A SYNOPSIS OF THE GENUS PULVINULA

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SUMMARY

Seventeen species of the genus *Pulvinula* are discussed in this treatment. A synoptic key to these species is provided as are descriptions of most of them. A review of the pertinent literature is given and comments on the morphology of members of the genus are provided. One new species, *P. neotropica* Pfister is described and several new combinations are made. Listed with the synonyms and excluded species of *Pulvinula* are a number of spherical-spored species of Pezizales which were examined in the course of this study and which are referred to other genera.

INTRODUCTION

Although *Pulvinula* Boudier is a well-defined member of the Pezizales, only Boudier (1907) previously attempted to treat all of the species of the genus together. The many species are scattered through the genera *Crouania*, *Barlaea*, *Barlaeina*, *Detonia*, and *Lamprospora*. To ferret them out, type studies have been necessary. In this preliminary report on the genus, I have brought together information gleaned from both the literature and study of specimens. At present, single collections are heavily relied upon to provide details. In recognition of this, I have been very conservative in my treatment. I have preferred to cover collections which are at minor variance with described species by means of comments on those species rather than to describe new taxa prematurely. Therefore, the number of species treated is fewer than will finally be assigned to the genus.

During the study of this genus for the *Flora Neotropica* project, it became apparent, as a practicality, that the temperate species required first attention. Nevertheless, many of the comments on species refer to collections from the Caribbean and will indirectly serve as a guide to the species of *Pulvinula* in that area.

GENERAL COMMENTS

The genus *Pulvinula* was originally mentioned by Boudier (1885) who listed *Peziza convexella* Karst., *Peziza sanguinaria* Cooke, and *Peziza constellatio* Berk. & Br. as species belonging to it. Later Boudier (1907) revised the nomenclature of two of the species and included a full generic description. At that time five species were included: *Pulvinula cinnabarina* (Fuck.) Boud., *P. carbonaria* (Fuck.) Boud., *P. constellatio* (Berk. & Br.) Boud., *P. haemastigma* (Hedw. ex Fr.) Boud. and *P. subaurantia* (Bomm. & Rouss.) Boud. The genus was not acknowledged until Le Gal's (1953) treatment of the genus from Madagascar. In the meantime, species of

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this genus were referred to *Barlaea*, *Barlaeina*, *Crouania*, *Detonia*, and *Lamprospora*. Le Gal (1953) selected *Peziza convexella* as type of the genus from the three original species mentioned by Boudier. Both she and Boudier considered this species a synonym of *Pulvinula haemastigma*, a view which I do not hold. For further comment on *P. haemastigma* see the discussion under *P. convexella*.

In recent treatments, only Rifai (1968), Moravec (1969) and Pfister (1972) have attempted to describe and delimit species of *Pulvinula*. These treatments are unfortunately limited by the geographical areas which were covered.

Taxonomic criteria which I consider of value in this genus are: the size of the ascospores; the size of the ascus; the presence or absence of croziers; the size of the apothecia; apothecial color; the type of substrate on which apothecia are produced. To some extent the number of ascospores per ascus is useful but there is variation among collections in this respect. The number of ascospores per ascus ranges from eight to four. All the asci of a single apothecium rarely contain eight ascospores. *Pulvinula tetraspora* and *P. lacteoalba* are the only species where the asci consistently have four spores. Ascospores of all members of the genus are smooth.

The construction of the excipular tissue is uniform among the species. However, though useful and diagnostic at the genetic level, it is of little use in distinguishing among species. The medullary excipulum is composed of textura intricata, the hyphae of which are thin, rarely exceeding 4 μm in diam. The ectal excipulum is composed of *textura globulosa*, the cells of which are sometimes compressed, or of *textura angularis*. Figures 1, 2A, and 2B show details of cross sections of apothecia.

The asci of a majority, though not all, of the species here placed in *Pulvinula* arise from prominent croziers which form a characteristic horseshoe-shaped, two-pronged base. This particular type of pleurorhychous crozier (Chadefaud, 1943) is illustrated diagramatically in figure 3. Crozier formation has been observed in the majority, though not all, of the species of *Pulvinula*. There is variation from species to species in the attenuation of the ascus base and position of the basal septa; however, this type of ascus is always obvious no matter what variation might accompany it. In one species, *P. miltina*, there are generally no croziers but in several specimens I have examined there were occasional croziers. This is unusual, since in other species croziers are either always present or always absent.

The genus has been placed in the Aleurieae (Dennis, 1968; Rifai, 1968; Korf, 1972), based on the occurrence of guttulate spores, of hyphoid hairs when present, and of carotenoid pigments. I do not feel this position is satisfactory. The species of the genus form a discrete unit which only superficially resemble other members of this tribe. The uniqueness of the genus is also evident in Arpin's (1969) chemical analysis of pigments of *Pulvinula constellatio* in which he found a new monocyclic carotenoid

