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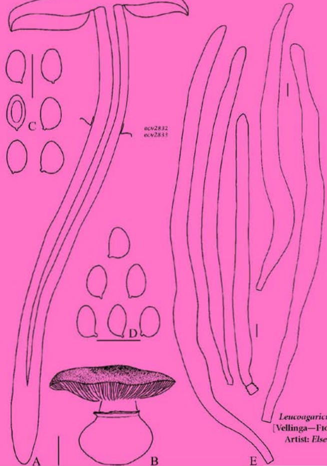

Leucoagaricus cupr
[Vellinga—FIGURE 7
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Type specimens in the Mycological Herbarium "Albert S. Muller" (VIA), Venezuela

Thamara Rojas, Denisse Caruso,
Ninoska Pons & Diego Diamont

trojas@inia.gob.ve
Instituto Nacional de Investigaciones Agrícolas
Centro Nacional de Investigaciones Agropecuarias
Departamento de Protección Vegetal, Maracay, 2101, Venezuela

Abstract — One hundred and ninety four type specimens held in the Mycological Herbarium "Albert S. Muller" (VIA) are listed. Ninety-eight relate to anamorphic fungi, 59 to *Ascomycota*, 36 to *Basidiomycota*, and one to *Oomycota*. The complete annotated collection list is available on: http://www.mycotaxon.com/resources/weblist.html.

Key words — Latin America, Neotropical fungi, reference collections

Introduction

The dried fungal reference collections in Latin America have been consistently neglected. Some important collections survive, but they remain little known even when holding valuable material, particularly type specimens that are essential in systematic research and the revision of taxa.

One example is the Mycological Herbarium "Albert S. Muller" (VIA) at the Instituto Nacional de Investigaciones Agrícolas of Venezuela. Founded in 1937, VIA remained inactive for almost 40 years (between 1941 and 1982) in the absence of systematic mycologists.

The reorganization of the herbarium, initiated in 1982, has involved several activities to fulfill basic requirements, such as finding an adequate space for the specimens, founding a library and a laboratory, and training of human resources. These tasks are still in progress.

An inventory of the original herbarium reveals that although much previously listed (Ciccarone 1948) material has been lost, some nomenclatural types remain among the specimens, including many from Venezuela.

An updated list of the VIA types is provided in this paper.

Materials and methods

Label information was recorded from all "type"-designated specimens. Original descriptions were scanned in order to confirm protologue data. When the literature associated with protologues was checked, some other holotypes and paratypes deposited in VIA and not previously labeled as "types" were detected.

Collections designated as "sp. nov." bearing names that could not be traced in the literature or in Index Fungorum (2008) are not included in the list. Holotype, isotype, lectotype, paratype, syntype, topotype, and similar terms have been included whenever this condition was clearly confirmed for the specimen, either on its label or in scanned related publications (electronic or printed). Information about hosts, collection sites, names of collectors, dates of collection and acronyms of reference collections holding duplicates are included.

The fungal taxa are systematically arranged in accordance with Index Fungorum (2008); abbreviations of authors of fungal names are given according to Kirk & Ansell (1992). Acronyms of reference collections follow Holmgren & Holmgren (2008).

Results

One hundred and ninety four type specimens are listed. Ninety-eight relate to anamorphic fungi, 59 belong to *Ascomycota*, 36 to *Basidiomycota,* and one to *Oomycota*. A summary is presented below, and the complete annotated specimen list is available on

http://www.mycotaxon.com/resources/weblist.html.

[Types from Venezuela are indicated by an asterisk (*).]

***Acremonium** exiguum*, ***Aecidium** hymenocallidis**, ***Anthracoidea** unciniae**, ***Antimanoa** grisleae**, ***Asteridiella** vilis* var. *caracacensis**, ***Asterina** orthosticha**, ***Asterinella** bredemeyerae**, ***Auerswaldiella** disciformis**;

***Bagnisiopsis** tovarensis**, *B. translucens**, ***Burrillia** sagittariae**;

Calothyrium** jahnii**, ***Cercospora** alabamensis*, *C. angolensis*, *C. apiicola**, *C. aragonensis*, *C. aurantia*, *C. batatas* Henn., *C. beticola*, *C. carbonacea*, *C. cordobensis*, *C. crotalariae* Syd.*, *C. curatellae**, *C. cyclantherae**, *C. cylindrata*, *C. dioscoreae-bulbiferae*, *C. ecliptae**, *C. fagopyri* Chupp & A.S. Mull.*, *C. fuchsiae**, *C. fusimaculans*, *C. hyptidicola**, *C. ipomoeae*, *C. ipomoeae-pedis-caprae*, *C. ipomoeae-purpureae*, *C. jaguarensis**, *C. lanugiflori**, *C. lonchitidis**, *C. marcelliana**, *C. melanotes**, *C. mirandensis**, *C. monochaeti**, *C. nubilosa*, *C. oldenlandiae*, *C. oxalidiphila**, *C. pachyderma*, *C. passifloricola**, *C. pittieri**, *C. poincianae**, *C. salpianthi**, *C. sorghi*, *C. spilosticta**, *C. stuckertiana*, *C. tokoroi*, *C. triumfettae**, *C. turbinae*, *C. uramensis**, *C. viridula*, *C. zeae-maydis*, ***Cercosporella** indica*, *C. ugandensis*, *C. yadavii*, ***Cercosporidium** venezuelanum**, ***Cicinnobella** heterothea**, ***Cintractia

oreoboli, ***Colletotrichum** jahnii**, ***Cordyceps** venezuelensis**, ***Creonectria** discostiolata**, *C. macrosporicola**, ***Cyclomyces** gigas**;

***Dactylaria** dioscoreae*, ***Dermatosorus** cyperi**, ***Diabolidium** calliandrae**, ***Dialacenium** cissi**, ***Dimeriellina** nervisequens**, ***Doassansia** epilobii*;

***Elsinoë** pruni**, ***Eutypella** aggregata**;

***Glabrotheca** aciculispora**, ***Glomerella** erythrinae**, ***Goplana** ribis-andicolae**;

***Hemidothis** pittieri**;

***Leptosphaeria** cryptica**, ***Leptosporella** lignicola**, ***Leptosporina** aciculospora**;

***Macrosporium** dioscoreae*, ***Melampsora** euphorbiae-geniculatae**, ***Meliola** venezuelana**, ***Mycosphaerella** erythrinicola**, *M. fijiensis*, *M. fijiensis* var. *difformis*, *M. pittieri**, *M. samaneae**, *M. venezuelensis**, ***Mycovellosiella** boldoae**, *M. deigtonii*, *M. fujikuroi*, ***Myrothecium** renaudii**;

***Oberwinkleria** anulata**, ***Oedothea** vismiae**, ***Ovulariopsis** passiflorae**;

Passalora** bunchosiae**, *P. caracasana**, *P. centrosematis**, *P. monninae**, *P. securidacae**, ***Pestalotia** palmarum*, ***Phaeoramularia** ciccaronei**, *P. rauvolfiae**, ***Phakopsora** randiae**, ***Phoma** heterospora*, *P. sacchari* Gutner, *P. saccharina*, ***Phomatospora** oyedaeae**, ***Phomatosporopsis** ingae**, ***Phyllachora** cedralensis**, *P. coutareae**, *P. deminuta**, *P. gelatinosa**, *P. panici-olivacei**, *P. pappophori**, *P. paritii-tiliacei**, *P. phari-latifoliae**, *P. saurauiicola**, *P. venezuelensis**, ***Phyllosticta** capparidis**, ***P. manihot, ***P. manihoticola***, ***P. manihotis***, ***P. sacchari***, ***P. saccharicola***, ***Pittierodothis** miconiae**, ***Plasmopara** venezuelana**, ***Polyrhizon** capparis**, ***Prospodium** araguatum**, *P. cumminsii**, ***Pseudocercospora** annonae-squamosae**, *P. blechi**, *P. conocarpi**, *P. durantae**, *P. pachirae**, *P. rhinocarpi**, *P. samaneae**, *P. struthanthi**, *P. tovariae**, ***Puccinia** chaetii**, *P. mirandensis**, *P. ponsae**, *P. waltheriae**, ***Pucciniopsis** anacardii**;

***Ragnhildiana** tranzschelii*, ***Ramularia** dioscoreae*, *R. ipomoeae*, ***Ravenelia** mirandensis**, *R. verrucata* var. *apurensis**;

***Schiffnerula** tovarensis**, *S. trematis**, ***Septoria** araguata**, *S. pittieriana**, *S. versicolor*, ***Sphaceloma** manihoticola*, ***Sphaeropsis** sacchari*, ***Sporidesmium** dioscoreae*, ***Sporisorium** absconditum**, *S. panici-hirticaulis**, *S. trachypogonis-plumosi**, ***Stenella** araguata**;

***Telimena** caudata**, ***Tilletia** brachypodii-mexicani**, ***Trabutia** saurauiae**;

***Uredo** combreti**, *U. lycoseridis**, *U. merremiae**, *U. monochaeti**, *U. paraphysata* F. Kern & Thurst. *, *U. pehriae**, *U. verruculosa**, ***Uromyces** tripsaci**, ***Ustilago** longiseti*, *U. shastensis*; and

***Xenomeris** eucalypti**.

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Marlyn Arana and Carla Figueroa are thanked for support in locating and photocopying literature and help in the search for information in electronic databases. The authors gratefully acknowledge José Carmine Dianese and David W. Minter for pre-submission review.

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Phallus roseus, first record from the neotropics

T. Ottoni B.S.[1], B.D.B. Silva[2],
E. Fazolino P.[2] & I.G. Baseia[1,2]

maraecobio@hotmail.com
[1] Programa de Pós-Graduação em Biologia de Fungos
Universidade Federal de Pernambuco, Depto. de Micologia
Cidade Universitária, CEP: 50670-901, Recife, PE, Brazil

baseia@pesquisador.cnpq.br
[2] Depto. Botânica, Ecologia e Zoologia
Universidade Federal do Rio Grande do Norte
Campus Universitário, CEP: 59072-970, Natal, RN, Brazil

Abstract — *Phallus roseus* is cited for the first time from the neotropics being found in the semi-arid Brazilian region. Detailed description and illustrations are presented.

Key words — *Phallaceae*, taxonomy, stinkhorn, fungi, Brazil

Introduction

The genus *Phallus* is the most representative of the family *Phallaceae* Corda with 25 species distributed worldwide (Calonge 2005). Eight species have been recorded for the neotropics: *Phallus atrovolvatus* Kreisel & Calonge (Calonge et al. 2005a), *P. galericulatus* (Möller) Kreisel (Rocabado el al. 2007), *P. glutinolens* (Möller) Kuntze (Trierveiler-Pereira et al. 2009), *P. hadriani* Vent. (Calonge et al. 2005b), *P. impudicus* L. (Calonge et al. 2005b), *P. indusiatus* Vent. (Calonge et al. 2005b, Rocabado el al. 2007, Baseia et al. 2006), *P. ravenelii* Berk. & M.A. Curtis (Calonge et al. 2005b), and *P. pygmaeus* Baseia (Baseia et al. 2003). Studies on *Phallus* from Brazil are few, and so far six species have been described from Brazil (Trierveiler-Pereira et al. 2009).

Phallus roseus was originally described from Egypt by Delile in 1813 (Dring 1964). Fischer included the species in the genus *Itajahya* Möller based on morphological characters such as the presence of a calyptra, a flat structure at the apex of the pileus. Later, Kreisel (1996) considered *Itajahya* as a subgenus of *Phallus*, given that it exhibits many common characteristics, such as the shape and configuration of the pileus surface, receptacle consistency, and gleba odor.

Material and methods

Field expeditions were conducted at the Estação Ecológica do Seridó, located at the district of Serra Negra do Norte, Rio Grande do Norte State, (6°33' – 6°37' S and 37°14' – 37°16' W), covering an area of 1,166.38 ha. Collections were made during the rainy period, between February and July 2008. The region presents a semi-arid climate with a xerophytic vegetation known as Caatinga. The annual rainfall is under 1,000 mm, normally with an amount between 250 and 800 mm distributed in a short period of 3–6 months (Velloso et al. 2002). The collection of *Phallus roseus* was photographed and examined in the field. The taxonomic study followed the techniques used by Miller & Miller (1988). Species identification was based on the following literature: Kreisel (1996), Baseia (2003), Calonge (2005), and Baseia et al. (2006). The terminology used followed that proposed by Kirk et al. (2008). Colour standardization was from Kornerup & Wanscher (1978). The spores were examined under a Phillips XL 30 scanning electron microscope (SEM) and a Motic BA200 optical microscope (OM). The collection was deposited in the UFRN herbarium.

Phallus roseus **Delile, Descr. Égypte, Hist. Nat. 2: 300. 1813.** FIG. 1

= *Itajahya rosea* (Delile) E. Fisch., Ber. Dtsch. Bot. Ges., 47: 294. 1929.

Egg subglobose or pyriform, 3–4 cm high by 2–2.5 cm wide, white to yellowish-brown (5A2), with developed rhizomorph. Basidioma 7–10 cm tall. Receptacle cylindrical, 1–1.5 cm tall and 2–2.5 cm wide, surface smooth. Pseudostipe pink (11A2), with remnants of exoperidium on the surface, spongy, hollow, cylindrical, 3–4.5 cm tall and 1.5–2 cm wide, formed by pseudoparenchymatous cells; calyptra pink (11A2) at the apex. Volva subglobose, with superficial layer constituted by pseudoparenchymatous cells; inner layer formed by hyphae. Gleba mucilaginous, olive (2F4). Spores elliptic, 3.0–3.5 × 1.8–2.0 µm; hyaline; smooth.

HABITAT: rocky soil with direct sun exposure.

MATERIAL EXAMINED: BRAZIL. RIO GRANDE DO NORTE: SERRA NEGRA DO NORTE. Estação Ecológica do Seridó, 06°35'02"S, 37°17'02"W, 202 m high, 23-V-2008, leg. *T. Ottoni*, 535 (UFRN), 800034 (URM).

DISTRIBUTION: Africa, Southern Yemen, North America, Southern France, Israel, India, and Pakistan (Dring 1964, Mornand 1986, Kreisel 1996, Kreisel & Al-Fatimi 2008).

TAXONOMIC REMARKS: The most diagnostic characteristics of *Phallus roseus* are the presence of a calyptra at the apex of the receptacle and a pink pseudostipe. The latter distinguishes *P. roseus* from *P. galericulatus*, which exhibits a white pseudostipe (Dring 1964 & Kreisel 2008). Fischer (1933) suggests that they belong to the same taxa. However, the taxonomic relationship between the two species is not yet well defined (Kreisel, 1996), a situation that calls for additional

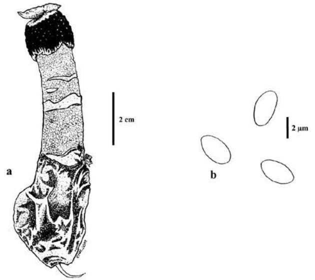

FIG. 1. *Phallus roseus*: a. basidioma; b. basidiospores.

molecular studies on the group. This is the first record of *P. roseus* from the neotropics.

Acknowledgment

We thank CNPq and PPBio for financial support; CTPETRO-INFRA and FINEP/LIEM for their collaboration with scanning electron microscopy. To Rhudson Henrrique S. F. Cruz for illustrations. Our special thanks to Hanns Kreisel and Maria Alice Neves for their critical comments and revisions.

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Tephromela follmannii (lichenized *Ascomycota*), a new species from the Canary Islands

Israel Pérez-Vargas*[1], Consuelo Hernández Padrón[1], Pedro L. Pérez de Paz[1] & John A. Elix[2]

ispeva@ull.es [1]
Dpto. de Biología Vegetal (Botánica), Universidad de La Laguna
c/ Astrofísico Sánchez s/n 38071 La Laguna, Tenerife, Canary Islands, Spain
[2]Research School of Chemistry, Building 33, Australian National University
Canberra ACT 0200, Australia

Abstract—*Tephromela follmannii*, found on basaltic rocks on the Canary Islands, is described as new to science. A description of the species is provided, together with notes on its chemistry, distribution, ecology, and taxonomy. Possible related taxa are discussed briefly.

Key words—biodiversity, Macaronesia

Introduction

The Canary Islands form part of Macaronesia, one of the world's biodiversity hotspots (Myers et al. 2000). The diverse lichen flora of the islands has more than 1500 species in an area of just 7447 km^2 (Hafellner 1995, 1999, 2002, 2005, 2008), and new species are still being discovered at frequent intervals (e.g. Elix & Schumm 2003, van den Boom & Vězda 2005, Pérez-Vargas et al. 2007, 2010a,b, Pérez-Vargas & Pérez de Paz 2009). In the present work we describe a new species of *Tephromela*.

The lichen genus *Tephromela* M. Choisy was resurrected by Hafellner to accommodate several species previously assigned to *Lecanora* (the *L. atra* s.l. complex), primarily on the basis of ascus structure, and placed in a new family, *Tephromelataceae*, within the *Lecanorales* (Hafellner 1984). However, the familial affiliation of this genus is unresolved, as recent molecular studies were inconclusive in deciding whether *Tephromela* should be included in the *Tephromelataceae* or assigned to the *Mycoblastaceae* (Miadlikowska et al. 2006, Arup et al. 2007). The genus includes approximately 40 species with arctic/alpine and temperate distributions in Australasia, Asia, Europe and

North America, and centers of speciation in tropical regions (Nash et al. 2004). *Tephromela follmannii* is closely related to the type species, *T. atra* (Huds.) Hafellner. However, the genus has not been monographed and some European morphotypes of *T. atra* remain poorly understood, as is the delimitation of *T. atra* from some extra-European species (Hafellner 2007). The lecideoid species were recently transferred to *Calvitimela* Hafellner on the basis of the ascomata and ascus type (Hafellner & Türk 2001). *Tephromela* is characterized by a poorly developed true exciple, the dark violaceous hymenium, *Bacidia*-type asci, simple or sparingly branched paraphyses and the occurrence of moniliform conidiogenous cells (Hafellner 1984, Nash et al. 2004).

Materials and methods

The morphology of the lichen specimens was examined using a Leica ZOOM 2000 or a Zeiss Stemi 2000C stereo-microscope. Sections for anatomical examination were cut by hand and mounted and observed in water. Anatomical structure and hymenial characters were studied with an Olympus CH light microscope. Chemical constituents were identified by thin layer chromatography using solvent systems A [benzene:dioxane: acetic acid, 180:45:5], B [hexane:methyl *tert.*-butyl ether:formic acid, 140:72:18] and C [toluene:acetic acid, 85:15] (Culberson 1972, Culberson & Johnson 1982, Elix & Ernst-Russell 1993), high performance liquid chromatography (Elix et al. 2003) and comparison with authentic samples. Specimens are deposited in TFC and CANB.

The species

Tephromela follmannii Pérez-Vargas, Hern.-Padr. & Elix, sp. nov. FIG. 1
MYCOBANK MB 515344

Tephromelae atrae *similis sed thallo crassiore, hymenium profundis et materia chimica differt. Thallus saxicola, albidus vel cremeus, 0.8–1.2 mm crassus. Apothecia usque ad 2(–3) mm in diametro, sessilia, margine thallino circumdata. Hymenium 150–180(–200) µm altum, violaceum. Asci clavati 60–65 × 10–15 µm, typum* Bacidia. *Ascosporae octonae, ellipsoideae, 10–11 × 6–7 µm. Materia chimica: atranorinum, acidum β-alectoronicum, acidum alectoronicum, acidum α-collatolicum, acidum β-collatolicum, acidum physodicum, acidum 4-O-methylphysodicum et substantia ignota.*

TYPE— Spain, Canary Islands, Tenerife, "Tiro del Guanche", El Teide National Park, on basaltic rocks, UTM: 334317/ 3122460, 2050 m alt., August 2006, C. Hernández & P. L. Pérez, TFC Lich: 6219 (TFC Lich-**holotype**, CANB-isotype).

ETYMOLOGY— The new species is named in honour of the German lichenologist, Prof. Dr. Gerhard Follmann, in recognition of his many contributions to Canarian lichenology and for his friendship.

Thallus saxicolous, areolate-bullate to verrucose, whitish to cream-coloured, 0.8–1.2 mm thick, lacking isidia and soredia. Cortex 15–25 µm thick, algal layer c. 40–60 µm thick; algal cells 10–12 µm wide; medulla white. Apothecia common, sessile, up to 2(–3) mm wide; disc concave or plane to slightly convex,

FIG. 1. *Tephromela follmannii*, part of holotype. Scale = 1 mm.

round, black, glossy and epruinose; thalline exciple prominent, persistent, smooth to folded over the disc, 180–225 µm wide; true exciple not apparent. Epihymenium dark violet; hymenium 150–180(–200) µm high, violet, I+ blue; subhymenium hyaline, 25–30 µm thick, hypothecium yellow-brown, 75–100 µm thick. Paraphyses stout, not or sparingly branched, mostly not anastomosing, 5–6 µm thick below (lumina c. 2 µm wide), 8–9 µm thick apically (lumina c. 3.5 µm wide). Asci of *Bacidia*-type, 8-spored, 60–65 × 10–15 µm. Ascospores ellipsoid, colourless, 10–11 × 6–7 µm. Pycnidia not seen.

CHEMISTRY— Atranorin (minor), β-alectoronic acid (minor or major), alectoronic acid (major or minor), α-collatolic acid (minor), β-collatolic acid (minor), physodic acid (trace), 4-*O*-methylphysodic acid (trace), unknown (minor).

ECOLOGY— *Tephromela follmannii* occurs on basaltic rocks on four of the Canary Islands. It exhibits considerable ecological plasticity but it appears to prefer moderate to high elevations. On Tenerife it was collected in the mountains of Teide National Park at 1900–2050 m, in "retamar", a montane shrub-dominated community. Phytosociologically this community belongs to *Spartocytisetum supranubii* Oberd. ex Esteve (Martín Osorio et al. 2007), with *Spartocytisus supranubius*, *Pterocephalus lasiospermus* and pine (*Pinus* *canariensis*) reafforestation. On La Palma *T. follmannii* grows at 550–2450 m in a *Pinus canariensis* forest (*Loto hillebrandii-Pinetum canariensis*, A. Santos) or in the high mountain in "codesar" (*Genisto benehoavensis-Adenocarpetum spartioidis* A. Santos (Del Arco Aguilar 2006)), with *Adenocarpus viscosus* subsp. *spartioides*, *Genista benehoavensis* and sporadically *Spartocytisus supranubius*, *Descurainia gilva*, or *Viola palmensis*. We have also collected this species on Gran Canaria at over 1000 m in a *Pinus canariensis* forest. Finally, on La Gomera *T. follmannii* was collected at 1100–1200 m alt., in an old pine plantation (*Pinus canariensis* and *P. radiata*) with *Erica arborea*, *Adenocarpus foliolosus*, *Chamaecytisus proliferus* and *Cistus* spp.

Additional specimens examined— **SPAIN, Canary Islands, Tenerife:** "El Boquete", El Teide National Park, on basaltic rocks, UTM: 335005/3121230, 2100 m alt., February 2006, C. Hernández & P. L. Pérez, TFC Lich: 6510 (duplicate in CANB); "Los Areneros", El Teide National Park, on basaltic rocks, UTM: 335330/3131162, 1900 m alt., August 2007, C. Hernández & P.L. Pérez, TFC Lich: 9025; **La Palma:** "Inmediaciones del Pico de Piedra Llana", Caldera de Taburiente National Park, on basaltic rocks, UTM: 222792/ 319279, 2320 m alt., November 2001, C. Hernández & P.L. Pérez, TFC Lich: 5311 (duplicate in CANB); "Cauce del barranco del Huanahuao", Caldera de Taburiente National Park, on basaltic rocks, UTM: 219650/ 317899, 550 m alt., January 2001, E. Muñoz & A Rebolé, TFC Lich: 3345; **Gran Canaria:** "Camino de Faneque, ca. Tamadaba", Pinar de Tamadaba, on basaltic rocks, 1000 m alt., April 1976, B. Méndez, TFC Lich: 118; **La Gomera:** "Laderas sobre Erquito", Garajonay National Park, on basaltic rocks, UTM: 277609/3111281, 1125 m alt., September, 2001, C. Hernández & P.L. Pérez, TFC Lich: 5035 (duplicate in CANB).

Discussion

The saxicolous *T. follmannii* is characterized by its thick, greyish cream, areolate-bullate to verrucose thallus, large, black apothecia, a thick hymenium, and by its complex chemistry.

This new species appears to be closely related to *T. atra*, and while it can resemble some well-developed saxicolous specimens of that species, it can be distinguished by the thicker verrucose thallus (0.8–1.2 mm vs. 0.3–0.5 mm thick), the thicker hymenium (150–200 µm vs. 50–60 µm), and more complex chemistry.

Morphologically, *T. follmannii* resembles the Australian *T. stenosporonica* Elix & Kalb, but the latter has a different chemistry, with the substitution of stenosporonic and colensoic acids for the depsidones present in most species of this group (α-collatolic and alectoronic acids). In addition, *T. stenosporonica* has white pruina along ridges and margins of the areolae (Elix & Kalb 2006).

Tephromela priestleyi (C.W. Dodge) Øvstedal, from Antarctica, has a similar hymenium, asci, and ascospores to *T. follmannii*, but it has a squamulose-placodioid thallus, larger apothecia (up to 3.5 mm wide), and simple chemistry (containing only atranorin) (Øvstedal & Lewis Smith 2009).

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MYCOTAXON

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Two new species of *Graphidaceae* (lichenized *Ascomycota*) from Brazil

Manuela Dal-Forno* & Sionara Eliasaro

manudalforno@hotmail.com
Depto. Botânica, Biológicas, Universidade Federal do Paraná
Cx. P. 19031, 81531-970, Curitiba, PR – Brazil

Abstract – *Phaeographis flavescens* and *Thalloloma pontalense* are described as new species. These species were found growing in restinga in Southern Brazil.

Key words – lichenized fungi, lichens, *Ostropales*, Paraná

Introduction

The family *Graphidaceae* Dumort. contains about 1000 species and is an important component of the lichen biota in tropical and subtropical regions (Staiger et al. 2006). During a survey of *Graphidaceae* in Paraná State, Southern Brazil, one new species of *Phaeographis* and one new species of *Thalloloma*, both with stictic acid, were encountered.

Phaeographis Müll. Arg. is a genus characterized by brown ascospores reacting I+ wine-red, generally inspersed hymenia, poorly developed and uncarbonized excipula and lirellae with exposed discs (Staiger 2002, Archer 2006, Cáceres 2007, Lücking & Rivas-Plata 2008).

Thalloloma Trevis. is characterized mainly by the ecorticate thallus and lirellae with brown or red exposed discs, hyaline ascospores reacting I+ violet, uncarbonized excipula and clear hymenia (Staiger 2002, Archer 2006, Cáceres 2007, Lücking & Rivas-Plata 2008).

The new species are described and illustrated below.

Materials and methods

The new species were described from specimens collected in a typical Brazilian coastal vegetation forest, known as restinga, in Paraná State, Southern Brazil. The

*Present address: Audubon Center of the North Woods,
PO BOX 530, Sandstone, MN, USA 55072

specimens were examined using standard stereoscopic and light microscopic techniques. Sections of thalli and ascomata were mounted in water, 10% KOH and Lugol's Solution. All measurements were made in water. Chemical constituents were identified by thin layer chromatography (Culberson & Ammann 1979, Elix & Ernst-Russell 1993) and by comparison with authentic samples.

Taxonomy

Phaeographis flavescens Dal-Forno & Eliasaro, **sp. nov.** FIG. 1

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Simile Phaeographis intricans *sed acidum sticticum continente differt.*

TYPE: **BRAZIL. PARANÁ: Pontal do Paraná.** PONTAL DO SUL, 28.II.2008, S25°34'11.1" W48°21'32.4", M. Dal-Forno 433 (**HOLOTYPE**–UPCB).

ETYMOLOGY: The specific epithet is derived from the Latin *flavus*, and it refers to the yellow color of the thallus after the application of potassium hydroxide solution.

Thallus corticolous, epiperidermal, continuous, 130–140 µm thick, with crystals; surface green to yellowish green, dull, smooth; corticate. Ascomata lirelliform, immersed in pseudostromata, flexuose, branched, 0.3–2.0 mm long, 0.2–0.3 mm wide, with small lateral cracks; disc exposed, grey with white pruina; pseudostromata conspicuous, pale yellow, distinctly raised from the thallus, 150–200 µm high, with crystals; labia entire; excipulum uncarbonized, 85–125 µm high, laterally rudimentary, base well developed, yellow, 25 µm high. Hymenium clear, 60–100 µm high, 125–175 µm wide, I–; paraphyses unbranched but with branched tips, filiform, 1.0–1.5 µm thick, hyaline, with brown tips; ascospores 8 per ascus, brown, I+ wine-red, ellipsoid, transversely (3–)5-septate, 21–25 × 6–7 µm.

CHEMISTRY: thallus K+ yellow, stictic acid and other stictic acid satellites present.

ADDITIONAL SPECIMENS EXAMINED – **BRAZIL. PARANÁ: Pontal do Paraná.** PONTAL DO SUL, 28.II.2008, S25°34'11.1" W48°21'32.4" M. Dal-Forno 336, 346, 371, 377 (UPCB).

COMMENTS – *Phaeographis flavescens* is characterized by immersed lirellae in a pale yellow prominent pseudostroma, with greyish white pruinose discs, an uncarbonized excipulum, a clear hymenium, brown, small and transversely 5-septate ascospores, and the presence of stictic acid and other related compounds.

This species is very similar to species in *Sarcographa* Fée, suggested by the formation of well defined stromatic clusters, conspicuously raised from the thallus, and by the chemistry. In addition, *Phaeographis flavescens* possesses small slits in the margins of the lirellae, which could be confused with the characteristic transverse fissures of *Sarcographa*. Despite these characteristics,

Figures 1–2: New species of *Graphidaceae* from Brazil. 1: *Phaeographis flavescens* (holotype, UPCB); 2: *Thalloloma pontalense* (holotype, UPCB); bars = 1 mm.

the brown ascospores reacting I+ wine-red, lirellae with exposed discs and the clear hymenia place the new species in the genus *Phaeographis*. The absence of carbonization in the exciple excludes the possibility of the new species being a species of *Sarcographa* or other related genus.

Sarcographa cuyabensis Redinger is very similar to *P. flavescens*, differing by the slightly smaller ascospores, (12–)15–18 µm long, and the indistinct pseudostroma (Redinger 1933).

Phaeographis intricans (Nyl.) Staiger closely resembles *P. flavescens*, differing only in the lichen compounds present: norstictic acid in *P. intricans* (Nylander 1863, Staiger 2002) and stictic acid and related compounds in *P. flavescens*.

Thalloloma pontalense **Dal-Forno & Eliasaro, sp. nov.** FIG. 2

MYCOBANK 513535

Simile Thalloloma anguinum *sed lirrelas latiores et acidum sticticum continente differt.*

TYPE: **BRAZIL. PARANÁ: Pontal do Paraná.** PONTAL DO SUL, 28.II.2008, S25°34'02.2" W48°22'01.8", M. Dal-Forno 592 (**HOLOTYPE**-UPCB).

ETYMOLOGY: The specific epithet is derived from the type locality, Pontal do Sul, Southern Brazil.

Thallus corticolous, epiperidermal, continuous, 40–70 µm high, with crystals; surface whitish pale grey, dull, smooth; corticate. Ascomata lirelliform, flexuose, unbranched to branched, immersed to erumpent, 0.8–1.0 mm long, 0.3–0.4 mm wide; disc exposed, pale brown pruinose; thalline margin laterally present, conspicuous, 200–225 µm high, 45–50 µm thick, extending beyond the hymenium and excipulum; labia entire; excipulum uncarbonized, 75–100 µm high, rudimentary. Hymenium clear, 75–100 µm high, 220–230 µm wide, I–; paraphyses branched and anastomosing, filiform, 1.0 µm thick, hyaline, with brown tips; ascospores 8 per ascus, hyaline to slightly brownish, I+ violet-blue, ellipsoid, muriform, 11–13 × 3–4-locular, 45–55 × 14–15 µm.

CHEMISTRY: thallus K+ yellow, stictic acid present.

ADDITIONAL SPECIMENS EXAMINED – **BRAZIL. PARANÁ: Pontal do Paraná.** PONTAL DO SUL, 28.II.2008, S25°34'02.2" W48°22'01.8" M. Dal-Forno 581 (UPCB).

COMMENTS – *Thalloloma pontalense* is characterized by the oblong to slightly elongated ascomata, not showing the typical shape of a lirella, with exposed, brown pruinose discs, muriform ascospores with 40–50 µm and presence of stictic acid.

Stictic acid is one of the most common lichen compounds found in the *Graphidaceae* (Staiger 2002) but it is uncommon in the genus *Thalloloma*. It occurs in *T. patulum* (A.W. Archer) A.W. Archer from the Solomon Islands (Archer 2007).

Thalloloma pontalense is very similar to *T. anguinum* (Mont.) Trevis., but differs in the shape of the lirellae, which are not very elongated, the presence of stictic acid, and the absence of lichexanthone. *Thalloloma pontalense* also has much wider ascomata, being 0.3–0.4 mm wide, whereas *T. anguinum* has lirellae 0.15–0.2 mm wide, exactly half the width, which in *Graphidaceae* is a significant difference. In addition, *Thalloloma pontalense* has a conspicuous thalline margin, extending 100 µm above the hymenium, whereas the thalline margin in *T. anguinum* is only present laterally, not extending beyond the level of the hymenium and excipulum.

Thalloloma pontalense is morphologically similar to a species found in Costa Rica, namely "*Thalloloma chroodiscoides*" (Sipman 2008). However, the later species has smaller ascospores, up to 26 µm long, and it lacks lichen compounds.

Thalloloma deplanatum (Nyl.) Staiger is also similar to *T. pontalense*, showing the same shape of ascomata and size of ascospores, but in *T. deplanatum* the thalline margin is less conspicuous, the excipulum has a double margin and the ascospores have only transverse septa.

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MYCOTAXON

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A new species of *Phlebia* (*Basidiomycetes*) from India

Avneet P. Singh*, Priyanka,
G.S. Dhingra & Nishi Singla

dhingragurpaul@gmail.com
Department of Botany, Punjabi University
Patiala 147 002

**Department of Biology, SD College*
Barnala 148 101

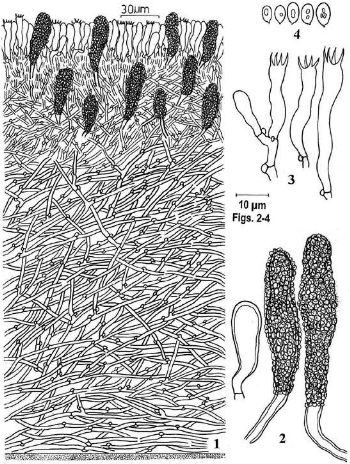
Abstract – A new corticioid species *Phlebia crassisubiculata* is described from Dalhousie hills (District Chamba) in Himachal Pradesh, India.

Key words – Banikhet, thick subiculum, large spores

During a mycological excursion in Dalhousie hills (Himachal Pradesh, India), Dhingra and Singla made a collection on the underside of a decaying gymnospermous stump. After detailed comparison of macroscopic and microscopic features with relevant literature (Dhingra 2005, Eriksson et al. 1981, Larsson & Hjortstam 1977, Parmasto 1968, Rattan 1977), it was found to be close to *Phlebia cremeoalutacea* (Parmasto) K.H. Larss. & Hjortstam. Characters in common were thick-walled encrusted cystidia and subclavate to clavate basidia. However, the subiculum in the newly described species was distinctly the thick compared with the thin subiculum in *Phlebia cremeoalutacea* and basidiospores were larger (5.1–6.8 × 2.8–4.5 µm) than those in the latter species (3.0–4.5 × 2.0–2.5 µm). A sample of the basidiocarp was sent to Prof. Nils Hallenberg, University of Gothenburg, Sweden, who supported the concept of a new species.

Phlebia crassisubiculata Avneet P. Singh, Priyanka, Dhingra & Singla, **sp. nov.**
MycoBank 515886 Figs 1–5

Basidiocarpum resupinatum, adnatum, effusum, ad 350 µm crassum; hymenium superficie laevigatum vel subtiliter pubescens, cremeum flavum, infuscatum in 3% KOH; systema hyphale monomiticum; hyphae ad 4 µm latae, ramosae, nodoso-septatae, tenuitunicatae vel paulo crassitunicatae; subiculum crassum, cum hyphis horizontalis; subhymenium augustum, de hyphis verticalis; cystidia 23–80 × 6.8–10.2 µm, subcylindrica vel subfusiformia, encrustata; basidia 23–40.3 × 5.1–6.2 µm, subclavata vel clavata, 4-



FIGS 1–4. Microscopic structures from basidiocarp of *Phlebia crassisubiculata*.
1. Section of basidiocarp; 2. cystidia; 3. basidia; 4. basidiospores.

sterigmata, ad basin fibuligera; basidisporae 5.1–6.8 × 2.8–4.5 µm, ellipsoidae, laeves, tenuitunicatae, multiguttatae.

TYPE: India, Himachal Pradesh: Chamba, 2 km from Dalhousie in direction to Banikhet, on decayed gymnosperm wood, Nishi 1405 (PUN, **holotype**), September 19, 1989.

ETYMOLOGY: Conspicuously thick subiculum.

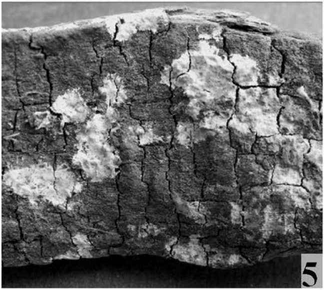


Fig. 5. *Phlebia crassisubiculata* basidiocarp.

Basidiocarps resupinate, arising as small colonies which may coalesce later on and become effused, adnate, up to 350 µm thick in section; hymenial surface smooth to finely pubescent under lens due to projecting cystidia, creamy yellow, darkening in 3% KOH; margins abrupt or indeterminately thinning, paler concolorous. Hyphal system monomitic; generative hyphae up to 4 µm wide, branched, septate, clamped, thin- to somewhat thick-walled; subicular zone very thick, of well developed horizontal hyphae running parallel to the substrate, followed by a narrow subhymenial zone of densely packed, vertical hyphae. Cystidia 23–80 × 6.8–10.2 µm, subcylindrical to subfusiform, encrusted with encrustation dissolving in 10% KOH, thick-walled, enclosed to somewhat projecting, pseudo-septa may be present. Basidia 23–40.3 × 5.1–6.2 µm, subclavate to clavate, thin- to somewhat thick-walled, 4-sterigmate, with a basal clamp; sterigmata up to 5.1 µm long. Basidiospores 5.1–6.8 × 2.8–4.5 µm, ellipsoid, smooth, thin-walled, inamyloid, acyanophilous, with oil droplets.

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Volvariella acystidiata (*Agaricomycetes*, *Pluteaceae*), an African species new to Europe, with two new combinations in *Volvariella*

Alfredo Vizzini[1]* & Marco Contu[2]

alfredo.vizzini@unito.it *

[1]*Dipartimento di Biologia Vegetale - Università degli Studi di Torino Viale Mattioli 25, I-10125, Torino, Italy*

[2]*Via Marmilla, 12 (I Gioielli 2), I-07026 Olbia (OT), Italy*

Abstract — *Volvariella acystidiata*, an African species belonging to the *V. gloiocephala*-complex, is firstly reported from Europe on the basis of a collection made in northern Sardinia. This species is easily recognized by its medium size, white overall colour, large, ellipsoid to ovoid basidiospores and the lack of cystidia of any kind. The study includes a description, a photograph of fresh basidiomes and line drawings of relevant micro-anatomic traits.

Key words — *Basidiomycota*, *Agaricales*, taxonomy, biodiversity

Introduction

During a field mycological study of a grassy, anthropically disturbed, coastal site near Golfo Aranci (northern Sardinia), basidiomes of a small, white *Volvariella* resembling the very common *V. gloiocephala* (DC.) Boekhout & Enderle 1986, were collected. They grew on graminaceous debris at the edge of an internal road of the Residence "L' Eucalyptus" in the La Marinella gulf. After a careful study of the macro- and microscopic features we concluded that they were to be ascribed to *V. acystidiata*, a central-African species of the *V. gloiocephala*-complex thus far known only from Zaire (Heinemann 1975, Pathak 1975). The aim of the paper is to provide a full description of this rare and little known species.

Materials and methods

The description of macro- and microscopical features is drawn from notes taken on fresh material. Microscopical observations were made from material mounted in distilled water, Melzer's reagent, and Congo red. Spore size is expressed both as a range and mean

* corresponding author

value based on 30 randomly chosen spores. Author citations follow the IPNI Authors and Index Fungorum Authors of Fungal Names websites. Herbarium abbreviations are according to Holmgren & Holmgren (1998). All examined material is housed at TO (Herbarium generale del Dipartimento di Biologia Vegetale, Università degli Studi di Torino, Italy).

The new combinations were deposited in MycoBank.

Taxonomy

Volvariella acystidiata N.C. Pathak, Bull. Jard. Bot. Natl. Belg. 45: 195 (1975).

Figs. 1-2

Pileus 20–30 mm broad, not very fleshy, convex expanding to plano-convex, slightly (obtusely) umbonate, glabrous, without patches from the universal veil, slightly sticky, but very soon dry and shiny, short-striate on the margin (up to 10 mm), white, tinged yellowish near the centre and pale pink towards the margin. Lamellae close to moderately close, broad, ventricose, free to rotundate, pale pink then salmon-pink, with uneven edges. Stipe 30–40 × 2–3 mm, central, not solid, stuffed then hollow, subequal or slightly enlarged downwards, but not really bulbous, glabrous, sericeous, white, dry. Volva saccate, but narrow and shallow, sheathing only the stipe base, thin, white, non-lobed. Context moderately thick in the centre of the pileus, thin towards the margin, soft, white, unchanging. Smell faint, raphanoid. Taste similar. Spore-print salmon-pink.

Basidiospores 10.5–16.5 × 7.5–10.5 µm, on average 14.5 × 10 µm, Q = 1.4–1.6, pale pink, ovoid to ellipsoid, thick-walled, with several oil-drops, inamyloid, smooth, with a prominent apiculus (Fig. 2a). Basidia 45–70 × 10–13.5 µm, 2–4-spored, clavate (Fig. 2b); sterigmata up to 1.5 µm long; subhymenium cellular. Hymenophoral trama inversely bilateral, made up of hyaline, thin-walled, cylindrical hyphae. Cheilo- and pleurocystidia absent. Pileipellis a cutis of variously twisted hyphae, up to 7.5 µm wide, slightly gelatinized in the suprapellis (Fig. 2c). Clamp-connections absent everywhere. Thromboplerous hyphae not seen.

Habitat. Firstly recorded from central Africa (Zaire) on dry forest soil and dung; in Sardinia collected among graminaceous debris on sandy, grassy soil, not far from the sea. In autumn and winter.

Distribution. Known with certainty only from central Africa (Zaire) and Italy (Sardinia). Probably also present elsewhere, but possibly misidentified as *V. gloiocephala* f. *speciosa*, a very common agaric, generally considered unworthy of study.

Material studied: ITALY: Sardinia, prov. Olbia-Tempio P., Golfo Aranci, loc. Golfo di Marinella, in grassy, sandy soil, on graminaceous debris (*Poaceae*), 2.XI.2009, leg. A. Vizzini and M. Contu (TO HG1973).

FIGURE 1. *Volvariella acystidiata*. Basidiomes (TO HG1973). Scale bar = 20 mm

Discussion

On describing *Volvariella acystidiata*, Pathak (1975) provided only a very short Latin diagnosis and presented no illustrations of either gross or micro-anatomical features. Shortly thereafter, Heinemann (1975) supplied a more detailed description of the species in French, regrettably based only on the poorly preserved type collection. A colour plate of the species can be found in Heinemann (1975: pl. XIV, fig. 1).

Doubtlessly, *V. acystidiata* belongs to the *V. gloiocephala* complex based on its very large basidiospores and slightly sticky pileus surface, but it is easily separated from the white form of *V. gloiocephala*, viz. f. *speciosa* (Fr.) Contu 1998, by the complete lack of cheilo- and pleurocystidia. We carefully examined all four specimens in our collection for the possible occurrence of even an occasional hymenial sterile element, but we were not able to find any. *V. gloiocephala*, by contrast, shows many large, versiform, clavate, ventricose to subfusiform cystidia, on both face and edge of lamellae (Shaffer 1957 as "*Volvariella speciosa* (Fr.) Sing."; Orton 1974, 1986; Boekhout 1990; Boekhout & Enderle 1986). Another white species of the *V. gloiocephala* complex, *V. cookei* Contu 1998, also shares an only slightly sticky pileus surface and a white volva, but it is readily distinguished by its conspicuous cystidia, which are clavate with a very long and thin appendage, and the smaller basidiospores (Contu 1998, 2004).

Other white, medium-sized species of *Volvariella* are *V. nivea* T.H. Li & Xiang-L. Chen 2009 (Li et al. 2009), *V. nauseosa* (see below), *V. strangulata* (see below), and *V. pusilla* (Pers.) Singer 1951. However, they are easily distinguished

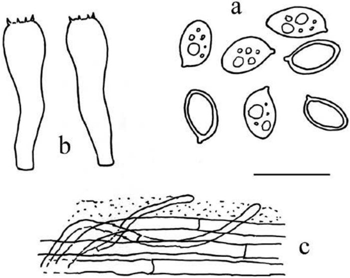

FIGURE 2. *Volvariella acystidiata*. Microscopical features (TO HG1973).
a. Basidiospores. **b**. Basidia. **c**. Pileipellis. Scale bar = 20 µm

especially by the obvious, well-developed cystidia and smaller basidiospores.

The diminutive members of the genus also showing white tinges to the pileus are even more easily separated by their smaller basidiospores and occurrence of cystidia (Shaffer 1957; Orton 1974, 1986; Heinemann 1978; Boekhout 1986, 1990; Boekhout & Enderle 1986).

New combinations in *Volvariella* Speg.

Volvariella nauseosa (Romagn.) Vizzini & Contu, **comb. nov.**

MycoBank MB 515695

Basionym: *Volvaria nauseosa* Romagn., Rev. Mycol. (Paris) 2: 93 (1937).

This very rare species has been recently collected in Slovenia (mat. in herb. priv. M. Contu). It is distinguished by the mainly fusiform cystidia and a spore size bigger than that of *V. pusilla*; otherwise it is very similar in habit.

Volvariella strangulata (Romagn.) Vizzini & Contu, **comb. nov.**

MycoBank MB 515696

Basiomym: *Volvaria strangulata* Romagn., Bull. trimest. Soc. Mycol. Fr. 94(4): 371 (1979, "1978").

Moser (2001) published a recent Austrian record of this rather uncommon agaric with a colour photograph depicting fresh basidiomes. M.C. had the chance to study an Italian collection made by Ledo Setti (fragm. in herb. priv. M. Contu) that agrees perfectly with the protologue (Romagnesi 1979).

Acknowledgements

Our most sincere thanks are due to Prof. G. Moreno (Univ. Alcalá de Henares, Madrid, Spain) and to Prof. E. Grilli (Popoli, Italy) for their pre-submission reviews.

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Taxonomic assessment of some pyronemataceous fungi from China

Wen-Ying Zhuang

zhuangwy@im.ac.cn
Key Laboratory of Systematic Mycology and Lichenology Laboratory
Institute of Microbiology, Chinese Academy of Sciences, Beijing 100101, China

Abstract — Four new species of the *Pyronemataceae*, *Aleuria medogensis*, *Cheilymenia sinensis*, *Otidea bicolor*, and *Scutellinia setosiopsis*, are described and illustrated. A name change is required for the previously published *Pulvinula guizhouensis*. *Psilopezia nummularialis* and *Smardaea verrucispora* are reported for the first time from China. Comments are made on nine other previously recorded taxa, *Cheilymenia vitellina*, *Humaria semi-immersa*, *Lamprospora haemastigma*, *L. wisconsinensis*, *Otidea abietina*, *Psilopezia deligata*, *Pulvinula laeterubra*, *Trichophaea bullata*, and *T. pseudogregaria*, all of which should be excluded from the Chinese fungus flora.

Key words — *Aleuria*, *Cheilymenia*, *Otidea*, *Scutellinia*, new Chinese records, corrections

Introduction

Early records of the pyronemataceous fungi from China date from Teng's first report on discomycetes (Teng 1934), in which 5 species of the genera *Pyronema* Carus, *Pulvinula* Boud. [as *Psilopezia* Berk.], *Scutellinia* (Cooke) Lambotte [as "*Patella* Weber"], and *Cheilymenia* Boud. [as *Patella*] were recorded. Species of *Lamprospora* De Not., *Melastiza* Boud. and *Sphaerosporella* (Svrček) Svrček & Kubička [as "*Sphaerospora* Sacc."] were later added, and a total of 12 species were known from the country five years later (Teng 1939). Teng's major contribution to taxonomy of the group was summarized in the eminent work "Fungi of China" (Teng 1963, 1996), where 25 taxa belonging to 11 genera were included with diagnostic features, habit, and the known distribution in the country for each species, and in which taxa of *Aleuria* Fuckel, *Geopora* Harkn. [as "*Sepultaria* (Cooke) Lambotte"], *Geopyxis* (Pers.) Sacc., and *Otidea* (Pers.) Bonord. were further recognized. Information about *Pyronemataceae* in China was updated in "Sylloge Fungorum Sinicorum" (Tai 1979), including 40 species of 14 genera with related references, distribution, and habit. Beginning in the 1980's, studies on this fungal group have flourished. Regional floras and detailed treatments of some genera in this family have been published more recently, significantly extending our knowledge of species diversity in China (Wang & Zang 1983; Korf & Zhuang 1984, 1985, 1987; Liu & Cao 1987; Zhuang & Korf 1989; Cao et al. 1990a,b; Zhang 1990; Liu 1991; Zhuang 1994, 2001, 2005, 2006, 2009; Liu & Peng 1996; Zang 1996; Wang 1998; Zhuang & Wang 1998a,b; Yu et al. 2000; Wang & Pei 2001; Zhuang & Yang 2008). Meanwhile, efforts are underway to publish a volume on *Pyronemataceae* as part of the FLORA FUNGORUM SINICORUM. Taxonomic and nomenclatural problems have been encountered and solved, and progress has been achieved. More than 120 taxa belonging 35 genera are recorded thus far. In this study, four species in *Aleuria*, *Cheilymenia*, *Otidea* and *Scutellinia* are described as new to science, attention is called to the requirement for the name change of a previously published taxon, two species are reported for the first time from China, and comments are made on nine previously recorded taxa that should be excluded from the Chinese fungus flora.

Material and methods

Historical specimens of the pyronemataceous fungi from China on deposit in the Mycological Herbarium, Chinese Academy of Sciences (HMAS) and Herbarium of Cryptogams, Kunming Institute of Botany, Chinese Academy of Sciences (HKAS) were re-examined. Recent collections of the family made in 1988–2009 from various areas of China were also identified. Apothecia were rehydrated and sectioned on a freezing microtome (YD-1508A, Yidi Medical Instrument Co., Jinhua, China) at a thickness of 20–25 µm. Measurements were taken from sections mounted in cotton blue-lactophenol solution and from squash mounts in the same medium. For SEM study of the spore surface morphology, a piece of hymenium was cut and attached directly to a stub. The materials were coated with gold-palladium and observed with SEM (FEI Quanta 200). Photographs were taken with a digital camera (Canon G5, Tokyo, Japan) connected to a Zeiss Axioskop 2 plus microscope.

Results and discussion

New species

Aleuria medogensis W.Y. Zhuang, **sp. nov.** FIGS. 1A–B, 3A, 5A

MYCOBANK MB 516515

Apotheciis in siccitate 7–20 mm diam.; ascis J–, 230–267 × 11–13 µm; ascosporis ellipsoideis vel oblongo-ellipsoideis, 15–18(–19) × 7.5–9 µm, superficie hemisphaerice tuberculatis, 0.7–1.8 µm diam.

HOLOTYPE: CHINA. Tibet, Medog, on duff and soil, 20 Aug 1982, X.L. Mao 135, HMAS 53470 (previously filed as *Melastiza chateri*).

ETYMOLOGY: Referring to the place where the fungus was first collected.

Dried apothecia discoid, sessile, 7–20 mm diameter, hymenium surface orange-brown to brown, receptacle surface concolorous, nearly smooth; short cell protrusions arising from the outermost cells of the ectal excipulum, subcylindrical, hyaline, smooth-walled, very short, 15–50 µm long and 5–7.5 µm wide; ectal excipulum of textura angularis, 30–50 µm thick, cells isodiametric or subellipsoid, hyaline, thin-walled, 8–31 × 7–24 µm or 9–20 µm diameter; medullary excipulum of textura intricata, 280–520 µm thick or thicker, hyphae hyaline, thin-walled, 2–4 µm wide; subhymenium ca 20 µm thick; hymenium 260–280 µm thick; asci operculate, 8-spored, subcylindrical, J– in Melzer's reagent with or without KOH pretreatment, 230–267 × 11–13 µm; ascospores ellipsoid to oblong-ellipsoid, hyaline, unicellular, with separate warts on surface, eguttulate, uniseriate, 15–18(–19) × 7.5–9 µm, spore markings hemispherical, solitary, occasionally 2–3 interconnected, densely distributed, 0.7–1.8 µm wide and 0.5–0.8(–1) µm high; paraphyses filiform, very slightly enlarged at apex, 3–5 µm wide at apex, 2 µm wide below.

NOTES: Among the known species of *Aleuria* (Rifai 1968, Thind & Waraitch 1971, Moravec 1972, 1994; Reid et al. 1981, Häffner 1993), *A. tectipus* (Spooner) W.Y. Zhuang & Korf is the most similar to *Aleuria medogensis* in width of asci and size of ascospores as well as presence of separate warts on the spore surface. *A. tectipus* differs in paler apothecia which are much smaller (up to 6.5 mm diam. when fresh), with shorter asci (160–180 × 11–13 µm), and uni- to biguttulate ascospores with much larger spore ornamentations (3–4 µm diam. and 1.5–3 µm high) (Reid et al. 1981). *Melastiza boudieri* (Höhn.) Le Gal is somewhat similar to *A. medogensis* in ascospore length and the warted spore surface, but it differs significantly in the brownish and longer hairs (70–250 × 9–16 µm), wider ascospores [(15–)16.5–19.5(–21) × 9.2–12.5(–15) µm], spore markings connected by fine crests and larger hemispherical markings (1.5–3(–4.5) µm diam.), and much smaller apothecia only 3–7 mm diam. when fresh (Moravec 1994).

Cheilymenia sinensis W.Y. Zhuang, **sp. nov.** FIGS. 1C–E, 3B, 5B, 6A

MYCOBANK MB 516516

Apotheciis discoideis, 1.5–4 mm diam., hymeniis luteis vel pallide persicino-flavis, receptaculis hirsutis; ascis J–, 167–216 × 10–12.5 µm; ascosporis ellipsoideis, eguttulatis, 14–16.5 × 8–10.5 µm.

HOLOTYPE: CHINA. Sichuan, Daocheng, 3900 m, on yak dung, 4 Jul 1998, Z. Wang 34, HMAS 75942 (previously filed as *Cheilymenia coprinaria*).

ETYMOLOGY: Referring to the country where the fungus was first collected.

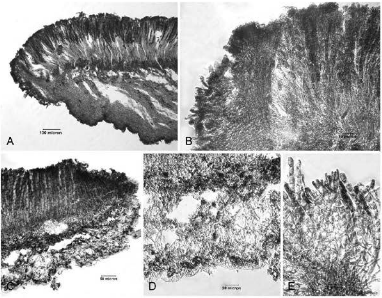

FIG. 1. Morphology of *Aleuria medogensis* and *Cheilymenia sinensis*. A–B. *Aleuria medogensis* (HMAS 53470). A. Anatomy of apothecium. B. Structure of apothecium at margin. C–E. *Cheilymenia sinensis* (HMAS 188412). C. Anatomy of apothecium. D. Structure of ectal excipulum. E. Portion of hymenium.

Apothecia discoid, sessile, 1.5–4 mm in diameter, hymenium surface orange-yellow to light pinkish yellow, receptacle lighter than hymenium, surface covered with setae arising from inner cells of excipulum, brown to light brown, with 1–2 rootlets at base, mostly with 4–9 septa, 180–500 × 18–33, walls 2–5 µm thick; ectal excipulum of textura angularis, 50–165 µm thick, cells nearly isodiametric, walls of outermost cells somewhat brownish and of inner ones subhyaline, 23–51 × 12–30 µm or 13–55 µm diameter if isodiametric; medullary excipulum of textura intricata, 38–115 µm thick, hyphae hyaline, thin-walled, 2.5–9 µm wide; subhymenium not clearly distinguishable, 0–20 µm thick; hymenium 185–203 µm thick; asci operculate, 8-spored, subcylindrical, J– in Melzer's reagent with or without KOH pretreatment, 167–216 × 10–12.5 µm; ascospores rectangular-ellipsoid, broadly ellipsoid to ellipsoid, with ends blunt, eguttulate, with contents refractive, sometimes with a de Bary bubble, surface very minutely granulate, 14–16.5 × 8–10.5 µm; paraphyses filiform, slightly wider at apex, 3.5–4.5 µm wide at apex and 2 µm wide below.

PARATYPES: CHINA. Qinghai, Ledu, 2800 m, on cow dung, 11 Aug 2004, W. Y. Zhuang & C. Y. Liu 5259, HMAS 188412; Qinghai, Datong, alt. 3000 m, on cow dung, 17 Aug 2004, W. Y. Zhuang 5388-1, HMAS 188413.

NOTES: Among the known species of *Cheilymenia* (Moravec 2005), *C. coprinaria* (Cooke) Boud. resembles the new species in length of ascospores, length of asci, and color of hymenium, but it produces somewhat larger apothecia [(2–)3–7(–10) mm diam.], much longer hairs (150–800(–1050) × 15–35(–45) µm], and a base that is bifurcate or (usually) multifurcate rather than having 1–2 rootlets. It also has wider asci (135–23 × 12–15 µm), narrower ascospores [(12.5–)13.5–17(–19) × (6.8–)7.5–9.2(–10.8) µm], densely distributed spore ornamentations, and obviously enlarged paraphysis apices (4.5–7.5(–9) µm wide).

Cheilymenia dennisii J. Moravec is somewhat similar to *C. sinensis* in size of apothecia, shape of ascospores, and size of setae, but differs in having much wider asci (170–240 × (13.5–)15–18 µm), larger spores [(14.5–)15.5–19.5(–21) × (8–)9.5–12.2(–13.5) µm] with higher and denser spore ornamentations, as well as wider paraphyses of a different shape and 6–10(–12) µm wide at apex (Moravec 2005). The ascospore surface morphology (SEM) of *Cheilymenia sinensis* is also similar to that of *C. magnipila* J. Moravec, but the two species differ significantly in many other aspects (Moravec 2005).

Otidea bicolor W.Y. Zhuang & Zhu L. Yang, **sp. nov.** FIGS. 2A–C, 4, 5C

MYCOBANK MB 516517

Apotheciis cupulatis, fissilibus, brevistipitatis, hymeniis leviter aurantiacis vel luteis, receptaculis leviter violaceis-brunneis; ascis J–, 140–182 × 9–10.5 µm; ascosporis ellipsoideis, biguttulatis, 10–12 × 5.5–6 µm.

HOLOTYPE: CHINA. Yunnan, Kunming, Heilongtan Park, on the ground among fallen conifer needles in mixed conifer and broadleaf tree forest, 16 Aug 2008, Z. L. Yang 5156, HKAS 54453 **holotype**; HMAS 188415 (isotype).

ETYMOLOGY: Referring to significant color difference between hymenium and receptacle surface.

Apothecia deep-cupulate with a split down to the base, short-stipitate, truncate, 10–22 mm wide when dry, hymenium surface light dirty orange to beige when fresh, receptacle surface light vinaceous brown or brown with a purplish tint when fresh, nearly smooth to minutely granulate; ectal excipulum of texture angularis mixed with textura globulosa, with small pustules on the surface and a few very short hyphal protrusions, 35–60 µm thick (excluding pustules), cells angular to subglobose, subhyaline, thin-walled, 8–23 µm diameter or 15–23 × 10–18 µm, pustules 20–60 µm high, cells in pustules commonly isodiametric, 8–18 µm diameter; medullary excipulum of textura intricata, 300–1400 µm thick, hyphae hyaline, thin-walled, 3.5–12.5 µm wide; subhymenium not clearly distinguishable; hymenium 150–160 µm thick; asci subcylindrical, operculate,

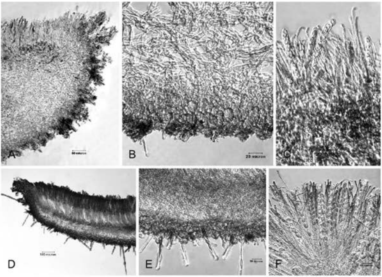

FIG. 2. Morphology of *Otidea bicolor* and *Scutellinia setosiopsis*. A–C. *Otidea bicolor* (HKAS 54453). A. Anatomy of apothecium near margin. B. Structure of excipulum. C. Asci and paraphysis apices. D–F. *Scutellinia setosiopsis* (HMAS 76074). D. Anatomy of apothecium. E. Structure of excipulum. F. Asci and paraphyses.

