have a longer stipe than expected for the species, but structurally they seem to represent *H. epiphyllum*. I present here a description of the species based on the two collections, in hopes that this may aid subsequent identification of the species in the neotropics.

Apothecial morphology — Apothecia variable, solitary, substipitate to subturbinate, to ca 2mm wide and ca 1.5mm high, colors not recorded in fresh condition, disc when dry slightly cupulate, rehydrating flat to slightly cupulate. Hymenium when dry flesh-colored to orange-yellow, rehydrating lighter and having a water-soaked appearance to pallid; margin concolorous with the hymenium; receptacle when dry off-white to gray-white, rehydrating lighter and lighter than the hymenium; stipe very broad in relation to diam of receptacle, concolorous with the receptacle when dry and rehydrated.

Apothecial anatomy — Asci 8-spored, 90-120x(9-)10-11(-12)μm, produced from croziers, long cylindric-clavate, gradually tapering towards the base and there not expanding to form a foot, wall ca 1μm thick, enlarged at the truncate apex and there 2-3μm thick; pore J+, the walls outlined faintly blue in Melzer's Reagent. Ascospores (16-)18-22(-24)x(3-)4-5μm, uniseriate throughout to less commonly biseriate above and uniseriate below, hyaline, smooth, aseptate, ellipsoid to subfusoid, ends rounded to slightly pointed, in outline inequilateral, flattened on one surface, both ends equal or anterior end slightly broader, guttules spherical to irregularly shaped, filling major portion of ascospore and generally separated by a narrow band of cytoplasm or with two large guttules and a broad band of cytoplasm in the central region of the spore. Paraphyses slightly exceeding the asci, internally hyaline or with yellowish golden, granular contents, branching at the base of the asci and towards the middle, septate, filiform, becoming slightly expanded at the apex and there 2-3µm wide, walls thin, smooth and hyaline. Subhymenium not well differentiated from the medullary excipulum, well developed, hyaline, in the center to ca to ca 30-40µm, consisting of generally loosely interwoven, more or less parallel, vertically oriented hyphae, the individual hyphae hyaline to rarely pigmented light brown, 1-3µm wide, the walls thin, hyaline and smooth. Medullary excipulum very well developed, comprising the vast majority of the apothecium, non-refractive, hyaline, consisting of sepate, branched, loosely interwoven (to parallel in the flanks and toward the margin) hyphae 1-2(-3)µm wide, the walls thin, non-refractive, hyaline and smooth. Ectal excipulum from base of stipe to margin constructed in the following manner: lower portion of apothecium composed of a zone to ca 50µm thick of angular to globose cells to the outside and to the inside composed of loosely to tightly interwoven hyphae 2-6(-8)µm wide, the individual cells hyaline to lightly pigmented with walls thin, hyaline and smooth; the outermost cells frequently giving rise to "hairs" 5-50µm long, 2-3µm wide at the slightly pointed apex, the walls thin to slightly thickened, hyaline, and smooth; in the flank the globose to angular cells replaced by narrow more or less parallel hyphae originating in the medullary excipulum, the hyphae towards the juncture with the stipe extending at high angles to the surface and becoming progressively at a lower angle toward the margin, lying parallel to the surface below the margin.

Specimens studied: Mexico, Oaxaca, in the vicinity of km 76, on the road from Oaxaca to Valle Nacional, on leaves of *Quercus*, 10 Aug 1967, K. P. Dumont s.n. (CUP-ME 144); data as 144, but occurring on pine needles (CUP-ME 146).

30. *Helotium flavo-aurantium* (Hennings) Rick, Brotéria, Sér. Bot. 25: 115. 1931.

≡ *Lanzia flavo-aurantia* Hennings, Hedwigia 41: 26. 1902.

NOTES. *Lanzia flavo-aurantia* was described on wood from south Brazil. It was transferred to *Helotium* by Rick (1931) and reported from Colombia by Cash (1937). I have examined a portion of the type deposited at S and conclude that it is the same as *Helotium rufo-corneum*. I, thus, place *Helotium flavo-aurantium* into synonymy with *H. rufo-corneum*, since the latter has priority. For a full discussion, see Dumont (1980).

The Cash (1937) report was based on a Martin collection, 3785, and is also *H. rufo-corneum*, a common neotropical lignicolous species.

Holotype: Lanzia flavo-aurantia - Brazil, Sta. Catharina, near Blumenau, A. Möller 259, wood, 26 Nov 1891 (ex S, herb Sydow).

Additional specimen studied: Colombia, Dpto. Magdelena, Sierra Nevada de Santa Marta, Cerro Quemado trial, G. W. Martin 3785, wood, 28 Aug 1935 (ex BPI as *Helotium flavo-aurantium*).

31. *Helotium fusco-brunneum* Patouillard & Gaillard, Bull. Soc. Mycol. France 4: 101. 1888. FIG. 7.

Stroma — Substratal, difficult to detect with the unaided eye, forming single or less commonly double black lines on the surface of the bark, or more easily observed when the wood is cut and then observed as dark lines just beneath the surface of the substrate and in association with the bases of the stipes of apothecia; the black lines composed of rind cells with differentially pigmented walls, irregular to epidermoid in face view; not known in culture.

Macroconidial state — Unknown, presumed absent.

Microconidial state — Unknown.

Apothecial morphology — Apothecia variable, scattered or gregarious, arising in association with black line stromata, substipitate, stipe length less than the diameter of the receptacle, 2-4mm in diam, to ca 1mm high, when fresh disc concave, drying flat to concave, drying flat to concave, rehydrating slightly concave; when fresh "toute la plate est d'un-rouxbrilliant," drying dark brick red to nearly black, when rehydrated in 2% KOH giving off a purple-red dye.

Apothecial anatomy — Asci 8-spored, 35-45x5-6µm, produced from small croziers, short cylindric-clavate, tapering toward the base and occasionally forming a small foot, wall thin to ca 1µm thick, at the rounded to subtruncate apex equal to side walls or slightly thicker; ascus reaction not observed. Ascospores 5-7x1.5-2.5µm, biseriate, obliquely uniseriate, or biseriate above and uniseriate below, hyaline, smooth, aseptate, ellipsoid or less commonly obovoid, ends rounded or slightly pointed, in outline inequilateral, flattened on one surface or commonly slightly curved, both ends more or less equal; guttules obscure, with two small, irregular, polar guttulate areas. Paraphyses equal to the tips of the asci, internally hyaline, branching towards the base of asci, sparingly septate, filiform, becoming slightly expanded at the apex and there 2-3µm wide, walls thin, smooth and hyaline. Subhymenium not well defined or differentiated from medullary excipulum, but with an indistinct zone beneath the base of the asci composed of hyphae slightly narrower and more compact than the medullary excipulum below, also with the zone pigmented light yellow-brown. Medullary excipulum well developed, well differentiated from the ectal excipulum and grading into the base of the asci, comprising the majority of the fruitbody, variable, non-refractive, hyaline or rarely slightly pigmented, consisting of loosely to tightly interwoven hyphae 3-7 µm wide, the walls thin or rarely thickened, smooth or rarely slightly roughened, hyaline to light brown. Ectal excipulum: inner ectal excipulum absent. Outer ectal excipulum well developed and well differentiated from the medullary excipulum, entire layer non-refractive, hyaline or pigmented light brown to the outside, very variable in thickness, and ca 20-45(-60) µm wide; consisting predominantly of a well-defined textura globulosa; the individual cells 4-8(-10)µm in diam, overlapping, frequently chain-like and oriented perpendicularly to the surface of the apothecium, globose to angular, the outermost cells light brown, to the inside hyaline, the walls thin to thickened, hyaline or pigmented, smooth or rarely roughened, the outermost cells unmodified; hairs absent. Margin constructed similarly to the receptacle, to the ouside with globose cells 4-6µm in diam, to the in-

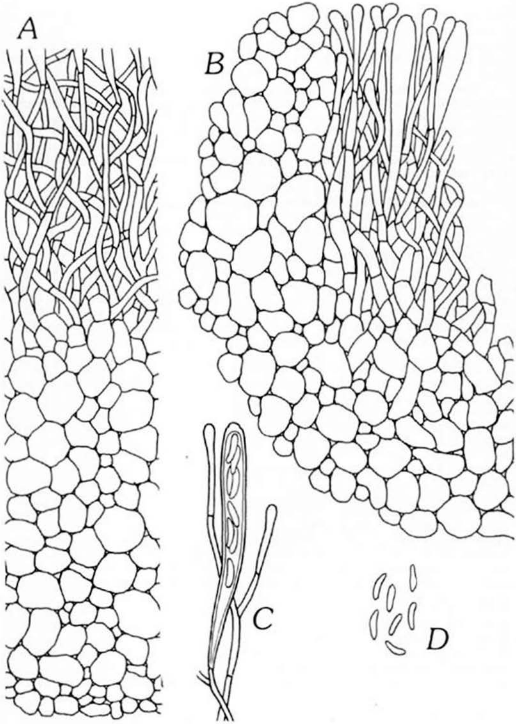


FIG. 7. *Moellerodiscus fusco-brunneus*, Gaillard 240, freehand drawings, x 1,000. A. Median longitudinal section of an apothecium at approximately midpoint between margin and stipe. B. Median longitudinal section of an apothecium through margin. C. An ascus with 8 ascospores and a paraphysis. D. 7 ascospores drawn after discharge from ascus.

side a zone to ca 15µm wide of narrow hyphae (paraphyses) terminating in expanded apical cells. Stipe constructed similarly to the receptacle, to the outside the outermost cells more intensely pigmented than those of the receptacle, and the internal hyphae maintaining a parallel orientation and only torn apart and interwoven in the center. Hairs absent.

Habitat: On wood.

Etymology of the specific epithet: refers to the color of the apothecium apparently in dry condition as the fruitbody was said to be reddish when fresh.

Holotype: Helotium fusco-brunneum - Venezuela, entre Maipures á San Fernando, sur ecorce d'arbre, 26 Août 87, Gaillard 240 (FH, PC).

Illustration: Le Gal, Discom. Madagascar p. 326, fig. 147. 1953.

NOTES. *Helotium fusco-brunneum* was described from wood in Venezuela. It was transferred to *Rutstroemia* by Le Gal (1953) who noted that the fungus produced a substratal stroma. Dennis (1970) transferred the species to *Ionomidotis* because the fruitbody yields a purple dye in ammonia. Since *Helotium fusco-brunneum* produces a stroma, I agree with Le Gal who placed the species in the Sclerotiniaceae, but conclude that it should be placed in the genus *Moellerodiscus* since the ectal excipulum is composed of a well developed textura globulosa to angularis and occurs on wood. The formal transfer is made here:

Moellerodiscus fuscobrunneus (Patouillard & Gaillard) Dumont, comb. nov.

Basionym: Helotium fusco-brunneum Pat. & Gail., Bull. Soc. Mycol. France 4: 101. 1888.

Within the genus *Moellerodiscus* there are two additional species which emit a purple or reddish purple dye in ammonia or 2% KOH, *M. musae* and *M. guttulatus*. In *M. guttulatus* the ascospores have two large obvious polar guttules which fill most of the spore, separated by a narrow band of cytoplasm; in *M. fuscobrunneus* the ascospores have two tiny, polar guttulate areas and lack the distinct guttules of the former species. *Moellerodiscus fuscobrunneus* appears to be most closely related to *M. musae*. Dumont (1976) reported the ascospores of *M. musae* to be (3-)4-5(-6)x1.5-2(-2.5)µm, while those of *M. fuscobrunneus* are reported to be 5-7x1.5-2.5µm. The two species are best separated on the basis of the different ascospore shapes. In *M. musae* they are equilateral in outline, ovoid to subellipsoid and have two well-defined polar guttules, while in *M. fuscobrunneus* they are generally inequilateral, generally flattened on one side and slightly curved, and lack well-defined guttules. Since both species are known to me from so few collections, I do not fully understand their morphological and anatomical variation. Should the ascospore shape prove to be variable and an unreliable character, then it is possible that the two really represent one variable taxon. Until more collections are studied, I maintain them as distinct species.

32. *Helotium fuscopurpureum* Rehm, Hedwigia 39: 94. 1900.

NOTES. *Helotium fuscopurpureum* was described on wood from Brazil by Rehm (1900) and was transferred to *Hymenoscyphus* by Dennis (1964). I have examined the holotype deposited at S and conclude that it is the same as *Helotium rufo-corneum*, which has priority. For full discussion, see Dumont (1980).

Holotype: Helotium fuscobrunneum - Brazil, Serra dos Orgaos, on wood, Oct 1896, E. Ule 2500 (ex S, herb Rehm).

Illustration: Dennis, Kew Bull. 1954: 329, fig. 38. 1954.

33. *Helotium gedeanum* Dennis, Kew Bull. 1954: 322. 1954.
FIG. 8.

≡ *Cudoniella javanica* P. Hennings, Monsunia 1: 173. 1899.

NOTES. *Cudoniella javanica* was originally described by Hennings from Java. Dennis (1954) demonstrated that it should be placed in *Helotium*, but the name was preoccupied by a Penzig and Saccardo epithet. He proposed the new name *Helotium gedeanum* Dennis, and later transferred it to *Hymenoscyphus* as *H. javanicus* (Hennings) Dennis. Neither Dennis nor I have been able to locate the type of *C. javanica*.

Dennis (1954) reported the species from Jamaica based on one of his collections, Dennis J50, and provided a description and illustrations of the species. He described the ectal excipulum as being composed of tightly interwoven hyphae, which appear almost pseudoparenchymatous in section and covered by brown, thin walled hairs. In his illustrations, he pictures the individual cells as having their long axis parallel to the surface of the apothecium, and forming a well-layered textura prismatica.

The excipulum of this species is complex and difficult to interpret, and my observations differ somewhat from those of Dennis. It is my impression that the hyphae of the medullary excipulum are comprised of well-defined and loosely arranged textura intricata, and toward the outside the hyphae become more and more tightly compact, with some of the hyphae maintaining hyphal-orientation while others lose this orientation and the hyphae become disrupted, and the resulting structure is of irregular to globose cells. The outermost ca 100μm is then composed of very refractive individual cells maintaining a perpendicular orientation to the surface and individual hyphae which appear to be disoriented and contorted. The outside of the surface is covered with "hairs" which are lightly pigmented, strongly clavate, often capitate, or cylindric.

The structure is similar to that described for *Chlorencoelia* by Dixon (1975). According to this interpretation, Dennis's collection of *Hymenoscyphus javanicus* cannot be *Hymenoscyphus* as defined here. Since I have not located the type of this species, I cannot determine if the type is, in fact, an *Hymenoscyphus*. I am not now ready to propose a new type for *C. javanica* and thus merely question the report of *H. javanicus* from the neotropics. Should the Dennis collection turn out to be the same as the type, it will then be placed in a genus other than *Hymenoscyphus*.

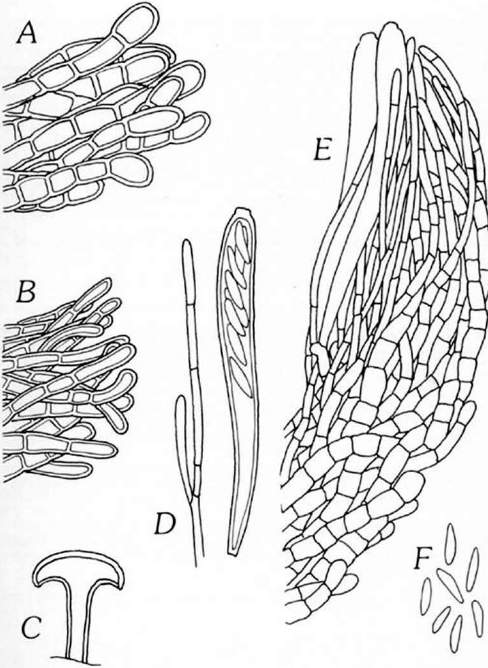


FIG. 8. *Helotium gedeanum*, Dennis J 50, freehand drawings. A. Hyphae on the surface of the stipe. B. Hyphae from the surface of the receptacle. C. Habit sketch of entire fruitbody (redrawn from Kew Bull. 1954: p. 322). D. An ascus with 8 ascospores and a paraphysis. E. Median longitudinal section of an apothecium through margin and upper portion of flank. F. 7 ascospores drawn after discharge from the ascus. A, B, D-F x 1,000; C, x ca 50.

The structure of the ectal excipulum is the same as that described by Dixon for *Chlorencoelia*. I have observed two short stipes and receptacles arising from a common larger stalk, but have not observed an ionomidotic reaction. However, I did see a yellow-brown dye given off in 2% KOH. The hymenium of the Dennis collection is dark brick-red, while the receptacle and stipe are blackish. With the combination of small asci, small ascospores, the complex excipulum described above, the characteristic tomentum hyphae, I refer the collection to *Chlorencoelia*. According to Dixon, this genus is separated from *Cordierites* by the lack of an ionomidotic reaction. I should also mention that the structure of the apothecium is very similar to *Bisporella*, which has a yellow color and lacks the hairs of *Chlorencoelia*.

Specimen studied: Jamaica, Blue Mountains, Mossman's Peak, logs, 22 Dec 49, R. W. G. Dennis J50 (ex K).

Illustration: Dennis, Kew Bull. 1954: 322, fig. 31. 1954.

34. *Helotium hyphicola* P. Hennings, Hedwigia 44: 69. 1905.

NOTES. *Helotium hyphicola* was described on twigs covered with hyphae of *Asterula corniculariiformis* from Amazonian Brazil. In the original description Hennings (1905) cited two collections, Ule 2829 and 2865, but did not designate either as the holotype. I have examined both collections deposited at HBG and conclude that they both represent the same taxon. I hereby designate Ule 2829 as the lectotype specimen of *Helotium hyphicola*. This collection was chosen instead of the other because it contains more apothecia.

This species is the same as what Carpenter & Dumont (1978) referred to as *Bisporella discedens*, which, as is suggested in this paper, is the same as *Bisporella sulfurina*.

Specimens cited: Brazil: Amazonas, Rio Jurua Mirim, dead wood, Oct 1901, Ule 2829 (Lectotype specimen of *Helotium hyphicola*, ex HBG); Amazonas, Rio Jurua Mirim, rotten wood, Oct 1901, Ule 2865 (syntype and now lectoparatype of *Helotium hyphicola*, ex HBG).

35. *Helotium irregulare* Rick, Brotéria, Sér. Bot. 25: 110. 1931.

NOTES. *Helotium irregulare* was described on wood from south Brazil. Dennis (1960a) mentioned a problem regarding reading the date on the label of the type of *H. irregulare*, deposited at PACA. The species was described in 1931 and Dennis interpreted the date to read "1939". I have concluded that the date should read "1929" and that the specimen deposited at PACA, 13213, and marked "Cotypus" is, in fact, the holotype specimen for *H. irregulare*.

Dennis suggested that *H. irregulare* could be synonymous with *H. leucopse*. I agree with him, and the latter name has priority. For full discussion, see notes under *H. leucopse* below.

Holotype: Helotium irregulare - Brazil, São Leopoldo, wood, June 1929, Rick (ex PACA 13213).

36. *Hymenoscyphus javanicus* (P. Hennings) Dennis, Persoonia 3: 77. 1964.

NOTES. See *Helotium gedeanum* for full discussion.

37. *Hymenoscyphus lasiopodius* (Patouillard) Dennis, Persoonia 2: 190. 1962.

≡ *Belonidium lasiopodium* Patouillard, Bull. Soc. Mycol. France 16: 184. 1900.

NOTES. According to Dumont & Carpenter (1981), *Hymenoscyphus lasiopodius* appears to be a common and widely occurring neotropical species. See Dumont & Carpenter for full description, discussion and illustrations.

38. *Helotium lasseri* Dennis, Kew Bull. 14: 432. 1960.
FIGS. 9, 10.

Stroma — Substratal, on the host difficult to detect with the unaided eye, visible in section as rind cells at the base of the stipe of the apothecium or as blackened areas of the host; the rind cells with differentially pigmented walls, epidermoid to irregular in face view; not known in culture.

Macroconidial state — Unknown, presumed absent.

Microconidial state — Unknown.

Apothecial morphology — Apothecia solitary, stipitate, 1-2mm in diam, 0.5mm high, when fresh disc concave, drying concave to flat, rehydrating concave to flat. Hymenium when fresh pallid, drying pinkish brown, rehydrating lighter; margin when fresh pallid, drying dirty white, rehydrating pallid to subtranslucent; receptacle when fresh pallid, drying white to off-white, rehydrating lighter; stipe cylindrical and short above, when fresh, dry, and rehydrated concolorous with the receptacle, darker below.

Apothecial anatomy — Asci 8-spored, (70-)75-85(-90)x(8-)9-11µm, produced from tiny croziers, clavate, gradually tapering towards the base and there forming a tiny foot, wall ca 1µm thick, enlarged at the rounded to truncate apex and there 2-3µm thick; pore J-. Ascospores (9-)10-11(-12)x 4-5µm, uniseriate to biseriate above and uniseriate below, in youth hyaline, smooth, aseptate, ellipsoid, ends rounded, in outline slightly inequilateral or rarely flattened on one side, both ends more or less equal or anterior end slightly broader; guttules poorly defined or obvious, two more or less equal or with anterior one slightly larger, irregularly shaped, large 1-2µm wide, polar or with two irregular guttulate areas; apparently discharged from the ascus while hyaline, becoming lightly pigmented after discharge, generally maintaining same shape or becoming slightly more expanded; guttules becoming more difficult to detect; walls faintly punctate; a few pigmented, punctuate, collapsed ascospores observed in apparently malfunctioning asci. Paraphyses equal to or slightly exceeding the asci, internally hyaline, branching at the base of the asci and toward the middle, rarely branching toward the apex, septate, filiform, becoming slightly expanded at the apex and there 1-2µm wide; walls

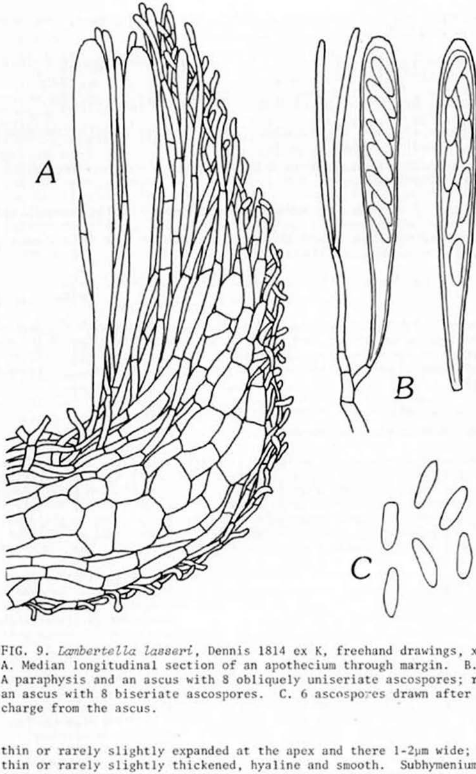


FIG. 9. *Lambertella lasseri*, Dennis 1814 ex K, freehand drawings, x 1,000. A. Median longitudinal section of an apothecium through margin. B. Left: A paraphysis and an ascus with 8 obliquely uniseriate ascospores; right: an ascus with 8 biseriate ascospores. C. 6 ascospores drawn after discharge from the ascus.

thin or rarely slightly expanded at the apex and there 1-2μm wide; walls thin or rarely slightly thickened, hyaline and smooth. Subhymenium well developed, pigmented light brown, in the center to ca 25μm wide, as narrow as 15μm at the margin, at the base of the asci consisting of generally very loosely interwoven, parallel, vertically oriented hyphae or towards

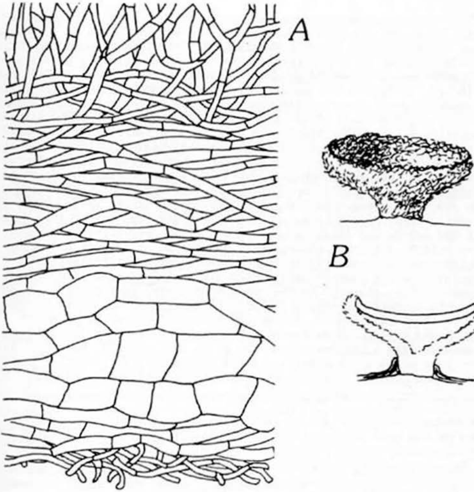


FIG. 10. *Lambertella lasseri*, Dennis 1814 ex K, freehand drawings. A. Median longitudinal section of an apothecium at approximately midpoint between margin and stipe, x 1,000. B. Upper: habit sketch of apothecium on substrate; lower sketch of section of apothecium showing distribution of tissues, redrawn from Dennis (1960), x ca 50.

the medullary excipulum a narrow zone of hyphae extending parallel to the base of the asci, the individual hyphae lightly pigmented to hyaline, 1-2 µm wide, the walls thin to slightly thickened, pigmented, smooth or rarely roughened. Medullary excipulum poorly developed and nearly absent in the flanks, obconical, non-refractive, hyaline to pigmented light brown, consisting of septate, branched, loosely to moderately tightly interwoven (to parallel in the flanks) hyphae 2-5µm wide, the walls thin to slightly thickened, non-refractive, hyaline or pigmented light brown and smooth. Ectal excipulum: inner ectal excipulum well-defined and well-differentiated from outer ectal excipulum and medullary excipulum, entire layer non-refractive, lightly to moderately pigmented brown, to ca 8-10µm wide towards the margin and to ca 20µm wide towards the stipe, consisting of loosely to tightly compact, parallel to slightly interwoven, lightly to intensely pigmented hyphae 2-3(-4)µm wide, the walls thin, non-refractive, pigmented, smooth to rarely slightly roughened. Outer ectal excipulum non-refractive, non-gelatinized, entire layer hyaline to occasionally lightly pigmented, ca 15μm broad towards the margin and to ca 20-30μm wide toward the stipe, consisting predominantly of textura prismatica with the individual hyphae extending parallel to or at low angles to the surface of the apothecium; the individual cells towards the margin (5-)8-15x3-5(-8) μm, (8-)10-16(-22)x(5-)8-12μm towards the stipe, the walls thin, hyaline and smooth. Outer covering layer present, the individual hyphae extending parallel to the surface of the apothecium, overlapping, hyaline to more commonly pigmented light brown, the walls non-refractive, thin, generally lightly pigmented and smooth or rarely finely roughened. Hairs present, originating from intercalary cells of the outer covering layer, clothing the surface of the apothecium, individually short or long, becoming tightly interwoven and details becoming obscured and frequently appearing cellular and filamentous. Margin poorly developed, narrow above, broader below, entire layer light brown to intensely pigmented, constructed similarly to the apothecial flank below, the individual cells smaller, the narrow hyphae between the brick-shaped cells and the layer of asci and paraphyses becoming more intensely pigmented than the corresponding layer below. Stipe in the upper portion constructed similarly to the apothecial flank; at approximately midpoint to the outside an outer covering layer of narrow hyaline to pigmented hyphae with walls thin, pigmented, smooth to roughened, to the inside a zone of parallel hyphae with hyaline to brown, brick-shaped cells with walls thin, hyaline to brown, smooth to roughened and grading into a pigmented zone comprised of longer and narrower cells in the central core; rind cells visible at the base of the stipe at the junction with the substrate; hairs present, as on the receptacle.

Habitat: Leaves and twigs of small trees in the Melastomataceae.

Etymology of the specific epithet: refers to Dr. Tobias Lasser, the Director of VEN when Dr. Dennis, the collector of the type, collected in Venezuela.

Holotype: Helotium lasseri - Venezuela, west ridge of El Avila, above Caracas, Dto. Federal, leaves and shoots of small trees in Melastomataceae, 17 Aug 1958, R. W. G. Dennis 1814 (K).

Illustrations: Dennis, Kew Bull. 14: 432, fig. 4. 1960.

NOTES. *Helotium lasseri* was described on leaves and twigs from Venezuela and was transferred to *Hymenoscyphus* by Dennis (1964). In his original description Dennis (1960) indicated, "This is certainly not a typical *Helotium*..." With the presence of a stroma on the host, I conclude that it is a member of the Sclerotiniaceae, and because of the presence of pigmented and punctate ascospores, I place the species into *Lambertella*. In general, my other observations agree with those of Dennis (1960), but the single apothecium which I studied was perhaps somewhat poorly preserved, and some of my observations of the sterile tissue are thus subject to modification as more material is available for study of this species.

The species appears to be most closely related to *Lambertella tropicalis*, which has subreniform ascospores, 12-14x4-6 μm, and is most easily distinguished from the other species by the following combination of characters: J- asci, tightly interwoven hairs clothing the surface of the apothecium and ascospores (9-)10-11(-12)x4-5μm. I propose here the formal transfer to *Lambertella*:

Lambertella lasseri (Dennis) Dumont, comb. nov.

Basionym: Helotium lasseri Dennis, Kew Bull. 14: 432. 1960.

39. *Helotium leucopse* (Berkeley & Curtis) Le Gal, Prod. Flore Mycol. Madagascar 4: 335. 1953. FIG. 11.

≡ *Peziza leucopsis* Berkeley & Curtis in Berkeley, J. Linn. Soc., Bot. 10: 368. 1868.

≡ *Hymenoscyphus leucopsis* (Berkeley & Curtis) Kuntze, Revis. gen. Pl. 3(3): 485. 1898.

Apothecial morphology — Apothecia variable, solitary to gregarious, stipitate, 4-7mm in diam, 2-4mm high, when fresh disc variable, characteristic, flat, irregular, convex, umbilicate, margin reflexed, wavy, lobed, drying strongly convex-umbilicate, rehydrated remaining convex. Hymenium when fresh variable, copper-colored, yellowish, pallid, off-white, drying pallid to flesh-colored, rehydrating pallid subtranslucent to light brown; margin generally concolorous with hymenium; receptacle generally slightly lighter than or concolorous with hymenium when fresh, dry or rehydrated; stipe in the upper portion concolorous with the lower portion of the receptacle, becoming dark brown towards the base of the stipe.

Apothecial anatomy — Asci 8-spored 38-52x4-5µm, produced from small croziers, cylindric-clavate, gradually tapering to the base and there forming a tiny foot or not; wall thin (less than 1µm), slightly enlarged at the rounded apex and there to ca 1µm thick; pore J+, the walls outlined blue in Melzer's Reagent. Ascospores (4-)5-7(-9)x1.5-2(-2.5)µm, obliquely uniseriate or biseriate above and uniseriate below, hyaline, smooth, aseptate, obovoid, pyriform, slipper-shaped, ends generally rounded or rounded above and slightly fusoid below, in outline generally equilateral, anterior end broader than posterior end; guttules generally present as two guttulate, indistinct, polar areas, anterior areas generally larger than posterior. Paraphyses equal to or rarely exceeding the asci, internally hyaline, branching at the base of the asci, septate, filiform, not noticeably expanded at the apex and there 1-2(-3)µm wide, walls thin, smooth, and hyaline. Subhymenium well-developed and well-differentiated from the medullary excipulum, hyaline or less commonly light yellow-brown, in the center to ca 30µm thick, as narrow as 15µm toward the margin; consisting of very tightly interwoven hyphae; the individual hyphae losing hyphal orientation and appearing cellular in many areas, hyaline or rarely light brown, 1-2µm wide, the walls thin, smooth and generally hyaline. Medullary excipulum well developed, obconical, non-refractive, hyaline, consisting of septate, branched, loosely to tightly interwoven (to parallel in the flanks and towards the margin) hyphae 3-7(-8)µm wide, the walls thin, hyaline, and smooth. Ectal excipulum: inner ectal exipulum absent. Outer ectal excipulum well developed, undifferentiated, grading into the medullary excipulum to the inside, entire layer non-refractive to slightly refractive, hyaline, to ca 30µm wide toward the margin and to 60µm wide toward the stipe, consisting of textura porrecta to a small celled textura prismatica with the individual hyphae tightly compact, frequently undulating, extending more or less parallel to the surface of the apothecium and parallel to each other or slightly interwoven, the individual cells towards the margin 5-22x3-4(-5)µm, toward the stipe the cells similar to those toward the margin or only slightly longer, the walls thin, or less commonly slightly thickened, hyaline or rarely pigmented light brown, but the outermost hyphae of the outer ectal excipulum occasionally lightly pigmented, brown and smooth. Outer covering layer absent. Hairs absent.

Margin simple, poorly developed, narrower above and broader below, entire layer hyaline or lightly pigmented yellow-brown, constructed similarly to the apothecial flanks below, the apically free cells unmodified. Stipe in the upper portion constructed similarly to the lower portion of the receptacle, below midpoint of the stipe and to the outside becoming lightly pigmented and becoming increasingly more intense toward the base of the stipe, the individual cells to the outside also frequently slightly rounded; rind cells absent. Hairs absent.

Habitat: On decorticated wood.

Etymology of the specific epithet: refers to the white color of the apothecium.

Holotype: Peziza leucopsis - Cuba, on dead wood, (date not indicated), C. Wright 372 (K).

Types of taxonomic synonyms: Holotype of *Helotium irregulare*: Brazil, São Leopoldo, on wood, 1929 (see notes below), Rick (ex PACA 13213). Neotype of *Helotium cupreum*: Brazil, São Leopoldo, on wood, Möller 54d (S).

Illustrations: Dennis, Kew Bull. 1954: 326, fig. 35 left. 1954. Dennis, Kew Bull. 1954: 326, fig. 35 right. 1954 (as *Helotium cupreum*). Le Gal, Prod. Flore Mycol. Madagascar 4: p. 336, fig. 150. 1953.

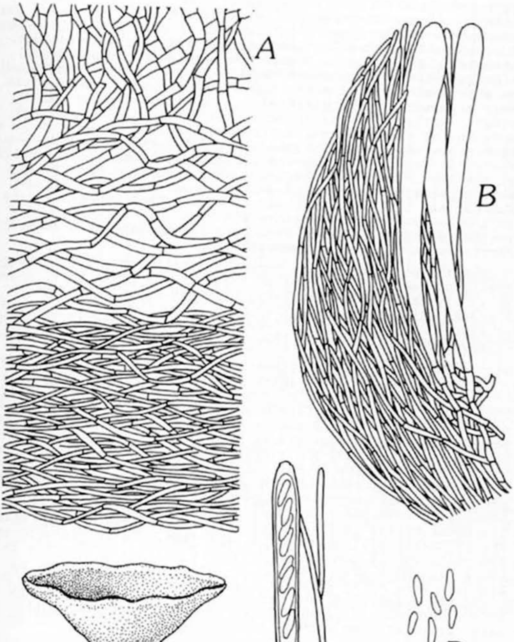
NOTES. Peziza leucopsis was originally described from Cuba by Berkeley & Curtis in Berkeley (1869), was based on a Wright collection 372, and was later transferred to *Hymenoscyphus* by Kuntze (1898) and to *Helotium* by Le Gal (1953). Dennis (1954) suggested that another neotropical *Helotium* might be closely related to it, *Helotium cupreum*, and further suggested that *H. irregulare* and *H. cupreum*..."ought probably to be reduced to synonymy under *H. leucopse*..." Dennis (1964) did, however, recognize at least two of these as distinct species, *H. leucopse* and *H. cupreum*, and placed them into *Hymenoscyphus*.

I agree with Dennis that the species should be placed in *Hymenoscyphus*, but after having examined the types of both *Helotium irregulare* and *H. cupreum*, I concluded that both are later taxonomic synonyms of *H. leucopse*, which has priority. I am uncertain as to its other affinities in the genus. The following combination of characters make this species readily separate from other species in the genus: small, obovoid to pyriform ascospores, undifferentiated ectal excipulum composed of narrow, parallel to undulating hyphae, its occurrence on wood, and large irregular apothecia.

40. *Helotium leucopus* Montagne in Gay, Historia Física y Política Chile, Botánica 7: 410. 1853.

NOTES. Helotium leucopus was described from Chile on leaves of *Persea lingue*, and in the original description nei-

FIG. 11. *Hymenoscyphus leucopsis*, Wright 372 ex K, freehand drawings. A. Median longitudinal section of an apothecium at approximately midpoint between margin and stipe. B. Median longitudinal section of an apothecium through margin. C. An ascus with 8 ascospores and a paraphysis. D. 6 ascospores drawn after discharge from the ascus. E. Habit sketch of apothecium on substrate. A-D x 1,000; E x ca 50.


A
B
C
D
E

ther ascospore nor ascus measurements were given. Dennis (1961) reported the species from New Zealand and reported the ascospores in the type collection and in the one from New Zealand to be 18-22x4-5.5µm and to contain 4-6 well developed guttules. According to Dennis the species was thus very closely related to *Hymenoscyphus caudatus*. I have attempted to borrow the type of *H. leucopus* from PC, but have received only a photocopy of a plate with no apothecial material to study. Without type or authentic material to study, I must rely on the original description and Dennis's comments. If as Dennis has suggested, *H. leucopus* and *H. caudatus* can be separated by the guttules in the ascospores, then we must consider the two as distinct species. Dumont & Carpenter (1981) have reported *H. caudatus* from Venezuela, Colombia, Panama, Ecuador and southern Peru, and concluded that the ascospores in the neotropical collections did, in fact, have guttules. If this is the case, then ascospore guttulation is a doubtful criterion to be used in separating the two.

Until type or authentic material is available for *H. leucopus*, I can only consider it as a possible synonym of *H. caudatus*. If, in the final analysis they are demonstrated to be the same, then the epithet "*leucopus*" must be adopted, since it has priority. *Helotium leucopus* was described in 1853 and *H. caudatum* by Karsten in 1866.

41. *Helotium lividum* Montagne in Gay, Historia Física y Política Chile, Botánica 7: 407. 1853.

NOTES. *Helotium lividum* was described from Chile as occurring on leaves of *Aextoxicum punctatum*. I have examined the presumed holotype deposited at PC and find the specimen very poorly preserved, and the single apothecium studied possibly attacked by a member of the Fungi Imperfecti. In the majority of the sterile tissue, I have not been able to determine the specific tissue composition and details of the hyphae. The medullary excipulum is composed of interwoven hyphae, while the ectal excipulum is composed of long, narrow hyphae, which are generally collapsed in this specimen. It is probable that the excipulum is composed of either a textura prismatica or porrecta, and I have seen no indication of a gelatinous matrix. I have noted a rather high proportion of misshapen and contorted ascospores, but the normal ascospores seem to be 4-6x2(-3)µm, obovoid, biguttulate, the ends were frequently slightly pointed to rounded and hyaline with no indication of pigmentation.

The apothecia on the leaves were substipitate with a very short stipe. I detected black line stromata extending irregularly along the surfaces of the leaf blade, and in section, I have seen well developed rind cells at the base of the stipe attached to the leaf. I conclude, therefore, that the species belongs in *Lanzia* in the Sclerotiniaceae and propose the formal transfer:

Lanzia livida (Montagne in Gay) Dumont, comb. nov.

Basionym: Helotium lividum Montagne in Gay, Historia Física y Política Chile, Botánica 7: 407. 1853.

Because of the state of preservation of the type specimen, I am unable to determine to what species *Lanzia livida* is most closely related or what its closest relatives are. Because of the small size of the ascospores, *L. livida* could be confused with *Lambertella microspora*, which has lightly pigmented ascospores. *Lanzia livida* could also be confused with *Helotium leucopse*, which also has small ascospores, but occurs on wood. In *L. livida* a stroma is produced, but it is absent in *H. leucopse*.

Presumed holotype: Helotium lividum - Chile, Valdivia, leaves of *Aextoxicum punctatum*, date not given, M. Gay s.n. (PC).

42. *Helotium lobatum* Starbäck, Bih. Kongl. Svenska Vetensk. Akad. Handl. 25(3,1): 5. 1899.

NOTES. *Helotium lobatum* was originally described on wood from south Brazil and was subsequently reported again from Brazil by Rick (1906, 1907, 1931) and appears to be a widely distributed neotropical species. Dennis (1954) tranferred the species to *Encoelia*; however, I am not prepared to transfer it to *Phibalis*, which was shown by Korf & Kohn (1976) to be an older name for *Encoelia*, since that generic name has been proposed as a *nomen rejiciendum*. I am uncertain as to the current circumscription of *Encoelia*, and this species further shows affinities to *Mollisia*. I thus, reserve judgement as to the placement of *Helotium lobatum* until the limits between the Dermateaceae and members of the Encoelioideae are better clarified and understood. For a complete description and illustration, see Dennis (1954).

Holotype: Helotium lobatum - Brazil, Rio Grande do Sul, Santa Angelo pr. Cachoeira, 4 II 1893, G. A. Malme 234 (not examined).

Illustration: Dennis, Kew Bull. 1954: p. 335, fig. 44. 1954.

Specimens studied: Brazil: S. Leopoldo, decorticated wood, 1929, Braun (ex PACA 13202); São Salvador, wood, June 1942, Rick (ex PACA 13203); São Leopoldo, wood, 1905, Rick (Fungi Austro-americana 83, ex PACA 13208); São Salvador, wood, 15 May 1944, Rick (ex PACA 22593); São Leopoldo, wood, 1930, Rick (ex PACA); Sao Leopoldo, wood, 1929, Braun (ex PACA 13223); São Leopoldo, wood, May 1929, Braun (ex PACA 13224); São Leopoldo, wood, 1930, Rick (ex PACA 13211); São Leopoldo, wood, 1905, Rick (ex PACA 13214); Mexico, Morelos, Cuernavaca, path to Salte de Antonio, living bark at base of elm tree, 31 Aug 1965, M. B. Spevak (CUP-ME 70).

43. *Helotium luteum* Rick, Brotéria, Sér. Bot. 25: 110. 1931.

NOTES. *Helotium luteum* was described on wood from south Brazil, and Dennis (1960) suggested that the species should be referred to *Phaeohelotium*, but did not make the actual transfer. I have examined the type collection of *H. luteum*, and conclude, as did Dennis, that it is a member of *Phaeohelotium*. Further, I have compared this collection with the type of *Phaeohelotium flavum* Kanouse, the type of *Phaeohelotium*, and find the two to be extremely closely related, if not the same taxon.

In *Helotium luteum* the ascospores and asci are respectively (16-)18-22(-24)x(4-)5-6(-8)μm and 120-140x9-11μm, while in *P. flavum* they are (12-)14-16(-18)x4-5μm and 95-100x7-10μm. In both species the spores become 1-septate and in *P. flavum* they are occasionally pigmented. However, there are instances when pigmented ascospores cannot be located; I have not observed pigmented ascospores in *H. luteum*. In both species there are internal guttules, generally broader above than below, and occasionally slightly curved. Both species produce sessile to turbinate apothecia which are yellow in fresh condition, and are to ca 2mm wide in *P. flavum* and to 4mm in *H. luteum*.

In the two species the structure of the sterile tissue is similar. Towards the base of the receptacle, the outermost tissues are composed or irregularly arranged globose to angular cells, which begin to form hyphae oriented perpendicularly to the surface of the apothecium. The individual hyphae then extend at high angles to the surface and progressing towards the margin the angle becomes less and less, until they are parallel at the margin.

As Dennis (1964) has pointed out, *Helotium monticolum* Berkeley is an older name for *P. flavum*. I have compared the Rick type with the types of *H. monticolum* and *P. flavum* and agree with Dennis that *H. monticolum* represents an older name for *P. flavum*. I further agree that *Helotium luteum* is a *Phaeohelotium*, and conclude from my studies, based on limited material of *H. luteum*, that they represent very closely related, but distinct species. I recognize, that the two species are known from widely disjunct areas. However, to date I have not knowingly collected and/or identified either one of these species from the neotropical region. It is still possible, though unlikely, that intermediate forms will be discovered. In view of this, I thus, propose the formal transfer to *Phaeohelotium* as follows:

Phaeohelotium luteum (Rick) Dumont, comb. nov.

Basionym: *Helotium luteum* Rick, Brotéria, Sér. Bot. 25: 110. 1931.

Habitat: On wood.

Etymology of the specific epithet: refers to the yellow color of the apothecia produced by the species.

Holotype: Brazil, São Leopoldo, wood, 1929, Rick (ex PACA 13232).

Illustration: Dennis, Kew Bull. 14: fig. 7, p. 121. 1960.

Additional specimens of Phaeohelotium monticolum studied: Michigan: Harbor Springs, wood, 9 Sept 1931, E. B. Mains 31-895 (ex MICH, holotype *Phaeohelotium flavum*); Pinckney, George Reserve, oak stump, 10 Nov 1931, A. H. Smith (ex MICH, paratype of *Phaeohelotium flavum*); Munsing, Miner's Falls, mossy log, E. B. Mains 32-578 (ex MICH, paratype of *Phaeohelotium flavum*). North Carolina, mountains, decorticated wood, 22 Jul 1856, M. A. Curtis 4471 (ex NY herb Massee, isotype of *Helotium monticolum*).

44. *Helotium miniatum* Patouillard in Duss, Champ. Guadeloupe & Martinique, p. 65. 1903.

NOTES. *Helotium miniatum* was described as occurring on wood from Guadeloupe. Dennis (1954) suggested that this species, *H. fuscopurpureum*, and *H. aurantio-rubrum* might represent the same species, but in 1964 Dennis placed the first two into *Hymenoscyphus*. I have studied the type specimens of both and find them to be the same species; and as discussed elsewhere(Dumont, 1980), *H. rufo-corneum* is the oldest name and must be used. I place *H. miniatum* into synonymy with *H. rufo-corneum*.

45. *Helotium miserum* Berkeley & Curtis in Berkeley, J. Linn. Soc., Bot. 10: 369. 1969.

NOTES. *Helotium miserum* was described from Cuba as occurring on bark and soil. As Dennis (1954) has pointed out, this is neither *Helotium* or *Hymenoscyphus*, rather it is more closely related to the lichens, and will not be considered further here.

46. *Hymenoscyphus musicola* (Dennis) Dennis, Persoonia 2: 190. 1962. FIG. 12.

≡ *Belonidium sclerogenum* (Berkeley & Curtis) Saccardo var. *musicola* Dennis, Kew Bull. 13: 461. 1959.

Apothecial morphology — Apothecia scattered on the substrate, stipitate, ca 1.5mm diam and approximately same in height; receptacle saucer-shaped, when fresh, dry and rehydrated, and hymenium slightly umbilicate. Hymenium, receptacle and stipe generally concolorous when fresh, dry and rehydrated; when fresh "pallid," drying dark yellow, flesh-colored or light reddish brown, rehydrating lighter.

Apothecial anatomy — Asci 8-spored, (90-)100-110x9-11µm, probably produced from small croziers, details obscured owing to staining of material, broad cylindric-clavate, gradually tapering towards the base and there becoming slightly expanded to form a small foot, wall 1-2µm thick, enlarged at the truncate apex and there 3-4(-5)µm thick; pore J+, the walls outlined light to dark blue in Melzer's Reagent. Ascospores (17-)18-22(-24)x 4-5(-6)µm, generally biseriate throughout or uniseriate above and biseriate below, hyaline, smooth, 1(-?3)-septate, ellipsoid, obvoid, ovoid-reniform, ends generally rounded or rarely slightly pointed, in outline inequilateral, frequently curved, anterior end generally broader than posterior; well-defined guttules absent, but with 2-4 irregular, indistinct, large guttulate areas frequently occupying majority of some ascospores, located in bipolar position and/or adjacent to the nearly median septum. Paraphyses slightly exceeding the asci by 5µm, internally hyaline, branching not observed, septate, cylindrical, at the apex 2-3µm wide, walls thin, smooth and hyaline. Subhymenium not a distinct, recognizable layer, undifferentiated from the medullary excipulum. Medullary excipulum well developed in the center, less in the flanks, obconical, non-refractive, hyaline, consisting of tightly compact, septate, branched, interwoven hyphae 3-4(-5)µm wide, the walls thin, hyaline and smooth. Ectal excipulum: inner ectal excipulum well-defined, well-differentiated from the outer ectal excipulum and grading into the medullary excipulum, entire layer non-refractive, hyaline or pigmented light yellow-brown towards the margin, to ca 12µm wide toward the margin and to ca 25µm toward the stipe, consisting of tightly compact, hyaline or lightly pigmented brown hyphae 2-3µm wide, the walls thin, non-refractive, hyaline or rarely light brown and smooth.

Outer ectal excipulum non-refractive, non-gelatinized, entire layer hyaline, ca 15µm broad towards the margin and to ca 25µm broad toward the stipe, consisting predominantly of a large-celled textura prismatica with the individual hyphae extending at low to high angles to the surface and continuing to the surface and with the apical cells overlapping and covering the surface, the individual cells towards the margin 10-18(-22)x4-8 µm and 16-26x(10-)12-15(-17)µm toward the stipe, the walls thin, hyaline, and smooth. Outer covering and hairs absent, but with the apical cells of the outer ectal excipulum continuing to the surface, overlapping and covering the majority of the surface, the individual cells 4-9µm wide toward the base, clavate and slightly broad towards the apex, hyaline or pigmented to light brown, smooth or rarely roughened. Margin well developed, narrower above, broader below, entire layer lightly pigmented yellow-brown to darkly pigmented, constructed similarly to the apothecial flanks below, the individual cells smaller and the pigmentation more intense, the apical cells slightly expanded and rarely subcapitate and 5-7µm wide. Stipe in the upper portion constructed as the lower portion of the receptacle, toward the base the hyphae becoming narrower, and more or less interwoven, and slightly refractive. Hairs absent.

Habitat: On *Musa sapientum*.

Etymology of the specific epithet: refers to the host of the type collection.

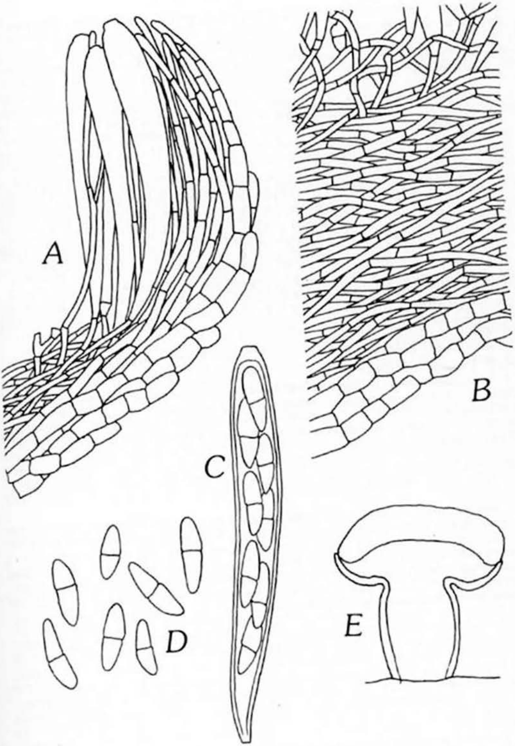
Holotype: Belonidium sclerogenum var. *musicola* - Bolivia, Coroico, Prov. Nor-Yungas, Dpto. La Paz, on *Musa sapientum*, 26 Jan 1956, R. Singer B. 553 (K).