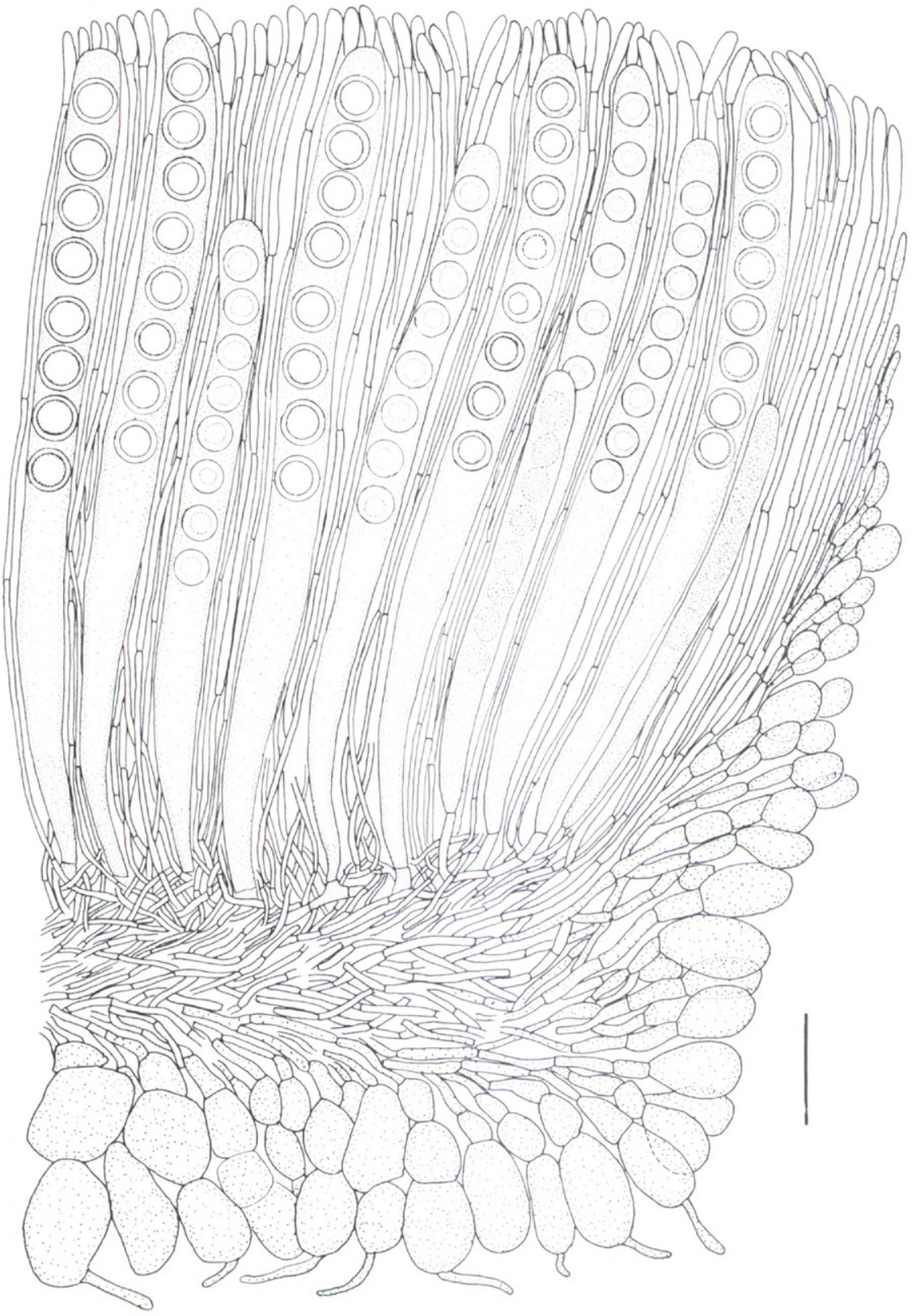

FIG. 1. *Pulvinula salmonicolor*. Cross section of apothecium at the margin. FH (Pfister 887) × approx. 200. Scale equals 25 μm.

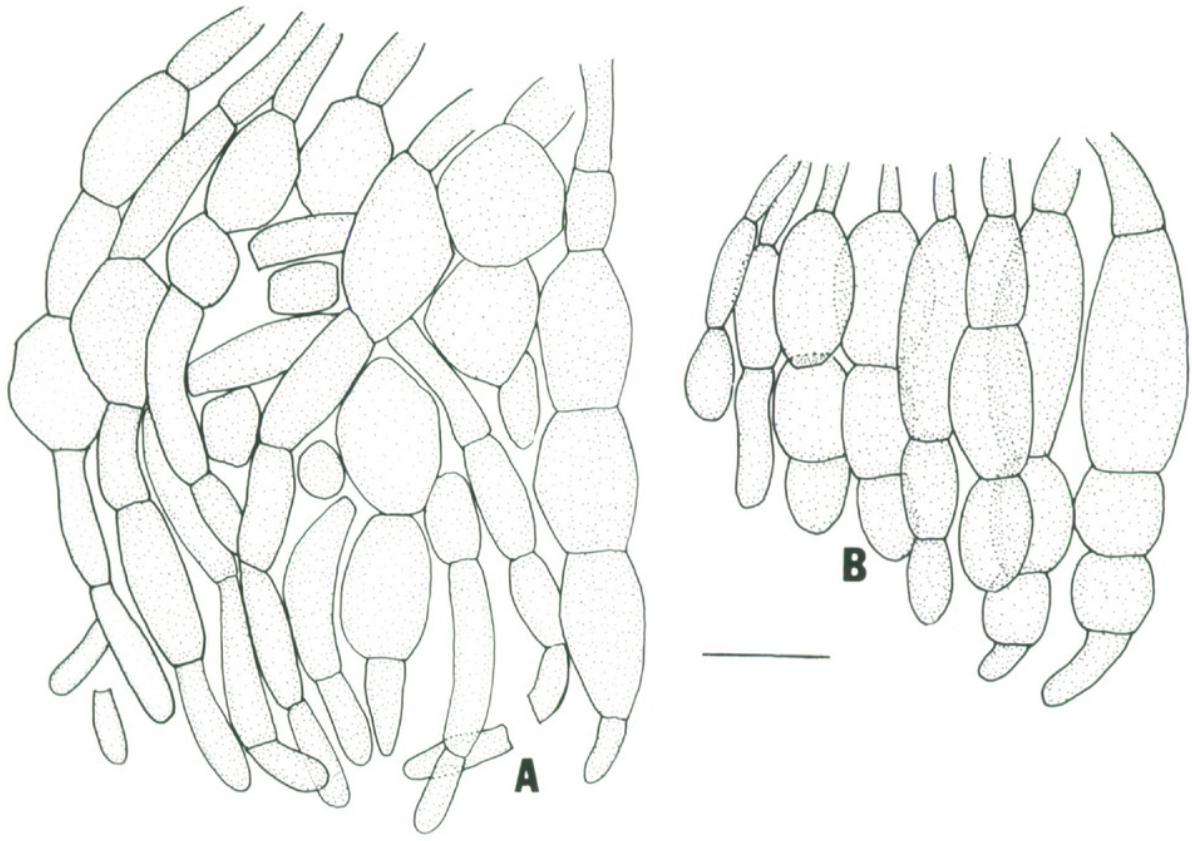

FIG. 2. A. *Pulvinula albida*. Portion of ectal excipulum. FH (isotype) × approx. 200. B. *Pulvinula neotropica*. Portion of ectal excipulum. FH (Pfister 811) × approx. 200. Scale equals 25 μm.

designated as P472. For the moment, however, rather than recognize yet another tribe in the heterogeneous family Pyronemataceae, I prefer to leave the genus in the Aleurieae. Since *Pulvinula* appears to be gymnohymenial, whereas at least some of the other Aleurieae are cleistohymenial, developmental studies may shed some light on its position.

IDENTIFICATION OF SPECIES

As an aid for the identification of species, I have constructed a synoptic key to the accepted species of *Pulvinula* using the method presented by Korf (1972). Using this key, the distinctive species can be easily identified. Certain species, however, cannot be separated without consulting descriptions for precise details of size, color, etc., which if included, would have made the synoptic key unwieldy. The numbers given in the key are those under which the name appears. The species are arranged in alphabetical order. If the fungus has more than one of the described characters, its numbers appear in lightface type. Those in boldface appear in only one category.

1. ASCI

1–1. Normal number of ascospores per ascus
  a. asci 4-spored **7, 16**
  b. (asci 8-spored or number of spores 8 or fewer within a single apothecium)

1–2. Form of ascus base
   a. (tapering toward the base)
   b. ascus base abrupt 3, **9**

1–3. Presence of croziers
   a. (croziers present)
   b. croziers absent 9, **13, 15**

1–4. Ascus length
   a. asci less than 150 μm long **2,** 6, 8, 17
   b. asci 150–250 μm long, **3, 5, 6, 7,** 8, **9, 10, 11, 12,** 13, **14,** 16, 17
   c. asci greater than 250 μm long **1, 4,** 5, 13, **15, 16**

2. ASCOSPORES

2–1. Ascospore size and shape
   a. ascospores elliptical **14**
   b. ascospores globose, 9–11 μm in diam **1, 2,** 6, **10,** 12
   c. ascospores globose, 11–16 μm in diam 3, 6, **7, 8, 9, 11, 12,** 13, 16, 17
   d. ascospores globose, 16 μm in diam or larger 3, **4, 5, 15,** 16, 17

3. PARAPHYSES

3–1. Branching at the apices
   a. (apices mostly unbranched)
   b. apices branched **2,** 4, **5, 8, 9**

3–2. Apices of paraphyses
   a. (apices hooked or circinate)
   b. apices straight 1, 6, **15**

3–3. Paraphyses width
   a. (less than 2 μm in diam)
   b. greater than 2 μm in diam 4, 5, **9,** 11, **15**

4. SUBSTRATE

4–1. Composition and condition of substrate
   a. (apothecia on soil)
   b. apothecia on burned material, scorched soil, etc. **2,** 3, 8, **11**

5. APOTHECIA

5–1. Apothecial color
   a. apothecia white or light colored **1,** 6, **7, 12, 16**
   b. apothecia brightly colored **2,** 3, **4, 5,** 8, **9, 10,** 11, 13, **14, 15, 17**

ACCEPTED SPECIES

1. **Pulvinula albida** (Rick) Pfister, comb. nov. Fig. 2A

≡ *Detonia albida* Rick, Brotéria **5**: 29. 1906.