8-spored, J– in Melzer's reagent with or without KOH pretreatment, 140–182 × 9–10.5 µm; ascospores ellipsoid, smooth-walled, hyaline, unicellular, biguttulate, uniseriate, 10–12 × 5.5–6 µm; paraphyses filiform, curved or circinate at apex, septate, 2.5–3.5 µm wide at apex, 1.8–2.5 µm below.

NOTES: This species is characterized by the combination of deep-cupulate apothecia with a split down to the base, significant color difference between the light dirty orange to beige hymenium surface and light vinaceous brown receptacle surface, which looks minutely granulate, and smooth-walled, 10–12 × 5.5–6 µm ascospores.

Among the known species of the genus, *Otidea sinensis* J.Z. Cao & L. Fan is possibly the closest and most similar species to *O. bicolor*. Both species show significant color contrast between the surface of the hymenium and of the receptacle and the size of asci and of ascospores are similar; they differ in apothecial color and shape and excipular structure. The former has broad-spathulate apothecia with a maize yellow disc and amber brown receptacle

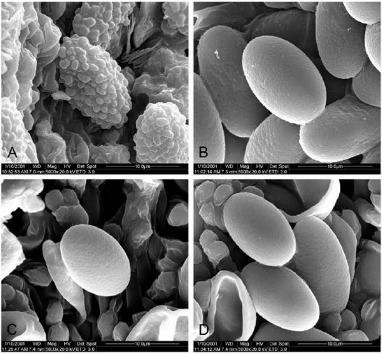

FIG. 3. SEM of ascospore surface morphology. A. *Aleuria medogensis*, from HMAS 53470. B. *Cheilymenia sinensis*, from HMAS 188412. C–D. *Scutellinia setosiopsis*, from HMAS 76074.

surface in fresh condition, cells of pustules commonly elongate and arranged in chains like those of *Helvella* species with a villose receptacle surface, and wider paraphyses (Cao et al. 1990a).

When apothecial shape and color contrast between disc and receptacle surface are considered, *Otidea grandis* (Pers.) Rehm is also similar, but differs obviously in the yellow hymenium and grayish brown to yellowish gray receptacle, ascospores that are elongate-ellipsoid to fusoid-ellipsoid, 14–17 × 6–7 μm, and have irregular crests on the spore surface (Boudier 1905–1911, Kanouse 1949, Liu & Zhuang 2006). *Otidea yunnanensis* (B. Liu & J.Z. Cao) W.Y. Zhuang & C.Y. Liu has a similar disc color, but possesses a spathulate apothecium with a long, tough, warm brown stalk and a brown to grayish brown receptacle surface lacking any purplish tint and larger ascospores 16.5–20 × 7.6–10 μm with spine-like ornamentations (Liu & Cao 1987, Liu & Zhuang 2006).

FIG. 4. Apothecia of *Otidea bicolor* on natural substrate, from HKAS 54453.

Scutellinia setosiopsis W.Y. Zhuang, **sp. nov.** FIGS. 2D–F, 3C–D, 5D, 6B

MYCOBANK MB 516518

Apotheciis discoideis, sessilibus, 3–5 mm in diam., hymeniis vitellinis, receptaculis hirsutis; pili setosis, brunneis, 55–820 × 11–25 µm; ascis J–, 218–274 × 10–12.7 µm; ascosporis ellipsoideis, 1(–2)-guttulatis, (13–)14–17.5 × 7.5–9.5(–10) µm.

HOLOTYPE: CHINA. Beijing, Dongling Mountains, on rotten wood, 4 Sept 1999, Z. Wang 320, HMAS 76074 (previously filed as *Cheilymenia* sp.).

ETYMOLOGY: Referring to the similar spore surface morphology to *Scutellinia setosa*.

Apothecia discoid, sessile, 3–5 mm in diameter, margin thin and distinct, hymenium surface egg-yellow when fresh and dirty orange to brown when dry, receptacle surface covered by brown setae arising from inner cells of excipulum or from brown and thick-walled outer cells, with 0–1–2(–3) rootlets, brown, 2- to multi-septate, mostly 55–820 µm long, 11–25 µm wide, walls 2–4.5 µm thick, with very short and light brown hairs with a blunt apex that are scattered at the apothecial base; ectal excipulum of textura angularis, 60–75 µm thick, cells angular to subglobose, subhyaline to light brown, 10–25 µm diameter or 18–38 × 9–33 µm, walls 1–1.3 µm thick; medullary excipulum of textura intricata, 50–100 µm thick, hyphae subhyaline, thin-walled, 2.5–7.5 µm wide; subhymenium not distinguishable; hymenium 240–255 µm thick; asci

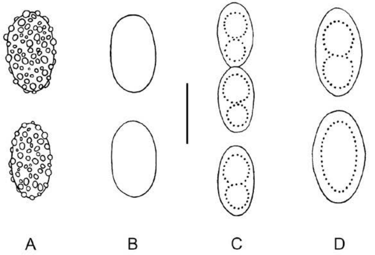

Fig. 5. Ascospore morphology.
A. *Aleuria medogensis*, from HMAS 53470. B. *Cheilymenia sinensis*, from HMAS 188412.
C. *Otidea bicolor*, from HKAS 54453. D. *Scutellinia setosiopsis*, from HMAS 76074.
Scale bar = 10 μm.

subcylindrical, operculate, 8-spored, J– in Melzer's reagent with or without KOH pretreatment, 218–274 × 10–12.7 μm; ascospores ellipsoid, surface nearly smooth, hyaline, unicellular, with 1–2 guttules, uniseriate, (13–)14–17.5 × 7.5–9.5(–10) μm; paraphyses filiform, very slightly enlarged at apex, 2.5–3.8 μm wide at apex, 2 μm wide below.

Notes: Among taxa of *Scutellinia* possessing nearly smooth-walled ascospores under the light microscope, *S. setosa* (Nees) Kuntze and *S. setosissima* Le Gal (Schumacher 1990) are similar to *S. setosiopsis*. *Scutellinia setosa* differs from the new species in smaller apothecia (1–2.5 mm diam.) with reddish to red brown hymenium, longer and wider hairs (450–880 × 15–30 μm), larger ectal excipular cells (20–60 μm diam.), and larger ascospores (17.8–20.6 × 10.2–12.4 μm). *Scutellinia setosissima* is characterized by a hymenium surface that is ochraceous white when dry, longer and wider setae (450–1250 × 25–35 μm), wider asci (195–240 × 12.8–16.5 μm), much larger ascospores (17.8–23.5 × 9.8–13.2 μm), and enlarged paraphysis apices 6–10 μm wide. The new species is characterized by the combination of yellow hymenium, narrow hairs 11–25 μm wide, and nearly smooth-walled ascospores (13–)14–17.5 × 7.5–9.5(–10) μm, which make it distinctive in the genus.

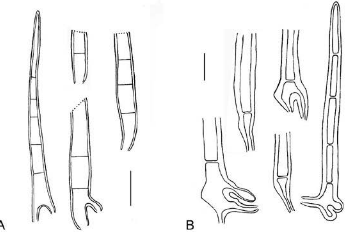

FIG. 6. Hair morphology.
A. *Cheilymenia sinensis*, from HMAS 188412. B. *Scutellinia setosiopsis*, from HMAS 76074.
Scale bars: A = 50 μm, B = 20 μm.

Name change for a previously published taxon

Pulvinula guizhouensis M.H. Liu, Acta Mycol. Sinica 10: 187, 1991.
= ***Pulvinula globifera*** (Berk. & M.A. Curtis) Le Gal,
Prodr. Flore Mycol. Madagascar 4: 94, 1953.

SPECIMEN EXAMINED: CHINA. Guizhou, Suiyang, alt. 1450 m, on sandy soil in broadleaf forest, 11 Aug 1987, M. H. Liu 1017 (holotype of *Pulvinula guizhouensis*); HMAS 97546 (isotype).

OTHER SPECIMENS EXAMINED: CHINA. Yunnan, Jizushan, on the ground, 12 Sept 1938, H. S. Yao, HMAS 17131 (previously filed as *Lamprospora wisconsinensis*); Yunnan, Kunming, on the ground, 13 Oct 1938, C. C. Cheo, HMAS 17132 (previously filed as *Lamprospora wisconsinensis*); Beijing, Qinghuayuan, on the ground, L. Shi, May 1935, HMAS 17133 (previously filed as *Lamprospora* sp.).

NOTES: Re-examination of the holotype of *Pulvinula guizhouensis* (LMH 1017) and consultation of the original description of the fungus (Liu 1991) indicate that it is identical to *P. globifera* as described by Rifai (1968). The latter name has the priority and is the correct name for the fungus.

New records for China

Psilopezia nummularialis Pfister & Cand., Mycotaxon 13: 367, 1981.

SPECIMENS EXAMINED: CHINA. China, Hubei, Wufeng County, Houhe Nature Reserve, alt. 800 m, on rotten bark, 12 Sept 2004, W. Y. Zhuang & C. Y. Liu 5528, 5530, 5531, HMAS 173269, 173270, 173271.

Smardaea verrucispora (Donadini & Monier) Benkert, Zeit. Mykol. 71: 148, 2005.

SPECIMEN EXAMINED: CHINA. China, Yunnan, Kunming, Xishan, on the ground, 14 Jul 1938, C. C. Cheo, HMAS 17134 (previously filed as *Lamprospora* sp.).

Previously recorded species that should be excluded from the Chinese fungus flora

Cheilymenia vitellina (Pers.) Dennis, British Cup-fungi and Their Allies p. 27, 1960.

CHINESE RECORD: Zhuang, Fungi of Northwestern China, p. 104, 2005.

NOTES: The Chinese record of *Cheilymenia vitellina* was based on a single collection (HMAS 83254) from northwestern China labelled as *C. vitellina* on deposit in the Mycological Herbarium, Institute of Microbiology, Chinese Academy of Sciences (Zhuang 2005). Re-examination of the material reveals that it possesses all the features of the genus *Tricharina* Eckblad (Yang & Korf 1985), such as apothecia cupulate, semi-immersed in soil, broadly attached to substrate, hairs arising from surface cells of ectal excipulum and not rooting at base, and 8 ascospores almost completely filling the ascus. The previous Chinese record of *C. vitellina* is based on a misidentification.

Humaria semi-immersa (P. Karst.) Sacc., Syll. Fung. 8: 143, 1889.

≡ *Sepultariella semi-immersa* (P. Karst.) Kutorga, Lietuvos Grybai (Vilnius) 3(5): 188, 2000, nom. provis.

CHINESE RECORD: Tai, Sylloge Fungorum Sinicorum, p. 159, 1979.

NOTES: The true *Humaria semi-immersa* is no longer considered to be a member of *Humaria* Fuckel in the current sense (Korf 1973) and has been transferred provisionally to a new genus *Sepultariella* Kutorga nom. provis. (Kutorga 2000). Dr. E. Kutorga kindly provided the following information based on his examination of the type material of this fungus: this species is affiliated with a *Peziza* (*Leucoscypha*) species or related fungi and its ascospores are (1–)2-guttulate (Kutorga pers commun).

The Chinese record of *Humaria semi-immersa* was based on the collections so labelled and deposited in HMAS (Tai 1979). Re-examinations of all specimens filed under this name (HMAS 12163, 17269, 33723) show that they belong to the genera *Geopora* and *Cheilymenia*. The previous record of *H. semi-immersa* is based on misidentifications.

Lamprospora haemastigma (Hedw.) Seaver, Mycologia 6: 17, 1914.

CHINESE RECORD: Teng, Fungi of China, p. 287, 1963.

NOTES: The taxonomic viewpoint on *Pulvinula* by Pfister (1976) is followed here, and *Pulvinula haemastigma* is treated as a nomen confusum.

Teng (1963) and Tai (1979) obviously accepted the species concept of *Lamprospora haemastigma* by Seaver (1928), who treated *Lamprospora* in a very broad sense. Judging from the description of "*L. haematostigma*" from Gansu Province by Teng (1963, 1996), the fungus possesses all the features of *Pulvinula* Boud. Re-examination of the only material on deposit in HMAS filed under "*Lamprospora haematostigma*" (HMAS 08974 collected and identified by S.C. Teng) indicates that the correct name for the fungus is *Pulvinula carbonaria* (Fuckel) Boud., which is recorded here for the first time from the mainland of China.

Lamprospora wisconsinensis Seaver, North American Cup-fungi (Operculates) p. 69, 1928.

CHINESE RECORD: Tai, Sylloge Fungorum Sinicorum p. 181, 1979.

NOTES: *Lamprospora wisconsinensis* was treated as a synonym of *Pulvinula laeterubra* by Pfister (1976). Tai's report of *L. wisconsinensis* was based on two specimens deposited in HMAS (HMAS 17131, 17132) from Yunnan Province. Re-examinations of these collections indicate that the correct name for the fungus is *Pulvinula globifera* (Rifai 1968).

Peziza abietina Pers., Neues Mag. Bot. 1: 113, 1794, sensu Seaver, North American Cup-fungi (Operculates) p. 228, 1928.

= *Otidea abietina* (Pers.) Fuckel, Jahrb. Nassauischen Vereins Naturk. 23–24: 330, 1870, sensu Kanouse, Mycologia 41: 675, 1949.

CHINESE RECORDS: Teng, Fungi of China p. 291, 1963. Tai, Sylloge Fungorum Sinicorum p. 262, 1979. Wang & Zang, Fungi of Xizang p. 25, 1983.

NOTES: For a long time, this name was commonly applied to a species of *Otidea* (Kanouse 1949). As indicated by Nannfeldt (1966) based on his study of authentic material of *Peziza abietina*, it is not a member of *Otidea* but a rough-spored member of *Peziza* Dill. ex Fr.

Teng (1963, 1996) reported "*Peziza abietina*" from Gansu Province as fruitbodies regular to irregular-cupulate, light brown, with a coarse and short stalk, ascospores ellipsoid containing a single large guttule, paraphyses enlarged at the apex. These characters do not fit the genus *Otidea*. Re-examination of the only specimen filed under *P. abietina* from Gansu and identified by S.C. Teng (HMAS 30799) indicates that though the morphology of the fungus is identical with Teng's description of "*Peziza abietina*" it is not a *Peziza* judging from the J– asci in Melzer's reagent. Its gross morphology is like those members of *Helvella* with cupulate fruitbodies, and its ascospores also resemble those of *Helvella* species, though the excipular structure seems to be different from *Helvella*.

The Chinese record of "*Peziza abietina*" by Tai (1979) is based on collections from Heilongjiang, Shanxi and Inner Mongolia on deposit in HMAS (HMAS

33642, 33848, 39243) and Teng's previous report (Teng 1963). Re-examinations of the above three specimens show that they are not *Otidea* species; rather one is *Urnula craterium* (Schwein.) Fr. and two are true *Peziza* species with warts and crests on the ascospores. The two *Peziza* specimens were examined and annotated in 1995 by D.H. Pfister as "*Peziza* sp., not *P. abietina*" for 33848 and "*Peziza* sp." for 39243. According to the ascospore size of both *Peziza* collections from China, they are neither *Otidea abietina* as circumscribed by Fuckel (1870), nor *Otidea abietina* sensu Kanouse (1949), nor even *Peziza abietina* sensu Saccardo (1889)."*Peziza abietina*" was also reported from Bomi, Tibet (Xizang) based a single collection deposited in HKAS (HKAS 5858) (Wang & Zang 1983). Re-examination of the collection indicates that its gross morphology and ascospore size do not fit the concept of *O. abietina* sensu Kanouse, but rather that of *O. alutacea* (Pers.) Massee var. *alutacea* (Kanouse 1949).

Psilopezia deligata (Peck) Seaver, North American Cup-fungi (Operculates) p. 107, 1928.

Chinese record: Wang & Pei, Mycotaxon 79: 311, 2001.

Notes: *Psilopezia deligata* was reported from Dongling Mountains, Beijing (Wang & Pei 2001) based on a single collection (HMAS 74678). Re-examination of the fungus reveals that it represents *P. dabaensis* W.Y. Zhuang (Zhuang 1997). *Psilopezia deligata* differs from the Chinese material in smaller fruitbodies, larger ascospores, and narrower asci (Pfister 1973).

Pulvinula laeterubra (Rehm) Pfister, Occ. Pap. Farlow Herb. Crypt. Bot. 9: 11 (1976).

Chinese record: Wang & Pei, Mycotaxon 79: 311, 2001.

Notes: Wang & Pei (2001) reported this species from China based on collections from Dongling Mountains, Beijing on deposit in HMAS. Both specimens under this name from Dongling Mountains identified by Z. Wang (HMAS 75887, 76048) were re-examined. My observations indicate that they are not *P. laeterubra* but *P. miltina* (Berk.) Rifai as evidenced by presence of the short hair-like hyphae about 2.5 µm diameter covering the receptacle surface (Rifai 1968).

Trichophaea bullata Kanouse, Mycologia 50: 131, 1958.

Chinese record: Wang & Pei, Mycotaxon 79: 312, 2001.

Notes: *Trichophaea bullata* was recorded from Dongling Mountains, Beijing (Wang & Pei 2001) based on a single collection (HMAS 74650). Re-examination of the fungus indicates that its hair base is never swollen to 30–35 µm in diameter as is characteristic of *T. bullata* (Kanouse 1958) and it fits well within the scope of *T. woolhopeia* (Cooke & W. Phillips) Arnould.

Trichophaea pseudogregaria (Rick) Boud., Histoire et Classification des Discomycètes d'Europe p. 60, 1907.

CHINESE RECORD: Zhuang, Mycotaxon 79: 378, 2001.

NOTES: *Trichophaea pseudogregaria* was recorded from China based on a single collection (HMAS 72821) on deposit in HMAS and so labeled (Zhuang 2001). Re-examination of the specimen shows that *T. gregaria* (Rehm) Boud. is the correct name for the fungus.

Acknowledgments

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Scutellinia jejuensis (*Pezizales*), a new species from Korea

Jae-Gu Han[1#], Young-Joon Choi[2#], Donald H. Pfister[2] & Hyeon-Dong Shin[1*]

hdshin@korea.ac.kr

[1]*Division of Environmental Science and Ecological Engineering College of Life Sciences and Biotechnology, Korea University, Seoul 136-701, Korea*

[2]*Department of Organismic and Evolutionary Biology, Harvard University 22 Divinity Ave., Cambridge, MA 02138, USA*

Abstract — A new species of *Scutellinia* discovered in Jeju, Korea, *Scutellinia jejuensis*, is formally introduced. A combination of morphological characteristics and sequence analysis of the partial LSU rDNA demonstrates that the fungus represents a species distinct from all other subglobose to globose-spored *Scutellinia* species.

Key words — aculeolate-reticulate, Jeju Island, soil-inhabiting, subglobose ascospores

Introduction

The cosmopolitan genus *Scutellinia* (Cooke) Lambotte forms a well-defined group within the family *Pyronemataceae* (*Pezizales*), which contains a group of fungi characterized by a red or orange colored apothecial ascoma, clothed with stiff, brownish or black hairs along the apothecial rim (Schumacher 1990). They are presumed to be saprobic on wood and humus. Of approximately 50 species recognized in the genus, only ten are characterized by subglobose or globose ascospores, and these are all humus saprotrophs (Schumacher 1990, Yao & Spooner 1995, Liu & Peng 1996, Matočec 2000). During research on cup fungi in Korea, we found a soil-inhabiting ascomycete at Mt. Halla in Jeju Island. Based on a careful macro- and micro- observation, the fungus unequivocally belonged to *Scutellinia* and was close to *S. barlae* (Boud.) Maire 1933, *S. minor* (Velen.) Svrček 1971, *S. rotundisperma* Donadini 1983, and *S. trechispora* (Berk. & Broome) Lambotte 1887 judging by its subglobose to globose ascospores and

# These authors contributed equally to this work and should be considered co-first authors

* Author for correspondence

aculeolate or reticulate wall sculpturing. The Korean material, however, differs from them in several aspects. We formally describe this fungus as a new species of *Scutellinia* based on morphological characteristics and sequences analysis of the D1/D2 region of LSU rDNA.

Materials and methods

Free-hand sections of the fresh materials were mounted in distilled water, lactic acid, lacto-cotton blue, and Lugol's reagent (IKI). These preparations were examined in brightfield- and DIC- light microscopy, using an Olympus BX51 microscope (Olympus, Tokyo, Japan) for observations and measurements and a Zeiss AX10 microscope (Carl Zeiss, Göttingen, Germany) mainly for photographs. Measurements were performed at 1000× for ascospores and at 100–400× for other structures; they are reported as follows; minimum-maximum (length) × minimum-maximum (width) [mean length ± standard deviation × mean width ± standard deviation, Q (l/w ratio) = average ± SD].

Genomic DNA was extracted directly from the matured apothecia by the methodology described in Lee and Taylor (1990). To raise the efficiency of extraction, the apothecia were pounded using a sterilized glass rod in the cell lysis step. Primers LR0R and LR5 (Moncalvo et al. 2000) were used for the amplification of D1/D2 region of 28S rDNA. The PCR products were purified using a QIAquick Gel Extraction Kit (Qiagen, Hilden, Germany) and sequenced on an automatic sequencer (ABI Prism TM 377 DNA Sequencer), using the BigDye™ (Applied Biosystems, Foster City, CA, USA) Cycle Sequencing Kit, version 3.1, with primers identical to those used for amplifications. Sequences were edited with the DNASTAR computer package (DNAStar, Inc., Madison, Wis.), version 5.05, and aligned using CLUSTAL X (Thompson et al. 1997). Phylogenetic trees were obtained from the data using Maximum Likelihood (ML) and Maximum Parsimony (MP). For ML inference, RAxML version 7.0.3 (Stamatakis 2006) was used with all parameters set to default values, using the GTRCAT variant. MP analysis was done using MEGA 4.0 (Tamura et al. 2007), with the default settings of the program, for which 1000 bootstrapping replicates were performed. We selected all the available sequences of *Scutellinia*, and used *Octospora leucoloma* Hedw. (DQ220380) as outgroup taxon according to the result of recent phylogenetic analysis (Perry et al. 2007).

Results

Taxonomic description

Scutellinia jejuensis J.G. Han, Y.J. Choi & H.D. Shin, **sp. nov.** FIGURE 1

MYCOBANK MB516040

Ascosporae subglobosa cum ornamentum aculeolatum-reticulatum. Scutellinia minor similis, sed in sporis ornamentis non reticulatus et minusculus differt.

HOLOTYPE – on damp soil, Mulchat-oreum, Mt. Halla National Park, Jeju, Korea, 33°25'21.42"N 126°37'18.11"E, alt. 610 m, 5 XI 2008, J.G. Han, Y.J. Choi and H.D. Shin (*KUS-F52411*). Sequence ex-type: GU361609 for D1/D2 region of 28S rDNA.

ETYMOLOGY – the specific epithet refers to the Jeju Island of Korea where the fungus was first collected.

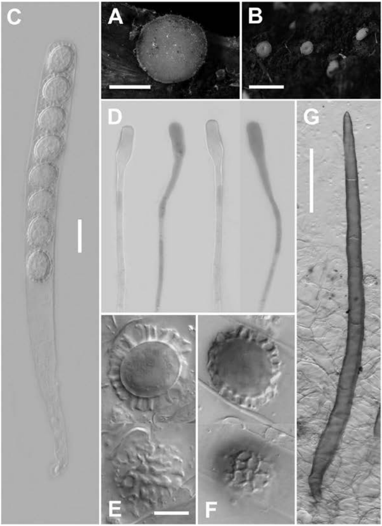

Figure 1. *Scutellinia jejuensis* (holotype *KUS-F52411*). A–B: flesh apothecia on damp soil, C: ascus, apical pore not blued in IKI, D: paraphyses, E–F: subglobose ascospores sculpturing aculeolate ornamentations, note on their interconnections, G: acuminate, thick-walled hair oriented from globose ectal cells.

Scale bars = 2 mm for A, 1 cm for B, 20 µm for C–D, 10 µm for E–F, and 100 µm for G.

Apothecia gregarious, almost sessile. Receptacle at first globose, then becoming shallowly cupulate to discoid, light red, externally covered with short dark brown hairs. Margins concolorous with the receptacle, surrounded by dark brown hairs. Disc up to 6 mm diam., plano-convex, reddish orange to scarlet when fresh, turning yellowish orange when dry. Ectal excipulum hyaline to yellowish, composed of textura globulosa to angularis, thin-walled, cells 43–100 × 28–95 µm. Marginal hairs not differentiated from lateral hairs, cylindric-conical, gradually narrowed to the apex, ventricose, thick-walled, walls 4–6 µm wide, brown to dark brown, with uni- or bi-furcate base, 3–11-septate, 190–640 × 17–30 µm. Asci cylindric, hyaline, 8-spored, walls not becoming blue in IKI without KOH pretreatment, 255–380 × 20–29 µm (318.8 ± 29.7 × 23.9 ± 2.7 µm, n = 26). Ascospores subglobose to globose but rarely broadly ellipsoidal when immature, hyaline, mature spores covered with ornamentations, aculeolate-reticulate, truncate-conical warts, commonly forming sinuate ridges which partly interconnect to a reticum below, 2.5–3 µm high, 0.5–1 µm wide, uniseriate, occupying upper 1/2 of the entire ascus length, 16–23 × 13–19 µm (18.7 ± 1.4 × 15.2 ± 1.1 µm, Q = 1.23 ± 0.08, n = 100) (not including the ornamentation). Paraphyses cylindric, hyaline, septate, unbranched, 3.5–4 µm, apical cells clavate, 37–69 × 6–9 µm (54.0 ± 9.7 × 8.1 ± 0.8 µm, n = 24), not exceeding the asci.

Phylogenetic analysis

The phylogenetic relationship among *Scutellinia* species was inferred from ML and MP analyses of the aligned sequences of the D1/D2 LSU rDNA. The result of the phylogenetic reconstructions by ML inference is shown in Figure 2. In the D1/D2 alignment, 86 of the 880 characters were parsimony-informative, and the parsimony analysis produced eight most parsimonious trees of 279 steps, with a CI and RI of 0.7380 and 0.6409, respectively. Since no differences were found between the tree topologies of the ML and MP analyses, only the ML tree is shown in Figure 2, with the addition of the support values of the MP analysis. In the phylogenetic tree, *S. jejuensis* occupied an independent branch within the genus *Scutellinia* and further formed a well-supported clade with *S. barlae*, *S. hyperborea*, and *S. trechispora* with high supporting values of 97 and 93 in ML and MP, respectively. However, sequence distances among the three species were considerable; 1.7% (15 of 880 nucleotide characters were different) to *S. barlae* and 1.6% (14 of 850) to *S. hyperborea* and *S. trechispora*.

Discussion

Up to now, ten *Scutellinia* species have been known to possess globose or subglobose ascospores, and all are found on soil (Schumacher 1990, Yao & Spooner 1995, Liu & Peng 1996, Matočec 2000). Among them, four species

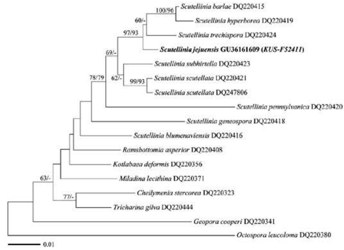

FIGURE 2. Phylogenetic tree inferred from ML analysis of the partial D1/D2 region of rDNA. Support values (ML BS/MP BS) above 50% are given above the branches. The number of nucleotide changes between taxa is represented by branch length. The scale bar equals the number of nucleotide substitutions per site. *Scutellinia jejuensis* sequence is shown in bold.

(*S. barlae*, *S. minor*, *S. rotundisperma*, *S. trechispora*) show aculeolate or reticulate sculpturing on ascospore surfaces similar to *S. jejuensis*, while in the other species the surface is tuberculate (*S. citrina* (Massee & Crossl.) Y.J. Yao & Spooner 1995, *S. hyperborea* T. Schumach. 1990, *S. paludicola* (Boud.) Le Gal 1966, *S. sinensis* M.H. Liu 1996, *S. tuberculata* Matočec 2000) or spinulose (*S. legaliae* Lohmeyer & Häffner 1983). Additionaly, *S. jejuensis* differs from *S. hyperborea* in low wart height (0.5–0.8 µm) and from other species with perfectly globose spores.

Scutellinia jejuensis is not likely to be confused with the four species sharing similar spore ornamentation because of its unique morphological and molecular characteristics. The perfectly globose ascospores in *S. barlae*, *S. rotundisperma*, and *S. trechispora* easily distinguish them from the new subglobose-spored species. In addition, *S. jejuensis* differs from *S. barlae* by having more septa in marginal hairs (3–11 vs 1–4). The present species has shorter (190–640 µm) marginal hairs that are not differentiated from the lateral ones. *Scutellinia rotundisperma* and *S. trechispora* show significantly long hairs (600–1000 and

500–2060 μm, respectively). The morphological separation of *S. jejuensis* from *S. barlae* and *S. trechispora* was also clearly supported by the present phylogenetic analysis of D1/D2 region of LSU rDNA. In overlapping dimensions of marginal hairs and subglobose ascospores, *S. jejuensis* was most similar to *S. minor*. The two species can be, however, easily discriminated by several characters: the wall ornamentation is aculeolate-reticulate with often-connected warts in the new species but aculeolate with isolated warts in *S. minor*. The warts in *S. jejuensis* are larger than those in *S. minor* (2.5–3 × 0.5–1 μm vs 1.0–1.8 × ca. 1.5 μm), and the length/width ratio was somewhat higher. Additionally, *S. minor* shows preference to boreo-polar habitats in Europe (Schumacher 1990, 1993), while *S. jejuensis* was collected in subtropical-warm temperature zone in East Asia.

A boreo-temperate species restricted to Europe, *Scutellinia decipiens* Le Gal 1966, is somewhat closer to *S. jejuensis* in that the ascospores have broadly ellipsoidal to subglobose shape, overlapping dimensions, and somewhat reticulate with partially interconnected warts (Le Gal 1966, Schumacher 1990). However, its longer and wider marginal hairs (400–1500 and 16–35 μm, respectively) and tuberculate sculpturing separates the new species. *Scutellinia kerguelensis* (Berk.) Kuntze 1891 and *S. chiangmaiensis* T. Schumach. 1990 also possess broadly ellipsoidal to subglobose ascospores, but they are easily discriminated from *S. jejuensis* by the smaller (15.3–18.0 × 11.0–13.0 μm) and reticulated ascospores and the larger (21.8–28.2 × 14.4–21.8 μm) and micro-verrucose ones, respectively.

Interestingly *S. jejuensis,* like all known *Scutellinia* species with globose to subglobose ascospores, is found on soil. Other *Scutellinia* species, those with ellipsoid ascospores, occur on well-decayed wood. This suggests that that the substrate may prove to be important in understanding the diversification of *Scutellinia*. In our limited study, the taxa with globose spores also all group together or form a monophyletic group with reasonably high support. Little is known of the evolutionary history of the genus or details of the biology of these species. It might be assumed that there may have been substrate specialization followed by radiation in the evolutionary history of *Scutellinia* species.

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Lactarius rupestris—a new species from the Brazilian semi-arid region

Felipe Wartchow & M. Auxiliadora Q. Cavalcanti

fwartchow@yahoo.com.br
Universidade Federal de Pernambuco, Departamento de Micologia/CCB
Av. Prof. Nelson Chaves, s/nº, Recife, PE, BRAZIL, 50670-901

Abstract — *Lactarius rupestris* is proposed as a new species from the Brazilian semi-arid region. It is characterized by the rather stout basidiome with a ochraceous salmon stipe that is up to 21 mm wide, a relatively smooth and viscid orange tinted pileus, close and frequently anastomosed lamellae, subglobose to ellipsoid basidiospores with distinct verrucae up to 0.7 µm high, a trichoderm pileipellis, and abundant sphaerocysts in the lamellar and pileus tramas.

Key words — *Agaricomycetes*, *Russulales*, neotropics, taxonomy

Introduction

The globally distributed genus *Lactarius* Pers., which with *Russula* Pers. forms the core of the family *Russulaceae*, is one of the major groups of ectomycorrhizal macrofungi. It can be identified by the basidioma exuding latex (Singer 1986) and the presence of common pseudocystidia (Miller et al. 2006).

In Brazil at least 19 taxa of *Lactarius* are known: *L. amazonensis* Singer, *L. annulifer* Singer, *L. campinensis* Singer, *L. gigasporus* Singer, *L. igapoensis* Singer, *L. mamorensis* Singer, *L. pallidipes* Singer, *L. reticulatus* (Berk.) Singer, *L. subpallidipes* Singer and *L. subreticulatus* Singer in Amazonian lowland forests (Pegler & Fiard 1979, Singer et al. 1983, Pegler 1988, Souza & Aguiar 2004); *L. deliciosus* (L.) Gray, *L. rufus* (Scop.) Fr. (these from exotic *Pinus* plantations) and *L. venezuelanus* Dennis from Paraná (Buyck & de Meijer 1999; de Meijer 2001, 2006); *L. deliciosus*, *L. rufus* and *L. russula* Rick from Rio Grande do Sul (Singer 1953, Guerrero & Homrich 1983, Singer et al. 1983, Sobestiansky 2005); *L. argillaceifolius* Hesler & A.H. Sm. var. *argillaceifolius*, *L. deliciosus*, *L. fragilis* (Burl.) Hesler & A.H. Sm. var. *fragilis*, *L. rufus* var. *parvus* Hesler & A.H. Sm. and *L. rufus* var. *rufus* in exotic *Pinus* plantation from Santa Catarina (Giachini et al. 2000, Karstedt & Stürmer as *L.* cf. *fragilis*); *L. hygrophoroides* Berk. & M.A. Curtis and *L. paulensis* Singer from São Paulo (Singer et al. 1983, Pegler 1997).

Here we describe a new species of *Lactarius* from the Brazilian semi-arid region, collected in the National Park of Catimbau, located in the ecoregion of the caatinga biome called "Planalto da Borborema" (Velloso et al. 2002) in an area characterized as "campo rupestre," which commonly occurs at 900-1000 m alt. (Rodal et al. 1998). In this area, members of *Apocynaceae*, *Bignoniaceae*, *Erythroxylaceae*, *Euphorbiaceae*, *Lauraceae*, *Fabaceae*, *Malpighiaceae*, *Myrtaceae*, *Polygonaceae*, *Rubiaceae*, *Sapindaceae*, *Simaroubaceae*, *Solanaceae*, *Trigoniaceae*, *Turneraceae*, and *Verbenaceae* are commonly found (Rodal et al. 1998, Andrade et al. 2004, Gomes et al. 2006).

Materials and methods

For microscopic analyses 3% KOH and Melzer's reagent were used and terminology for microstructures follows Verbeken (1998a). Colors of basidiomes were observed in fresh material, and color coding follows Online Auction Color (2004). Presentation of basidiospore data follows the methodology proposed by Tulloss et al. (1992) where the notation "[*a*/*b*/*c*]" at the beginning of the spore data set is to be read "*a* spores measured from *b* basidiomes taken from *c* collections." Other abbreviations include **L(W)** = basidiospore length (width) average from a single basidiome, Q = the length : width ratio range as determined from all measured basidiospores, and **Q** = the Q value averaged from all basidiospores measured within a single basidiome. The holotype of *L. rupestris* is deposited in the Herbarium of the Mycology Department of the "Universidade Federal de Pernambuco" (URM).

Taxonomy

Lactarius rupestris Wartchow, **sp. nov.** FIG. 1–5

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Pileus 60–70 mm, concavus-subinfundibuliformis, depressus, margine regulari, subviscosus, brunneo-aurantius ad flavidum in margine. Lamellae subdecurrentes, confertae, ochraceae, salmonescentes. Stipes 35–45 × 18–21 mm, subcylindratus, pallide ochraceus salmonescens. Latex cremeous, haud abundantibus. Basidiosporae (6.5–)7–8.5(–9) × (5.5–)6–7(–7.5) µm late ellipsoideae, subreticulatae, cristis usque ad 0.3–0.7 µm altis ornatae, macula suprahilaris non amyloidea. Basidia 35–50 × 8–11 µm, clavata, tetraspora. Pleurocystidia absentia. Pleuropseudocystidia rara. Pileipellis trichoderma, cellulae terminales 20–51 × 4–6 µm, subfusiformes, clavatae vel subcylindricae, tenuitunicatae; subpellis hyphis angustis.

TYPE: Catimbau National Park ("Trilha do Camelo"), Buíque, Pernambuco, Brazil, 23 July 2007 **Holotype:** F. Wartchow 15/2007 (URM 80214), preserved in a phormol-acetic acid-alcohol solution.

PILEUS 60–70 mm, concave-subinfundibuliform, somewhat umbilicate, orange (OAC 763) at center to brownish orange towards margin (OAC 694, OAC 715), moderately viscid, smooth to somewhat cracking, very indistinctly tomentose; margin entire, not striate neither sulcate, slightly involute. LAMELLAE short decurrent, cream-salmon (OAC 766–767), crowded to most frequently sub-crowded, up to 3 mm broad, frequently dichotomously branching in several lengths; margin smooth, concolorous; lamellulae frequent, with diverse lengths. STIPE 35–45 × 18–21 mm, central, cylindrical, slightly tapering near the base, pale ochraceous salmon (OAC 763), with short decurrent lines at upper surface near to lamellae attachment, longitudinally slightly ribbed (only under lens). CONTEXT spongy, pale yellow ochraceous (OAC 793–794) in pileus, cream yellow (OAC 793) in stipe. LATEX cream-colored to more or less concolorous with lamellae, not abundant.

BASIDIOSPORES [25/1/1] (6.5–)7–8.5(–9) × (5.5–)6–7(–7.5) µm (**L** = 7.8 µm, **W** = 6.3 µm, Q = (1.13–)1.16–1.34(–1.39), **Q** = 1.24), broadly ellipsoid to ellipsoid, occasionally subglobose; ornamentation amyloid, finely verrucose with each wart ranging to 0.5–0.7 µm high, interconnected by fine line, but never forming a complete reticulum; hilar appendix narrowly obtuse to subconical to conical; plage not very distinct, but with amyloid spot. BASIDIA 35–50 × 8–11 µm, clavate, bearing mainly four, but sometimes two very long (6–10 µm long) sterigmata. PSEUDOPLEUROCYSTIDIA very scarce, 170 × 24 µm long, with brownish refractive contents, thin-wall, arising from deep in the hymenophoral trama. LAMELLA EDGE sterile, with MARGINAL CELLS 30–45 × 4–6 µm, cylindrical somewhat sinuous, thin-walled, hyaline. PILEUS CONTEXT with abundant sphaerocysts 25–65 × 24–50 µm, globose or nearly so; filamentous hyphae up to 10 µm wide; lactiferous hyphae common, up to 15 µm broad, with a longitudinal orientation, somewhat diverging from trama, but not forming projecting pseudocystidia. SUBHYMENIUM with clavate, inflated clavate to nearly subglobose cells 16–27 × 9–17 µm. HYMENOPHORAL TRAMA heteromerous, with abundant nearly isodiametric (17–25 × 13–18 µm) cells, filamentous hyphae 3.5–6.5 µm; lactiferous hyphae frequent, up to 7–12 µm broad, straight and only occasionally branching. PILEIPELLIS a trichoderm up to 140 µm thick, two layered; elements of suprapellis 20–51 × 4–6 µm, plentiful, colorless, thin-walled somewhat thickening up to 0.5 µm, obtuse, subacute to infrequently subcapitate or pyriform; subpellis composed of plentiful hyphae of 3–8 µm wide and somewhat more inflated cells to 10–18 µm wide, colorless. Clamp-connections absent in all tissues examined.

HABITAT: buried with up to 2/3 of the stipe in sandy soil near several shrubs (*Fabaceae* subfam. *Mimosoideae* and others) in a semi-arid region, after heavy precipitation.

DISTRIBUTION: Known only from the type locality.

REMARKS: *Lactarius rupestris* is characterized by the rather stout basidiome with an ochraceous salmon stipe that is up to 21 mm wide, a relatively smooth pileus with orange tints when fresh, close and frequently anastomosed lamellae, broadly ellipsoid to ellipsoid basidiospores that are distinctly verrucose with ornamentation up to 0.7 µm high, a trichodermial pileipellis with a suprapellis of erect thin-walled elements, and a cellular pileus trama. Its presence in the Brazilian semi-arid makes it unique among the *Lactarii*.

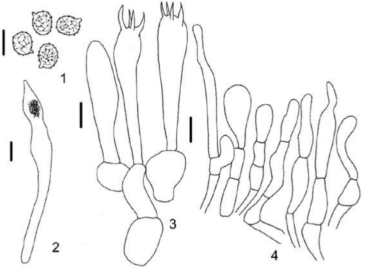
According to the key in Verbeken (2001), the lack of annulus, unchanging context, relatively smooth (neither pruinose nor truly tomentose) pileus, pale basidiospores with interconnected low spines, non-zonate pileus, entire lamellar edge, stout basidioma, non-palisade type pileipellis structure, and absence of thick-walled dermatolamprocystidia support placement of *L. rupestris* into *Lactarius* sect. *Edules* Verbeken. However, the frequently aerolate, relatively dry pileus surface and less ornamented basidiospores cited in the protologue for sect. *Edules* by Verbeken & Walleyn (1999) does not fit our new species. This section remains unclassified at the subgenus level, and Verbeken & Walleyn (1999) and Buyck et al. (2007) report that it would probably be elevated to subgenus after more research on a global scale (Buyck et al. 2007).

Verbeken (2001) includes at least six tropical African species in this section, among which four also have the crowded lamellae and somewhat similar basidiospore size found in *L. rupestris*: *Lactarius densifolius* Verbeken & Karhula, *L. inversus* Gooss.-Font. & R. Heim, *L. phlebophyllus* R. Heim, and *L. nodosicystidiosus* Verbeken & Buyck. All four differ from *L. rupestris* in their lower basidiospore ornamentation and dry cracking aerolate pileus, distinctive features of these African taxa (Verbeken & Walleyn 1999, Buyck et al. 2007).

In the Verbeken (2001) key, *Lactarius* sect. *Chamaeleontini* Verbeken, characterized by a smooth pileus, contains one species, *L. laevigatus* Verbeken, with a trichoderm pileipellis without thick-walled elements, features that differ from the rest of this section (Verbeken 1998b). However, the strongly striate, deeply sulcate pileus margin that characterizes this section (Verbeken 1998b) is lacking in *L. rupestris;* furthermore, the ornamentation of *L. laevigatus* basidiospores does not exceed 0.2 mm (Verbeken 1996).

We regard *L. rupestris* as a rather isolated species that does not fit entirely into any tropical infrageneric taxon proposed by Verbeken (2001). Its slightly moist, non-aerolate pileus and relatively high basidiospore ornamentation separate our new species from *L.* sect. *Edules* as well as from *L. laevigatus* of sect. *Chamaeleontini.*

Different infrageneric arrangements exist for *Lactarius* outside the sections discussed above (Verbeken 1998b, 2001). The occurrence of abundant subisodiametric to sphaerocystidioid cells in the lamellar trama of *Lactarius rupestris* also characterizes *L.* sect. *Polisphaerophori* Singer. Montoya et al. (2007), however, recently transferred the type species of the section — *L. verae-crucis* Singer (Pegler & Fiard 1979, Singer et al. 1983, Singer 1986) — to



Figs. 1–4. *Lactarius rupestris* (from holotype).
1. Basidiospores. 2. Pleuropseudocystidium. 3. Basidia, basidiole and subhymenium.
4. Terminal elements of the pileipellis.
Scale bar = 10 µm (Figs. 1,3,4) & 20 µm (Fig. 2)

Fig. 5. *Lactarius rupestris* (from holotype). Basidiomes.
Photo by E.R. Drechsler-Santos.

subgenus *Lactiflui* (Burl.) Hesler & A.H. Sm. emend Verbeken based on similar basidiome color, distant lamellae, basidiospore morphology, and possession of a pseudoparenchymatous pileipellis with thick-walled lamprocystidia shared with *L. luteopus* Verbeken.

A previous comparison of a Brazilian collection with the holotype of *L. venezuelanus* (a species from Venezuela also classified in *Polisphaerophori* by Pegler & Fiard, 1979), showed that *L. venezuelanus* should be referred to subgenus *Lactariopsis* (Henn.) R. Heim sect. *Chamaeleontini* (Buyck & de Meijer 1999) due to presence of thick-walled lamprocystidia and the well developed underlying pseudoparenchymatous layer and the absence of veil and macrocystidia. Such analyses suggest that sect. *Polisphaerophori* is rather artificial, and detailed morphological and molecular analyses are needed before classifying new world taxa at an infrageneric level.

Lactarius rupestris differs from the other taxa in sect. *Polisphaerophori* with a brightly colored (but not yellow) pileus and distinctly pigmented stipe covered by Singer et al.'s (1983: 294) key as follows:

The Amazonian *L. mamorensis* is differentiated by a conspicuously ribbed and slender (≤ 13 mm diam) stipe, with each rib somewhat anastomosing, a mature pileus that is tuberculate-sulcate or transparently striate, and a pileipellis composed of upright chains of 2–4 sphaerocysts forming a short epithelium at the base of the thin walled dermatocystidia (Singer et al. 1983).

Lactarius paulensis, from the State of São Paulo, differs from *L. rupestris* in the much more slender (≤ 8 mm diam) stipe, short-sulcate pileus margin, reddish brown to brownish cinnamon pileus color, and larger (8.5–10 × 7–9 µm) basidiospores (Singer et al. 1983). The pileipellis of this species was described as having erect dermatocystidioid elements with thin or slightly thickened (to 1 µm) walls that arise from a subpellis consisting of a shallow and often discontinuous layer of sphaerocysts and more elongated elements, and some crenate in outline (Singer et al. 1983). These cells might be interpreted as a trichopalisade pileipellis, on which a distinct layer is never formed, with generally ascending, anticlinal elements that are inflated or almost rounded and terminal elements that arise from these elements (Verbeken 1998a).

Lactarius rupestris was collected with more than 2/3 of its stipe buried in the sandy soil in "campos rupestres". A similar pattern was recently observed with *Amanita lippiae* Wartchow & Tulloss also collected from this forest vegetation type where one of the basidiomes was completely hypogeous (Wartchow et al. 2009).

Other Brazilian *Lactarius* species are known from campina, campinarana, and periodically inundated Igapó forests from Amazonas, North Brazil, where the plants (mostly shrubs) are adapted to sandy nutrient-poor soils (Singer

& Araújo 1979, Singer et al. 1983, Singer & Aguiar 1986). Lleras & Kirkbride (1978) named this type of forest the "Amazonian caatinga".

The "campos rupestres" are open, dry forests that occur commonly at 900–1000 m alt. (Rodal et al. 1998). Actually, *L. rupestris* is not the only species restricted to dry open forests. Verbeken & Buyck (2002) observed a relatively high phytogeographical and ecological specificity for several taxa (mainly *Lactarius*) of ectomycorrhizal fungi that are found in open (miombo, *Uapaca* woodland) or dense forest types (e.g., rain-, riparian, gallery swamp, dry evergreen forest). Pegler & Fiard (1979) concluded that in the Lesser Antilles *Lactarius* is largely restricted to dry and semi dry forests accompanying putative ectotrophic forest trees [e.g., *Pisonia fragrans* (*Nyctaginaceae*), *Coccoloba diversifolia* (*Polygonaceae*)].

The "campos rupestres" where *Lactarius rupestris* was collected also contains members of putative ectomycorrhizal tree families (sensu Singer & Araújo 1979, Singer et al. 1983), such as *Euphorbiaceae*, *Fabaceae* (all three subfamilies), *Myrtaceae*, *Nyctaginaceae*, and *Polygonaceae* (Rodal et al. 1998, Andrade et al. 2004, Gomes et al. 2006). Due to this high plant diversity, it is difficult to identify for certain the putative mycorrhizal associate of *L. rupestris*, and so it becomes necessary to record all potential hosts within a 20 m radius. Taylor & Alexander (2005) note that it is virtually impossible to identify a host solely based on where the basidiome is collected and that choosing the nearest tree species as the host could be very misleading.

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Anaselenosporella sylvatica gen. & sp. nov. and *Pseudoacrodictys aquatica* sp. nov., two new anamorphic fungi from Mexico

RAFAEL F. CASTAÑEDA RUIZ

rfcastaneda@inifat.co.cu
Instituto de Investigaciones Fundamentales en Agricultura Tropical "Alejandro de Humboldt" (INIFAT), Calle 1 Esq. 2, Santiago de Las Vegas, C. Habana, Cuba, C.P. 17200

GABRIELA HEREDIA ABARCA & ROSA MARÍA ARIAS MOTA

gabriela.heredia@inecol.edu.mx & rosa.arias@inecol.edu.mx
Instituto de Ecología, A.C., Km. 2.5 Carretera Antigua Xalapa-Coatepec No.351. Col. Congregación El Haya, 91070 Xalapa, Veracruz, México

MARC STADLER

marc.stadler@t-online.de
InterMed Discovery GmbH, Otto-Hahn-str, 15, D-44227 Dortmund, Germany

MASATOSHI SAIKAWA

saikawa@u-gakugei.ac.jp
Department of Biology, Tokyo Gakugei University
Nukuikita-machi, Koganei-shi, Tokyo 184-8501, Japan

DAVID W. MINTER

d.minter@cabi.org
CABI, Bakeham Lane, Egham, Sur5rey, TW20 9TY, United Kingdom

Abstract — *Anaselenosporella sylvatica* anam. gen. & sp. nov. found on dead leaves of an unidentified plant and *Pseudoacrodictys aquatica* found on a decaying twig submerged in a stream, both in Veracruz, Mexico, are described and illustrated. The former is distinguished by fasciculate, macronematous, dichotomous branched, brown conidiophores, and polyblastic, sympodially proliferating conidiogenous cells with flat to slightly convex and obscure loci. The conidia are solitary, unicellular, acicular, semicircular, and curved to uncinate. The latter is characterized by sub-involute or imbricate, globose to irregular, dark brown to black conidia.

Key words —aquatic fungi, conidial fungi, cloud forest, systematics

Introduction

During two expeditions in 1999 in a cloud forest, "Las Cañadas", and in 2002 in several undisturbed rainforests of "Los Tuxtlas", Veracruz, Mexico, two interesting anamorphic fungi were collected, one on decaying leaves in leaf litter and the other on a submerged decaying twig in a stream. These fungi were distinctly different morphologically from any previously described anamorphic fungi and are therefore described as new taxa.

Materials and methods

Samples of submerged plant material in a stream were collected during expeditions in 2002 through the rainforest "Los Tuxtlas", and in 1999 in a cloud forest, "Las Cañada", all in Veracruz State, Mexico. Individual collections were placed in paper bags and taken to the laboratory as described by Castañeda (2005), then incubated in Petri dishes at 25ºC placed in a moist chamber composed of plastic containers (50 L capacity) with 200 mL of sterile water plus 2 mL of glycerol, and examined at regular intervals for the presence of microfungi. Mounts were prepared in polyvinyl alcohol-glycerol (8.0 g in 100 mL of water, plus 5 mL of glycerol) and measurements made at a magnification of × 1000. Micrographs were obtained with a Zeiss Axioskop 40 microscope.

Taxonomy

Anaselenosporella Heredia, R.F. Castañeda & R.M. Arias, **anam. gen. nov.**
MycoBank MB 515452

Fungus anamorphicus. Coloniae *in substrato naturali pilosae, effusae, brunneae vel nigrae. Mycelium partim superficiale et partim in substrato immersum.* Conidiophora *macronemata, mononemata, ramosa, erecta vel prostrata, septata, laevia vel verrucosa, ferruginea vel brunnea.* Cellulae conidiogenae *polyblasticae, lageniformes, cylindricae ad usque subulatae, discretae, indeterminatae cum proliferationibus holoblasticis sympodialibus. Loci conidiogeni complanati, lentiformes vel convexi, laterales et apicales.* Secessio conidiorum *schizolytica.* Conidia *solitaria, acicularia, filiformia, fusiformia vel semicircularia, unicellularia, hyalina, laevia vel verruculosa, sicca vel tenuitunicata. Teleomorphosis ignota.*

Species typica: *Anaselenosporella sylvatica* Heredia, R.F. Castañeda & R.M. Arias

Etymology: Greek, *Ana-*, meaning upwards, back and again; Latin, *-selenosporella*, referring to a hyphomycete genus *Selenosporella*.

Anamorphic fungi. Colonies on the natural substratum effuse, hairy, brown or black. Mycelium superficial and immersed. Conidiophores macronematous, mononematous, erect or prostrate, septate, smooth or verruculose, brown. Conidiogenous cells polyblastic, lageniform, cylindrical to subulate, indeterminate with holoblastic sympodial proliferations, discrete. Conidial secession schizolytic. Conidiogenous loci flattened, lenticular or convex, lateral and apical, slightly melanized. CONIDIA solitary, acicular, filiform, fusiform to semi-circular, unicellular, hyaline, smooth or verruculose, dry or hygroscopic. Teleomorph unknown.

COMMENTS. The genera *Selenosporella* G. Arnaud ex MacGarvie (Castañeda et al. 2009) and *Selenosporopsis* R.F. Castañeda & W.B. Kendr. (Castañeda & Kendrick 1991) can be compared with *Anaselenosporella* in conidial ontogeny and shape, particularly in terms of the sympodial proliferation of conidiogenous cells of the main body. There are, however, clear differences in the ramification and distinctive compact cluster formed by the conidiogenous cells of *Anaselenosporella*. The conidiogenous loci in *Selenosporella* and *Selenosporopsis* are short and long denticulate respectively, whereas they are flattened or somewhat convex and slightly melanized, producing conidia truncate at the base in *Anaselenosporella*. Although conidiogenous cells of *Amphophialis*, *Sporendocladia*, *Stylaspergillus*, *Thysanophora*, and *Veramyces* are arranged in a similar compact cluster, the pattern of proliferation of the conidiogenous cell is enteroblastic and a succession of conidia are produced through each conidiogenous locus.

Anaselenosporella sylvatica Heredia, R.F. Castañeda & R.M. Arias, **sp. nov.**

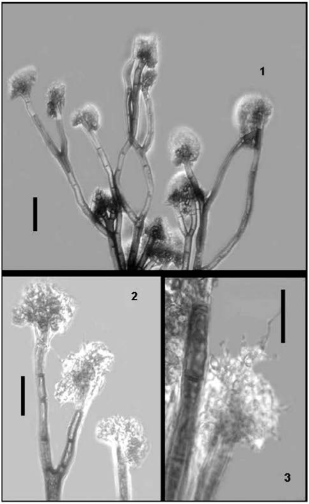
MYCOBANK MB 515453 FIGS 1–8

COLONIAE in substrato naturali pilosae, effusae, atrobrunneae. Mycelium partim superficiale et partim in substrato immersum, ex hyphis septatis ramosis, brunneis, 2–4 µm diam compositum. CONIDIOPHORA macronemata, mononemata, saepissime dichotome ramosa, erecta, multiseptata, luxuriantia, 700–1200 µm alta, 12–28 µm crassa prope basim, laevia, ferruginea vel atrobrunnea sed saepe leviter brunnea vel lurida punctata vel guttata, dilute brunnea vel pallidiora ad apicem. CELLULAE CONIDIOGENAE polyblasticae, lageniforme, interdum leviter geniculatae ad apicem, indeterminatae cum proliferationibus holoblasticis sympodialibus, discretae, compactae, fasciculatae, subhyalinae, 5–10 × 2.0–2.5 µm, ex ramis metuloideis, cuneiformibus, 3.0–4.5 µm crassis, orientes. Loci conidiogeni complanati vel lentiformes, laterales et apicales, leviter maculati. SECESSIO CONIDIORUM schizolytica. CONIDIA solitaria, acicularia, curvata ad usque semicircularia, unicellularia, truncata ad basim, hyalina, 7–12(–15) × 0.8–1.2 µm, laevia, tenuitunicata, interdum in massa alba congregata. Teleomorphosis ignota.

TYPE: 6 km from Huatusco, "Las Cañadas", Veracruz, Mexico, on decaying leaves of an unidentified plant, 20.V.1999. G. Heredia & R.M. Arias (Holotype: MUCL 45630).

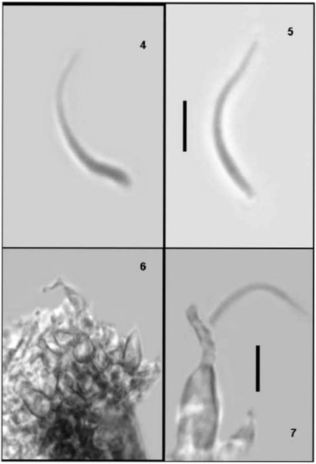
ETYMOLOGY: Latin, *sylvatica* – meaning growing wild.

COLONIES on the natural substrate effuse, hairy, amphigenous, dark brown. MYCELIUM superficial and immersed; hyphae septate, branched, 2–4 µm diam, smooth-walled, brown. CONIDIOPHORES macronematous, mononematous, dichotomously branched, erect, straight or flexuous multi-septate, smooth-walled, luxurious, 700–1200 × 12–28 µm, dark brown at the base, rusty to dark brown, but dotted with pale brown or lurid round spots across the length and



Figs 1–3. *Anaselenosporella sylvatica*, photographs from holotype (MUCL 45630).
Conidiophores, conidiogenous cells, and conidia.
Scale is indicated by bars: Fig. 1 = 100 µm; Fig. 2 = 50 µm; Fig. 3 = 10 µm.

pale brown or subhyaline towards the apex. Conidiogenous cells polyblastic, lageniform, slightly geniculate and elongated towards the apex, 5–10 × 2.0–2.5 µm, indeterminate, sympodial proliferating, discrete, formed in a compact



Figs 4–7. *Anaselenosporella sylvatica*, photographs from holotype (MUCL 45630).
4–5. Conidia. 6–7. Conidiogenous cells and conidium.
Scale is indicated by bars = 5 µm.

cluster on cuneiform, 3.0–4.5 µm wide metula-like branches. Conidiogenous loci flattened to slightly lenticular or convex and obscure (melanized), lateral and apical. Conidial secession schizolytic. Conidia solitary, acicular, curved to semicircular, unicellular, truncated at the base, hyaline, 7–12(–15) × 0.8–1.2 µm, smooth, hygroscopic or slightly tunicate, sometimes forming white mucilaginous masses. Teleomorph unknown.

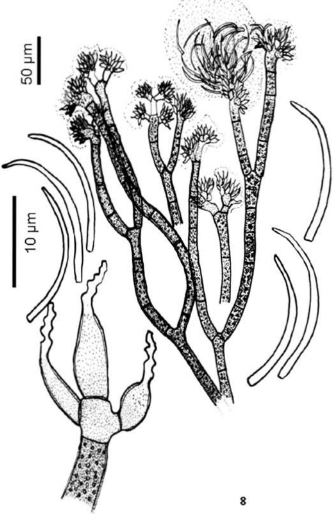


FIG. 8. *Anaselenosporella sylvatica*, drawings from holotype (MUCL 45630).
Conidiophore, conidiogenous cells, and conidia.
Scale is indicated by bars.

Pseudoacrodictys aquatica R.F. Castañeda, R.M. Arias & Heredia, **sp. nov.**
MycoBank MB 515454 Figs 9–16

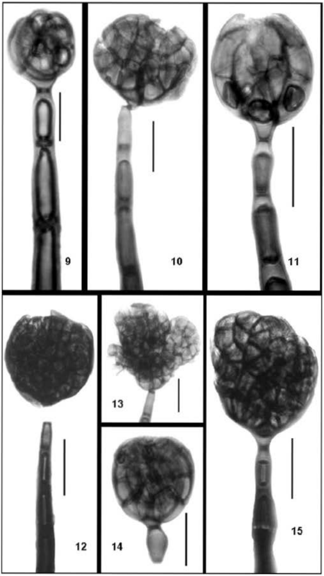
Coloniae in substrato naturali effusae, pilosae, nigrae, brunneae. Conidiophora macronemata, mononemata, 4–7-septata, simplicia, 180–270 × 12–15 µm, atrobrunnea vel nigra ad usque basim versus brunnea ad apicem, laevia cum 2–6 proliferationibus enteroblasticis percurrentibus praedita. Cellulae conidiogenae hologenosae, monoblasticae, cylindricae vel doliiformes, 15–37 × 5–10 µm, integratae, indeterminatae, atrobrunneae et brunneae ad apicem. Secessio conidiorum schizolytica. Conidia solitaria, acrogena, dictyoseptata, sub-involuta ad usque imbricata, globosa, nonnunquam leviter laxa ad apicem vel irregularia, nigra, 31–46 × 30–46 µm, sicca, cum cellulis basalibus cuneiformibus, 6–9 µm latis, brunneis. Teleomorphosis ignota.

Type: "Los Tuxlas", Estación de Biología, Veracruz, Mexico, on a decaying twig submerged in a stream, 19.V.2002. coll. R. M. Arias and J.Y.C. Elizondo (**Holotype**: XAL CB745).

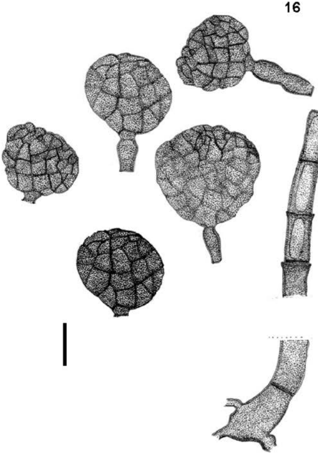
Etymology: Latin, *aquatica* – refers to its growth in water.

