

SOME INTERESTING SPECIES OF *EPIPOLAEUM* AND *DIMERIELLA* (PYRENOAMYCETES: DIMERIACEAE) FROM SOUTH AMERICA

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RESUMEN

Este trabajo trata de 5 especies de *Dimeriella* Speg. y *Epipolaeum* Theiss. & Syd. (4 sobre Compositae y 1 sobre Boraginaceae) de América del Sur. Se dan los rasgos de ambos géneros y se describen las especies en detalle.

This paper deals with five species of *Dimeriella* Spegazzini and *Epipolaeum* Theissen & Sydow (four on compositae and one on Boraginaceae) known from South America. It represents a small, preliminary part of a comprehensive, long-term project involving monographic studies of these genera and their close relatives.

The main difficulty in studying these fungi lies in the lack of enough mature and reasonably fresh collections of many taxa to ascertain species and even genus variability and limits, or to determine the value and significance of the diagnostic characters currently used in classifying the Dimeriaceae. Intensive and extensive collecting efforts are needed to remedy this situation.

Another problem in defining species concepts in these fungi arises when species occurring on unrelated hosts (*i.e.* belonging to different plant families) are morphologically very similar, differing only slightly in the sizes of certain components. Are these minor variations intrinsic in each species or do they result from interactions of one species with different hosts? Only cross-inoculation experiments could answer this question - provided techniques can be developed for obtaining inoculum.

For the present study, the fungi were observed by means of celluloid strips, crush mounts, and 5-7 μ m longitudinal sections in a pa-

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raffin-like embedding material. In the descriptions, the word "ostiole" is used in the second sense, of Ainsworth (1971). The term 'setae' is limited to those appendages that are morphologically specialized in some manner, and hence does not include undifferentiated hyphae that happen to be attached to the ascocarp and usually grow down to merge with the vegetative mycelium.

Both *Epipolaeum* and *Dimeriella* are characterized by superficial, black perithecia, two-celled ascospores, and the presence of a more or less pigmented mycelium on the leaf surface. In species of *Dimeriella*, this mycelium characteristically also produces hyphae penetrating the host cuticle or tissues (as, for example, in *D. hirtula*, the type species), or forming bands in the cuticle (as in *D. cordiicola* and *D. melioloides*). *Dimeriella* was equated with *Wentomyces* Koorders by Müller and Arx (1962), but differs from that genus by having pigmented ascospores, as presented in more detail earlier (Farr, 1965). *Epipolaeum* is separable from *Dimeriella* by the absence of setae (as defined above) on the ascocarps, and by the apparently completely superficial habit. The taxonomic importance of mycelium orientation in relation to the host tissues, and of other features such as ascospore color, presence of setae, etc., remains to be established by future studies. In the interim, these characteristics offer a convenient way of classifying these fungi. Paucity of material and lack of time permitted only preliminary observations on centrum structure, but more attention will be devoted to this aspect in future reports.