Apothecia gregarious, 6–8 mm in diam. Disc white, margin somewhat convoluted at least when dry. Ectal excipulum up to 138–161 μm thick at the base of the apothecium, composed of globose to compressed globose cells 11–13 × 11–16 μm in diam, randomly arranged toward the outside and producing loose hyphoid hairs which form a tomentose outer layer.

Medullary excipulum composed of textura intricata of hyphae 1–2.2 μm in diam. Subhymenium not a distinct layer. Hymenium about 280 μm thick. Asci 265–282 × 16–20 μm, 8-spored. Bases of asci with prominent two-pronged croziers. Ascospores uniseriate, globose, hyaline, generally with no prominent oil globule, smooth-walled, 10.2–12 μm diam. Paraphyses gracile, 1–1.5 μm at base, 1.5–2 μm apically, straight or only slightly curved.

SPECIMEN EXAMINED. **Brazil.** On soil, Saõ Leopoldo, Rio Grande do Sul, 1932, det. Rick (FH).

The specimen in the Farlow Herbarium general mycological collection, which appears to be part of the type collection, is the only specimen of this species I have seen. The species is close to the neotropical examples of *Pulvinula globifera* but differs in that the asci in the Rick specimen are much longer. It is also similar to *P. convexella* but differs in the form of the paraphyses which are straight in *P. albida* rather than curved as in *P. convexella* and the apothecia are white rather than orange.

2. **Pulvinula archeri** (Berk. in Hook.) Rifai

≡ *Peziza archeri* Berk. in Hook., The Botany of the Antarctic Voyage. III. Flora Tasmaniae **2**:274. 1859. ≡ *Barlaea archeri* (Berk.) Sacc., Syll. Fung. **10**:5. 1892. ≡ *Humaria archeri* (Berk.) Cooke, Handbook of Australian Fungi. p. 256. 1892. ≡ *Barlaeina archeri* (Berk.) Sacc. & Trav. in Sacc., Syll. Fung. **20**:138. 1910. ≡ *Pulvinula archeri* (Berk.) Rifai, Verh. K. ned. Akad. Wet. II **57**(3):213. 1968.

= *Peziza gemmea* Phil. in Cooke, Mycographia p. 236, fig. 398. 1879. ≡ *Barlaea gemmea* (Phil. in Cooke) Sacc., Syll. Fung. **8**:112. 1889.

= *Lamprospora pyrophila* Snider, Mycologia **28**:484. 1936.

? = *Barlaeina strasseri* Bres. in Strasser, Verh. Zool.-Bot. Ges. Wein **55**:613. 1905.

Apothecia gregarious to scattered up to 7 mm in diam. Disc orange, convex, margins more or less even. Ectal excipulum relatively small-celled, cells (10–)13–15 μm in diam, globose to subglobose. Medullary excipulum of textura intricata, hyphae 2 μm in diam. Hymenium less than 150 μm thick. Asci 135–145 × 10–11 μm with or without prominent croziers, tapering toward the base. Ascospores globose, generally with a single large oil droplet, smooth-walled, 9–10.5(–11.5) μm in diam. Eight or fewer ascospores per ascus. Paraphyses slender, 1–2 μm in diam, circinate and pigment filled, mostly branched apically.

SPECIMENS EXAMINED. **Austria.** Holotype of *Barlaeina strasseri*, Sonntagberg 26. IX. 1904 (S). **U.S.A.** Holotype of *Peziza gemmea*, on fallen leaves of *Sequoia sempervirens* (Harkness 876) (K); on soil in burn area, Benton Co., Mary's Peak, Philomath, Ore., H. J. Larsen (no. 247), 11. IX. 71 (OSU); on burned material, Polk Co., Camp Kilowan and vicinity 5 mi. S. of Falls City, Ore., H. J. Larsen, 27. V. 1972 (OSU); on soil in fire spot, Benton Co., Mary's Peak, Philomath, Ore., H. J. Larsen (no. 252), 17. IX. 1971 (OSU).

