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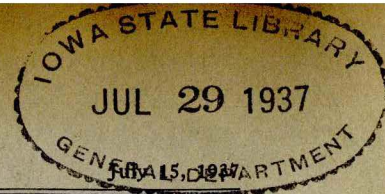
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STUDIES IN NATURAL HISTORY

Volume XVII

Number 5

An Addition to Bibliographies of  
the Genus *Cuscuta*

by HENRY LEE DEAN

The Morphology of *Podaxis Pistillaris*

by TRAVIS W. BRASFIELD

Discomycetes from Panama and Colombia

by EDITH K. CASH

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Insect galls on species of *Cuscuta*. Proc. Indiana Acad. Sci. 43:70-71. 1935.

## THE MORPHOLOGY OF PODAXIS PISTILLARIS

TRAVIS W. BRASFIELD

*Podaxis pistillaris* has been known for some two hundred and fifty years and has been the subject of many taxonomic discussions, but little investigation of its general morphology seems to have been attempted. This is doubtless to be attributed to the restricted habitat and hypogaeic habit of the fungus, and hence the difficulty of obtaining young specimens for histological study. The purpose of the work here reported was to investigate certain of the developmental stages and to ascertain their possible bearing upon the problem of the relationships of *Podaxis* to other Basidiomycetes.

The study was suggested by Prof. G. W. Martin, and the work was carried on under his direction in the Department of Botany of the State University of Iowa.

### Review of the Literature

An adequate review of the taxonomic literature has been given by Morse (11) and need not be repeated except with respect to points requiring further discussion. Cooke (4) spoke of the resemblance of the peridium to a volva which is more or less confluent with the surface of a pileus. De Bary (1), in speaking of the Secotieae, said "their arrangement in one special group along with *Podaxon* (i.e. *Podaxis*) is founded only on superficial resemblances and is not tenable—the group of the Podaxineae as hitherto constituted must be broken up." Lloyd (10) remarked that "the tribe Podaxineae forms a natural connecting link between the Gastromycetes and agarics; thus *Podaxon* is a true Gastromycete with capillitia mixed with spores." Hollós (9) remarked on the resemblance of *Secotium* (i.e. *Endoptychum*) *agaricoides* to the agaricinean type of fructification. Conard (3), after working out the development of *Secotium agaricoides*, concludes that it is nearly related to *Agaricus*, being an arrested or paedogenic form, and that it is not closely related to the Gasteromycetes or the Phalloids. Cunningham (5) places *Podaxis* in the family Tulostomataceae, remarking that the details of development are especially

required to determine the manner in which the fasciculate basidia of *Podaxis* arise.

Clements and Shear (2), in speaking of the Lycoperdales, maintain that that order is closely connected with the Agaricales, and that the Lycoperdaceae have probably developed from the Agaricaceae through such genera as *Gyrophragmium*, *Secotium* and *Podaxis*. Heim (8) has given us an interesting account of the method of spore formation in *Podaxis*, showing that the spores are formed simultaneously or successively, one to four to the basidium, and that even in the same species spores may exhibit great variation in form and size, the latter probably correlated with nutritional or other environmental factors.

A detailed description of the mature and nearly mature fructification of *Podaxis* has been given by Morse (11). She examined a large number of specimens from both hemispheres representing most of the so-called species of the genus which have been described and on the basis of this study concluded that the genus probably contains but a single widely distributed and variable species, *Podaxis pistillaris*; she would place *Podaxis*, together with any other forms having a corresponding arrangement of fascicled basidia and a powdery gleba at maturity, in a tribe of the Lycoperdaceae, the Podaxineae.

Fischer (6), investigating three young specimens which were supplied him by Miss Morse, concludes that the fructification of *Podaxis* is definitely of the "einhütig" type, the columella being equivalent to the stipe and the peridium equivalent to the pileus of an agaric. He finds that the hymenophore arises on the inner (or lower) side of the peridium and grows to the stipe. He also finds that the connection between the stipe and the pileus is greatly attenuated and reports that in one specimen it was completely lacking. He describes and illustrates hyphae arising from the stipe and penetrating the hymenophore folds. Fischer concludes therefore that *Podaxis* is very close to the Secotiaceae.

#### Material and Methods

Material for this study was secured from Miss Morse (Berkeley, California) and through Miss Morse from E. V. C. Northrop (El Centro, Calif.), three specimens preserved in alcohol from the former, and four preserved specimens from the latter. The preserved specimens, from which the developmental stages were obtained, ranged in size from 4.5 mm. to 17.5 mm. in diameter; since the material was so

limited, a complete developmental series was not obtained. The specimens were imbedded in 52 degree paraffin. Median longitudinal, tangential and cross sections were made 8, 10 and 12 $\mu$  in thickness; the 10 $\mu$  sections were found to be most satisfactory. Some of the sections were stained with Delafield's haematoxylin and counter-stained with rapid safranin; others were stained with a modified Flemming's triple stain using safranin in 50% alcohol, orange G and Gentian violet in 1% clove oil. The latter was found to be most effective for bringing out tissue differentiation. Mounts of capillitium and spores from the dried material were placed in 95% alcohol, 3% KOH, and then stained with phloxine, cotton blue or crystal violet; 4% glycerine was added; after several days the glycerine had become concentrated and the preparations were then sealed.

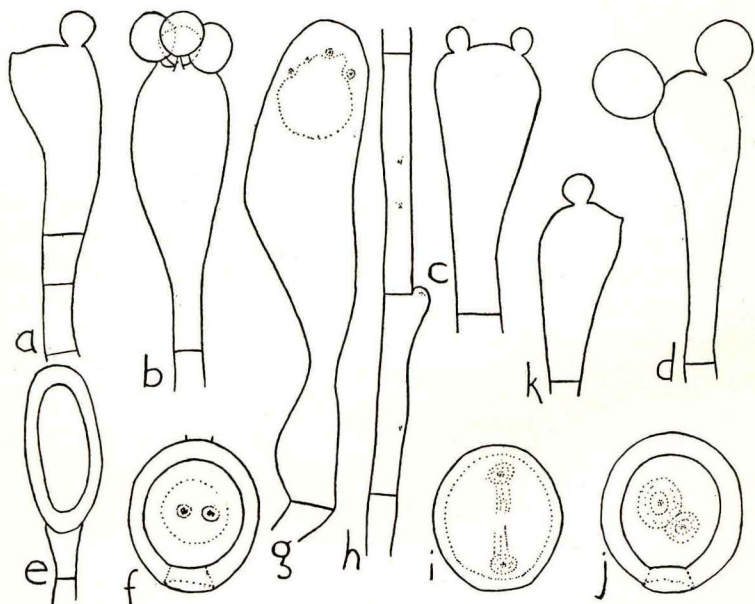
Slides of various developmental stages of *Secotium agaricoides* were borrowed from Prof. H. S. Conard of Grinnell, Iowa. These were compared with corresponding stages of *Podaxis pistillaris*; photomicrographs of comparable stages were made in order to illustrate morphological homologies and differences.

