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Epifoliar fungi from Panama

Don R. REYNOLDS[1*] *& Gregory S. GILBERT*[2]

[1]*Research and Collections*
Natural History Museum, LAC, 900 Exposition Boulevard
Los Angeles, California 90007, USA

[2]*Environmental Studies*
1156 High St., 405 ISB, University of California, Santa Cruz, CA 95064, USA
and
Smithsonian Tropical Research Institute
Apartado 2072, Balboa, Panama, Republic of Panama

Abstract – Epifoliar ascomycete taxa are annotated from leaf surfaces collections in the lowland tropical rain forest at the Smithsonian San Lorenzo canopy crane research site on the Caribbean slope of the Republic of Panama. This paper provides comparative taxonomic descriptions of 23 species of epifoliar fungi in 17 genera and 8 families as a companion to a study conducted at Cape Tribulation, Queensland, Australia.

Epifoliar fungi / Panama

INTRODUCTION

Epifoliar fungi comprise specialized nutritional guilds on living plant surfaces, particularly the leaves. Several polyphyletic Ascomycete groups evolved into this habitat at higher taxonomic or deep clade branch levels. All share morphological adaptations including melanin pigmentation and the manner of ascospore and mitospore production. They comprise several ecological guilds as well, living as saprobes or parasitizing plants or other fungi. Lichenized taxa of epifoliar fungi have developed similarly morphological adaptations to the epifoliar habitat, but at more shallow taxonomic levels of genus and species (Lücking, 2002).

Epifoliar fungi are known from previous mycological work in Central America. Monographic literature on Panamanian fungi extends back over a century; citations are included in works encompassing higher taxonomic levels (Batista 1959b; Müller and Arx 1962; Batista and Ciferri, 1962, 1963a, 1963b; Santesson, 1952) as well as in the more specific revisions cited below. Any regional assessment of the diversity of epifoliar fungi is complicated by a number of historical factors that make it difficult to reconcile modern and historical approaches to classification. Many species are now known only from descriptions in the literature. Much historical material from the neotropics was destroyed during wars, especially type specimens such as those collected by 20th century

* Corresponding Author: Email: dreynold@nhm.org

mycologists H. Sydow, P. Sydow and H. Rehm; those collections that survived are now scattered in world-wide herbaria. A major problem is the common practice of inadvertent repetitious description of the same species based on minor morphological variation or similar collections from different host plant species. For example, over 100 species described in the genus *Micropeltis* by A.C. Batista and his coworkers utilized single, regional collections. Another major issue is the widespread and unfounded assumption of a one-to-one relationship of a saprobe or a parasite with an associated host plant species that results in species proliferation and ambiguity. The best example is of this unfortunate practice is the monograph of the Meliolales by Hansford (1961).

Here we describe 23 species of epifoliar fungi from 17 genera and 8 families from the San Lorenzo rain forest in Panama. This represents a companion study to one conducted at Cape Tribulation, Queensland, Australia (Gilbert and Reynolds, 2005). Together with that study, these data provide the basis for an ecological assessment of the observed host range and microclimate preferences of epifoliar fungi (Gilbert, Reynolds, and Bethancourt *submitted manuscript*).

METHODS

Examined fungi were primarily from pressed and dried leaves collected from the tropical lowland rain forest at the Smithsonian Tropical Research Institute crane facility at San Lorenzo (formerly called Fort Sherman) (9°17'N, 79°58'N; Altitude: 130 m above sea level), on the Caribbean coast of the Republic of Panamá (Colón province). The site averages 3152 mm rain annually. Specimens were collected from ground level to the top of the forest canopy; vertical access was facilitated by the canopy access crane (Wright *et al.*, 2003). Other specimens were obtained for comparison from other herbaria (Holmgren et al., 1990; www.nybg.org/bsci/ih/ih.html). Each of our Panama collections is identified with a unique number prefixed with PA.

Observations and measurements of fungal structures were made from dried specimens mounted in lactophenol, using Zeiss dissecting and compound light microscopes and a Cambridge Scanning Electron Microscope. Photomicrographs were taken with a Nikon Coolpix 4500 digital camera. The 175 specimens collected at the crane site utilized in this study, and cited in Appendix 1, are curated at the University Herbarium (UC) at the University of California, Berkeley, CA, USA and Herbarium PMA at the Universidad de Panamá, Republic of Panamá.

FUNGAL DESCRIPTIONS

Brefeldiellaceae (Theissen) Müller & von Arx. 1962:48 emend. Reynolds & Gilbert, 2005:270.

Thallus comprised of flattened cells arranged radially and circularly or in bands or in irregularly diverging rows; Ascomata dispersed, subthallal, round or

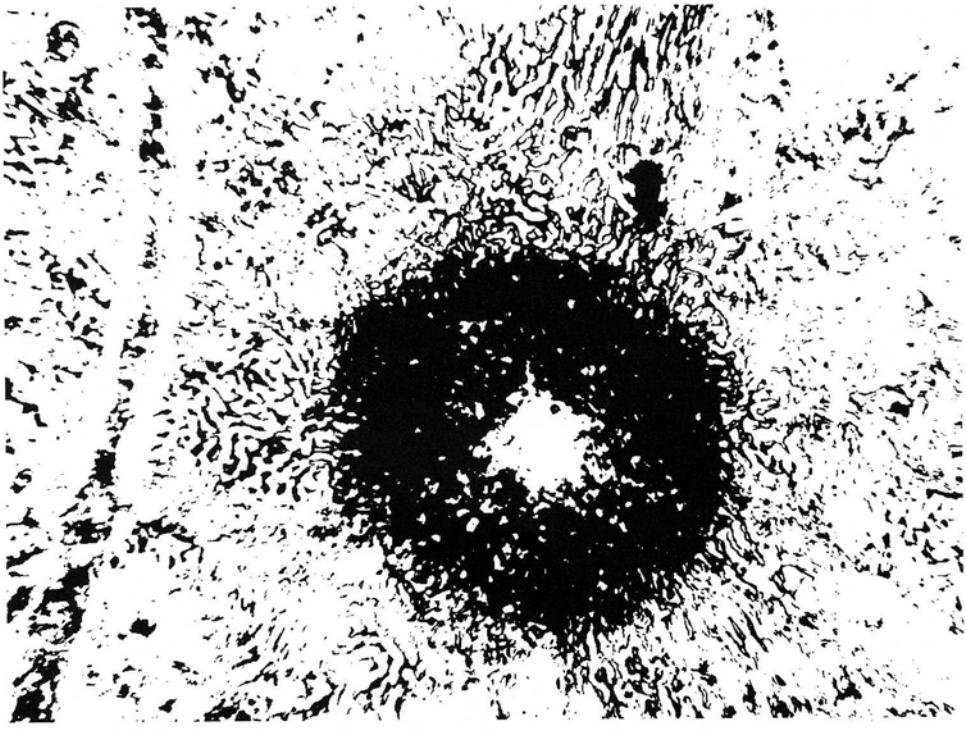

Fig. 1. *Brefeldiella brasiliensis*. PA84. The ascocarp, seen here, and the pycnidium when present, form a similar fruiting structure under a hyphal band. Bar = 35 µ.

elongate in outline, pore formed as an apical fissure of covering thallus cells; asci clavata, obvate or spherical, paraphysate; ascospores hyaline or brown, 1-2 septate.

