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SIEMASZKOA AND BOTRYANDROMYCES, TWO SEGREGATES OF MISGOMYCES (LABOULBENIALES)

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SUMMARY

Laboulbenia heteroceratis and *Misgomyces heteroceri* are transferred to *Botryandromyces* gen. nov., characterized by clustered simple antheridia just above the spore septum and a perithecium with three cells in two adjacent rows of outer wall cells and four cells in the other two rows [*Botryandromyces heteroceratis* (Thaxt.) comb. nov. (holotype), *B. heteroceri* (Maire) comb. nov.]. *Misgomyces ptenidii*, *M. annae*, and *M. flexus* constitute the genus *Siemaszkoa* gen. nov., characterized by a many-celled, unbranched, uniseriate receptacle, a typically unbranched appendage, and a perithecium with three 3-celled rows of wall cells and one 4-celled row, in which the fourth cell protrudes apically beyond the terminal cells of the other rows [*Siemaszkoa flexa* (Majewski) comb. nov. (holotype), *S. ptenidii* (Scheloske) comb. nov., *S. annae* (Majewski) comb. nov.].

Although the perithecia of members of all genera of Laboulbeniales have four vertical rows of outer wall cells, there are different numbers of cells in these rows. The number of cells is a generic characteristic and is constant at maturity when the number is small. Among those genera with species having a large number of cells in each row of perithecial wall cells, there are a few, such as *Eusynaptomyces*, where alternating rows differ in number of cells because of a difference in cell lengths (see Scheloske, 1969). In some of the genera where each vertical row of wall cells consists of a small number of cells, there may be one more cell in one row than there is in another row. One such genus is *Misgomyces*, in which the type species *M. dyschirii* Thaxt. (on Carabidae and Staphylinidae) has four cells in each row of outer wall cells. This characteristic is shared only by *M. clivinae* Thaxt. (on Carabidae; Tavares, unpublished). In *M. heteroceri* Maire (on Heteroceridae) there are three cells in two adjacent rows and four cells in the other two rows. A similar cellular arrangement is found in *M. perpendicularis* Thaxt. and several other species ascribed to *Misgomyces* that occur on Carabidae (Tavares, unpublished). On the other hand, in *M. flexus* Majewski, *M. ptenidii* Scheloske, and *M. annae* Majewski (all on Ptiliidae) there are only three cells in three of the rows and four cells in the remaining row.

The most distinctive characteristic of *Misgomyces heteroceri* is the cluster of sessile or short-stalked phialides just above the original spore septum. This arrangement of antheridia also occurs in *Laboulbenia heteroceratis* Thaxter (1912), which was placed in *Laboulbenia* because of its 5-celled receptacle surmounted by a colorless cell resembling the insertion cell of *Laboulbenia* spp. However, our observations have shown that the perithecium of *L. heteroceratis*, like *M. heteroceri*, has two 3-celled outer wall cell rows and two 4-celled rows instead of all 4-celled rows as in *Laboulbenia* spp. In addition, the upper receptacle and appendages of *L. heteroceratis* are similar to those of *M. heteroceri*. Consequently, the two species must be considered congeneric.

Picard (1913) believed that *M. dyschirii* forms a compound antheridium; this opinion has been confirmed (Tavares, unpublished). Although the antheridium of *M. dyschirii* is rather simple in structure, such an antheridium makes it necessary to remove all other species from this genus as represented by *M. dyschirii* and establish other genera.

Two new genera are being proposed here to include not only the two species referred to above on Heteroceridae, but also three taxa occurring on Ptiliidae that have been placed in *Misgomyces*.

Botryandromyces gen. nov.

Paries perithecii exterior ex seriebus duabus cellularum ternarum altitudine inaequarum contiguis verticalibus et ex seriebus duabus cellularum quaternarum constans; receptaculum inferius ex cellulis duabus vel pluribus infra cellulam perithecii pedicellarem superpositis constans; receptaculum superius ex cellula una infima cellulas duas parallelas subtendente constans; antheridia sunt phialides supra cellulas receptaculi aggregatae, interdum etiam in ramis appendicularibus terminales vel laterales; perithecium cellula pedicellari secondaria cellulisque basalibus bene evolutis praeditum.

Perithecium with two adjacent vertical rows of wall cells consisting of three cells of unequal length and the other two rows consisting of four cells of unequal length; secondary stalk cell (*VII*) and basal cells (*m*, *n*, *n'*) of perithecium with well-defined walls; lower receptacle uniseriate, of two or more superposed cells; upper receptacle, above stalk cell (*VI*) of perithecium, normally 3-celled with the lowermost cell subtending two parallel cells; antheridia simple phialides (rarely with two cells discharging into a single neck) (Fig. 1b), arising from small cells just above the spore septum; antheridia also may be terminal or lateral on branches of appendage (Fig. 1c); lower tier of wall cells forming venter of perithecium shorter than cells of the second tier; fourth cell of 4-celled rows projecting slightly beyond terminal cells of 3-celled rows; spores normal, with two unequal cells; ascogenic cells 1--2; on Heteroceridae.

Etymology: *botrys*--cluster (of grapes); *andros*--male; *myces*--fungus.

Holotype: *Botryandromyces heteroceratis* (Thaxter) comb. nov. Basionym: *Laboulbenia heteroceratis* Thaxter, 1912, Proc. Amer. Acad. Arts Sci. 48: 207. On leg of *Heterocerus* sp., La Plata, Argentina. Also reported from Lawrence, Kansas, U.S.A. [unpublished hosts for specimens in Thaxter's collection are *Neoheterocerus pallidus* (Say) and *Lanternarius brunneus* (Melsh.), tribe Heterocerini according to the revision of Heteroceridae by Pacheco, 1964]. Other specimens from Argentina were found on *Erus ciliaticollis* (Steinh.) (Heterocerini) and *Heterocerus validus* Grouv. (Spegazzini, 1917) (latter species not included in Pacheco's revision, but placed in subgenus *Heterocerus* by Zaitzev, 1910). On various parts of body. Unpublished collection: *Heterocerus* sp., Salt Fork River, 2.5 miles northwest of Homer, Champaign County, Illinois, U.S.A., J. D. Unzicker, July 17, 1972; on elytra, upper part of head, legs, and tarsi.

One other species: *Botryandromyces heteroceri* (Maire) comb. nov. Basionym: *Misgomyces heteroceri* Maire, 1920, Bull. Soc. Hist. Nat. Afr. Nord 11: 159. On legs and elytra of *Heterocerus maritimus* Guér. (tribe Augyliini), mouth of Seybouse River, Cape Bône, Algeria (usually referred to subgenus *Litorimus*--see Balazuc, 1973, p. 253; however, *Litorimus* is not included among the tribes to which Pacheco elevated existing subgenera). Other collections: France--on *H. (Taenheterocerus) fusculus* Kiesenw., Trappes, Seine-et-Oise (Balazuc, 1973); West Germany--on *H. (T.) fusculus* and *H. (T.) fenestratus* (Thunb.), near Rettern/Forchheim and Kosbach/Erlangen (Scheloske, 1969); Poland--on *H. fusculus*, Smrock, Maków Mazowiecki County (Majewski, 1972). Unpublished collections from Poland: *H. fusculus*, *H. fenestratus*, marshy bank of Wkra River, Pomiechówek, Nowy Dwór Mazowiecki County, June--July, 1973; *H. (T.) intermedius* Kiesenw., marshy bank of small stream flowing into Bug River, Olendry, Siemiatycze County, June, 1970; *H. fenestratus*, sandy bank of Narew River, Sielc Stary, Maków Mazowiecki County, August, 1971; *H. fusculus*, marshy bank of small body of water near Wisła River, Buraków, Nowy Dwór Mazowiecki County, June, 1971 (collected by T. Majewski, determined by T. Plewka). Subgenus *Taenheterocerus* was included by Pacheco (1964) in tribe Augyliini.

Thalli of *Botryandromyces heteroceri* probably occur on all parts of the exoskeleton (Scheloske, 1969). Scheloske found two infected specimens among nine individuals of *H. fenestratus* and seven infected beetles among 28 of *H. fusculus*, but no thalli were seen on 17 individuals of *H. (Heterocerus) marginatus* (Fabr.) that he examined.

The North African specimens of *Botryandromyces heteroceri* were found on gregarious burrowing beetles in maritime mud. The hosts of the European collections often live together in moist, muddy or sandy, sun-heated places on the banks of rivers, ponds, and lakes. They excavate shallow, small burrows in which they usually live. The soil is commonly rich in organic material and has an abundant insect fauna; *Dyschirius* and *Bledius* are the most characteristic beetles of these habitats. Members of both genera bear *Misgomyces dyschirii*.

Infection of hosts is probably either by direct contact of insects or by contact with moist soil containing spores (see also Scheloske, 1969, p. 69). According to Dr. T. Plewka (personal communication), *Heterocerus* beetles are hatched in July and August in Poland; thus, it is probable that the beetles collected early in summer overwintered and were hatched the preceding year.

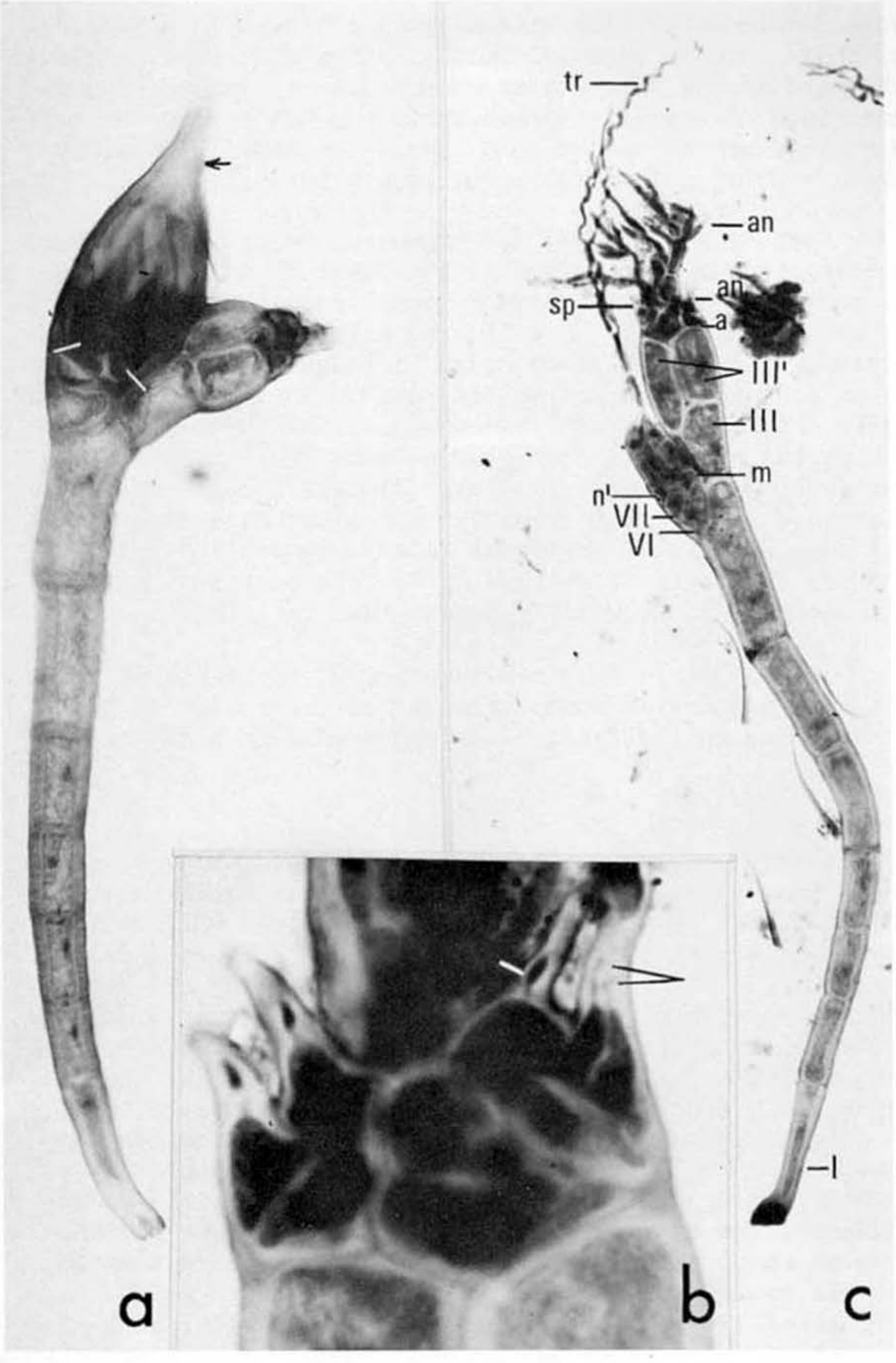
Scheloske believed that the Algerian specimens of *B. heteroceri* are taxonomically indistinguishable from those of West Germany (1969), although there is a deviation in size. The German specimens, which are from the prothorax and head, are mostly much larger (298-585μ in length, rather than 163-320μ); the lower receptacle has 4--9 cells, rather than 2--5, as in the Algerian thalli; the color appears to be paler; and there is scarcely any roughness of the outer surface of the receptacle. It is possible that the larger size of the European specimens, which was confirmed by Majewski (1972), results from growth in a more favorable location on the host. However, Maire's figures (1920) suggest that some of his measurements may be erroneous.

In the Polish collections of *B. heteroceri*, one specimen (from the prosternum) had an extremely long lower receptacle--518μ, with 13 cells; the smallest number of lower receptacle cells found was five. Although the longer receptacles tended to have a greater number of cells, there was some variation in cell length, which resulted in considerable difference in height among thalli with the same number of cells. For example, in two thalli from legs having seven lower cells, these cells were 40-68μ in length (total lower receptacle 354μ long) in one individual, while the other had cells 28-48μ in length (with the lower receptacle only 255μ long). As the thallus grows, the cells of the receptacle subdivide and horizontal septa are formed, at least in the earlier stages of development.

In *Botryandromyces*, the spore septum (*a*) is just above the two parallel *III*' cells of the upper receptacle (Figs. 1c, 2c). The perithecial initial (cell *d*) is cut off laterally by the *II* cell (in *B. heteroceri*, by the uppermost *II* cell). At this time, the inner cell *III*' is formed. At first, it is equal in length to cell *III* and separated from it by a vertical septum in *B. heteroceri* (Fig. 3d), whereas in *B. heteroceratis*, it is a short cell formed from the upper inner corner of cell *III* (Fig. 3c). Cell *III* subsequently divides and a horizontal septum separates the two daughter cells, the upper one becoming the outer *III*' cell (Fig. 3e). In *B. heteroceri*, cell *III* expands (Fig. 3f) until the vertical septum turns inward and becomes diagonal in its lower length; the upper receptacle eventually resembles that of *B. heteroceratis* in the arrangement of cells (Figs. 1c, 2c). Sometimes the internal *III*' cell divides in *B. heteroceri*, resulting in a 4-celled upper receptacle, according to Maire (1920).

In the young sporeling of *B. heteroceratis*, the upper septum of the basal appendage cell is thick and black (Fig. 3a). This cell divides, a horizontal septum is formed (Fig. 3b), and the lower daughter cell subsequently produces the cells of the antheridial zone (Fig. 2c). In both species, additional appendages arise from the antheridial zone and extend upward beside the initial primary appendage. In *B. heteroceri* these appendages bear antheridia differing in size and shape from the clustered antheridia below (Fig. 1c). In *B. heteroceratis*, antheridia borne laterally on

Fig. 1. *Botryandromyces heteroceri*. a. Mature thallus (from Smrock), showing trichogyne stump (arrow) and two groups of asci (white lines); rough outer wall of receptacle is visible. x 420. b. Antheridial cluster of thallus at 2-tier stage (trichogyne at right; Smrock specimen), showing two normal phialides at left and one at right (white line); antheridium at far right consists of two cells extending upward into one neck (v-line points to apices of spermatial upgrowths); acetocarmine stain. x 2500. c. Thallus at 2-tier stage (from Buraków), showing spiraled trichogyne (*tr*), spermatium (*sp*) in sessile antheridium at left, two superposed sessile antheridia (*an*) at right, spermatium-producing phialides (*an*) on appendages, and diagonal inner wall of cell *III*; acetocarmine stain. x 405.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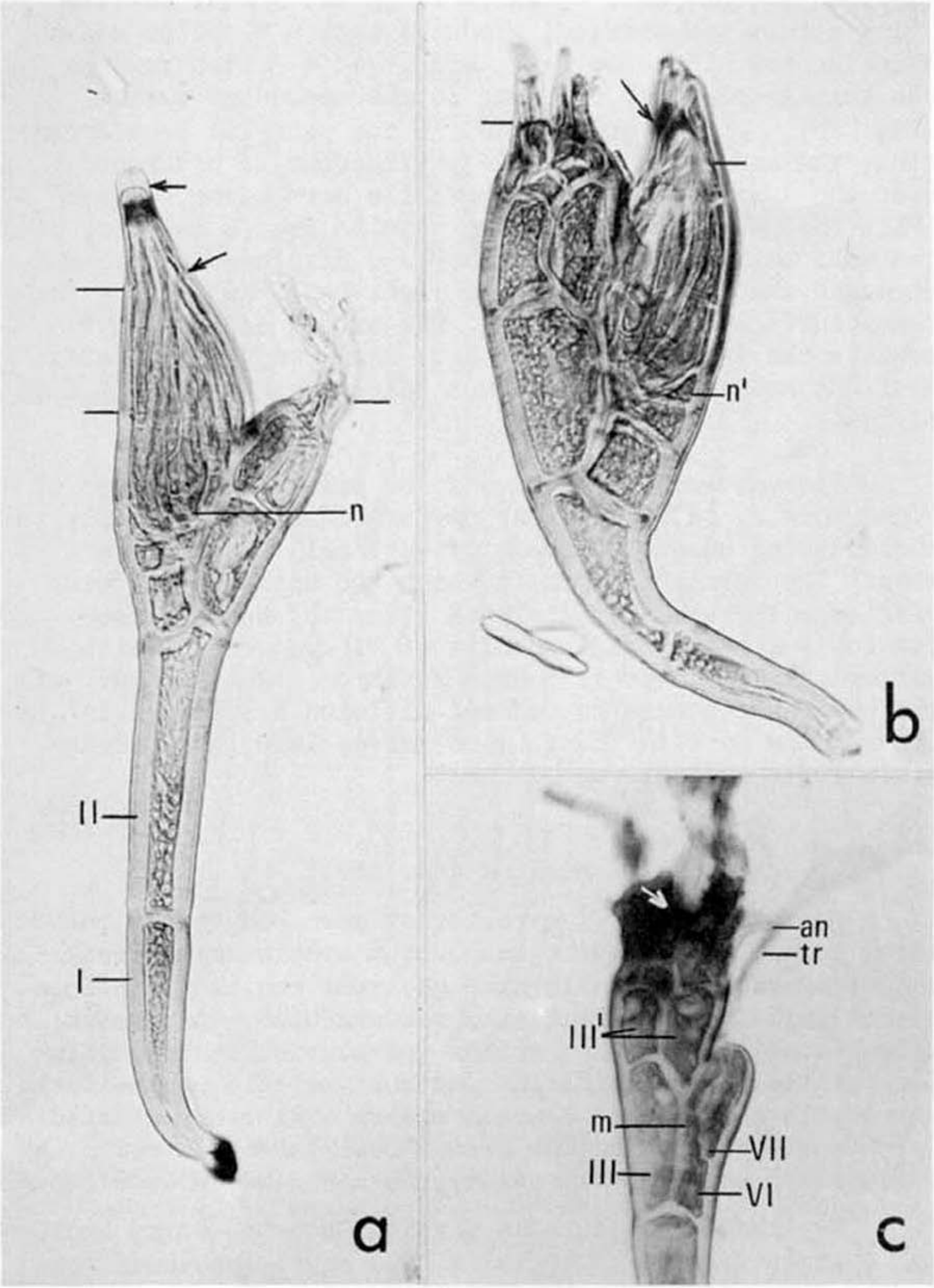
well developed primary appendages are closer in appearance to those grouped together in the antheridial zone, although they are narrow at the base. Subsequently formed appendages in *B. heteroceratis* apparently do not produce antheridia; they may become numerous in mature thalli, possibly proliferating from old, nonfunctional antheridia.

In addition to the more numerous cells in the lower receptacle (Maire reported in 1920 that they may sometimes be reduced to two), *Botryandromyces heteroceri* differs from *B. heteroceratis* in the following ways: (1) the upper receptacle cells are almost equal in length (Fig. 1a), whereas in *B. heteroceratis* the *III* cell is longer than the *III*' cells (Fig. 2c); (2) the thallus is devoid of a black septum on the primary appendage and lacks black color on the perithecium (see Figs. 2a, 2c); (3) cell *VI* is somewhat flattened, rather than roughly cubical or elongate; and (4) the *II* cells of the lower receptacle are typically shorter than cell *I*, whereas in *B. heteroceratis* the undivided cell *II* is usually longer than cell *I*.

As in *Botryandromyces heteroceri*, the 4-celled rows, with the trichogyne stump, are on the inner side of the perithecium in thalli of *B. heteroceratis* from Kansas and

Fig. 2. *Botryandromyces heteroceratis*. a. Holotype, from Argentina, showing twisting of outer perithecial wall cell rows (lower arrow to point where upper right wall cell row curves underneath), difference in length of rows (upper arrow to tip of 3-celled rows), and blackening of entire width of perithecium below apex; black septum of appendage barely visible (line at right); faint blackening present at junction of perithecium with upper receptacle; two wall septa visible at left (indicated by lines). x 370. b. Slightly younger spore-producing thallus from Kansas (on *Neoheterocerus pallidus*; slide 9945), with broader cell *VI* and upper receptacle; black septum visible on appendage (line at left); blackening below apex of perithecium on inner side only (arrow); undivided third tier in shorter row visible at right (line at right). x 520. c. Thallus (from Kansas, same host; slide 9944), at 1--2 tier stage, with black septum on appendage (white arrow); antheridial neck visible at right adjacent to trichogyne (out of focus). x 545.


n
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Illinois. Thus, cell *n*, which is in the normal position lying across one surface, produces both a 3-celled and a 4-celled row. The two long, blackened 4-celled rows in the Kansas specimens lie next to the appendage system (Fig. 2b). On the other hand, in the material from Argentina, the entire width of the perithecium is blackened near the apex and the short rows lie across one surface (Fig. 2a). This configuration results from a twisting of the wall cell rows, so that they are displaced one-fourth turn and the apex of the upper right-hand row lies on the lower surface of the thallus. The origin of the short rows is the same with relation to the *n*, *m*, and *n'* cells. A slight amount of twisting was detected in a thallus from Illinois.

Botryandromyces appears to be related to species of *Misgomyces s. lat.* occurring on Carabidae, particularly to those having unequal numbers of wall cells in different rows. The rare phialides in which two antheridial cells discharge through a single neck (Fig. 1b) bear a resemblance to the antheridial cells of *M. dyschirii*, which differ chiefly in their innate position. The tendency of the lower receptacle to undergo division has a parallel in *Laboulbenia partita* Thaxt. (see Maire, 1920, and Spegazzini, 1917, p. 555).

Siemaszkoa gen. nov.

Paries perithecii exterior ex seriebus tribus cellularum ternarum altitudine inaequarum contiguis verticalibus et ex serie una cellularum quattuor constans, cellula quarta apicaliter protrudente; receptaculum non ramosum, uniseriatum, ex cellulis tribus vel pluribus infra cellulam perithecii pedicellarem constans; cellula pedicellaris secondaria et cellulae basales misere evolutae; antheridia (si adsunt) sunt phialides breves basi latae, in parte inferiore appendicis primariae typice non ramosae sessiles.

Perithecium with three vertical rows of outer wall cells consisting of three cells of unequal length and one row of four cells of unequal length, the fourth cell of the latter row protruding apically (Fig. 4c), together with a short upgrowth of cell wall material rising above one of the opposite wall cell rows; receptacle uniseriate, unbranched, with three or more cells subtending the stalk cell of the perithecium; the secondary stalk cell and basal cells not evident at maturity because their cell walls do

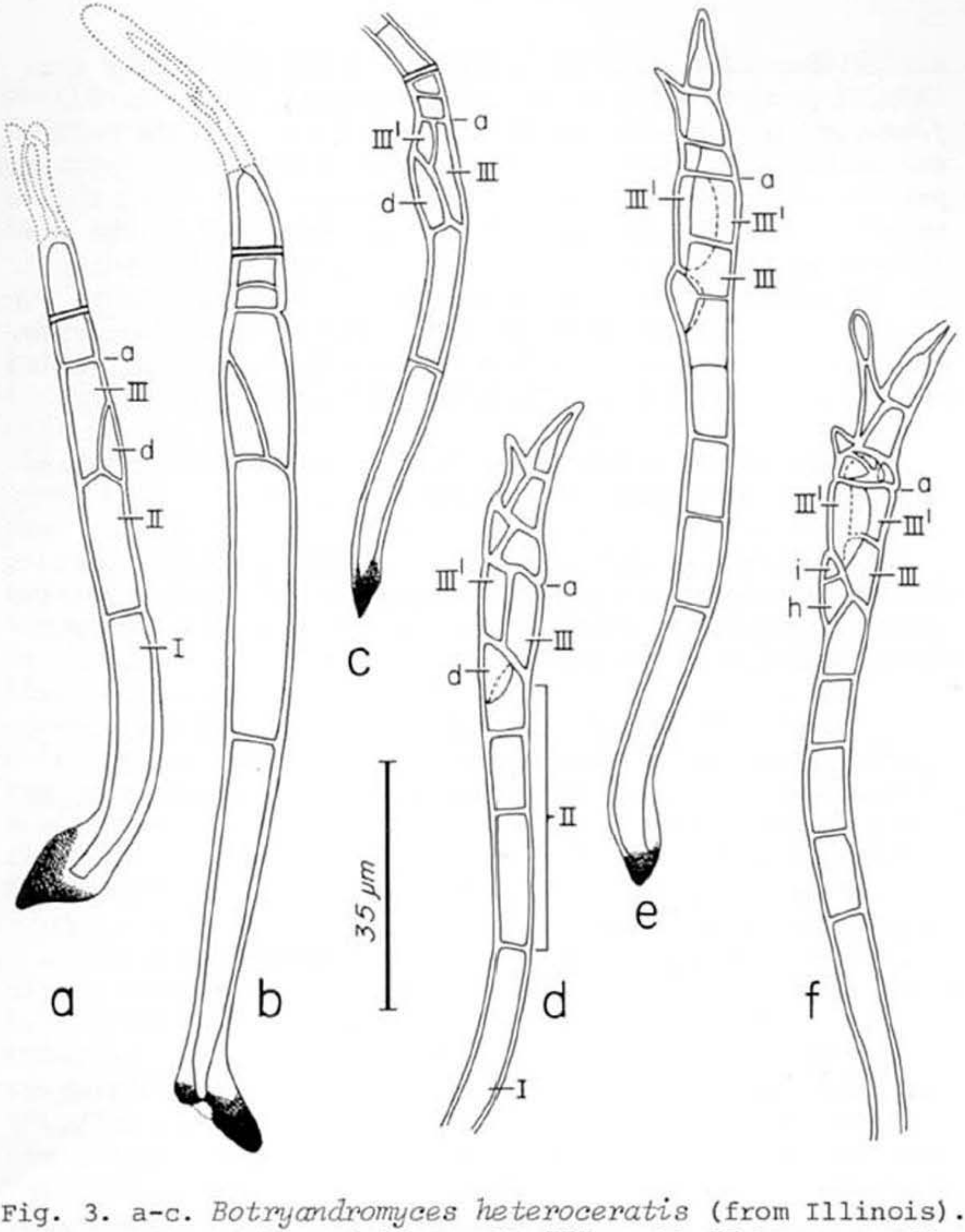

Fig. 3. a-c. *Botryandromyces heteroceratis* (from Illinois). a. Sporeling with undivided cell *III*; cell *II* has cut off perithecial initial cell (*d*) (2930a). b. Older thallus in which lower cell of appendage (above spore septum *a*) has divided (2930a). c. Thallus in which cell *III* has divided, forming cell *III*' (2904). d-f. *Botryandromyces heteroceri* (from Pomiechówek, 1329). d. Sporeling with cells *III* and *III*' of equal length; cell *II* has undergone division. e. Older thallus in which *III* has divided to form short *III*' cell above. f. Thallus in which cell *d* has divided to form cells *h* (perithecial primordium) and *i* (primordial cell of procarp); upper septum of cell *III* curves upward.

not thicken, although cells *VII* and *m* may be clearly visible in younger thalli; antheridia observed only in *S. flexa*, where they are short, sessile, with a broad base, and arise in a series from successive cells of the proximal part of the unbranched primary appendage (Fig. 4e); the appendage may branch somewhat in age, possibly by the proliferation of branchlets from nonfunctional antheridia. The antheridia of the other species may be evanescent; even in *S. flexa* they are difficult to observe in surface view. The spores are normal, with a shorter lower cell as viewed within the perithecium; the ascogenic cell is solitary.

Etymology: named after Janina and Wincenty Siemaszko, Polish investigators of Laboulbeniales.

Holotype: *Siemaszkoa flexa* (Majewski) comb. nov. Basionym: *Misgomyces flexus* Majewski, Acta Mycol. 9: 119. 1973. On *Ptenidium fuscicorne* Er., Kiełpin, Nowy Dwór Mazowiecki County, Poland.

Number of species: three, possibly four, because *Ecteinomyces pusillimus* Speg. may belong here (reported from unknown trichopterid [Ptiliidae] in ant nests, Argentina, by Spegazzini in 1917).

Siemaszkoa annae (Majewski) comb. nov. Basionym: *Misgomyces annae* Majewski, Acta Mycol. 9: 118. 1973. On *Ptilium myrmecophilum* (Allib.), Sadówka, Nowy Dwór Mazowiecki County, Poland.

Siemaszkoa ptenidii (Scheloske) comb. nov. Basionym: *Misgomyces ptenidii* Scheloske, Parasit. Schriftenr. Heft 19: 135. 1969. On *Ptenidium* sp. (*P. fuscicorne*?), near Schwand/Nürnberg and Dechsendorf/Erlangen, West Germany. Also reported (Majewski, 1973b) on *Ptenidium fuscicorne* Er., Kurzeszyn Nowy, Rawa Mazowiecka County, Poland. Another collection from this host species (Warszawa-Morysinek, 1 May 1972, B. Burakowski) differs in having a shorter, broader perithecium (120µ x 25µ) and smaller spores (ca. 23µ x 1.25µ inside perithecium), but it has a similar cell *VI* and receptacle cells (Fig. 4a). A large form of *S. flexa* occurred with it, in which the perithecium is 58µ long x 37µ wide, with the receptacle 102µ below cell *VI* (Fig. 4e).

Scheloske (1969) reported a 6.8% infection of 161 beetles of *Ptenidium* examined. He found his specimens in *Alnus* woods, in moist, rich soil, and in piles of plant debris on pond margins. Polish specimens of *S. ptenidii* and *S. flexa* were also found in debris under *Alnus*, whereas *S. annae* was found in an anthill.

The species of *Siemaszkoa* differ in the shape of cell *VI*, the number and shape of cells in the receptacle, and the shape and orientation of the perithecium at maturity, as well as the position of the 4-celled row of outer wall cells. Although the perithecium remains parallel to the persistently erect appendage in *S. ptenidii* and *S. annae* (Fig. 4a, 4b), in *S. flexa* it is bent sharply downward at maturity by curvature of the receptacle just below cell *VI* (Fig. 4d); at the same time, the appendage turns outward. Although the perithecium of *Ecteinomyces pusillimus* does not bend downward, the appendage grows outward as the thallus matures. Although Spegazzini (1917) stated that the basal cells of the perithecium are visible, his drawing shows only the faint outline of one cell above cell *VI*. The presence of sessile conical antheridia on the lower cells of the appendage and the small size of the thallus suggest that this species belongs in *Siemaszkoa*, although it is possible that it is related more closely to *Ecteinomyces trichopterophilus*.

The trichogyne in *Siemaszkoa flexa* is at the level of the lower part of the upper wall cell tier at the 2-tier stage; this lower portion is later cut off by a septum. Thus, at the 3-tier stage, the second tier is very short and indicates the position of the trichogyne stump (Fig. 4e), which is located on the outside of the perithecium in *S. ptenidii* and on the inside in the other species. The trichogyne stump is on the 4-celled wall row, which is slightly longer; Scheloske's drawing (1969) shows a longer outer row in *S. ptenidii*. Evidently in this species there is some twisting of the perithecium, as the trichogyne usually faces the appendage in the Laboulbeniales.

The following is a key to the species:

Perithecium swollen, ca. obpyriform, bent backward parallel to receptacle at maturity; cell *VI* short, flat, broad; receptacle many-celled. *S. flexa*

Perithecium ca. obclavate, borne erect at maturity.
  Receptacle few-celled (ca. 3); cell *VI* cubical; extra wall cell in row on inner side of perithecium. *S. annae*
  Receptacle many-celled; cell *VI* elongate; extra wall cell in row on outer side of perithecium. *S. ptenidii*

Siemaszkoa is closely related to *Euphoriomyces*, *Carpophoromyces*, *Meionomyces*, and *Phaulomyces*, which have similar perithecia (I. Tavares, unpublished). The antheridia of *S. flexa* are similar to those of *Carpophoromyces*.

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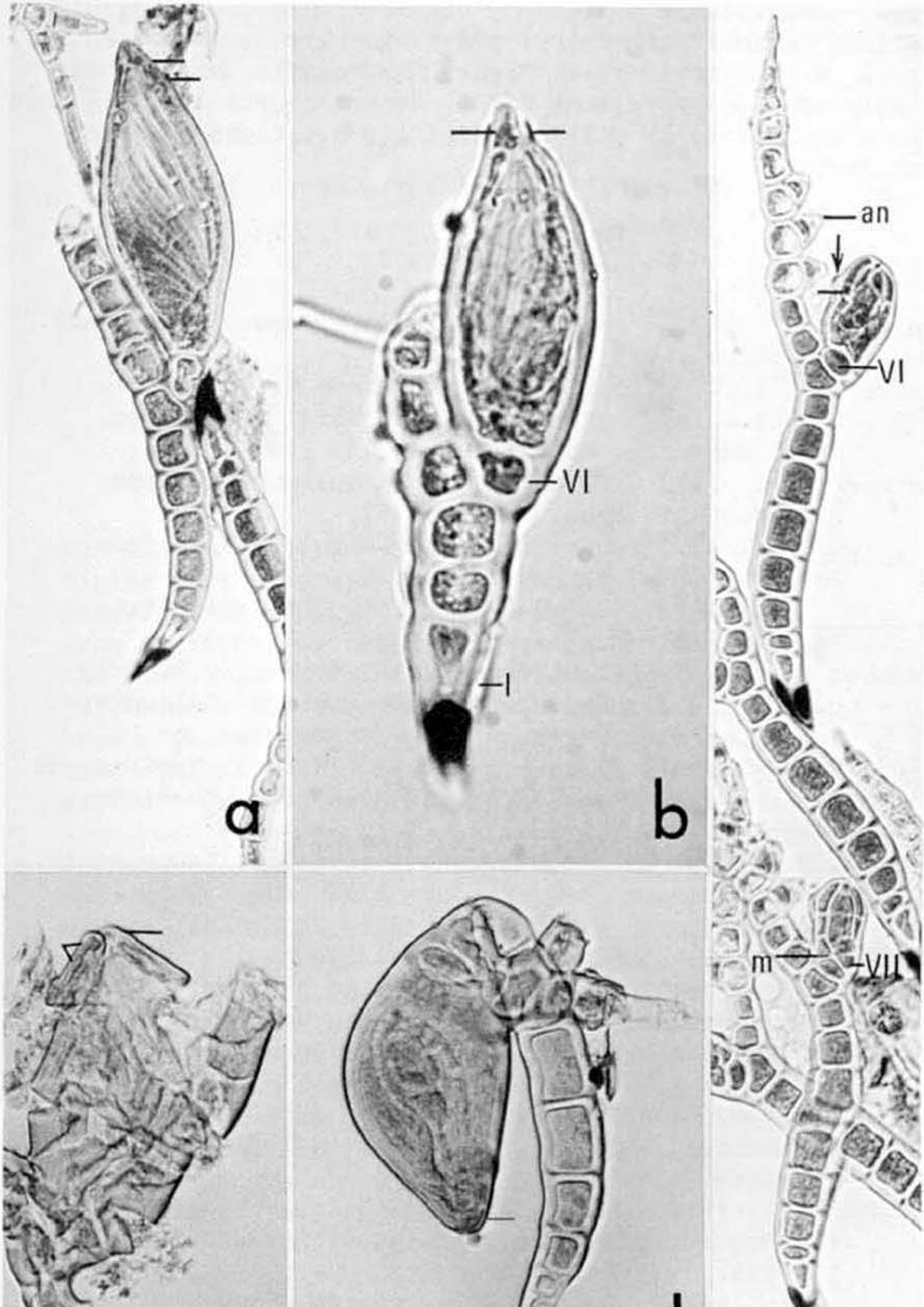
Fig. 4. *Siemaszkoa*. a. *S. ptenidii* (Burakowski collection), showing extra cell on outer side of perithecial apex (line to its base; lower line indicates trichogyne stump); associated young thalli are *S. flexa*. x 640. b. *S. annae*, mature thallus, type collection, showing extra apical cell in inside row (line at left) and flap of wall material (line at right) on outer side of perithecial apex. x 1440. c-e. *S. flexa*. c. Apex of mature perithecium (from type collection), flattened, showing two outer wall cells in row at left (v-line) and upgrowth of wall material at right (line). x 600. d. Holotype, mature thallus, showing curve of thallus at maturity and extra apical cell in inside row (line); lateral branch base is visible on appendage. x 600. e. Thallus, 3-tier stage (Burakowski collection; upper specimen), showing sessile antheridia, trichogyne stump (arrow), and short second tier; lower thallus is in 2-tier stage. x 640.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ings. The Latin diagnoses by Dr. W. J. Dress, Bailey Hortorium, Cornell University, are gratefully acknowledged. Dr. R. K. Benjamin, Rancho Santa Ana Botanic Garden, very kindly provided specimens for *L. heteroceratis* from Illinois for examination, as well as helpful suggestions for the manuscript.