Colonies on the natural substratum effuse hairy, black. Mycelium mostly immersed. Hyphae septate, branched, 2–3 µm diam, smooth-walled, black to dark brown. Conidiophores macronematous, mononematous, 180–270 × 12–15 µm, erect, straight or slightly curved, subulate, sometimes with a nodulose aspect after percurrent proliferation, 4–7-septate, single or sometimes loose fasciculate, dark brown or black at the base and brown towards the apex, smooth, with 2–6 enteroblastic percurrent proliferations. Conidiogenous cells holoblastic, monoblastic, terminal, cylindrical, doliiform to slightly subulate, integrated, indeterminate with enteroblastic percurrent proliferations, 15–37 × 5–10 µm, dark brown to brown, smooth-walled. Conidial secession schizolytic. Conidia solitary, acrogenous, dictyoseptate, globose, sub-involute, imbricate or irregular, sometimes slightly loose at the apex, 31–46 × 30–46 µm, black, dry with cuneiform, 6–9 µm wide, brown basal cells. Teleomorph unknown.

Comments. The genus *Pseudoacrodictys* was introduced by Baker & Morgan-Jones (2003) to classify seven species previously described under a broad generic concept of *Acrodictys*; the included species were distinguished by more commonly indeterminate, enteroblastic percurrently proliferating, cylindrical, doliiform to subulate conidiogenous cells and schizolytic conidial secession. Conidia are holoblastic, solitary, acrogenous, subglobose to broadly pyriform to turbinate or irregular, dictyoseptate, bearing one or several aseptate or septate, somewhat "hyphae-like", straight, undulate, involute to uncinate cellular appendages. Subsequently another species was described, *Pseudoacrodictys dimorphospora* Somrith. & E.B.G. Jones (Somrithipol & Jones 2003), which strongly resembles *Ceratosporella compacta* (Castañeda et al. 1996). Only *P. deightonii* (M.B. Ellis) W.A. Baker & Morgan-Jones and *P. dennisii* (M.B. Ellis) W.A. Baker & Morgan-Jones (Baker & Morgan-Jones 2003) superficially resemble *P. aquatica*. *Pseudoacrodictys deightonii,* however, has conidia that



Figs 9–15. *Pseudoacrodictys aquatica*, photographs from holotype (XAL CB 745). Conidiogenous cells and conidia. Scale is indicated by bars = 20 µm.



FIGS 16. *Pseudoacrodictys aquatica*, drawings from holotype (XAL CB 745). Conidiogenous cells and conidia. Scale is indicated by bars = 20 µm.

are highly variable in shape, ranging from irregularly turbinate to obpyriform with a botryose aspect derived from swollen and protruding peripheral cells (42–84 × 28–57 µm) and a cuneiform, 3.5–5.0 µm wide basal cell; *P. dennisii* has conidia that are obovoid to pyriform, often somewhat flattened apically and sometimes compressed sub-apically and laterally, 26–57 × 19–30 µm and distinctly protuberant, with a cylindrical, 4–6 µm wide, darker basal cell. Both species can be easily separated from *P. aquatica*.

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Endogenospora, a new genus of anamorphic fungi from Venezuela

Rafael F. Castañeda Ruiz

rfcastaneda@inifat.co.cu
Instituto de Investigaciones Fundamentales en Agricultura Tropical "Alejandro de Humboldt" (INIFAT), Calle 1 Esq. 2, Santiago de Las Vegas, C. Habana, Cuba, C.P. 17200

Osmar Morillo, Belkis Tovar & Zulaima Hernández

osmarm@ciepe.gob.ve, belkistova@hotmail.com, zulaimahernandez@yahoo.es
Centro de Investigaciones del Estado para la Producción Experimental Agroindustrial, Fundación CIEPE, San Felipe, Estado Yaracuy, Venezuela

Teresa Iturriaga

titurri@usb.ve
Departamento de Biología de Organismos, Universidad Simón Bolívar Apartado 89000, Sartenejas, Baruta, Edo Miranda, Venezuela

David W. Minter

d.minter@cabi.org
CABI, Bakeham Lane, Egham, Surrey, TW20 9TY, United Kingdom

Josepa Gené & Josep Guarro

josepa.gene@ urv.cat & josep.guarro@urv.cat
Unitat de Microbiologia, Facultat de Medicina i Ciencies de la Salut Universitat Rovira i Virgili, 43201 Reus, Tarragona, Spain

Marc Stadler

marc.stadler@t-online.de
InterMed Discovery GmbH, Otto-Hahn-Strasse 15, D-44227 Dortmund, Germany

Abstract — *Endogenospora aspectabilis* anam. gen. et sp. nov. found on a decaying branch in the "Las Veras" rainforest, Lara State, Venezuela, is described and illustrated. It is characterized by endogenous conidium ontogeny development at the reduced internal area of inflated or globose bases of conidiophores, vase-shaped conidiogenous cells and clavate to sub-cylindrical, (5–)7-septate, brown conidia with truncate base and rounded apex.

Key words — tropical rainforest, systematics, conidial fungi

Introduction

During a survey of microfungi in Lara state, Venezuela, an interesting and curious anamorphic fungus was collected on decaying branches of an unidentified plant. Its conidium ontogeny and conidiogenous event development in the inner and deep-seated conidiogenous cell showed some resemblance with the genus *Conioscypha* Höhn., but also is superficially similar to the genus *Ascoconidium* Seaver by the urceolate to elongated infundibuliform conidiogenous cells. Therefore, the new genus *Endogenospora* is described and illustrated herein.

Materials and methods

Samples of plant material were collected during an expedition in July 2009 through the forest "Las Veras," Lara State, Venezuela. Individual collections were placed in paper bags and taken to the laboratory, then incubated in Petri dishes at 25° C placed in a moist chamber composed of plastic containers (50 L capacity) with 200 ml of sterile water plus 2 ml of glycerol, and examined at regular intervals for the presence of microfungi. Mounts were prepared in polyvinyl alcohol-glycerol (8.0 g in 100 ml of water, plus 5 ml of glycerol) and measurements made at a magnification of × 1000. Micrographs were obtained with a Zeiss Axioskop 40 microscope.

Taxonomy

Endogenospora R.F. Castañeda, O. Morillo & Minter, **anam. gen. nov.**
MycoBank MB 515396

Coloniae in substrato naturali effusae, brunneae ad usque nigrae. Conidiophora plerumque nulla, in cellula conidiogena reducta, interdum septata. Cellulae conidiogenae endogenosae-holoblasticae, uniloculares, urceolatae, clavatae, subcylindricae vel prolongatae infundibuliformes, brunneae vel atrobrunneae, determinatae vel indeterminatae cum aliquot proliferationibus enteroblasticis percurrentibus, cum parietibus incrassatis, circa basim dispositae. Loci conidiogeni intra-suprabasilibus. Secessio conidiorum schizolytica. Conidia solitaria, clavata usque ad cylindrica, manifeste enterogenice producentia, pluriseptata, brunnea vel atrobrunnea, laevia vel verruculosa, sicca vel tenuitunicata, seriata, in massa sicca, congesta. Teleomorphosis ignota.

Species typica: *Endogenospora aspectabilis* R.F. Castañeda, O. Morillo & Minter

Etymology: Greek, *Endogeno-*, meaning endogenous, arising from inner and deep-seated layers of the conidiogenous cells; Latin *-spora* referring to the conidia.

Colonies on the natural substrate effuse, brown or black. Conidiophores mostly absent, reduced to conidiogenous cells, sometimes septate. Conidiogenous cells endogenous-holoblastic, unilocal, vase-shaped, clavate, subcylindrical or elongated infundibuliform, brown or dark, determinate or with several enteroblastic percurrent proliferations, thick-walled, internal and deep, located

FIGS. 1–3. *Endogenospora aspectabilis*, photomicrographs from holotype (INIFAT C09/74). Conidiogenous cells and conidia. Enterogenous internal development of conidia near the base. Scale is indicated by bars = 10 µm.

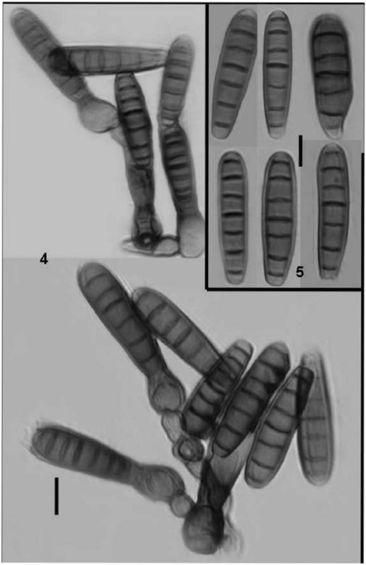
at the inflated base. CONIDIAL SECESSION schizolytic. CONIDIA solitary, clavate to cylindrical, enteroblastic, multi-septate, smooth or verrucose, dry or slightly tunicate, brown to dark brown, seriate, accumulating in dry masses.

NOTES. The genus *Ascoconidium* can be compared with *Endogenospora* in conidium ontogeny, the shape and number of cells, but conidia are hyaline and sometimes dictyoseptate in the former; in both genera conidia are formed singly and successively after schizolytic secession, but conidia in *Ascoconidium* bear a conspicuous marginal frill produced by the separation process of the outer wall layer(s) and inner wall layer(s). The separation of the wall layers is not simultaneous, the outer wall layer(s) breaks first and conidia are observed attached only by the inner wall layer(s) as occurs in several anamorphic genera including *Stigmina* (Sutton & Pascoe 1989). The enterogenous conidium ontogeny occurs in an internal locus near the base, a process that shows obvious differences between *Ascoconidium*, *Endogenospora* and other genera such as *Chalara*, *Sporoschisma* and *Sporoschimopsis* as was discussed by Nag Raj & Kendrick (1975). Although the conidiogenous cells of these fungi have been described as "phialides", the events relating to conidiogenesis are different, and the broadly applied term phialide does not accurately describe these stationary conidiogenous cells, which produce successive enteroblastic conidia. In *Endogenospora aspectabilis* inner wall layer(s) near the inflated base produce successive conidia in a process similar to what Minter et al. (1982) interpreted as holoblastic in *Cryptosporiopsis* sp. Minter et al. (1982) defined holoblastic as "the mode of production of cell wall in which, following completion of any developmental stage, the fungus in a new stage lays down wall layers which are continuous with all of the wall layers used in the previous stage." This definition supports the description of conidiogenous cells in *Endogenospora aspectabilis* as endogenous-holoblastic because all inner wall layers are involved in the production of successive conidia and are continuous with the conidia wall layer. The vase-shaped conidiophores can be described as unicellular conidiomata when at maturation they produce successive conidia. *Endosporoideus* W.H. Ho et al. (2005) is also superficially similar to *Endogenospora*, but the former does not produce successive conidia, and after maturation shows disarticulation of the conidial cell similar to the "chlamydospora" of *Chalara* spp.

Endogenospora aspectabilis R.F. Castañeda, O. Morillo & Minter, **sp. nov.**

MYCOBANK MB 515397 — FIGS 1–6

COLONIAE in substrato naturali effusae, atrobrunneae vel brunneae. Mycelium plerumque superficiale vel in substrato immersum, ex hyphis septatis, cylindricis, aliquando cum cellulis globosis vel inflatis, (2.5–)4–6 µm diam., ramosis, dilute brunneis ad usque brunneis. CONIDIOPHORA plerumque nulla in cellula conidiogena reducta vel mononemata,



FIGS. 4–5. *Endogenospora aspectabilis*, photomicrographs from holotype (INIFAT C09/74).
4. Conidiogenous cells and conidia. 5. Conidia.
Scale is indicated by bars = 10 µm.

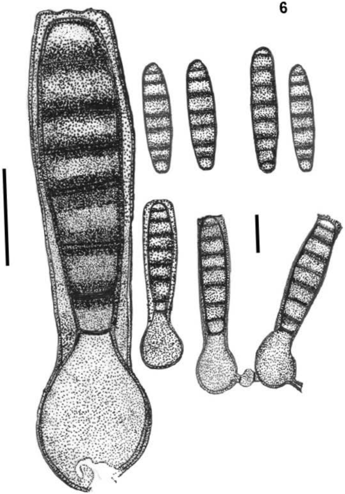


Fig. 6. *Endogenospora aspectabilis*, drawing from holotype (INIFAT C09/74).
Conidiogenous cells and conidia..
Scale is indicated by bar = 10 µm.

fasciculata, 1-septata, laevia, brunnea, urceolata, vel prolongata, infundibuliformia, plerumque inflata vel globosa ad basim, 42–53 × 8–13 µm. Cellulae conidiogenae *urceolatae, clavatae, subcylindricae vel prolongatae infundibuliformes, ad basim globosae, enterogenosae, uniloculares, discretae, brunneae vel atrobrunneae, plerumque determinatae, interdum indeterminatae cum 1–2 proliferationibus enteroblasticis percurrentibus, 7–11 × 8–13 µm, cum parietibus incrassantis, brunneis, circa basim dispositae. Locis conidiogenis intra-suprabasilibus, complanatis.* Secessio conidiorum *schizolytica.* Conidia *solitaria, endogenica, clavata usque ad cylindrica, sub-truncata ad basim, rotundata ad apicem, (5–)7-septata, brunnea vel atrobrunnea, sed utrimque pallidiora, i.e. pallide brunnea, 32–38 × 8.5–10.5 µm, laevia vel tenuitunicata, seriata, in massa atrobrunnea, sicca congesta. Teleomorphosis ignota.*

Type: Las Veras, Barquismeto, Lara, Venezuela, on decaying branch of an unidentified plant, 25.VI.2009. O. Morillo (**Holotype:** INIFAT C09/74).

Etymology: Latin, *aspectabilis* – meaning visible, worthy of being seen.

Colonies on the natural substrate effuse, dark brown or brown. Mycelium mostly superficial and somewhat immersed; hyphae septate, branched, cylindrical and sometimes with globose to inflated, thickened cells, (2.5–)4–6 µm diam., smooth-walled, pale brown to brown. Conidiophores mostly absent, reduced to conidiogenous cells, but sometimes macronematous, mononematous, fasciculate, erect, straight, 1-septate, vase-shaped to elongated infundibuliform, always inflated or globose at the base, smooth-walled, 42–53 × 8–13 µm, brown or dark brown at the base, pale brown towards the apex. Conidiogenous cells unilocal, endogenous, enterogenous, globose, vase-shaped, clavate to slightly infundibuliform, discrete, determinate or indeterminate with 1–2 enteroblastic percurrent proliferations, 7–11 × 8–13 µm, with thickened, brown wall, smooth, arranged at the base near the bottom of the conidiomata. Conidiogenous loci internal and supra-basal, flattened. Conidia solitary, endogenously produced, clavate to sub-cylindrical, truncate at the base, rounded at the apex, (5–)7-septate, darkened at the septa, brown to dark brown and pale brown at the ends, 32–38 × 8.5–10.5 µm, smooth-walled or slightly tunicate, successively produced and accumulating in dark brown and dry masses. Teleomorph unknown.

Acknowledgements

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The genus *Leucocoprinus* in western Washington

Joshua M. Birkebak

birkebak@gmail.com
Department of Ecology and Evolutionary Biology, University of Tennessee
Knoxville, TN 37996-1610

Abstract — The genus *Leucocoprinus* in Washington state was investigated based on fresh and herbarium collections as a part of a survey to assess the biodiversity and abundance of all lepiotaceous (*Agaricaceae*) fungi in the Pacific Northwest. Seven species were found to occur in the study area. *Leucocoprinus (Lc.) flavescens* is reported from Washington while *Lc. brebissonii* and *Lc. heinemannii* are credibly recorded in North America for the first time. The complex history of *Lc. cretaceus* in North America including its first record from Washington is discussed. The above four species as well as *Lc. birnbaumii, Lc. cepistipes,* and *Lc. ianthinus* are described and their microscopic characters illustrated.

Keywords — agarics, introduced species, western North America

Introduction

Pale-spored members of the family *Agaricaceae* (lepiotaceous fungi as defined by Vellinga 2004a; formerly *Lepiotaceae*) have remained rather understudied in North America (Vellinga, 2004a). The western half of the continent has received little attention since the works of Burlingham (1945), Murrill (1912), and Zeller (1922, 1929, 1933 1934, 1938). The methods of investigation ignored characters now considered of great importance, and microscopic features were left essentially unexamined. Although the lepiotaceous flora of California (and to a lesser extent that of Oregon) has received much attention in the last 40 years bringing to light many of the details needed to clarify species' identities and relationships (Smith & Sundberg 1979; Sundberg 1967, 1971a, 1971b, 1976, 1989 1995; Vellinga 2001a, 2001b, 2007a, 2007b, 2007c, 2007d; Vellinga & Davis 2007; Vellinga & Sundberg 2008), pacific northwest species have been relatively neglected, except for the work by Sieger (2003).

In an attempt to lessen the disparity of knowledge regarding lepiotaceous fungi, the present paper is presented as a first in a series of investigations concerned with assessing the biodiversity of lepiotaceous fungi in the Pacific Northwest.

The genus *Leucocoprinus* Pat. was originally erected to accommodate the sulcate/plicate species intermediate between *Leucoagaricus (La.)* Locq. ex Singer and *Macrolepiota* Singer (Singer 1986). This position is problematic as there are many *Leucoagaricus* species that have moderately to slightly sulcate pileus margins. The distinction was clarified with the discovery of pseudoparaphyses (also called brachybasidioles and pavement cells) between the basidia, which species of *Leucoagaricus* lack.

Genetic investigations have not well supported *Leucocoprinus* as independent but show its species intermixed with *Leucoagaricus* species. The possible monophyly of *Leucocoprinus* cannot, however, be completely rejected (Vellinga 2004b). The present paper treats *Leucocoprinus* as an artificial but conveniently recognizable morpho-genus rather than a natural assemblage of species. It appears that the presence of pseudoparaphyses is not phylogenetically significant, but it is still unclear whether this character has evolved several times to give rise to close groups of species or whether it has been gained and lost several times at the species level and thus has no particular taxonomic value. Here *Leucocoprinus* is used in a sense that excludes species of *Leucoagaricus* section *Annulati* and section *Piloselli* — e.g., *La. americanus* (Peck) Vellinga, *La. badhamii* (Berk. & Broome) Singer — which some authors (e.g. Moser 1967; Reid 1990) have included.

Species of *Leucocoprinus* appear to benefit greatly from human disturbance. They grow quickly and readily in potting soils and other man-made organic-rich materials in which they appear to have been transported. As a result, it is probable that all seven species known to occur in Washington were introduced during the 20th century. *Leucocoprinus brebissonii* is especially interesting: since the first report in 1994, its populations have become very common and are now readily encountered in most Puget Sound basin forests. Vellinga (2001c) suggests that *L. brebissonii* has become more common in the Netherlands due to increasing nitrogen enrichment of the soil (Vellinga 2001c).

The first report of a *Leucocoprinus* species from Washington was "*Lepiota cretacea* (Bull.) Morgan" reported by Murrill (1912), who cited "*Lepiota cepaestipes* Quél." as a synonym. It is impossible to discern exactly what species Murrill reported as he had an extremely broad species concept (see remarks under *Lc. cretaceus*). Sheridan (1956) reported *Lc. birnbaumii* (as "*Lepiota lutea* (Bolton) Matt.") from Washington for the first time as a common greenhouse inhabitant or found outdoors in soil that had been artificially heated during the winter. The next two additions to the Washington *Leucocoprinus* mycota were *Lc. cepistipes* and *Lc. ianthinus* (as *Lc.* "*lilacinogranulosus*") by Sieger (2003). This paper presents the first reports of *Lc. flavescens* and *Lc. cretaceus* (in the narrow sense) from Washington state and the first documented reports of *Lc. brebissonii* and *Lc. heinemannii* from North America.

Materials and methods

Synonyms are listed only when helpful or informative. For a complete list, see Vellinga (2009). The generic names *Lepiota, Leucoagaricus, and Leucocoprinus* are abbreviated as *L., La.,* and *Lc.*

Because of the lack of data on fresh material, the macroscopic description for *Lc. ianthinus* is borrowed from Sieger (2003). Color notations in quotation marks are from Ridgway (1912).

Descriptions of microscopic characters were made using the glossary of Vellinga & Noordeloos (2001) whenever possible. Microscopic observations were made from exsiccate revived in 3% KOH. Dimensions were recorded from 30 measurements made from one specimen for spores (in profile view), cheilocystidia, and pileus covering cells. Ten basidia and pseudoparaphyses from each collection were measured. Measurements and Q-values (a ratio of length over width) are displayed as follows: lower extreme–mean–upper extreme. Pseudoparaphyses, sterigmata, and basidia were measured during, or shortly after, sporulation. The pileus covering was sectioned at the disc and mid-margin and near the edge to observe the full variability of pileus structure. When possible, both immature and mature pileus were sectioned to determine the development of the covering.

All cited collections are deposited at the University of Washington herbarium (WTU).

Results

Of the seven species of *Leucocoprinus* encountered, four were found to grow only indoors or in artificially heated habitats, one grew both indoors and outdoors, and two were found only outdoors. Basidiocarps of *Leucocoprinus* species are most often encountered July through September rarely fruiting as late as November.

The seven *Leucocoprinus* species known from Washington state are described and illustrated. An artificial key to their identification is presented below.

Key to *Leucocoprinus* species of Washington

1. Carpophores with yellow tones 2

1. Carpophores lacking yellow tones 3

2. Center of pileus with fulvous tones, lacking scales; pileus covering composed of loosely arranged globose cells; spores subglobose, lacking a germ pore .... 5. *Leucocoprinus flavescens*

2. Center of pileus lacking fulvous tones, with distinct scales; pileus covering lacking globose cells; spores broadly amygdaliform and with a distinct germ pore .... 1. *Leucocoprinus birnbaumii*

3. Pileus and stipe covered with a copious farinose covering; lacking contrasting scales or fibrils; entire fruiting body white to cream colored .... 4. *Leucocoprinus cretaceus*

3. Pileus and stipe only slightly farinose (if at all); with contrasting scales or fibrils. . . .4

4. Pileus with black to dark grey disc and scales 5
4. Pileus with purple to brown colored disc and scales 6

5. Pileus with minute, granule-like scales; found in forests (suspected from green-houses) .... 2. *Leucocoprinus brebissonii*
5. Pileus with small, fibrillose scales; known only from greenhouses .... 6. *Leucocoprinus heinemannii*

6. Pileus with small, violet- to lilac-brown scales; found indoors (to date) in flower pots etc. .... 7. *Leucocoprinus ianthinus*
6. Pileus with medium to small, brown to tan, appressed scales; found in wood-chips, compost heaps, gardens etc. .... 3. *Leucocoprinus cepistipes*

1. *Leucocoprinus birnbaumii* (Corda) Singer, Sydowia 15(1-6): 67 (1962) FIG. 1

≡*Agaricus birnbaumii* Corda, Icon. Fung. (Prague) 3: 48 (1839)
=*Lepiota lutea* Godfrin, Bull. Soc. mycol. Fr. 13: 33 (1897)
≡*Leucocoprinus luteus* (Godfrin) Locq., Bull. mens. Soc. linn. Lyon 14: 93 (1945)

PILEUS: 2.0–7.5 cm, at first paraboloid to cylindrical, later paraboloid to obtusely conical upon expansion, more or less plane to broadly umbonate with age; margin at first incurved, later decurved, sometimes straight with age, sulcate-striate; with appressed-fibrillose scaly to squarrose scales; disc solid, breaking up outward into scales on a somewhat farinose background, these often absent by 3/4th out; scales "old gold" to "Verona brown" to "raw umber;" background "barium yellow" to "citron yellow" to "massicot yellow" to "naphthalene yellow" to "sulphur yellow", pallid in the furrows; texture moderately firm when young but soft and fragile with age. ODOR: absent to sometimes fungal (like *Lycoperdon* spp.). LAMELLAE: free, often noticeably remote, subdistant to crowded, ventricose with age, soft, very thin, "sulphur yellow" to "citron yellow", edge notably fimbriate. STIPE: 2.5–9.0 cm long, 2–6 mm broad at apex, often gradually enlarging below to a slightly enlarged to somewhat clavate to bulbous, 4–15 mm broad, base, farinose to pruinose to somewhat floccose-squamulose, "citron yellow" to "massicot yellow" to "naphthalene yellow," sometimes discoloring "buffy brown", hollow and stuffed with pith. ANNULUS: thin, felt-like, superior to inferior, moveable, band-like, "citron yellow" to "barium yellow" to "naphthalene yellow;" rarely leaving remnants on pileus margin.

SPORES: 7.7–8.9–10.5 × 5.9–6.5–7.3 µm, Q-value 1.12–1.36–1.56, ellipsoid to slightly amygdaliform in profile view, thick-walled, with a large apical germ pore that is often covered with a hyaline cap, metachromatic, dextrinoid. BASIDIA: 19.8–27.5 × 7.7–11.0 µm, pyriform to narrowly clavate, 4-spored, surrounded by four pseudoparaphyses. STERIGMATA: 1.4–2.2 × 0.8–1.2 µm. PSEUDOPARAPHYSES: 16.5–22.1 × 10.5–12.8 µm, narrowly utriform to narrowly clavate, lacking a pedicel, often somewhat angular. CHEILOCYSTIDIA:

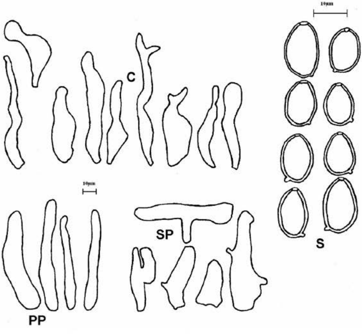

FIGURE 1. *Leucocoprinus birnbaumii* –
S. spores; C. cheilocystidia; PP. pileus covering; SP. contextual elements
(all from collection PBM 1943).

22.5–40.4–62.5 × 7.5–11.3–14.3 µm, very variable, lageniform to fusiform, less often clavate to utriform, at apex often with a flexuous excrescence that is up to ½ of total length, rarely with mucronate to obtuse apices, thin-walled, often with somewhat yellow colored vacuolar contents. PILEUS COVERING: a confluent layer of terminal cells when young, disarticulating into scales and/or patches revealing short, inflated to cylindrical, loosely attached cylindrical, H-, T- to L-shaped contextual elements (these being the only discernable cell type in poorly preserved collections or in collections in which scales are indistinct or absent). Terminal elements ascending to somewhat repent conglomerations of 32.5–65.7–155.0 × 7.5–12.8–18.8 µm, flexuous cylindrical to somewhat narrowly lageniform to rarely elongate clavate terminal. STIPE COVERING: composed of repent to ascending, cylindrical, 5–8 µm broad elements similar to the terminal elements of the pileus. STIPITIPELLIS: a cutis made up of 10–15 µm broad, cylindrical elements. CLAMP CONNECTIONS: absent.

HABITAT AND DISTRIBUTION: solitary to subconnate imbricate in rich soils, very often in greenhouses or in flowerpots indoors. Cosmopolitan.

COLLECTIONS EXAMINED: U.S.A.: Washington, King Co., Seattle: PBM 1943, det. P.B. Matheny, 8/21/2000; University of Washington Botany greenhouse: SAR 88/417, det. S.A. Rehner, 2/24/1988; University of Washington campus: MTS 4997, det. M.T. Seidl, 8/29/2002; STZ 9330, det. D. Stuntz, 11/09/1955. Spokane Co., Whitworth College: D. Brown 9/1989, det. J.M. Birkebak

REMARKS: The bright yellow coloration and cosmopolitan distribution in areas of human disturbance has made *Lc. birnbaumii* one of the most easily recognized mushrooms. Its toxicity (Singer 1986) further contributes to its fame.

The species is reputedly an indoor species in northern temperate locations, but it has been collected outdoors in Washington in an area with artificially heated soils (Sheridan 1956). It is unclear whether this species is truly restricted to artificially warm soils, as I have heard many unconfirmed reports and at one point seen what appeared to be an immature *Lc. birnbaumii* in natural conditions in a pacific northwest forest.

There is some confusion regarding the structure of the pileus covering, and sometimes only the upper contextual elements are described and illustrated (e.g., Sundberg 1967, Pegler 1972).

2. *Leucocoprinus brebissonii* (Godey) Locq., Bull. mens. Soc. linn. Lyon 12: 41. 1943 FIG. 2

=*Lepiota brebissonii* Godey in Gillet, Hyménomycètes: 64. 1874.

PILEUS: 2.0–5.5 cm broad, short cylindrical when very young, becoming conic to convex to more or less paraboloid, sometimes becoming plano-convex when mature, often collapsing to more or less truncate conic; margin often straight to decurved, sulcate-striate, sometimes with sparse velar remnants, often eroding with age; disc subtomentose to velutinous, immediately around disc breaking up into granular scales that are very sparse near margin; "dark grey" to black to sometimes "fuscous" tinted, rarely as pale as "smoky grey;" context white, rarely discoloring slightly yellow, very soft and thin, somewhat fragile. ODOR: distinctly fungal. LAMELLAE: free, close to crowded, 2–6 mm broad, at margin fimbriate; white or with "cream buff" tints. STIPE: 3.5–9.0 cm long, 1–4 mm thick at apex, enlarging downward to clavate, 3–6(–10) mm thick base, sometimes rather flexuous, central to very rarely slightly eccentric, often appearing minutely fibrillose or minutely pruinose near apex, white to "ivory yellow," sometimes discoloring pinkish flesh-colored to dingy orange-pink with age especially near the base, at very base often with some light grey tints, hollow and often stuffed, somewhat fibrous-friable when fresh. ANNULUS: thin, upturned, median; white to pale cream, sometimes leaving loose remnants on the pileus margin.

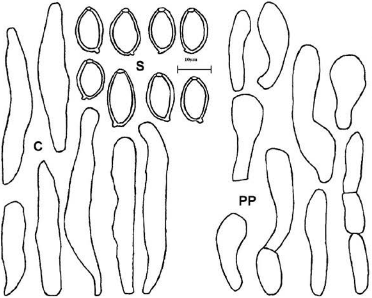

FIGURE 2. *Leucocoprinus brebissonii* – S. spores; C. cheilocystidia; PP. pileus covering (all from collection JMB 9-13-2006-01).

SPORES: 9.2–10.6–12.1 × 4.9–6.0–7.2 µm, Q-value 1.50–1.77–2.08, oblong ellipsoid to slightly amygdaliform, thick-walled, with an apical germ pore that often somewhat slants toward the adaxial side, metachromatic, dextrinoid. BASIDIA: 18.7–23.1 × 9.2–10.8 µm, pyriform, 4-spored, surrounded by four pseudoparaphyses. STERIGMATA: 1.0–1.5 × <0.7 µm. PSEUDOPARAPHYSES: 14.3–17.6 × 6.6–10.2 µm, narrowly clavate, only slightly enlarged at apex. CHEILOCYSTIDIA: 22.0–46.8–73.7 × 7.7–11.4–19.8 µm, cylindrical to very slightly fusiform, somewhat flexuous, often slightly constricted before the apex giving the cells a slightly capitate appearance, often somewhat pedicellate to tapered, thin-walled, hyaline. PILEUS COVERING: a dense layer of terminal cells that disarticulates into several minute scales and remaining confluent at disc revealing cylindrical to sometimes branching, repent, contextual elements; terminal cells 26.3–41.8–60.0 × 15.0–19.1–27.5 µm, broadly clavate to ellipsoid to pyriform, often with a very broad point of attachment, rarely with a short pedicel, filled with grayish-olive brown vacuolar pigment, somewhat loosely chained with 1–6 pigmented elements that become narrower, longer and blend into contextual cells. STIPE COVERING: restricted to very base, composed of cylindrical to sometimes narrowly clavate, moderately pigmented, sparse elements. STIPITIPELLIS: a cutis made up of 7.5–11.3 µm broad, cylindrical, repent elements. CLAMP CONNECTIONS: absent.

HABITAT AND DISTRIBUTION: scattered to gregarious, sometimes imbricate and more or less connate, growing on duff of *Alnus rubra*, *Acer macrophyllum* and/or *Thuja plicata*, less commonly on debris of *Tsuga heterophylla* and/or *Pseudotsuga menziesii* or sometimes on very decayed *Thuja plicata* wood. Known from throughout the tropics: known from Europe and the Pacific Northwest (where it is likely invasive for the latter; see below) in temperate areas.

COLLECTIONS EXAMINED: U.S.A.: Washington, King Co., Bridle Trails State Park: LB 2007-06-18-05, LB 2007-06-21-06, LB 2007-07-16-09, LB 2007-07-23-01, LB 2007-07-23-02, LB 2007-07-27-03, LB 2007-07-30-01, All det. J.M. Birkebak and L. Bayler; Carkeek Park: JMB 68, det. J.M. Birkebak, 10/13/2003; D. Oliver s. n. 2004, det. J.M. Birkebak, 2004; Coal Creek Park: JMB 75, det. J.M. Birkebak, 9/25/2003; Fauntleroy Park, JMB 258, det. J.M. Birkebak, 9/17/2004; JMB 9-13-2006-01, det. J.M. Birkebak, 9/13/2006; Lincoln Park: JMB 56, det. J.M. Birkebak, 9/30/2003; Redmond Preserve: Forrest Beckwith 7140402, det. J.M. Birkebak, 7/14/2004; St. Edwards State Park: GRW 778, det. J.M. Birkebak, 10/02/1994. Snohomish Co., Tulalip: M. Bennett 6/24/2004, det. J.M. Birkebak.

REMARKS: *Leucocoprinus brebissonii* may be the most commonly encountered *Leucocoprinus* species in Washington. This species has probably gone unnoticed, despite its abundance, as a misdetermined *Lepiota atrodisca* Zeller, another species that features black scales on a white background but which is easily distinguished by a more robust stature and the vastly differing microscopic characters easily distinguish it. *Leucocoprinus heinemannii*, the other *Leucocoprinus* species with a black pileus covering, is differentiated by its punctate scales and short, broad elements.

Leucocoprinus brebissonii appears to have been introduced to Washington, as its first collection dates from 1994; given its current abundance, it is highly improbable that it could have gone uncollected and unnoticed for so long. This species has become naturalized to a great extent and is commonly encountered in most forests in the greater Seattle area. Whereas interspecies competition and displacement are poorly known, it is impossible to determine whether the arrival of this species has impacted native mycoflora to any significant extent.

This report extends the known distribution of *Lc. brebissonii* to include North America. The three previous reports of this species from North American are doubtful or ambiguous. Smith's (1981) report of "*Lc. brebissonii*" refers to a fibrillose pileus composed of narrow, somewhat cylindrical elements, features that clearly separate her description from the current concept and likely represent something in the *Lepiota atrodisca* complex (Else Vellinga, pers.

com.). Arora (1986) mentioned collecting "*Lepiota*" *brebissonii* from a lawn in Berkeley, California. Not only is this habitat highly unusual, the description of the carpophores as "2-3cm, with brownish to grayish scales," casts further doubt upon his identification, as *Lc. brebissonii* is described as a black to dark grey (at palest) species; the name is probably a misapplication based on Smith's 1981 species concept. It has not been seen in the Berkeley area since this report (Else Vellinga, pers. com.) and there is also no preserved collection that can be examined. Akers (1997) reports "*Leucocoprinus cf. brebissonii*" from Florida, but the reference seems doubtful as he described the stature as resembling *Lc. fragilissimus* "(Rav. & Berk.) Pat.", a much more fragile species than *Lc. brebissonii*.

The present paper cites many collections for the species in Washington, and the nrITS sequence of Washington material is identical to those from European collections (Else Vellinga, pers. com.). The distribution in North America needs further investigation.

3. ***Leucocoprinus cepistipes*** (Sowerby: Fr.) Pat., J. Bot., Paris 3: 336 (1889)
[sensu J. E. Lange] Fig. 3
=*Lepiota cepistipes* (Sowerby: Fr.) P. Kumm., Führ. Pilzk. : 136 (1871)

Pileus: 2.5–5.5 cm broad, ovoid to conic when young, becoming obtusely campanulate, broadly umbonate to somewhat truncate at times; margin at first incurved, becoming straight to more often decurved, sulcate-striate; glabrous to finely appressed tomentose at disc, toward margin becoming diffracted into sometimes slightly recurved to appressed squamulae, widely spaced near margin, rest of surface radially fibrillose to farinose; disc and scales "mummy brown" to "hazel" to "sayal brown" to "snuff brown" to "cinnamon brown" to "cinnamon" to "clay color" to "buffy brown" to "warm buff" to "honey yellow," background white to "pale pinkish buff" to "pale cream buff;" context soft (but rather sturdy for this genus), more or less white. Odor: mild, fungal. Lamellae: free, often noticeably remotely so, close, rather broad, thin; white, sometimes discoloring "amber yellow," edge notably fimbriate. Stipe: 2.5–7.5 cm long, 1.5–4.0 mm broad at apex, often slightly and gradually increasing in breadth downward to an often moderately clavate base, 6–7 mm broad base, glabrous to innately fibrillose to slightly tomentose (especially toward base), "light vinaceous cinnamon" to "light pinkish cinnamon" to "pinkish buff" to "buffy brown" to "avellaneous," generally darker downward, often discoloring "clay color" to "sayal brown." Annulus: membranaceous, flaring, superior, "avellaneous" to "buffy brown" to "cinnamon."

Spores: 7.7–9.2–10.5 × 5.5–6.7–7.7 µm, Q-value 1.19–1.37–1.52, ellipsoid to slightly amygdaliform, thick-walled, with an apical germ pore covered with a hyaline lens, metachromatic, dextrinoid. Basidia: 22.9–28.3 × 9.7–10.8 µm,

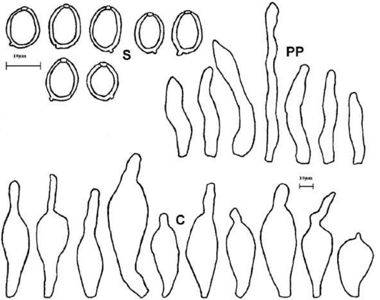

FIGURE 3. *Leucocoprinus cepistipes* – S. spores; C. cheilocystidia; PP. pileus covering (all from collection STZ 14210).

clavate pedicellate to cylindrical pedicellate, 4- to rarely 2-spored, surrounded by 4 pseudoparaphyses. STERIGMATA: 1.4–2.2 × 0.7–1.2 µm. PSEUDOPARAPHYSES: 16.4–18.7 × 9.4–10.4 µm, pyriform to more or less sphaeropedunculate with a very short, broad pedicel, rarely broadly fusiform. CHEILOCYSTIDIA: 30.0–45.3–57.5 × 10.0–14.8–17.5 µm, clavate to lageniform to rarely fusiform, often with a pedicel of short to moderate length, with obtuse to mucronate apices or with a flexuous, often tapering but sometimes capitulate, rarely forked, 4.5–6.5 µm broad excrescence up to 2/5th of cystidium length, thin-walled, hyaline. PILEUS COVERING: a loose turf of terminal cells when young, thinning with age and breaking into scales, revealing repent, cylindrical to T-shaped contextual elements that often become loose and disarticulated; terminal cells 32.5–56.0–92.5 × 5.6–8.3–11.3 µm, very variable, flexuous, lageniform to less often cylindrical to narrowly clavate, yellowish brown, loosely chained; with 2-5 pigmented, angular globose to short cylindrical cells that generally blend into trama. STIPE COVERING: like pileus covering but more often cylindrical to narrowly clavate, less often lageniform, shorter and broader, 30.4–58.0 × 7.6–10.8 µm. STIPITIPELLIS: made up of cylindrical, 10.0–17.5 µm broad, elements.

CLAMP CONNECTIONS: absent.

HABITAT AND DISTRIBUTION: solitary to gregarious to subconnate imbricate on rich soils, compost heaps, and wood chips. Can be found both indoors (greenhouse) and outdoors. Cosmopolitan.

COLLECTIONS EXAMINED: U.S.A.: Washington, King Co., Foster Island: STZ 14859, det. D. Stuntz, 9/12/1968; Lincoln Park: STZ 14210, det. D. Stuntz, 8/30/1967; University of Washington Arboretum: STZ 18980, det. J.M. Birkebak, 9/8/191975; University of Washington Botany Greenhouse: FVDB 3787, det. F. Van De Bogart, 9/23/1976; STZ 786, det. J.M. Birkebak, 9/10/1944; STZ 1638, det. D. Stuntz, 8/9/1945; STZ 19453, det. J.M. Birkebak, 9/10/1976.

REMARKS: This cosmopolitan *Leucocoprinus* rivals *Lc. brebissonii* as the most common representative of the genus in Washington. Like many of its brethren, this species fruits both indoors and outdoors.

One *Lc. cepistipes* collection included numerous primordia in a large, tight, confluent patch with mature specimens. The development of the universal veil and the hymenophoral cavity was found to be essentially the same as described for *Lepiota clypeolaria* (Bull. : Fr.) P. Kumm. and *Lepiota magnispora* Murrill (Atkinson 1914). The only difference noticed was that considerable elongation of the stipe tissue (2–3 mm) preceded hymenophoral differentiation and enlargement of the pileal cells. This difference between cell enlargement in the stipe and lack of enlargement in the center of the pileus context explains the abrupt cellular difference between the pileus and stipe context causing their very easy separation ("ball and socket" attachment).

4. *Leucocoprinus cretaceus* (Bull.: Fr.) Locq., Bull. mens. Soc. linn. Lyon 14: 93 (1945) FIG. 4

=*Lepiota cretacea* (Bull.: Fr.) Morgan, J. Mycol. 13: 3 (1907)

=*Lepiota farinosa* Peck, Rep. N.Y. St. Mus. nat. Hist. 43: 81. (1890)

=*Leucocoprinus breviramus* H.V. Sm. & N.S. Weber, Contrib. Univ. Mich. Herb. 15: 301. (1982)

PILEUS: 3.5–6.0 cm broad, hemispherical when young, expanding to plano-convex to campanulate, often somewhat umbonate; margin decurved, slightly sulcate-striate, at most sulcate to 1/5th to center; when young with many, dense, soft floccules, readily collapsing or wearing off to leave farinose covering; "light buff" to white at center, white elsewhere. LAMELLAE: remotely free, close, rather broad, thin; white, edge slightly fimbriate. STIPE: 5–8 cm long, 4–6 mm broad at apex, gradually enlarged downward to a broadly clavate to somewhat fusiform 6–13 mm broad base; sometimes coarsely farinose to slightly flocculose-farinose below annulus, subfarinose above; white to ivory yellow tinted (especially darker below). ANNULUS: very soft, somewhat flaring, median to superior, white.

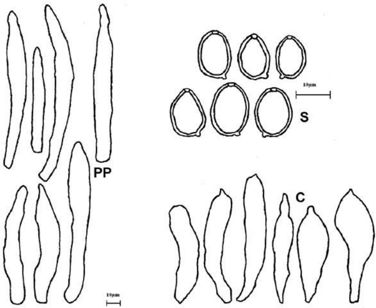

FIGURE 4. *Leucocoprinus cretaceus* – S. spores; C. cheilocystidia; PP. pileus covering (all from collection SJ22).

SPORES: 8.1–9.4–11.8 × 5.9–6.8–7.8 µm, Q-value 1.32–1.47, ellipsoid to somewhat amygdaliform, thick-walled, with an apical germ pore covered with a hyaline lens, metachromatic, dextrinoid. BASIDIA: 16.9–21.3 × 9.3–11.2 µm, pyriform to somewhat clavate with a somewhat bulbous base, 4-spored, surrounded by 4 pseudoparaphyses. STERIGMATA: 1.3–2.0 × 0.7–1.1 µm. PSEUDOPARAPHYSES: 10.4–13.3 × 7.4–9.6 µm, sphaeropedunculate to broadly clavate to pyriform, point of attachment very broad. CHEILOCYSTIDIA: 27.0–49.3–75.6 × 7.2–10.5–17.6 µm, subcylindrical to narrowly fusiform to slightly narrowly lageniform, mucronate, rarely obtuse, or with a flexuous excrescence, moderately pedicellate, thin-walled, hyaline. PILEUS COVERING: a sparse layer of terminal cells essentially absent on mature pilei, most prevalent near the center of young pilei, 45.0–73.9–117.0 × 7.0–8.1–9.3 µm, cylindrical to somewhat narrowly lageniform, with flexuous necks, often mucronate or with a short, tapering, apical excrescence with thinner wall than subterminal cells, very loosely chained to elements that become shorter, broader and blending with the anastomosing, often H- to T-shaped very loosely disarticulating contextual elements with numerous excrescences: these elements being very common on the entirety of the pileus surface and making up the farinose covering. STIPE COVERING: structure like that of pileus, with terminal cells even more sparse. STIPITIPELLIS: a cutis of narrowly cylindrical, 5.0–7.5 µm broad elements. CLAMP CONNECTIONS: absent.

HABITAT AND DISTRIBUTION: subconnate imbricate on heap of mixed wood chips and horse manure. Cosmopolitan.

COLLECTION EXAMINED: USA: Washington, Snohomish Co., Monroe: SJ 22, det. J.M. Birkebak, 9/28/1990.

REMARKS: My species concept for *Lc. cretaceus* follows Bulliard's original (for a detailed account of the complex history of usage of the name *Agaricus cretaceus* see Vellinga 2001c).

In North America most authors — notably Morgan (1907) and Kauffman (1924) — have applied the name *Lepiota cretacea* to what is now considered *Leucocoprinus cepistipes* (i. e. sensu J. E. Lange). Murrill (1914), however, used the name *Lepiota cretacea* in its broadest sense, which included *Leucocoprinus birnbaumii* (as "*Agaricus luteus* With."), *Leucocoprinus cepistipes* (as "*Lepiota cepaestipes* Quél."), and even *Leucocoprinus fragilissimus* (as "*Hiatula fragilissima* Berk. & Rav.").

Peck (1890) created the name *Lepiota farinosa* for the all white, farinose species here referred to *Lc. cretaceus*. Murrill (1911, 1914) included Peck's species as a synonym for *L. cretacea*. To complicate matters further, Smith and Weber (1982), who applied the name *Lc. cretaceus* to the current concept of *Lc. cepistipes*, published the name *Lc. breviramus* for the species I refer to *Lc. cretaceus*. Their "breviramus" is distinguished only by slightly smaller spores and subtle differences in the size and shape of cheilocystidia, differences that I regard as taxonomically insignificant. Akers (1997) applies the name *Lc. breviramus* to what clearly represents my concept of *Lc. cretaceus*.

5. *Leucocoprinus flavescens* (Morgan) H.V. Sm., The Michigan Botanist 20(2): 50 (1981) FIG. 5

≡*Lepiota flavescens* Morgan, Journal of Mycology 13(1): 5 (1907)

PILEUS: 20–32 mm broad when expanded, cylindrical with a blunt disc in button stage, rounded conic to more obtuse and with a rounded umbo, more or less collapsing and curling on drying; margin decurved to straight, sulcate-striate, especially so in older specimens; surface dry and coated with a more or less loose granular layer; at disc "barium yellow" to "amber yellow" or faintly tinted brown, "sulphur yellow" to white tinted with "sulphur yellow" to "naphthalene yellow' outward, paler at margin; context very thin and soft, pliable, white with yellow tint at cuticle on disc. Odor: more or less pungent. LAMELLAE: free, more or less close, narrow; edges straight at first then becoming crisped with age; faces white, edge appears tinted with more or less "sulphur yellow" to "pale yellowish

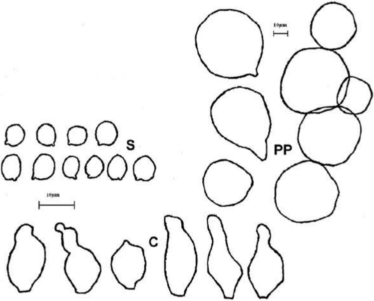

FIGURE 5. *Leucocoprinus flavescens* – S. spores; C. cheilocystidia; PP. pileus covering (all from collection JFA 8466).

white." STIPE: 65–85 mm long, at apex 4mm wide, at base narrowly clavate (up to 5–6 mm); with a granular to farinose coating; more or less "sulphur yellow" or this tinted with white, in age and with handling the stipe becomes deeper and brighter yellow (more or less "picric yellow"). ANNULUS: fragile, moveable, median to superior, "sulphur yellow" to "picric yellow."

SPORES: 4.4–5.1–5.9 × 3.6–4.1–4.8 µm, Q-value 1.00–1.27–1.42, broadly ellipsoid, thin walled, dextrinoid, metachromatic. BASIDIA: 13.4–16.5 × 6.1–7.2 µm, clavate pedicellate to pyriform, 4-spored; surrounded with 4 pseudoparaphyses at right angles (in a more or less checkerboard pattern). STERIGMATA: 1.7–2.2 × 0.7–1.0 µm. PSEUDOPARAPHYSES: 11.4–15.3 × 6.9–8.5 µm, sphaeropedunculate to broadly clavate, more rarely ellipsoid with very short pedicel, often somewhat angular/isodiametric. CHEILOCYSTIDIA: 11.0–17.1–24.2 × 5.5–8.2–13.2 µm, very variable, lageniform to utriform to, more rarely, clavate to obclavate, apex obtuse to mucronate or with a strangulate to constricted-subcapitate excrescence up to ½ of cell length, thin walled, hyaline.

PILEUS COVERING: of a loose layer of terminal elements concentrated on disc and somewhat sparse on rest of pileus, on a cutis of cylindrical, repent contextual elements; terminal elements loose globose to subglobose, sometimes ellipsoid, 13.8–34.4–50.0 × 15.0–30.3–47.5 µm, (Q-value 1.00–1.14–1.32) loosely chained, sometimes with a short excrescence connecting it to adjacent cells, generally more ellipsoid to fusiform downward. STIPE COVERING: composed of loose, globose elements like those of the pileus covering. STIPITIPELLIS: composed of short, cylindrical elements 20–30 µm broad. CLAMP CONNECTIONS: absent.

HABITAT AND DISTRIBUTION: In an outdoor covered can filled with greenhouse potting soil, growing in large clusters at ambient temperature. For distribution see remarks below.

COLLECTION EXAMINED: USA: Washington, King Co., Seattle, University of Washington campus: JFA 8466, det. J.M. Birkebak, 12/19/1979.

REMARKS: This sole representative of section *Denudati* Beeli in Washington has been collected only once in the Pacific Northwest. It was found on the University of Washington campus in a covered can outside of the botany greenhouse.

This is the first report of *Leucocoprinus flavescens* in the Pacific Northwest. It was originally described from Ohio (Morgan 1907) and also from Illinois (Kuo 2007), Massachusetts, and California (the last two from greenhouses; Smith 1981).

6. ***Leucocoprinus heinemannii*** Migl., Micol. Ital. 16(2): 9 (1987) FIG. 6

PILEUS: 16–22 mm when expanded, ovate when young, expanding to convex to plano-convex, center sometimes slightly depressed, often with a small umbo; margin more or less straight to uplifted, sulcate-striate; disc black to dark grey, innately fibrillose, very soon breaking into small, fibrillose scales on a white background that thin greatly until nearly absent near margin; context very thin and fragile, white. ODOR: fungal. LAMELLAE: free, crowded, somewhat broad, white. STIPE 12–35 mm long, 2 mm broad at apex, with an enlarged, bulbous, up to 5 mm broad base, with abundant white rhizomorphs from base, longitudinally silky, often innately fibrillose; white, often with a thin black to "dark grey" band near very base of stipe, hollow; context white. ANNULUS: membranous, white, somewhat band-like to slightly upturned, median.

SPORES: 6.3–6.9–7.4 × 3.5–3.8–4.2 µm, Q-value 1.66–2.10, oblong ellipsoid, rarely slightly amygdaliform or slightly phaseoliform, thin-walled, dextrinoid, faintly metachromatic. BASIDIA: 14.5–17.8 × 7.3–8.4 µm, broadly clavate, rarely pyriform, 4-spored; surrounded with 4 pseudoparaphyses at right angles (in a more or less checkerboard pattern). STERIGMATA: 1.5–2.2 × 0.8–1.1 µm. PSEUDOPARAPHYSES: 8.9–13.3 × 4.4–6.8 µm, broadly clavate to short cylindrical, more rarely ellipsoid, point of attachment often quite broad. CHEILOCYSTIDIA:

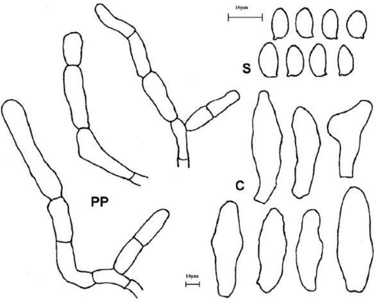

FIGURE 6. *Leucocoprinus heinemannii* – S. spores; C. cheilocystidia; PP. pileus covering (all from collection JMB 07-11-08-2001).

15.1–20.1–25.9 × 5.2–7.2–8.9 μm, cylindrical, broadly fusiform to slightly utriform, occasionally somewhat irregular in outline, not distinctly pedicellate, thin-walled, hyaline. PILEUS COVERING: a loose cutis made of long chained, cylindrical to inflated, 23.4–42.6–63.0 × 6.1–8.6–14.4 μm, olivaceous grey to dark brownish grey vacuolar pigmented elements with moderately constricted septa, occasionally developing slight secondary septations, blending into cylindrical to branched, hyaline contextual elements. Bare areas a cutis of cylindrical to branching, hyaline hyphae. STIPE COVERING: limited to the very base of the stipe, like that of the pileus but elements thinner and less strongly pigmented. STIPITIPELLIS: a cutis made of narrowly cylindrical to somewhat interwoven, 4–9 μm broad cells. CLAMP CONNECTIONS: absent.

HABITAT AND DISTRIBUTION: gregarious in potting soil in greenhouses. Known from Europe and western North America.

COLLECTIONS EXAMINED: U.S.A.: Washington, King Co., University of Washington Botany greenhouse: JMB 07-07-2008-01, det. J.M. Birkebak, 7/7/2008; JMB 07-11-2008-01, det. J.M. Birkebak, 7/11/2008; JMB 07-18-2008-01, det. J.M. Birkebak, 7/18/2008.

REMARKS: The pileus margin of this species is barely sulcate and strongly resembles *Leucoagaricus* species, especially *La. melanotrichus* (Malençon & Bertault) Trimbach (see Migliozzi & Zecchin 1999). This species also resembles *L. phaeostictiformis* Murrill from Florida but this similarity needs closer examination.

This species has probably been found in the University of Colorado greenhouse (Vellinga, pers. com.).

7. *Leucocoprinus ianthinus* (Sacc.) Locq., Bull. mens. Soc. linn. Lyon 14: 94. (1945) FIG. 7

≡*Lepiota ianthina* Sacc., Syll. Fung. 9: 10 (1891) [as "*Lepiota janthina*"]

=*Leucocoprinus lilacinogranulosus* (Henn.) Locq., Bull mens. Soc. linn. Lyon 12: 94 (1943)

≡*Lepiota lilacinogranulosus* Henn., Verh. bot. Ver. Prov. Brandenb. 40: 145 (1898)

PILEUS: 1.5–4.5 cm broad, ovoid to parabolic when young, truncate conic and collapsing slightly with age; margin decurved when young, sulcate-striate; disc unbroken, violet brown to reddish violet, breaking into minute granular scales the color of the disc or lighter on a buff background. ODOR: unremarkable or merely fungal. LAMELLAE: free, crowded, becoming wrinkled, whitish aging to pale flesh. STIPE: 4–5 cm long, 2.5–4.0 mm thick at apex, base bulbous; whitish, darker at base, not changing when bruised. ANNULUS: membranous, whitish, median. (Adapted from Singer 2003)

SPORES: 8.8–9.9–11.6 × 6.0–6.8–7.7 µm, Q-value 1.29–1.46–1.60, ellipsoid to somewhat amygdaliform, sometimes tapering slightly toward apical germ pore, with a small hyaline cap, thick-walled, thinning toward apex, dextrinoid, metachromatic. BASIDIA: 18.7–25.1 × 7.7–9.9 µm, pyriform to clavate, less often cylindrical-pedicellate, 4-spored, surrounded by 4 pseudoparaphyses. STERIGMATA: 2.3–3.3 × 1.1–1.7 µm. PSEUDOPARAPHYSES: 16.6–20.5 × 9.6–11.4 µm, sphaeropedunculate to broadly clavate. CHEILOCYSTIDIA: 37.5–60.1–88.6 × 11.3–17.3–23.8 µm, quite variable, cylindrical to utriform to broadly clavate, often, but not always, distinctly pedicellate, thin walled, hyaline. PILEUS COVERING: of a dense covering of terminal elements that breaks into scales usually leaving the disc confluent, revealing cylindrical to branching, hyaline contextual elements; terminal elements more or less erect, loose chains of 2–4, lightly grayish-lilac vacuolar pigmented, globose to cylindrical, 12.5–20.4–28.8 × 8.8–12.4–21.3 µm. STIPE COVERING: restricted to very base of stipe, erect to semi-erect, cylindrical elements, approximately 50–75 × 5–8 µm. STIPITIPELLIS: a cutis made of rather short, cylindrical, 13–18 µm broad elements. CLAMP CONNECTIONS: absent.

HABITAT AND DISTRIBUTION: solitary to gregarious on potting soil in artificially high temperatures indoors (especially prevalent in greenhouses). Cosmopolitan

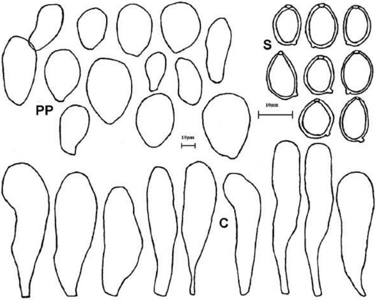

FIGURE 7. *Leucocoprinus ianthinus* – S. spores; C. cheilocystidia; PP. pileus covering (all from collection SAT 99-198-01).

COLLECTIONS EXAMINED: U.S.A.: Washington, King Co., Seattle: PBM 0020—040096, det. P. B. Matheny (as *Lepiota lilacinogranulosus*); SAT 99-198-01, det. S. Trudell (as "*Leucocoprinus lilacinosquamulosus*"), 7/17/1999; University of Washington Botany greenhouse: JFA 10097, det. J.M. Birkebak, 5/23/1990.

REMARKS: This distinctive species is the only *Leucocoprinus* with purple tones known from western North America. It has been collected several times in plant pots indoors. It has not yet been found outdoors.

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Type studies and nomenclatural revisions in *Parasola (Psathyrellaceae)* and related taxa

László G. Nagy[1*], Csaba Vágvölgyi[1] & Tamás Papp[1]

*cortinarius2000@yahoo.co.uk
[1]*Department of Microbiology, Faculty of Science and Informatics, University of Szeged, Közép fasor 52., Szeged, H-6726, Hungary*

Abstract — Basidiomycetes belonging in the genus *Parasola* and some satellite taxa have been revised on the basis of type studies and original diagnoses. As a result of an extensive taxonomic survey, 34 names affiliated with *Parasola* (formerly *Coprinus* subsections *Glabri* and *Auricomi*) have been identified. Type materials of 15 taxa have been found in various herbaria and examined. These taxa are described and their basidiospores, basidia, cheilocystidia, pleurocystidia, and pileipelli illustrated. The results support *P. leiocephala* as a synonym of *P. lactea*. An epitype for *P. plicatilis* and a neotype for *P. misera* are designated and illustrated in detail. *Parasola auricoma* is lectotypified. *Pseudocoprinus besseyi* and *C. elongatipes* are synonymized with *P. auricoma*. The type of *P. galericuliformis* represents an immature *P. lactea*. *Coprinus plicatilis* var. *filopes* is a later synonym of *P. lactea*. *C. longipes* and *C. rimosus* are synonymized with *P. schroeteri*, while *Pseudocoprinus brunneolus* belongs to *P. lactea*. Where possible, our conclusions were confirmed by molecular phylogenetic analyses.

Key words —synonymization, deliquescence

Introduction

The genus *Parasola* Redhead et al. (formerly *Coprinus* subsection *Glabri* and *Auricomi*) comprises coprinoid taxa that lack veils and caulocystidia and have parasol-like, non-deliquescent pilei (Doveri 2004, Orton & Watling 1979, Redhead et al. 2001, Uljé & Bas 1985). Nagy et al. (2009) have recently referred to the process of fruitbody maturation observed in *Parasola,* which differs from both "true" deliquescence and non-deliquescence, as "collapsing", in order to avoid confusion with non-deliquescent coprinoid and *Psathyrella* taxa. Although many widely distributed, well-known taxa belong here, such as *P. plicatilis* (Curtis) Redhead et al. or *P. leiocephala* (P.D. Orton) Redhead et al., taxonomic delimitation is still problematic and much confusion surrounds most species.

Redhead et al. (2001) recognized 18 taxa in the genus *Parasola*, resurrecting a number of taxa forgotten in the recent literature, such as *Coprinus mirabilis*, *C. pachyterus*, *C. setulosus*, *Pseudocoprinus lacteus*, *Ps. brunneolus*, etc. Many of these, however, are known only from the type collections. Furthermore, in the cases of *C. mirabilis*, *Ps. lacteus*, *Ps. besseyi*, and *Ps. brunneolus*, no modern description or type study was available, so it has been impossible to come to any conclusion concerning status. In the present study, we have revised all available type materials and validly published names of "collapsing" taxa that belong to, or have been affiliated with, the genus *Parasola* or *Coprinus* subsection *Glabri* and *Auricomi*. Taxa with missing or unavailable types have also been revised based on their original descriptions.