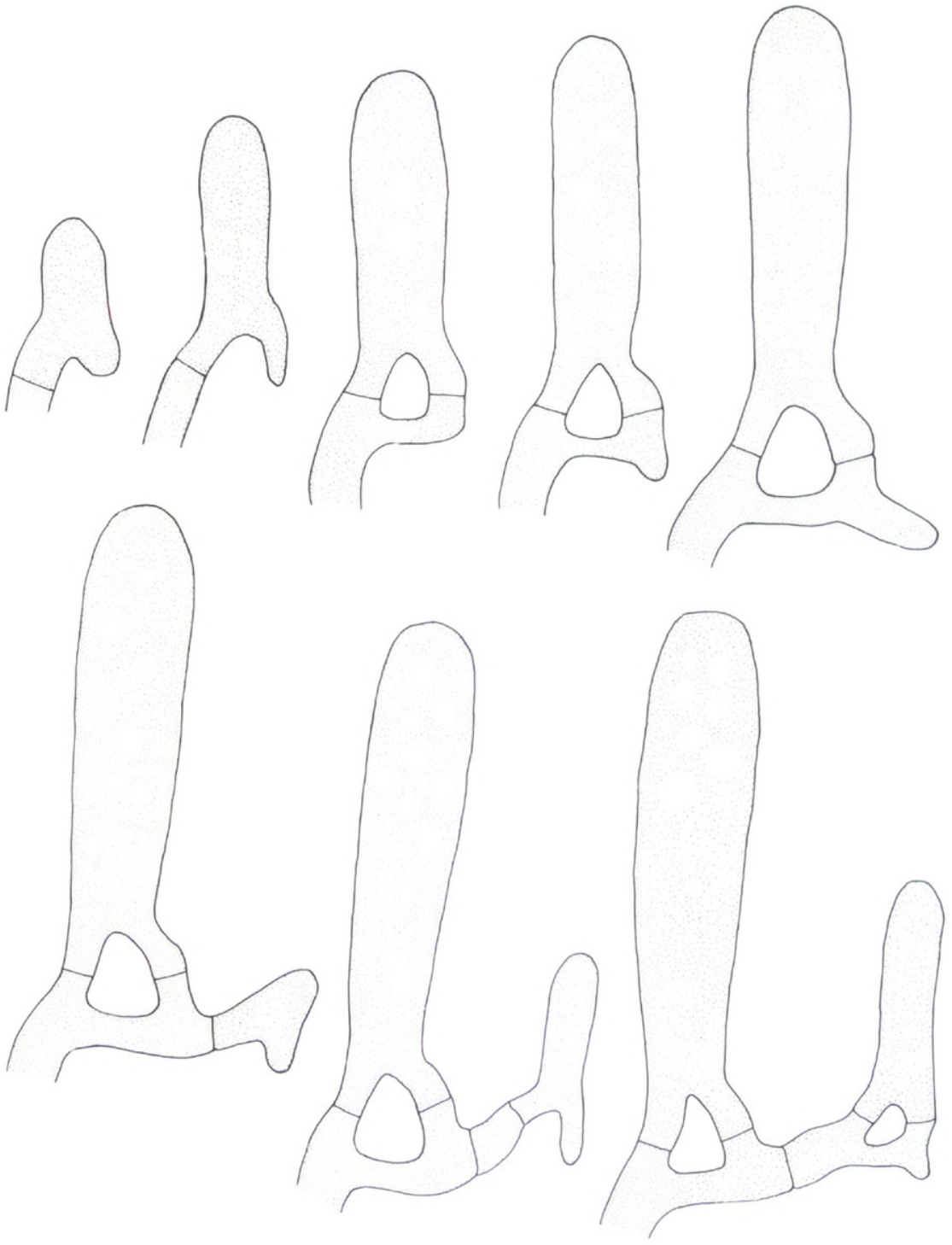

FIG. 3. A–H. Diagrams illustrating the formation and development of asci in most species of *Pulvinula*.

A collection from Oregon (Benton Co., Mary's Peak Campground, 27. V. 1972) sent for examination by Harold Larsen agrees with this species except in the form of the paraphyses, where they are practically straight and mostly unbranched.

Based on collections I have seen from the western United States, I presume this is the most common species found on burned wood and surrounding soil in that part of the country. Both *Peziza gemmea* and

Lamprospora pyrophila were described from material from the western states. The holotype of *L. pyrophila* in the mycological herbarium at the University of Washington was not available for study.

3. **Pulvinula carbonaria** (Fuck.) Boud.

≡ *Crouania carbonaria* Fuck., Jahrb. Nassauischen Vereins Naturk. **27–28**:64. 1873. ≡ *Peziza sanguinaria* Cooke, Mycographia p. 14, fig. 19. 1879 (a name change). ≡ *Pulvinula carbonaria* (Fuck.) Boud., Hist. Class. Discom. d'Eur. p. 70. 1907.

Apothecia gregarious, 1–3 mm in diam. Disc at first subconcave then flat to repand, orange-scarlet. Receptacle smooth, lighter than the disc. Ectal excipulum about 115 μm thick, composed of textura globosa to compressed angular cells, 9–11 × 16–23 μm. Ectal excipulum of textura intricata, hyphae about 2 μm in diam. Subhymenium not a distinct layer. Hymenium about 215 μm thick. Asci 196–230 μm long, 4–8 spored. Ascus base moderately broad with a prominent crozier. Ascospores uniseriate, globose, hyaline, with a single large guttule and some smaller satellite guttules, smooth-walled, 15–17 μm diam. Paraphyses gracile, up to 1.5 μm in diam throughout; mostly strongly bent or curved apically with abundant carotenoids.

SPECIMENS EXAMINED. Fuckel, Fungi rhenani no. 2482 (FH). **U.S.A.**: Burnt ground in woods, Burbank, E. Tenn., R. Thaxter (7944), Aug. 20–Sept. 5, 1887 (FH). Burnt spot in hemlock woods, Purgatory Swamp, Norwood, Mass., D. H. Linder, 27. IX. 1936 (FH).

4. **Pulvinula cinnabarina** (Fuck.) Boud.

≡ *Crouania cinnabarina* Fuck., Jahrb. Nassauischen Vereins Naturk. **27–28**:64. 1873. ≡ *Peziza laeterubra* Cooke, Mycographia p. 14, fig. 20. 1879 (a name change, non *Peziza cinnabarina* Schw.). ≡ *Lamprospora laeterubra* (Cooke) Lagarde, Ann. Mycol. **4**:217. 1906. ≡ *Pulvinula cinnabarina* (Fuck.) Boud., Hist. Class. Discom. d'Eur. p. 70. 1907. [≡ *Lamprospora cinnabarina* (Fuck.) Moser in J. Gams, Kleine Kryptogamenflora **2a**:112. 1963. (basionym not cited)].

Apothecia usually gregarious, up to 7 mm in diam. Disc vermillion, drying red, margin wavy. Receptacle smooth where exposed. Ectal excipulum up to 115 μm thick at the base of the apothecium; composed of radially arranged elongate cells, 7 × 11 μm in diam. Medullary excipulum composed of textura intricata of hyphae up to 4 μm in diam. Subhymenium not a distinct layer. Hymenium about 280–320 μm thick. Asci 260–275 × 20–23 μm, 4–8-spored (8 predominating in type collection). The ascus tapers toward the base with a definite crozier. Ascospores uniseriate, hyaline with one or a few guttules, smooth-walled, 16–20 μm in diam. Paraphyses thin, up to 2.2–4 μm in diam throughout, curved or only slightly curved apically, sometimes branched.

SPECIMENS EXAMINED. Fuckel, Fungi rhenani no. 2481 (FH). **U.S.A.:** On soil among mosses, Deep Creek, Great Smoky Mountains National Park, Tennessee, 11. XI. 1970. P. E. Powell and D. H. Pfister (349) (FH).

5. **Pulvinula convexella** (Karst.) Pfister, comb. nov.

≡ *Peziza convexella* Karst., Not. Sällsk. Fauna Fl. Fenn. Förh. **10**:123. 1869. ≡ *Leucoloma convexellum* (Karst.) Rehm, Ascomycetes Lojkani p. 8. 1882. ≡ *Barlaeina convexella* (Karst.) Sacc., Syll. Fung. **18**:24. 1906.

= *Peziza constellatio* Berk. & Br., Ann. Mag. Nat. Hist. Ser. 4. **17**:142. 1876. ≡ *Leucoloma constellatio* (Berk. & Br.) Rehm, Ber. Naturhist. Vereins Augsburg **26**:5. 1881. ≡ *Aleuria constellatio* (Berk. & Br.) Gill., Champ. France, Discom. p. 207. 1888. ≡ *Plicariella constellatio* Lindau in Engler & Prantl, Nat. Pflanzenfam. **1**(1):180. 1897. ≡ *Pulvinula constellatio* (Berk. & Br.) Boud., Hist. Class. Discom. d'Eur. p. 70. 1907. ≡ *Barlaeina constellatio* (Berk. & Br.) Rehm in Dodge, Trans. Wisconsin Acad. Sci. **7**:1037. 1914.

= *Crouania livida* Rehm in Hazsl., Math. Naturwiss. Ber. Ungarn 21: 262. 1886. ≡ *Barlaeina livida* (Rehm in Hazsl.) Sacc. & Trott. in Sacc., Syll. Fung. **22**:621. 1913.

Misapplication: *Pulvinula haemastigma* (Hedw. ex Fr.) Boud. sensu Boud., Hist. Class. Discom. d'Eur. p. 70. 1907.