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TAXONOMY, MORPHOLOGY AND ONTOGENY OF GELATINODISCUS FLAVIDUS[1]

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ABSTRACT

The gross morphology of the ascocarp of a subalpine Discomycete, *Gelatinodiscus flavidus*, is described in detail. Development of apothecia from artificially inoculated twigs and needles of the host, *Chamaecyparis nootkatensis* (Alaskan yellow cedar), is described. These arise from hyphae which leave infested needles through exit tubes (new term) in the host epidermal cell wall and exit pegs (new term) in the host cuticle. Ascospore germination results in a thick-walled, pigmented, lunate structure referred to here as a 'secondary spore.' A microconidial state possibly referable to the genus *Myrothecium* was discovered; microconidia were found attached to trichogynes, and it is suggested that they may act as spermatia. Discovery of the inoperculate nature of the ascus in *G. flavidus* and the necessity to transfer it from the Pezizales is discussed. A new family, the Gelatinodiscaceae (Helotiales), is erected for the monotypic genus *Gelatinodiscus*. The Gelatinodiscaceae represents a family perhaps intermediate between the Cyttariaceae (Cyttariales) and the Leotiaceae (Helotiales).

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[1] Based on a thesis presented to the Graduate School of Cornell University in partial completion of the requirements for the degree of Master of Science.

INTRODUCTION

The genus *Gelatinodiscus* and its single species, *G. flavidus*, was first described by Kanouse and Smith (1940) and placed in the order Pezizales, family Pezizaceae, based on "the operculate asci, large *Peziza*-like spores and the friable consistency of the dry apothecia." It was characterized by them as having asci that blue at the apices in Melzer's reagent, circinate, anastomosing paraphyses, and eight, hyaline, biguttulate ascospores. Its host is *Chamaecyparis nootkatensis* (D. Don) Spach (Alaskan yellow cedar). It is only found under snow or in runoff water from melting snowbanks.

Since that time, few workers have dealt with the structure or taxonomy of this organism. Eckblad (1968) briefly discussed the genus in a list of excluded genera; Korf (1972, 1973b) briefly discussed the genus in his Discomycete keys, finally deciding (Korf, 1973a) that *Gelatinodiscus* does not belong in the Pezizaceae, but making no suggestions as to its proper taxonomic position. Ecological mention of this fungus was made by Cooke (1955) in a footnote. Seaver (1942, 1951) did not cite the genus in his extensive treatment of North American Discomycetes.

In July, 1972 in the Mt. Jefferson Wilderness Area of Oregon, the author had the opportunity to collect this relatively unusual Discomycete. Whereas Kanouse and Smith (1940) had erroneously reported the ascus to be operculate, my fresh collections, when mounted in Melzer's reagent, showed a very distinctive apical pore in the ascus. Since one of the major taxonomic criteria used in Discomycete taxonomy is the operculate or inoperculate nature of the asci, the placement of this genus in taxonomic treatments based extensively on literature surveys has been erroneous.

The discovery of the inoperculate nature of the ascus, and the further discovery of simultaneous maturation of the asci of *Gelatinodiscus* by Dr. R. P. Korf (*pers. comm.*) and myself led me to undertake anatomical and developmental studies.

MATERIALS AND METHODS

Source of cultures and isolation procedures

Ascocarps of *Gelatinodiscus* were collected near Breitenbush Lake, Oregon, in late July, 1972. Fresh apothecia were placed in glass vials and plastic bags in the field, and in turn placed in an ice-chest. Within 4 hr of collection, fresh ascocarps were affixed to Petri dish lids with petroleum jelly, such that the hymenium faced downwards when the lid was placed on the dish bottom. Ascospores were ejected from the apothecia onto water agar in the dish; the lid was rotated slightly every few minutes to disperse the ascospores over the agar surface.

Upon germination, spores were harvested *en masse* from the agar surface and transferred to agar slants. These cultures were maintained in darkness at 6 C.

Culture media

All media were autoclaved for 20 min at 1.1×10^5 N/m^2 and 121 C unless otherwise stated.

Stock cultures were maintained on slants of "Difco" potato dextrose agar (PDA) in test tubes at 3 C and remained viable for over a year. For rapid production of vegetative mycelium, a yeast-glucose liquid medium (YG) consisting of 0.5% "Difco" yeast-extract and 2.0% glucose in tap water was employed. A 2% "Difco" water agar (WA) was also used in some experiments.

For detection of fermentative or oxidative metabolism, "Difco" bacto-OF basal medium (OF), after Hugh and Leifson

(1953) was used. The medium was supplemented with glucose to a final concentration of 1%. OF medium includes Bromthymol-blue as an indicator which turns from dark greenish-blue to bright yellow in the presence of fermentative metabolism. Mycelium from YG cultures was placed deep in the agar near the bottom of tubes containing 10 ml of the indicator medium. This preparation was covered with sterile, molten petrolatum to a depth of approximately 1 cm and incubated at 24 C. Controls with no inoculum and controls without petrolatum were also prepared.

Sexual reproductive processes were studied on an undefined or "natural" medium (NM). Forest litter and fallen cones and twigs of *C. nootkatensis* were collected from the summit of Iron Mountain in the Cascade Mountains of Oregon at 1700 m; ascocarps of *Gelatinodiscus* were found in the vicinity of this collection. The substrata were air-dried and stored in paper bags for 6 months or more before use.

When needed, the forest litter (consisting primarily of leaves of *Abies lasiocarpa* and *Vaccinium* spp.) was placed in a thin layer at the bottom of a 5 cm Petri dish lid and several *Chamaecyparis* twigs and cones of various ages were placed on top of this layer and wetted with tap water. This container was in turn placed in the bottom of a 9 cm Petri dish and covered with the lid of the larger dish. After autoclaving, inoculum from PDA slants was placed on top of the *C. nootkatensis* twigs. Following inoculation, plates were placed in a walk-in chemical storage room (used primarily for the storage of organic solvents) maintained at 4 C, with fluorescent lamp approximately 40 cm above the lid of the dishes providing approximately 690 lux for 16 hr per day. As cultures began to dry up over extended periods of time, sterile tap water was added.

Ascospore germination studies

Mature apothecia from NM cultures were affixed to Petri dish lids and allowed to eject ascospores onto WA as described above.

Sterile cellophane strips and cotton strands were placed separately on PDA plates; twigs of *C. nootkatensis* were placed on 2% WA. Agar blocks bearing ascospores were placed with the spore-bearing face down directly on the cotton strands and cellophane strips, or blocks were placed adjacent to twigs of *Chamaecyparis* with the spore-bearing face up. All treatments were incubated as described above for NM cultures.

Histological procedures

Squash mounts were prepared in cotton blue-lactophenol, Phloxine-B dye or Melzer's reagent. In addition, a 1% solution of Congo red in 2% aqueous KOH was used in the study of ascus wall structure. These stains are widely used by Discomycete workers and are described by Dennis (1968) and Korf (1973b).

To study initial development of fungal structures on the host, it was usually necessary to employ paraffin sections. Specimens were fixed in Carnoy's fixative with the formulation of 6 parts absolute alcohol, 3 parts chloroform and 1 part acetic acid. In a few instances, specimens were fixed in formalin-acetic-acid (FAA) after Jensen (1962).

To avoid loss of fungal material on *Chamaecyparis* twigs, the specimens were covered with molten WA after a 1 hr fixation, allowed to harden and replaced a fixative. Specimens were then placed in a slight vacuum for a minimum of 8 hr, dehydrated in a tertiary butyl alcohol series and embedded in 53-55 C "Bioloid" paraffin after Jensen (1962). Sections 10 μm thick were cut on a rotary microtome and affixed to microscope slides using Haupt's adhesive with 4% formalin.

Slides were stained in safranin-fast green or Heidenhain's iron haematoxylin with a counterstain in fast green after Jensen (1962). After staining, slides were mounted in Canada balsam and heated at 65 C for two days.

HABITAT

Gelatinodiscus flavidus is host specific for fallen needles, cones and small branches of Alaskan yellow cedar, *Chamaecyparis nootkatensis*. From collections made by the author and from a survey of the literature, the range of *G. flavidus* extends from British Columbia (Eckblad, 1968) south to central Oregon, based upon my own collections. Frenkel (1974) reported a disjunct population of *C. nootkatensis* in the Aldrich Mountains in eastern Oregon; at my request, *Gelatinodiscus* was sought and found there on the host by Frenkel, who kindly forwarded the material to me. The host range is discussed further by Hepting (1971). The climate for the host is described as moderate to cool, with cool, humid summers and winters that are not severe. Temperatures may occassionally drop to -28 C. Mean annual precipitation ranges from 50 to 250 cm.

Gelatinodiscus can be found fruiting beneath the snow, but more often at the seepage edge of melting snowbanks. If found under the snow, the apothecia are usually found on branches not directly in contact with the snow, but instead entangled beneath other branches. In such cases, the mass of branches is saturated with moisture.

VEGETATIVE GROWTH IN CULTURE

The vegatative hyphae of *G. flavidus* develop very slowly on PDA at both 4 C and 24 C. Most growth occurs beneath the agar surface in a spherical, dull-white colony, perhaps indicating a preference for an environment with a low oxygen concentration. As colonies age, they become dark brown. After two months of growth on PDA at 4 C, the mycelium, which is normally composed of cells 25-30 X 4-5 µm, rounds up into large, globose vesicles, 10-15 µm in diameter. The mass of vesicles becomes surrounded by a dark brown fungal exudate, forming a compact tissue which superficially resembles a stroma. However, no definite tissue layers are differentiated within the mass.

YG liquid cultures grow relatively fast at 24 C, a dense growth of white mycelium appearing around the contrastingly dark brown inoculum within 5 days. Growth in YG cultures is quite slow at 4 C. Colonies in YG always remain at the bottom of the culture tube. Cultures in 1.5% YG agar emit a characteristic "yeasty" odor after approximately one week at 24 C.

Inoculations into the OF medium indicated that *Gelatinodiscus* is capable of anaerobic, fermentative growth. The color of the medium changed from dark greenish-blue to bright, clear yellow within 36 hr after inoculation. Uninoculated control tubes remained dark greenish-blue in color. Control tubes without petrolatum seals turned the medium light greenish-yellow within one week after inoculation.

Mycelium in NM culture dishes always remained at the bottom of the dish, completely covering the substrata within 3 to 4 months. In general, aerial hyphae were bright yellow in color, closely corresponding to the color of mature apothecia. When such cultures were allowed to air-dry before the onset of apothecial production, the mycelium and substrata adhered together in a compact disc. When such a disc, after several months of storage, was rehydrated with sterile tap water and replaced in the NM growth chamber, apothecia were produced within two months.

When inoculum from one-year-old PDA cultures was placed in moist chambers, the top of the inoculum block soon became covered with bright yellow hyphae in small clumps, resembling the globose primordia formed in NM cultures, as described in a later section. However, no mature archicarps could be discerned in such structures.

DEVELOPMENT OF THE APOTHECIUM

The apothecium proper is completely epiphytic on the needles and twigs of *C. nootkatensis*, but is connected to hyphae in the epidermal cells of needles. Primordia, which usually give rise to two apothecia, are visible as discrete brown spots on twigs with the naked eye. As development proceeds, the primordia are topped with one or two bright yellow, globose structures, which consist of the archicarp and ensheathing hyphae.

The primordium (Fig. 1A,C) consists of a basal layer of globose cells, dark brown fungal exudate, archicarps and ensheathing hyphae. The basal layer of hyphae, which are 5-6 µm wide, is 3-6 cells thick, tapering to 1-2 cells at the edges. Hyphae in the basal regions of the primordium are surrounded by a large amount of dark brown exudate.

Hyphae in the palisade and epidermal layers are 7-10 (-15) µm across and uninucleate. Epidermal cells of the host are each packed with 3 to 6 globose fungal cells, which in turn arise from profusely branching, broad hyphae in the palisade layer of the needle. About 6 epidermal cells beneath the primordium (in sectional view) are filled with hyphae; these hyphae are connected between epidermal cells.

Hyphae in the portion of the epidermal cell adjacent to the cuticle produce a smooth-walled cylindrical tube, here termed an *exit tube,* through the epidermal cell wall, but not into the cuticle (Fig. 1D,E). The exit tube is 1.0 µm in width; a brown exudate can be seen surrounding it in the host cell wall. A thin, tapering hypha, here termed an *exit peg,* is formed from the exit tube, is rough-walled, yellowish-brown, 1.0 µm wide at the base and tapers to a fine point at the apex, leading from the exit tube apex through the cuticle and connecting with a globose cell at the base of the primordium. The exit peg stains in fast green.

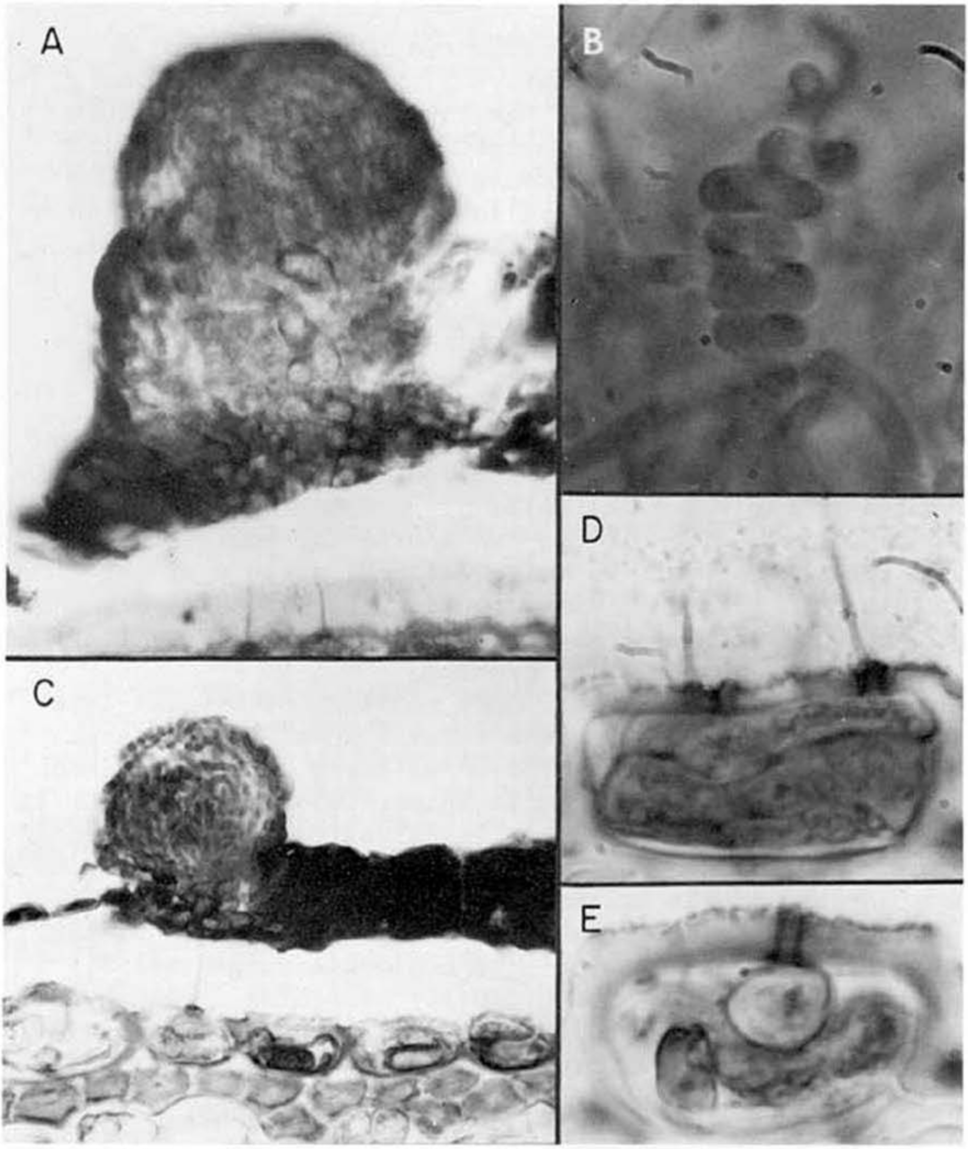


FIG. 1. Photomicrographs of *Gelatinodiscus flavidus* from NM cultures, A, CE, 10 μm paraffin sections in safranin-fast green, bright-field microscopy; B, squash mount in cotton blue-lactophenol. A. Remains of archicarp present in developing apothecium on needle, with exit pegs visible in the host cuticle, × 620. B. Detail of archicarp teased out of a developing primordium, × 1500. C. Primordium subtended by an exit peg produced by hypha in a host epidermal cell, × 620. D. Detail of host epidermal cell filled with hyphae which have produced exit tubes and exit pegs, × 1500. E. Detail of exit tube in host epidermal cell, × 1500.

In general, only one exit peg per hypha in the epidermal cell is produced, although a hypha may produce two such pegs in rare instances. As many as eight exit pegs have been observed connecting a primordium with hyphae in the epidermal cells of the host.

In the central region of the primordium are found one or more archicarps and ensheathing hyphae. Usually two archicarps are formed, each apparently capable of giving rise to a complete apothecium. The archicarp is bounded at the top by the trichogyne and at the base by a foot cell. Unfertilized, whole archicarps are difficult to demonstrate. In one observed case, the archicarp (Fig. 2) consisted of 14 uninucleate cells, 4-5 X 10 µm, arranged in five to eight tight coils. The trichogyne connected to this archicarp consisted of eight cells, the first six 2 X 15 µm, the seventh 2 X 30 µm and the eighth or terminal cell 2 X 75 µm. The terminal cell was devoid of cytoplasm. The foot cell is 2-2.5 X 10 µm. The ensheathing hyphae surrounding the archicarp are 1-1.5 µm broad, and with the archicarp form a bright yellow globose structure, 40-60 µm across, just visible to the naked eye.

After fertilization the archicarp foot cell is carried upward with the other cells of the developing stipe until the archicarp is 50-75 µm from the base of the stipe. At this point, the outer excipular layers have differentiated from cells at the sides of the primordium into a characteristic textura prismatica, surrounded by a layer of protruding "hairs." Under the dissecting microscope, the apex of the stipe takes on a watery or filmy appearance, in sharp contrast to the dull appearance of the sides of the stipe.

After the initial upward expansion of the stipe, thin-walled ascogenous hyphae can be seen within the tissues of the stipe. Cells comprising these hyphae are 4-6 X 12-15 µm, often collapsing in paraffin sections and appearing to be almost devoid of cytoplasm. Nuclei are difficult to observe in these cells. Ascogenous hyphae stain much lighter in iron haematoxylin-fast green mounts than the surrounding hyphae. The ascogenous hyphae branch extensively within the medullary excipulum as upward expansion of the stipe continues.

When the stipe has elongated to a height of 4 to 5 mm, the apex begins to expand laterally, the watery apex expanding with the outer tissues of the stipe, the ascogenous hyphae begin profuse branching, contributing to the developing hymenium, paraphyses are formed from hyphae in the medullary excipulum, and the margin is differentiated.

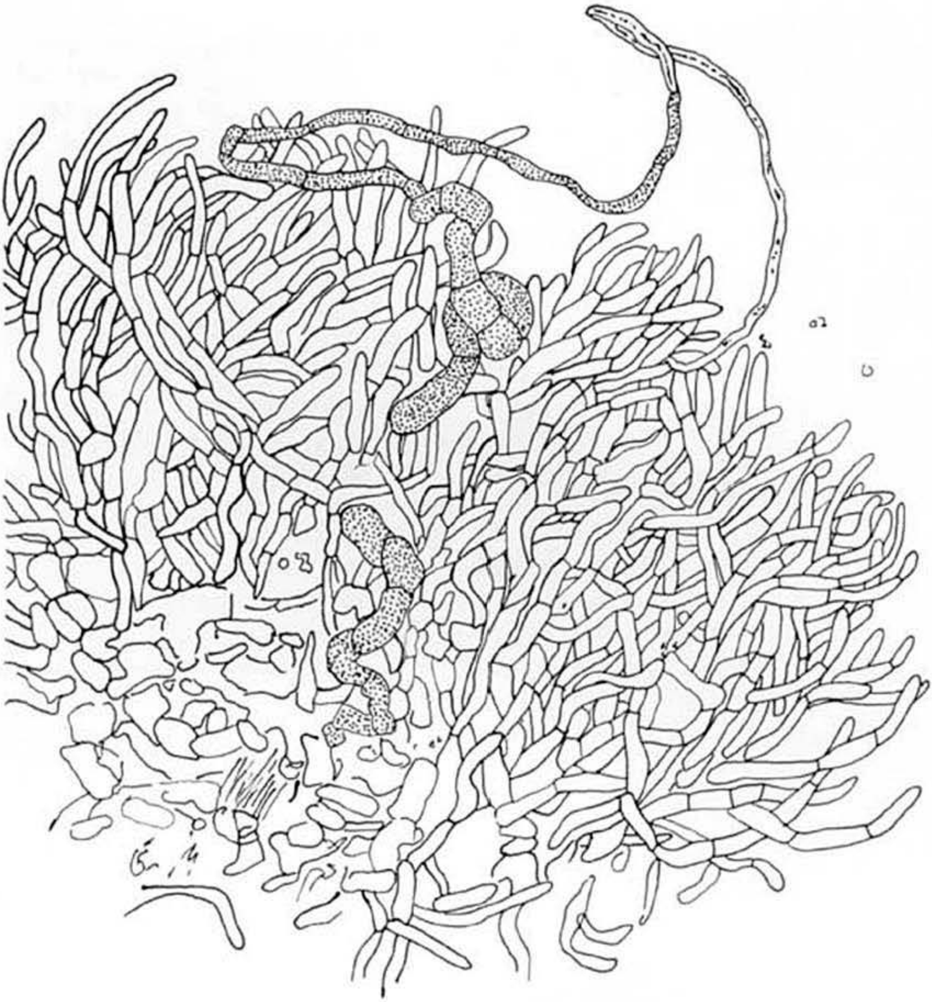


FIG. 2. Camera lucida drawing of a primordium containing an archicarp and trichogyne, × 850.

Laterally protruding "hairs" are present on the outer surface of the apothecium. The cells of the archicarp are now only visible as thick-walled hyphae, devoid of cytoplasm and covered with a brown incrustation, near the base of the stipe. Once the margin and hymenium differentiate, a period of 7 to 9 days elapses in culture before formation of the fully expanded and repand hymenium.

During development, young apothecia are positively phototropic. If culture dishes are turned so that the apothecia are facing away from the light source, the stipe bends towards the light within 24 hr. Once lateral expansion of the apex of the apothecium commences, the phototropic response diminishes or disappears.

It appears from culture experiments that maintenance of proper substrate moisture and humidity is important in the production and development of apothecia. More apothecia were found on twigs perched above the water level in culture dishes than twigs that were partially submerged. In addition, submerged hyphae remain off-white in color, and as the water level recedes, hyphae exposed to the air become bright yellow.

Apothecia only developed on *C. nootkatensis* materials in the dishes, and not on the other litter. In general, younger twigs produced the bulk of apothecia and primordia, while woody twigs and cones produced few apothecia. Apothecia failed to develop on any of the agar media used in various experimental regimes.

As Kanouse and Smith (1940) have previously described, the apothecia of *G. flavidus* reach a maximum diameter of 5 mm and a height of 5-8 mm. The color of the apothecium is bright yellow and not at all greenish or greenish-brown as Korf (1972, 1973b) has indicated. His comments (R. P. Korf, *pers. comm.*) were based on examination of fresh material of a Japanese Discomycete not yet fully studied (Korf, 1966; Sagara, 1974), but which, based upon my examination, is not a species of *Gelatinodiscus*.

ANATOMY OF THE ASCOCARP

At the time of the original diagnosis of *G. flavidus*, microanatomical characteristics of apothecia were not of the taxonomic importance that they are presently. Therefore I provide an emended description here. Terms used are based on those presented by Korf (1973b).

ECTAL EXCIPULUM: The outermost layer of the ectal excipulum is composed of uninucleate, elongate, septate hyphae, 5-7 μm in width, interwoven in a textura porrecta 20 μm thick. At the base of the stipe these hyphae originate from the cells composing the inner layer of the ectal excipulum. Most of the hyphae lie parallel to the long axis of the stipe, but there are many tapering, septate branches (or "hairs") lying at right angles to the stipe (Fig. 3C). These branches form the hairy or cobwebby appearance of very young apothecia.

The inner layer of the ectal excipulum is 80-100 µm thick, and is composed of angular to rectangular cells, forming a textura prismatica (Fig. 3A,C). These cells are thin-walled, 20-45 X 10 µm and 2- to 4-nucleate. At the base of the stipe, these cells are covered with dark brown exudate. As the apothecium expands upward and outward, this exudate becomes ruptured. The rectangular cells near the base of the stipe narrow into the thin-walled cells forming the outermost layer of the ectal excipulum, and protrude through the brown exudate.

MEDULLARY EXCIPULUM: The medullary excipulum is composed of long-celled hyphae, the cells 3-8 X 30-60 µm, and 2- to 4-nucleate, forming a textura intricata. Near the base of the stipe, the hyphae are closely packed, becoming very loosely arranged as the zone of paraphysis differentiation is neared (Fig. 3A,B). Large interhyphal spaces are present in the upper portion of the medullary excipulum.

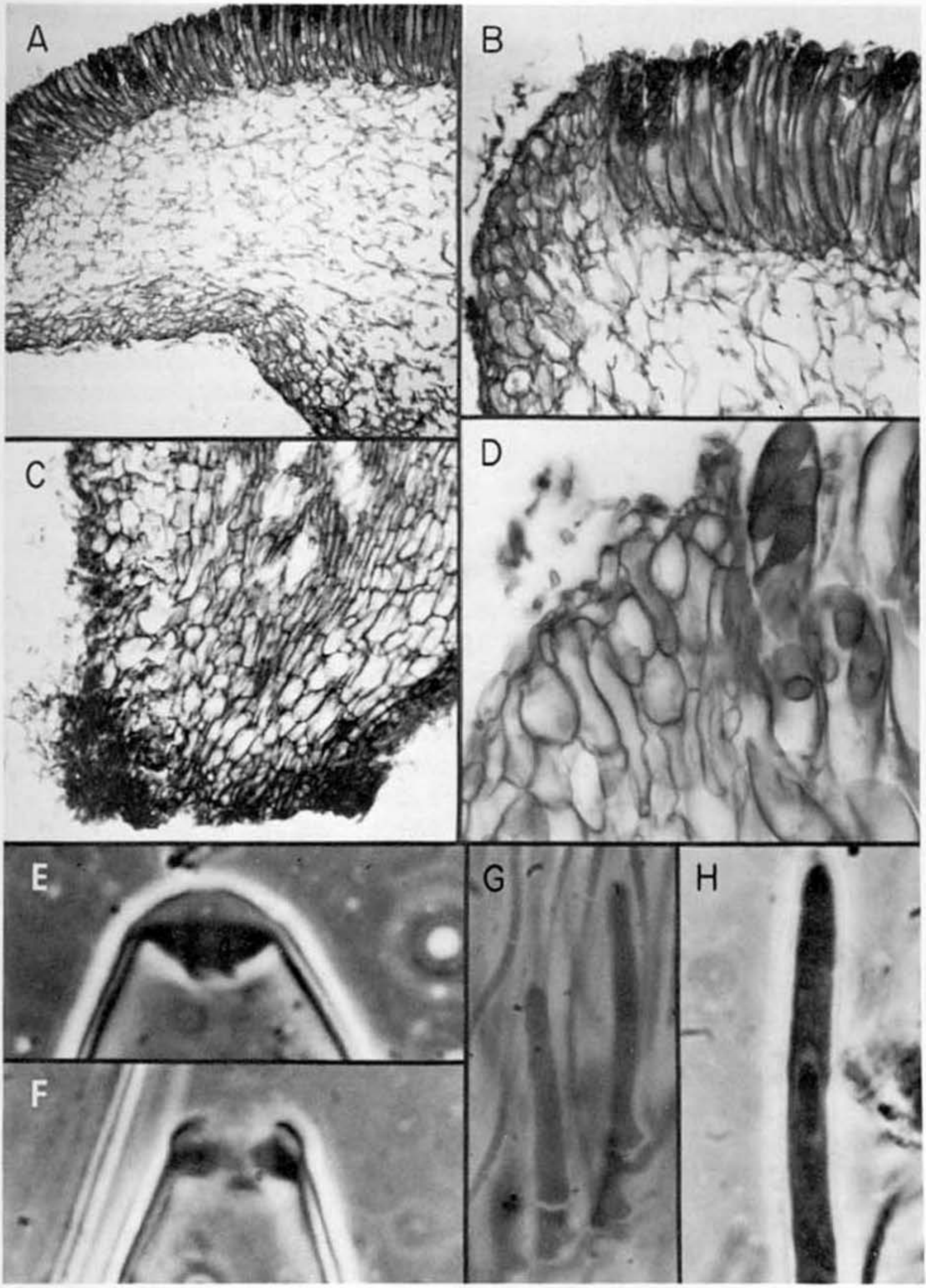
MARGIN: The margin is composed of both tissue layers found in the ectal excipulum, and is about 100 µm in width. The asci and paraphyses extend slightly above the margin (Fig. 3B,D).

In naturally produced apothecia, the margin is forced backwards, toward the flanks of the apothecium, due to the expansion of the medullary and hymenial tissues. Apothecia produced in culture do not become as repand as those in nature, thus their margins remain vertical.

SUBHYMENIUM: The subhymenium is not clearly differentiated from the medullary excipulum. It consists of ascogenous hyphae and differentiated paraphyses, and is 40-50 µm in height.

HYMENIUM: The hymenium is 150-190 µm high, and is composed of asci and circinate, anastomosing, branched

FIG. 3. Photomicrographs of *Gelatinodiscus flavidus*. A-F, apothecia collected from nature (=Carpenter 22). A-D, 10 µm vertical sections in safranin-fast green, bright-field microscopy. A. Section through a mature apothecium, × 70. B. Detail of margin and hymenium, × 180. C. Detail of stipe tissues, × 180. D. Detail of margin, × 425. E-F, squash mounts of asci in Melzer's reagent, phase-contrast microscopy. E. Detail of ascus apex demonstraing a portion of the pore cylinder and the thin region in the outer wall, × 1500. F. Ascus apex after dehiscence with evaginated pore cylinder,



× 625. G-H, squash mounts of hymenium from apothecia from NM cultures in cotton blue-lactophenol. G. Developing asci in young hymenium, bright-field microscopy, × 1330. H. Diploid nucleus in developing ascus, phase-contrast microscopy, × 1500.

paraphyses. The paraphyses are 1.5 μm wide, and terminate in a bulbous tip, 2.5-3.0 μm wide. The paraphyses extend slightly beyond the asci, and the coiling branches have a tendency to curl around the asci.

THE ASCUS

Under natural conditions, the development and maturation of asci of *G. flavidus* is simultaneous rather than seriatim. It is possible, by collecting minute ascocarps in the field, to find some of the early developmental stages of the asci. In culture, the simultaneity of ascus development does not occur, possibly due to the impreciseness of environmental stimuli in the artificial environment. Because of the above factors, it was possible to follow some of the stages of ascus development by observation of natural and cultured materials.

Asci arise from ascogenous hyphae which are thin-walled, devoid of cytoplasm as they age, 4-6 μm in width. Multiple croziers are formed from these hyphae in the subhymenium, and an intricate branching system is present in the hymenium (Fig. 3G).

Once crozier proliferation and branching has ceased, young asci, 5-7 X 2.5-3.0 μm are formed. A young ascus contains two small nuclei, and the cytoplasm appears very dark and granular in iron haematoxylin preparations. The young ascus increases in size to 30-35 X 3-5 μm; then karyogamy occurs. At this stage, the spherical nucleolus of the diploid nucleus is 2.5 μm across.

After karyogamy, the diploid nucleus migrates into the upper third of the ascus as vertical and lateral expansion of the ascus proceeds (Fig. 3H). During this process, the asci lose the dark granular appearance in iron haematoxylin preparations. When the ascus reaches about 150 X 10-12 μm, the nucleolus is 3 μm across, with a clear spot visible slightly off-center. The nuclear envelope is 8 μm across at this stage. The chromosomes of this organism have thus far proven too small to count during meiotic divisions.

Upon completion of meiosis, four small nuclei are evident in the upper third of the ascus. At this time, the apex of the ascus thickens in a hyaline region, 4-5 μm in height. After meiosis, a mitotic division of all four nuclei results in eight nuclei, surrounded by spherical walls. As the spores develop, the ascus width increases to

15-17 µm.

The mature ascus apex is 2.5-3.0 µm thick and inoperculate. The wall at the extreme upper center of the ascus appears much thinner than the rest of the wall (Fig. 3E). This thin region is 1.0 µm across and lies directly over the top of the pore plug. The pore cylinder, which surrounds the pore plug, is 2.0 µm wide at its base (located at the ascus lumen), tapering to 1.0 µm wide at the extreme tip of the ascus.

An umbraculiform region in the apex turns blue in Melzer's reagent. It consists of a shield-like, broad upper zone, which lies about 0.5 µm back from the unreactive, outermost portion of the wall, and the pore cylinder wall, which is quite distinct where it extends through the hyaline, unreactive portion of the apex (Fig. 4B). The pore plug does not appear to react in Melzer's reagent.

After ejection of ascospores, the apex appears to have been blown completely away, as illustrated by Kanouse and Smith (1940), who concluded the ascus was operculate. However, close examination of the torn apex reveals that the pore cylinder simply evaginates, along with the broadly blueing region of the apex, during dehiscence (Fig. 3F); such a process is described and illustrated for *Ciboria acerina* by Corlett and Elliott (1974), and is common in many species of the Helotiales (van Brummelen, *pers. comm.*).

THE ASCOSPORE

Development

Ascospores are cleaved-out in the upper third of the ascus following the post-meiotic mitotic division, are spherical, 10-12 µm across and uninucleate. As development proceeds, the ascospores become elliptical and are filled with a granular-appearing yellowish substance. They have a hyaline outer wall that is 1-1.5 µm thick which is smooth to somewhat irregular. The dimensions of the young elliptical ascospores are about 31 X 11 µm. Developing ascospores are at first eguttulate, becoming distinctly biguttulate as maturation proceeds.

Development of the ascospores within the ascus is at first uniseriate, the spores' long axes arranged horizontally in youth, later shifting to a vertical or subvertical position as a result of elongation, thus becoming irregularly biseriate in the mature ascus. In general, the end of the

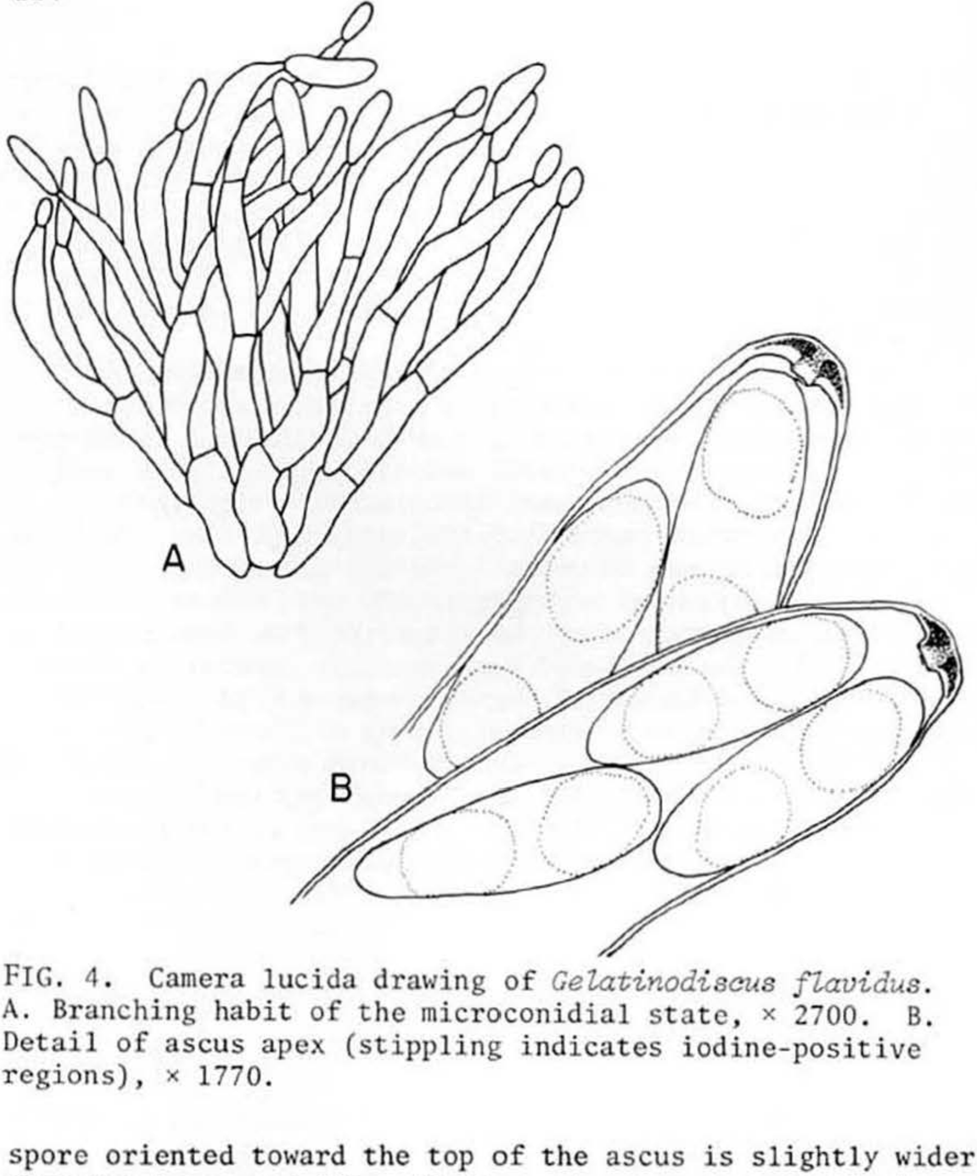


FIG. 4. Camera lucida drawing of *Gelatinodiscus flavidus*. A. Branching habit of the microconidial state, × 2700. B. Detail of ascus apex (stippling indicates iodine-positive regions), × 1770.

spore oriented toward the top of the ascus is slightly wider than the lower end (Fig. 5G,H), a phenomenon common in inoperculate Discomycetes according to Korf (1973b). Fully developed spores are 30-34 X 9-10 µm, uninucleate, with the nucleus located in the central region between the two large polar guttules (Fig. 5I). Yellowish material is present around the nucleus and guttules, giving an oily appearance. The nucleus and yellowish substance stain in cotton blue-lactophenol, safranin and iron haematoxylin. The nucleus is 3 µm across.

The mature ascospore is surrounded by a hyaline sheath, visible in India-ink mounts or under phase contrast (Fig. 5G,H). This sheath forms a 5 µm thick layer around the spore. In general, this structure is difficult to demonstrate in dried herbarium specimens unless they are allowed to rehydrate for 15 to 20 min.