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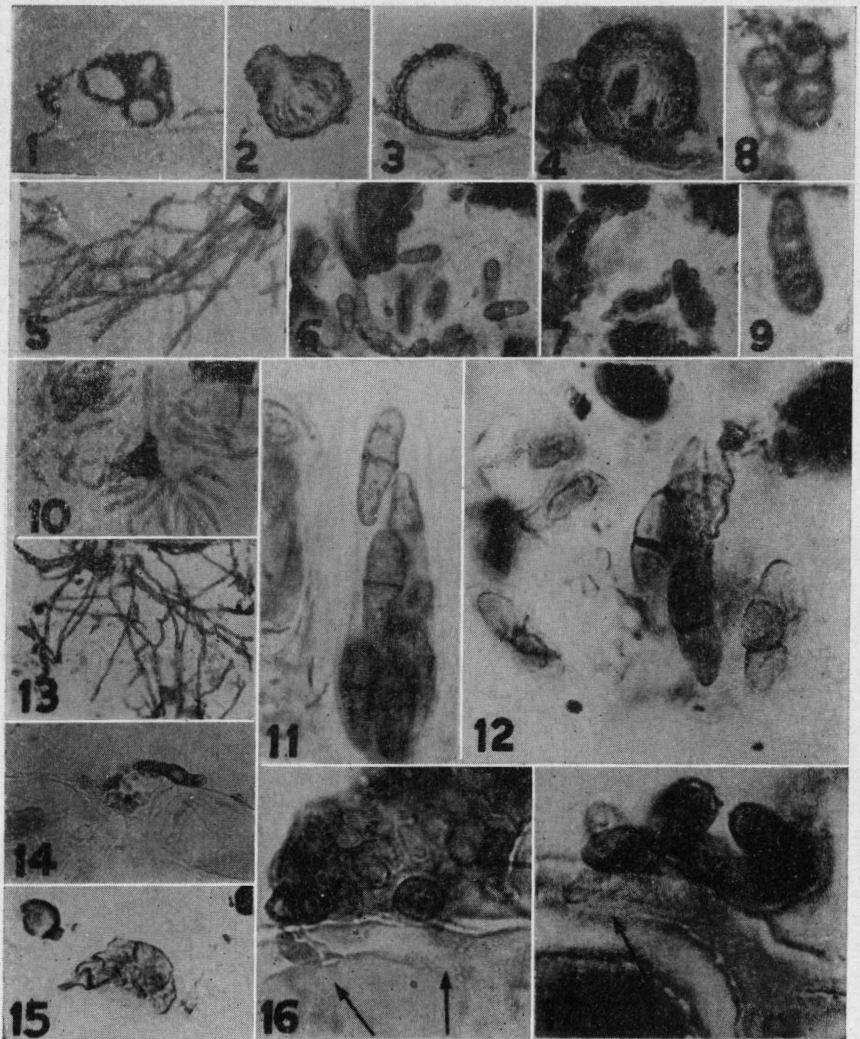
***Epipolaeum irradians* (Patouillard) Theissen and Sydow, Ann. Mycol.**

16 (1/2): 7-8. 1918. *Asterina irradians* Patouillard, in Pat. and Lagerheim, Bull. Soc. Mycol. France 7 (3): 172. 1891. *Antennularia*? *irradians* (Pat.) Theissen, Abh. Zool.-Bot. Ges. Wien 7 (3): 28. 1913. (Figs. 1, 5-9).

Colonies epiphyllous, blackish, irregularly rounded, conspicuous, closely gregarious to nearly confluent, up to 2 mm in diam, not causing any leaf symptoms; *mycelium* wholly superficial, mostly radiating out from the center of the colony, abundant, bright reddish brown by transmitted light, consisting of relatively straight, indistinctly or distinctly septate hyphae 2.5-5.0 μ m in diam, often with indistinct margins, sometimes darker, wider, and more closely septate near the fruiting bodies.

Ascocarps inconspicuous, closely gregarious to densely crowded in the center of the colony, dull blackish, subglobose, somewhat flattened, ostiolate at maturity, 130-200 μ m in diam, ca 70-72 μ m high, glabrous or beset in the lower part with more or less numerous, rather

dark brown, often tangled hyphae which extend down to merge with the mycelium; perithecial wall pseudoparenchymatous, consisting of 1-2 layers of irregularly rectangular to polygonal cells 5-12 μm in diam; ostiole irregularly circular, ca 12-17 μm in diam. *Asci* pseudoparaphysate, 8-spored, broadly cylindrical, short-pedicellate basally, 50-76 x 16-22 μm (*vide* Theissen, 1913, and Theissen and Sydow, 1918); pseudoparaphyses numerous, hyaline, delicate (*vide* Theissen and Sydow, 1918, pp. 7-8). *Ascospores* pale brown when young, medium dark brown



at maturity, ellipsoid to clavulate, barely to mildly constricted at the septum, with subequal cells or the bottom cell slightly longer, broadly rounded at the ends, 10-15(-16) x 4-5(-6) μm , more or less asperulate, sometimes guttulate.