Brefeldiella Spegazzini, 1889:58.
Brefeldiella brasiliensis Spegazzini, 1889:558.
=*Asterina subcuticulosa* Cooke, 1889:81.
=*Asterella subcuticulosa* (Cooke) Saccardo, 1891:937.
=*Brefeldiella subcuticulosa* (Cooke) Theissen, 1912:16.

Description : Ascoma pelliculate, applanate, irregular to confluent, without mycelium, becoming darkly pigmented; paraphyses disintegrating at maturity, 95-180 µm; ascus, pyriform, 25 µm in length; ascospores hyaline, elliptical-clavate, 3-6 septate, 15-44 × 3-10 µm. Fig. 1

Notes : The ascospores of our collections are larger than those found in Australian collections (Reynolds and Gilbert 2005). Also, we did not find any associated asexual reproduction.

Specimens examined: PA083, PA084, PA085, PA109, PA115, PA136, PA166, PA171, PA198, PA248, PA291, PA304, PA329, PA330, PA331, PA336, PA351, PA399, PA417, PA418, PA442, PA444, PA445, PA446.

Capnodiaceae (Saccardo) Höhnel ex Theissen, 1916:363.

We found 2 ascomycete and two mitosporic genera in this family. The inclusion of monomorphic mitosporic and ascosporic fungi as well as pleomorphic genera and species in this family elaborates a concept of polyholomorphism in systematic mycology that was explored by Hughs (1971) and Reynolds and Taylor (1993)."Sooty mold" mitosporic taxa share morphological attributes of their phylogenetically associated sexual ascomycetes in the Capnodiaceae. The conidiomata is an upright structure developed from a superficial mycelium on living plant surfaces. Walls of mycelium and reproductive structures have dark brown to black pigments. The asexual sooty mold taxa have a common spore dispersal strategy. The mitospores form in a centrum that is predictably positioned in several stalk locations (Olejnik *et al.* 1999). The mitospores range from small, unicellular, hyaline mitospores to multiseptate, hyaline or darkly pigmented spores; ascospores vary similarly. Spores disperse via the canopy flow-through water and germinate quickly once dispersed.

***Conidiocarpus* Woronichin. in Jaczewski, 1917:743.**

***Conidiocarpus penzigii* Woronochin, 1926:250.**

Description : Conidiomata elongate, narrow, darkly pigmented, 200 - 1000 µm long, the midstalk conidiogenous swelling up to 50-80 µm wide and otherwise 10-15 µm. The mitospores are hyaline, ellipsoid, 5 µm × 1.5 µm.

Notes : We identify our collections as *Conidiocarpus*. Batista and Ciferri (1963b) maintain that Woronochin's (1926) description of *Conidiocarpus* was characterized by two different conidiomata: an elongate one and an oval and short one. Both morphs were present in our collections. They appear to represent different stages of fruit body development, while both produce mitospores. Hughes (1976) acknowledged both morphs in his redescription of the genus. One of us (Reynolds) examined Woronochin material from the V. L. Komarov Botanical Institute in St. Petersburg, Russia (Herbarium LE) and found no specimen of *C. penzigii*. We also found no specimens of *Conidiocarpus* in the Woronochin collections at the Georgian Academy of Sciences in Tbilisi, Republic of Georgia (Herbarium TBI).

Hughes (1971) interpreted single-spore isolation data from Yamamoto (1954) to link *Conidiocarpus* to *Scorias*, thus establishing a pleomorphic link of this mitotic fungus with *Scorias* as well as with *Phragmocapnias*. We examined Yomomoto specimens at the National Taiwan University (Herbarium NTUF) and reviewed his available original research material and determined that there was no apparent success in establishing a pleomorphic connection between *Conidiocarpus* and *Scorias* from single spore isolate cultures as might be infered from Yamamoto's (1954) report. The coincidence of the co-occurrence in Nature on the same mycelium of *Conidiocarpus* and *Phragmocapnias* reproductive structures was recognized by Hughes (1996) and was found in our collections from Australia (Reynolds and Gilbert 2005) as well as those at hand from Panama.
Specimens examined : PA082, PA146, PA201, PA201, PA291, PA418.

Fumiglobus gen. nov.
=*Asbolisia sensu* Batista, Nascimento and Ciferri. *in* Batista & Ciferri, 1963b:37.
Non *Asbolisia* Spegazzini, 1918:293.

Type species : ***Asbolisia citrina*** Batista, Nascimento & Ciferri, *in* Batista, 1959:38.
Type specimen : URM2743, Coll: 16 May 1956 by M. da Silva. Loc: Brasilia, F.D., Brazil.

Etyology : *Fumioglobus: fumeus*-a smoky wisp to refer to the *Capnodium*-like pigmentation; *globus* -rounded to indicate the characteristic shape of the conidiomata.

Description : *Mycelium superficiale, membranosum laxum, ex hyphis fuscus-brunneis, constrictis, compositum. Pycnostoma globosa ad subglobosa, glabrata. Mitosporae continuae, hyalinae, bacillae, ellipsoideae vel cylindricae.*

Mycelium superficial, sometimes becoming aerial, membranose or loosely formed, composed of dark-brown, blackish, constricted hyphae. Pycnothecium formed from several hyphae or from intercallary hyphal cells, globose to subglobose, glabrous; mitospores hyaline, continuous, and bacillate to ellipsoidal or cylindric.

***Fumiglobus ficina* (Batista, Nascimento & Ciferri) Reynolds & Gilbert nov. comb.**
= *Asbolisia ficina* Batista, Nascimento and Ciferri *in* Batista & Ciferri, 1963b:41

Description : *Conidiomata globose-depressed, glabrous, darkly pigmented, ostiolate, 855-100 µm; mitospores hyaline, continuous, 3-4 µm × 1-3 µm.*

This species is based on a P.C. Stanley collection in 1924 from the Canal Zone in Panama.

Notes : The nomenclatural status of the generic name *Asbolisia sensu* Batista, Nascimento and Ciferri (Batista & Ciferrib, 1963) and the related family name Asbolisiaceae is clearly in need of resolution (Hansford, 1946; Hughes, 1971). In an attempt to resolve the nomenclature of *Asbolisia*, Batista and Ciferri (1963b) reinterpreted Spegazzini's type specimen and description of the taxon. Still, Sutton (1977) and Petrak (1929) considered the name *Asbolisia* as 'dubious', and Kirk *et al.* (2001) declared the taxon a *nomen dubium*.