Germination

The first noticeable event in germination is dispersal of the large guttules into smaller guttules. The large guttules are not lost in this process, but become noticeably smaller (Fig. 5J). At this point, the large nucleus is still visible in the central region of the spore.

Within 45 hr after ejection from the ascus (at room temperature), a small blastogenous growth emerges from the ascospore, and in most cases continues to grow into a large, sublunate, vesicular structure which soon becomes thick-walled and pigmented, and is here termed the *secondary spore* (Figs. 5J-N). Usually the secondary spore is produced slightly off-center toward either end of the ascospore; it may assume a linear or globose shape. The secondary spore is about 8 µm wide at its center, tapering to 3 µm wide at the rounded ends, and is 20-25 µm long (measured from the tip of one arm to the tip of the other). As the secondary spore grows, the cytoplasm in the ascospore can be seen to retract from the wall opposite the secondary spore and migrate into the secondary spore. As this process continues, the guttules disappear. The secondary spore is finally cut off from the ascospore by a septum, with a thin cytoplasmic connection visible between the two spores. Some cytoplasm is left within the ascospore (Fig. 5L).

Although the above description of secondary spore formation covers most instances, there is much variability in size, shape and position of the secondary spore.

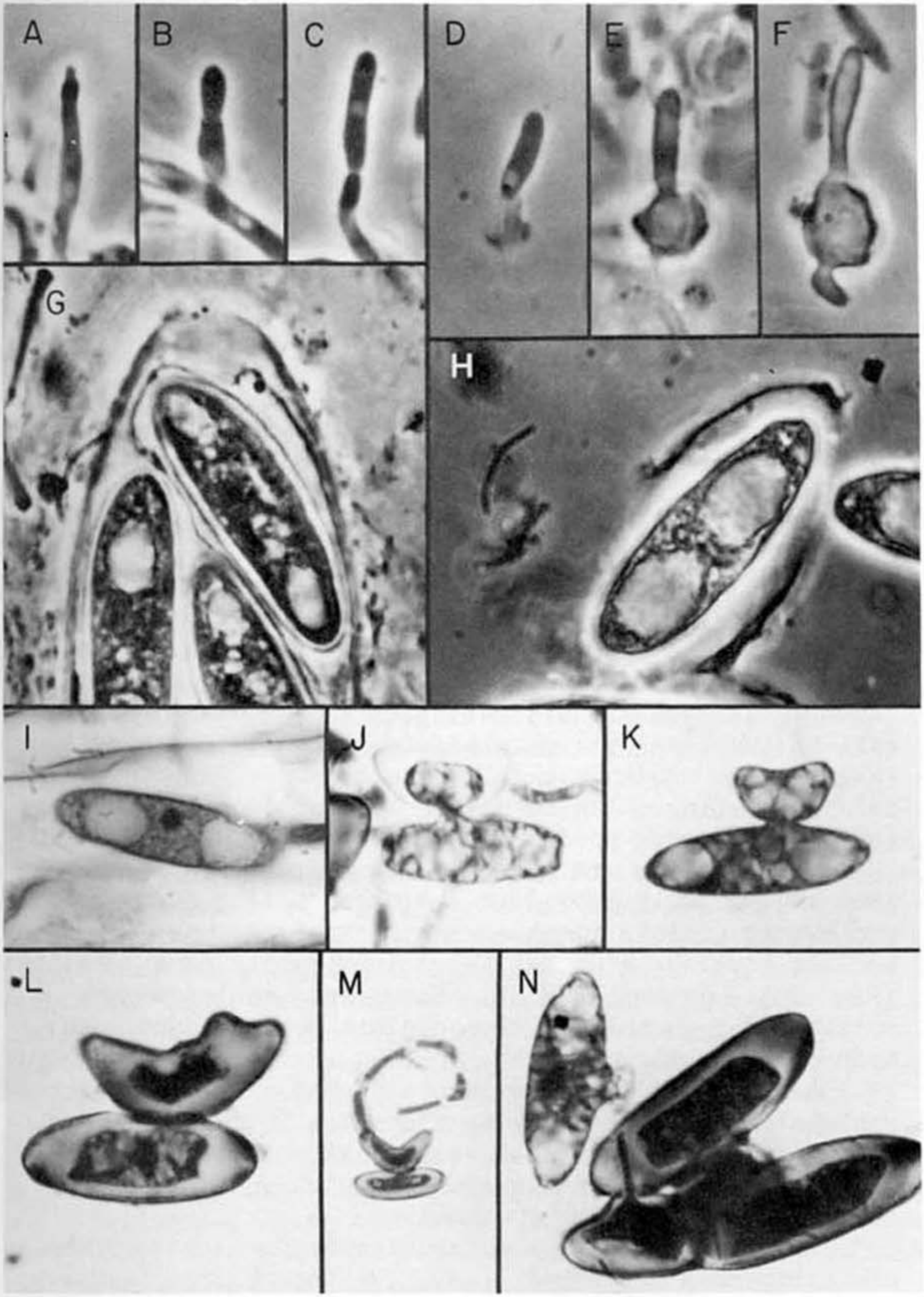
Once blastogenous development has ceased, the secondary spore and ascospore become pigmented, appearing a deep yellow-brown. In material collected from nature, nearly all ascospores germinated and both structures became pigmented with 72 hr after ejection. Ascospores produced in NM cultures often failed to germinate and did not turn brown in such instances. Other spores from the same deposit took up to one week to germinate and for the two spores to turn brown. Field-collected material produced darker pigment in the spores than culture-produced material.

After pigmentation, the secondary spore may produce either a hypha or penetration peg. If a hypha is formed, it may emerge from either the center or one of the arms of the secondary spore (Fig. 5M). Usually, the walls of the first two or three cells of such a hypha are less deeply pigmented than the walls of the spores, imperceptibly merging into hyaline cell walls as one follows the growth away from the secondary spore. After formation of 3 to 6 cells, lateral structures, resembling penetration pegs, are formed from the apical and subapical cells of the hypha. In several instances, these pegs have been observed entering hyphae produced by adjacent germinating spores. In one case, the peg produced by a terminal cell penetrated a branch produced from the subterminal cell of the same hypha.

If a hyphal system is not formed, the secondary spore may produce a penetration peg into the adjacent substrate. Undischarged ascospores may germinate by producing a secondary spore, and from that a penetration peg which pierces the ascus wall; a hyphal system can develop from such spores. Ascospores landing adjacent to each other will often each produce a secondary spore, and from each secondary spore a penetration peg will enter the adjacent ascospore (Fig. 5N).

Those ascospores placed within 1 mm of *Chamaecyparis* twigs on WA plates showed no tendency to grow in any particular direction, the fungus forming circular colonies. Secondary spores produced from ascospores placed on cellophane strips on PDA plates did not penetrate the cellophane, although the hyphae they produced did grow along the surface of the strips. Secondary spores produced from ascospores placed on cotton fibers on PDA plates did not directly penetrate the cotton, but did show a marked tendency to form hyphae which grew along and around fibers, indicating a possible thigmotrophic response.

FIG. 5. Photomicrographs of *Gelatinodiscus flavidus*. A-F, from NM cultures, squash mounts in Phloxine-B, phase-contrast microscopy, × 1370. A-C. Phialosporous development of microconidia. D. Nucleus in a microconidium. E-F. Germination of microconidia. G-H, rehydrated herbarium material, squash mounts in Melzer's reagent, phase contrast microscopy (Carpenter 222). G. Ascospore sheath surrounding the spore in the ascus, × 1440. H. Ascospore sheath in discharged spore, × 1370. I-N, material collected from nature (Carpenter 22), bright-field microscopy. I. Mature ascospore with central nucleus and polar guttules, 10 µm section in safranin-fast green, × 400. J-L. Germination of secondary spore from ascospore, in cotton blue-lactophenol, × 400. M-N, spores stained in cotton blue-lactophenol. M. Germination of hypha from secondary spore, × 160. N. Penetration peg from secondary spore entering an adjacent ascospore, × 400.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SPORODOCHIA AND MICROCONIDIA

Sporodochia, perhaps best assigned to the form-genus *Myrothecium* Tode ex Fr., appear as slimy, light yellowish to white masses on twigs in NM cultures. They are 1-2 mm across, arising from a basal mass of globose hyphae surrounded by brownish exudate. These are the first structures formed on NM cultures and appear as the water level recedes, partially exposing needles to the air.

Cells near the base of the sporodochium are 8-10 μm across, and arise from exit tubes and exit pegs produced by hyphae in the epidermal cells of the host in the same manner as primordia. The basal cells of the conidiogenous hyphae are thick-walled, 4-6 X 8-10 μm, appearing somewhat rectangular, and branching three to four times. The cells of the conidiophore become progressively smaller and lighter in color near the apex, where they end in a dichotomy (Fig. 4A).

Phialides are 18-20 X 2-2.5 μm, unbranched, slightly curved, septate and constricted near the base. In some cases, phialides are 5-8 μm in length and branched. The wall at the tipe of a phialide is somewhat thickened (Fig. 5A,B). In some cases, phialides may form intercalary, hyaline chlamydospores, similar in size and shape to chlamydospores produced by microconidia.

Microconidia are hyaline, elliptical, rounded at the apex and slightly fusoid at the base, 5-11 X 2 μm. The nucleus is visible in phase-contrast microscopy, the clear nuclear envelope bounding the contrastingly dark nucleolus (Fig. 5D). In bright-field microscopy, nuclei may be mistaken for guttules. Microconidia tend to adhere to each other in large masses.

Although no direct evidence is yet available, microconidia probably function as spermatia in sexual reproduction; trichogynes often have many microconidia attached to them, and microconidia are commonly found adhering to the base of developing apothecia.

Microconidia may produce chlamydospores at one end in a blastogenous manner (Fig. 5E,F). The chlamydospores range in size from 5 to 15 μm in diameter, and have a conspicuously wrinkled, yellowish-brown outer wall. The end of the microconidium distal to the chlamydospore will often branch and anastomose with adjacent chlamydospores. In no case were chlamydospores observed anastomosing with microconidia which had not produced a terminal chlamydospore.

It was observed that microconidia in young NM cultures did not germinate. NM cultures over 4 months old produced microconidia which germinated.

Through proliferation of additional chlamydospores, a system of hyphae is produced that strongly resembles globose cells found in old PDA cultures and those found at the base of primordia and sporodochia. It is possible that microconidia act as dispersal propagules.

DISCUSSION

Until now, *Gelatinodiscus* has been placed in the Pezizales, family Pezizaceae, by virtue of its assumed operculate nature and the blueing reaction of the asci with Melzer's reagent. Since it is now clear that this Discomycete is inoperculate, a transfer from the Pezizales must be made.

The salient features of the genus are as follows: 1) simultaneous maturation of asci; 2) inoperculate asci with a broadly blueing apex in Melzer's reagent; 3) uninucleate ascospores which turn brown after discharge; 4) a tuberculoid, phialosporic microconidial state; and 5) a simple ascocarp (an apothecium).

Simultaneous maturation of asci is relatively uncommon in the Discomycetes, being reported for the genera *Cookeina, Microstoma* and *Boedijnopeziza,* which comprise the Boedijnopezizeae of the Sarcoscyphaceae (Korf, 1972). These genera are also characterized by their J-, suboperculate asci, which differ radically from the asci of *Gelatinodiscus*. One other family, the Cyttariaceae (Cyttariales) also includes members with simultaneous ascus maturation, as reported by Korf (1973b). The ascocarp of *Cyttaria,* the sole genus in the order, is compound and in some species I have observed, the asci have a broadly blueing, inoperculate apex very like that of *Gelatinodiscus*.

Ascospores which turn brown at the time of germination are unusual and found in some genera of the Hemiphacidiaceae, Sclerotiniaceae and Leotiaceae. Some members of *Cyttaria,* which normally have hyaline ascospores in the ascus, are reported to produce black spore prints (Korf, 1973b), which indicates pigmentation following discharge. Delayed pigmentation of ascospores is common among conifer-inhabiting Discomycetes. Both *Rhabdocline* (Hemiphacidiaceae) and *Chloroscypha* (Leotiaceae) are such genera. Of special interest is the production of a secondary spore in *Chloroscypha* (Terrier, 1952; Kobayashi, 1965), which strongly resembles that produced by *Gelatinodiscus*, and of a dark germ tube in *Rhabdocline* (Brandt, 1960).

Phialosporic, tuberculoid microconidial states are known in the Helotiales and remain unreported in the Pezizales. Such states are reported for many members of the Sclerotiniaceae and the Leotiaceae. Members of the Cyttariales have a pycnidial state produced on the compound ascocarps as illustrated by Gamundi (1971).

Although a transfer of *Gelatinodiscus* from the Pezizales is indicated, proper placement of this genus within the current classification schemes remains a difficult problem. Similarities with *Chloroscypha* are striking, but probably represent adaptations to cupressaceous hosts. Certainly the structure of the ascocarp of *Gelatinodiscus* is not at all similar to that of *Chloroscypha*, the latter genus having a strongly gelatinized ectal excipulum. Although ascus structure and development strongly parallels that found in *Cyttaria*, the nature of the ascocarp is radically different.

Presently, a Discomycete with inoperculate asci and a simple, discoid apothecium with an ectal excipulum of a textura prismatica must, by definition, be placed in the Helotiales. By virtue of its developmental processes, *Gelatinodiscus* could perhaps be accommodated in the Cyttariales, but the taxonomic validity of this order remains questionable to me. Until further developmental work can be undertaken on Discomycetes showing similarities to both the Helotiales and Cyttariales, placement of *Gelatinodiscus* in the former order seems more appropriate.

The salient features of *Gelatinodiscus* are unlike any others found in the various families of the Helotiales. A new family, the Gelatinodiscaceae, is herewith proposed to accommodate this genus. It represents a family intermediate between the Leotiaceae and Cyttariaceae. The presence of broadly blueing, simultaneously maturing asci suggests strong affinities with the Cyttariaceae. Some members of the Cyttariaceae are parasitic on subalpine, evergreen *Nothofagus* in the southern hemisphere, a habitat superfically similar to that of *Gelatinodiscus* and one that may account for similar adaptations of *Cyttaria* and *Gelatinodiscus*. The simple ascocarp and tuberculoid microconidial state, on the other hand, suggest relationships with the admittedly heterogenous Leotiaceae.

FORMAL TAXONOMY

GELATINODISCACEAE Carpenter, *fam. nov.* (Helotiales)

Ascocarpus apothecium stipitatum est; asci eodem tempore omnes maturescens, non operculati, pariete pori cylindrici et parte superiore apicis incrassati asci in iodo coerulescentibus; ascospori uninucleati, hyalini vel subhyalini, utroque germinante et sporum secundarium producente, ambobus brunnescentibus.

Genus typicum: *Gelatinodiscus* Kanouse & Smith.

Ascocarp a stititate apothecium; asci maturing simultaneously, inoperculate, the pore cylinder and the upper portion of the thickened ascus apex blueing in iodine; ascospores uninucleate, hyaline to subhyaline, germinating to produce a secondary spore, both of which become brown.

SPECIMENS EXAMINED: WASHINGTON: Isotype specimen, on leaves of *Chamaecyparis nootkatensis*, Sol Duc Park Trail, Olympic National Forest, July 20, 1939, A. H. Smith 14488 (= CUP 49536). OREGON: 2 miles SW of Breitenbush Lake, near Mt. Jefferson, Willamette National Forest, July 8, 1972, S. E. Carpenter 22; 3 miles SW of Breitenbush Lake, May 14, 1973, S. E. Carpenter 222 (= CUP 54529); At the summit of Iron Mountain, Santiam Pass, Lane County, 1700 m., May 18, 1973, S. E. Carpenter 225.

ACKNOWLEDGEMENTS

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Appreciation is extended to Dr. Richard P. Korf for his advice and criticism and for serving as Chairman of the author's Special Committee. Thanks are also due Dr. W. A. Sinclair for serving as a member of the Special Committee and for his advice.

Thanks are extended to Dr. W. C. Denison, Oregon State University, for first arousing my interest in the Discomycetes and for his encouragement during the preliminary stages of this study.

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MYCOTAXON

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THE GENUS PLATYSTICTA

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SUMMARY

The type species of *Platysticta* Cooke is an abnormal, muriform-spored variant of *Lichenopsis sphaeroboloidea* Schw. and the genus *Platysticta* falls into synonymy with *Lichenopsis*. The other included species is here transferred to *Ocellularia*. Other muriform-spored fungi in the Ostropales are discussed.

Cooke (1889), in a discussion of *Lichenopsis* Schw., mentioned a fungus, communicated by Ravenel and deposited in the Berkeley herbarium as #2423, having the external appearance of *L. sphaeroboloidea* Schw. and differing only in having muriform spores which came apart at the septa. This fungus was described as a new species, *Platysticta simulans* Cooke and Massee. From Berkeley and Broome's (1875) description of *Platygrapha magnifica* Berk. and Br., Cooke concluded that that species was congeneric and transferred it to *Platysticta*. The character of spores which came apart at the septa was stressed.

Cooke failed to indicate a type for his genus. Saccardo (1889) lectotypified *Platysticta* by transferring *P. magnifica* (Berk. & Br.) Cooke to *Lichenopsis* and retaining *P. simulans* in *Platysticta* [cfr. Korf and Rogers (1967)]. This choice of type was followed by Clements and Shear (1931), who synonymized the genus with *Melittosporium* Corda.

Examination of an apparent isotype of *P. simulans*, Curtis #2423 (FH as *Lichenopsis sphaeroboloidea*) = Ravenel Fungi Caroliniani I:72 p.p. , reveals a fungus which agrees in all characters except the muriform spores with *L. sphaeroboloidea*. *L. sphaeroboloidea* is easily distinguished from other Stictidaceous fungi by periphysoids which stain J+ blue in Melzers reagent*, and by knoblike brown paraphyses tips. The specimen also agrees with Schweinitz's species in other respects,

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*All specimens were rehydrated in water and sectioned on a freezing microtome.

such as the thickness of the ascus cap and the shape of the pore, tardy and irregular dehiscence of the ascocarp, and poorly developed crystalline layer in the margin. Size of spores, and number of spores per ascus, are both extremely variable. I see no evidence that the cells separate at the septa at maturity.

Figure 1 illustrates Ravenel Fungi Caroliniani II - 54 (CUP-D-6326), which was issued as *Stictis pupula* Fr. but is *P. simulans*.

Examination of the other species of *Platysticta*, *P. magnifica*, reveals that it is a typical Thelotremataceous lichen referable to the genus *Ocellularia*. It is accordingly transferred to that genus and briefly redescribed.

OCELLULARIA MAGNIFICA (Berk. & Br.) Sherwood comb. nov.(Fig. 2)

≡ *Platygrapha magnifica* Berk. & Br. J. Linn. Soc. Bot. *14*:110. 1875

≡ *Platysticta magnifica* (Berk. & Br.) Cooke & Massee Grevillea *17*: 94. 1889

Thallus thin, entirely within the substrate, indicated by a greenish-yellow discoloration of the bark. Apothecia 2-5 mm in diameter, bright orange, not sunken in thalloid warts, with a dark margin composed mainly of discolored bark. Columella absent. The orange color is derived from the orange color of the bark beneath the hymenium rather than from hymenial pigments. Paraphyses scarcely exceeding the asci, 1.0μm thick, 1-2 times branched above, giving the apothecial disc a pruinose appearance. Asci 150-160 x 14-18μm, very thick walled when young, moderately thick walled when mature, with an apical cap 5-6μm thick. Hymenium J-. Spores 100-120 x 10-12μm, circa 20-septate with lenticular cells, staining faintly purple in Melzer's reagent.

TYPE: (Herb. K) D. Thwaites, Ceylon. "C. L[eighton]204 (624 to Berk."

In this material many asci contain spores some of whose cells are disintegrating or aborted. Evidently Berkeley interpereted this as disarticulation at the septa.

The above species has a distinct, although inconspicuous thallus, and this, as well as the characteristic spores with lenticular cell lumen and walls which stain purple in iodine solutions, place it unambiguously in the Thelotremataceae, a family considered by many lichenologists to belong in the Ostropales. All known representatives of the non-lichenized Ostropales [Ostropaceae, sensu Nannfeldt(1932)], and the Lichen genus *Conotrema* Tuck., whose resemblance to *Stictis* Pers. has been well documented (Gilenstam, 1974), have spores with a cylindrical cell lumen and thin or uniformly thickened

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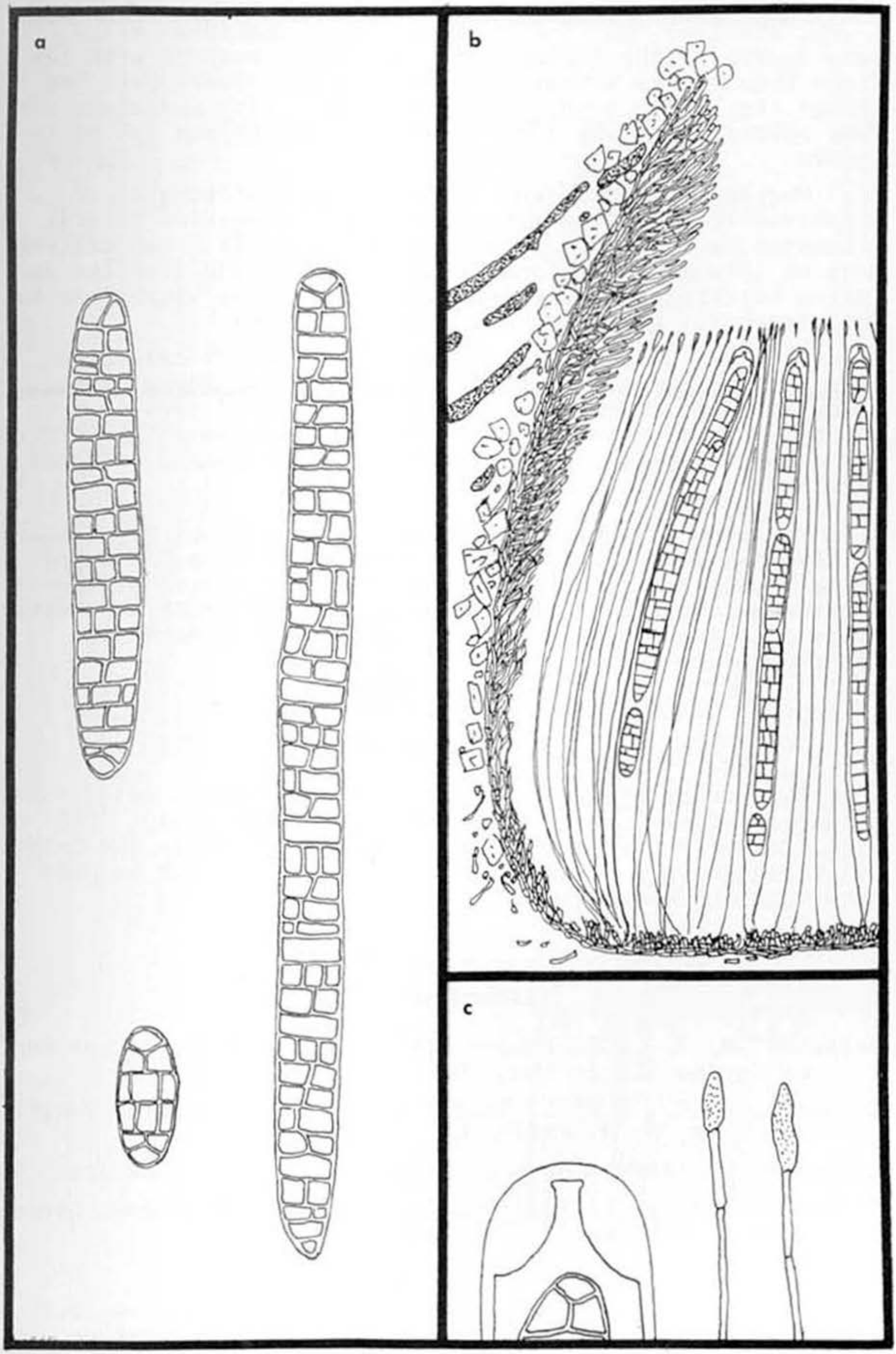
Figure 1. *Platysticta simulans*. a. Ascospores, x750. b. Vertical section at the margin, x225. c. Apex of ascus and two paraphyses, x1500. Drawn from CUP-D-6326.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walls which do not stain purple in iodine solutions. *Platysticta simulans,* and the unnamed fungus mentioned below, have spores of the latter type, and this, coupled with the close resemblance between *P. simulans* and *Lichenopsis,* excludes the Lichen genus *Thelotrema* Ach., with colorless muriform spores, from the list of possible synonymns for *Platysticta.*

Muriform spores occur elsewhere in the Ostropales. Gilenstam (1974) illustrates *Conotrema harmandii* (Pitard) Gilenstam, a muriform-spored species known from two collections on *Ilex* from the Canary Islands. Judging from the detailed descriptions provided, this species is very close to the phragmosporous *Conotrema urceolatum* Tuck.

Figure 3 illustrates a fungus (CUP 54717) collected near Austin, Texas. In this case the normal form, presumably a small *Stictis,* is unknown. The sequence of septation in the muriform spores is unlike that in *Thelotrema,* in which the immature spores resemble those of *Ocellularia* as shown in figure 2-b.

The genus *Platysticta,* which is typified by *P. simulans,* an abnormal form of *Lichenopsis sphaeroboloidea,* is based primarily on a misinterpretation (that the spores of the two species disarticulate at the septa), is not synonymous with *Melittosporium,* and should be treated as a synonymn of *Lichenopsis.*

ACKNOWLEDGEMENTS

The author wishes to thank J. P. M. Brennan (K) for loaning specimens, R. T. Jackson for his collection (CUP 54717) from Texas, Don Pfister (FH) for specimens and helpful bibliographic suggestions, and R. P. Korf for help in preparing the manuscript.

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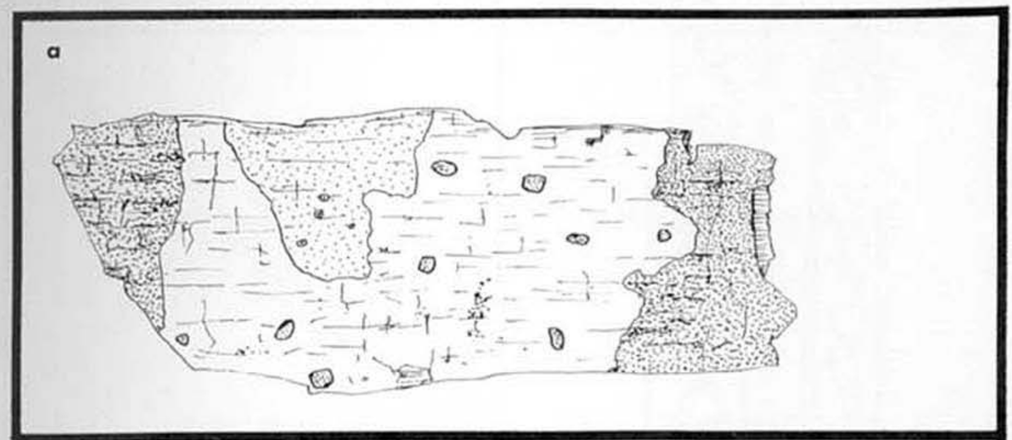
Gilenstam, Gunnar (1974). Studies in the lichen genus Conotrema. Ark. Bot. *7*(2-3):149-179.

FIGURE 2. *Ocellularia magnifica.* a. Habit sketch, x0.75. b. Immature, mature, and disintegrating asci, and a mature ascospore, x750. Drawn from the type.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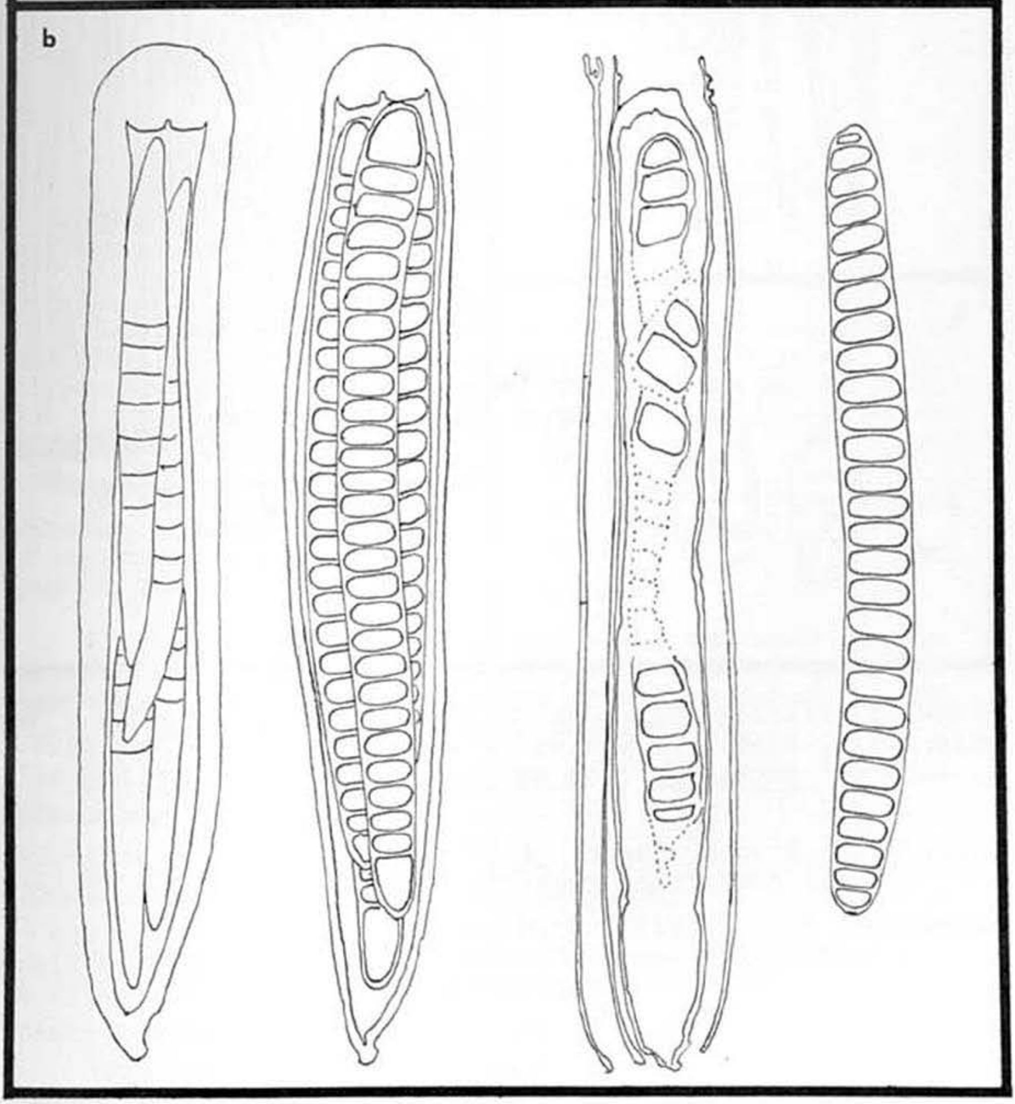
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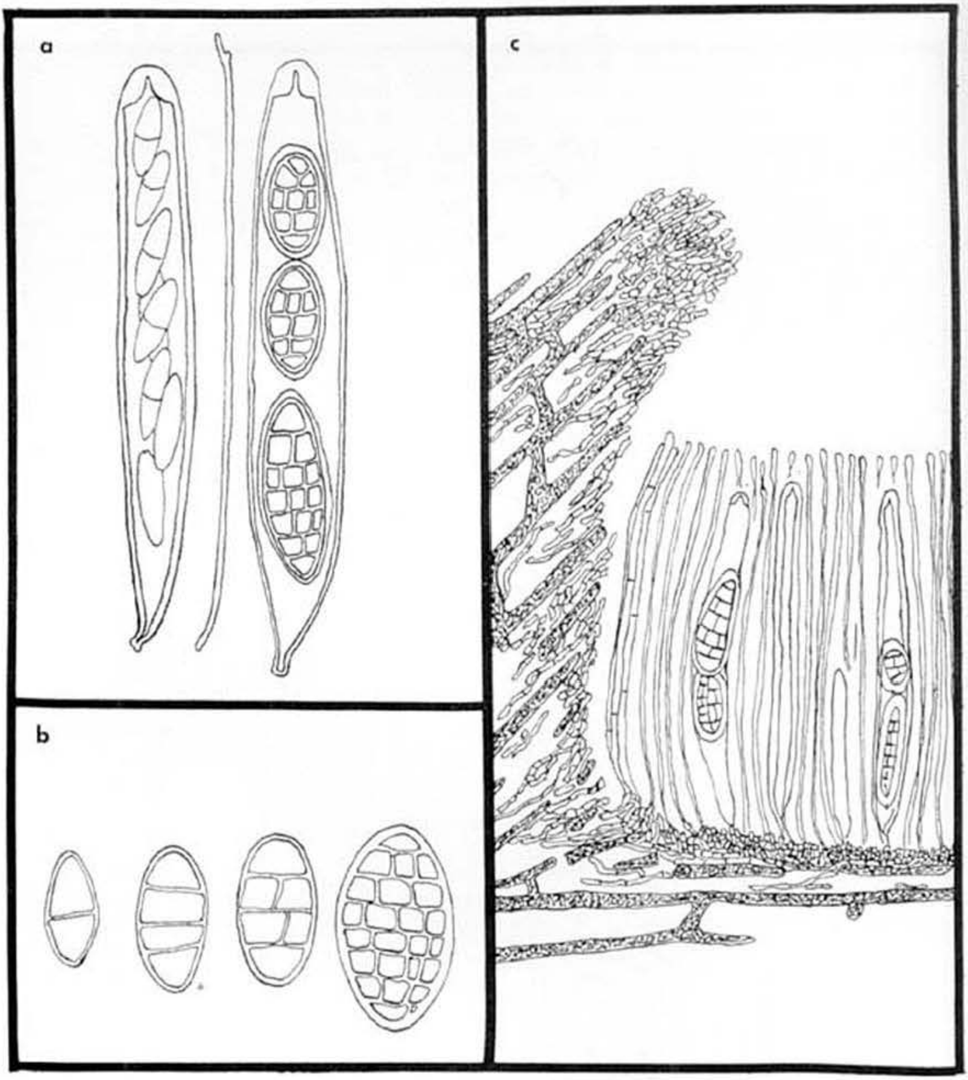

FIGURE 3. *Stictis?* sp. a. Young and mature asci, and a paraphysis, x750. b. Stages in ascospore maturation, x750. c. Vertical section at the margin, x375. Drawn from CUP 54717.

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SPECIFIC AND INFRASPECIFIC NAMES FOR FUNGI USED IN 1821.

PART III. D - G.[1]

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Summary

Data on publication dates of several 1821 and pre-1821 works are reviewed, additional pre-1821 literature is listed, and appropriate fungus names, D-G, are summarized.

Since publication of the last portion of this review series, no additional 1821 literature has been uncovered (but see below). In a letter, however, Dr. D. P. Rogers has brought forward several facts not previously known to me, and has generously allowed me to use the information here.

1. Persoon, C. H. "1822." Abhandlung über die essbaren Schwämme. Heidelberg. [Translation by J. H. Dierbach]. This volume was mentioned in Hinrichs Verzeichnis. 1821. July-December, page 68, indicating possible appearance in 1821.

2. ENA and NNA (see part 1 of this series for codes) appeared in part I of "Nova Acta." Volume 10 was distributed in two parts, apparently divided by a rule before the title beginning on page 257. The first part was mentioned in the following:

Sprengel, K. 1822. Neue Entdeckung im ganzen Umfang der Pflanzenkunde 3: 283-285.

As "Tom 10. Pars I. Bonn. 1820. 254 S. in Quart." These two references (ENA, NNA) therefore, may be pre-1821.

3. The following has not been seen by me, and I request any information or xerox copy of appropriate pages.

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[1] This paper represents contribution no. 457 from the Botanical Laboratories, University of Tennessee.

Capelli, C. 1821. Catalogus stirpium quem aluntur in Regio Horto Botanico Taurinense. Augstae [sic] Taurinorum.

4. POM 2, dated by me as 1799 (from the title page), also bears the following on the leaf facing the title page: "Animadversiones et dilucidationes circa varias fungorum species ... 1800." The date of publication, therefore, is uncertain.

5a. The *latest* date of publication of Gray's "Natural Arrangement" was December 21, 1821, minus time for delivery from London to Glasgow.

b. Hooker's "Flora Scotica" was published *no later* than May 10, and *after* April 10. The relative appearance dates of Hooker and St.-Amans are therefore uncertain.

6. Some copies of FO 2 include an introduction. Full citation should include X + 376 pp + pls. V-VIII.

7. PD was first published as "Dispositio methodica fungorum" in "Neues Magazin für die Botanik (Römer) 1: 81-128, pls. I-IV. 1794." With only a change in pagination, this became pages 1-48 of "Tentamen." Pages 49-76 were a supplement to this.

Noting my confusion over the publication dates of Bulliard's plates (see part II of this series), Dr. G. C. Ainsworth kindly has referred me to the following two references, which have proved of much help in this and the related matter:

Gilbert, E. J. 1952. Un espirit - une oeuvre. Bulliard, Jean Baptiste Francois, dit Pierre (1752-1793). Bull. Soc. Mycol. France 68: 5-131.

Ramsbottom, J. 1933. Dates of publication of Sowerby's English Fungi. Brit. Mycol. Soc. Trans. 18: 167-170.

In addition the following can also be supplied:

Dick 2: 25 *sub Clavaria farinosa* cites HBR. Both were published ostensibly in the same year, but obviously HBR appeared before Dick 2. Moreover, Dick 2 was reviewed in Ann. Bot. 4: 101. 1793.

More pre-1821 Mycological Literature

Agh Agardh, Caroli A. 1817. Synopsis algarum scandinaviae.
xl + 135 pp.

All Allioni, Carolo. 1785. Flora Pedemontana sive enumeratio methodica stirpium indigenarum pedemontii.
Tom. 1. Augustae Taurinorum. xix + 344 pp.
Tom. 2. Augustae Taurinorum. 366 pp.
[fungi: 337-360] + xxiv indexes
Tom. 3. Augustae Taurinorum. xiv + 94 pls.

Brot Brotero, Felicis Avellar. 1804. Flora Lusitanica, seu plantarum, quae in Lusitania vel sponte crescunt, vel frequentius coluntur, ex florum praesertim sexubus systematice distributarum, synopsis. Olissipone.
Vol. 1. xviii + 607 pp.
Vol. 2. 557 pp.