Apothecia less than 8 mm in diam. Disc yellow-orange. Ectal excipulum of globose, subglobose to angular cells. Medullary excipulum of narrow diameter hyphae forming textura intricata. Asci 230–255(–270) μm × 16–20 μm. Eight spores or sometimes fewer per ascus. The base of the asci with prominent two-pronged croziers. Ascospores smooth-walled, uniseriate, globose, hyaline with one or more oil droplets, (16–)18–20 μm in diam. Paraphyses up to 2.3 μm in diam, moderately curved and regularly branched apically.

This is the type species of the genus *Pulvinula* selected by Le Gal (1953). Boudier (1907) synonymized this species with *P. haemastigma* (Hedw. ex Fr.) Boud., a synonymy which has been since followed by most workers, including Le Gal. I do not follow this position and consider *P. haemastigma* a *nomen confusum*. My reason is that the illustration upon which the species concept must now be based, in the absence of a specimen, is not adequately diagnostic in several critical features, such as the form of the paraphyses, the form of the apothecium, and the configuration of the crozier at the ascus base. In addition, there is no information on ascus or ascospore size. Boudier (1907) pointed out that Saccardo (1889) had interpreted *Peziza haemastigma* differently than he had. Neither Le Gal nor subsequent workers have designated a lectotype from among the eligible specimens in the Karsten Herbarium. There are two specimens bearing practically the same information which might have been referred to by Karsten. Having examined the specimens, I designate number 1273 lectotype of *P. convexella*.

There have been five varieties and one subspecies described and attributed to *Pulvinula convexella* or to specific names listed in its synonymy. These are listed below. Such a proliferation of infraspecific taxa suggests something of the diversity within this complex species.

Peziza constellatio var. *fuckelii* Cooke, Mycographia p. 45, fig. 82. 1879.
Barlaea constellatio var. *minuta* F. E. Clements, Bot. Surv. Nebraska **4**: 10. 1896.
Pulvinula convexella subsp. *tjibodensis* Penz. & Sacc., Malpigia **16**: 202. 1901?
Detonia constellatio var. *aurantiaca* F. E. Clements & E. S. Clements, Cryptogamae Formationum Coloradensium no. 114. 1906.
Lamprospora haemotostigma [sic] var. *gigantea* Thind & Batra, Jour. Indian Bot. Soc. **38**: 221. 1959.
Pulvinula haemastigma var. *luteoflava* Moravec, Česká Mykol. **23**: 25. 1969.

CRITICAL SPECIMENS EXAMINED. **Finland.** Lectotype: Tavastia australis, Tammela, Mustiala, ad terram nudam ad rivuli marginem in horto, 30. VIII. 1867, leg. et det. P. A. Karsten (Herb. Karsten 1273); Travastia australis, Tammela, Saloris (=Soloinen), in via, 6. VII. 1878, leg. & det. P. A. Karsten (H, Herb. Karsten 1275); Tavastia australis, Tammela, Mustiala, 30. VIII. 1867, leg. et det. P. A. Karsten (H, Herb. Karsten 1272). **U.S.A.** On moist rotted log in shade in spruce-fir forest, Gothic, Colorado, leg. Mary Alt, 8. VIII. 1963 (OSU) and eight additional specimens from North America in FH general herbarium.

A number of specimens from several exsiccati examined in the course of this study were issued under one of the synonymous names. Those which are unquestionably referrable to *Pulvinula convexella* are as follows: H. Sydow and P. Sydow, Mycotheca germanica, nos. 496 (sub *Barlaea convexella*), 1620, 1621 (sub *Barlaea constellatio*); P. Sydow, Mycotheca Marchica, no. 2862 (sub *Crouania constellatio*); H. Rehm, Ascomyceten, no. 406 (sub *Detonia constellatio*); E. Bartholomew, Fungi Columbiani, no. 2909 (sub *Barlaea subaurantia*); J. B. Ellis and B. M. Everhart, North American Fungi, no. 2306 (sub *Barlaea constellatio*); F. E. and E. S. Clements, Cryptogamae Formation Coloradensium, no. 114 (sub *Detonia constellatio aurantiaca*); A. Allescher and J. N. Schnal, Fungi Bavarici Exsiccati, no. 942 (sub *Barlaea constellatio*); W. Krieger, Fungi Saxonici, no. 1038 (sub *Barlaea constellatio*).

6. **Pulvinula globifera** (Berk. & Curt.) Le Gal

≡ *Peziza globifera* Berk. & Curt., J. Linn. Soc., Bot. **10**: 366. 1868. ≡ *Barlaea globifera* (Berk. & Curt.) Sacc., Syll. Fung. **8**: 114. 1889. ≡ *Humaria globifera* (Berk. & Curt.) Cooke, Handbook of Australian Fungi p. 256. 1892. ≡ *Barlaeina globifera* (Berk. & Curt.) Sacc. & Trav. in Sacc., Syll. Fung. **19**: 139. 1910. ≡ *Pulvinula globifera* (Berk. & Curt.) Le Gal, Prodr. Flore Mycol. Madagascar **4**:94. 1953.

My Caribbean collections of *Pulvinula globifera* have all been white, as described earlier (Pfister, 1972). Rifai (1968) also gives a full description of *Pulvinula globifera* (Berk. & Curt.) Le Gal. The geographical range and the degree of intraspecific variation remain to be clarified. Rifai pointed out that Le Gal (1953) misinterpreted this species, and

considers the species description by Le Gal to be *P. orichalcea* (Cooke) Rifai. The collection studied by Gamundi (1966) is also probably *P. orichalcea* although I have not seen her specimen. The morphology of the paraphyses of *P. globifera* is variable; occasionally they are curved and at times become inflated apically and below the septa. This is especially evident at the margin.

W. C. Denison's collection from Arizona (OSU 23,991) might also be referred to *Pulvinula globifera*. I have no data on the color or size of the apothecia when fresh.

Two varieties of *Pulvinula globifera* have been described. They are listed below, but no attempt has been made to reevaluate their status. Both have recently been treated. Rifai (1968) reported that *Peziza globifera* var. *etiolata* was not significantly different from the holotype of *Peziza globifera* to consider it distinct. I have not reexamined Cooke's specimen.

Barlaea globifera var. *sphaeroplea* (Berk. & Curt.) Sacc., Syll. Fung. **8**:114. 1889. = *Sphaerosporella brunnea* (Alb. & Schw. ex Fr.) Svrček & Kubička fide Rifai (1968).

Peziza globifera var. *etiolata* Cooke, Mycographia p. 236, fig. 399. 1879. ≡ *Pulvinula etiolata* (Cooke) Le Gal, Prodr. Flore Mycol. Madagascar **4**:91. 1953, see Rifai (1968).

SPECIMENS EXAMINED: eleven specimens from Puerto Rico and Guadeloupe (FH).

7. **Pulvinula lacteoalba** J. Moravec, Česká Mykol. **23**: 231. 1969.

This is probably a 4-spored form of *Pulvinula globifera* and should not, perhaps, be considered a distinct species. For a description see the original publication by Moravec.

SPECIMENS EXAMINED. Holotype: Ad terram nudam in olla cum *Sparmania africana* in domo-Libán, districtus Jiecín, 22. V. 1966, leg. Jiri Moravec (PR 674713).