Materials and methods

Attempts were made to locate type materials of all validly published names connected with *Parasola* or *Coprinus* subsection *Glabri* and *Auricomi*. Types of 15 taxa were obtained on loan. Where we did not succeed in locating or obtaining the type specimens on loan, we base our comments exclusively on the original description. Despite repeated attempts, we were unable to obtain type material of *P. subprona* (Cleland) J.A. Simpson & Grgur. and *P. virgulacolens* (Cleland) J.A. Simpson & Grgur. on loan. 'Non-collapsing' *Parasola* taxa, i.e. *P. conopila* and its close allies (Larsson & Örstadius 2008, Padamsee et al. 2008, Vasutová et al. 2008) are not considered here.

As there is no type collection for the widely known taxon, *P. misera*, we selected a neotype to stabilize its nomenclatural status by adhering to the following criteria: (i) the neotype should accord with the original description as closely as possible; (ii) if the original description is not sufficiently diagnostic, the neotype should conform to the currently most widely-accepted usage of the name, unless this contradicts the original description; (iii) the neotype should be typical of the taxon it intends to represent; and (iv) a rich, complete collection should be selected that allows examination of all taxonomically important features. We did not attempt to select collections that originated from the type locality of the holotype. This may be important if it is presumed (e.g., from molecular studies) that the taxon is composed of many cryptic species, resulting from allopatric speciation. Neither morphological nor molecular studies (Nagy, unpublished results) suggest cryptic speciation in *P. misera*. Types have been deposited in BP, and parts of the type materials can be found in SzMC (Szeged Microbiological Collection).

All anatomical observations were made from dried material, except in the cases of the neotype of *P. misera* and the epitype of *P. plicatilis*, which were macroscopically annotated from fresh material. Before examination, herbarium materials were revived in 10% KOH, then mounted with Congo Red in NH_4OH. Unfortunately, many types were in poor condition because of their age and/or fruiting bodies poorly preserved by the collector. At times, most of the important features had collapsed, and only basidiospores could be observed. To mitigate the effects of partially collapsed fruitbodies we applied a longer treatment in 10% NH_4OH solution: up to 1.5–2 hours. This gave improved dissection in many cases.

Drawings of microscopic characters are based on microphotographs. Measurements were made at ×1000 with a calibrated optical micrometer. Basidiospore measurements are based on at least 20 samples from each collection. The numbers in square brackets after the word „Basidiospores" refer to the number of spores measured, the number of fruiting bodies examined, and the collections they originate from, respectively. Spore measurements are given as follows: length range × breadth range × width range. Q values were calculated as follows: Q_1 = length divided by breadth; Q_2 = length divided by width. Measurements of basidia included sterigmata. Pleurocystidia and cheilocystidia were observed and measured by cutting the gill edge from the rest of the gill to avoid blending of the two cystidial types. The interpretation of microscopic details follow standard conventions (Vellinga 1988). Abbreviations of names of herbaria follow Holmgren et al. (1990).

Results

Our extensive literature search identified 34 names that (potentially) belong to the genus *Parasola*. Of the 34 names associated with *Parasola* or *Coprinus* subsection *Glabri* and *Auricomi*, we examined type collections representing 15 taxa: *C. pallidus*, *Agaricus leptosceles*, *C. galericuliformis*, *C. hercules*, *C. kuehneri*, *C. leiocephalus*, *C. lilatinctus*, *C. megaspermus*, *C. nudiceps*, *C. pachyterus*, *C. plicatilis* var. *filopes*, *C. schroeteri*, *C. setulosus*, *Pseudocoprinus besseyi*, and *Ps. lacteus*. Among the remaining 19 taxa, types of *C. plicatilis, C. elongatipes* and *C. miser* are missing, while for the other 16 we could not obtain or locate the type. Missing types were sought in several herbaria. We located type specimens of *C. virgulacolens* and *Psathyrella subprona* (in AD), but they were not available on loan. Comments on taxa with unavailable types are based on the original descriptions or type studies published by other authors (Grgurinovic 1997, Pegler 1986).

We have lectotypified *P. auricoma* to stabilize its nomenclatural status, epitypified *P. plicatilis,* and designated a neotype for *P. misera*. *Parasola leiocephala*, *P. galericuliformis*, and *Pseudocoprinus brunneolus* are synonymized with *Ps. lacteus*. Types of *Ps. besseyi* and *C. elongatipes* were found to be conspecific with *P. auricoma* and are proposed as synonyms of that species. *C. longipes* and *C. rimosus* turned out to be younger synonyms of *P. schroeteri*. The results of the type studies, herbarium details, and nomenclatural revisions are summarized in Table 1.

Type studies

Agaricus leptosceles Berk. & Broome, Journal of the Linnean Society, Botany 11: 558 (1871). Fig. 4–5.

Isotype: Sri Lanka: Peradeniya, September 1868, G.H.K. Thwaites 770 (Berk. 1348) (K).

Original diagnosis: *Pileo hemispherico, acute umbonato subtiliter tomentoso, usque ad umbonem striato, stipite gracili (No. 770)*. On the ground. Peradeniya. Sept. 1868.

Pileus 1-inch across, striated up to the acute and elongated truncate umbo; stem 2.5–3 inches high, 1/2 line thick; gills ventricose, shortly adnate, spores egg-shaped, – 0003 long [0.0003 inches]. Allied to *A. hydrophorus*.

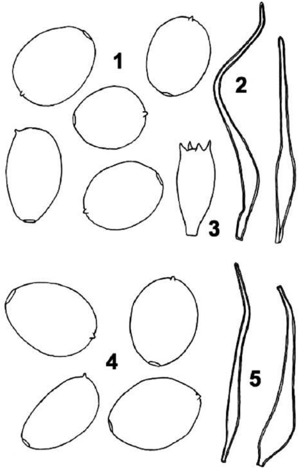

Fig. 1–5. Type material of *Coprinus pallidus* and *Agaricus leptosceles*.
Spores (1), basidium (2), and sclerocystidia (3) are depicted for *C. pallidus*.
Figs. 4 and 5 represent spores and sclerocystidia of *A. leptosceles*, respectively

Observations on the type—In the type envelope, there are 3 half fruiting bodies glued on a paper card, in a rather good state. Their pale-greyish pilei are more similar to dried *P. conopila* specimens, but the gills are more reminiscent of deliquescent *Parasola* taxa.

TABLE 1. Synopsis of the proposed nomenclatural changes and the status of taxa in the genus *Parasola*.

TAXON NAME	TYPE	NAME STATUS/ CURRENT NAME
Agaricus leptosceles	K	*P. setulosa*
Agaricus plicatilis	Lectotype & epitype (BP) selected here	*P. plicatilis*
Agaricus subtilis	?	Rejected name
Coprinus auricomus	Lectotype selected here	*P. auricoma*
Coprinus elongatipes	Not existent	*P. auricoma*
Coprinus galericuliformis	E	*P. lactea*
Coprinus hansenii	Not existent	*P. auricoma*
Coprinus hemerobius	Not existent	Rejected name
Coprinus hercules	L	*P. hercules*
Coprinus kuehneri	L	*P. kuehneri*
Coprinus leiocephalus	E	*P. lactea*
Coprinus lilatinctus	L	*P. lilatincta*
Coprinus longipes	?	*P. schroeteri*
Coprinus megaspermus	E	*P. megasperma*
Coprinus mirabilis	?	Rejected name
Coprinus miser	Neotype (BP) selected here	*P. misera*
Coprinus miser f. *marasmioides*	?PC	*P. misera*
Coprinus nudiceps	E	*P. schroeteri*
Coprinus pachyterus	K	?= *Coprinopsis vermiculifera*
Coprinus pallidus	K	*P. setulosa*
Coprinus plicatilis var. *filopes*	PRM	*P. lactea*
Coprinus plicatilis var. *microsporus*	?PC	*P. kuehneri*
Coprinus plicatilis var. *tenellus*	?GH or W	*Coprinopsis* sp.
Coprinus proximellus	Not in NY	Rejected name
Coprinus pseudonycthemerus	Probably not existent	? = *P. schroeteri*
Coprinus rimosus	Not in UC, MICH, WELT	*P. schroeteri.*
Coprinus schroeteri	H	*P. schroeteri*
Coprinus setulosus	K	*P. setulosa*
Coprinus sulphureus	?	? = *P. auricoma*
Coprinus virgulacolens	AD	Rejected name
Psathyrella subprona	AD	? = *P. megasperma*
Pseudocoprinus besseyi	MICH	*P. auricoma*
Pseudocoprinus brunneolus	?CFMR	*P. lactea*
Pseudocoprinus lacteus	MICH	*P. lactea*

Basidiospores [20,1,1] 9.3–12.6 × 7.6–9.8 × 6.3–7 µm, on average 10.8 × 8.6 × 6.7 µm, Q_1 = 1.17–1.43, Q_2 = 1.47–1.54 lentiform, in the frontal view ovoid-subglobose, some slightly rounded triangular, with an obtuse apex, which may seem concave in some cases due to the large germ-pore, and more or less obtuse base, some with a more acute base (like *Panaeolus acuminatus* (Schaeff.) Quél.), in the lateral view ellipsoid, germ-pore central, 1.8–2 µm wide; basidia, cheilocystidia, and pleurocystidia not observable; pileipellis collapsed, with scarce, thick-walled lageniform hairs, ca. 120–130 × 5–10 µm.

Several papillate subglobose spores found on the cap cuticle do not belong to this fungus.

Remarks—On the basis of the presence of thick-walled hairs on the pileus and the lentiform spores with a central germ-pore, this taxon is identical with *P. setulosa*, another taxon described from the same place at the same time, a fact already noted by Pegler (1986). As in *C. pallidus*, the only difference between *A. leptosceles* and *P. setulosa* is the much larger sclerocystidia, found in the type of the latter species.

Coprinus galericuliformis Losa ex Watling, Notes from the Royal Botanic Garden, Edinburgh 28: 42 (1967). Figs. 6–9.

Holotype: United Kingdom, Scotland: Edinburgh, Royal Botanic Garden, 14 May 1966, Watling 26310 (E).

Original diagnosis: *Pileus primo glandiformis vel ellipticus altus, 6–15 mm vix expansus clare fulvo-ochraceus vel ferrugineo-mellinus vulgo ad discum obscurius coloratus. Stipes 10–35 × 2–3 mm, subaequalis ad basim leviter incrassatus, albus. Caro concolorata siccitate intus albida. Lamellae fere liberae ex albo albida vel cacainae dein nigro-umbrinae; basidia 4-sporigera; basidiosporae 10.5–12.5 × 10–11 × 5–7 µm lentiforme poro germinativo. Cheilocystidia ellipsoideo-vesiculosa. Pleurocystidia et velum absentia.*

Observations on the type—The holotype, which is in a good state, contains numerous fruiting bodies in different stages of maturity.

Basidiospores [20,1,1] 10–12 × 9.8–10.9 × 5.3–7.2 µm, on average 11.68 × 10.31 × 5.96 µm, Q_1 = 1.02–1.25, Q_2 = 1.66–2.10, strongly lentiform, in the frontal view broadly ovoid to subglobose, more rarely angular or rounded triangular, in the lateral view ellipsoid or amygdaliform, with an up to 1.8 µm wide, eccentric germ-pore, mainly immature, medium dark reddish brown, smooth, with a moderately thick wall; basidia four-spored, clavate, 22–27 × 8.5–11 µm; cheilocystidia abundant, lageniform, utriform or subcylindrical, 19–53 × 12–30 µm; pleurocystidia utriform, oblong or cylindrical, 40–82.5 × 15–27 µm; pileipellis hymeniform; veil, pileocystidia, and caulocystidia not found.

Remarks—On the basis of the shape and the size of the basidiospores, this collection belongs to *P. lactea* (*P. leiocephala*). The holotype fruitbodies are

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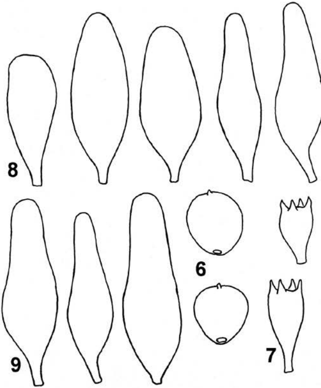

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Fig. 6–9. Spores (6), basidia (7), cheilo- (8), and pleurocystidia (9) from the type of *C. galericuliformis.*

imperfectly matured, which causes the basidiospores to be more globose than typical in *P. lactea*. In our experience, the basidiospores reach their final rounded triangular or angled shape in the last stage of development, and accordingly no taxonomic value can be assigned to subglobose basidiospores in this case. Specimens with subglobose spores have recently been included in ITS- and LSU-sequence based phylogenetic analyses. With strong support from Bayesian, Maximum Likelihood, and Maximum Parsimony analyses, they were nested in the clade formed by *P. lactea* specimens (Nagy et al. 2009). That study strongly suggests that subtle spore shape differences should be regarded cautiously and that spore size should be given higher priority in defining the taxa of *Parasola*.

According to the original description (Watling 1967), the pleurocystidia are lacking, a statement that we cannot confirm here. Numerous utriform–oblong pleurocystidia were found on the sides of the gills. A lack of pleurocystidia would be surprising, as all but one collapsing species (*P. misera*) of *Parasola* possess pleurocystidia.

Roux & Garcia (Roux 2006) recently treated *P. galericuliformis* (and *P. leiocephala*) as a variety of *P. plicatilis*. However, our molecular and morphological results suggest that *P. galericuliformis* is synonymous with *P. lactea* (= *P. leiocephala*) a species distinct from *P. plicatilis* (Nagy et al. 2009).

Coprinus hercules Uljé & Bas, Persoonia 12: 483 (1985). FIG. 10.

HOLOTYPE: The Netherlands: Leiden, 10 August 1984, C.B. Uljé (L).

ORIGINAL DIAGNOSIS: *Pileus primo campanulatus vel hemisphaericus, dein convexus vel applanatus, 8–14(–17) mm latus, sulcatus usque ad centrum, brunneus vel pallide brunneus, postea cinerascens, nudus. Lamellae liberae, subdistantes (L = 16–24; l = 0–1(–3), ex albo cinerascentes vel nigricantes. Stipes 48–71 × 0.6–1.2 mm, sursum subattenuatus, albidus, subvitreus, glaber, fragilis, basi subbulbosus. Sporae 12.4–17.2 × 11.3–15.2 × 8.2–10.8 μm, valde lentiformes, subtriangulatae vel subquinque-angulatae, poro germinativo excentrico instructae, obscure rubro-brunneae (fere nigrae), in cumulo purpureo-nigrae; basidia 4-sporigera. Cheilocystidia vesiculosa vel late utriformia, usque ad 50(–70) μm longa. 10–23(–30) μm lata. Pleurocystidia subutriformia vel subcylindrica, usque ad 105 μm longa, 22–30 μm lata. Pileipellis hymeniformis. Fibulae praesentes.*

OBSERVATIONS ON THE TYPE—The holotype contains several well-preserved, but old, fruiting bodies. Unfortunately, all microscopic cells have collapsed except the basidiospores.

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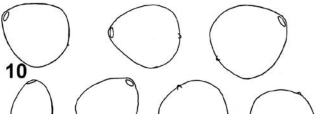

FIG. 10. Spores from the type of *C. hercules*.

BASIDIOSPORES [20,1,1] 13.8–17.5 × 14.8–16.9 × 10–11 μm, on average 15.83 × 15.42 × 10.63 μm, Q_1 = 0.9–1.15, Q_2 = 1.4–1.5; strongly lentiform, in the frontal view rounded triangular or quadrangular, more rarely subglobose or ovoid, in the lateral view ellipsoid to amygdaliform, with a strongly eccentric, 2.6–2.7 µm wide germ-pore, color very dark reddish-brown, almost blackish, opaque, smooth, with a moderately thick wall; BASIDIA, PLEURO-, and CHEILOCYSTIDIA collapsed; PILEIPELLIS hymeniform; VEIL, PILEOCYSTIDIA, and CAULOCYSTIDIA not found.

REMARKS—The diminutive fruitbody size and the low number of lamellae could also be observed on the type. According to the general view (Uljé & Bas 1985, 1988, Vila & Rocabruna 1996), these are diagnostic features that distinguish *P. hercules* from *P. schroeteri*. In our experience, *P. schroeteri* is macromorphologically a very variable species, and poorly developed small fruitbodies can be encountered. Furthermore, habitat preferences cannot be considered diagnostic, as both *P. schroeteri* and *P. hercules* also occur on both dung and soil. Therefore, we assign diagnostic value only to the size of the spores. The distinction of *P. hercules* from *P. schroeteri*, however, is strongly supported by molecular results (Nagy et al. 2009).

Coprinus kuehneri Uljé & Bas, Persoonia 13: 438 (1988). FIGS. 11–15.

HOLOTYPE: The Netherlands: prov. Zuid-Holland, Leiden, park Leiden-Noord. 31 May 1987., C.B. Uljé (L).

ORIGINAL DIAGNOSIS: *Pileus ad 35 mm latus, sulcatus, obscure rubrobrunneus, interdum autantiobrunneus vel flavobrunneus, postea cinerascens, glaber. Lamellae stipite remotae, primo albidae, dein griseobrunneae vel atrogriseae. Stipes ad 100 × 3 mm, sordide albidus vel sordide albobrunneus. Sporae 6.5–10.5 × 5.5–8 × 5–6 µ, Q = 1.05–1.6, Q = 1.16–1.45, cordiformes, ad rhombeae vel mitriformes inclinatae, 3–4-, raro 5 angulatae, porogermilani excentrico praeditae. Cheilocystidia 30–80 × 12–28 µ, collo 11–23 µ lata, cylindrica vel utriformes, interdum sublageniformes vel elongato-ellipsoidea, raro fere solum globosa. Pleurocystidia 40–100 × 22–40 µ, collo 21–30 µ lata, plus minusve cheilocystidiis similia. Fibulae adsunt.*

OBSERVATIONS ON THE TYPE—The holotype is a good collection, containing many fruiting bodies, both young and old. All microscopic details could be observed on the material.

BASIDIOSPORES [20,1,1] 8–10.4 × 7.2–8.4 × 5.4–6.3 µm, on average 9.36 × 7.85 × 5.9, Q_1 = 1.12–1.28 Q_2 = 1.45–1.60, strongly lentiform, in the frontal view (narrowly) ovoid to rounded triangular, some with rhomboidal outline, in the lateral view amygdaliform, with an eccentric, ca 1.5 µm wide germ-pore, dark reddish-brown, almost opaque in NH_4OH, smooth, with a moderately thick wall; BASIDIA four-spored, dimorphic, 27–40 × 8–10 µm; CHEILOCYSTIDIA abundant, very variable in shape and size, mainly cylindrical-utriform with some clavate or fusoid ones, 39–75 × 12–31.2 µm; PLEUROCYSTIDIA numerous, predominantly cylindrical, a few broadly fusoid and ellipsoid, some with an enlarged apex, 55–113 × 21–33 µm; PILEIPELLIS a hymeniderm; VEIL, PILEOCYSTIDIA, and CAULOCYSTIDIA not found.

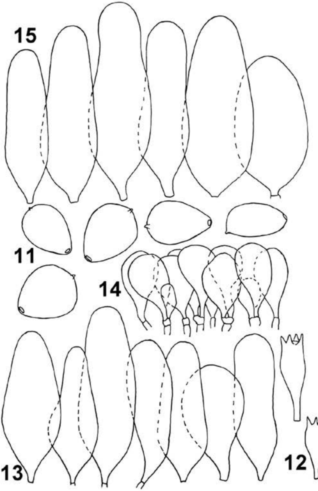

Fig. 11–15. Type material of *C. kuehneri.*
Spores (11), basidia (12), cheilo- (13), and pleurocystidia (15),
as well as pileipellis structure (14) could be observed.

Remarks—The spore size seems to be slightly too large as compared with other materials of this species (Nagy, unpubl.). Our observations in part contradict the original description (Uljé & Bas 1988) with regard to the size range of the spores. We think that the explanation of this difference in spore sizes is because Uljé & Bas (1988) measured several immature spores as well.

Coprinus leiocephalus P.D. Orton, Notes from the Royal Botanic Garden, Edinburgh 29: 88 (1969). FIG. 16.

HOLOTYPE: Scotland: Wheatfen, Surlingham, Norfolk, 18 Sept. 1965. Orton 2566 (E).

ORIGINAL DIAGNOSIS: *Pileus juventute 5–15 mm altus, 4–13 mm latus, dein 13–32 mm, ovoideus vel ellipsoideus dein conico-convexus, postremo expanso-convexus interdum ad discum depressus, castaneus, fulvo-brunneus vel ochraceo-mellinus ad discum obscuriore vel fulvo tinctus, siccitate pallide ochraceus vel sordide cremeus ad discum ochraceo-luteolobrunneus, rufo-brunneus vel fuscus, senectute circa marginem griseascens et radiliter sulcato-striatus, ad discum persistente laevis. Lamellae liberae, remotae, anguste lanceolatae, ex albido griseae vel colore pilei tinctae, postremo nigrescentes, vix confertae, L c. 32–40, l 0–1, ad aciem primo albo-flocculosae. Stipes (30)62–74(90)/1–2 mm, aequalis vel sursum leviter attenuatus, ex albo vel albido deorsum ochraceo-lutescens vel rufo-brunnescens; glaber, opacus, cavus, fragilis, ad basim albo tomentosus vel strigoso-tomentosus. Caro tenuissima, ad discum colore pilei concolorata. Odor nullus.*

*Sporae lentiformes, ellipsoideae vel ovoideae leviter angulatae, poro germinativo excentrico aliquantum amplo, 8.5–11/5.5–6.5/7–8.5 µm (*FIG. 1, g*), sub micr. obscure rufo-brunneo, in cumulo fere nigrae. Cystidia aciei lamellarum vesiculoso-clavata 30–42/16–32 µm, vel lageniformia ad apicem obtusa, 50–84(–92)/12–32 µm ad apicem 10–18(–24) µm lata. Cystidia faciei lamellarum vesiculose-clavate, pyriformia vel utriforme-lagiformia ad apicum obtuse lata c. 50–90/16–42 µm. Cellulae cuticulae pilei globosae vel ellipsoideae, setulae nullae.*

Ad terram, solitarius vel catervatim, vulgo in locis humidis: Shobdon Herefordshire, 24 Oct. 1959; Wheatfen, Surlingham, Norfolk, 18 Sept. 1965, P.D. Orton. (typus in Herb. Kew.); ad solum vel ad lignam purridissimam solitarius vel subcaespitosus, Freshfield, Lancs., 16 Sept. 1959. A sporis et probibiliter habitatione distinguitur.

OBSERVATIONS ON THE TYPE—The holotype contains mature, well-preserved fruiting bodies; unfortunately, however, only spores and incomplete, collapsed basidia could be observed.

BASIDIOSPORES [30,1,1] 9.5–12 × 8.4–9.5 × 6.2–7 µm, on average 10.73 × 8.81 × 6.73 µm, Q_1 = 1.06–1.32, Q_2 = 1.57–1.79 strongly lentiform, in the frontal view mainly ovoid, rarely rounded triangular, subhexagonal or subglobose, mostly with a rounded apex, rarely subpapillate, in the lateral view ellipsoid, with a moderately thickened wall, germ-pore eccentric, ca. 1.8 µm in diameter, color very dark reddish-brown, subopaque, smooth, with moderately thick wall; BASIDIA four-spored, clavate, bimorphic, mainly collapsed; PLEUROCYSTIDIA and CHEILOCYSTIDIA collapsed; VEIL, PILEOCYSTIDIA, and CAULOCYSTIDIA not found.

REMARKS—The basidiospores of the holotype mainly have an obtuse apex, in contrast to numerous other *P. leiocephala* collections cited as having basidiospores with an acute, often papillate end (Breitenbach & Kränzlin 1995, Lanconelli 2003, Orton 1972, Orton &Watling 1979, Uljé & Bas 1988, Uljé &

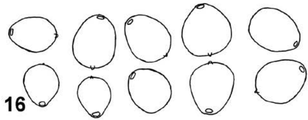

FIG. 16. Spores from the type of *C. leiocephalus*.

Bender 1997). Despite this discrepancy, the examined collection falls within the range of variability cited for this species. It is well known that *P. leiocephala* is an extremely variable species both macroscopically and microscopically (Uljé & Bas 1988, Uljé & Bender 1997, Nagy et al. 2009). Its spore shape ranges from markedly rounded triangular with distinct angles to subglobose with hardly visible angles. Further, spore shapes commonly vary considerably within a single fruiting body, showing different proportions of rounded and triangular spores (Nagy, unpubl.).

This species was recently reduced to varietal status under *P. plicatilis* (Roux 2006). There is, however, strong (phylogenetic) evidence in favour of treating *P. leiocephala* as a species separate from *P. plicatilis* (Nagy et al. 2009).

Coprinus lilatinctus Bender & Uljé, in Uljé & Bender, Persoonia 16: 373 (1997).
FIGS. 17–20.

HOLOTYPE: The Netherlands: Alphen a/d Rijn, prope Zegerplas, 27. August 1988, C.B. Uljé 987 (L).

ORIGINAL DIAGNOSIS: *Pileus junior usque ad 30 mm altus, 16 mm latus, cylindricus, ellipsoideus vel conicus, adultus ad 50 mm latus, junior distincte lilacino-tinctus, demum lilaceo-griseo-brunneus vel pallide griseo-brunneus vel griseus, glaber. Lamellae, L = 36–45, l = 1–3(–5), liberae, primo albae demum griseae vel atrae acie pallidior. Stipes usque ad 100 × 2–3 mm, versus basim incrassatus vel bulbosus, albus vel griseo-albus.*

Sporae 9.6–13.3 × 9.0–11.2 × 6.1–8.3 µm, 5-angulatae, cordiformes, poro germinativo excentrico praeditae. Basidia 20–45 × 9–12 µm, tetrasporigera. Cheilocystidia 25–70 × 12–28 µm, vesiculosa, ellipsoidea, obovoidea vel subcylindracea, interdum utriformia. Pleurocystidia 30–95 × 22–38 µm, vesiculosa, subcylindracea, ellipsoidea vel subutriformia. Fibulae presentes. Pileipellis hymeniformis e elementis clavatis vel vesiculosis. Elementae microscopicae, praesertim in pilei-pelle vel hymenio cum granulae griseo-alutaceae. Ad terram argillaceam vel ad fragmentam lignam, gregarius.

OBSERVATIONS ON THE TYPE—The holotype consists of several fruiting bodies, including young and mature ones, perfectly preserved. No trace of a lilaceous tint was seen on the fruiting bodies, and they were slightly more golden-yellow than usual in *P. lactea*.

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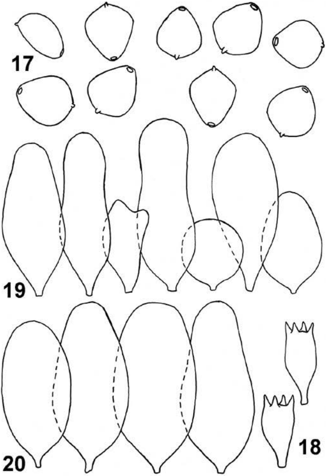


Fig. 17–20. Spores (17), basidia (18), cheilo- (19), and pleurocystidia (20) from the holotype of *C. lilatinctus*.

Basidiospores [20,1,1] 11–13.5 × 9–10.8 × 6.7–7.5 µm, on average 12.01 × 9.86 × 7.35 µm, Q_1 = 1.14–1.33, Q_2 = 1.6–1.75 strongly lentiform, in the frontal view mainly quadrangular to rounded triangular, sometimes 5- or 6-angled, or ovoid, ellipsoid to amygdaliform in lateral view, with a strongly eccentric, 1.6–1.9 µm wide germ-pore, smooth, with a moderately thick wall; basidia four-spored, clavate, bimorphic, surrounded by pseudoparaphyses, 22–34 × 10–12 µm; CHEILOCYSTIDIA abundant, versiform, mainly cylindrical, ellipsoid or oblong, more rarely utriform or globose, 27–49 × 15–20 µm; PLEUROCYSTIDIA subcylindrical, ellipsoid, oblong or obovoid, rather abundant, 50–67 × 27–32 µm; PILEIPELLIS hymeniform, glabrous; no droplets could be observed in the basidia, pseudoparaphyses or pileipellis elements; VEIL, PILEOCYSTIDIA, and CAULOCYSTIDIA not found.

REMARKS—Although we could not find the yellowish droplets typical of *P. lilatincta* in the type, their original presence cannot be excluded. Both Uljé (in Uljé & Bender 1997, Uljé 2005) and we have repeatedly observed that these droplets disappear from the cells in older herbarium materials. Upon examination of other materials collected by Uljé at the same locality (e.g. *Uljé 1212,* preserved in L), we found traces of oily droplets, mainly in the pileipellis.

Similarly, although the lilaceous colouration could not be observed in the type material, many other specimens collected by Uljé exhibited lilaceous tints.

Coprinus megaspermus P.D. Orton, Notes from the Royal Botanic Garden, Edinburgh 32: 141 (1972). FIG. 21.

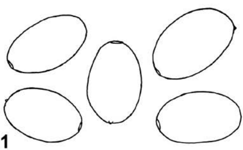
HOLOTYPE: United Kingdom, England: Norfolk. Hedenham Wood, ad terram, 24. October 1971, Orton 4132 (E).

ORIGINAL DIAGNOSIS: *A sociis a sporis vix lentiformibus permagnis facile distinguitur.*

*Pileus ovoideus, 11/12 mm, dein expansus ad discum depressus, 15–30 mm, juventute fere ferrugineus dein ad discum fulvus vel cinnamomeus et ad marginem versus argillaceo-luteolus et forte plicato-striatus, vix deliquescens circa discum senectute cinnamomeotinctus. Lamellae ± liberae, nigricantes, confertae, L= ca. 50, l= 0–1, ad aciem albidoflocculosae. Stipes 52–60/2 mm; aequalis vel ad basim leviter incrassatus, albus dein pallide argillaceo-luteolus, laevis, ad basim tomentosus. Caro ad discum pilei admodum crassa. Sporae ellipsoideae vel ellipsoideo-ovoideae interdum leviter lentiformes, 15–18/8.5–9.5/10–11 µm (*FIG. 1.f*), in cumulo nigro-umbrinae. Basidia 4-sporigera. Cystidia aciei lamellarum ± lageniformia, ca. 50–60/18–20 µm, ad apicem conicum vel cylindrico-obtusum 8–10 µm latae. Cystidia faciei lamellarum non vidi. Cellulae cuticulae pilei 12–28 µm latae. Setulae et sphaerocystes desunt.*

OBSERVATIONS ON THE TYPE—The holotype contains two, slightly fragmented mature fruiting bodies in good condition. All microscopic details have collapsed, except the basidiospores.

BASIDIOSPORES [26,1,1] 15–18.7 × 10–12 × 7.7–9 µm, on average 16.5 × 10.66 × 8.5 µm, Q_1 = 1.40–1.78, Q_2 = 1.83–1.95 strongly lentiform, in the frontal view ellipsoid, broadly ellipsoid, rarely ovoid, in the lateral view ellipsoid or subamygdaliform, germ-pore slightly eccentric, 2–2.3 µm wide, color very dark reddish brown, subopaque, smooth, with moderately thick wall; BASIDIA,



21

Fig. 21. Spores from the type of *C. megaspermus*.

pleurocystidia and cheilocystidia collapsed; veil, pileocystidia, and caulocystidia not found.

Remarks—The germ-pore in this collection is eccentric, albeit only slightly, which is in contrast with the finding of Orton (1972), who described the germ-pore as central. In fact, *P. megasperma* can have either a central or a more or less eccentric germ-pore, even in the same collection (Uljé & Bas 1988, Uljé 2005), so this discrepancy does not compromise the interpretation of this taxon. Phylogenetic analyses supported the view that the position of the germ-pore in this species is variable (Nagy et al. 2009).

Coprinus nudiceps P.D. Orton, Notes from the Royal Botanic Garden, Edinburgh 32: 142 (1972). Figs. 22–24.

Holotype: United Kingdom, Scotland: Inverness-shire. Tomich, ad fimum equinum, 3 September 1971, Orton 4133 (E).

Original diagnosis: *A* C. misero *sporis majoribus et habitu robustiore differt. Pileus ellipsoideus vel ovoideus 7–15/4–8 mm, dein expansus 9–24 mm interdum ad discum depressus, luteolus vel ochraceus dein ad discum fulvum vel cinnamomeum versus griseascens, primo laevis leviter nitidus, mox ad marginem dein ad discum versus sulcatus vel plicato-striatus, ad marginem postremo manifeste laceratus vel radialiter fissuratus. Lamellae liberae vel anguste adnatae, e pallide luteolo vel ochraceo mox umbrinae vel nigricantes, subconfertae, ad aciem primo albo-flocculosae. Stipes 30–60/0.5–1 mm, sursum attenuatus, leviter bulbosus (ad basim 1.5–3 mm latus) ex albido sordide cremeus vel cremeo-luteolofuscus, minute adpresse sericeostriatus, ad basim primo fibrillis albosericeis manifestis obtectus. Caro pilei concolorata ad discum admodum crassa. Odor nullus.*

*Sporae lentiformes, ellipsoideo-ovoideae vel subgloboso-triangulares interdum leviter 5- vel 6-angulatae, 13–15.5/8.5–9.5/10–12 µm (*Fig. 1.h*), poro germinativo medio, in cumulo violaceonigrae. Basidia 4-sporigera. Cystidia aciei lamellarum pyriformia vel utriformia interdum irregulare vel late fusiformia vel vesiculosa, 30–60/14–28 µm. Cystidia faciei lamellarum non vidi. Cellulae cuticulae pilei 10–26 µm latae. Setulae et sphaerocystes desunt.*

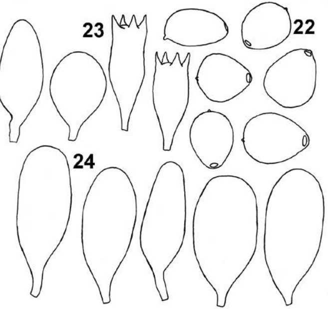


FIG. 22–24. Spores (22), basidia (23), and cheilocystidia (24) from type material of *C. nudiceps*.

OBSERVATIONS ON THE TYPE—The holotype contains both young and mature fruiting bodies, preserved in a very good state. All essential features could be observed except cheilocystidia, which were impossible to locate because of the fragmentation of the gill edges.

BASIDIOSPORES [22,1,1] 11.8–16 × 11–13 × 8.2–8.7 µm, on average 13.94 × 11.84 × 8.45 µm, Q_1 = 1.07–1.37, Q_2 = 1.6–1.68 strongly lentiform, in the frontal view broadly ovoid to rounded triangular, some ovoid, in the lateral view ellipsoid or slightly amygdaliform, wall moderately thickened, with a strongly eccentric ca. 2 µm wide germ-pore, smooth, with a moderately thick wall; BASIDIA four-spored, clavate, bimorphic 42–58 × 10–15 µm, surrounded by pseudoparaphyses; PLEUROCYSTIDIA abundant, from subglobose to ellipsoid, often utriform, 40–90 × 32–40 µm; VEIL, PILEOCYSTIDIA, CHEILOCYSTIDIA, and CAULOCYSTIDIA not found.

REMARKS—Our examinations of the type confirm the general view that *C. nudiceps* is a younger synonym of *P. schroeteri* (Breitenbach & Kränzlin 1995, Uljé & Bas 1988, Uljé & Bender 1997, Uljé 2005).

In the protologue, Orton (1972: 144) states that the germ-pore is central, which cannot be confirmed here. As Orton himself depicts correctly (Fig. 1g, p. 143), the germ-pore is eccentric as is typical for this species.

Coprinus pachyterus Berk. & Broome, Journal of the Linnean Society, Botany 11: 561 (1871). FIGS. 25–26.

ISOTYPE: Sri Lanka: Peradeniya, on soil. October 1868. Thwaites 806. (K).

ORIGINAL DIAGNOSIS: *Pileo persistenter campanulato plicato-sulcato; stipite firmiore; lamellis arcuatis adnexis. (N° 806).*

Hab. Ad terram, Peradeniya Ceylon (Thwaites)–Pileus 5 cm. latus glaber; stipes 6–8 cm. longus, validior quam in C. plicatili.

OBSERVATIONS ON THE TYPE—The holotype contains 4 entire fruiting bodies glued on paper cards. The specimens are in a rather good state.

BASIDIOSPORES [20,1,1] 11.5–13.8 × 7.3–8.2 × 6.8–7.8 µm, on average 12.61 × 7.81 × 7.2 µm, Q_1 = 1.47–1.84, Q_2 = 1.57–1.86 strongly lentiform, in the frontal view ellipsoid to oblong, in the lateral view amygdaliform, slightly flattened with a central, 1.5–1.8 µm wide germ-pore, dark blackish-brown, subopaque, smooth, with moderately thick wall; BASIDIA, PLEUROCYSTIDIA, and CHEILOCYSTIDIA collapsed; PILEIPELLIS in a poor state, cuticular; VEIL elements on pileipellis diverticulate, made up of dichotomously branched, coralloid elements 5–9 µm in diameter, terminal elements often inflated, clavate; excrescences mostly with acute tips; wall of velar elements hyaline, 1–3 µm thick in places; clamp connections present.

REMARKS—The material obtained on loan (coll. Thwaites 806) belongs to subsection *Alachuani* of the genus *Coprinus* s.l. by virtue of the diverticulate velar elements on the pileus and the cuticular pileipellis. In that subsection, it is apparently conspecific with *C. vermiculifer* (Joss. ex Dennis) Redhead et al. as this is the only species that combines large basidiospores with thick-walled velar elements (Josserand 1944, Uljé & Noordeloos 1996, 1997). The only difference between the types of *C. pachyterus* and *C. vermiculifer* that could be found is that *C. vermiculifer* grows on dung, based on the very limited number of collections known worldwide (Enderle et al. 1986, Uljé 2005, Uljé & Noordeloos 1996, 1997, Doveri 2004). This is of very limited value, however, considering the scarce information available on *C. vermiculifer*. Pegler (1986), who also studied the type and other collections of *C. pachyterus,* reported a hymeniform pileipellis, devoid of any veil-like structures. Further, he noted that the material consisted of two species; he referred one to *P. plicatilis* and the other to a taxon close to *P. hemerobia* (Fr.) Redhead et al. At present, *P. plicatilis* and *P. hemerobia* s. auct., which have a hymeniform pileipellis, are considered synonymous (Nagy et al. 2009, Uljé & Bas 1988, Uljé 2005, present work). However, the fungus that we examined clearly has an *Alachuani*-type veil and a

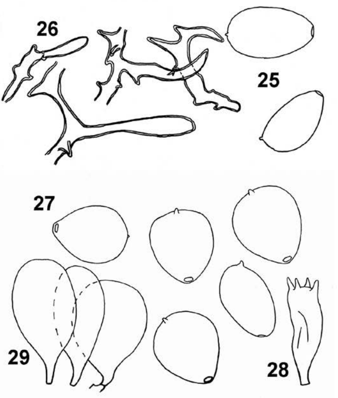


FIG. 25–29. *Coprinus pachyterus* and *C. plicatilis* var. *filopes*.
FIGS. 25 and 26 represent spores and velar elements of *C. pachyterus*.
For *C. plicatilis* var. *filopes* spores (27), a basidium (28), and pileipellis cells (29) are depicted.

cuticular pileipellis, which was confirmed by re-examination of the microscopic slide made from the type. Moreover, the shape of the spores (which tend to be oblong) and central germ-pore indicate that this specimen is more similar to *C. vermiculifer*. As it is questionable whether we obtained the same specimen on loan that Pegler (1986) examined, no further conclusions can be drawn.

Coprinus pallidus Berk. & Broome, Journal of the Linnean Society, Botany 11: 560 (1871). FIGS. 1–3.

ISOTYPE: Sri Lanka: on dead wood, September 1868. G.H.K. Thwaites 1157 (Berk. 1405) (K).

Original diagnosis: *Pileo inaequali subcylindrico pallido, disco laevi umbrino; stipite flexuoso fistuloso pallido; lamellis subliberis fuscis (No. 1157, cum icone). On dead wood. July 1869.*

Pileus 3 line across, 5 high, pale umber, disc even, much dark, its edges reflected; stem flexuous, 1.5 inches high, 1 line thick, fistulose, equal, smooth, pale umber, truncate at the base; gills 1 line wide, umber, then dark brown, slightly ventricose, nearly free; spores – 0003 [0.0003 inches] long.

Observations on the type—The type material obtained from Kew contains one fruiting body in two parts, glued on a paper card and in a rather poor state. One part of the fruiting body is immature; the other parts are mature. Because of the poor state of the material, only spores, basidia, and sclerocystidia were observable. The hymenium seemed to be in good state, but cystidia were not found.

Basidiospores [20,1,1] 9–11 × 7.5–8.6 × 5.7–6 µm, on average 9.7 × 8.03 × 5.7 µm, Q_1 = 1.08–1.32, Q_2 = 1.55–1.65, lentiform, ovoid to subglobose with a rounded apex and base, not rounded triangular, but some tend to be minimally angular in the frontal view, ellipsoid, slightly amygdaloid in the lateral view, thick-walled, medium red-brown under the microscope, germ-pore central, rather small, 1.4–1.6 µm; basidia four-spored, clavate, bimorphic, ca. 22.5 × 11 µm; cystidia not found; pileipellis structure not observable, long, thick-walled, lageniform, brownish sclerocystidia present, these measure 87–150 × 6–8 µm.

Remarks—The lentiform, ovoid spores combined with sclerocystidia on the pileus readily identify this species as *P. setulosa* (Berk. & Broome) Redhead et al., as already noted by Pegler (1986). The only discrepancy that we found between the types of *P. setulosa* and *C. pallidus* is that *P. setulosa* has extremely large, pike-like sclerocystidia, whereas those of *C. pallidus* are more like those of *P. auricoma*. However, *P. setulosa* is still insufficiently known to allow the assumption that this difference falls within the range of the variability for that species.

Coprinus plicatilis* var. *filopes Wichanský, Mykologický Sborník 45: 16 (1968).
Figs. 27–29.

Holotype: Czech Republic: Prague, Kinského sady, Loco graminoso, 29. Sept., 1967, Wichansky (PRM).

Original diagnosis: *A typo differt pileo tenerrimo maturitate plane explanato 7 mm diametro, lamellis angustis, distantibus, non diffluentibus, stipite hyalino, filiformi, usque 5 cm alto et 0.5 mm crasso.*

Auctor 2 specimina loco graminoso ad viam 29. IX. 1967 in horto publico Kinského sady dicto Pragae legit. Typus in herbario Musei nationalis Pragae depositus est.

Observations on the type—The holotype envelope contains a small amount of material with fully mature pilei. Two other collections were also obtained on loan (PRM 682556 and 682555), which were collected one year later at the same locality by Wichanský. They display similar features to those of the holotype but are also mature.

BASIDIOSPORES [20,1,1] 9.6–12 × 8.6–10.3 × 6.3–7 µm, on average 10.93 × 9.3 × 6.77 µm, Q_1 = 1.09–1.30, Q_2 = 1.5–1.65, strongly lentiform, in the frontal view mostly ovoid or rounded triangular, rarely rectangular, apex often subpapillate, in the lateral view ellipsoid, to subamygdaloid, with a 1.4–1.7 µm wide, eccentric germ-pore, dark reddish-brown, smooth, with moderately thick wall; BASIDIA mainly collapsed, four-spored, clavate, ca. 27 × 10 µm; PLEUROCYSTIDIA and CHEILOCYSTIDIA collapsed; VEIL, PILEOCYSTIDIA, and CAULOCYSTIDIA not found; PILEIPELLIS hymeniform, composed of vesiculose-clavate elements, no pigment or oily granules observed, elements 25–37 × 20–27 µm.

REMARKS—The spores of the holotype clearly show that this taxon is synonymous with *P. lactea*. Indeed, the fruitbodies are smaller than normal in *P. lactea*, but this feature is of no taxonomic value at all in view of the considerable variability that can be encountered even within one collection.

Coprinus schroeteri P. Karst., Meddelanden af Societas pro Fauna et Flora Fennica 5: 34. (1879). FIG. 30.

HOLOTYPE: Finland: Tavastia, Mustiala, in fimo bovino, 20. August 1878. Karst. 3762. (H).

ORIGINAL DIAGNOSIS: *Pileus tenerrimus, ex ellipsoideo vel ovoideo expansus revolutusque, sulcatus, glaber, ochreo-isabellinus vel subgilvus, expallens, demum dilute fuliginatus, ad 1 cm. usque latus. Stipes aequalis, sursum leviter striatulus, primitus puberulus, 1–2 cm. longus. Lamellae fuscae. Sporae angulato-ovoideae, subinde anguloso-sphaeroideae vel sphaeroideo-ellipsoideae, fuscae (s. l.), pellucidae, longit. 13–15 mmm., crassit. 8–12 mmm. In fimo bovino prope Mustiala die 20 m. Aug. h. a. semel. Priori proximus. Solitarius.*

OBSERVATIONS ON THE TYPE—The type material obtained on loan was in poor condition. The only character that we succeeded in observing in detail was the basidiospores.

BASIDIOSPORES [20,1,1] 13–15.3 × 11–12.8 × 9.2–11 µm, on average 14.44 × 11.83 × 9.72 µm, Q_1 = 1.16–1.27, Q_2 = 1.46–1.68 strongly lentiform, in the frontal view typically rectangular or rounded triangular with or without median constriction, more rarely ovoid, in the lateral view ellipsoid, mostly immature, with large, 2–2.3 µm wide, eccentric germ-pore, subopaque, very dark reddish brown, smooth, with a moderately thick wall; BASIDIA mainly collapsed, four-spored, clavate; PLEUROCYSTIDIA and CHEILOCYSTIDIA collapsed; VEIL, PILEOCYSTIDIA, and CAULOCYSTIDIA not found.

REMARKS—This collection is typical of the taxon it represents. The large, 13–15 µm long, rounded triangular spores are characteristic of this species, as is its habit on dung. The species was long considered obligately coprophilous (Bender

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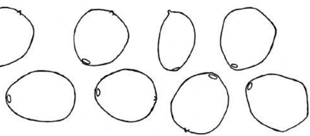

Fig. 30. Spores from the type of *C. schroeteri.*

& Enderle 1988, Orton 1972, Orton & Watling 1979). We examined over 60 collections (Nagy, unpublished) and found that it grows more often on soil than on dung. Generally, the taxa of the genus *Parasola* are more or less ubiquitous in terms of the habitat, except for *P. misera,* the only obligately coprophilous species in this group (Uljé 2005).

Coprinus setulosus Berk. & Broome, Journal of the Linnean Society, Botany 11: 561 (1871). Figs. 31–33.

Lectotype: Sri Lanka: Peradeniya, habitat and date not given, Thwaites 936. (K) (Pelger 1968: 511) Syntype: same locality, Thwaites 845. (K)

Original diagnosis: *Pileo cylindrico campanulato obtuso usque ad discum striato setis fulvis undique obsito; stipite fistulosus candido sursum attenuato; lamellis angustissimus adnexis. (N° 845, cum icone, N° 936).*

Hab. in vegetabilibus emortius, Peradeniya Ceylon (Thwaites)–Pileus 10 mm. altus, basi 4 mm. latus; stipes 2.5 cm. longus, medio 1 mm. crassus; lamellae adscendentes, non perfecte evoluta in speciminibus, in quibus candidae sunt sporisque carentes.

Observations on the type—The holotype contains 2 partly decayed fruiting bodies (1 old, 1 young) stuck on paper cards.

Basidiospores [21,1,1] 8.8–10.4 × 7.4–8.9 × 5.3–6.7 µm, on average 9.69 × 8.12 × 6.06 µm, Q_1 = 1.12–1.36, Q_2 = 1.40–1.88, strongly lentiform, in the frontal view subglobose-broadly ovoid, often minutely subhexagonal or triangular, in the lateral view ellipsoid to subamygdaliform, with a prominent hilum, a central germ-pore, 1.7–1.9 µm wide, color dark reddish brown, smooth, with a moderately thick wall; basidia not seen; cheilocystidia mainly collapsed, only a single complete cystidium was found, which was utriform; pleurocystidia collapsed, probably subcylindrical-oblong; pileipellis hymeniform, with long, lancet-like sclerocystidia (hairs), with brown, thick walls and an obtuse apex (as compared to *P. auricoma*), 150–310 × 10–16 µm, walls up to 3.5 µm thick; veil and caulocystidia not found.

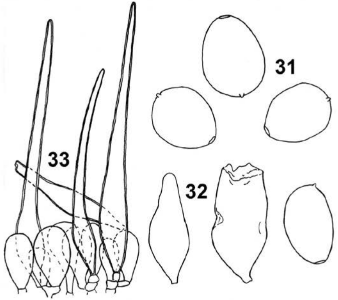

Fig. 31–33. Type material of *C. setulosus*.
Spores (31), partial cystidia (32), and sclerocystidia (33) could be observed.

Remarks—This is a good species in its own right, but, unfortunately, we know of no recent records. The only specimen reported as *C. setulosus* (WU 14796, leg.: A. Hausknecht, in herb.) is from La Réunion, but this represents a hitherto unclarified *Parasola* taxon with completely elliptical, 7–10 µm long basidiospores that may well represent an undescribed species.

Pseudocoprinus besseyi A.H. Sm., in Smith & Hesler, Journal of the Elisha Mitchell Scientific Society 62: 189 (1946). Figs. 34–36.

Holotype: USA: Michigan, East Lansing, 27. September 1945, E.A. Bessey (MICH).

Original diagnosis: *Pileus 1–2.5 cm. altus, 15–20 mm. crassus, conicus, subviscidus, glaber, demum convexus et udus, levis demum plicato-striatus, castaneus demum incarnato-cinnamomeus; lamellae confertae demum subdistantes, adnatae, angustae; stipes (3)5–8(9) cm. longus, 3–4.5 mm. crassus, aequalis, subalbidus, glaber; sporae 12–15(16) × 7–7.5 × 8–8.5 µ; pleurocystidia 100–160 × 20–30 µ, subventricosa, obtusa; cheilocystidia vesiculosa vel ventricosa, 16–25 × 10–18 µ vel 28–42 × 12–16 µ.*

Habit, habitat and distribution: Scattered to gregarious around and on plant debris, in compost heaps, buried wood, sticks and on lawns but then usually from buried debris.

34

35

36

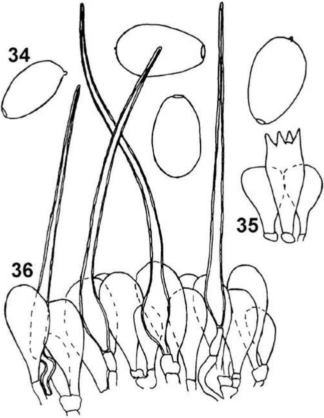

Fig. 34–36. Spores (34), basidia (35), and sclerocystidia (36) from the type material of *Pseudocoprinus besseyi*.

Observations on the type—Only part of the holotype was obtained on loan. This contained fragments of probably artificially matured fruiting bodies, in which most cells were collapsed.

Basidiospores [20,1,1] 13–15 × 8–8.9 × 7.5 µm, on average 13.79 × 8.44 µm, $Q_1 = 1.51–1.74$, $Q_2 \approx 1.8$ strongly lentiform, in the frontal view oblong to subcylindrical, not flattened, with a 1.5–1.8 µm wide central germ-pore, color red-brown, smooth, with a moderately thick wall; basidia four-spored, clavate, bimorphic, mainly collapsed; pleurocystidia and cheilocystidia collapsed;

PILEIPELLIS hymeniform, with numerous brown thick-walled erect hairs, up to 250 µm in length; VEIL and CAULOCYSTIDIA not found.

REMARKS—These specimens clearly belong to *P. auricoma*, a well-known, widespread representative of the genus, on account of the ellipsoid spores with a central germ-pore and thick-walled hairs on the pileus. As the epithet *auricomus* dates back to 1886, it has priority over *Ps. besseyi*. Although the basidiospores are on average somewhat larger than usual in *P. auricoma*, we have confirmed that this specimen represents a younger synonym for *P. auricoma*.

Pseudocoprinus lacteus A.H. Sm., in Smith & Hesler, Journal of the Elisha Mitchell Scientific Society 62: 191. (1946). FIGS. 37–39.

HOLOTYPE: USA: Michigan, Ann Arbor, Sept. 12., 1945, A.H. Smith 20520-type. (MICH).

ORIGINAL DIAGNOSIS: *Pileus 10–15 mm. altus, 8–10 mm. latus, conicus, glaber, plicatostriatus, ad discum levis, lacteus vel „pinkish buff" (pallide argillaceus), demum lividus; lamellae adnatae, confertae, angustae, lacteae demum fuscae; stipes 3–5 cm. longus 1mm. crassus, aequalis, glaber, fragilissimus; sporae 8.4–10.5 × 5–6.3 × 7–8.4 µ; cheilocystidia distinctissima, 22–36 × (8)10–16 µ.*

Habit, habitat and distribution: Gregarious to scattered on bare soil in an oak woods.

OBSERVATIONS ON THE TYPE—Only a part of the holotype was obtained on loan. This contained portions of well-preserved, mainly mature fruiting bodies with a striking whitish pileus. Of the taxonomically important characters, we succeeded in observing basidiospores, basidia, and pleurocystidia.

BASIDIOSPORES [20,1,1] 9.2–11 × 8.2–9.2 × 5.8–6.3 µm, on average 9.99 × 8.61 × 6.12 µm, Q_1 = 1.09–1.23, Q_2 = 1.47–1.66, strongly lentiform, in the frontal view mostly rounded triangular, some ovoid or subglobose present as well, in the lateral view ellipsoid, germ-pore eccentric, 1.5–1.7 µm in diameter, color dark reddish brown, more or less translucent, but this may be because many immature spores were found, smooth, with a moderately thick wall; BASIDIA four-spored (only incomplete, collapsed basidia were found), clavate; PLEUROCYSTIDIA broadly cylindrical or ellipsoid, ca. 67 × 30 µm; CHEILOCYSTIDIA collapsed; VEIL, PILEOCYSTIDIA, and CAULOCYSTIDIA not found.

REMARKS—To judge from the above description, this species represents a synonym of the taxon currently known as *P. leiocephala*. As the name *Ps. lacteus* (1946) is older than *C. leiocephalus* (1969) and is validly published, it has priority over the epithet *leiocephalus*. The affinity of *Ps. lacteus* to *P. leiocephala* has already been suggested by Uljé et Bas (1988).

The whitish pileus is somewhat unusual for this species, as in most cases the pileus color is some shade of ochraceous or pale-brownish. Such whitish, faded collections can exceptionally be encountered in dry weather (e.g. SZMC-

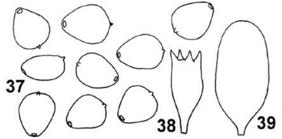

FIG. 37–39. Type material of *Pseudocoprinus lacteus*.
Spores (37), basidium (38), and pleurocystidium (39).

NL-0669 in our herbarium), but no taxonomic value can be assigned to them. In our opinion, both the holotype of *Ps. lacteus* and our collection represent extremities of the species currently known under the name *P. leiocephala* and therefore deserve no taxonomic status.

Nomenclatural revisions

Agaricus plicatilis Curtis, Flora Londinesis 1: tab. 215 [engraved no. 200]. (1781)

ORIGINAL DIAGNOSIS: Stalks single, in those which are full grown two inches of more in height, the size of a small wheat straw, upright, round, of the same thickness throughout, hollow, smooth, white, and tender.

Cap at first springs up is about size of a kernel of a hazel nut, of a yellowish brown color, scarce perceptibly striated, it soon becomes an oblong bell-shaped, the small furrows appear more evidently, are somewhat waved, and the color changes to grey or mouse color, now full grown it becomes more bell-shaped, and afterwards appears flat, is from an inch to an inch and half in diameter, of a mouse color, tender, pleated, the crown, flat, brown or white; the skin transparent, without any flash, at top not sprinkled with meal, of the ridges of the plaits somewhat willous, with the fructification is over, the edge becomes black and turns in.

Gills few, of the same color as the cap, throwing out a very fine powder of a bluish-black color.

Its usual place of growth is in pastures, meadows and grass plats, in all of which it is not infrequent during the months of September and October.

REMARKS—Although the protologue is quite obscure and may apply to any *Parasola* taxon, there is consensus about the interpretation and usage of the name *C. plicatilis* in recent literature (Uljé & Bas 1988, Uljé & Bender 1997, Uljé 2005). As Art 8.1 of the Botanical Code allows illustrations to serve as types, we hereby designate as lectotype:

LECTOTYPE HERE DESIGNATED: W. Curtis (1781), Flora Londinensis 1: tab. 215 [engraved no. 200].

Additionally, it seems necessary to designate an epitype in order to stabilize the taxonomy of this name and to give a thorough, modern description of the specimen:

EPITYPE HERE DESIGNATED: Hungary, Bács-Kiskun: Kecskemét, Nyír, *Convallario-Quercetum roboris* on sandy soil, 3 September 2006., L. Nagy, *SZMC-NL0075* (BP). FIGS. 40–43.

DESCRIPTION—PILEUS 5–10 × 8–20 mm when still closed, cylindrical, ellipsoid or obovoid, expanding to convex–hemispherical, finally applanate with a slightly enrolled margin and a markedly depressed disc, surface glabrous, radially translucently striate when young, on expanding becomes radially sulcate-grooved, up to 35 mm in diameter when fully expanded; margin even when young, soon becoming crenulate, color varying from melleous to pale-brown when young, becoming warm fawn on the ridges when mature, between ridges whitish, at centre with +/– sharply delimited darker button, on aging gradually becoming grayish-tinted, not discoloring; LAMELLAE crowded, thin, free, not reaching stipe, ending up in a collarium-like formation, up to 2 mm broad, not or only very slightly ventricose, edge fimbriate in young stages, white when young, later greyish, finally blackish, different parts of the gills do not mature in parallel, not deliquescent, only collapsing when fully mature; STIPE 0.5–3 × 30–70 mm, slender, fragile, fistulose, cylindrical, at base with scanty whitish tomentum, surface glabrous or finely longitudinally silky, whitish all over when young, on aging becoming pale-ochraceous; CONTEXT thin and brittle, whitish, without a distinct smell or taste.

BASIDIOSPORES [20,1,1] 10.8–14.2 × 7.8–8.5 × 6.8–7.5 µm, on average 12.41 × 8.21 × 7.14 µm, Q_1 = 1.34–1.67, Q_2 = 1.61–1.86, strongly lentiform, in the frontal view chiefly limoniform–subhexagonal, more rarely ovoid, broadly ellipsoid, in the lateral view ellipsoid to subamygdaliform, with an eccentric, 1.9–2.3 µm wide germ-pore, color very dark reddish brown, opaque, smooth, with a moderately thick wall; BASIDIA clavate, most with median constriction, bimorphic, 23–34 × 10–12 µm; CHEILOCYSTIDIA densely packed, mainly utriform, cylindrical, oblong, rarely clavate–globose, 40–60 × 13–27 µm; PLEUROCYSTIDIA mainly broadly utriform, oblong or subcylindrical, often obovoid, rather abundant; PILEIPELLIS hymeniform, glabrous; VEIL, PILEOCYSTIDIA, and CAULOCYSTIDIA absent; CLAMPS present.

Nuclear ribosomal ITS and LSU sequences have shown that the epitype collection is nested within the clade formed by other specimens of *P. plicatilis*. These sequences clustered together with other materials of *P. plicatilis*, forming a well-supported lineage (BPP: 1.00, ML and MP bootstrap: 100%) (Nagy et al. 2009). In this case it was important to test the position of the epitype specimens, because unpublished sequence data suggest the existence of another species related to *P. plicatilis*. Typical specimens of this hitherto undescribed taxon

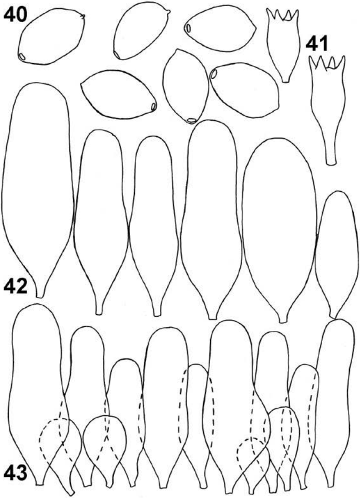

Fig. 40–43. Epitype of *Parasola plicatilis*.
Spores (40), basidia (41), pleuro- (42), and cheilocystidia (43) are depicted.

have a lilaceous stipe, and a slightly darker-brown pileus than *P. plicatilis*. As in *P. lilatincta*, it is often difficult to recognize the lilaceous colouration of the stipes.

Further, in dried specimens, the lilac colouration fades to a dark ochraceous tint, making identification of dry materials difficult.

Agaricus subtilis Fr., Systema Mycologicum 1: 302. (1821).

ORIGINAL DIAGNOSIS: *pileo submembranaceo campanulato levi albido, lamellis adnatis nigris, margine albis, stipite glabro albo. Tenellus. Stipes ½ unc. Longus, filiformis, nudus, laevis, fragilis. Pileus 3 lin. altus & latus, obtusus, leavis. Lamellae latiusculae, adscendentes, cinereo-nigricantes. In fimo locis udis silvaticis. Sept. Oct.*

REMARKS—Some authors consider this taxon a synonym of *P. misera* (e.g. Josserand 1962) or *P. schroeteri* (Bender & Enderle 1988). Although the original diagnosis allows such an interpretation, many important details are missing from the description, and we prefer therefore not to assign this name to *P. schroeteri*. Orton & Watling (1979: 10) came to the same conclusion.