The type collection of *E. irradians*—type species of *Epipolaeum*—appears to be overly ripe; most ascospores seen were near or past liberation, and no intact asci were found. The difference in ascus measurements by the various authors treating this taxon may be noteworthy. Theissen and Sydow (1918) cite ascus dimensions almost identical with those of the original diagnosis (50-60 x 16-18 μm), whereas Theissen's earlier (1913, p. 28) description lists them as 62-76 x 18-22 μm . The original diagnosis depicts the asci as aparaphysate. Theissen's (1913) dimensions for perithecial wall cells (24-28 μm) are obviously in error. Although the description presented here generally agrees with the earlier ones, the spore dimensions listed by all previous authors are significantly larger (16-19 x 6-8 μm) and the color is given as greenish or green (Theissen, 1913; Petrak, 1950, p. 483) or greenish brown (original diagnosis). Perhaps in fresh material the spores appear green.

Judged from the sparse material seen of the two species on *Liabum* Adans., *E. irradians* appears to be distinct from *E. liabi* (q v), but the discrepancy in ascospore dimensions listed for the former species raises the possibility that the two taxa may represent different levels of development of one fungus.

Known neotropical distribution: Ecuador, on *Liabum ignianium* Less. = *L. bonplandii* Cass.

Specimens examined: Rehm *Ascomyc.* 1907 (type, NY).

Epipolaeum liabi (Sydow) Müller in Müller & Arx, Beitr. Kryptogamenfl. Schweiz II (2): 485. 1962. *Antennularia liabi* Sydow, Ann. Mycol. 28 (1/2): 68. 1930. *Gibbera liabi* (Sydow) Petrak, Sydowia 4: 491. 1950. (Figs. 2, 10, 11).

Colonies epiphyllous, suborbicular to irregular and several mm in diam, or coalescing to form large blotches, not causing any leaf symptoms; *mycelium* superficial, reticulate, composed of medium brown, septate hyphae 3-4 μm in diam.

Ascocarps gregarious, black, globose, obpyriform, or ampuliform with a more or less conic neck 44-50 μm long and 40-62 μm wide, ostiolate, 110-165 μm in diam, 80-135 (-160) μm high, glabrous; perithecial wall pseudoparenchymatous, consisting of 2-3 layers of variously shaped polygonal, thin-walled cells 4-10 μm in diam, sometimes darker and more compact around the ostiole, and with the outer walls of the outside layer darker and sometimes slightly thicker; ostiole circular, 25-40 μm in diam. *Asci* numerous, pseudoparaphysate, 8-spored, narrowly ellipsoid, (42-)48-60 x 12-14 μm ; pseudoparaphyses

hyaline, filiform, sometimes with short branches at the apex. *Ascospores* light brown, clavulate to fusiform or ellipsoid, 14-16(-18) x 5-7(-8) μm , asperulate.

Although the mycelium envelops the epidermal trichomes and sometimes forms a few supporting hyphae or a mass of intermixed hyphae beneath the fruiting bodies, there is no suggestion of a hypostroma, nor did sectioned material display any evidence of host penetration. Thus, this species appears to be properly placed in *Epipolaeum*. It should be mentioned, however, that the type and only specimen examined is old and brittle and the tissue badly disintegrated in sectioning; freshly collected material undoubtedly would disclose a more reliable picture of the host-fungus relationship.

The above description corresponds with the detailed original diagnosis, except that all my measurement ranges represent lower portions of those given by Sydow. Specialized, conidiophore-like hyphal branches on the mycelium surrounding the trichomes, as mentioned by Petrak, were not found.

Based on the type and only specimen available, *E. liabi* differs from *E. irradians* by the scattered to gregarious occurrence of the ascocarps, the inconspicuous, reticulate, and more delicate mycelium, and the slightly larger and paler ascospores.

Known neotropical distribution. Venezuela, on *Liabum megacephalum* Sch. (evidently known only from the type).

Specimens examined. Sydow, *Fungi Venezuelani* 330 (BPI).

Dimeriella hirtula Spegazzini, Rev. Mus. La Plata 15 (ser. 2, vol.

II): 13; fig. D. 1908. *Asteromyxa hirtula* (Speg.) Theissen & Sydow, Ann. Mycol. 15 (6): 419. (1917) 1918. *Wentomyces hirtulus* (Speg.) Müller & Arx, Beitr. Kryptogamenfl. Schweiz 11 (2): 491. 1962. (Figs. 3, 12-17).