#### Morphological Development

The youngest specimen sectioned (4.5 mm. in diameter) shows the hyphae of the stipe region to be essentially parallel in arrangement, with some interweaving. Even in this early stage (fig. 1) the hymenophore is shown as two uneven layers of palisade tissue, composed of deeply granular, heavily staining hyphae, oriented downwards from the apical region, arranged symmetrically on either side of the stipe. Two distinct annular cavities just beneath the palisade regions are very evident, with very weak hyphal connection through the cavities. The connecting hyphae are small in diameter, intricately interwoven, having no apparent orientation. The hyphae of the hymenophore region are centrifugal in arrangement, frequently branching to the uneven palisade region, ending in the portion near the periphery of the fructification.

Examination of median longitudinal and tangential sections of an older specimen (9.5 mm. in diameter) shows the method of development of the palisade region (figs. 3, 5). Folds appear which are formed by the downward growth of the hyphae from the hymenophore; such folds seem to be entirely similar to like structures in the early

developmental stages of agarics. They are, therefore, referred to as lamellae. The hymenophore, with its uneven folds representing gill salients, continuous growth; the tramal hyphae, 4-8 $\mu$  in diameter, closely compacted, sparsely branching, with relatively few septa and deeply staining, fill the portion between the hymenium on either side of the lamella. The lamellae show some branching and anastomosing; no spores were observed in these sections.



TEXT FIGURE I

*Podaxis pistillaris*

Outlined with the aid of camera lucida and reproduced at a magnification of approximately  $\times 1500$ . Figs. g and h from 17.5 mm. specimen. All others from 15.6 mm. specimen. a. Basidium with one sessile spore attached. b. Mature basidium, with four spores attached. c. Young basidium with two spores developing. d. Basidium with two sessile spores. e. Single basidium transformed into one spore. f. Mature spore, with the attached fragment of a sterigma. g. Unusually large basidium, with three nuclei and suggestion of a fourth. h. Clamp connection, from the stipe region. i. Immature spore, with two nuclei. j. Mature spore, with two nuclei. k. Small basidium, with one sessile spore and one sterigma.

Examination of median longitudinal sections of a 15.6 mm. specimen (fig. 10) shows the details of lamellar structure and basidia much better than those described above. The tramal hyphae occupy only a small central portion of the gills, with a conspicuous subhymenium composed of rectangular cells. The spores are either sessile or borne

upon very short sterigmata (text fig. 1, a-d, k). The basidia are notably more clavate than those figured by Heim (8). Spores are most numerous near the point of attachment of the gills to the pileus. The number gradually decreases toward the edge of the gills, where few may be seen. There is also a decreasing number of spores from the stipe to the periphery, indicating centrifugal maturation of the basidiocarp. The basidia vary greatly in size (text fig. 1, a-d, g, k), agreeing in this respect with Heim's report.

The mature lamellae are much branched and anastomosing; the trama consists of long, sparsely branching, slightly interwoven hyphae whose ultimate branchlets form densely crowded basidia very much as described by Conard for *Secotium agaricoides*, with the exception that the gills in *Podaxis* are more truly lamellate than those in *Secotium* (Cp. figs. 9 and 10). Growth of the gills is primarily marginal, although folds may originate and develop at any place.

The material at hand is not young enough to show whether a universal veil exists in *Podaxis*; a loose web of hyphae with little affinity for the stain, which encloses the upper portion, might be considered the remains of one. In tangential sections of an intermediate stage, a well-differentiated partial veil may be observed (fig. 8, p.v.); the hyphae between the upper part of the stipe and the outer peridium (fig. 8, a) have become looser in texture, indefinite in arrangement and more lightly staining than the vertically oriented parallel hyphae on the one hand and the compactly interwoven ones of the peridium on the other. A schizogenous area of lacunae extending horizontally beneath the gill chamber and downward to the periphery of the stipe (fig. 8, s) marks the boundary between the stipe and the partial veil.

Tangential sections of an older specimen (17.5 mm. in diameter) illustrate the method in which the gills break down to form the capillitium. As the basidiocarp rapidly increases in size the tramal hyphae become separated; the individuality of the gills is lost; all that remains is the tramal hyphae extending from the endoperidium into the chamber on either side of the columella; the ultimate branchlets of the tramal hyphae end in the fascicled basidia frequently mentioned by previous workers. The abundance or scantiness of the capillitium depends on the relative number of tramal hyphae that disintegrate; the tramal plates are not so persistent as in *Secotium agaricoides*. The capillitium, the remains of collapsed basidia and mature and immature spores fill the cavities on either side of the columella; it is interesting



to note that no connection of the capillitial elements, i.e., tramal hyphae, at least in part, to the columella is evident in any of the stages examined.

Capillitia taken from the upper portion of the fructification (fig. 11) show fascicles of collapsed basidia, immature basidia and spores clustered around them; details are difficult to distinguish. Septa are not easily seen in the capillitial threads, due perhaps to their collapse and flattening, but their presence has been depicted by Morse (11, pl. 12, fig. a). Branching of the tips is easily observed. What appears to be a clamp connection (fig. 11) may in reality represent a broken branchlet of the tramal hypha. Clamp connections were numerous and well defined in the stipe of the largest specimen (text fig. 1, h) but were not so easily seen in the fertile tissues.

#### Possible phylogenetic relationships

In the stages examined, the morphological development of *Podaxis pistillaris* agrees essentially with that of *Secotium agaricoides* as described by Conard. That author studied very young, undifferentiated specimens, as well as some older ones. The folding, anastomosing, radially developing lamellae, the central stipe continuing through the basidiocarp as a percurrent columella, the absence of cystidia or other aberrant cells in the hymenium of densely crowded basidia, and the loosening of the tramal hyphae toward maturity all coincide with Conard's description of *Secotium*. One minor difference is that the immature gills are more truly lamellate in *Podaxis* than in *Secotium* (Cp. figs. 9 and 10). In *Podaxis* a definite universal veil is not evident; a fairly well differentiated partial veil is present. The remains of the tramal hyphae with basidia attached at the tips of the branches (fig. 11) constitute the capillitium of *Podaxis*. Thus it would seem that *Podaxis* also represents an agaric which, because of some modifications correlated with its environment, has not expanded its pileus and has come to maturity unopened. Failure to expand when the lamellae are maturing and growing downwards from the pilear region might account for the crowding together, anastomosing and branching of the gills. Irregular branching and anastomosing of gills has been reported in several members of the Agaricaceae, namely *Pholiota erebia*, *Agaricus campestris*, *Cortinarius armillatus* and *Tubaria furfuracea*, all due to abnormalities affecting simple radial gills.