Coprinus auricomus Pat., Tabulae Analyticae Fungorum 1(5): 200. (1886).

ORIGINAL DIAGNOSIS: Chapeau ovoide puis campanulé, membraneux, glabre sur la disque, pruineux (á la loupe) sur le restant, cendré-roux avec le sommet brun-rougeátre, finement strié. Lames étroites, serrées, roussátres-noires; cystides cylindriques; spores ocracées-brunes. Stipe vreux, gréle, blanc, fragile, glabre.

La jeune est d'abord enveloppé par un ozonium doré, dont il reste parfois des filaments sur le chapeau adulte et á la base du pied. L'aspect cendré pruineux du chapeau est du aux cellules epidermiques incolores placées sur un tissu roussátre.

Cespiteux sur les vieilles souches. Été. Bois de Vincennes.

REMARKS—We did not succeed in locating any specimen as type. However, Table 453 of Patouillard (1886: 200) can serve as type, and accordingly we hereby designate this as lectotype:

LECTOTYPE HERE DESIGNATED: N.T. Patouillard (1886) Tabulae Analyticae Fungorum 1(5): tab. 453. 1886.

The original description is sufficiently diagnostic for a clear-cut definition of this taxon.

The structure interpreted as ozonium by Patouillard may in fact represent abundant thick-walled hairs at the base of the stipe. This is often visible on young fruiting bodies, but vanishes during development of the stipe. We have not observed true ozonium in any species of *Parasola* to date.

Coprinus elongatipes A.H. Sm. & Hesler, Journal of the Elisha Mitchell Scientific Society 62: 180 (1946).

ORIGINAL DIAGNOSIS: *Pileus 2–5 cm. latus, conicus vel convexus, udus, glaber, hygrophanus, cinnamomeo-brunneus dein fulvus vel avellaneus, cum sicco atomatus, non plicatus; lamellae ferrugineo-brunneae, perangustae, confertae, adnatae, margine albo-fimbriatae; stipes 6–10 cm. longus 2–3 mm. crassus, fragilis, aequalis, sursum pruinosus, deorsum glaber; ozonium fulvum; sporae 10–12.5 × 6.5–8 μ, ellipsoideae vel subovoideae.*

Habit, habitat and distribution: Among grass and weeds on soil in open deciduous woods, Estes Park, Rocky Mountain National Park, 8500 ft. elev., July 10, 1940, L.R. Hesler 12689-type

REMARKS—The type specimen in TENN is thought to be missing. It has been suggested (Patricia Rogers, pers. comm.) that it may have been transferred to MICH, but we did not succeed in finding it there.

Despite the lack of type we consider that this species is synonymous with *P. auricoma*, which is supported by the original description. Although not mentioned in the protologue, Smith & Hesler (1946: 181, FIG. 1E) depict the characteristic thick-walled hairs on the pileus, characteristic of *P. auricoma*.

Coprinus hansenii J.E. Lange, Dansk Botanisk Arkiv 2(3): 48 (1915).

ORIGINAL DIAGNOSIS: Spores oval-ovate, 12–13 × 7 μ, dark grayish-brown, slightly pellucid. Basidia 9–10 diam.; paraphyses 17–18 μ. Cystidia vesiculous, somewhat bottle-shaped, with a short or rather long neck about 20 μ broad. The surface of the cap is formed by balloon-shaped or almost pyriform cells (16–24 μ broad).

FIG. Specim.: Hunderup, on the ground near a dead stump of Populus, June 1902.– Also Horsens, 1908, and Lundeborg, Aug. 1914, on naked ground behind a garden-hedge.

Cap at first oval-cylindric, 1¼–2 cm high, dark rufous chestnut-brown (apex darker), naked, striate, then expanded, at last flat, fisso-sulcate 2/3 way up (disc flat or slightly depressed), 3–4.5 cm across, of a lighter and paler brownish color than the bud. Stem rather tough, whitish (tinted slightly brownish), inside subochreceous, fistulose, glabrous, top somewhat striate, 7–9 cm × 3–4 mm. Gills free, narrow, at first pale, then ochraceous-brown, at last black, hardly diffluent. Subfasciculate.

Having found no description anywhere of this characteristic species I have named it after Hansenii in commemoration of the Danish biologist and mycologist Emil Chr. Hansen, author of Fungi fimicoli Danici.

REMARKS—Although Lange (1915, 1935) describes the pileus as devoid of hairs, we acknowledge the widely accepted synonymy of *C. hansenii* with *P. auricoma* (Breitenbech & Kränzlin 1995, Uljé & Bas 1988, Uljé 2005). Orton & Watling (1979) disagreed upon the synonymy of *C. hansenii* with *P. auricoma*, suggesting that Lange's species may be a forgotten taxon needing rediscovery. However, as all other details of the original description as well as the figures given by Lange agree with those of *P. auricoma*, and we have been unable to find any specimen that would fit the description, for the time being we prefer to treat *C. hansenii* as a synonym of *P. auricoma*.

Coprinus hemerobius Fr., Epicrisis Systematis Mycologici: 253 (1838).

ORIGINAL DIAGNOSIS: *Pileo tenerrimo ovato laeviusculo, expanso campanulato fisso sulcato glabro, vertice subprominente, stipite elongato attenuato glabro pallido, lamellis linearibus e pallido-nigricantibus collario obsoleto adnexis.* A. campan. *Bolt. 31. Pollich. Pal. 3. p. 295. Cfr. Secr. N. 428. Juxta vias. Habitus omnino praeced. Sed stipes collarium vix manifestum, lam. 1–1.5 lin. latae. Notis discerni nequit* A. bubalinus *Schum. (Fl. Dan. T. 1960. f. 2.) a statu primario, pileo nondum fisso.*

REMARKS—The identity of this taxon has long been disputed (Orton & Watling 1979, Orton 1972, Uljé & Bas 1988). Most commonly, the epithet *hemerobius* has been applied to *P. auricoma* and *P. plicatilis* (Kühner & Josserand 1934, Lange 1935, Uljé & Bas 1988), but since no type material exists, we consider it a name to be rejected.

In the literature, this name is often used to refer to a species with elliptical basidiospores and glabrous pileus (i.e. no hairs on the pileipellis) (Orton 1972, Orton & Watling 1979). Orton & Watling (1979) distinguished this species from *P. plicatilis* in view of its not or only slightly lentiform spores and incompletely expanding pileus. In our experience, the spore shape can vary considerably, but we have never observed completely non-lentiform spores during our studies on *Parasola* (Nagy, unpublished). It has also been argued that, in fact, this species does not exist (Uljé & Bas 1988). In course of our examinations of hundreds of *Parasola* collections, we have come across a few specimens with such a combination of features (ellipsoid spores, and no hairs on the pileus), but careful examination of these specimens always revealed some tendency of the basidiospores to be hexagonal or ovoid and lentiform. Hence, in our opinion, the above-mentioned interpretation of *C. hemerobius* refers to +/– aberrant collections of *P. plicatilis*. Due to the dubious usage of the epithet *hemerobius*, we continue to use *P. plicatilis* for these collections.

Coprinus longipes Buller, in Bisby et al., Fungi of Manitoba: 118 (1929).

ORIGINAL DESCRIPTION: pileus 6–10 mm. high before expansion, bay-brown, darker at the obtuse apex, at first conico-campanulate, on expanding becoming broadly convex but never becoming flattened or revolute, thus resembling the pileus of *C. plicatilis*; when fully expanded 13–23 mm. broad, usually 15–18 mm.; the disc 3–4 mm. wide, reddish brown and markedly depressed; the convex sides of the pileus grayish brown and beautifully plicate, the surface of the pileus lacking both hairs and scales. Stipe sometimes only 4–5 cm. long, but usually 6–11 cm., occasionally up to 15 cm. long, evenly cylindrical, 1–1.5 mm. in diameter except at the base where it is 2 mm., straight, somewhat brownish below, white above, smooth, hollow, somewhat stiff. Gills grayish, narrow, 1–1.5 mm. wide, free and attached to a collar below the disc, autodigestion ocurring to some extent along the edges. Flesh very thin, brownish at the disc. Spores black in mass, jet-black under the microscope, smooth, rounded heart-shapes with three differring dimensions, 14–15.5 × 12–13 × 10 μ. Basidia dimorphic, each surrounded by 5–8 paraphyses. Cystidia on the sides of the gills, ovoid-tapering, sometimes capitate, fairly numerous in the young pilei but disappearing by deliquescence during spore discharge. Observed on a number of occasions in laboratory horse-dung cultures, coming up after several weeks or month.

This species resembles *C. plicatilis* in general appearance and might be mistaken for it; but it differs in coming up on horse dung instead of in grassy places, in having a slightly smaller depressed disc, in having gills which waste or deliquesce at their edges instead of remaining entire, and having a stipe which is usually longer.

REMARKS—In our opinion, the above description fits very well with *P. schroeteri*. All the diagnostic features are given by Buller: plicate, glabrous pileus, flattened spores with length between 13 and 15 µm, no deliquescence, habitat on dung and resemblance to *C. plicatilis*, and we feel that it is sufficient enough to synonymize it with *P. schroeteri*. This is in contrast with the opinion of earlier authors (Bender & Enderle 1988, Uljé & Bas 1988), who preferred to consider it a nomen dubium. They came to this conclusion because, when tracing the type, only spore prints were received (not made by Buller himself), which they assigned to *C. marculentus*, a totally different species. However, we see no evidence that the spore prints and the type of *C. longipes* have anything in common. Furthermore, the original diagnosis (as far as it can be trusted) excludes *C. marculentus* by stating: "the surface of the pileus lacking both hairs and scales".

Similar to Uljé & Bas (1988), we could not locate the type.

Considerably after the publication of this name, Buller (1958: FIGS. 35–39) reported photographs of *C. longipes*, depicting a typical *Parasola*-like fungus. The photographs were taken from laboratory cultures, which may explain the unusual length of stipes (for instance, when cultured in flasks). Unfortunately, the photographs are not accompanied by collection numbers or dates, so they are not suitable for typification.

Coprinus mirabilis Mont., Annales des Sciences Naturelles, Botanique, 4e Sér., 1: 106 (1854).

ORIGINAL DIAGNOSIS: *Pileo tenerrimo primitus… tandem explanato sulcato albo margine crenulato, stipite gracili fistuloso concolori, lamellis distantibus convexis tandem nigris, sporis globosis.-Hab. In herbidis ambulacri urbis Cayennae. Coll. 1059.*

REMARKS—The only clue that suggests a *Parasola* species in the protologue is the globose spores. Otherwise, it is very unclear and may apply to numerous *Coprinus* s.l. species. We could not trace any type material. Pegler (1983) presented specimens and a description of a mushroom with affinities to *P. auricoma*, but differing in lenticular spores. However, it was not detailed how this species relates to the original description and what the author's concept is based on. As presented by Pegler (1983), *P. mirabilis* may be similar if not identical with *P. setulosa* (see above).

Coprinus miser P. Karst., Bidrag till Kännedom af Finlands Natur och Folk 37: 236 (1882).

ORIGINAL DIAGNOSIS: Glasklar, m. späd, bar ljust askgrå; hatten veckad; lamellerna glesa, få (6–15), slutl. Af sporerna svarta; sporerna pyramidförmigt äggrunda eller elliptiska. Hästexkr. 9. finl. (Mustiala).

Remarks—We could not trace any type material in H. However, as there is consensus concerning the usage of this name, we hereby designate a neotype, nested in the *P. misera* clade by ITS and LSU sequences (Nagy et al. 2009):

Neotype here designated: Hungary, Heves: Bükk mts., Cserépfalu, Bogár-hegy, on cow dung, in grazed, calcareous mountainous grassland, 12 March 2007, L. Nagy, *SZMC-NL-0280* (BP). Figs. 44–47.

Description of the neotype—Pileus 3–6 × 1–4 mm when closed, ellipsoid, obovoid, rarely subglobose, expanding to obtusely conical or campanulate, convex-hemispherical when older, applanate or plano-concave when fully mature, up to 15 mm in diameter; margin straight, translucently striate up to 2/3rd of pileus, even when young, later becoming undulate-crenate as the pileus expands, surface glabrous, smooth at disc, slightly rugulose-grooved when young, upon expanding becomes sulcate-plicate; color warm melleous, apricot colored, darker towards disc, becoming greyish on aging; lamellae crowded, free, forming a delicate collarium-like structure around stipe, up to 1.5 mm broad, strongly ventricose, edge fimbriate, whitish, color whitish when young, gradually becoming grayish to blackish, maturation takes place in patches, not deliquescent; stipe 0.3–1 × 10–25 mm, cylindrical, often with a somewhat swollen base, fistulose, very fragile, minutely silky-fibrillose when young, later glabrous-silky, whitish to pale ochraceous when old; context very thin, fragile, without peculiar smell or taste.

Basidiospores [20,1,1] 8.5–10.6 × 8.5–10 × 5.9–6.6 µm, on average 9.45 × 9.05 × 6.21 µm, Q_1 = 0.96–1.12, Q_2 = 1.43–1.61, strongly lentiform, in the frontal view subglobose, rounded triangular or heart-shaped, more rarely ovoid, apex sometimes papillate, in the lateral view ellipsoid, with a 1.5–1.7 µm wide, strongly eccentric germ-pore, color very dark reddish brown, opaque, smooth, with moderately thick wall; basidia bimorphic, clavate, often with median constriction, four-spored, 25–35 × 9–10 µm; cheilocystidia clavate, vesiculose or globose, abundant, 20–25 × 13–17 µm; pleurocystidia absent; pileipellis hynemiform, made up mainly of vesiculose-globose elements, 22–40 × 21–25 µm; veil, pileocystidia, and caulocystidia absent; clamps present.

Coprinus miser* f. *marasmioides Romagn., Bull. Soc. Mycol. Fr. 77: 325 (1962, "1961").

Original diagnosis: *A typo differt pileo truncato et sporis minoribus, 7.7–9.5 × 7–9 × 5.7–6.5 µ.*

Remarks—Unfortunately, type material could not be obtained from PC. From the size of the basidiospores it may be assumed that this collection belongs to the variant with four-spored basidia (two-spored specimens represent a phylogenetically distinct taxon; Nagy et al. unpubl.), and we therefore consider this taxon a synonym of *P. misera* var. *misera*.

Coprinus plicatilis* var. *microsporus Kühner & Joss., Bulletin de la Société Mycologique de France 50: 57 (1934).

ORIGINAL DIAGNOSIS: Dans l'herbe ou les feuilles mortes au Bois de Vincennes, mai-juillet. Chapeau (D: 1.5–4 cm) campanulé subglobuleux ou ellipsoide puis conique obtus surbaissé ou convexe plan, souvent nettement déprimé ombiliqué et á la fin cyathiforme mais parfois aussi non ombiliqué ou méme obtusément mammelonné au fond de la dépression centrale, plissé véliforme, brunâtre puis gris, gris jaunâtre diaphane avec le centre gris-jaunâtre, jaune-brun hyalin ou fauvâtre (jaune brun au début).

Revétement glabre ou micacé sur les côtes.

Lames (L:28–50; l:1) +/− espacées chez l'adulte, ténues diaphanes adnées á un disque bien développé.

Stipe (H:4–7.5 cm; D:1–2 mm) subégel, blanc hyalin (la base parfois un peu hyalin brunâtre) glabre ou un peu soyeux, tubuleux.

Spores brun bistre foncé et opaque s.l. mais pas tout á fait noires, á silhoutte ovoide, ovoide cinuque, ovoide rhombique, nettement atténué vers la partie supérieure, á profil elliptique aplani sur la face dorsale: 8.2–10 × 5.5.–7.5 × 4–5.7 µ.

Pore légérement incliné sur la face ventrale.

Basides tétrasporiques.

Cystides faciales de grande taille.

Revétement piléique celluleux hyméniforme dépourvu de poils; voile nul.

Ad caules emortuos, et folia putrescentia. Gallia.

REMARKS—This taxon is currently known as *P. kuehneri* (Uljé & Bas 1988). It is characterized by small spores with a tendency to be rhomboid or quadrangular. Other differences, such as a brighter color of the pileus and more cylindrical cheilocystidia (Uljé & Bas 1988, Uljé & Bender 1997), are, in our experience, not sufficiently constant to be considered diagnostic for identification.

Coprinus plicatilis* var. *tenellus Rick, Broteria 5: 20 (1906), as "*tenella*".

ORIGINAL DIAGNOSIS: *Ad terram. Firmior et minor quam typus et pede minute pruinoso. Similis* Coprino filiformi Berk. et Br.

REMARKS—In our opinion, this taxon certainly does not belong to *Parasola* in view of the pruinose stipe and the resemblance to *C. filiformis* (probably a *Coprinopsis*) as mentioned by Rick. Unfortunately, we did not succeed in locating the type.

Coprinus proximellus P. Karst. Meddelanden af Societas pro Fauna et Flora Fennica 5: 34 (1879).

ORIGINAL DIAGNOSIS: *A praecedente praecipue sporis ellipsoideis, fuscis, semipellucidis, 10-13 mmm. longis, 5-7 mmm. crassis recedens. Locis stercoratis in horto Mustialensi mensibus Majo et Augusto parce. Pileus primitus subhirtellus et pallide subgilvus. Solitarius.*

Remarks—We could not locate the type material, and the original description is quite obsolete. To judge from the spore size it could be either *P. plicatilis* or *P. auricoma*.

Coprinus pseudonycthemerus Britzelm., Hymenomyceten aus Südbayern. IX. Teil: 13, Melanospori f. 250 (1893). [Also published as: Botanisches Centralblatt 54: 70 (1893).]

Original diagnosis: (from Bot. Centralbl. 54: 70): Sp. 14 : 10, unförmlich rundlich mit einem spitzen Ende; H. gefurcht, gelbgrau, grau, Mitte gelblich; L. z. g., angeheftet, grau, schwarz bestäubt, zuletzt schwarz; St. durchscheinend, unt etwas rothbraun, s. gebrechlich; Sommer, Herbst, A.

Remarks—Uljé & Bas (1988: 444) and Bender & Enderle (1988) pointed out that this species might have affinities to *P. schroeteri*. This is supported by the rounded spores with a size of around 14 × 10 µm. Unfortunately, Britzelmayr left types only very scantily, and accordingly tracing of the type of this species is very unlikely.

Coprinus rimosus Copel., Annales Mycologici 3: 26 (1905).

Original diagnosis: *Pileo tenui, cylindrico-campanulato vel conico, truncato, 1.5–2 cm alto et lato, glabro, pseudo-plicato, in lamellis moi deorsum fisso, externe fulvo-griseo, in rimis nigrescente, discus fulvo, plano vel depresso; lamellis liberis, modice remotis, stipitem versus excavatis, ad marginem obtusis, nigris pallescentibus, cystidiis carentibus: sporis nigris, typicis subangularibus, 15 × 13.5 µ, apicem versus crassissimis; stipite albo, glabro, aequali, cavo.*

Ad fimum aequinum. Manila.– A Coprino plicatili *Fries pileo non explanato, sporis crassioribus et substrato fimi distinguitur.*

Remarks—We consider that the glabrous pileus, the habitat on dung, and the spore size are sufficiently diagnostic for a clear identification of *C. rimosus* as a younger synonym of *P. schroeteri*. This relationship has already been suggested (Uljé & Bas 1988), but no conclusion was drawn awaiting further evidence or type study. The type could not be found at UC, MICH, or WELT.

Coprinus sulphureus McClatchie, Proceedings of the Southern California Academy of Sciences 1: 381 (1897).

Original diagnosis: *Pileo oblongo-campanulato, dein expanso et margine revoluto, griseolo v. luteolo-brunneo, subtiliter striato, villoso, 2–3.5 cm. alto; stipite cavo, sursum attenuato, 5–7.5 cm. longo, medio 3–4 mm. crasso, pilis luteolis tecto; lamellis liberis, linearibus, 8–12 mm. latis, acie sulphureis; sporis ellipticis, 15–18 × 8.*

Hab inter folia et ramos dejectos sub arboribus, Pasadena et Compton Californiae (McClatchie).

Remarks—The above description fits best with *P. auricoma*, although the spores are slightly larger, but the yellowish hairs on the pileus are diagnostic. Unfortunately, no recent description or type study is available for this taxon.

Coprinus virgulacolens Cleland, Transactions of the Royal Society of South Australia 57: 194 (1933).

ORIGINAL DIAGNOSIS: *Pileus 1.2–2.5 cm., 16 mm. altus cylindrico-conicus ad lato-conicus, deinde se expandens, membranaceus, disco glabro subconvexo fusco, striato-plicatus, pallido-furfuraceus-granulosus, cinereo-brunneus. Lamellae subadnexae vel adnatae, primum adscendentes, confertae, angustae, albidae, deinde purpureo-brunneae. Stipes 3.7–6.2 cm., granulosus et striatus, deinde glaber, concavus, sub-bulbosus, albus. Caro pertenuis, brunnea. Sporae obliquae, fuscae, 7.5–9 μ, interdum 11 × 4–5 μ. Plantae in terra virgulis applicatae. S.A.–Mount Lofty.*

REMARKS—Simpson & Grgurinovic (2001) recombined this taxon in *Parasola*, presumably on the basis of a former examination and lectotypification (Grgurinovic 1997). However, both the original description and the observation of Grgurinovic (1997) point away from the genus *Parasola*. The protologue clearly mentions granulosity of the pileus and stipe when young, a feature typical of subsection *Nivei* of *Coprinus s.l.* Unfortunately, no further information can be found in the above-mentioned two descriptions and no type material could be obtained from AD. Therefore, for the time being we feel it premature to draw any conclusion about the identity of this taxon.

Psathyrella subprona Cleland, Transactions of the Royal Society of South Australia 51: 306 (1927).

ORIGINAL DESCRIPTION: Pileus ½ in. (1–2 cm.) broad, 3/8 in. (10mm.) high, conico-campanulate with an acute apex, drying an opaque pallid whitish with fine anastomosing striae, greyer when moist. Gills ascending a little, adnate, moderately close, clouded fuscous-grey. Stem 1 to 1 and ½ in. (2.5 to 3.7 cm.) high, slender, slightly mealy, then polished, slightly hollow, somewhat brittle, white. Flesh thin, that of the stem different in textrue from the flesh of the pileus. Spores nearly black, elliptical, 15x8 μ.

REMARKS—To judge from the only available modern description (Grgurinovic 1997: 475), this species may be closely related or even conspecific with the taxon currently known as *P. megasperma*. Grgurinovic (1997) reported the germ-pore as central, whereas *P. megasperma* usually has a more or less eccentric germ-pore. Unfortunately, type material could not be obtained from AD. Without study of the type, however, the available evidence is not sufficient to allow change of the widely accepted name *megasperma* to *subprona*.

Pseudocoprinus brunneolus McKnight, in McKnight & Allison, Morris Arboretum Bulletin 20: 73 (1970, "1969").

ORIGINAL DIAGNOSIS: *Pileus lato-convexus disco subdepresso praeditus, 10–17 mm diam.; discus glaber, modice brunneus, profundo plicato striatus, e disco ad marginem roseo-griseus usque brunneo-roseus; caro tenuis, odore et sapore carentibus.*

Lamellae crassae, dissettae cum lamellulis alternantes, primum albae deinde griseae demum sporis maturis fere atrae, margine acuto et superficiebus convergentibus praeditae, non deliquescentes, in maturitate e stipite separantes.

Stipes cartilagineus, fragilis, 20–50 × 0.5–1.0 mm filiformis, semi translucidus, albus, glaber, bizonatus, cellulis texturae centralis in zona interiori 4–5 µ, in zona corticali 1.3–3.5 µ diam.

Cuticula pilei e palo cellularum piroformium 25–40 × 15–18 µ composita; hypodermium in KOH ochraceum; cheilocystidia e subcylindrico clavata vel ventricosa, tenui-tunicata, fasciculata, 11–15 × 55–60 µ; pleurocystidia non visa; basidia tetraspora; sporae in KOH sordide cacainae, a latere visea brevi-ellipticae et applanatae, a fronte angulato-ovoideae, distincte apiculatae, uniguttulatae, 9–11.8 × 6.7–7 × 7.9–9.7 µ, poro germinationis distincto lato apicali praeditae.

Hab. ad terram muscosam sub Quercus, *Laurel, Maryland. Typus legit O.K. Miller 6919 (BFDL).*

Remarks—The above description fits perfectly with *P. lactea* (= *P. leiocephala*) in all important details, and we therefore consider *Ps. brunneolus* to be a synonym of that species. Unfortunately, we did not succeed in finding the type in BFDL (= CFMR).

Discussion

As might be expected from in-depth nomenclatural revisions of even better known taxa, we found that numerous names neglected in the recent literature have priority over their younger counterparts in every day usage. We were able to study types of 15 taxa formerly recombined or affiliated with *Parasola* or *Coprinus* subsection *Glabri* and *Auricomi*. As a result of the study of the holotype of *Ps. lacteus,* we found that *P. leiocephala* should be substituted by *P. lactea,* which dates back to 1946, as opposed to *Coprinus leiocephalus*, which was described in 1969. This relationship has already been suggested by Uljé & Bas (1988), but they did not study the type, and hence could not come to the proper conclusion.

Coprinus leiocephalus is such a widely accepted and used name that the necessity of a name change raises the possibility of conservation of the epithet *leiocephalus* against *lacteus*. The conservation of a name simply because it is inappropriate or not popular is generally counteradvised, and we think that in this case it is better to adhere to the rules than to initiate a long-lasting decision procedure by the Nomenclatural Committee. Besides *P. leiocephala*, *Ps. brunneolus*, *C. plicatilis* var. *filopes*, and *C. galericuliformis* should be synonymized with *P. lactea*. Of these, *C. galericuliformis* is often accepted as a separate taxon (e.g. Orton & Watling 1979, Roux 2006, Uljé & Bas 1988, Uljé 2005), but no straightforward definition is given by any of the mentioned authors. The only difference constantly cited is the shape of the spores, which is subglobose, whereas *P. lactea* should differ in having more triangular spores (Roux 2006, Uljé & Bas 1988, Uljé & Bender 1997, Uljé 2005). In fact the type of *P. galericuliformis* is composed of immature fruiting bodies, and hence the shape of the spores is not surprising. Specimens of *P. lactea* with partially subglobose spores can be encountered quite often (Nagy, unpublished, Uljé & Bas 1988). Molecular studies using ITS and LSU sequences have demonstrated that specimens with subglobose spores are identical to *P. lactea* and that phylogentically only one species can be recognized in this group (Nagy et al. 2009).

We found the following taxa conspecific with *P. auricoma*: *Ps. besseyi*, *C. sulphureus*, *C. hansenii*, *C. elongatipes*. A name change from *P. megasperma* to *P. subprona* will likely be needed in the future, but as we were unable to obtain the type material of *Psathyrella subprona* on loan, at this stage we refrain from formally proposing a name change.

Parasola setulosa is redescribed on the basis of the holotype as a species with brown, thick-walled sclerocystidia on the pileus (similarly to *P. auricoma*) and lentiform spores, a unique combination of characters in the genus *Parasola*. Unfortunately, this species is known only from three type collections. New collections would be helpful in addressing the variability and phylogenetic position of this species. As *P. setulosa* combines morphological features of early-branching *Parasola* taxa (*P. conopila* and *P. auricoma*) with features of other taxa of the genus (which we formerly referred to as "crown" *Parasola* taxa, e.g. *P. plicatilis* and *P. lactea*, see Nagy et al. 2009), we hypothesized it may represent a link between *P. auricoma* and the other collapsing species of *Parasola* ("crown" *Parasola* taxa).

As exemplified above, many names of coprinoid fungi (*Parasola, Coprinellus* and *Coprinopsis*) that are out of use today may apply to well-known and common taxa. Although this is a general phenomenon in all groups of organisms, it may be particularly pronounced in coprinoid fungi, because this group has been central in research in consequence of the practical importance of certain taxa as model organisms. Type revisions of other groups of coprinoid fungi show that many of the currently well-established names have older, validly published synonyms (Nagy, unpublished). Similarly, nomenclatural and taxonomic questions of the genus *Parasola* are far from being settled, and much research is needed to clarify species boundaries and distributions.

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Three new species of *Septobasidium* (*Septobasidiaceae*) from Gaoligong Mountains in China

CHUNXIA LU[1,2] & LIN GUO[1]*

*Ch.x.lu@hotmail.com & *guol@im.ac.cn*

[1]*Key Laboratory of Systematic Mycology and Lichenology Institute of Microbiology, Chinese Academy of Sciences Beijing 100101, China*

[2]*Graduate University of Chinese Academy of Sciences Beijing 100049, China*

Abstract — Three new species, *Septobasidium gaoligongense* and *S. euryae-groffii* on *Eurya groffii* associated with *Pinnaspis* spp. and *Septobasidium polygoni* on *Polygonum campanulatum* associated with *Pseudaulacaspis kuisiuensis*, are described. They were collected from Gaoligong Mountains in Yunnan Province, China.

Key words — *Pucciniomycetes*, *Septobasidiales*, taxonomy

Previously, a new species of *Septobasidium* was found in Gaoligong Mountains of Yunnan province (Lu & Guo 2009b). From the same area an additional three new species are described as follows:

Septobasidium gaoligongense C.X. Lu & L. Guo, **sp. nov.** FIGS. 1–6

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Basidiomata resupinata, 15–20 cm longa, 7.5–8 cm lata, cinnamomeo-brunnea, brunnea vel atrobrunnea, margine determinata, superficie laevia, maturitate fissurata, in sectione primum (260–)525–580 µm crassa, deinde 1360–5000 µm crassa. Subiculum brunneum, 30–50 µm crassum. Contextus 2–3-stratosus. Columnae hyalinae vel brunneolae, primum 190–430 µm longae, deinde 3000–4900 µm longae, 290–340 µm latae, ex hyphis 3–5 µm latis compositae. Hymenium hyalinum, 40–50 µm crassum. Basidia fusiformia, cyclindrica vel leviter irregularia, recta vel leviter curvata, 4-cellularia, 17–26 × 4–7 µm, hyalina vel brunnea. Sine probasidio. Basidiosporae non visae. Haustoria ex hyphis irregulariter spiralibus constantia.

TYPE: On *Eurya groffii* Merr. (*Theaceae*): China, Yunnan, Gaoligong Mountains, Baoshan, Baihualin, alt. 1400 m, 8.VII.2009, T.G. Hou 17, HMAS 199577 (**holotype**), associated with *Pinnaspis* sp. (*Diaspididae*).

*corresponding author

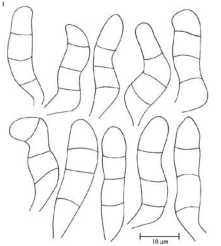
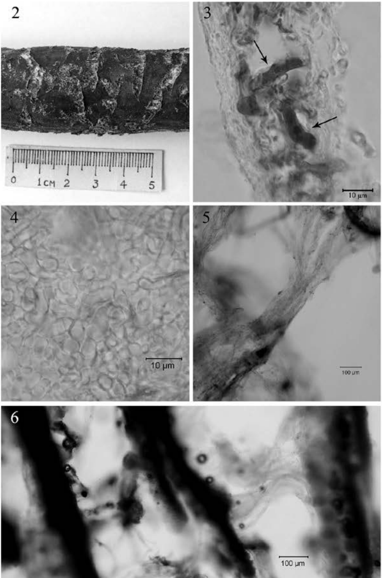


Fig. 1. Basidia of *Septobasidium gaoligongense* (HMAS 199577, holotype).

Basidiomata on branches, resupinate, 15–20 cm long, 7.5–8 cm wide, cinnamon-brown, brown or dark brown; margin determinate; surface smooth at first, becoming cracked at maturity. In section (260–)525–580 µm thick in the young stage and 1360–5000 µm thick in the old stage. Subiculum 30–50 µm thick, brown. Pillars 190–430 µm high in the young stage, 3000–4900 µm high in the old stage, 290–340 µm wide, hyphae of pillars 3–5 µm thick, hyaline or brownish, forming 2–3 horizontal layers. Hymenium 40–50 µm thick, hyaline. Basidia arising directly from the hyphae, fusiform, cylindrical or slightly irregular, straight or slightly curved, 4-celled, 17–26 × 4–7 µm, hyaline or brown, without a probasidial cell. Basidiospores not seen. Haustoria consisting of irregularly coiled hyphae.

Remarks: Morphologically, *S. gaoligongense* is similar to *S. crinitum* (Fr.) Couch, but differs mainly in forming 2–3 horizontal hyphal layers, having smaller basidia (17–26 × 4–7 µm vs 40–55 × 8.4–10 µm), and lacking a top layer. *Septobasidium crinitum* has a thick top layer (100–200 µm high), and lacks horizontal layers.

Figs. 2–6. *Septobasidium gaoligongense* (HMAS 199577, holotype). 2. Basidiomata on branches. 3. Basidia (arrows). 4. Haustoria. 5. Pillars. 6. Section of basidioma.


2
0 1CM 2 3 4 5
3
10 µm
4
10 µm
5
100 µm
6
100 µm

Septobasidium polygoni C.X. Lu & L. Guo, **sp. nov.** FIGS. 7–13
MYCOBANK MB 516524

Basidiomata resupinata, 2–15.5 cm longa, 1–3 cm lata, alba, cinnamomeo-brunnea vel brunnea, margine determinata, superficie laevia, in vetustate separata, in sectione 390–1550 μm crassa. Subiculum hyalinum vel brunneum, 30–100 μm crassum. Columnae hyalinae vel brunneae, primum 50–80 μm altae, deinde 440 μm altae, 30–70 μm crassae vel hyphis laxe completae, interdum hyphae repullulantes, super hymenium stratum

7

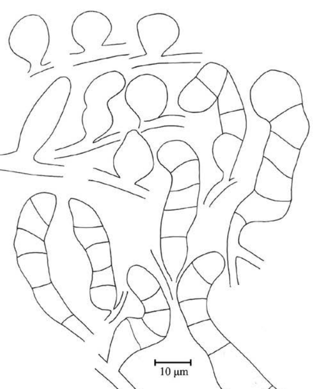
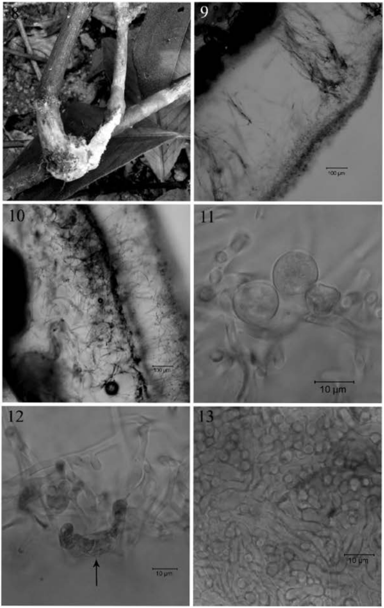


FIG. 7. Probasidia and basidia of *Septobasidium polygoni* (HMAS 196488, holotype).

FIGS. 8–13. *Septobasidium polygoni* (HMAS 196488, holotype). 8. Basidiomata on branches. 9–10. Sections of basidiomata. 11. Probasidia. 12. Basidium (arrow). 13. Haustoria.


8
9
100 µm
10
100 µm
11
10 µm
12
10 µm
13
10 µm

hypharum secundum 50–200 µm altum formantes. Hymenium 50–100 µm crassum, unistratosum vel 2-stratosum. Probasidia subglobosa vel pyriformia, 10–17 × 10–15 µm, subhyalina vel flavidobrunnea, persistentia. Basidia cyclindrica, curvata, 4-cellularia, 24.5–34 × 7.5–10 µm, hyalina or flavidobrunnea. Basidiosporae non visae. Haustoria ex hyphis irregulariter spiralibus constantia.

Type: On *Polygonum campanulatum* Hook. f. (*Polygonaceae*): China, Yunnan, Gaoligong Mountains, Tengchong, alt. 2050 m, 5.IX.2008, S.H. He, Y.F. Zhu & L. Guo 2371, HMAS 196488 (**holotype**), associated with *Pseudaulacaspis kuisiuensis* (*Diaspididae*).

Basidiomata on stems and branches, resupinate, 2–15.5 cm long, 1–3 cm wide, white, cinnamon-brown or brown; margin determinate; surface smooth, peeling off in old stage. In section 390–1550 µm thick. Subiculum hyaline or brown, 30–100 µm thick. Pillars hyaline or brown, 50–80 µm high in young stage, up to 440 µm high in old stage, 30–70 µm wide, or loosely filled with 220–400 µm high hyphae, sometimes from hymenial layer the fungal hyphae renews growth to form a second hyphal layer, 50–200 µm high. Hymenial layer 50–100 µm thick, single or 2-stratose. Probasidia subglobose or pyriform, 10–17 × 10–15 µm, subhyaline or pale yellowish brown; probasidial cell persistent after the formation of the basidia. Basidia cylindrical, curved, 4-celled, 24.5–34 × 7.5–10 µm, hyaline or yellowish brown. Basidiospores not seen. Haustoria consisting of irregularly coiled hyphae.

Remarks: Morphologically, *S. polygoni* is similar to *S. citricola* Sawada from which it differs in having tall pillars (up to 440 µm vs 84–126 µm), a thinner hymenium (50–100 µm vs 100–390 µm), and smaller basidia (24.5–34 × 7.5–10 µm vs 50–65 × 8.2–9.7 µm).

Septobasidium euryae-groffii C.X. Lu & L. Guo, **sp. nov.** Figs. 14–19

MycoBank MB 516525

Basidiomata resupinata, 5–16 cm longa, 4–11 cm lata, cinnamomeo-brunnea, brunnea vel castaneo-brunnea, margine determinata, superficie laevia et protuberantia, deinde fissurata, in sectione 1260–2620 µm crassa, 3–12-stratosa. Subiculum 40–50 µm crassum, brunneum. Columnae 40–100 altae, 50–165 µm latae, superne ramosae tunc strato hypharum 360–560 µm alto formantae, hyphae repullulantes tum duo strata horizontalia 130–180 µm alta formantes. Hymenium 50–60 µm crassum. Interdum super hymenium columnae secundae 60–110 µm altae formatae et strata hypharum 4-stratosa 810–1050 µm alta successive superposita. Hymenium denuo formatum 70–110 µm altum. Basidia cylindrica, recta vel leviter curvata, 4-cellularia, 20–45 × 5–8 µm, hyalina or brunneola. Sterigmata conica, 2–3 µm longa. Sine probasidio. Basidiosporae non visae. Haustoria ex hyphis irregulariter spiralibus constantia.

Type: On *Eurya groffii* Merr. (*Theaceae*): China, Yunnan, Gaoligong Mountains, Baoshan, Baihualin, alt. 1400 m, 8.VII.2009, T.G. Hou 21, HMAS 199579 (**holotype**), associated with *Pinnaspis* sp. (*Diaspididae*).

Basidiomata on branches, resupinate, perennial, 5–16 cm long, 4–11 cm wide, cinnamon brown, brown or chestnut brown; margin determinate; surface

14

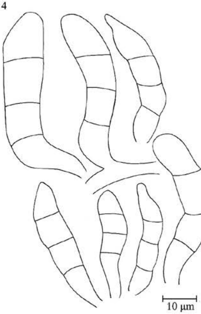
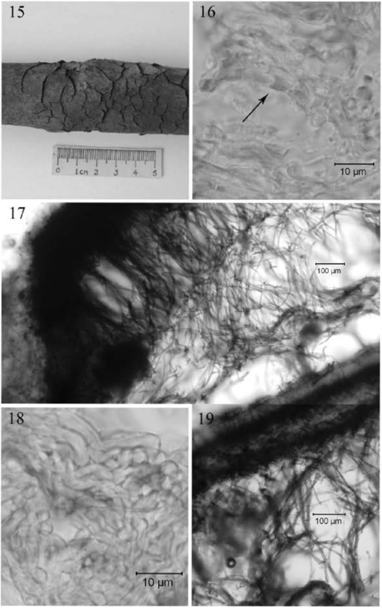


FIG. 14. Basidia of *Septobasidium euryae-groffii* (HMAS 199579, holotype).

smooth and protuberant, becoming cracked later. In section 1260–2620 µm thick, composed of 3–12 layers. Subiculum 40–50 µm thick, brown. Pillars 40–100 µm high, 50–165 µm wide, branched outwards to form a hyphal layer 360–560 µm high, the hyphae renewing to form two horizontal layers 130–180 µm high, forming a hymenial layer 50–60 µm thick at the upper, with closely packed parallel upright threads. Sometimes from the hymenium successively forming pillars 60–110 µm high, and 4 hyphal layers 810–1050 µm high. Hymenial layer renewing, up to 70–110 µm high. Basidia arising directly from the hyphae without a probasidial cell, cylindrical, straight or slightly curved, 4-celled, 20–45 × 5–8 µm, hyaline or brownish. Sterigmata coniform, 2–3 µm long. Basidiospores not seen. Haustoria consisting of irregularly coiled hyphae.

REMARKS: *Septobasidium euryae-groffii* is similar to *S. henningsii* Pat., from which it differs in producing shorter pillars (40–110 µm vs 300–1100 µm) and shorter sterigmata (3–5 µm vs 14–34 µm). In addition, the basidioma surface of *S. euryae-groffii* is bumpy whereas that of *S. henningsii* is smooth. Another similar species, *S. thwaitesii* (Berk. & Broome) Pat., has curved basidia and probasidial cells.


15
0 1cm 2 3 4 5
16
10 µm
17
100 µm
18
10 µm
19
100 µm

Excluded species

Septobasidium parlatoriae Sawada, Rep. Dept. Agric. Govt. Res. Inst. Formosa. 51: 57, 1931.

A study of the type specimen of *S. parlatoriae*, borrowed from TAI, showed that no scale insects are present beneath the fungal hyphae. It is an anamorphic fungus.

To date, 23 species of *Septobasidium* have been reported in China (Sawada 1933, Couch 1938, Teng 1963, Tai 1979, Kirschner & Chen 2007, Lu & Guo 2009a, b,c, Lu et al. 2010), including the three species reported in this paper.

Acknowledgements

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FIGS. 15–19. *Septobasidium euryae-groffii* (HMAS 199579, holotype). 15. Basidiomata on branches. 16. Basidia (arrow). 17, 19. Sections of basidiomata. 18. Haustoria.

MYCOTAXON

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Peniophora pseudonuda is a synonym of *P. laeta*

Nils Hallenberg, Eugene Yurchenko*
& Masoomeh Ghobad-Nejhad**

nils.hallenberg@dpes.gu.se
Department of Plant and Environmental Sciences, Gothenburg University
Box 461, SE-405 30, Gothenburg, Sweden

* *eugene_yu@tut.by*
V.F. Kuprevich Institute of Experimental Botany
Akademichnaya str. 27, BY-220072, Minsk, Belarus

***masoomeh.ghobadnejhad@helsinki.fi*
Botanical Museum, Finnish Museum of Natural History
P.O. Box 7, FI-00014, Helsinki, Finland

Abstract — *Peniophora laeta* is easily recognized because it is restricted to *Carpinus* as host in Europe, and the reddish yellow basidioma is provided with prominent teeth or hyphal pegs, disrupting the bark when developing. *P. pseudonuda* was earlier not even thought of as related to *P. laeta*, because basidiomata are smooth and developing on the bark. Moreover, basidioma initiation starts with a thin layer of brown-pigmented hyphae on the bark surface. This gives a bluish tint to the mature basidioma, which is in striking contrast to the orange-yellow basidiomata found in *P. laeta*. Nevertheless, both ITS sequences and crossing tests show that *P. pseudonuda* is conspecific with *P. laeta*. This was supported also by similarities in spores, basidia, and cystidia morphology.

Key words — *Corticiaceae*, epicortical basidiomata, spore morphometrics

Introduction

The corticioid fungus *Peniophora pseudonuda* was described in 1980, firstly as a species with restricted natural range, known from hyrcanian forests of northern Iran, in Elburz Mountains (Hallenberg 1980). Later it was collected and published from the northwestern part of Main Caucasus, in Krasnodar Province, Russia, in temperate broadleaved communities of *Quercus*, *Fagus*, and *Fagus-Abies* forest belts (Mukhamedshin 1992, Hallenberg et al. 1996). The species epithet reminds on the presence of wide broadly clavate gloeocystidia,

* corresponding author

similar to those in *P. nuda* (Fr.) Bres. The brown-pigmentation of hyphae in the subiculum was a reason why this taxon was referred to the subgenus *Peniophora* (Boidin 1994).

Peniophora laeta is a fungus distributed in Europe and Pacific part of North America (Ginns & Lefebvre 1993, Boidin 1994). Until 1957 *P. laeta* was not distinguished from *P. incarnata* s. l. (Donk 1957), and due to light-pigmented hyphae it has been referred to the subgenus *Gloeopeniophora*.

Materials and methods

Morphology

Specimens were studied in 5% potassium hydroxide (KOH), Melzer´s reagent (IKI) and Cotton Blue in lactic acid (CB). Measurements and drawings were made in KOH solution; spore measurements are based on at least thirty spores. In each range, the values in the parentheses are 10% of variation extremes.

Sampling and crossing tests

The specimens studied (Table 1) were selected from the FCUG culture collection (http://www.systbot.gu.se/database/FCUG/FCUG.html) at the University of Gothenburg (Sweden).

Crossing tests were restricted to specimens for which non-clamped single spore isolates were available. Single-spore mycelia from different specimens were placed in pairs on malt-extract agar (1.25% malt extract) and left in room temperature for three weeks. From each specimen, two to four single-spore mycelia were used. Paired cultures were checked for clamp formation in three different regions: at the immediate contact zone and on opposite sides of the inocula, some 20 mm from respective inoculum. Plates with negative results were re-checked after an additional three weeks.

DNA extraction, amplification, and sequencing

For crossing tests and as a source of DNA extraction, single-spore mycelium was isolated, cultivated on malt agar plates (1.25% malt extract), and subsequently placed in malt liquid solution (malt extract as above) for three weeks. When single-spore mycelium was not available, polyspore mycelium was used. Mycelia were harvested and dried between sheets of sterile filter paper; approximately 2 mg (dry-weight) of input mycelium were used per specimen. DNA extraction was accomplished using the DNeasy® Plant Mini Kit (QIAGEN®); during this and the following steps of the DNA preparation, purification, and sequencing, the recommendations of the respective manufacturer were followed.

The polymerase chain reactions were carried out using Ready-To-Go™ PCR Beads kits (Amersham Pharmacia Biotech), a Biometra TRIO-Thermoblock (Biometra, Germany), the PCR primers ITS1F and ITS4B, and the PCR set-up of Gardes & Bruns (1993). The PCR product was purified using QIAquick™ Spin procedure (QIAGEN®) and the sequence reactions were conducted using 100 ng of template DNA and the CEQ 2000 Dye Terminator Cycle Sequencing with Quick Start Kit (Beckman Coulter). Sequences were obtained using the CEQ 2000XL DNA Analysis System (Beckman Coulter).

Results and discussion

Molecular divergence and crossing tests

The ITS1 and ITS2 sequences were aligned manually and divergence was small. In total, the maximum variation between the samples in TABLE 1 were 1.9%, which is clearly within intraspecific variation (Nilsson et al. 2008). Moreover, crossing tests indicated conspecifity between the two species (TABLE 2).

TABLE 1. Details of the studied specimens. The substrate is specified to the extent known. The abbreviation 'dec.' refers to deciduous wood. FCUG numbers in bold were used for crossing tests.

TAXON / FCUG NR.	LOCALITY	SUBSTRATUM	OTHER NUMBER	GENBANK
Peniophora laeta				
FCUG 1005	Romania, Iasi	*Carpinus*	NH 7998	GU322862
FCUG 1266	Sweden, Scania	*Carpinus*	NH 8557	GU322861
FCUG 1475	Romania, Cluj	dec. wood	NH 9358	GU322864
FCUG 1905	Sweden, Öland	*Carpinus*	EL 87-1	GU322860
FCUG 2729	Russia, Krasnodar	*Carpinus*	NH 13150	GU322863
Peniophora pseudonuda				
FCUG 86	Iran, Golestan	dec. wood	NH 2555	GU322867
FCUG 2384	Russia, Krasnodar	dec. wood	NH 12298	GU322866
FCUG 2390	Russia, Krasnodar	*Carpinus*	NH 12003	GU322865
FCUG 2664	Russia, Krasnodar	dec. wood	NH 12930	GU322868
FCUG 2681	Russia, Krasnodar	*Carpinus*	NH 12978	GU322869

TABLE 2. Results of crossing tests. All performed crossings resulted in clamp formation (+).

TAXON	SUBSTRATUM	FCUG CULTURE	1005	1266	1475	1905	2729	2384	2390
P. laeta	*Carpinus*	1005		+	+	+	+	+	+
P. laeta	*Carpinus*	1266			+	+	+	+	+
P. laeta	deciduous wood	1475				+	+	+	+
P. laeta	*Carpinus*	1905					+	+	+
P. laeta	*Carpinus*	2729						+	+
P. pseudonuda	deciduous wood	2384							+
P. pseudonuda	*Carpinus*	2390							
P. pseudonuda	deciduous wood	86						+	+

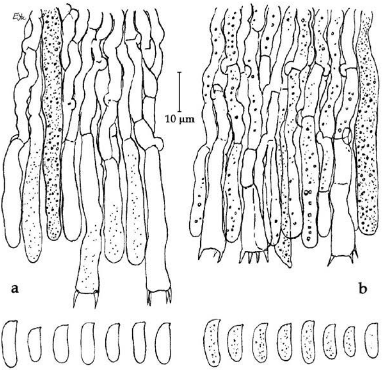

FIG. 1. Hymenium, subbasidial hyphae, and basidiospores in *Peniophora pseudonuda* (a, GB12298/FCUG 2384) and *P. laeta* (b, MSK 6943). Depending on the view, only 2 or 3 sterigmata of 4 are visible on basidia.

Macromorphologically, decorticating samples are well distinguished from non-decorticating: they have wart-like to hydnoid hymenophore projections, hymenophore color varies from pinkish or cream to light ochraceous. Basidiomata of *P. pseudonuda* always develop epicortically, hymenial surface is smooth, and the color varies from whitish cream with brownish hue to pale ochraceous and bluish grey. Thus, hymenium colors are partly overlapping in the two taxa.

On the other hand, the comparison of basidioma micromorphology of *P. pseudonuda* and *P. laeta* has shown a notable similarity in several characters. The shapes of spores and basidia are indistinguishable and hyphae are also very similar (FIG. 1). Morphometrics of the spores have demonstrated that there is

TABLE 3. Spore sizes in *Peniophora laeta* samples.

BASIDIOMA GROWTH HABIT*	REFERENCE COLLECTION NR.	REGION / LATITUDE	SPORE SIZE RANGE / ARITHMETHICAL MEANS (N=30), µm
d	FCUG 1266/ NH 8557	Sweden, Scania/ 56° N	(9.8–)10.6–12(–12.5) × (3.1–)3.3–4.2(–4.5)
d	MSK-F 6738	Belarus, Asipovichy / 53.3° N	7.5–11 × 2.7–4.1 / 8.79 × 3.31
d	MSK-F 7076	Belarus, Hlusk / 52.8° N	8–11.4 × 2.8–4.2 / 9.66 × 3.36
d	MSK-F 4560	Belarus, Petrykau / 52.2° N	8–11.5 × 2.2–3.7 8.87 × 3.08
d	KW 17598	Ukraine, Kyiv / 50° N	8.1–11.5 × 2.8–4.2 / 9.66 × 3.59
d	CWU(myc) Ch-24	Ukraine, Cherkasy / 49.7° N	7.6–11.2 × 2.2–4.1 / 9.21 × 3.05
d	KW 17590	Ukarine, Kirovhrad / 48.4° N	8.7–12.8 × 3–4.5 / 10.15 × 3.59
d	MSK-F 5981	Ukraine, Crimea / 45° N	7.5–11.7 × 2.5–4.1 / 9.28 × 3.29
nd	FCUG 2384/ NH12298	Russia, Krasnodar / 44° N	7.2–11.2 × 2.2–3.7 / 9.01 × 3.00
nd	MSK 6688	Russia, Stavropol' / 43.9° N	7.2–10.6 × 2.7–3.5 / 8.79 × 3.12
nd	Ghobad-Nejhad 413	Iran, E. Azerbaijan / 38.8° N	(8.3–)9–12(–13) × (3–)3.5–4.4(–5)
nd	FCUG 86/ NH2555	Iran, Golestan / 37.3° N	10–12(–13) × 4–5

* d – decorticating; nd – non-decorticating. The same abbreviations in SPECIMENS EXAMINED.

no distinction that can be treated as specific (TABLE 3). Besides, variation in spore size does not display any dependence on geographical latitude.

Gloeocystidia are of variable morphology, depending on the age of basidioma and their position in certain parts of the basidioma. *P. pseudonuda* has numerous ellipsoid-clavate gloeocystidia, while *P. laeta* has predominantly subcylindrical ones, but all shapes of gloeocystidia which were observed in *P. pseudonuda*, were also found in *P. laeta* though in different frequency (FIG. 2, 3). Lamprocystidia are rare or scattered in both taxa, but usually more frequent in *P. pseudonuda*. The main micromorphological difference between them is the composition of subiculum. In *P. pseudonuda* there is a more or less pronounced basal layer, always of compact, agglutinated hyphae, while in *P. laeta* three different types of subicular layers can be recognized: (1) a more or less thin layer of compact subhorizontal hyphae (FIG. 3), (2) a much thicker layer of intertwined and loosely arranged hyphae (FIG. 4a), and (3) a layer of wide, short-celled hyphae, agglutinated and parallelly arranged, forming a

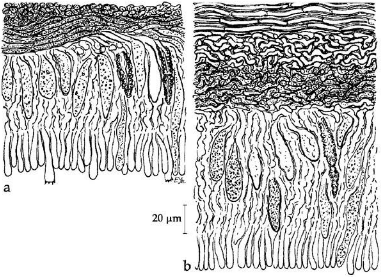

FIG. 2. Vertical basidioma sections in *Peniophora pseudonuda* (GB12298/FCUG 2384): a – in thinner part, with brown compact basal layer, b – in thicker part, with hyaline to brownish, less compact subicular hyphae.

pseudoparenchymatous tissue. The last type of subiculum occurs as tramal tissue in the teeth of the hymenophore (FIG. 4b). Subicular hyphae in *P. laeta* are usually hyaline or subhyaline, but in old basidiomata some hyphae become yellow or yellow-brown, like in *P. pseudonuda*.

We regard the differences in subiculum organization as an adaptation to subcortical or epicortical growth. In order to break and uplift the bark to expose the hymenium, the fungus develops hydnoid projections, together with thicker and looser subiculum, often containing the characteristic pseudoparenchyma. On twigs with thin bark and/or with few or no lenticels, the fungus can easily break the bark layer. However, on twigs with firm bark the fungal mycelium emerges through bark holes, apparently not being able to rupture the bark. The brown pigmentation of the epicortical subiculum in *P. pseudonuda* is considered as an adaptation to light exposure. It is well known from other *Peniophora* species that a brown subicular layer may yield a basidioma with a brownish grey or bluish grey color of the hymenium (Eriksson et al. 1978). Contrary, the basidiomata of *P. laeta* are partly covered from direct sunlight during the subcortical basidioma formation and the subicular layer consists of hyaline or subhyaline hyphae. Based on samples collected in Eurasia from Sweden to Iran, an emended morphological description of *P. laeta* has been constructed.

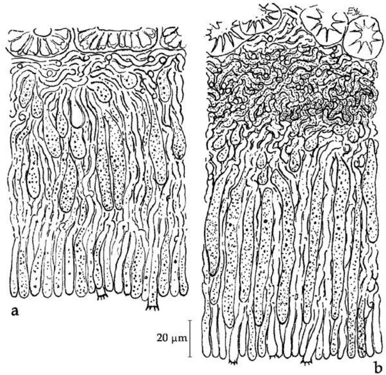

Fig. 3. Vertical basidioma sections in *Peniophora laeta* (MSK 6943): a – in thinner part, with scarce hyaline subicular hyphae, b – in thicker part, with moderately developed yellow compact subiculum and elongated gloeocystidia.

Peniophora laeta (Fr.) Donk Figs. 1–4

= *Peniophora pseudonuda* Hallenb.

Basidioma annual, resupinate, closely adnate, developing under the bark and extending through and rupturing the bark upon growth, or – alternatively – extending on bark and soon becoming confluent, ceraceous, 80–150 µm thick in smooth parts; hymenium surface pruinose under a lens, color variable – creamish, creamish-orange with reddish tint, or bluish grey; hymenophore smooth to irregularly tuberculate-odontoid, teeth scattered, up to 2.5 mm long and 1 mm wide, occasionally joined and aggregated; margin abrupt to thinning out.

HYPHAL SYSTEM monomitic, hyphae with clamps, arranged vertically in subhymenium, 3–4 µm wide, thin-walled, not changed in KOH. Subiculum 40–400 µm thick, almost lacking in some collections; texture variable, from dense, consisting of agglutinated golden brown hyphae, to pseudoparenchymatous in the centre of teeth, or composed of loose and intertwined, subhyaline hyphae. CYSTIDIA of two types: 1) gloeocystidia, 40–115 × 9–20 µm, often developing deeply in the subhymenium, vesicular-clavate, becoming elongate, and reaching the hymenial surface, contents refractive, granular to homogeneous, walls thin to moderately thickened, 2) metuloids (encrusted pointed cystidia), also developing deeply in the subhymenium, rare or even lacking in some collections, crystallized part 15–37 × (7.5–)10–12 µm. A few naked and pointed cystidia are sometimes present among the basidia, only slightly projecting above the hymenium. BASIDIA subcylindrical to narrowly clavate, little flexuose, 35–50 × 5–6.5 µm, with a basal clamp, with four sterigmata, walls slightly thickened in mature basidia. SPORES subcylindrical, slightly depressed adaxially, (7.2–)8–11.5(–13) × (2.2–)3–4.5(–5) µm, with a small apiculus, contents hyaline or subhyaline, walls smooth, thin, CB+, IKI–.

SUBSTRATA — On dead, still-attached, sometimes fallen, thin (0.2–1.5 cm) twigs and branches of hardwood trees. In Europe mostly found on *Carpinus betulus*, occasionally *Quercus robur*; in W. Asia also found on *Corylus avellana*, *Fagus orientalis*, *Parrotia*, *Quercus*. In North America it has only been recorded from *Amelanchier*, which suggests that this material needs to be re-examined.

SPECIMENS EXAMINED — **BELARUS: Mahilyou oblast**, ASIPOVICHY, BRYTSALAVICHY, on *Carpinus*, 6.IX.2006, Yurchenko (MSK-F 6738; d); **Minsk oblast**, SALIHORSK, HOTSK, on *Carpinus*, 20.VI.2008, Yurchenko (MSK-F 6943); HLUSK, SLAUKAVICHY, on *Carpinus*, 1.X.2008, Yurchenko (MSK-F 7076; d); **Homel' oblast**, PETRYKAU, ADASI, on *Carpinus*, 19.X.1998, Yurchenko (MSK-F 4560; d). **GEORGIA:** COLCHIS, KULO, alt. 1200 m, on *Corylus avellana*, 5.X.1963 Parmasto (TAA 16745; nd). **IRAN: E. Azerbaijan**, W. KALEIBAR, MAKIDI, on *Carpinus*, 3.X.2006, Ghobad-Nejhad 413A (nd); **Golestan**, GOLESTAN NATIONAL PARK, on fallen hardwood, 26.IV–8.V.1978, Hallenberg 2555 & Danesh-Pajuh (**HOLOTYPE** of *Peniophora pseudonuda*, GB; nd). **ROMANIA:** CLUJ NEAR POIENI, on *Carpinus*, 23.X.1985, Hallenberg 9358 (GB-0073654; FCUG 1475; d). **RUSSIA:** ADYGEYA, MAYKOP, GUZERIPL', on *Fagus orientalis*, 14.IX.2003, Kotiranta 22517 (HK ref. herb.; dupl. MG ref. herb.; nd); KRASNODAR, MOSTOVSKOJ, PSEBAJ, on fallen hardwood, 15.IX.1991, Hallenberg 12298 (GB-0073645; FCUG 2384; nd); STAVROPOL', KISLOVODSK, on *Carpinus*, 20.VIII.2000, Yurchenko (MSK-F 6688; nd). **SWEDEN: Gotland**, VISBY, DBW BOTANICAL GARDEN, on *Carpinus betulus*, 5.X.1984, Nordin 9428 (H; d); SCANIA, STENSHUVUD, on *Carpinus*, 1.X.1984, Hallenberg 8557 (GB-0073663; FCUG 1266; d). **UKRAINE: Kyiv oblast**, RZHYSHCHIV, HREBENI, on *Carpinus*, 8.IX.1973, Soldatova (KW 17598, dup. in MSK; d); **Kirovhrad oblast**, HOLOVANIV, on *Carpinus*, 24.VIII.1973, Soldatova (KW 17590; dup. in MSK; d); **Cherkasy oblast**, KANIV RESERVE, on *Quercus robur* (!), 10.IX.2003, Akulov (CWU myc Ch-24; d); **Crimea**, SUDAK, LESNOE, 2.VIII.2001, Yurchenko (MSK-F 5981; d).