Colonies amphigenous, spanning more or less extensive, irregular leaf areas but not producing any symptoms, visible macroscopically only by a black stippling denoting the fruiting bodies; *mycelium* relatively scanty, consisting of branching and anastomosing, septate, medium to dark brown hyphae 3-4(-7) μm in diam, with moniloid portions composed of nearly isodiametric, slightly constricted cells, rarely forming agglomerations in the stomatal cavities or penetrating cuticle or epidermis.

Ascocarps scattered to gregarious, dull black, subglobose to ovoid or hemispheric, 55-100 μm in diam, 60-75 μm high, at maturity with a circular ostiole ca 13-20 μm in diam, covered with numerous setae; perithecial wall consisting of 2-3 (1-2 basally) rows of more or less isodiametric, rectangular to irregularly polygonal cells 4-12 μm in diam, with thick, dark walls, sometimes darker around the ostiole,

and 1-2 inner layers of smaller, delicate cells with thin, pale brownish walls; setae dark brown (sometimes paler toward the apex), septate or aseptate, simple or rarely narrowly bifurcate, rigid or slightly undulate, mostly 15-40 x 4-6 μm , sometimes attenuated to 2 μm at the narrowly to broadly rounded apex. *Asci* ?sparsely pseudoparaphysate, 8-spored, ellipsoid to ovoid (scarcely to broadly expanded below), straight or curved, ca 22-50 x 11-17 μm . *Ascospores* pale brown at maturity, ellipsoid to broadly fusiform, scarcely to distinctly constricted at the septum, 12-18 x 4-6 μm , smooth.

Crush mounts of fruiting bodies in varying stages of maturity indicate that young ascocarps are filled with a slimy substance that disappears during maturation of the hymenium. Longitudinal sections show a few very delicate filaments among the asci, but whether these represent pseudoparaphyses or merely remnants of disintegrating tissues is not certain at this point.

Known neotropical distribution. Brazil, Ecuador, on *Baccharis* spp.

Specimens examined. Brazil: *Usterius* 1 (LPS 463, holotype; isotype, FH; possible isotype, S), on *Baccharis* sp.; *Dusén* s n, on *Baccharis brevifolia* DC, ex Sydow herb. (IME, NY).

Dimeriella melioides (Berkeley & Curtis) Theissen, Ann. Mycol. 10 (1): 1. 1912. *Asterina melioides* Berk. & Curt. in Berkeley, Grevillea 4 (29): 10. 1875. *Meliola baccharidis* Berk. & Ravenel in Berkeley, Grevillea 4 (32): 158. 1876. *Dimerosporium puiggarii* Spegazzini, Bol. Acad. Nac. Cienc. Córdoba 11(4): 381. 1889. *Dimeriella horridula* Sydow, Ann. Mycol. 7 (4): 352. 1909. (Figs. 18-21).

Twenty-one additional synonyms are cited by Müller and Arx (1962, p. 493), including several Spegazzini taxa.

Colonies black (appearing sooty when abundant), usually epiphyllous, occasionally amphigenous, discrete to coalescing, more or less orbicular, 2-10 mm in diam, or covering extensive, irregular leaf areas, sometimes apparently causing pale brown discolorations there; *mycelium* forming a closely appressed, loose to dense surface reticulum of light brown, septate hyphae 2-3 μm in diam (sometimes attenuating to paler apices 1.5 μm in diam), from which delicate hyaline filaments penetrate the cuticle and give rise to a more or less dense layer of hyaline hyphae ca 2 μm in diam.

Ascocarps closely gregarious, clustered, or densely crowded, sometimes concentrated in the center and in 1-2 concentric lines toward the periphery of the colony, black, subglobose to globose with a papillate ostiole, 70-145 μm in diam, 65-105 μm high, conerved with usually numerous hyphae which are dark brown, septate, unbranched, 4-6 μm thick near the base, single or forming strands of 2-several, radiating out in all directions, ultimately bending down and attenuating to

merge with the surface mycelium; perithecial wall pseudoparenchymatous, consisting of 2-3 layers of variously shaped, polygonal cells mostly 4-8 μm in diam (the outermost layer with black outer walls up to ca 1.5 μm thick, the inner layers progressively paler brown and thinner walled), frequently darker around the ostiole; ostiole circular, ca 15-20 μm in diam. *Asci* pseudoparaphysate, 8-spored, broadly cylindrical to ellipsoid, clavate, or obclavate, sometimes basally pedicellate, (22-) 24-44 x 8-10(12) μm ; pseudoparaphyses hyaline, filiform, simple or branched, sometimes slightly enlarged at the apex, exceeding the asci and converging to extend into the ostiole. *Ascospores* 3-4-guttulate and hyaline when young, turning pale yellow-brown, clavate to ellipsoid or subcylindric, (9-)10-12(-13) x 2-4(-5) μm , smooth.