Cunningham's assignment of *Podaxis* to the Tulostomataceae (5) does not seem logical phylogenetically, in view of the present knowledge of the group. *Gyrophragmium*, *Phellorinia* and *Battarrea* may prove to be other nearly related forms; it will be necessary to have early stages of these genera for comparative purposes before any definitive relationship can be determined. In the opinion of the author, the close relationship of *Podaxis* to such genera as *Agaricus* and *Hypoholoma* is clearly and unmistakably shown. The suggestion of Morse (11) that *Podaxis* may have arisen through *Leucogaster* and *Alpova* does not seem to be warranted by the evidence; *Podaxis* has a definitely organized hymenium in the early stages of its development. Fischer (6) states that *Podaxis* shows close relationship to the Secotiaceae. *Podaxis pistillaris*, together with *Secotium agaricoides*, may be placed as an appendix to the Agaricales as an intermediate between the Agaricales and the Gasteromycetes, as is done by Gäumann (7). If, however, the Gasteromycetes are derived, at least in part from the Agaricales, as the evidence seems to suggest, then *Podaxis* and similar forms may better be regarded as Gasteromycetes which still retain more of their ancestral features than other members of the group. Thus the most logical place for *Podaxis pistillaris* is in the family Secotiaceae of the order Hymenogastrales.

#### Conclusions

1. *Podaxis pistillaris* shows a distinctly organized hymenium arising from the hymenophore in its early developmental stages.
2. The hymenium, of closely compacted basidia, covers the surface of folding, anastomosing and branching lamellae.
3. The basidia arise from the ultimate branchlets of the tramal hyphae and when the basidiocarp is mature appear to be fasciculate.
4. The clavate or irregularly elliptical basidia bear one to four spores to the basidium; the spores may either be sessile or borne upon very short sterigmata.
5. *Podaxis pistillaris* is very similar to *Secotium (Endoptychum) agaricoides* in its development. Both are to be regarded as Gasteromycetes showing definite evidence of development from the Agaricales. As Gasteromycetes, they are for the present best retained in the family Secotiaceae of the order Hymenogastrales.

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## PLATE XII

Figs. 2, 4, 6, 7 and 9 are photomicrographs of preparations loaned by Prof. H. S. Conard of Grinnell College

- Fig. 1. *Podaxis pistillaris*. Slightly tangential longitudinal section of specimen 4.5 mm. in diameter. Shows parallel arrangement of stipe hyphae, deeply staining hymenophore region and uneven layers of palisade tissue with weak connection of hyphae through the annular cavities.
- Fig. 2. *Secotium agaricoides*. Median longitudinal section of specimen 3.5 mm. in diameter. First indication of the pileus and the hymenophore.
- Fig. 3. *Podaxis pistillaris*. Median longitudinal section of specimen 9.5 mm. in diameter. Shows the method of development of the palisade region. The gills are seen anastomosing and folded, with the breaking down of the hyphal connections through the gill chamber.
- Fig. 4. *Secotium agaricoides*. Median longitudinal section of specimen 3.8 mm. in diameter. Shows the fundament of the hymenophore and gill chambers.
- Fig. 5. *Podaxis pistillaris*. Tangential section of specimen pictured in fig. 3, taken from near the edge of the basidiocarp.
- Fig. 6. *Secotium agaricoides*. Tangential section of specimen shown in fig. 4. Note the outer "blematogenous layer", representing the universal veil of agarics.