BrP Brotero, F. A. Phytographia Lusitaniae selectior, seu novarum, rariorum, et aliarum minus cognitarum stirpium, quae in Lusitania sponte veniunt, ejusdemque floram spectant, descriptiones iconibus illustratae. Olisipone.
Tom. 1. 1816. 235 pp + 82 pls.
[Tom. 2. 1827. 263 pp + pls. 83-181.]

Ehren Ehrenberg, C. G. 1818. Sylvae mycologicae Berolinenses. Berolini. 32 pp + 1 pl.
[Asher reprint, 1972]

GUN Gunner [i], Jo. Ern. Flora Norvegica, observationibus praesertim oeconomicis, panosque norvegici locupletata.
Pars prior. 1766. Nidrosiae. 96 pp + index
Pars posterior. 1772. Hafniae. 148 pp + index + 9 pls.

Holm Holmskjold, T. 1796. Coryphaei. Clavarias Ramariasque complectentes cum brevi Structurae interioris Expositione. Neue Ann. Bot., Usteri 11: 30-149.

Mey Meyer, Georgio Friderico Wilhelmo. 1818. Primitiae Florae Essequeboensis adjectis descriptionibus centrum circiter stirpium novarum, observationibusque criticis. Gottingae. 316 pp + 2 pls.

PAB Persoon, C. H. 1794. Nähere Bestimmung und Beschreibungen einiger sich nahe verwandter Pflanzen. Neue Ann. Bot., Usteri 5: 1-32.

Paul Paulet, Jean Jacques. 1793. Traité des champignons, ouvrage dans lequel, on trouve aprés l'histoire analytique and chronologique des découvertes and des travaux fur ces plantes, fuivie de leur synonimie botanique and des tables nécessaires, la description détaillée, les qualités, les effets, les différens usages non-seulement des champignons proprement dits, mais des truffes, des agarics, des morilles, and autres productions de cette nature, avec une fuite d'expériences tentées fur les animaux, l'examen des principes pernicieux de certaines espèces, and les moyens de prévenir leurs effets ou d'y remédier; le tout enrichi de plus de deux cents planches où ils sont représentés avec leurs couleurs and en général leurs grandeurs naturelles, and distribués suivant une nouvelle méthode. Paris.
Vol. 1. 629 pp.
Vol. 2. 476 pp + index

[Virtually no Latin names are used in the body of the text, but such names can be found and correlated, with difficulty, in the index. Copy at NY.]

PNT Pici, Victorii. 1788. No overall title, but see below. Augustae Taurinorum. 283 pp + 2 pls.
[This appears to be a thesis defended in Taurin, with the following chapter headings:
Ex physica de fungorum generatione
Ex materia medica de fungis
Ex anatome deglutitionis organa
Ex physiologia deglutitio
Extheorica de symptomatibus quae fungorum venanatorum esum consequi solent
Ex praxi de ratione medendi iis qui a fungis veneficis male habent]

Poll Pollini [us], Cyrus. 1816. Horti et provinciae Veronensis plantae novae vel minus cognitae, quas descriptionibus et observationibus exornavit.
Facs. 1. Ticini. 39 pp + 2 pls.
[Reprint from: Giorn. Fisica, Chim. and Stor. Nat. Med. and Arti di Pavia, vol. 9. Copy at NY bound separately]

RC Roth, Alberto. [Albrecht] Guilielmo. Catalecta botanica quibus plantae novae et minus cognitae describuntur atque illustrantur.
Vol. 1. 1797. Lipsiae. viii + 251 pp.
Vol. 2. 1800. Lipsiae. 258 pp.
Vol. 3. 1806. Lipsiae. 350 pp [no fungi]

REB Rebentisch, Joanne Frid. 1805. Index plantarum circum Berolinum sponte nascentium adiectis aliquot fungorum descriptionibus. Berolini. iv + 46 pp.
[Copy at NY]

Relh Relhan, Richard. 1785. Flora Cantabrigiensis, exhibens plantas agro Cantabrigiensi indigenas, secundum systema sexuale digestas, cum characteribus genericis, diagnosi specierum, synonymis selectis, nominibus trivialibus, loco natali, tempore inflorescentiae. Cantabrigiae. introd. + 490 pp.

RelS Relhan, Richard. Florae Cantabrigiensi supplementum.
Supplement. 1786. Cantabrigae. 39 pp.
Supplementum Alterum. 1788. Cantabrigiae. 36 pp.
Supplementum tertium. 1793. Cantabrigiae. 44 pp.
[All parts include fungi. Bound together with Relh at NY.]

Rum Rumphius, Georgii Everhardi. Herbarium Amboinense, plurimas conplectens arbores, frutices, herbas, plantas terrestres and aquaticas, quae in Amboina, et adjacentibus reperiuntur insulis, adcuratissime descriptas juxta earum formas, cum diversis denominationibus, cultura, usu, ac virtutibus. Quod and insuper exhibet varia insectorum animaliumque

genera, plurima cum naturalibus eorum figuris depicta. Omnia magno labore ac studio multos per annos conlecta, and duodecim conscripta libris. Nunc primum in lucem edita, and in Latinum sermone versa.
Pars sexta. Amstelaedami. 1750.

Scop Scopoli, Joannis Antonii. 1772. Flora Carniolica, exhibens plantas Carnioliae indigenas et distributas in classes, genera, species, varietates, ordine Linnaeano.
Tom. II. Vindobonensis. 496 pp + index + pls. 33-65.

SIN Swartz, Olavi. 1797. Flora Indiae Occidentalis aucta atque illustrata sive descriptiones plantarum in prodromo rescensitarum. Erlangae. 1940 pp.
[Continuously paged in 4 volumes. Fungi: pp. 1920-1940. Copy at NY]

SMH Schmidt, J. C. 1817. Neue Arten, von der Herausgebern beschreiben. Mykol. Hefte 1: 67-92.

TRAT Trattinnick, Leopoldus. Fungi Austriaci, iconibus illustrati. Descriptiones ac historiam naturalem completans. [Also: "Oesterreichs Schwämme, in sein ausgemahlten Abbildungen dargestellt."]
Lieferung 1. "1805" [1804] Wien. 35 pp.
Lieferung 2. 1805 Wien, Baden, Triest pp. 37-76
Lieferung 3. 1805 Wien, Baden, Triest pp. 77-98
Lieferung 4. 1805 Wien, Baden, Triest pp. 99-124
Lieferung 5. 1805 Wien, Baden, Triest pp. 125-154
Lieferung 6. 1806 Wien, Baden, Triest pp. 155-202

[The following notes occur in the NY copy: "Lieferung 1-4 had appeared before 15 May 1805 (see Bot. Zeit. Regensb. 4: 202-204. 15.v.1805). *Probably* the entire work appeared in 1805, except the last lieferung, and this in 1806." "In his introduction to the 2nd edition, the author states that lief. 1 appeared toward the end of 1804 - D. P. R[ogers]."]

WEB Weber, Georgii Henrici. 1778. Spicilegium florae Goettingensis. Plantas inprimis cryptogamicas hercyniae illustrans. Gothae. Introd. + 288 pp + index + 5 pls.

-- D --

dasypus (Agaricus) Fr: 50 ← [PS: 348]
dealbatus (Agaricus) Fr: 92, not 93 ← [SEF: no. 123, pl. 123]
decastes (Agaricus) Fr: 49 ← [FO 2: 105]
decipiens (Agaricus) Fr: 236 ← [PS: 298-299]
decipiens (Hydnum) SA: 546 ← [DC 2: 112-113]
decipiens (Sphaeria) M: 139 ← [DC 2: 285]
decolorans (Agaricus) Fr: 56, nom. nov
decolorans (Sphaeria) FSS: no. 184, H: 6-7 ← [PD: 3 :] Fr 2: 412
decomponens (Sphaeria) G: 530 ← [SEF: no. 217, pl. 217]
decorticans (Sphaeria) P: 279, Schl: 59 ← [SEF: no. 137, pl. 137 † "decorticata"]
decorticata (Nemania) G: 517 ← [SEF: no. 137, pl. 137 (Sphaeria)]
decorticata (Sphaeria stigma [var.]) H: 5 ← [SEF: no. 137, pl. 137 (Sphaeria ____)]
decorus (Agaricus) Fr: 108, nom. nov.
delicata (Clavaria subtilis [var.]) Fr: 475, var. nov.
delicatus (Agaricus) Fr: 23, sp. nov.
deliciosus (Agaricus) Fr: 67, R: 28, N&B: 325, SA: 564-565, L: 472, P: 188-189, M: 54 ← [LSpPl: 1641]
deliciosus (Agaricus lactifluus) Z: 314 † ← [LSpPl: 1641 (Agaricus ____)]
deliciosus (Agaricus (Lactifluus)) K: 8-9 ← [LSpPl: 1641 (Agaricus ____)]
deliciosus (Lactarius) G: 624 ← [LSpPl: 1641 (Agaricus)]
deliquescens (Agaricus) (as "A. copr. ____"): Fr: 309 ← [BH: 409, pl. 558, fig. 1]
deliquescens (Agaricus) SA: 568, N&B: 320, M: 57 ← [BH: 409, pl. 437, fig. 2, pl. 558, fig. 1]
deliquescens (Tremella) P: 177-178, M: 28, SA: 536 ← [BH: 219, pl. 455, fig. 3]
dematium (Sphaeria) FSS no. 202 ← [PS: 88]: Fr 2: 505
demissus (Agaricus) Fr: 157, sp. nov.
dendritica (Byssus) G: 552 ← [Agh: 96 (Conferva)]
dendroides (Botrytis) M: 14, N&B: 367 ← [BH: 105, pl. 504, fig. 9 (Mucor)]
denigratus (Agaricus) Fr: 30 ← [PS: 267]
dentatum (Phacidium) Schl: 58 ← ["Moug[eot]"]
dentatus (Agaricus) HFD 12: t. 1735, fig. 2 ← [Sae 2: 284]
denticulatus (Agaricus) Fr: 112 ← [Sae 2: 327]
denticulatus (Agaricus pratella) Z: 312 † ← [Bolt: 4, pl. 4 (Agaricus ____)]
denticulatus (Prunulus) G: 630 ← [Bolt 4: pl. 4 (Agaricus)]
depallens (Agaricus) Fr: 58 † ← [PS: 440]
depexus (Agaricus) Fr: 230 ← [FO 2: 53]

depluens (Agaricus) Fr: 275 ← [BEFC 1: 167, pl. 122]
depressa (Sphaeria) P: 490 ← [Bolt: 122, pl. 122, fig. 1]
depressum (Peripherostoma) G: 515 ← [Bolt: 122, pl. 122, fig. 1 (Sphaeria)]
depressum (Peripherostoma fuscum [var.]) G: 514, var. nov.
destructor (Polyporus) Fr: 359 ← ["Schrader spic. 166" (Boletus)]
destruens (Poria) G: 639, nom. nov. ← ["Schrader spic. 166" (Boletus "destructor")]
destruens (Serpula) G: 637 ← [PS: 496]
detonsus (Agaricus) Fr: 232, sp. nov.
deusta (Nemania) G: 516 ← [Hoffm 1: 3, pl. 1, fig. 2 (Sphaeria)]
deusta (Sphaeria) LD 22: 386, Schl: 59, H: 5, M: 138, SA: 520, N&B: 297 ← [Hoffm 1: 3, pl. 1, fig. 2]
devexus (Agaricus) Fr: 158 †, sp. nov.
diaphana (Odontia) G: 651 ← ["Schrader spic. 178" (Hydnum)]
diaphana (Pistillaria) Fr: 498 ← [Sae 2: 405 (Clavaria)]
diaphanum (Hydnum) Fr: 418 ← ["Schrader spic. 178"]
diatretus (Agaricus) Fr: 83 ← [FO 2: 200]
dichotoma (Rhizomorpha) P: 306 ← [SEF: no. 298, pl. 298]
dichrous (Agaricus) Fr: 202 ← [PS: 343]
dichrous (Polyporus) Fr: 364 ← [FO 1: 125]
dicksoni (Mitrula) G: 660, sp. nov.?
dictyorhizus (Agaricus) Fr: 192 ← ["DC 2: 594" - not found]
difforme (Geoglossum) Fr: 489 ← [FO 1: 159]
difformis (Agaricus) Fr: 170 ← [PS: 462]
diffusa (Nemania) G: 517 ← [SEF: no. 373, pl. 373, fig. 10 (Sphaeria)]
digitaliformis (Agaricus) M: 57, N&B: 321, L: 472 ← [BH: 435, pl. 22, pl. 525, fig. 1]
digitata (Monilia) SA: 527, L: 466 ← [PS: 693]
digitata (Mucor) H: 34 ← [PS: 693 (Monilia)]
digitata (Monilia penicillata var. Mucor ____) M: 14 † ← [PS: 693 (Monilia ____)]
digitata (Sphaeria) Schl: 59, P: 495, SA: 520 ← [LSpPl: 1652 (Clavaria)]
digitatiformis (Agaricus) SA: 567 ← [BH: 435, pl. 525, fig. 1, "digitaliformis"]
digitatum (Hypoxylon) G: 513, M: 138 ← [LSpPl: 1652 (Clavaria)]
digitatum (Xylodon) G: 649 ← [PS: 553]
dillwynii (Typhoderma) G: 559, nom. nov.
dimidiata (Helvella) P: 238 ← [BH: 290, pl. 498, fig. 2]
dimidiatus (Agaricus inconstans var.) M: 51 ← [Sch 4: 57 (Agaricus ____)]
dimidiatus (Agaricus inconstans [var.]) SA: 560 ← [Sch 4: 57 (Agaricus ____)]

disciforme (Corynium) Schl: 57 ← ?
disciformis (Nemania) G: 518 ← [Hoffm 1: 15, pl. 4, fig. 1 (Sphaeria)]
disciformis (Sphaeria) N&B: 298, H: 5, Schl: 59, M: 141 ← [Hoffm 1: 15, pl. 4, fig. 1]
disciformis (Thelephora) Fr: 443, Schl: 59 ← [DC 6: 31]
discoideus (Agaricus) Fr: 33 ← [PS: 365]
discolor (Hydnum) Fr: 411, nom. nov.
dispersa (Sphaeria) Schl: 59, sp. nov.?
dispersa (Thelephora) Schl: 59, sp. nov.?
disseminatus (Agaricus) Fr: 305 ← [PCS: 87]
disseminatus (Agaricus coprinus) Z: 113 † ← [PCS: 87]
disseminatus (Coprinus) G: 634-635 ← [PCS: 87 (Agaricus)]
ditopus (Agaricus) Fr: 171 ← [FO 1: 91 †]
diversidens (Hydnum) Fr: 411, sp. nov.
djamor (Agaricus) Fr: 185, not 188 ← ["Fries" ← Rum 5: 125 "djanior" †]
doliolum (Sphaeria) H: 7, P: 283, ← [PIC 2: 39, pl. 10, figs. 5, 6]
doliorum (Sphaeria) Schl: 59 ← [PIC 2: 39, pl. 10, figs. 5, 6, "doliolum"]
domestica (Himantia) Schl: 57, LD 21: 164 ← [PS: 703]
domestica (Peziza) G: 666 ← [SEF: no. 351, pl. 351]
domestica (Thelephora) Fr: 451 ← [PS: 703 (Himantia)]
domesticus (Agaricus) P: 232 ← [Bolt: 26, pl. 26]
domesticus (Agaricus, as "A. copr. ____") Fr: 311 ← [Bolt: 26, pl. 26 (Agaricus ____)]
domesticus (Coprinus) G: 635 ← [Bolt: 26, pl. 26 (Agaricus)]
dorsalis (Agaricus) Fr: 184 ← [Bosc: 85, pl. 4, fig. 4]
dryadeus (Boletus) G: 642 ← [PS: 537 (B. fomentarius [var.] ____) ← POM 2: 3 (B. "drijadeus")]
dryadeus (Polyporus) Fr: 374 ← [POM 2: 3, (Boletus "drijadeus")]
dryina (Sphaeria) G: 529 ← [PS: 58]
dryinus (Agaricus) Fr: 180 ← [PCS: 96]
dryophilus (Agaricus) Fr: 124, Schl: 56, SA: 573, M: 66, G: 612 ← [BH: 470, pl. 434]
dryophillus (Agaricus) H: 24, P: 228-229 ← [BH: 470, pl. 434 "dryophilus"]
dubia (Tremella amethystea var.) M: 28 ← [PCS: 127 (Acrospermum ____)]
dubia (Nemaspora) G: 532 ← [SEF: no. 375, pl. 375, fig. 7 (Sphaeria)]
dubium (Coryne) G: 595 ← [PCS: 127 (Acrospermum)]
dulcis azonus (Agaricus subdulcis var.) M: 54 † ← [not BH: 493]
dulcis zonatus (Agaricus subdulcis var.) M: 54 † ← [not BH: 493]
dunaldi (Agaricus) SA: 575 ← [DC 6: 47, "dunalii"]
dunalii (Agaricus) Fr: 176 ← [DC 6: 47]

duplex (Exormatostoma) G: 523 ← [SEF: no. 375, pl. 375, fig. 4 (Sphaeria)]
dura (Daedalea quercina [var.]) G: 638, var. nov.?
durum (Sclerotium) FSS: 218, Schl: 59, SA: 617, H: 10 ← [PAB: 31]
dycmogalus (Agaricus) M: 53, L: 472, SA: 563 ← [BH: 503, pl. 584]
dyctiorhysus (Agaricus) M: 87 ← ["DC 2: no. 560" not found]

-- E --

ebuli (Hymenella) FSS no. 216 ← ["Fries"]: Fr 2: 234
eburneus (Agaricus) Fr: 33, N&B: 316, R: 37, P: 392, M: 70, SA: 575-576 ← [Bolt: 4, pl. 4, fig. 2]
eburneus (Agaricus gymnopus) Z: 91 † ← [Bolt: 4, pl. 4, fig. 2 (Agaricus ____)]
eburneus (Gymnopus) G: 610 ← [Bolt: 4, pl. 4, fig. 2 (Agaricus)]
echinatus (Agaricus) Fr: 286 ← [RC 2: 255 ← Gun 2: 125, pl. 7, fig. 6]
echinophila (Peziza) M: 23-24 ← [BH: 235, pl. 500, fig. 1]
echinus (Hydnum) Fr: 410 ← ["PCC: 26" (Hericium)]
ectypus (Agaricus) Fr: 108, sp. nov.
edule (Leccinum) G: 647 ← [BH: 322, pl. 60, 494 (Boletus)]
edulis (Agaricus) L: 473, M: 61, SA: 570-571, N&B: 322, R: 32 ← [BH: 630, pls. 137, 514]
edulis (Agaricus [Pratella]) K: 16-17 ← [BH: 630, pls. 137, 514 (Agaricus ____)]
edulis (Boletus) Fr: 392, LD 20: 181, M: 44-45, L: 470-471, SA: 553-554, K: 23-24, P: 438, N&B: 335, R: 22 ← [BH: 322, pls. 60, 494]
edulis (Pratella) G: 626 ← [BH: 630, pls. 137, 514 (Agaricus)]
elastica (Helvella) LD 20: 513, M: 29-30, Schl: 57, SA: 537, N&B: 346 ← [BH: 299, pl. 242]: Fr 2: 21
elasticus (Agaricus crassipes var.) P: 199 ← [With 4: 313 (Agaricus ____)]
elatinum (Hysterium) Schl: 58 ← PS: xxviii ← ["Acharius Lich. Suec. p. 22" (Opegrapha)]
elatus (Agaricus) Fr: 248 ← [BEFC 2: 11]
elegans (Agaricus) Fr: 149 ← [PS: 391]
elegans (Daedalea) Fr: 335 ← ["Sprengel V.A.H. 1820: 51"]
elegans (Thamnidium) G: 560, MNA: 507 ← [LM 3: 31]
elegans (Thelephora) Fr: 430 ← [Mey: 305]
elegans (Clavaria coralloides var.) P: 269-270, var. nov. ← [Bolt: 115, pl. 115 (Clavaria ____)]
elegans (Didymocrater) MNA: 510 ← ["Fl. Crypto. Erlangsi, p. 363"]
elephantinum (Leccinum) G: 648 ← [With 4: 412 (Boletus)]

elephantinus (Agaricus) P: 203-204, H: 20 ← [Bolt: 28, pl. 28]
elephantinus (Omphalia adusta [var.]) G: 614 ← [Bolt: 28, pl. 28 (Agaricus ____)]
eleutheratorum (Isaria) G: 563 ← ["NS 2: 23"]
elixa (Omphalia) G: 614 ← [SEF: no. 172, pl. 172 (Agaricus)]
elodes (Agaricus) Fr: 196, not 198, nom. nov.
elongata (Byssus) M: 12 ← [DC 2: 67]
elongatum (Hysterium) LD 22: 401 ← [WFL: 523]
elongatus (Agaricus mycena) Z: 102 † ← [PIC 1: 3-4, pl. 1, fig. 4 (Agaricus ____)]
elveloides (Clavaria) K: 34-35 ← ["Jacquin"]
embolus (Mucor) H: 14 † ← [With 4: 482]
emetica (Russula) G: 618 ← [Sch 4: 9 (Agaricus)]
emeticus (Agaricus) Fr: 56, Re: 53, R: 26 ← [Sch 4: 9]
emeticus (Agaricus russula) Z: 351 † ← [Sch 4: 9 (Agaricus ____)]
encephalium (Gyraria) LD 22: 306 ← ["Link"]
entomorhiza (Xylaria) G: 511 ← [Dick 1: 22 (Sphaeria)]
ephebeus (Agaricus) Fr: 238 ← ["FO 2: 187," not found]
ephemeroides (Agaricus) N&B: 319, L: 472, M: 55, SA: 565-566 ← [BH: 403, pl. 582, fig. 1]
ephemeroides (Agaricus) as "A. copr. ____" Fr: 313 ← [BH: 403, pl. 582, fig. 1]
ephemerus (Agaricus) L: 473, SA: 567, M: 57, N&B: 320 ← [BH: 394, pl. 542, fig. 1]
ephemerus (Agaricus) as "A. copr. ____" Fr: 313 ← [BH: 394, pl. 542, fig. 1]
epibryus (Agaricus) Fr: 275, not 278, sp. nov.
epichysium (Agaricus) Fr: 169 ← [PD: 25]
epidendra (Peziza) SA: 533, Schl: 58, L: 467, P: 459, M: 24, N&B: 348 ← [BH: 246, pl. 467, fig. 3]
epigaeus (Crepidopus) G: 616-617 ← [PS: 484 (Agaricus) ← POM 2: 47 (Agaricus)]
epiphylla (Isaria) M: 13 ← [PCC: 100]
epiphylla (Leotia) H: 30-31 ← [Dick 3: 22 (Clavaria)]
epiphylla (Sphaeria) Spr: 318 ← ?
epiphyllum (Dematium) H: 34, Schl: 57 ← [PS: 695]
epiphyllum (Micromphale) G: 622 ← [PS: 468 (Agaricus)]
epiphyllus (Agaricus) Fr: 139 † ← [PS: 468, in part]
epiphyllus (Agaricus) L: 474, M: 64, SA: 572 ← [BH: 543, pl. 569, fig. 2]
epiphyllus (Agaricus omphalia) Z: 346 † ← [PS: 468 (Agaricus ____)]
epipterygia (Mycena) G: 619-620 ← [Scop: 455 (Agaricus)]
epipterygius (Agaricus) Fr: 155 ← [Scop: 455]

episphaeria (Sphaeria) P: 491, in obs, Spr: 278, Schl: 59, M: 145 ← [TM 2: 21]
epixylon (Aegerita) M: 15-16 ← [BH: 90, pl. 472, fig. 1 (Reticularia)]
epixylon (Agaricus) M: 50 ← [BH: 382, pl. 581, fig. 2]
epixylon (Egerita) SA: 528-529 ← [BH: 90, pl. 472, fig. 1 (Reticularia)]
equestris (Agaricus) P: 227, H: 24 ← [LSpPl: 1642]
equina (Onygena) M: 127, G: 580 ← ["Willdenow. Berl. 412"]
equina (Peziza) G: 666 ← ["FD: pl. 779, fig. 3"]
equina (Sphaeria) G: 527, sp. nov.?
erebius (Agaricus) Fr: 246, sp. nov.
erebius (Agaricus) SB no. 582, pl. 582, fig. 2 ← [Fr: 246]
erecta (Sphaeria) P: 285-286, sp. nov.
ericaeus (Prunulus) G: 631 ← [PS: 413 (Agaricus)]
ericetorum (Agaricus) Fr: 165 ← [POM 1: 50]
ericetorum (Agaricus) M: 70 ← [BH: 523, pl. 188, pl. 523, fig. 1 "ericeus"]
ericetorum (Clavaria) Schl: 56 ← ["Schmiedel. Ic. Pl: 56; pl. 5"]
ericetorum (Micromphale) G: 622 ← [POM 1: 50 (Agaricus)]
ericeus (Agaricus) Fr: 291 ← [PS: 413]
ericeus (Agaricus) M: 66-67 ← [BH: 523, pl. 188, pl. 551, fig. 1]
ericeus (Agaricus coprinus) Z: 107 † ← [PS: 413 (Agaricus ____)]
ericosus (Agaricus pratensis [var.]) HFD 12: t. 1731, fig. 1 ← [PS: 413 (Agaricus ____)]
ericosus a flavescens (Agaricus pratensis [var.]) HFD 12 †
erinaceus (Hydnum) Fr: 407, LD 22: 95, L: 469, M: 36-37, SA: 545 ← [BH: 304, pl. 34]
eringii (Agaricus) M: 69 ← [DC 6: 47 ← Paul 2: index, cf also p. 133 "eryngii"]
ermineus (Agaricus) Fr: 22, sp. nov.
ermineus (Agaricus) SB: no. 594, pl. 594, fig. 1 ← [Fr 1: 22]
erosus (Agaricus) Fr: 145, sp. nov.
erubescens (Agaricus) Fr: 32, nom. nov.
eryngii (Agaricus) Fr: 84 ← [DC 6: 47 ← Paul 2: index, cf. also p. 133]
eryngii (Agaricus) SA: 575 ← [Paul 2: index, cf. also p. 133]
erysiphe (Sclerotium) H: 10 ← [LSpPl: 1656 (Mucor)]
erythropus (Agaricus) Fr: 122 ← [PS: 367]
erythropus (Boletus) K: 24-25 ← [POM 1: 23]
erythropus (Clavaria) G: 658 ← [PD: 38]
erythropus (Typhula) Fr: 495 ← [PD: 38 (Clavaria)]

escharioides (Agaricus) Fr: 260 ←[FO 2: 131]
eschholzii (Sphaeria) Spr: 310 ← ["EHor"]
esculenta (Helvella) K: 36, P: 453, LD 20: 513 ← [LSp: 1178(Phallus)]
esculenta (Morchella) L: 477, M: 90, G: 661, K: 38, Schl: 58, H: 31, SA: 591, N&B: 346 ← [LSp: 1178 (Phallus)]
esculentus (Agaricus) Fr: 131 ← ["WJ 2: pl. 14, fig. 4"]
esculentus (Agaricus mycena) K: 14-15 †, Z: 103 † ← ["WJ 2: pl. 14, fig. 4"]
esenbeckii (Actidium) G: 509, nom. nov.
essequeboensis (Agaricus) Fr: 175 ← [Mey: 301]
euchrous (Agaricus) Fr: 203 ← [PS: 343]
euonymi (Erysiphe) M: 132 ← [DC 6: 105]
euphorbae cyparissiae (Hypoderma virgultorum var.) M: 152 †
evernius (Agaricus) Fr: 212, not 202 ← [FO 2: 79]
evolvens (Thelephora) Fr: 441 ← [FO 1: 154]
exaratus (Agaricus) P: 231, nom. nov.?
excelsus (Agaricus) Fr: 17, nom. nov.
excoriatus (Agaricus) Fr: 21 ← [Sch 4: 10]
excoriatus (Lepiota procera [var.])G: 601 ← [Sch 4: 10 (Agaricus ____)]
exilis (Agaricus) Fr: 206 ← [FO 2: 95]
expallens (Agaricus) Fr: 172, not 170 ← [PS: 461]
expansum (Hormiscium) LD 21: 430 ← ["Kunze. Mycet. Fasc. 1"]
expansum (Penicillium) G: 553 ← [LM 3: 17]
expansus (Merulius) SA: 558 †, sp. nov.
excissus (Agaricus) Fr: 114, sp. nov.
extinctorius (Agaricus) L: 472, M: 56, SA: 567 ← [BH: 408, pl. 437, fig. 1 ← ?LSpPl: 1643]
extinctorius (Agaricus coprinus) Z: 108 † ← [Bolt: 24, pl. 24 (Agaricus ____)]
extinctorius (Prunulus) G: 632 ← [Bolt: 24, pl. 24 (Agaricus)]

fabarum (Corynoides) G: 654 ← ["SEF: no. 404," not found]
fagicola (Sphaeria lichenoides var.) M: 146, var. nov.?
faginea (Rubigo) G: 555 ← ["LM 3: 16," not found]
faginea (Sphaeria) Schl: 59, M: 142, H: 6 ← [PD: 3]
fagineum (Erineum) M: 16, Schl: 57 ← [POM 2: 102]
fagineum (Hydnum) Fr: 423 ← [PS: 552?]
falcata (Clavaria) Fr: 485 ← [PCC: 31, pl. 1, fig. 3]
fallax (Dermodium) G: 570 ← ["NS 2: 29"]
fallax (Hydnum) Fr: 422 ← [FNS: 39]
fallax (Sphaeria) Spr: 279 ← [PIC 2: 41, pl. 10, fig. 11]
fallax (Thelephora) Fr: 454 ← [PS: 574]
farinacea (Himantia) LD 21: 165 ← [PS: 704]
farinacea (Omphalia) G: 612 ← [Bolt: 64 (Agaricus) ← "HFA: 616"]
farinaceum (Hydnum) Fr: 419, M: 37 ← [PS: 562]
farinaceus (Agaricus) Fr: 188, not 189 ← [Sae: 365]
farinaceus (Agaricus) P: 214, H: 22 ← [Bolt: 64 ← "HFA: 616"]
farinaceus rosellus (Agaricus omphalia) Z: 348 †, nom. nov.
farinellus (Polyporus) Fr: 384, not 584, nom. nov.
farinosa (Clavaria) P: 473 ← [HBR 1: 94, with illust. (Ramaria)]
farinosa (Corynoides) G: 654 ← [HBR 1: 94, with illust. (Ramaria)]
fasciatus (Polyporus) Fr: 373 ← [SIN: 1921 (Boletus)]
fasciculare (Hydnum) Fr: 418, not 413 ← [A&S: 269, pl. 10, fig. 9]
fascicularis (Agaricus) Fr: 288, not 283, P: 196, 216, Schl: 56 ← [Bolt: 29, pl. 29]
fascicularis (Agaricus pratella) Z: 311† ← [Bolt: 29, pl. 29 (Agaricus ____)]
fascicularis (Pratella) G: 627 ← [Bolt: 29, pl. 29 (Agaricus)]
fascinans (Agaricus) Fr: 64, sp. nov.
fastibilis (Agaricus) Fr: 249 ← [PS: 326]
fastidiosa (Thelephora) Fr: 435 ← [PCC: 97]
fastigiata (Clavaria) N&B: 344, H: 29-30, SA: 540, M: 32, P: 268-269 ← [LSpPl: 1652]
favus (Boletus) M: 40 ← [BH: 363, pl. 421 ← ?LSpPl: 1645]
favus (Polyporus) Fr: index, as synonym †
felleus (Agaricus) Fr: 57, sp. nov.
felleus (Boletus) Fr: 394, SA: 554, M: 45 ← [BH: 325, pl. 379]

fenestrale (Byssocladium) G: 551 ← ["LM 7: 36"]
ferruginea (Auricularia) M: 34, P: 455-456 ← [BH: 281, pl. 378]
ferruginea (Clavaria pistillaris var.) M: 30 ← [BH: 211, not pl. 244]
ferruginea (Daedalea) Fr: 339 ← [Sae 2: 373]
ferruginea (Gyraria) G: 593 ← [BH: 281, pl. 378 (Auricularia)]
ferruginea (Nemania) G: 518 ← [POM 1: 66, pl. 5, figs. 1, 2 (Sphaeria)]
ferruginea (Peziza nigra [var.]) SA: 535, var. nov. ← [not BH: 238 †]
ferruginea (Peziza tremelloidea var.) M: 26 ← [BH: 240, pl. 410, fig. 1A]
ferruginea (Sphaeria) H: 6 ← [POM 1: 66, pl. 5, figs. 1, 2]
ferruginea (Thelephora) SA: 543, L: 468 ← [BH: 281, pl. 378 (Auricularia)]
ferruginea (Thelephora) H: 29, Schl: 60 ← [PS: 569]
ferruginea (Tremella) H: 32 ← [BH: 281, pl. 378 (Auricularia)]
ferrugineum (Hydnum) Fr: 403 ← [FO 1: 133]
ferrugineum (Stereum) G: 653 ← [PS: 569 (Thelephora)]
ferrugineus (Hypochnus) LD 22: 368 ← [PS: 569 (Thelephora)]
ferruginosus hortensis (Agaricus coprinus) Z: 112 † ← [PS: 400 †]
ferruginosus lignorum (Agaricus coprinus) Z: 112 † ← [PD: 62]
ferruginosus (Hydnum) Fr: 416 ← [PS: 562]
ferruginosus (Polyporus) Fr: 378 ← [PS: 544 (Boletus) ← ?SSp: 172]
fertilis (Agaricus) Fr: 197 ← [PS: 328]
fertilis (Gymnopus) G: 606, sp. nov. ← [not PS: 328]
fibrillosus (Agaricus) Fr: 297 ← [PS: 424]
fibrosum (Phacidium) FSS no. 162, sp. nov.?: Fr. 2: 113
fibula (Agaricus) Fr: 163, M: 67, P: 412, SA: 573-574 ← [BH: 534, pl. 186, pl. 550, fig. 1]
fibulaeformis (Hymenoscyphus) G: 673 ← [Bolt: 176, pl. 176 (Helvella)]
fibulare (Micromphale) G: 623 ← [PS: 471 ← "SOW no. 45"]
ficoides (Agaricus) R: 37, M: 69 ← [BH: 526, pl. 587, fig. 1]
ficoides (Agaricus) P: 431-432 †, in obs. ← [not BH: 526]
filiforme (Stilbum) M: 18 ← [PAB: 31, pl. 2, fig. 2 "piliforme"]
filiformis (Clavaria) M: 31, LD 21: 166, P: 272-273, SA: 539 ← [BH: 205, pl. 448, fig. 1]
filiformis (Typhula) Fr: 496 ← [BH: 205, pl. 448, fig. 1 (Clavaria)]
filopes (Agaricus) Fr: 142, N&B: 317, M: 63 ← [DC 2: 161 ← BH: pl. 320 only]
fimbriata (Daedalea) Schl: 57, sp. nov.?
fimbriatum (Hydnum) Fr: 421 ← [POM 1: 88 (Odontia)]
fimbriatum (Micromphale) G: 622 ← [Bolt: 61, pl. 61 (Agaricus)]

fimbriatus (Agaricus) Fr: 94, not 44 ← [Bolt: 61, pl. 61]
fimbriatus (Boletus) SA: 552-553, M: 44 ← [BH: 332, pl. 254]
fimbriatus (Polyporus) Fr: index only † ← [PD: 29 (Poria)]
fimetarium (Helotium) LD 20: 509, M: 19, SA: 530 ← [POM 2: 21 †]
fimicola (Agaricus) Fr: 301 † ← [PS: 412]
fimicola (Agaricus coprinus) Z: 111 † ← [PS: 412]
fimiputris (Agaricus) Fr: 300, M: 57-58, SA: 568, P: 223-224, L: 473, N&B: 321 ← [BH: 430, pl. 66]
firma (Calycina) G: 670 ← [PS: 658 (Peziza)]
fissilis (Cantharellus) Fr: 324, not 314, nom. nov.
fistulosa (Agaricus) M: 62-63, SA: 572 ← [BH: 454, pl. 518]
fistulosa (Clavaria) Fr: 479 ← [HBR: 15, with illustr.]
fistulosa (Clavaria) M: 31 ← [BH: 213, pl. 463, fig. 2]
flabellaris (Thelephora) Fr: 433 ← [BEFC 1: 227]
flabellatus (Agaricus) P: 239-240 ← [Bolt: 72, pl. 72, fig. 2]
flabelliformis (Agaricus) Fr: 185, P: 238, H: 24 ← [Sch 4: 20]
flabellus (Agaricus: "flabellaris" of index) Fr: 231, sp. nov.
flaccida (Clavaria) Fr: 471, sp. nov.
flaccidus (Agaricus) Fr: 81, P: 186-187 † ← [SEF: no. 185, pl. 185]
flammans (Agaricus) Fr: 244 ← [BEF: 87]
flammeolus (Agaricus) Fr: 71 ← [Poll: 34]
flava (Clavaria) Fr: 467 ← [Sch 4: 118, pl. 175 ← "Tourn."]
flava (Clavaria) K: 31-32 ← [Sch 4: 118]
flava (Pinuzza) G: 646 ← ["Bolt: 169," not found]
flava (Thelactis) MNA: 507, sp. nov.
flavescens (Agaricus adonis var.) M: 64, var. nov. ← [not BH: 445]
flavescens (Byssus) SA: 525, M: 11-12, L: 466 ← [DC 2: 67]
flavescens (Byssus parietina var.) M: 11, var. nov.
flavida (Spathularia) Fr: 491, G: 663, H: 30 ← [PD: 36]
flavidus (Agaricus) Fr: 250, P: 227-228 ← [Sch 4: 17]
flavidus (Boletus) Fr: 387 ← [FO 1: 110]
flavidus (Mucor) G: 560 ← [PD: 14]
flavipes (Agaricus) P: 231-232 ← [Sib: 365]
flavipes (Clavaria) Fr: 483 ← [PCC: 75]
flavipes (Agaricus mycena) Z: 101 † ← [Sib: 365 (Agaricus ____)]