8. **Pulvinula laeterubra** (Rehm) Pfister, comb. nov.

≡ *Barlaea laeterubra* Rehm, Ann. Mycol. **5**: 516. 1905. ≡ *Barlaeina laeterubra* (Rehm) Sacc. & Trott. in Sacc., Syll. Fung. **22**: 622. 1913. ≡ *Detonia laeterubra* (Rehm) Dodge, Trans. Wisconsin Acad. Sci. **17**: 1037. 1914. ≡ *Lamprospora wisconsinensis* Seaver, North American Cup-Fungi (Operculates) p. 69. 1928 (a name change).

Apothecia gregarious, 1–4 mm diam. Disc salmon-red (sometimes yellow). Ectal excipulum 90–115 μm thick composed of textura angularis, the cells of which are about 11× 17 μm in diam, cells more or less radially arranged. Medullary excipulum composed of textura intricata of hyphae 2 μm in diam. Subhymenium not a distinct layer. Hymenium about 180 μm thick. Asci (140–)161–184(–200) μm, 1–8 ascospores per ascus, ascus base has a prominent two-pronged crozier. Ascospores uniseriate, globose, hy-

aline generally with indiscrete oil droplets, smooth-walled, 11–13.8 μm in diam. Paraphyses thin (about 1 μm), curved and commonly branched.

SPECIMENS EXAMINED. **U.S.A.** Holotype of *Barlaea laeterubra*, [on soil], Madison, Wisconsin, 7. V. 1904, Harper (412) (s, Herb. Rehm), isotype (FH). Also six specimens in FH general herbarium.

There are two Puerto Rican collections (DHP 1320 and 1329) which differ slightly from *Pulvinula laeterubra:* they are yellow, and the paraphyses are broader.

Seaver (1928) proposed the name *Lamprospora wisconsinensis*, when he treated *Barlaea laeterubra* in *Lamprospora*, since he also treated *Lamprospora laeterubra* (Cooke) Lagarde. See the list of excluded species for comments on this fungus. He gave the spore size as smaller than 10 μm, which is not the case in the type collection where the ascospores are 12–14 μm in diam. Red-orange North American collections with spores from 12–14 μm in diam, have been erroneously referred to *Pulvinula constellatio* and *P. convexella*. They should be referred to *Pulvinula laeterubra*.

9. **Pulvinula miltina** (Berk. in Hook.) Rifai

≡ *Peziza miltina* Berk. in Hook., Fl. Nov. Zealand. **2**: 199. 1855. ≡ *Barlaea miltina* (Berk.) Sacc., Syll. Fung. **8**: 113. 1889. ≡ *Humaria miltina* (Berk.) Cooke, Handb. Austral. Fungi. p. 256. 1892. ≡ *Barlaeina miltina* (Berk.) Sacc. & Trav. in Sacc., Syll. Fung. **19**: 139. 1910. ≡ *Pulvinula miltina* (Berk.) Rifai, Verh. K. Ned. Akad. Wet. II **57**(3): 204. 1968.

For a description of this species of *Pulvinula* see Rifai (1968).

Several Caribbean collections are similar to *Pulvinula miltina* but with spores 9–11.5 μm in diam, and asci 140–165 μm long. These measurements are smaller than those given for *P. miltina* by Rifai. The Caribbean collections are all on charred wood. They have the same broad ascus base as is present in *P. miltina*, but might well represent an undescribed species. These collections are listed below.

SPECIMENS EXAMINED. **Guadeloupe, F.W.I.** On charred wood and surrounding soil, Le Mamelles, Guadeloupe National Park, January 5, 1974 (DHP 813) FH. **Puerto Rico.** On burned bamboo, El Verde, Luguillo National Forest, April 8, 1974. (DHP 1331) FH; on burned branches, as above (DHP 1325) FH.

10. **Pulvinula mussooriensis** (Thind, Cash & Singh) Batra & Batra

≡ *Lamprospora mussooriensis* Thind, Cash & Singh, Mycologia **51**: 457. ≡ *Pulvinula mussooriensis* (Thind, Cash & Singh) L. R. Batra & S. W. T. Batra, Kansas Univ. Sci. Bull. **44**: 167. 1963.

Pulvinula mussooriensis is very near *P. niveoalba* except in color and in ascus length. In *P. mussooriensis* the asci exceed 200 μm and the hymenium is yellow, whereas in *P. niveoalba* the asci are 160–180 μm and the hymenium is white. Both have variable spore numbers with 8 spores per ascus predominating. Whether the two species should be distinguished

from each other is a question which can be resolved only by additional field collections and by additional distributional data. Both are known only from the type collections.

SPECIMEN EXAMINED. **India.** Isotype of *P. mussooriensis,* (Brewery Road, Mussoorie), on soil amid mosses, Aug. 12, 1956 (BPI).

11. **Pulvinula neotropica** Pfister, sp. nov. Fig. 2B

Apothecium ad 4 mm diam, convexum, flavovirens, in sicco luridum. Asci 165–177 × 11–14 μm, octospori. Ascospori globosi laevigati (12–)13–14(–15) μm. Paraphyses filiformae ad 4 μm diam ad apices. In ligno ustulato. Holotypus: on burned wood, El Yunque, Luquillo National Forest, Puerto Rico, D. H. Pfister (1342) and J. D. Rogers, 9. IV. 1974 in FH.

Apothecia gregarious, 2–4 mm diam. Disc pale yellowish-greenish, convex, drying buff, margin more or less even. Receptacle pulvinate, smooth or slightly furfuraceous. Ectal excipulum 30–45 μm thick, of globose cells and/or laterally compressed cells, cells 10–15 × 25–32 μm arranged radially, 3–5 cells deep. Medullary excipulum composed of more or less tightly interwoven textura intricata of hyphae, about 2 μm in diam. Subhymenium not clearly differentiated from the medullary excipulum. Hymenium about 200 μm thick. Asci 165–177 × 11–14 μm, arising from prominent croziers, not broad at base, 8-spored. Ascospores uniseriate, globose, hyaline, with a single large oil globule, smooth-walled (12)13–14(-15) μm. Paraphyses thin, 2–3 μm below, 3–4 μm toward the apex, mostly curved in the upper portion but not strongly.

SPECIMENS EXAMINED. **Puerto Rico.** Holotype: on burned wood, El Yunque, Luquillo National Forest, D. H. Pfister (1342) and J. D. Rogers, 9.IV.1974 (FH); on charcoal in fire spot, El Toro Trail, El Yunque, D. H. Pfister et al. (639), 9.VII.1973 (FH). **Guadeloupe, F.W.I.** On soil and charred wood, Les Mamelles, Guadeloupe National Forest, 5.I.1974, D. H. Pfister (811), Martha Sherwood, and Steve Carpenter (FH); burn site, Parc Tropicale, D. H. Pfister (1249), S. Carpenter, M. Sherwood, 10.I.1974 (FH).

12. **Pulvinula niveoalba** J. Moravec

≡ *Pulvinula niveoalba* J. Moravec, Česká Mykol. **23**:231. 1969.

Pulvinula niveoalba can be distinguished by its relatively small apothecia (0.6–3 mm in diam), white hymenium, ascus size (160–180 μm) and ascospore dimensions (9.5–12.2 μm).