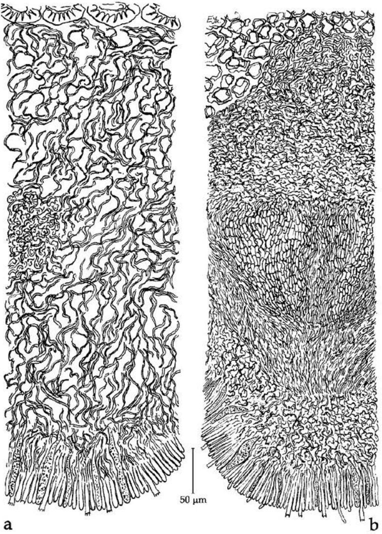

FIG. 4. Vertical basidioma sections in *Peniophora laeta* (MSK 6943) in thicker part and hymenophore projections: a – a portion with subiculum of loose hyaline hyphae, b – a portion with hyaline to yellowish subiculum, with pseudoparenchymatic insertion (center).

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MYCOTAXON

Volume 112, pp. 163–172 April–June 2010

A new species of *Pluteus* (*Pluteaceae*, *Agaricales*) from Mexico

Olivia Rodríguez[1], Adrián Galván-Corona[1], Alma R. Villalobos-Arámbula[2], Aarón Rodríguez[1] & Laura Guzmán-Dávalos[1]

oliviaro@cucba.udg.mx lguzman@cucba.udg.mx
[1]*Departamento de Botánica y Zoología, Universidad de Guadalajara*
Apartado postal 1-139, Zapopan, Jalisco, 45101, Mexico

[2]*Departamento de Biología Celular y Molecular, Universidad de Guadalajara*
Apartado postal 39-82, Zapopan, Jalisco, 50110, Mexico

Abstract— A new species, *Pluteus nevadensis* from subtropical and pine forests in Mexico, is described and compared with similar taxa. Phylogenetic analyses of the ITS rDNA sequence data support the classification of this new taxon in *Pluteus* section *Celluloderma*.

Key words— cystidia, *Pluteus aurantiorugosus*, *Pluteus horakianus*

Introduction

Pluteus Fr. is an agaric genus typically classified in the *Pluteaceae* Kotl. & Pouzar (Singer 1986). It is characterized by the free and pink-coloured lamellae, absent volva and annulus, and the convergent lamellar trama. It has a worldwide distribution that includes saprobic species, the majority of them lignicolous.

Until now, 33 species of the genus *Pluteus* have been reported from Mexico. Some of the species that are only known from this country include *Pluteus horridus* Singer, *P. leucocyanescens* Singer, *P. multistriatus* Murrill, *P. nitens* Pat., *P. triplocystis* Singer, and more recently *P. neotropicalis* Rodr.-Alcánt. and *P. horakianus* (Patouillard 1898, Murrill 1911, Singer 1973, Rodríguez et al. 2008, 2009).

Continuing with our study of *Pluteus* in Mexico, a careful study of some Mexican collections previously reported as *P. aurantiorugosus* revealed that some specimens represent a new species. Using morphological and molecular characters, this new species, *Pluteus nevadensis*, is described and reported from subtropical and pine forests in the states of Guerrero and Jalisco. Based on the infrageneric classification used by Singer (1986), which is corroborated with phylogenetic analyses of the internal transcribed spacer (ITS) of rDNA sequence data (Rodríguez et al. 2009), *P. nevadensis* is included in *Pluteus* section *Celluloderma* Fayod.

Material and methods

Morphology

Micromorphological observations were made from sections of the basidiomata mounted in 3% KOH. The terms for the descriptions are mainly those of Vellinga (1998) and in some cases those of Largent et al. (1977). Basidiospores shape was determined according to the Q (length-width ratio) (Bas 1969) of at least 20 mature and randomly selected basidiospores. The length of basidia measurements includes sterigmata. Illustrations were made with the aid of a drawing tube. The herbaria and author abbreviations follow Holmgren et al. (1990) and Kirk & Ansell (1992), respectively.

DNA extraction

Total genomic DNA was extracted from herbarium specimens following the protocol described in Aljanabi & Martinez (1997) with some modifications (Torres-Torres et al. 2009). Pellet DNA was resuspended in 30–80 µl of TE. The raw DNA was then diluted 1:2 in MilliQ water to reduce pigment concentration.

PCR amplification

The internal transcribed spacer (ITS), containing the ITS1, 5.8S and ITS2 regions of rDNA, was amplified by the polymerase chain reaction (PCR), using the pair primers ITS1F-ITS4 to amplify the entire ITS (Vilgalys & Hester 1990) or ITS5-ITS5.8S to amplify the ITS1 and ITS5.8SR-ITS4S to amplify the ITS2 (Gardes & Bruns 1993, Kretzer et al. 1996). The PCR reaction volumes were adjusted to 25 µL, consisting of 16.9 µL of MilliQ water, 2.4 µL of 10X reaction buffer (100 µM Tris, 500 µM KCl), 1.2 µL $MgCl_2$ (Applied Biosystems), 1.2 µL of 5 mM dNTPs, 0.1 µL of Taq DNA polymerase 5U/µL (Applied Biosystems), 0.5 µL of each 10 µM primer, 1.2 µL of BSA (bovine serum albumine) (New England Bio Labs), and 1 µL of DNA template.

PCR amplifications were performed in a MJ Research PTC 200 thermocycler as described by Rodríguez et al. (2009). Amplification from ITS region was confirmed under UV light using 1.5% agarose (NuSieve, FMC Bioproducts) gel electrophoresis in the presence of ethidium bromide. PCR products were purified with GFX™ purification kit (Amersham Biosciences) according to the instructions provided.

Sequencing

Sequencing reactions were performed with BigDyeTM Terminator v3.1 Cycle Sequencing (Applied Biosystems) following the manufacturer's protocols with the same primers as those used in the PCR. Sequencing reactions were purified with AutoSeqTM G-50 column (Amersham Biosciences) with 18 µL of formamide being added. Sequences were obtained by capillary electrophoresis on an ABI-Prism 310 Genetic Analyzer (Applied Biosystems). Three new sequences were generated, thirteen were from Rodríguez et al. (2009) and four were retrieved from GenBank. New sequences were deposited in GenBank with accessions numbers GU551941-GU551943 (Table 1). Resulting chromatograms were edited using Chromas 1.45 (McCarthy 1996–1998) and manually corrected when necessary. The assembly of the sequence fragments and the alignment of all sequences were carried out using MacClade 4.0 (Maddison & Maddison 2000).

Molecular analyses

One dataset was prepared based on 20 ITS rDNA sequences of 17 taxa: 15 sequences from 12 *Pluteus* species, one *Volvariella*, one *Leucoagaricus* and three *Entoloma* taxa (Table 1). Phylogenetic trees were inferred with PAUP* 4.0b10 (Altivec) (Swofford

Table 1. Species used in the phylogenetic analysis.

DNA code	Species	Origin	Collector, number (herbarium), collection date	GenBank accession
113	*P. albostipitatus* var. *poliobasis* Singer	Mexico	O. Rodríguez 1545 (IBUG), 2006	FJ375244[a]
160	*P. aurantiorugosus* (Trog) Sacc.	Spain	J.C. Zamora s.n (AH), 2001	FJ375248[a]
6	*P. cervinus* (Schaeff.) P. Kumm.	Mexico	L. Guzmán-Dávalos 3513 (IBUG), 1986	FJ375241[a]
242	*P. diverticulatus* Corriol	France	0092579 (holotype, PC), 1950	FJ375247[a]
58	*P. horakianus* Rodr.-Alcánt.	Mexico	L. Guzmán-Dávalos 7488 (IBUG), 1998	FJ375250[a]
60	*P. horakianus*	Mexico	L. Guzmán-Dávalos 7271 (holotype, IBUG), 1998	FJ375251[a]
65	*P. nevadensis* Rodr.-Alcánt.	Mexico	V. Calderón s.n. (FCME-13128), 1984	GU551941
67	*P. nevadensis*	Mexico	O. Vargas 525 (holotype, IBUG), 1991	GU551942
114	*P. nigrolineatus* Murrill	Mexico	O. Rodríguez 1548 (IBUG), 1996	FJ375245[a]
222	*P. pellitus* (Pers.) P. Kumm.	Mexico	J. García 9934 (IBUG), 1996	FJ375243[a]
100	*P. petasatus* (Fr.) Gillet	Mexico	O. Rodríguez 2587 (IBUG), 2004	FJ375242[a]
236	*P. pulverulentus* Murrill	West Indies	W.E. Broadway (holotype, NY), 1905	GU551943
119	*P. romellii* (Britzelm.) Lapl.	Mexico	O. Rodríguez 1565 (IBUG), 1996	FJ375246[a]
85	*P. thomsonii* (Berk. & Broome) Dennis	France	95091602	FJ375252[a]
155	*P. thomsonii*	Spain	F. Pardo s.n. (AH), 2001	FJ375253[a]
GB	*Leucoagaricus sinicus* (J.Z. Ying) Zhu L. Yang	GB		DQ182505[b]
GB	*Entoloma bloxamii* (Berk. & Broome) Sacc.	GB		EF530938[c]
GB	*Entoloma nitidum* Quél.	GB		AY228340[d]
GB	*Entoloma sericeum* Quél.	GB		AF357020[e]
176	*Volvariella gloiocephala* (DC.) Boekhout & Enderle	USA	L. Guzmán-Dávalos 8444 (IBUG), 2000	FJ375254[a]

[a] Rodríguez et al. (2009): [b] From Matheny & Hibbett in 2005; [c] From Denis et al. in 2007; [d] From Acorn et al. in 2003; [e] From Hofstetter et al. in 2002.

2000) and were rooted with species of *Volvariella*, *Leucoagaricus* and *Entoloma*. Branch-and-bound searches were performed using the criterion of maximum parsimony with furthest addition sequence, branches collapsed if maximum branch length is zero, only minimal trees were kept, and MulTrees option in effect. Gaps were treated as missing characters. Starting trees were obtained via stepwise addition. Relative branch support was estimated with 1000 bootstrap replications (Felsenstein 1985) with the same parameters previously mentioned. The initial dataset included 785 characters. For the parsimony analysis, 443 sites at both ends of the sequences and ambiguous regions were excluded. The parsimony tree scores, including tree length and consistency, retention, rescaled consistency and homoplasy indices (CI, RI, RC and HI) excluding uninformative characters, were calculated. Additionally, the percentage of sites (base pairs) differing between sequences of *P. nevadensis* and both *P. aurantiorugosus* and *P. horakianus* sequences was obtained.

Results

Description of the species

Pluteus nevadensis Rodr.-Alcánt., **sp. nov.** FIGS. 1–8

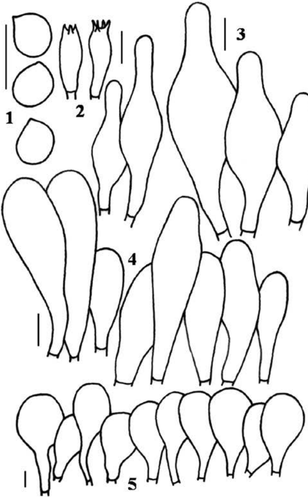
MYCOBANK MB515446

*Pileus 15–38 mm latus, primo conic vel campanulatus, dein plano-convexus, umbonatus, rugulosus vel levis ad discum, deflexus, erosus vel planus marginem rubroaurantiacus vel brunneoruber, siccus vel humidus. Lamellae liberae, latus vel ventricosae, primo albus vel albidus, dein salmoneus-roseus, ad aciem floccosus vel fimbriatus, albidue. Stipes 6–45 × 2–6 mm, cylindricus, aequalis, curvatus, flavus vel flavobrunneus ad apex aurantiacus obscure vel aurantiacus tinctus basalis, albidus, cottoneus-strigae mycelium, levis vel fibrillosus, sericeus, siccus. Caro 1mm, albidula ad pileus vel flavobrunneus vel aureus. Odor saporque nulli. Basidiosporae 5–6.5(–8) × 4.5–6.5 µm, late ellipsoideis vel ellipsoideis, rarus globosus. Basidia 22–29 × 6.5–7.5 µm, clavata, 4-sporigera, defibulata. Cheilocystidia (24–)32–52(–61) × (8–)10–18.5(–24) µm, clavata vel angustus clavata, utriformis, subcylindricus, obovatus, hyalina. Pleurocystidia 42–75(–82) × 12–24(–27.5) µm, polymorphica, lageniformia, brevicollis vel elongatus, subfusiformia vel subutriformis, hyalina. Caulocystidia nulla. Pileipellis e epithelium cellulis clavatis vel sphaeropedunculate formantibus, 26–60 × 14–31 µm, hyalina. Fibulae nullae. Habitatio ad lignum putridum in silvis mixtis (*Pinus, Quercus*).

HOLOTYPUS: Mexico, Jalisco: Municipality of Zapotlán el Grande, Nevado de Colima, El Floripondio 2100 m, 10.VIII.1991, O. Vargas 525 (IBUG).

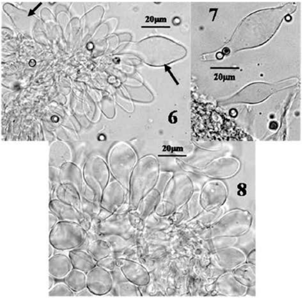
ETYMOLOGY – *nevadensis*. Named after the mountain where the type material was collected.

PILEUS 15–38 mm broad, conic when young, campanulate to convex or plane-convex when mature, umbonate; margin decurved, even or slightly eroded; surface dry to moist, rugulose towards the margin, with the disk rugose to smooth; sometimes white-yellowish context underneath the cuticle is visible; red-orange to reddish-orange. LAMELLAE free, crowed, broad to ventricose, white or whitish when young to salmon-pinkish in age; edge floccose or



FIGS. 1–5: *Pluteus nevadensis* (Holotype),
1: basidiospores (× 2000), 2: basidia (× 1000), 3: pleurocystidia (× 1000),
4: cheilocystidia (× 1000), 5: pileipellis (× 500).

fimbriate, whitish. STIPE 6–45 × 2–6 mm, central, equal, glabrous to slightly fibrillose, silky, hollow, yellow or yellowish at the apex, deep orange or with orange tinges towards the base; with cottony-strigose, whitish mycelium at the



FIGS. 6–8: *Pluteus nevadensis*,
6: cheilocystidia with two pleurocystidia, 7: pleurocystidia,
8: elements of pileipellis.

base. PILEUS CONTEXT 1 mm thick or more at the disk, fleshy, whitish. STIPE CONTEXT yellowish or yellow gold. SMELL AND TASTE not distinctive.

BASIDIOSPORES 5.5–7(–8) × 4.5–6.5 µm, Q = (1–)1.09–1.2 (L^m = 6.1 µm, W^m = 5.2 µm), subglobose to broadly ellipsoid, rarely globose, smooth, wall thin to slightly thickened, subhyaline. BASIDIA 22–29(–36) × 6.5–7.5 µm (including sterigmata), clavate, 4-spored, with refringent content, hyaline. PLEUROCYSTIDIA (38.5–)41.8–75(–81.8) × 11.8–24(–27.5) µm, frequent, scattered, lageniform with short or elongated neck, some subfusiform or subutriform, thin-walled, hyaline. CHEILOCYSTIDIA (24–)32–55(–61) × (8–)10–18.5(–24) µm, crowded, clavate to narrowly clavate, some utriform, subcylindrical or obovoid, thin-walled, hyaline. LAMELLAR TRAMA convergent PILEIPELLIS an epithelium with elements 25.6–60 × 13.6–31.2 µm, clavate or sphaeropedunculate, generally with a long pedicel, wall thin or slightly thickened, hyaline. OLEIFEROUS HYPHAE and CLAMP CONNECTIONS absent.

MATERIAL EXAMINED – MEXICO: GUERRERO, Municipality of Chilpancingo, Cerro Palo Hueco, Omiltemi, 14.VII.1984, *V. Calderón s.n.* (FCME-13128). JALISCO: Municipality of Zapotlán el Grande, Nevado de Colima, El Floripondio, 23.VII.1988, *L. Guzmán-Dávalos 4261* (IBUG), 10.VIII.1991, *O. Vargas 525* (holotypus, IBUG).

Molecular analyses

A Branch-and-Bound search of the ITS rDNA sequence data generated four most parsimonious trees with a tree length of 247 steps. Of the 342 sites considered for the analysis, 54 were parsimony informative. Excluding uninformative characters CI = 0.555, RI = 0.7478, RC = 0.490 and HI = 0.445. Figure 9 shows one of the trees, which has the same topology of the other three, except in the placement of *P. pulverulentus*. This species always was placed within section *Celluloderma*, but its position is not resolved in the strict consensus tree. The bootstrap support for the clades is from 55 to 100%, except for one clade that is below 50%. *Pluteus nevadensis* is placed in the clade representing section *Celluloderma* along with the morphologically similar species *P. aurantiorugosus*, but *P. nevadensis* has a sister relationship with *P. horakianus* in a different subclade.

The analysis of the ITS region shows that the percentage of sites (base pairs) differing between *P. nevadensis* and both *P. horakianus* and *P. aurantiorugosus* are 7.6% and 14.3%, respectively.

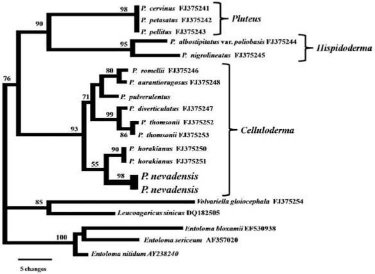


Fig. 9 One of the four phylograms resulting from a branch-and-bound search, of 12 species (15 samples) of *Pluteus*, and five outgroups, based on ITS rDNA sequence data. Tree length = 247 steps, parsimony informative characters = 54, CI excluding uninformative characters = 0.555, RI = 0.7478, RC = 0.490. Bootstrap values > 50% obtained from a branch-and-bound search with 1000 replicates are given above each branch.

Discussion

The Mexican collections are macromorphologically similar to *Pluteus aurantiorugosus*, so much so that all of the studied specimens (Calderón s.n., Guzmán-Dávalos 4261, Vargas 525) were previously recorded as this species (Cifuentes et al. 1989, Rodríguez & Guzmán-Dávalos 2001). *Pluteus aurantiorugosus* is the most similar taxon because of the scarlet, orange to red-orange pileus, the yellow to orange stipe, and the fimbriate and whitish lamellar margin. Micromorphologically, *P. aurantiorugosus* has a percentage of basidiospores that are oblong, cystidial shapes that are variable from clavate, broadly clavate to subfusiform and pileipellis elements that are typically globose with or without pigment. *Pluteus nevadensis* is distinguished by the lack of oblong basidiospores, the lageniform pleurocystidia and narrowly clavate cheilocystidia that are larger and more slender than those observed in *P. aurantiorugosus*, and by the more typically clavate pileipellis elements without pigment.

Pluteus nevadensis and *P. horakianus* are also morphologically similar fungi in the fragile basidiome, red pileus, and by the form of the pleuro- and cheilocystidia. However, *P. horakianus* is distinguished by the orange-reddish lamellar edges, the red stipe, and the pigmented pileipellis elements. Other superficially similar fungi, mainly sharing basidiome coloration, are *P. aurantiopustulatus* E. Horak, *P. aurantipes* Minnis et al., *P. flammipes* E. Horak, *P. laetifrons* (Berk. & M.A. Curtis) Sacc., and *P. laetus* Singer. Micromorphological characters such as a lack of pleurocystidia, form and size of cystidia, or different type of pileipellis readily separate *P. nevadensis* from these species. Rodríguez et al. (2009) summarized these characters for species similar to *P. horakianus*.

Previously, Rodríguez et al. (2009), based upon analyses of ITS rDNA sequence data, found that *P. horakianus* represented a distinct taxon belonging to section *Celluloderma* and that it was in a different clade than *P. aurantiorugosus*. Here, a phylogenetic analysis of the ITS region data (Fig. 9) shows that *P. nevadensis* is in a sister relationship with *P. horakianus* in section *Celluloderma*. This indicates that the two species are phylogenetically very closely related and distant to other *Pluteus* species, in particular to *P. aurantiorugosus*.

Furthermore, the analysis of the ITS region shows the percentage of ITS region sites differing between *P. nevadensis* and both *P. horakianus* and *P. aurantiorugosus* to be rather large (7.6% and 14.3%, respectively). Those percentages are high values compared with 2.2 – 4.0% between *Cortinarius* species (Vila et al. 2008).

Finally, we concluded that the examined collections of the Mexican *P. nevadensis* have enough morphological and molecular differences to be considered as a distinct new species.

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Three new species of the genus *Erysiphe* (*Ascomycota*, *Erysiphales*) on legumes and some new combinations

Uwe Braun

uwe.braun@botanik.uni-halle.de
Martin-Luther-Universität, Institut für Biologie
Bereich Geobotanik und Botanischer Garten
Herbarium, Neuwerk 21, D-06099 Halle (Saale), Germany

Julia Kruse

Julia.Kruse1@gmx.de
Nobelring 10, Zi. 217
D-30627 Hannover, Germany

Silvia M. Wolcan

swolcan@speedy.com.ar
Comisión de Investigaciones Científicas BA, CIDEFI
Facultad de Ciencias Agrarias y Forestales, UNLP
60 y 119, (1900), La Plata, Buenos Aires, Argentina

Mónica Murace

mmurace@gmail.com
Cátedra de Protección Forestal
Facultad de Ciencias Agrarias y Forestales, UNLP
60 y 119, (1900), La Plata, Buenos Aires, Argentina

Abstract — The new combination *Erysiphe trifoliorum* (= *Erysiphe trifolii*) is introduced, and its former varieties *E. trifolii* var. *intermedia* and var. *desmanthi* are reassessed and raised to species rank. Furthermore, three new species of the genus *Erysiphe*, viz. *Erysiphe baptisiae* on *Baptisia australis* in Europe, *E. baptisiicola* on *Baptisia* spp. in North America and *E. sesbaniae* on *Sesbania punicea* in Argentina, South America, are described, illustrated and discussed. A key to species of *Erysiphe* on legumes allied to the new species is provided.

Key words — *Erysiphaceae*, *E. desmanthi*, *E. intermedia*, *Fabaceae*, lectotype

Introduction

Powdery mildews (*Erysiphales*) of the genus *Erysiphe* DC. on legumes represent one of the taxonomically most complicated groups within this genus. There is a wide range of species on legumes with unbranched, irregularly branched to dichotomously branched chasmothecial appendages that are intermediate between those of the classical genera, *Erysiphe* and *Microsphaera* Lév. (Braun 1987, Heluta 1998), now treated as sections of *Erysiphe* emend. U. Braun & S. Takam. (Braun & Takamatsu 2000). The existence of such intermediate taxa questioned the justification of the classical discrimination between *Erysiphe* and *Microsphaera*. Phylogenetic hypotheses based on molecular sequence analyses (Saenz & Taylor 1999, Mori et al. 2000) supported the assumption that a separation of *Erysiphe* and *Microsphaera* is not tenable, which led to the merging of the two genera (Braun & Takamatsu 2000, Braun et al. 2002). In this work, the nomenclature and taxonomy of the *Erysiphe trifolii* complex are reassessed and revised. Furthermore, three new species on legumes belonging to the morphologically intermediate taxa described above have been found. They are described and discussed, and a key to them and allied species is provided.

Materials and methods

Fruiting bodies were mounted in distilled water and examined for description by means of standard light microscopy (Olympus BX 50, Hamburg, Germany) using oil immersion (bright field and phase contrast), but without any staining. Anamorphs were mounted in lactic acid, gently heated and stained with cotton blue. Thirty measurements (× 1000 magnification) of conidia and other structures were made. The extremes are given in parentheses. The collections examined are deposited in the herbaria BPI, HAL, LPS and STR (abbreviations according to Holmgren et al. 1990).

Taxonomy

1. Reassessment of nomenclature and taxonomy of *Erysiphe trifolii*

Erysiphe trifolii is a common and widespread powdery mildew on a wide range of legumes, and it is well characterized and distinguished from *E. pisi* DC. by its very long, non-mycelioid chasmothecial appendages (Braun 1987, 1995; Braun & Takamatsu 2000). The appendages are usually unbranched, but in fully mature samples some apices may become 1–2(–3) times dichotomously branched with straight ultimate tips, which renders this species a morphologically intermediate taxon between the former classical concepts of *Erysiphe* (now *Erysiphe* sect. *Erysiphe*) and *Microsphaera* (now *Erysiphe* sect. *Microsphaera* (Lév.) U. Braun & Shishkoff). Recently, original material of powdery mildew species described by Wallroth (1819a,b) under *Alphitomorpha* Wallr. has been re-examined and considered, in some cases, for lectotypification purposes. Type material, designated below, of *Alphitomorpha trifoliorum*, a name that is older than *E. trifolii*, proved to be identical with the current concept of the latter species, i.e. *A. trifoliorum* has priority and must be reallocated to *Erysiphe*. The epithets "*trifoliorum*" and "*trifolii*" are not confusable. Also, the former concept of *E. trifolii* is morphologically heterogeneous and includes several taxa that have to be recognized as distinct from *E. trifolii*. Two morphologically well-discriminated varieties have been previously described (Braun 1984, 1985, 1987, 1995), and these are herein, in a first step, raised to species rank. *E. trifolii* s. str., now *E. trifoliorum*, without its varieties is still a complex species with wide host range and considerable morphological variability. Braun (1987) listed names of various species as synonyms of *E. trifolii*, e.g. *Erysiphe robiniae* Grev. and *Microsphaera caraganae* Magnus. It is now necessary in a subsequent publication to re-examine and reassess the whole complex in a second step.

Erysiphe trifoliorum (Wallr.) U. Braun, **comb. nov.**

MycoBank, MB 516541

Bas.: *Alphitomorpha trifoliorum* Wallr., Ann. Wetterauischen Ges. Gesammte Naturk. 4: 238, 1819.

= *Erysiphe trifolii* Grev., Fl. edin.: 459, 1824.

≡ *Microsphaera trifolii* (Grev.) U. Braun, Nova Hedwigia 34: 685, 1981.

Lectotype of *A. trifoliorum* **(designated here)**: on *Trifolium medium* L. (= *T. flexuosum* Jacq.), GERMANY, without any further data, herb. Wallroth (STR).

Notes: Wallroth (1819b) introduced the name *A. trifoliorum*, i.e. he undoubtedly intended to and described a new species of powdery mildew for *Trifolium* spp. The lectotype is the only collection in Wallroth's herbarium deposited as *A. trifoliorum* [on *Trifolium medium* (= *T. flexuosum*)], i.e. a host species mentioned by Wallroth (1819b) in the original description, and we presume it is part of the original material. *A. trifoliorum* is the oldest valid name for this species. The morphological characteristics of the lectotype collection of *A. trifoliorum* agree well with those of other collections of *E. trifoliorum* on *Trifolium* spp.: Chasmothecia 90–130 µm diam., with 8–20 appendages, 2–5 times as long as the chasmothecial diam., with few septa, apex mostly simple, rarely dichotomously branched, asci 4–8, 50–70 × 25–45 µm, 3–5-spored, ascospores 19–24 × 10–14 µm.

Erysiphe intermedia (U. Braun) U. Braun, **comb. et stat. nov.**

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Bas.: *Microsphaera trifolii* var. *intermedia* U. Braun, Zentralbl. Mikrobiol. 140: 416, 1985.

≡ *Erysiphe trifolii* var. *intermedia* (U. Braun) U. Braun & S. Takam., Schlechtendalia 4: 15, 2000.

Holotype: on *Lupinus perennis* L., USA, Massachusetts, Mouson, Aug. 1883, A.B. Seymour, Rabenh., Fungi Eur. Exs. 3243a (HAL). Isotypes: Rabenh., Fungi Eur. Exs. 3243a. Paratypes: on *Lupinus perennis*, USA, New Jersey, Jamesburg, Jul. 1889, B.D. Halsted, Ellis & Everh., N. Amer. Fungi 2338 (FH); USA, Ohio, Toledo, 21 Jul. 1900, F.D. Kelsey, Vestergr., Micromyc. Rar. Sel. Praec. Scand. 664 (FH).

NOTES: This species is confined to hosts of the genus *Lupinus* in North America and Europe. It is easily distinguishable from *E. trifoliorum* by having 0–1-septate, colorless chasmothecial appendages with a distinct tendency to turn towards one direction, as for instance in *Erysiphe astragali* DC. and *E. baeumleri* (Magnus) U. Braun & S. Takam. (Braun 1987, 1995). The appendages in *E. trifoliorum* are horizontally spread, 0–6-septate and pigmented below the septa.

Erysiphe desmanthi (U. Braun) U. Braun, **comb. et stat. nov.**
MYCOBANK, MB 516543

BAS.: *Microsphaera trifolii* var. *desmanthi* U. Braun, Mycotaxon 19: 375, 1984.
≡ *Erysiphe trifolii* var. *desmanthi* (U. Braun) U. Braun & S. Takam., Schlechtendalia 4: 15, 2000.

HOLOTYPE: on *Desmanthus illinoensis* (Michx.) MacMill. ex B.L. Rob. & Fernald (= *D. brachylobus* Benth.), USA, Missouri, St. Louis, Oct. 1886, herb. Trelease (FH).

NOTES: *E. desmanthi* is an endemic North American species well-distinguished from *E. trifoliorum* by having much smaller, usually caulicolous chasmothecia, 70–90(–105) µm diam., and evidently verrucose appendages (Braun 1987).

2. A new species of *Erysiphe* on *Baptisia australis* in Europe

Erysiphe baptisiae U. Braun & J. Kruse, **sp. nov.** FIG. 1
MYCOBANK, MB 516544

Erysiphes intermediae *similis, sed appendicibus chasmotheciorum horizontaliter effusis, cellulis basalibus conidiophorum saepe curvatis vel sinuosis.*

ETYMOLOGY: derived from the host genus.

TYPE: GERMANY. NIEDERSACHSEN, Hannover, Herrenhausen/Leinhausen, Vinnhorster Weg, Schulbiologiezentrum, on *Baptisia australis* (L.) R. Br. (*Fabaceae*), 5 Oct. 2009, J. Kruse (HAL 2337 F, **holotype**).

MYCELIUM amphigenous, in grayish white patches or effuse, often covering the entire leaf surface, thin, persistent; hyphae branched, usually straight to somewhat sinuous, 3–7 µm wide, septate, hyaline, thin-walled, smooth or almost so. APPRESSORIA solitary, 3–7 µm diam., lobed. CONIDIOPHORES arising from superficial hyphal mother cells, terminal to lateral, almost in the middle of the mother cell or toward one end, erect, straight, up to about 80 µm long (without conidia), foot-cells 15–35 × 5–8 µm, cylindrical, straight to mostly somewhat curved to distinctly sinuous, followed by 1–2 shorter cells, about 10–30 µm long. CONIDIA formed singly, primary conidia ellipsoid-ovoid, secondary conidia ellipsoid-cylindrical to almost doliiform, 22–35 × 12–16 µm, length/width ratio usually 1.8–2.5, ends rounded to truncate. CHASMOTHECIA scattered to gregarious, 80–120 µm diam., subglobose; peridium cells irregularly polygonal, 10–25(–30) µm diam., walls of the cells up to about 2 µm thick. APPENDAGES 6–15(–20), ± equatorial, flexuous, straight, curved to sinuous,

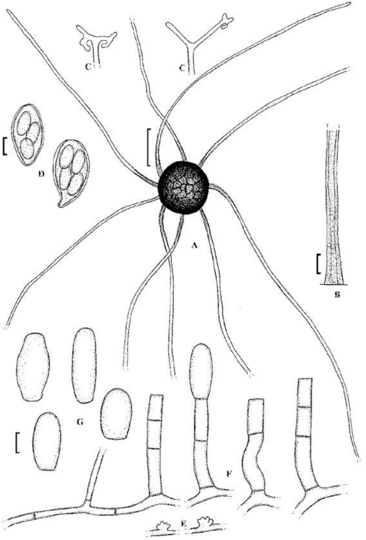

FIG. 1. *Erysiphe baptisiae* (based on type material).
A. Chasmothecium. B. Appendage. C. Branched tips of appendages (from Eliade 1990, as *Microsphaera rayssiae*). D. Asci. E. Appressoria. F. Conidiophores. G. Conidia.
Scale bars = 100 µm (A), 10 µm (B–G). U. Braun del.

more or less horizontally spread, not turning towards one direction, apex usually unbranched, rarely 1–2 times dichotomously branched in fully mature samples, ultimate tips straight to somewhat curved, 4–10 times as long as the chasmothecial diam. (up to about 800 µm long), 3–8 µm wide, width somewhat decreasing from base to top, aseptate, hyaline, thick-walled at the base, up to 3 µm, becoming gradually thinner towards the tip, verruculose towards the base, smooth above. ASCI 3–8 per chasmothecium, obovoid to saccate, 45–70 × 25–35 µm, sessile to short-stalked, wall thin, up to 1.5 µm, terminal oculus indistinct, 3–5-spored, ascospores ellipsoid-ovoid, 14–23 × 10–14 µm, colorless.

COMMENTS: European powdery mildew on *Baptisia australis* has previously been referred to as *Erysiphe rayssiae* (Mayor) U. Braun & S. Takam. [≡ *Microsphaera rayssiae* Mayor] (Mayor 1968, Eliade 1990). *Erysiphe rayssiae* on *Spartium* [*Fabaceae*, *Genisteae*] is quite distinct from *E. baptisiae* on *Baptisia* [*Fabaceae*, *Thermopsideae*] by having straight, cylindrical conidiophores and very irregularly shaped, mycelioid, strongly geniculate-sinuous chasmothecial appendages with frequently branched apices. *Erysiphe baptisiae* belongs to the *E. trifoliorum* complex, characterized by chasmothecia with very long, but usually unbranched appendages. Eliade's (1990) description agrees very well with *E. baptisiae*, but she described and illustrated the occurrence of terminally branched appendages. However, material on *Baptisia* from Romania and Switzerland was not available for re-examination. The foot-cells of the conidiophores in *E. intermedia* and *E. trifoliorum* are cylindrical, usually straight, only occasionally slightly curved or flexuous. The appendages in *E. trifoliorum* are 0–6-septate and pigmented below the septa. The long appendages in *E. intermedia* have an obvious tendency to turn towards one direction, as in *E. astragali* and *E. baeumleri*. The appendages in the latter two species are often dichotomously branched. *Erysiphe* on *Baptisia* spp. is known from North America and was previously identified as *E. polygoni* DC., *E. communis* (Wallr.) Schltdl. and *E. martii* Lév. Several collections deposited at BPI have been examined, but all of them proved to belong to another species, one described below, that is morphologically closer to *E. pisi*.

3. A new species of *Erysiphe* on *Baptisia* spp. in North America

Erysiphe baptisiicola U. Braun, **sp. nov.** FIG. 2

MYCOBANK, MB 516545

Erysiphes pisi *similis, sed cellulis basalibus conidiophorum saepe curvatis vel sinuosis, conidiis angustioribus, plus minusve < 15 µm latis, appendicibus chasmotheciorum obscure pauciseptatis, parietibus basim versus incrassatis, verruculosis.*

ETYMOLOGY: derived from the host genus.

TYPE: USA. CONNECTICUT, Elm City Nursery, on leaves of *Baptisia australis* (*Fabaceae*), Oct. 1907, G.P. Clinton (BPI 564440, **holotype**).

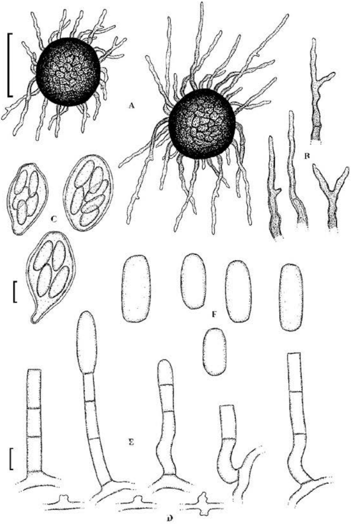

FIG. 2. *Erysiphe baptisiicola* (based on type material).
A. Chasmothecia. B. Appendages. C. Asci. D. Appressoria. E. Conidiophores. F. Conidia.
Scale bars = 100 µm (A), 10 µm (B–F). U. Braun del.

Mycelium amphigenous, forming dense, thin to thick, persistent patches or complete covers; hyphae branched at more or less right angle, straight to sinuous, 2–7 µm wide, septate, hyaline, thin-walled, smooth to verruculose. Appressoria solitary or occasionally in opposite pairs, nipple-shaped, with crenulate outline to somewhat lobed, 2–5 µm diam. Conidiophores arising from superficial hyphal mother cells, terminal to lateral, usually somewhat towards one end of the cell, erect, up to about 90 µm long (without conidia), foot-cells 15–30 × 6–9 µm, subcylindrical, straight to usually curved-sinuous, followed by 1–3 shorter cells, cells of about the same length or even longer. Conidia formed singly, narrowly ellipsoid-cylindrical, 25–38 × 10–17 µm, on average < 15 µm wide, length/width ratio 1.6–2.5. Chasmothecia scattered to gregarious, 80–120 µm diam., subglobose to depressed-globose or almost hemispherical; peridium cells irregularly polygonal, 5–20 µm diam., wall of the cells up to 2.5 µm thick. Appendages numerous, equatorially arising and from the lower half, mycelioid, almost straight to usually sinuous or geniculate-sinuous, often strongly so, unbranched or occasionally irregularly branched, with short branchlets, 0.25–2 times as long as the chasmothecial diam. (up to about 220 µm), 3–9 µm wide, aseptate or only with few rather inconspicuous septa, at first hyaline, later pigmented, shorter appendages yellowish brown to medium brown throughout, longer ones brown below and paler towards the apex, tips subhyaline or hyaline, wall at first thin, later thin above and somewhat thickened towards the base, up to 2 µm thick, almost smooth to usually distinctly verruculose. Asci 3–10, broadly ellipsoid-obovoid, saccate, 40–75 × 25–40 µm, sessile to short-stalked, (3–)4–6(–7)-spored, ascospores ellipsoid-ovoid, 15–25 × 8–12 µm, colorless to yellowish.

Additional material examined: USA. Connecticut, Westville, Elm City Nursery, 29 Oct. 1907, G.P. Clinton (BPI 564441); without locality, 5 Nov. 1942, G.M. Reed (BPI 564442); Massachusetts, Wellesley, on leaves of *Baptisia tinctoria* (L.) R. Br., 14 Oct. 1884, C.E. Cummings (BPI 562107); Massachusetts, Andover, 6 Oct. 1924, E.W. Thompson (BPI 562196); New York, Rockland County, Nyack, 18 Aug. 1883, without collector (BPI 563594); Pennsylvania, Westmoreland County, New Florence, 8 Sep. 1907, D.R. Sumstine (BPI 562108); without locality and date, W.G. Farlow (BPI 562107).

Comments: *Erysiphe baptisiicola* is easily distinguishable from *E. baptisiae* by its much shorter, mycelioid (geniculate-sinuous), septate, pigmented chasmothecial appendages. This species belongs to the *Erysiphe pisi* complex, but it differs in having chasmothecial appendages without or with only few rather inconspicuous septa and walls that are thick-walled towards the base. Furthermore, the anamorph of *E. baptisiicola* is quite distinct by having conidiophores with curved-sinuous foot-cells and narrower conidia (foot-cells straight and conidia 24–55 × 13.5–22 µm, on average > 15 µm wide, in *E. pisi*, see Braun 1987, 1995).

4. A new species of *Erysiphe* on *Sesbania punicea*

Erysiphe sesbaniae Wolcan & U. Braun, **sp. nov.** FIG. 3

MYCOBANK, MB 516546

Erysiphes robiniicolae *similis, sed cellulis basalibus conidiophorum brevioribus, 20–45 × (5–)6–9(–10) µm, appendicibus chasmotheciorum ubique crassitunicatis, ascosporis anguste ellipsoideis-ovoideis, interdum apice attenuato.*

ETYMOLOGY: derived from the host genus.

TYPE: ARGENTINA. BUENOS AIRES PROVINCE, La Plata, in a nursery, on leaves of young trees of *Sesbania punicea* (Cav.) Benth. (*Fabaceae*), Oct. 2009, N. Acosta (HAL 2330 F, **holotype**; LPS 48291, isotype).

MYCELIUM amphigenous, in white patches or effuse, often covering the entire leaf surface, thin to usually rather thick, persistent; hyphae branched, 2–7 µm wide, septate, hyaline, thin-walled, smooth to somewhat rough-walled. APPRESSORIA solitary, 3–10 µm diam., slightly to moderately lobed, occasionally almost nipple-shaped. CONIDIOPHORES arising from superficial hyphal mother cells, more or less terminal, in the middle or somewhat towards one end, erect, straight, up to about 80 µm long (without conidia), foot-cells 20–45 × (5–)6–9 (–10) µm, cylindrical, usually straight, occasionally somewhat sinuous, followed by 1–2(–3) shorter cells, sometimes followed by a single cell of about the same length. CONIDIA formed singly, primary conidia ellipsoid-ovoid, secondary conidia narrowly cylindrical or ellipsoid-cylindrical, 25–40 × 10–18 µm, length/width ratio 1.9–2.9, ends rounded to subtruncate. CHASMOTHECIA scattered to gregarious, (80–)100–140 µm diam., subglobose; peridium cells irregularly polygonal, 10–30 µm diam., walls of the cells up to 2 µm thick. APPENDAGES numerous, mostly about 10–15, ± equatorial and in the lower half, straight to often strongly sinuous-subgeniculate, simple, unbranched or apically irregularly to dichotomously branched, depending on age and developmental stage, 0.5–3.5 times as long as the chasmothecial diam. (up to about 350 µm long), 4–10 µm wide from base to top or somewhat narrower towards the apex, aseptate or 1–3(–4)-septate in the lower half, septa thin and often rather inconspicuous, hyaline or brown below and paler or colorless towards the apex, wall thick-walled from base to top or thinner towards the apex, up to 3 µm thick, rough-walled, often coarsely verruculose. ASCI 5–10 per chasmothecium, obovoid to saccate, 60–80 × 25–50 µm, short-stalked, wall up to 2.5 µm thick, terminal oculus relatively small, about 8–12 µm diam., (2–)3–4(–5)-spored, ascospores narrowly ellipsoid-ovoid, sometimes distinctly attenuated towards one end, (18–)20–28(–30) × 9–12 µm, colorless.

COMMENTS: *Erysiphe sesbaniae* belongs to a group of *Erysiphe* species that are characterized by having strongly sinuous-subgeniculate, thick-walled, distinctly, often coarsely verrucose chasmothecial appendages. The appendages are simple, unbranched or apically irregularly to dichotomously branched,

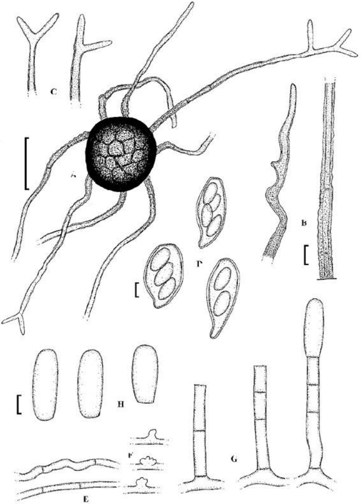

Fig. 3. *Erysiphe sesbaniae* (based on type material).
A. Chasmothecium. B. Base and apex of an appendage. C. Tips of appendages.
D. Asci. E. Hyphae. F. Appressoria. G. Conidiophores. H. Conidia.
Scale bars = 100 µm (A), 10 µm (B–H). U. Braun del.

depending on age and developmental stage, rendering the species concerned morphologically intermediate between *Erysiphe* sect. *Erysiphe* and *Erysiphe* sect. *Microsphaera*. The following species, almost all from Asia, belong to this group: *Erysiphe bremeri* U. Braun on *Alhagi* and *Sophora* spp.; *E. crispula* (U. Braun) U. Braun & S. Takam. on *Astragalus* (Asia and North America), *E. hedysari* (U. Braun) U. Braun & S. Takam. on *Hedysarum* spp. and *Anthyllis maura* Beck; *E. thermopsidis* R.Y. Zheng & G.Q. Chen [= *Microsphaera thermopsidis* U. Braun (≡ *E. shinii* U. Braun & S. Takam.)] on *Thermopsis* spp.; and *E. robiniicola* U. Braun & S. Takam. [≡ *Microsphaera robiniae* F.L. Tai, non *Erysiphe robiniae* Grev.] on *Robinia* spp. (Braun 1987, Braun & Takamatsu 2000, Braun et al. 2009, Liu & Braun 2009). *Erysiphe robiniicola*, known from China on *Robinia hispida* L. and *R. pseudoacacia* L., is morphologically close to *E. sesbaniae*, but it differs in having conidiophores with longer foot-cells, 30–65 µm, appendages thick-walled below and thin-walled towards the apex, and broadly ellipsoid-ovoid ascospores, 15–22 × 9–14 µm, which are never distinctly attenuated towards one end (Braun et al. 2009). *Robinia* and *Sesbania* are two related genera that cluster together in the robinioid clade [*Robinieae*] (Wojciechowski et al. 2004). There are numerous records of powdery mildew on various *Sesbania* spp. under different names, e.g. *Erysiphe communis*, *E. polygoni* and *Oidium* sp. (Amano 1987). The identity and relation of these records to *E. sesbaniae* are unclear.

5. Key to the species of the *Erysiphe bremeri / E. pisi / E. trifoliorum* complex on legumes

1. Chasmothecia only with 1–4(–7) appendages, 0(–3)-septate, apex occasionally 1(–2) times branched; on *Pueraria*, China. . *E. puerariae* R.Y. Zheng & G.Q. Chen

1* Chasmothecia with numerous appendages 2

2. Chasmothecial appendages mycelioid (geniculate-sinuous), about 0.5–3 times as long as the chasmothecial diam., equatorially arising and from the lower half, unbranched or irregularly branched 3

2* Chasmothecial appendages either apically at least partly dichotomously branched and/or appendages not mycelioid, straight to flexuous, and very long, 3–10 times the chasmothecial diam. 13

3. Appendages rather short, 0.5–1(–2) times as long as the chasmothecial diam., hyaline or only faintly yellowish, 0–1(–2)-septate, thin-walled, usually curved, "spider-like;" on *Genista*, *Melilotus* and *Thermopsis*, Asia, Armenia .... *E. thermopsidis*

3* Appendages not characteristically curved, not "spider-like" 4

4. Appendages frequently irregularly branched or even branched in a coral-like manner 5

4* Appendages usually unbranched, only occasionally irregularly branched 6

5. Appendages frequently and strongly branched, hyaline to yellowish, aseptate or only with 1–2 inconspicuous septa; on *Lathyrus* and *Vicia* in Asia . . . . *E. viciae-unijugae* (Homma) U. Braun

5* Appendages moderately branched, brown throughout or at least in the lower half, thin-walled, conspicuously pluriseptate; on *Lathyrus* and *Ononis*, Europe . . . . *E. pisi* var. *cruchetiana* (S. Blumer) U. Braun

6. Chasmothecia large, (100–)110–185(–210) µm diam., confined to stems, appendages narrow, 3.5–7 µm wide, fairly thick-walled throughout, aseptate or only with few inconspicuous septa; on *Astragalus*, Asia, Europe . . . . *E. caulicola* (Petr.) U. Braun

6* Chasmothecia smaller, and/or appendages thin-walled, distinctly pluriseptate, not confined to stems 7

7. Chasmothecial appendages at least thick-walled towards the base, aseptate or only with few rather inconspicuous septa, verruculose 8

7* Chasmothecial appendages thin-walled, distinctly pluriseptate, smooth or only faintly rough-walled 9

8. Chasmothecia 90–120 µm diam., appendages brown throughout or brown below and paler towards the tip when mature, usually unbranched, only occasionally irregularly branched, with short branchlets; on *Baptisia* spp., North America . . . . *E. baptisiicola*

8* Chasmothecia large, 90–180 µm diam., appendages colorless or only faintly pigmented at the base, rather narrow, 3.5–8.5 µm, at first unbranched, but apex always irregularly to dichotomously branched when fully mature (on *Anthyllis* and *Hedysarum*, Asia and Europe, see immature samples of *E. hedysari*) or appendages 5–10.5 µm wide, causing deformations and defoliations of the hosts (on *Alhagi* and *Sophora*, Asia, see immature samples of *E. bremeri*)

9. Chasmothecia small, 65–100(–110) µm diam., asci 2–7-spored, ascospores small, 14–20 × 9–13.5 µm; on *Cercis*, China . . . . *E. cercidis* T. Xu

9* Chasmothecia and ascospores larger 10

10. Asci with 2–4 rather large ascospores; conidiophores with short, straight foot-cells, 20–30 µm long; on *Hoffmannseggia*, South America, Argentina . . . . *E. deserticola* Speg.

10* Asci (2–)3–8-spored; foot-cells of the conidiophores longer or curved-sinuous; on other hosts 11

11. Chasmothecia scattered to usually gregarious, appendages pigmented, at least brown in the lower half, 4–10 µm wide, asci 3–5(–6)-spored; foot-cells of the conidiophores straight; on *Pisum* and numerous other hosts, worldwide . . . . *E. pisi* var. *pisi*

11* Chasmothecia characteristically (regularly) scattered, appendages colorless or only faintly pigmented, yellowish, narrow, (2–)3–6(–8) µm wide, asci 4–8-spored; foot-cells of the conidiophores curved-sinuous; on *Amphicarpaea*, *Desmodium*, *Glycine*, *Lespedeza* 12

12. Asci 4–7-spored, mostly 5–6-spored; on *Amphicarpaea*, *Desmodium*, *Glycine*, North America and Asia .... *E. glycines* F.L. Tai
12* Asci 6–8-spored; on *Lespedeza*, Asia .... *E. lespedezae* R.Y. Zheng & U. Braun
13(2*) Appendages short, 0.5–4 times the chasmothecial diam., strongly sinuous-geniculate, contorted, apex often simple, branchings rarely developed, wall mostly thickened and verruculose; on *Alhagi*, *Anthyllis*, *Genista*, *Hedysarum*, *Robinia*, *Sophora*, *Thermopsis*, Asia and Europe, or *Sesbania*, South America 14
13* Appendages very long, mostly 3–10 times the chasmothecial diam., when relatively short, appendages rather stiff, not mycelioid; on other host genera and also on *Sophora* 18
14. Mycelium dense, persistent, causing deformations and defoliations, "witches' brooms;" on *Alhagi* and *Sophora*, Asia .... *E. bremeri*
14* Mycelium amphigenous and caulicolous, subpersistent, without deformations or defoliations; on other host genera 15
15. Chasmothecia large, (95–)110–170(–180) µm diam., appendages 5–20, narrow, 3.5–8.5 µm wide, tips in fully mature samples often recurved, appendages in mature samples strongly rough-walled; on *Anthyllis maura*, *Hedysarum* spp., Asia and Europe .... *E. hedysari*
15* Chasmothecia smaller, about 80–140 µm diam., appendages wider, up to about 10 µm, tips straight; on other hosts 16
16. Appendages very numerous, 10–40, mostly more than 20, faintly rough-walled; on *Genista*, *Melilotus*, *Thermopsis*, Asia, Armenia .... *E. thermopsidis*
16* Appendages less numerous, about 6–25, mostly 10–20, distinctly rough-walled, often coarsely verruculose 17
17. Asci (4–)5–6(–7)-spored, ascospores small, 14–20 × 10–15 µm; foot-cells of the conidiophores 30–65 µm long; on *Robinia*, China .... *E. robiniicola*
17* Asci (2–)3–4(–5)-spored, ascospores larger, 20–28 × 9–12 µm; foot-cells of the conidiophores shorter, 20–45 µm; on *Sesbania*, South America ..... *E. sesbaniae*
18(13*) Appendages either ± horizontally spread, septate and pigmented, at least up to the middle of the stalk, or appendages with a tendency to turn towards one direction, aseptate or 1(–2)-septate, hyaline or only pigmented at the very base, flexuous, but not mycelioid, most appendages simple, only a varying percentage apically 1–3 times branched in fully mature samples, branchings diffuse, wide (*E. trifoliorum* complex: *E. astragali*, *E. baeumleri*, *E. baptisiae*, *E. intermedia*, *E. trifoliorum*) 19
18* Appendages mycelioid, irregular, sinuous-geniculate (on *Astragalus* or *Spartium*), apex frequently dichotomously branched 24
19. Appendages frequently branched in mature samples, with a moderate tendency to turn towards one direction, tips of the ultimate branchlets straight; on *Vicia*, North America, Asia, Europe .... *E. baeumleri*
19* Branched appendages rare; on other host genera 20

20. Appendages mostly with a conspicuous tendency to turn towards one direction, sometimes even subfasciculate, tips of the ultimate branchlets in fully mature samples often recurved; on *Astragalus* and *Oxytropis* .... *E. astragali*

20* Appendages horizontally spread, tips of the ultimate branchlets straight to somewhat curved or appendages only with a slight to moderate tendency to turn towards one direction and tips straight; on various other host genera ... 21

21. Chasmothecia small, 70–90(–105) µm diam., appendages evidently verrucose, at least below, caulicolous; on *Desmanthus*, USA .... *E. desmanthi*

21* Chasmothecia larger, on average > 90 µm, appendages smooth to verruculose towards the base; on other hosts 22

22. Foot-cells of the conidiophores usually curved to flexuous, sinuous; appendages horizontally spread, aseptate, colorless; on *Baptisia*, Europe .... *E. baptisiae*

22* Foot-cells of the conidiophores usually straight, only occasionally slightly curved or sinuous; appendages either septate and pigmented below the septa or with a tendency to turn towards one direction 23

23. Appendages 0–1-septate, hyaline or only pigmented at the very base, often with a slight to moderate tendency to turn towards one direction; on *Lupinus* .... *E. intermedia*

23* Appendages 0–6-septate, pigmented at least in the lower half, usually horizontally spread; on *Trifolium* and hosts of various other genera .... *E. trifoliorum*

24(18*) Appendages smooth to faintly rough-walled, branchlets of different orders frequently recurved, flexuous to curled, tips mostly recurved to almost spirally coiled; on *Astragalus*, Asia, North America .... *E. crispula*

24* Appendages evidently verrucose, only primary branches sometimes recurved, tips straight to partly recurved; on *Spartium*, Mediterranean region ..... *E. rayssiae*

Acknowledgements

We are much obliged to A.M. Minnis (USDA, ARS, Systematic Mycology and Microbiology Laboratory, Beltsville, USA) and H.D. Shin (Korea University, Division of Environmental Science and Ecological Engineering, Seoul, Korea) for providing pre-submission reviews and to the curators of BPI, LPS and STR for the possibility to examine collections deposited in these herbaria.

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Two new marasmielloid fungi widely distributed in the Republic of Korea

Vladimír Antonín[1*], Rhim Ryoo[2,3] & Hyeon-Dong Shin[3*]

vantonin@mzm.cz
[1]*Moravian Museum, Department of Botany*
Zelný trh 6, CZ-659 37 Brno, Czech Republic

rryoo@korea.ac.kr & hdshin@korea.ac.kr
[2]*Department of Forest Resources Utilization, Korea Forest Research Institute*
Seoul 130-712, Republic of Korea

[3]*Division of Environmental Science and Ecological Engineering*
Korea University, Seoul 136-701, Republic of Korea

Abstract — Two species of the genus *Marasmiellus*, *M. koreanus* and *M. rhizomorphigenus*, are described as new taxa from the Republic of Korea. Both have been recorded several times during the past years. Their systematic positions are supported through DNA analyses.

Key words — euagarics, DNA studies

Introduction

During joint field excursions sponsored by the Czech-Korean project, "Phylogenetic taxonomy of *Marasmius* (*Basidiomycota*, *Marasmiaceae*) and related genera in the Republic of Korea", several interesting marasmioid, marasmielloid, and gymnopoid fungi have been collected. Some results have already been published (Antonín et al. 2009a,b, 2010). The two new marasmielloid taxa presented here were rather frequently found at several South Korean localities.

Materials and methods

Macroscopic descriptions of collected specimens are based on fresh basidiocarps and made by the first author. Microscopic features are described from dried material mounted in H_2O, KOH, Melzer's reagent, and Congo Red using an Olympus BX-50 light microscope with a magnification of 1000×. For basidiospores, the factors E (quotient of

* Authors for correspondence

length and width in any one spore) and Q (mean of E-values) are used. For lamellae, L stands for the number of entire lamellae and l for the number of lamellulae between each pair of entire lamellae. Authors of fungal names are cited according to the International Plant Names Index Authors website (http://www.ipni.org/ipni/authorsearchpage.do), and colour abbreviations follow Kornerup & Wanscher (1983). Herbarium specimens of the studied fungi are preserved in the herbarium of the Moravian Museum, Brno, Czech Republic (BRNM).

DNA extraction, PCR amplification of ITS and LSU regions of ribosomal DNA, sequencing, and sequence alignment methods followed Antonín et al. (2010). Phylogenetic analyses were made using Bayesian modelling (Geyer 1991) performed with MRBAYES, version 3.0b4 (Ronquist & Huelsenbeck 2003). For a given data set, the general time reversible (GTR) model as selected with Modeltest v 3.06 (Posada & Crandall 1998) was employed with gamma-distributed substitution rates. Markov chains were run for 2,000,000 generations, saving a tree every 100th generation. Among these, the first 1000 trees were discarded as the burn-in phase of each analysis. MRBAYES was used to compute a 50 % majority rule consensus of the remaining trees to obtain estimates for the posterior probabilities (PPs) of the groups. Two species of *Marasmius*, *M. rotula* and *M. capillaris*, were selected as outgroup taxa for rooting purposes.

Taxonomy

Marasmiellus koreanus Antonín, R. Ryoo & H.D. Shin, **sp. nov.** FIG. 1

MYCOBANK MB 516550

NCBI ACCESSION NUMBERS: BRNM 714972 [GU319113 (ITS), GU319117 (LSU)]; BRNM 718782 [GU319114 (ITS), GU319118 (LSU)]

Pileo 27–60 mm lato, hemisphaerico usque ad planum-convexum, centro leviter depresso, subtiliter tomentoso, sulcato, griseo-aurantiaco, brunneo-aurantiaco vel brunneo. Lamellis distantibus, pallide luteis vel aurantiaco-albidis. Stipite 14–70 × 2–3.5(–5) mm, furfuraceo, albido, pallide luteo vel aurantiaco-albido. Basidiosporis 7.5–10(–11) × (3.5–)4.0–5.0(–5.5) µm, fusiformibus, ellipsoideo-fusiformibus vel ellipsoideis, hyalinis, inamyloideis. Cheilocystidiis 25–55 × 4.0–10 µm, cylindraceis, clavatis, fusiformibus vel subutriformibus, irregularibus, coralloideis vel submoniliformibus. Pileipellis ex hyphis cylindraceis, incrustatis, laevibus vel disperse diverticulatis constitua. Caulocystidiis 18–70(–105) × (4.0–)6.0–10 µm, cylindraceis, clavatis, subulatis, fusiformibus, iterum diverticulatis. Hyphis fibulatis, indextrinoideis. Ad ramulos putridos.

HOLOTYPUS: *Korea meridionalis, Chiaksan, Wonju, 19. VII. 2009 leg. V. Antonín (09.125) et R. Ryoo* (**holotypus** *in herbario BRNM 718782 preservatur*).

BASIDIOCARPS single or in groups. PILEUS 27–60 mm broad, hemispherical with plane to (slightly) depressed centre, then plano-convex with almost applanate to slightly depressed centre and with low and obtuse central umbo within this depression, margin inflexed and crenulate, undulate when old, finely (fibrillose) tomentose especially at centre, except for smooth centre distinctly radially rugulose-sulcate and finely innately fibrillose (under a lens), translucently striate when moist, greyish orange, brownish orange or brown (6B4–C5, 6–7C5, 7E7) with paler, almost whitish margin. LAMELLAE distant,

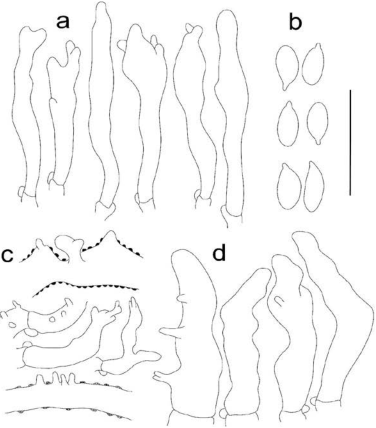

FIG. 1. *Marasmiellus koreanus.*
a. cheilocystidia, b. basidiospores, c. pileipellis hyphae, d. caulocystidia.
Scale bar = 20 µm.

L = 15–20, l = (1–)2–3 (irregular), ± broadly adnate with tooth, ± arcuate when young, slightly intervenose towards pileus margin, light yellow to orange white (4–5A2, 4A3), with concolorous, finely pubescent edge. STIPE 14–70 × 2–3.5 (–5.0) mm, cylindrical or slightly tapering towards base, sometimes laterally compressed (especially when old), slightly broadened above, subbulbous at base, (sub)insititious, longitudinally fibrillose, entirely furfuraceous especially when young, later ± tomentose-furfuraceous especially in upper part, whitish to light yellow to orange-white (± lamellae colour); with whitish basal hairy tomentum descending to the substrate (± 1 mm). CONTEXT membranaceous, whitish, hollow in stipe, without special smell, taste mild.