flavipes (Mycena) G: 619 ← [Sib: 365 (Agaricus)]
flavo-virens (Agaricus gymnopus) Z: 99 † ← [PCS: 16 (Agaricus "flavovirens")]
flavo-virens (Nemania) G: 518 ← [Hoffm 1: 10, pl. 2, fig. 4 (Sphaeria "flavovirescens")]
flavovirens (Agaricus) Fr: 41 ← [PCS: 16]
flavus (Aspergillus) G: 555 ← [LM 3: 16]
flavus (Boletus) P: 439 ← [With 4: 415]
flavus (Cirrolus) MNA: 511, sp. nov.
flexipes (Agaricus) Fr: 212 ← [PS: 275]
flexuosus (Agaricus) Fr: 74 ← [PS: 430 (A. lactifl. ____)]
flexuosus (Lactarius) G: 624 ← [PS: 430 (A. lactifl. ____)]
flexuosus (Agaricus lactifluus) Z: 318 † ← [PS: 430]
floccopus (Boletus) Fr: 393 ← ["Vahl. Delph: 1036"]
floccosum (Hyphasma) N&B: 369, sp. nov.
floccosus (Agaricus) P: 415 ← [Sch 4: 27]
floriformis (Sphaeria) G: 530 ← [SEF: no. 297, pl. 297]
flos (Agaricus) Fr: 177 ← [Mey: 301]
flos aquae (Byssus) Fodere: 249 †
fluxilis (Agaricus) Fr: 189, sp. nov.
fodina (Byssus) M: 12 ← [DC 6: 10]
foenisecii (Agaricus) Fr: 295, not 225 ← [PIC 2: 42, pl. 11, fig. 1]
foenisecii (Prunulus) G: 631 ← [PIC 2: 42, pl. 11, fig. 1 (Agaricus)]
foetens (Agaricus) Fr: 59, not 54, R: 26 ← [POM 1: 102 (Russula)]
foetida (Thelephora puteana var.) Fr: 448 ← [Ehren: 30 (Thelephora ____)]
foetidum (Merisma) G: 654 ← [PCC: 92]
foetidus (Agaricus) Fr: 138 ← [SEF: no. 21, pl. 21 (Merulius)]
foetidus (Agaricus piperatus [var.]) SA: 562, var. nov.?
foetidus (Merulius) P: 391 ← [SEF: no. 21, pl. 21]
foetidus (Phallus) P: 470 ← [SEF: no. 21, pl. 21 (Merulius)]
foliacea (Clavaria) SA: 541, sp. nov.
foliacea (Gyraria) G: 594 ← [POM 2: 98 (Tremella)]
foliorum (Fumago) Schl: 57 ← ["P[ersoon]"]
fomentarius (Boletus) P: 244, G: 641, H: 28 ← [LSpPl: 1645]
fomentarius (Polyporus) Fr: 374 ← [LSpPl: 1645 (Boletus)]
foraminulosus (Agaricus) M: 63 ← [BH: 460, pl. 403, figs. B, C, pl. 535, fig. 1]

foraminulosus (Agaricus mycena) Z: 105 † ← [BH: 460, pl. 403, figs. B, C, Pl. 535, fig. 1 (Agaricus ____)]
formosa ([Agaricus] pseudo-aurantiacus var. amanita ____) M: 87-88 ← POM 2: 37 (Amanita muscaria var. ____)]
formosa (Clavaria) Fr: 466 ← [PIC 1: 11, pl. 3, fig. 5]
formosus (Agaricus) Fr: 208, not 206, sp. nov.
fornicatus (Pleuropus) G: 615 ← [PS: 474 (Agaricus)]
fraceolens (Hydnum) Fr: 402 ← [BrP 1: 202, pl. 82]
fragariae (Xyloma) Schl: 60, sp. nov.?
fragiformis (Peripherostoma) G: 513 ← [Dick 1: 24 (Sphaeria) ← "Scop 2: 399"]
fragiformis (Sphaeria) N&B: 296, P: 485, Schl: 59, H: 4-5 ← [Dick 1: 24 ← "Scop 2: 399"]
fragiformis (Sphaeria bicolor var.) M: 139 ← [Dick 1: 24 (Sphaeria ____) ← "Scop 2: 399"]
fragile (Hydnum) Fr: 417 ← [PS: 561]
fragile (Micromphale) G: 623 ← [LSp: 1175 (Agaricus)]
fragilis (Agaricus) Fr: 269 ← [BEFC 2: 87, pl. 39, fig. 215 ← LSp: 1175]
fragilis (Agaricus) Fr: 57 ← [PS: 440 (A. russ. ____)]
fragilis (Clavaria) Fr: 484 ← [HBR 1: 7, with illustr.]
fragilis (Rhizomorpha) M: 136, L: 485 ← [RC 1: 232 ← "Roth. Usteri's Ann. Bot. 1: 7"]
fragrans (Agaricus) Fr: 171 ← [SEF: no. 10, pl. 10 (not With.)]
fragrans (Agaricus) H: 19 ← [SEF: no. 10, pl. 10]
fragrans (Omphalia) G: 613 ← [SEF: no. 10, pl. 10 (Agaricus)]
fraxinea (Sphaeria) P: 487-488 ← [Relh: 471 ← "HFA no. 641"]
fraxineus (Boletus) M: 41-42 ← [BH: 341, pl. 433, fig. 2]
fraxineus (Polyporus) Fr: 374 ← [BH: 341, pl. 433, fig. 2 (Boletus)]
fraxini (Asteroma) SA: 517 ← [DC 6: 163-164]
fraxini (Erysiphe) Schl: 57, M: 131 ← [DC 2: 273]
fraxini (Hypoderma) M: 152-153, SA: 516, G: 509 ← [PD: 5 (Hysterium)]
fraxini (Hysterium) H: 8, Schl: 58, P: 319-320 ← [PD: 5]
frondescens (Thelephora) Fr: 436, sp. nov.
frondosa (Grifola) G: 643 ← [Dick 1: 18 (Boletus)]
frondosus (Boletus) N&B: 336, P: 440 ← [Dick 1: 18]
frondosus (Polyporus) Fr: 355 ← ["Schrank" ← Dick 1: 18 (Boletus)]
fructigena (Peziza) P: 459, M: 23 ← [BH: 236, pl. 228]
fructigenum (Oideum) ENA: 195 ← [SMH: 80]
fructigenus (Hymenoscyphus) G: 673 ← [BH: 236, pl. 228 (Peziza)]
frumentaceus (Agaricus) Fr: 46, M: 77 ← [BH: 602, pl. 571, fig. 1]

frustulata (Thelephora) Fr: 445, Schl: 60 ← [PS: 577]
frustulosa (Auricularia) M: 34 ← [PS: 577 (Thelephora "frustulata")]
fucatus (Agaricus) Fr: 40, sp. nov.
fugax (Cytispora) FSS no. 211, sp. nov.: Fr 2: 544
fugax (Merulius) Fr: 328 ← [FO 1: 100]
fulgens (Agaricus) Fr: 216 † ← [PC: 10]
fuliginea (Clavaria pistillaris var.) M: 30, nom. nov. ← [BH: 211, polynomial]
fuligineo-album (Hydnum) Fr: 400, "fuligineoalbum" of index ← [SMH: 88, "fuligineo-album"]
fuligineus (Albatrellus) G: 645 ← [PS: 516 (Boletus)]
fuligineus (Merulius hydrolips var.) M: 48 ← [PS: 490, (Merulius ____)]
fuligeneus (Polyporus) Fr: 348 ← [PS: 516 (Boletus)]
fuliginosa (Auricularia reflexa var.) M: 34 ← [BH: 282, pl. 483, fig. 2 "fuliginea"]
fuliginosa (Elvella) LD 20: 513 ← [Sch 4: 113, t. 320]
fuliginosa (Helvella) H: 31, P: 256-257 ← [Sch 4: 113 (Elvella)]
fuliginosa (Nemania) G: 517, sp. nov.?
fuliginosa (Thelephora) Schl: 60, sp. nov.
fuliginosa (Torula) Schl: 60 ← ["P[ersoon]"]
fuliginosum (Dematium) Schl: 57 ← ["Ach[arius]"]
fuliginosus (Agaricus) Fr: 73 ← ["Fries" ← "Krapf. t. 4, figs. 5-7"]
fuliginosus (Boletus) Schl: 56 ← ["Schr[ader]"]
fulva (Helvella mitra [var.]) SA: 537 ← [BH: 298 †, pl. 466]
fulva (Helvella mitra var.) M: 29 ← [BH: 298 †, pl. 466]
fulva (Merulius undulatus var.) M: 48 ← [BH: 293, pl. 465, figs. 1A, D, E (Helvella crispa var. ____)]
fulva (Peziza scutellata var.) P: 460 ← [Relh: 466 ← "HFA no. 636"]
fulvum (Polystigma) SA: 516, M: 151 ← ["Persoon in Mougeot & Nestler. Vog. Crypt. no. 271"]
fulvus (Agaricus) Fr: 37, SA: 579, M: 76 ← [BH: 608, pl. 555, fig. 2, pl. 574, fig. 1]
fulvus (Agaricus pectinaceus var.) M: 52, var. nov. ← [not BH: 599]
fulvus (Agaricus pectinatus [var.]) SA: 562, var. nov. ← [not BH: 599]
fulvus (Agaricus pyxidatus var.) M: 68, var. nov. ← [not BH: 514]
fulvus (Boletus) Fodere: 249, sp. nov.?
fumosa (Clavaria) Fr: 483 ← [POM 1: 31-32]
fumosus (Agaricus) Fr: 88 ← [PS: 348]
fumosus (Hypochnus) LD 22: 368 ← [FO 2: 279-280]
fumosus (Polyporus) Fr: 367 ← [PS: 530 (Boletus)]
fungorum (Dematium herbarum) Schl: 57 ← [PS: 699 (D. herbarum [var.] ____)]

fungorum (Sclerotium) SA: 617 ← ["De Candolle. Mem. Mus. 2: 414"]
furcata (Clavaria) Fr: 486, nom. nov.
furcatus (Agaricus) R: 26 ←[POM 1: 102 ← "Gmelin. Syst. Nat. Linn. II: 1410"]
furcatus (Agaricus) Fr: 59 ← ["Lamarck. Encycl. p. 106" (Amanita)]
furfuraceus (Agaricus) Fr: 262 ← [PS: 454]
furfuraceus (Agaricus) M: 78 ← [BH: 621, pl. 532, fig. 1]
furfuraceus (Ascobolus) H: 33 ←[POM 1: 33]
fusca (Auricularia cariophyllea var.) M: 33 ← [BH: 284, pl. 278 (A. "caryophyllea" var. ____)]
fusca (Auricularia reflexa var.) M: 34 ← [BH: 282, pl. 483, fig. 2]
fusca (Auricularia tremelloides var.) M: 34 ← [BH: 278, pl. 290]
fusca (Clavaria coriacea var.) M: 33, var. nov.?
fusca (Daedalea) Fr: 339 ← ["Link"]
fusca (Helvella elastica var.) M: 29-30 ← [BH: 299, pl. 242, fig. C]
fusca (Helvella mitra [var.]) SA: 537 ← [BH: 298, pl. 190, figs. D, E, pl. 466, fig. E]
fusca (Helvella mitra var.) M: 29 ← [BH: 298, pl. 190, figs. D, E, pl. 466, fig. E]
fusca (Merulius undulatus var.) M: 48 ← [BH: 293, pl. 465, figs. B, C (Helvella crispa var. ____)]
fusca (Morchella esculenta var.) M: 90 ← [BH: 274, pl. 218, figs. E, F, H (Phallus esculentus var. ____)]
fusca (Peziza) M: 19 ← [POM 1: 29]
fusca (Peziza labellum var.) M: 25 ← [BH: 262, pl. 204]
fusca (Peziza stipitata var.) M: 24 ← [BH: 271, pl. 196, figs. A, B, C]
fusca (Sphaeria) N&B: 296, M: 139, L: 486, G: 529, H: 5, Schl: 59 ← [PAB: 22, pl. 2, fig. 3]
fusca (Thelephora) Fr: 451 ← [POM 1: 38 †]
fuscescens (Dasyscyphus) G: 671 ← [PS: 654 (Peziza)]
fusco-atrum (Hydnum) Fr: 416 ← [FNS 1: 39]
fusco-purpureus (Agaricus) Fr: 128, "fuscopurpureus" of index ← [PIC 1: 12, pl. 4, fig. 1]
fusco-violaceum (Hydnum) Fr: 421 ← [Ehren: 30 (Sistotrema)]
fuscum (Peripherostoma) G: 513 ← [PAB: 22, pl. 2, fig. 3 (Sphaeria)]
fuscum (Sporotrichum) G: 551 ← [LM: 12]
fuscus (Hypochnus) Schl: 58 ← [FO 2: 280]
fusiformis (Agaricus) M: 71, sp. nov. ← [BH: 612 †]
fusiformis (Clavaria) Fr: 480, P: 476, G: 657 ← [SEF: no. 234, pl. 234]
fusipes (Agaricus) Fr: 120, N&B: 313, SA: 578-579, M: 71 ← [BH: 612, pl. 516, fig. 2, pl. 106]
fusipes (Gymnopus) G: 604-605 ← [BH: 612, pl. 516, fig. 2, pl. 106 (Agaricus)]

-- G --

galeatum (Helotium) LD 20: 507 ← ["Holmskjold. Coryphaei p. 25"]
galeopsidis (Erysiphe) M: 134 ← [DC 6: 108]
galericulata (Mycena) G: 619 ← [Scop: 455 (Agaricus)]
galericulatus (Agaricus) P: 413 ← [Scop: 455]
galericulatus (Agaricus mycena) Z: 100 † ← [Scop: 455 (Agaricus ____)]
galii (Hypoderma virgultorum var.) M: 152, var. nov.?
geicola (Sphaeria lichenoides var.) M: 146, var. nov.?
gelatinosa (Helvella) SA: 538, P: 259-260, M: 30 ← [BH: 296, pl. 473, fig. 2]
gelatinosa (Peziza) M: 26 ← [BH: 239, pl. 460, fig. 2]
gelatinosum (Hydnum) LD 22: 95 ← [Scop: 472]
gelatinosum (Steccherinum) G: 651 ← [Scop: 472 (Hydnum)]
gentianae (Erysiphe) Schl: 57, sp. nov.?
geophilus (Agaricus) M: 80 ← [BH: 546, pl. 522, fig. 2]
geophyllus (Agaricus) P: 406 ← [BH: 546, pl. 522, fig. 2 "geophilus"]
georgii (Agaricus) P: 409, H: 21 ← [LSpPl: 1642]
geotropicus (Agaricus) SA: 575 ← [BH: 521, not pl. 573, pl. 400 "geotropius"]
geotropus (Agaricus) M: 69, N&B: 315 ← [BH: 521, pl. 573, fig. 2 "geotropius"]
gibba (Omphalia) G: 612 ← [PS: 449 (Agaricus)]
gibbosa (Daedalea) P: 248-249 ← [POM 1: 21 (Merulius)]
gibbosa (Dothydea) Schl: 57 ← [FOM 2: 349 "gibberulosa" ← "Acharius. sec. spec."]
gigantea (Byssus) M: 12, not 11, SA: 525 ← [TM 1: 36 (Xylostroma)]
giganteum (Xylostroma) P: 508, G: 559 ← [TM 1: 36]
giganteus (Agaricus) P: 400 ← [Sch 4: 37]
gilva (Omphalia) G: 612 ← [PS: 448-449 (Agaricus)]
gilvus (Agaricus omphalia) Z: 348 † ← [PS: 448-449 (Agaricus ____)]
glabra (Agaricus ephemeroides var.) M: 55, var. nov. ← [not BH: 403-404]
glabrum (Geoglossum) LD 18: 357, Schl: 57, G: 658 ← ["PCC: 36"]
glabrum (Helotium) LD 20: 509 ← [TM 1: 22, pl. 4, fig. 35]
glandulosa (Tremella) M: 28, SA: 536, L: 235 ← [BH: 220, pl. 420, fig. 1]: Fr 2: 224
glandulosus (Agaricus) M: 51 ← [BH: 388, pl. 426]
glauca (Monilia) N&B: 367, SA: 526-527, M: 14, H: 33-34 ← [LSP: 1186 (Mucor)]
glaucopa (Cortinaria) G: 629 ← [Sch 4: 23 (Agaricus)]
glaucopus (Agaricus araneosus var.) M: 82, SA: 583, P: 204-205 ← [Sch 4: 23 (Agaricus ____)]

glaucum (Coremium) G: 563 ← [LSP: 1186 (Mucor)]
glaucus (Agaricus) M: 72 ← [BH: 593, pl. 521, fig. 1]
glaucus (Aspergillus) G: 553 ← [LSP: 1186 (Mucor)]
glaucus (Mucor) P: 502 ← [LSP: 1186]
glechomae (Sphaeria) Schl: 59, sp. nov.?
gleditschii (Poronia) G: 515 ← [Willd: 400]
globifera (Cytispora) FSS no. 212 ← ["Fries. V.A.H. 1818: 119" (Bostrychia)]: Fr 2: 546
globosum (Hysterium) LD: 22: 400, Schl: 58 ← [PS: 98]
globulare (Sclerotium) M: 130 ← [DC 2: 278]
glomerata (Sphaeria) Schl: 59 ← ["Ach[arius]"]
glomerulosa (Botrytis) M: 15, SA: 528 ← [BH: 101, pl. 504, fig. 3 (Mucor)]
glomerulata (Sphaeria) SA: 521, M: 140, LD 22: 386 ← [BH: 178, pl. 468, fig. 3 (Hypoxylon)]
glutinosus (Agaricus) SA: 582 ← [BH: 527, pl. 587, fig. 2; pl. 539, pl. 258]
glutinosus ([Agaricus]) M: 81 ← [BH: 527, pl. 587, fig. 2; pl. 539, pl. 258]
gnaphaliocephalus (Agaricus) M: 69-70 ← [BH: 517, pl. 576, fig. 1]
gnomon (Sphaeria) P: 280 ← [TM 2: 50, pl. 16, fig. 125]
gossypinus (Agaricus) M: 56 ← [BH: 419, pl. 425, fig. 2]
gracile (Hysterium) Spr: 310 ← ["Ehor"]
gracilis (Agaricus fistulosus var.) M: 63, var. nov. ← [not BH: 454]
gracilis (Agaricus pratella) Z: 308 † ← [PS: 425 (Agaricus ____)]
gracilis (Clavaria) G: 656, P: 268 ← [Bolt: 111, pl. 111, fig. 1]
gracilis (Prunulus) G: 630-631 ← [PS: 425 (Agaricus)]
graminaria (Sphaeria punctiformis var.) M: 146, var. nov.: Fr: 2: 525
graminis (Erysiphe) M: 133 ← [DC 6: 106]
graminis (Nemania) G: 516 ← [POM 1: 18 (Sphaeria)]
graminia (Peziza) Schl: 58, sp. nov.?
graminis (Sphaeria) N&B: 299, M: 141, Schl: 59 ← [POM 1: 18]
grammocephalus (Agaricus) M: 76 ← [BH: 616, pl. 594]
grammopodius (Agaricus) N&B: 313, M: 71-72 ← [BH: 617, pl. 548, pl. 585, fig. 1]
graniformis (Sphaeria) Schl: 59, sp. nov.?
granulata (Tubercularia) G: 547, M: 129 ← [PS: 113]
granulosa (Lepiota) G: 602 ← [BEF: 79]
granulosa (Peziza) M: 22 ← [BH: 258, pl. 438, fig. 3 "granulata"]
granulosa (Sphaeria) SA: 521, P: 493, M: 139 ← [BH: 176, pl. 487, fig. 2 (Hypoxylon)]
granulosum (Peripherostoma) G: 514 ← [BH: 176, pl. 487, fig. 2 (Hypoxylon)]

granulosus (Agaricus croceus var.) P: 197-198 ← [BEF: 79 (Agaricus ____)]
granulosus (Mucor) P: 503 † ←[BH: 109, pl. 504, fig. 13]
graphicum (Hypoderma) LD 22: 371 ← [FOM 1: 194 (Hysterium)]
graveolens (Agaricus) R: 37, P: 206-207 ← [PS: 361]
graveolens (Gymnopus) G: 609-610 ← [PS: 361 (Agaricus)]
grisea (Ascophora) G: 561 ← [PD: 14 (Mucedo)]
grisea (Clavaria) N&B: 344 ← [PCC: 44]
grisea (Haplaria) LD 20: 273, G: 552 ← [LM: 11]
grisea (Helvella mitra [var.]) SA: 537, nom. nov.
grisea (Himantia) LD 21: 164 ← [FOM 1: 211]
griseum (Fusidium) G: 544 ← [LM: 8]
griseum (Tuber) N&B: 351 ← [PS: 127-128]
grossa (Clavaria) Schl: 56, N&B: 345 ← ["POM 2: 50," not found]
grysea (Peziza papillosa var.) M: 22, var. nov.
guttaeforme (Astoma) G: 524 ← [SEF: no. 393, pl. 393, fig. 5 "gutta"]
gyrans (Clavaria) LD 21: 166, M: 30, P: 471 ← [BEFC 1: 235, fig. 164]

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BOLETES OF THE SOUTHWESTERN UNITED STATES

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SUMMARY

Results of three summer collecting seasons in the southwestern United States are presented. Descriptions of the following previously undescribed species of boletes are included: Boletus barrowsii, Leccinum subalpinum, Suillus kaibabensis, Suillus occidentalis and Suillus wasatchicus. A total of fifty-five species of these fungi have now been recorded from this area.

During the summers of 1970, 1971 and 1972 collecting expeditions were made to the southwestern states with considerable amounts of time spent in southwestern Colorado, northern and western New Mexico, the Uintas Mountains in eastern Utah and northern and western Arizona. The specific purpose was to explore the bolete flora of these regions; however, all fleshy fungi were collected as time permitted. During June and early July the flora was extremely limited, but during late July and August, perhaps as a result of increased thunderstorm activity, there was a marked increase in the variety and number of basidiocarps. Two areas were particularly impressive: the aspen forests of southern Colorado and the Kaibab Plateau in northern Arizona. Both areas supported an abundant flora of boletes, particularly Leccinum and Suillus species, as well as other Homobasidiomycetes. The New Mexico and Utah areas, although not as productive during the time spent there, undoubtedly have a significant and interesting flora of fleshy fungi.

Data from these explorations, supplemented by herbarium records and earlier reports in the literature, indicate that Boletus is represented by twenty species, Suillus by eighteen, Leccinum by twelve, Tylopilus by three, and both

Gyroporus and Fuscoboletinus by one each. None of the areas within the southwest has been extensively studied and all warrant further study. Particularly exciting would be an opportunity to study the flora of the forested peaks of southern Arizona and New Mexico because of their isolation from other forested areas.

The data, although obviously incomplete, indicate a rather close affinity with the fleshy fungus flora of the west coast. No rough-spored species, for example, have been found in either area. Furthermore, there is a much greater duplication of species between this region and the west coast than with those on the east coast or midwest. Some eastern species, however, such as Boletus affinis, B. luridus, Suillus subaureus and Tylopilus alboater, do extend into New Mexico, but are not known from more westerly regions. There is much duplication in the floristic composition of the forests of the southwest and far west which is probably the most important factor influencing the similarity of the fungus flora of the two regions.

In the following descriptions of new species all colors in quotes are from Ridgway (1912). Collections are on deposit in the Cryptogamic Herbarium of San Francisco State University (SFSU). Grateful acknowledgement is made to the National Science Foundation for Grants Nos. 2932 and 2932A which financed much of the field work.

Boletus barrowsii Thiers & Smith sp. nov.

Pileus 9-20 cm latus, convexus demum late convexus vel plano-convexus, siccus, tomentosus vel velutinus, albidus vel pallide subroseo-bubalinus, immutabilis. Contextus 2-3 cm crassus, albus, immutabilis. Sapor odorque mites. Tubuli 1-2 cm longi, subflavi vel isabellini; pori 1-2 mm lati, immutabiles. Stipes 8-15 cm longus, 2-5 cm crassus, reticulatus, clavatus, immutabilis, siccus, pileo concolorus. Sporae 13-15 x 4-5 µm, subcylindricae vel anguste subfusoideae. Cystidia 37-50 x 5-9 um, fusoideo-ventricosa. Hyphae cuticulae appressae vel intertextae. Holotypus (Thiers 27816) lectus prope Jacob Lake, Kaibab National Forest, Coconino County, Arizona, Aug. 21, 1971; in herbario San Francisco State University (SFSU) conservatus.

Pileus (6) 9-10 (30) cm broad when mature, convex to pulvinate when young becoming broadly convex to plano-convex with age; surface dry, dull, smooth, sometimes obscurely rimose, when young often covered with a fine pruinose coating that is easily removed, or appearing glabrous, sometimes becoming tomentose to velutinous with age, or remaining glabrous, white to whitish or buff ("cartridge buff" to "pale pinkish buff" to "pinkish buff") during all stages of development, unchanging or becoming brown when bruised; margin incurved, entire. Context 2-3 cm thick, floccose, white except sometimes pale vinaceous near the cuticle, unchanging when exposed; taste mild, odor mild or sometimes strong and unpleasant when dried.

Tubes 1-2 cm long, depressed, white when young, becoming yellow ("colonial buff" to "deep colonial buff" to as dark as "Isabella color") with age; pores 1-2 mm, angular, stuffed when young, concolorous with the tubes, unchanging or darkening slightly when bruised.

Stipe 8-15 cm long, 2-5 cm broad at the apex, bulb up to 9 cm broad, equal to clavate to bulbous at the base, sometimes with a narrowed point at the base; solid; surface dry, whitish to pinkish buff or pinkish cinnamon, white at the base, unchanging when bruised, reticulate, often all the way to the base, reticulations typically fine and delicate. Context white, unchanging when exposed.

Spores 13-15 x 4-5 µm, subfusoid to subellipsoid in face view, inequilateral in profile, smooth, thin-walled, pale ochraceous in KOH and Melzer's reagent; basidia clavate, 4-spored, hyaline in KOH, 25-34 x 8-11 µm; hymenial cystidia crowded on the pores, scattered to numerous on the sides, hyaline in KOH, thin-walled, cylindric to subclavate to obscurely fusoid-ventricose, 37-50 x 5-9 µm; tube trama strongly divergent from a poorly defined central strand, hyaline in KOH, hyphae 3-5 µm broad; pileus trama homogeneous, interwoven, hyphae 2-4 µm broad; cuticle poorly differentiated as a cutis of appressed to slightly interwoven hyphae, hyphae 4-6 µm broad, hyaline, not gelatinous. No clamp connections seen.

Spore deposit dark olive brown.

Chemical Reactions. HNO_3 - cuticle orange, context yellow. $FeSO_4$ - context gray.

Habit, habitat and distribution. Gregarious to solitary in soil under conifers. It is typically found under ponderosa pine (Pinus ponderosa Dougl. ex P. & C. Lawson) but firs (Abies sp.) have sometimes been observed in the immediate vicinity. In New Mexico it has also been found in mixed populations of conifers and hardwoods, particularly oaks. At present Boletus barrowsii is known from New Mexico and Arizona in the southwestern United States and from Idaho in the northwestern region. It has also been found in Mexico.

Material studied. Arizona: Thiers 27739, 27816 - holotype, 27817, 27818, 27819, 28110, 28176, 28185, 28279, 28969. Idaho: Miller 9, 9a, Trueblood 2220. New Mexico: Barrows 922, 1348. Mexico: Guzman 3013.

Observations. The white tubes that are "stuffed" when young and which later become yellow plus the reticulate stipe place this species in the section Boletus, Subsection Boleti with Boletus edulis, B. aereus and other well known species. The white to pallid color of the pileus and stipe readily distinguishes it from other species within that section. Other characteristics which distinguish it are the somewhat narrow spores, the absence of any amyloid reaction in the hymenium and the poorly developed cuticle. Its edibility is unknown.

This species is named in honor of Charles Barrows of Sante Fe, New Mexico, who first brought it to our attention.

Leccinum subalpinum sp. nov.

Pileus 8-20 cm latus, globosus vel convexus demum plano-convexus vel planus vel depressus, siccus demum viscidus, tomentosus vel appresso-fibrillosus demum fibrilloso-squamosus, russus vel lateriticius vel rufobrunneus. Contextus albus tarde fuscus. Sapor et odor mites. Tubuli 1-2.5 cm longi, pallide olivaceo-bubalini, tactu avellanei. Stipes 6-15 cm longus, 1-3 cm crassus, siccus, albus; squamae parvae, albae aetate nigrae. Sporae 13.5-15.5 x 4-5 µm, ellipsoideae vel subellipsoideae. Cystidia 28-35 x 8-13 µm. Cuticula intertexta. Holotypus (Thiers 26823) lectus prope Bald Mountain Pass, Uintas Mountains, Wasatch National Forest, Summit County, Utah, Aug. 7, 1970; in herbario San Francisco State University (SFSU) conservatus.

Pileus (5) 8-20 cm broad, globose to convex when young becoming pulvinate to plano-convex to plane to slightly depressed on the disc with age; surface dry to subviscid when young becoming viscid with age, conspicuously tomentose to appressed fibrillose when young, typically becoming strongly appressed-fibrillose scaly with age, usually scales more strongly developed toward the margin, tips of scales sometimes breaking free with age, remaining strongly apparent in dried basidiocarps; surface more or less evenly colored dark reddish brown ("morocco red" to "burnt sienna" to "mahogany red" to "bay") when young, often with areas irregularly distributed which are red ("grenadine red" to "flame scarlet"), unchanging or becoming dark reddish brown to reddish orange ("Kaiser brown" to "Hays russet" to "Mars orange" to "English red") with age, unchanging when bruised; margin usually with a conspicuous sterile flap. Context white, unchanging or very slowly and erratically changing directly to fuscous with no reddish intermediate phase; taste and odor mild.

Tubes 1-2.5 cm long, adnexed to deeply depressed, pallid ("pale olive buff"), staining pale vinaceous ("avellaneous") when exposed or bruised; pores small, up to 1 mm broad, angular, concolorous with the tubes, staining brown when bruised.

Stipe 6-15 cm long, 1-3 cm broad at apex, equal to subclavate to clavate, not bulbous, occasionally ventricose; solid; surface dry, background white or occasionally pale umber or gray, scabrosities typically pallid when young becoming very dark brown or black with age, sometimes remaining inconspicuous. Context white, unchanging or slowly becoming fuscous, rarely with a slightly reddish intermediate phase in basal portion, occasionally becoming blue in the base.

Spores 13.5-15.5 x 4-5 µm, pale ochraceous in KOH, ochraceous in Melzer's reagent, ellipsoid to subcylindric in face view, ventricose in profile, smooth, thin-walled; basidia 18-22 x 7-9 µm, hyaline, clavate, 4-spored; hymenial cystidia rare to scattered, obscure, hyaline, clavate, 28-35 x 8-13 µm; tube trama obscurely divergent, hyaline, subgelatinous, hyphae 7-9 µm broad; pileus trama interwoven, homogeneous, hyphae 4-6 µm broad; pileus cuticle differentiated as a tangled trichodermium, cells elongated, no short or inflated cells, little or no disarticulation, walls smooth, contents pale yellow-orange in KOH, bright ochraceous tawny in Melzer's reagent, pigment globules developing in Melzer's reagent, hyphae 5-6 µm broad. No clamp connections seen.

Chemical Reactions. $FeSO_4$ - context gray. Guaiac - positive.

Habit, habitat and distribution. Scattered to gregarious in soil under lodgepole pine and Engelmann spruce. It has been collected only at altitudes between 6,000 and 8,000 feet and has been found only in Utah and Arizona.

Material studied. Arizona: Thiers 27269. Utah: Thiers 26778, 26823 - holotype, 26824, 26825, 26826.

Observations. When first seen this species was somewhat suggestive of Leccinum fallax because of its stature and similarly colored pileus. There are, however, several differences between the two species. The most important of these is that the pileus of L. subalpinum is either conspicuously tomentose or fibrillose to fibrillose-scaly, whereas that of L. fallax appears fibrillose only when viewed under a lens. In addition, the cap of L. fallax remains orange red when dried, the stipe is strongly clavate and the scales on the stipe surface never blacken, whereas in L. subalpinum the basidiocarps are dull reddish brown when dried, the stipe is not clavate-bulbous and the scales on the stipe typically become black with age.

Suillus kaibabensis sp. nov.

Pileus 3-8 cm latus, convexus demum plano-convexus vel depressus, glaber, viscidus, bubalinus vel subroseo-bubalinus interdum luteus vel ochraceo-bubalinus, immutabilis, margine glabro. Contextus 1-1.5 cm crassus, albus vel flavus, immutabilis. Sapor et odor mites. Tubuli 3-5 mm longi, ochraceo-bubalini vel lutei, immutabiles; pori 1-3 mm lati. Stipes 2-4 cm longus, 4-15 mm crassus, siccus, albidus, ad basim flavus, glandulosus, sine velo. Sporae 8-9 x 3-3.5 µm, ellipsoideae vel subcylindricae. Cystidia fusca in KOH et Melzer's. Cuticula intertexta, viscida. Holotypus (Thiers 27813) lectus prope Jacob Lake, Kaibab National Forest, Coconino County, Arizona, Aug. 21, 1971; in herbario San Francisco State University (SFSU) conservatus.

Pileus 3-8 cm broad, convex to plano-convex to depressed on the disc with a slightly elevated margin, often somewhat undulating on the margin; surface smooth, viscid, even, glabrous, buff to light brown ("warm buff" to "ochraceous buff" to "pinkish cinnamon" to occasionally as dark as "cinnamon") when older, sometimes more yellow ("light greenish yellow" to "pale greenish yellow"), unchanging or darkening slightly when bruised; margin incurved becoming decurved, entire, no evidence of a false veil. Context 1-1.5 cm thick, typically white except yellow to yellowish directly above the tubes, unchanging when exposed or bruised; taste and odor not distinctive.

Tubes 3-5 mm in length, depressed to subdecurrent, buff ("ochraceous buff" to "colonial buff") to yellow ("antimony yellow" to "chamois") during all stages of development, unchanging when bruised; pores 1-3 per mm, angular, concolorous or frequently dark salmon ("ochraceous salmon"), unchanging when bruised, often with scattered droplets of liquid when young.

Stipe 2-4 cm long, 1-2 cm broad at the apex, equal or tapering slightly toward the apex; solid; surface dry, typically white to pale yellow when young in the apical region and pale vinaceous ("avellaneous") toward the base, becoming darker yellow in the apex with age, unchanging in the base, noticeably glandulose, at least in upper portion, sometimes becoming inconspicuously so toward the base; glandulae reddish brown, small, but sometimes large and elongated to irregular in outline; no partial veil. Context yellow, unchanging.

Spores pale yellow to hyaline in KOH, ochraceous in Melzer's reagent, ellipsoid to subcylindric, walls thin, smooth, 7.6-9.5 x 3.2-4.5 µm; basidia 4-spored, clavate to cylindric, hyaline in KOH, yellow in Melzer's reagent, 21-26 x 6-7 µm; hymenial cystidia clustered, clavate, dark orange brown in KOH, slightly darker in Melzer's reagent, 38-72 x 6-11 µm; tube trama strongly divergent, hyaline in KOH, yellow in Melzer's reagent, subgelatinous; pileus trama homogeneous, hyaline except ochraceous near cuticle; pileus cuticle an ixotrichodermium, hyaline in KOH, hyphae 2-4 µm broad; stipe cuticle subgelatinous to gelatinous, interwoven, with numerous fascicles of caulocystidia similar to the hymenial cystidia. Clamp connections absent.

Chemical Reactions. KOH - context vinaceous. $FeSO_4$ - context gray.

Habit, habitat and distribution. Scattered to gregarious in soil under ponderosa pine (*Pinus ponderosa*). Basidiocarps often occurring in large numbers during August, and sometimes forming fairy rings. Commonly found in National Forest Campgrounds, for example, the Jacob Lake Campground in northern Arizona where considerable soil compaction had occurred. Known only from the Kaibab National Forest in Arizona at elevations of 6,000 to 8,000 feet.

Material studied. Arizona: Thiers 27623, 27673, 27678, 27776, 27813 - holotype, 27905, 28035, 28184, 28295, 29572, 29749, 29780, 29784, 29787.

Observations. This species belongs to the section *Suillus*. It is distinguished by the pallid, glabrous pileus, the absence of a veil or false veil, the short tubes and the strong development of the glandulae on the stipe. *S. occidentalis* with which it might be confused lacks noticeable glands on the surface of the stipe. The reddish to pink pores of *S. wasatchicus* distinguish it from *S. kaibabensis*. The pallid color of the pileus and the absence of a false veil separate *S. kaibabensis* from *S. granulatus* and *S. albidipes*.

Suillus occidentalis sp. nov.

Pileus 6-10 cm latus, convexus demum late convexus vel plano-convexus, glaber, viscidus, ochraceo-bubalinus, margine glabro. Contextus albus, ad marginem flavus, immutabilis. Sapor et odor mites. Tubuli 0.5-1 cm longi, flavi, immutabiles; pori 1-2 mm lati. Stipes 2-4 cm longus, 1-2 cm crassus, siccus, albus vel flavus; glandulis inconspicuis, sine velo. Sporae 8-9 x 3-4 µm, ellipsoideae vel subcylindricae. Cystidia fasciculata, fusca in KOH. Cuticula intertexta, viscida. Holotypus (Thiers 27775) lectus prope Point Sublime, North Rim, Grand Canyon National Park, Coconino County, Arizona, Aug. 19, 1971; in herbario San Francisco State University (SFSU) conservatus.

Pileus 6-10 cm broad when mature, convex when young, becoming broadly convex to plano-convex to highly irregular in outline with age, margin sometimes uplifted and often rimose in older pilei; surface viscid, gluten often unevenly distributed causing surface to appear scaly, no trace of fibrils or fibrillose scales, glabrous, but sometimes becoming rimose-scaly with age, buff to light brown ("light ochraceous buff" to "ochraceous buff"), sometimes pinkish brown ("light pinkish cinnamon") on the disc, unchanging when bruised; margin incurved, entire, glabrous, no evidence of false or partial veil fragments. Context 1-2 cm thick, white when young becoming yellow, at least on the margin, when older, unchanging when exposed; taste and odor mild.

Tubes 0.5-1 cm long, subdecurrent to shallowly depressed, when young tan to yellow ("warm buff" to "antimony yellow") to occasionally near yellow ("pinnard yellow") on the margin with age typically becoming dark yellow to orange yellow ("pale yellow orange" to "light orange yellow" to "buff yellow" to apricot yellow"), unchanging when bruised; pores 1-2 mm, angular, concolorous with the tubes.

Stipe 2-4 cm long, 1-2 cm broad at apex, equal to tapering slightly toward the base or apex; solid; surface dry, white to yellow ("baryta yellow") at the apex becoming pale yellow ("ivory yellow") toward the base; glandulae obscure and often not apparent to the naked eye, never becoming conspicuous, but becoming more noticeable after handling. Context yellow in the cortex, whitish toward the center, unchanging when exposed.

Spores 8-9.6 x 3-4 µm, ellipsoid to subfusoid to subcylindric, hyaline to pale ochraceous in KOH and Melzer's reagent, walls thin, smooth; basidia hyaline in

KOH, 4-spored, 19-23 x 6-8 µm; hymenial cystidia fascicled, clavate, dark brown in KOH, dark orange-brown in Melzer's reagent, 40-50 x 8-10 µm; tube trama divergent, hyaline in KOH; pileus trama homogeneous, interwoven, hyaline in KOH except dark brown under cuticle; pileus cuticle an ixotrichodermium, hyaline in KOH; caulocystidia similar to the hymenial cystidia. Clamp connections absent.