SPECIMEN EXAMINED. **Czechoslovakia.** Holotype, ad terram humidam nudam in societe *Pulvinulae haemastigmae,* viae cavae in piceto prope Drhleny, districtus Mladá Boleslav, 23. VI. 1969, leg. Jiří Moravec (PR 674714).

13. **Pulvinula orichalcea** (Cooke) Rifai

≡ *Peziza orichalcea* Cooke, Mycographia p. 235, fig. 397. 1879. ≡ *Barlaea orichalcea* (Cooke) Sacc., Syll. Fung. **8**:114. 1889. ≡ *Barlaeina*

orichalcea (Cooke) Sacc. & Trav. in Sacc., Syll. Fung. **19**: 140. 1910. ≡ *Pulvinula orichalcea* (Cooke) Rifai, Verh. K. Ned. Akad. Wet. II. **57**(3): 213. 1968.

Le Gal's (1953) description of *Pulvinula globifera* is, according to Rifai, based on *P. orichalcea*. I have seen two collections of this species from the Caribbean.

SPECIMENS EXAMINED. **Jamaica.** On soil, trail from Whitfield Hall to Portland Gap, to Blue Mountain Border of St. Thomas and Portland Parishes, R. P. Korf et al., 17. I. 1971 (CUP–MJ–593); on soil, Traveller's Rest, Silver Hill Gap on the border of Portland and St. Andrew Parish, R. P. Korf et al., 8. I. 1971 (CUP–MJ–103).

14. **Pulvinula ovalispora** Boud. Fig. 1

≡ *Pulvinula ovalispora* Boud., Bull. Soc. Mycol. France **33**: 16. 1917.

This is the only species of the genus reported to have ellipsoidal spores. When describing *Pulvinula ovalispora*, Boudier indicated that, although the spores were oval, all other characteristics agree with those of the genus. The ascus bases are forked as is typical of the genus. The type collection consists of a single, small, partially dissected apothecium, thus details of the excipulum were not studied.

SPECIMEN EXAMINED. **Algeria.** Ad terram nudam, Februario, leg. Rene Mairé (PC).

15. **Pulvinula salmonicolor** (Seav.) Pfister

≡ *Lamprospora salmonicolor* Seaver, Mycologia **17**: 47. 1925. ≡ *Pulvinula salmonicolor* (Seav.) Pfister, Phytologia **24**: 211. 1972.

Apothecia usually solitary, 5–7 μm diam. Disc yellow-orange to orange, convex, drying buff-salmon, margin even. Receptacle pulvinate, smooth where exposed. Ectal excipulum up to 65 μm thick at the base of the apothecium, composed of globose to slightly laterally compressed cells, 30–35 × 40–45 μm, becoming somewhat radially arranged at the margin, random at the base of the apothecium. Medullary excipulum composed of tightly interwoven hyphae (textura intricata), 2–3 μm in diam. Subhymenium not clearly differentiated from the medullary excipulum. Hymenium about 375–400 μm thick. Asci 242–286 × 22–23 μm, 8-spored, ascus base lacking croziers. Ascospores uniseriate, globose, hyaline, generally with a single oil globule, smooth-walled though the cytoplasm sometimes gives them a granular appearance, 20–23 μm diam. Paraphyses stout, 4 μm at the base, 7–10 μm apically, straight.

SPECIMENS EXAMINED. **Guadeloupe, F.W.I.** On soil among mosses, La Soufriére, July 20, 1973, D. H. Pfister (594) and W. Sarriera; on soil, Les Mamelles, Guadeloupe National Forest, 5.I.1974, D. H. Pfister (887), Martha Sherwood, and Steven Carpenter (FH); on soil at base of a banana plant, Camp Jacob, Saint Claude, 500–550 m, 7.I. 1974, D. H. Pfister (1063), Martha Sherwood, and Steven Carpenter (FH); on soil, Parc Tropicale, Basse Terre, 10.I.1974, D. H. Pfister (1197), Martha Sherwood, and Steven Carpenter (FH). **Puerto Rico.** On soil among mosses, El Yunque, 9.IV.1974, D. H. Pfister (1340 & 1343).

The species was discussed earlier (Pfister, 1972). Recent collections have permitted this more complete description.

16. **Pulvinula tetraspora** (Hansf.) Rifai

≡ *Lamprospora tetraspora* Hansf., Proc. Linn. Soc. New South Wales **79**:126. 1954. ≡ *Pulvinula tetraspora* (Hansf.) Rifai, Verh. K. ned. Akad. Wet. II. **57**(3):207. 1968.

Misapplication: *Pulvinula etiolata* (Cooke) Le Gal, Prodr. Flore Mycol. Madagascar **4**:91. 1953. ≡ *Peziza globifera* var. *etiolata* Cooke, Mycographia p. 236, fig. 399. 1879.

Rifai (1968) provides a complete description of this species, which, in addition to *Pulvinula lacteoalba*, are the only two species thus far known to have exclusively 4-spored asci.

17. **Pulvinula** sp.

There is a distinct species of *Pulvinula* which resembles *P. convexella* and *P. carbonaria* but which differs in that the apothecia are on soil rather than on charcoal and the asci are smaller than in *P. convexella*. The only specimen of this species I have seen is in Fuckel, Fungi rhenani no. 2290 (FH). This specimen was given the name *Crouania humosa* (Fr.) Fuckel. However, Fuckel's description and specimen do not agree with Fries concept of the species, thus that epithet is not available. Future type studies may provide an available name for this species.

SYNONYMS, EXCLUDED SPECIES AND COMMENTS ON SPHERICAL-SPORED SPECIES OF PEZIZALES

In searching for species of *Pulvinula*, a number of species were examined which were referrable to other genera of the Pezizales or were synonyms of accepted species of *Pulvinula*. They are listed alphabetically below under the accepted name if one could be determined.

LAMPROSPORA ASPERELLA (Rehm) Boud., Hist. Class. Discom. d'Eur. p. 69. 1907. ≡ *Crouania asperella* Rehm, Hedwigia **24**:226. 1885. ≡ *Barlaea asperella* (Rehm) Sacc., Syll. Fung. 8:113.

The placement of this species in *Lamprospora* by Boudier (1907) seems to be correct. The structure of the excipulum agrees with that found in *Lamprospora* sensu Rifai (1968). Seaver (1928) synonymized it with *L. crec'hqueraulti*.

LAMPROSPORA ASTROIDEA (Hazsl. in Cooke) Boud. Hist. Class. Discom. d'Eur. p. 68. 1907. ≡ *Peziza astroidea* Hazsl. in Cooke, Mycographia p. 29, fig. 49. 1879. ≡ *Barlaea astroidea* (Haszl. in Cook) Sacc., Syll. Fung. 8: 111. 1889.

Peziza astroidea was treated by Boudier (1907) as *Lamprospora*. I have not seen a specimen of this species but follow Boudier's placement

of it. Cooke's plate shows the apothecia with fimbriate margins which would certainly substantiate Boudier's deposition of it.

BARLAEINA CENTROSPORA Kirschst., Ann. Mycol. **33**:206. 1935.

This is a species of *Lamprospora* sensu stricto and is close or identical to *Lamprospora crec'hqueraulti*. The specimen should be reexamined when a critical revision of the genus *Lamprospora* is done. Holotype in B examined.