NOTES. Dennis (1958) originally described *Belonidium sclerogenum* var. *musicola* from a Singer collection from Bolivia, and later (Dennis, 1962a) raised the variety to specific rank and transferred it to *Hymenoscyphus*, a decision with which I concur.

Hymenoscyphus musicola appears to be most closely related to two additional neotropical species studied by Dumont & Carpenter (1981), *H. sclerogenus* and *H. lasiopodius*. In *H. sclerogenus*, the ascospores are generally aseptate, or occasionally 1-septate, (22-)26-30(-35)x3-4(-6)µm, and have a nuclear staining area as reported by Dumont & Carpenter (1981); in *H. musicola* the ascospores are regularly 1-septate, (17-)18-22(-24)x4-5(-6)µm, and lack the staining nuclear area. In *H. lasiopodius* the ascospores are 3-septate, or rarely 1-septate, (20-)24-30(-35)x4-5(-6)µm, and the stipe produces obvious and characteristic hairs, while in *H. musicola* the ascospores are generally 1-septate, smaller, and the stipe lacks the hairs of *H. lasiopodius*.

Dennis (1958) reported the ascospores of *Belonidium sclerogenum* var. *musicola* to be 3-septate, whereas I have noted only

FIG. 12. *Hymenoscyphus musicola*, Singer B 553 ex K, freehand drawings. A. Median longitudinal section of an apothecium through margin. B. Median longitudinal section of an apothecium at approximately midpoint between margin and stipe. C. An ascus with 8 biseriate, 1-septate ascospores. D. 6 ascospores drawn after discharge from ascus. E. Habit sketch of an apothecium on substrate. A-D x 1,000; E x ca 50.


A
B
C
D
E

1-septate ascospores, with the possibility of an occasionally 3-septate ascospore.

47. *Helotium nigripes* (Fries) Fries, Summa veg. Scand., p. 356. 1849.

NOTES. *Helotium nigripes* was reported from Cuba by Berkeley (1869) and was based on a Curtis collection (634). I have examined the collection deposited at FH and find the collection to represent a species of *Bisporella*; it will not be considered further here.

Rick (1931) described *Helotium nigripes* var. *brasiliense* from south Brazil as occurring on wood, but failed to designate a holotype. I have examined four collections so identified in the Rick Herbarium, 13205, 13209, 13227, and 20220. The last collection was made after the species was described, July 1943, while the other three were doubtless the collections upon which Rick based his description. I designate herewith number 13227 as the type as it fits the protologue well. All four collections represent the same species of *Hymenoscyphus*. I place this variety into synonymy with *H. leucopsis*.

Lectotype: Helotium nigripes var. *brasiliense* - Brazil, São Leopoldo, on wood, 1929, Rick s.n. (ex PACA, herb Rick 13227).

Specimens studied: Cuba: dead wood, "Aug.", Wright 634 (ex FH, Fung. Cub. no. 701, herb Curtis). Brazil: São Leopoldo, wood, 1929, Braun (ex PACA, herb Rick 13205); São Leopoldo, wood, June 1929, Braun (ex PACA, herb. Rick 13209); São Salvador, wood, July 1943, Rick (ex PACA, herb. Rick 20220).

48. *Helotium ombrophiloides* Rick, Brotéria, Sér. Bot. 25: 109. 1931.

NOTES. *Helotium ombrophiloides* was described by Rick from south Brazil as occurring on mixed fragmentary plant debris. As Dennis (1960a) has pointed out, neither type nor authentic material of this species can be located in the Rick Herbarium, and from the brief description given by Rick, I am unable to speculate as to where the species could be placed. I will not consider the species further.

49. *Helotium pallidulum* Saccardo, Atti Soc. Venet. - Trent. Sci. Nat. 4: 36 (reprint no.). 1875.

NOTES. *Helotium pallidulum* was described by Saccardo from Italy as occurring on wood and reported from Brazil by Rick (1931). The specimens upon which the report was based cannot now be located in the Rick Herbarium, and it is impossible to verify this report; nor is it possible from the description, to determine exactly what Rick had, although from the description, it could be a species of *Orbilia* or *Bisporella*.

50. *Helotium persoonii* Montagne in Gay, Historia Física y Política Chile, Botanica 7: 410. 1853.

NOTES. *Helotium persoonii* was described from Chile by Montagne (1853) as occurring on wood. The holotype specimen cannot now be located at PC. Without type or authentic material, it is impossible to tell from the description what the species actually is. The description is suggestive of a species of *Orbilia*.

51. *Helotium pezizoideum* Cooke & Phillips in Cooke, Grevillea 19: 72. 1891.

NOTES. *Helotium pezizoideum* was originally described by Cooke & Phillips from New Zealand. The species was reported from Panama by Cash (1937), based on a Martin collection (2410). I have examined the Martin collection and find that it is not an *Helotium* or *Hymenoscyphus*, but rather is probably a member of the genus *Bisporella*. A final placement of this species can be made only after my studies are completed, and until that time, I cannot treat the collection further.

Specimen studied: Panama: Prov. Chiriquí, Valley of upper Rio Chiriquí Viejo, alt. 1600-1800 M, wood, 2 Jul 1935, G. W. Martin 2410 (ex BPI).

52. *Helotium phlebophorum* Patouillard, Bull. Soc. Mycol. France 18: 179. 1902.

NOTES. *Helotium phlebophorum* was described on leaves from Guadeloupe. Dennis (1962) transferred the species to *Ciboriopsis*. Dumont (1976) demonstrated that *Moellerodiscus* was an older name for *Ciboriopsis*, and placed *H. phlebophorum* into synonymy with *Moellerodiscus lentus* (Berkeley & Broome) Dumont. For full descriptions, illustrations and synonymy, see Dumont (1976) and Dennis (1954, 1962).

53. *Helotium radicola* P. Hennings, Hedwigia 41: 24. 1902.

NOTES. *Helotium radicola* was originally described from a Möller collection from south Brazil growing on decaying roots. I have been unable to locate Möller 668, the holotype specimen, at B, S, K, BPI, NY, CUP, Munich, and am unable to determine with any degree of certainty what this neotropical species is. Lignicolous species of *Hymenoscyphus* (Leotiaceae) or *Lanzia* (Sclerotiniaceae) with the small ascospore measurements (4-5x1.5μm) given by Hennings (1902) are uncommon. The most common appears to be *Helotium leucopse*, which is a species with larger ascocarps. *Helotium microspermum* Speg., a species from Argentina, also has small ascospores, but the fruitbodies are also much larger than those reported in the original description of *H. radicola*. In view of the lack of type or authentic material, I am unable to determine where this species should be placed.

54. *Helotium rhytidodes* Berkeley & Curtis in Berkeley, J. Linn. Soc., Bot. 10: 369. 1869.

NOTES. *Helotium rhytidodes* is a corticolous species described from Cuba and based on Wright 373. I agree with Dennis who suggested that the species is probably an operculate

Discomycete and could be a member of the genus *Sarcoscypha*. Since it is an operculate Discomycete, it will not be treated further here.

55. *Helotium rufo-corneum* Berkeley & Broome, J. Linn. Soc., Bot. 14: 108. 1873.

NOTES. Dumont (1980) has recently published an extensive study on this species. Consult this work for detailed description, illustrations, and discussion.

56. *Hymenoscyphus sclerogenus* (Berkeley & Curtis) Dennis, Persoonia 2: 190. 1962.

≡ *Peziza sclerogena* Berkeley & Curtis in Berkeley, J. Linn. Soc., Bot. 10: 369. 1868.

NOTES. *Hymenoscyphus sclerogenus* was originally described from a collection on palm petioles from Cuba. Dumont & Carpenter (1981) have fully described and illustrated the species and discussed at some length the variability of the morphological features of the fruitbody and the wide substrate range. I agree with the Dumont & Carpenter treatment of this species and accept it as a valid species of *Hymenoscyphus*.

57. *Helotium scutula* (Persoon) Karsten, Not. Sällsk, Fauna Fl. Fenn. Forh. 11: 233. 1870.

≡ *Peziza scutula* Persoon, Mycol. Eur. 1: 284. 1822.
≡ *Hymenoscyphus scutula* (Persoon ex Persoon) Phillips, British Discomycetes p. 136. 1887.

NOTES. Dumont & Carpenter (1981) have recently discussed this species in detail. See that publication for full descriptions, illustrations, and discussion, as *Hymenoscyphus scutula*.

58. *Helotium serotinum* (Persoon ex Persoon) Fries, Summa veg. Scand. p. 355. 1849.

≡ *Peziza serotina* Persoon, Syn. Meth. Fung. p. 661. 1801.
≡ *Peziza serotina* Persoon ex Persoon, Mycol. Eur. 1: 292. 1822.

NOTES. Dumont & Carpenter (1981) have recently discussed this species in detail, have recorded it from the neotropics, and have accepted its placement in *Hymenoscyphus*. For a full description, discussion, and illustrations, see that paper.

59. *Helotium singeri* Dennis, Kew Bull. 13: 463. 1959.

NOTES. *Helotium singeri* was described on a pteridophyte and possibly dead palm leaves from Bolivia. I have examined the type deposited at K and find this to represent *Lambertella microspora* (Seaver) Dumont. This is a very common and widespread neotropical species which is not always recognized as a *Lambertella* because the ascospores only become lightly pigmented in the ascus, developing full pigmentation after discharge from the ascus. For full descriptions, illustrations, and discussion of this species, see Dumont (1971) under the name *Lambertella pallidispora* Dumont.

Holotype: Helotium singeri - Bolivia: Prov. Nor. Yungas, Rio Yariza, Dpto. La Paz, elev. 1400-1500, pteridophyte and ? dead palm leaves, 23 Feb 1956, R. Singer B. 1415 (ex K).

60. *Helotium sloaneae* Patouillard, Bull. Soc. Mycol. France 16: 183. 1900.

NOTES. *Helotium sloaneae* was originally described from Guadeloupe as occurring on leaves. The type specimen cannot now be located at either PC or FH. Dumont (1980) has suggested that this species may be a synonym of *Helotium rufocorneum*. See Dumont (1980) for a full discussion.

61. *Hymenoscyphus spadiceo-ater* (Montagne) Dennis, Persoonia 3: 66. 1964.

≡ *Helotium spadiceo-atrum* (Montagne) Saccardo, Syll. Fung. 8: 236. 1889.

NOTES. *Peziza* (*Phialea*) *spadiceo-atra* Montagne was originally described from Juan Fernandez Island on leaves of *Gunnera scabra*. Dennis (1964) redescribed and illustrated the species and transferred the species to *Hymenoscyphus*. I have examined the type and find it to be the same species as *Lambertella chromoflava* (Rick) Dumont, which Dumont (1974) showed to be an older name for *Lambertella phaeoparaphysata* Dumont. *Peziza spadiceo-atra* represents a still older name and I thus propose the transfer as follows:

Lambertella spadiceo-atra (Montagne) Dumont, comb. nov.

Basionym: Peziza spadiceo-atra Montagne, Ann. Sci. Nat. Bot., sér. 2, 3: 352. 1835.

For full description, illustrations, and discussion, see Dumont (1971) under *Lambertella phaeoparaphysata* and for additional notes on nonmenclature and taxonomy, see Dumont (1974).

Holotype: Peziza spadiceo-atra - Juan Fernandez Islands, leaves of *Gunnera scabra*, Mai 1830, Bertero 1704 (ex FH, herb Patouillard).

62. *Helotium subcastaneum* Hennings in Saccardo & Sydow, Syll. Fung. 14: 764. 1899.

NOTES. *Helotium subcastaneum* is a renaming of *Helotium castaneum* P. Hennings, a later homonym of *Helotium castaneum* Saccardo & Ellis. See notes under *Helotium castaneum* above for a full discussion.

63. *Helotium subserotinum* P. Hennings & Nyman, Monsunia 1: 33. 1900.

NOTES. *Helotium subserotinum* was originally described as occurring on wood, from Java, but has not actually been reported from the neotropics. Dumont (1980) has placed the species into synonymy with *Helotium rufo-corneum*, a species widely distributed in the neotropics. Consult that paper for a full discussion.

64. *Helotium subturbinatum* P. Hennings, Hedwigia 36: 233. 1897.

NOTES. *Helotium subturbinatum* was originally described from south Brazil as occurring on twigs. I have been unable to locate type or authentic material of the species, and from the brief description am unable to determine what the species is. Rick (1931) also reported the species from Brazil and gave a near translation of the Hennings description. No specimen of *H. subturbinatum* can now be located in the Rick Herbarium.

I know very few neotropical species of *Hymenoscyphus*, *Lanzia* or *Poculum* occurring on wood with ascospores "19-24x5-6"µm with brown fruitbodies. One possibility could be *Hymenoscyphus serotinus* as defined by Dumont & Carpenter (1981). Until type or authentic material is available for study I cannot treat the species further here.

65. *Helotium sulfurellum* Ellis & Everhart, Bull. Torrey Bot. Club 10: 98. 1883.

NOTES. *Helotium sulfurellum* was described from the U.S. as occurring on leaves. The species was placed into synonymy with *Rutstroemia longipes* by White (1942). It was reported from Brazil by Rick (1906, 1931) as occurring on wood and leaves. I have studied the sole collection of this species in the Rick Herbarium and find in the packet, 13228, a single leaf devoid of any apothecia. The leaf does contain abundant line stroma and darkened areas which could represent the stroma of a species of Sclerotiniaceae. I am unable to verify the Rick reports, and the species is unknown to me from the neotropics.

66. *Helotium tectum* Rick, Brotéria, Sér. Bot. 25: 109. 1931.

NOTES. *Helotium tectum* was described from Brazil as occurring on leaves. No type or authentic material of this species can now be located. When Rick described the species he failed to give the ascospores measurements, and for this reason, I cannot hazard a guess as to what the species could be.

67. *Helotium titubans* Montagne in Gay, Historia Física y Política Chile, Botánica 7: 408. 1853.

≡ *Hymenoscyphus titubans* (Mont. in Gay) Dennis, Persoonia 3: 76. 1964.

Stroma — Substratal, variable, visible on the host as black lines extending irregularly along the surface of the leaf; the black lines in section composed of rind cells with differentially pigmented walls, epidermoid to irregular in face view; not known in culture.

Macroconidial state — Unknown, presumed absent.

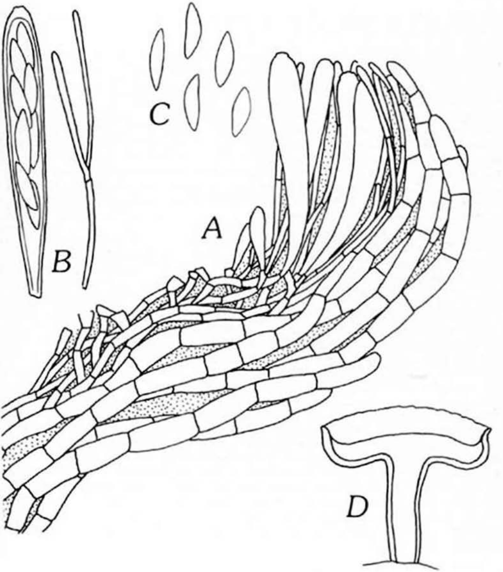


FIG. 13. *Poculum titubans*, lectotype ex PC, freehand drawings. A. Median longitudinal section of an apothecium through margin and upper portion of receptacle, stippling represents gelatinous matrix. B. An ascus with 8 ascospores and a paraphysis. C. 5 ascospores drawn after discharge from the ascus. D. Cross section of whole apothecium. A-C x 1,000; D x ca 50.

Microconidial state — Unknown.

Apothecial morphology — Apothecia solitary to gregarious, arising in association with black lines on the host, stipitate, ca 1mm in diam, ca 0.5-.75mm high, disc when fresh cupulate, drying with the margin curling over the hymenium, rehydrating flat to slightly convex, when fresh "rojo amoratado o fuliginoso," hymenium drying brown, rehydrating lighter; receptacle when dry and rehydrated concolorous with hymenium or slightly lighter; stipe when dry concolorous above with the lower portion of the receptacle, black at the base.

Apothecial anatomy — Asci 8-spored, 50-60x8-10(-12)µm, presence or absence of croziers not determined, broadly clavate to cylindric-clavate, tapering toward the base, wall 1-2µm thick, enlarged at the rounded apex and there 3-4µm thick; pore reaction in Melzer's Reagent not determined. Ascospores (9-)11-13x3-4µm, obliquely uniseriate to irregularly biseriate, hyaline, smooth, aseptate, ellipsoid, subfusoid, occasionally torpedo shaped, ends generally slightly pointed, in outline generally equilateral and frequently flattened on one surface, occasionally slightly curved, anterior end generally broader than posterior; guttules present, varying in shape and size, generally arranged in a single line occupying the majority of each ascospore and individually separated by narrow bands of cytoplasm. Paraphyses present, details obscured due to preservation of apothecium. Subhymenium not a distinct layer. Medullary excipulum poorly developed in the center of the receptacle and in the flanks, well differentiated from the ectal excipulum, non-refractive, lightly to intensely pigmented brown, consisting of septate, tightly compact, probably branching, parallel to interwoven hyphae 1-3µm wide, the walls thin, brown and generally lightly to coarsely roughened. Ectal excipulum: inner ectal excipulum not a distinct layer. Outer ectal excipulum highly refractive, gelatized, entire layer hyaline or with the gelatinous matrix pigmented yellow-brown, ca 25 µm wide towards the margin and to ca 25µm wide towards the stipe, consisting of long and narrow or brick-shaped cells extending parallel to each other (or slightly interweaving) and at low to high angles to the surface of the apothecium. Hairs and outer covering layer absent. Margin well developed, narrower above, broader below, entire zone light brown to more intensely pigmented towards the asci, constructed similarly to the apothecial flank below, the individual cells slightly smaller, the apically free cells unmodified. Stipe constructed somewhat differently from the receptacle, lacking the refractive, glassy appearance of the receptacle, to the outside a zone of hyaline to lightly pigmented textura prismatica grading to the inside to a zone of longer and narrower, intensely pigmented hyphae, in the central core the hyphae remaining parallel or slightly interwoven, the individual hyphae with walls thin to slightly thickened, smooth or more commonly roughened towards the center; at the base, rind cells observed. Hairs absent.

Habitat: On leaves.

Etymology of the specific epithet: relevance to the fungus uncertain.

Lectotype: Helotium titubans - Chile, ad folia, Gay (PC).

Illustration: Gay, Flora Chileana Atlas Botanica Cryptogamia pl. 8, fig. 6. 1850. (not seen).

NOTES. *Helotium titubans* was originally described by Montagne (1853) as occurring on leaves in Chile, and was reported from Cape Horn by Hariot (1889). In the original description no holotype specimen cited, and there are three specimens deposited at PC under this name. One collection was made by Hariot and serves as the voucher specimen for the Cape Horn report and is, thus, not eligible as a possible type. The remaining two were both collected in Chile by Gay and represent the same species. I have annotated them with two of my own numbers 3085 and 3164. I select, herewith the specimen deposited at PC bearing my number 3085 as the lectotype specimen for *Helotium titubans*. It agrees in all regards with the protologue, is certainly one of the specimens used in the original description, and has more apothecia than specimen 3164. Dennis (1964) transferred the species to *Hymenoscyphus* and commented "*H. titubans* should possibly be referred elsewhere..." In view of the fact that the fungus produces a substratal stroma, the species doubtless belongs in the Sclerotiniaceae; and because of the presence of a gelatinous matrix in the ectal excipulum, it should be placed in the genus *Poculum*. I herewith propose the formal transfer:

Poculum titubans (Montagne in Gay) Dumont, comb. nov.

Basionym: Helotium titubans Montagne in Gay, Historia Física y Política Chile, Botánica 7: 408. 1853.

Poculum titubans is most easily distinguished from other foliicolous species of *Poculum* by the presence of large, brick-shaped cells in the ectal excipulum, and by multiguttulate spores measuring (9-)11-13x3-4μm. The pigmented, sterile tissue is further characteristic of the species. I have examined the Hariot collection upon which the report of the species from Cape Horn was made, and I conclude that it is a very different species, still unknown to me.

68. *Helotium uleanum* (Rehm) Dennis, Kew Bull. 1954: 323. 1954.

≡ *Phialea uleana* Rehm, Hedwigia 39: 93. 1900.

NOTES. *Phialea uleana* was described from Brazil on leaves. Dennis (1954) transferred it to *Helotium* and later to *Ciboriopsis* (Dennis, 1962). Dumont (1976) placed the species into synonymy with *Helotium lentum* Berkeley & Broome, and transferred that species to *Moellerodiscus*, a decision which I still accept.

69. *Helotium umbilicatum* (Le Gal) Dennis, Kew Bull. 1954: 326. 1954. FIG. 14.

≡ *Pachydisca umbilicata* Le Gal, Rev. Mycol. (Paris) 3: 133. 1938.

Apothecial morphology — Apothecia variable, gregarious, substipitate to turbinate, to ca 5mm broad and to ca 3mm high, when fresh disc concave, umbilicate, margin wavy, drying slightly cupulate to flat, rehydrating flat to slightly concave. Hymenium when fresh yellow to cream, drying ochraceous, orange, rehydrating lighter; margin when fresh, dry, and rehydrated concolorous with the hymenium; receptacle concolorous with hymenium or slightly lighter, occasionally appearing dirty white due to "hairs" when fresh, dry, and rehydrated; stipe generally off-white to dull yellow when fresh, dry, and rehydrated.

Apothecial anatomy — Asci 8-spored, (90-)100-120(-130)x(7-)8-9(-10)μm, possibly produced from small croziers, long cylindric-clavate, gradually tapering to the base and there becoming slightly expanded to form a small foot, wall ca 1μm thick, enlarged at the subtruncate, rounded to subpapillate apex and there 3-4μm thick; pore J+, the walls stained very light blue in Melzer's Reagent. Ascospores (13-)15-18(-20)x(3-)4-5μm, generally biseriate throughout, less commonly biseriate above and uniseriate below

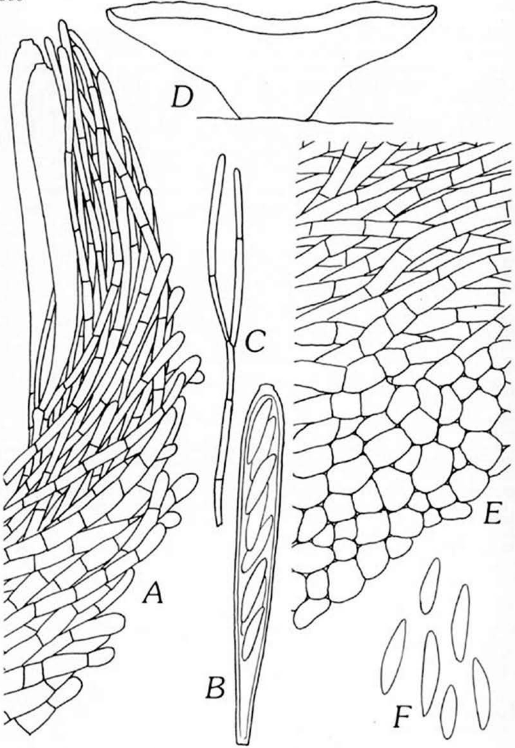


FIG. 14. *Hymenoscyphus umbilicatus*, lectotype ex PC, freehand drawings. A. Median longitudinal section of an apothecium through margin. B. An ascus with 8 ascospores. C. A paraphysis. D. Habit sketch of an apothecium on the substrate. A-C x 1,000; D x ca 50.

to irregularly uniseriate, hyaline, smooth, at first aseptate, becoming 1-septate after discharge or rarely while in the ascus, ellipsoid to fusoid, anterior end frequently pointed, posterior end rounded, in outline inequilateral, frequently flattened on one side or occasionally curved, anterior end frequently narrower than posterior end; guttules present, spherical to irregular, 2-3, large and also with smaller associated ones. Paraphyses equal to or slightly exceeding the asci, internally hyaline or possibly with contents staining golden yellow in Melzer's Reagent, branching towards the base of the asci, septate, filiform, not noticeably expanded at the apex and there 2-3µm wide, the walls thin, smooth and hyaline. Subhymenium well developed, not well differentiated from the medullary excipulum, hyaline, in the center to ca 60µm wide, consisting of hyphae generally very tightly interwoven and somewhat vertically oriented beneath the base of the asci or extending more or less parallel to the base of the asci towards the hyphae of the medullary excipulum, the individual hyphae 1-2µm wide, the walls thin, hyaline, and smooth. Medullary excipulum well developed, non-refractive, consisting of septate, branched, loosely interwoven hyphae 3-4(-5)µm wide, the walls thin, hyaline, and smooth. Ectal excipulum: inner ectal excipulum absent. Outer ectal excipulum towards the stipe composed of globose, angular to irregularly shaped cells, these cells becoming replaced by a poorly developed textura prismatica at first extending perpendicularly to the surface of the apothecium, the hyphae then extending at high angles to the surface and becoming progressively less so until the hyphae lie parallel to the surface of the apothecium towards the margin; individual brick-shaped cells towards the margin 8-12x3-4µm and the globose to irregular cells toward the stipe to ca 12µm wide at their broadest point; the walls thin or slightly thickened, hyaline and smooth. Outer covering layer absent. Hairs absent, but the apically free cells of the hyphae on the outer surface of the apothecium cylindric, clavate, or subcapitate, generally less than 15 µm long, 2-3(-4)µm wide, at the base septum, 3-8µm wide at the apex, simple, occasionally 1-septate, the walls thin, hyaline, smooth or rarely slightly roughened. Margin constructed of small brick-shaped hyphae as in the upper portion of the flanks, apical cells as in the flanks. Stipe constructed similarly to the lower portion of the flanks, at approximately midpoint and to the outside a zone of globose to irregular cells, in the center composed of parallel and interwoven hyphae without apparent organization. Hairs as on the flanks.

Habitat: Wood and acorns of *Quercus* sp. and wood of undetermined species.

Etymology of the specific epithet: refers to the umbilicate shape of the apothecium in fresh condition.

Holotype not designated in original description. The original description of *Pachydisca umbilicata* appears to have been based on more than one collection, and I designate herewith the following specimen as the lectotype specimen of the species as it appears to have been one of the collections cited in the original description and agrees with the protologue: France, Yerres, sur/souche de *Quercus* et cupule de gland, Jul 1937 (collector not cited) (ex PC).

Illustrations: Le Gal, Rev. Mycol. (Paris) 3: 133, fig. 3; 135, fig. 4. 1938.

Additional specimen examined: Jamaica, north side of Newhaven Gap, Blue

Mts., on wood, 26 Dec 1949, R. W. G. Dennis, s.n. (ex K).

NOTES. *Pachydisca umbilicata* was originally described from France as occurring on wood and acorns of *Quercus*. Dennis (1954) reported the species from Jamaica and transferred it to *Helotium* and later (Dennis, 1971) transferred it to *Phaeohelotium*. I have compared the type (designated here) with the Dennis collection and conclude that they represent the same species. I have, however, noted considerable variation between the two which may, in part, be due to the respective age of each specimen when collected. The Le Gal type is apparently slightly overmature with the majority of the ascospores discharged and adhering to the surface of the tips of the asci; the Dennis collection appears to be somewhat immature.

In the Le Gal type, the hyphae of the ectal excipulum extend at a very high angle to the surface of the apothecium, terminating in short hyphal protrusions, which gives the apothecium a downy appearance. In the Dennis collection, the hyphae also extend at a very high angle to the surface, but the apical cells are elongated and become easily detached from the outer surface and appear hair-like. The ascospores of the two collections are similar, those of the Le Gal type become occasionally septate, while I have not observed septate ascospores in the Dennis collection. Dennis (1954) and Le Gal both indicate that the ectal excipulum is composed of brick-shaped cells, but Dennis (1971) placed the species into *Phaeohelotium* indicating that the sterile tissue is composed of thin walled globose cells. I agree with Dennis (1971) that, at least in part, the lower portion of the ectal excipulum is composed of globose to angular cells, but they are replaced in the upper portion by a well developed textura prismatica.

The structure of *Helotium pachydiscum* is very similar to that of *Hymenoscyphus epiphyllus* sensu authors. In *H. epiphyllus* the stipe is composed mainly of globose to angular cells, which at the juncture of the stipe and substipe become replaced by textura prismatica extending at high then low angles to the surface of the apothecium, much in the same way that the tissue is formed in *H. pachydiscum*. In *H. pachydiscum*, however, the globose to irregular cells extend well into the flanks before being replaced by the parallel hyphae, whereas in the comparable structure in *Hymenoscyphus epiphyllus* the globose cells generally do not extend much beyond the juncture of the stipe and receptacle.

In view of the similarity of the sterile tissues of *Hymenoscyphus epiphyllus* and *Helotium pachydiscum*, I conclude that they both belong in the same genus. It is still premature to erect a new genus for *Hymenoscyphus epiphyllus* and allies, since the remaining species of *Helotium*/*Hymenoscyphus* should be studied and interpreted. The evidence now is that species such as *Hymenoscyphus caudatus* and its allies as defined by Dumont & Carpenter (1981) are fundamentally different in structure from the *H. epiphyllus* group. I make the formal transfer of *Pachydisca umbilicata* to *Hymenoscyphus* as follows:

Hymenoscyphus umbilicatus (Le Gal) Dumont, comb. nov.

Basionym: Pachydisca umbilicata Le Gal, Rev. Mycol. (Paris) 3: 133. 1938.

70. *Helotium velhaense* (P. Hennings) Le Gal, Prod. Flore Mycol. Madagascar 4: 350. 1953.

≡ *Ciboria velhaensis* P. Hennings, Hedwigia 41: 28. 1902.
≡ *Hymenoscyphus velhaensis* (P. Hennings) Dennis, Persoonia 3: 74. 1964.

NOTES. *Helotium velhaense* was originally described from Brazil as occurring on wood and as Le Gal (1953) pointed out, type material cannot now be located.

From the original description it is impossible to determine exactly what Hennings had; however, it is possible that it is either *Hymenoscyphus lasiopodius* or *H. sclerogenus*. Both have small waxy, yellow, fruitbodies occurring on wood and ascospores which would fall into the range given by Hennings, 23-33x5-7µm.

As Dumont & Carpenter (1981) have pointed out, *H. lasiopodius* is almost always 3-septate, while *H. sclerogenus* is only rarely 1-septate. Hennings reported his species to be at first 1-septate and later 3-septate, and he further notes that the stipe is pruinose, the character from which *H. lasiopodius* derives its name!

Dennis (1964) has transferred *Ciboria velhaensis* to *Hymenoscyphus*, an act with which I am not in full agreement. Rather, it is probably that it is a taxonomic synonym of *H. lasiopodius* or *H. sclerogenus*, more likely the former. A final decision can be made only after a neotype is designated or an authentic specimen located.

71. *Helotium vile* Rick, Brotéria, Sér. Bot. 25: 114. 1931.

NOTES. *Helotium vile* was described from south Brazil on leaves. Dennis (1960a) reported having examined the type of *H. vile* and indicated that it was like *Helotium caracassense* Dennis. He noted that the two species were similar in habit and structure, but differed in color; he chose not to place his species into synonymy with the Rick species. Dennis (1964) transferred *H. caracassense* to *Hymenoscyphus*, but did not treat the older *Helotium vile*. I have examined the Dennis and Rick types and conclude that they are the same and place them both into synonymy with *Lambertella microspora* (Seaver) Dumont. See Dumont (1971, 1974a) for full description, illustration, and discussion of this species under the name *Lambertella pallidispora*.

Presumed holotype: Helotium vile - Brazil, São Leopoldo, on leaves, 1929, J. Rick (ex PACA 13216).

72. *Helotium viridi-flavum* Rick, Brotéria, Sér. Bot. 25: 115. 1931.

NOTES. *Helotium viridi-flavum* was described on wood from Brazil with ascocarps 3-4mm wide and 2-4mm high, "Viridi-flavum," and with ascospores 22-25x3-5μm. As Dennis (1960a) pointed out, the type specimen from the Rick Herbarium does not contain any recognizable apothecia. Without type or authentic material, I am uncertain as to where the species should be placed, and cannot treat the species further here.

Acknowledgements

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NORTH AMERICAN WOOD-ROTTING FUNGI THAT CAUSE BROWN ROTS[1]

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SUMMARY

One hundred and thirteen species of North American wood-rotting Basidiomycetes are reported to cause brown rots. The majority of these, 71, are in the Polyporaceae. Others are distributed in various families of the Tremellales, Aphyllophorales, and Agaricales. Most occur primarily on conifers and play an essential role in maintaining the coniferous forest ecosystem. A synopsis and a check list give information on substrata, distribution, and sexuality and references to literature on cultural studies and other aspects of the brown rot fungi. New combinations proposed are *Crustoderma resinosum*, *Fomitopsis meliae*, and *Laetiporus persicinus*.

Decay of wood by wood-rotting fungi is generally considered to be of two major types commonly referred to as white rots and brown rots. The white rot fungi are able to degrade both of the major components of woody cell walls, cellulose and lignin. They also bleach the wood and leave a white to pale colored residue that has a spongy, stringy or laminated structure. Most produce extracellular phenol oxidases and generally give positive oxidase tests on gallic and tannic acid media (52, 138) and with gum guaiac (73, 139) or syringaldazine (80) reagents. Some wood-rotting fungi are unable to degrade lignin and selectively remove cellulose and other polysaccharides from wood. These brown-rot fungi leave an amorphous, brown, crumbly residue that is composed largely of lignin. They do not produce extracellular phenol oxidases and generally give negative oxidase tests on gallic and tannic acid media and with gum guaiac and syringaldazine reagents.

Although brown-rot fungi are able to degrade cellulose rapidly in natural wood, they are generally unable to decompose pure cellulose. Exceptions to this are 15 members of the Coniophoraceae in the genera *Coniophora*, *Coniophorella*, *Leucogyrophana*, and *Serpula*, as well as *Paxillus panuoides* and *Hygrophoropsis aurantiacus* of the Paxillaceae. All 17 of these fungi gave positive tests for cellulase when grown on agar media containing pure cellulose (135, 136). As pointed out by Nilsson and Ginns (136), *P. panuoides* and *H. aurantiacus* have basidial, hyphal, and spore characters that indicate a close relationship to species in the Coniophoraceae.

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North American wood-rotting fungi that cause brown rots have been estimated to comprise only about 6 per cent of the total number (70). My previous estimate was that only about 106 species out of 1669 were brown-rot fungi. The number of brown-rot fungi recognized in this synopsis is slightly higher, 113. More species of wood-rotting fungi including some that cause brown rots will undoubtedly be discovered in North America in the future but the percentage of known brown-rot fungi will probably remain about the same.

About 70 per cent of North American brown-rot fungi are in the Polyporaceae. The other 30 per cent are distributed among several families in the orders Aphyllophorales, Agaricales, and Tremellales. Apparently the brown-rot type of enzyme system has evolved independently in a number of groups that do not show close relationships as indicated by comparative morphology. The question arises as to why the Polyporaceae contains such a high percentage of the brown-rot fungi. The answer to this question should provide an important clue to the phylogeny of polypores. For one thing, the Polyporaceae is one of the largest families containing wood-rotting fungi. North American polypores in monographs by Overholts (142) and Lowe (110) number approximately 368, and 71, or 19 per cent, cause brown rots. The total includes the polyporoid Hymenochaetaceae, all of which are white rot fungi. If an estimated 50 species of *Phellinus* and *Inonotus* are removed from this total, the percentage of brown-rot fungi in the Polyporaceae is 22.7 per cent.

Substratum relationships of brown-rot fungi are summarized in Table 1. It has been pointed out (70, 140) that brown-rot fungi are primarily associated with conifers. Most occur primarily on dead conifer wood including dead standing and fallen trees, stumps, logging slash, other dead wood on the ground, and wood in service. Some of these also occur less commonly on hardwoods, particularly aspen, an associate of conifers in coniferous forest areas (107). A small number occur primarily on dead hardwoods. Some brown-rot fungi decay heartwood in living trees. Of these, the ones that cause heartrots in species of the Cupressaceae are the most host-specific. *Tyromyces amarus* is restricted to incense cedar (28, 170), *Poria sequoiae* to redwood (99, 100), *Poria sericeomollis* to western red cedar (33), *Daedalea juniperina* to junipers (72), and *Tyromyces basilaris* to Monterey and Arizona cypresses (3). *Veluticeps berkeleyi* has been reported to cause heart rot only in hard pines (87), *Lentinus kauffmanii* only in Sitka spruce (25), and *Tyromyces balsameus* only in balsam fir (98). Most of the brown-rot fungi that decay heartwood in species of the Pinaceae are known to occur on species from several genera of that family. These include *Fomitopsis officinalis*, *Phaeolus schweinitzii*, *Sparassis crispa*, and *Laetiporus sulphureus*. A few brown-rot fungi cause heart rots in hardwoods only. Examples of this group are *Tyromyces spraguei*, *Coprinus atramentarius*, *Fomitopsis meliae*, and *Daedalea quercina*. Brown-rot fungi that decay heartwood in both conifers and hardwoods include *Fomitopsis pinicola*, *Laetiporus sulphureus*, *Poria cocos*, and *Sparassis herbstii*.

The most important brown-rot fungus in terms of losses in volume of merchantable timber is probably *Phaeolus schweinitzii*. Gross volume losses due to *P. schweinitzii* are much less than caused by *Phellinus pini* in Douglas fir (29, 31). However, since practically all of the volume loss is in the high-grade butt log, the actual economic loss is higher than a comparable volume loss in other logs would entail.

The sexuality of the majority of the brown-rot fungi remains undetermined. The ones that have been studied are predominately heterothallic, and bipolar. However, tetrapolar mating systems have been reported in a number of genera including *Veluticeps*, *Dacryobolus*, *Serpula*, *Amylocystis*, and *Tyromyces*. Indeed, the recent work of David (47) indicates that most species of *Tyromyces* are tetrapolar. Homothallism is also known in the brown-rot fungi, specifically in *Coniophora puteana* (141) and *Coriolellus malicola* (148). Most heterothallic brown-rot fungi have clamp connections on dikaryotic generative hyphae, and their sexuality could probably be readily determined. Species of brown-rot fungi lacking clamps occur primarily in the genera *Coniophora*, *Coniophorella*, *Phaeolus*, and *Laetiporus*. Multiple clamps, a character commonly associated with homothallism, are found in *Coniophora puteana* and *Amylosporus graminicola*. *Coniophora puteana* is homothallic and the sexuality of *A. graminicola* has not been determined.

Brown-rot fungi have an essential role in the functioning of coniferous forest ecosystems. Brown-rot residues are extremely stable and may persist in the upper layers of forest soils for 500 years or more (102). They may constitute up to 26% of the total soil volume in the upper 1 foot of soil and amount to over 40,000 lbs per acre dry weight (125). These large volumes of brown cubical rot residues have several attributes that enhance the establishment and development of conifers and other plants. The gradual decay process plays a key role in recycling nutrients and keeping them in the forest ecosystem (23). Decay fungi in themselves may serve as nutrient sinks and minimize loss of mineral nutrients by leaching. A number of studies have shown that continuous removal of wood residues results in a reduction in site quality and a reduction in plant growth (83). Soils with a high content of brown-rot residues have an increased water holding capacity and a higher cation exchange capacity (83, 95, 96). Brown-rot residues in coniferous forest soils are a major site of ectomycorrhizal root development (83, 84, 85, 86, 95, 96, 102) particularly during the dryer periods of the growing season. These residues are also a site of nitrogen fixation both in or on the soil (83, 84, 85, 94, 95, 96, 102, 103).

These ecological functions of brown-rot fungi are more than important; they are essential to the perpetuation of our great North American coniferous forest ecosystems (85). Wood residues in our coniferous forests represent a critical natural resource that must be managed wisely and maintained at an adequate level to insure continuous productivity and perpetuation of all of the desirable attributes of our coniferous forest ecosystems for future generations. Rapidly developing demands on wood residues as an energy source require that management programs to protect their essential ecological function be instituted as soon as possible.

In Table 1 the distribution by states and provinces is listed by regions and indicated by abbreviation as follows:

Southeast and Gulf Coast

AL- Alabama; AR- Arkansas; DC- District of Columbia; FL- Florida; GA- Georgia; LA- Louisiana; MS- Mississippi; NC- North Carolina; OK- Oklahoma; SC- South Carolina; TN- Tennessee; TX- Texas; VA- Virginia

Midwest

IL- Illinois; IN- Indiana; IA- Iowa; KS- Kansas; KY- Kentucky; MI- Michigan; MN- Minnesota; MO- Missouri; NB- Nebraska; ND- North Dakota; OH- Ohio; SD- South Dakota; WI- Wisconsin

Northeast

CT- Connecticut; DE- Delaware; ME- Maine; MD- Maryland; MA- Massachusetts; NH- New Hampshire; NJ- New Jersey; NY- New York; PA- Pennsylvania; RI- Rhode Island; VT- Vermont; WV- West Virginia

West

AK- Alaska; AZ- Arizona; CA- California; CO- Colorado; HI- Hawaii; ID- Idaho; MT- Montana; NV- Nevada; NM- New Mexico; OR- Oregon; UT- Utah; WA- Washington; WY- Wyoming

Canada

AT- Alberta; BC- British Columbia; MB- Manitoba; NB- New Brunswick; NF- Newfoundland; NWT- Northwest Territories; NS- Nova Scotia; OT- Ontario; PEI- Prince Edward Island; QB- Quebec; SK- Saskatchewan; YT- Yukon Territory

Symbols indicating sexuality are as follows:
0- Homothallic; H- Heterothallic, type of mating system unknown; II- Heterothallic and bipolar; IV- Heterothallic and tetrapolar; ND- No data.

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SYNOPSIS OF NORTH AMERICAN WOOD-ROTTING FUNGI THAT CAUSE BROWN ROTS

Key to Orders of Basidiomycetes that contain brown-rot fungi

1. Basidia septate . . . . TREMELLALES
1. Basidia not septate 2
   2. Hymenophore in form of radial lamellae; basidiocarps mostly fleshy, deteriorating readily after maturity . . . . AGARICALES
   2. Hymenophore smooth, hydnaceous, merulioid, in the form of united tubes or erect flattened branches; if lamellate, then basidiocarps tough, corky and not deteriorating rapidly . . . . APHYLLOPHORALES

TREMELLALES

One species in the genus *Helicobasidium* Pat. of the family Auriculariaceae is known to cause a brown rot.

Helicobasidium corticioides Bandoni. Basidiocarps effused; hymenial surface white to cream colored; hyphae simple-septate; basidia usually 4-celled, slightly coiled or circinate; basidiospores broadly ellipsoid with a large, blunt apiculus, 14-22 x 6.5-12.5 µm.

APHYLLOPHORALES

Key to families of Aphyllophorales that contain brown-rot fungi

1. Basidiocarps with hymenophore in form of united or separate tubes 2
1. Basidiocarps not as above 3
   2. Tubes united . . . . POLYPORACEAE
   2. Tubes separate . . . . FISTULINACEAE
3. Basidiocarps much branched with hymenium on surface of erect, anastomosing, petal-like lobes . . . . . SPARASSIDACEAE
3. Basidiocarps not as above 4
   4. Basidiospores brown to yellowish, dextrinoid or not in Melzer's reagent . . . . CONIOPHORACEAE
   4. Basidiospores hyaline or faintly pigmented, negative, amyloid or dextrinoid in Melzer's reagent 5
5. Basidiocarps becoming effused-reflexed to sessile . . .STEREACEAE
5. Basidiocarps remaining completely resupinate. . . . CORTICIACEAE

Family CORTICIACEAE

Key to genera that contain brown-rot fungi

1. Hymenial surface smooth to tuberculate, basidiocarps resupinate 2
1. Hymenial surface merulioid, basidiocarps often reflexed . . . . *Pseudomerulius* Jülich

Pseudomerulius aureus (Fr.) Jülich. Basidiocarps small, not over a few cm wide; hyphae with clamps; cystidia lacking; basidia 15-17 x 3-3.5 µm; basidiospores cylindric, slightly curved, pale yellowish in KOH, negative in Melzer's reagent, 3.5-4.5 x 1.5-2 µm. (Syn.: *Merulius aureus* Fr.; *Plicatura aurea* (Fr.) Parm.)

2. Basidia small, 20-25 x 3-3.5 µm; basidiospores allantoid, 4.5-6 x 0.7-1.5 µm . . . . *Dacryobolus* Fr.
2. Basidia large, 30-100 m long and 5-7 µm wide; basidiospores cylindric to ellipsoid, over 3 µm wide 3

3. Basidia clavate, 30-80 x 5-9 µm; basidiospores cylindric to broadly ellipsoid, 7-12 x 3-7 µm. . . . . . .*Crustoderma* Parm.
3. Basidia long and slender, up to 100 µm long, 5-6 µm wide; basidiospores cylindric, 12-18 µm long . . . . *Chaetoderma* Parm.

Chaetoderma luna (Rom.) Parm. Basidiocarps white to cream colored, developing in small, often confluent patches, pilose under a 10 x lens; hyphae with clamps; cystidia very abundant, cylindric to narrowly clavate, thick-walled, wall thinning out at apex; basidia narrowly clavate; basidiospores hyaline, negative in Melzer's reagent. (Syn.: *Peniophora luna* Rom.)

Key to species of *Crustoderma*

1. Basidiospores cylindric to cylindric-ellipsoid, 8-12 x 3-4 µm; cystidia with walls moderately thickened at base

Crustoderma dryinum (Berk. et Curt.) Parm. Basidiocarps becoming extensively effused; hyphae with clamps; cystidia abundant, cylindric, thin- to slightly thick-walled, not incrusted, up to 160 µm long, 6-10 µm in diam; basidia 25-35 x 5-6 µm; basidiospores cylindric, hyaline, negative in Melzer's reagent, 8-12 x 3-4 µm. (Syn.: *Peniophora dryina* (Berk. et Curt.) Rogers et Jacks.)

1. Basidiospores broadly ellipsoid, 7-9 x 4.5-5.5 µm; cystidia with walls strongly thickened at base

Crustoderma resinosum (Jacks. et Deard.) comb. nov. (basionym-*Peniophora resinosa* Jacks. et Deard., Can. J. Res., C, 27:147). 1949) Basidiocarps becoming widely effused, buff to reddish brown on drying, often resinous; hyphae with clamps; cystidia abundant, clavate, incrusted apically with resinous material; basidiospores hyaline, negative in Melzer's reagent.

Key to species of *Dacryobolus*

1. Hymenial surface smooth; cystidia thick-walled

Dacryobolus karstenii (Bres.) Oberw. ex Parm. Basidiocarps becoming extensively effused; hymenial surface cream colored to pale buff, cracking extensively on drying; hyphae thin-walled, with clamps, or thick-walled and aseptate; basidiospores 4.5-6 x 1-1.5 µm; fresh basidiocarps and rot with a sweet anise odor. (Syn.: *Peniophora crassa* Burt)

1. Hymenial surface papillate with amber colored droplets at the apices of the papillae; cystidia thin-walled

Dacryobolus sudans (Fr.) Fr. Basidiocarps effused up to several cm; hymenial surface cream colored to ochraceous-buff; hyphae thin- to thick-walled, with clamps; cystidia with clamps or simple septa, clustered at apices of papillae; basidiospores 4-5.5 x 0.7-1 µm. (Syn.: *Odontia sudans* (Fr.) Bres.)

Family CONIOPHORACEAE

Key to genera

1. Hymenophore smooth or tuberculate 2
1. Hymenophore irregularly folded or toothed 3
    2. Cystidia absent, or if present, small and aseptate . . . . *Coniophora* DC. ex Mérat
    2. Large, septate cystidia abundant . . . . *Coniophorella* Karst.

Coniophorella olivacea (Fr.) Karst. Basidiocarps resupinate, adnate; hymenial surface smooth, olivaceous, strongly cystidiate under 10 x lens; hyphae simple-septate; cystidia abundant, septate, coarsely incrusted, projecting to 140 µm, 9-12 µm in diam; basidiospores cylindric-ellipsoid, strongly dextrinoid in Melzer's reagent, 8-13 x 4-6 µm.

3. Basidiospores pigmented, pale, dark yellowish-brown in KOH solution, dextrinoid in Melzer's reagent. . . *Serpula* S. F. Gray
3. Basidiospores hyaline in KOH, dextrinoid in Melzer's reagent . . . . *Leucogyrophana* Pouz.

Key to species of *Coniophora*

1. Basidiospores ovoid to ellipsoid, 10-18 µm long 2
1. Basidiospores fusiform, 16-24 µm long

Coniophora fusispora (Cke. et Ell.) Cke. Basidiocarps arid, separable; hymenial surface dark olivaceous brown, smooth; margin cream colored; subiculum soft, cream colored; hyphae simple-septate; cystidia lacking; basidiospores dextrinoid in Melzer's reagent.

    2. Basidiocarps thin, arid; hyphae simple-septate or with very rare single clamps 3
    2. Basidiocarps becoming thick, fleshy; some hyphae with single, double or multiple clamps

Coniophora puteana (Schum, ex Fr.) Karst. Basidiocarps resupinate, adnate; hymenial surface olive brown; margin cream colored, floccose; hyphae up to 14 µm in diam; cystidia lacking; basidia up to 110 µm long; basidiospores strongly dextrinoid in Melzer's reagent, 11-16 x 7-9 µm. (Syn.: *Coniophora cerebella* Pers.)

3. Basidiospores 14-18 x 5.5-8 µm; basidiocarps not rhizomorphic, adnate 4
3. Basidiospores 7.5-14 x 5.5-8 µm; basidiocarps fragile, rhizomorphic, easily separated from substratum

Coniophora eremophila Linds. et Gilbn. Basidiocarps resupinate; hymenial surface smooth light brownish olive; subiculum white, floccose; rhizomorphs white; cystidia lacking; basidia 50-55 x 6-8 µm; basidiospores strongly dextrinoid in Melzer's reagent, 7.5-14 x 5-9 µm.