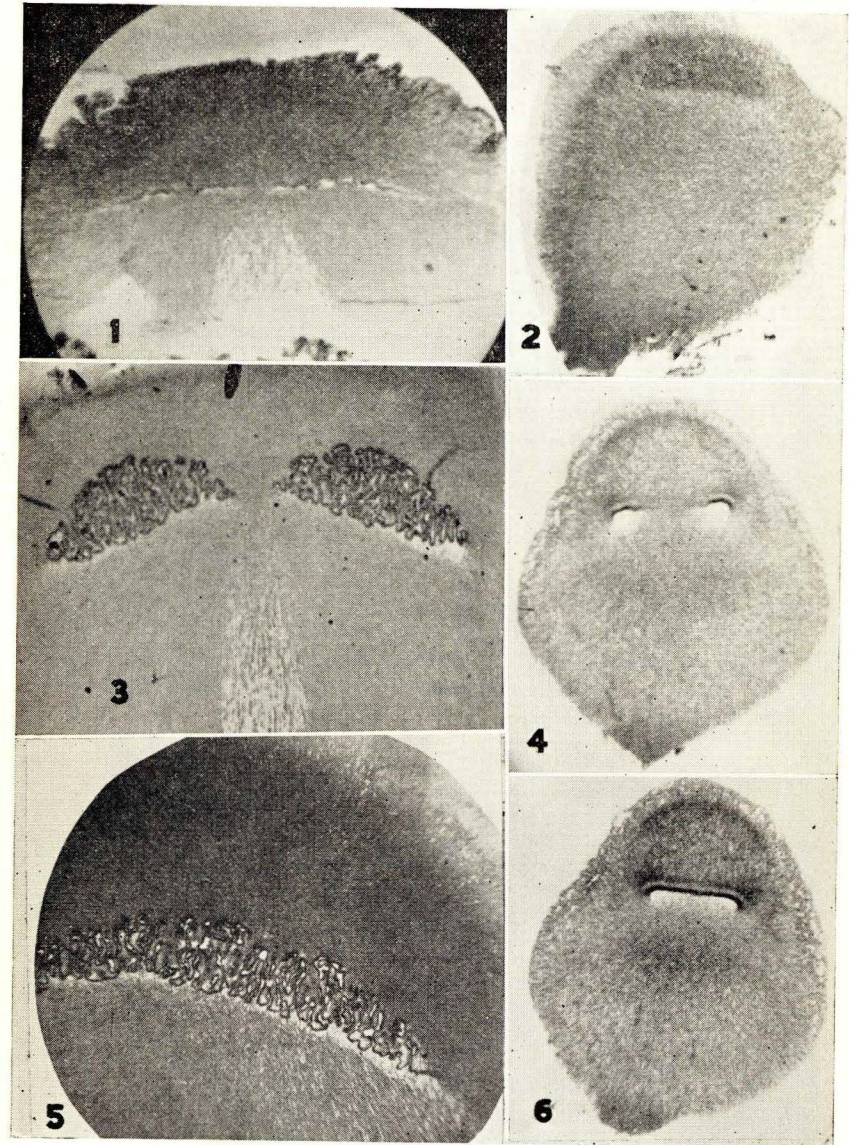


PLATE XII

## PLATE XIII

- Fig. 7. *Secotium agaricoides*. Cross section of specimen 9 mm. in diameter. Lamellae grown against the columella, but no connection of hyphae to the latter.
- Fig. 8. *Podaxis pistillaris*. Tangential section of specimen 12.3 mm. in diameter. The gills are more truly lamellate than those of *Secotium agaricoides*. There is no evidence of hyphal connections through the gill chamber.
- Fig. 9. *Secotium agaricoides*. Median longitudinal section of 9 mm. specimen. Compare with fig. 10. Note the decurrent and marginal growth of the gills.
- Fig. 10. *Podaxis pistillaris*. Median longitudinal section of 15.6 mm. specimen. Compare with fig. 9. Gills not decurrent and more truly lamellate than in *Secotium*. Note the centrifugal ripening of the basidiocarp, as evidenced by the decreasing number of spores from the center out and downward on the gills.
- Fig. 11. *Podaxis pistillaris*. Capillitium, immature basidia and spores from the gleba of a dried specimen, representing the remaining portion of the gill after disintegration.
- Fig. 12. *Podaxis pistillaris*. Greatly magnified portion of the young gill tip, taken from a tangential section of 9.5 mm. specimen. Shows the forking nature of the gill, tramal hyphae, subhymenium and immature basidia.

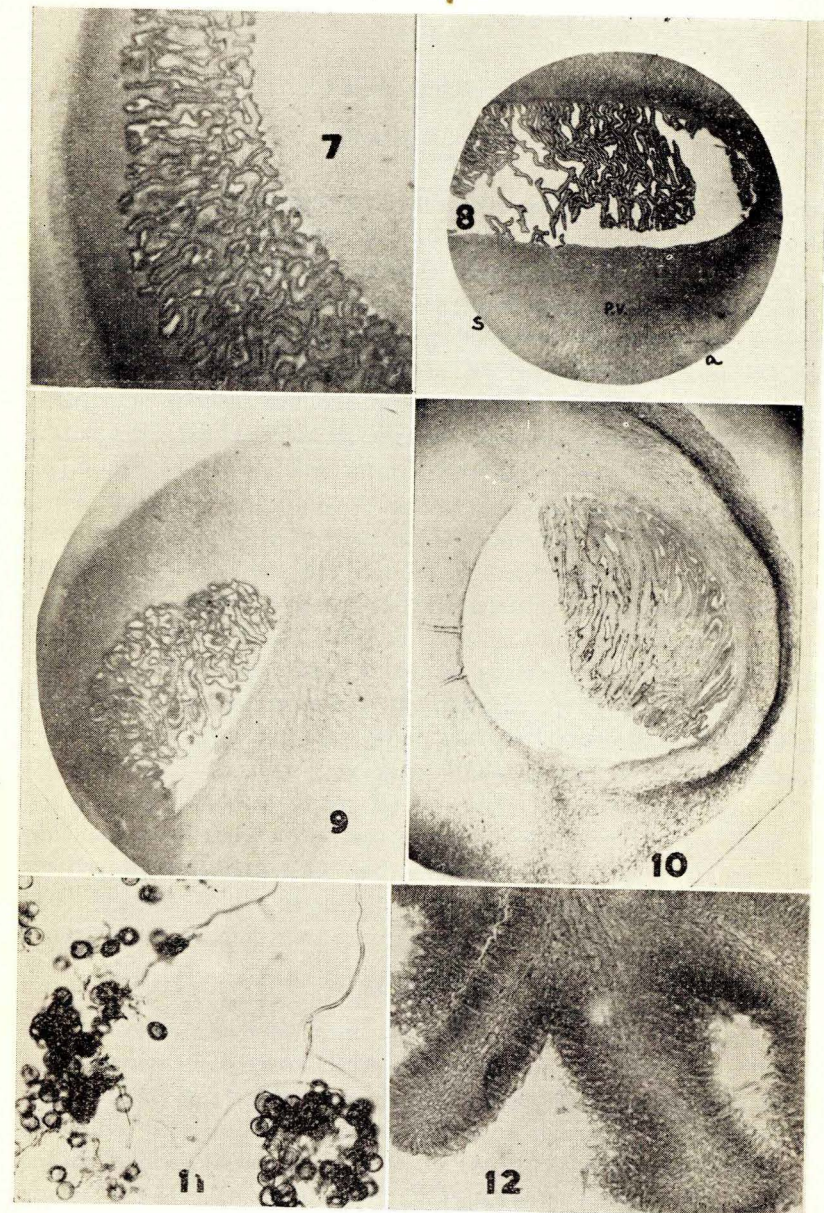


PLATE XIII

## DISCOMYCETES FROM PANAMA AND COLOMBIA

EDITH K. CASH

The collections comprising this list were made by Dr. G. W. Martin during the summer of 1935. Since few discomycetes have been recorded from either Panama or Colombia, they constitute a noteworthy addition to the species hitherto known from these countries. Previously published lists of Panama fungi by Standley (9), (10) and Weston (12) include only five discomycetes. From Colombia, Seaver (8) has listed nine species, and one other has been noted by Sydow (11). The present list includes six species previously reported, the remaining numbers being the first records from Colombia.

For the sake of conciseness, localities are designated by the symbols used in a previous list by Martin (5); Panama: BC=Barro Colorado Island; Chi=Province of Chiriquí; Co=Province of Coclé; CZ=Canal Zone, except Barro Colorado Island; Colombia: SN=Sierra Nevada de Santa Marta. The altitudes at which the collections were made vary from less than 100 m. in portions of the Canal Zone to over 2000 m. in the mountains of Colombia.

Of the fifty-one numbers listed, six are described as new; notes are also given on other specimens which appear to be undescribed, but are not in sufficient quantity to justify naming as new species. A complete set of these collections is in the herbarium of the State University of Iowa, Iowa City, and duplicates of most of them have also been deposited in the Mycological Collections of the Bureau of Plant Industry, Washington.

### DERMATEACEAE

1. *Godronia splendida* Speg. On twigs, Chi.
2. *Ionomidotis Sprucei* (Berk.) Durand. On wood, SN.
3. *Pezicula* sp. Apothecia sessile, gregarious, fleshy, applanate, round in outline or sometimes contorted, margin obtuse, 0.5-1 mm. in diameter, maize yellow (R),<sup>1</sup> Pl. 9 G3 (MP), drying orange rufous to English red (R), Pl. 4 E12 - J12 (MP), exterior darker; asci cylindrical.