In further rectification, and even though we found a single example of the taxon, we propose the new name, *Fumiglobus*, for the genus *Asbolisia nomen confusum*. We have examined the specimens cited in Batista and Ciferri (1963b) and the Spegazzini material. We recognize the concept for the genus as defined by Batista and Ciferri (1963b). The family Asbolisiaceae *sensu* Batista and Ciferri (1963b) is not addressed here.

Batista & Ciferri (1963b) clearly define a distinct sooty mold genus that is found throughout the tropics. The typical sooty mold myceliuim of melinoid pigmentation. a pellicle forms that ranges in habit from flattened on the leaf surface and to having aerial hyphae. The fruit bodies are formed as intercallary or terminal structures from single or several hyphal cells. They become globose, glabrous, ostiolate structures producing an abundance of uncellular, hyaline, ellipsoid or cylindrical mitospores.

Batista & Ciferri (1963b) utilized *Asbolisia* as a definitive mitotic taxon in the sense implied by the common designation of 'sooty mold' and members of the Capnodiaceae. Kirk *et al.* (2001) noted, "They created the family Asbolisisiaceae for these mitosporic species of the Capnodiaceae with darkly pigmented mycelium and reproductive structures that characteristically occur on living plant surfaces." They excluded Spegazzini's type, *A. ampullula*, from the genus because of its putative synonomy with *Cicinnobella ampula* and

inadmissibly designated a Brazilian species, *A. citrina* Batista, Nascimento and Ciferri, as a 'Lectotypus.' Hughes (1976) concurred that *Asbolisia* was dubious, noting that Hansford (1946) regarded *Cicinnobella* species as the mitosporic component of hyperparasites of Dimeriaceae genera in the Pleosporales.

Specimen examined: PA356, URM4836 ex BPI (type), URM2470 (type).

Additional Fumiglobus species
Fumiglobus ampullula (Spegazzini) Reynolds & Gilbert *nov. comb.*
=*Asbolisia ampullula* (Spegazzini) Spegazzini 1918:293.
Fumiglobus citrina (Batista & Ciferri) Reynolds & Gilbert. *nov. comb.*
=*Asbolisia citrina* **Batista & Ciferri, 1963b:38.**
Fumiglobus didymopanacis (Batista, Nascimento & Ciferri) Reynolds & Gilbert *nov. comb.*
=*Asbolisia didymopanacis* Batista, Nascimento & Ciferri, *in* Batista & Ciferri, 1963b:40.
Fumiglobus foeda (Saccardo) Reynolds & Gilbert *nov. comb.*
=*Capnodium foeda* Saccardo, 1882:77
=*Apiosporium foeda* Saccardo, 1882:77
=*Asbolisia foeda* (Saccardo) Ciferri & Batista, *in* Batista & Ciferri, 1963b:42.
=*Chaetophoma foeda* Saccardo,1884:200.
=*Asbolisia citrina* Batista & Ciferri, *in* Batista & Ciferri, 1959:38.
Fumiglobus glabroides (F.L. Stevens) Reynolds & Gilbert *nov. comb.*
=*Asbolisia glabroides* (F.L. Stevens) Spegazzini 1918:293.
=*Meliola glabroides* F.L. Stevens, 1916:18.
Fumiglobus indica (Agarwal & Sharma) Reynolds & Gillbert *nov. comb.*
=*Asbolisia indica* G.P.Agarwal & N.D. Sharma, *in* Sharma & Agarwal, 1974:260.
Fumiglobus juniperina (Baccarini) (1917) Reynolds & Gilbert *nov. comb.*
=*Capnodium junperinum* Baccarini. *in* Saccardo, 1921:383.
=*Asbolisia juniperina* (Baccarini) Ciferri & Batista, *in* Batista & Ciferri, 1963b:43.
It was assumed to be a pleomorphic component of *Phragmocapnias juniperi*
Fumiglobus portoricensis (Spegazzini) Reynolds & Gilbert *nov. comb.*
=*Asbolisia portoricensis* Spegazzini,1924:362.

Excluded species
Asbolisia inocarpi Batista, *in* Batista & Ciferri,1963b:42.
This species (URM5690) is a *Polychaeton*.

An anamorphic status was indicated (sensu ICBN, 1999, Article 59) by Batista & Ciferri for *A. juniperi* in putative association with *Phragmocapnias juniperi* (Cooke) Theissen & Sydow 1917:480. [*sic* "(Phillips & Plowright) Clements & Shear"] *fide* Batista and Ciferri, 1962:43. The Index of Fungi (Kirk *et al.* 2005) cites a teleomorphic connection to *Aithaloderma* for *A. citrina, A. didymopacis, A. ficina, A. foeda, A. glabroides, A. indica, A. inocarpi, A. juniperina* and *A. portoricensis* although there is no documentation of these pleomorpic associations (P. Kirk, personal communication).

Limacinula (Saccardo) Höhnel emend. Reynolds 1971:1185.
Limacinula tenuis *(Earle) Saccardo & Trotter* 1913:65.
=*Antennularia tenuis* Earl, 1904:302
=*Phaeosacardinula tenuis* (Earle) Seaver & Chardon, 1926:39.
=*Tephrosticta ficina* Sydow, 1913:271.
=*Phaeosaccardinula ficina* (Sydow) Hansford, 1946:156.
=*Limacinia malloti* Rehm, 1913:395.

=*Phaeosaccardinula malloti* (Rehm) Theissen, *in* Theissen & Sydow, 1917:481.
=*Naetrocymbe depressum* Batista, 1951:154.
=*Naetrocymbe perparum* Batista, 1951:157.
=*Limacinula zantedeschiae* Batista & Ciferri, 1963:139.
=*Phaeopeltis sapotae* Batita, 1951:159.
=*Naetrocymbe mauritiae* Batista, 1951:155.
=*Naetrocymbe inspersum* Batista, 1951:157.
=*Limacinula samoensis* von Höhnel, 1909:1200.
=*Limacinula samoensis* von Höhnel, 1907:101. Not validly published; generic name not yet published. This species was incorrectly revised as *L. samoensis* von Höhnel (Reynolds, 1971).

Description: Ascocarp reddish brown, 200-500 µm diam.; ascospores hyaline, 6-7 transseptate, 35 µm × 6-9 µm, muriform.

Notes: The ascocarps of this taxon are typically collabent (Fig. 6). A superficial similarity with the ascomata typical of the Chaetothyriaceae derives from a circumcutious continuation of hyphal strands from the apical region of the fruit body. The chaetothyriaceous ascomata is appendaged with a covering shield comprised of a distinctive tissue, that continues onto the substratum. Bitancourt (1936) described the structure as adherent to the outer wall of the upper part of the ascomata. Batista & Ciferri (1957, 1962) refer to the structure as a "mycelial network or pellicle."