When luxuriantly developed, this fungus has the aspect of the Perisporiopsidaceae. Whether or not it actually causes any leaf symptoms is debatable, since it is not consistently associated with discolored blotches. (Most of the specimens studied were 30-70 years old, however, and fresh material probably would clarify the situation).

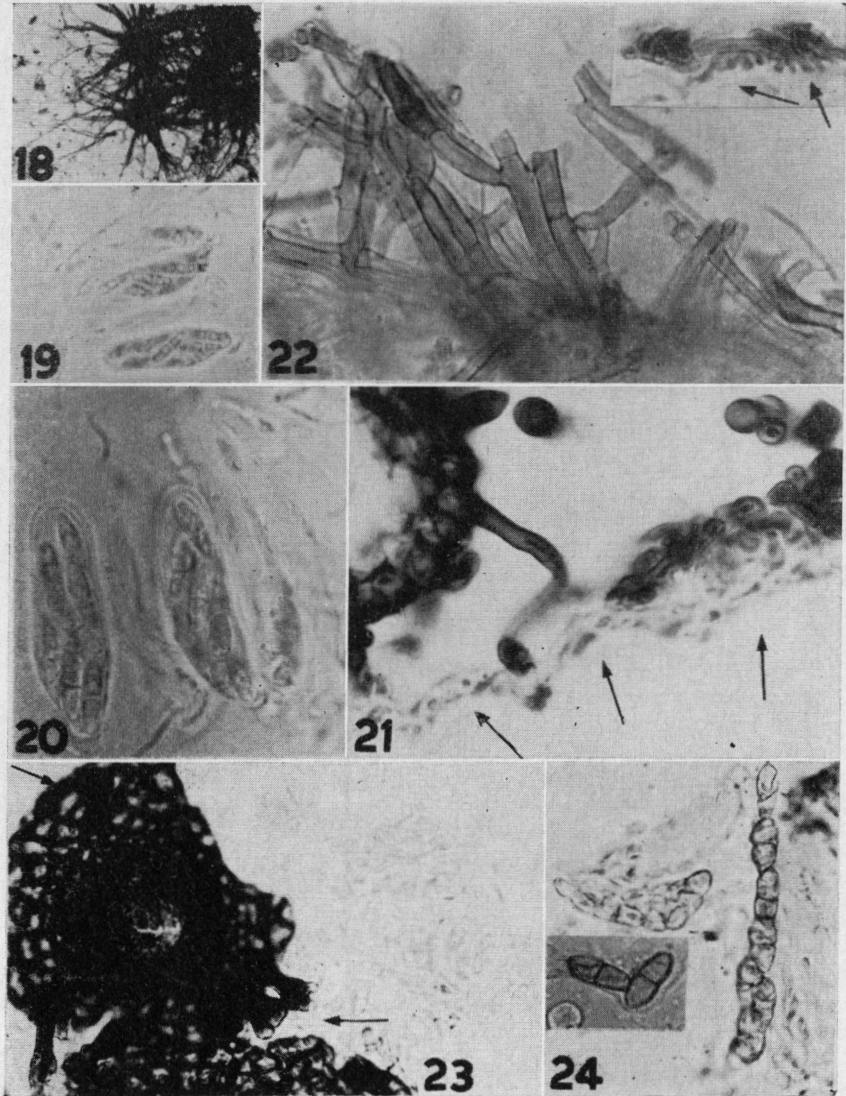
When the fungus appeared on both leaf surfaces, the hypophyllous ascocarps were smaller, sparser, and less densely "hairy" than those of the epiphyllous colonies, but many were fertile, with contents indistinguishable from those of the epiphyllous ascocarps. Centrum development could not be pursued, but examination of immature fruiting bodies suggests that these are initially filled with a delicate tissue which deliquesces as the hymenium grows. Most of the specimens seen did not display fully ripe ascospores. In *Whetzel 184*, however, some spores still within the asci showed a pale yellow-brown tint, and several free, pale brown spores of the same shape and size (sometimes slightly constricted at the septum) also were present. In several collections, few to numerous loose, dark brown, 1-celled, ellipsoid to fusiform spores 16-18 x 6-8 μm were associated with the fruiting bodies, but their relationship, if any, to the species at hand is not known.