<sup>1</sup>"R" in color citations refers to Ridgway, Color Standards and Color Nomenclature, Washington, 1912; "MP" to Maerz and Paul, A Dictionary of Color, Ed. 1, New York, 1930.

cal-clavate, narrowing to the apical pore, short-stipitate, 90-100 x 10-12 $\mu$ ; spores irregularly 1-2-seriate, 3-septate, fusoid-clavate, hyaline, 20-24 x 5-7 $\mu$ , usually about 20 x 5 $\mu$ ; paraphyses hyaline, filamentous, not swollen at the apex; exciple prosenchymatic, yellowish to pale brown, parenchymatic at the base. On wood, SN, 3421. Since species of this genus are generally closely limited as to host, it does not seem advisable to name a species on an unknown host plant.

## BULGARIACEAE

4. *Bulgaria inquinans* (Pers.) Fr. On wood, Chi.

5. *Bulgariopsis viridi-flava* P. Henn. On wood, SN. The Colombian material agrees with Hennings' description of this species, which was first found in Brazil. The genus *Bulgariopsis* P. Henn. has been regarded as doubtful by various authors. Von Hoehnel at first (2) considered the type, *B. moellerianus* P. Henn., as belonging in *Ombrophila*, but later (3) reversed his opinion and maintained *Bulgariopsis* as a separate genus. Killermann (4) does not recognize Hennings' genus, dismissing it with the comment that the bacillar spores are probably conidia, since *Bulgariopsis moellerianus* is described by Saccardo as having large dark spores. Killermann's statement, however, is erroneous, being due to an obvious confusion between *Bulgaria* (*Sarcosoma*) *moelleriana* P. Henn., the large-spored fungus listed by Saccardo under *Bulgaria*, and the bacillar-spored *Bulgariopsis moellerianus* P. Henn.

6. *Coryne sarcoides* (Jacq.) Tul. On wood, SN, ?Chi.

7. *Ombrophila blumenaviensis* P. Henn. On wood, SN.

8. *Orbilbia epipora* Karst. On wood, developed in moist chamber, Co.

9. *Orbilbia epipora* Karst. f. *major* Speg. On wood, Chi, CZ, BC, SN.

10. *Orbilbia juruensis* P. Henn. On wood, Co.

## PATELLARIACEAE

11. *Karschia lignyota* (Fr.) Sacc. On dead wood, SN.

## MOLLISIACEAE

12. *Belonopsis aciculispora* n. sp. (Pl. 14, fig. 8).

Apotheciis sessilibus, 0.5-1.2 mm. diam., patellatis, molle ceraceis, hymenio citrino, margine et extus fusco-brunneo; ascis cylindrico-clavatis, 45-55 x 4.5-5 $\mu$ ; sporis biseriatis, aciculo-fusoideis, hyalinis, 10-15 x 1-1.5 $\mu$ ; paraphysibus filiformibus, hyalinis.

Apothecia sessile, emerging singly or two to three together from

cracks in the bark. 0.5-1.2 mm. diam.; soft-waxy, patellate, hymenium naphaline yellow to barium yellow (R), Pl. 10 G1-I1 (MP), drying primuline yellow to yellow ochre (R), Pl. 10 L5-L7 (MP), with a thin, brown, inrolled margin, externally fuscous black; asci cylindrical-clavate, rounded at the apex, 8-spored, 45-55 x 4.5-5 $\mu$ ; spores biseriata, acicular-fusoid, guttulate to uniseptate, straight, hyaline, 10-15 x 1-1.5 $\mu$ ; paraphyses filiform, hyaline, unbranched, 1-1.5 $\mu$  diam. at the apex; hypothecium hyaline, thin; exciple parenchymatic, of brown, thin-walled cells 10-12 $\mu$  in diam., elongate and often clavate at the margin. On twigs. Prov. Chiriquí, Panama: Valley of upper Rio Chiriquí Viejo, 1600-1800 m., June 29, 1935, 2125.

13. *Mollisia cinerea* (Batsch) Karst. On wood, Chi.

## HELOTIACEAE

14. *Belonioscypha campanula* (Nees) Rehm. On stems, Chi.

15. *Belonium rimosum* n. sp. (Pl. 14, fig. 4).

Apotheciis sessilibus, patellatis, carnosomembranaceis, 0.5-2 mm. diam., hymenio brunneo, rimoso, margine undulato, fimbriato; ascis clavatis, longe stipitatis, apice rotundatis, 150-175 x 15-18 $\mu$ ; sporis 1-2-seriatis, hyalinis, fusoideis, curvatis, uniseptatis, 27-38 x 6-8 $\mu$ ; paraphysibus filamentosis, brunneo-granulosis; excipulo tenui, prosenchymatico, pallide brunneo.

Apothecia sessile, superficial, gregarious, patellate, fleshy-membranous, 0.5-2 mm. diam., hymenium rimose, clove brown to chaetura drab (R), Pl. 8 C11-C8 (MP), exterior darker, entire fungus becoming black when dry, margin undulate and contorted, inrolled, delicately fimbriate; asci clavate, long-stipitate, rounded at the apex, 8-spored, 150-175 x 15-18 $\mu$ ; spores irregularly 1-2-seriate, hyaline, fusoid, curved, uniseptate, 27-38 x 6-8 $\mu$ ; paraphyses filamentous, unbranched, filled with brownish granules, not enlarged at the apex; exciple thin, prosenchymatic, pale brown, darker at the base. On woody stems, Sierra Nevada de Santa Marta, Dept. Magdalena, Colombia, Cerro Quemado trail, 1500-2300 m., Aug. 23, 1935, 3649.

16. *Belonium sordidum* n. sp. (Pl. 14, fig. 3).

Apotheciis sessilibus, globosis dein pulvinatis, carnosis, 0.2-0.5 mm. diam., sordide albis vel pallide-olivaceis, siccis nigris, margine crenato; ascis cylindrico-clavatis, saepe arcuatis, apice attenuatis, 130-150 x 15-18 $\mu$ ; sporis 2-3-seriatis, hyalinis pallidisve, cylindrico-clavatis, 7-septatis, 37-45 x 5-8 $\mu$ ; paraphysibus hyalinis, filamentosis, ramosis, curvatis et intertextis; textura excipuli subhyalina, prosenchymatica.

Apothecia sessile, superficial, applanate to pulvinoid, soft-fleshy, globose and black when dry, 0.2-0.5 mm. diam., hymenium dirty white to olive buff (R), Pl. 20 B1 (MP), exterior concolorous, margin delicately crenate; asci cylindrical-clavate, long-stipitate, often arcuate, abruptly narrowed to the apical pore, 8-spored, 130-150 x 15-18 $\mu$ ; spores irregularly 2-3-seriate, hyaline or pale yellowish, cylindrical-clavate, 7-septate, 37-45 x 5-8 $\mu$ , obtuse or sometimes narrowed at the lower end; paraphyses hyaline, filamentous, branched about two-thirds of the distance from the base, curving and interwoven; exciple subhyaline, prosenchymatic, composed of thin-walled, fine hyphae, paler and fimbriate at the margin. On decorticated wood. Prov. Coclé, Panama; Valle Chiquita, about 7 k. s. of El Valle de Antón, 500-600 m., July 25, 1935, 3008.