Specimens examined: PA336, NY(type); URM138, NY (Rehm Ascomycetes 1075); URM9232; URM279; URM6478; URM5531; URM7993; URM585.

Phragmocapnias Theissen and Sydow emend. Reynolds, Reynolds, 1979:421.
Phragmocapnias betle (Sydow & Butler) Theissen Sydow emend. Reynolds, 1979:425

Description: Ascoma mimimally stalked, ostiolate, 75-165 µm × 70-120 µm, with setae measuring 55-115 µm in length; ascus fissitunicate, 35-50 µm; ascospores hyaline, 3 (-5) septate, cylindrical to elliptical, 16-29 µm × 3-5 µm.

Notes: This species is similar to *Trichomerium* (Reynolds, 1982) and differs with a stalked, setose ascomata and more transsepta in the ascospores (Reynolds, 1979). The association with *Conidiocarpus* is a constant one.

Specimens examined: PA082, PA291, PA418, K (Isotype).

Chaetothyriaceae Hansford ex Barr, 1979:
Ciferriusia Batista, 1962:17.
Ciferriusia orientalis Batista & Costa. *in* Batista & Ciferri, 1962:17

Description: Ascomata globose-depressed, with a mycelical shield, 90-180 µm diameter, ostiolate; asci clavate, fissitunicate, paraphysate, 40-60 µm; ascospores clavate, 3-transversely septate, hyaline, 15-20 µm × 4-5 µm.

Notes: Batista and Ciferri (1962) distinguished this genus within their Chaetothyriaceae with nonsetose ascomata and hyalophragmiae ascospores. Arx and Müller (1975) placed *Ciferriusia* as a synomym of *Yatesula* Sydow (1917), which has muriform ascospores, and with *Ceramothyrium* Batista & Maia (Ciferri, 1956) *pro parte*. Sydow (1917) described *Yatesula calami* in a monotypic genus as a member of the "Microthyriacearum" from the Philippines and as having muriform ascospores. Batista & Ciferri (1962) defined *Ciferrusia* species as paraphysate and included both paraphysate and nonparaphysate species in

Ceramothyrium, which may have been the character on which Arx and Müller (1975) selected certain species to transfer to *Yatesula*. They also included the name *Ceramothyrium* Batista & Maia (non-*pro parte*) as a synonym of the Metacapnodiaceae genus *Limacinia* Neger (Johow, 1896).
Specimens examined: PA284, PA285, PA303, URM11203 (=BO16599).

Meliolaceae G.W. Martin ex Hansford, 1946:23.
Meliola Fries, 1825:111.

Meliola protii Stevens,1928:19.

Description: Capitate hypopodia alternate; mycelial setae scattered, straight to 250 µm with dentate tips; ascomata 225 µm diameter; ascospore 4-septate, 40-45 µm × 25 µm.

Notes: This name is the closest fit to the morphology of the *Meliola* species found in our collections. The Hansford (1961) generic concept is likely unreflective of speciation in this lineage. The premise he utilized organized *Meliola* species by the host plant family. As a result a very large number of species have been described by virtue of the same fungus being recognized on hosts in different families. There are no data in support of an obligate fungus - host relationship. Hansford made exceptions to this contrived rule with the recognition of some *Meliola* species in more than one family and the description of species for which the identity of the host is unknown.

Using Hansford's concept, 30 species have been described from Panama collections and an additional 26 species were reported as new records for the country. *M. protii* is also reported from Puerto Rico and British Guiana. The type specimen host is *Protium panamense* in the Burseraceae. Our collections were found on the Araceae, Annonaceae, and Moraceae. The mycelial setae are shorter than described in *M. protii* and the ascospores are slightly larger.
Specimens examined: PA202, PA239, PA386, PA459.

Micropeltidaceae Clements & Shear, 1931:100.

This family is characterized by a specialized, flattened, and inverted ascoma called a thyriothecium or scutullum. The basal plate of the thyriothecium, equivalent to a lower, outer wall plus ascogenous cells, is hyaline. Superficial mycelium may be present or not at maturity of the ascomata. The construction of the upper plate ranges from reticulate to plectenchmatic and parachymatic; if the component tissue is radiate or parallel it is at the periphery only. This contrasts with the Microthyriaceae where the construction of this layer is of parallel hyphae. Dehiscence is via a rounded pore or one that appears stellate or irregularly fractionated from further modification of the pore or a centralized nonporate spore dispersal area. The color of the ascomata has been described as black, black-green, brown, blue-black, blue-green, cinnamon, maroon-black, and olive. The multicellular ascospores are hyaline.

***Hansfordiopeltopsis* Farr, 1986:274.**
Hansfordiopeltopsis amazonensis Farr, 1986:275.

Description: Conidiomata blue-green, ostiolate, 150-380 µm; conidiophores flabellate; mitospores hyaline, bacillate, continuous, 5-6 µm × 1 µm. Fig. 2

Notes: The genus is distinguished from *Hansfordiopeltis* (Batista and Costa, 1956) by a lack of mycelium and the absence of conidiophores. The

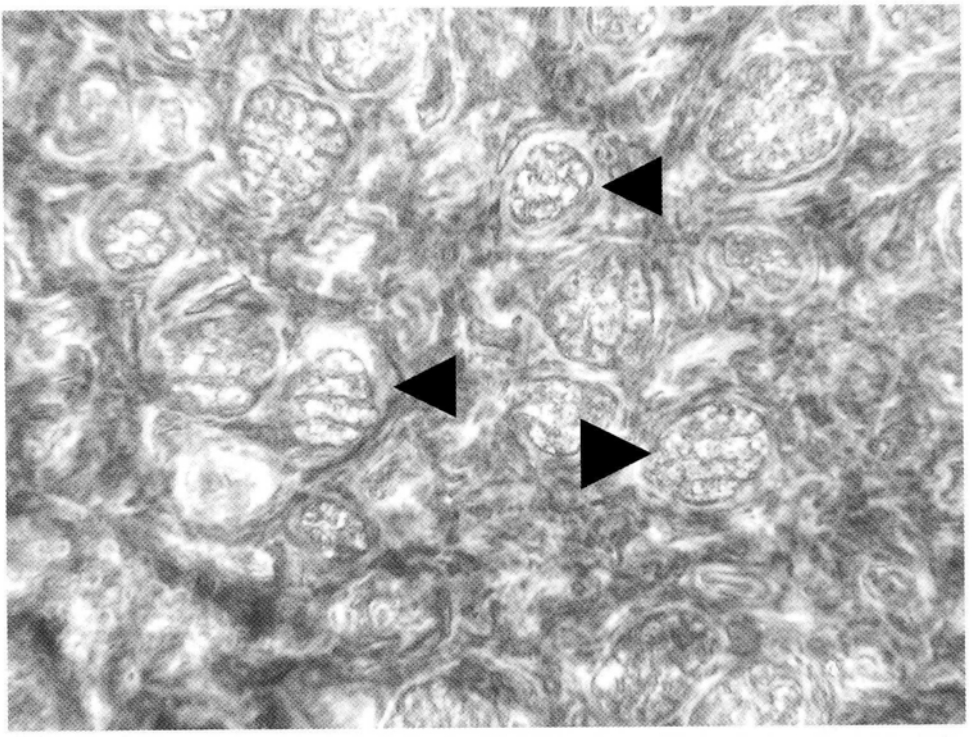

Fig. 2. Cyanodiscus glabrescens. PA331. The rounded asci (arrows) containing ascospores are visible on the ascomata surface. Bar = 45µ.

mycelium is sparce in our specimens. The ascomata and the mitospores are larger than described by Farr (1986). This taxon and other mitosporic species with an conidiomata construction similar to the Micropeltidaceae would be placed in the family Plenotrichaceae *fide* Batista and Ciferri (1959).