    4. Subicular hyphae incrusted

Coniophora suffocata (Pk.) Massee. Basidiocarps resupinate, adnate; hymenial surface smooth, olivaceous to umber; margin usually whitish; basidia utriform; cystidia lacking; basidiospores strongly dextrinoid, 10-14 x 6-7 µm.

4. Subicular hyphae not incrusted

Coniophora arida (Fr.) Karst. Basidiocarps resupinate; hymenial surface smooth, pale brown to olive brown, margin yellowish brown to whitish; basidia utriform, up to 80 µm long; cystidia lacking; basidiospores strongly dextrinoid in Melzer's reagent, 10-18 x 7-8 µm.

Key to species of *Leucogyrophana*

1. Hymenophore smooth, grandinioid, or merulioid. 2
1. Hymenophore becoming strongly hydnaceous

Leucogyrophana pinastri (Fr.) Ginns et Weres. Basidiocarps resupinate, readily separable; hymenial surface olive-brown to yellowish brown; hyphae with clamps; basidia 18-30 x 6-7 µm; basidiospores ellipsoid, dextrinoid in Melzer's reagent, 4.5-7 x 3-5 µm. (Syn.: *Merulius pinastri* (Fr.) Burt; *Serpula pinastri* (Fr.) W. B. Cooke)

2. Hymenial surface merulioid 3
2. Hymenial surface smooth to grandinioid, mustard colcred to olive-green

Leucogyrophana olivascens (Berk. et Curt.) Ginns et Weres. Basidiocarps fragile; hymenial layer pelliculose; subiculum white, floccose; hyphae with clamps; basidia 20-25 x 5-5.5 µm; cystidia hyphoid, up to 60 µm long, 3-4 µm in diam; basidiospores ellipsoid, dextrinoid in Melzer's reagent, 4-6.5 x 3-4 µm. (Syn.: *Coniophora olivascens* (Berk. et Curt.) Massee)

3. Basidiospores negative in Melzer's reagent. 4
3. Basidiospores dextrinoid in Melzer's reagent. 5
4. Basidiospores 5-7 x 3.5-4.5 µm

Leucogyrophana pulverulenta (Fr.) Ginns. Basidiocarps effused, fleshy; hymenial surface raduloid to merulioid, drying dark brown; margin and subiculum cream colored, soft; hyphae with clamps; basidiospores ellipsoid, yellow.

4. Basidiospores 4-5 x 2.5-3 µm

Leucogyrophana sororia (Burt) Ginns. Basidiocarps effused, separable; hymenial surface merulioid, pale orange; subiculum white to cream colored, hyphae with clamps; basidiospores ellipsoid, pale yellow. (Syn.: *Coniophora sororia* Burt)

5. Basidiospores 4.5-9 µm long. 6
5. Basidiospores 3-4.5 µm long

Leucogyrophana montana (Burt) Domanski. Basidiocarps soft, fragile, readily separable; hymenial surface shallowly merulioid, purplish pink when fresh, drying dark purplish brown; margin floccose, ochraceous; hyphae with clamps; basidiospores ovoid to ellipsoid, pale yellow, 4-4.5 x 2.5-3 µm. (Syn.: *Coniophora montana* Burt)

6. Hymenial surface pinkish orange; basidiocarp thick, fleshy. 7
6. Hymenial surface yellow; basidiocarp thin, delicate, pelliculose

Leucogyrophana romellii Ginns. Basidiocarps becoming widely effused; hymenial surface smooth to shallowly merulioid; hyphae with clamps; basidia 25-28 x 5-7 µm; basidiospores ellipsoid, pale yellowish, 4.5-6 x 3.5-4.5 µm.

7. Basidiospores with an apical germ pore

Leucogyrophana arizonica Ginns. Basidiocarps becoming widely effused, soft, separable; hymenial surface strongly merulioid, drying cream-buff to dark reddish brown; hyphae with clamps; basidia 27-30 x 7-8 µm; basidiospores ellipsoid, pale yellow, strongly dextrinoid in Melzer's reagent, 7-9 x 4-5 µm.

7. Basidiospores without an apical germ pore

Leucogyrophana mollusca (Fr.) Pouz. Basidiocarps resupinate, rarely effused-reflexed; easily separable; hymenial surface strongly merulioid, orange to brownish orange; margin and subiculum tissue white to cream colored, soft; hyphae with clamps. (Syn.: *Merulius molluscus* Fr.)

Key to species of *Serpula*

1. Basidiocarps thick, fleshy, becoming effused-reflexed

Serpula lacrimans (Wulf. ex Fr.) S. F. Gray. Basidiocarps often extensive; hymenial surface rusty brown, with deep folds, porose to strongly dentate; hyphae with clamps; cystidia lacking; basidiospores strongly dextrinoid in Melzer's reagent, 9-10.5 x 5.5-6 µm. (Syn.: *Merulius lacrimans* Wulf. ex Fr.)

1. Basidiocarps thin delicate, completely effused

Serpula himantioides (Fr.) Bond. Basidiocarps separable, usually associated with pink or pale purplish, floccose mycelium; hymenial surface pale to dark brown, with shallow folds; hyphae with clamps; cystidia lacking; basidiospores narrowly ellipsoid, strongly dextrinoid in Melzer's reagent, 9-14 x 5-6 µm. (Syn.: *Merulius himantioides* Fr.)

Family FISTULINACEAE

Single genus - *Fistulina* Bull. ex Fr.

Fistulina hepatica Schaeff. ex Fr. Basidiocarps sessile or with a narrowed base; 10-30 cm wide; applanate; upper surface reddish orange to reddish brown; context soft, oozing a reddish juice;

tubes soft, 10-15 mm long; basidiospores ovoid, pale rusty brown in mass, negative in Melzer's reagent, 4-5.5 x 3-4 µm.

Family POLYPORACEAE

Key to genera containing brown-rot fungi

1. Basidiocarps stipitate, sessile, or effused-reflexed, sometimes resupinate at first 2
1. Basidiocarps resupinate at all stages of development . . . . *Poria* Pers. ex S. F. Gray
   2. Basidiocarps annual, rarely reviving a second year. 3
   2. Basidiocarps perennial, tubes typically stratified. . . . . *Fomitopsis* Karst.
3. Hymenophore in form of united tubes, tube mouths (pores) circular to angular or daedaloid 4
3. Hymenophore in form of radial lamellae . . . .*Gloeophyllum* Karst.
   4. Contextual and tramal hyphae simple-septate, clamps lacking 5
   4. Contextual and tramal generative hyphae with clamp connections, clamps at base of basidia 6
5. Contextual tissue and pileus surface brown or orange; large non-incrusted cystidia present . . . . *Phaeolus* (Pat.) Pat.
5. Contextual tissue white to pinkish buff; pileus surface orange or pinkish brown; cystidia lacking . . . . *Laetiporus* Murr.
   6. Generative hyphae with simple clamps; basidiospores not amyloid in Melzer's reagent. 7
   6. Generative hyphae with some double and multiple clamp connections; basidiospores amyloid in Melzer's reagent. . . . . *Amylosporus* Ryvarden

Amylosporus graminicola (Murr.) Ryvarden. Basidiocarps substipitate on ground to sessile on standing trees; drying light and fragile; upper surface white at first, becoming buff to pale brownish, finely tomentose; pores 2-4 per mm; context white when fresh, becoming buff to vinaceous brown, soft and fragile on drying; older specimens malvaceus; dimitic; generative hyphae thin-walled with some single, double, or multiple clamps; skeletal hyphae thick-walled, aseptate; gloeoplerous hyphae also present; cystidia lacking; basidiospores ellipsoid, hyaline, weakly to strongly amyloid in Melzer's reagent; smooth or with amyloid granules, 4.5-5.5 x 2.5-4 µm. (Syn.: *Tyromyces graminicola* Murr.)

7. Pores strongly daedaloid . . . . *Daedalea* Pers. ex Fr.
7. Pores circular to angular. .8
   8. Basidiocarps fibrous to corky when dried. 9
   8. Basidiocarps hard and bone-like on drying . . . .*Osteina* Donk

Osteina obducta (Berk.) Donk. Pileus circular, dimidiate or spathulate; upper surface pale buff to gray; pore surface cream colored to yellowish; basidiospores oblong ellipsoid, hyaline, negative in Melzer's reagent, 4-6 x 2-2.5 µm. (Syn.: *Polyporus osseus* Kalchbr.; *Polyporus zelleri* Murr.).

9. Basidiocarps sessile or effused-reflexed; mainly on conifers . 10
9. Basidiocarps laterally substipitate; virtually restricted to *Betula*. . . . .*Piptoporus* Karst.

Piptoporus betulinus (Fr.) Karst. Basidiocarps dimidiate, solitary; upper surface gray to pale buff, pelliculose; margin rounded, usually extending below pore surface; context white; tube layer easily separated when fresh; hyphal system trimitic, generative hyphae with clamps; cystidia lacking; basidiospores cylindric to allantoid, hyaline, negative in Melzer's reagent, 4.5-6 x 1.5-2 µm. (Syn.: *Polyporus betulinus* Fr.)

10. Hyphal system monomitic although some generative hyphae may become thick-walled 11
10. Hyphal system dimitic or trimitic with distinct thick-walled, aseptate skeletal hyphae 12
11. Contextual hyphae, tramal hyphae and cystidia, if present, not amyloid . . . . *Tyromyces* Karst.
11. Contextual hyphae, tramal hyphae, and cystidia amyloid, at least in part. . . . . *Amylocystis* Bond. et Sing.

Amylocystis lapponica (Rom.) Bond. et Sing. Basidiocarps sessile; becoming reddish brown on bruising or drying; upper surface often hispid; hyphae with clamps; cystidia thick-walled, frequently incrusted at apex; basidiospores cylindric, hyaline, negative in Melzer's reagent, 8-11 x 2.5-3.5 µm. (Syn.: *Polyporus lapponicus* Rom.)

12. Context and tramal tissue white to ochraceous, if brown then pores more or less hexagonal; fresh basidiocarps and rot not with an anise odor. . . . . *Coriolellus* Murr.
12. Context and tramal tissue brown; pores circular to elongated; fresh basidiocarps and rot with an anise odor. . . . . *Osmoporus* Sing.

Osmoporus odoratus (Wulf. ex Fr.) Sing. Basidiocarps sessile or effused-reflexed; upper surface rusty brown, strigose to tomentose or darkening and glabrous with agar; pore surface yellowish brown, pores circular to angular, 2-3 per mm; hyphal system dimitic, generative hyphae with clamps; cystidia none; basidiospores cylindric, hyaline, negative in Melzer's reagent, 9-13 x 3.5-5 µm. (Syn.: *Trametes odorata* (Wulf. ex Fr.) Fr.; *Trametes americana* Overh.)

Key to species of *Coriolellus*

1. Context and pore surface distinctly brown. 2
1. Context and pore surface white to cream colored or pale buff. . 3
2. Fruiting on charred conifer wood; pores hexagonal; basidiospores allantoid

Coriolellus carbonarius (Berk. et Curt.) Bond. Basidiocarps usually resupinate, sometimes effused-reflexed or sessile; pores 2-3 per mm; hyphal system dimitic, generative hyphae with clamps; cystidia lacking; basidiospores hyaline, negative in Melzer's reagent, 7-9 x 2.5-3 µm. (Syn.: *Trametes carbonaria* (Berk. et Curt.) Overh.)

2. Fruiting on uncharred hardwoods; pores circular to angular; basidiospores cylindric

Coriolellus malicola (Berk. et Curt.) Murr. Basidiocarps effused-reflexed or sessile; pores 3-4 per mm; hyphal system trimitic, generative hyphae with clamps; cystidia lacking; basidiospores hyaline, negative in Melzer's reagent; 7-11.5 x 2.5-3.5 µm. (Syn.: *Trametes malicola* Berk. et Curt.)

3. Basidiocarps usually sessile or effused-reflexed. 4
3. Basidiocarps usually resupinate

Coriolellus serialis (Fr.) Murr. Basidiocarps white to cream colored; hyphal system trimitic, generative hyphae with clamps; cystidia lacking; basidiospores cylindric, hyaline, negative in Melzer's reagent, 8-11 x 2.5-4 µm. (Syn.: *Trametes serialis* Fr.; *Trametes alaskana* Baxter)

4. Basidiospores mostly more than 10 µm long 5
4. Basidiospores 7-10 µm long

Coriolellus variiformis (Pk.) Sarkar. Upper surface of basidiocarps reddish brown; pore surface white to cream colored; pores angular or elongated, 1-2 per mm; hyphal system trimitic; generative hyphae with clamps; cystidia lacking; basidiospores cylindric, hyaline, negative in Melzer's reagent, 7-10 x 3-4 µm. (Syn.: *Trametes variiformis* Pk.)

5. Basidiospores 12-14 µm long; pores 1-3 mm in diam

Coriolellus heteromorphus (Fr.) Bond. et Sing. Upper surface of basidiocarps cream colored to ochraceous; pore surface ivory white; hyphal system dimitic, generative hyphae with clamps; cystidia lacking; basidiospores cylindric, hyaline, negative in Melzer's reagent, 12-14 x 4-5 µm. (Syn.: *Trametes heteromorpha* (Fr.) Bres.)

5. Basidiospores 8-12 µm long; pores 1-2 per mm.

Coriolellus sepium (Berk.) Murr. Upper surface of basidiocarps cream colored to pale brownish; pore surface ivory white; hyphal system dimitic, generative hyphae with clamps; basidiospores cylindric, hyaline, negative in Melzer's reagent; 8-12 x 2.5-4 µm. (Syn.: *Trametes sepium* Berk.)

Key to species of *Daedalea*

1. Context tissue cream colored to ochraceous 2
1. Context tissue dark brown

Daedalea berkeleyi Sacc. Upper surface and pore surface of basidiocarps reddish brown; pores up to 2 mm in diam; dissepiments thick and entire; hyphal system dimitic, generative hyphae with clamps; cystidia lacking; basidiospores cylindric, hyaline, negative in Melzer's reagent, 7-8 x 2.5-3 µm.

2. Basidiocarps effused or narrowly reflexed; on *Juniperus* only

Daedalea juniperina Murr. Upper surface of basidiocarps pale buff to cinnamon buff; pore surface light buff; pores up to 2 mm in diam; dissepiments thick, entire; hyphal system dimitic; generative hyphae with clamps; cystidia lacking; basidiospores cylindric, hyaline, negative in Melzer's reagent, 6.5-9 x 2.5-3.5 µm.

2. Basidiocarps sessile; on hardwoods, especially *Quercus*

Daedalea quercina L. ex Fr. Basidiocarps applanate to ungulate; upper surface pale buff and tomentose at first, becoming blackened and rimose with age; context light buff; pore surface pale buff, the pores up to 2 mm in diam; dissepiments thick and entire; hyphal system dimitic, generative hyphae with clamps; cystidia lacking; basidiospores cylindric, hyaline, negative in Melzer's reagent, 5-6 x 2-3 µm.

Key to species of *Fomitopsis*

1. Context and pore surface rose colored. 2
1. Context and pore surface white to pale buff, not rose colored. .3
   2. Basidiocarps usually sessile, ungulate; basidiospores straight, 5-8 x 2-3 µm

Fomitopsis rosea (Alb. et Schw. ex Fr.) Karst. Upper surface of basidiocarps rose colored at first, becoming brown to blackish and rimose with age; hyphal system dimitic, generative hyphae with clamps; cystidia lacking, basidiospores cylindric, hyaline, negative in Melzer's reagent. (Syn.: *Fomes roseus* Alb. et Schw. ex Fr.)

2. Basidiocarps sessile to effused-reflexed, usually applanate, often imbricate; basidiospores curved, 5-8 x 1.5-2.5 µm

Fomitopsis cajanderi (Karst.) Kotl. et Pouz. Upper surface of basidiocarps pinkish brown, becoming blackish and rimose with age; hyphal system dimitic, generative hyphae with clamps; cystidia lacking; basidiospores allantoid, hyaline, negative in Melzer's reagent. (Syn.: *Fomes cajanderi* Karst.; *Fomes subroseus* (Weir) Overh.)

3. Context tough-corky; tissue not bitter. 4
3. Context chalky and crumbly; tissue bitter

Fomitopsis officinalis (Vill. ex Fr.) Bond. et Sing. Basidiocarps ungulate to columnar; upper surface white to light buff, becoming rimose; pores 4-5 per mm; hyphal system dimitic, generative hyphae with clamps; cystidia lacking, basidiospores ovoid, hyaline, negative in Melzer's reagent, 4-7 x 3-3.5 µm. (Syn.: *Fomes officinalis* (Vill. ex Fr.) Faull)

4. Basidiocarps usually sessile, applanate to ungulate

Fomitopsis pinicola (Swartz ex Fr.) Karst. Basidiocarps usually sessile, applanate to ungulate; upper surface glabrous, brownish to black, often reddish and resinous at the margin; pores circular, 5-6 per mm; hyphal system dimitic, generative hyphae with clamps; cystidia hyphoid; basidiospores ellipsoid, hyaline, negative in Melzer's reagent, 6.5-7.5 x 3-4 µm. (Syn.: *Fomes pinicola* (Sw. ex Fr.) Cke.)

4. Basidiocarps resupinate to effused-reflexed; on living hardwoods

Fomitopsis meliae (Underw.) comb. nov. (basionym = *Polyporus meliae* Underw., Torrey Bot. Club. Bull. 24:85. 1897). Basidiocarps sessile or effused-reflexed, often imbricate; upper surface whitish to pale brownish; pores 4-5 per mm; hyphal system dimitic; generative hyphae with clamps; cystidia lacking; basidiospores cylindric, hyaline, negative in Melzer's reagent, 6-8 x 2-3 µm. (Syn.: *Fomes meliae* (Underw.) Murr.)

Key to species of *Gloeophyllum*

1. Upper surface of basidiocarps azonate or indistinctly zonate, dull brown; context usually less than 1 mm thick. 2
1. Upper surface of basidiocarps usually zonate, often with bright yellowish or reddish brown zones; context often up to 3-4 mm thick.

Gloeophyllum saepiarium (Wulf. ex Fr.) Karst. Basidiocarps effused-reflexed to sessile; hyphal system dimitic; generative hyphae with clamps; cystidia cylindric; basidiospores cylindric, hyaline, negative in Melzer's reagent, 8-11 x 3-3.5 µm. (Syn.: *Lenzites saepiaria* (Wulf. ex Fr.) Fr.)

2. Hymenial surface often completely poroid, varying to lamellate

Gloeophyllum trabeum (Pers. ex Fr.) Murr. Basidiocarps effused-reflexed to sessile; hyphal system dimitic, generative hyphae with clamps; cystidia cylindric; basidiospores cylindric, hyaline, negative in Melzer's reagent, 7.5-9 x 3-3.5 µm. (Syn.: *Lenzites trabea* Pers. ex Fr.)

2. Hymenial surface completely lamellate

Gloeophyllum striatum (Swartz ex Fr.) Murr. Basidiocarps usually sessile; hyphal system dimitic; generative hyphae with clamps; cystidia cylindric; basidiospores cylindric, hyaline, negative in Melzer's reagent 6-8 x 2-4 µm. (Syn.: *Lenzites striata* (Swartz ex Fr.) Fr.)

Key to species of *Laetiporus*

1. Contextual tissue white; pileus surface orange; pore surface yellow

Laetiporus sulphureus (Bull. ex Fr.) Bond. et Sing. Basidiocarps often in imbricate clusters, sessile on wood, bleaching to a white crumbly mass after weathering; some contextual hyphae thick-walled, aseptate, much branched and interlocking; basidiospores ovoid to ellipsoid, hyaline, negative in Melzer's reagent, 5-7.5 x 4-5 µm. (Syn.: *Polyporus sulphureus* Bull. ex Fr.).

1. Contextual tissue pinkish buff; pileus surface light buff to pinkish brown; pore surface cream colored or brownish on drying

Laetiporus persicinus (Berk. et Curt.) comb. nov. (basionym - *Polyporus persicinus* Berk. et Curt., Grevillea 1:37. 1872).

Basidiocarps stipitate, terrestrial from buried wood; contextual hyphae thin- to thick-walled, some much branched; spores broadly ellipsoid to subglobose, hyaline, negative in Melzer's reagent, 5-8 x 4-5 µm. (Syn.: *Scutiger persicinus* (Berk. et Curt.) Murr.)

Key to species of *Phaeolus*

1. Basidiocarps sessile, effused-reflexed or resupinate; pore surface and context bright orange. 2
1. Basidiocarps stipitate to sessile, context brown; pore surface greenish brown when fresh, becoming dark rusty brown

Phaeolus schweinitzii (Fr.) Pat. Basidiocarps solitary on ground to imbricate on standing trees and stumps; circular or irregular lobed to dimidiate; upper surface bright yellowish brown at first, becoming dark brown, tomentose to hirsute; hyphae thin- to thick-walled, simple-septate; cystidia abundant, cylindric, not incrusted, 7-13 µm in diam, projecting to 75 µm; vascular hyphae with dark contents present in hymenium; basidiospores ellipsoid to ovoid, hyaline, negative in Melzer's reagent, 6-9 x 3.5-5 µm. (Syn.: *Polyporus schweinitzii* Fr.)

2. Pores 1 mm or more in diam; basidiospores 10-14 µm long

Phaeolus alboluteus (Ell. et Ev.) Pilát. Basidiocarps commonly effused for 1 meter or more, narrowly reflexed to resupinate, developing in spring in snow and deteriorating rapidly after snow melts; upper surface soft and spongy, bright orange; hyphae thin- to thick-walled, simple-septate, bright red then hyaline in KOH; cystidia abundant, cylindric, 6-9 µm in diam and projecting up to 80 µm; basidiospores cylindric, hyaline, negative in Melzer's reagent, 10-14 x 3-4 µm. (Syn.: *Polyporus alboluteus* Ell. et Ev.)

2. Pores 2-3 per mm; basidiospores 5-6 µm long

Phaeolus fibrillosus (Karst.) Bourd. et Galz. Basidiocarps usually sessile, solitary or imbricate, up to 9 cm wide; upper surface orange, becoming hispid to radially fibrillose; hyphae thin- to thick-walled, simple-septate, bright red, then hyaline in KOH; cystidia cylindric, 3.5-4.5 µm in diam, projecting to 35 µm; basidiospores short-chlindric, hyaline, negative in Melzer's reagent, 5-6 x 2.5-3 µm. (Syn.: *Polyporus fibrillosus* Karst.)

Key to species of *Poria*

1. Generative hyphae simple-septate. 2
1. Generative hyphae with clamps 3
   2. Basidiospores 8-11 x 3-4 µm; pores 1-2 per mm

Poria cocos (Schw.) Wolf. Basidiocarps sometimes associated with buried sclerotia or "tuckahoes"; pore surface light ochraceous buff to pinkish buff; some hyphae up to 20 µm in diam; aseptate skeletal hyphae present; cystidia lacking; basidiospores cylindric, hyaline, negative in Melzer's reagent.

2. Basidiospores 4-5 x 2.5-3.5 µm; pores 3-5 per mm.

Poria inflata Overh. Pore surface whitish to cream colored or tan; tube layer drying rapid and brittle; monomitic; some hyphae up to 20 µm in diam; fusoid cystidia present; basidiospores oblong to ovoid, hyaline, negative in Melzer's reagent.

3. Hyphal system monomitic. 4
3. Hyphal system dimitic or trimitic 12
   4. Cystidia present 5
   4. Cystidia absent. 6
5. Pore surface yellow, drying yellowish buff

Poria aurea Pk. Basidiocarps annual pores 2-4 per mm; tube layer soft and cheesy on dried specimens; cystidia imbedded or projecting, thick-walled, ventricose, mostly apically incrusted, 20-50 x 12-25 µm, projecting to 15 µm; basidiospores narrowly ellipsoid, hyaline, negative in Melzer's reagent, 5-7 x 3-3.5 µm.

5. Pore surface white to light buff

Poria sericeomollis (Rom.) Egel. Basidiocarps annual; pores 4-6 per mm; cystidia occasional to abundant, ventricose, thick-walled, some apically incrusted, barely projecting, 14-26 x 6-10 µm; basidiospores oblong to cylindric-ellipsoid, hyaline, negative in Melzer's reagent, 4-5 x 2-2.5 µm. (Syn.: *Poria asiatica* (Pilât) Overh.)

   6. Basidiospores hyaline. 7
   6. Basidiospores brown at maturity

Poria incrassata (Berk. et Curt.) Burt. Basidiocarps annual; rhizomorphic; pore surface becoming brown on drying; pores 1-3 per mm; subiculum often with a dark, hard layer above the tubes; basidiospores ellipsoid, becoming brown, thick-walled, 8-13 x 4-6.5 µm. (Syn.: *Serpula incrassata* (Berk. et Curt.) Donk)

7. Pore surface brightly colored. 8
7. Pore surface white to light buff 10

   8. Pore surface yellow to lavender. 9
   8. Pore surface pale pink

Poria placenta (Fr.) Cke. Basidiocarps annual; taste mild; pores 3-4 per mm; basidiospores oblong to oblong-ellipsoid; hyaline, smooth, 5-7 x 2-3.5 µm. (Syn.: *Poria microspora* Overh.)

9. Pore surface pale yellow; margin with yellow rhizomorphs

Poria albolutescens (Rom.) Egel. Basidiocarps annual, soft and fragile; pores 3-4 per mm; basidiospores oblong, hyaline, weakly amyloid in Melzer's reagent, 3-4.5 x 2-3.5 µm.

9. Pore surface variable in color, yellowish buff to lavender; margin not rhizomorphic

Poria bombycina (Fr.) Cke. Basidiocarps annual, soft; pores 2-3 per mm; basidiospores broadly ellipsoid, hyaline, weakly amyloid in Melzer's reagent, 5-8 x 3-5 µm.

10. Fusoid cystidioles lacking. 11
10. Fusoid cystidioles abundant in hymenium

Poria crassa (Karst.) Sacc. Basidiocarps perennial; taste bitter; pores 5-6 per mm; tube layer waxy, up to 1.5 cm thick; fusoid cystidioles present; basidiospores oblong to oblong-ellipsoid, 4-8 x 3-4 µm.

11. Basidiospores oblong to short-cylindric, 6-8 x 2-3 µm

Poria rancida Bres. Basidiocarps annual; taste rancid; pores 1-4 per mm; basidiospores hyaline, negative in Melzer's reagent.

11. Basidiospores cylindric, 7-11 x 2-3 µm

Poria mappa Overh. et Lowe. Basidiocarps annual, taste mild; basidiospores hyaline, negative in Melzer's reagent.

12. Basidiospores ovoid to ellipsoid 12
12. Basidiospores cylindric to oblong 18
13. Basidiospores smooth. 14
13. Basidiospores echinulate

Poria lenta Overh. et Lowe. Basidiocarps annual; rhizomorphs present beneath basidiocarps; pores 2-3 per mm; basidiospores broadly ovoid to subglobose, hyaline, amyloid in Melzer's reagent, 5-6 x 4-5 µm.

14. Pore surface and context white to light buff or orange-yellow. 18
14. Pore surface and context dark purplish brown

Poria nigra (Berk.) Cke. Basidiocarps perennial; pores 4-8 per mm; context dark purplish brown, often with a dark hard layer next to the substratum; basidiospores hyaline, ovoid to narrowly ellipsoid, negative in Melzer's reagent, 3-5 x 2-3 µm.

15. Pore surface white to cream colored or pale buff. 16
15. Pore surface bright orange yellow

Poria radiculosa (Pk.) Sacc. Basidiocarps annual; pores 3-4 per mm; margin fimbriate to strongly rhizomorphic; rhizomorphs cream colored, up to 2 mm in diam; basidiospores ellipsoid, hyaline, negative in Melzer's reagent, 6-7 x 3-4 µm.

16. Basidiospores 5-7 µm long 17
16. Basidiospores 3-4 µm long

Poria sequoiae Bonar. Basidiocarps annual, pores 3-4 per mm; subiculum white; basidiospores oblong-ellipsoid to ellipsoid, 3.5-5 x 2-3.5 µm.

17. Tubes and context drying soft

Poria vaillantii (DC. ex Fr.) Cke. Basidiocarps annual; pores 2-4 per mm; margin often with white rhizomorphs; basidiospores ellipsoid, hyaline, negative in Melzer's reagent, 5-6.5 x 3-4.5 µm.

17. Tubes drying firm and rigid; context soft

Poria gossypium Speg. Basidiocarps annual; pores 4-6 per mm; subiculum white, soft-fibrous; basidiospores ovoid to ellipsoid, hyaline, negative in Melzer's reagent, 5-7 x 2-3.5 µm.

18. Subiculum uniform in color 19
18. Subiculum with a dark brown layer next to the substratum

Poria albobrunnea (Rom.) Baxt. Basidiocarps annual; pore surface drying reddish brown, pores 5-7 per mm; hyphae of brown layers pale to dark brown in KOH; basidiospores allantoid, hyaline, negative in Melzer's reagent, 5-7 x 1.5-2 µm.

19. Pore surface bright yellow when fresh 20
19. Pore surface white to cream colored or light buff. 21

20. Basidiocarps perennial; pores 1-5 per mm

Poria alpina Litsch. Basidiocarps perennial; taste bitter; pores 3-4 per mm; tubes chalky when dry; context tough, firm; fusoid cystidioles abundant; basidiospores allantoid, hyaline, negative in Melzer's reagent, 3-4 x 1.5-2 µm.

20. Basidiocarps annual; pores 5-7 per mm

Poria xantha (Fr.) Cke. Basidiocarps frequently on charred logs, annual, crumbly or chalky when dry; pores 5-7 per mm; taste bitter; skeletal hyphae weakly amyloid in Melzer's reagent; fusoid cystidioles abundant; basidiospores allantoid, hyaline, negative in Melzer's reagent, 3.5-5 x 1.5-2 µm.

21. Tissue not reacting in Melzer's reagent 22
21. All tissue strongly amyloid in Melzer's reagent

Poria carbonica Overh. Basidiocarps annual; pores 3-5 per mm tube layer up to 1 cm thick; taste mild; basidiospores short-cylindric to oblong, hyaline, negative in Melzer's reagent, 5-5.5 x 2.5-3 µm.

22. Pores 2-4 mm. 23
22. Pores 4-7 per mm 24
23. On conifers; basidiospores allantoid

Poria sinuosa (Fr.) Cke. Basidiocarps annual, tough; taste resinously bitter; pores circular to sinuous, 2-4 per mm; basidiospores hyaline, negative in Melzer's reagent, 4-5.5 x 1.5-2 µm.

23. On hardwoods; basidiospores oblong

Poria oleracea Davids. et Lombard. Basidiocarps perennial; pores 2-4 per mm; tube layer and subiculum chalky to brittle when dry; fusoid cystidioles present; basidiospores oblong, tapered toward the apiculus; hyaline, negative in Melzer's reagent, 5-7.5 x 2-3 µm.

24. Basidiospores up to 10 µm long 25
24. Basidiospores up to 6.5 µm long 26

25. On juniper; binding hyphae lacking

Poria ferox Long et Baxter. Basidiocarps perennial; pores 4-6 per mm; fusoid cystidioles present; basidiospores cylindric, often fusoid, hyaline, negative in Melzer's reagent, 6.5-8 x 2.5-3 µm.

25. On other conifers; binding hyphae present

Poria stenospora Overh. Basidiocarps annual; pores 6-7 per mm; hyphal pegs present; basidiospores cylindric, hyaline, negative in Melzer's reagent, 6-10 x 2-2.5 µm.

26. Basidiospores oblong. 27
26. Basidiospores narrowly allantoid

Poria odora (Pk.) Sacc. Basidiocarps annual; taste mild; odor of fresh basidiocarps and rot strong, garlic-like; pores 4-6 per mm; fusoid cystidioles present; basidiospores hyaline, negative in Melzer's reagent; 5-6.5 x 1-1.5 µm.

27. Margin usually becoming resinous and reddish brown

Poria sitchensis Baxter. Basidiocarps annual, with a strong sweet odor when fresh; pores 4-7 per mm; margin often resinous and reddish brown; taste resinously bitter; globules of exudate abundant in KOH solution; tramal hyphae weakly amyloid in Melzer's reagent; basidiospores cylindric, hyaline, negative in Melzer's reagent, 4-5 x 1.5-2 µm.

27. Margin not resinous and reddish-brown

Poria oleagina Overh. Basidiocarps perennial, becoming crumbly, chalky; pores 4-6 per mm; fusoid cystidiole present; basidiospores short cylindric to oblong, 3.5-5 x 1.5-2 µm.

Key to species of *Tyromyces* that cause brown rots

1. Hyphae with clamp connections 2
1. Hyphae simple-septate

Tyromyces mollis (Pers. ex Fr.) Kotl. et Pouz. Basidiocarps sessile, effused-reflexed, or resupinate; upper surface pale purplish brown, glabrous, becoming rugose; pore surface and context pale pinkish brown; cystidia lacking; basidiospores allantoid, hyaline, negative in Melzer's reagent, 4.5-5.5 x 1-1.5 µm. (Syn.: *Polyporus mollis* Pers. ex Fr.)

2. Basidiospores negative in Melzer's reagent. 3
2. Basidiospores dextrinoid in Melzer's reagent

Tyromyces transmutans (Overh.) Lowe. Basidiocarps usually narrowly reflexed, often resupinate, rarely sessile; upper surface whitish, becoming blotched with reddish brown or bruising on drying; cystidia lacking; basidiospores ellipsoid to short-cylindric, 5-6 x 2-3 µm. (Syn.: *Polyporus subcartilagineus* Overh.; *Tyromyces kravtzevianus* Bond. et Parm.)

3. Gloeocystidia or fusoid cystidia present in hymenium. 4
3. Cystidia lacking. 5
   4. Gloeocystidia present; cystidia lacking

Tyromyces leucomallellus Murr. Basidiocarps effused-reflexed, resupinate, or sessile; upper surface white, drying with reddish brown patches, fibrillose to glabrous; hyphal pegs present; gloeocystidia rare to abundant, imbedded or projecting; basidiospores cylindric, slightly curved, hyaline, 4.5-6 x 1-1.5 µm.

   4. Fusoid cystidia present; gloeocystidia lacking

Tyromyces balsameus (Pk.) Murr. Basidiocarps sessile or effused-reflexed, solitary or in imbricate clusters, dimidiate or laterally fused and elongated; upper surface whitish to pale brownish, faintly zonate; cystidia numerous, often incrusted, 11-21 x 5-7 µm; basidiospores ovoid to ellipsoid, 3.5-4 x 2.5-3 µm. (Syn.: *Polyporus balsameus* Pk.)

5. Basidiospores ellipsoid to ovoid. 6
5. Basidiospores cylindric to allantoid 8
   6. On hardwoods; hyphal system dimitic or trimitic. 7
   6. Restricted to incense cedar; hyphal system monomitic

Tyromyces amarus (Hedgc.) Lowe. Basidiocarps sessile, ungulate, up to 16 cm wide; upper surface drying ochraceous; gloeoplerous hyphae present, cystidia lacking; basidiospores oblong to ellipsoid, thick-walled, 6.5-7.5 x 3.5-4.5 µm. (Syn.: *Polyporus amarus* Hedgc.)

7. Basidiocarps up to 20 cm wide, drying very light in weight; thick-walled, context soft-felty

Tyromyces trichrous (Berk. et Curt.) Lowe. Basidiocarps centrally to laterally substipitate to sessile; upper surface ochraceous, glabrous to tomentose; context soft-felty, cream colored; basidiospores ellipsoid to ovoid or slightly curved, 4-5 x 2.5-3.5 µm. (Syn.: *Polyporus trichrous* Berk. et Curt.; *Polyporus pseudosulphureus* Long)

7. Basidiocarps smaller, up to 15 cm wide, drying firm

Tyromyces spraguei (Berk. et Curt.) Murr. Basidiocarps sessile to effused-reflexed; upper surface cream colored to pale buff, developing reddish brown to blackish areas on drying, especially at the margin; context cream colored, firm and fissile on drying; basidiospores subglobose to broadly ellipsoid, 5.6-5 x 4.5-5 µm. (Syn.: *Polyporus spraguei* Berk. et Curt.)

   8. Hyphal system monomitic. 9
   8. Hyphal system dimitic or trimitic with distinct skeletal hyphae

Tyromyces palustris (Berk. et Curt.) Murr. Basidiocarps sessile or effused-reflexed; upper surface cream colored to pale reddish brown, glabrous; context cream colored, fibrous, firm, up to 2.5 cm thick; gloeoplerous hyphae present, cystidia lacking; basidiospores cylindric to oblong, 6-7.5 x 2.5-3 μm. (Syn.: *Polyporus palustris* Berk. et Curt.)

9. Basidiocarps white to rufescent, not with blue tints. 10
9. Basidiocarps whitish with a blue or grayish blue cast

Tyromyces caesius (Schrad. ex Fr.) Murr. Basidiocarps sessile or effused-reflexed, solitary, dimidiate or narrow and shelf-like; cystidia lacking; basidiospores cylindric to allantoid, 4.5-6 x 1-1.5 μm. (Syn.: *Polyporus caesius* Schrad. ex Fr.)

10. Basidiocarps white to pale buff, not discoloring markedly on bruising or drying. .11
10. Basidiocarps cream colored to pale buff, staining dark reddish brown on bruising or drying

Tyromyces fragilis (Fr.) Donk. Basidiocarps sessile or effused-reflexed, dimidiate to elongated; hyphal pegs present; basidiospores allantoid, 4-5 x 1-2 μm. (Syn.: *Polyporus fragilis* Fr.)

11. Upper surface of basidiocarps tomentose to glabrous. 12
11. Upper surface of basidiocarps cottony, growing down over and partially enclosing pore surface

Tyromyces leucospongia (Cke. et Harkn.) Bond. et Sing. Basidiocarps effused-reflexed to sessile, dimidiate to elongate, developing under snow; upper surface white to pale buff with a thick layer of soft, cottony tomentum, basidiospores allantoid, 4.5-6 x 1-1.5 μm. (Syn.: *Polyporus leucospongia* Cke. et Harkn.)

12. Upper surface without shallow, circular depressions. . . .13
12. Upper surface with shallow, circular depressions

Tyromyces guttulatus (Pk.) Murr. Basidiocarps sessile to substipitate, dimidiate to flabelliform, applanate; upper surface glabrous, cream colored to pale buff; tissues with a bitter taste; gloeoplerous hyphae present; fusoid cystidioles present; basidiospores short-cylindric, 4-5 x 2-2.5 μm. (Syn.: *Polyporus guttulatus* Pk.)

13. On dead conifers or hardwoods. 14
13. On living Monterey and Arizona cypress and juniper

Tyromyces basilaris (Overh.) K. J. Martin. Basidiocarps sessile to laterally substipitate, flabelliform to dimidiate, single or umbricate; upper surface light buff, zonate, tomentose to radially fibrillose; single and double clamps present; hyphal pegs present; basidiospores oblong to cylindric-ellipsoid, 4.5-5 x 2-3 μm. (Syn.: *Polyporus basilaris* Overh.)

14. Tissue not bitter 15
14. Tissue bitter tasting. 16
15. Pores large, 1-3 per mm; reflexed specimens with undulate margin

Tyromyces undosus (Pk.) Murr. Basidiocarps effused-reflexed or occasionally resupinate, upper surface cream colored to pale buff; basidiospores allantoid, 4-7 x 1-1.5 μm. (Syn.: *Polyporus undosus* Pk.)

15. Pores smaller, 3-4 per mm; reflexed portions not undulate

Tyromyces lowei (Pilát) Bond. Basidiocarps effused-reflexed to sessile; upper surface whitish with reddish radial streaks; basidiospores allantoid, 4.5 x 1.5-2 µm. (Syn.: *Leptoporus lowei* Pilát)

16. Basidiocarps effused-reflexed to sessile, pileus elongate to dimidiate 17
16. Basidiocarps petaloid with a narrowed base or imbricate in centrally attached rosettes

Tyromyces floriformis (Quél.) Bond. et Sing. Upper surface white to cream colored or darkening on drying, sometimes radially fibrillose; margin acute, usually incurved; hyphal pegs present; basidiospores oblong to cylindric-ellipsoid. 3.5-5 x 2-2.5 µm. (Syn.: *Polyporus floriformis* Quél.)

17. Upper surface rough to tomentose, white to light buff. 18
17. Upper surface of basidiocarps smooth, pellicular, cream colored to mousy gray.

Tyromyces lacteus (Fr.) Murr. Basidiocarps sessile or effused-reflexed, elongate to dimidiate; pore surface white, becoming yellowish on drying; basidiospores cylindric to allantoid, 4-5 x 1-2 µm.

18. Basidiocarps soft-fibrous on drying

Tyromyces perdelicatus Murr. Basidiocarps sessile to effused-reflexed; pilei dimidiate to elongate; context drying soft-fibrous, tubes drying soft; basidiospores allantoid, 4-5.5 x 1-1.5 µm. (Syn.: *Polyporus perdelicatus* (Murr.) Murr.)

18. Basidiocarps firm and rigid on drying

Tyromyces stipticus (Fr.) Kotl. et Pouz. Basidiocarps usually sessile; pilei dimidiate; context frying hard, tubes drying brittle; basidiospores cylindric to oblong 3.5-5 x 1.5-2 µm. (Syn.: *Polyporus stipticus* Fr.; *Polyporus immitis* Pk.)

Family SPARASSIDACEAE

Single genus - *Sparassis* Fr.

Key to species of *Sparassis*

1. Lobes of basidiocarp thin, crisp, cream colored to buff

Sparassis crispa Wulf. ex Fr. Basidiocarps annual, usually from roots on a perennial, elongated underground pseudosclerotium as a rounded cluster of many anastomosing petaloid lobes with thin, wavy margins; cream colored to yellowish tan; hyphae irregularly inflated, mostly with clamps; aseptate gloeoplerous hyphae present; basidiospores ellipsoid, hyaline; negative in Melzer's reagent, 5-7 x 3-5 µm. (Syn.: *Sparassis radicata* Weir)

1. Lobes of basidiocarps thick, brown with a paler marginal zone

Sparassis herbstii Pk. Basidiocarps annual, arising from a central stalk as many anastomosing branches in rounded clusters; lobes flattened, fleshy-tough when fresh, drying cartilaginous; contextual hyphae mostly thick-walled, 4-12 µm in diam, simple-septate; subhymenial hyphae with clamps; refractive hyphae present at base of basidiocarp; basidiospores ellipsoid, hyaline, negative in Melzer's reagent, 6-7 x 4.5-5.5 µm.

Family STEREACEAE

Key to genera

1. Hymenial surface smooth. . . . .*Columnocystis* Pouz.
1. Hymenial surface with projecting fascicles of sterile hyphae . . . .*Veluticeps* Cke. emend. Pat.

Veluticeps berkeleyi (Berk. et Curt.) Cke. Basidiocarps sessile, effused-reflexed or resupinate; hymenial surface brown; dimitic; generative hyphae with clamps; basidia narrowly clavate, up to 75 µm long; basidiospores cylindric, slightly curved, hyaline, negative in Melzer's reagent, 10-14 x 4-5 µm. (Syn.: *Veluticeps fusca* Humphrey et Long)

Key to species of *Columnocystis*

1. Generative hyphae with clamps 2
1. Generative hyphae lacking clamps, simple-septate

Columnocystis ambigua (Pk.) Pouz. Basidiocarps effused-reflexed or resupinate; hymenial surface grayish brown; hyphae thin- to thick-walled; cystidia cylindric to clavate, thick-walled, with secondary septa; basidia narrowly clavate, often with secondary septa, 70-120 x 5-8 µm; basidiospores cylindric to fusoid, hyaline, negative in Melzer's reagent, 12-16 x 3.5-4 µm. (Syn.: *Stereum ambiguum* Pk.)

2. Basidiospores 17.5-25 µm long; basidia up to 12 µm in diam

Columnocystis pimeriensis Gilbn. Basidiocarps effused in small confluent patches, resupinate to narrowly reflexed; hymenial surface brown, with glistening, needle-like crystals; hyphae thin- to thick-walled, with clamps and some simple septa; cystidia cylindric, some with secondary septa; basidia up to 110 µm long, with stout sterigmata up to 20 µm long and 4 µm in diam; basidiospores cylindric to ellipsoid, hyaline, negative in Melzer's reagent, 17.5-25 x 7-10 µm.

2. Basidiospores 10-15 µm long; basidia 8-9 µm in diam

Columnocystis abietina (Pers. ex Fr.) Pouz. Basidiocarps sessile, effused-reflexed, or resupinate; hymenial surface grayish brown, with glistening needle-like crystals; dimitic; generative hyphae with clamps; cystidia abundant, narrowly clavate, with a thick wall that thins at the apex, 100-300 x 6-8 µm, some with secondary septa; basidia narrowly clavate, 85-120 x 8-9 µm; basidiospores cylindric, hyaline, negative in Melzer's reagent, 10-15 x 4-5.5 µm. (Syn.: *Stereum abietinum* (Pers. ex Fr.) Fr.; *Stereum rugisporum* (Ell. et Ev.) Burt)

AGARICALES

Key to families containing brown-rot fungi

1. Spore print white . . . . .TRICHOLOMATACEAE
1. Spore print pale brown to black 2
   2. Spore print black; basidiocarps deliquescing at maturity . . . . COPRINACEAE
   2. Spore print pale brownish; basidiocarps not deliquescing at maturity . . . . PAXILLACEAE

Family COPRINACEAE

One genus contains brown-rot fungi - *Coprinus* (Pers. ex Fr.) S. F. Gray

Key to species of *Coprinus* that cause brown rots

1. Upper surface of pileus lacking glistening, mica-like particles

   Coprinus atramentarius (Bull. ex Fr.) Fr. Basidiocarps centrally stipitate, single to clustered, 4-10 cm tall; pileus conical, becoming campanulate; up to 6 cm wide; upper surface grayish to brownish, dry; gills free, crowded, pale grayish white, becoming black; contextual hyphae with clamps, up to 20 μm in diam; cuticle with swollen cells up to 30 μm in diam; pleurocystidia present; basidia separated by larger sterile cells 10-20 μm diam; basidiospores ellipsoid, dark blackish brown, truncate with a large pore at apex, 9-12 x 5-6 μm.

1. Upper surface with glistening mica-like particles

   Coprinus micaceus (Bull. ex Fr.) Fr. Basidiocarps centrally stipitate, usually in dense clusters; pilei 1-5 cm diam, conical to campanulate; upper surface pale buff to darker brownish, radiately striate; gills crowded, white, becoming black; contextual hyphae with clamps; subhymenial tissue of gill trama dextrinoid; pleurocystidia present; basidiospores ovoid to narrowly ellipsoid; dark brown in KOH, truncate and with a large pore at apex, 5.5-8 x 4.5-6 μm.

Family PAXILLACEAE

Key to genera that contain brown-rot fungi

1. Basidiocarps sessile or laterally substipitate . . . *Paxillus* Fr.
1. Basidiocarps centrally stipitate .*Hygrophoropsis* (Schroet.) Maire

Hygrophoropsis aurantiacus (Fr.) Maire. Basidiocarps centrally stipitate, single to gregarious; pileus up to 6 cm wide; upper surface orange-yellow to brownish orange, finely strigose; gills decurrent; stalk orange; contextual hyphae with clamps; basidiospores ellipsoid, hyaline in KOH, weakly dextrinoid in Melzer's reagent, 5-7 x 3-4 μm. (Syn.: *Clitocybe aurantiaca* (Fr.) Studer)

Key to species of *Paxillus*

1. Basidiocarps laterally substipitate; upper surface rusty brown

Paxillus atrotomentosus (Batsch. ex Fr.) Fr. Basidiocarps single or in clusters; gills decurrent; stipe with dense dark brown hairs; basidiospores ovoid, clay color in mass, dextrinoid in Melzer's reagent; 5-7 x 3-4 µm.

1. Basidiocarps sessile; upper surface ochraceous buff

Paxillus panuoides Fr. Basidiocarps 2-7 cm wide, single or in confluent clusters; upper surface ochraceous buff, moist, slightly strigose at base; gills pinkish buff; context white; contextual hyphae with clamps; cystidia lacking; basidiospores ellipsoid, hyaline, dextrinoid in Melzer's reagent, 4.5-5 x 3-3.5 µm.

Family TRICHOLOMATACEAE

One genus contains brown-rot fungi - *Lentinus* Fr.

Key to species of *Lentinus* that cause brown rots

1. Annulus absent 2
1. Annulus present

Lentinus lepideus Fr. Basidiocarps up to 15 cm in diam, stipe with recurved squamules at apex; gloeoplerous hyphae present in context; cylindric to fusoid pleurocystidia abundant, 40-60 x 3-5 µm; basidiospores cylindric, hyaline, negative in Melzer's reagent, 9-11 x 3-3.5 µm.

2. Basidiocarps small, 1-8 cm wide. 3
2. Basidiocarps large, up to 27 cm wide

Lentinus ponderosus O. K. Miller. Basidiocarps up to 27 cm wide; stipe lacking round squamules at apex; gloeoplerous hyphae present in context; pleurocystidia cylindric to fusiform, 4.5 x 3-4.5 µm; barely projecting; basidiospores cylindric, hyaline, negative in Melzer's reagent, 9-11 x 3-3.5 µm.

3. Basidiocarps up to 8 cm wide; upper surface tomentose to glabrous; on Sitka spruce

Lentinus kauffmanii A. H. Smith. Basidiocarps centrally to eccentrically stipitate; gills crowded, decurrent and extending down stipe 1-2 cm; pleurocystidia abundant, cylindric to ventricose, 60-100 x 7-12 µm; cheilocystidia present; hyphae with clamps; basidiospores cylindric or slightly curved, hyaline, pale red in Melzer's reagent, 5-6 x 2 µm.