BASIDIOSPORES 7.5–10(–11) × (3.5–)4.0–5.0(–5.5) µm, average = 8.7 × 4.4 µm, E = 1.6–2.4(–2.5), Q = 1.8–2.0(–2.2), fusoid, ellipsoid-fusoid or (broadly) ellipsoid, smooth, hyaline, thin-walled, non-dextrinoid. BASIDIA 27–40 × 8.0–10 µm, 4-, rarely 2-spored, clavate. BASIDIOLES 15–35(–45) × 3.0–10 µm, cylindrical, clavate or fusoid. CHEILOCYSTIDIA 25–55 × 4.0–10 µm, variable in shape, cylindrical, clavate, fusoid, subutriform, irregular, lobed, sometimes rostrate, with broad, obtuse projection(s), coralloid or submoniliform, thin- to slightly-walled. TRAMA HYPHAE ± cylindrical, thin- to slightly thick-walled, non-dextrinoid, up to 10(–15) µm wide. PILEIPELLIS a cutis composed of cylindrical, radially arranged, mostly coarsely incrusted (zebroid), smooth to often scatteredly diverticulate, non-dextrinoid, up to 8.0(–12) µm wide hyphae; terminal elements and lateral projections rarely incrusted, vesiculose, conical or cylindrical, with diverticula or not, sometimes subcoralloid; incrustation dark (grey-)brown in KOH. PILEOCYSTIDIA absent. STIPITIPELLIS a cutis of cylindrical, parallel, slightly thick-walled, incrusted, smooth or scatteredly diverticulate, non-dextrinoid, up to 6.0 µm wide hyphae. CAULOCYSTIDIA numerous, adpressed to erect, 18–70(–105) × (4.0–)6.0–10 µm, cylindrical, clavate, subulate, fusoid, mostly (slightly) irregular or moniliform, sometimes diverticulate, obtuse, thin-walled. CLAMP CONNECTIONS present in all tissues.

HABITAT — On dead twigs of broadleaf trees and *Pinus densiflora* in a mixed forest with dominating *Pinus densiflora*, *Quercus mongolica* and *Acer* sp.

ADDITIONAL COLLECTIONS — Chuncheon, Dongsan-myeon, Bongmyeong-ri, Experimental forest of Kangwon National University, 37° 46' 46" N, 127° 48' 59" E, alt. c. 212 m, 22 July 2007 leg. V. Antonín and R. Ryoo (Antonín 07.106, 07.107, BRNM 714972 and 714973). – Ibid., 15 Aug. 2008, leg. R. Ryoo KG 247 (BRNM 721948). – Wonju, 4 July 2008 leg. J.G. Han (Antonín 08.71, BRNM 718700). – Deogyusan National Park, Cheon-yeon Falls, 24 Aug. 2007 leg. R. Ryoo KG 155 (BRNM 721947). – Heogseong, Seowon-myeon, 28 Aug. 2007 leg. R. Ryoo KG 167 (BRNM 721949). – Ibid., 21 Aug. 2008, leg. R. Ryoo KG 251 (BRNM 721950).

REMARKS — *Marasmiellus koreanus* is a rather robust fungus characterised by a brownish orange, rugulose pileus (except for the centre), light yellow, broadly adnate lamellae, a long, whitish to light yellow stipe, moderately large, fusoid, ellipsoid-fusoid, or (broadly) ellipsoid basidiospores, variably shaped cheilocystidia, a pileipellis missing a Ramealis-structure, and numerous cylindrical, clavate, subulate, fusoid, mostly (slightly) irregular or moniliform, sometimes diverticulate caulocystidia. According to Singer (1973), it belongs to sect. *Dealbati* Singer, subsect. *Quercini* Singer.

Among similar species, *Marasmiellus ramorum* Singer is distinguished by a smaller (± 11 mm broad) pileus, a smaller (13–14 × 1 mm) stipe that is brownish below, narrower basidiospores [8.5–10.3 × 3–3.2(–4) µm)], and differently shaped cheilocystidia (Singer 1973). *Marasmiellus enodis* Singer has a smaller (≤ 19 mm broad) brown pileus, lamellae concolorous with pileus, a shorter (7–21 × 0.5–2 mm) stipe that browns from the base, smaller basidiospores (6.5–9 × 2.5–4(–4.5) µm), and a stipe covering of *Crinipellis*-type hyphae (Singer 1973). *Marasmiellus dendroegrus* Singer is distinguished by a smaller (9–19 mm broad) striate pileus, a smaller (13–26 × 1–2 mm) stipe soon entirely cinnamon to deeply chestnut coloured, and smaller basidiospores (6–8.5 × 2.8–4.5 µm) (Singer 1973). *Marasmiellus synodicus* (Kunze) Singer has only a 3–9 mm broad pileus, a short stipe (5–8 × 0.5–1 mm), and smaller basidiospores [(3.5–)4.5–6(–6.5) × 2.2–3.5(–3.7) µm] and lacks distinct cheilocystidia (Singer 1973). *Marasmiellus stenophyllus* (Mont.) Singer is also smaller (pileus 2–15 mm broad, stipe 6–15 × 0.5–1.7 mm) and produces smaller basidiospores (6.8–8 × 2.7–3.5 µm) and different cheilocystidia (Singer 1973).

Marasmiellus rhizomorphigenus Antonín, R. Ryoo & H.D. Shin, **sp. nov.** FIG. 2

MYCOBANK 516551

NCBI ACCESSION NUMBERS: BRNM 714969 [GU319115 (ITS), GU319119 (LSU)]; BRNM 715003 [GU319116 (ITS), GU319120 (LSU)]

Pileo 6–20 mm lato, late convexo, late conico usque ad planum, centro leviter depresso, ruguloso-plicato, pubescente-tomentoso, albido vel pallide griseo, centro pallide griseo-brunneo. Lamellis distantibus, albidis vel pallide luteis. Stipite 5–20 × 0.5–1.5 mm, cylindraceo vel ad basim attenuato, pubescente vel furfuraceo, apicem albido vel pallide luteo, ad basim obscure brunneo-griseo vel griseo-brunneo. Rhizomorphis praesentibus. Basidiosporis 13.5–17 × 4.5–6.5 µm, fusiformibus, clavatis vel lacrimoideis, hyalinis, inamyloideis. Cystidiis hymenialibus 34–70 × 8.0–14 µm, (sub)fusiformibus, rostratis, tenui- vel leviter crassitunicatis. Pileipellis ex hyphis cylindraceis, laevibus vel leviter incrustatis. Pileocystidiis 35–140 × 6.0–14 µm, lageniformibus, subulatis vel fusiformibus, rostratis, tenui- vel leviter crassitunicatis. Caulocystidiis 35–140 × (5.0–)6.0–12 µm, cylindraceis, subulatis, sublageniformibus, iterum rostratis, tenui- vel leviter crassitunicatis. Hyphis fibulatis, indextrinoideis. Ad ramulos putridos.

HOLOTYPUS: *Korea meridionalis, Hongcheon, Bukbang-myeon, Seongdong-ri, 27. VI. 2007 leg. V. Antonín 07.148* ***(holotypus*** *in herbario BRNM 715003 preservatur).*

BASIDIOCARPS single or in groups. PILEUS 6–20 mm broad, broadly convex to broadly conical with obtuse or papillate centre and involute to inflexed margin when young, then ± broadly conical to almost applanate with plane to slightly depressed centre (sometimes still with obtuse papilla), and with straight to uplifted irregular margin, smooth or rugulose at the very centre, rugulose-plicate otherwise, margin crenulate, hygrophanous, translucently striate when moist, surface entirely finely pubescent-tomentose to tomentose, white or greyish tinged with pale greyish brown (6D2–3, 6E3–4) coloured centre. LAMELLAE distant, L = 10–18, l = 0–2, broadly adnate to shortly decurrent, lamellulae very narrow, irregular to branched, intervenose especially when old, mostly not reaching the pileus margin when old, whitish to pale yellowish

(3–4A2), sometimes with greyish tinge when old, with concolorous, finely pubescent edge. STIPE 5–20 × 0.5–1.5 mm, central, usually cylindrical and slightly broadened at apex or tapering towards base, rarely slightly broadened (up to 1.25 mm) towards base, insititious, finely fibrillose and sometimes twisted, entirely whitish pubescent to (especially at apex) furfuraceous, concolorous with lamellae at apex, brownish grey or greyish brown (6E3–4, 7E2) towards base. RHIZOMORPHS present, numerous, strigose, dark brown to black-brown, smooth. CONTEXT membranaceous, without special smell and taste.

BASIDIOSPORES 13.5–17 × 4.5–6.5 µm, average = 15.2 × 5.3 µm, E = 2.4–3.6, Q = 2.7–3.3, fusoid, lacrimoid, clavate, sometimes curved, smooth, hyaline, thin-walled, non-dextrinoid. BASIDIA 43–52 × 11–15 µm, 1-, 2-, 3- and 4-spored (4-spored ones seem to be the most frequent), clavate. BASIDIOLES 25–52 × 5.0–10(–16) µm, cylindrical or (broadly) clavate. HYMENIAL CYSTIDIA 34–70 × 8.0–14 µm, fusoid, (sub)lageniform, rostrate, obtuse, thin- to slightly thick-walled, hyaline. TRAMA HYPHAE cylindrical to subinflated, thin- to slightly thick-walled, hyaline, non-dextrinoid, up to 20 µm wide. PILEIPELLIS a cutis composed of cylindrical, radially arranged, thin- to slightly thick-walled, smooth or minutely incrusted, non-dextrinoid, up to 12 µm wide hyphae; terminal cells ± cylindrical, regular or irregular, thin-walled. PILEOCYSTIDIA 35–140 × 6.0–14 µm, lageniform, subulate, fusoid, rostrate, obtuse, thin- to slightly thick-walled (walls up to 0.75 µm). PILEOSETAE absent. STIPITIPELLIS a cutis of cylindrical, parallel, thin- to slightly thick-walled, smooth or minutely incrusted, non-dextrinoid, up to 7.0 µm wide hyphae. CAULOCYSTIDIA adpressed to erect, 35–140 × (5.0–)6.0–12 µm, cylindrical, subulate, sublageniform, mostly slightly irregular or submoniliform, often rostrate, obtuse, thin- to mostly slightly thick-walled (walls up to 0.5 µm). RHIZOMORPH HYPHAE cylindrical, thick-walled, smooth, up to 4.0 µm wide, yellow-brown in KOH in cortex, similar but hyaline in medulla. CLAMP-CONNECTIONS present in all tissues.

HABITAT — On dead twigs of *Larix* sp., *Castanea serrata*, *Quercus mongolica*, *Alnus* sp. and a broadleaved tree (*Quercus*?) in mixed forests.

ADDITIONAL COLLECTIONS — Chuncheon, Dongsan-myeon, Bongmyeong-ri, Experimental forest of Kangwon National University, 37° 46' 46" N, 127° 48' 59" E, alt. c. 212 m, 22 July 2007 leg. V. Antonín and R. Ryoo (Antonín 07.99, BRNM 714969). – Ibid., 15 July 2009 leg. V. Antonín and R. Ryoo (Antonín 09.100, BRNM 718759). – Hongcheon, Gongjaksan Ecological Park, 16 July 2009 leg. V. Antonín and R. Ryoo (Antonín 09.111, BRNM 718771). – Guri, Donggureung (Nine East Tombs), 37° 36' 59" N, 127° 07' 56" E, alt. c. 35 m, 11 July 2009 leg. V. Antonín and R. Ryoo (Antonín 09.70, BRNM 718731).

REMARKS — *Marasmiellus rhizomorphigenus* is characterised by having a greyish to whitish pileus, irregular to branched lamellae that are intervenose especially when old, a short stipe often tapering towards base that is concolorous with lamellae at the apex and brownish grey or greyish brown towards base,

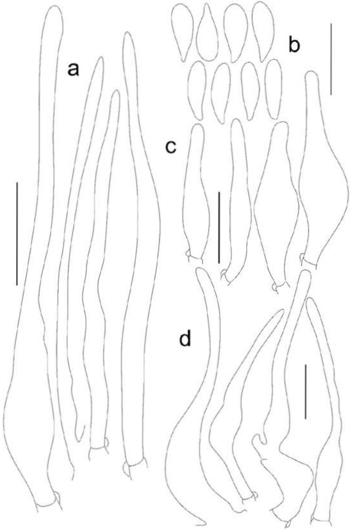

Fig. 2. *Marasmiellus rhizomorphigenus.*
a. caulocystidia, b. basidiospores, c. hymenial cystidia, d. pileocystidia.
Scale bar = 20 μm.

well-developed rhizomorphs, rather large basidiospores, well-developed fusoid or (sub)lageniform hymenial cystidia, the presence of pileocystidia, and the absence of pileosetae. These characters place it in *Marasmiellus* sect. *Candidi* Singer according to traditional systematics (Singer 1973).

The macroscopically very similar species *M. candidus* (Bolton) Singer especially differs by the absence of rhizomorphs and distinct pileocystidia (Antonín & Noordeloos 2010); this species has already been recorded from the Korean Peninsula (Wojewoda et al. 2004). On the other hand, the fungus published as *M. candidus* with a photo by Park & Lee (1991) represents our *M. rhizomorphigenus*. *Tetrapyrgos nigripes* (Schwein.) E. Horak differs by the shape of its basidiocarps (stipe longer than pileus diameter), the tetrahedric shape of the basidiospores, a different pileipellis structure, and the absence of rhizomorphs and setoid pileocystidia. *Marasmiellus albofuscus* (Berk. & M.A. Curtis) Singer has a reticulate-sulcate pileus, a pallid to white stipe, and slightly smaller basidiospores (10.8–15.3 × 3.5–6.2 µm). *Marasmiellus subnigricans* (Murrill) Singer has a larger (15–40 mm), white pileus that ages or dries to deep fuscous or blackish, often blackish lamellae, a white stipe becoming black-punctate, and smaller basidiospores (10.2–14.5 × 3.5–4.3 µm). Moreover, neither *M. albofuscus* nor *M. subnigricans* form rhizomorphs (Singer 1973).

No previously described rhizomorph-forming species (Desjardin et al. 1993, Singer 1973) belongs to sect. *Candidi*. The macroscopically very close *Marasmiellus tenerrimus* (Berk. & M.A. Curtis) Singer differs by a pileus that appears finely cinnamon punctate under a lens, a smaller stipe (5–12 × 0.3–0.4 mm), shorter hymenial cystidia (20–27 × 4–6 µm), and the presence of pileosetae (Desjardin et al. 1993, Singer 1973).

Phylogenetic analyses

The phylogenetic relationships of *Marasmiellus koreanus* and *M. rhizomorphigenus* were inferred from Bayesian (MCMC) analyses based on internal transcribed spacer (ITS) and nuclear ribosomal large subunit (LSU) rDNA sequences obtained in this study and from GenBank. ITS and LSU sequences were aligned and the ends trimmed to create a dataset of 561 and 797 base pairs, respectively. The resulting phylogenetic trees are shown in Fig. 3 (ITS) and Fig. 4 (LSU).

The phylogeny inferred from LSU and ITS sequences support the isolated position of the species delimited by macro- and micro-morphological characteristics. The independent taxonomic status of the two new *Marasmiellus* species in relation to other closely related species was concordant with high posterior probability. The results of this study were supported by the phylogenetic relationships and placement of *Marasmiellus* s.l. in previous studies by Mata et al. (2004) and Wilson & Desjardin (2005).

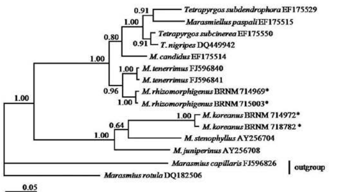

FIG. 3. Phylogenetic tree of *Marasmiellus koreanus* and *M. rhizomorphigenus* based on ITS rDNA sequences, showing mean branch lengths of a 50 % majority-rule consensus tree from a MCMC analysis. An asterisk (*) denotes taxa sequence on this study. The bar indicates number of expected substitutions per position.

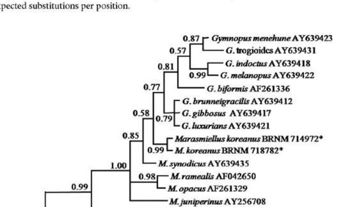

FIG. 4. Phylogenetic tree of *Marasmiellus koreanus* and *M. rhizomorphigenus* based on the nLSU rDNA sequences, showing mean branch lengths of a 50 % majority-rule consensus tree from a MCMC analysis. An asterisk (*) denotes taxa sequence on this study. The bar indicates number of expected substitutions per position.

Both ITS and LSU sequences place *Marasmiellus koreanus* in the same clade with *M. juniperinus* (the type species of *Marasmiellus*) and *M. stenophyllus* (ITS) and *M. synodicus, M. ramealis,* and *M. opacus* (LSU). According to the phylogenetic analyses of Mata et al. (2004) and Wilson & Desjardin (2005), *Marasmiellus juniperinus* belongs to the same clade as species of *Gymnopus* sect. *Vestipedes*. The proposed transfer of *M. juniperinus* to the genus *Gymnopus* by Mata et al. (2004) was not accepted by Wilson & Desjardin (2005). This study confirms the placement of *Marasmiellus koreanus* in the /marasmiellus clade according to Wilson & Desjardin (2005).

The other new species, *Marasmiellus rhizomorphigenus*, forms a distinct sister branch to *Tetrapyrgos* taxa in two phylogenetic trees. This species is placed in the same clade with *Marasmiellus tenerrimus* from ITS analysis and with *M. candidus* from LSU analysis. According to Moncalvo et al. (2002), the /tetrapyrgos clade from the upper /tetrapyrgoid clade forms a sister clade of /marasmioid; both upper clades belong to /marasmiaceae. Analogous results were published by Matheny et al. (2006). Nevertheless, Wilson & Desjardin (2005) excluded the /tetrapyrgos clade from /marasmiaceae, which corresponds to the /marasmioid clade of Moncalvo et al. (2002). In general, the phylogenetic positions of *Marasmiellus, Tetrapyrgos,* and *Gymnopus* sect. *Vestipedes* deserve further study.

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The lichen genus *Lepraria* (*Stereocaulaceae*) in South Korea

Yogesh Joshi, Xin Yu Wang, Young Jin Koh & Jae-Seoun Hur

*jshur1@sunchon.ac.kr
Korean Lichen Research Institute, Sunchon National University
Sunchon 540-742, Korea

Abstract — The species belonging to lichen genus *Lepraria* that occur in South Korea are revised. Seventeen taxa are accepted. Brief descriptions of the species and a key to the taxa are provided. All species described here except *L. coriensis* are new to South Korea. Among them, *L. caesiella*, *L. eburnea*, *L. leprolomopsis*, *L. lobata*, *L. pallida*, *L. texta* and *L. xerophila* are reported for first time from eastern Asia (including China and Japan).

Key words — geographical distribution, lichen-forming fungi, taxonomy

Introduction

As the name indicates, *Lepraria* Ach. (Latin *leprosus* = a scurfy sorediate appearance) is characterized by leprose thallus with an entirely sorediate surface (Laundon 1992, Tønsberg 1992) that is sometimes squamulose or with isidia like structures (Crespo et al. 2006, Tønsberg 2004, Wirth et al. 2004). The chemistry of this genus includes depsides, depsidones, usnic acids, benzyl esters, dibenzofurans, fatty acids, anthraquinones, terpenoids, and aliphatic acids.

Lepraria is a widely distributed genus that comprises ca. 61 species (Elix & Kalb 2008, Kukwa & Flakus 2009, Saag et al. 2009). It occurs in alpine, temperate, and tropical regions on soil, rock, mosses, wood, bark, and other lichens. Recent molecular studies by Ekman & Tønsberg (2002) have confirmed that it belongs to *Stereocaulaceae*.

Saag et al. (2009) have surveyed the genus on a worldwide basis. However, the East Asian species have not been critically revised. Wei (1991) reported 2 species of *Lepraria* from China [*L. incana* (L.) Ach. and *L. yunnaniana* (Hue) Zahlbr.], while Harada et al. (2004) reported 5 species from Japan [*L. cacuminum* (A. Massal.) Loht., *L. cupressicola* (Hue) J.R. Laundon, *L. lobificans*, *L. membranacea*, *L. vouauxii*]. However, only one species, *L. coriensis* (≡ *Crocynia coriensis* Hue), has been reported from South Korea (Hue 1924, Hur et al. 2005, Kim 1981, Sato 1943). Moon (1999) reported *Lepraria* from South Korea but excluded it from her studies because of taxonomic complexities in this genus.

Herbarium study at Korean Lichen Research Institute (KoLRI) and recent collection of leprarioid lichens from different places in South Korea revealed the occurrence of 17 *Lepraria* species within this country. Except *L. coriensis*, all the species are new to South Korea. Seven taxa (*L. caesiella*, *L. eburnea*, *L. leprolomopsis*, *L. lobata*, *L. pallida*, *L. texta*, *L. xerophila*) are new to East Asia.

The present paper covers the leprarioid lichens reported from South Korea for the first time as well as species earlier reported from this part of the continent and expands the knowledge of lichen diversity in East Asia including China and Japan. A brief taxonomic description and comments are provided for each species along with a key to all the leprarioid lichens of South Korea.

Materials and methods

The study is based on lichen specimens lodged in the herbarium of Lichen & Allied Bioresource Center, Korean Lichen Research Institute (KoLRI), Sunchon National University, South Korea, as well as fresh samples collected during recent field trips. A total of thirty-five specimens have been examined under NIKON C-PS 1068908 dissecting microscope and studied with Thin Layer Chromatography (TLC) using solvents A and C, following the standardized methods of Culberson (1972), Elix et al. (1987), and White & James (1985).

Taxonomy

Key to the species of *Lepraria* in South Korea

(adapted from Saag et al. 2009 with some amendments)

1. Granules or lobules similar to isidia present, soredia few or absent ..... *L. xerophila*
1. Granules or lobules similar to isidia absent, soredia numerous 2

2. Stictic acid complex present..3
2. Stictic acid complex absent 5

3. Terpenoids present 4
3. Terpenoids absent .... *L. caesioalba* var. *caesioalba*

4. Thallus greenish; soredia fine to medium sized (20–60 μm diam.) and with long projecting hyphae; zeorin present....................... *L. lobificans*
4. Thallus yellowish; soredia medium sized to coarse (75–110 μm diam.) and with or without short projecting hyphae; zeorin absent .... *L. leprolomopsis*

5. Alectorialic acid present..6
5. Alectorialic acid absent 7

6. Thallus soft, soredia loosely packed, medulla distinct and thick .... *L. eburnea*
6. Thallus hard, soredia densely packed, medulla inconspicuous........... *L. neglecta*

7. Pannaric acid or one of pannaric acid derivatives present as main substance 8
7. Pannaric acid and its derivatives absent or in traces besides other major dibenzofurans 10
8. Lobes absent or poorly developed 9
8. Lobes present .... *L. membranacea*
9. Thallus with less or no patches of exposed medulla; 4-oxypannaric acid 2-methylester as major dibenzofuran .... *L. diffusa*
9. Thallus with exposed patches of medulla between soredia; pannaric acid 6-methylester as major dibenzofuran .... *L. vouauxii*
10. Usnic acid present together with zeorin 11
10. Usnic acid absent, zeorin present or absent 13
11. Distinct well developed marginal lobes present, over 0.5 mm wide and with marginal rim .... *L. coriensis*
11. Marginal lobes absent or obscure, less than 0.5 mm wide and without marginal rim 12
12. Obscure lobes present; medulla present, thick; soredia fine to coarse (up to 450 µm in diam.) .... *L. leuckertiana*
12. Obscure lobes absent; medulla absent or thin; soredia fine (up to 50 µm in diam.) .... *L. texta*
13. Norascomatic acid present .... *L. xerophila*
13. Norascomatic acid absent 14
14. Distinct well-developed marginal lobes present, over 0.5 mm wide and with marginal rim 15
14. Marginal lobes absent or obscure 16
15. Hypothallus present, gray to black; unidentified fatty acids present ...... *L. pallida*
15. Hypothallus absent (medulla present); rangiformic/jackinic acid present .. *L. lobata*
16. Zeorin present, fatty acids present or absent 17
16. Zeorin absent, roccellic/angardianic acid present .... *L. celata*
17. Fatty acids absent; medulla and/or hypothallus absent .... *L. caesiella*
17. Fatty acids present; medulla and/or hypothallus present 18
18. Thallus hard, soredia densely packed, consoredia up to 300 µm diam ..... *L. lobata*
18. Thallus soft, soredia loosely packed, consoredia up to 160 µm diam. .... *L. jackii*

1. ***Lepraria caesiella*** R.C. Harris, Opuscula Philolichenum 2: 51, 2005

Diagnostic characters — Thallus leprose, powdery, pale bluish gray, margin diffuse, forming thin to thick ±continuous extensive irregularly spreading patches, or sometimes forming ±rounded colonies. Lobes absent. Soredia abundant, dispersed or forming a thick continuous layer, very fine, 20–30 µm in diam., commonly aggregated in ±round consoredia up to 100 µm diam., projecting hyphae present. Medulla absent. Hypothallus absent. For further descriptions see Lendemer (2005).

Chemistry — Spot test reactions: thallus K+ faint yellow to yellow-orange, C−, KC−, P−. Secondary metabolites: Atranorin and Zeorin.

Besides atranorin and zeorin, Saag et al. (2007) also reported roccellic/angardianic acid or an unidentified fatty acid from some specimens of *L. caesiella.*

Ecology — The species was found growing over *Pinus* bark at an elevation of 431 m.

Geographical distribution — North and South America, Greenland (Saag et al. 2009); new to East Asia (South Korea).

Specimen Examined – South Korea: Gyongsangbuk Prov.: Mt. Kongduck, N36°44'42.5", E128°15'54.2", alt. 431 m, on *Pinus* bark, 20 June 2007, Hur 070772 (KoLRI).

Remarks — *Lepraria jackii, L. lobata,* and *L. pallida* are the other atranorin and zeorin containing South Korean *Lepraria* species with which *L. caesiella* is most likely to be confused. *L. jackii* differs in having jackinic/rangiformic acid and a white hypothallus. *L. lobata* differs in having lobes and roccellic/angardianic acid, while *L. pallida* differs in having lobes and tomentose, gray to black hypothallus.

2. *Lepraria caesioalba* (B. de Lesd.) J.R. Laundon, Lichenologist 24: 324, 1992, **var. *caesioalba***

Diagnostic characters — Thallus leprose, powdery, whitish gray to bluish gray to yellowish gray to grayish green, forming ±regular rosettes which later sometimes coalesce and form irregular patches. Margin delimited or not. True lobes absent, but obscure minute lobes sometimes present without raised rims. Soredia abundant, usually compact, coarse, 150–180(–200) µm in diam., commonly aggregated in ±round consoredia up to 200–300 µm diam., projecting hyphae sometimes present, short. Medulla present, inconspicuous, white. Hypothallus absent. For further descriptions see Laundon (1992), Lohtander (1994) and Saag et al. (2007).

Chemistry — Spot test reactions: thallus K+ yellow, C−, KC−, P+ yellow. Secondary metabolites: Atranorin, Stictic acid complex and Zeorin (Chemotype 2). It is the most common Chemotype of this species in South Korea.

Two other chemotypes besides Chemotype 2 have been reported for this species: Chemotype 1, which is regarded as the most frequent (at least in Europe), contains atranorin, fumarprotocetraric acid, protocetraric acid and ±roccellic/angardianic or rangiformic acid, while Chemotype 3, the rarest chemotype, contains atranorin, psoromic acid and roccellic/angardianic or rangiformic acid (Leuckert et al. 1995).

Ecology — *Lepraria caesioalba,* one of the most common *Lepraria* species in South Korea, has been found growing over bark, soil, and non-calcareous rocks between elevations of 70–1104 m.

Geographical distribution — Europe, North and South America, Asia, Australasia, Antarctica, Greenland (Saag et al. 2009); new to South Korea.

Specimens Examined – South Korea: Jeollanam Prov.: Sunchon, Sunchon National University, N34°57'59.3", E127°28'44.8", alt. 70 m, on *Pinus densiflora*, 05 October 2005, L. Lőkös 050628 (KoLRI); Kangwon Prov.: Galjeongo bong, N37°52'952", E128°30'161", alt. 1104 m, on rock, 22 May 2009, Y. Joshi & X. Y. Wang 090589 (KoLRI); Kangwon Prov.: Mt. Seorak, N38°09'981", E128°27'267", alt. 463 m, on soil over rock, 24 May 2009, Y. Joshi & X. Y. Wang 090756, 090794 (KoLRI); Kangwon Prov.: Hangae ryong, N38°05'433", E128°25'131", alt. 750 m, 25 May 2009, on dead trunk, Y. Joshi & X. Y. Wang 090902 (KoLRI).

Remarks — *Lepraria leprolomopsis* and *L. lobificans,* which are the other stictic acid complex containing South Korean species with which *L. caesioalba* var. *caesioalba* can be confused, differ in having a well developed conspicuous medulla. *Lepraria nivalis* J.R. Laundon and *L. santosii* Argüello & A. Crespo are the other atranorin and stictic acid complex containing species with which *L. caesioalba* var. *caesioalba* is often confused. *L. nivalis* differs in having a well developed medulla, while *L. santosii* differs in having distinctly lobate thallus with thick raised marginal rims.

3. *Lepraria celata* Slav.-Bay., Lichenologist 38: 504, 2006

Diagnostic characters — Thallus leprose, powdery, bluish gray, margin diffuse or delimited, forming thin to thick ±continuous extensive irregularly spreading patches. Lobes absent. Soredia abundant, forming a thick continuous layer, very fine, 20–30 μm in diam., projecting hyphae absent. Medulla absent. Hypothallus sparsely present as white patches. For further descriptions see Slavíková-Bayerová & Orange (2006).

Chemistry — Spot test reactions: thallus K−, C−, KC−, P−. Secondary metabolites: Atranorin and a fatty acid (roccellic/angardianic acid).

Ecology — The species is found growing over non-calcareous rocks at an altitude of 1192 m.

Geographical distribution — Europe (Saag et al. 2009); new to Asia (South Korea).

Specimen Examined – South Korea: Kangwon Prov.: Dongpalam valley, N37°51'359", E128°30'974", alt. 1192 m, on rock, 23 May 2009, Y. Joshi & X. Y. Wang 090670-1 (KoLRI).

Remarks — *Lepraria lobata* and *L. neglecta* are other roccellic/angardianic fatty acid containing South Korean species with which *L. celata* may be confused. *Lepraria lobata* differs in having zeorin, distinct lobes, a medulla, and no hypothallus, while *L. neglecta* has alectorialic acid as a major compound, obscure minute lobes, and an inconspicuous medulla.

4. *Lepraria coriensis* (Hue) Sipman, Herzogia 17: 28, 2004

Diagnostic characters — Thallus leprose, powdery to membranous, greenish gray, often forming irregular rosettes which later sometimes coalesce and form non-areolate appressed crust of powdery granules. Margin delimited. Lobes present, obscure or more often well developed (0.5–1.5 mm wide) with raised marginal rim. Soredia sparse to abundant, exposing smooth ecorticate surface, fine to coarse, 70–100(–250) µm in diam., commonly aggregated in ±round consoredia up to 200–350 µm diam., projecting hyphae absent. Medulla usually present, white. Hypothallus sometimes present, brown to black. For further descriptions see Laundon (2003), Sipman (2004) and Elix (2009).

Chemistry — Spot test reactions: thallus K–, C–, KC–, P–. Secondary metabolites: Usnic acid, Zeorin, Constipatic acid (Chemotype 1). It is the commonest chemotype met within this species.

Besides Chemotype 1, two other chemotypes have been reported for this species: Chemotype 2 (usnic acid, zeorin, protodehydroconstipatic and constipatic acids, isousnic acid, argopsin, norargopsin, atranorin) and Chemotype 3 (usnic acid, zeorin, protodehydroconstipatic and constipatic acids, caloploicin, fulgidin, isousnic acid, atranorin) (Elix 2006b).

Ecology — At the collection site (425 m), the species was found growing over non-calcareous rocks.

Geographical distribution — Asia (India, Hong Kong, Taiwan, South Korea) and Australia (Saag et al. 2009, Elix 2009).

Specimen Examined – South Korea: Chungchongbuk Prov.: Mt. Songni, N36°32'34.7", E127°51'15.0", alt. 425 m, on rocks, 21 April 2006, Hur 0600023 (KoLRI).

Remarks — The presence of distinctly lobed thallus margins with raised rims and constipatic acid separate *L. coriensis* from the two other usnic acid containing South Korean species, *L. leuckertiana* and *L. texta*. The other two species both have a diffused thallus margin or rimless lobes and lack constipatic acid.

5. *Lepraria diffusa* (J.R. Laundon) Kukwa, Ann. Bot. Fennici 39: 226, 2002

Diagnostic characters — Thallus leprose, powdery to cottony, grayish cream to yellowish green, diffuse, forming thin to thick ±continuous extensive irregularly spreading patches, or sometimes forming ±rounded colonies. Margin diffuse or rarely delimited. Lobes absent. Soredia abundant, usually compact, coarse, up to 100 µm in diam., projecting hyphae sometimes present, short. Medulla present, white. Hypothallus sometimes present, whitish gray to brownish. For further descriptions see Laundon (1992) and Kukwa (2006).

Chemistry — Spot test reactions: thallus K+ pale yellow, C–, KC–, P–. Secondary metabolites: 4-oxypannaric acid 2-methylester.

Ecology — At the collection site (706 m), the species was found growing over non-calcareous rocks.

Geographical distribution — Asia, Europe and North America (Saag et al. 2009); new to South Korea.

Specimen Examined – South Korea: Kangwon Prov.: Dongpalam valley, N37°51'692", E128°31'522", alt. 706 m, on rock, 23 May 2009, Y. Joshi & X. Y. Wang 090730-1 (KoLRI).

Remarks — *Lepraria diffusa*, which has 4-oxypannaric acid 2-methylester as the only major dibenzofuran, might be confused with two other dibenzofuran-producing South Korean species, *L. membranacea* and *L. vouauxii*. *Lepraria membranacea*, however, has pannaric acid as the major dibenzofuran, while *L. vouauxii* has pannaric acid 6-methylester as a major secondary compound.

6. *Lepraria eburnea* J.R. Laundon, Lichenologist 24: 331, 1992

Diagnostic characters — Thallus leprose, powdery to cottony, white to whitish gray to bluish gray, greenish gray or yellowish gray, shape irregular. Margin diffuse to rarely delimited. Lobes usually absent, but sometimes with indistinct lobes. Soredia abundant or sparse, exposing smooth ecorticate surface, fine, 45–60 µm in diam., commonly aggregated in ±round consoredia up to 200–400 µm diam., projecting hyphae present, long. Medulla present, thick, white. Hypothallus not distinct. For further descriptions see Orange (1997) and Elix (2009).

Chemistry — Spot test reactions: thallus K– or + yellow, C– or + reddish orange, KC+ reddish orange, P+ yellow or orange. Secondary metabolite: Alectorialic acid (Chemotype 3).

Besides Chemotype 3, two other chemotypes have been reported for this species: Chemotype 1, the most frequently encountered, contains alectorialic acid and protocetraric acid, while Chemotype 2 has alectorialic acid, psoromic acid and 2'-*O*-demethylpsoromic acid (Orange 1997).

Ecology — *Lepraria eburnea*, one of the most common *Lepraria* species in South Korea, has been found growing over bark of *Pinus densiflora* and on soil over rocks between elevations of 115–673 m.

Geographical distribution — Europe, North America, Australasia and Greenland (Saag et al. 2009); new to East Asia (South Korea).

Specimens Examined – South Korea: Jeollanam Prov., Boseong Co., Mt. Illim, N34°41'17.7", E127°00'57.3", alt. 220 m, on bark, 01 September 2005, Hur 050370 (KoLRI); Hwasun Co., Mt. Baega, N35°10'32.4", E127°08'23.", alt. 320 m, on *Pinus* *densiflora* bark, 08 October 2005, L. Lökös 050654 (KoLRI); Sunchon, Sunchon National University, N34°58'00.4", E127°28'32.9", alt. 115 m, on *Pinus densiflora* bark, 08 October 2005, L. Lökös 050676 (KoLRI); Haenam Co., Mt. Talmasan, N34°22'52.7", E126°34'40.8", alt. 270 m, on *Pinus densiflora* bark, 26 July 2005, Hur 050331 (KoLRI); Kangwon Prov., Mt. Seorak, N38°09'969", E128°27'831", alt. 673 m, on rock, 24 May 2009, Y. Joshi & X. Y. Wang 090835 (KoLRI).

Remarks — *Lepraria neglecta,* another alectorialic acid containing South Korean species, differs in having a hard, granular thallus with inconspicuous medulla and densely packed soredia, in contrast to the thallus of *L. eburnea,* which is soft with a distinct medulla and loosely packed soredia.

7. *Lepraria jackii* Tønsberg, Sommerfeltia 14: 200, 1992

Diagnostic characters — Thallus leprose, powdery, whitish green to greenish or bluish gray, usually diffuse, forming thin to thick ±continuous extensive irregularly spreading patches, or sometimes forming ±rounded colonies which eventually coalesce. Margins diffuse or rarely delimited. Lobes absent. Soredia abundant, dispersed or forming a thick continuous layer, very fine to coarse, 20–40(–130) µm in diam., commonly aggregated in ±round consoredia 80–160 µm diam., projecting hyphae sometimes present, short. Medulla absent. Hypothallus present, sparse to continuous, white. For further descriptions see Tønsberg (1992), Bayerová et al. (2005), Slavíková-Bayerová & Orange (2006), and Elix (2009).

Chemistry — Spot test reactions: thallus K− or + pale yellow, C−, KC−, P−. Secondary metabolites: Atranorin, Zeorin and a fatty acid (jackinic/rangiformic acid).

Ecology — In South Korea, the species is found growing over bark at an altitude of 500 m.

Geographical distribution — Europe, North America, Asia and Australia (Saag et al. 2009); new to South Korea.

Specimen examined – South Korea: Chungchongbuk Prov.: Mt. Joryong, N37°48'27.0", E128°03'32.0", alt. 500 m, on bark, 10 July 2008, Hur 080314 (KoLRI).

Remarks — *Lepraria jackii* may be confused with two other atranorin and zeorin containing South Korean species: *L. caesiella* and *L. lobata. Lepraria caesiella* differs in lacking jackinic/rangiformic acid and a medulla and/or hypothallus, while *L. lobata* has relatively hard thallus with densely packed soredia and bigger (≤ 300 µm) consoredia.

8. *Lepraria leprolomopsis* Diederich & Sérus., Bibl. Lichenol. 64: 76, 1997

Diagnostic characters — Thallus leprose, powdery to cottony, yellowish green, forming thin to thick ±continuous extensive irregularly spreading patches, or sometimes forming ±rounded colonies which eventually coalesce.

Margin delimited. Lobes absent. Soredia abundant, medium sized, 75–110 μm in diam., commonly aggregated in ±round consoredia up to 140–300 μm diam., projecting hyphae sometimes present. Medulla present, white. Hypothallus usually present, poorly developed, white. For further descriptions see Aptroot et al. (1997).

Chemistry — Spot test reactions: thallus usually K+ yellow, C–, KC–, P+ pale orange. Secondary metabolites: Atranorin and Stictic acid complex.

Ecology — At the collection site (285 m), the species was found growing over non-calcareous soil.

Geographical distribution — Australasia (Papua New Guinea) (Saag et al. 2009); new to East Asia (South Korea).

Specimen Examined – South Korea: Chungchongbuk Prov.: Mt. Joryong, N37°01'33.3" E128°11'59.2", alt. 285 m, on soil, 28 October 2006, Hur 061111 (KoLRI).

Remarks — *Lepraria leprolomopsis,* which may be confused with *L. lobificans,* another South Korean species containing atranorin and the stictic acid complex, can be diagnosed by its yellowish thallus, medium to coarse (75–110 μm diam.) harder soredia with or without projecting hyphae, and lack of zeorin. *Lepraria lobificans* differs in having greenish thallus, loosely packed fine to medium sized (20–60 μm diam.) soft soredia with long projecting hyphae, and zeorin.

9. *Lepraria leuckertiana* (Zedda) L. Saag., Lichenologist 41: 41, 2009

Diagnostic characters — Thallus leprose, cottony and powdery to granular, whitish gray to bluish gray, diffuse or weakly delimited, forming ±regular rosettes or irregular patches, firmly attached to the substratum. Margins delimited but not forming true lobes, obscure sublobes present. Soredia abundant, fine to coarse, up to 425 μm in diam., not well separated from each other. Medulla present, well developed, white, patches with exposed medulla present. Hypothallus absent. For further descriptions see Zedda (2000).

Chemistry — Spot test reactions: thallus K–, C–, KC–, P–. Secondary metabolites: Usnic acid, Zeorin, Isousnic acid (traces), Triterpenes.

Ecology — At the collection (1222 m), the species was found growing over bark.

Geographical distribution — Widely distributed throughout Central and South America, Australia, southern/southeastern Asia (Singapore, Indonesia, Sri Lanka), and southern Africa (Saag et al. 2009, Elix 2009); new to South Korea.

Specimen Examined – South Korea: Kangwon Prov.: Gitdae bong, N37°18'367" E128°56'766", alt. 1222 m, on bark, 15 May 2009, Y. Joshi & X. Y. Wang 0910401 (KoLRI).

REMARKS — Other closely similar usnic acid containing South Korean species with which *L. leuckertiana* might be confused are *L. coriensis* and *L. texta*. Distinctly lobed thallus margins with raised rims and presence of constipatic acid diagnose *L. coriensis*, while the lack of medulla and presence of whitish hypothallus distinguishes *L. texta*.

10. *Lepraria lobata* Elix & Kalb, Mycotaxon 94: 220, 2006 ["2005"]

DIAGNOSTIC CHARACTERS — Thallus leprose, granular, bluish gray, margin delimited, forming thin to thick ±continuous extensive irregularly spreading patches. Margins with sublobes 0.2–0.7 mm wide. Soredia sparse to abundant, dispersed or forming a thick continuous layer, fine to coarse, 20–60 μm in diam., aggregated in ±rounded consoredia up to 300 μm diam., projecting hyphae present, long, up to 100 μm long. Medulla present, conspicuous, white. Hypothallus absent. For further descriptions see Elix (2006a).

CHEMISTRY — Spot test reactions: thallus K+ yellow, C–, KC–, P+ pale yellow. Secondary metabolites: Atranorin, Zeorin and a fatty acid (roccellic/angardianic acid).

ECOLOGY — At the collection site (494 m), the species was found growing over bark.

GEOGRAPHICAL DISTRIBUTION — Australia (Saag et al. 2009); new to East Asia (South Korea).

SPECIMEN EXAMINED – South Korea: Kangwon Prov.: Baekseok bong, N37°28'739" E128°39'760", alt. 494 m, on bark, 16 May 2009, Hur 090456, 090462 (KoLRI).

REMARKS — The similar *L. pallida*, another South Korean lepraria containing atranorin and zeorin, can be differentiated from *L. lobata* by its gray to black hypothallus and an unidentified fatty acid. *Lepraria lobata* lacks a hypothallus and has roccellic/angardianic fatty acid.

11. *Lepraria lobificans* Nyl., Flora 56: 196, 1873

DIAGNOSTIC CHARACTERS — Thallus leprose, cottony to rarely powdery, bluish gray to greenish gray, margin diffuse to rarely delimited, forming thin to thick ±continuous extensive irregularly spreading patches, or sometimes becoming partly detached from the thallus. Margins sometimes with delimited sublobes 0.5–1.0 mm wide. Soredia abundant, dispersed or forming a thick continuous layer, fine to coarse, 20–60 μm in diam., commonly aggregated in ±round consoredia up to 300 μm diam., projecting hyphae present, long, up to 100 μm long. Medulla present, conspicuous, white. Hypothallus rarely present, scarce, pale brown. For further descriptions see Laundon (1992) and Elix (2009).

CHEMISTRY — Spot test reactions: thallus K–, C–, KC–, P+ pale orange. Secondary metabolites: Atranorin, Zeorin and Stictic acid complex.

Ecology — At the collection site (630 m), the species was found growing on soil over non-calcareous rocks.

Geographical distribution — Cosmopolitan (Saag et al. 2009); new to South Korea.

Specimen Examined – South Korea: Kangwon Prov.: Mt. Hwangbyong, N37°44'41.3" E128°37'31.0", alt. 630 m, on soil over rocks, 14 July 2008, Hur 080352 (KoLRI).

Remarks — *Lepraria leprolomopsis* and *L. caesioalba* var. *caesioalba* are the other atranorin and stictic acid complex containing South Korean species. A yellowish thallus, harder, medium sized to coarse (75–110 µm diam.) soredia with or without short projecting hyphae separates *L. leprolomopsis* from *L. lobificans,* while the absence of medullary hyphae distinguishes *L. caesioalba* var. *caesioalba*.

12. *Lepraria membranacea* (Dicks.) Vain., Acta Soc. Fauna Flora Fennica 49(2): 265, 1921

Diagnostic characters — Thallus crustose to squamulose to subfoliose, leprose, membranous, pale yellow gray to yellow-white, consisting of powdery lobes, forming irregular rosettes. Margins delimited. Lobes present, well developed, up to 2 mm long and wide, with a raised rim. Soredia abundant, sometimes not well separated at margin, fine to coarse, 40–65 µm in diam., commonly aggregated in ±round consoredia up to 130–210 µm diam., projecting hyphae sometimes present, short. Medulla present, conspicuous, white. Hypothallus present, well developed, dark, sometimes white along margins. For further descriptions see Laundon (1989) and Elix (2009).

Chemistry — Spot test reactions: thallus K+ yellow, C−, KC−, P+ reddish orange. Secondary metabolites: Pannaric acid, atranorin (in traces).

Ecology — At the collection site (770 m), the species was found growing over non-calcareous rocks.

Geographical distribution — Cosmopolitan (Saag et al. 2009); new to South Korea.

Specimen Examined – South Korea: Chongchung Prov.: Mt. Gyeryong, N36°21'25.6", E127°12'35.3", alt. 770 m, on rock, 23 October 2004, Hur 041632 (KoLRI).

Remarks — *Lepraria diffusa* and *L. vouauxii* are the other dibenzofuran producing South Korean species with which *L. membranacea* might be confused. However, *L.membranacea* has pannaric acid as its major secondary compound separating it from *L. diffusa* with 4-oxypannaric acid 2-methylester as the only major dibenzofuran and *L. vouauxii* with pannaric acid 6-methylester as the major dibenzofuran.

13. *Lepraria neglecta* (Nyl.) Erichsen, Flechtenflora von Nordwestdeutschland: 394, 1957

Diagnostic characters — Thallus leprose, granular, whitish gray to bluish gray to yellowish gray, margins diffuse or weakly delimited, forming ±regular rosettes or irregular patches, firmly attached to the substratum. True lobes absent, obscure sublobes present. Soredia abundant, coarse, 100–130(–200) µm in diam., commonly aggregated in ±round consoredia up to 200–300 µm diam., projecting hyphae usually absent. Medulla sometimes present, inconspicuous. Hypothallus sometimes present, poorly developed, gray to brown. For further descriptions see Laundon (1992) and Elix (2009).

Chemistry — Spot test reactions: thallus K+ yellow, C– or + orange-red, KC+ orange-red, P+ lemon yellow or orange. Secondary metabolites: Alectorialic acid and a fatty acid (roccellic/angardianic acid).

Ecology — *Lepraria neglecta,* one of the most common *Lepraria* species in South Korea, has been found growing on bark and soil over rocks between elevations of 300–706 m.

Geographical distribution — Widely distributed throughout Europe, North and South America, Asia, Australasia, Antarctica, Greenland (Saag et al. 2009); new to South Korea.

Specimens Examined – South Korea: Jeollanam Prov.: Jangheung Co., Mt. Cheongwan, N34°32'09.1" E126°55'32.3", alt. 450 m, on *Pinus densiflora*, 07 October 2005, L. Lökös 050651 (KoLRI); Jeollanam Prov.: Mt. Cheongwan, N34°32'33.1" E126°55'46.7", alt. 300 m, on bark, 07 October 2005, Hur 050543 (KoLRI); Jeollanam Prov.: Mt. Cheongwan, N34°32'33.1" E126°55'46.7", alt. 300 m, on soil over rock, 07 October 2005, Hur 050545 (KoLRI); Kangwon Prov.: Dongbalam valley, N37°51'692" E128°31'522", alt. 706 m, on soil over rock, 23 May 2009, Y. Joshi & X. Y. Wang 090730-2 (KoLRI).

Remarks — *Lepraria eburnea,* another alectorialic acid containing South Korean species, differs in having a soft thallus with a distinct medulla and loosely packed soredia. The thallus of *L. neglecta* is hard and granular with an inconspicuous medulla and densely packed soredia.

14. *Lepraria pallida* Sipman, Herzogia 17: 33, 2004

Diagnostic characters — Thallus leprose, granular to partly membranous, whitish gray to bluish gray, forming ±regular rosettes or irregular patches, loosely attached to the substratum. Margins usually delimited. Lobes present in places, usually well developed (0.5–2.0 mm wide and long) with ±raised marginal rim. Soredia abundant, sometimes not well separated from each other, medium sized up to 100 µm in diam., projecting hyphae absent. Medulla present, white. Hypothallus present, tomentose, gray to black. For further descriptions see Sipman (2004).

Chemistry — Spot test reactions: thallus K+ pale yellow, C–, KC–, P– or pale yellow to yellow-orange. Secondary metabolites: Atranorin and Zeorin in majority, unidentified fatty acids (minor).

Ecology — *Lepraria pallida,* one of the most common *Lepraria* species in South Korea, has been found growing over both bark and non-calcareous rocks between elevations of 410–1265 m.

Geographical distribution — South America and Africa (Saag et al. 2009); new to East Asia (South Korea).

Specimens Examined – South Korea: Jeollanam Prov.: N35°19'09.7" E127°44'31.4", alt. 1265 m, on rocks, 15 November 2006, Hur 060652 (KoLRI); Kyongsangnam Prov.: Mt. Cheontae, N36°09'26.6" E127°36'22.7", alt. 542 m, on rock, 03 November 2006, Hur 061190 (KoLRI); Kyongsangnam Prov.: Mt. Worak, N36°52'55.5" E128°06'35.8", alt. 990 m, on soil over rocks, 19 September 2004, Hur 041235 (KoLRI); Kyongsangnam Prov.: Mt. Gaya, N35°48'11.9" E128°08'35.0", alt. 500 m, on soil over rocks, 05 May 2006, Hur 060090 (KoLRI); Chungchongbuk Prov.: Mt. Songni, N36°32'06.6", E127°50'42.5", alt. 410 m, on *Pinus* bark, 21 April 2006, Hur 0600039 (KoLRI); Kangwon Prov.: Mt. Seorak, N38°09'981" E128°27'267", alt. 463 m, on soil over rocks, 24 May 2009, Y. Joshi & X. Y. Wang 090815 (KoLRI); Kangwon Prov.: Gitdae bong, N37°18'367" E128°56'766", alt. 1222 m, on soil over rocks, 15 May 2009, Y. Joshi & X. Y. Wang 090403 (KoLRI).

Remarks— *Lepraria lobata* is another atranorin, zeorin and fatty acid containing South Korean species with which *L. pallida* is likely to be confused. Lack of hypothallus and presence of roccellic/angardianic acid separate *L. lobata* from *L. pallida,* which always has a gray to black hypothallus and unidentified fatty acids.

15. *Lepraria texta* K. Knudsen, Elix & Lendemer, Lichen Flora of Greater Sonoran Desert Region Vol. 3: 387, 2008

Diagnostic characters — Thallus leprose, powdery, yellow green to greenish gray, forming thin to thick ±continuous extensive irregularly spreading patches, or sometimes forming ±rounded colonies. Margins not delimited. Lobes absent. Soredia abundant, dispersed or forming a thick continuous layer, not well separated from each other, fine, up to 50 µm in diam., projecting hyphae present, short. Medulla absent. Hypothallus sometimes present, conspicuous, white. For further descriptions see Knudsen & Elix (2008).

Chemistry — Spot test reactions: thallus K± yellow, C–, KC–, P–. Secondary metabolites: Usnic acid, Zeorin, Atranorin.

Ecology — At the collection site (1104 m), the species was found growing over non-calcareous rocks.

Geographical distribution — North America (Saag et al. 2009); new to Asia (South Korea).

SPECIMEN EXAMINED – South Korea: Kangwon Prov.: Galjeongok bong, N37°52'952" E128°30'161", alt. 1104 m, on rocks, 22 May 2009, Y. Joshi & X. Y. Wang 090583 (KoLRI).

REMARKS — *Lepraria texta* might be confused with two other usnic acid containing South Korean species, *L. coriensis* and *L. leuckertiana.* Distinctly lobed thallus margins with raised rims and presence of constipatic acid distinguish *L. coriensis,* and the presence of thick and cottony medulla characterises *L. leuckertiana.*

16. *Lepraria vouauxii* (Hue) R.C. Harris, Bryologist 90: 163, 1987

DIAGNOSTIC CHARACTERS — Thallus leprose, cottony to powdery, yellowish gray, margins diffuse to weakly delimited, forming ±regular rosettes or irregular patches, firmly attached to the substratum. True lobes absent, obscure lobes present, without raised rims. Soredia abundant, coarse, up to 100 µm in diam., aggregated in ±round consoredia up to 300 µm diam. Medulla present, thick, white, often exposed between soredia. Hypothallus present, brownish. For further descriptions see Laundon (1989) and Tønsberg (2004).

CHEMISTRY — Spot test reactions: thallus K+ faint yellow, C−, KC−, P−. Secondary metabolites: Pannaric acid 6-methylester, Atranorin and Zeorin.

ECOLOGY — At the collection site (1192 m), the species was found growing over soil on rocks.

GEOGRAPHICAL DISTRIBUTION — Cosmopolitan (Saag et al. 2009); new to South Korea.

SPECIMEN EXAMINED – South Korea: Kangwon Prov.: Dongbalam valley, N37°51'359", E128°30'974", alt. 1192 m, on rocks, 23 May 2009, Y. Joshi & X. Y. Wang 090672-1 (KoLRI).

REMARKS — *Lepraria vouauxii* is often confused with two other dibenzofuran producing South Korean species, *L. diffusa* and *L. membranacea. Lepraria diffusa* has 4-oxypannaric acid 2-methylester as only major dibenzofuran, while *L. membranacea* differs in producing pannaric acid as major substance. *Lepraria vouauxii*, on the other hand, contains large quantities of pannaric acid 6-methylester.

17. *Lepraria xerophila* Tønsberg, Lichen Flora of Greater Sonoran Desert Region Vol. 2: 328, 2004

DIAGNOSTIC CHARACTERS — Thallus crustose to squamulose to subfoliose, membranous, pale yellow-gray to yellow-white, determinate, forming ±irregular patches. Margins delimited, obscurely lobed, lobes up to 2 mm long and wide, with ±raised rim. Soredia few or absent, numerous large granules similar to isidia are present. Medulla present, conspicuous, white. Hypothallus absent. For further descriptions see Tønsberg (2004).

Chemistry — Spot test reactions: thallus K−, C−, KC−, P−. Secondary metabolites: Norascomatic acid (Chemotype 2). It is the rarest chemotype of this species.

The common chemotype of this species is Chemotype 1, which contains pannaric acid 6-methylester, rangiformic and/or roccellic acid, atranorin, methyl porphyrilate, porphyrilic acid, pannaric acid, and an unknown dibenzofuran (Tønsberg 2004, Elix & Tønsberg 2004).

Ecology — At the collection site (1101 m), the species was found growing over non-calcareous rocks.

Geographical distribution — Europe and North America (Saag et al. 2009); new to Asia (South Korea).

Specimen Examined – South Korea: Kangwon Prov.: Galjeongok bong, N37°52'880", E128°26'849", alt. 1101 m, on rocks, 22 May 2009, Y. Joshi & X. Y. Wang 090637 (KoLRI).

Remarks — So far *Lepraria xerophila* is the only South Korean norascomatic acid containing species and thus easily separated from other Korean species.

Acknowledgments

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Symphaster ximeniae sp. nov.: a rare asterinaceous fungus from Brazil

José Luiz Bezerra[1], Elisandro Ricardo Drechsler-Santos[2], Jadergudson Pereira[1*] & Leonor Costa Maia[2]

*jader@uesc.br

[1]Deptº. de Ciências Agrárias e Ambientais, Universidade Estadual de Santa Cruz – UESC Rod. Ilhéus-Itabuna, km 16, Ilhéus, BA, 45662-000, Brazil

[2]Deptº. de Micologia, Universidade Federal de Pernambuco – UFPE Av.Prof. Nelson Chaves s/n, Recife, PE, 50670-420, Brazil

Abstract — A new asterinaceous fungus collected on *Ximenia americana* is described from Northeastern Brazil and named *Symphaster ximeniae*.

Key words — *Asterinaceae*, *Olacaceae*, systematics

Introduction

Among the 46 genera of *Asterinaceae* Hansf. recently listed (Kirk et al. 2008), *Symphaster* Theiss. & Syd. (Theissen & Sydow 1915: 217) has the smallest number of species. It comprises only two species: the type species *S. gesneriaceae* (Henn.) Theiss. & Syd. (basionym *Cocconia gesneriaceae* Henn.), and *S. areolata* (Doidge) Arx (basionym *Isipinga areolata* Doidge). The first species was observed in Rio de Janeiro, Brazil, by Hennings (1904: 91) on leaves of an unknown *Gesneriaceae* plant, and since then no other registers of specimens of this fungus have been made, indicating its rare condition. The second species was found on *Euclea natalensis* A. DC. (*Ebenaceae*) in South Africa (Doidge 1921: 15).

Many epiphytic fungi have been described on leaves of *Ximenia americana* L. (*Olacaceae*), mainly *Meliolales* (Viégas 1961, Silva & Minter 1995, Mendes et al. 1998), but no *Symphaster* species has been registered. Similarly, new *Asterina* species have been recorded in recent years (Hosagoudar et al. 2001a; Hofmann & Piepenbring 2008; Song 2003; Song & Li 2002, 2004; Song et al. 2003a,b, 2004), but no new *Symphaster* species.

During the past few decades, Müller & Arx (1962) and Arx & Müller (1975) added new information about *Symphaster* and in this century Hosagoudar et al.

(2001b) and Bezerra (2004) made new contributions. The family *Asterinaceae* has been well characterized by Müller & Arx (1962), Lutrell (1973), Arx & Müller (1975), Barr (1987), Hosagoudar et al. (2001b), and Bezerra (2004).

As occurs with other biotrophic pathogens in *Asterinaceae*, *Symphaster* species are apparently host specific. In this case, not only morphological characters but also the host plant may be useful to separate species. Considering the low number of records of the genus, however, host specificity should be confirmed. For Hofmann & Piepenbring (2008), induction of plant infection and DNA sequence data may help elucidate this question for this family.

During a survey of *Asterinaceae* in a tropical forest in Brazil, a fungus with characteristics of *Symphaster* was found and is now described as a new species.

Materials and methods

Leaves of *Ximenia americana* (local name: Limão; Ameixeira-do-Brasil) showing superficial black stromata of an asterinaceous fungus were collected in October 2006 in the "Reserva Ecológica de Dois Irmãos", a remnant of Atlantic Rain Forest, in the municipality of Recife, State of Pernambuco, Brazil. The aspect of the colonies on the leaf was observed on a stereomicroscope and the adhesive transparent tape method was used to visualize hyphae and hyphopodia. Free hand sections and squash mounts stained with lactophenol cotton blue were used to study the morphology of the fungus under the light microscope. The structures were measured in water. An exsiccatum of the material was deposited in the mycological collection of URM Herbarium and Mycobank number for new species was cited.

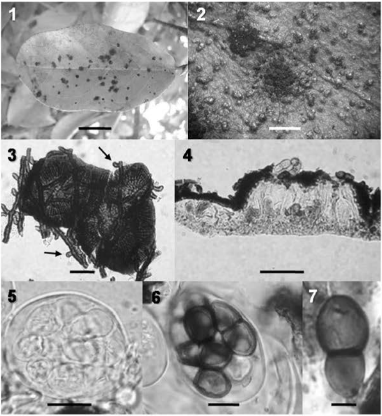
Taxonomy

Symphaster ximeniae J.L. Bezerra, Drechsler-Santos & Jad. Pereira, **sp. nov.**
MycoBank MB512160 Figs. 1–7

Coloniae epyphyllae vel amphigenae, densae, dispersae vel confluentes, 1–4 mm diam. Hyphae flexuosae, brunneae, septatae, hyphopodiatae, ramosae, cellulis 16–20 × 5–6 µm. Hyphopodia unicellularia, brunnea obovata vel oblonga, recta vel incurvata, alternata vel opposita, integra, cellulis, 8–13 × 5.5–7 µm. Haustoriae intraepidermale, hyalinae. Thyriothecia ad 60–200 µm diam, confluentes, multiloculllata, rotunda vel irregulariter, stellato dehiscentes ad centre, margine crenata; asci 38–52 × 23–32 µm, octosporae, globosae, bitunicatae, sessilia; paraphysoides mucosae praeditae; ascosporae 21–25 × (6–)7–10(–14) µm, ellipsoideae, brunneae, bicellulatae, fortiter constrictae, submediane septae, parietus glabrae vel leniter espinescentis.

Type: BRAZIL: Pernambuco, Recife, Reserva Ecológica de Dois Irmãos (08°00'39.1"S and 34°56'38.8"W, 10m alt.), 12.X.2006, leg. J.L. Bezerra and E.R. Drechsler-Santos, on living leaves of *Ximenia americana* (Holotype, URM 79224).