Specimens examined: PA192, PA193, PA206, PA295, PA298, PA330, PA360, PA375, PA412, PA422, PA426.

Micropeltis Montagne *in* R. de la Sagra, 1838:325. *sensu* Gómez-Ascosta, 1995.

=*Scolecopeltis* Spegazzini. 1889:574.
=*Scolecopeltis* Spegazzini emend,Toro. 1925:135.
=*Micropeltella* Sydow, 1913:404.
=*Parapeltella* Spegazzini, 1919:505.
=*Micropeltidium* Spegazzini, 1923:350.
=*Scolecopeltella* Spegazzini, 1923:354.
=*Scolecopeltidium* Stevens & Manter, 1925:282.

Since the description of the type species *Micropeltis applanata* Montagne (1842), 228 specific names have been proposed in the family. In a major review of the taxon, Batista (1959) recognized 89 species and 2 subspecies. Following Clements and Shear (1931), In organizing the Micropeltidaceae,

Batista (1959) placed the 33 genera that are "destituidos de micélio livre" (lacking free mycelium) into the subfamilies Dictyopeltoideae (those with blue-green ascomata) and the Haplopeltoideae (brown ascomata). The 12 genera with ascomata that mature within a "micélio livre" were placed in the subfamily Stomopeltoideae. Distinction of genera in the family was based on a combination of characters, including presence or absence an ostiole, setae, and periphyses.

Micropeltis was recognized by Batista (1959) as having a blue-green to brown thyriothecium with plectenchymatous construction, paraphysate asci, and multiseptate, hyaline ascospores. Distinction of species was based on variation of color of the thyriothecium, size of the ascothecium and ascospore length and width. We find the Gómez-Ascosta (1995) revision of the genus and several species from the Greater Antilles, including specimens from select type localities, to be a good, conservative approach to speciation in this taxon. Using historical and recently collected material, the genus was revised as: the thyriothecium forming without free mycelium, orbicular, dimidiate, blue-green with a central pore, with plectenquimatic, retulate or meanderform cellular construction. Paraphyses were described as hyaline, and few or abundant, sometimes forming a column in the central cavity of the ascomata. The ascus was determined to be "bitunicate", generally sacciform to elliptical, sissile or subsessile. The ascospores are hyaline, of variable form, and with multiple-transseptation. The revisionary emphasis was on ascospore shape as filiform or clavate, the number of septa, and corresponding size.

The synonomy for the revision of this taxon by Gómez-Ascosta (1995) included 8 genera and by implication their 302 named species. Of this number, 210 were described as new by Batista and his coworkers and 45 taxa were transferred from older authors.

This group of species recognized by Batista and coworkers is in need of revision. Ninty-two percent of the species were described from a single collection and most of them have not been reported in the literature since the initial report. The 210 Batista collections were made in the vicinity of Recife, Brazil, the location of his home institution, thus representing a sporadic sampling of a limited area.

The 24 collections of *Micropeltis* in our study were made from 8 hosts in 7 vascular plant families that were found within a 0.9-ha sample plot. We determined that there is little evidence for host specificity for these fungi from analysis of collections from sites in tropical Australia and Panama (Gilbert, Reynolds, and Bethancourt, *submitted manuscript*).The characters utilized by Batista to define the species were found to have a range of values in this sample rather than discrete, host-related recognition. The color and size of the ascocap, the shape of the ostiole, and the abundance of paraphyses were similarly variable.

The determination of a species epithet for our Panama material is somewhat arbitrary in that no attempt was made to review all available historical specimens. We relied on descriptions in the literature as well as herbarium material to interpret the data from our specimens. We mainly used the Saccardian ascospore characters to determine a useful name. We annotate similarities with other descriptions, thus suggesting a synonomy rather than formally proposing one. Where the species was recognized by Batista (1959) in a genus other than *Micropeltis*, a *nov. comb.* was made.

Micropeltis aspidiospermae Batista & Vital, *in* Batista 1959:71.

Description : Ascocomata blue-green with brown overlay, 375-425 µm, ostiole becoming stellate; ascus 40 µm; ascospores 3-4 septate, 30-35 µm × 3-4 µm, hyaline.

Notes : Our material differs from the original species description in having 3-4 septa rather than 2-3, and an ascospore width less than 5.5-11 µm. The closest species seems to be *M. hirtellaeana* Batista & Lima (Batista 1959:111) with fewer transsepta.

Specimens examined : PA315, PA334.

Micropeltis bambusina von Höhnel, 1909:322.

Description : Ascomata blueish, 175-350 µm, ostiolate becoming stellate; ascus 30-35 µm; ascospores hyaline, 3-4 septate, 15-28 µm × 5-6 µm.

Notes : This species is similar to *M. clava* Toro, *Micropeltis consimilis* Rhem (=*Micropeltella consimilis* (Rehm) Theissen), *M. hexaspora* Batista & H. Lima, *M. marginata* Montagne, *M. pseudo-ostiolata* Batista, (=*Micropeltella marginata* (Montagne) Batista) *M. subapplanata* Spegazzini (=*Parapeltella subapplanata* (Spegazzini) Batista), and *Micropeltidium cassicola* Batista.

Specimens examined : PA137, PA248, PA294, PA311, PA314, PA317, PA333, PA354.

Micropeltis bauhiniae Rehm, 1945. Leaflets of Philippine Botany 6:1945.

Description : Ascomata blueish, ostiolate, 125-35 µm; ascus 35 µm; ascospores hyaline, 3-4 septate, 10-40 µm × 5-6 µm.
Specimens examined : PA184, PA294.

Micropeltis bogorensis von Höhnel, 1912:346.

=*Micropeltella bogoriensis* (von Höhnel) Sydow

Description : Ascomata blue-green, ostiolate, 450-1000 µm; asci 128 µm in length; ascospores hyaline, 2-13 septate, 23-63 µm × 6-13 µm. Fig. 3

Specimens examined : PA115, PA123, PA142.