Chemical Reactions. NH_4OH - context rose-red. KOH - context rose-red to vinaceous. $FeSO_4$ - context gray.

Habit, habitat and distribution. Scattered to gregarious in soil under ponderosa pine (Pinus ponderosa). This Suillus is known only from the Kaibab National Forest of Arizona where it occurs at elevations varying from 6,000 to 8,000 feet.

Material Studied. Arizona: Thiers 27622, 27650, 27655, 27661, 27674, 27775 - holotype, 27880, 28149, 28175, 28294.

Observations. This species belongs to the Section Suillus. It is distinguished by the obscure glands on the surface of the stipe, the absence of a veil, the pallid color of the pileus and the white stipe. The glandulae on the stipe are either absent or poorly developed suggesting a possible relationship with S. subaureus which has, however, a tomentose or fibrillose cuticle, or with S. brevipes which has a short stipe and a much darker colored pileus. In addition neither of these species is known to form mycorrhizal associations with ponderosa pine.

Suillus wasatchicus sp. nov.

Pileus 5.5-6.5 cm latus, convexus demum planus vel plano-convexus, viscidus, glaber, subflavus vel flavus, margine glabro. Contextus 1-1.5 cm crassus, subflavidus, immutabilis. Sapor mitis; odor pungens. Tubuli 0.5-1 cm longi, flavi, immutabiles; pori minus quam 1 mm lati, glandulis testaceis. Stipes 3-5 cm longus, 1.5-2 cm crassus, tubulis concolorus apice, ad basim albus, siccus, glandulosus, sine velo. Sporae 8-10.4 x 3-4.5 µm, ellipsoideae vel subcylindricae. Cystidia fasciculata.

Cuticula intertexta, viscida. Holotypus (Thiers 25618) lectus prope Yellow Pines Campground, Uintas Mountains, Wasatch National Forest, Summit County, Utah, June 21, 1970; in herbario San Francisco State University (SFSU) conservatus.

Pileus 5.5-6.5 cm broad, convex when young becoming plane to plano-convex, sometimes undulate on the margin; surface viscid but not glutinous, shining when moist, dull when dry, glabrous, yellow ("primuline yellow" to "antimony yellow" to "yellow ocher") during all stages of development, occasionally with pinkish or reddish flushes but never developing reddish blotches or scales as in S. americanus or S. sibiricus; margin entire, incurved; no evidence of a false or partial veil. Context 1-1.5 cm thick, very pale yellow throughout, unchanging when exposed; taste mild, odor rather strong and pungent.

Tubes 0.5-1 cm long, decurrent when young becoming somewhat depressed with age, dark yellow ("mustard yellow" to "wax yellow"), unchanging when bruised or exposed; pores less than 1 mm broad, angular, densely covered with reddish to testaceous glandulae causing the pores to appear dark pink to red when young, usually becoming yellow with age, unchanging when bruised.

Stipe 3-5 cm long, 1.5-2 cm broad at the apex, equal except somewhat attenuated or pinched at the base; solid; surface concolorous with the tubes in apical portion becoming white or whitish toward the base, dry, covered with conspicuous glandulae over the entire surface; glandulae reddish when young, darkening with age. Context very pale yellow, unchanging when exposed.

Spores 8-10.4 x 3-4.5 µm, pale ochraceous in KOH, ochraceous in Melzer's reagent, ellipsoid to subfusoid to subcylindric, slightly inequilateral in profile, walls thin, smooth; basidia 4-spored, hyaline in KOH, contents granular in KOH, 20-25 x 7-9 µm; hymenial cystidia rare to absent on sides of tubes, crowded to abundant on pores, fascicled, no solitary cystidia seen, basal portion of cystidial cluster staining brown in KOH and Melzer's reagent, individual cystidia clavate to cylindric, thin-walled, 27-35 x 7-10 µm; caulocystidia similar to hymenial cystidia; tube trama hyaline in KOH, strongly divergent from a poorly defined central strand, hyphae 4-7 µm broad, no laticiferous hyphae; pileus trama loosely interwoven, hyphae 4-5 µm in diam., pale brown in KOH; pileus cuticle differentiated as an ixotrichodermium, 250-350 µm thick, hyphae closely interwoven, hyphae 2-4 µm in diam., hyaline in KOH; hypodermis narrow, compactly interwoven, brown in KOH. Clamp connections absent.

Chemical Reactions. Unknown.

Habit, habitat and distribution. Scattered to solitary in rocky soil under ponderosa pine (*Pinus ponderosa*). Known only from the type locality in the Uintas Mountains of eastern Utah.

Material studied. Utah: Thiers 25439, 25618 - holotype.

Observations. *S. wasatchicus* seems to be related to the *S. granulatus* - *S. albidipes* complex but these species have a dark brown pileus. The reddish to pink discoloration of the pores of *S. wasatchicus* due to the accumulation of glandulae is highly distinctive. The absence of any type of fibrillose covering on the surface of the pileus readily distinguishes this species from *S. hirtellus*. *Suillus flavoluteus* can easily be distinguished by the purplish-red color of the basal portion of the stipe.

The following species of boletes are now known from the southwestern United States.

Boletus affinis
Boletus amylosporus
Boletus barrowsii
Boletus bicolor
Boletus calopus
Boletus chrysenteron
Boletus edulis
Boletus erythropus
Boletus fragrans
Boletus luridus
Boletus piperatus
Boletus porosporus
Boletus pulverulentus
Boletus rubripes
Boletus subglabripes
Boletus subtomentosus
Boletus subvelutipes
Boletus truncatus
Boletus vermiculosis
Fuscoboletinus aeruginascens
Gyroporus castaneus
Leccinum atrostipitatum
Leccinum aurantiacum
Leccinum brunneum
Leccinum cinnamomeum
Leccinum discolor
Leccinum fallax
Leccinum incarnatum
Leccinum insigne var. *insigne*
Leccinum insigne var. *brunneum*

Leccinum insigne
    var. *insigne*
    f. *ochraceum*
Leccinum subalpinum
Leccinum vulpinum
Suillus albidipes
Suillus americanus
Suillus brevipes
Suillus brunnescens
Suillus flavogranulatus
Suillus glandulosipes
Suillus granulatus
Suillus kaibabensis
Suillus lakei
Suillus luteus
Suillus occidentalis
Suillus pseudobrevipes
Suillus sibiricus
Suillus subaureus
Suillus tomentosus
Suillus umbonatus
Suillus wasatchicus
Tylopilus alboater
Tylopilus ferrugineus
Tylopilus porphyrosporus

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MYCOTAXON

Vol. III, No. 2, p. 274 January-March 1976

NOTICE

MYCOTAXON POLICY ON ARGUMENTS SUPPORTING PROPOSALS ON NOMINA GENERICA CONSERVANDA

Supporting statements and arguments in support of proposals for the conservation of generic names have, until recently, been published in full in the journal TAXON, the official journal of the International Association for Plant Taxonomy.

In the interests of conserving space, the Editors of that journal have determined that henceforth only ten-line summaries of such arguments will be published there, with xerox copies of the original type scripts available upon request (Taxon 24(4): 534. 1975).

Authors of proposals for conserved generic names for fungi and lichens should still process their proposals through the International Association for Plant Taxonomy so that they will come to the attention of the appropriate Special Committees for consideration. It is the belief of the Editors of MYCOTAXON, however, that the arguments which may be raised often have application beyond the specific case in point. We open the pages of this journal to full documentation and discussion of any such proposal for conservation of names of genera of fungi or lichens.

MYCOTAXON

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SPECIES OF LYCOPERDON WITH A SETOSE EXOPERIDIUM

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SUMMARY

Three species of *Lycoperdon*, two of them new, with a setose exoperidium are described. Their taxonomic position is discussed and a key to *Lycoperdon* with unusual spherocysts in their peridium is provided.

RESUME

Trois espèces de *Lycoperdon*, dont deux nouvelles, à exopéridium formé de sétas sont décrites. Leur position taxonomique est discutée et un clé pour la détermination des *Lycoperdon* pourvus de sphérocystes inhabituels dans le péridium est fournie.

First described by Kreisel and Dring (1967) in *Morganella velutina* (Berk. et Curt.) Kreisel et Dring, an exoperidium whose exostratum is composed of spherocysts transformed into setae was also found by Kreisel (1967) in *Bovista ochrotricha* Kreisel. In the course of my monographic revision of the genus *Lycoperdon*, I have now observed such an exoperidium in three species of this genus, while in several others some of the spherocysts show a tendency toward a setose type. Such an anatomy seems, therefore, not to be exceptional among the Lycoperdaceae, especially in tropical regions.

Observations of peridial structures were made on preparations boiled in chloral hydrate. Melzer's reagent was

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(*) Chargé de recherches du F.N.R.S.

used to detect a dextrinoid (pseudoamyloid) reaction. Spores and capillitium were observed in lactophenol-cotton blue after a short boiling. Spore measurements are based on 10 spores per fruitbody; the values given are the extremes and the extreme means. For capillitium and spherocysts only maxima are recorded. The term spherocyst is used to designate all inflated more or less individualised elements of the exoperidium, whatever their exact shape. The letters A,B,C,D refering to spores indicate increasingly strong warts (A spores punctate, D almost spiny).

I am much obliged to the curators of several herbaria cited in the text (abbreviations according to the Index herbariorum) for the loan of material and to H. Kreisel and I.P.S. Thind for the loan or gift of interesting personal collections. The Royal Botanical Gardens in Kew, the New York Botanical Garden and the National Fungus Collection at the USDA Center Beltsville are institutions which have been especially helpful. I thank D.M. Dring and J.T. Palmer for critical reading of my manuscript.

LYCOPERDON ATRUM PAT.,

Bull. Soc. Mycol. France XVIII (2) : 176 (1902)

Syn. : *L. juruense* P. Henn., Hedwigia 43 : 184 (1904).

Fig. 1a; 2a,b; 3-5.

Fruitbodies subglobose, turbinate or pyriform, 1-4,5 cm high, 1,2-3,5 cm broad. Subgleba cream to yellowish brown, subcompact, small (0,2 mm) locules being only locally visible, transition to the gleba gradual. Exoperidium a dense coating of warts or small spines or even a continuous velvety layer near the base of the fruitbody. Colour from yellowish brown to blackish, always darker at the top of the fruitbody. Exoperidium (exostratum) at top of fruitbody made up of thick walled setae (up to 85 x 12 μ, wall 4,0 μ) mixed with more isodiametric but also thick walled and usually irregularly shaped elements (Fig. 2a). In some fruitbodies, near the base, when the exoperidium is velvety, the setae are dominant and up to 220 x 28 μ, wall 4,0 μ (Fig. 2b). In other fruitbodies caducous tips are present continuing the warts in spines made up of elements variable in shape (from hyphae to pure spherocysts) but always thin walled (Fig. 4). Those spines of thin walled spherocysts may be restricted to the base of the fruitbody or totally lacking. In the darkest specimens, setae of the top contain

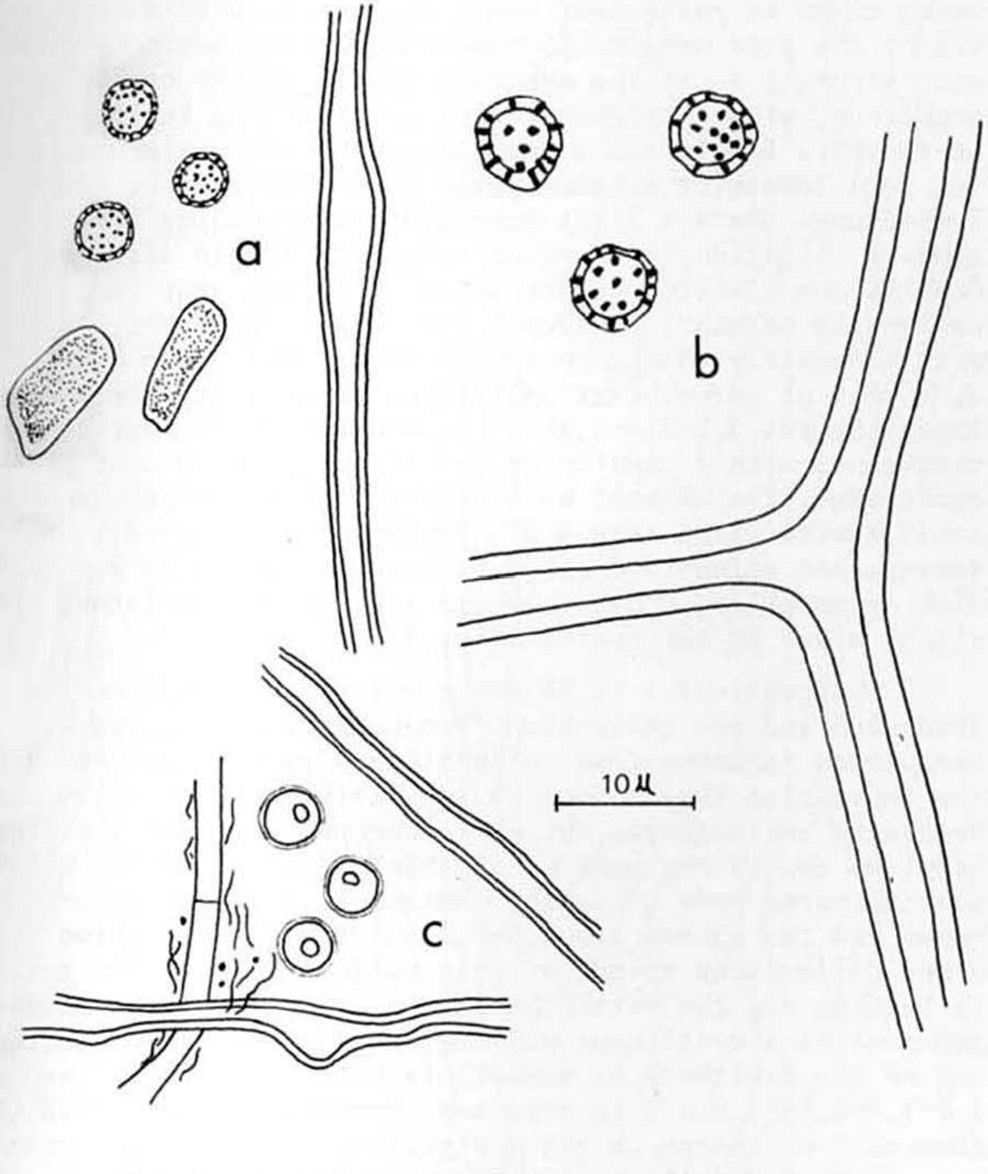

Fig. 1. a. Spores, capillitium and persistent basidia (?) of *Lycoperdon atrum* (Isotype of *L. juruense*, Ule, Herb. Bras. 2707, HBG). b. Spores and capillitium of *L. setiferum* (Thind 10092, LG). c. Spores, capillitium and paracapillitium of *L. melanesicum* (Lauterbach 56h, WRSL). All drawings 1500 x.

a dark brown pigment usually maintained in chloral hydrate, even without fixation. Some setae may be slightly dextrinoid. Endoperidium only accidentally visible,e.g. when plates of exoperidium excoriate as happens in some specimens, cream to yellowish, dull, frequently with raised lobes at the pore margin. Endoperidial hyphae dextrinoid,the most strongly so at the subgleba level, weakly or not cyanophilous, with little septation and swelling (up to 10 µ) at the pore level, the formation of the pore being mostly due to a loosening of the hyphae which may even be entirely lacking. Gleba a light purplish brown tending toward greyish lilacine, with pseudocolumella little distinct. Capillitium elastic, seldom septate, fairly branched, occasionally nodular, broadness variable up to 2,8-8,4 µ, with moderately thick, yellowish brown wall up to 0,6-1,2 µ, devoid of pores. Paracapillitium lacking or poorly developed. Spores 3,2-3,4-4,6-5,2 µ, moderately (C) but densely verrucose, with a density of 10-16 warts for 10 µ of circumference. The highest wart density (14-16) occurs on the small spores (less than 4 µ). Broken pedicels, badly preserved, and oblong bodies (e.g. 9 x 5 or up to 16 x 6 µ) with cyanophilous content, which seem to be persistent basidia, mixed to the spores (Fig. 1a, 5).

Observations : 1. If one compares the specimens from Bradenton and the collection from Cuba or the isotypes of *Lycoperdon juruense* (two collections very similar) one gets the impression they belong to two distinct species. In the Bradenton collections, spines (caducous on top of the fruitbody) up to 0,5 mm, made up of thin walled elements, continue the warts made of setae, the colour is at most dark brown and the spores are 3,6-4,2-4,6-4,9 µ. In the two other collections spines of thin walled elements are totally lacking and the warts themselves are thinner but denser and pass to a continuous velvety cover on the subgleba,the top of the fruitbody is almost black and the spores are 3,2-3,4-3,65-3,8 µ . In this case however it seems that the dimension of spores is not a significant taxonomic character. These two collections are the only ones with spores

Fig. 2. a. Setae on top of the fruitbody of *Lycoperdon atrum* (Isotype of *L. juruense*, Ule, Herb. Bras. 2707, HBG). b. id. near base of the fruitbody. c. Setae of *L. setiferum* (Thind 10092, LG). d. Setae of *L. melanesicum* (Lauterbach 56 h, WRSL). All drawings 750 x.

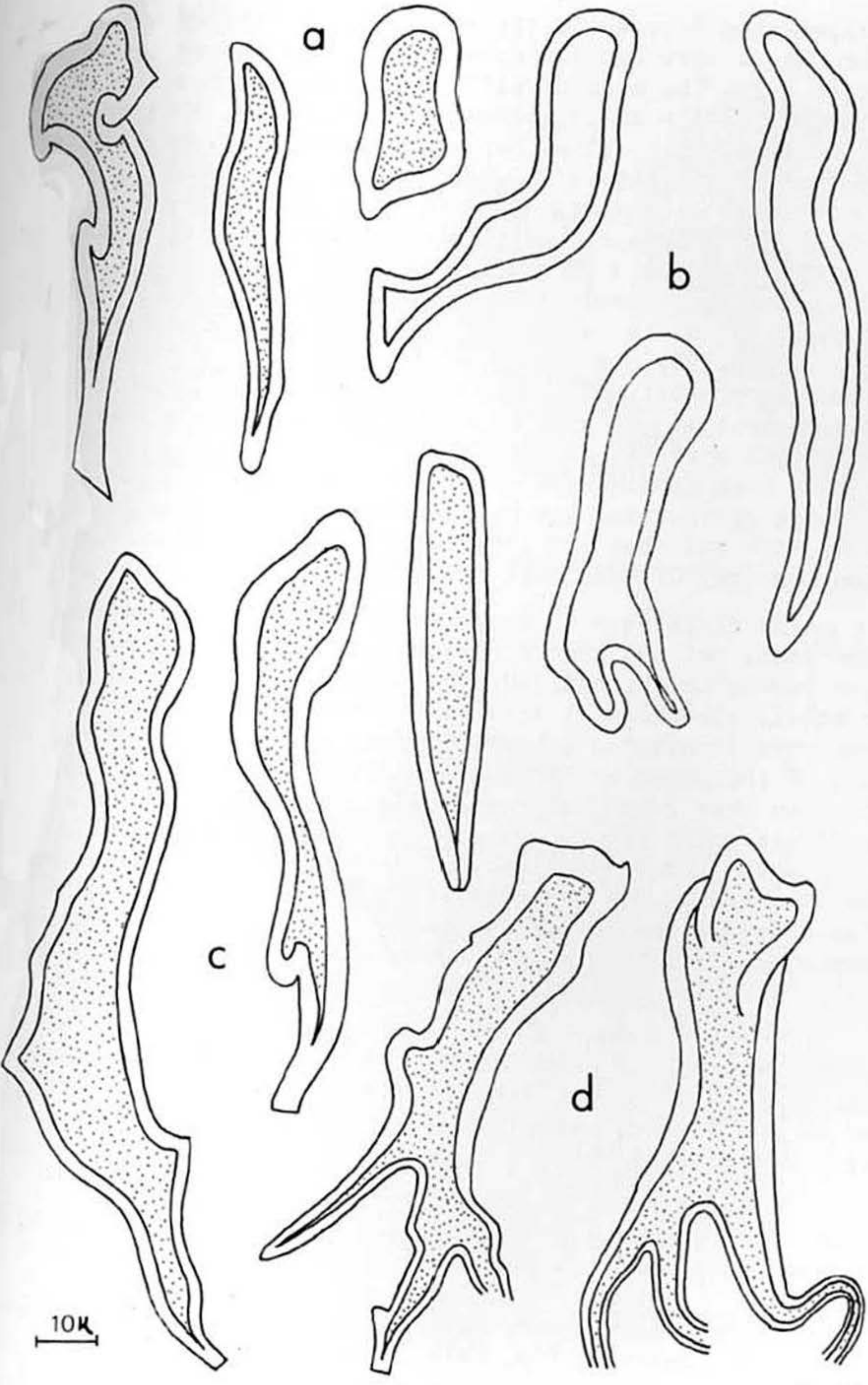

Fig. 2

smaller than 4 μ, while the material distributed by Rick, which has a very similar exoperidium, has spores of the larger type. The mean of all spore diameters measured in collections with small spores (5 fruitbodies, 10 spores per fruitbody) is 3,5 μ. For collections with large spores (23 fruitbodies) it is 4,4 μ. The corresponding spore volumes would be approximately 22,5 and 44,6 μm^3 or almost exactly the double for large spores. Further the mean wart density is 12 for a circumference reduced to 10 μ in large spores and 15 in small spores. As the ratio 12/15 = 0,800 is almost equal to the one of the mean spore diameter 3,5/4,4 = 0,795, one must conclude that wart density is inversely proportional to spore diameter. The general conclusion is that one must be dealing with a species having forms with a simple and a double nuclear number per spore as have been studied by Gross and Schmitt (1974). As long as these spore sizes are not correlated with other characters, I do not consider these small and large spore variants worthy of taxonomic recognition.

The difference in exoperidial aspect could be more important, but the second Florida collection is already much poorer in thin-walled spherocysts, while the Uruguayan material, though still retaining a few caducous spines, is even more intermediate between those collections and the rest of the material. It may be that more collecting would disclose that some differences are constant enough to necessitate splitting the species as here understood (for example the Florida collection, or the Florida collection and the Uruguay ones on one side), but, given the large plasticity of exoperidial characters in response to environmental effects (see, for example, Calonge and Demoulin, 1975), I would not expect it.

2. The presence of capillitium distinguishes this species from *Morganella*, whilst the anatomy of the exoperidium, the subcompact subgleba and the total lack of pores in the capillitium separate it from *L. molle* Pers. per Pers. and related species.

3. The type of *L. atrum* was lost in the post when returned by Dennis who had borrowed it from FH. An extensive description has however been made by this author and

Fig. 3. *Lycoperdon atrum*, dark extremely setose form (Isotype of *L. juruense*, Ule, Herb. Bras. 2707, HBG). x 1,2.

Fig. 4. *Lycoperdon atrum*, pale form with a few spines (Florida, Cocoanut Grove, by Peacock River, Thaxter, NY). x 2,5.

Fig.3

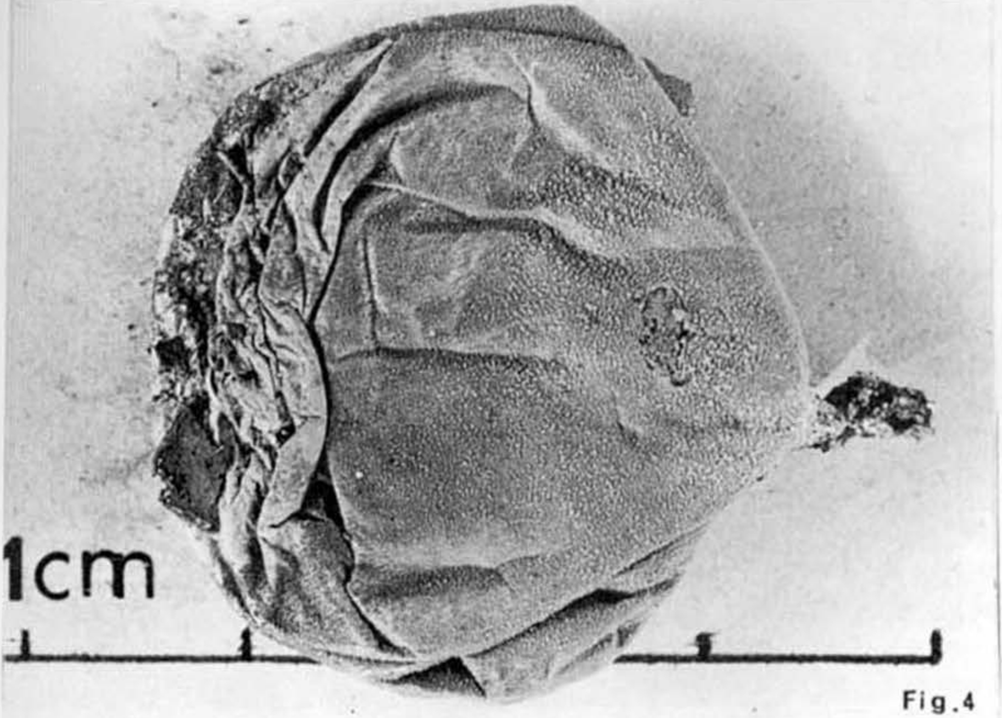

Fig.4

deposited in FH (partly published in Dennis, 1953) allowing an unambiguous interpretation of the taxon. One point only is obviously inaccurate in Dennis description : the mention of reticulated spores, which would be quite unexpected in a *Lycoperdon*. Given the very dense warts, I have ascertained it is not difficult when not using the best mounting media and optics to mistake the space between warts for a raised reticulum. The setae were recorded by Dennis in his manuscript notes but not in the published description.

Material studied :

- Brasil : Estado de Amazonas, im Wald v. Juruá Miry, 8/1901, E. Ule, Herbarium Brasiliense 2707 (HBG, isotype of *L. juruense*, should be considered lectotype following the destruction of Hennings's herbarium. A duplicate of the same collection is in FH). São Leopoldo, 1907, Rick, Fungi Austro-Americani 214. Distributed under the name of *L. juruense* which is correct but antedated by *L. atrum*. The collection at HBG was studied in detail. Other parts seen are in BPI, COI, NY, PAD.

- Cuba : Prov. of Oriente, Ensenada de Mora, on dead wood, 26-29/3/1912, N.L. Britton, J.F. Cowell and J.A. Shafee 13000 (NY).

- Martinique, no date, P. Duss, notes on type of *L. atrum* in FH (cf. obs. 3).

- Uruguay : Dep. de Canelones, Floresta, silv. cupress. ad vias aren., 20/6/1948 and 6/1949, W.G. Herter 50248 and 50847 (BPI).

- U.S.A. : Florida, 315, 16th str., Bradenton, Manatee Co., 17/9/1946, 26/6/1947, 12/1948, early July 1949, 16/10/1952, C.B. Stifler (FLAS, F47911, 47913, 47907, 47895, 47886). F47886 is given as growing under Carissa. Florida, Cocoanut Grave, by Peacock River, no date, R. Thaxter (NY). Two collections.

Fig. 5. *Lycoperdon atrum*, **spores, capillitium and persistent basidia (?) (Florida, Cocoanut Grove, by Peacock River, Thaxter, NY). x 1500.**

Fig. 6. *Lycoperdon setiferum*, **spores, capillitium and broken pedicels (holotype, Murree, Ahmad, K). x 1500.**

Fig. 5

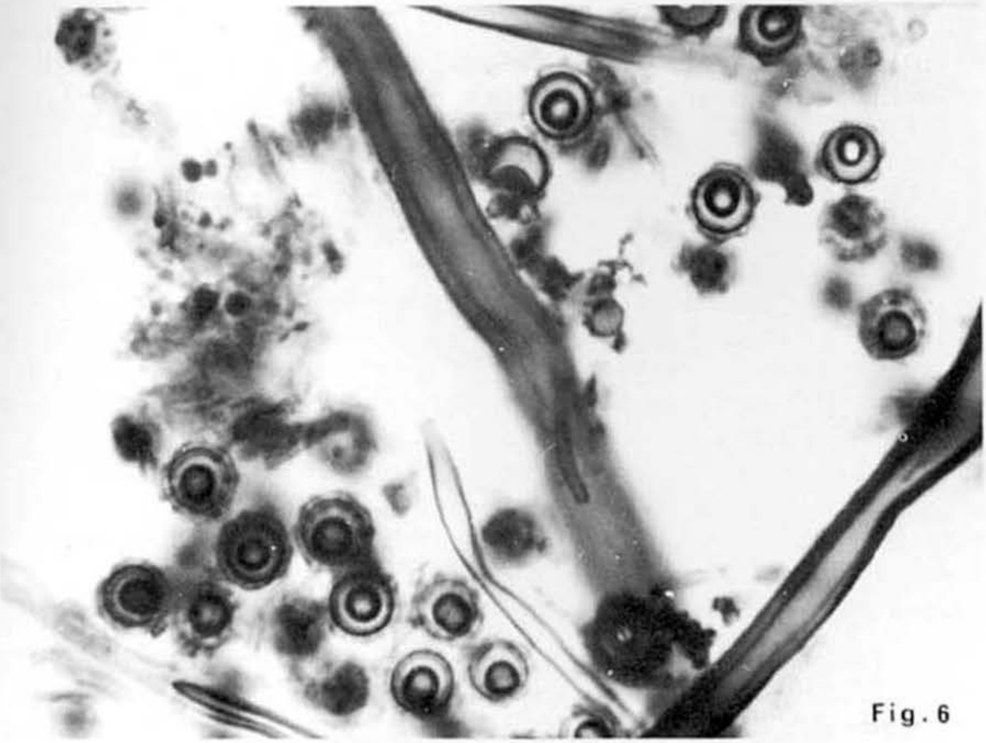

Fig. 6

LYCOPERDON SETIFERUM DEMOULIN, sp. nov.

Fig. 1b, 2c, 6, 7.

Carposomata subglobosa usque turbinata, 2-5 cm diam., verrucis angulatis vel aculeis imperfectis luteo-brunneis usque nigricantibus dense obtecta. Gleba purpuraceo-brunnea. Subgleba bene evoluta. Exoperidium ex setis (ex. 130 x 16 µ, paries 2,6 µ) pigmentum brunneum continentibus praecipue compositum. Capillitium usque 4,8-8,0 µ latum, elasticum, brunneum, sine septis, pariete crasso (usque 0,9-1,8 µ), poris absentibus vel rarissimis. Sporae magnae, 4,0-4,5-4,8-5,2 µ, verrucis altis (D), sparsis (7-9 cum 10 µ circ.), reliquiis sterigmatorum intermixtae. Alteris *Lycoperdonibus* cum setoso exoperidio distinctum sporis valde verrucosis et *L. atropurpureo*, *L. mauryano* et *L. delicato* exoperidii setis distinctum.
Holotypus : Pakistan, Murree, 8/1948, S. Ahmad (K).

Fruitbodies subglobose to turbinate, 2-5 cm in diam. Subgleba cream to lilacine, with rather well formed locules, up to 1 mm. Exoperidium a dense coating of angular warts or ill defined convergent spines, from yellowish brown to blackish, darker on top of the fruitbody. Beside some regular spherocysts and more or less isodiametric elements of contorted shape, those warts are dominated by seta-like, thick walled, spherocysts, about a hundred µ in length (e.g. 130 x 16 µ, wall 2,6 µ) (fig. 2c). At least on top of the fruitbody they hold a dark brown pigment usually maintained in chloral hydrate, even without fixation. Near the base of the fruitbody there is much less intracellular pigment and one can sometime find tips of spines made up of thin-walled spherocysts (up to 35 µ in diam.). Endoperidium only accidentally visible, cream to yellowish, slightly shiny, sometimes with raised lobes at the margin of the pore. Endoperidial hyphae dextrinoid but only some of them cyanophilous (gleba level), with some septation and swelling (up to 15 µ) at the pore level. Gleba purplish brown, with a not very well developed pseudocolumella. Capillitium elastic, aseptate, fairly well branched, up to 4,8-8,0 µ broad, with a thick brown wall, up to 0,9-1,8 µ, devoid of

Fig. 7. ***Lycoperdon setiferum*** **(holotype, Murree, Ahmad, K). x 2,25. Courtesy of the Royal Botanic Gardens, Kew (negative n° 14683).**

Fig. 8. ***Lycoperdon melanesicum*** **(holotype, Degener 15547a, NY). x 6.**

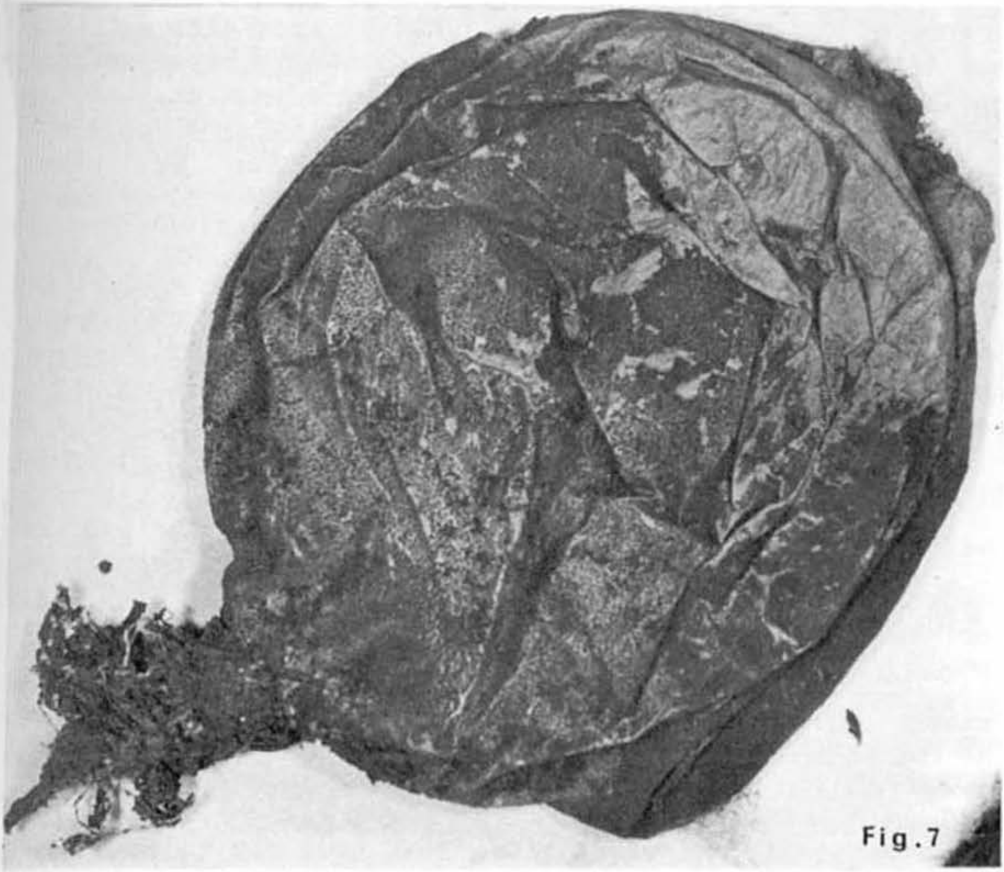

Fig.7

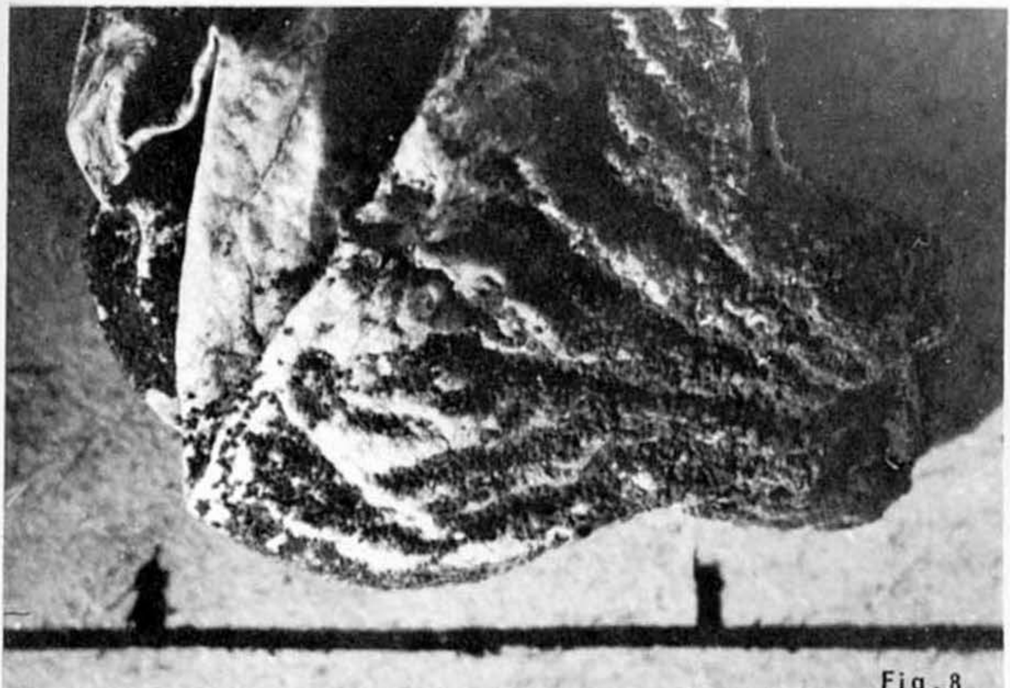

Fig.8

pores or these very rare, small and of irregular outline, restricted to some of the thinner walled hyphae. Paracapillitium lacking. Spores 4,0-4,5-4,8-5,2 µ in diam., with very strong (D) sparse warts (density 10-16 for 10 µ of circumference). Ectospore frequently conspicuous. Well preserved broken pedicels abundantly mixed with the spores (fig. 1b, 6).

Observations : 1. This species is liable to be confused with *L. delicatum* Berk., which occurs in the same area. The diagnostic characters are the setae of the exoperidium and the spores with higher, sparser warts (10-12 for 10 µ of circumference in *L. delicatum*). Macroscopically the exoperidium presents better defined spines in *L. delicatum*. The heavily verrucose spores separate this species from all other *Lycoperdon* spp. with setoid elements in the exoperidium. *L. atropurpureum* Vitt., from southern Europe and the mediterranean basin, and *L. mauryanum* Demoulin, from America, have similar spores but lack a setose exoperidium.