3. Basidiocarps up to 3 cm wide; upper surface with reddish brown radial fibrillose scales

Lentinus sulcatus Berk. Basidiocarps centrally stipitate, gills distant, free to adnate, edges appearing granulose under 30 x lens; hyphae without clamps, some thin-walled, simple-septate, others thick-walled, aseptate; pleurocystidia cylindric to fusoid, 60-100 x 7-10 µm; cheilocystidia present; basidiospores broadly cylindric, hyaline, negative in Melzer's reagent, 10-14 x 5-6 µm. (Syn.: *Panus fulvidus* Bres.)

Table 1. Annotated check list of North American brown-rot fungi

BROWN ROT FUNGUS	SUBSTRATA	DISTRIBUTION	SEX	CULTURES	GEN. REFS.
AMYLOCYSTIS LAPPONICA	dead conifers	MI MN; NH NY VT; AK AZ CO ID MT OR UT WY; AT BC MB OT QB	IV	63,140,161	27,62,63,69,111, 112,121,142,147, 152
AMYLOSPORUS GRAMINICOLA	living hardwoods	TX; AZ CA	ND	75	75,111,146
CHAETODERMA LUNA	dead conifers	AK AZ CO ID MT UT	ND	4,127,161	4,64,69,88,120, 127
COLUMNOCYSTIS ABIETINA	dead conifers	NY AK AZ CO ID MT OR UT WA WY; AT BC NF NS NWT YT	ND	26,138, 141,161	26,37,64,69,93, 104
C. AMBIGUA	dead conifers	NC TN; ME NY VT	ND	161	34,37,93
C. PIMERIENSIS	dead ponderosa pine	AZ	ND	ND	69
CONIOPHORA ARIDA	dead conifers and hardwoods	LA NC; IL MO: MA NJ NY PA RI VT; AZ CO ID MT; MB NS ON QB	ND	97,163	35,69,107,123
C. EREMOPHILA	dead desert hard- woods and juniper	AZ	ND	ND	71,72,106
C. FUSISPORA	dead conifers	NJ; BC NS	ND	ND	35,123
C. PUTEANA	dead conifers and hardwoods, structural timbers	DC; IA IL MI MO OH; MA NJ NY PA VT; AK AZ CA CO ID MT WA; AT BC MB NB NS OT QB	0	26,40,50, 56,138,141	26,31,35,40,69, 87,88,107,117,123
C. SUFFOCATA	dead conifers and hardwoods	DC FL LA; IL IN MO; MA NJ NY PA VT; ID MT WA; BC NS OT	ND	ND	35,76

BROWN ROT FUNGUS	SUBSTRATA	DISTRIBUTION	SEX	CULTURES	GEN. REFS.
CONIOPHORELLA OLIVACEA	dead conifers and hardwoods	AL GA LA SC; MO OH; MD NH NJ NY PA VT; AZ CO ID MT; AT BC MB MN OT NS	ND	97, 131	35,64,69,107,123
COPRINUS ATRAMENTARIUS	Butt rot in aspen	VA; OH; MD NY; AZ CO MT NM WY	ND	149,150	1,107,130,132,144, 158,159
C. MICACEUS	hardwood stumps	MI WI; MD NY; MT; YT	ND	ND	1,107,130,158,159
CORIOLELLUS CARBONARIUS	dead charred conifers	FL GA SC TN; MI MO; NY; AZ CA ID MT NM OR WA	ND	6,140,161	68,69,110,112,113, 121,142
C. HETEROMORPHUS	dead conifers and hardwoods	AL NC TN VA; MI MO MN SD WI; MA ME NH NY PA VT; AK AZ CA CO ID MT NM OR UT WA WY; AT BC NB NS OT QB YT	II	72,97,138 140,141, 148,161	10,27,60,68,69,71, 91,97,107,112,113, 121,142,147,152
C. MALICOLA	dead hardwoods	DC GA LA NC TN; IA IL IN KY MI MO OH SD WA WI; CT NJ NY PA VT WV; AZ MT WY; AT MB OT QB	0	13,61,140, 141,148, 161	13,27,60,68,107, 112,113,142,174
C. SEPIUM	dead conifers and hardwoods	AL AR DC FL GA LA MS NC TN TX VA; IA IL IN KS KY MO NB OH WI; CT DE MA MD NH NJ NY PA WV; AZ CA MT NM OR WA; BC NB OT QB	ND	6,72,138 140,141, 148,161	68,112,113,121, 142
C. SERIALIS	dead conifers and hardwoods	AL AR FL GA LA NC TN TX VA; IA IL KS KY MI MN MO OH WI; CT MA ME MD NH NJ NY PA VT WV; AK AZ CA CO ID MT NM NV OR UT WA WY: AT BC MB NF NS NWT OT QB YT	II	6,40,50, 97,137, 138,140, 148,151, 161	2,15,27,31,40,60, 68,69,88,91,92, 97,107,110,112, 113,121,142,143, 147,152,160,174

BROWN ROT FUNGUS	SUBSTRATA	DISTRIBUTION	SEX	CULTURES	GEN REFS.
CORIOLELLUS VARIIFORMIS	dead conifers	TN; MI MN; ME NH NY VT; AK CO ID MT OR UT WA; AT BC NB NF NS OT QB YT	II	138,140, 141,148, 161	10,68,112,113,121, 142,152
CRUSTODERMA DRYINUM	dead conifers and hardwoods	AL; AZ NM OR; BC	ND	ND	35,64,69,107,120, 157
C. RESINOSUM	dead conifers	MT OR WA; BC	ND	ND	120
DACRYOBOLUS KARSTENII	dead conifers	AL NC SC; MA NH NJ NY PA VT; AZ ID NM OR WA; BC NS QB	ND	ND	64,69,93,120,157
D. SUDANS	dead conifers and hardwoods	NC TN; MI MN WI; NY MD AZ CO ID NM WY; BC OT	IV	26,161	26,64,69,72,107, 120
DAEDALEA BERKELEYI	dead conifers	AL FL LA MS SC TN TX VA; AZ	ND	ND	112,113,142
D. JUNIPERINA	trunk rot of living junipers	AR DC FL MS NC VA; KS KY MO NB NY; AZ CO OR	ND	140	14,72,112,113,142
D. QUERCINA	dead hardwoods, especially oaks and chestnuts; also on living trees	DC NC VA; IA OH; CT DE ME MD MA NJ NY PA VT WV; CA OR; NS	ND	40,53, 138,140 141,161, 165	27,31,40,62,91, 112,113,140,142, 147,168

BROWN ROT FUNGUS	SUBSTRATA	DISTRIBUTION	SEX	CULTURES	GEN. REFS.
FISTULINA HEPATICA	heartrot of living oaks	AL AR DC GA NC TN VA: MI OH; CT DE MD NY MD WV	ND	39,40,53	1,27,31,39,40,49, 62,130,162,173
FOMITOPSIS CAJANDERI	dead conifers: rarely on dead hardwoods; heartrot in fruit trees	AL AR FL GA NC TN VA; IA IN KY MI MN NE SD WI; CT MA MD ME NH NJ NY PA VT WV; AK AZ CA CO ID MT NM NV OR UT WA WY; AT BC MB NB NS OT PEI QB	II	19,38, 138,140, 141,161 165	19,27,31,62,69, 107,109,112,113, 121,142,152,167, 175
F. MELIAE	dead hardwoods	AL AR FL LA NC TN TX; IN MO NB; AZ	II	38,126, 140,161	113,142
F. OFFICINALIS	trunk rot of living conifers	MI SD WI; AK AZ CA CO ID MT NV OR WA; AT BC OT	ND	38,40, 138,140, 141,161	27,29,30,31,40, 62,65,69,88,91, 109,112,121,128, 142,147
F. PINICOLA	dead conifers, also a trunk rot in conifers and black cherry	NC TN VA; MI MN MO OH SD WI; MA ME NH NY PA VT WV; AK AZ CA CO ID MT NM NV OR UT WA WY; AT BC MB NB NS NF NWT OT PEI QB SK YT	II	6,38,40, 50,97, 133,138, 140,141,	
F. ROSEA	dead conifers and aspen; top rot in Douglas fir	IA; ME NH NY VT; AZ CA CO ID MT NM NV OR UT WY; AT BC NB NS PEI	II	6,38, 138,140, 141,161	27,29,30,31,62, 91,107,109,112, 121,142,147,152, 160

BROWN ROT FUNGUS	SUBSTRATA	DISTRIBUTION	SEX	CULTURES	GEN. REFS.
GLOEOPHYLLUM SAEPIARIUM	dead conifers and rarely on hardwoods, especially aspen	AL AR FL GA LA MS NC SC TN TX VA; IA IN KS MI MN NB OH SD WI; CT MA MD ME NH NJ NY PA VT WV; AK AZ CA CO ID MT NM OR UT WA WY; AT BC MB NB NF NWT NS OT PEI QB SK YT	II	20,40,43, 97,138, 140,141, 151,161, 165	2,20,27,31,40,62, 69,72,91,97,107, 112,113,121,130, 142,143,147,152, 160
G. STRIATUM	dead junipers and cypress	FL GA NC; AZ	ND	45,140, 151,161	2,112,113,142
G. TRABEUM	dead hardwoods and conifers; important in houses and other structures	AL GA LA MS NC OK SC TN VA; IA IN KS KY MI MN MO NB OH WI; CT MA MD ME NJ NY PA RI VT WV; AZ CA CO ID MT OR; MB NB OT QB	II	24,40,43, 59,138, 140,141, 161,165	27,31,40,59,62, 69,72,91,112,113, 121,142,147,152, 160
HELICOBASIDIUM CORTICIOIDES	dead conifers	AZ CO MT	ND	55,127	55,123,127
HYGROPHOROPSIS AURANTIACUS	dead hardwoods and conifers	AZ ID OR; BC	ND	ND	130,158,159
LAETIPORUS PERSICINUS	root and butt rot of hardwoods and conifers	AR FL NC SC	ND	ND	113
L. SULPHUREUS	butt rot of hardwoods and conifers; also on stumps and logs	AL AR DC FL GA LA MS NC OK TN SC TX VA; IA IL IN KS KY MI MN MO NE OH WI; CT DE MA MD ME NH NJ NY PA RI VT WV; AK AZ CA ID MT OR WA; AT BC MB NB NS OT QB	ND	5,40,53, 138,140, 141,161, 164	1,27,30,31,40,62, 69,91,107,112, 113,121,128,130, 142,147,158,164, 168

BROWN ROT FUNGUS	SUBSTRATA	DISTRIBUTION	SEX	CULTURES	GEN. REFS.
LENTINUS KAUFFMANII	trunk rot of Sitka spruce	AK CA OR WA; BC	ND	25,138, 141	25,31,123,159
L. LEPIDEUS	butt rot of living conifers and on dead conifers	CT ME NH NY; AZ MT ID; NB NS	ND	40,138, 141	31,40,69,123,128, 130,158,159,160, 169
L. PONDEROSUS	dead conifers	AZ ID	ND	ND	69,129,159
L. SULCATUS	dead hardwoods and junipers	AZ; MD	ND	134	71,72,106,107,159
LEUCOGYROPHANA ARIZONICA	dead conifers	TN; MD NY; AZ NM	ND	78	69,78,120
L. MOLLUSCA	dead conifers and hardwoods	AL TN; IN MA MI; NH NY; AZ ID MT OR WA; BC OT QB NS	ND	78,79,161	36,64,69,78,79, 120
L. MONTANA	dead conifers	NY; ID	ND	ND	36,78
L. OLIVASCENS	dead conifers and hardwoods	AL FL LA NC TX VA; MI OH; CT DE MA ME MD NH NJ NY PA VT; AZ ID NM; NS OT	ND	78,79, 105,161	69,78,79,105,120
L. PINASTRI	dead conifers, rarely hardwoods	NC SC VA; OH WI; NY PA; AZ CA ID NM WA; BC OT QB	ND	78,79,82 140,161	36,69,78,79,82, 107,120,154
L. PULVERULENTA	dead conifers and hardwoods	IN; ME PA; CO; BC NS	ND	78	78
L. ROMELLII	dead conifers	NC; SD WI; ME NH NY VT; AZ ID MT NM; BC NS OT PEI QB	ND	78	78

BROWN ROT FUNGUS	SUBSTRATA	DISTRIBUTION	SEX	CULTURE	GEN. REFS.
LEUCOGYROPHANA SORORIA	dead conifers and hardwoods	MD; WA	ND	ND	36,77,78
OSMOPORUS ODORATUS	dead conifers and conifer wood in service	FL TN VA; MI MN WI; DE ME NH NJ NY PA RI VT; WV; AK AZ CA CO ID MT NM OR UT WA WY; AT BC MB NB NF NS NWT OT YT	II	16,138, 140,141, 161	16,27,62,69,91, 112,113,121,142, 147,152
OSTEINA OBDUCTA	dead conifers; rarely on dead hardwoods	IA MI MN WI; MA NH NY PA; AZ CA CO ID MT NM NV OR WA; BC	ND	140,161	62,88,91,112,121, 142,145,147,152
PAXILLUS ATROTOMENTOSUS	dead conifers; also a butt rot of red pine	DC DC; MN WI; MD NY; ID MT WA	ND	57	1,57,130,159
P. PANUOIDES	dead conifers and on mine timbers	DC FL MI TN VA: MI: MD NY RI WV; AZ ID NV	ND	40,156,166	1,40,69,130
PHAEOLUS ALBOLUTEUS	dead conifers; rarely on aspen	MI NY; AK AZ CA CO ID MT NM OR UT WA WY; AT BC NB OT	ND	11,44, 140,161	11,27,60,69,107, 110,112,121,142, 147,152
P. FIBRILLOSUS	dead conifers; rarely on hard-woods	MI MN; CT MA ME NH NY PA VT WV; AK CA CO ID MT OR WA; AT BC MB NF NS OT PEI QB SK	ND	21,44,138, 140,141, 161	21,27,62,112,113, 121,142,147,152
P. SCHWEINITZII	butt rot of living conifers	AL AR DC FL GA LA NC SC TN TX VA; MI MO SD; CT DE MA MD ME NH NJ NY PA VT WV; AK AZ CA CO HI ID MT NM OR UT WA WY; AT BC MB NB NF NS OT PEI QB	ND	5,40,42, 44,138, 140,141, 161	27,29,30,31,40,62, 69,87,91,112,113, 121,128,130,142, 147,152,155

BROWN ROT FUNGUS	SUBSTRATA	DISTRIBUTION	SEX	CULTURE	GEN. REFS.
PIPTOPORUS BETULINUS	on dead and living birches	NC TN WV; IA KS MI MN WI; CT MA ME NH NJ NY PA VT; AK ID MT WA; AT BC MB NB NS OT PEI QB	II	40,116, 138,140, 141,161	27,31,40,62,112, 113,116,142,147
PORIA ALBOBRUNNEA	dead conifers	AK AZ CO ID MT OR WA; AT BC	ND	108,140	12,60,67,69,108, 110,112,121,145, 147
P. ALBOLUTESCENS	dead conifers	LA NC TN; MI IN; NY VT; AK CO ID OR WA; AT	ND	108	16,60,67,108,110, 112,121,147
P. ALPINA	dead conifers	ID MT OR	ND	108	87,108,110,112, 121
P. AUREA	dead conifers	ME NY; AK AZ NM; BC SK	ND	48,161	17,27,48,60,69, 110,112
P. BOMBYCINA	dead conifers; rarely on aspen	MI; MA NH NY WV; AK AZ CO ID MT NM OR WA; OT QB	ND	108,140, 161	27,60,67,69,107, 108,110,112,113, 121,147
P. CARBONICA	dead conifers and conifer wood in service	AZ CA ID MT NM NV OR WA; BC	ND	108,137, 138,140, 141,161	67,69,108,110, 112,121
P. COCOS	dead conifers and hardwoods	AR DC FL GA MS NC SC TN TX VA; KS KY MN MO; DE MD NH NY PA; CA ID MT OR WA; AT OT NB SK	ND	17,53, 140,161	17,31,51,66,67,69, 107,110,112,113

BROWN ROT FUNGUS	SUBSTRATA	DISTRIBUTION	SEX	CULTURES	GEN. REFS.
PORIA CRASSA	dead conifers, rarely dead hardwoods	NC; MI OH WI; NY PA; AK AZ MT NM WA; BC	ND	140	27,60,67,69,110, 112,113,147
P. FEROX	dead junipers	AR OK; AZ NM OR	ND	17	13,72,110,112,113
P. GOSSYPIUM	dead conifers	NY PA; AZ CO; NF OT	ND	ND	60,110,147
P. INCRASSATA	dead conifers and structural timbers	AL DC FL GA LA MS OK SC TN TX VA; IL KY; CT NY; CA ID OR WA; BC NB OT	ND	13,140	13,31,36,56,67,90, 110,112,113,121
P. INFLATA	heartrot of living oaks and on dead hardwoods	FL; MI MO OH; NY WV	ND	ND	110
P. LENTA	dead conifers	FL GA NC SC TN; NY; AZ WA; BC OT	ND	ND	110,113
P. MAPPA	dead conifers	NY; ID; BC NF	ND	140	67,110,112,121,147
P. NIGRA	dead hardwoods	AL AR FL NC SC TN; IA IL IN KS KY OH MO WI; WV	ND	13,53,161	13,110
P. ODORA	dead conifers	NY PA; AZ NM; NB	ND	140	69,110,121
P. OLEAGINA	dead conifers	TN; MI MN NH NY PA VT; OT	ND	ND	67,110,121
P. OLERACEA	dead hardwoods	AR FL GA LA NC TN; MI OH; MD NY; AZ	ND	140,161	110,113
P. PLACENTA	dead conifers and hardwoods structural timbers	MI; NY; AZ CO ID MT NM NV WA; AT BC	II	40,137, 138,140, 141,151,161	14,40,60,67,110, 112,147

BROWN ROT FUNGUS	SUBSTRATA	DISTRIBUTION	SEX	CULTURES	GEN. REFS.
PORIA RADICULOSA	dead conifers and hardwoods	FL LA MS NC TN; NY; AZ CA ID MT WA	ND	108,161	69,110,112,113
P. RANCIDA	dead conifers	AR TN; NY PA; AZ CO NM	ND	ND	110
P. SEQUOIAE	butt rot of living redwood	CA	ND	137,140, 141	31,99,100,110,112
P. SERICEOMOLLIS	heartrot in western red cedar; also on dead conifers or rarely hardwoods	FL NC SC TN; AZ CA CO ID MT OR WA; BC NB NS NWT	ND	50,108, 138,140, 141,161	10,27,31,33,60,67, 69,108,110,112, 113,121,147
P. SINUOSA	dead conifers	MI NJ NY VT; AK AZ CO ID MT NM OR WA; AT BC NS OT SK	ND	108,140, 141,148, 161	27,60,67,69,72, 92,108,110,147
P. SITCHENSIS	dead conifers	NY; AK AZ CA ID MT NM OR; BC	ND	11	11,67,69,110,112, 121
P. STENOSPORA	dead conifers	CA; WA; BC	ND	ND	67,110,112
P. VAILLANTII	dead conifers and structural timbers	DC NC TN VA; MO; MD NY; AZ CA ID NV OR WA; BC	ND	22,40,108, 138,140, 141,161, 163	22,27,40,60,67,69, 92,108,110,112, 113,121,147
P. XANTHA	dead conifers and hardwoods	NC SC TN WV; AK AZ CA CO ID MT NM OR WA WY; AT BC NS SK	ND	40,50,108, 138,140, 141,151, 161	10,27,40,60,67, 69,92,107,108, 110,112,113,121, 147
PSEUDOMERULIUS AUREUS	dead conifers	NC; MI MN; MA NH NJ NY VT; AZ NM; NS QB	ND	7,140, 151	7,36,69,77

BROWN ROT FUNGUS	SUBSTRATA	DISTRIBUTION	SEX	CULTURES	GEN. REFS.
SERPULA HIMANTIOIDES	dead conifers	NH NY WV; MO; AZ CO ID WA; AT BC MB NB NS OT QB	IV	8,82 140,151	8,36,56,69,82,87, 107,123
S. LACRIMANS	structural timbers	CT NY; IL; MA NJ; AZ ID NM NV; NS OT	IV	40,82,138, 140,141, 161	36,40,56,82
SPARASSIS CRISPA	butt and root rot of living conifers	AZ CA ID NM OR WA; BC	II	58,76,119, 122	69,76,119,122,123, 130,154,155,158, 171
S. HERBSTII	butt and root rot of living conifers and hardwoods	AR NC SC; MD	ND	76,119	76,119
TYROMYCES AMARUS	trunk rot of incense cedar	CA ID OR	ND	161	28,30,31,111,112, 128,142,170
T. BALSAMEUS	butt rot of living conifers, also on dead conifers	NC TN; MI MN WI; NH NY PA; AZ CA ID MT NM OR WA; BC NB NS OT QB	IV	17,47,50, 138,140, 141,161	17,31,33,62,69, 98,101,111,112, 113,121,124,142
T. BASILARIS	trunk rot of living Monterey and Arizona cypress	AZ CA	ND	3	3,31,142
T. CAESIUS	dead conifers and hardwoods	AL DC NC TN VA; IA KY MI MO OH WI; CT DE ME NJ NY PA WV; AK AZ CA CO ID MT NM OR UT WA; BC MB NB NS OT PEI QB	IV	40,47,81, 140,153, 161	18,27,62,91,107, 111,112,113,121, 142,147,152,174

BROWN ROT FUNGUS	SUBSTRATA	DISTRIBUTION	SEX	CULTURES	GEN. REFS.
TYROMYCES FLORIFORMIS	dead conifers	NC TN; MI; MA NH NY PA; AZ CA CO ID OR; MB NS OT	ND	ND	27,62,111,112,113, 142,147
T. FRAGILIS	dead conifers	DC NC TN VA; MI WI; CT MA ME NH NY PA; AK AZ CA CO ID MT NM OR WA; BC	ND	5,40,47, 138,140, 141,161	12,27,62,69,91, 92,107,110,111, 112,113,121,142, 147,152
T. GUTTULATUS	dead conifers; rarely on hard-woods	NC TN VA; IN KY MI MN OH WI; MA ME NH NY PA VT; AZ CA ID MT OR WA; BC MB NF NS OT PEI QB	ND	47,54,138, 140,141, 161	62,69,111,112,113, 121,142,147
T. LACTEUS	dead hardwoods and conifers	DC NC TN; IA IN KS MO NB OH; CT DE MD NJ NY PA VT WV; AZ ID MT NM; BC MB NS OT QB	II	114,140	27,62,69,91,111, 112,113,114,121, 147
T. LEUCOMALLELLUS	dead conifers	MD; MI MN; AZ; MB	ND	47	60,91,111,147
T. LEUCOSPONGIA	dead conifers	AZ CA CO ID MT NM NV NM OR UT WA WY; BC	ND	5,9,21, 47,161	9,21,27,31,107, 111,112,121,142, 152
T. LOWEI	dead conifers	NY	ND	47	27,60,62,111,147
T. MOLLIS	dead conifers	AL AR FL LA TX; MI; NH NY; AZ CA CO ID MT NM OR WA WY, BC NB NS QB	ND	47,138, 140,141, 161	27,62,69,91,111, 112,113,121,142, 147
T. PALUSTRIS	dead conifers and hardwoods	AR DC FL GA LA MS SC TN VA; KY	II	5,126,137, 138,140, 141,161, 174	111,113,142,174

BROWN ROT FUNGUS	SUBSTRATA	DISTRIBUTION	SEX	CULTURES	GEN. REFS.
TYROMYCES PERDELICATUS	dead conifers	AZ CA ID MT OR WA; BC	ND	ND	69,107,111,112, 121,142
T. SPRAGUEI	on living and dead hardwoods	AR DC GA LA NC TN VA; IL IN IO MI MO NE OH; CT MA NH NJ NY PA VT WV; OR WA; OT	II	47,53,126, 140,161	31,111,112,113, 142,172
T. STIPTICUS	dead conifers and hardwoods	TN; MI OH; MA NH NY PA VT; AZ ID NM; BC MB NB NS OT	IV	47,97, 140,161	62,91,97,111,112, 113,142,147,156
T. TRANSMUTANS	dead conifers and hardwoods	TN; NY PA; AZ MT NM NV; QB	ND	46,50, 138,140, 161	60,69,107,110, 111,112,113,121, 142,147
T. TRICHROUS	dead hardwoods	AL FL SC	ND	161	111,115
T. UNDOSUS	dead conifers and hardwoods	NC TN VA; ME NH NY VT WV; AK AZ ID MT NM WA; BC OT	II IV	32,47,140	27,32,60,69,91, 107,110,111,112, 113,121,142,147
VELUTICEPS BERKELEYI	trunk rot of ponderosa pine; also on stumps and logs	AZ NM WA	IV	41,74, 118,161	41,74,87

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CREPIDOTUS CINNABARINUS IN NORTH AMERICA

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ABSTRACT

Collections of Crepidotus cinnabarinus Pk. from Canada and the United States are described, illustrated and mapped. A previous report of the species from Alabama is discounted and recent collections from the Great Smoky Mountains National Park, North Carolina, establish the southernmost known location. Light microscope and SEM comparative studies on the type of C. decurrens States, the type of C. cinnabarinus, and additional materials indicate that a single species is involved.

Crepidotus cinnabarinus Pk. was originally described from materials sent to Charles Horton Peck by L. N. Johnson from Ann Arbor, Michigan (Peck, 1895). This distinctive bright red species was next reported from Ohio by Stover (1910, 1912), and re-recorded from Ann Arbor by Kauffman (1918). Murrill (1917) reported it from Ohio, Michigan and Alabama without citing specimens or any supporting publish-

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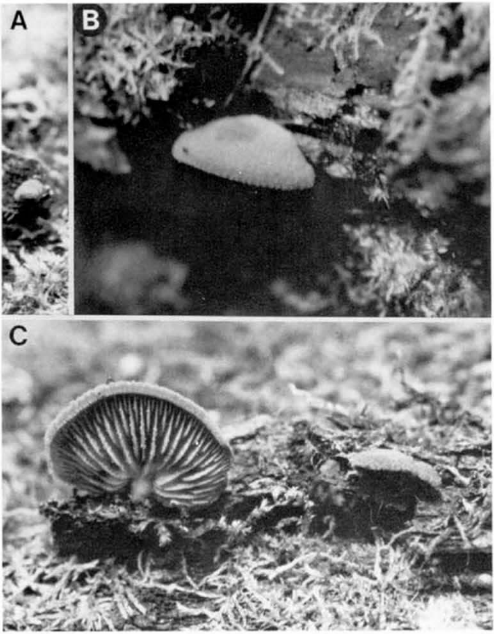

Fig. 1. Crepidotus cinnabarinus in natural habitat. A. Immature sporocarp. B-C. Mature sporocarps. DAOM 174971. ± 2X

Møller & Westergaard (Møller, 1945) described the species as new based on the first known European collections, which were from Denmark. Coincidentally they named it Crepidotus cinnabarinus Møller & Westerg. (Møller, 1945). Møller (1946) subsequently realized that the fungus had been previously described by Peck and offered a correction. Pilat (1948) also examined a North American collection which is in the Bresadola herbarium now at Stockholm (S). This collection is possibly from Cincinnati, Ohio as Lloyd is involved as the collector or distributor (Møller, 1946; Pilat, 1948). If Lloyd did indeed collect it, there is no mention in any of his writings (Stevenson, 1933). Hesler & Smith (1965) studied Peck's type material at Albany (NYS) and isotype material deposited at Ann Arbor (MICH). They reported its distribution as Michigan, Ohio, Alabama, presumably based on Murrill (1917), and Denmark. A single collection of C. cinnabarinus has also been reported by Bulakh (1977) from the Upper Ussuri River area of extreme Eastern USSR, near its border with Chinese Manchuria, ± 150 miles from the Sea of Japan. We have not seen the collection on which this record is based and therefore cannot confirm its identification. However, the implication of this report on the overall distribution of C. cinnabarinus is significant, since it has previously been reported only from Denmark on the Eurasian continents. The taxon could, then, most certainly be expected to occur in adjacent China. Apparently it has not been reported from China so far, according to Tai (1979).

Crepidotus cinnabarinus was reported to be the sole member of Crepidotus sect. Cinnabarini Hesler & Smith until States (1972) described as new, C. decurrens States from Alberta. This taxon was said to differ from C. cinnabarinus by its narrower, closer, decurrent lamellae, and its more coarsely ornamented spores which lacked a reddish tint in mass.

Although the spacing, shape and disposition of the lamellae have been used by Hesler & Smith (1965) to help characterize species, as was noted by States (1972), it should be added that they advise caution regarding the use of such characters because of developmental variability (1965: 9). In the case of Crepidotus cinnabarinus very limited material was observed by Hesler & Smith and States, resulting in some doubt regarding the potential for lamellar variability. The fact that the spore print from the type of C. decurrens lacked reddish tinges is also not definitive, since both McDougall (1922) and Martin (1928) have reported brown spore prints for C. cinnabarinus. Finally, the question of spore ornamentation has been open to interpretation.

Peck (1895) in his original description of Crepidotus cinnabarinus and Murrill (1917) made no mention of spore ornamentation at all. Kauffman (1918) stated that the spores were "smooth" and Møller (1945) illustrated them as smooth, but later (1946) described them as "slightly rough" ("paulum asperae"). Singer (1947) found them to be "strongly punctate, with heterogeneous wall". Pilat (1948) described the ornamentation for this species as "avec une membrane tres finement verruqueuse" and provided an accurate illustration. In 1950 he also gave the ornamentation for C. cinnabarinus as "subtillime et indistincte punctatae" (p. 243) and "minutissime punctatae" (p. 246). Finally, Hesler & Smith (1965) reported "punctate" spores for this species, due to "minute canals extending through the spore wall".

Faced with these doubts and the opportunity of both authors to examine fresh collections, a detailed study of sect. Cinnabarini was undertaken.

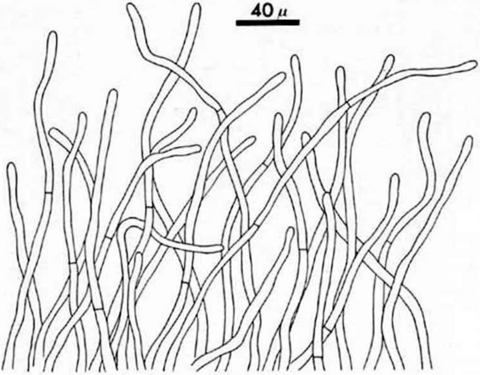

Fig. 2. Crepidotus cinnabarinus. Trichodermium. Holotype C. decurrens.

Comparisons of the holotypes for Crepidotus cinnabarinus and C. decurrens as well as additional collections from UBC, MICH, NYS, DAOM, F, NY and TENN were made based on light microscopy. Structures were also examined under the scanning electron microscope (SEM). The SEM stubs were made from either a spore print (DAOM 170700), or from lamellar fragments (holotypes of C. cinnabarinus and C. decurrens and TENN 41923). These materials were prepared for scanning electron microscopy by thoroughly drying and attaching them to SEM stubs by either double-stick cellophane tape and/or Elmer's Glue, which was allowed to dry and harden overnight. The stubs were then coated with carbon followed by gold in a Denton DV-515 vacuum evaporator at a high vacuum of 2-6 X 10^{-5} torr. Observations were made under an ETEC - Autoscan SEM at a voltage of 20 KV, and photographed using Polaroid Type 665 positive/negative film. Abbreviations of herbaria were taken from Holmgren & Keuken (1974), and color names in quotes are from Ridgway (1912).

Based on the above studies we have found the width of the lamellae and the apparent attachment to the basal plug to vary with age and from collection to collection. The spacing of the lamellae was found to vary around what is a moderate ('close') distance, not being notably distant or crowded and no obvious differences in spacing were noted between the two dried holotypes and other collections.

Although the type of Crepidotus cinnabarinus is very limited and in poor condition, microscopically enough spores were found on a minute lamellar fragment to show that the spore ornamentation is identical to that of the type of C. decurrens (Figs. 4, 5 B-D).

Ornamentation of mature spores of Crepidotus cinnabarinus consists of hemispheric, elongated or slightly irregular, smooth verrucae, often and usually with verruculae (see arrows) in between (Figs. 4, 5 B-D, 6). The elongate verrucae may be straight or curved, and often appear to be composed of two (rarely more) adjacent fused verrucae. The ornamentation is less pronounced in the suprahilar region (Fig. 5 B). A similar situation was found by Pegler & Young (1972) for C. variabilis (Pers. ex Fr.) Kummer.

Crepidotus cinnabarinus has spore ornamentation which most closely approaches what Pegler & Young (1972) have illustrated for C. variabilis. Canals of the type described by Hesler & Smith (1965: 11) for Crepidotus spores, and as seen in the genus Ganoderma as shown by Perreau (1973), were not seen by either Pegler & Young (1972) or by us. Although much more pronounced, the spore ornamentation on Melanoleuca vulgaris Pat. as seen in SEM photographs (Perreau, 1976), is somewhat similar to that of C. cinnabarinus.

Another surprising discovery was the identity of a collection from Alabama deposited in the New York Botanical Garden's herbarium (NY). The collection was made in 1896 at Auburn and was identified as Crepidotus cinnabarinus by C. F. Baker. It was purchased for the N.Y. Botanical Garden in 1902 making it available for Murrill to examine before his report in the North American Flora (1917) and presumably is the basis of his report of that species from Alabama. When reexamined, it was found to be a poorly preserved collection of Panellus stipticus (Bull. ex Fr.) Karsten. Why it was misdetermined is a mystery, but reports of C. cinnabarinus from as far south as Alabama should be discounted until verified by additional collections.

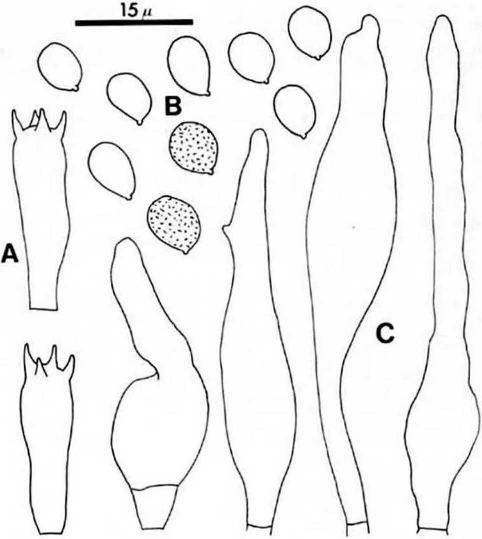

Fig. 3. Crepidotus cinnabarinus. A. Basidia. B. Spores. C. Cheilocystidia. DAOM 174971.

Finally, as can be seen in Figure 7, the geographic distribution of Crepidotus cinnabarinus in North America is continuous between the two type localities, clearly following that for the eastern deciduous forest and extending along the lower boreal forest where mixed Populus forests and grassland occur. Thus there is no reason to believe that the two type collections came from isolated geographic ranges.

The following is a description based on specimens examined:

Crepidotus cinnabarinus Peck, Bull. Torr. Bot. Club 22(12): 489. 1895. [!]

= Crepidotus cinnabarinus Møller & Westergaard in Møller, Friesia 3(2): 95. 1945.

= Crepidotus decurrens States, Bull. Torr. Bot. Club 99 (5): 250. 1972. [!]

Figures 1-7.

Pileus 2.2-18 mm wide, conchate to dimidiate, convex becoming nearly plane, opaque, when fresh "Scarlet Red" to "Spectrum Red", drying to ± "Dragon's Blood Red" or paler, tomentose, fibrillose to matted pubescent, dry; margin mostly even with incurved edges when young; context whitish except near the pellis; odor and taste not distinctive. Lamellae adnate to decurrent by minute teeth, becoming broad on larger basidiomes, moderately spaced, pallid-brown to honey colored on the faces when sporulating, becoming uniformly "Cinnamon Buff" to "Clay Color" to "Sayal Brown" or paler when dried, ± "Scarlet Red" on the edges when fresh and fimbriate-fringed; lamellulae in 1-2 tiers. Stipe plug-like or lacking, up to ± 2 X 1 mm, laterally attached, pubescent, concolorous with the pileus, or paler.

Pileipellis an interwoven layer of filamentous hyphae 4.5-6.5 µm diam., with smooth, thin walls, simple septa and reddish contents, giving rise to a loose trichodermium; trichoderm hyphae up to ± 240 (300) µm long, 3.2-7.2(8.0) µm diam., straight, twisted, bent or contorted, simple, smooth, thin-walled, simple-septate with usually 1-3 septa, mostly cylindric but apex sometimes cylindric-clavate; contents pale orange or pale orange-brown in KOH, especially so apically. Pileus trama somewhat duplex; hyphae loosely interwoven on the upper portion, compactly interwoven and with denser cytoplasmic contents below, thin-walled, smooth, simple-septate, often slightly inflated, 4-11 µm diam. Lamellar trama hyphae similar to the lower pileus trama hyphae, parallel to somewhat interwoven, thin-walled, smooth, simple-septate and often distinctly inflated, 5-25 µm diam.; subhymenial hyphae less inflated, interwoven. Pleurocystidia none. Cheilocystidia abundant, forming a distinct fringed sterile edge, 35-62 X (6)9-11.5 µm, fusoid to filamentous with a fusoid to ventricose base, sometimes with a long pedicel, rarely ± branched, often slightly undulating above, thin-walled, smooth, apex rounded to subacute; contents reddish. Basidia (17.6)20-23 X (6.1)6.4-7.2(8) µm, clavate, thin-walled, mostly 4-spored, lacking basal clamp, ± hyaline in KOH. Basidiospores 6.4-8.8(9.6) X 4.5-5.8(6.4) µm, obscurely obovoid to broadly ellipsoid, inequilateral in profile, usually tapering more towards the small apiculus than towards the distal end, thin-walled, appearing punctate to finely rugose under the light microscope (see previous for SEM studies), pale umber in mass as ± "Tawny Olive" or slightly darker.

Distribution: Canada: Alberta, Manitoba. United States: Illinois, Iowa, Michigan, Minnesota, New York, North Carolina, Ohio, Wisconsin. (Fig. 7) Denmark. USSR.

Substrates and Habitats: scattered on exposed or moss covered bark or decorticated fairly firm wood of (1) *Populus* spp., (2) *Fagus* sp., (3) *Tilia americana* L. and (4) *Ulmus americana* L. and unidentified hardwoods in the eastern deciduous forest or parkland-like prairie-boreal forest areas.

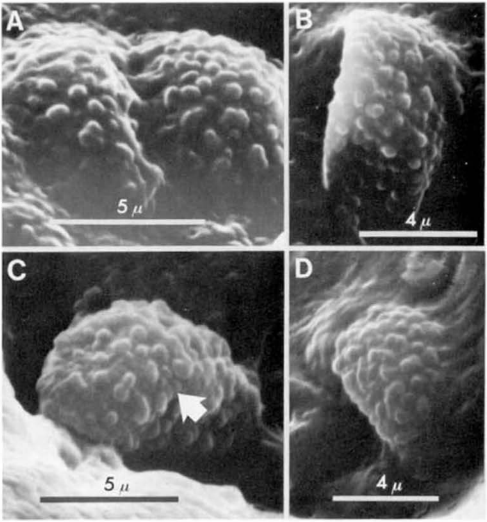

Fig. 4. *Crepidotus cinnabarinus*. A-D SEM view of basidiospores. For arrow see text. Holotype *C. cinnabarinus*.

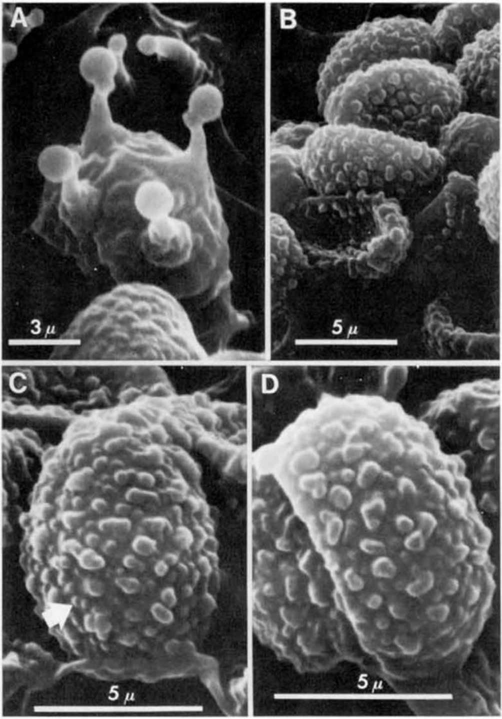

Fig. 5. Crepidotus cinnabarinus. A. SEM view of basidium. B-D. SEM view of basidiospores. For arrow see text. Holotype C. decurrens.

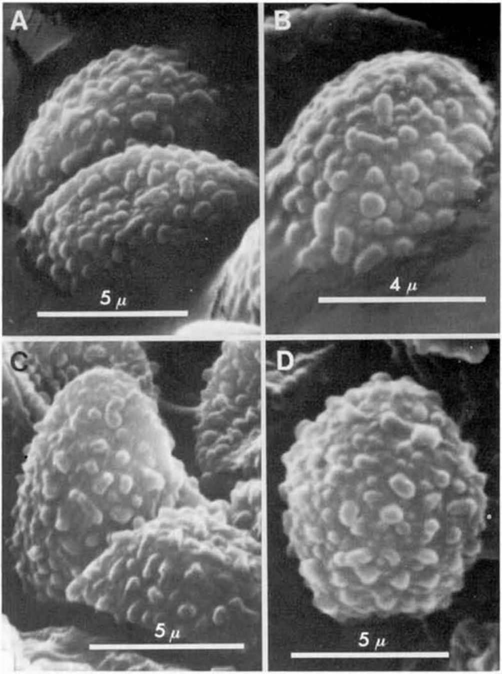

Fig. 6. Crepidotus cinnabarinus. SEM view of basidiospores. A-B. DAOM 170700. C-D. TENN 41923

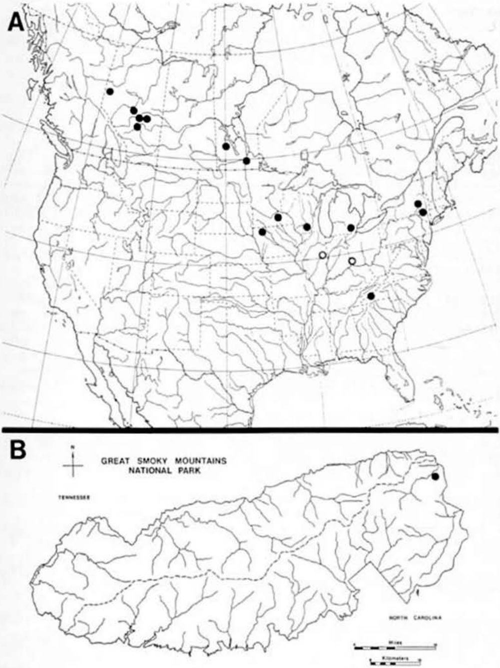

Fig. 7. Crepidotus cinnabarinus. A. Distribution in North America. B. Southernmost collection site in the Great Smoky Mountains National Park. ● = verified with borrowed collections, ○ = not verified with collections or collections nonexistent.

Considering the confusion and inaccurate reports in the past regarding spore ornamentation, and how useful SEM studies were for helping to solve the present problem, we feel that a detailed SEM survey of N. American Crepidotus spores is warranted. Such a study would help provide the basis for a more natural infrageneric classification.

Specimens Examined

Canada

Alberta: Calmar, Aug. 10, 1968, J. States & D. Chomyn 777 (type of C. decurrens, ASC); Edmonton, Sept. 2, 1970, S. A. Redhead 138 (UBC); 20 mi. E. of Edmonton, Sept. 4, 1970, S. A. Redhead 159 (UBC, DAOM 161155); Elk Island Natl. Park near Edmonton, Aug. 6, 1971, on (1), J. A. Traquair (DAOM 174973); Sandy Lake, 50 mi. NW of Edmonton, Aug. 8, 1976, on (1), H. M. E. Schalkwyk 165 (DAOM 160985); same loc., July 29, 1977, H. M. E. Schalkwyk 553 (DAOM 170700); Buffalo Lake, Sept. 17, 1978, R. M. Danielson 2844 (DAOM 176623).

Manitoba: Winnipeg, July 19, 1927, G. R. Bisby & I. L. Conners (DAOM F-6955); same loc., July 22, 1927, G. R. Bisby & Newton (DAOM 155259); same loc., Sept. 20, 1927, W. L. Gordon et al. (DAOM 189430); same loc., Sept. 29, 1927, G. R. Bisby et al. (DAOM 152568); same loc., July 5, 1935, B. Peturson (DAOM 156610); Riding Mt. Natl. Park, Jackfish Cr. at Lake Audy, Aug. 22, 1979, on (1), J. E. & S. A. Redhead 2984 (DAOM 174971).

United States

Iowa: Milford, Aug. 4, 1933, G. W. Martin (NY); same loc., Aug. 7, 1933, L. W. Miller (NY).

Michigan: Ann Arbor, May 26, 1894, on (2), L. N. Johnson 1627 (NY); same loc., Sept. 24, 1894, L. N. Johnson (type of C. cinnabarinus, NYS, isotype MICH); same loc., Nov. 12, 1910, C. H. Kauffman (MICH); same loc., June 28, 1929, A. H. Smith (MICH).

Minnesota: Rice Co., Nerstrand Woods State Park, June 23, 1968, on (3), M. G. Weaver 1544 (MICH).

New York: Greene Co., edge of Catskill ("Kaaterskill"), mouth of Hillyer Ravine, Aug. 19, 1966, on (4), S. J. Smith 40510 & E. Blackman (NYS); Otsego Co., gorge N. of Cherry Valley, July 17, 1967, S. J. Smith 41656 & W. V. Glider (NYS); same loc., July 31, 1969, on (3), S. J. Smith 44405, W. V. Glider & D. J. Moore (NYS).

North Carolina: Great Smoky Mts. Natl. Park, Haywood Co., Big Cr. Area, Baxter Cr. Trail, Aug. 6, 1978, B. S. Luther 759 (TENN 41923); same loc., Sept. 24, 1978, B. S. Luther 812 (TENN 41924).

Wisconsin: Blue Mounds, Oct. 19, 1901, R. A. & A. M. Harper 176 (NYS); same loc., Aug. 8, 1903, on (3), E. T. & S. A. Harper (F 1316271).

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NOTES ON ARGENTINIAN LABOULBENIALES, WITH THE DESCRIPTION OF A NEW GENUS, BENJAMINELLA

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SUMMARY

Rickia platensis, *R. pumila*, *R. perpusilla*, and *R. melanophthalmae* constitute the genus *Benjaminella* gen. nov., characterized by the biseriate or triseriate receptacle (consisting of short cells), which bears sessile or subsessile phialides and lacks appendages opposite or below the perithecium (*Benjaminella melanophthalmae* [Thaxt.] comb. nov. [holotype], *B. perpusilla* [Speg.] comb. nov., *B. pumila* [Speg.] comb. nov., *B. platensis* [Speg.] comb. nov.). *Ecteinomyces perpusillus* is being transferred to *Aporomyces* (*Aporomyces perpusillus* [Speg.] comb. nov.) because of its prominent, persistent, terminal trichogyne base (which rises above the apical outer wall cells of the perithecium and through which the ascospores are discharged) and the poorly developed basal cells of its perithecium. *Ecteinomyces pusillimus* is being transferred to *Siemaszkoa* (*Siemaszkoa pusillima* [Speg.] comb. nov.) because its appendage is simple and the outer wall of its perithecium consists of 3 vertical rows of 3 cells each and 1 row of 4 cells; the cell walls of the perithecial basal cells are indistinct at maturity.

Partly because of the large quantity of Argentinian fungi that had been accumulated by Carlos Spegazzini, Roland Thaxter travelled to South America in 1905-6 during his sabbatical year. While in Argentina and Chile he collected large numbers of fungi, including Laboulbeniales. His interest in these insect parasites, in turn, inspired Spegazzini to study this order. Publications by both men on the Argentinian taxa appeared in 1912. Thaxter had collected in a number of the localities in which Spegazzini obtained the majority of his specimens--these areas were all near Buenos Aires and La Plata. In his later publication (1917) Spegazzini added other taxa which he had collected from this region, as well as a few that had been obtained from Neuquén Province in the forested area around Lake Nahuel-huapí and some (mostly *Laboulbenia* species) from other parts of the country. Even though the area that was intensively surveyed was small, the number of families of hosts (belonging mostly to the Coleoptera, but also to the Acarina, Blattaria, Dermaptera, Diptera, Hemiptera [Corixidae and Veliidae], and Hymenoptera [Formicoidea]) was quite large. However, there is a need for additional collections of some of these families for clarification of the identity of the fungus parasites--for example, Catopidae and Pselaphidae. Other families of Coleoptera that should be examined are Leiodidae and Histeridae, as well as the five families in the Cucujoidea (Corylophidae, Cryptophagidae, Lathridiidae, Phalacridae, and Rhizophagidae) on which species of *Benjaminella* have been found.

BENJAMINELLA GEN. NOV.

Although Thaxter described nine new genera in 1912, he placed one new species in the genus *Rickia* (*R. melanophthalmae*) even though there was no indication of the distinctive appendages subtended by thick, constricted, black septa that are characteristic of that genus (in Thaxter's material, all of the primary appendages appear to have broken off). In October, 1915, Spegazzini obtained from the same place--the Escuela Regional de Santa Catalina, near Llavallol (a few miles south of Buenos Aires and now a suburb)--three additional taxa which were quite similar in appearance, but which occurred on different families of beetles, although they probably occupied similar habitats. Spegazzini described these species as *Rickia* (1917), even though there were no constricted black septa on the well-developed thalli. In the last volume of his monograph, Thaxter (1931) pointed out that these four closely related species of *Rickia* should be removed from the genus. I now take the opportunity of placing these species in a new genus named for Dr. Richard K. Benjamin, who has devoted many years to the study of the Laboulbeniales and who one might say has followed faithfully in Thaxter's footsteps, both in his intensive collecting and in his artistic abilities.