17. *Chlorosplenium aeruginascens* (Nyl.) Karst. On wood, Chi.

18. *Chlorosplenium versiforme* (Pers.) de Not. On wood, Chi.

19. *Dasyscypha albidula* Penz. & Sacc. On leaves, SN. Hitherto known only from Java. The Colombian specimens agree with the illustration in Penzig and Saccardo (7, pl. 50, fig. 4).

20. *Dasyscypha cerina* (Pers.) Fckl. On wood, SN.

21. *Dasyscypha congregata* P. Henn. On wood, Chi.

22. *Dasyscypha varians* Rehm. On stems, SN.

23. *Dasyscypha* sp. Apothecia minute, long-stipitate, globose to cyathiform, 0.5 mm. diam., 1 mm. high, membranous, white or pale pinkish, covered with white hairs; hymenium white, margin setose, stipe 0.5-0.7 x 0.1-0.2 mm., pilose, asci clavate, apex rounded, 25-35 x 3-4 $\mu$ ; spores uniseriate, hyaline, clavate-ellipsoid, 4-5 x 1-1.5 $\mu$ ; paraphyses filiform, unbranched; hairs hyaline, verrucose, septate, slightly inflated at the apex, 50 x 3 $\mu$ . On wood, SN, 3723. This specimen agrees most closely with *Dasyscypha latebrosa* (Ell.) Sacc.; however, material of the latter species from Newfield, N. J., June, 1881, issued in Ellis, N. Am. Fungi 845, has more delicate, smaller apothecia, with rougher hairs. The Colombian fungus differs from *Dasyscypha duseinii* Rehm in shorter, more obtuse hairs, and from *D. cyatheicola* P. Henn. and *D. flavidula* Rehm in color and shorter spores.

24. *Dasyscypha* sp. On herbaceous stems, SN, 3658. The fungus is similar to *D. ochroleuca* Penz. & Sacc., which, however, occurs on corticated branches and has longer spores.

25. *Dasyscyphella acutipila* n. sp. (Pl. 14, fig. 1).

Apotheciis stipitatis, globosis dein cupulatis, ceraceis, 0.5-1.5 mm.

diam., albo-pilosis, hymenio cremeo,\*sicco aurantio-flavo; stipite 0.2-0.5 x 0.2 mm.; ascis cylindratis, 60-65 x 4.5-5 $\mu$ ; sporis acicularibus, guttulatis, eseptatis, 33-45 x 0.7-1 $\mu$ ; paraphysibus filiformibus, rigidiusculis, 1 $\mu$  diam.; pilis hyalinis, tenuiter echinulatis, brevibus, 2-3 $\mu$  diam., apice acutis, base interdum bulbosis.

Apothecia stipitate, superficial, sparse or gregarious, globose then cupulate, with thin, incurved margin, 0.5-1.5 mm. diam., waxy, white-pilose; hymenium cream color (R), Pl. 10 E2 (MP), drying light orange yellow to orange (R), Pl. 9 J6-L10 (MP), stipe 0.2-0.5 x 0.2 mm., pilose; asci narrow-cylindrical, apex rounded, gradually attenuated at the base, 8-spored, 60-65 x 4.5-5 $\mu$ ; spores acicular, hyaline, guttulate, non-septate, parallel, 33-45 x 0.7-1 $\mu$ ; paraphyses filiform, rather stiff, longer than the asci, 1 $\mu$  diam.; exciple plectenchymatic, hyaline; hairs hyaline, faintly echinulate, septate, acute at the apex, often bulbous at the base, 50-75 x 2-3 $\mu$ . On woody stems. Prov. Chiriquí, Panama: Valley of upper Rio Chiriquí Viejo, 1600-1800 m., June 30, 1935, 2218, July 1, 1935, 2275 (type), and July 5, 1935, 2498.

26. *Dasyscyphella appressa* n. sp. (Pl. 14, fig. 2).

Apotheciis obconicis vel infundibuliformibus, stipitatis, 0.2-1 mm. diam., 0.5 mm. altis, ceraceo-membranaceis, pilosis, ochraceis vel brunneis, margine fimbriato, ad superficiem hospitis appressis; stipite ochraceo-fusco, -1 x 0.2-0.3 mm., base deflecto; ascis cylindricis, apice attenuatis, 90-110 x 7-9 $\mu$ ; sporis parallelis, acicularibus, multiguttulatis vel 1-5-septatis, chlorinis-hyalinis, 40-55 x 2.2-5 $\mu$ ; paraphysibus filiformibus, hyalinis, apice 1.5 $\mu$ ; pilis pallide brunneis, verrucosis, 2-3 $\mu$  diam.

Apothecia obconic to infundibuliform, sparse or gregarious, superficial, stipitate, 0.2-1 mm. diam., 0.5 mm. high, waxy-membranous, pilose, ochraceous-tawny (R), Pl. 13 H10 (MP) at the margin, gradually darkened toward the base to warm sepia (R), Pl. 8 J7 (MP), margin and exterior pilose; hymenium cinnamon brown to fuscous (R), Pl. 7 A12 to Pl. 8 H7 (MP); stipe -1 x 0.2-0.3 mm., ochraceous tawny (R), Pl. 13 H10 (MP) above, fuscous (R), Pl. 8 H7 (MP) below, bent at right angles so that the apothecium is closely flattened against the surface of the host; asci cylindrical, narrowed at the apex, 8-spored, 90-110 x 7-9 $\mu$ , short-stipitate; spores parallel, acicular, multiguttulate to 1-5-septate, greenish-hyaline, 40-55 x 2-2.5 $\mu$ ; paraphyses filiform, hyaline, unbranched, 1.5 $\mu$  at the apex; hairs pale brown, verrucose, 2-3 $\mu$  diam. Prov. Chiriquí, Panama: Valley of upper Rio Chiri-

quí Viejo, 1600-1800 m., July 8, 1935, 2667 (*type*), July 9, 1935, 2672; (?) July 9, 1935, 2681; Sierra Nevada de Santa Marta, Dept. Magdalena, Colombia, Cerro Quemado Trail, 1500-2300 m., Aug. 28, 1935, 3786 and 3787. This fungus is similar in general appearance and dimensions to two species described by Starbäck as *Erinella isabellina* and *E. avellanco-mellea*, but the paraphyses of *Dasyscyphella appressa* are slender and filiform, not acute at the apex, as in Starbäck's species. If *Dasyscyphella* Tranzschel is to be retained as distinct from *Erinella* on the basis of this character, this species and the preceding clearly belong to the former genus.