Micropeltis caesalpiniae F. Tassi, 1899:28.

Description : Ascomata blue-green, ostiolate becoming stellate, 100-200 µm; ascus 60 µm; ascospore hyaline, 1-2 septate, 10-12 µm × 5-6 µm.

Notes : This is one description that stands apart within the described *Micropeltis* species. The ascospores in our material are 2-3 septate vs. 4 septa in the original description and are a little wider. The species was described from the botanical garden in in Senensi, Italy. The host plant, *Cesalpinae gilliesii,* is a native of southern South America.

Specimens examined : PA318, PA359.

Micropeltis clavispora (Sydow) comb. nov

=*Micropeltella clavispora* Sydow, 1913:404.

Description : Ascomata 640 µm, maroon; ascus 100 µm; ascospores hyaline, 4-5 septate, 25-35 µm × 4 µm.

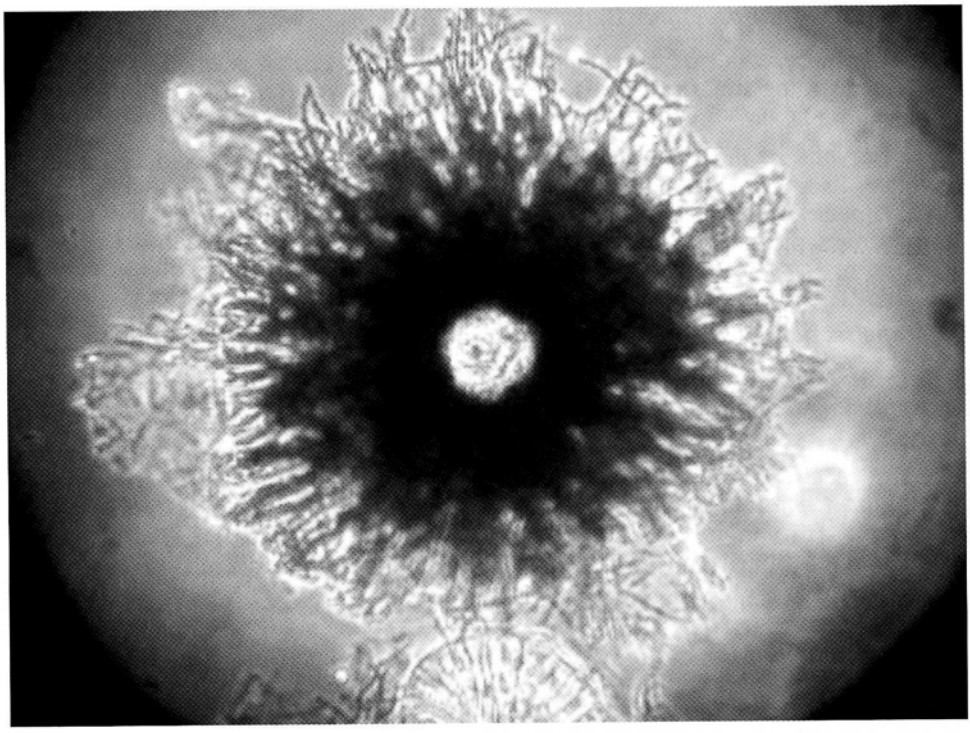

Fig. 3. *Micropeltis bogorensis.* PA142. The ascomata is rounded in this top view on a leaf surface; the ostiole is formed in an elevated central region. Note the absence of mycelium. Bar = 200 µ.

Notes : Our material differs from the original description with larger ascomata, and narrower ascospores. It is similar to *M. rhopaloides* Sydow, which also has wider ascospores.

Specimen examined : PA123, PA142, PA336

Micropeltis megasperma (Sydow) nov. comb.

=*Micropeltella megasperma* Sydow emend. Batista, 1959:161.
=*Dictyothyreilla megasperma* (Sydow) Stevens & Manter, 1925:273.

Description : Ascomata blue-green, ostiolate; ascus 170 µm; ascospores hyaline, 2 septate, 70 µm × 10 µm.

Notes : This species is similar to *Micropeltis hansfordii* Batista & Vital and *M. psychotriae* Batista.

Specimen examined : PA374.

Micropeltis semecarpa Sydow 1913:488.

=*Dictyothyriella semecarpi* (Sydow) Stevens & Manter 1925:273.

Description : Ascomata olivaceous-maroon, ostiolate; 425 µm; ascus 55 µm; ascospore hyaline, 1 sepate, 15 µm × 3-5 µm.

Specimens examined : PA104, PA163, PA174, PA193, PA312, PA412.

Setopeltis Batista and Vital, 1959:411.

Setopeltis perseae Batista & Vital *in* AC Batista 1959:411.

Description : Ascomata brown with dark ringed ostiole, setae 65 µm in length, 160 µm in diameter, with fringed edge; ascus 45 µm in length, paraphysate; ascospores hyaline, 1 septate, 13-15 µm × 5 µm.

Specimen examined : PA206.

Stomiopeltella Theissen, 1914:86.

Stomiopeltella caricis Siemaszko, 1925:271

=*Stomiopeltella coccolobicola* Batista, 1954:47.

Description : Mycelium persistent; ascomata maroon, 100-150 µm, ostiolate; ascus 45 µm; ascospore hyaline, 1 septate, 8 × 3 µm.

Specimen examined : PA130.

Microthyriaceae Saccardo, 1883:658.

Elachopeltella Batista and Cavalcanti, 1964:178.

Elachopeltella rubescens Farr, 1986:272.

Description : Pycnothecium upper plate brown hyphae radiate with component hyphae continuing individually as a fringe, ostiolate, 125-250 µm; phialides flask shaped, forming palisade on lower tissue layer of upper plate; mitospore hyaline, elongate, 6-8 × 2.5 µm.

Notes : The pycnothecial fringe formed by individual hyphae continue in a parallel pattern is more prominate in our material compared to the description by Batista and Cavalcanti (1963) and Farr (1986) for *E. rubescens*, both from Brazil. An ostiole forms in the densely pigmented center; the distinguishable individual hyphae continue in a parallel pattern to form an outer fringe. The conidiophores are prominent, flash-shaped. This mitosporic genus and others with a conidiomata construction similar to those in the Microthyriacee were placed in the family Pelasteraceae.

Specimens examined : PA121, PA130, PA137, PA280, PA356, PA396, PA431.

Saccardiaceae von Höhnel, 1909:95.

Cyanodiscus E. Müller & Farr, 1971:1081.

Cyanodiscus glabrescens Gómez-Acosta, 1997 [1998]:135.