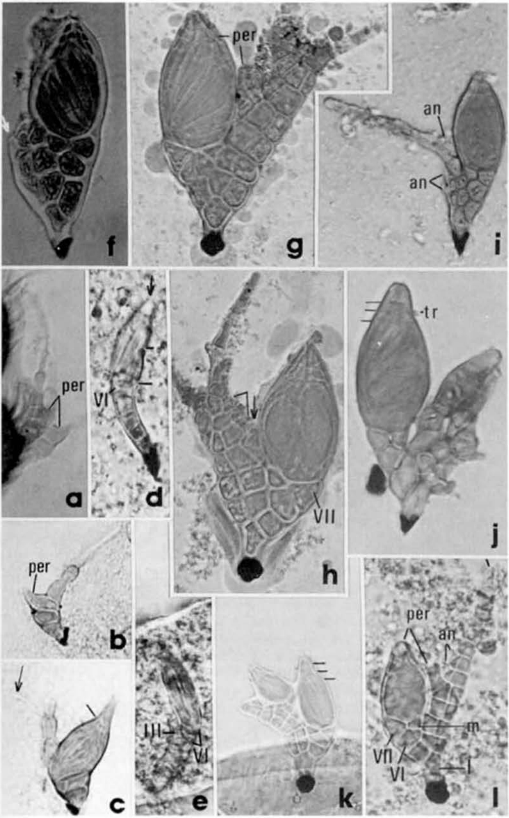
Benjaminella gen. nov. Paries perithecii exterior ex quattuor seriebus cellularum horizontalibus altitudine inaequis constans; receptaculum multicellulare, biseriatum vel triseriatum; antheridia sunt phialides in margine exterior receptaculi partim inclusae; septa constricta nigra nulla.

Receptacle multicellular, composed of short, more or less cubical, rhomboidal, or rounded cells arranged in two or three vertical rows, which may extend some distance above the base of the perithecium. Simple primary appendage terminates primary axis; there may be some short lateral appendages on the primary axis above the perithecium. Antheridia are sessile or subsessile phialides with slightly protruding necks; they may be borne either above the perithecium on the anterior side of the upper receptacle (facing the perithecium) or on the posterior side of the lower receptacle opposite the perithecium. There are no appendages bearing constricted black septa like those occurring in *Rickia*. Outer wall of perithecium consists of 4 vertical rows of 4 cells each, the 3 upper cells being much shorter than the lower cell in each row.

Holotype: *Benjaminella melanophthalmae* (Thaxt.) comb. nov. Basionym: *Rickia melanophthalmae* Thaxter, 1912, p. 161, on elytra of *Melanophthalma* sp. (Lathridiidae). Escuela Regional de Santa Catalina, south of Buenos Aires, Argentina, April, 1906 (Thaxter no. 1980).

Benjaminella differs from *Homaromyces* and *Amphimyces* by its bi- or triseriate receptacle and from *Rhipidiomyces* by the shape of its receptacle cells (in *Homaromyces* and *Amphimyces* the receptacle is multiseriate and bears appendages; the fan-shaped receptacle of *Rhipidiomyces* is composed of narrow, vertically elongate cells). Sessile or subsessile phialides are borne along the receptacle margin in all of these genera (possibly excepting *Amphimyces*). *Asaphomyces* and *Dermapteromyces* differ in the greater height of the perithecium with respect to its width; as in *Benjaminella* and *Amphimyces*, the lowest cell in each vertical row of outer perithecial wall cells is much taller than any of the three upper cells. In *Asaphomyces* only one cell is visible above cell *VI* at the base of the mature perithecium.

Plate I. Figs. a-c. *Aporomyces perpusillus* (slide 242). X 720. a. Pair of young perithecia-bearing thalli borne on antenna. b. Thallus with young perithecium; narrow upper part of primary appendage extends from broader, lower part. c. Mature thallus; narrow termination of primary appendage has broken off; narrow extension (arrow) apparently is not attached to appendage; inner wall cells visible at the upper limits of outer wall cells (line) just below persistent trichogyne base (*tr*); ascospores occupy base of perithecium, obscuring remnants of perithecial basal cells. Figs. d-e. *Siemaszkoa pusillima*. X 760. d. Mature thallus showing protruding apical cell of perithecium (arrow); stalk cell of perithecium (*VI*) is at left; lines at right indicate extent of primary appendage, which has broken off. e. Mature thallus with cell *VI* at right (v-line) and cell *III* (upper receptacle cell) at left; primary appendage has broken off; elongate spores are visible inside perithecium. Fig. f. *Benjaminella melanophthalmae* (slide 2976); arrow points to neck of subsessile phialide; upper 3 tiers of outer wall cells clearly visible. Figs. g-h. *Benjaminella platensis* (type slide). X 720. g. Mature thallus with 2 perithecia; short appendages are present just above young perithecium; apex of primary appendage visible at right. h. Lectotype; 2-3 cells, which are probably phialides, are present (v-line); arrow points to unicellular incipient perithecium; cell *VII* (secondary stalk cell) is in the normal outer position; appendage extending upward is probably primary appendage. Figs. i-j. *Benjaminella perpusilla*. i. Submature thallus; phialide is present just above perithecium; 2 phialides (*an*) are on lower receptacle. X 720. j. Mature thallus with 2 perithecia; lines indicate septa in outer walls; trichogyne stump visible at right (*tr*). X 760. Figs. k-l. *Benjaminella pumila*. k. Thallus with 2 fully developed perithecia. X 560. l. Thallus with 1 young perithecium above the submature primary perithecium; 2 phialides are above perithecia; cells *m* (one of perithecial basal cells) and *I* (basal cell of thallus) are indicated (line at upper right points to apex of appendage). X 760.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The four species of *Benjaminella* and their characteristics are as follows:

Benjaminella melanophthalmae. Specimens examined: FH 2975-6; Benjamin collection: on *Cryptophagus* (Cryptophagidae), Sublette Co., Wyoming (11 mi. SE of Bondurant on Routes 187-189 at 7300 feet in aspen litter, C. C. Hoff, 7 Aug. 1959 [R. K. Benjamin 2467]), which belongs to this taxon, although the primary axis bends sharply outward like that of *B. perpusilla*. The ovoid perithecium is similar to that of *B. platensis* (pl. I, fig. f); cell *m* is laterally adnate to the receptacle (like those of *B. platensis* and *B. pumila*, the receptacle is triseriate across the base when sufficiently mature), which extends only a short distance above the basal cells of the perithecium before it narrows abruptly. In the Wyoming specimens, the narrow upper portion of the primary axis bends sharply outward just above the base of the perithecium; in the type collection the primary axes are broken off at this point (there is no evidence of their turning outward). This species differs from *B. platensis* by the presence of antheridia on the lower receptacle in normal thalli at maturity and by the absence of an elongate, biseriate upper receptacle bearing phialides and a secondary perithecium (the Wyoming specimens bear a phialide just above the perithecium). Thaxter's measurements (1912) were: perithecium 35-43 µm tall, 23 µm wide; receptacle 40 µm tall, 27-31 µm wide; total height 75-85 µm (the Wyoming collection includes smaller mature thalli ca. 50-65 µm tall).

Benjaminella perpusilla (Speg.) comb. nov. Basionym: *Rickia perpusilla* Spegazzini, 1917, p. 666, on elytra of *Phalacrus* sp.? (Phalacridae). Escuela Regional de Santa Catalina and La Plata, winter, 1915. Specimens examined: LPS 38700 (Inst. Bot. Speg., La Plata; October, 1915, Santa Catalina)(slide 367-1915). Perithecium obpyriform, as in *B. pumila*, but neck may be less distinct; cell *m* tends to be free laterally from the receptacle, which narrows just above the base of the perithecium, although a secondary perithecium may develop (presumably because the primary perithecium has aborted)(pl. I, fig. j); on thalli bearing only a primary perithecium, subsessile phialides are present on young thalli along the posterior margin of the lower receptacle (pl. I, fig. i) and sessile phialides may occur above the perithecium. Spegazzini's measurements were: perithecium 30-35 µm tall, 13-14 µm wide; height to apex of perithecium 60-70 µm; thallus width 10-11 µm; total height 75-90 µm.

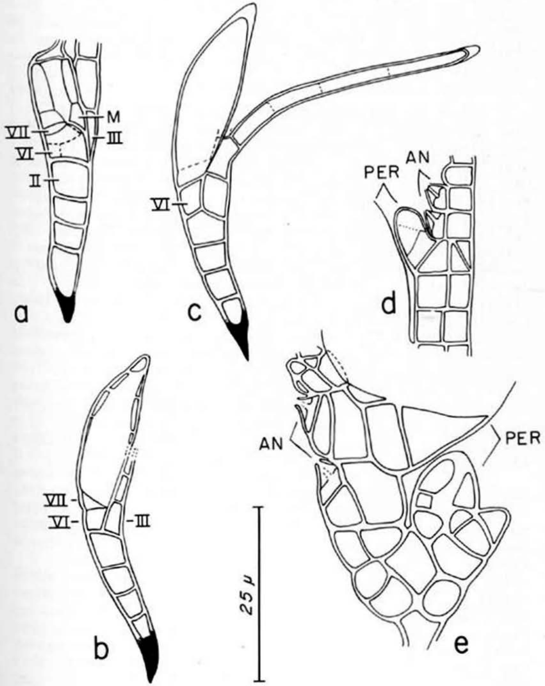
Benjaminella platensis (Speg.) comb. nov. Basionym: *Rickia platensis* Spegazzini, 1917, p. 667. On elytra of *Europs vicinus* Grouvelle (Rhizophagidae, subfamily Monotominae, which is sometimes put in the Cucujidae), Escuela Regional de Santa Catalina, 3 October, 1915. Specimens examined: LPS 38701-2. The ovoid perithecium is very broad at the base and tapers evenly to the narrow apex; the perithecial basal cell *m* is laterally adnate to the receptacle; the broad, biseriate primary axis extends half the height of the primary (lower) perithecium before it narrows--it terminates in a uniseriate primary appendage, which usually breaks off; phialides are formed on the cells above the secondary perithecium, which arises just above the first (pl. I, fig. h) or which may be separated from the primary perithecium by a tier of cells (pl. I, fig. g). Under unusual circumstances mature thalli may bear phialides on the posterior margin of the lower receptacle--for example, in the thallus shown in pl. II, fig. e, in which the primary perithecium aborted and a mature secondary perithecium is present. The thallus of *B. platensis* is large in size--Spegazzini's measurements were: perithecium 40-50 µm tall, 22-25 µm wide; height to apex of perithecium 70-80 µm; thallus width 32-35 µm; total height 70-100 µm.

Benjaminella pumila (Speg.) comb. nov. Basionym: *Rickia pumila* Spegazzini, 1917, p. 668, on elytra of *Sacium* sp. ? (Corylophidae). Escuela Regional de Santa Catalina, October, 1915. Specimens examined: LPS 38699 (no. 370-1915). Similar in appearance to *B. platensis* but much smaller (pl. I, figs. k,l); perithecium obpyriform, having a distinct neck; cell *m* may not be laterally adnate in younger thalli (compare pl. II, fig. d with pl. I, fig. l). Spegazzini's measurements were: perithecium 22-25 µm tall, 13-15 µm wide; height to perithecial apex 48-52 µm; thallus width 20-22 µm; total height 75-85 µm.

A single ascogenic cell is present in the perithecium in *Benjaminella*; the inner wall cells apparently arise from the basal cells of the perithecium. Observations on a young thallus of *B. pumila* showed that at first the thallus is uniseriate. The receptacle cells divide by horizontal divisions, their septa becoming constricted. Superposed upon a series of several inflated cells are some short, uninflated cells that probably are primary appendage cells, although the lowest cubical cell might represent cell *III*. Later, vertical divisions occur in the receptacle cells. In a young specimen of *B. melanophthalmae* from Wyoming, a short, broad cell lay between the spore septum and the upper receptacle cell producing the phialide; the slender primary appendage was two-celled. From the appearance of the cells at the posterior margin in all of the species, it seems probable that spermatia might sometimes be formed in young thalli opposite the perithecium and evidence of their presence be obliterated later. In some thalli (for example, that shown in pl. I, fig. h) it is possible that posterior phialides have been formed early in development; after spermatium discharge ceased, the phialide protoplast may have extended outward, obliterating the neck. The phialide protoplast subsequently could divide obliquely, the upper, outer cell again having the capability of functioning as a phialide. The extent to which this proposed sequence might be initiated and continued probably would depend on the species and on the circumstances of development. It is possible that posterior phialides are limited only to those taxa in which the upper receptacle narrows quickly; however, it is essential that young stages of all taxa be studied in order to determine the manner of development. If thalli having only posterior phialides are self-fertile, one would expect a long trichogyne to extend across the receptacle. Short trichogynes extend to the upper, anterior phialides in the Wyoming thalli of *B. melanophthalmae*; possibly the posterior phialides function in cross-fertilization.

It would be desirable to find out if additional host groups are parasitized by *Benjaminella* to the north along the Paraná River in Argentina. Beetles and possibly also mites frequenting leaf mold or decaying branches may harbor this genus. Cross-inoculation experiments should be made

Plate II. Figs. a-c. *Siemaszkoa pusillima*. a. Thallus having perithecium in 1-tiered stage; inner walls not detected; cells *VII* and *III* partially lie under the large cell *VI*. b. Mature thallus, showing protruding apical cell of perithecium. c. Mature thallus; branch from lowermost cell of primary appendage has broken off (possibly a phialide was borne in this position when the perithecium was immature). d. *Benjaminella pumila*. Phialides (*an*) and young perithecium of thallus shown in pl. I, fig. l. e. *Benjaminella platensis* (type slide); thallus in which primary perithecium has aborted and secondary perithecium is fully developed; two phialides are on posterior side of lower receptacle.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to determine whether the taxa will grow on hosts in different families and what, if any, effect the identity of the host has on the morphology of the fungus species. In particular, the question might be asked whether *B. platensis*, when germinated on *Melanophthalma*, might grow less extensively than it does on *Europs* and retain posterior phialides, which may be a juvenile characteristic.

SIEMASZKOA AND *APOROMYCES*

One of the habitats that was investigated by Spegazzini was the nests of the leaf-cutting, fungus-growing ant *Acromyrmex lundi* (Guérin-Méneville), which is one of the most important ants in southern South America from an economic standpoint, according to Weber (1972). The following species were described by Spegazzini in 1917 from beetles found in these nests: *Pselaphidomyces pselapti* (a new genus) on *Pselaptus tuberculifer* Raffray (Pselaphidae), La Plata; *Stigmatomyces urophilus* on *Heterothops formicetorum* Bernhauer (Staphylinidae, Staphylininae), Escuela Regional de Santa Catalina, Florencio Varela (southeast of Buenos Aires), and La Plata; *Corethromyces scydmaenicola* on an unidentified scydmaenid, La Plata (the latter two taxa will be dealt with in a subsequent publication); *Ecteinomyces perpusillus* on *Rhopalopherus gestroi* Bernhauer (as *Rhopalophorus*)(Staphylinidae, Oxytelinae), Florencio Varela, La Plata, and Escuela Regional de Santa Catalina; and *Ecteinomyces pusillimus* on an unidentified ptiliid, Escuela Regional de Santa Catalina and La Plata (it is possible that this host was *Limulodes elongatus* Bruch [Physis 7: 227-231. 1924], which was described from a nest of this ant).

The latter two species were undoubtedly placed in *Ecteinomyces* because of the uniseriate receptacle consisting of at least 3 cells below the perithecium. Thaxter had not yet described the genera *Phaulomyces, Meionomyces, Euphoriomyces,* and *Carpophoromyces*, all of which, like *Siemaszkoa* (Tavares and Majewski, 1976), have perithecia with basal cells that remain thin-walled (and thus are indistinct at maturity) and with only 3 cells in 3 vertical rows of outer wall cells and 4 in the fourth row. Neither had he described *Aporomyces*, which also has poorly defined perithecial basal cells, as well as a protruding, persistent, apical trichogyne base and a primary appendage that appears to emerge from the side of the mature perithecium (pl. I, figs. b,c)(these genera were described by Thaxter in 1931).

Aporomyces perpusillus (Speg.) comb. nov. (basionym: *Ecteinomyces perpusillus* Spegazzini, 1917, p. 543) was reported to occur on the apical annulations of the antennae of *Rhopalophorus gestroi*; the correct genus name is *Rhopalopherus* (see Blackwelder, 1944-57). The original misspelling led to Thaxter's error in listing the host as a member of the Cerambycidae; he also erred in listing the host genus as *Rhopalocera* when he apparently meant *Rhopalophora* (see note, Benjamin, 1971). Specimens examined: LPS 38635-6 (type collection, presumably from La Plata; slide 210, 1915 [type]; 242, June, 1915). Spegazzini's measurements: total height, 60-65 µm; perithecium 45-48 µm X 17-18 µm; receptacle 18-20 µm high, 10-12 µm wide; appendage 25 µm X 5 um. The perithecia are somewhat smaller than those of *Aporomyces szaboi* Bánhegyi (1944)(50-58 X 29-34 µm), but they are close to the size of those of the three species described by Thaxter in 1931, although those of *A. trinitatis* Thaxt. are wider. All of the species except *A. perpusillus* are probably dioecious, a minute male being paired with the female. By contrast, many perithecium-bearing thalli grew in pairs in Spegazzini's material (pl. I, fig. a). No antheridia were observed; Spegazzini (1917) indicated a long, narrow structure on the primary axis cell just above the base of the perithecium that presumably was considered to be either an antheridium or an antheridial neck. However, I did not observe such a structure on the thalli examined (note the position of the narrow "outgrowth" in pl. I, fig. c [arrow]). It should be determined whether intercalary cells of the primary axis above the perithecium function as phialides for a brief period or whether a narrow phialide terminates the primary appendage. There appear to be 3 outer wall cells in each vertical row and 2 tiers of inner wall cells enclosed within the neck just below the persistent trichogyne base terminating the perithecium (pl. I, fig. c); possibly the inner wall cells arise from the lowest tier of outer wall cells. There is one ascogenic cell.

Siemaszkoa pusillima (Speg.) comb. nov. (basionym: *Ecteinomyces pusillimus* Spegazzini, 1917, p. 545) was reported to occur on the elytra of an unidentified trichopterid (Ptiliidae). Specimens examined: LPS 38973 (presumably type collection and from La Plata [slide 319-1915]). Spegazzini's measurements: perithecium 35 µm tall, 12-13 µm wide, receptacle 30 um tall, 5-7 um wide, appendage 40-45 µm tall, 2-3 µm wide. This taxon is similar to *S. ptenidii* (Scheloske) I. Tavares & Majewski, but it is smaller (in error, perithecial length in *S. ptenidii* was given as 120 um rather than 59 um by Tavares and Majewski in 1976). In both species the 4-celled outer wall cell row (pl. II, fig. b) is on the anterior (outer) side of the perithecium.

Siemaszkoa ptenidii occurs on *Ptenidium* (Ptiliidae) in Europe (Tavares and Majewski, 1976). The secondary stalk cell of the perithecium (cell *VII*) is in the normal anterior position in *S. pusillima* (pl. II, fig. a). Spegazzini (1917) reported that antheridia are formed on the anterior side of the appendage cells; possibly a phialide was produced by the first appendage cell in the thallus shown in pl. II, fig. c. There is one ascogenic cell in *S. pusillima*. The appendage, which bends outward (pl. II, fig. c), is usually broken off (pl. I, figs. d,e)(the appendage in *S. ptenidii* is erect).

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PHOMA CYANEA SP. NOV. FROM WHEAT DEBRIS

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An unusual *Phoma* species which produces a rather exceptional blue colour in the agar was isolated from wheat field debris. This was found to be a stable cha= racteristic after several subcultures and unique among *Phoma* species.

Phoma cyanea sp. nov.

Coloniae in agaro farinae avenaceae moderatae crescentes, ad 25°C septum diebus 60 mm attingentes. Mycelium elevatum gossypinum floccosum, griseum ad cyaneum atro-cyanescens, coloniae reversus atro-cyaneus.

Hyphae laeves ad verruculosae, septatae, ramosae, clarae, hyalinae vel dilutae cyaneae ad atro-cyaneae, saepe incrustatae cristallis cyaneis, flexuosae, 2,5-7,5 µm diam. Hyphae vestustiores crassae saepe septis constrictae.

Pycnidia superficialia, 100-300 µm diam, laevia, globosa ad subglobosa subinde ellipsoidalia, cyanea ad atro-cyanea, collo brevi, ostiole colloratum uno collo praeditum, paries pycnidialis 12,5-19,0 µm crassi, ex 1-2 stratis cellularum parenchymatarum formata. Cellu= lae conidiogenae (phialides) hyalinae, globosae ad sub= globosae vel irregulares, 3,75-6,25 x 5,0-7,5 µm, collo 1,0-2,0 x 1,0 µm. Conidia hyalina, continua, laevia, albida in toto, rectae vel moderate curvata, oblonga ellipsoidalia, fusiformia vel subinde clavata, 5,0-10,0 x 1,8-4,0 µm.

Chlamydosporae ubi immaturae globosae ad subglobosae, atro-cyaneae, numero cellularum variabilis, cellulae in=dividuae 10-0-21,0 x 10,0-12,5 µm, parietis crassiuscu=lae.

Habitat: In foeno tritici, Heilbron, Africa australis.

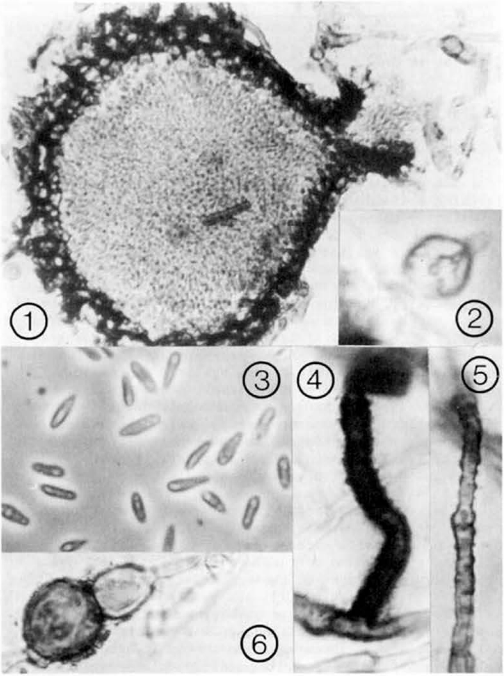
Holotypus: Cultura siccata PREM numero 45736.

The colonies grow moderately fast on oatmeal agar, reaching a diameter of 60 mm in 7 days at 25°C. The mycelium is raised, cottony, floccose, grey to cyan blue (1), becoming dark cyan blue.

The pycnidia are superficial, 100-300 µm in diame=ter, smooth, globose to subglobose or occasionally ellipsoidal, cyan blue to very dark cyan blue, usually with a single ostiole in a short neck with a collarette (Fig.1). The pycnidial wall is 12,5-10,0 µm thick and consists of 1-2 layers of parenchymatous cells. The conidiogenous cells (Fig.2) are hyaline, amphygnous, globose to subglobose or irregularly shaped phialides, 3,75-6,25 x 5,0-7,5 µm with a neck of 1,0-2,0 x 1,0 µm. The conidia (Fig.3) are hyaline and whitish in mass, continuous, smooth straight or moderately curved, ob=long ellipsoidal or obovoid, occasionally clavate, 5,0-10,0 x 1,8-4,0 µm with a length:width ratio of 2,7:1.

The hyphae are septate, branched, flexuous, bright, hyaline or light to dark cyan blue, 2,5-7,5 µm in dia=meter, occasionally encrusted in cyan blue cristals (Fig.4) or smooth to verruculose (Fig.5). Older hyphae are often constricted at the septa.

The chlamydospores are dark cyan blue, with indivi=dual cells globose to subglobose, intercalary or termi=nal with somewhat thick walls encrusted in blue crys=tals (Fig.6). In older cultures dictyochlamydospores are common, they are intercalary or terminal on branched hy=phae (Fig.7); the number of cells are variable and the individual cells are 10,0-21,0 x 10,0-12,5 µm.



Figures 1-6. *Phoma cyanea*. Fig.1. Section through pycnidium showing 1-2 cell wall layers and short neck (X720). Fig.2. Single globose phialide (X3600). Fig.3. Conidia (X1400). Fig.4. Encrusted hypha (X1400). Fig.6. Chlamydospore (1400).

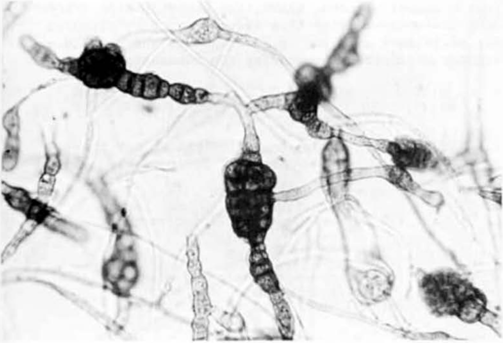


Figure 7. *Phoma cyanea*. Intercalary and terminal dictyoclamydospores (X770).

The specific epithet of this fungus is derived from the cyan blue colour of the hyphae, pycnidia and chla= mydospores. This colouring is also the main diagnostic feature. However, the globose pycnidia with the short neck and collarette as well as the distinctive arrangement of the dictyochlamydospores, are valuable diagnostic cha= racters.

Living cultures of the fungus have been deposited at the Centraal Bureau voor Schimmelcultures, Baarn, The Netherlands, no. CBS 388.80 and in the Potchefstroom University Culture Collection no. 1307. The holotype is deposited as a dried culture in the Mycological Herba= rium (PREM) of the Plant Protection Research Institute, Private Bag, X134, Pretoria, 0001.

ACKNOWLEDGEMENTS

We thank the C.S.I.R. Pretoria and South African Department of Agriculture and Fisheries for financial assistance, Dr. H.A. van der Aa of the Centraal Bureau voor Schimmelcultures, Baarn, for assistance in determi= ning the uniqueness of this fungus, dr. H.W. Simpson for assistance with the latin diagnosis and Dr. G.C.A. van der Westhuizen for reading the manuscript.

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PHAEOTHECA AND *PHAEOSCLERA*, TWO NEW GENERA OF DEMATIACEOUS HYPHOMYCETES AND A REDESCRIPTION OF *SARCINOMYCES* LINDNER

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ABSTRACT

Recently, we examined several dematiaceous, sclerotic fungi which displayed remarkable similarity in their appearance on the host and in culture, yet differed considerably in their conidium ontogeny. A new genus, *Phaeotheca*, is described for an isolate which produces sporangium-like mother cells containing one to several endoconidia. *Sarcinomyces* Lindner is redescribed for two isolates which form blastic conidia from multicellular sclerotic bodies. Fungi which develop only bulbil-like masses of sclerotic cells by conversion of short strands of hyphae are included in the new genus *Phaeosclera*.

INTRODUCTION

While examining a canker of *Cronartium coleosporioides* on lodgepole pine, *Pinus contorta*, one of us (A.T.) noticed numerous small colonies of a dematiaceous fungus among the aeciospores and nearby on the bark of the tree. From the canker, we isolated a black, slow-growing, sclerotic fungus which later produced sporangium-like mother cells with one to a few endoconidia. Since we observed no gametangia or evidence of sexual reproduction, we describe this fungus as a new form-genus of the Hyphomycetes, *Phaeotheca*.

Subsequently, we found another dematiaceous, sclerotic fungus on rust galls caused by *Endocronartium*.

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On the host and in culture, this new isolate appeared remarkably similar to *Phaeotheca*, but it produced filiform blastic conidia from multicellular sclerotic bodies. It is identified as *Sarcinomyces* Lindner.

These fungi were compared with two other isolates from the culture collection of the Northern Forest Research Centre, Edmonton, which also appeared similar in culture. However, they produced only bulbil-like masses of sclerotic cells by conversion of short hyphal strands. They are described in the new genus *Phaeosclera*.

MATERIAL AND METHODS

Specimens and cultures: Type specimens are deposited in the UAMH. Subcultures from the type strains have also been sent to the American Type Culture Collection, the Commonwealth Mycological Institute and the Centraalbureau voor Schimmelcultures. Duplicates of dried colonies prepared from the type cultures are deposited in the National Mycological Herbarium, Ottawa, Canada and the CMI.

Microscopy: Critical-point drying was used to prepare most of the specimens for scanning electron microscopy. However, *Sarcinomyces crustaceus* was air-dried after fixation with osmium vapour to prevent conidia from detaching. Detailed procedures for fixation and dehydration of materials were the same as those described previously (Tsuneda and Hiratsuka, 1979).

TAXONOMIC PART

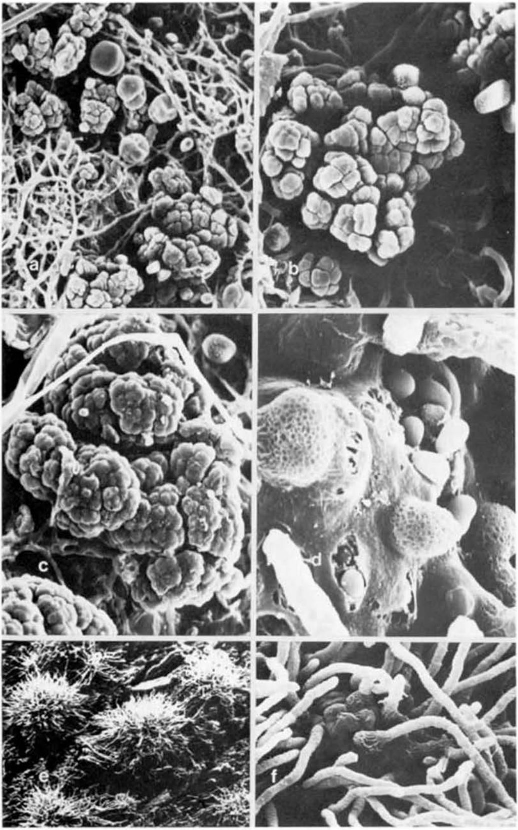
1. **Phaeotheca** Sigler, Tsuneda et Carmichael gen. nov.

Diagnosis

Fungi Imperfecti, Hyphomycetes.
Hyphae dematiae, infrequentes vel absunt. Coloniae restrictae, nigrae, multicellularium sclerotiformium cellarum gregatim, compositae. Cellae dividunt penitus forte; formandae unum, duo vel numerosa endoconidia. Endoconidia dematia, reniformia vel triangularia. Reproductio sexualis ignota.
Typus: *Phaeotheca fissurella* Sigler, Tsuneda et Carmichael.

Phaeotheca fissurella Sigler, Tsuneda et Carmichael sp. nov.

Fig. 1. *Phaeotheca fissurella*. a-c. Colonies composed of masses of sclerotic cells, among aeciospores of *Cronartium* and hyphae of another fungus. a, x200, b-c, x500. d. Endoconidia released by degeneration of mother cell wall, x1500. e-f. Hyphae produced on blocks of *Pinus contorta*, e, x30, f, x400.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Hyphae et endoconidia, et cetera in modo generis. Endoconidia fusca, 4-5.5 x 8-9.5 µm. Coloniae in agaro ad 18C restrictae, nigrae, mucosae et rugosae vel siccae specie et cerebriformes. Incrementum abest ad 25C. Typus: UAMH 4285, in cancro ex *Cronartio coleosporioide* in *Pino contorta*, Banff, Alberta, 1979.

Description

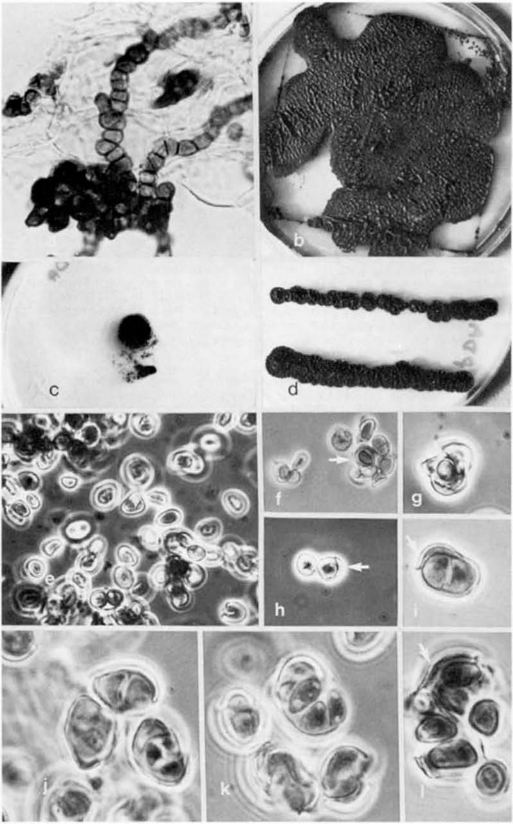
On the host, *Phaeotheca fissurella* produced black, punctiform colonies scattered on the bark of the canker and among the aeciospores. An individual colony, observed by scanning electron microscopy, appeared as a cauliflower-like mass of cells (Fig. 1a-c), which were at first smooth and undifferentiated (Fig. 1a), but later divided into clusters of 2 or more (Fig. 1b-c). Few hyphae were seen emerging from the sclerotic clusters. The hyphae adjacent to the clusters in Fig. 1a belong to another fungus, possibly *Hormonema dematioides* (UAMH 4298), which was also isolated from the canker. Light microscopic examination revealed masses of sclerotic cells and short hyphal strands (Fig. 2a).

When *P. fissurella* was grown on small blocks of *Pinus contorta* at 18C in a moist chamber, hyphae developed more abundantly than on the host (Fig. 1e-f). As the colony matured, the cell wall of the mother cells degenerated and single-celled conidia were released (Fig. 1d).

In culture, growth was optimal at 18C on potato dextrose agar (PDA, Difco), but there was good growth on phytone yeast extract agar (PYE, BBL), Pablum cereal agar and oatmeal agar (see Sigler and Carmichael, 1976). Colonies were notable for their black color and looked remarkably similar on all media. When grown on agar layered with a cellophane membrane (Sigler and Carmichael, 1976), colonies were flat or only slightly elevated, and very mucoid (Fig. 2c). If the plate were held and tilted, the colony spread across the membrane. The colony center became drier and more wrinkled after 2-3 weeks on PDA (Fig. 2b), but the margin remained mucoid. On PDA without cellophane, colonies spread very little and were wrinkled or cerebriform, drier and more elevated (Fig. 2d).

Phaeotheca fissurella is psychrophilic; growing well at 18C, slowly at 7C, but not at 25C. It is slightly cellulolytic but not keratinolytic.

Fig. 2. *Phaeotheca fissurella*. a. Sclerotic cells and hyphae on host, x600 BF. b-c. Colonies on cellophane on PDA after 2 (c) and 5 (b) weeks, x0.7. d. Colony on PDA with no cellophane after 3 weeks, x0.7. e. Endoconidia, slightly flattened on one side, X600. f-g. Single endoconidium developing within mother cell. f, x600, g, x950. h-l. Two or more endoconidia within mother cells, some showing remnants of mother cell wall (arrows). h, x600, i-l, x1600.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In agar culture, reproduction occurs by division of the mother cell into 1-several endoconidia (Fig. 2e-l). The developing endoconidium(ia) can be observed within the mother cell (Fig. 2f,j) and release is by rupture of the mother cell wall. Remnants of this wall can be seen around the conidia (Fig. 2g-i,k-l). Endoconidia are dark brown, frequently flattened on one side, and measure 4-5.5 x 8-9.5 µm. The number of endoconidia per cell is random, sometimes 1, frequently 3, but on PDA we found enlarged, sometimes hypha-like mother cells which divided to form numerous endoconidia (Fig. 3a-d).

Attempts to stain the nuclei of *P. fissurella* gave equivocal results. After the fungus was fixed and hydolyzed using Kendrick and Chang's (1971) procedure, it was bleached in 1.5% sodium hypochlorite to decolorize the melanized walls. At this concentration, the bleach decolorized the cell walls of the larger hypha-like mother cells, but not the mother cell wall containing a single endoconidium. Nuclei of *P. fissurella* were not visible when the fungus was stained with a buffered Wright's stain, "Camco Quik," yet nuclei of *Petriellidium boydii* stained by the same procedure. Nuclei were weakly stained by the Feulgen reaction using a cold Schiff reagent. There appeared to be one nucleus per developing endoconidium within the larger mother cells.

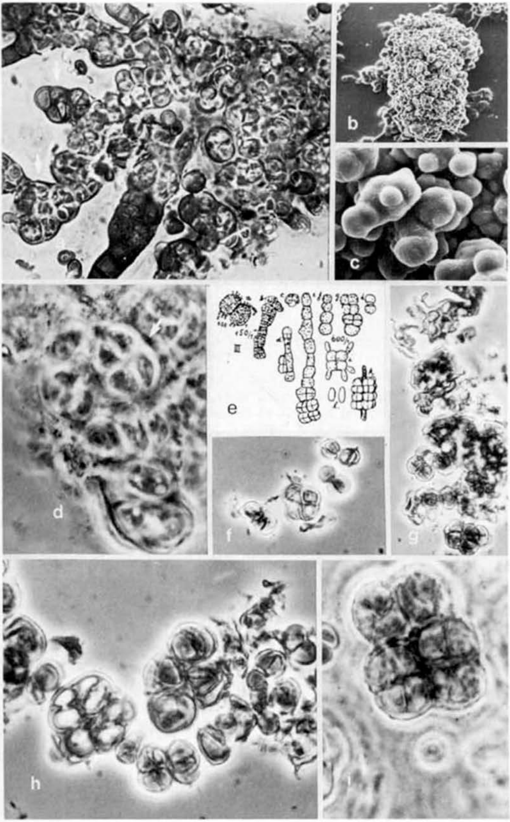
Hyphae formed most extensively when *Phaeotheca fissurella* was grown on the blocks of *Pinus contorta* or in slide culture, but still remained scant. No budding was seen.

Holotype: UAMH 4285, the type specimen, is on a canker of *Pinus contorta* caused by *Cronartium coleosporioides* coll. Saskatchewan crossing, Banff, Alberta, Sept. 1979, by J. Petty, as CFB 20955. A culture and dried colonies prepared from the type specimen are preserved in UAMH as 4245.

Discussion

Although *Phaeotheca* sometimes forms mucoid, yeast-like colonies, the genus is better placed with the Hyphomycetes rather than with the Blastomycetes since budding has not been observed. Endosporulation is an unusual method of conidium ontogeny in the Hyphomycetes. Sporangium-like endosporulation has previously been reported in *Prototheca* and *Coccidioides*.

Fig. 3. a-d. *Phaeotheca fissurella*. e-i. *Sarcinomyces crustaceus*. a-d. Colony on PDA displaying larger hypha-like mother cells containing numerous endoconidia. a, x600 BF, b, x75, c, x350, d, x1600. e. Lindner's line drawings of *Sarcinomyces crustaceus*. f-i. Bulbils on different substrates. f and h from Lindner's type specimen, f, x600, h, x1600. g. UAMH 4286 on *Endocronartium harknessii*, x600. i. 4286 on PDA, x1600.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Although originally described as a fungus, *Prototheca* is now generally considered to be an achlorophyllous alga which grows in culture medium in a yeast-like form (de Camargo and Fischman, 1979). *Prototheca* forms sporangial mother cells containing endospores which are released by rupture of the sporangial wall. Ultrastructural examination of *Prototheca* has demonstrated membrane-bound starch granules in the cytoplasm and storage granules occasionally bound by a single lamella which indicate a close relationship to the colorless algae (Nadakavukaren and McCracken, 1973; Kaplan, 1978). True chloroplasts have not been seen.

Fissuricella filamenta was originally described as a *Prototheca* (Arnold and Ahearn, 1972), but later transferred to *Sarcinosporon* by King and Jong (1975). However, the type species of *Sarcinosporon*, *S. inkin*, forms only hyphae and budding cells.

In their description of *Fissuricella*, Pore, d'Amato and Ajello (1977) noted that the cells became divided internally by cross-walls to form clusters of various sizes, but that there was no release of endospores even after mechanical disruption, and they found no empty mother cells. Since they observed some budding and their isolates were hyaline, they referred *Fissuricella* to the Blastomycetes.

Coccidioides immitis is a pathogen which reproduces in tissue by forming spherules which divide internally to form endoconidia. Sun and Huppert (1976), in their cytological investigation of spherule development, were unable to determine whether karyogamy preceded nuclear division in the developing spherule. Although endosporulating spherules of *C. immitis* can be induced *in vitro* in an appropriate medium (Sun and Huppert, 1976), *C. immitis* usually grows as a mold and produces alternate arthroconidia typical of *Malbranchea* (see Sigler and Carmichael, 1976).

Material examined: UAMH 4260, *Sarcinosporon inkin*, case of tinea cruris in Portuguese female caused by *Trichophyton tonsurans*, 1967, ATCC 18020; UAMH 4261, *Fissuricella filamenta*, TYPE, human skin, Cleveland, Ohio, by D.G. Ahearn, ATCC 22432.

2. **Sarcinomyces crustaceus** Lindner 1898, Mikroskopische Betriebskontrolle in den gahrungsgewerben mit einer Einfuhrung in die Hefenreinkultur, Infectionslehre und Hefenkunde. pp. 228-229, Ed. 2, Paul Pary, Berlin.
   =*Coniothecium crustaceum* (Lindner) Neger 1917

Historical Background

Lindner described two species in *Sarcinomyces*, dematiaceous *S. crustaceus* and hyaline *S. albus*. Although neither was designated as type species, Clements and Shear (1931, p. 392) listed *S. crustaceus*. Because no type material remains, the identity of *S. albus* is uncertain (de Hoog and Hermanides-Nijhof, 1977).

In 1917, Neger described several fungi occurring on fir trees which he called sooty fungi. One kind which occurred frequently, he identified as Lindner's *Sarcinomyces crustaceus*. His description and illustrations agree very well with Lindner's. He proposed a new combination for *S. crustaceus* in *Coniothecium* even though he noted the difficulty in identifying species of *Coniothecium* from published descriptions,

The form-genus *Coniothecium* is considered by Hughes (1958) to be a *nomen dubium* since no type material could be found for the type species, *C. atrum*. Most of the lichenicolous species of *Coniothecium* have been disposed in other genera (Hawksworth, 1975).

More recently, Hermanides-Nijhof (1977) examined the type specimen of *Sarcinomyces crustaceus* and placed *Exophiala werneckii* into synonymy with it, even though she was unable to determine the exact nature of conidiogenesis in *Sarcinomyces*. This disposition was not accepted by McGinnis (1979) or by Carmichael et al. (1980).

Lindner, in his original description, clearly described and illustrated (see Fig. 3e) the development of *Sarcinomyces*:

> "Aus der isolierten Spore (Fig. c) tritt nach dem Platzen der ausseren Haut ein hefezellahnliches Gebilde hervor, in dem jedoch bald Querwande erscheinen. Die Teilungen finden bei dem Wachstum so regelmassig statt, dass der neue Zellenkomplex oft genau Wurfelform annimmt (Fig. k). Die Zellen sind glashell und gleicht das ganze Gebilde durchaus einer Sarcina maxima. Waren ganze Zellreihen ausgekeimt, dann entstehen Gebilde wie in a und b."

However, in our examination of a slide prepared from the type of *S. crustaceus*, we found only thick-walled dematiaceous cells which were usually divided transversely and longitudinally to form units of 4 or more (Fig. 3f,h). We found neither endoconidia nor any evidence of budding. Also we found no annellated butts as described by Hermanides-Nijhof (1977).

Although the type specimen of *S. crustaceus*, which is an air dried culture grown on wood, shows only sclerotic cells, one of our isolates, from a gall of *Endocronartium harknessii*, does show both the sclerotic and blastic states illustrated by Lindner (see Fig. 3e) and Neger. This isolate is described below.

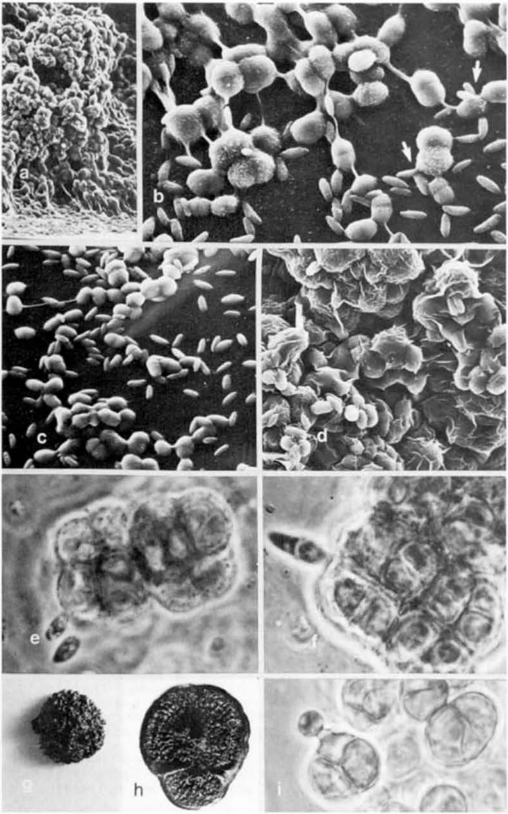
Description

On the host, *Sarcinomyces crustaceus* appeared as small, black, discrete colonies scattered among the aeciospores and on the outside bark of the gall. Macroscopically, the colonies greatly resembled those of *Phaeotheca fissurella*. Material from these colonies, when examined microscopically, was composed of multicellular aggregations (Fig. 3g), occasional 2-celled fragments and scant hyphae.

In culture, *S. crustaceus* formed clusters of brown sclerotic cells or bulbils which often became warty in age (Fig. 3i,4b). They measured from 25-70 um initially, and in older cultures disassociated reluctantly. From these multicellular packets, blastic conidia were expressed (tretic conidiogenesis?). The conidia emerged singly from different loci (Fig. 4b). We found no evidence of successive conidiogenesis from the same locus. No detachment scar or butt could be seen on the sclerotic cells. When first produced, the conidia are small, hyaline, single-celled, filiform and measure 1.5-2 x 4.5-7 µm (mostly 2 x 5 µm)(Fig. 4c,e). After detachment, the conidia enlarged (to 3-5 x 7-8 µm), became pale brown, and divided transversely, then longitudinally and continued to divide to form the multicellular bulbils (Fig. 4c). Occasionally, enlargement and septation occurred while the conidium remained attached (Fig. 4f). Only rarely, we observed the filiform conidia emerging from non-septate dematiaceous cells. Occasionally, cracks or splits occurred in the cell wall of the warty bulbils, but no endoconidia were released. A similar peeling of the outer layer has been observed in the multicellular sclerotic bodies of *Wangiella dermatitidis* (Szaniszlo et al., 1976) and by us in isolates of *Phaeococcomyces nigricans* (unpublished data, UAMH 4084,4297).

The production of blastic conidia from the sclerotic cells was influenced by the conditions of growth. They were abundant in mucoid regions of colonies on PDA (Fig. 4a) and cereal agar, yet occurred less frequently in dry colonies. We found none in material taken from the gall of *Endocronartium harknessii* (Fig. 3g). It appears that growth of *Sarcinomyces* occurs either in a dry or a mucoid state; in the dry state bulbil formation predominates, whereas in the slimy state blastic conidia are abundant.

Fig. 4. a-h. *Sarcinomyces crustaceus*. i. *Wangiella dermatitidis*. a. Colony on PDA. Central region composed of clusters of sclerotic cells or bulbils, outer mucoid margin containing blastic conidia, x200. b. Blastic conidia borne singly from different loci on smooth or warty bulbils, x800. c. Stages in development from blastic conidia to bulbils, x550. d. Slimy coating on bulbils, x700. e-f. Single and two-celled conidia emerging from bulbils, x1600. g-h. Colonies on PDA (g) and cereal (h), x0.7. i. Budding and sclerotic cells of UAMH 4278, x1600.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On the host, we see the former, and this may explain the lack of blastic conidia in the type specimen of *Sarcinomyces* (which was grown on wood).

Small capsules were observed when material from mucoid colonies was viewed by negative stain. This slimy covering can also be seen by scanning electron microscopy (Fig. 4d).

Colonies resembled those of *Phaeotheca* and also grew best at 18C. On cereal agar with cellophane, colonies (Fig. 4h) were black, initially flat with radial folds, mucoid and glistening, later drier and elevated in the centre, and mucoid at the margin. After 6 weeks, they measured 33 mm. On PDA and PYE, colonies adhered poorly to the cellophane and were dry and crumbly. Colonies (Fig. 4g) on PDA without cellophane after 42 days were black, glistening with slime, cerebriform and elevated, and measured 22 mm. Streaked colonies on PDA had a metallic sheen. Growth on PYE was poor. There was good growth at 7C, but very scant growth at 25C.

Sarcinomyces crustaceus grew abundantly at the surface of Brewer's thioglycollate broth (Difco), and the growth consisted predominantly of sclerotic cells with few blastic conidia. In contrast, *Phaeotheca fissurella* and *Phaeosclera dematioides* showed only scant growth.

The description above is based on UAMH 4286. Late in the study, we found another isolate, UAMH 1553, which had been received as *Sirodesmium* sp. and later filed as *Coniosporium* sp. This strain, when regrown on cereal agar and PDA also formed the distinctive blastic conidia from sclerotic cells. However, this isolate differed from UAMH 4286 in growing more rapidly at 25 C, and in forming extremely wet colonies which, when incubated upside down in petri dishes, dripped on to the lid of the petri dish. Mounts from the material on the lid revealed abundant blastic conidia. In young cultures, hyphae emerged from clusters of the bulbil-like masses, but these hyphae soon became converted to bulbils. This strain may represent a different species of *Sarcinomyces*, but until more isolates have been found, it is difficult to determine the range of variation for the species.

Discussion

Sarcinomyces is treated here as a form-genus of the Hyphomycetes, along with the other so-called black yeasts (de Hoog and Hermanides-Nijhof, 1977). However, the dividing line between the Blastomycetes and the Hyphomycetes is not clearly defined (see Carmichael et al., 1980; p. 6).

Sclerotic cells have previously been reported in a strain identified as *Wangiella dermatitidis* (UAMH 4278 =Duke 3378, see Jotisankasa, Nielsen and Conant, 1970).

When Jotisankasa et al. (1970) examined the dry, granular colonies of this strain, they found only large cells divided transversely and longitudinally. They did not see budding. When we grew this strain on PDA and cereal agar, we found both budding and sclerotic cells (Fig. 4i). A yeast cell developed multiple broad-based buds, or the budding was bipolar and resulted in short chains of budding cells. In old cultures, sclerotic cells predominated. No true hyphae were seen. This isolate differs from other strains of *W. dermatitidis* which require acidic conditions to form the sclerotic bodies (Szaniszlo et al., 1976). It differs from *Sarcinomyces* in forming multiple broad-based buds and chains of budding cells. *Phaeococcomyces* de Hoog also forms broad based buds and chains of budding cells, but is not known to produce sclerotic cells. Therefore, the status of this isolate remains undecided.