2. I have studied a collection from Japan which apparently belongs to this species, Chiba, 10/1906, M. Gono in h. C.G. Lloyd, cat. 23330 (BPI) (n° in my notes, 474). However, since it is made up of two specimens only, I prefer to wait for further collecting to decide upon its identity.

Material studied :

- unlocalised : SW Himalayas, no date, Falconer (K) (note n° 415).

- India : Sat tal, Nainital (U.P.), coniferous forest, 17/8/1973, I.P.S. Thind 10201 (PAN) (note n° 651). Jagat Sukh, Kulu, H.P., 25/9/1971, I.P.S. Thind 10092 (dupl.) (LG).

- Pakistan : Murree, 8/1948, S. Ahmad (K) (note n° 412) (holotype). Ibid., 25/9/1953, S. Ahmad 15721 (K and dupl. in pers. herb. H. Kreisel) (note n° 414). Patriata, Murree Hills, 9/1953, no collect. (K) (note n° 416).

LYCOPERDON MELANESICUM DEMOULIN, sp. nov.

Fig. 1c, 2d, 8-10.

Carposomata subglobosa, 1,3-2 cm diam., rhizomorphis albis praedita. Gleba brunnea. Subgleba aut absens aut minima et albida. Exoperidium velutinum vel granulosum, brunneum, setis (ex. 100 x 10 µ, paries 2,6 µ) in base ramosis et pigmentum brunneum continentibus compositum. Capillitium usque 2,9-3,7 µ latum, elasticum (luteo-) brunneum, pariete haud valde crassa (usque 0,6-1,0 µ), sine septis et poris. Paracapillitium praesens. Sporae minutae, 3,3-3,7-3,8-4,0 µ, leves. *L. pyriformi* proximum, sed subgleba parum evoluta et exoperidio insignite setoso distinctum.
Holotypus : Fiji, Viti Levu, Ra, 17/6/1941, O. Degener 15547a (NY).

Fruitbodies subglobose, 1,3-2 cm in diam. White rhizomorphs well developed. Subgleba white, reduced to a swelling of the endoperidium or seldom with a few small (0,2 mm) ill-defined locules. Exoperidium a dense velvety to granular deep brown coating (Fig. 8) of rather irregularly shaped, thick-called setae up to 100 µ in length (e.g. 100 x 20 µ, wall 7 µ) with a slightly yellowish, dextrinoid wall and brown contents, and a branching, root like base (Fig. 2d, 10). Endoperidium only accidentally visible, cream, dull, rather thick, made up of generative (septate and thin-walled) and sclerified (thick walled e.g. 1,4 µ for a diam. of 3,3 µ,aseptate) hyphae, dextrinoid but not (or occasionally the contents) cyanophilous. Gleba brown. Pseudocolumella lacking. Capillitium elastic, aseptate, little branched, but somewhat nodulose, up to 2,9-3,7 µ, with brown (on the yellowish side) wall up to 0,6-1,0 µ, devoid of pores. Paracapillitium abundant, but thin (2,4-3,0 µ) and not very well preserved. Capillitium and paracapillitium incrusted by debris from glebal membranes and pedicels and cyanophilous globules. Spores 3,3-3,7-3,8-4,0 µ in diam., appearing smooth in usual mounting media (Fig. 1c, 9).

Observations : 1. This species might be mistaken for a *Morganella* [especially *M. samoensis* (Bres. et Pat.) Ponce de Leon] from which it differs in the presence of capillitium. Glebal membranes are also more disorganised than usual in that genus. The other possible confusion is with *Lycoperdon pyriforme* Schaeff. per Pers., whose subgleba is better developed and distinctly chambered and whose exoperidium is made up of spherocysts which, while of irregular, often spiny outline, are often more or less isodiametric and not more than 50 μ long. The Lauterbach and Troggatt collections were, in fact, filed under *L. pyriforme*.

2. The lack of a well developed, chambered subgleba would exclude this species from the genus *Lycoperdon* as emended by Kreisel (1964). It is, however, so obviously related to *L. pyriforme* with spores, capillitium and anatomy of the endoperidium almost identical, and an exoperidium, although different, closely related with irregular, thick-walled, dextrinoid spherocysts, I cannot place it in a distinct genus.

Material studied :

- Wald bei Butaneny, Novo-Guinea, 3/5/1890, Lauterbach 56 h (WRSL).

- Solomon Islands, growing on dry trunk of Coconut, 20/7/1909, W.W. Troggatt in h. C.G. Lloyd, cat. 54488 (BPI).

- Fiji, Viti Levu, Ra, vicinity of Rewasa near Vaileka, alt. 50-200 m, Vatundamu, on log on dry forested forehill, 28/5-17/6/1941, O. Degener 15547a (NY) (holotype).

Taxonomic position of *Lycoperdon* with setose exoperidium

Exoperidial characters are those one is most tempted to use in the taxonomy of *Lycoperdaceae* because they are quite easily observed. Aspects observed with the unaided eye or a good lens are usually correlated with microscopical anatomy, the observation of which does not require the excellent optic necessary to study spore ornamentation or capillitial pits. Caution must, however, be exercised when using those characters, for they seem strongly influenced

Fig. 9. *Lycoperdon melanesicum* (holotype, Degener 15547a, NY). Spores, capillitium and paracapillitium. x 1500.

Fig. 10. *Lycoperdon melanesicum* (holotype, Degener 15547a, NY). Setae. x 300. Melzer reagent.

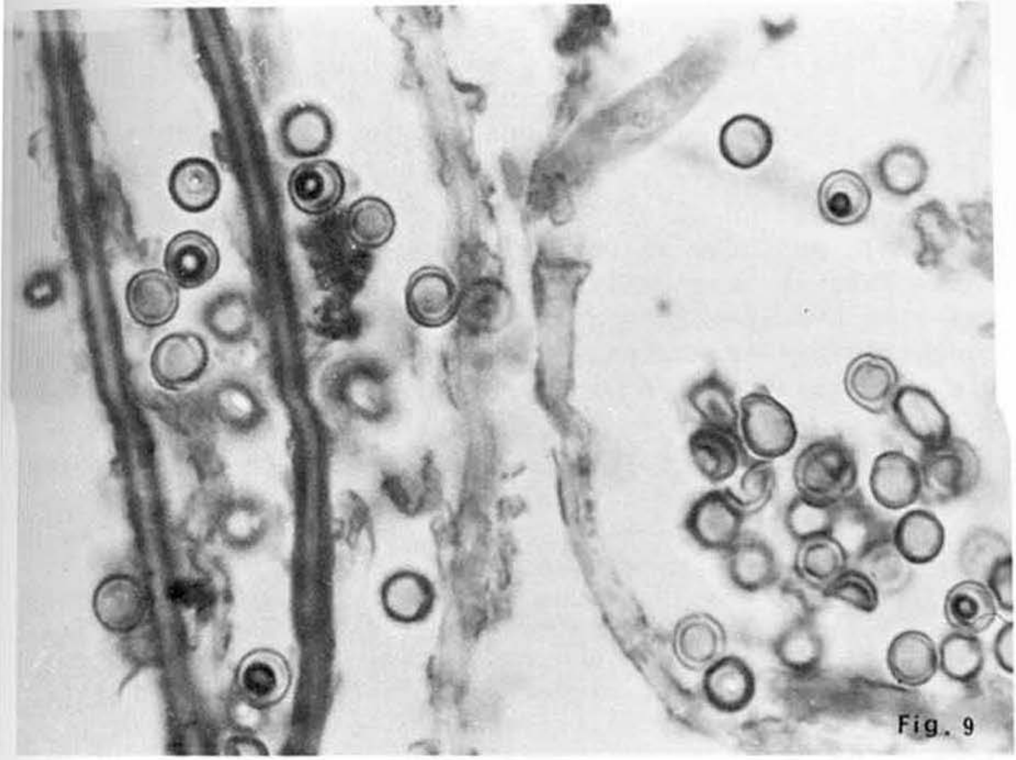

Fig. 9

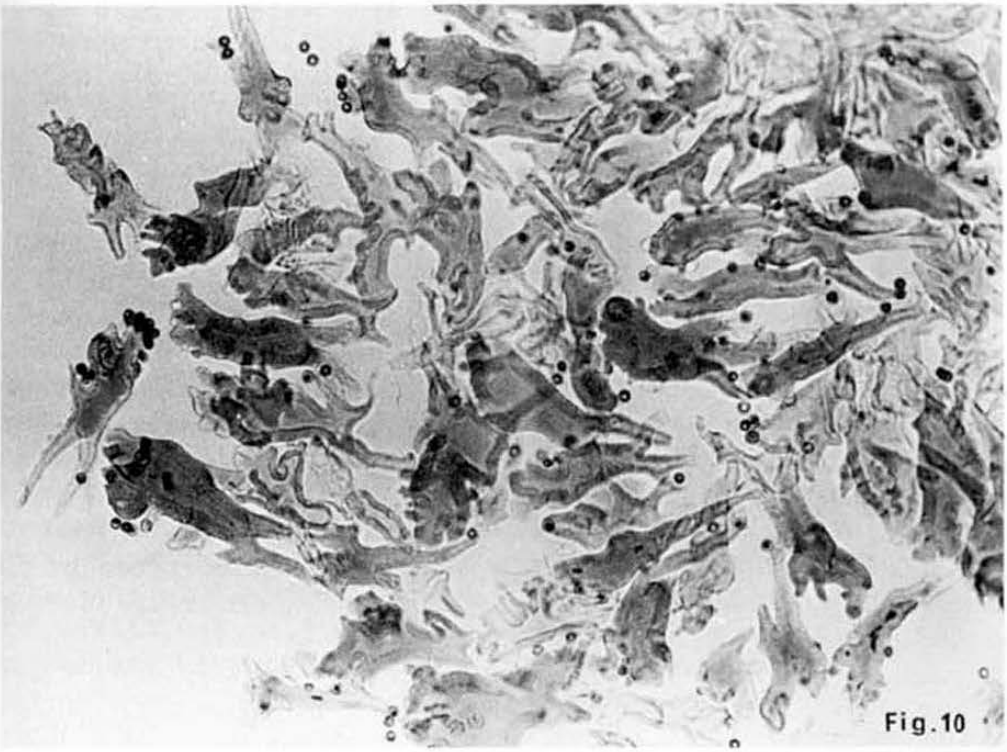

Fig.10

by ecology. In some species, a given character may be under direct environmental control and such an ecophenic variation must be taken into account when delimiting species. The same character may be constant in other species but those will usually prove to be of a restricted ecology and the character should not be used in sectional classification.

This is especially true of colour and size of the spines : on average, *Lycoperdaceae* of wet areas have darker, longer spines than those of dry regions. A species of oceanic affinity like *Lycoperdon foetidum* always has long dark spines, while *L. marginatum*, of dry continental open areas, always has short white spines. A species with broad ecology and distribution like *L. perlatum* varies from whitish to blackish and two sides of a single fruitbody may even be quite different.

Nonetheless when correlated with other characters, especially structure of the endoperidium, spores and capillitium, some trends in exoperidial anatomy may be considered of phylogenetic significance. While I do not want to place a judgement at the moment on the possible relationships to species of other genera with a similar exoperidium, it is my conviction the *Lycoperdon* spp. with a setose exoperidium are rather closely related.

It is common in *Lycoperdon*, especially among the species of the *L. molle* group, to have thicker walled spherocysts at the base of the spines than at the top. From this standard situation, one may derive exoperidia where all spherocysts are rather thin-walled (*L. marginatum*, *L. perlatum*) and exoperidia entirely composed of thick walled elements like those described here.

The key species in this transition is *L. echinatum* (and the related *L. americanum*) where it has been well known since the work of Kreisel (1962) that there is a striking contrast between the large thick walled spherocysts that form the base of the spines and the interjacent reticulation and the thinner walled narrow elements of the spines. Without being setiform, the basal spherocysts of *L. echinatum* are frequently elongated and of irregular outline like some elements found beside the setae in *L. atrum*. The presence of caducous spines made up of thin walled hyphae in some collections of *L. atrum* perfects the comparison. Two characters are important to support a relationship between *L. echinatum* and *L. atrum* : the greyish lilacine tinge of the gleba (in *L. echinatum* mostly in unripe specimens) and the cottony, unclearly lacunar subgleba. The verrucae of the spores are about the same height in both species and point in their relationship to the *L. molle* group, while, if the capillitium lacks any pores in *L. atrum*, they are frequently quite inconspicuous in *L. echinatum*.

Two other species are also important for understanding the transition between the *L. molle* group and species with setose exoperidium.

One is *L. bispinosum* Yasuda, known to me only through the type specimen (isotype, or even holotype ?) in the Lloyd collection (cat. 24801, BPI). In this species, the spines do not fall leaving a reticulum but are conspicuously distinguished from the dark basal layer of thick walled spherocysts through their pale colour.

The other species is very close to *L. atrum*, of which it constitutes a kind of African vicariant : it is *Lycoperdon umbrinoides* Dissing et Lange, also described a few years later as *L. ashantiense* Dring. Of this species, I have studied in detail the type of *L. umbrinoides* (BR) and an isotype of *L. ashantiense* communicated by Dr. Dring (LG) and seen other collections in K. I find it differs from *L. atrum*, with which it even shares peculiar characters like the oblong bodies (persistent basidia ?) in the mature gleba only in the exoperidium. At gleba level, the spines are rather long and blackish, made up of thin-walled, elongated elements disposed in chains like in *L. echinatum* and pass to irregular thick-walled spherocysts, some of them setiform (ex. : 52 x 14 µ, wall 2,3 µ). On the subgleba, the contrast between the tips of the spines and their bases is even stronger, the tips being pale and the bases having a greater proportion of more setiform elements. At this level the spines are quite fragile and caducous and, after their fall, the exoperidium is locally truly setose (setae e.g. 100 x 12 µ,wall 2,5 µ), making this species a perfect intermediate between *L. echinatum* and *L. atrum*.

In the case of *L. setiferum*, the spores and to some degree the capillitium are very similar to those of *L. atropurpureum* and the former species lacks the peculiar subgleba and colour of the gleba of *L. echinatum*, *atrum*, etc. I therefore consider it probably evolved in a parallel way from *L. atropurpureum*. This would mean an origin distinct from that of the other setiferous species, though still from the *L. molle* group.

In *L. pyriforme*, most of the spherocysts are usually not setiform, but, except for their length/breadth ratio, they are very close to those of *L. melanesicum*, and the proximity of the two species has already been discussed. I consider them derived from fungi similar to *L. atrum*, the warts on the spores of which have become so small as to be invisible without special staining or electron microscopy and which have acquired a number of generative hyphae in the endoperidium. From the standpoint of endoperidial structure, one may note that the very strongly dextrinoid hyphae of *L. atrum* are already similar to those of *L. pyriforme* and that the dehiscence is by nearly total disappearance of these hyphae a character opposed to the tendency toward swelling and septation which occurs in so many species. One will also note that in *L. atrum*, the subgleba is paler than usual and there is an occasional dextrinoid reaction of spherocyst walls.

Figure 11 extracted from an unpublished scheme of possible *Lycoperdon* phylogeny will summarize these ideas.

Finally I hope the following key to all species of *Lycoperdon* known to me with unusual spherocysts may help in the determination of the species discussed so far.

Key to *Lycoperdon* with unusual, large, thick-walled spherocysts in their peridium (pore zone excluded).

1 Spherocysts arising from the endoperidium on which they persist after the fall of the caducous exoperidium... 2

1' Spherocysts a part of the exoperidium (separated from the endoperidium by the pseudoparenchymatous layer).. 3

2 Spines brown, slender, falling individually, with large (up to 55 μ), moderately thick walled (up to 1,8 μ) spherocysts at their bases, which separate them clearly

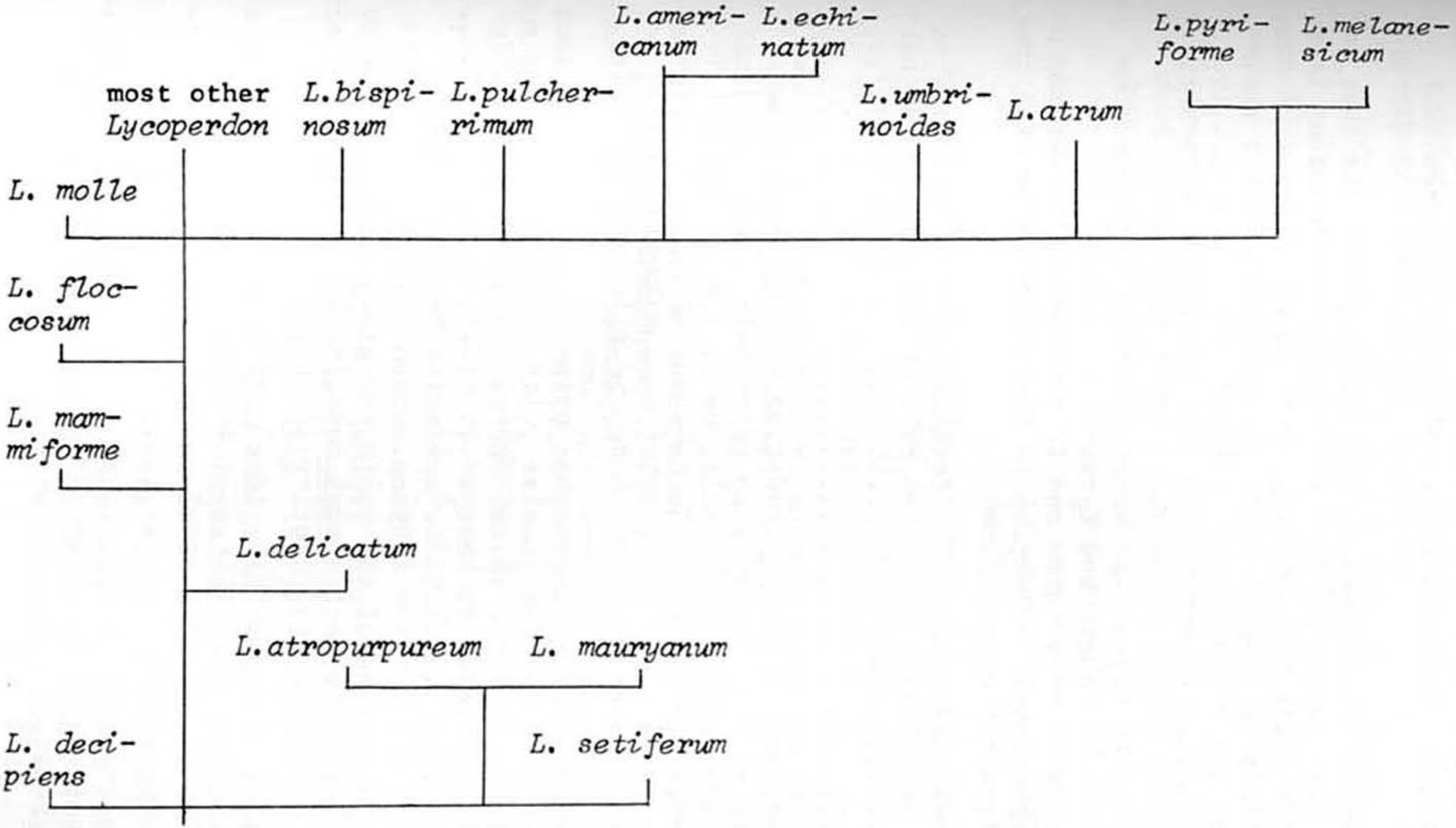

Fig. 11. Proposed phylogeny of *Lycoperdon* with setose exoperidium and related species.

from the pseudoparenchymatous layer. Growing in woods of Eastern U.S.A. and Mexico .... *L. calvescens* Berk. et Curt.,
Grevillea II (16) : 50 (1873)

2' Spines white, pyramidal, falling in plates for they are not well separated from the pseudoparenchymatous layer (spherocysts thin walled, up to 25 μ). Species of open habitats in several parts of the world, with a preference for a continental climate .... *L. marginatum* Vitt. ex Moris et De Not.,
Fl. Caprariae : 226 (1839)
Syn. : *L. cruciatum* Rostk., *L. candidum* Auct. non Pers.

N.B. In *L. marginatum* and *L. calvescens*, do not confuse spherocysts belonging to the endoperidium with those from the exoperidium.

3 Brown-walled spherocysts forming a reticulum on top of the fruitbodies after the fall of the caducous spines 4

3' No reticulum 5

4 Spines comparatively slender,up to 3 mm long. Spherocysts of the areolae with relatively regular outlines and moderately thick walls, up to 1,8 μ. Spores 4,1-4,4-5,4-5,8 μ. In deciduous woods of Eastern North America .... *L. americanum* Demoulin,
Lejeunia, N.S., 62:2 (1972)

4' Spines very strong, somewhat pyramidal, up to 5 mm long. Spherocysts of the areolae with irregular outlines and walls up to 3-4 μ thick. Spores 3,8-4,1-4,6-5,1 μ. In deciduous woods of Europe .... *L. echinatum* Pers. per Pers.,
Synop.method.Fung. : 147 (1801)

N.B. A species of the *echinatum* group occurs in the NW Himalayas, but not enough material has yet been collected to define its identity adequately.

5 Presence of permanent spines made up of relatively thin-walled elongated rectangular elements disposed in chains on top of a basal layer of irregular thick walled spherocysts 6

5' Spines lacking or fugacious, the exoperidium being mostly velutinous or granular and composed of irregular, thick-walled spherocysts 7

6 Spines on top of the fruitbody blackish, concolorous with the basal layer, which is made up of elements of setiform type, especially near the base of the fruitbody. Tropical Africa .... *L. umbrinoides* Dissing et Lange, Bull. Jard. Bot. Etat XXXII (4) : 344 (1962)
Syn. : *L. ashantiense* Dring, Mycol. Pap. 98 : 42 (1964)

6' Spines on top of the fruitbody cream, in contrast to the dark brown basal layer, made up of rather isodiametric but irregularly shaped spherocysts; the subgleba exoperidium has ordinary, isodiametric, thin-walled spherocysts. Japan....... *L. bispinosum* Yasuda, Bot.Mag. (Tokyo) XXXVII (439-444) : 130 (1923)

7 Subgleba white or lacking. Endoperidium composed of thin-walled, septate and thick-walled aseptate hyphae. Spores smooth. Paracapillitium abundant. Lignicolous species with well developed rhizomorphs 8

7' Subgleba coloured. Endoperidium of aseptate thick walled hyphae. Spores verrucose. Paracapillitium little developed 9

8 Subgleba lacking or with a very few inconspicuous lacunae. Exoperidium from large (e.g. 100 x 20 μ, wall 2,6 μ) setae with branched root-like bases (Fig. 1d, 10). Known until now only from New Guinea, Solomon and Fiji Islands .... *L. melanesicum* Demoulin

8' Subgleba with obvious lacunae. Exoperidium with elements very irregular in shape but seldom elongated. Subcosmopolitan .... *L. pyriforme* Schaeff.per Pers, Synop.method.Fung.: 148 (1801)

9 Spores moderately but densely verrucose (10-16 warts for 10 μ of circumference), mixed with oblong bodies having cyanophilous content (Fig. 1a, 5). Subgleba cottony, with obscure lacunae. Gleba with a greyish lilacine tint. Tropical Americas... *L. atrum* Pat.
(Syn. : *L. juruense* P.Henn.)

9' Spores strongly but sparsely verrucose (7-9 warts for 10 μ of circumference), not mixed with oblong bodies (Fig.1b,6). Subgleba of the usual lacunose type. Gleba purplish brown. W. Himalayan region, Japan (?) .... *L. setiferum* Demoulin

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MYCOTAXON

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MYXOMYCETES OF MEXICO I

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ABSTRACT

Eighty-six species of Myxomycetes are reported from Mexico, 48 of them for the first time. Field collected specimens were made from ground sites by the senior author in seven of the twenty-nine states of Mexico: Guerrero, Yucatán, Jalisco, Chihuahua, México, Morelos and San Luis Potosí. Also included are collections from seven additional states which were studied in Dr. Guzmán's Herbarium at the Instituto Politécnico Nacional, Escuela Nacional de Ciencias Biológicas. One collection was made by Dr. G. W. Martin from a moist-chamber development that apparently represents an undescribed species of *Colloderma*. Another moist-chamber collection made by the authors is believed to represent a new species of *Echinostelium*. Nomenclature follows that of Martin and Alexopoulos (1969). Specimens have been placed in the National Fungus Collections and are retained in the private herbaria of the authors.

ABSTRACTO

Ochenta y seis especies de mixomicetos están reportadas de México, cuarenta y ocho de ellas por primera vez. Los especímenes coleccionados en el campo fueron encontrados por el mayor autor en siete de los veinte y nueve estados de México: Guerrero, Yucatán, Jalisco, Chihuahua, México, Morelos, y San Luis Potosí. También incluidas son colecciones de siete estados adicionales, las cuales fueron estudiadas en el herbario seco del Dr. Gastón Guzmán en el Instituto Politécnico Nacional, Escuela Nacional de Ciencias Biológicas. Una colección, hecha por el Dr. G. W. Martin de un desarrollo en cámara húmeda, aparentemente representa una especie indescrita de *Colloderma*. Otra colección hecha por los autores en cámara húmeda se cree representar una especie nueva de *Echinostelium*. La nomenclatura sigue la de Martin y Alexopoulos (1969). Los especímenes ya están colocados en el herbario seco de National Fungus Collections y también están retenidos en el privado herbario seco de los autores. (JRB)

AUSZUG

Achtundsechzig Gattungen von Myxomycetes werden behandelt, 48 davon zum ersten Mal. Im Feld gesammelte Exemplare wurden vom ersten Verfasser aus sieben der 29 Staaten von Mexiko genommen: Guerrero, Yucatán, Jalisco, Chihuahua, Méxiko, Morelos, und San Luis Potosí. Eingeschlossen sind auch Sammlungen aus sieben anderen Staaten, die in Doktor Guzmán's Pflanzensammlung bei der Instituto Politécnico Nacional, Escuela Nacional de Ciencias Biológicas untersucht wurden. Eine Sammlung wurde von Doktor G. W. Martin in einer Feuchtkammer erzeugt, die eine bis jetzt unbeschriebene Gattung, anscheinend von *Colloderma*, darstellt. Noch eine andere Feuchtkammersammlung von den Verfassern soll eine neue Gattung von *Echinostelium* darstellen. Die Fachsprache entspricht Martin und Alexopoulos (1969). Die Exemplare sind in die Pflanzensammlung von National Fungus Collections und in die privaten Sammlungen der Autoren untergebracht worden. (DMR)

INTRODUCTION

A study of the pertinent literature shows that little has been written about the plasmodial slime molds of Mexico, a point of view confirmed by Dr. Gastón Guzmán in personal communication with the senior author.

The earliest report found concerning the Myxomycetes of Mexico was by Macbride and Smith (1896) who listed 13 species. Emoto (1933) published an additional 23 species and Alexopoulos (1968) followed by Guzmán (1972) each added one more. In this paper 48 species new to Mexico are reported, bringing the total to 86.

It is surprising that more has not been published on the plasmodial slime molds of Mexico, for during the rainy season (May to October) conditions are such that luxurient myxomycete fruitings take place. Guadalajara has proved to be an especially good collecting area, although the region surrounding Taxco has been equally productive.

This is the first in a series of papers dealing with the Myxomycetes of Mexico. The collections discussed in this paper have been made primarily on decaying wood and leaf litter (ground sites), although Dr. Martin's collection was made as a moist-chamber development from the bark of a living "long leaf pine". The next paper in the series will place special emphasis on the corticolous slime molds harvested from moist-chambers.

It is hoped that this paper will encourage other myxomycetologists to consider Mexico as a productive area for collections.

The following is a list of all species collected in Mexico that have been published, not including the 48 species new to Mexico reported later in this paper. After each scientific name is the name of the individual reporting the collection, according to the following legend:

T. H. Macbride	(Mac)
Y. Emoto	(E)
K. L. Braun	(B)
C. J. Alexopoulos	(A)
G. Guzmán	(G)

I. CERATIOMYXACEAE
Ceratiomyxa fruticulosa (Müll.) Macbr. (E,G,B)

II. LICEACEAE
Licea pedicellata (H. C. Gilbert) H. C. Gilbert (B)
Listed from Mexico in Martin and Alexopoulos (1969)

III. RETICULARIACEAE
Lycogala epidendrum (L.) Fries (Mac,E,B,G)

IV. CRIBRARIACEAE
Dictydium cancellatum (Batsch) Macbr. (E)

V. TRICHIACEAE
Arcyria cinerea (Bull.) Pers. (E,B)
A. denudata (L.) Wettst. (Mac,E,B,)
Hemitrichia serpula (Scop.) Rost. (Mac,B)
Metatrichia vesparium (Batsch) Nann.-Brem. (Mac)

Perichaena chrysosperma (Currey) A. Lister (E,B)
Trichia decipiens (Pers.) Macbr. (Mac)
T. favoginea (Batsch) Pers. (Mac,G)
T. verrucosa Berk. (Mac)

VI. STEMONITACEAE

Comatricha longa Peck (E)
C. pulchella (C. Bab.) Rost. (Mac,G)
C. typhoides (Bull.) Rost. (Mac,E,B)
Stemonitis pallida Wingate (E)
S. smithii Macbr. (Mac)
S. splendens Rost. (E,G)
S. trechispora (Torrend) Macbr. (E)

VII. PHYSARACEAE

Badhamia affinis Rost. (E,B,G)
Craterium leucocephalum (Pers.) Ditmar (E,B)
Fuligo septica (L.) Wiggers (Mac,G)
Physarella oblonga (Berk. and Curt.) Morgan (E)
Physarum compressum Alb. and Schw. (E,B)
P. globuliferum (Bull.) Pers. (E,B)
P. nicaraguense Macbr. (E)
P. nutans Pers. (Mac,E,B)
P. oblatum Macbr. (E)
P. stellatum (Massee) Martin (E)
P. sulphurium Alb. and Schw. (E)
P. tenerum Rex (E,B)
P. vernum Somm. Listed from Mexico in Martin & Alexopoulos (1969)

VIII. DIDYMIACEAE

Diderma effusum (Schw.) Morgan (E,B)
D. hemisphaericum (Bull.) Hornem. (E,B)
Didymium clavus (Alb. and Schw.) Rab. (E,B)
D. nigripes (Link) Fries (E,B)
D. squamulosum (Alb. and Schw.) Fries (E,B)
Physarina echinospora Thind and Manocha (A)

The Mexican Myxomycetes reported here for the first time in the literature represent collections made in 12 states of Mexico. Although collections were made from Puebla and Oaxaca, none of these species is new to Mexico. To prevent redundancy in the collection data, the states are listed below with their average temperature (C) and average rainfall for a five year period.

State	Month	Temperature	Rainfall (cm)
Chihuahua	June	26	2.5
Colima	October	26	7.75
Guerrero	July	21	30.5
	August	21	34.5
Hidalgo	June	16	7.0
Jalisco	June	22	19.3
	July	20	25.4
México	June	16	12.4
	July	16	12.5
	September	16	11.7
	October	15	3.3
	November	13	1.6
Morelos	July	20	21.8
	August	20	22.1
San Luis Potosí	July	20	5.8
Sonora	September	31	8.4
Tlaxcala	April	17	1.75
Veracruz	April	25	2.1
	July	27	35.1
Yucatán	December	23	3.1

The map (Fig. 1) shows the areas in which collections were made.

REPUBLICA MEXICANA

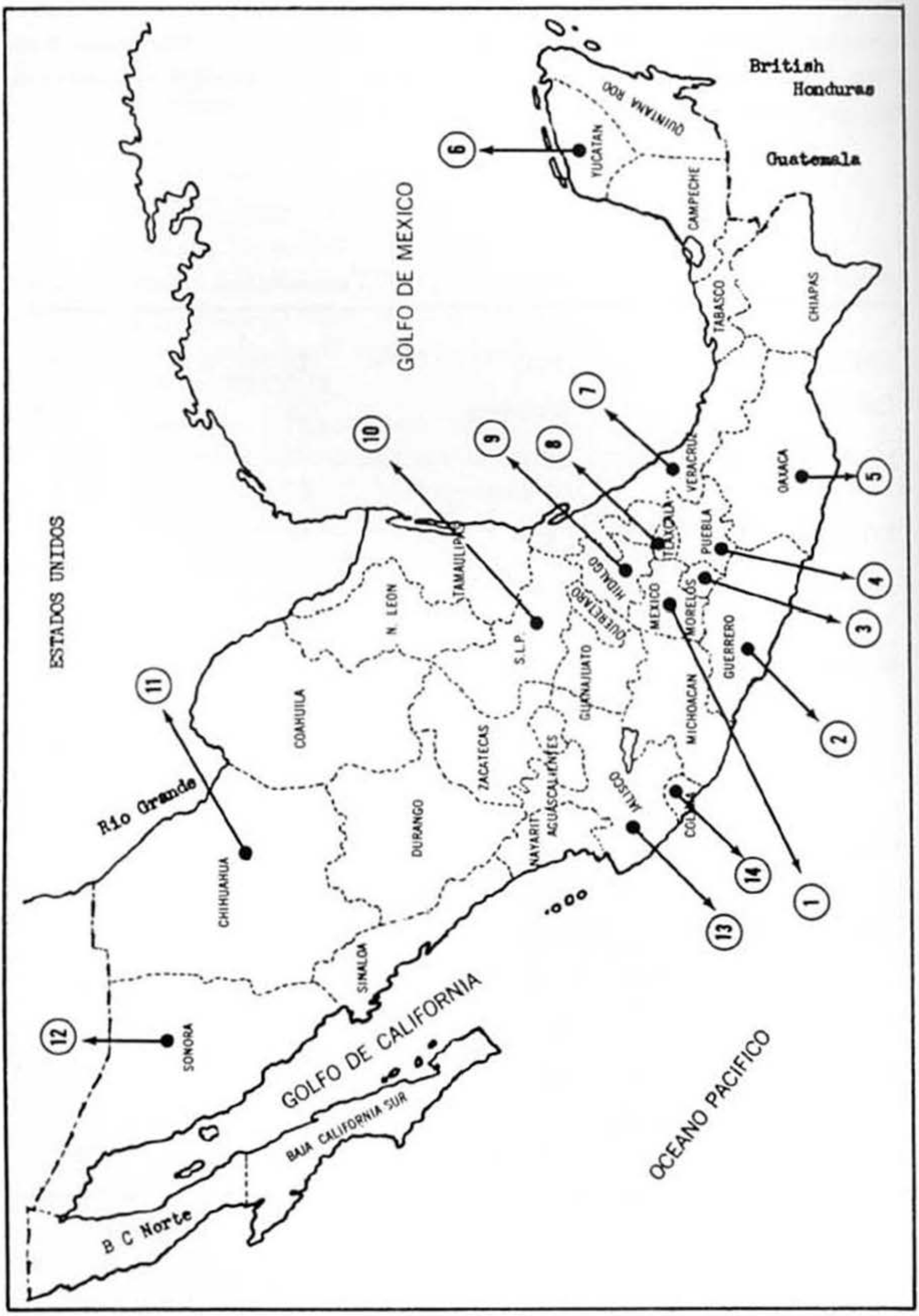

Figure 1. Map of Mexico showing 29 states and 2 territories. The states in which collections have been made are numbered.

In the following list, 48 Myxomycetes are reported as new to Mexico, along with the appropriate collection data. Collections are discussed only when the authors feel that they differ significantly from the species descriptions given in Martin and Alexopoulos (1969). IPN numbers indicate specimens in the herbarium of the Instituto Politécnico Nacional collected by Dr. Guzmán and his students.

LICEACEAE

Licea minima Fries, Syst. Myc. 3:199. 1829

Tlaxcala (8), see map. Texcoco and Capalupán, km 66-67 on rte 136. Low, rolling, pine covered hills. Harvested from moist-chamber by Dr. G. W. Martin 4-13-68, alt. ca. 2231m (GWM 9027, KLB 616)

RETICULARIACEAE

Reticularia intermedia Nann.-Brem.,Med.Bot.Mus. Utrecht 149: 773. 1958.

Jalisco (13). Guadalajara, Parque Agua Azul. On dead tree stump, 6-27-71, alt. ca. 1579m (KLB 581)

Tubifera ferruginosa (Batsch) J.F. Gmel.,Syst.Nat. 2: 1472.1791.

México (1). Carretera México, Toluca, La Venta, México, Conifer forest, 10-16-70, alt. ca. 2638m (IPN 54)

Morelos (3). Km 32 Autopista Mex. Cuernavaca, Pine woods, 7-21-68, alt. ca. 2900m (IPN 6801)

Hidalgo (9). Bosque Real de Huasca, 2 km SE of Huasca, Pinus-quercus woods, 6-24-73, alt. ca. 2150m (IPN 262)

Tubifera microsperma (Berk. and Curt.) Martin,Mycologia 39: 461 1947.

Veracruz (7). Ocotopec. Municipio de Jalacingo, Oak forest, 7-4-70, alt. ca. 1700m (IPN 1513)

CRIBRARIACEAE

Cribraria argillacea (Pers.) Pers.,Neues Mag. Bot.1: 91. 1794.

México (1). Llano Grande, carretera México a Río Frío, Pine woods, 7-26-70, alt. ca. 3100m(IPN 7967)

Cribraria violacea Rex, Proc. Acad. Phila. 43: 393. 1891

Yucatán (6). Uxmal, near pyramid of Magician. Bark of living tree, not identified, 12-24-74. Moist-chamber wetted, 1-3-75, harvested 1-20-75, alt. ca. 65m (KLB 619)

ECHINOSTELIACEAE

Echinostelium minutum de Bary, in Rost. Mon. 215. 1874.

Yucatán (6). Kabah, near entrance to archeological grounds, 12-24-74. Moist-chamber wetted 1-3-75, harvested 1-15-75, alt. ca. 65m (KLB 623)

Echinostelium sp. (To be published elsewhere as a new species.)

Yucatán (6). Kabah, 12-24-74. Moist-chamber wetted 1-3-75, harvested 1-15-75, alt. ca. 65m (KLB 624, HWK 1381, 1383, 1396, 1416)

TRICHIACEAE

Arcyria insignis Kalchbr. and Cooke, in Kalchbr., Grevillea 10: 143. 1882.

Guerrero (2). Taxco, San Francisco Cuadra along bank of Río Cuadra, on decaying wood, 7-2-71, alt. ca. 1705m (KLB 541)

Arcyria leiocarpa (Cooke) Martin and Alexop. in Martin and Alexopoulos. Myxomy. 131. 1969.