27. *Dasyscyphella* sp. Apothecia light orange yellow (R), Pl. 9 J6 (MP), with orange hairs around the margin, densely gregarious, cupulate, contorted by mutual pressure, 1-2 mm. diam.; asci short-stipitate, 77 x 9-11 $\mu$ ; spores 1-3-septate, ends narrowed but not acute, 20 x 3.5-4 $\mu$ ; paraphyses hyaline, filiform; hairs golden yellow, slender, septate, 90-120 x 2-3 $\mu$ . On wood, Chi, 2385. From the characters noted, this appears to be different from any species described. Only one small specimen was found.

28. *Davincia helios* Penz. & Sacc. On stems, Chi. Except for slightly longer spores, this specimen agrees exactly with the description given by Penzig and Saccardo, as well as with their illustration (7, pl. 54, f. 2). So far as is known, the species has not been reported in literature since its description from Java, so that its occurrence in Panama would not have been expected. It may possibly occur more generally in the tropics, but if so, has hitherto escaped notice.

29. *Erinella longispora* (Karst.) Sacc. On twigs, SN, ?Chi. This and the following species have been reported from Colombia by Seaver (8).

30. *Erinella similis* Bres. On wood, Chi, SN.

31. *Helotium flavo-aurantium* (P. Henn.) Rick. On bark, SN.

32. *Helotium pezizoideum* Cke. On wood, Chi.

33. *Helotium* sp. Apothecia subsessile, applanate, cupulate when dry, hymenium buffy citrine (R), Pl. 15 H8 (MP), drying clove brown (R), Pl. 8 E8 (MP), darker without, 1.5-2 mm. diam.; asci 170 x 10-12 $\mu$ , with apex flattened and wall thickened to 5 $\mu$ ; spores guttulate, often with one large guttule filling nearly the entire spore, the hyaline ends giving it an apiculate appearance, elongate-ellipsoid to fusoid, slightly curved, 25-30 x 7-8 $\mu$ ; paraphyses filiform, numerous; exciple yellowish prosenchymatic on the surface, parenchymatic beneath. On

wood, Chi, 2465. The specimen does not appear to agree with any species of *Helotium*. It is too fragmentary to afford an adequate description.

34. *Helotium* sp. Apothecia cup-shaped to cyathiform, fleshy-membranous, hymenium and exterior avellaneous to wood brown (R), Pl. 14 B8-A8 (MP) when moist, burnt Sienna (R), Pl. 6 K12 (MP) when dry, margin undulate, 3-4 mm. diam.; stipe 3 x 1 mm.; asci cylindrical-clavate, long-stipitate, rounded with wall thickened at the apex, 40-45 x 3-4 $\mu$ ; spores fusoid-clavate, hyaline, uniseriate, 4-5 x 1.5 $\mu$ ; exciple plectenchymatic, composed of fine, thin-walled mycelium. On wood, SN, 3502. This may be *Helotium subcastaneum* P. Henn., but differs from the description of that species in the pale hymenium.

35. ?*Lambertella* sp. (Pl. 14, fig. 5). Apothecia sessile or short-stipitate, patellate, becoming convex, 1-2 mm. diam., Prout's brown to fuscous black (R), Pl. 8 H11-C7 (MP), fleshy coriaceous, margin fimbriate, with a few delicate threads of pale brown, septate mycelium, 150 x 5-8 $\mu$ ; asci cylindrical, rounded at the apex, gradually narrowed at the base, pore blue with iodine, 90-110 x 7 $\mu$ ; spores dark olivaceous-brown, ellipsoid, 2-guttulate, unsymmetrical, uniseriate, 11-13 x 4-6 $\mu$ ; paraphyses filiform, hyaline, simple, 3 $\mu$  in diameter at the apex; exciple hyaline, prosenchymatous. On decaying nut of unknown host, SN, 3761. Only a single nut was collected. Since no sclerotial tissue is evident in the decayed nut covered by the apothecia of the fungus, it is questionable whether it should be placed in *Lambertella*, a genus differing from *Sclerotinia* in having dark spores. *Phaeociboria*, the only other genus in the Helotiaceae with one-celled, dark spores, is characterized by a thick, furfuraceous margin, and appears to be very similar to *Velutaria*. This Colombian specimen does not fit satisfactorily in either of the two genera, but is provisionally assigned to *Lambertella* in the hope that further collections may be made which will make possible more definite conclusions as to its relationships.

#### PEZIZACEAE

36. *Aleuria cestricea* (E. & E.) Seaver. On plant debris in soil, Chi.

37. *Aleurina stipitata* n. sp. (Pl. 14, fig. 6).

Apotheciis carnosis, stipitatis, dense caespitosis, 1-2 cm. diam., infundibuliformibus vel irregulariter plicatis; stipite cartilagineo, 5 x 2-3 mm.; hymenio fusco-brunneo; ascis cylindricis, breve stipitatis, apice truncatis, 200-220 x 9-11 $\mu$ ; sporis brunneis, verrucosis, 12-15 x 7-9 $\mu$ , ellipticis; paraphysibus granulosis, brunneis, agglutinatis, 3-4 $\mu$  diam.



Apothecia fleshy, 1-2 cm. diam., 1 cm. deep, stipitate, single or densely caespitose, infundibuliform or irregularly plicate, exterior fuscous, rugose or wrinkled, hymenium Argus brown to fuscous (R), Pl. 8 L12-H7 (MP), stipe 5 x 2-3 mm., tough cartilaginous; asci cylindrical, short-stipitate, truncate at the apex, 8-spored, 200-220 x 9-11 $\mu$ ; spores uniseriate, ellipsoid, at first hyaline, later brown, covered with coarse tubercles, 12-15 x 7-9 $\mu$ ; paraphyses brownish, granular, unbranched, agglutinated, 3-4 $\mu$  at the apex. In soil. Prov. Chiriquí, Panama: Valley of upper Rio Chiriquí Viejo, 1600-1800 m., June 29, 1935, 2130. No stipitate species of *Aleurina* with dark, verrucose spores of these dimensions has been described. Another specimen apparently identical with this material was received some years ago from the Rev. J. Rick, Brazil, collected at Nova Petropolis, Rio Grande do Sul, 1923, J. Rick, 300.

38. *Cookeina Colensoi* (Berk.) Seaver. On wood, Chi, SN.

39. *Cookeina sulcipes* (Berk.) Kze. On wood. Co, BC.