Material examined of *Sarcinomyces crustaceus*: slide ex TYPE, dried culture on wood with dextrose nutrient fluid, isolated from air by Lindner, Mus. Bot. Berlin, slide prepared by M.R. McGinnis, NCMH 769; UAMH 1553, from air, received from C.L. Kramer, Univ. Kansas, 1963; UAMH 4286, on gall of *Endocronartium harknessii* on *Pinus contorta*, Jasper, Alberta, coll. Oct. 1978, by A. Tsuneda, isol. L. Sigler, May 1980.
Isolates of *Phaeococcomyces*: *P. catenatus*, UAMH 2901, air contaminant, Edmonton, by A. Padhye, 1968; *P. nigricans*, UAMH 4084, type, paint of storage tank, U.S.A.; UAMH 4123, contaminant, Edmonton, by L. Sigler, 1978; UAMH 4297, gall of *Endocronartium harknessii* on *Pinus contorta*, Jasper, Alberta, by L. Sigler, 1980.

3. **Phaeosclera** Sigler, Tsuneda et Carmichael gen. nov.

Diagnosis

Fungi Imperfecti, Hyphomycetes.
Hyphae dematiae, septatae, mutabiles. Bulbillae evolvunt ex hyphis post multiplices septationes. Vetustae bulbillae separant difficiliter. Coloniae atrae, bulbillarum compositae.
Typus: *Phaeosclera dematioides* Sigler, Tsuneda et Carmichael

Phaeosclera dematioides Sigler, Tsuneda et Carmichael sp. nov.

Hyphae et bulbillae in modo generis. Bulbillae fuscae vel furcae, 10-50 µm vel grandiores, in mucosa matrice. Coloniae atrae, restrictae, altae, cerebriformes, nitidae propter mucum. Typus: UAMH 4265, in medulla viva in *Pino contorta*, Strachan, Alberta 1957.

Description

On blocks of *Pinus contorta* after 3 weeks, colonies consist of bulbil-like masses with a slimy coating (Fig. 5a,e). Few hyphae are produced (Fig. 5b).

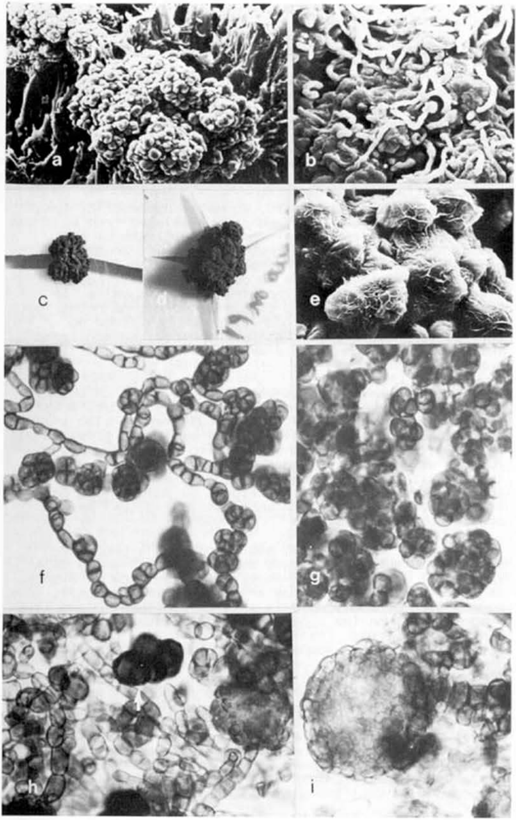
Colonies on all media appear similar. On agar without cellophane at 25C (Fig. 5c-d), they are dull black, slow growing (after 35 days approximately 17-22 mm in diameter), matted, cerebriform, dry (on PYE and PDA) or enveloped in slime and glistening (on cereal). The colonies are elevated and after 4-5 weeks may touch the lid of the petri dish. The margin digs into the agar and after several weeks, deep cracks appear in the agar below the colony. Because the colonies are tough and matted, or enveloped in slime (on cereal), they are difficult to tease apart for microscopic preparations and when dried (for method, see Sigler and Carmichael, 1976), become extremely hard. Colonies at 18C are similar but grow slightly slower. There is scant growth at 7C. Growth on cellophane is more restricted and colonies adhere poorly.

The hyphae are dematiaceous and septate, but rapidly convert to thick-walled bulbil-like masses. The conversion occurs randomly as short segments of a hypha enlarge and divide both transversely and longitudinally (Fig. 5f-g). Eventually the entire hypha is converted to a bulbil-like mass of sclerotic cells. Older cultures are composed of dark brown, smooth bulbil-like masses of variable size (from 10 µm to as large as 50 µm or more) which separate from each other reluctantly even when teased apart (Fig. 5g). They are sometimes covered in a slimy coating (Fig. 5e). Occasionally, a splitting or shedding of the wall of a bulbil could be seen. No other conidia were produced on any medium or at different temperatures.

Muriform, dematiaceous fungi isolated from wood or trees have often been called *Fumago* sp. Indeed, the two strains described above are probably the same species as an isolate identified by Wang (1965, p. 52) as *Fumago* sp. Unfortunately, her culture is no longer available (personal communication).

Holotype: UAMH 4265, pith of *Pinus contorta*, Strachan, Alberta, by R.J. Bourchier, May 1957, from A. Tsuneda as C-428.

Fig. 5. a-g. *Phaeosclera dematioides*. (a-b,e, UAMH 4251; c-d,f-g, UAMH 4265). h-i. *Soredospora graminis*. a-b. Colonies on *Pinus contorta* showing bulbil-like masses of sclerotic cells and hyphae, a, x250, b, 340. c-d. Colonies on cereal (c) and PYE (d) after 5 and 6 weeks, x0.7. e. Slimy coating on bulbil-like masses, x600. f-g. Development of bulbils by conversion of hyphal cells, x600 BF. h-i. Hyphae, dictyoconidia (arrow) and globose, multicellular structures, x600 BF.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g
h
i

Other strain examined: UAMH 4251, pith of *Pinus contorta*, Kananaskis Forest, Alberta, by R.J. Bourchier, May 1957, from A. Tsuneda as C-430.

GENERAL DISCUSSION

Both *Phaeotheca fissurella* and *Sarcinomyces crustaceus* grow on the host as discrete black colonies composed of masses of sclerotic cells and occasional hyphae (Figs. 2a,3g). They are identified by their unique development in agar culture. No original host material was available for the two isolates of *Phaeosclera dematioides*, but when grown on blocks of wood, they also formed bulbil-like masses (Fig. 5a) with scant hyphae.

Dematiaceous, sclerotic, somewhat nondescript fungi have frequently been observed on or isolated from wood and trees. In one of the early reports on culture of sooty molds, Neger (1917) found that *Sarcinomyces crustaceus* occurred frequently on fir trees. By growing *S. crustaceus* in culture, Neger was able to observe the distinctive blastic conidia produced from the sclerotic cells. In transferring *S. crustaceus* to *Coniothecium*, he noted that published descriptions of *Coniothecium* contained no mention of these special "sprout" conidia. He concluded that these fungi could only be identified with certainty from pure culture.

Late in the study, we examined a slide from the presumed type of *Coniothecium epidermidis* on *Betula* (ex Herb. Corda Prague, 155448, DAOM 40978) which also showed dematiaceous sclerotic cells. There were also a few, broad thick-walled hyphae which appeared to be a different fungus. We concur with Neger that cultures are necessary to establish even the generic identity of masses of sclerotic cells on wood. Therefore, *C. epidermidis* Corda (1837, Icones Fungorum I:2 and Tab. I, fig. 24) may be considered a *nomen dubium*.

Hughes (1976) defined sooty molds as a group of saprophytic fungi which form dark colored colonies on a variety of living plants. Sooty molds can grow as hyphae, as hyphal plates or as clusters of isodiametric cells. One common type of sooty mold is a thin, confluent black layer predominately on the upper surface of leaves or bark of broad-leafed trees. Traditionally, this type of growth has been called *Fumago vagans*. Microscopically, it consists of dematiaceous, muriform cells and *Cladosporium* conidia (Friend, 1965a,b). One of the problems in identifying sooty molds is that several species frequently grow together and are not readily distinguishable from each other on the host (Hughes, 1966). Indeed, when Friend (1965a,b) cultured scrapings of the black growth found on lime trees in England, he found that the principal components were *Aureobasidum pullulans*, *Cladosporium herbarum* and occasionally *Alternaria*. Since *F. vagans* was composed mostly of two elements, Friend (1965b) rejected it as a *nomen confusum*. When we examined black material on the upper side of branches from local *Populus tremuloides*, we also observed brown, thick-walled masses of cells and a few short segments of hyphae. In culture, we grew *A. pullulans* and *C. herbarum* (UAMH 4347 and 4348).

The mixture of *A. pullulans* and *C. herbarum* known as *F. vagans* is one of the few sooty molds that grows readily in culture. The other sooty molds described by Hughes (1976) are known only from the host. However, they often form distinctive sporulating structures, in contrast to the multicellular aggregations of the *Fumago vagans* type.

Neger called *Sarcinomyces crustaceus* a sooty mold. Indeed, our isolates of *Sarcinomyces* and *Phaeotheca* appear to fit Hughes' (1976) definition of sooty molds. However, both formed small, discrete colonies localized on or near rust cankers and grew readily in culture. *Phaeosclera* is known to us only from culture. In any event, cultures are necessary to distinguish these genera of dematiaceous, sclerotic fungi.

Another dictyosporic, dematiaceous genus with questionable status is *Soredospora* (Carmichael et al., 1980). Hughes (1958) transferred the type species, *Soredospora graminis*, to *Fumago*. We have examined slides prepared from the type specimen (grass leaves, ex Herb. Corda Prague 155636, DAOM 50059). They consist of dark brown, *Peyronelia*-like dictyoconidia (Fig. 5h) borne on undifferentiated hyphae, along with globose, multicellular structures (Fig. 5i) (immature ascomata? or conidiomata?) and a few conidia of the *Cladosporium* type. *Soredospora* appears to be a *nomen dubium* or *nomen confusum*.

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BASIDIUM REPETITION IN CONFERTICIUM
(CORTICIACEAE, BASIDIOMYCETES)

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The genus Conferticium, a segregate from Gloeocystidiellum, was founded among other things on the occurrence of basidial repetition (Hallenberg 1980). In the description of the genus basidial repetition was said to be occasional but later investigations have shown that it seems to be the sole mode of development in older hymenia.

MATERIALS AND METHODS. The following species were examined:

Conferticium insidiosum (Bourd. & Galz.) Hallenb./Iran, Gorgan, Golestan forest/On a fallen log/1978-05-01/ N. Hallenberg 2278.

C. karstenii (Bourd. & Galz.) Hallenb./Sweden, Uppland, Uppsala/On a decayed trunk of Populus tremula/1948-05-16/ J.A. Nannfeldt 9769.

C. ochraceum (Fr.) Hallenb./Sweden, Värmland, Långserud/On a fallen trunk of Picea abies/1975-06-10/ T. Hallingbäck 8864.

Gloeocystidiellum lactescens (Berk.) Boid./Sweden, Södermanland, Bälinge/On a stump of Fraxinus excelsior/1975-11-09/ I. Nordin 6275

Horizontal sections, 10—30 um from the hymenial surface, were studied in transmission electron microscope. In C. insidiosum also vertical sections were studied. Although not belonging to Conferticium, Gloeocystidiellum lactescens is included in this investigation for comparative studies.

Pieces of fructifications were fixed in 4% glutaraldehyde at 4°C. After washing in phosphate buffer the pieces were postfixed in 2% osmiumtetroxide at room temperature. The samples were dehydrated in an ethanol series and embedded in a low-viscosity epoxy resin according to Spurr (1969). The sections were cut with glass knives on a LKB ultratome III ultramicrotome, poststained with 4% uranyl acetate and lead citrate (Reynolds 1963), and finally examined with a Philips EM 301 electron microscope.

RESULTS AND CONCLUSIONS. Horizontal sections were taken from the basidial and subbasidial level in the fructifications. Sections from *Conferticium*-species show that the cell walls are composed of several layers (fig. 1 A, 1 B, 2 B, arrows). In some parts of the sections, two cells (i.e. sectioned basidia or hyphae) seem to be joined by a common outer wall (fig. 2 B, dubble arrow; in 3 B reproduced as a drawing). The vertical section of *C. insidiosum* (fig. 1 C, reproduced in 3 C) shows branching of hyphae within common outer walls. The branching takes place proximal to the septum, which besides has a distinct dolipore (fig. 1 C, arrow).

When vertical sections from fructifications of *Conferticium*-species are observed in a light microscope, basidial repetition is frequently observed (fig. 3 A). However, still more often it is seen that walls of vertical hyphae are fragmented ("scaly") on their outside when mounted in KOH solution. These "scales" must be interpreted as outer hyphal walls, destroyed by the crushing when making the preparate.

Fructifications of *Conferticium*-species are developed from a very thin subiculum. Thereon a dense hymenium is formed, probably without any basidial repetion involved. As the hymenium is thickening, repetition from the old basidia or from single vertical hyphae seems to be the normal development. When branching occurs in this very dense tissue, it seems to take place within an already formed cell (fig. 3 B, C).

On the contrary, in *Gloeocystidiellum lactescens* the cell walls have obviously only one layer (fig. 2 A, arrow). Besides, no internal, basidial repetition is observed in the light microscope.

Common characters for *G. lactescens* and *Conferticium* are the vertically directed hyphae in the fructification, the lack of clamps and the amyloid spores. For further details concerning the anatomy of the species discussed here, see Eriksson & Ryvarden (1975) and Hallenberg (1980).

Hitherto has obligate basidial repetition only been observed in *Repetobasidium* John Erikss. In that genus, repetition is caused by a protuberance from an old basidial septum growing into the old basidium. The location of earlier formed septa on basidiophorous hyphae is easily seen, due to the presence of clamps.

Even if basidial repetition in *Conferticium* is unquestionable, it is not necessarily performed in the same way as in *Repetobasidium*. The closely packed texture and the absence of clamps make it difficult to see the finer details in this process.

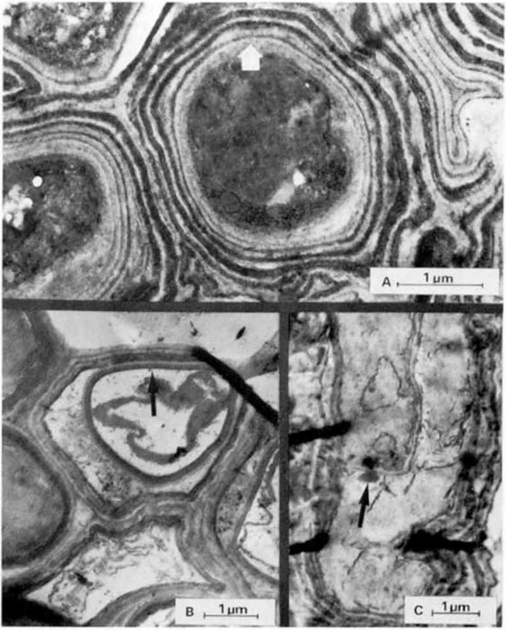

Fig. 1. A) Horizontal section from Conferticium insidiosum. B) Horizontal section from C. karstenii. C) Vertical section from C. insidiosum.

Fig. 2. Horizontal sections from A) *Gloeocystidiellum lactescens*, B) *Conferticium ochraceum*.

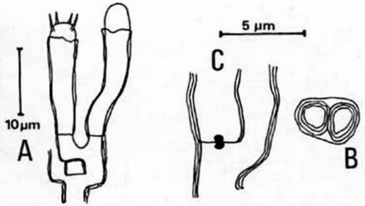

Fig. 3. A) Hymenial detail in *Conferticium insidiosum*.
B) *C. ochraceum*, drawing reproduction of a part of fig. 2 B.
C) *C. insidiosum*, drawing reproduction of fig. 1 C.

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SYNOPSIS OF WOOD-INHABITING APHYLLOPHORALES (BASIDIOMYCETES) AND HETEROBASIDIOMYCETES FROM N. IRAN

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ABSTRACT. The hitherto known wood-fungus flora in the Caspian forests (N. Iran) is presented herewith. Relations to the deciduous forests of the nemoral zone in Europe are discussed, as well as general patterns for the distribution of wood-fungi within this zone. Altogether 275 species are recorded here from Iran, among them 80 for the first time.

THE ENVIRONMENT. On the northern slopes of the Elburz mountains (N. Iran) there is a rich deciduous forest. Humid winds from the Caspian Sea is the basis for this vegetation. Though isolated by dry mountains in W. and S. and steppes in E., the Caspian forests clearly belong to the nemoral zone in Europe. The climatic conditions are favourable enough to allow cultivation of, among other things, rice, cotton and tea in the lowlands. Even if the summers are hot (25-27°C, the average for July) there is a distinct winter season with a January mean temperature a few degrees above freezing point. Higher up in the mountains there is a sharp drop in the winter temperatures, with January minima down to -30°C and with frosty days for up to 5 months. The precipitation is high (800 - 2000 mm/annum) and rather evenly distributed over the year. Most of the plain close to the Caspian Sea is cultivated. Natural forest vegetation occurs in river valleys and on the mountain slopes. From these forests come the great majority of collections of wood-fungi in Iran. The area is divided into three provinces, viz. (from W. to E.) Gilan, Mazanderan and Gorgan.
For further details about vegetation and climate, see Zohary (1973).

INVESTIGATIONS ON THE WOOD-FUNGUS FLORA. Before 1972 there were only scattered records (see below). Saber (1972, 1974), Soleimani (1975) and Ershad (1977) were the first to make comprehensive works on the wood-fungus flora in Iran, while in 1976 and 1978 I collected wood-fungi in the area, which resulted in 208 species new to Iran. In this synopsis 275 species are recorded, among them 80 for the first time from Iran.

NOTES ON FUNGAL GEOGRAPHY. The distribution of wood-fungi in N. Europe has earlier been discussed by Eriksson (1958), Eriksson & Strid (1969) and Strid (1975). From the numerous collections made in this area it is obvious that several factors are involved in the distribution of wood-fungi.

The *habitat* is an important factor which also reflects the local climate essential for the species concerned. Species which are mostly found on still-attached twigs and branches, seem to be adapted to the dry condition where these substrates are placed. On the other hand, species growing on fallen trunks in herbaceous river valleys seem to be favoured by the more humid conditions existing there.

The *substrate* on which a species is growing is another factor. The distribution of wood-fungi preferring a certain substrate is often limited by the general distribution of the latter. The same may also be valid for particular forest types which usually inhabit a characteristic wood-fungus flora. Even if the development of particular forest types (e.g. nemoral, deciduous forests; boreal, coniferous forests) may be influenced by local conditions, their general distribution seems to be determined mainly by the macro-climate, as does the distribution of wood-fungi. However, the geographical limits of the latter are not necessarily the same as for the forest types where these fungi usually grow. Besides, a great deal of wood-fungi is found in many different forest types and distributed over almost the entire N. hemisphere.

In the present study comparisons have been made between the wood-fungus flora of the deciduous forests in N. Iran and the nemoral zone in Europe. This zone, as defined by Walther (1973), is characterized by a rather rainy and warm vegetational period of 4 - 6 months, while winters are rather short (usually 3 - 4 months) and mild or at least not extremely cold. The forest vegetation is mainly composed of deciduous trees and the zone in Europe covers the C. and W. parts down to the Mediterranean area, and is in the N. limited to S., W. Sweden and the most S. part of Norway.

The Caspian forests may be regarded as the S.E. limit of the nemoral zone and especial attention has been paid to making a comparison with deciduous forests at it's N. limits in Europe.

This comparison shows that 78 % of the species recorded here have also been collected in N. Europe. Furthermore, as an example, 68 % of the species found on a little island in C. Sweden (Högholmsskär in Lake Mälaren) with virgin nemoral vegetation, are even common to N. Iran.

GENERAL PATTERNS OF DISTRIBUTION IN EUROPE FOR SPECIES FOUND IN THE CASPIAN FOREST. The following species are in Europe confined to the Central-Eastern and South-Eastern parts:

Cystostereum heteromorphum	Xylobulus subpileatus
Donkia pulcherrima	Schizopora carneo-lutea
Hyphoderma litschaueri	Inonotus nidus-pici
Hypochnicium caucasicum	Bourdotia galzinii
Vuilleminia cystidiata	Dacrymyces minor

Still more species added to this group which besides, even are found in E., S.E. parts of Northern Europe (though mostly very rarely):

Cystostereum subabruptum	Scytinostroma galactinum
Hyphodontia spathulata	Vararia ochroleuca
Peniophora lilacea	Datronia stereoides
Phanerochaete raduloides	Trichaptum biforme
Phlebia lindtneri	Phellinus punctatus

Central - Southern species in Europe:

Auriculariopsis ampla	Vuilleminia megalospora
Conferticium insidiosum	Lenzites warnieri
Fibrodontia gossypina	Oxyporus latemarginatus
Hyphoderma transiens	Polyporus arcularius
Hyphodontia juniperi	Rigidoporus ulmarius
Peniophora proxima	Trametes cervina
Phanerochaete martelliana	T. ljubarskyi
Phlebiopsis roumeguerei	Tyromyces gilvescens
Stereum insignitum	Phellinus torulosus

Most of the species common to N. Iran and N. Europe are in the latter area confined to nemoral forests in the South and along the coasts. However, except for the E., S.E. species mentioned above there are still some having a more restricted distribution in N. Europe.

Species growing in areas with mild winters in Europe (along the S.W. coast of Norway, the W. coast in Sweden, and the entire Denmark) are:

Hyphodermella corrugata	Stereum rameale
Lopharia spadicea	Trechispora alnicola
Mycoaciella bispora	Aurantioporus alborubescens
Peniophora lycii	Ganoderma australe
Pulcherricium coeruleum	G. resinaceum

Some species growing on deciduous wood in N. Iran, but found on coniferous wood in N. Europe are:

Athelia decipiens	Phlebia centrifuga
Botryobasidium obtusisporum	Antrodia lindbladii
Dacryobolus sudans	Tyromyces hibernicus
Fibulomyces septentrionalis	T. placenta

Most of these species, together with *Ceraceomyces borealis* and *Gloeoporus pannocinctus*, belong to the boreal wood-fungus flora.

Further, some species also more or less common in all parts of N. Europe are:

Botryobasidium botryosum
B. subcoronatum
Cristinia helvetica
Hyphoderma praetermissum
Hyphodotia subalutacea
Laeticorticium roseum
Merulius tremellosus
Phanerochaete sordida
Sistotrema brinkmannii
Trechispora farinacea
T. vaga
Coniophora puteana
Bjerkandera adusta
Ceriporia viridans
Cerrena unicolor
Fomes fomentarius
Fomitopsis pinicola
Gloeoporus dichrous
Piptoporus betulinus
Polyporus varius
Pycnoporus cinnabarinus
Trametes pubescens

OTHER DISTRIBUTIONAL PATTERNS.

A few species that have earlier only been collected in N. America are:

Botrybasidium curtisii (perfect state)
Gloeodontia columbiensis
Ceriporia alachuana
Nigroporus niger
Phellinus johnsonianus

A few having a tropical - subtropical distribution are:

Coriolopsis floccosa
Schizopora trichiliae
Coltricia spathulata

The following species are so rare that it is impossible to say anything about their distribution:

Hyphoderma echinocystis
Phanerochaete septocystidia
Tubulicrinis thermometrus
Heteroporus fractipes
Sistotrema camshadalicum

Finally, a number of species which hitherto have only been collected in N. Iran:

Botrybasidium grandinioides
Cystostereum stratosum
Fibrodontia subceracea
Galzinia longibasidia
Oliveonia subfibrillosa
Peniophora pseudonuda
Phanerochaete aculeata
P. macrocystidiata
Phlebia caspica
Sistotrema resinicystidium
S. suballantosporum
Trechispora dimitica
T. fibrillosa
T. granulifera
Tubulicrinis incrassatus
Ganoderma manoutchehrii

Two species which are very common in deciduous forests in N. Europe, viz. *Stereum rugosum* (Pers. ex Fr.)Fr. and *Phlebia radiata* Fr., have apparently not been collected in the Caspian forests. One earlier record of *Stereum rugosum* (Watling & Sweeney, 1975), has been proved to be *Xylobolus subpileatus*.

Some species have been excluded from the above lists, for though reported from Iran they have never been collected in the Caspian forests:

Lopharia heterospora
Pyrofomes demidoffii
Inonotus hispidus
I. pseudohispidus

Further, species only collected on introduced coniferous trees have also been excluded:

Conferticium ochraceum
Gloeophyllum sepiarium
Heterobasidion annosum
Heteroporus biennis

GENERAL CONCLUSIONS ABOUT THE DISTRIBUTION OF WOOD-FUNGI IN NEMORAL FORESTS.

Even today too little is known about the wood-fungus flora in different parts of the nemoral zone. However, from available records it is possible to observe some differences in the distributional patterns. Even if most of the fungi found in N. Iran are distributed all over the nemoral zone, there must be some reasonable explanation for the more restricted distribution which is apparent for some of the species recorded here.

HUMIDITY: In most places within the nemoral zone, the precipitation is high enough and sufficiently spread over the year to allow the development of a deciduous forest. Even if these may have different features, most collections of wood-fungi are made in mainly virgin forests with lots of dead wood of different dimensions and in varying positions. These substrates offer a series of different conditions of humidity for the fungi. As this is the situation existing almost all over the nemoral zone, humidity cannot be considered as a differentiating factor in the geographical distribution of wood-fungi.

TEMPERATURE: The isotherms in Europe has different directions in summer and winter. During the summer they run from W. to E., while during the winter in a N.W. - S.E. direction. Then it is cold in the N.E. and mild in the S.W. It seems that the distributional patterns for the nemoral wood-fungi are mainly determined by the temperature, when considered over the whole year. The E. - S.E. species are apparently adapted to endure the cold winters, at the same time as they are favoured by long and warm summers. They seem to be driven out from the W. parts, where winters are milder and summers still warm by the competition of other fungi. On the other hand, some species require mild winters or at least a very long period without frost. These are widely distributed in C. And S. Europe and may reach N. Europe along the W. coasts and in Denmark (see list above).

On the N. slopes of the Elburz there is a great deviation in winter temperatures at different levels. There are also many different local climatic conditions (Probst, 1974). As a matter of fact, the variation in climate within the small area covered by the Caspian forests is almost as great as within the whole nemoral zone in Europe.

At higher altitudes in the Elburz mountains (1000 - 1500 m. s.m.), where the winters are cold, there are almost pure *Fagus*-forests. Among the wood-fungi collected there, even 89 % are common to N. Europe.

SUBSTRATE SPECIFICNESS: A main difference in the choice of substrate is between fungi growing on wood from coniferous and deciduous trees.

In Iran there are no natural conifer forests. Among fungi growing on deciduous trees, substrate specificness is not very pronounced but does occur for instance for wood-fungi on *Quercus* spp. It is also more common among fungi infecting living trees and those which fructificate on still-attached branches and twigs that are dead - but perhaps were alive when infected.

Within the nemoral zone, the substrate spectrum for certain wood-fungi generally decreases towards the north. This is illustrated by *Peniophora lilacea*, which in N. Europe is mostly found on *Ulmus carpinifolia*, *Fomes fomentarius* on *Fagus silvatica* and *Betula* spp, *Trametes gibbosa* on *Fagus silvatica*, *Phylloporia ribis* on *Ribes* spp and *Hirneola auricula-judae* on *Sambucus nigra*. In C. and S. Europe as well as in N. Iran, these species grow on a variety of lignose plants. This decrease in the number of possible substrates probably depends on competition from other wood-fungi.

A conclusion regarding the geographical distribution of wood-fungi in the nemoral zone in Europe must be that the temperature factor sets the main limits, within which there are several factors regulating the distribution, involving substrate specificness, competition with other wood-fungi and, generally, the occurrence of the special ecological niches required.

NOTES ON HABITATS. These notes are based on my own collections made during the periods 1 - 19th July, 1976 (Hallenberg 1978, 1979) and 26th April - 13th May, 1978 (Hallenberg 1980).

A. In most cases it was impossible to determine the substrate, but the following species and genera were noted:

Acer velutinum
Alnus
Buxus hyrcana
Carpinus
Crataegus
Diospyros lotus
Fagus orientalis
Gleditsia caspica
Mespilus germanica
Parrotia persica
Populus
Prunus
Pterocarya fraxinifolia
Quercus castaneifolia
Rosa
Ulmus

In the "list of species", below these substrates are mentioned only by their generic names.

B. Species exclusively found on, or preferring Quercus castaneifolia as substrate:

Peniophora quercina
Xylobolus frustulatus
X. subpileatus
Tomentella chlorina
Daedalea quercina
Gloeoporus dichrous
Nigroporus niger
Hymenochaete rubiginosa
Inonotus cuticularis
I. nidus-pici
Phellinus contiguus

C. The following species were collected on Buxus hyrcana:

Cystostereum subabruptum
Hyphodontia juniperi
Peniophora proxima
Ceriporia alachuana
Irpex lacteus
Schizopora carneo-lutea
Phellinus punctatus

D. Wood-fungi which seem to be more or less restricted to trunks and logs:

Gloeocystidiellum lactescens
Laeticorticium roseum
Phlebia centrifuga
Xylobolus frustulatus
X. subpileatus
Scytinostroma galactinum
Coniophora puteana
Tomentella chlorina
Antrodia lindbladii
Gloeoporus pannocinctus
Perenniporia medulla-panis
Trichaptum biforme
Laetiporus sulphureus

E. Wood-fungi which have been collected only on fallen or still-attached branches and twigs:

Auriculariopsis ampla
Ceratobasidium cornigerum
Gloeocystidiellum porosum
Phanerochaete martelliana
P. tuberculata
Phlebia albida

Hyphodontia crustosa	Stereum rameale
Peniophora cinerea	Trechispora fibrillosa
P. lilacea	Vuilleminia comedens
P. lycii	V. cystidiata
P. pseudonuda	Incrustoporia nivea
P. quercina	Hymenochaete cinnamomea

F. Frequent species fructificating on live or dead standing trees or on stumps:

Daedalea quercina	Ganoderma australe
Fomes fomentarius	G. lucidum
Fomitopsis pinicola	Phellinus igniarius
Polyporus squamosus	P. pomaceus
Rigidoporus ulmarius	P. torulosus
Trametes gibbosa	Phylloporia ribis

NOTES ON PERIODS OF FRUCTIFICATION AND ON THE MYCOFLORA IN MOUNTAIN FAGUS-FORESTS.

G. Species occurring much more frequently in the summer collection (1976) than that made in the spring (1978):

Gloeocystidiellum porosum	Trechispora fibrillosa
Hyphoderma transiens	Rigidoporus ulmarius
H. sambuci	Ganoderma australe
Mycoacia uda	G. lucidum
Peniophora lycii	Hymenochaete rubiginosa
Phanerochaete aculeata	Phellinus torulosus
P. radulans	P. contiguus
Phlebia rufa	
Phlebiopsis roumeguerei	

H. Species much more frequent in the spring collection (1978) than in the July one (1976). Those marked "F" were more or less restricted to the mountain Fagus-forest.

Athelia epiphylla	F	Subulicystidium longisporum
Cystostereum subabruptum	F	Vuilleminia comedens
Dacryobolus sudans	F	Tomentella chlorina
Hyphoderma setigerum		Bjerkandera adusta
Hyphodontia crustosa		Polyporus arcularius
Lopharia spadicea		Schizopora paradoxa
Peniophora incarnata		Trametes hirsuta
P. pseudonuda		T. pubescens
P. lilacea		Tyromyces gilvescens
P. quercina		Auricularia mesenterica
Phlebia caspica	F	Hirneola auricula-judae
P. centrifuga	F	Bourdotia galzinii
P. livida		Eichleriella spinulosa
Radulomyces molaris		Exidiopsis grisea
Scopuloides hydnoides	F	Tulasnella eichleriana

I. Except for those species marked "F" in the list above, the following frequent species were mainly found in the mountain Fagus-forest, while making the spring collection (1978):

Galzinia incrustans
Hyphodontia quercina
Peniophora cinerea
Sistotremastrum niveo-cremeum
Ceriporia purpurea

K. Besides, the following species were frequent in the mountain Fagus-forest but were also common in other parts of the Caspian forests:

Byssomerulius corium
Hyphoderma setigerum
Phanerochaete sordida
Phlebia livida
Sistotrema brinkmannii
Subulicystidium longisporum
Bjerkandera adusta
Schizopora carneo-lutea
S. paradoxa
Fomes fomentarius
Bourdotia galzinii
Exidiopsis grisea
Trametes gibbosa

LIST OF SPECIES. Frequent species collected in 1976 and 1978 are marked NH I and NH II and with the total number of my own collections given. When less than 4 collections/ species, the collection numbers are noted.

Numbers below 2000 refer to 1976. For descriptions of new species and new combinations, see Hallenberg (1978, 1979, 1980). Records from the following authors are also included: Fallahyan (1973); Khabiri (1958); Niemelä & Uotila (1977), in the list marked "Niemelä"; Petrak (1939, 1949); Probst (1977); Rabenhorst (1871); Rostrup (1908); Saber (1972, 1974), marked "Saber I" and "Saber II" respectively; Soleimani(1975); Watling & Sweeney (1975). An unpublished collection by Probst is also included. In the list these authors are referred to by their names.

The collected material is deposited in GB and IRAN.

In the list below, the families of Aphyllophorales are treated in the following order: Corticiaceae, Coniophoraceae, Lachnocladiaceae, Thelephoraceae, Polyporaceae, Ganodermataceae, Hymenochaetaceae, Hericiaceae, Clavariaceae, Cyphellaceae, Fistulinaceae, Schizophyllaceae, Auriculariaceae, Tremellaceae, Dacrymycetaceae, and Tulasnellaceae. Within the families, the species are enumerated in alphabetical order.

CORTICIACEAE

Athelia arachnoidea (Berk.)Jül.
Gorgan. On fallen branches. NH 2357, 2369.

A. decipiens (v.Höhn. & Litsch.) John Erikss.
Gorgan. On a brown-rotted log. NH 2301, 2303.

A. epiphylla Pers.
Gorgan, Mazanderan. On fallen trunks, logs and branches of *Quercus*, *Fagus*, and indet. ligneous plants, on leaves, bark and mosses on the ground. NH II; 25 collections.

Athelia sp.
Gorgan. On a fallen branch. NH 2588 (see Hallenberg 1980).

Auriculariopsis ampla (Lév.) Maire
Gorgan. On a fallen twig. NH 2025.

Botrybasidium aureum Parm.
Gorgan, Mazanderan. On a fallen log and on a white-rotted trunk of *Fagus*. NH 1426, 2556.

B. botryosum (Bres.)John Erikss.
Mazanderan. On wood on the ground, on a branch, on a root of *Parrotia*. NH 1731, 1875, 2687.

B. candicans John Erikss.
Gorgan. On brown-rotted wood. NH 2377.

B. conspersum John Erikss.
Gorgan. On a decayed trunk on the ground. NH 2537.
N.B. Only the conidial state, *Haplotrichum conspersum* (Link)Hol.-Jech. is present in this collection.

B. curtisii Hallenb.
Gorgan, Mazanderan, Gilan. On fallen trunks and branches. NH I, II; 7 collections.

B. grandinioides Hallenb.
Mazanderan. On a fallen trunk. NH 1752.

B. laeve (John Erikss.)Parm.
Gilan. On a fallen branch. NH 1946.

B. obtusisporum John Erikss.
Gorgan. On a fallen trunk of *Parrotia*. NH 1402.

B. subcoronatum (v.Höhn. & Litsch.)Donk
Gorgan, Gilan. On branches and logs of *Quercus* and indet. ligneous plants. NH I, II; 7 collections

Botryohypochnus isabellinus (Fr.)John Erikss.
Gorgan, Mazanderan. On fallen trunks, branches and twigs of *Carpinus*, *Fagus*, *Parrotia*, *Quercus*, and indet. ligneous plants. NH I, II; 14 collections.

Brevicellicium olivascens (Bres.)Hjortst. & K.-H. Larss.
Syn.: *Trechispora mutabilis* (Pers.)Liberta
Gorgan. On a fallen branch. NH 2053 B.

Byssomerulius corium (Fr.)Parm.
Gorgan, Mazanderan. On fallen branches and twigs of *Parrotia*, *Carpinus*, *Fagus*, and indet.ligneous plants. NH I, II; 16 collections; Saber II, Probst.

Ceraceomerulius serpens (Fr.) Erikss. & Ryv.
Mazanderan. On a fallen branch of *Fagus*. NH 2852.

Ceraceomyces borealis (Rom.)Erikss. & Ryv.
Gorgan, Mazanderan. On a fallen, white-rotted trunk and on a root of *Carpinus*. NH 2330; Probst.
N.B. The spores are somewhat short, 5.5 – 6.5 X 1.8 – 2 µm (Erikss. & Ryv., 1973: 6 – 8 X 1.8 – 2 µm).

Ceratobasidium cornigerum (Bourd.)Rog.
Gorgan. On a hanging twig. NH 1627.

Chondrostereum purpureum (Fr.)Pouz.
Gorgan, Mazanderan, Tehran. On trunks, branches, twigs and stumps of *Alnus, Carpinus, Fagus, Populus, Prunus divaricata, P. domestica, P. spinosa, Quercus,* and indet. ligneous plants. NH 1757, 2028; Khabiri, Probst, Saber II, Soleimani.

Conferticium insidiosum (Bourd. & Galz.)Hallenb.
Syn.: *Gloeocystidiellum insidiosum* (Bourd. & Galz.)Donk
Gorgan. On white-rotted, fallen logs and a trunk. NH II; 7 collections.

C. ochraceum (Fr.)Hallenb.
Syn.: *Gloeocystidiellum ochraceum* (Fr.)Donk
The Elburz mountains. On dry twigs of *Pinus*. Rabenhorst.

Cristinia helvetica (Pers.)Parm.
Gorgan, Mazanderan. On fallen trunks, logs and branches of *Fagus, Quercus,* and indet. ligneous plants. NH I, II; 6 collections.

Cylindrobasidium evolvens (Fr.)Jül.
Gorgan, Mazanderan. On cut wood and on a stump of *Carpinus* and indet. ligneous plant. NH 2207, 2212; Probst.

Cystostereum heteromorphum Hallenb.
Mazanderan. On a fallen log of *Fagus*. NH 2712.

C. stratosum Hallenb.
Gilan. On a fallen log. NH 1925.

C. subabruptum (Bourd. & Galz.)Erikss. & Ryv.
Gorgan, Mazanderan, Gilan. On fallen trunks, logs and branches of *Buxus, Fagus,* and indet. ligneous plants. NH I, II; 10 collections.

Dacryobolus sudans (Fr.)Fr.
Gorgan, Mazanderan. On fallen branches of *Fagus* and indet. ligneous plants. NH I, II; 5 collections.

Dendrothele acerina (Fr.)Lemke
Gorgan. On the bark of a live *Acer*-tree. NH 2026.

Donkia pulcherrima (Berk. & Curt)Pil.
Gorgan, Mazanderan, Gilan. On trunks and branches of *Fagus* and indet. ligneous plants. NH I, II; 5 collections; Soleimani.

Fibrodontia gossypina Parm.
Gorgan, Mazanderan. On wood of *Fagus* and on a fallen trunk of *Quercus*. NH 2471, 2697.

F. subceracea Hallenb.
Gorgan, Gilan. On fallen branches and on white-rotted wood. NH I, II; 5 collections.

Fibulomyces septentrionalis (John Erikss.)Jül.
Gorgan. On a hanging branch. NH 1582.

Galzinia incrustans (v.Höhn. & Litsch.)Parm.
Gorgan, Mazanderan. On fallen twigs and branches of **Parrotia** and **Fagus**. NH I, II; 4 collections.

G. longibasidia Hallenb.
Gorgan. On fallen branches. NH 2403, 2417.

Gloeocystidiellum lactescens (Berk.)Boid.
Gorgan, Mazanderan. On fallen trunks and logs. NH I, II; 4 collections. N.B. NH 2564 has rather short spores, 5 – 6.5 X 4 – 5 µm (Erikss & Ryv, 1975:6 – 7 X 4 – 4.5 µm, Rattan, 1977: 5 – 7.5 X 4 – 5.5 µm).

G. porosum (Berk. & Curt.)Donk
Gorgan, Mazanderan, Gilan. On fallen twigs and branches of **Quercus**, **Fagus**, and indet. ligneous plants. NH I, II: 10 collections

Gloeodontia columbiensis Burt ex Burds. & Lomb.
Gorgan. On a fallen branch and a twig. NH 1478, 2529.

Hyphoderma argillaceum (Bres.)Donk
Gorgan, Mazanderan. On a branch and on a fallen, brown-rotted trunk. NH 2384; Probst.

H. cremeoalbum (v.Höhn. & Litsch.)Jül.
Mazanderan. On a fallen twig of **Fagus**. NH 2698.

H. echinocystis Erikss. & Strid
Gilan. On a fallen branch. NH 1933.

H. litschaueri (Burt)Erikss. & Strid
Mazanderan. On a fallen branch of **Fagus** . NH 2790.

H. mutatum (Peck)Donk
Gorgan. On a fallen twig. NH 1396.

H. pallidum (Bres.)Donk
Gorgan. On a fallen trunk. NH 2320.

H.praetermissum (Karst.)Erikss. & Strid.
Syn.: **H. tenue** (Pat.)Donk sensu auct.
Gorgan, Mazanderan, Gilan. On fallen logs and branches and on wood on the ground of **Fagus**, **Pterocarya**, **Quercus**, and indet. ligneous plants. NH I, II; 28 collections.

H. puberum (Fr.)Wallr.
Gorgan, Mazanderan. On fallen trunks, logs and branches of **Quercus** and indet. ligneous plant. NH I, II; 11 collections.

H. roseocremeum (Bres.)Donk
Mazanderan. On wood and branches of **Fagus** on the ground. NH 2647, 2702. N.B. NH 2647 deviates by somewhat narrower spores.

H. sambuci (Pers.)Jül.
Syn.: **Hyphodontia sambuci** (Pers.)John Erikss.
Rogersella sambuci (Pers.)Liberta & Navas
Gorgan, Mazanderan. On fallen logs, on fallen and hanging branches and twigs. NH I; 4 collections.

H. setigerum (Fr.)Donk
Gorgan, Mazanderan. On fallen logs and branches of **Fagus**, **Quercus**, and indet. ligneous plants. NH I, II; 19 collections.

H. transiens (Bres.)Parm.
Gorgan, Mazanderan, Gilan. On branches and twigs of Buxus, Quercus, and indet. ligneous plants. NH I, II; 5 collections.

Hyphodermella corrugata (Fr.)Erikss. & Ryv.
Syn.: Odontia corrugata (Fr.)Bourd. & Galz.
Gorgan. On fallen branches and twigs of Crataegus and indet. ligneous plants.NH I, II; 7 collections.

Hyphodontia arguta (Fr.)John Erikss.
Gorgan, Mazanderan. On a fallen trunk of Fagus, on fallen branches of indet. ligneous plants. NH 1773, 2481, 2764.

H. crustosa (Fr.)John Erikss.
Gorgan, Mazanderan. On fallen logs, branches and twigs of Diospyros, Fagus, Quercus, and indet. ligneous plants. NH I, II; 22 collections.

H. nespori (Bres.)Erikss. & Hjortst.
Gorgan. On a fallen branch. NH 2410.

H. juniperi (Bourd. & Galz.)Erikss. & Hjortst.
Mazanderan. On fallen and hanging branches and twigs of Buxus. NH 1694, 1721.

H. quercina (Fr.)John Erikss.
Gorgan, Mazanderan. On fallen twigs and branches of Parrotia, Fagus, and indet. ligneous plants. NH I, II; 10 collections.

H. quercina (Fr.)John Erikss. f. coralloides Hallenb.
Mazanderan. On a still-attached branch of Fagus. NH 2797.

H. spathulata (Fr.)Parm.
Gorgan. On wood and a branch on the ground. NH 2020, 2603, 2604.
N.B. The spores are smaller, 3.5 – 4 X 2.5 – 3 µm, than in European specimens (Erikss. & Ryv., 1976: 4.5 – 5.5 X 3.5 – 4 µm, Rattan, 1977: 4 – 5 X 3 – 3.5 µm).

H. subalutacea (Karst.)John Erikss.
Mazanderan. On fallen, white-rotted branches of Fagus NH 2755, 2786.

Hypochniciellum ovoideum (Jül.)Hjortst. & Ryv.
Syn.: Leptosporomyces ovoideus Jül.
Gorgan. On wood on the ground. NH 2484.

Hypochnicium caucasicum Parm.
Mazanderan. On a white-rotted stump of Fagus. NH 2684.

H. polonense (Bres.)Strid
Mazanderan. On a white-rotted, fallen log of Fagus. NH 2710.

Laeticorticium roseum (Fr.)Donk
Mazanderan. On a fallen log of Fagus, on Quercus. NH 2845; Probst.

Laxitextum bicolor (Fr.)Lentz
Gorgan, Mazanderan, Gilan. On a fallen trunk, branch and twig of Fagus, Quercus and Carpinus. NH 1652, 2666; Probst.

Lopharia spadicea (Fr.)Boid.
Gorgan, Mazanderan. On fallen branches and on a stump of Carpinus, Fagus, and indet. ligneous plants. NH I, II; 6 collections; Probst.

L. heterospora (Burt)Reid
Fars. On Quercus brantii. Probst.

Merulius tremellosus Fr.
Gilan. On a fallen branch. NH 1944.

Mycoacia aurea (Fr.)Erikss. & Ryv.
Syn.: *M. stenodon* (Pers.)Donk
Mazanderan. On fallen branches of *Pterocarya* and indet. ligneous plant. NH 1705, 1819.

M. uda (Fr.)Donk
Gorgan, Mazanderan, Gilan. On fallen logs, branches, twigs and on wood of *Parrotia*, *Fagus*, and indet. ligneous plants. NH I, II; 11 collections.

Mycoacia sp.
Gorgan. On a fallen branch. NH 2139 (see Hallenberg 1980).

Mycoaciella bispora (Stalpers)Erikss. & Ryv.
Gorgan, Mazanderan, Gilan. On fallen trunks and branches. NH I; 4 collections.

Oliveonia subfibrillosa Hallenb.
Gorgan, Mazanderan. On fallen trunks and on wood of *Quercus*, *Fagus*, and indet. ligneous plant. NH II: 2222, 2227, 2868.

Peniophora cinerea (Fr.)Cke
Gorgan, Mazanderan. On fallen branches and twigs of *Alnus*, *Buxus*, *Fagus*, *Parrotia*, and indet. ligneous plants. NH I, II; 22 collections. N.B. Fructifications mostly with well developed basal layers of densely united, brown hyphae.

P. incarnata (Fr.)Karst.
Gorgan, Mazanderan. On fallen logs, branches, twigs and on a stump of *Fagus*, *Carpinus*, *Alnus*, *Gleditsia*, and indet. ligneous plants. NH II; 5 collections; Probst, Saber II. N.B. Interfertility tests have been carried out between the Iranian specimens 2215, 2267 and LY 2481, from France. They were all positive.

P. lilacea Bourd. & Galz.
Gorgan. On fallen twigs and a branch. NH 2037, 2135, 2136.

P. lycii (Pers.)v.Höhn & Litsch.
Gorgan, Mazanderan. On fallen branches and twigs of *Crataegus*, *Diospyros*, *Parrotia*, indet. ligneous plants, and *Rosa*. NH I, II; 19 collections.

P. nuda (Fr.)Bres.
Gorgan. On fallen branches. NH 1504, 2361.

P. proxima Bres.
Gorgan, Gilan. On still-attached and fallen branches and twigs of *Buxus*. NH 1679, 1938.

P. pseudonuda Hallenb.
Gorgan, Mazanderan. On fallen and still-attached branches of *Fagus*, *Quercus*, *Parrotia*, and indet. ligneous plants. NH I, II; 8 collections.

P. quercina (Fr.)Cke
Gorgan, Mazanderan. On fallen and still-attached branches and twigs of *Quercus* and indet. ligneous plants. NH I, II; 8 collections; Probst.

P. quercina (Fr.)Cke f. *phlebioides* Hallenb.
Gorgan. On a fallen twig. NH 2051.

Peniophora violaceo-livida (Sommerf.)Mass.
Gorgan, Mazanderan. On fallen branches and twigs. NH 1503, 1702.

Peniophora sp.
Mazanderan. On a fallen branch. NH 1858 (see Hallenberg 1978).

Phanerochaete aculeata Hallenb.
Gorgan, Mazanderan. On fallen logs and branches. NH I; 4 collections.

P. macrocystidiata Hallenb.
Gorgan. On a fallen log. NH 1618.

P. martelliana (Bres.)Erikss. & Ryv.
Gorgan. On fallen twigs and a branch. NH 1602, 2399, 2422.

P. radulans Hallenb.
Syn.: *Acia subochracea* (Bres.)sensu Bourd. & Galz.
Gorgan, Gilan. On fallen trunks, logs and branches of *Pterocarya* and indet. ligneous plants. NH I, II; 5 collections.

P. raduloides Erikss. & Ryv.
Gorgan, Mazanderan. On fallen logs, branches and twigs of *Fagus* and indet. ligneous plants. NH I, II; 4 collections.

P. septocystidia (Burt)Erikss. & Ryv.
Gorgan, Gilan. On fallen branches of *Parrotia* and indet. ligneous plant. NH 1443, 1884.

P. sordida (Karst.)Erikss. & Ryv.
Syn.: *P. cremea* (Bres.)Parm.
Gorgan, Mazanderan. On fallen logs, branches and twigs of *Fagus*, *Parrotia*, *Quercus*, and indet. ligneous plants. NH I, II; 25 collections; Petrak, Probst.

P. tuberculata (Karst.)Parm.
Gorgan. On fallen branches and twigs of *Quercus* and indet. ligneous plants. NH I, II; 12 collections.