Description : Ascomata 250-750 µm; ascus 45 µm in length, paraphysate; ascospores hyaline, 2-4 septate,7-25 µm × 3-6 µm. Fig. 4

Notes : *Cyandodiscus glabrescens* was described from Cuba (Gómez, 1977). There are two outstanding differences between this species and the original *C. occidentalis* (Müller & Farr 1971). The ascocarps range up to twice the diameter. In one collection (PA304) the characteristic blue-green pigmentation was absent, but the ascocarps were broadly sessile rather than stalked as in *Epibelonium* E. Müller. In *C. glabrescens* the ascospores are larger and the crosssepta range in number from 2 –11, whereas *C. occidentalis* was described with

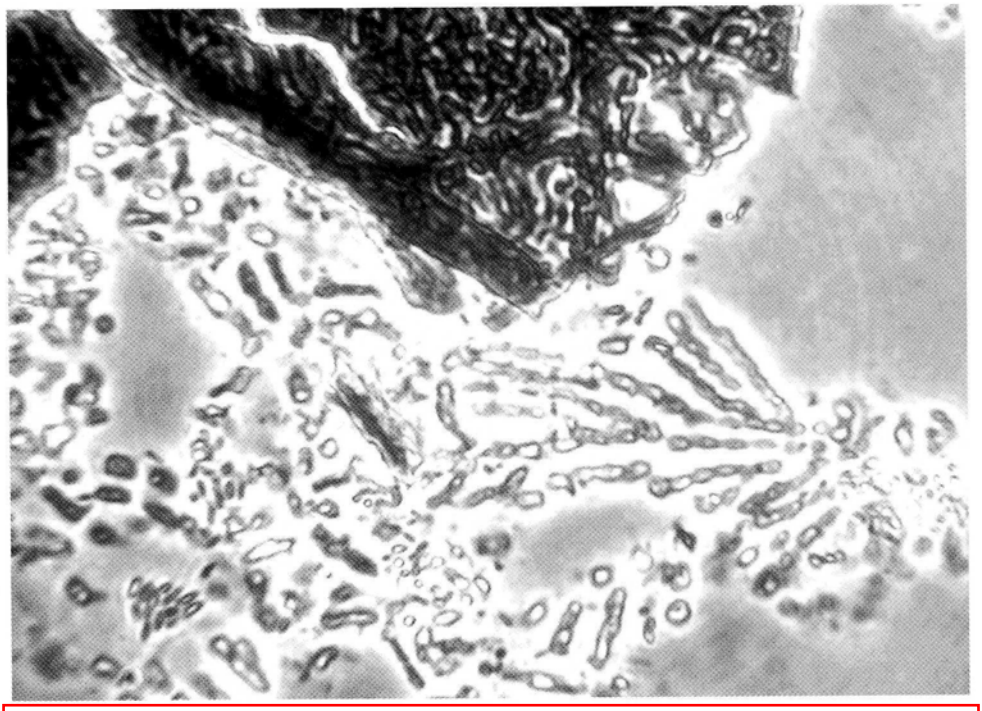

Fig. 4. Hansfordiopeltopsis amazonensis. PA130. The conidiophores are flabellate. Bar = 10µ. The arrows indicate asci with ascospores.

3 - 5 crossepta. However, the entire range of ascospore septation can be found collectively in several ascomata rather than in a single example.

Specimens examined: PA127, PA136, PA164, PA195, PA272, PA304, PA335, PA351, PA356, PA361, PA389.

Schizothyriaceae Höhnel ex Trotter, in Saccardo, 1928:1254

Metathyriella Sydow, 1927:96.

Metathyriella roupalae Sydow, 1927:96.

Description: Mycelium absent. Ascomata dimidiate, somewhat subcuticular, scutate, ovate, 125 - 175 µm; asci, 25 µm in length, paraphysate; ascospores hyaline, 3-septate, 12 × 5 µm.

Notes: The ascostromata in the original description measure up to 350 µm in diameter; the ascospores are described as 16 µm in length.

Specimens examined: PA128, PA129, PA186, PA193, PA194, PA229, PA304, PA444.

Plochmopeltis Theissen, 1914:87.

Plochmopeltis ellisii Arx, 1959:3.

Description : Ascoma, flat, shield shaped, rounded, dark brown, 450-800 µm; ascus 20-82 µm in length, developing from a colorless basal shield, formed on the cuticular surface, ellipsoid to globose, surrounded by longer upright paraphyses with branched, darkly pigmented tips; ascospores hyaline, 2-celled, 10-12 µm × 3-5 µm.

Notes : The ascospores of our species are slightly smaller in length than described for *P. ellisii.*

Specimens examined : PA101, PA129, PA351.

Vizellaceae Swartz, 1971:455.

The Viziellaceae was described by Swart (1971) with 2 genera. *Viziella* and its 15 recognized species, including two of Eocene age, was distinguished from the monotypic *Blasdalea* Saccardo & Sydow (1902) by an ascospore character. Arx & E. Müller (1975) included *Entopeltis* Höhnel in the family. *Viziella* species are subcuticular.

Vizella Saccardo, 1883:662. Sylloge Fungorum 2:662

The hyphae are characteristically dark banded at the septa. The brown ascospores have a conspicuous, traversely median hyaline band. Many species have a characteristic small, hyaline basal unicellular appendage.

Vizella royenae (Doidge) Arx & E. Müller, 1954:102.

=*Stigmatopeltis royenae* Doidge, 1927 Bothalia 2:232
=*Hypocelis costariencis* Petrak, 1929:27

Description : Ascomata subcuticular, dimidiate, 150-265 µm diameter, ostiolate at maturity; Asci 35-50 µm in length; ascospores brown, with horozontal band, 13-23 × 9-15 µm; the small basal appendage present in some species is not apparent here. Fig. 5.

Notes : This species is similar to *Vizella amazonica* Farr (1987). The ascospore's basal appendage is slightly larger in our material than that of Farr's species. We did not observe the association with the mitotic species, *Marginella oblongispora* Farr (1986), that Farr emphasized.

Specimens examined : PAN109, PAN144, PAN351, PAN359, PAN360, PAN433.

Mitotic Ascomycete

Cordella Spegazzini emend. Subramanian, 1962:38.

Cordella coniosporioides Spegazzini, 1886:210.

Description : Colonies linear, darkly pigmented on leaf surface; mitospores originate from short, brown, nonseptate, attenuated cells; conidia one-celled, dark brown, lenticular, circular in outline, smooth, 11-22 µm × 6-10 µm; peripheral rim is pale colored, appearing as a distinctive line in a side view. Mitospores are produced singly and acrogenously.