40. *Cookeina tetraspora* Seaver. On corticated wood, SN. Some apothecia measure as much as 7 mm. in diameter, while Seaver's description gives 4 mm. as the maximum. The spores are also somewhat larger; occasionally only two spores measuring up to 33 x 15 $\mu$  are present in an ascus. However, the Colombian specimens resemble *C. tetraspora* Seaver so closely that it seems best to refer them to that species.

41. *Cookeina tricholoma* (Mont.) Kze. On wood, BC, Co, CZ.

42. ?*Humaria orinocensis* Pat. & Gaill. On soil, Chi. The apothecia are smaller, but the other characters agree with the description and illustrations given by Patouillard and Gaillard (6, pl. 18, fig. 1) of the type from Venezuela.

43. *Lachnea cubensis* (B. & C.) Sacc. On wood, Chi, SN.

44. *Lachnea setosa* (Nees) Gill. On wood, CZ.

45. *Lamprospora constellatio* (B. & Br.) Seaver. In soil, Co. The spores of this material are slightly smaller than Seaver's description of the fungus, but agree with the dimensions given in Saccardo.

46. *Lamprospora trachycarpa* (Curr.) Seaver. In soil, Chi.

47. *Lamprospora* sp. (Pl. 14, fig. 7). Apothecia fleshy, cupulate to applanate, attached to the wood at the base by a mass of fine filamentous, hyaline mycelium, which is less evident as the fungus matures, bone brown (R), Pl. 8 H7 (MP) when moist, chaetura black (R), Pl. 8 A8 (MP), when dry, furfuraceous, hymenium concolorous, un-

even from the protruding asci, 1-3 mm. diam.; asci cylindrical, short-stipitate, 200-220 x 15-20 $\mu$ , apex obtuse; spores globose, clustered at the top of the ascus when immature, later uniseriate in the upper half of the ascus, globose, hyaline to pale brown, smooth when young, with several small guttules, becoming echinulate with numerous short spines 1 $\mu$  long, reticulately arranged, 12-16.5 $\mu$  diam. including the spines; paraphyses filamentous, hyaline to pale yellow and swollen at the tips to 3 $\mu$ . On much decayed wood, SN, 3716b. Species of *Lamprospora* occur generally in soil, rather than on wood, but except for this habitat, the fungus appears most closely related to that genus. The fungus was developed in moist chamber a year after collection.

48. *Phillipsia chardoniana* Seaver. On dead wood with mosses, Co.

49. *Phillipsia domingensis* Berk. On bark, SN.

#### HELVELLACEAE

50. *Morchella esculenta* (L.) Pers. In soil, Chi.

#### GEOGLOSSACEAE

51. *Trichoglossum hirsutum* (Pers.) Boud. In soil, BC.

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## PLATE XIV

- Fig. 1. *Dasyscyphella acutipila*, 2275, x 8.  
 Fig. 2. *Dasyscyphella appressa*, 3787, x 10.  
 Fig. 3. *Belonium sordidum*, 3008, x 8.  
 Fig. 4. *Belonium rimosum*, 3649, x 7.  
 Fig. 5. ?*Lambertella* sp., 3761, x 5.  
 Fig. 6. *Aleurina stipitata*, 2130, x 1.  
 Fig. 7. *Lamprospora* sp. 3716b, x 7.  
 Fig. 8. *Belonopsis aciculispora*, 2125, x 7.  
 (Photographic negatives made by M. L. F. Foubert.)

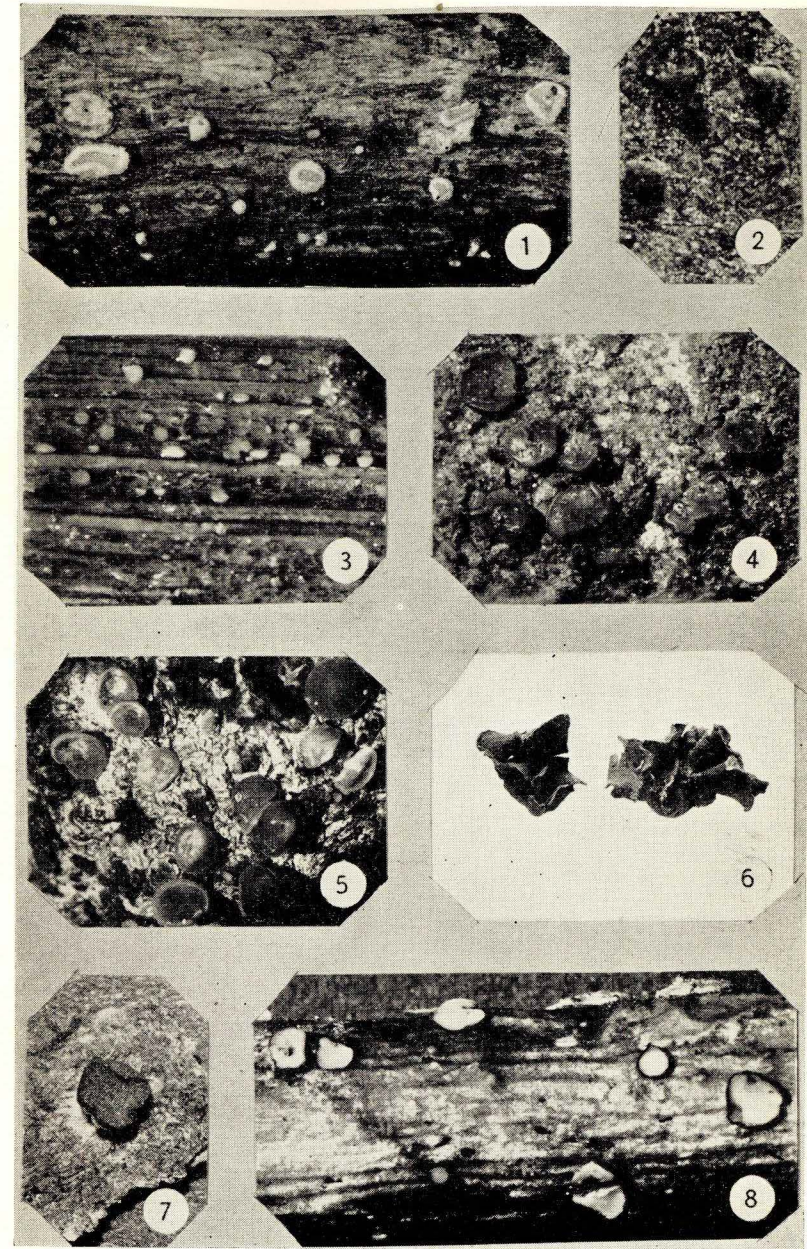


PLATE XIV

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