P. velutina (Fr.)Erikss. & Ryv.
Gorgan, Mazanderan. On fallen trunks and branches of *Fagus*, *Carpinus*, *Quercus*, and indet. ligneous plant. NH I, II; 4 collections.

Phlebia albida v.Post in Fr.
Gorgan, Mazanderan. On fallen branches and twigs of *Quercus* and indet. ligneous plants. NH I, II; 9 collections.

P. caspica Hallenb.
Gorgan, Mazanderan. On fallen trunks and branches of *Fagus* and indet. ligneous plants. NH II; 6 collections.

P. centrifuga Karst.
Mazanderan. On fallen logs of *Fagus*. NH 2776, 2777.

P. lindtneri (Pil.)Parm.
Syn.: *P. meruloidea* Parm.
Gorgan. On a fallen branch. NH 1441.

P. livida (Fr.)Bres.
Gorgan, Mazanderan, Gilan. On logs, branches and twigs of *Fagus*, *Pterocarya*, and indet. ligneous plants. NH I, II; 14 collections.

P. rufa (Fr.)Christ.
Gorgan, Mazanderan, Gilan. On fallen trunks, logs, branches and twigs

of Fagus, Carpinus, Parrotia, and indet. ligneous plants. NH I, II; 21 collections.

Phlebia subochracea (Bres.)Erikss. & Ryv.
Gorgan, Mazanderan. On fallen branches and twigs and on wood of Fagus and indet. ligneous plants. NH I, II; 4 collections.
N.B. Two specimens, earlier reported as P. segregata coll. (Hallenberg 1978) belong to this taxon.

Phlebiopsis roumeguerei (Bres.)Erikss. & Hjortst.
Syn.: Phlebia roumeguerei (Bres.)Donk
Gorgan, Mazanderan, Gilan. On a fallen trunk, log and branches, on still-attached branches and twigs, on a stump and on wood on the ground of Parrotia, Pterocarya, Quercus, and indet. ligneous plants. NH I, II; 24 collections.

Pulcherricium coeruleum (Fr.)Parm.
Gorgan. On a fallen log of Quercus. NH 2505.

Radulomyces confluens (Fr.)Christ.
Gorgan, Mazanderan. On fallen logs, branches and twigs, on a still-attached twig of Alnus, Buxus, Quercus, and indet. ligneous plants. NH I, II; 14 collections

R. molaris (Fr.)Christ.
Gorgan. On a fallen log, twig and branches of indet. ligneous plants, on a still-attached branch of Quercus. NH I, II; 7 collections.

Scopuloides hydnoides (Cke & Mass.)Hjortst. & Ryv.
Syn.: Phlebia hydnoides (Cke & Mass.)Christ.
Gorgan, Mazanderan. On fallen trunks, logs and branches of indet. ligneous plants, on a deal of Fagus. NH I, II; 10 collections.

Sistotrema brinkmannii (Bres.)John Erikss.
Gorgan, Mazanderan. On fallen trunks, logs, branches and twigs, on wood on the ground of Fagus, Parrotia, Quercus, and indet. ligneous plants. NH I, II; 27 collections.
N.B. One specimen (NH 2325) deviates by the presence of long, widened hyphal ends, protruding from the apices of aculei (see Hallenberg 1980).

S. camshadalicum Parm.
Gorgan. On a fallen branch. NH 1556.

S. commune John Erikss.
Gorgan. On a fallen branch. NH 2190.

S. coroniferum (v.Höhn. & Litsch.)Donk
Mazanderan. On a fallen branch of Fagus. NH 2753.

S. diademiferum (Bourd. & Galz.)Donk
Gorgan, Mazanderan. On a fallen log, branch and twigs of Fagus, Parrotia, and indet. ligneous plants. NH I, II; 5 collections.

S. oblongisporum Christ. & Hauersl.
Gorgan. On burnt wood. NH 2302.

S. raduloides (Karst.)Donk
Gorgan. On a fallen branch. NH 2269.

S. resinicystidium Hallenb.
Gorgan. On brown-rotted wood of Quercus on the ground. NH 2104, 2105, 2466.

Sistotrema suballantosporum Hallenb.
Gorgan. On decayed wood on the ground. NH 2019.

Sistotrema sp.
Gilan. On a fallen twig. NH 1885 (see Hallenberg 1978).

Sistotremastrum niveo-cremeum (v.Höhn. & Litsch.)John Erikss.
Gorgan, Mazanderan, Gilan. On fallen logs and branches, on wood of Fagus and indet. ligneous plants. NH I, II; 17 collections.

Steccherinum fimbriatum (Fr.)John Erikss.
Gorgan, Mazanderan. On fallen trunks, logs, branches and twigs, on wood on the ground of Fagus, Quercus, and indet. ligneous plants. NH I, II; 8 collections; Probst.

S. ochraceum (Fr.)S.F. Gray
Gorgan, Mazanderan, Gilan. On fallen logs and branches, on still-attached branches and twigs of Fagus, Parrotia, Quercus, and indet. ligneous plants. NH I, II; 17 collections.

S. robustius (John Erikss. & Lundell)John Erikss.
Gorgan. On a fallen log. NH 2590.

Stereum hirsutum (Fr.)Fr.
Gorgan, Mazanderan, Gilan, Fars, Azerbaidjan. On fallen and leaning trunks and logs, on fallen and still-attached branches and twigs of Acer, Alnus, Carpinus, Diospyros kaki, Fagus, Gleditsia, Parrotia, Quercus, Ulmus, Vitis, and indet. ligneous plants. NH I, II; 28 collections; Niemelä, Probst, Rabenhorst, Saber II, Soleimani.

S. gausapatum (Fr.)Fr.
Gorgan, Mazanderan, Gilan, Fars. On fallen branches and on a stump of Quercus castaneifolia, Q. brantii, and indet. ligneous plants. NH 2036, 2125; Probst, Watling & Sweeney.

S. insignitum Quél.
Gilan, Mazanderan. On fallen logs of Fagus and on a still-attached branch of indet. ligneous plant. NH 1852, 2676, 2871; Probst, Rabenhorst.

S. rameale (Pers.)Fr.
Gorgan. On a fallen twig of Quercus. NH 1356.

S. subtomentosum Pouz.
Gorgan. Mazanderan, Gilan. On fallen trunks, logs and branches, on a still-attached branch of Carpinus, Fagus, and indet. ligneous plants. NH I, II; 6 collections; Probst, Saber II.

Subulicystidium longisporum (Pat.)Parm.
Gorgan, Mazanderan. On fallen trunks, logs, branches and twigs, on wood of Acer, Crataegus, Fagus, Quercus, and indet. ligneous plants. NH I, II; 18 collections.

Trechispora alnicola (Bourd. & Galz.)Liberta
Gorgan, Mazanderan, Gilan. On fallen and still-attached branches and twigs of Pterocarya and indet. ligneous plants. NH I, II; 9 collections.

T. confinis (Bourd. & Galz.)Liberta
Gorgan, Mazanderan. On fallen branches of Fagus and indet. ligneous plants. NH 2149, 2530, 2709.

Trechispora dimitica Hallenb.
Gorgan. On a fallen branch. NH 2328.

T. farinacea (Fr.)Liberta
Gorgan, Mazanderan. On fallen trunks, logs and branches of Buxus, Fagus, Quercus, and indet. ligneous plants. NH I, II; 9 collections.

T. fibrillosa Hallenb.
Gorgan, Mazanderan. On fallen branches and twigs of Carpinus, Diospyros, and indet. ligneous plants. NH I, II; 10 collections.
N.B. One specimen (NH 2053 A) was growing close to Brevicellicium olivascens (Bres.)Hjortst. & K-H Larss.

T. granulifera Hallenb.
Gorgan, Gilan. On a fallen trunk and log of Parrotia and Quercus. NH 1885, 2449.

T. microspora (Karst.)Liberta
Gorgan. On a fallen log and branches of Quercus and indet. ligneous plants. NH I, II; 4 collections.

T. mollusca (Fr.)Liberta
Gorgan. On a fallen log of Quercus. NH 2498.

T. praefocata (Bourd. & Galz.)Liberta
Mazanderan. On a fallen trunk of Fagus. NH 2725.

T. vaga (Fr.)Liberta
Syn.: Cristella sulphurea (Fr.)Donk
Gorgan, Mazanderan. On a fallen log and branches of Fagus and indet. ligneous plants. NH 1448, 1711, 2830.

Tubulicrinis incrassatus Hallenb.
Gorgan. On fallen branches. NH 1491, 1517.

T. thermometrus (Cunn.)Christ.
Mazanderan. On brown-rotted wood of Fagus. NH 2791

Uthatobasidium fusisporum (Schroet.)Donk
Gorgan. On a fallen branch of Parrotia. NH 1312.

Vuilleminia comedens (Fr.)Maire
Gorgan, Mazanderan. On fallen and still-attached branches and twigs of Fagus, Quercus, and indet. ligneous plants. NH II; 6 collections.

V. cystidiata Parm.
Gorgan. On fallen and still-attached branches and twigs of Crataegus, Mespilus germanica, and indet. ligneous plants. NH I, II; 4 collections.

V. megalospora (Bres.)Bourd. & Galz.
Gorgan. On a thin, still-attached branch. NH 2156.

Xenasma pruinosum (Pat.)Donk
Gorgan. On fallen branches of Parrotia and indet. ligneous plant. NH 1290, 1579.

X. pulverulentum (Litsch.)Donk
Gorgan. On a fallen branch. NH 1434.

Xenasmatella allantospora Oberw.
Gorgan, Mazanderan. On fallen branches and on wood of Fagus and indet. ligneous plants. NH 1850, 2003, 2631.

Xenasmatella grisella (Bourd.)Oberw.
Gorgan, Mazanderan. On fallen branches of *Fagus* and indet. ligneous plant. NH 2491, 2883. N.B. Spores somewhat larger (up to 6.5 X 3 µm) than in typical specimens (according to Oberwinkler /1965/ 4 - 5 X 2 - 3 µm). These specimens thus occupy an intermediate position between *X. grisella* and *X. ralla* (Jacks.)Oberw. As the separation of these two species is uncertain (Oberwinkler 1965), I prefer the oldest name for these specimens.

X. tulasnelloidea (v.Höhn. & Litsch.)Oberw. ex Jül.
Gorgan, Mazanderan, Gilan. On decayed wood, fallen trunks, logs, branches and twigs of *Alnus*, *Carpinus*, *Fagus*, *Parrotia*, *Quercus*, and indet. ligneous plants. NH I, II; 23 collections.

Xylobolus frustulatus (Fr.)Boid.
Gorgan, Mazanderan. On fallen and leaning trunks and logs of *Quercus*. NH I, II; 8 collections.

X. subpileatus (Berk. & Curt.)Boid.
Gorgan, Mazanderan. On fallen and leaning trunks and logs of *Quercus*. Probst also reports *Fagus* and *Carpinus* as substrates. NH I, II; 9 collections; Probst.

CONIOPHORACEAE

Coniophora puteana (Fr.)Karst.
Gorgan, Mazanderan. On brown-rotted, fallen trunks and a log of *Quercus*. NH I, II; 5 collections.

LACHNOCLADIACEAE

Scytinostroma galactinum (Fr.)Donk
Mazanderan. On fallen trunks of *Fagus*. NH 2764, 2867.

S. odoratum (Fr.)Donk
Gilan. On a fallen branch. NH 1917.

Vararia ochroleuca (Bourd. & Galz.)Donk
Gorgan. On fallen trunks of *Quercus*. NH 2559, 2560.

THELEPHORACEAE

Tomentella bryophila (Pers.)M.J.Larsen
Gorgan. On wood on the ground. NH 2533.

T. chlorina (Mass.)Cunn.
Syn.: *Amaurodon viride* (Fr.)Schroet.
Gorgan, Mazanderan. On decayed, fallen logs and trunks of *Fagus*, *Quercus*, and indet. ligneous plants. NH I, II; 11 collections. N.B. This species was especially common on fallen, brown-rotted trunks of *Quercus* during the spring collection (1978).

T. crinalis (Fr.)M.J.Larsen
Mazanderan. On a fallen branch NH 1778.

T. ferruginea (Pers.)Pat.
Gorgan. On a fallen branch. NH 1458.

Tomentella ferruginella Bourd. & Galz.
Gorgan. On a fallen branch. NH 1578.

T. neobourdotii M.J.Larsen
Gorgan. On a fallen twig. NH 1569.

T. ochracea (Sacc.)M.J.Larsen
Mazanderan. On a fallen branch and twig. NH 1774, 1827.

Tomentellastrum floridanum (Ell. & Ev.)M.J.Larsen.
Gorgan, Gilan. On fallen branches. NH 1472, 1912.

POLYPORACEAE

Antrodia albida (Fr.)Donk
Gorgan. On fallen branches and twigs of *Parrotia* and indet. ligneous plants, on a dead standing tree. NH I, II; 8 collections.

A. lindbladii (Berk.)Ryv.
Syn.: *Poria cinerascens* (Bres.)Sacc.
Mazanderan. On a fallen trunk. NH 1836.

A. semisupina (Berk. & Curt.)Ryv.
Mazanderan. On a fallen branch and on a still-attached branch of *Fagus*. NH 2697, 2889.

Aurantioporus albo-rubescens (Bourd. & Galz.)Jahn
The Caspian forests. Fallhyan.

A. fissilis (Berk. & Curt.)Jahn
Gorgan. On a dead standing tree. NH 1547.

Bjerkandera adusta (Fr.)Karst.
Gorgan, Mazanderan, Gilan. On fallen trunks, logs and branches of *Acer, Carpinus, Citrus, Fagus, Parrotia, Quercus,* and indet. ligneous plants. NH I, II; 13 collections; Fallahyan, Saber I, II, Soleimani, Watling & Sweeney.

B. fumosa (Fr.)Karst.
Mazanderan. On a fallen trunk. NH 1687.

Ceriporia alachuana (Murr.)Hallenb.
Gorgan, Mazanderan. On a fallen trunk and on fallen branches of *Buxus* and indet. ligneous plants. NH 1649, 1722, 1746.

C. excelsa (Lundell)Parm.
Mazanderan. On fallen branches. NH 1720, 1754.

C. purpurea (Fr.)Donk
Gorgan, Mazanderan. On fallen branches and twigs, on wood of *Diospyros, Fagus,* and indet. ligneous plants. NH I, II; 11 collections.

C. reticulata (Fr.)Donk
Mazanderan. On a fallen log, on a stump and on decayed wood of *Fagus*. NH 2683, 2773, 2864.

C. viridans (Berk. & Br.)Donk
Gorgan, Mazanderan, Gilan. On decayed trunks, logs and branches. NH I, II; 10 collections.

Cerrena unicolor (Fr.)Murr.
Gorgan. On fallen logs and branches of a leguminous bush and indet. ligneous plants, on a stump of Quercus. NH II; 4 collections.

Coriolopsis floccosa (Jungh.)Ryv.
Gorgan, Mazanderan. On a fallen log of Fagus, on fallen and hanging branches of Acer and indet. ligneous plants, on a stump. NH I, II; 6 collections.

C. gallica (Fr.)Ryv.
Syn.: Polyporus extenuatus Dur. et Mont.
Gorgan. On fallen trunks and branches of Quercus and indet. ligneous plants. NH I, II; 5 collections; Soleimani.

Daedalea quercina Fr.
Gorgan, Mazanderan, Gilan. On fallen trunks of Parrotia and Quercus, on a stump of Quercus. NH I, II; 4 collections; Saber I, Niemelä, Watling & Sweeney.

Daedaleopsis confragosa (Fr.)Schroet.
Gorgan, Mazanderan. On fallen branches of Parrotia and indet. ligneous plant. NH 1321, 1786. N.B. Two deviating specimens (NH 2515, 2691) are determined as D. confragosa s.l. by Ryvarden.

Datronia stereoides (Fr.)Ryv.
Mazanderan. On a fallen twig of Fagus. NH 2769.

Fomes fomentarius (Fr.)Fr.
Gorgan, Mazanderan, Gilan, Azerbaidjan, Tehran, Kashan, Karadj. On fallen trunks and logs, on dead standing trees of mainly Fagus. Also recorded from Acer, Alnus, Amygdalus, Carpinus, Parrotia, Populus, Quercus, Salix, Ulmus. NH I, II; 18 collections; Khabiri, Niemelä, Saber I, II, Soleimani.

Fomitopsis pinicola (Fr.)Karst.
Gorgan, Mazanderan, Gilan. On fallen and leaning trunks and logs of Carpinus, Fagus, Parrotia, Pterocarya, and indet. ligneous plants. NH I, II; 4 collections; Saber I, Soleimani.

Gloeophyllum **saepiarium (Fr.)Karst.**
Mazanderan, Gilan. On dead wood of a coniferous tree. Soleimani.

Gloeoporus dichrous (Fr.)Bres.
Gorgan, Mazanderan, Gilan. On fallen logs and branches of Acer, Carpinus, Fagus, Quercus and indet. ligneous plants. Especially common on thin, white-rotted branches in dry half-closed Quercus-forests. NH I, II; 7 collections; Soleimani.

G. pannocinctus (Rom.)John Erikss.
Mazanderan. On a fallen trunk of Carpinus. NH 1839.

Grifola frondosa (Fr.)S.F. Gray
Mazanderan, Gilan. On Fagus, Carpinus. Soleimani.

Hapalopilus nidulans (Fr.)Karst.
Gorgan. On a fallen log and branches of Quercus and indet. ligneous plants. NH 1604, 2006, 2518.

Heterobasidion annosum (Fr.)Bref.
Syn.: Fomes annosus (Fr.)Cke
Karadj. On a living tree of Pinus nigra. Fallahyan, Soleimani.

Heteroporus biennis (Fr.)Laz.
Karadj. On dead wood of *Pinus eldarica*. Soleimani.

H. fractipes(Berk. & Curt.)Fidal
Gilan. On fallen branches NH 1872, 1893.

Incrustoporia nivea(Jungh.)Ryv.
Syn.: *Popyporus semipileatus* Peck
Gorgan, Mazanderan, Gilan. On fallen branches and twigs of *Fagus*, *Gleditsia*, *Parrotia*, and indet. ligneous plants. NH I, II; 16 collections.

Irpex lacteus (Fr.)Fr.
Gorgan, Mazanderan, Gilan. On fallen branches and twigs, on live standing trees of *Buxus*, *Citrus aurantium*, *C. vulgaris*, *C. limonia*, *Diospyros*, *Gleditsia*, *Quercus*, and indet. ligneous plants. NH I, II; 18 collections; Petrak, Saber I, Soleimani.

Junghunia nitida(Fr.)Ryv.
Mazanderan. On a fallen branch. NH 2851.

Laetiporus sulphureus (Fr.)Murr.
Mazanderan, Gilan, Karadj. On fallen brown-rotted logs of *Parrotia*, *Ulmus*, and indet. ligneous plant. NH 1821; Saber I, Soleimani.

Lenzites betulina (Fr.)Fr.
Mazanderan. On fallen logs of *Betula*, *Carpinus*, *Fagus*, *Pinus*. NH 2808; Niemelä, Soleimani.

L. warnieri Dur. & Mont.
Gorgan. Niemelä.

Meripilus giganteus (Fr.)Karst.
Mazanderan, Gilan. On a decayed root, on fallen logs of *Fagus* and *Quercus*. Saber I, Soleimani.

Nigroporus niger (Berk.)Ryv.
Gorgan. On a fallen trunk of *Quercus*. NH 2581.

Oxyporus latemarginatus (Dur. & Mont.)Donk
Mazanderan. On fallen branches of *Citrus aurantium* and indet. ligneous plant. NH 1767; Saber I.

O. populinus (Fr.)Donk
The Caspian forests. On living trees of *Acer*, *Carpinus*, *Fagus*, *Tilia*. Soleimani.

Perenniporia elongata (Overh.)Dom.
Gorgan. On a leaning trunk of *Quercus*. NH 1667.

P. fraxinea (Fr.)Ryv.
Syn.: *Fomitopsis cytisina* (Berk.)Bond. & Sing.
Mazanderan. On *Carpinus*, *Citrus* and *Quercus*. Saber I, Soleimani.

P. medulla-panis (Fr.)Donk
Gorgan. On fallen trunks, logs, a branch, and on a stump of *Quercus*. NH I, II; 5 collections.

P. tenuis (Schw.)Ryv. cfr.
Gorgan. On wood on the ground. NH 2569. N.B. According to Ryvarden (in lit.) this specimen could be a young specimen of *P. tenuis*. A comparison with North American material, det. by Lowe, shows no noticeable differences.

Piptoporus betulinus (Fr.)Karst.
The Caspian forests. On a living Betula-tree. Fallahyan, Soleimani.

Polyporus arcularius (Batsch.)Fr.
Syn.: P. anisoporus Del. & Mont.
organ, Mazanderan. On fallen branches and twigs of Fagus, Quercus and indet. ligneous plants. NH 10 collections; Niemelä, Soleimani.

P. picipes Fr.
The Caspian forest. On Fagus. Soleimani.
N.B. P. picipes is a synonym to both P. melanopus Fr. and P. badius (S.F. Gray)Schw. As I have not seen Soleimanis material, it is impossible to refer it to the right species.

P. squamosus Fr.
Gorgan, Gilan, Azerbaidjan, Karadj. On stumps and living trees of Fagus, Fraxinus, Platanus, Populus, Prunus spinosa, Salix and Ulmus. NH 2251, 2263; Khabiri, Saber I, II, Soleimani.

P. varius Fr.
Gorgan, Gilan. On fallen trunks and branches. NH 1323, 2389; Rostrup.

Poria lenis (Karst.)Sacc.
Mazanderan, Gilan. On a fallen branch and twig. NH 1898, 1910.

Pycnoporus cinnabarinus (Fr.)Karst.
Gorgan, Mazanderan, Gilan. On fallen logs and branches of Fagus and indet. ligneous plants. NH 2249, 2294, 2661; Saber I, Soleimani.

Pyrofomes demidoffii (Lév.)Kotl. & Pouz.
Gorgan. On a live standing tree of Juniperus polycarpus in steppe vegetation. NH 2133.

Rigidoporus ulmarius (Fr.)Imazeki
Gorgan, Mazanderan, Gilan. At the base of dead or live standing, old trees and on fallen trunks of Acer, Alnus, Carpinus, Parrotia, Pterocarya, Ulmus, and indet. ligneous plants. NH I, II; 11 collections; Niemelä, Saber I, II, Soleimani.

Schizopora carneo-lutea (Rodw. & Clel.)Kotl. & Pouz.
Syn.: S. phellinoides (Pil.)Donk
Poria pseudoobducens Pil.
Gorgan, Mazanderan, Gilan. On fallen trunks, logs, branches, twigs and on stumps of Buxus, Carpinus, Fagus, Parrotia, Quercus, and indet. ligneous plants. NH I, II; 31 collections; Saber I, Probst.

S. paradoxa (Fr.)Donk
Gorgan, Mazanderan. On fallen logs, branches and twigs of Fagus, Parrotia, Quercus, and indet. ligneous plants. NH I, II; 32 collections.

S. trichiliae (van der Byl)Ryv. cfr.
Gorgan. On a fallen log. NH 2556.
Note: According to Ryvarden (in lit.) this specimen is microscopically identical with S. trichiliae. However, the pores are more split than in specimens from tropical - subtropical areas of Africa and America, where it is a widespread species.

Trametes cervina (Schw.)Bres.
Gorgan, Mazanderan. On a dead, standing tree of Pterocarya, on a stump of Quercus, on a fallen log of Fagus. NH 1776, 2337, 2723.

Trametes gibbosa (Pers.)Fr.
Gorgan, Mazanderan, Gilan. On fallen trunks, logs and branches, on stumps and dead standing trees of *Acer, Carpinus, Fagus, Parrotia,* and indet. ligneous plants. NH I, II; 15 collections; Khabiri, Saber I.

T. hirsuta (Fr.)Pil.
Gorgan, Mazanderan, Gilan. On fallen trunks, branches and twigs, on stumps of *Fagus, Populus,* and indet. ligneous plants. NH I, II; 10 collections; Niemelä, Saber I, Soleimani, Watling & Sweeney.

Trametes ljubarskyi Pil.
Gorgan. On a stump. NH 2248.

T. pubescens (Fr.)Pil.
Gorgan, Mazanderan. On fallen trunks, logs, branches and twigs of *Alnus, Fagus, Quercus,* and indet. ligneous plants. NH I, II; 12 collections; Niemelä, Saber I.

T. suaveolens (Fr.)Fr.
Gorgan. On a stump. NH 2298.

T. trogii Berk.
Gorgan, Mazanderan, Azerbaidjan, Tehran. On a stump, on live standing trees of *Populus, Salix,* and indet. ligneous plants. NH 1606, 2921, 2922; Saber I, Soleimani.

T. versicolor (Fr.)Pil.
Gorgan, Mazanderan, Gilan, Karadj. On fallen trunks, logs, branches, twigs and on stumps of *Carpinus, Citrus aurantium, Fagus, Parrotia, Platanus, Prunus, Quercus, Ulmus,* and indet. ligneous plants. NH I, II; 16 collections; Khabiri, Niemelä, Rabenhorst, Saber I, II, Soleimani, Watling & Sweeney.

T. zonatella Ryv.
Gorgan. On a live standing tree of *Crataegus*. NH 2092.

Trichaptum biforme (Fr.)Ryv.
Syn.: *Hirschioporus pargamenus* (Fr.)Bond. & Sing.
Gorgan, Mazanderan, Gilan. On fallen trunks, logs, branches and on dead standing trees of *Carpinus, Fagus, Parrotia, Quercus,* and indet. ligneous plants. NH I, II; 17 collections; Niemelä, Saber I, II.

Tyromyces gilvescens (Bres.)Ryv.
Gorgan, Mazanderan. On fallen trunks and logs of *Fagus* and indet. ligneous plants. NH II; 5 collections.

T. hibernicus (Berk. & Br.)Ryv.
Syn.: *Polyporus subsericeomollis* Rom.
Gorgan, Mazanderan. On a fallen trunk of *Quercus* and on a branch. NH 1957, 2563.

T. lacteus (Fr.)Murr.
Mazanderan. On a fallen log of *Fagus,* on *Quercus, Ulmus*. NH 2872; Soleimani.

Tyromyces placenta (Fr.)Ryv. cfr.
Mazanderan. On a decayed stump. NH 1824. N.B. *T. placenta* is hitherto only known from coniferous wood. As this specimen was growing on deciduous wood the determination is uncertain.

GANODERMATACEAE

Ganoderma applanatum (S.F. Gray)Pat.
Gorgan, Mazanderan. On a stump of Fagus, on a root, on living and dead trees of Carpinus, Fagus, Gleditsia, and indet. ligneous plant. NH 2252; Saber I, Soleimani, Watling & Sweeney.

G. australe (Fr.)Pat.
Syn.: G. adspersum (Schulz.)Donk
G. europaeum Steyaert
Gorgan, Mazanderan, Gilan. On fallen trunks, logs and branches, on dead standing trees of Carpinus, Citrus aurantium, Citrus sp., Diospyros kaki, Fagus, Gleditsia, Mespilus, Parrotia, Populus, Prunus spinosa, Prunus sp., Quercus, Tilia, and indet. ligneous plants. NH I, II; 11 collections; Saber I, II, Soleimani.

G. lucidum (Fr.)Karst.
Gorgan, Mazanderan, Gilan. On fallen logs and branches, on roots and stumps, on live standing trees of Carpinus, Diospyros, Parrotia, Quercus, Ulmus, and indet. ligneous plants. NH I, II; 8 collections; Khabiri, Saber I, Soleimani.

G. manoutchehrii Steyaert
Mazanderan. On Acacia. Steyaert.

G. resinaceum Boud. in Pat.
Mazanderan. On a dry root and on dry wood of Pterocarya and indet. ligneous plant. Saber I.

HYMENOCHAETACEAE

Coltricia spathulata (Hooker)Murr.
Mazanderan. On the ground. Niemelä.

Hymenochaete cinnamomea (Pers.)Bres.
Gorgan, Mazanderan, Gilan. On fallen branches and twigs of Fagus, Quercus, and indet. ligneous plants. NH I, II; 17 collections; Probst.

H. corrugata (Fr.)Lév.
Gorgan. On a fallen branch. NH 1485.

H. rubiginosa (Fr.)Lév.
Gorgan, Gilan. On fallen branches of Quercus and indet. ligneous plants. NH I; 5 collections.

H. tabacina (Fr.)Lév.
Gorgan. On a fallen trunk of Quercus. NH 2577.

Inonotus cuticularis (Fr.)Pil.
Gorgan, Mazanderan, Azerbaidjan, Karadj. On a stump of Quercus, on fallen trunks, on a living tree of Salix, Populus, and indet. ligneous plant. NH 1362. Saber I, Soleimani.

I. hispidus (Fr.)Karst.
Azerbaidjan, Karadj. On living trees of Ulmus campestris, Malus communis, Platanus. Fallhyan, Saber II, Soleimani.

I. nidus-pici Pil.
Gorgan. In a hollow in a live standing Quercus. NH 1350.

Inonotus obliquus (Fr.)Pil.
The Caspian forests. On dead wood. Soleimani.

I. pseudohispidus Kravts.
Tehran, Karadj. On living trees of Platanus and Populus. Soleimani.

Phellinus contiguus (Fr.)Pat.
Gorgan, Mazanderan. On fallen logs and branches of Quercus and indet. ligneous plants. NH I; 4 collections.

P. ferruginosus (Fr.)Pat.
Gorgan, Mazanderan, Gilan. On fallen trunks, logs and branches, on wood of Carpinus, Fagus, Quercus, and indet. ligneous plants. NH I, II; 15 collections.

P. igniarius (Fr.)Quél.
Gorgan. Mazanderan, Azerbaidjan. On dead and live standing trees, on stumps of Carpinus, Crataegus, Fagus, Vitis, and indet. ligneous plants. NH I, II; 4 collections: Saber II, Soleimani.

P. johnsonianus (Murr.)Ryv. cfr.
Gorgan. On a dead standing tree of Parrotia. NH 2096.
N.B. This specimen deviates from American one´s by hyaline spores instead of yellowish to pale rusty brown (Ryvarden in lit.).

P. pomaceus (Pers.)Maire
Gorgan, Mazanderan. On dead and live standing trees, on still-attached branches, on stumps of Prunus and indet. ligneous plants. NH II; 6 collections; Saber I, Soleimani.

P. punctatus (Fr.)Pil.
Gorgan, Mazanderan. On a fallen log of Buxus, on live standing trees of Carpinus. NH 1482, 1691, 1709.

P. robustus(Karst.)Bourd. & Galz.
The Caspian forests. On live standing trees of Fagus and Quercus.

P. torulosus (Pers.)Bourd. & Galz.
Gorgan, Mazanderan, Gilan. At the base of living trees and stumps of mainly Parrotia. Also found on Crataegus and Quercus. NH I, II; 7 collections; Probst (1977), Saber I, II, Soleimani.

Phylloporia ribis (Fr.)Ryv.
Syn.: Phellinus ribis(Fr.)Quél.
Gorgan, Azerbaidjan, Tehran. At the base of living trees, on stumps of Crataegus, Populus, Prunus, Quercus, Salix, and indet. ligneous plants. NH I, II; 4 collections; Saber II, Soleimani.

HERICIACEAE

Hericium coralloides (Fr.)Pers.
The Caspian forests. On dead trees of Acer, Carpinus, Fagus, Fraxinus. Soleimani.

CLAVARIACEAE

Mucronella calva (Fr.)Fr.
Gorgan, Mazanderan. On fallen logs and branches. NH 1563, 1685, 1971.

CYPHELLACEAE

Henningsomyces candidus (Fr.)Kunze
Syn.: Solenia candida Fr.
Gorgan, Mazanderan. On a fallen branch of Quercus, on wood on the ground. NH 1387, 1682, 2493.

Stigmatolemma poriaeformis (Fr.)Br. & Cke
Mazanderan. On a fallen log of Fagus. NH 2707.

Stromatoscypha fimbriata (Fr.)Donk
Mazanderan. On a fallen trunk of Fagus. NH 2759.

FISTULINACEAE

Fistulina hepatica Fr.
Mazanderan. On a live Quercus-tree. Soleimani.

SCHIZOPHYLLACEAE

Schizophyllum commune (Fr.)Fr.
Gorgan, Mazanderan, Gilan, Karadj. On fallen and hanging branches, twigs, on fallen trunks of Acer, Alnus, Carpinus, Citrus, Fagus, Morus albus, Populus, Quercus, Salix, and indet. ligneous plants. NH I, II; 5 collections; Niemelä, Petrak, Rabenhorst, Rostrup, Soleimani, Watling & Sweeney.

AURICULARIACEAE

Auricularia mesenterica (Dicks.)Pers.
Gorgan, Mazanderan, Gilan. On fallen trunks, logs and branches, on stumps of Fagus, Quercus, and indet. ligneous plants. NH I, II; 11 collections; Khabiri, Rabenhorst.

Helicogloea lagerheimi Pat.
Syn.: Saccoblastia sebacea Bourd. & Galz.
Gorgan, Mazanderan. On a fallen branch, on wood of Fagus. NH 1467, 2668.

Hirneola auricula-judae (Hook)Underw.
Gorgan, Mazanderan. On fallen and leaning trunks, on branches of Fagus, Quercus, and indet. ligneous plants. NH I, II; 10 collections; Soleimani.

Saccoblastia sphaerospora Möller
Mazanderan. On fallen branches. NH 1783, 1785.

TREMELLACEAE

Basidiodendron cinereum (Bres.)Luck-Allen
Mazanderan. On a fallen branch, on wood of Fagus. NH 1838, 2740.

B. deminuta (Bourd.)Luck-Allen
Gorgan. On fallen branches. NH I, II; 4 collections.

Basidiodendron eyrei (Wakef.)Luck-Allen
Mazanderan. On a fallen branch of Fagus. NH 2624.

Bourdotia galzinii (Bres.)Bres. & Torr.
Gorgan, Mazanderan, Gilan. On fallen logs, branches, twigs, on stumps of Alnus, Fagus, Gleditsia, Quercus, and indet. ligneous plants. NH I, II; 35 collections.

Eichleriella spinulosa (Berk. & Curt.)Burt
Gorgan, Mazanderan. On fallen logs, branches and twigs, on a stump. Most common on Fagus. NH I, II; 9 collections.

Exidia glandulosa Fr.
Gorgan, Mazanderan. On fallen branches and twigs of Betula, Carpinus, Fagus, Parrotia, Quercus and indet. ligneous plants, on a still-attached twig of Celtis. NH I, II; 6 collections; Soleimani.

E. thuretiana (Lév.)Fr.
Mazanderan. On fallen branches of Fagus. NH 2622, 2882.

Exidiopsis grisea (Pers.)Bourd. & Maire
Syn.: E. effusa (Bref.)Möll.
Gorgan, Mazanderan. Mostly on fallen or still-attached, thin branches of Fagus, Parrotia, and indet. ligneous plants, on a fallen trunk of Fagus. NH II; 14 collections.

E. molybdea (Mc Guire)Ervin
Compared with the type.
Gorgan. On a leaning, brown-rotted trunk of Acer. NH 2086.

Heterochaetella dubia (Bourd. & Galz.)Bourd. & Galz.
Gorgan. On brown-rotted wood. NH 2522.

Myxarium podlachicum (Bres.)Raitv.
Syn.: Sebacina podlachica Bres.
Gorgan, Mazanderan. On a fallen log, on wood of Fagus. NH 2318, 2800.

Sebacina incrustans (Fr.)Tul.
Gorgan. On litter on the ground. NH 1379, 1488.

Tremella mesenterica Fr.
Gorgan, Mazanderan, Gilan. On fallen branches and twigs of Fagus and indet. ligneous plants. NH 2225, 2435, 2757; Soleimani.

DACRYMYCETACEAE

Calocera cornea Fr.
Gorgan, Mazanderan. On a fallen log and branch, on a deal. NH 1741, 2513, 2842.

Dacrymyces minor Peck
Gorgan. On a fallen branch. NH 2075.

TULASNELLACEAE

Tulasnella allantospora Wakef. & Pears.
Gorgan. On wood on the ground. NH 2360.

Tulasnella eichleriana Bres.
Gorgan, Mazanderan. On fallen trunks, logs and branches, on wood of *Fagus*, *Quercus*, and indet. ligneous plants. NH II; 8 collections.

T. violea (Quél.)Bourd. & Galz.
Gorgan, Mazanderan. On a fallen branch, on a fallen log of *Fagus*. NH 2262, 2736.

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RÉCOLTE DE THUEMENELLA CUBISPORA AU GABON

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RÉSUMÉ

Thuemenella cubispora (Ellis & Holw.) Boedijn ne semble pas avoir été récolté depuis Seaver (1910). Une description et comparaison avec le typus en est faite d'après une récolte des environs de Libreville (Gabon).

SUMMARY

Thuemenella cubispora (Ellis & Holw.) Boedijn does not appear to have been collected since reported by Seaver (1910). A redescription is given from a collection taken in the Libreville, Gabon, area, and comparison was made with the type specimen.

G. Gilles le récolteur a pu observer les stromas jeunes: "Ils se présentent commes des petites masses abricot assez rouge de 2 à 3 mm de diamètre, érumpentes; puis ces masses grossissent en prenant une forme irrégulière et en devenant francement jaunes, les ostioles brunissent" (in litt. F.C., 23-VII-78).

Stromas mûrs 8-11 mm de large, 10-15 mm de long, de forme sinueuse et irrégulière, substipités, jusqu'à 5 mm d'épaisseur (Fig. 1). Surface veloutée laissant voir les ostioles sombres des périthèces (Fig. 2). Milieu du stroma à consistance cotoneuse (Fig. 3). Cet aspect velouté de la surface du stroma correspond à des éléments diverticulés (Fig. 4) de 50 à 60 µm de long, au dessus des périthèces, lesquels se trouvent au milieu d'un tissus pseudoparenchymateux composé de cellules à parois minces, irrégulièrement angulaires et globuleuses de 6-15 µm, devenant vers le milieu du stroma des hyphes flasques et lâches (Fig. 5) de 7 à 12 µm de diamètre. Périthèces enfoncés de 200-250 µm

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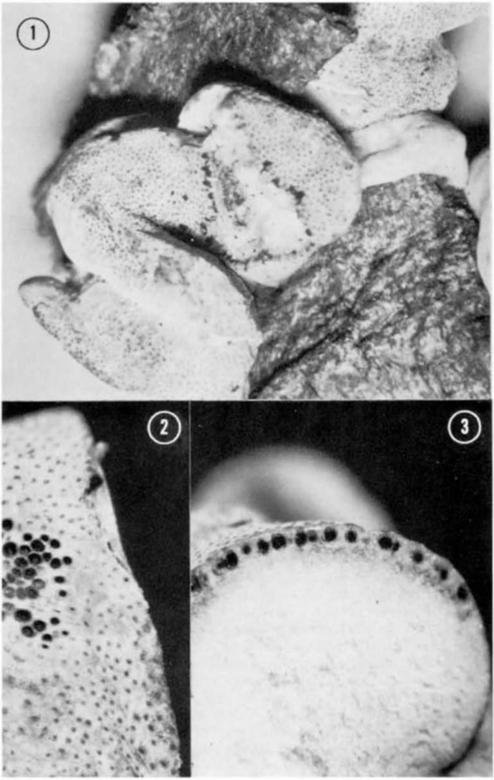
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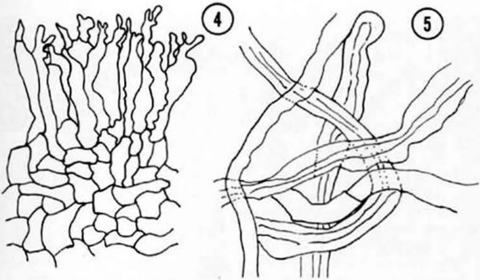

Fig. 4. Eléments diverticulés de la surface du stroma, x 600.
Fig. 5. Hyphes lâches de la partie inférieure du stroma, x 600.

à l'intérieur du stroma, sur un seul niveau (Fig. 3) dispersés irrégulièrement, globuleux 250-280 µm de diamètre, canal des ostioles 200-250 µm long. Asques 8 spores, naissant à la base des périthèces, courtement stipités, cylindriques, 60-65 × 5.0-5.5 µm, insensibles à l'iode. Spores unisériées, lisses, unicellulaires, de formes irrégulières soit angulaires, cubiques ou arrondies aux extémités, 5.5-7.0 × 3-4 µm, avec une ou deux guttules à l'intérieur, colorées sépia brun olive (Figs. 6, 7). Paraphyses d'environ 3µm de diamètre, rares, fragiles, incolores, se désagrégeant rapidement.

Récolte: G. Gilles, 23-VII-1978. A terre, sur écorce de branche morte. Forêt La Mondah, 27 km 200, Nord Libreville, Gabon. F.C. 4806-1 (= CUP 58816).

DISCUSSION

Nous avons déterminé cette récolte: Thuemenella cubispora (Ellis & Holway) Boedijn, sans trop de certitude, les descriptions de Seaver et d'Ellis & Holway étant

Figs. 1-3. **Thuemenella cubispora** (Ellis & Holw.) Boedijn. Fig. 1. Surface et forme du stroma, x 5. Figs. 2-3. Coupe horizontale et verticale laissant voir les périthèces, x 15

Fig. 6. Asques et spores, x 700.

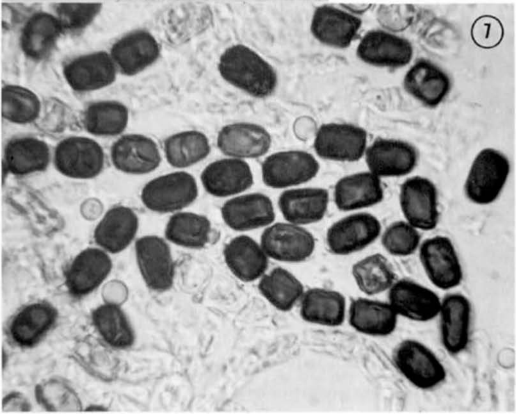

Fig. 7. Asques et spores, x 1400.

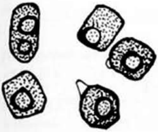
Fig. 8. Spores, x 1575.

insuffisantes. Nous avons demandé au Dr. G. Samuels (DSIR, Auckland, N.Z.) at au Dr. C. T. Rogerson (NYBG, Bronx, USA) de nous confirmer cette récolte et si possible de la comparer au typus. Ils ont bien voulu le faire et nous les en remercions vivement. Voici les conclusions du Dr. Clark Rogerson: "Dr. Gary Samuels and I finally have been able to compare the collection labelled Thuemenella cubispora (Ellis & Holway) Boedijn from Gabon (G. Gilles, 23/7/78) that you sent me. In all microscopic features the specimen matches the type collection of Hypocrea cubispora Ellis & Holway. The cuboid ascospores are the same size, shape and color and have smooth surfaces; the asci are 8-spored and are the same shape and size. The collection from Gabon does have a brighter color of the stroma, both outside and inside, and the immersed perithecia are more widely dispersed and are larger than in the type of H. cubispora (there is indication that this specimen may have been treated with alcohol or some other preservative before or after drying). We believe that the differences in stromatic features of color are not enough to modify your tentative identification. Seaver placed Hypocrea cubispora in his new genus Chromocreopsis stressing the 1-celled dark ascospores and 8-spored asci plus the stromatic characteristics. Boedijn synonymized Chromocreopsis with Thuemenella since both had been characterized by the dark, 1-celled ascospores. I tentatively maintained the two genera as distinct in my survey of the hypocrealean fungi stressing the cuboid ascospores in Chromocreopsis and the globose ascospores in Thuemenella. I have not had the opportunity to study this complex in detail but since the ascospores of the type species of both Chromocreopsis and Thuemenella have 1-celled, smooth-walled, dark ascospores, I would now accept Boedijn's synonymy. I have reservations as to whether or not the recently described species of Thuemenella are congeneric with its type. These species have warted ascospores and according to Doi the asci are 4-spored, the spores breaking apart to form 8 part spores.

"In summary, Dr. Samuels and I agree with your identification of the collection from Gabon as being

Thuemenella cubispora (Ellis & Holway) Boedijn." (in litt., F.C. 12-III-79).

Nous n'avons pu trouver dans nos connaissances un mycologue connaissant ou ayant récolté cette espèce. Le Dr. Y. Doi (TNS, Tokyo, Japon) ne l'a jamais récolté ni au Japon ni ailleurs (in litt., F.C. 26-9-78). Les professeurs R. P. Korf (CUP, Ithaca, USA) et J. Webster (University of Exeter, G.B.) non plus. Nous pensons qu'il s'agit d'une espèce très rare, apparemment connue jusqu'à présent de lowa, Jamaique, et Gabon.

Nour remercions G. Gilles de cet envoi très intéressant, ainsi que Bruno Erb (Erlinsbach, Suisse) de nous en avoir fait les photos.

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GLOMUS ALBIDUS: A NEW SPECIES IN THE ENDOGONACEAE [1]

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SUMMARY

A new species in the Endogonaceae is described producing spores which fall into the morphological category of "white reticulate spore". The fungus is known to form vesicular-arbuscular mycorrhizae with onion, sorghum, and poplar.

INTRODUCTION

Separate investigations into the Endogonaceae and endomycorrhizae of Iowa and Ohio yielded the same undescribed species. This species has many of the characteristics ascribed to the "white reticulate" spore types of El-Giahmi et al. (1976), Hayman (1978), Mosse (1972), and Mosse & Bowen (1968a, 1968b). The spores are white, have a poorly defined subtending hypha at maturity, appear somewhat "reticulate" when viewed through a compound microscope, and germinate by production of a germ tube through the spore wall. The species is herein named *Glomus albidus* sp. nov. The Ohio isolate was established in pot culture on corn, and specimens from two such cultures were used for the type collection. The paratype is from a field collection from central Iowa.

GLOMUS ALBIDUS Walker and Rhodes sp. nov. Figure 1

Sporocarpia ignota. Chlamydosporae (85-)95-168(-198) x (85-)95-168 (-177) µm, globosae, subglobosae, ovoideae vel irregulares, luce reflexa hyalinae, albae vel albidae, luce transmissa luteae vel testaceae, hypha sustinenti una vel raro hyphis sustinentibus duobus. Tunica sporarum stratis duobus: exteriore 0.5-2 µm crasso, hyalino, ad maturitem fatiscenti et expanso in locos usque ad 8 µm, tum in parte exuto; interiore 0.5-2 µm crasso, flavo, subtiliter lamellato. Hypha affixa (3-)5-15 µm in diam, tunicis duobus, plerumque recta, simplex, et aperta, ad maturitem collabens.

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2. Present address: Forestry Commission, Northern Research Station, Roslin, Midlothian EH25 9SY, Scotland.

Sporocarps unknown. *Chlamydospores* under reflected light hyaline when young, white to off-white at maturity, always appearing yellowish to brownish-yellow by transmitted light through a compound light microscope. Spores with one subtending hypha (rarely with two subtending hyphae), borne singly in the soil on coenocytic hyphae. Mature spores (85-)95-168(-198) x (85-)95-168 (-177) µm, globose to subglobose, occasionally ovoid or irregular; cyanophilous in cotton blue at maturity, slowly and less strongly so in youth; mature spores becoming dull orange to yellow in Melzer's reagent, young spores becoming pink to orange-red.

Spore walls continuous with hyphal walls, clearly double in youth, consisting of an outer hyaline wall 0.5-2 µm thick, and an inner subequal finely laminated wall, light yellow and 0.5-2 µm thick. At maturity, the outer wall crumbling and expanding, becoming as much as 8 µm thick in places and rendering the spore opaque; then partly sloughing, often becoming less than 1 µm thick and having a roughened granular appearance.

Subtending hyphae 2-walled, outer wall thickened at spore base, (3-)5-15 µm wide, usually straight and simple, but sometimes constricted at the spore base or expanded by thickening of the outer wall to become slightly funnel-shaped. Occasionally with a bulging septum 5-20 µm distad of the pore, but usually open. Outer wall up to 0.7 µm thick, sloughing at maturity to leave the inner wall (0.2-0.5 µm thick) unsupported; hypha then shrivelling and collapsing, often becoming difficult to see.

Spore contents of crowded oil droplets, usually becoming angular from mutual pressure to give a reticulate appearance; seemingly sealed off by collapse of the subtending hypha at maturity.

Germination by germ tube penetrating the spore wall. Regrowth of the subtending hypha not observed.

Figure 1. Chlamydospores of *Glomus albidus*

(a) Mature spore (left) and immature spore (right) in juxtaposition.

(b) Young spore of *Gl. albidus*. Note the two distinct walls.

(c) A mature spore with the outer wall expanded (top) and sloughed (base).

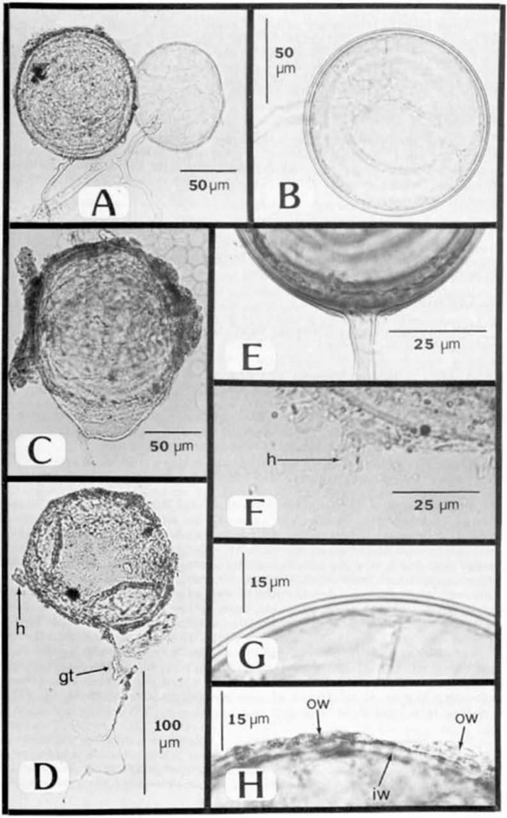
(d) Germinating spore. The germ tube (gt) has grown directly through the spore wall. The collapsed subtending hypha (h) is on the left.

(e) Detail of subtending hypha of a young spore. Note the two walls.