According to Theissen (1912, pp. 2-3) the ascocarps are not ostiolate, but dehiscence by apical disintegration. Müller and Arx (1962, p. 493) assert "Im papillenförmigen Scheitel öffnen sie sich bei der Reife mit einem rundlichen Porus". Although this more correctly depicts the situation, in the collections examined during this study, even very young ascocarps (10 μm in diam) often exhibited a distinct ostiole, as well as hyphal appendages. The so-called deliquescent paraphysoids ["verschleimende Paraphysoiden"] mentioned by these authors appear to be persistent filaments.

The diagnoses of both *Asterina melioides* and *Meliola baccharidis* are vague, but the few semimature ascocarps on their common type specimen clearly reveal its identity.

The fungus is illustrated in all stages by Arnaud (1918, pl. III). For a nomenclatural and taxonomic discussion, see Müller and Arx (1962).

Known neotropical distribution. Tropical America, on *Baccharis* spp. and other Compositae (*vide* Müller and Arx, 1962). Also known from warmer parts of North America, and Bermuda.



Specimens examined. U.S.A., South Carolina: *Ravenel Car. Inf.* 1355 (type, BPI). Florida: *Hedgcock sn* (BPI, F.P. 25113); *Thaxter 6 and 10* (BPI); *Hageman & Stegmaier sn* (U. S. Plt. Quarant. Intercept. 26805, BPI); *Rhoads sn* (BPI, 5 collections); *Stevenson sn* (BPI); *Diehl sn* (BPI); *Cain 30923* (BPI). Bermuda: *Seaver 1510* (BPI); *Seaver and Waterston 70* (BPI); *Whetzel 184* (BPI); *Britton sn* (BPI); *Ogilvie Berm. F'gi. 172* (BPI). Brazil: *Puiggari 2586* (type of *Dimerosporium puiggarii* Speg., LPS 454). Paraguay: *Balansa 3582* (as *Dimerosporium puiggarii* Speg., LPS 478).

Dimeriella cordiicola (Hennings) Hansford, CMI Mycol. Pap. # 15: 44. 1946 *Dimerosporium cordiicola* Hennings, *Hedwigia* 43: 355. 1904. *Epipolaeum cordiicola* (Henn.) Arx & Müller in Müller & Arx, *Beitr. Kryptogamenfl. Schweiz II* (2): 488. fig. 196. 1962. *Dimerosporium cordiae* Hennings, *Hedwigia* 48 (1): 4. 1908. *Dimeriella cordiae* (Henn.) Theissen, *Beih. Bot. Centralbl.* 29: 67. 1912. *Chaetostigme cordiae* (Henn.) F. L. Stevens, *Illinois Biol. Monog.* 11 (2): 17. 1927. *Dimerium stevenssi* Garman, *Mycologia* 7 (6): 337. 1915. (Figs. 22-24).

Colonies epiphyllous (rarely with a few additional hypophyllous ones), gregarious, more or less orbicular, occasionally irregular or coalescing, dark gray to sooty black, up to 6(-10) mm in diam, not causing leaf symptoms; *mycelium* variable in abundance, reticulate, often denser and darker near the fruiting bodies and with 2-several hyphae aligned in strands, consisting of light brown, more or less sinuous, indistinctly septate hyphae 2-4 μ in diam on the leaf surface, giving rise to slender, hyaline hyphae penetrating the cuticle in layers similar to those of *D. melioides* but much less extensive and numerous, with occasional hyphae entering the epidermis.