Notes : This is one of the most common species in our collections. As we found in the Australia collections, (Reynolds & Gilbert, 2005) the mitospores in our material are consistent with those of *C. coniosporioides*, but somewhat smaller

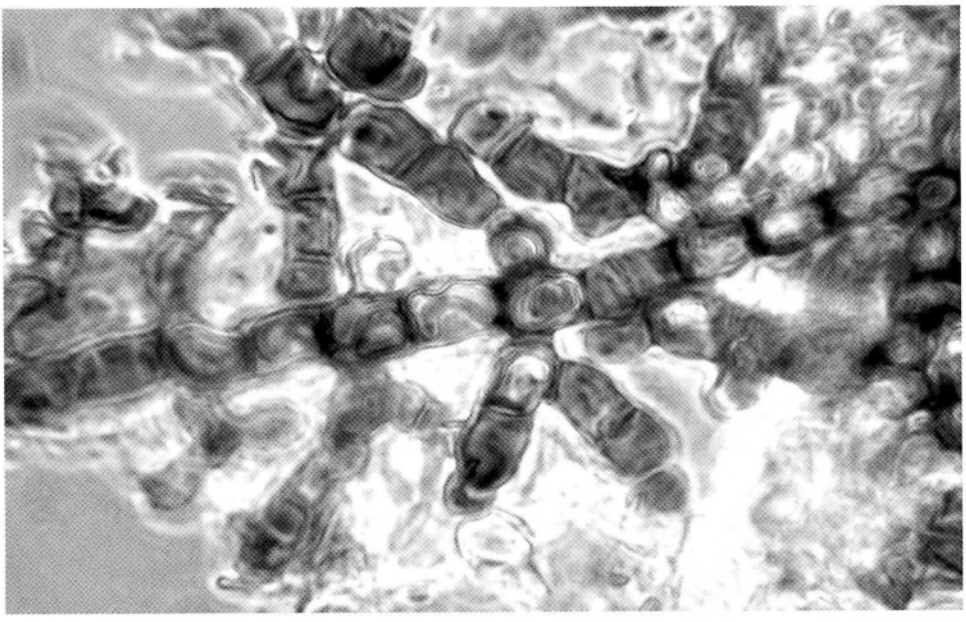

Fig. 5. *Vizella royenae*. PA144. Hyphal strands with thickened septa that appear as dark bands. Bar = 10 μ.

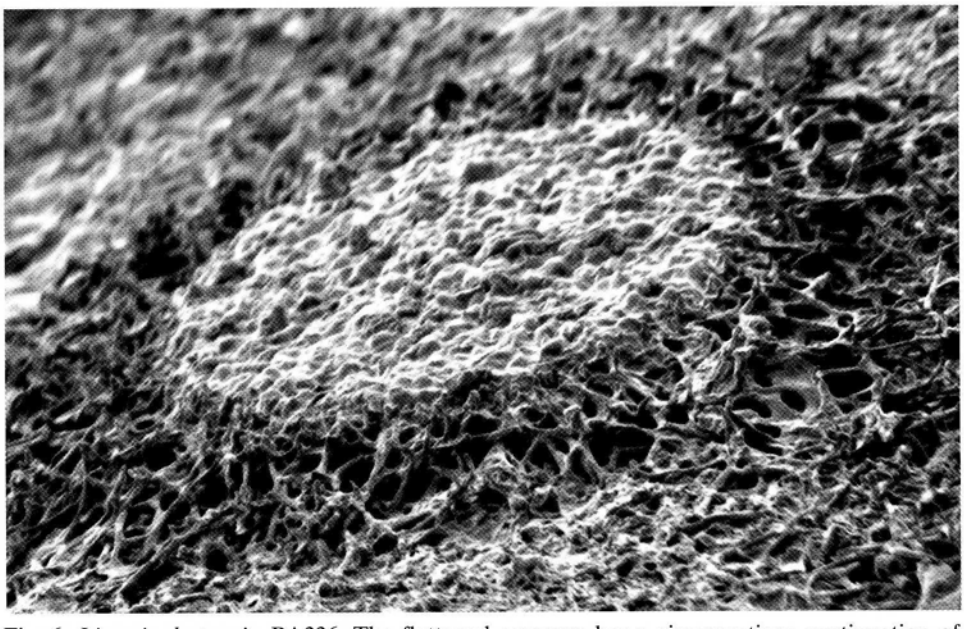

Fig. 6. *Limacinula tenuis*. PA336. The flattened ascocarp has a circumcutious continuation of hyphal strands from the apical edge that merge into the mycelium on the substratum.

than those described for *C. vinosa*. The conidiophores are formed only from hyphal cells with hyaline, multicellular, lanceolate structures observed in the outer areas.

Specimens examined: PA087, PA110, PA114, PA121, PA138, PA139, PA152, PA157, PA160, PA161, PA163, PA165, PA166, PA169, PA177, PA180, PA181, PA183, PA185, PA189, PA199, PA204, PA211, PA225, PA232, PA280, PA282, PA283, PA285, PA286, PA287, PA305, PA308, PA323, PA325, PA352, PA353, PA355, PA365, PA366, PA367, PA368, PA369, PA370, PA376, PA380, PA383, PA384, PA387, PA388, PA393, PA394, PA407, PA413, PA415, PA417, PA431, PA441.

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sp.; PA393, Araceae, *Monstera* sp.; PA394, Araceae, Aroid 1; PA396, Lauraceae, *Ocotea ira*; PA399, Malvaceae, *Theobroma bernoullii*; PA407, unknown, unknown opploop1; PA412, PA413, Clusiaceae, *Tovomita longifolia*; PA415, unknown, unknown; PA417, Convolvulaceae, *Maripa panamensis*; PA418, Apocynaceae, *Lamellea panamensis*; PA422, Celastraceae, Celastraceae unknown; PA426, unknown, Unknown wideveins1; PA431, Fabaceae, *Tachigali versicolor*; PA433, Sapindaceae, *Cupania scrobiculata*; PA441, PA442, PA444, PA445, PA446 Lauraceae, *Nectandra purpurea*; PA459, Moraceae, *Brosimum utile*

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K, East Pakistan, Dacca, *Piperis betle*, 5 April 1910, Coll: S. Som; URM138, NY (Rehm Ascomycetes 1075); URM279, Brazil, Pernambuco, Apipucos, 16 January 1948, Coll: A.F. Vital; URM585, Brazil, Pernambuco, Recife, 19 January 1948, Coll: A. Vital; URM11203(=BO16599), Philippines, Luzon, July 1916, Coll: A.D.E. Elmer; URM 2743, Brazil, Camaragibe, *Citrus limetta*, 16 May 1956. Coll: M. da Silva; URM2470, Brazil, Pernambuco, Recife, *Didymopanax morototoni*, 4 February 1956, Coll: S.J. da Silva;URM4836 ex BPI, Panama, Balboa, Canal Zone, *Ficus hemsleyana*, November – January 1924. Coll: P.C. Standley; URM5531, St. Thomas, Wasney's Crown Mt., 30 November 1952; URM5690 (ex UC15295), Tonga, Tongatabu Island, *Inocarpus*, June-August 1926, Coll: W.A. Setchell and H.E. Parks; URM6478, Brazil, Pernambuco, Recife, Coll. W.S. da Silva; URM7993, Brazil, Pernambuco, Paulista, 2 November 1957, Coll: S. Pires; URM9232, Brazil, Pernambuco, Recife.