Guerrero (2). Taxco, San Francisco Cuadra along bank of Río Cuadra, on decaying wood, 7-2-71, alt. ca. 1705m (KLB 544)

Discussion: This species has a widely scattered distribution throughout the world, but is seldom reported apparently due to its confusion with *Arcyria cinerea* (Bull.) Pers. Our collection consists of a number of sporangia, tightly clustered in groups of 6 to 20. The ochraceous color of the sporangia is quite obvious in our material. Martin and Alexopoulos (1969) note that on the capillitial threads"...the loose spirals look spiny, particularly on the outside of curves, but careful examination will show that these are not spines,..." In our specimens the spines are clearly evident on the conspicuous spirals, although portions of the capillitium consist of smooth spiral bands. Martin and Alexopoulos

(1969) transferred this species from *Hemitrichia* to *Arcyria* and in so doing emphasized the arcyria-like habit of the sporangia and arcyriaceous organization (elastic network) of the capillitium. In any event this is quite a distinct species and the suggestion by Martin and Alexopoulos (1969) that it be considered a variety of *A. cinerea* has little merit.

Arcyria nutans (Bull.) Grev., Fl. Edin. 455. 1824

Hidalgo (9). Las Ventanas, Parque Nacional El Chico, Abies forest, on dead wood, 6-9-68, alt. ca. 3000m (IPN 6585)

Colima (14). East of Santiago, Carretera Manzanillo, tropical vegetation, on dead wood, 10-26-67, alt. ca. 20m (IPN 6230)

Calonema luteolum Kowalski, Madroño, Vol. 20: 4. 1969.

México (1). Teotihuacán, SE of Pirámide del Sol, found associated with *Hemitrichia karstenii* on leaf litter, 6-30-71, alt. ca. 2278m (KLB 514)

Discussion: This collection agrees with the original description except that the sporangia developed on plant litter rather than on dung of herbivorous animals, the usual substratum for this species. Kowalski (1969) acknowledges the similarity of *C. luteolum* to the genus *Perichaena* in the capillitial and spore characteristics but later puts more emphasis on the differences, "Species of *Perichaena*, however, have a two-layered peridium and the sporangia, while they may be clustered, are never heaped." *Perichaena quadrata* Macbr. has heaped sporangia and the upper half of the sporangia is dark and double-walled whereas the membranous lower half of the sporangia is more brightly colored and single-walled (Keller, 1971). *Perichaena microspora* Penz & A. Lister has a membranous peridium that appears single. In addition the perichaenoid capillitium of *C. luteolum* is identical to that of *P. quadrata* and *P. depressa* Libert which according to Keller, 1971 has "...close-set constrictions at regular intervals, appearing as annulae in surface view and as septations in optical sections;..".

Electron micrographs of capillitial threads of *P. depressa* (collection HWK 520) clearly show that the so-called annulae and septations are wedge-shaped intrusions of the wall into the lumen of the thread and more accurately can be described as partial septations (unpublished observations by one of us HWK). The two species, *P. quadrata* and *C. luteolum,* may be conspecific with *P. liceoides* Rost. *Calonema luteolum* agrees with Rostafinski's description of *P. liceoides* in every detail except that in the latter species the capillitium is usually more scanty or completely lacking. There is some doubt whether or not Rostafinski's type still exists, but if it does, and if it is identical with *P. quadrata* or *C. luteolum,* then the epithet *liceoides* has priority.

Hemitrichia karstenii (Rost.) A. Lister, Mycet. 178. 1894.

México (1). Teotihuacán, found on leaf litter, 6-30-71, alt. ca 2278m (KLB 588)

Perichaena depressa Libert, Pl. Crypt. 378. 1837.

Yucatán (6). Uxmal, near pyramid of Magician. Moist-chamber collection from bark of living tree (unidentified). Bark collected 12-24-74, wetted 1-3-75, harvested 1-15-75, alt. ca. 65m (KLB 618)

Hemitrichia calyculata (Speg.) Farr, Mycologia 66: 887. 1974.

Jalisco (13). Guadalajara, on dead wood, 6-25-71, alt. ca. 1579m (KLB 597)

Guerrero (2). Taxco, San Francisco Cuadra along the Río Cuadra, on dead wood, 7-2-71, alt. ca. 1705m (KLB 507)

Morelos (3). 5km NW of Tepoztlán, near autopista to Cuatla, on wood in subtropical forest of Quercus, 8-16-70, alt. ca. 1400m (IPN 8052)

Trichia varia (Pers.) Pers., Neues Mag. Bot. 1: 90. 1794.

Veracruz (7). Jalapa, early April, 1894. Legit: C. L. Smith, Fide: G. W. Martin. alt. ca. 1362m

STEMONITACEAE

Colloderma sp.

México (1). Cerro Cualtepec, near Sultepec, on bark of living long-leaved pine, bark taken from 1.4m above ground, 9-30-66, alt. ca. 2480m (GWM 9025)

Discussion: On bark of living *Pinus* (unidentified) in moist-chamber. The bark sample on which this specimen appeared was gathered by Dr. Paul Sorensen. Dr. G. W. Martin placed part of this bark sample in a moist-chamber in October, 1966 and incubated it at room temperature. Aside from an abundance of *Echinostelium minutum* deBary, it produced only molds, and was discarded. The remainder was cultured similarly on January 28, 1967, but this time it was placed in an incubator at 18 C. Here, in addition to the *E. minutum*, it produced *Licea minima* Fries in small quantities and the *Colloderma* in great abundance. The fructifications developed very slowly, taking about two weeks to attain full maturity, but continued to appear over a period of about three months. In personal notes given to one of us (HWK) by Dr. Martin shortly before his death, this *Colloderma* was considered an undescribed species and given a provisional name. There is no question that this specimen is quite different from *Colloderma oculatum* (Lippert) G. Lister but it is similar in many ways to *Colloderma robustum* Meylan. We believe more collections are needed before a decision can be made as to whether this material represents a new species or is assignable to *C. robustum*. Therefore, only a detailed description and a discussion of our specimen is provided at this time.

Sporangia sessile, pulvinate, clustered or scattered on a broad or somewhat constricted base, circular or somewhat elongated but scarcely plasmodiocarpous except by fusion of adjacent sporangia, 0.4-0.8 mm diameter, rarely exceeding twice the diameter in length, dark brown; peridium double, the outer layer thick, nearly colorless, with included brownish granules and waste material from the substratum, gelatinous when moist, shrinking and appressed against the inner membranous and shiny layer when dry, the combined layers toughcartilaginous; hypothallus colorless, thin, scarcely visible when moist and rarely visible when dry, but apparently continuous with the gelatinous outer wall; columella none; capillitium a delicate network of slender mostly colorless to pale brownish threads, the junctions few and only slightly enlarged and occasionally with swellings; spores globose, deep brown in mass, yellowish brown and paler on one side by transmitted light, densely and conspicuously spiny, the spines appearing longer and darker on one side, 14 - 16 µm in diameter including the ornamentation. Phaneroplasmodium dingy white on emergence, changing through dull pinkish and dingy ochraceous to brown.

In its general habit, peridial characteristics and in the size and spiny spores this specimen closely resembles *C. robustum,* from which it differs in its very delicate and rather scanty almost colorless capillitium (giving a hoary appearance in blown out sporangia) and in the somewhat browner color of the spores which have longer spines on one side and a distinct paler area on the opposite side. Dr. D. T. Kowalski, who has examined Meylan's type (Kowalski, 1975) and who kindly examined our specimen, noted in a personal communication that our specimen was "...very close to, if not identical with *C. robustum*. I have examined two collections of *C. robustum,* one from Poland and Meylan's type from Switzerland, and while there are some differences, they are minute." and with this we are in general agreement.

Comatricha elegans (Racib.) G. Lister, Guide Brit. Mycet. ed. 3. 31. 1909.

Jalisco (13). Guadalajara. 1579m on dead wood. 6-27-71. (KLB 613)

Discussion: Our specimen is a typical example of this species in which the abundant capillitium is well developed as an intricate system of threads that branch and anastomose eventually terminating in many free ends. Raciborski's type was examined and found to be identical with our specimen. Over the years one of us (HWK) has made numerous collections of a *Comatricha* from the bark of living trees that was provisionally assigned to *C. elegans* even though the capillitium was less abundant, seldom branched and was united at the periphery into a surface net with few or no free ends. This taxon is close to *Paradiacheopsis cribrata* Nann. Brem. except for the consistantly smaller spores of 8-9.5 µm. Additional specimens and types must be studied before the exact taxonomic status of this *Comatricha* from living trees can be determined.

Comatricha subcaespitosa Peck, Ann. Rep. N.Y. State Mus. 43: 71. 1890.

San Luis Potosí (10). Valles, growing on well rotted material (one of the fleshy fungi) on soil. 7-19-58 alt. ca. 89m (KLB 503)

Comatricha tenerrima (M.A. Curt.) G. Lister, Guide Brit. Mycet. ed. 4. 39. 1919.

Guerrero (2). Taxco, San Francisco Cuadra along Río Cuadra near the hacienda, on dead wood, 7-2-71, alt. ca. 1705m (KLB 538)

Lamproderma arcyrionema Rost., Mon. 208. 1874.

Guerrero (2). Taxco, San Francisco Cuadra, Río Cuadra, on leaf litter, 7-2-71, alt. ca. 1705m (KLB 535)

Lamproderma echinulatum (Berk.) Rost., Mon. App. 25. 1876.

México (1). La Marquesa, Parque Nacional Miguel Hidalgo, dead wood, Abies forest, 6-16-68, alt. ca. 3000m (IPN 12). The identification of this specimen has been verified by Dr. D. T. Kowalski.

Discussion: This collection represents the first record for the New World. Although the sporangia are in poor condition and moldy due to excessive weathering, they agree in detail with the species description in Martin and Alexopoulos (1969).

Macbrideola cornea (G. Lister and Cran) Alexop., Mycologia 59: 112. 1967.

Yucatán (6). Uxmal, from living tree (unidentified). Collected 1.24m above ground, 12-24-74. Wetted

3-18-75, harvested 3-24-75, alt. ca. 65m (KLB 511)

Stemonitis axifera (Bull.) Macbr.,N. Amer. Slime-Moulds 120.1889.

México (1). Barranca de Ameyallo, Camino Amecameca, Tlamacas. Dead wood, Abies forest, 6-26-72, Alt. ca. 3000m (IPN 10051)

Stemonitis fusca Roth, Mag.Bot. Römer and Usteri 1 (2): 26.1787.

Chihuahua (11). Creel, near train station, found on Ponderosa Pine (on dead wood) 6-17-71, alt. ca. 2250m (KLB 558)

Stemonitis virginiensis Rex, Proc.Acad.Phila. 43: 391. 1891.

Morelos (3). Cuernavaca (Cortez Palace), found on living grass at base of tree stump, 7-21-72, alt. ca. 1550m (KLB 578)

PHYSARACEAE

Badhamia gracilis (Macbr.) Macbr., in Macbr. and Martin, Myxom. 35. 1934.

México (1). Teotihuacán, found at base of "prickly pear" cactus on dead nopal leaf, 7-18-72, alt. ca. 2278m (KLB 506)

Badhamia utricularis (Bull.) Berk., Trans. Linn.Soc. 21: 153.1853.

México (1). 3km sobre la Desviación a Chalma. Bosque de Pinus-Abies. On dead wood, 7-2-71, (IPN 89)

Craterium aureum (Schum.) Rost., Mon. 124. 1874.

Guerrero (2). Taxco, San Francisco Cuadra, along Río Cuadra, found on dead leaf, 7-2-71, alt. ca. 1705m (KLB 525)

Fuligo cinerea (Schw.) Morgan, Jour.Cinc.Soc.Nat.Hist. 19: 33.1896.

Sonora (12). Monte la Esperanza, 4 km NE of Altar. On debris in Bosque de Mezquite, Sept. 1968, alt. ca. 400m (IPN 13)

Physarum bogoriense Racib., Hedwigia 37: 52. 18 F. 1898.

Guerrero (2). Taxco. San Francisco Cuadra, 1550m, on dead tree twig. 7-2-71. (KLB 524)

Discussion: On dead twig as part of ground litter. This collection has the typical sessile fructifications that vary from globose sporangia to elongate, unbranched plasmodiocarps. The peridium dehisces in a stellate fashion, remaining as persistant lobes. The capillitium is distinctly physaroid and is characterized by discrete, rounded lime-knots connected by hyaline threads. The globose spores are free (not clustered), pale brown in mass, and uniformly and faintly warted. This collection, as well as many others from the tropics and subtropics where this species is very common, and others from the temperate and cooler regions of the world where this species tends to be more infrequent, agree well with Raciborski's original description.

The species description of *P. bogoriense* in Martin and Alexopoulos (1969) differs from that of previous monographers (the Listers 1911, 1925; Macbride and Martin 1934; Hagelstein 1944; Martin 1949) and also from Raciborski's original description (1898) in that it is expanded to include "often reticulate plasmodiocarps", in reference to the habit, and "sometimes clustered" in reference to the spores. These changes were prompted by specimens sent to Dr. Martin by Dr. D. T. Kowalski from California which clearly exhibited these characteristics. In their monograph Martin and Alexopoulos (1969) note that "Dr. Kowalski, in correspondence, reports that he has examined Raciborski's type and finds that the spores are clustered, as they are in one of his northern California collections and in Plunkett's 182 from southern California." Much later, after the monograph had gone to press, Dr. Martin had recognized that two taxa were involved here, and that the California material represented a distinct species. In his personal notes he gave the California specimens a new name and tabulated the differences of the two taxa. These differences Dr. Martin described as "The prominently clustered spores which are very dark and much more strongly warted, and the very different peridium..." and later "The thick, tough, smooth, shining peridium of your specimen is not at all like that of what I should call *P. bogoriense* as I know it from the central states and Central America, nor, so far as my rather scanty material permits me to judge, from the Old World tropics."

One of us (HWK) has examined 18 collections gathered by Dr. D. T. Kowalski (DTK 's 1407, 1497, 2466, 5224, 5229, 5237, 5244, 5248, 5252, 5256, 5443, 5487, 5494, 5672, 5675, 5768, 5785, 7954) during December to March in the Sacramento Valley, where this taxon is extremely abundant. This is a lowland taxon, occurring at approximately 100 m elevation on the decaying bark of hardwood logs and also on accumulated dead leaves. A number of characteristics set apart these collections from *P. bogoriense*, some of which were noted by Dr. Martin. These differences include a tendency toward a more robust and intricately branching plasmodiocarpous habit, often becoming reticulate and extending up to 3cm in length; a double peridium greatly thickened and charged with lime that gives a shiny and varnished appearance reminiscent of *Leocarpous fragilis* (Dicks) Rost.; dehiscence by irregular fragmentation but never by preformed lines at the apex or by splitting into lobes along the sides; a more badhamoid capillitium of irregular and branching tubules and in plasmodiocarps the presence of a massive columella that may fill up to half the chamber; and spores almost black in mass, that adhere in loose or tight clusters of variable numbers.

One of us (HWK) has examined all of the specimens identified as *P. bogoriense* in the University of Iowa Myxomycetes collection, as well as collections made in Florida (HWK #'s 318, 326, 793, 977) where the species is extremely common. None of these collections has reticulate plasmodiocarps, a badhamoid capillitium, a conspicuous columella, or clustered spores and indeed differ in many significant characteristics from the California material. Raciborski's original description in German (1898), and the descriptions of later monographers such as the Listers (1911, 1925), Macbride and Martin (1934), Hagelstein (1944), Martin (1949) accurately and correctly circumscribe *P. bogoriense*. Our examination of many collections of *P. bogoriense* supports the findings of earlier monographers and a brief summary of salient features follows: the peridium is double and the outer layer splits into lobes which separate above but remain attached below, exposing the membranous inner peridium; the capillitium is distinctly physaroid, the small usually rounded or irregular lime-knots rarely collect in the center suggesting a pseudocolumella, but a true columella is absent; the spores are free and brown in mass.

There appear to be two strikingly different and distinct taxa involved here, not a single variable species linked by collections of an intermediate nature. Nevertheless, the taxonomic status of *P. bogoriense* remains in doubt since our repeated attempts to obtain Raciborski's type have been unsuccessful. As noted above, Dr. Kowalski believes Raciborski's type is the same as his California material. If Raciborski's original description accurately describes the type specimen, as we believe it does, then the type of dehiscence alone would rule out the possibility that the California material is the same. It appears to us that the California material, previously included in the species description of *P. bogoriense* by Martin and Alexopoulos (1969), is a distinct species, but its taxonomic status must remain uncertain until we can examine the type.

Physarum cinereum (Batsch) Pers., Neues Mag. Bot. 1: 89. 1794.

Guerrero (2). Taxco. San Francisco Cuadra, along the Río Cuadra on leaf litter. 1705m. 7-2-71. (KLB 548)

Jalisco (13). Guadalajara, on dead twig, 6-28-71, alt. ca. 1579m (KLB 573)
Guadalajara, on living grass, 6-25-71, alt. ca. 1579m (KLB 603)
Guadalajara, on living grass, 7-18-72, alt. ca. 1579m (KLB 614)

Physarum ?citrinum Schum., Enum. Pl. Saell. 2: 201. 1803.

Mexíco (1). 3 km sobre la Desviación a Chalma, on dead wood, Bosque de Pinus and Abies, 7-2-71, (IPN 93)

Discussion: Our specimen consists of about 50 fructifications growing on dead wood. Although this specimen is very close to the Martin and Alexopoulos (1969) description, there are some obvious differences and therefore a description of our specimen follows. A similar specimen (TEX 1474) was described by Alexopoulos and Sáenz (1975) which, as they imply, may very well represent a new species.

Sporangia gregarious, many in pairs closely appressed, stipitate, globose to subglobose with slight invagination below, pale yellow, 0.8-1.5mm tall (total), 0.6-0.8mm in diameter; hypothallus venulose, scanty, membranous, yellowish brown; stipe stout, calcareous, erect, tapering upward, yellow, very short to about half total height; columella small, convex, yellow; peridium thin, membranous, covered with yellow calcareous patches, persisting at base of columella; capillitium dense, delicate, consisting of numerous elongated, yellow lime nodes and hyaline connecting filaments; spores dark brown in mass, violaceous brown by transmitted light, 10-12µm in diameter, minutely punctate (1000x) with conspicuous wart clusters.

Physarum melleum (Berk. and Br.) Massee, Mon. 278. 1892.

Guerrero (2). Taxco, San Francisco Cuadra along Río Cuadra, leaf litter, 8-10-75, alt. ca. 1705m (KLB 595)

Jalisco (13). Guadalajara, on dead grass, 6-24-71, alt. ca. 1579m (KLB 609)

Physarum mutabile (Rost.) G. Lister, in Lister, Mycet. ed. 2. 53. 1911.

Jalisco (13). Guadalajara, on living grass, 6-25-71, alt. ca. 1579m (KLB 576)

Physarum penetrale Rex, Proc. Acad.Phila. 43: 389. 1891.

Guerrero (2). Taxco, San Francisco Cuadra, along the Río Cuadra, on dead wood, 8-17-59, alt. ca. 1705m (KLB 505)

Physarum pusillum (Berk. and Curt.) G. Lister, Mycet. ed. 2. 64. 1911.

México (1). Teotihuacán, on leaf litter, 6-30-71, alt. ca. 2278m (KLB 589)

Teotihuacán, in front of Café Pirámide, found on cotton string, 6-30-71, alt. ca. 2278m (KLB 610)

Jalisco (13). Guadalajara, on leaf litter, 6-25-71, alt. ca. 1579m (KLB 602)

Guadalajara, on leaf litter, 6-25-71, alt. ca. 1579m (KLB 591)

Physarum virescens Ditmar, in Sturm, Deuts. Fl. Pilze 1: 123. 1817.

Guerrero (2). Taxco, San Francisco Cuadra, along Río Cuadra on decaying wood. Associated with *Comatricha*. 7-2-71, alt. ca. 1705m (KLB 550)

Physarum viride (Bull.) Pers., Ann. Bot. Usteri 15: 6. 1795

Guerrero (2). Taxco, San Francisco Cuadra, along Río Cuadra, on dead, well decayed tree, 7-2-71, alt. ca. 1705m (KLB 519)

DIDYMIACEAE

Diderma crustaceum Peck, Ann. Rep. N. Y. State Mus. 26: 74. 1874.

Guerrero (2). Taxco, San Francisco Cuadra, along Río Cuadra on dead leaf, 7-2-71, alt. ca. 1705m (KLB 534)

Diderma niveum (Rost.) Macbr., N. Am. Slime-Moulds. 100. 1899.

Guerrero (2). Taxco, San Francisco Cuadra, along Río Cuadra on leaf litter, 8-17-58, alt. ca. 1705m (KLB 503)

Diderma spumarioides (Fries) Fries, Syst. Myc. 3: 104. 1829.

México (1). Carretera México, Amecameca. Bosque de Pinus, Cupressus, Quercus. Found on moss, 11-2-69, alt. ca. 2295m (IPN 68-A)

Diderma testaceum (Schrad.) Pers., Syn. Fung. 167. 1801.

Guerrero (2). Taxco, San Francisco Cuadra along Río Cuadra on dead leaves and moss, 8-17-58, alt. ca. 1705m (KLB 501)

Taxco, Op. cit., on decaying wood, 8-17-59, alt. ca. 1705m (KLB 502)

Didymium anellus Morgan, Jour.Cinc.Nat. Hist. 16: 148. 1894.

Guerrero (2). Taxco, San Francisco Cuadra on dead leaf, 7-2-71, alt. ca. 1705m (KLB 517)

Didymium difforme (Pers.) S.F. Gray, Nat.Arr. Brit.Pl. 1: 571. 1821.

Jalisco (13). Guadalajara, on leaf litter, 6-28-71, alt. ca. 1579m (KLB 572)

Guerrero (2). Taxco, San Francisco Cuadra, along Río Cuadra on leaf litter, 7-2-71, alt. ca. 1705m (KLB 553)

Didymium iridis (Ditmar) Fries, Syst.Myc. 3: 120. 1829.

Guerrero (2). Taxco, San Francisco Cuadra, Río Cuadra, on leaf litter, 7-2-71, alt. ca. 1705m (KLB 615, 619, 620)

Didymium minus (A. Lister) Morgan, Jour.Cinc.Soc.Nat.Hist. 16: 145. 1894.

Guerrero (2). Taxco, San Francisco Cuadra, Río Cuadra, on leaf litter, 7-2-71, alt. ca. 1705m (KLB 621, 513)

Mucilago crustacea Wiggers, Prim.Fl.Holst. 112. 1780. Not *M. crustacea* (L.) Schrank 1789.

México (1). Barranca de Ameyalco, Camino Amecameca, Tlamacas, Abies forest, on moss, 6-26-72, (IPN 198)

ACKNOWLEDGEMENTS

We should like to thank Dr. G. W. Martin who, shortly before his death, provided us with collections and notes of the *Colloderma* and *Liceas* reported here. We wish to thank Dr. D. T. Kowalski for his valuable comments concerning *Colloderma robustum*. Dr. T. E. Brooks and Dr. M. L. Farr identified many of the more difficult specimens and their assistance is greatly appreciated. The senior author wishes to thank Louise Flannery, Jeanne Braun, and Marilyn Lesher for their help in collecting specimens. Special thanks to Herman H. Flannery who made most of the 1971 collections. Thanks also to Dr. Gastón Guzmán of the Instituto Politécnico Nacional, Escuela Nacional de Biológicas, for his help and permission to examine specimens in his herbarium. We should also like to thank Jeanne Braun and David Reichel for their Spanish and German translations of the abstract respectively. This project was supported by NSF Institutional Grant (GU-3646) to Wright State University and awarded through the University Research Council to Harold W. Keller.

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MYCOTAXON

Vol. III, No. 2, p. 318 January-March 1976

BOOK REVIEW

by

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THE MICROFLORA IN THE SETTLING AND SUBSOIL WATER ENRICHING BASINS OF THE BUDAPEST WATERWORKS. A COMPARATIVE STUDY IN ECOLOGY, LIMNOLOGY AND SYSTEMATICS, par T. HORTOBAGYI, 342 p., 610 fig., 17 × 24 cm, relié, 1973. Akademiai Kiado, Budapest. S 20.20.

Toute étude écologique sérieuse se doit d'être basée sur une taxonomie précise de la flore. L'auteur présente excellement la description taxonomique de 415 espèces (algues pour la plupart, dont 130 *Scenedesmus*, et deux champignons) dans les eaux de Budapest. Il s'adresse aux algologues et aux écologites.

MYCOTAXON

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A REVISION OF HELOTIOPSIS

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SUMMARY

Three species of *Helotiopsis*, a genus of inoperculate Discomycetes with spherical, ornamented spores, are discussed. Of these, H. jenkinsii is described as new, and H. anonyma is transferred to the genus.

Ornamented ascospores are rare among non-lichenized inoperculate Discomycetes. Attempts to identify a minute Mexican Discomycete with spherical, spinulose spores and inoperculate asci led the authors to *Helotiopsis* von Höhnel, a poorly-known, tropical genus.

Von Höhnel (*1910*) characterized *Helotiopsis* by spherical, smooth or spiny ascospores and a margin constructed of overlapping, pale yellow hyphae with thickened ends. He included one species, *H. apicalis* (Berk. & Br.) v.Höhn., and suggested that *Pezizella anonyma* Rehm was congeneric. Examination of the type material of *P. anonyma* and of *H. apicalis*, and comparison with the Mexican collections, showed all three to be congeneric.

The Mexican fungus appears distinct from the other two species and is here designated *Helotiopsis jenkinsii* in honor of Anna E. Jenkins (Obrien, *1975*), a lifelong friend and benefactor of this Herbarium.

HELOTIOPSIS von Höhnel, Sitzungsber. Kaiserl. Akad. Wiss., Math.-Naturwiss. Cl., Abt. 1, 119: 623. 1910.

Apothecia minute to small, subsessile or short stipitate, light-colored, glabrous to faintly roughened when dry, rather glassy when wet. Excipulum composed at least in part of hyphae with thick, gelatinizing walls, parallel to or at a low angle to the surface. Paraphyses numerous, filiform, gelatinizing in one species. Asci small, cylindrical,

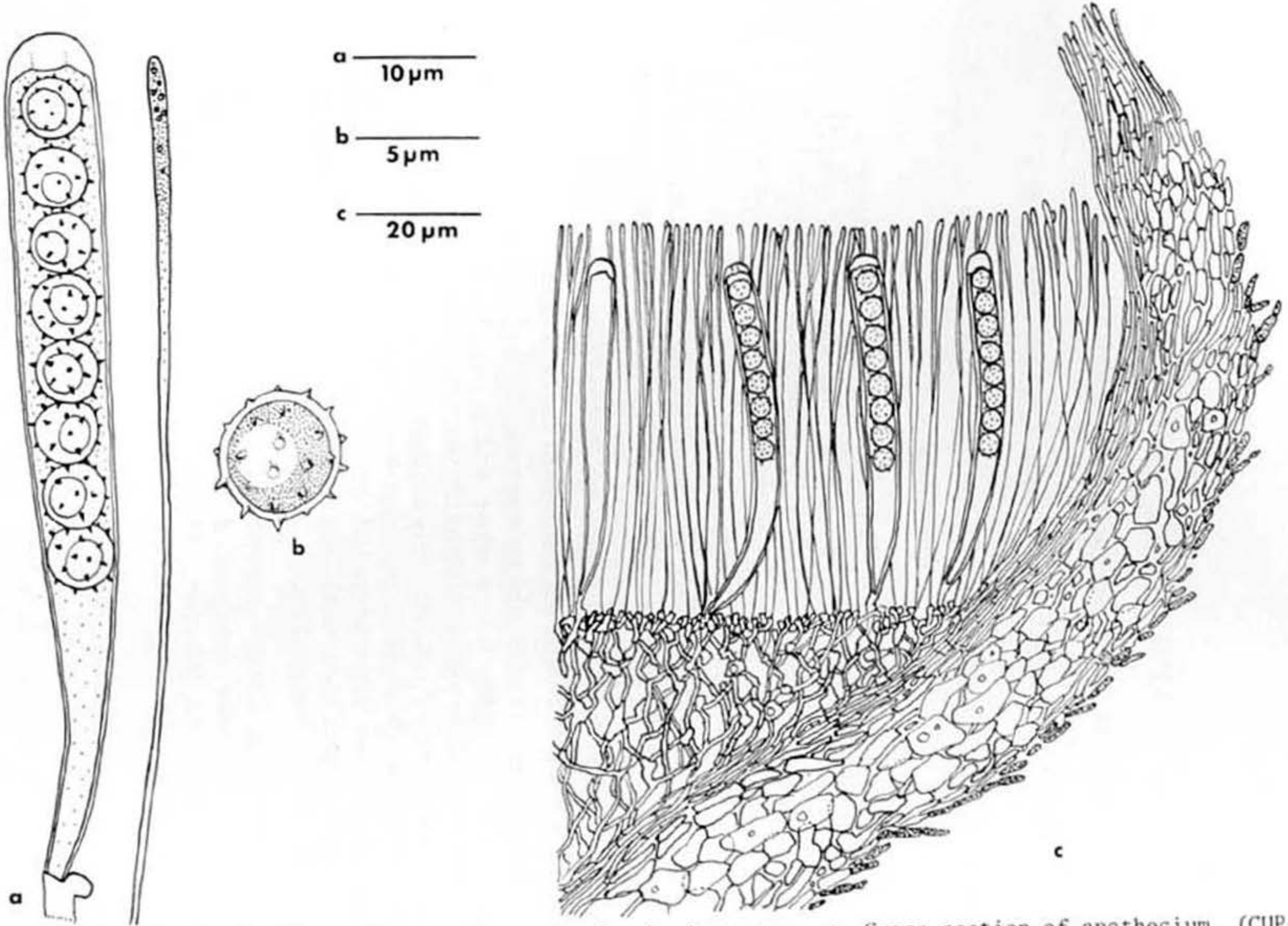

FIG. 1. *Helotiopsis jenkinsii*. a. Ascus and paraphysis. b. Ascospore. c. Cross section of apothecium. (CUP-ME 67.)

with a rather thick apical cap and no obvious preformed pore, J– (whether rehydrated in water or in 2% aqueous KOH). Ascospores 8, uniseriate, globose, colorless, at first smooth, eventually ornamented with coarse spines (? permanently smooth in *H. anonyma*).

KEY TO THE SPECIES

A. Ectal excipulum with short, non-gelatinizing, hairlike projections; apothecia appearing faintly roughened when dry.
H. jenkinsii

A'. Outermost tissues of ectal excipulum gelatinizing and agglutinated; apothecia smooth when dry.

  B. Hyphae of the ectal excipulum inflated at their tips; walls much narrower than the cell lumen.
  H. apicalis

  B'. Hyphae of the ectal excipulum not enlarged at their tips; walls nearly as thick as the cell lumen.
  H. anonyma

Helotiopsis jenkinsii Sherwood & Korf, *sp. nov.* (FIGS. 1, 2c.)

Apothecia 1 mm in diam. vel minora, breviter stipitata, pallide flava. Cellulae excipuli ectalis globosae, hyphis brevibus brunneis filiformibus interspersis, cellulae excipuli medularis hyphales, laxe intertextae, interdum inflatae. Paraphyses filiformes, supra parum amplificatae, contentu flavescente, granulari. Asci parietibus crassiusculis et apice crassissimo praediti, poro dehiscentes, 65-70 × 5-7 μm, iodo tincto non caerulescentes. Spori sphaerici, achromi, 5.0 μm in diam., spinis grossis ornati. Habitat in radicibus filicum. Holotypus: CUP-ME 67.

Apothecia small, short-stalked, yellowish when dry, ca. 1 mm in diameter, appearing roughened. Excipulum entirely hyphal near the margin, becoming distinctly 3-layered near junction with the stipe. Outer layer of inflated, nearly isodiametric cells with gelatinizing walls, interspersed with 1-2-celled, non-gelatinizing projections; middle layer of parallel, non-gelatinizing hyphae lying at a low angle to the surface; inner layer of vertically oriented, loosely interwoven, irregularly inflated hyphae. Paraphyses simple, septate, 1.5 μm in diameter, scarcely enlarged above. Asci strictly cylindrical, 65-70 × 5-7 μm, when young with an apical cap 3.0 μm thick, this becoming thinner with age.

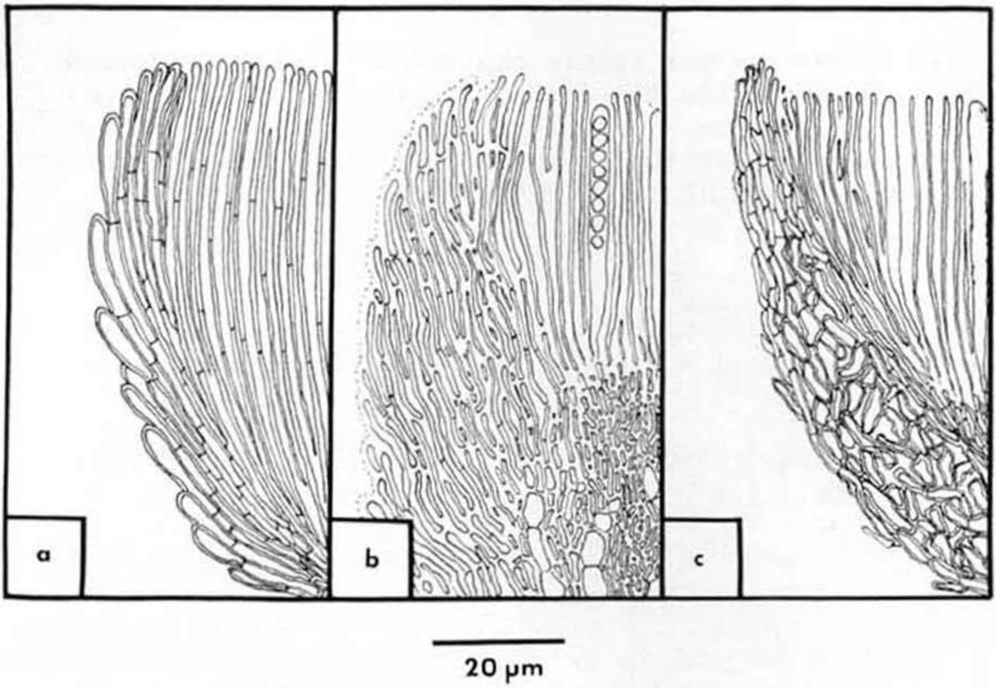

FIG. 2. a. *Helotiopsis apicalis*. (FH-von Höhnel 5395.) b. *H. anonyma*. (S-Rehm 1115b.) c. *H. jenkinsii*. (CUP-ME 67.)

Spores spherical, with coarse, cyanophilic spines, 5.0 μm in diameter (smaller spores seem immature), containing a single large guttule. HOLOTYPE: CUP-ME 67, on fern roots, Salto de Aquiparaba, Guerrero, Mexico, leg. M.B. Spevak, August 29, 1965. PARATYPE: CUP-ME 58, same collection data.

HELOTIOPSIS APICALIS (Berk. & Br.) von Höhnel, Sitzungsber. Kaiserl. Akad. Wiss., Math.-Naturwiss. Cl., Abt. 1, 119: 623. 1910. (FIG. 2a.)

≡ *Peziza apicalis* Berk. & Br., J. Linn. Soc., Bot. 14: 106. 1873.
≡ *Pseudohelotium apicalis* (Berk. & Br.) Sacc., Syll. Fung. 8: 304. 1889.
≡ *Mollisiella apicalis* (Berk. & Br.) Sacc. & Sacc. *in* Sacc., Syll. Fung. 18: 64. 1906.

Apothecia ca. 0.5 mm in diameter, short-stalked, dark yellow, glabrous. Excipulum not distinctly layered above junction with the stipe, consisting of hyphae lying at a low angle to the surface, 2.0-2.5 μm in diameter, with gelatinizing walls, ending in inflated tips 4-7 μm broad. Asci ca. 60 × 6 μm, the apex thickened. Ascospores spherical, 4.0-5.0 μm in diameter, containing a large guttule and ornamented with short spines. On mosses, Ceylon.

SPECIMEN EXAMINED: FH-von Höhnel 5395, *Helotiopsis apicalis*, Orig. on *Rhacomitrium sulcatum*, Ceylon, Thwaites (ISOTYPE).

The above description is based partly on von Höhnel's (*1910*) description and partly on his prepared slides; reactions in cotton blue and in iodine are unknown. Smaller overall size and smaller asci and spores also distinguish this species from *H. jenkinsii*.

Helotiopsis anonyma (Rehm) Sherwood & Korf, *comb. nov.* (FIG. 2b.)

≡ *Pezizella anonyma* Rehm, Hedwigia 34: 165. 1895.
≡ *Mollisiella anonyma* (Rehm) Rehm, Hedwigia 44: 9. 1905.

Apothecia 0.1-0.5 mm in diameter, densely gregarious, subsessile to short-stalked, drying yellow, glabrous. Excipulum unlayered, composed throughout of parallel hyphae with a cell lumen 1.5-2.0 µm wide and thick, gelatinizing walls. Subhymenium containing conspicuous, inflated cells 4.0-6.0 µm in diameter. Asci cylindrical, 45 × 5 µm, the cap 1.0 µm thick and refractive. Ascospores globose, 2.0-3.0 µm in diameter, smooth (at least in youth). Paraphyses filiform, scarcely exceeding the asci, with gelatinizing walls. On stromata of *Valsaria*, Ecuador.

SPECIMENS EXAMINED: S-Rehm, Ascomyceten #1115b, *Pezizella anonyma*, auf dem Stroma von *Valsaria crenata* Rehm an Zweigen einer *Melastoma*, Ecuador, Prov. Pichincha, Prof. V. Lagerheim, 7/1892 (LECTOTYPE, designated here); NY, LECTO-ISOTYPE.

Von Höhnel (*1910*) concluded that this species belonged in *Helotiopsis*, but apparently never made the combination. Many of the apothecia in this collection are immature and lack asci; the species seems, however, to be congeneric, and distinct from the other two.

EXCLUDED SPECIES

HELOTIOPSIS MARGINALIS Vain., Ann. Acad. Sci. Fenn., Ser. A, 15: 151. 1921.

≡ *Bacidia marginalis* (Vain.) R. Sant., Symb. Bot. Upsal. 12: 445. 1954.

According to Santesson (*1952*) this is a foliicolous lichen unrelated to *Helotiopsis*. We accept Santesson's placement of this species.

CONCLUSIONS

Helotiopsis, by virtue of substipitate to stipitate apothecia, hyphal characters of the excipulum, and lack of any obvious stroma is best placed among the Leotiaceae, where its affinities appear to be with *Cyathicula*. The small size and nondescript appearance undoubtedly account for the fragmentary distribution records for this genus. Two of the known species are Neotropical, the other, Paleotropical. All three species occur on cryptogams (fern, moss, Pyrenomycete).

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