(f) Detail of subtending hypha of an old spore. The outer wall has disappeared and the hypha (h) has almost collapsed.

(g) Wall structure of a young spore. Two layers can clearly be seen.

(h) Wall structure of an old spore. The inner wall (iw) is intact, but the outer wall (ow) has crumbled and is breaking down.


50 µm
A
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D
25 µm
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DISTRIBUTION AND HABITAT

Known from the rhizosphere of winter wheat (*Triticum aestivum* L.) in Ohio, and from around the roots of grasses (*Setaria* spp. and *Bromus inermis* Leyss.) and poplars (*Populus* spp.) in an old meadow site in central Iowa. Found throughout the growing season. Probably also present in winter as resting spores in the soil and mycelium in living roots.

MYCORRHIZAL ASSOCIATIONS

Forming vesicular-arbuscular mycorrhizae with corn (*Zea mays* L.), onion (*Allium cepa* L.), sorghum (*Sorghum vulgare* Pers.), and poplar (*Populus* x *euramericana* (Dode) Guinier). Associated in the field with mycorrhizal roots of poplars, foxtail grasses (*Setaria* spp.), smooth brome (*B. inermis*), and wheat (*T. aestivum*).

ETYMOLOGY

Latin, *albidus*: whitish. Referring to the white to off-white appearance of the spores when viewed by reflected light.

COLLECTIONS EXAMINED

HOLOTYPE: OHIO - Pickaway Co (Collected by L H Rhodes, 6 vi 1977) among roots of winter wheat (*T. aestivum*). Type specimens from two pot cultures on corn (*Zea mays*), Walker #169, (OSC; isotype FH, ISC). *PARATYPE*: IOWA - Marshall Co, Rhodes, at the Iowa State University Rhodes Farm, Walker #179, 23 viii 1978 (ISC).

In addition, specimens from the Rhodes Farm were examined from random soil samples taken every two weeks during the summer and early autumn of 1978 as part of a population dynamics study of endogonaceous spores.

DISCUSSION

Mature spores of *Glomus albidus* are separated from those of other *Glomus* species by their white to off-white color and by their thin-walled, collapsed subtending hyphae. The change of color to yellowish when viewed through a compound microscope is also characteristic. *Gl. gerdemannii* Rose, Daniels & Trappe also has a very delicate subtending hypha, but, unlike *Gl. albidus*, the hypha is thickened for a short distance from the point of attachment. The outer wall of *Gl. albidus* and the middle wall of *Gl. gerdemannii* both appear firm in youth and then swell and break down as the spore matures. However, the breakdown of the former is into granular material, whereas the latter is into flaky pieces of laminations. *Glomus clarus* Nicolson & Schenck, and *Gl. occultus* Walker sp. ined. have hyaline to white spores possessing an outer coat which sloughs off with maturity. Both these species, however, lack the consistently whitish colour of *Gl. albidus* at maturity and have well-defined subtending hyphae at all stages of development (Nicolson & Schenck, 1979; C Walker, Iowa State University, in prep.).

Young spores of *Gl. albidus* are hyaline and can be confused with those of *Gl. occultus*, *Gl. clarus*, and *Gl. pallidus* Hall. *Glomus occultus* has a more complex wall structure than *Gl. albidus*, consisting of three layers, is generally much smaller (35-100 x 40-120 μm), and has a persistent subtending hypha which lacks an outer wall. The subtending hypha of *Gl. occultus* often is recurved, whereas the subtending hypha of *Gl. albidus* usually is straight. The walls of *Gl. clarus* spores are not of equal thickness, the outer wall being much thicker than the inner. The two walls of young spores of *Gl. albidus* are of almost equal thickness. In addition, young spores of *Gl. clarus* have a thin outer coat, tightly adhering to the outer wall, thus making three layers in all. The description of *Gl. pallidus* indicates that only one, laminated wall is present in that species (Hall, 1977), and even mature spores are much smaller than many of the immature specimens of *Gl. albidus* to be found in a collection. Finally, young spores of *Gl. albidus* have a characteristic pink to orange-red reaction to Melzer's reagent. *Gl. clarus*, *Gl. occultus*, and *Gl. gerdemannii* have no such reaction. The response of *Gl. pallidus* to this reagent is unknown.

Careful observation of a series of spores will allow all stages of development to be studied, making identification easier and more certain.

Glomus albidus is probably one of the "white reticulate" isolates referred to in the literature. However, Hall & Fish (1979) refer to Hayman's (1978) "white reticulate" species, and state that it is not the same as that of Mosse & Bowen (1968a, 1968b). The key of Hall & Fish (1979) indicates that Hayman's spore has projections 12-30 μm high on the outer wall. No such structures occur on *Gl. albidus*, and therefore it is not the same as that observed by Hayman (1978). The "white reticulate" spores described by Mosse & Bowen (1968a) apparently are similar to *Gl. albidus*, but one of us (Walker) has received spores from G D Bowen of an Australian "white reticulate" isolate, and these are not *Gl. albidus*. The "white reticulate" spores of El-Giahmi et al. (1976) and Mosse (1972) look very similar to *Gl. albidus*, but the descriptions are insufficient for conclusive identification. It is possible that several taxa have spores that could fall into the general morphological category of "white reticulate".

Consideration was given to raising a new genus to accommodate chlamydosporic species of the Endogonaceae that germinate through the spore wall, but there are good reasons for not doing so. The germination of many *Glomus* spp. has not been observed, and it therefore would be impossible to place such species to genus if germination mode was used as the sole generic criterion. At least one other species in *Glomus* (*Gl. pallidus*) is known to germinate through the spore wall (Hall, 1977), but in all other respects it clearly is a *Glomus* species. In the genus *Gigaspora*, there are two germination modes viz., with or without compartmentalization of spore contents prior to germ tube egress, but as yet there seems no justification for splitting the genus on germination characteristics. If *Glomus* were separated on such features, the same might justifiably be done for *Gigaspora*. It may be that, as more is learned about members of the Endogonaceae, subgenera will be erected based on mode of germination. The use of such characters for generic delimitation at present would lead to confusion rather than clarification.

Rose et al. (1979) referred to the similarities between *Gl. gerdemannii* and azygosporic species in *Gigaspora* and *Acaulospora*. There are two characteristics of *Gl. albidus* that could similarly be considered as evidence for a link between it and azygosporic species in the family. The germination directly through the spore wall, rather than by regrowth through the subtending hypha, is similar to that of *Gigaspora* and *Acaulospora*; and the reaction to Melzer's reagent is typical of the white-spored species in these two genera. However, there is no evidence of sexual or pseudosexual structures, such as the thin-walled hyphae on the mother vesicle of *Acaulospora* spp., or the small hyphal projection on the bulbous suspensor-like cell of *Gigaspora*.

ACKNOWLEDGMENTS

We wish to thank Dr James M Trappe and Dr Norman C Schenck for their helpful comments. Dr Trappe prepared the latin diagnosis, for which we thank him. Thanks are also due to Kathleen M Bason and Joan Zito for their help in preparing the photographic plate, and to Mrs E S Ellis and Mrs L Queen for preparing the camera-ready copy.

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MYCOTAXON

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ACAULOSPORA SPINOSA SP. NOV. WITH A KEY TO THE SPECIES OF ACAULOSPORA*

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Surveys of the Endogonaceae in Mexico by Trappe and Iowa by Walker revealed an undescribed taxon in the genus Acaulospora. The species is easily distinguished from all other known members of the genus.

ACAULOSPORA SPINOSA Walker & Trappe sp. nov. (Figs. 1-8)

Sporocarpia ignota. Sporae singillatim in terra enatae, sessiles, lateraliter gestae in hypha infundibuliformis vel cylindracea in vesiculam globosam prope terminata. Sporae 100-298 x 100 335μm, plerumque globosae vel subglobosae, interdum ellipsoideae vel reniformes, obscure avellaneae vel atrohiberae, spinis 1-4μm altis ornatae. Sporae tunica e stratis tribus, exteriore avellaneo vel atrohibero, 4-10μm crasso, medio et interiore hyalines, 0.2-1μm crassis.

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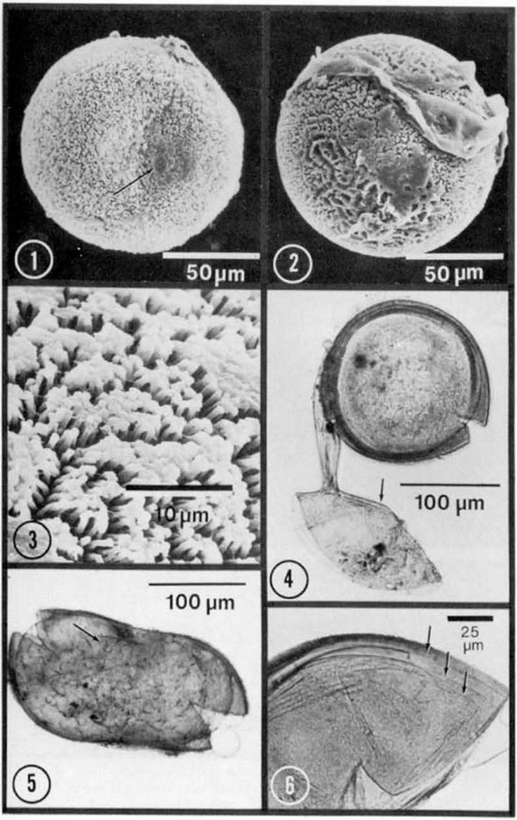
Sporocarps unknown. Azygospores formed singly in soil, sessile, attached by a collar 8-15μm broad to the side of a funnel-shaped to cylindrical hypha; hypha terminating in a globose vesicle about the same size as the spore and sometimes with thin tapering hyphal projections, becoming empty and shrunken at spore maturity. Vesicle and hypha with hyaline to yellow walls 0.5-3μm thick. Spores 100-298 x 100-335μm, usually globose to subglobose but occasionally ellipsoid or reniform, dull yellowish brown to dark reddish brown, usually with part of the vesicle attached. Surface ornamented with crowded blunt spines 1-4μm high, 1μm in diam at the polygonal base, tapering to 0.5μm at the tip, separated by ±0.2μm, sometimes adhering in lines to form an irregular, partial reticulum on parts of the spore surface (visible only by scanning electron microscopy). Patches of hyaline to subhyaline amorphous material up to 2μm thick often irregularly encrusting the spines but rarely covering the whole spore surface. Spore wall continuous except for the occluded openings, three-layered: outer layer light yellowish brown to reddish brown, 4-10μm thick including spines and encrustations, enclosing two membranous hyaline walls, each 0.2-1μm thick, the inner wall usually slightly thinner.

DISTRIBUTION AND HABITAT: Abundant throughout the growing season in soil around roots of annual grasses, forbs, and trees on a sandy river terrace near the Des Moines River in central Iowa and present in small numbers in a heavy black soil in an old meadow near Rhodes, Iowa, in both sites associated with other endomycorrhizal Endogonaceae. Found in the wet subtropics of Veracruz State, Mexico, in soil beneath roadside grasses and weeds.

MYCORRHIZAL ASSOCIATIONS: Forms vesicular-arbuscular (VA) mycorrhizae with _Fragaria vesca_ L. in pot culture. Associated in the field with VA mycorrhizae of grasses, forbs, and trees (_Populus_ spp. and _Fraxinus americana_ L.).

Figures 1-6. _Acaulospora spinosa_ azygospores.
1. Scanning electron micrograph (SEM) showing globose form, surface ornamentation, and the occluded pore (arrow). 2. SEM showing part of vesicle adhering to the spore and spines joined in a partial, irregular reticulum. 3. SEM detail of the crowded spines with patches of amorphous deposits. 4. Azygospore attached to collapsed vesicle (arrow). 5. Subreniform spore, with the occluded pore (arrow). 6. Three layers of spore walls (arrows).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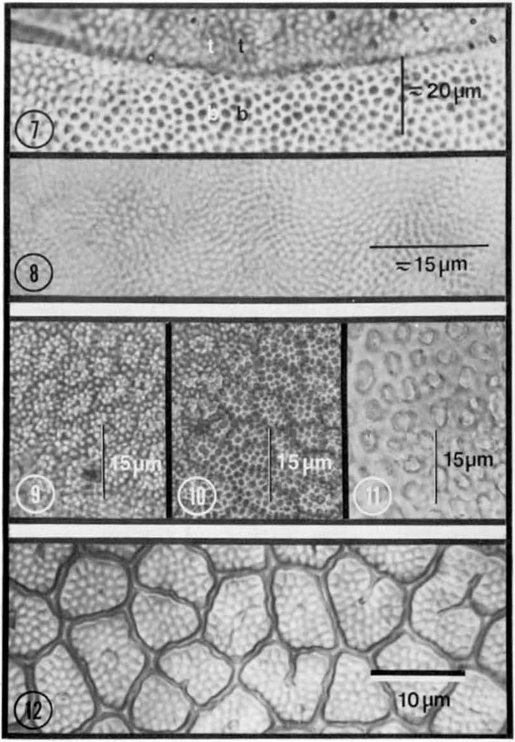
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15µm
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10 µm
12

ETYMOLOGY: Latin, *spinosa*, "spinose", in reference to the spore ornamentation.

COLLECTIONS EXAMINED: TYPE: U.S.A.: Iowa, Boone Co., 4-H Camp, 23 Aug. 1979, Walker #164 (OSC; isotype FH, ISC). PARATYPES: U.S.A.: Iowa, Boone Co., 4-H Camp, 3 Nov. 1978, Walker #68 (OSC). MEXICO: Veracruz, Tuxtla Biological Field Station, Univ. Nac. Auton. Mexico, Municipio San Andres, 9 July 1972, Trappe #3596 (OSC and ENCB).

The spores from Iowa are lighter colored and more yellowish brown than those from Mexico, which are generally deep reddish brown. This variation also occurs in *A. laevis*. The Mexican spores are generally somewhat larger than Iowa spores, though the ranges overlap considerably. We regard these modest differences as infraspecific variation.

A. spinosa resembles *A. elegans* Trappe & Gerd. but differs in lacking a complete reticulum superimposed on the spines at maturity (Figs. 7-11) and having only two thin inner walls (vs. three thickened inner walls in *A. elegans*). The two are difficult to distinguish at immature stages. *A. bireticulata*, the other species with an elaborate ornamentation of projections and reticulum, is readily differentiated from *A. spinosa* and *A. elegans* by its prominent three-layered reticular walls and stout, polygonal projections (Fig. 12).

KEY TO SPECIES OF *ACAULOSPORA*

Six species of *Acaulospora* have been discovered since Gerdemann and Trappe (1974) described the first two of the genus. Detailed descriptions can be found in the cited literature for each except *A. foveolata*, which will be published shortly.

Figures 7-12. Light micrographs of spore surfaces. (7-8) *Acaulospora spinosa*. 7. A cracked spore showing detail of spine tipe (t) and bases (b). 8. Lower magnification detail of tips of spines, showing swirled arrangement. (9-11) *A. elegans*. 9. Microscope focused on tips of spines. 10. Microscope focused on bases of spines to show reticulate appearance. 11. Microscope focused on reticulum overlaid on spines. 12. *A. bireticulata*, showing the reticulum and enclosed projections (photo by F. M. Rothwell, from Rothwell & Trappe 1979).

1 Spores less than 100μm broad, hyaline to very pale yellow; wall apparently single, roughened so minutely as to appear smooth..*A. trappei* Ames & Linderman (1976)

1 Spores broader than 100μm, hyaline to olive, brown, or dark reddish brown; wall with 2 or more layers; surface shiny-smooth or distinctly ornamented.........2

2(1) Spores shiny-smooth, globose to ellipsoid or reniform, 119-300 x 119-520μm, olive to yellowish brown or reddish brown; wall with a rigid outer layer 2-4μm thick and 2 thin inner layers.................. ....*A. laevis* Gerdemann & Trappe (1974)

2 Spores distinctly ornamented.......................3

3(2) Spores with spines or polygonal projections, with or without a reticulum....................................4

3 Spores with pits or cerebriform folds, lacking a surface reticulum...6

4(3) Reticulum lacking; spores with crowded spines 0.5-2μm tall, sometimes overlaid with irregular, patchy hyaline encrustations.......................... ....*A. spinosa* Walker & Trappe

4 Reticulum present; spore surface between reticulum walls with crowded spines or polygonal projections..5

5(4) Spore surface with crowded spines ± 2 x 0.5μm, with a hyaline, alveolate reticulum overlaid on the spines at maturity; reticulum walls 1-layered, ± 1μm thick; spores globose to ellipsoid, 140-285 x 145-330μm, olive to brown or reddish brown.....................*A. elegans* ....Trappe & Gerdemann in Gerdemann & Trappe (1974)

5 Spore surface with polygonal projections ± 1 x 1μm, enclosed by a grayish green, alveolate reticulum with 3-layered walls 1.5-2μm broad; spores globose, 150-155μm in diam, light brown................................. ....*A. bireticulata* Rothwell & Trappe (1979)

6(3) spore surface with cerebriform folds up to 12μm tall; spores globose, 200-250μm in diam, brown; walls 2-layered, the inner layer reticulate............... *A. gerdemannii* Schenck & Nicolson in Nicolson & Schenck

6 Spore surface pitted..............................7

7(6) Spores white to light olive brown, 100-240 x 100-220 µm, the surface with pits 1-1.5 x 1-3µm separated 2-4µm. ....*A. scrobiculata* Trappe (1977)

7 Spores dark reddish brown to nearly black, 200-260 x 220-260µm, the surface with pits 4-8 x 4-16µm irregularly separated by 1-12µm..*A. foveolata* Trappe sp. ined.

ACKNOWLEDGMENTS

Robert N. Ames, University of California, Berkeley, established *A. spinosa* in pot culture with strawberry after attempts at Iowa State University had failed. Joan Zito and Kathleen Bason, Iowa State University prepared the photographic plates of *A. spinosa* and *A. elegans*. Ned Klopfenstein, Iowa State University, assisted in the SEM studies. Dr. F. M. Rothwell, U.S. Forest Service, Berea, Kentucky, kindly provided the photograph of *A. bireticulata*.

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DISTRIBUTION OF AMANITA NAUSEOSA*

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Amanita nauseosa (Wakef.) Reid was described by Wakefield (1918) (as Lepiota nauseosa Wakef.) from a collection made in a greenhouse with exotic plants in the Royal Botanic Gardens at Kew, England. Reid (1966) reported this species from the same habitat and transferred the species to Amanita. Later, Guzmán (1975) described for first time A. nauseosa from a wild habitat at the edge of a tropical rain forest in the SE of Mexico.

Recently, Watling (1980) reported A. nauseosa from the Royal Botanic Gardens at Edinburgh also in a greenhouse. However, Watling doubts whether the Mexican material is conspecific with the Kew and Edinburgh material. Watling (1980) and Holden (1980) accepted the belief that Wakefield's fungus was introduced to Kew and Edinburgh from tropical regions through exotic plants.

Watling's doubts concerning whether the Mexican material of A. nauseosa is the same as that of Wakefield's and Reid's has no foundation, because as Guzmán (1975) stated, the Mexican material was checked with a collection from Kew sent to him and identified by Reid. All the macroscopic and microscopic features both in the English and in the Mexican material agree well. However, both collections have a membranous or floccose annulus on the stipe, a feature not reported by Wakefield (1918), Reid (1966) and Bas (1965). Surely the annulus is not of taxonomic value in this species because it is very friable and frequently lost in adult specimens.

Bas (1969) who revised the available collections of Amanita of the world, only reported A. nauseosa from Wakefield's and Reid's materials. Bas related A. nauseosa with A. aureofloccosa Bas, a species only known from the African Congo. It is interesting to observe that Pegler (1977) did not report either A. nauseosa nor A. aureoflo-

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ccosa from Eastern Africa, and Dennis (1970) did not report these species from Venezuela and adjacent countries. A. nauseosa is also close to A. praegraveolens (Murr.) Sing. only known from Florida (Bas, 1969) and a tropical locality in Mexico (Guzmán, 1975).

Consequently, the only report of A. nauseosa in a wild habitat is from Mexico, where Guzmán (1975) collected it in three localities in the State of Veracruz and one (Welden & Guzmán, 1978) in the State of Oaxaca. However, A. nauseosa is a very rare fungus in Mexico, because in spite of the numerous explorations made by the author in the American tropics in collaboration with Dr. A.L. Welden and his colleagues since 1976 to the present, the species has been found only four times. It is probable that this species also grows in the tropical forests of South America, mainly in Brazil where mycological explorations are very scarce at present. The introduction of A. nauseosa in Great Britain surely was through exotic plants taken from America. In this connection, Watling (1980) and Holden (1980) show that the introduction of Leucocoprinus birnhaumii (Corda) Sing., in Great Britain,a common tropical species in Mexico (Guzmán, 1979), was from the tropical region of Eastern Australia through exotic plants.

The author expresses his thanks to Dr. B. Lowy of Louisiana State University, for revising the text and improving the English.

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DIPODASCUS POLYPORICOLA NOV. SP., A PARASITIC HEMIASCOMYCETE ON PIPTOPORUS SOLONIENSIS (FR.) PIL.

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SUMMARY

Dipodascus polyporicola is described as new from Piptoporus soloniensis collected in Thailand. The host is reported as new to Southeast Asia and it is concluded that it is best placed in Piptoporus. A complete synonymy is reported for the host.

Among some fungi brought back from Thailand by one of us (T.S.) there was a polypore that macroscopically was almost identical with Laetiporus sulphureus. However, a microscopical examination revealed two startling facts. Firstly, the generative hyphae had clamps, which excluded L. sulphureus with its simple septate hyphae.

Secondly, and more exciting, the only fertile structures found in the hymenial tubes were asci containing ascospores. Basidia and basidiospores were totally lacking. Repeated examinations of sections taken on different parts of the specimens and in different depths of the tubes, gave the same result, no basidia, but an omnipresent, undifferentiated layer of septate hyphae producing asci. The outer parts of the tubes apparently had more asci than the inner parts. The polypore was obviously infected by a hemiascomycete, but looked otherwise healthy without colour-change or apparent distortions.

After having searched the literature in vain for a suitable name, pieces of the infected polypore were sent to different colleagues to see whether anyone had some knowledge about this parasite. The response was negative, but a possible relationship to Dipodascus Lagerh., Endomyces Reess, Helicogonium White and Myriogonium Cain was revealed, the two latter genera mainly because of their affinity to corticiaceous hosts.

It is well known that primitive ascomycetes may infect and parasitize basidiomycetes. In the family Endomycetaceae, the genus Endomyces is now circumscribed by the presence of naked, nonproliferating asci formed without visible conjugation on apparently diploid hyphae; hat-shaped, hyaline, gelatinous sheathed ascospores and the formation of an im-perfect state of catenulate, cylindrical blastoconidia. In this circumscription the genus embraces three species, all growing parasitic on agarics (Redhead & Malloch 1977, von Arx 1977). Other species with naked asci from conjugating gametangial cells and with oval to ellipsoidal, sheathed ascospores, formerly placed in Endomyces, are by Redhead & Malloch (1977) referred to the three genera Zendera Redhead & Malloch, Galactomyces Redhead & Malloch and Magnusiomyces Zender and excluded from the Endomycetaceae. Von Arx (1977) disputed Redhead and Malloch's classification of these primitive ascomycetes and maintained that they should better be placed in the genus Dipodascus based on similar cultural and conidial characters. In his emended description of Dipodascus, the genus, with its broad concept, includes species with the typical arthroconidial form state Geotrichum; naked one-to many-spored asci formed from conjugating gametangial cells; ascospores hyaline to slightly pigmented, from ellipsoidal to almost spherical, ornamented or surrounded by a sheath. The members are commonly associated with animal or vascular plant exudates or extracts, but is so far not recorded as parasitic on fungi.

White (1942) described a primitive ascomycete parasitizing Corticium microsporum, apparently without any adverse effects on the host. It was placed in a new genus as Helicogonium jacksonii and characterized by the formation of naked asci from conjugating gametangial cells, asci with a thickened tip, multi-spored; and two-celled, oblong to fusoid unsheathed ascospores with secondary budding and the formation of secondary ellipsoid to cylindric ascopores while still in the asci. Cain (1948) came across another non-ascocarpous ascomycete while examining a collection of the corticiaceous Dacryobolus sudans and described it as Myriogonium odontiae. The new genus was characterized by asci produced in unilateral, cymose clusters from fusion of indifferentiated gametangial cells, giving rise to hyaline, one-celled, elongate-ovate unsheathed ascospores in a constant number of eight, which are liberated through an inamyloid broad pore at the tip of the asci.

After having compared the descriptions of the current non-ascocarpous ascomycete genera, we have come to the conclusion that the new species on Piptoporus soloniensis could best be placed in Dipodascus Lagerh. emend. von Arx, which was also suggested by von Arx (pers. comm.). The presence of ellipsoid, sheathed ascospores and asci developing from the fusion of two gametangial protuberances from two adjacent cells on the same or separate hyphae, indicate that Dipodascus is the proper genus (cf. Fig. 1.).

DIPODASCUS POLYPORICOLA Schum. & Ryv. nov. sp. Fig. 1.

Ascocarpa nulla. Asci sparsi vel dispersi, ex apicibus cellularum conjugantium evoluti qui seu vicini ex una seu ex

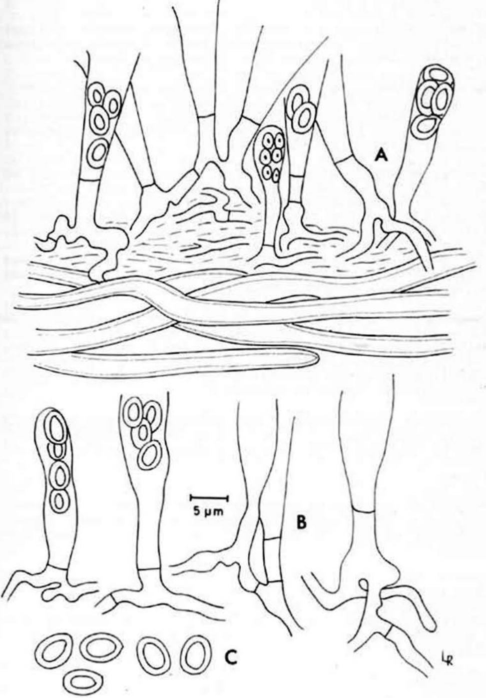

Fig.1. Dipodascus polyporicola. A) part of tubes with asci, B) asci, C) spores.

hyphis diversis oriuntur, asci clavatis vel subcylindraceis, 15-28 x 6-8 um, 4-6 (10) sporati, ad apicem dissolventes. Ascosporae ellipsoidei, hyalinae, strato mucilaginoso circumdatae, 4,5-6,0 x 3,0-4,8 um. Conidia non observantes. Habitat Piptoporus soloniensis (Fr.) Pil.

Type: Thailand. Cangwat Chiang Mai, Amphoe Mae Rim, Ban Kong Hae, 800 m a.s.l. in Dipterocarpus-forest, growing on Piptoporus soloniensis, 14. September 1978. T. Schumacher. TH 106. Holotype in herb. O, isotypes in K,CBS,DAOM,GB,CUP.

Ascocarp absent, asci single or in clusters, subconical to short cylindric, bifurcate at the base, 4-6(-10)-spored, developing from conjugation of gametangial protuberances which arise from two adjacent or separate hyphal cells, 15-28 x 6-8 um, ascospores hyaline, ellipsoid, smoothwalled, 1-celled, with a persistent mucilaginous sheath, inamyloid, 4.5-6.0 x 3.0-4.8 um inclusive sheath, when mature filling up the whole ascus, being somewhat polygonal in shape when densely packed. Conidial state not observed.

The ascopsores are liberated by the dissolving of the ascus-walls, and spores from adjacent asci accumulate in a mucilaginous spore ball attached to old ascus walls or hyphae. This type of spore liberation is indicative of insect dispersal, and insects are assumed to be the most possible vectors of the fungus in nature.

The species is obviously close to Dipodascus australiensis v. Arx et Barker (v. Arx 1977), described from rotting cladodes of the cactus Opuntia inermis. It is distinguished by smaller asci and ascospores and by its substrate.

The host of Dipodascus polyporicola was sterile, but its similarity to Laetiporus sulphureus soon lead to Polyporus trichrous Berk. & Curt. a prior name for P. pseudosulphureus Long (Lowe 1975).

However, the oldest name available to this taxon is Polyporus soloniensis Fr., published in 1821. Tortic (1975) in her discussion of P. schulzeri Fr. and its confused history, concluded that P. soloniensis should best be left in Piptoporus to which it had been transferred by Pilat (1936-42).

Piptoporus is typified by P. betulinus which has a soft and spongy consistency with a dimitic hyphal system as in P. soloniensis. A striking character of the latter is the skeletal hyphae, which partly dissolve in KOH. This is not the case with P. betulinus, at least not to a degree comparable with that of P. soloniensis. It is disputable how much taxonomic significance should be attributed to a character like this.

P. betulinus is glabrous with a papery thin, smooth cuticle on the pileus. P. soloniensis is first soft and dull, feeling velutinous when touched. With age the upper hyphae agglutinate and become pale dirty brown, and some sort of cuticle is developed, but it is never papery smooth as in P. betulinus. The spores of the latter are hyaline, non-amyloid and allantoid, while those of P. soloniensis are hyaline, non-amyloid but ellipsoid. At the generic level the spore shape is of little significance and there are several examples of accepted genera with a variable spore-form, such as, Tyromyces, Phellinus, Inonotus and Trametes, to mention some of the larger ones. In these genera there is also a considerable variation with regard to pileus cover and it seems appropriate to accept a certain generic variation in such macromorphological characters. If not, there will be an enormous proliferation of small genera which will only cause confusion.

Lowe (1975) placed P. soloniensis in Tyromyces which he gave a rather wide circumscription. The genus is typified by T. chioneus, a monomitic species or a few skeletal hyphae may occur. We feel that Tyromyces should be restricted to species with a predominantly monomitic hyphal system allowing for the presence of a few, scattered vegetative hyphae, apparently being developed rather late. P. soloniensis, with its almost total dominance of skeletal hyphae (generative hyphae can be very difficult to find), should be excluded from Tyromyces and left in Piptoporus.

P. soloniensis seems to be a very rare species everywhere. The last report from Europe seems to be the French collection mentioned by Tortic (1975:22) which was made in 1969.

A modern description of Piptoporus soloniensis is given by Lowe (1975), sub. T. trichrous. The synonyms of the host are cited below. If the type has been examined, the herbarium in which it is deposited is cited with an exclamation mark. The country of the type collection is given in parenthesis.

Piptoporus soloniensis (Fr.) Pilat
Atl. Champ. Europ. 3: 126, 1937. - Polyporus soloniensis Fr. Syst. mycol. 1:365, 1821. (France)-Polyporus trichrous Berk. & Curt. Ann. Mag. Nat. Hist. ser. 2 vol. 12:434, 1853 (USA) (K!)-Polyporus irpex Schulz. Verh. zool. bot. Ges. Wien 16:421, 1866 nomen nud. non. valid. publ. (Hungary). - Polyporus schulzeri Fr. Hymen. europ. p. 556, 1874. (renaming of P. irpex Schulz.) nomen illegit. non Kalchbr. 1868. - P. sublutescens Ellis & Everh. in Langlois Cat. Pl. Bas.-La. p. 33, 1887. (USA) nomen nudum non. valid. publ. - Polyporus pseudosulphureus Long. New Mex. Phi Kappa Phi 1:1, 1917 (USA) (BPI!). - Polyporus angolensis Lloyd Mycol. Writ. 6:997, 1920 (Angola) (BPI!). - Polyporus medullae Lloyd Mycol. Writ. 7:1330, 1924. (BPI!) (China).- Polyporus sambuceus Lloyd Mycol. Writ. 7:1360, 1925 (BPI!) (Japan)- Polyporus irpex Schulz. ex Krause, Arch. Ver.

Freunde Naturg. Mechlenburg II, 1:129, 1925 (validating Schulzers nomen nudum).

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Dr. J.A. von Arx, Dr. R.W.G. Dennis, Dr. J. Eriksson and Dr. R.P. Korf have examined the new species and given comments and advice. We greatly appreciate their stimulating help.

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MYCOTAXON

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REVUE DES LIVRES

par

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THE GENUS *PENICILLIUM* AND ITS TELEOMORPHIC STATES *EUPENICILLIUM* AND *TALAROMYCES*, par John I. PITT, viii + 634 p., 132 fig., in 8°, relié toilé, "1979" (publication date communicated by A.P. being 13.2.1980). Academic Press, 24-28 Oval Road, London NW1 7DY, UK. Prix: US 92.-.

Depuis 1949, le *Manual of the Penicillia* de Raper et Thom était la seule monographie relativement complète disponible pour l'identification des *Penicillium*. Elle reconnaissait 141 espèces et variétés.

Le concept générique de *Penicillium* supporté par Thom puis Raper et Thom voulant, en opposition avec l'art. 59 du Code de nomenclature, que seul le nom le plus ancien, qu'il soit anamorphique ou téléomorphique, couvre l'entièreté du champignon (l'holomorphe)(concept botanique des genres, voir Hennebert 1971), suscita d'autant plus d'opposition que le nombre de découvertes de *Penicillium* à fructification sexuée allait grandissant. Une revision s'imposait donc.

Pitt l'entreprit et la publie. Sa revision est caractérisée par trois traits: (1) le désir de conformité avec le Code de Nomenclature, du moins dans l'esprit, si ce n'est dans la lettre, (2) l'acceptation de 93 espèces des 141 espèces de Raper et Thom et l'addition de 57 autres espèces pour la plupart récentes, (3) l'emphase donnée sur la croissance en milieux de culture nouveaux et à différentes températures, sans s'attacher beaucoup plus que Raper et Thom à la morphologie.

Les 150 espèces reconnues par Pitt comprennent 37 *Eupenicillium* et 16 *Talaromyces* ayant une forme *Penicillium* pour anamorphe et 97 espèces anamorphiques de *Penicillium*.

Des 37 espèces incluses dans le genre *Eupenicillium*, 12 répondent à des taxa décrits dans Raper et Thom (1949), les 25 autres étant plus récentes. Du genre *Talaromyces*, l'auteur reprend 16 espèces à forme conidienne *Penicillium*, (les espèces à anamorphe *Merimbla* et *Geosmithia* n'étant pas reprises), dont 9 espèces de Raper et Thom et 7 postérieures à 1949. C'est dire les progrès de ces dernières décades.

Le genre anamorphique conidien *Penicillium* Link ex S.F. Gray est divisé en 4 sous-genres, puis en sections et en séries. Le sous-genre *Aspergilloides* (25 espèces) ne comprend que les monoverticillés stricts à l'exclusion des *Ramigena* de Raper et Thom, soit 18 espèces de ces auteurs et 7 postérieures. Le sous-genre *Furcatum* Pitt regroupe les biverticillés, c'est-à-dire les *Ramigena* et les *Divaricata* de Raper et Thom ainsi que *Penicillium citrinum* qui dans les *Velutina* n'occupait qu'une place de transition. Des 27 espèces incluses, 5 seulement sont postérieures à 1949.Le sous-genre suivant, *Penicillium* sbg.*Penicillium*, regroupe les espèces triverticillées (ou bivertillées asymétiques) et comprend 22 espèces, dont 18 appartenaient aux *Velutina, Lanata, Funiculosa et Fasciculata* de Raper et Thom (des *Lanata et Funiculosa*, beaucoup d'espèces étant rendues synonymes aux autres). Ce sous-genre inclut *Penicillium expansum* lectotype proposé du genre. Le sous-genre *Biverticillium* Dierckx (23 espèces) regroupe 13 espèces des *Biverticillata symetrica* de Raper et Thom, 2 espèces réhabilitées de Dierckx et 8 espèces récentes.

On notera que les formes *Penicillium* des espèces d'*Eupenicillium* et *Talaromyces* ne sont pas reprises dans la classification générale des *Penicillium*, ni même mentionnées (à l'exception de trois, p.166-169) dans les clés dichotomiques des espèces.C'est regrettable d'autant plus que l'auteur voit dans la séparation des nomenclatures anamorphique et téléomorphique la possibilité d'aborder l'espèce par une seule de ses formes et ainsi arriver à son identification précise. Il est d'autre part curieux de constater que le traitement de *Eupenicillium* et celui de *Talaromyces* (dont l'un précède celui de *Penicillium* et l'autre le suit, on ne sait pourquoi) sont accompagnées de clés synoptiques chiffrées selon le modèle de Leenhouts, alors que le genre *Penicillium* est introduit par des clés dichotomiques. Pourquoi cette différence? Des clés synoptiques pour les *Penicillium* auraient beaucoup aidé à l'identification rapide.

Sur le plan de la nomenclature, Pitt s'efforce de suivre le Code Internationale de Nomenclature Botanique, ainsi fait-il, contrairement à Raper et Thom, une claire distinction entre la nomenclature des téléomorphes et des anamorphes. Cependant il s'en écarte, sans doute à bon droit, si ce n'était prématurément. En effet il suit la nomenclature qui devrait résulter de la conservation du genre *Penicillium* Link ex Gray (lectotype *P. expansum* Link ex Gray) contre *Penicillium* Fr. non Link (holotype *Mucor crustaceus* L.) selon la proposition 420 de Hawksworth, Pitt and Sutton in Taxon, 25:665-670, 1976. De plus il met déjà en application les propositions d'amendement de l'art. 59 par le Secrétariat de Nomenclature de l'Association Mycologique Internationale (Taxon 28: 424, 1979). Ainsi il recombine dans les genres téléomorphiques appropriés les 17 espèces décrites avec téléomorphe et classées par Raper et Thom dans le genre *Penicillium*. Cette prise de position hardie peut sans doute démontrer le bien-fondé et le bon fonctionnement de ces propositions.

Il n'en reste pas moins que la revision de Pitt exigera du taxonomiste habitué à la monographie de Raper et Thom un effort de réadaptation En plus des changements nomenclaturaux des espèces retenues, l'identificateur devra se convaincre de la synonymie des espèces rejetées. Un index donnant la redisposition des espèces de Raper et Thom pourra un peu l'aider, mais cet index est sans pagination. De plus, l'auteur a modifié les mileux de culture standards utilisés par Raper et Thom, y ajoute un troisième milieu et recommande leur usage à trois températures différentes. Cette exigence ne facilitera pas le passage d'une monographie à l'autre bien qu'elle soit acceptable.

L'auteur semble en effet mettre l'attention sur les caractères culturaux, en particulier la vitesse de croissance à différentes températures.On eut sans doute souhaité un approfondissement de l'étude morphologique et de la variabilité des espèces. Les descriptions morphologiques sont succintes. Les photographies, en microscopie interférentielle, excellentes pour la plupart, suppléeront, espérons-le, à la pauvreté des dessins.

Le livre est fort bien édité, comme il se doit. Cependant quelques imprécisions ou erreurs sont passées inapercues. Le Professeur Biourge est considéré le "student" de son élève Fr. Dierckx. Ceci est d'autant plus contraire à l'histoire que la plupart des souches étudiées par Dierckx lui avait été données pour étude par Biourge lui-même. Dierckx a élaboré son *Essai de revison du genre Penicillium* à la fois sous la direction et l'inspiration de Biourge qui s'y était attelé déjà depuis 1898. Je ne mentionnerai encore qu'une autre erreur, dans la diagnose du sous-genre *Furcatum* p. 233 où les "metularum" doivent être des "phialidum" pour que ce sous-genre regroupe des biverticillés.

Dans l'identification de champignons aussi répandus et aussi importants que les *Penicillium*, on est heureux d'accueillir l'ouvrage de Pitt, fruit de 10 années de travail difficile, louable effort vers une taxonomie et une nomenclature plus sûre de ces champignons.

ENTOLOMA (AGARICALES) IN INDOMALAYA AND AUSTRALASIA, par E. HORAK, Beihefte zur Nova Hedwigia vol. 65, 352 p., 234 fig., 19 pl. (8 pl. col.), in 8°, relié cartonné, 1980, J. Cramer ed., POB 48, D 3306 Lehre, Deutschland. Prix: DM 150.- (souscr. DM 120.-).

L'auteur nous est bien connu déjà pour l'importance de ses contributions à la flore mondiale des Agaricales (Mycotaxon 3(3):396). Il commença cette étude en Nouvelle-Zélande par la récolte de 1967 à 1969 de 50 espèces nouvelles d'*Entoloma*. Il explora ensuite Sri Lanka (Ceylan), Singapore et l'Indonésie mais dût compléter ses trop pauvres récoltes des collections de ces régions que lui offrit généreusement le Pr. E. Corner. Il explora encore la Malaisie, les îles Papua et Solomon, de 1971 à 1973. 234 Espèces d'*Entoloma*, pour la plupart nouvelles, sont décrites de ces régions, et l'auteur estime n'en décrire encore qu'une partie de la flore. Toutes ces récoltes ont été étudiées sur le frais, décrites et dessinées avec méthode (carpophore, cuticule, baside, spore, cystide). L'auteur suit les règles de la nomenclature, rejetant le nom *Rhodophyllus* Quel. Par ailleurs, il estime les sous-genres établis par Romagnesi et Gilles (1979) comme trop fragiles pour tenter d'y grouper ses espèces, à l'exception de *Claudopus*, *Richoniella* et *Pouzaromyces* qu'il trouve pratiques. Il lui importe plutôt de bien décrire les taxas. On regrettera qu'un erratum corrigeant d'autres erreurs que des coquilles ait dû être ajouté à un texte bien typographié et de lecture agréable.

A BIBLIOGRAPHY OF NORTH AMERICAN GASTEROMYCETES: I. PHALLALES. par William R. BURK, Bibliotheca Mycologica vol. 73, 216 p., in 8°, relié toilé, 1980, J. Cramer ed., POB 48, D 3306 Lehre, Deutschl. Prix DM 50.- (souscr. DM 40.-).

L'auteur inclut dans sa liste toutes les références, autant populaires que scientifiques, relatives aux Phallales (Clathracées et Phallacées) d'Amérique du Nord. Chaque référence s'accompagne de la liste des taxa traités et de leurs illustrations, ainsi que de leur distribution géographique.

CONTRIBUCIÓN AL ESTUDIO DE LOS *APHYLLOPHORALES* ESPAÑOLES, par M.T. TELLERIA, Bibliotheca Mycologica vol. 74, 464 p., 82 fig. (36 phot.) in 8°, relié toilé, 1980, J. Cramer ed. POB 48, D 3306 Lehre. Deutschland. Prix DM 100.- (souscr. DM 80.-).

Dans un système taxonomique moderne des *Aphyllophorales*, l'auteur présente un relevé actuel de la flore d'Espagne basé sur des récoltes récentes et anciennes. Le relevé couvre l'ensemble de la péninsule à l'exception de la Catalogne, de l'Andalousie orientale, de la Galicie et des Asturies dont le relevé est seulement bibliographique. L'ensemble couvre 15 familles, 114 genres, 260 espèces dèsquelles 81 sont nouvelles pour l'Espagne. Le système taxonomique est étayé de bonnes descriptions et remarques sur la distribution géographique, illustré de cartes et appuyé de clés dichotomiques des familles, genres et espèces. L'intérêt de l'ouvrage, évident pour la flore espagnole, dépasse de beaucoup ce cadre par la valeur de la taxonomie proposée comme une synthèse de la taxonomie des *Aphyllophorales* de Donk (1933-1958) et des apports plus récents tels les *Corticiaceae* de Erisson et Ryvarden (1973-1978) et les *Polyporaceae* de Ryvarden (1972-1978). Le livre est en espagnol, les clés dichotomiques sont aussi en anglais.

UNTERSUCHUNGEN ZUR GENETIK DES FORTPFLANZUNGSVERHALTENS UND DER FRUCHTKÖRPER- UND ANTIBIOTIKABILDUNG DES BASIDIOMYCETEN *AGROCYBE AEGERITA*, par F. MEINHARDT, Bibliotheca Mycologica vol. 75, 128 p. 5 fig., 14x22 cm, dos papier, 1980, J. Cramer ed. Prix DM 40(32).

La propagation végétative de *Agrocybe aegerita* est déterminée par une incompatibilité homogène dans le cadre d'une sexualité tétrapolaire, réglée par 2 gènes indépendants A et B dont l'ordre peut varier de race à race. Etudiant 2 races différentes l'auteur définit les types compatibles de croisement. La fructification du champignon, d'autre part, est réglée par 3 gènes, un gène Su permettant la fertilité des dicaryote, un gène Fi déclanchant l'initiation du carpophore et un gène Fb réglant sa différenciation. Appliquant ces résultats, la caractérisation précise des souches permettra d'obtenir à coup sûr des fructifications. Cette thèse a été réalisée sous la direction du Pr. Karl Esser.

STUDIES ON THE TOLERANCE TO ELEVATED TEMPERATURE IN *PLEUROTUS OSTREATUS* (Jacq. ex Fr.)Kummer. A CONTRIBUTION TO TAXONOMY AND THE GENETICS OF THE FRUITING PROCESS. par SUI LONG LI, Bibliotheca Mycologica vol. 76, 86 p. 11 fig., 17x22cm, dos papier, 1980, J. Cramer ed., DM

Cette thèse réalisée à l'Université de Marburg sous la direction du Pr. G. Eger-Hummel, apparaît importante pour la génétique de *Pleurotus ostreatus* et la sélection de souches adaptées aux méthodes de culture industrielle. L'auteur, étudiant les monocaryons et dicaryons de souches à optimum thermique élevé (Floride) et bas (Europe) et de leurs hybrides démontre l'existence de 7 gènes commandant la croissance mycélienne selon la température et un gène unique Ft réglant, en fonction de la température, le développement du carpophore, de sa couleur et de sa texture. De cette manière l'auteur démontre l'identité spécifique entre souches de haute et basse température et la synonymie d'espèces telles que *P. pulmonarius* Fr., *P. sapidus* Kalchbr. à *P. ostreatus*, les conditions climatiques faisant prévaloir de maintien de génotype à optimum haut ou bas suivant les régions.

AUTHOR INDEX, VOLUME TWELVE

INDEX TO FUNGOUS AND LICHEN TAXA, VOLUME TWELVE

This index includes genera, infrageneric taxa, species, and infraspecific taxa. New taxa are in **boldface** as are the pages where they are published. New suprageneric taxa are in bold **CAPITALS.**

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ERRATA, VOLUME ELEVEN

Page 290, lines 34-37, final words: *for* N~ 1. isoneotyp Exsi
read Neo- 1230 isoneotypes Exsic-
411, line 1: *for* DEVELOPEMENT *read* DEVELOPMENT
414 7: *for* (Fig. 3) *read* (Fig. 9)
10: *for* (Fig. 2), *read* (Fig. 8),
443 26: for *C.* read *Chaetosphaeria*

ERRATA, VOLUME TWELVE

Page 1,	line 10:	*for* sphaeriales *read* sphaerales
8	11:	*for* Lating *read* Latin
12	5:	for *Pseudobalsmia* read *Pseudobalsamia*
	27:	for *Galactomyces*. read *Dipodascus*.
14	13:	for *aveolata* read *alveolata*
16	18, 20:	for *Ascodesmus* read *Ascodesmis*
17	5:	*for* conbination *read* combination
	13:	for *Malbranchia* read *Malbranchea*
	34:	*for* Arachnioideae *read* Arachniotoideae
18	2:	*for* Arthrodermoideae *read* Arthrodermatoideae
	14:	*for* ARACHNIOIDEAE *read* ARACHNIOTOIDEAE
19	11:	for *Arachiotus* read *Arachniotus*
	31:	*for* ARTHRODERMOIDEAE *read* ARTHRODERMATOIDEAE
22	21:	delete *eberhardtii*
25	26:	*after* =Eurotiaceae *add* Clements & Shear, Genera of Fungi, p. 50, 1931.
26	13:	for *Emericalla* read *Emericella*
	25:	*for* ear. *read* eae.
	27:	for *Aspergillua* anamorphs, *Sago*- read *Aspergillus* anamorphs, *Sage*-
	28:	for *nema* read *noma*
31	42:	FOR *sulfurea*. For those remaining genera READ *sulfurea*, that include
36	19:	*for* ASCOSPHAERIALES *read* ASCOSPHAERALES
39	24:	*for* here. *read* there.
45	4:	for *Lophotricus* read *Lophotrichus*
45	17:	for *cum poris* read *sine poris*
	26:	*for* with germination *read* without germination
48	30:	*for* homonym *read* synonym
52	34:	for *Ceratocysis* read *Ceratocystis*
54	14:	*for* Muller *read* Müller
57	45:	*for* concieved *read* conceived
59	17:	for *Ascodesmus* read *Ascodesmis*
61	2:	for *Fleishhakia* read *Fleischhakia*
62	5:	for *ponese* read *ponense*
66	29:	for *Plectolitus* read *Plectolithus*
71	19:	for *Xenophilia* read *Xenophila*
	41:	for *Lepidosphaera* read *Lepidosphaeria*
86, col.	2:	*for* ASCOSPHAERIALES *read* ASCOSPHAERALES
		for Ascosphaeriaceae *read* Ascosphaeraceae
87	1:	for *Triptosporella* read *Tripterosporella*
	2:	for *Richingerella* read *Rechingerella*
	3:	for *Fleishhakia* read *Fleischhakia*
		for *Puressiella* read *Preussiella*
		for *Ceratocarpis* read *Ceratocarpia*
91	1:	FOR *Sagenoma* 26, 68, READ *Sagenoma* 26, *30*, 68
98, line	13:	for *Termitaria* read *Termitariopsis*
115	36:	for <u>H. solida</u> read <u>Heterocephalacria solida</u>
139	13:	for *B.* read *Boerlagiomyces*
147	36:	for *A.* read *Acanthostigmina*
163	19:	for *Acanthostigma minuta* read *Acanthostigma minutum*
	21:	for *Acanthostigmina minutum* read *Acanthostigmina minuta*
255	11:	for *brasiliensis* read *brasiliense*
	27:	*for* (Dumont, 1980) *read* (Dumont, 1981)
256	30:	for *brasiliensis* read *brasiliense*
261	48:	for *brasiliensis* read *brasiliense*
272	24:	for *siliensis* read *siliense*
277	20:	*insert* ____. 1981. (In press, Mycotaxon 12: 313-371.)

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