Ascocarps gregarious to clustered, densely crowded, or somewhat heaped, black, globose or nearly so, ostiolate at maturity, 60-100 (-100) μ m in diam, 50-76 μ m high, more or less setose but usually mixed with some glabrous ones; perithecial wall pseudoparenchymatous, often rather tough, consisting of 2 layers of light brown, irregularly rectangular or polygonal cells 4-10 (-12) μ in diam, with only the outer walls darkened and thickened, sometimes darker around the ostiole; ostiole more or less circular, sometimes slightly protruding, 15-30 μ m in diam; setae, when present, occurring on the upper part of the perithecium, usually sparse, dark brown, 0-2(-3)-septate, straight but with very irregular, sinuous margins (sometimes slightly crooked or geniculate at the septa), mostly 14-46 \times 4-6 μ m, with bifurcate to multilobate (lobes up to 12 μ m long), rarely simple apex; mycelioid appendages present on the lower half of the ascocarps, similar to the underlying hyphae and growing down to merge with them. *Asci* not numerous, pseudoparaphysate, 8-spored, broadly ellipsoid, occasionally ovoid, with a distinct basal "pedicel", straight or slightly curved, 36-50 \times 14-25 μ m; pseudoparaphyses numerous in younger stages, but

decreasing in abundance with advancing maturity of the asci, slender (ca 0.5-1.5 μm thick), hyaline, as long as the asci or up to 10 μm longer, *Ascospores* light yellowish to medium brown, clavulate to subellipsoid, straight, 16-20 \times 6-8 μm , with the cells subequal or the lower one somewhat longer, sometimes 2-4 guttulate when young.

The above description agrees completely with that of Hansford (1946), which is based on his study of type material of *Dimerosporium cordiicola*. It also comports with Sydow's (1926, pp. 325-327) detailed account of *D. cordiae*, based on Costa Rican collections which he compared with the type, of the latter species, except for the smaller ascospore dimensions given there (10.0-16.5 \times 5.0-7.5 μm). This discrepancy is undoubtedly due to different stages of spore maturity; hyaline or very pale brownish, still enclosed spores may be as small as 12 μm (or less) \times 4-5 μm . Although pigmentation often appears before spore liberation, the spores apparently attain full size and a darker shade of brown afterwards.

The ostiole seems to be poorly differentiated and formed late in perithecial development, as it was not evident on immature ascocarps (as was the case in some other species), or in median or submedian longitudinal sections. In this respect as well as in the scanty, often rather broad and thick-walled asci, this fungus approaches the Perisporiopsidaceae (*sensu* Müller and Arx, 1962). The mycelium varied considerably in abundance on the specimens examined and, when plentiful, could be peeled off the leaf as a subiculum-like layer.

Müller and Arx (1962, p. 488) unite Hennings' two species, albeit without commentary. The original diagnoses of *Dimerosporium cordiicola* and *D. cordiae* differ from each other only in stated length of asci and size of ascospores. I have not seen type material of Hennings' taxa, but the various published descriptions, as well as the examination of numerous specimens, certainly indicate that the two taxa merely constitute different states of maturity of one fungus. I therefore follow Müller and Arx's treatment.

Known neotropical distribution. Puerto Rico, República Dominicana, Grenada, St. Vincent, Barbados, Costa Rica, Brazil, Venezuela, Trinidad, on *Cordia* spp.

Specimens examined. Puerto Rico: *Seaver* and *Chardon* 53 (Explor. P. R. 1318, NY). Rep. Dominicana: *Ekman* s n (Herb. Ciferri 2916, BPI, NY); *Ekman* s n (ex Sydow herb., NY); *Ekman* s n (Herb. Ciferri 2813, Pltae. Hispan. Exp. III Regnell. N., NY); Kern and Toro (Explor. Santo Dom. 278, BPI NY); Kern and Toro (Explor. Santo Dom. 279, NY). Costa Rica: *Sydow Fgi. Exot. Exs.* 633 (BPI, NY); *Standley* and *Juvenal Valerio* 48380 (BPI, NY). Trinidad: *F. L. Stevens Fgi. Trin.* 862 & 893 (BPI). Venezuela: *Sydow* s n (Petraik Mycoth. Gen. 625, BPI); *Sydow Fgi. Venez.* 10 (BPI); *Sydow Fgi. Exot. Exs.* 802 (BPI, NY).

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