PLICARIA CHAIGNONI Pat., Bull. Soc. Hist. Nat. Autun. **17**:154. 1904. = *Pulparia planchonis* (Dun. ex Boud.) Korf, Pfister, and Rogers, Phytologia **21**:206. 1971. Holotype in FH examined.

LAMPROSPORA CHOPRAIANA Batra, Mycologia **52**:665. 1960.

This is not a *Pulvinula* but type material is too scanty to make an identification. Rifai (1968) excluded it from *Lamprospora*.

PULVINULA CONSTELLATIO (Berk. & Br.) Boud., Hist. Class. Discom. d'Eur. p. 70. 1907.

Pulvinula constellatio has been accepted as a distinct taxon by most workers. I feel it intergrades with *P. convexella* and tentatively regard it as a synonym as did von Hohnel (1917). *Pulvinula constellatio* is part of a complex of species, including *P. cinnabarina*, *P. convexella*, and *P. laeterubra*, which is yet to be adequately defined. Complete synonymy of this species is given under *P. convexella*.

BARLAEA DISCOIDEA P. Henn. & E. Nym., Monsunia **1**:33. 1900. ≡ *Barlaeina discoidea* (P. Henn. & E. Nym.) Sacc. & Syd., Syll. Fung. **16**:710. 1902. ≡ *Pulvinula discoidea* (P. Henn. & E. Nym.) Batra, Univ. Kansas Sci. Bull. **44**:143. 1963.

The type material of this taxon was not located. In this group, where microscopic features are critical for proper and accurate identification, no attempt is made to place it.

PULVINULA ETIOLATA (Cooke) Le Gal, Prodr. Flore Mycol. Madagascar **4**:91. 1953. ≡ *Peziza globifera* Berk. var. *etiolata* Cooke, Mycographia p. 236, fig. 399. 1879.

Rifai (1965) considered Le Gal's use of this name a misapplication. According to him, the specimen described is referrable to *Pulvinula tetraspora*. *Peziza globifera* var. *etiolata*, according to Rifai, is indistinguishable from *Pulvinula globifera*. I have not studied Cooke's specimens.

BARLAEINA FEURICHIANA Kirschst., Ann. Mycol. **33**:205. 1935.

This is a species of *Lamprospora* sensu stricto. Holotype in B examined.

PEZIZA GEMMEA Phil. in Cooke, Mycographia p. 236, fig. 398. 1879.

This is a synonym of *Pulvinula archeri* (Berk. in Hook.) Rifai.

BARLAEINA HENNINGSII Kirschst., Notizbl. Bot. Gart. Berlin–Dahlem **15**:830. 1943.

This is a species of *Lamprospora*, close or identical to *L. crec'hqueraulti*. Holotype in B examined.

CROUANIA KNAJASCHENSIS Karst., Hedwigia **23**:37. 1884. ≡ *Barlaea knajaschensis* (Karst.) Sacc., Syll. Fung. **8**:113. 1889. ≡ *Lamprospora knajaschensis* (Karst.) Boud., Hist. Class. Discom. d'Eur. p. 68. 1907.

No specimen of this species could be located in the Karsten Herbarium at Helsinki. From the original description, it appears to be a species of *Pulvinula* since it is said to have smooth spores, curved paraphyses which are relatively narrow, and asci within the proper size range. However, it was treated by Boudier (1907) as a *Lamprospora*. Without a specimen the question is irresolvable.

PEZIZA LAETERUBRA Cooke, Mycographia p. 14, f. 20. 1879. ≡ *Lamprospora laeterubra* (Cooke) Lagarde, Ann. Mycol. **4**:213. 1906.

This name was proposed as a substitute for the epithet *cinnabarina* when Cooke wished to transfer *Crouania cinnabarina* Fuck. to *Peziza*. Both Cooke (1879) and Lagarde (1906) described and illustrated the globose ascospores as being finely reticulate. I have not examined their specimens, but Fuckel's specimen in Fungi rhenani no. 2481 is definitely a *Pulvinula* and has smooth ascospores. The fungus with ornamented spores illustrated and discussed by Cooke and Lagarde is apparently without a legitimate name.

CROUANIA LIVIDA Rehm ex Hazsl., Math. Naturwiss. Ber. Ungarn. **21**:262. 1886.

This is a synonym of *Pulvinula convexella*, which see for complete synonymy. Apparently Rehm did not intend to publish this as a new species since the packets are annotated as *Peziza convexella* Karst. and the species was published as *Leucoloma convexellum* (Rehm 1882). Specimen examined: in excavatione terrae callis "Riu mare" infra alpen Retyezat Transsylvaniae 8/1872, Lojka sub 1870.

BARLAEINA PLATENSIS Speg., Anales Mus. Nac. Hist. Buenos Aires ser. 3. **1**:70. 1902.

The ascospores of this species are not spherical but rather are broad ovoid-ellipsoid, 10–12 × 9–10 μm in diam and smooth. The hairs are flexuous and blunt tipped and arise from ± globose cells of the outer layer of the ectal excipulum. The cells of the ectal excipulum are brown colored. The paraphyses are characteristic in that they are swollen apically and many times swollen again below the septa giving the paraphyses a slim moniliform appearance. This may represent a species of *Leucoscypha*. Holotype in LPS examined.

LAMPROSPORA PYROPHILA Sydner, Mycologia **28**:484. 1936.

The holotype is deposited at the University of Washington herbarium but for some reason is not available for study. I wish to thank Dr. Amy Y. Rossman of Oregon State University for locating the specimen in the University of Washington herbarium. Since a number of specimens from the northwest were examined and found to agree with both the original description of *Lamprospora pyrophila* and with Rifai's (1968) description of *Pulvinula archeri*, *Lamprospora pyrophila* is here considered to be a synonym of *Pulvinula archeri*.

BARLAEINA ROSEA Kirschstein in Schieferdecker, Die Schlauchpilze der Flora von Hildescheim p. 97. 1954.

This is a species of *Lamprospora*. It appears to be very similar to *L. dictydiola* Boud. Holotype in B examined.

PEZIZA SANGUINARIA Cooke, Mycographia p. 14, fig. 19. 1879.

The name was introduced by Cooke as a *nomen novum* to replace the epithet *carbonaria* when he transferred *Crouania carbonaria* to *Peziza*. See *Pulvinula carbonaria* for complete notes on this species.

BARLAEINA STRASSERI Bres. in Strasser, Verh. Zool.–Bot. Ges. Wein **55**: 613. 1905.

This is a *Pulvinula* close, if not identical, to *Pulvinula archeri*. The small ascospores, 8–10 μm in diam, and the apically branched paraphyses are very characteristic. Holotype in B examined.

PEZIZA SUBAURANTIA Bomm. & Rouss., Bull. Soc. Roy. Bot. Belgique **23**: 134. 1884. ≡ *Barlaea subaurantia* (Bomm. & Rouss.) Sacc., Syll. Fung. **8**: 114. 1889. ≡ *Pulvinula subaurantia* (Bomm. & Rouss.) Boud., Hist. Class. Discom. d'Eur. p. 70. 1907.

I was unable to locate the holotype of this species in either BR or in PC, thus its placement within the genus is unresolved. The specimen in Fungi Colombiani no. 2909 issued under this name is *Pulvinula convexella*.

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