Etymology: derived from the host genus *Ximenia*.



Figs. 1–7. *Symphaster ximeniae*. 1–2. A leaf of *Ximenia americana* showing epiphyllous colonies. 3. Young ascomata with hyphopodiate hyphae (arrows) 4. Vertical section of ascoma. 5. Young bitunicate ascus. 6. Ascus with mature ascospores. 7. Ascospore with septum below the middle. Scale bars: 1 = 5 mm; 2 = 1 mm; 3, 4 = 50 µm; 5 = 20 µm; 6 = 10 µm; 7 = 5 µm.

Colonies dull black, amphigenous, mostly epiphyllous, crustose, subcircular to irregular, isolate or confluent, scattered, 1–4 mm diam. Mycelium superficial of flexuous, brown, septate, hyphopodiate, oppositely or unilaterally branched, teleomorphic hyphae 16–20 × 5–6 µm. Hyphopodia unicellular, brown concolorous with the hyphae, obovoid to oblong or cylindrical, straight or curved, opposite or alternate, entire, 8–13 × 5.5–7 µm. Haustoria coralloid, hyaline, intra-epidermical. Ascomata dark brown, round to irregular, scutate, confluent, 60–200 µm diam, forming stromatic multilocular crusts; upper wall, opaque dark brown, 8–17 μm thick, formed of radiating rectangular cells, 6–12 × 3–5 μm diam, opening by stellate dehiscence. Basal wall, 10–17 μm thick, formed by hyaline, thin walled hyphal cells. Paraphysoids numerous, in gelatinous mass, hyaline, filiform, septate, 2–3 μm diam. Asci 8-spored, globose to subglobose, sessile, thick walled, bitunicate, not bluing in Melzer's reagent, 38–52 × 23–32 μm. Ascospores 1-septate below the middle, constricted in the septum, oblong, with rotund ends, brown at maturity, smooth to slightly rough, 21–25 × (6–)7–10(–14) μm, with a larger apical cell.

Notes: *Symphaster ximeniae* differs from *S. gesneriaceae* and *S. areolata* by possessing globose to subglobose asci and smaller ascospores, which are septate below the middle. *Symphaster areolata* and *S. gesneriaceae* differ from each other in ascospore size and type of hyphopodia. Authentic material of *S. areolata* (URM 23061 = PRE 22362) was examined, but no ascoma was seen. Each of the three *Symphaster* species occurs on a different host family.

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Clitopilus byssisedoides, a new species from a hothouse in Germany

Machiel Noordeloos[1], Delia Co-David[1] & Andreas Gminder[2]

noordeloos@nhn.leidenuniv.nl

[1]Netherlands Centre for Biodiversity Naturalis (section NHN)
P.O. Box 9514, 2300 RA Leiden, The Netherlands

[2]Dorfstrasse 27, D-07751 Jena, Germany

Abstract — *Clitopilus byssisedoides* is described as a new species found in a hothouse in Botanischer Garten Jena, in Jena, Germany, of unknown, possibly tropical origin. In this study, it is described, illustrated and distinguished from other pleurotoid *Clitopilus* species with rhodocyboid spores, particularly from other members of (*Rhodocybe*) sect. *Claudopodes*

Key words — *Entolomataceae*, phylogeny, taxonomy

Introduction

Gminder (2005) described a remarkable pleurotoid species with rhodocyboid spores from a hothouse in the botanical garden in Jena, Germany. It was provisionally called "*Rhodocybe byssisedoides*" because of its resemblance to *Entoloma byssisedum* (Pers.) Donk. In a recent molecular phylogenetic study of the *Entolomataceae* (where this new species was included as "*Rhodocybe* sp."), it has been shown that *Clitopilus* is nested within *Rhodocybe*. As a result, both genera were merged into *Clitopilus* sensu lato (Co-David et al. 2009). In this study, we formally describe the new species, *Clitopilus byssisedoides* and compare it to the other pleurotoid taxa.

Material and methods

The morphology was studied on dried material with standard methods, using sections mounted in either ammonia 5% or Congo red and a Leica DM1000 microscope. Microscopic structures were drawn with help of a drawing tube.

Taxonomic description

Clitopilus byssisedoides Gminder, Noordel. & Co-David, **sp. nov.**

MycoBank # 515443 Fig. 1, Plate 1.

Basidiocarpia pleurotoidea ad 20 mm lata cinerescentia incarnate hygrophanea glabra, lamellae modice distantes cremeo cinereae ochrascentes, sporae 5.5–7 µm longae 4–4.5 µm latae pustuluata vel leniter angulares lateraliter visu, pseudocystidia fibulaeque desunt. Ligno putrescente in olla cum Phalaenopside sp. in caldaria tropica.

Holotypus: *Germania, Jena, 27.IV.2004, A. Gminder (L), isotypus in herbario Gminder sub numero 20040050.*

Etymology: *byssisedoides* = referring to the resemblance to *Entoloma byssisedum*.

Macrocharacters — Basidiocarps pleurotoid, dorsally attached to its substratum with distinct rhizomorphs. Pileus up to 20 mm broad, conchate/shell-shaped with undulating involute margin, grayish incarnate, hygrophanous, translucently striate, glabrous. Lamellae moderately distant, rather distant creamy-grey turning dark ochre with age. Stipe lacking. Context very thin, watery grayish cream.

Microcharacters — Spores 5.5–7 × 4–4.5 µm, Q = 1.3.5–1.55–1.65, elliptical to pip-shaped, slightly thick-walled, pustulate, in profile weakly angular under a light microscope, strongly cyanophilous. Basidia 15–32 × 5–9 µm, 4-spored. Lamella edge fertile, cystidia absent, pseudocystidia absent. Pileipellis a compact cutis of narrow (2–6 µm wide), cylindrical hyphae, gradually passing into pileitrama with incrusted pigment. Pileitrama regular, made up of 4–12 µm wide, cylindrical hyphae. Clamp-connections absent.

Habitat — On decayed wood in pot with *Phalaenopsis* (*Orchidaceae*) in a tropical hothouse.

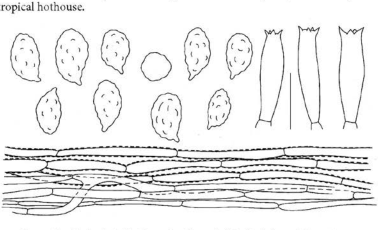

Fig. 1. *Clitopilus byssisedoides*. Spores, basidia, and pileipellis (holotype). Bar = 10 µm

PLATE 1. *Clitopilus byssisedoides*. Habit (holotype). Photo A. Gminder.

COMMENTS — *Clitopilus byssisedoides* is remarkable because there are only a few pleurotoid species of *Clitopilus* with rhodocyboid spores that have been described, and most of them are only known from their type locality.

This new species fits well in (*Rhodocybe*) section *Claudopodes* Singer ex T.J. Baroni (Baroni 1981), the section containing species with stipe either absent or laterally placed and with pseudocystidia with brightly colored content absent.

Since it is likely of tropical origin, *C. byssisedoides* is compared with all known pleurotoid, rhodocyboid-spored *Clitopilus* species. It can be distinguished as follows: *Clitopilus claudopus* (Singer ex T.J. Baroni) Noordel. & Co-David, known from Argentina, has a yellowish brown, cracked-rimose pileus, well-developed eccentric stipe, and short, globose to subglobose spores (Baroni 1981). *Clitopilus pleurogenus* (Pegler) Noordel. & Co-David from Tanzania is described with an ash grey pileus, and short, globose spores (Pegler 1977). *Clitopilus rhizogenus* (T.J. Baroni & E. Horak) Noordel. & Co-David from the USA differs by its pale argillaceous to pale brownish-orange, fibrillose, estriate pileus, well-developed, central to eccentric stipe, and well-developed cheilocystidia (Baroni & Horak 1994). *Clitopilus paurii* (T.J. Baroni, et al.) Noordel. & Co-David from India, differs by its much darker colour, tomentose pileus, and small subglobose spores (Moncalvo et al. 2004). *Clitopilus crystallinus* (T.J. Baroni) Noordel. & Co-David from Venezuela is a white, dimidiate species with densely tomentose pileal surface (Baroni & Horak 1994). Two species described by Horak also differ considerably from our species and cannot be conspecific: *Clitopilus albovelutinus* (G. Stev.) Noordel. & Co-David from New Zealand has whitish fruitbodies and a well developed lateral stipe (Horak 2008), and *C. lateralipes* (E. Horak) Noordel. & Co-David from Papua New Guinea shares the pale brown, striate pileus with *C. byssisedoides* but has a short, lateral stipe and ovoid to subglobose spores (Horak 1979). *Clitopilus balearicus* (Courtec. & Siquier) Noordel. & Co-David, the only previously reported European species with conchate basidiocarps, differs not only in having purely white pileus, but also by the presence of pseudocystidia which places it in another (*Rhodocybe*) section, *Crepidotoides* Singer ex T.J. Baroni (Courtecuisse & Siquier 1997).

Ongoing phylogenetic studies within the Rhodocybe–Clitopilus clade confirms that *C. byssisedoides* belongs to the subclade with a mixture of other species from sections *Rhodocybe*, *Decurrentes* and *Rufobrunnea*. The results of these studies will be published in due course.

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Mrs. Anita Walsmit-Sachs and Mr. Ben Kieft are thanked for preparing the illustrations for print. Dr. Jan-Frits Veldkamp kindly provided the Latin diagnosis. Dr. Olga Morozova and Dr. Thomas W. Kuyper reviewed an earlier version of this paper, for which we are very grateful.

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New and noteworthy *Entoloma* species from the Primorsky Territory, Russian Far East

[1]Machiel E. Noordeloos & [2]Olga V. Morozova

noordeloos@nhn.leidenuniv.nl
[1]*Netherlands Centre for Biodiversity Naturalis (section NHN)*
P.O. Box 9514, 2300RA Leiden, The Netherlands

ovm.leptonia@gmail.com
[2]*Komarov Botanical Institute*
197376, 2 Prof. Popov Str., St Petersburg, Russia

Abstract — An account is given of some new and interesting *Entoloma* species collected in the Primorsky Territory of the Russian Far East. Six species (*Entoloma eugenei*, *E. kedrovense*, *E. pallidocarpum*, *E. angustispermum*, *E. pallidoflavum*, *E. subcaesiellum*) are new to science and their taxonomic position is discussed. In addition some interesting records of other species are documented.

Key words — *Entolomataceae*, new species, Kedrovaya Pad Nature Reserve

Introduction

Entoloma is the second largest genus of *Agaricales*. It is monophyletic (Co-David et al. 2009) and highly variable in morphological characters. It is estimated to contain more than 1500 species and is found worldwide, from arctic to tropical habitats (Largent 1977, 1994, Romagnesi & Gilles 1979, Horak 1980, 2008, Noordeloos 1981, 1992, 2004, Manimohan et al. 2006, Gates & Noordeloos 2007, Noordeloos & Hausknecht 2007, Noordeloos & Gates 2009). However, large areas are still under-explored, particularly in Africa, South America, India, and S.E. Asia.

The present paper gives an account of some new and interesting species collected by the second author in the Primorsky Territory, Russian Far East. Vassiljeva (1973), who provided the most complete data on *Entoloma* in this Territory, supplied descriptions and partly illustrated 34 species. Additional information can be found in the checklists of Nature Reserves of the Russian Far East and other papers (Azbukina & Kharkevich 1984, Egorova 2002, Vassiljeva & Bezdeleva 2006, Morozova 2007). The full list of literature devoted to the mycobiota of this territory can be found in Bulakh (2005). In total, 52 species of *Entoloma* are known up to the present day for the Russian Far East.

The Kedrovaya Pad Nature Reserve is located at the southern tip of the Primorsky Territory in the spurs of the Eastern-Manchurian Mountains that extend eastward into Russia from China and North Korea. Its name originates from the Kedrovaya River, which flows through it. The reserve lies in the monsoon climate zone, and the warm, humid air masses from the Philippines combined with the mountainous relief play a significant role in creating a microclimate within the reserve. The vegetation of the Nature Reserve unites elements of the taiga and subtropical forests, but a southern flora predominates. Coniferous-broadleaved forests represent the native vegetation type, which today covers just over ten percent of the reserve's total area. Dominated by Manchurian firs (*Abies holophylla* Maxim.), these forests also incorporate warmth-loving trees such as *Quercus mongolica* Fisch. ex Turcz., *Tilia amurensis* Rupr., *T. mandshurica* Rupr. & Maxim., and *Fraxinus rhynchophylla* Hance. Forests of *Quercus mongolica* occupy nearly half of the territory and represent mostly secondary vegetation together with *Acer mono* Maxim., *Betula dahurica* Pall., *B. lutea* Michx., *Tilia amurensis*, *T. mandshurica*, and *Ulmus laciniata* Mayr. The valleys are occupied by *Alnus hirsuta* Turcz., *Chosenia arbutifolia* (Pall.) A.K. Skvortsov, *Fraxinus rhynchophylla*, *Populus maximowiczii* Henry, *Salix schwerinii* E.L. Wolf, *S. gracilistyla* Miq., *Ulmus laciniata*, and *U. japonica* (Sarg. ex Rehder.) Sarg. (Vasilyev et al. 1984). As can be expected from the geographic position of this area, the *Entoloma* flora appears to be Eurasian in character, with western and eastern elements.

Materials and methods

The specimens were collected, documented and preserved using standard methods. Macroscopic descriptions are based on the study of the fresh material as well as on analysis of the photos. The dried material was examined using standard microscopic techniques. Spores, basidia and cystidia were observed in squash preparations of small parts of the lamellae in 5% KOH or 1 % Congo Red in concentrated NH_4OH. The pileipellis was examined in a preparation of the radial section of the pileus in 5% KOH. Microscopic measurements and drawings were made with Micmed 2–2 and AxioImager A1 microscopes. Basidiospore dimensions are based on observing 20 spores, cystidia and basidia dimensions on observing at least 10 structures per collection. Spore length to width ratios are reported as Q. The collected material is deposited in the National Herbarium of the Netherlands (L) and in the Mycological Herbarium of the Komarov Botanical Institute (LE).

Plate 1. 1. *Entoloma eugenei* (holotype). 2. *E. kedrovense* (holotype). 3. *E. pallidocarpum* (holotype). 4. *E. angustispermum* (holotype). 5. *E. subcaesiellum* (holotype). 6. *E. roseoflavum* (holotype). 7. *E. caesiellum* (LE 253780). 8. *E. parasericellum* (LE 253788) . 9. *E. gomerense* (LE 253784).

Taxonomy

I. New taxa

1. *Entoloma eugenei* Noordel. & O.V. Morozova, **sp. nov.** FIG. 1, PLATE 1.1.
MYCOBANK 515675

PILEUS 13–45 mm latus, semiglobosus demum convexus, plano-convexus, margine involuto, haud hygrophanus, haud translucente striatus, toto velutinus, juventute cyaneus demum margine violaceo. LAMELLAE adnato-emarginatae, albae demum rosae acie concolor. STIPES 30–80 × 4–8 mm, clavatus vel cylindraceus basi incrassata, squamuliscum, pileo concolor, apice violaceo, basi albotomentosa. CARO albida. ODOR paulum acer. SAPOR nullus. SPORAE 10.0–12.5 × 6.0–8.0 µm, Q = 1.3–1.7, 5–7 angulatae. BASIDIA 34–44 × 9–12 µm tetrasporigera fibulata. ACIES lamellarum sterilis. CHEILOCYSTIDIA 28.5–37.5 × 6.5–15.5 µm, cylindracea vel leviter lageniformia. PILEIPELLIS trichoderma elementis terminalibus 90–200 × 12–20 µm pigmento caeruleo intracellulari. FIBULAE abundantes. GRANULA LUCENTIA desunt. HABITAT ad terram in silva frondosa humida.

HOLOTYPUS: RUSSIA; Primorsky Territory, Kedrovaya Pad Nature Reserve, the right bank of the Kedrovaya River, 43°05'51" N, 131°33'34" E, 24 Aug. 2005, *leg. E. Popov, LE 253771.*

ETYMOLOGY: this species is named in honor of Dr Eugene Popov for his support.

MACROCHARACTERS — PILEUS 13–45 mm broad, hemispherical expanding to plano-convex with incurved margin, not hygrophanous, not translucently striate, entirely velvety when young, becoming glabrous at the margin, uniformly deep blue (Indian blue) at first, then with violet tinge at margin, dry. LAMELLAE adnate-emarginate with decurrent tooth, pure white in youth becoming pink, with irregular concolorous edge. STIPE 30–80 × 4–8 mm, clavate or cylindrical with swollen base (to 15 mm), concolourous with the pileus or slightly paler, entirely squamulose with concolorous squamules, base with white tomentum. FLESH white, dark blue beneath the surface. SMELL slightly spicy. TASTE mild.

MICROCHARACTERS — SPORES 10.0–12.5 × 6.0–8.0 µm, Q = 1.3–1.7, heterodiametrical, with 5–7 angles in side view. BASIDIA 34–44 × 9–12 µm, clavate, clamped. LAMELLAE edge sterile. CHEILOCYSTIDIA 28.5–37.5 × 6.5–15.5 µm, cylindrical, narrowly lageniform or irregularly shaped, colourless. HYMENOPHORAL TRAMA regular, made up of cylindrical to inflated elements, 10–20 µm wide. Brilliant granules absent. PILEIPELLIS a trichoderm of cylindrical hyphae with terminal elements 90–200 × 12–20 µm. Pigment blue, intracellular. CLAMP CONNECTIONS abundant in pileipellis.

HABITAT — On soil in the flood plain forest.

COMMENTS — *Entoloma eugenei* is a striking blue species in section *Leptonia*, characterized by the trichodermal pileipellis with clamp connections. It is close to the European *E. dichroum* (Pers.) P. Kumm. and *E. tjallingiorum* Noordel. and the North American *E. cyaneum* (Peck) Sacc., from which it differs in

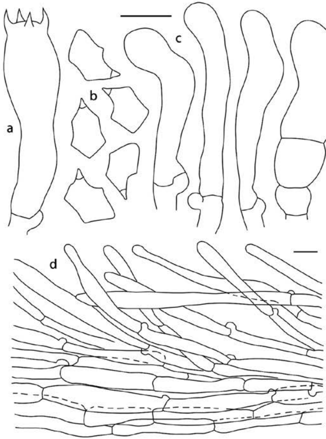

FIG. 1. *Entoloma eugenei*. Basidium (a), spores (b), cheilocystidia (c), and pileipellis (d). All figs from holotype. Bar = 10 µm.

the deep blue colour, strongly contrasting white lamellae, and shape of the spores and cheilocystidia. *Entoloma egregium* E. Horak from New Guinea is macroscopically similar but differs with respect to spore shape, cheilocystidia and pileipellis structure. *Entoloma panniculus* (Berk.) Sacc. from Australia is similarly colored but produces smaller spores and different pileipellis pigments (Berkeley 1859).

2. *Entoloma kedrovense* Noordel. & O.V. Morozova, **sp. nov.** FIG. 2, PLATE 1.2
MYCOBANK 515676

PILEUS 15–30 mm latus, conicus vel semiglobosus demum convexus, plano-convexus, haud hygrophanus, paulisper translucente striatus, obscure griseobrunneus, juventute tomentosus, demum centro squamuloso, margine fibrilloso-rimoso. LAMELLAE adnato-emarginatae, paulo dente decurrentes, albae demum rosae acie concolor. STIPES 70–90 × 2.5–4 mm, cylindraceus vel compressus, griseo-caeruleus, longitudinaliter fibrillosus, apice squamuliscum, basi albotomentosa. CARO superficie concolor odore saporeque indistinctis. SPORAE 8.0–11.2 × 6.0–7.5 µm, Q = 1.3–1.6, 5–6 angulatae. BASIDIA 21.5–37.0 × 12–13.5 µm tetrasporigera efibulata. ACIES lamellarum heterogenea, cheilocystidia 18–27 × 5–9 µm, cylindracea, clavata vel formae irregularis. PILEIPELLIS cutis trichoderma transient, centro trichoderma vel hymeniderma elementis terminalibus inflatis 25–80 × 7–19 µm pigmento griseobrunneo intracellulari; fibulae desunt. GRANULA LUCENTIA abundantia. HABITAT ad terram in silva frondosa humida.

HOLOTYPUS: RUSSIA; Primorsky Territory, Kedrovaya Pad Nature Reserve, the right bank of the Kedrovaya River, 43°05'56" N, 131°33'21" E, 17 Aug. 2005, *leg. O. Morozova, LE 253772.*

ETYMOLOGY: named after the type locality — valley of the Kedrovaya River.

MACROCHARACTERS — PILEUS 15–30 mm broad, conical to hemispherical, then convex to plano-convex, with minute pointed umbo, never distinctly umbilicate, not hygrophanous, slightly translucently striate at margin only, dark grey-brown, tomentose when young, breaking up into rather coarse squamules at centre, with smaller, rather regularly distributed squamules towards margin, on paler brown background, sometimes with a slight purple tinge. LAMELLAE adnate-emarginate with small decurrent tooth, whitish then pink with concolourous edge. STIPE 70–90 × 2.5–4 mm, cylindrical or compressed with longitudinal groove, mouse gray or, sometimes with purplish tinge, minutely squamulose in the upper half grayish blue, longitudinally fibrillose in the lower part, base with white tomentum. CONTEXT concolorous with the surface, whitish in the inner part. ODOUR indistinct. TASTE indistinct.

MICROCHARACTERS — SPORES 8.0–11.2 × 6.0–7.5 µm, Q=1.3–1.6, heterodiametrical, with 5–6 angles in side view. BASIDIA 21.5–37.0 × 12–13.5 µm, clavate, clamps not seen. LAMELLAE edge heterogeneous. CHEILOCYSTIDIA 18–27 × 5–9 µm, cylindrical to clavate or irregularly shaped, septate, colourless. Brilliant granules abundant in hymenophoral- and pilei-trama. PILEIPELLIS cutis with transition to a trichoderm, in central part more like a trichoderm or hymeniderm of inflated terminal elements, 25–80 × 7–19 µm. Pigment dark grey-brown, intracellular. CLAMP CONNECTIONS absent.

HABITAT — On soil in the flood plain forest.

COMMENTS — *Entoloma kedrovense* is distinguished by the dark grey squamulose pileus and floccose, blue-grey stipe. It keys out in series *Anatinum* of section *Cyanula* (Noordeloos 1992). *Entoloma coeruleoflocculosum* Noordel. has a deep

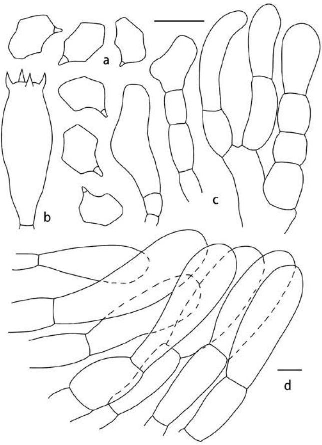

Fig. 2. *Entoloma kedrovense*. Spores (a), basidium (b), cheilocystidia (c), and pileipellis (d). All figs from holotype. Bar = 10 µm.

reddish brown pileus and a completely sterile lamella edge, often with brown intracellular pigment. *Entoloma mougeotii* (Fr.) Hesler has a more violaceous-grey pileus and stipe, a more regularly tomentose-squamulose pileus, and a completely sterile lamella edge. In Largent (1977) this species keys out in series *Paludocybe*, close to *Leptonia gracilipes* Peck, which, however, differs among other things by having a polished, glabrous stipe. None of the Asian species in Horak (1980) fits with our species.

3. *Entoloma pallidocarpum* Noordel. & O.V. Morozova, **sp. nov.** FIG. 3, PLATE 1.3
MYCOBANK 515677

PILEUS 80–130 mm latus, plano-convexus, centro applanato margine recto, hygrophanus, paulisper translucente striatus, pallide brunneolus, in sicco striis radialibus pallescens, glaber, radiatim rugulosus. LAMELLAE confertae, adnato-emarginatae, ad 10 mm late, albae demum rosae acie denticulata concolor. STIPES 140–160 × 17–20 mm, cylindraceus, firmus, albus, innate longitudinaliter fibrillosus basi albotomentosa. CARO albo odore saporeque leviter farinaceis demum nucis. SPORAE 7.0–9.2 × 6.0–7.5 µm, Q = 1.0–1.3, 6–7 angulatae. BASIDIA 37–54 × 9–14 µm, tetrasporigera fibulata. ACIES lamellarum heterogenea. CHEILOCYSTIDIA 15–50 × 3–10 µm, cylindracea vel formae irregularis. PILEIPELLIS cutis e hyphis 2–4 µm latis pigmento intracellulari vel incrustato formata; fibulae abundantes. HABITAT ad terram in silva frondosa.

HOLOTYPUS: RUSSIA; Primorsky Territory, Kedrovaya Pad Nature Reserve, vicinities of the Second Zolotoy stream, 43°06'37" N, 131°31'31" E, 20 Aug. 2005, *leg. O. Morozova, LE 253773.*

ETYMOLOGY: *pallidus* = pale, *carpum* = fruit (body), referring to the pale basidiomes.

MACROCHARACTERS — PILEUS 80–130 mm broad, plano-convex with applanate centre and straight margin, hygrophanous, slightly translucently striate at margin, pale brownish, pallescent on drying in radial streaks, glabrous, radially rugulose. LAMELLAE crowded, adnate-emarginate, to 10 mm broad, white then pinkish with irregular concolorous edge. STIPE 140–160 × 17–20 mm, cylindrical, white, innately longitudinally fibrillose, glabrous, base with white tomentum. FLESH white. ODOUR farinaceous then reminiscent of hazel nuts. TASTE mild.

MICROCHARACTERS — SPORES 7.0–9.2 × 6.0–7.5 µm, Q = 1.0–1.3, subisodiametrical, with 6–7 angles in side view. BASIDIA 37–54 × 9–14 µm, narrowly clavate, clamped. LAMELLAE edge heterogeneous. CHEILOCYSTIDIA 15–50 × 3–10 µm, cylindrical or irregularly shaped, colourless. PILEIPELLIS a cutis of 2–4 µm wide, cylindrical sometimes slightly ascending hyphae. Pigment intracellular, in some hyphae of subpellis slightly incrusting. HYMENOPHORAL- AND PILEI-TRAMA regular, made up of short, inflated elements, 40–120 × 5–10 µm. CLAMPS numerous in the pileipellis.

HABITAT — On soil in broad-leaved forest (*Quercus mongolica*, *Tilia amurensis*, *Acer* spp., *Alnus* spp.).

COMMENTS — Within the group of tricholomatoid species of subgenus *Rhodopolia*, only a few species have well-developed cheilocystidia. *Entoloma noordeloosii* Hauskn., known from Central Europe, has larger spores and lacks incrusting pigment. *Entoloma inusitatum* Noordel. et al., another widespread European species, differs by smaller basidiomes with sordid brown colour, larger spores, and more intensely incrusted hyphae in the uppermost layer of the pileus. *Entoloma kallioi* Noordel. is a much darker species with filiform

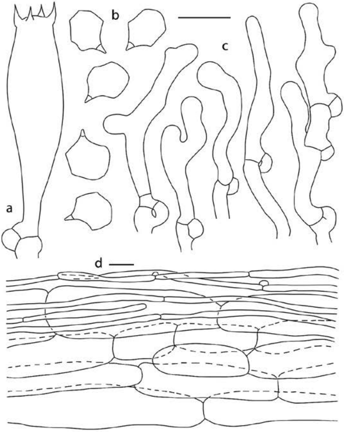

FIG. 3. *Entoloma pallidocarpum*. Basidium (a), spores (b), cheilocystidia (c), and pileipellis (d). All figs from holotype. Bar = 10 µm.

cheilocystidia (Noordeloos 2004). No similar species could be found in Horak (1980).

4. *Entoloma angustispermum* Noordel. & O.V. Morozova, **sp. nov.**

MYCOBANK 515680 FIG. 4, PLATE 1.4

PILEUS 15–20 mm latus, semiglobosus demum plano-convexus centro depresso, paulo hygrophanus, paulisper translucente striatus, alutaceus, pallide brunneolus, margine pallidior centro obscurior minute squamuloso. LAMELLAE adnato-emarginatae, albae

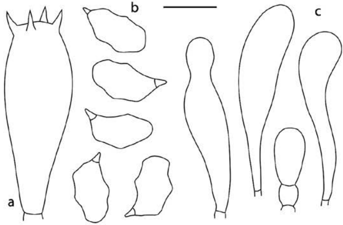

FIG. 4. *Entoloma angustispermum*. Basidium (a), spores (b), and cheilocystidia (c). All figs from holotype. Bar = 10 µm.

demum rosae acie concolor. STIPES *60–80 × 2.5 mm, cylindraceus vel compressus, griseolus, politus, basi albotomentosa.* CARO *superficie concolor odore saporeque indistinctis.* SPORAE *9.0–13.0 × 5.5–7.6 µm, Q=1.3–1.8(2.1), 6–8 angulatae.* BASIDIA *21–32 × 11.8–13.5 µm tetrasporigera efibulata.* ACIES *lamellarum heterogenea.* CHEILOCYSTIDIA *12–40 × 7–15 µm, cylindracea vel clavata interdum septata.* PILEIPELLIS *cutis trichoderma transient, elementis terminalibus cylindraceis vel clavatis 30–70 × 9–19 µm pigmento intracellulari; fibulae desunt.* GRANULA LUCENTIA *adsunt.* HABITAT *ad terram in silva frondosa.*

HOLOTYPUS: RUSSIA; Primorsky Territory, Kedrovaya Pad Nature Reserve, vicinities of the Second Zolotoy stream, 43°06′37″ N, 131°31′31″ E, 20 Aug. 2005, *leg. O. Morozova, LE 253774.*

ETYMOLOGY: *angustus* = narrow, referring to the narrow spores.

MACROCHARACTERS — PILEUS 15–20 mm broad, hemispherical when young, expanding to plano-convex with depressed centre, slightly hygrophanous, translucently striate to half of radius, smooth, pale beige, with darker, minutely squamulose centre. LAMELLAE adnate-emarginate, first white then pink with concolorous edge. STIPE 60–80 × 2.5 mm, cylindrical or compressed with longitudinal groove, greyish beige, polished, glabrous, base with white tomentum. CONTEXT whitish. ODOUR indistinct. TASTE indistinct.

MICROCHARACTERS — SPORES 9.0–13.0 × 5.5–7.6 µm, Q=1.3–1.8(2.1), heterodiametrical, with 6–8 angles in side view. BASIDIA 21–32 × 11.8–13.5 µm, clavate, no clamps seen. LAMELLAE edge heterogeneous. CHEILOCYSTIDIA 15–30

× 6–7 µm, cylindrical or clavate, sometimes septate, colourless. PILEIPELLIS a cutis with transition to a trichoderm, made up of cylindrical to clavate elements, 30–70 × 9–19 µm. Brilliant granules present in trama. Pigment intracellular in pileipellis. CLAMP CONNECTIONS absent.

HABITAT — On soil in the broad-leaved forest (*Quercus mongolica*, *Tilia amurensis*, *Acer* spp., *Alnus* spp.).

COMMENTS — *Entoloma angustispermum* keys out in section *Cyanula* stirps *Sarcitulum* based on the pale brown colour, translucently striate pileus, and polished stipe (Noordeloos 2004). No European species has such narrow spores. *Entoloma mutabilipes* Noordel. & Liiv from Europe also is similar, but usually has a distinctly blue stipe, particularly when young, and smaller spores (Noordeloos & Liiv 1992). No similar species could be found in Horak (1980).

5. *Entoloma roseoflavum* Noordel. & O.V. Morozova, **sp. nov.** FIG. 5, PLATE 1.6
MYCOBANK 515678

PILEUS 13–45 mm latus, semiglobosus demum plano-convexus vel applanatus centro depresso, paulo hygrophanus, translucente striatus, alutaceus, pallide brunneolus ad albido adumbratione roseolus margine pallidior glabro centro flavobrunneo squamuloso. LAMELLAE adnato-emarginatae, albae demum rosae acie concolor. Stipes 50–100 × 2–3 mm, cylindraceus vel compressus, albus demum flavidus, politus, basi albotomentosa. CARO alba odore saporeque indistinctis. SPORAE 8.3–11.0 × 6.5–7.8 µm, Q=1.2–1.5, 5–7 angulatae. BASIDIA 29–32 × 9–12 tetrasporigera efibulata. ACIES lamellarum sterilis. CHEILOCYSTIDIA 39–81 × 5–12 µm, cylindracea vel clavata, septata. PILEIPELLIS cutis trichoderma transient, elementis terminalibus clavatis 10–22 µm latus pigmento intracellulari; fibulae desunt. GRANULA LUCENTIA adsunt. HABITAT ad terram in silva frondosa humida.

HOLOTYPUS: RUSSIA; Primorsky Territory, Kedrovaya Pad Nature Reserve, the right bank of the Kedrovaya River, 43°05′56″ N, 131°33′21″ E, 17 Aug. 2005, *leg. O. Morozova, LE 253775.*

ETYMOLOGY: *roseus* = pink, *flavum* = yellow, referring to the colour of the basidiomes.

MACROCHARACTERS — PILEUS 13–45 mm broad, hemispherical when young, expanding to plano-convex then applanate with depressed centre, slightly hygrophanous, translucently striate to half of the radius, squamulose at centre, glabrous towards margin, pale beige, buff with a pink hue, with contrasting dark yellowish brown centre. LAMELLAE adnate-emarginate with decurrent tooth, first white then pink with irregular concolorous edge. STIPE 50–100 × 2–3 mm, cylindrical or compressed with longitudinal groove, white then yellowish, polished, glabrous, base with white tomentum. CONTEXT white. ODOUR indistinct. TASTE indistinct.

MICROCHARACTERS — SPORES 8.3–11.0 × 6.5–7.8 µm, Q=1.2–1.5, heterodiametrical, with 5–7 angles in side view. BASIDIA 29–32 × 9–12 µm, clavate, clampless. LAMELLAE edge sterile. CHEILOCYSTIDIA 39–81 × 5–12 µm,

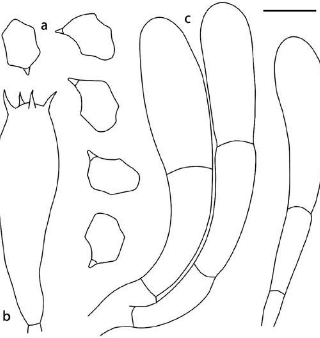

FIG. 5. *Entoloma roseoflavum*. Spores (a), basidium (b), and cheilocystidia (c). All figs from holotype. Bar = 10 μm.

cylindrical or clavate, septate, colourless. PILEIPELLIS a cutis with transition to a trichoderm made up of clavate terminal elements, 10–22 μm wide. Pigment intracellular. Brilliant granules present. CLAMP CONNECTIONS absent.

HABITAT — On soil in the flood plain forest.

COMMENTS — *Entoloma roseoflavum* is a pale member of section *Cyanula*, characterized mainly by the pale pinkish pileus with yellow centre and yellowish stipe. It is distinguished from the European species with pink tinges as follows: *Entoloma ritae* Noordel. & Wölfel has also a pinkish pileus and yellow stipe but clearly differs microscopically by the larger spores, presence of clamp-connections, and pileipellis structure (Wölfel & Noordeloos 1997); *E. roseotinctum* Noordel. & Liiv has grey tinges in pileus and stipe and lageniform cheilocystidia (Noordeloos & Liiv 1992); *E. roseum* (Longyear) Hesler and

E. reinwaldii Noordel. & Hauskn. differ by having more intensely pink basidiomes without yellow tinges (Hesler 1967, Noordeloos & Hausknecht 2000). *E. roseoluteolum* G.M. Gates & Noordel. from Tasmania is superficially similar but differs by the slight violaceous tinges in the pileus and the fertile lamella edge without cheilocystidia (Gates & Noordeloos 2007).

6. *Entoloma subcaesiellum* Noordel. & O.V. Morozova, **sp. nov.**

MycoBank 515679 — Fig. 6, Plate 1.5

Pileus 5–20 mm latus, conicus vel semiglobosus demum plano-convexus, paulo hygrophanus, translucente striatus, caeruleus, demum margine pallide violaceogriseo, centro squamuliscum. Lamellae adnato-emarginatae, albae demum rosae acie concolor. Stipes 45–70 × 2–3 mm, cylindraceus vel compressus, caeruleus, politus, basi albotomentosa. Caro superficie concolor odore saporeque indistinctis. Sporae 8.0–11(–12.0) × 6.0–8.0 µm, Q = 1.2–1.5, 5–7 angulatae. Basidia 21–34 × 8–11.5 µm, bi- vel tetrasporigera efibulata. Acies lamellarum sterilis vel heterogenea. Cheilocystidia 12–40 × 7–15 µm, clavata vel lageniformia. Pileipellis cutis trichoderma transient, elementis terminalibus clavatis 30–90 × 7–21 µm pigmento caeruleo intracellulari; fibulae desunt. Granula lucentia adsunt. Habitat ad terram in silva frondosa humida.

Holotypus: Russia; Primorsky Territory, Kedrovaya Pad Nature Reserve, the right bank of the Kedrovaya River, 43°05′56″ N, 131°33′21″ E, 17 Aug. 2005, *leg. O. Morozova, LE 253776.*

Etymology: named after its similarity to *Entoloma caesiellum.*

Macrocharacters — Pileus 5–20 mm broad, conical to hemispherical, expanding to plano-convex, with or without small umbo, or slightly depressed centre, faintly hygrophanous, translucently striate up to the centre, bright blue with fine darker blue squamules at centre, glabrous towards margin, fading to light purplish gray at margin on drying. Lamellae adnate-emarginate, almost free, first white then pink with concolorous, straight edge. Stipe 45–70 × 2–3 mm, cylindrical or compressed with longitudinal groove, blue, concolorous with pileus, smooth, glabrous, polished, matt at base with white tomentum. Odour indistinct. Taste indistinct.

Microcharacters — Spores 8.0–11(–12.0) × 6.0–8.0 µm, Q = 1.2–1.5, heterodiametrical, with 5–7 angles in side view. Basidia 21–34 × 8–11.5 µm, clavate, 2–4 spored, clampless. Lamellae edge sterile or heterogeneous. Cheilocystidia 12–40 × 7–15 µm, mostly shorter than the basidia, broadly clavate or lageniform, colourless. Pileipellis a cutis with transitions to a trichoderm, particularly at centre of pileus, made up of cylindrical to clavate elements, 30–90 × 7–21 µm. Pigment intracellular. Brillliant granules present in hymenophoral- and pilei-trama. Clamps absent.

Habitat — On soil in the flood plain forest and broad-leaved forest (*Quercus mongolica, Tilia amurensis, Acer* spp., *Alnus* spp.).

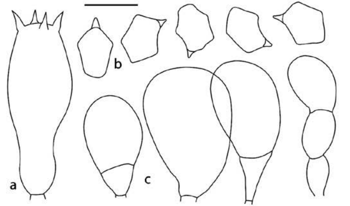

Fig. 6. *Entoloma subcaesiellum*. Basidium (a), spores (b), and cheilocystidia (c). All figs from holotype. Bar = 10 µm.

Additional Collections examined — **RUSSIA. Primorsky Territory, Kedrovaya Pad Nature Reserve**, vicinities of the Second Zolotoy stream, 43°06'37" N, 131°31'31" E, 20 Aug. 2005, leg. *O. Morozova, LE 253777*; **Kedrovaya Pad Nature Reserve**, the right bank of the Kedrovaya River, 43°05'56" N, 131°33'21" E, 17 Aug. 2005, leg. *O. Morozova, LE 253779*.

Comments — *Entoloma caesiellum* differs by having slenderer and longer cheilocystidia, and a more slate blue-grey, convex-umbilicate pileus. This species also strongly resembles *E. chalybeum* var. *lazulinum* (Fr.) Noordel., differing however by the lack of blue tinges in the lamellae, and the concolorous lamella edge with relatively short and broad cheilocystidia which do not arise from a strand of hyphae running along the lamella edge (*serrulatum*-type, see Noordeloos 2004).

II. New records

7. *Entoloma caesiellum* Noordel. & Wölfel, in Noordeloos et al., Z. Mykol. 61(2): 185 (1995) Fig. 7, Plate 1.7

Macrocharacters — Pileus 30–40 mm broad, hemispherical when young, expanding to plano-convex with depressed centre, slightly hygrophanous, translucently striate to half of the radius, centrally squamulose, smooth towards margin, light beige, with delicate blue tinge on the margin. Lamellae adnate-emarginate, first white then pink with irregular concolorous edge. Stipe

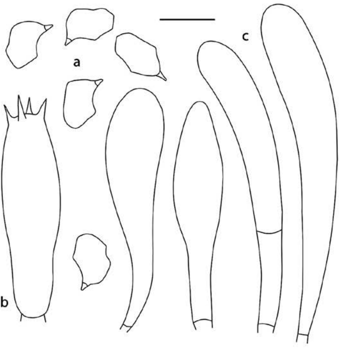

FIG. 7. *Entoloma caesiellum*. Spores (a), basidium (b), and cheilocystidia (c). From LE 253780. Bar = 10 µm.

70–80 × 2–3 mm, cylindrical or compressed with longitudinal groove, sky blue, polished, glabrous, base with white tomentum. ODOUR slightly spicy. TASTE indistinct.

MICROCHARACTERS — SPORES 8.5–10.4 × 5.7–7.8 µm, Q = 1.3–1.6, heterodiametrical, with 5–7 angles in side view. BASIDIA 31.2–43.5 × 9.0–10.5 µm, clampless. LAMELLAE edge sterile. CHEILOCYSTIDIA 28.6–72.8 × 7.8–16.9 µm, narrowly clavate to lageniform, colourless. PILEIPELLIS a cutis with transition to a trichoderm. Pigment intracellular. CLAMPS absent.

HABITAT — on soil in *Alnus hirsuta* and *Quercus mongolica* forest.

COLLECTION EXAMINED — **RUSSIA. PRIMORSKY TERRITORY: Kedrovaya Pad Nature Reserve**, THE LEFT BANK OF THE KEDROVAYA RIVER, SOUTHERN SLOPE OF THE GAKKELEVSKY MOUNTAIN RIDGE, 43°06'10" N, 131°33'34" E, 19 Aug. 2005, leg. *O. Morozova, LE 253780.*

COMMENTS — *Entoloma caesiellum* is characterized by the conical to convex with umbilicate centre, translucently striate, brownish beige pileus with minute blackish blue squamules in the central part and pale blue-lilac tinge in the marginal zone, white then pink lamellae with concolorous edge, and blue-grey, polished stipe, small spores, and relatively slender cheilocystidia. So far this species had been known only from the type locality in Italy where it was found in a subalpine peat-bog with *Betula* and *Alnus* (Noordeloos 2004), and in a submontane forest in Spain (Vila & Caballero 2007). *Entoloma pseudocoelestinum* Arnolds is similar but has a brown-tinged pileus and lacks cheilocystidia. *Entoloma chalybeum* var. *lazulinum* differs by the bluish lamellae with brown edge and larger spores (Noordeloos 1992). *Entoloma decolorans* E. Horak from New Zealand has a darker, entirely squamulose, non-translucent striate pileus (Horak 1973). *Entoloma transmutans* G.M. Gates & Noordel. from Tasmania differs by having pinkish purple tinges in the expanding pileus, and much smaller spores (Gates & Noordeloos 2007).

8. *Entoloma parasericellum* Corner & E. Horak, in Horak, Beih. Nova Hedwigia 65: 97 (1980) FIG. 8, PLATE 1.8

MACROCHARACTERS — PILEUS 8–28 mm broad, hemispherical when young, expanding to plano-convex and applanate with depressed centre, not hygrophanous, not translucently striate, radially finely silky-fibrillose, whitish to cream-coloured. LAMELLAE adnate, whitish then pink, with serrulate concolourous edge. STIPE 55–70 × 3–5 mm, cylindrical, slightly broadened towards base, sometimes with longitudinal groove, white, pruinose at apex, white tomentum at base. CONTEXT whitish. ODOUR strong like aromatic soap. TASTE indistinct.

MICROCHARACTERS — SPORES 9.3–13.0 × 6.0–8.0 µm, Q=1.3–1.9, heterodiametrical, with 5–7 angles in side view. BASIDIA 28.5–39.0 × 10.0–11.0 µm, clavate, clampless. LAMELLAE edge sterile. CHEILOCYSTIDIA cylindrical or narrowly clavate, sometimes septate, 33.0–90.0 × 4.0–6.0 µm. PILEIPELLIS a cutis made up of hyphae 4.0–10.0 µm wide with pale intracellular pigment. CLAMPS absent.

HABITAT — On soil in broad-leaved forest (*Quercus mongolica*, *Tilia amurensis*, *Acer* spp., *Alnus* spp.).

COLLECTION EXAMINED — **RUSSIA. PRIMORSKY TERRITORY: Kedrovaya Pad Nature Reserve**, VICINITIES OF THE SECOND ZOLOTOY STREAM, 43°06'37" N, 131°31'31" E, 20 Aug. 2005, leg. *O. Morozova and E. Popov, LE 253788.*

COMMENTS — This collection is strongly reminiscent of the very widespread *Entoloma sericellum* (Fr.) P. Kumm., from which it mainly differs by the rather persistent white colour, the lack of clamp connections, sterile lamella edge, and predominantly 5–7 angled spores. The description and illustration of

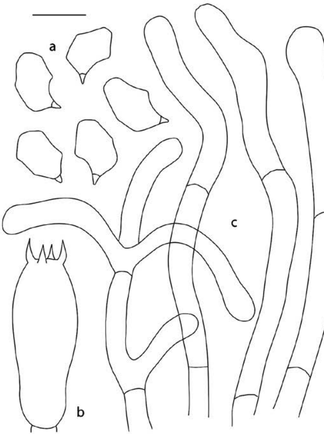

Fig. 8. *Entoloma parasericellum*. Spores (a), basidium (b), and cheilocystidia (c). From LE 253788. Bar = 10 µm.

E. parasericellum fit very well (Horak 1980). Our specimen differs from it only by the strong aroma with a saponaceous tinge. However, this species has only been recorded from New Guinea and Sabah to date. *Entoloma albidosimulans* G.M. Gates & Noordel. from Tasmania is also very similar, but differs by having a more differentiated pileipellis tending to a trichoderm (Gates & Noordeloos 2007). *Entoloma neosericellum* E. Horak from New Zealand is similar, differing by having abundant clamp connections (Horak 2008).

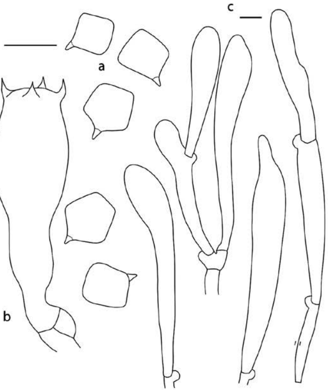

FIG. 9. *Entoloma quadratum*. Spores (a), basidium (b), and cheilocystidia (c). From LE 253783. Bar = 10 µm.

9. *Entoloma quadratum* (Berk. & M.A. Curtis) E. Horak, Sydowia 28: 190 (1976, « 1975 ») FIG. 9.

MACROCHARACTERS — PILEUS 10–40 mm broad, conical or campanulate with distinct acute papilla, hygrophanous, translucently striate, salmon pink, yellowish orange with paler serrulate margin. LAMELLAE adnate-emarginate, almost free, ventricose, first salmon pink then pink with concolorous or paler edge. STIPE 55–130 × 2–4 mm, cylindrical or slightly broadened towards base, longitudinally striate, often twisted, pruinose in the upper part, concolorous with pileus or paler, base with white tomentum. SMELL indistinct. TASTE indistinct.

MICROCHARACTERS — SPORES 8.3–10.4 × 7.8–9.1 µm, Q=1.0–1.2, cuboid. BASIDIA 48–62 × 11,7–13 µm, 4 spored, clamped. LAMELLAE edge sterile. CHEILOCYSTIDIA of *serrulatum*-type, with dense clusters of septate hyphae with cylindrical or narrowly clavate terminal elements 52–96 × 10–15.5 µm, without pigment. PILEIPELLIS a cutis consisting of cylindrical hyphae. Pigment intracellular. CLAMPS present.

HABITAT: on soil in the *Alnus hirsuta* and *Quercus mongolica* forest and in the broad-leaved forest (*Quercus mongolica, Tilia amurensis, Acer* spp.).

COLLECTIONS EXAMINED — **RUSSIA. PRIMORSKY TERRITORY: Kedrovaya Pad Nature Reserve,** THE LEFT BANK OF THE KEDROVAYA RIVER, THE RIGHT BANK OF THE KEDROVAYA RIVER, 43°05'56" N, 131°33'21" E, 17 Aug. 2005, leg. *E. Popov, LE 253783*; THE SOUTHERN SLOPE OF THE GAKKELEVSKY MOUNTAIN RIDGE, 43°06'10" N, 131°33'34" E, 19 Aug. 2005, leg. R.H. Petersen; *LE 253781*; VICINITY OF THE SECOND ZOLOTOY STREAM, 43°06'37" N, 131°31'31" E, 20 Aug. 2005, leg. *O. Morozova, LE 253782*.

COMMENTS — *Entoloma quadratum* is very easy to recognize on its salmon pink to orange basidiomes and cuboid spores. It is widespread, and locally common in North America and Japan, and extends also in eastern Asia (Horak 1976, 1980; Noordeloos & Hausknecht 2007). It was reported as *E. salmoneum* (Peck) Sacc. from Kedrovaya Pad Nature Reserve by Vassiljeva (1973).

The complex of *Entoloma serrulatum* (Fr.) Hesler

In the survey of the Kedrovaya Pad Nature Reserve, several collections have been made of taxa belonging to the cosmopolitan, and morphologically very plastic, complex of *Entoloma serrulatum*, characterized by the so-called *serrulatum*-type of lamella edge, which is a dense strand of hyphae running along the lamella edge with more or less clavate terminal endings, often in irregular, dense clusters, causing a fimbriate lamella edge when examined with a hand lens. Usually these elements or "cheilocystidia" are filled with a deep blue or blackish blue, rarely brown or purple, intracellular pigment. Many species have been distinguished in this group, mainly based on colour differences of the pileus and stipe combined with slight differences in spore size and shape. At present we feel that a thorough revision using molecular markers would contribute to a better understanding of the diagnostic value of these characters.

The following collections have been named using existing literature:

10. *Entoloma gomerense* Wölfel & Noordel., Öst. Z. Pilzk. 10: 192 (2001)

FIG. 10, PLATE 1.9

MACROCHARACTERS — PILEUS 7–10 mm broad, plano-convex with depressed centre, slightly hygrophanous, translucently striate, very dark grayish blue with purple or brown tinge in centre and stripes, almost white between them,

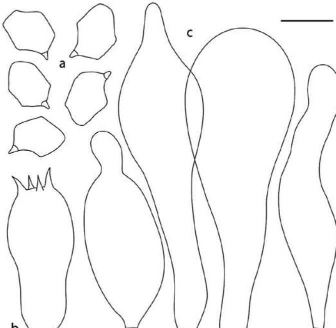

Fig. 10. *Entoloma gomerense*. Spores (a), basidium (b), and cheilocystidia (c). From LE 253784. Bar = 10 µm.

covered by grayish blue scales. Lamellae adnate-emarginate with small decurrent tooth, grayish pink with serrulate blackish purple edge. Stipe 22–25 × 1 mm, cylindrical, dark grayish blue, polished, glabrous, base with white tomentum. Context concolorous with the surface, whitish in the inner part. Odour indistinct. Taste indistinct.

Microcharacters — Spores 8.5–10.5(11.7) × 6.5–8.5 µm, Q=(1.1)1.3–1.5, heterodiametrical, with 5–6 angles in side view. Basidia 22–26 × 9–12 µm, clavate to broadly ellipsoid, clampless. Lamellae edge sterile. Cheilocystidia 20–73 × 8–22 µm, broadly clavate or lageniform with dark intracellular pigment. Pileipellis a cutis with transition to a trichoderm. Pigment intracellular. Clamps absent.

Habitat — on soil and decayed wood in the flood plain forest.

Collection examined — **RUSSIA. Primorsky Territory: Kedrovaya Pad Nature Reserve,** the right bank of the Kedrovaya River, 43°05′56″ N, 131°33′21″ E, 17 Aug. 2005, leg. *O. Morozova*, *LE 253784*.

Comments — The small dark grayish blue basidiomes with deeply translucently striate pileus and blackish blue, *serrulatum*-type lamella edge are distinctive for this tiny *Cyanula*. Originally described from the Island of Gomera, Islas Canarias, Spain, it now has also been recorded from a few European localities (Noordeloos 2004). It seems to prefer moist places with mosses and peaty soil.

11. *Entoloma caesiocinctum* (Kühner) Noordel., Persoonia 11(4): 470 (1982)

Fig. 11

Macrocharacters — Pileus 20–25 mm broad, infundibuliform, slightly hygrophanous, translucently striate, radially fibrillose, dark grayish blue and squamulose at centre, grayish brown from the centre becoming grayish blue at margin. Lamellae subdecurrent or arcuate, first blue, then grayish pink with serrulate dark blue edge. Stipe 55–60 × 3–5 mm, cylindrical or compressed with longitudinal groove, dark blue or grayish blue, glabrous, polished, base with white or grayish tomentum. Context concolour with the surface, inner part whitish. Odour spicy. Taste of starch.

Microcharacters — Spores 7.5–11.0 × 5.5–7.5 µm, Q=1.2–1.6, heterodiametrical, with 5–7 angles in side view. Basidia 21–31 × 8–12 µm,

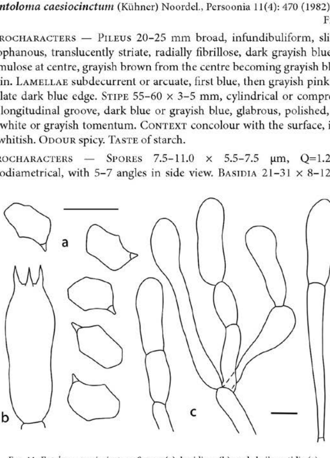

Fig. 11. *Entoloma caesiocinctum*. Spores (a), basidium (b), and cheilocystidia (c). From LE 253786. Bar = 10 µm.

clavate, clampless. LAMELLAE edge sterile. Cheilocystidia of *serrulatum*-type, with dense clusters of septate hyphae with cylindrical or narrowly clavate terminal elements 50–120 × 6–10 µm, with bluish intracellular pigment. PILEIPELLIS a cutis with transition to a trichoderm. Pigment intracellular. CLAMPS absent.

HABITAT — On soil in broad-leaved forest (*Quercus mongolica*, *Tilia amurensis*, *Acer* spp., *Alnus* spp.).

COLLECTIONS EXAMINED — **RUSSIA. PRIMORSKY TERRITORY: Kedrovaya Pad Nature Reserve,** THE RIGHT BANK OF THE KEDROVAYA RIVER, 43°05′56″ N, 131°33′21″ E, 17 Aug. 2005, leg. *O. Morozova, LE 253785*; **PRIMORSKY TERRITORY, Kedrovaya Pad Nature Reserve,** VICINITIES OF THE SECOND ZOLOTOY STREAM, 43°06′37″ N, 131°31′31″ E, 20 Aug. 2005, leg. *O. Morozova, LE 253786.*

COMMENTS — The above collections could be identified as *E. caesiocinctum* due to their predominantly brown, translucently striate pileus, but our specimens differ from the typical *E. caesiocinctum* by the clitocyboid form of the basidiome and slightly smaller spores.

12. *Entoloma violaceoserrulatum* Noordel., Fungi Europaei, 5a: 1038 (2004)

FIG. 12

MACROCHARACTERS — PILEUS 26–40 mm broad, infundibuliform, not hygrophanous, not translucently striate, brownish gray with violaceous tinge, entirely squamulose. LAMELLAE decurrent, grayish pink with serrulate violaceous edge. STIPE 55–70 × 3–5 mm, cylindrical, slightly broadened towards base, with longitudinal groove, bluish gray with violaceous tinge, white at apex, squamulose, base with white tomentum. CONTEXT whitish. SMELL indistinct. TASTE indistinct.

MICROCHARACTERS — SPORES 8.0–10.5 × 6.0–8.0 µm, Q=1.1–1.6, heterodiametrical, with 5–6 angles in side view. BASIDIA 22–45 × 11–15 µm, clavate to broadly ellipsoid, clampless. LAMELLAE edge sterile. CHEILOCYSTIDIA of *serrulatum*-type, with dense clusters of septate hyphae with cylindrical or clavate terminal elements 50–120 × 10–22 µm, with bluish intracellular pigment. PILEIPELLIS a cutis with transition to a trichoderm, made up of inflated terminal elements, 40–70 × 5–22 µm with blue, intracellular pigment. Brilliant granules abundant in pilei- and hymenophoral-trama. CLAMP CONNECTIONS absent.

HABITAT — On soil in the flood plain forest.

COLLECTION EXAMINED — **RUSSIA. PRIMORSKY TERRITORY: Kedrovaya Pad Nature Reserve,** THE RIGHT BANK OF THE KEDROVAYA RIVER, 43°05′56″ N, 131°33′21″ E, 17 Aug. 2005, leg. *O. Morozova, LE 253787.*

COMMENTS — The description of *Entoloma violaceoserrulatum* (originally from Finland) characterized by the violaceous tinges in both the pileus and stipe fits this collection well (Noordeloos 2004).

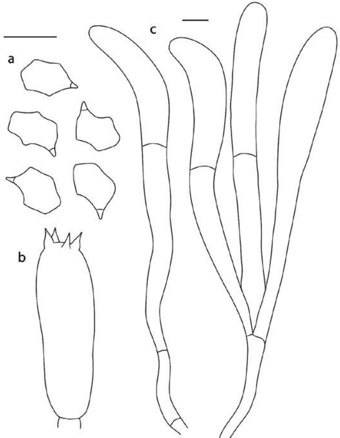

Fig. 12. *Entoloma violaceoserrulatum*. Spores (a), basidium (b), and cheilocystidia (c). From LE 253787. Bar = 10 µm.

Acknowledgments

The authors thank the administration of the Kedrovaya Pad Nature Reserve for help in the organization of the expedition. We are very grateful to Prof. A. Kovalenko, Prof. R.H. Petersen, Dr E. Popov, and Dr N. Psurtseva for fieldwork and support and Mrs. Anita Walsmit-Sachs for preparing the line drawings for print. Dr. G. Gates and Dr. A. Vizzini are thanked for critically reviewing an earlier version of this paper. The study was partly supported by the Russian Foundation for Basic Research and the Program of the Presidium of Russian Academy of Sciences "Biodiversity". The Kits van Waveren foundation made it possible to print the coloured plate.

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Lylea indica: a new hyphomycete species from India

Kedar G. Karandikar[1] & Sanjay K. Singh [2*]

singhsksingh@rediffmail.com
[2] National Facility for Culture Collection of Fungi
MACS' Agharkar Research Institute, G.G. Agarkar Road, Pune–411004

kedar_karandikar@yahoo.com
[1]Department of Botany, K.M.C. College, Khopoli, Dist. Raigad – 410 203

Abstract — A new hyphomycete species, *Lylea indica*, from Nagzira, Vidharba region of Maharashtra state in India found on dead culms of *Bambusa arundinacea* is here described.

Key words — fungal diversity, anamorphic fungus, taxonomy

Introduction

Morgan-Jones (1975) established *Lylea* (type species *L. catenulata* Morgan-Jones) on twigs of *Pinus taeda* L. collected in Auburn, Alabama. Four species have been described in the genus (Morgan-Jones 1975, Mercado et al. 1977, Chang 1999, McKenzie 2009). A fifth *Lylea* species has been found among fungi collected from forests of Vidarbha region in Maharashtra state. The new species is illustrated and described below.

Materials & methods

A Nikon Stereozoom microscope (Model SMZ-1500 with Digi-CAM) was used to study patterns of colonies growing on herbarium specimens. Semi-permanent microscopic slides were prepared by making scrape mounts from the specimens. Specimens were mounted in lactophenol-cotton blue for micrometric details using an Olympus CX-41. Measurements of fungal structures were taken with a calibrated ocular micrometer. Illustrations were prepared using camera lucida. Holotype material is deposited in Ajrekar Mycological Herbarium (AMH), MACS' Agharkar Research Institute, Pune, India (AMH, according to Holmgren et al. 1990).

Attempts to culture the described species on V-8 Juice Agar and Potato Dextrose Agar (Tuite 1969) were unsuccessful.

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*Author for correspondence

Taxonomic description

Lylea indica K.G. Karand. & S.K. Singh, **sp. nov.** FIGS 1–4

MYCOBANK MB 515199

Lylea catenulata *similis sed conidiophoris macronematis et conidiis in catenis simplicibus.*

HOLOTYPE — on dead culms of *Bambusa arundinacea* Willd. *(Poaceae)*, India, Nagzira, Vidarbha, Maharashtra, 21.12.1983, *K.G. Karandikar*, 6632: AMH.

ETYMOLOGY — *indica* refers to the country of origin.

COLONIES effuse. *Mycelium* brown partly superficial. HYPHAE branched, septate, pale brown, 1.5–2.0 µm wide. CONIDIOPHORES determinate, macronematous, mononematous, simple, cylindrical, straight or flexuous, unbranched, pale-brown, 1–4 septate, smooth, 24–65 × 1.5–2.0(–3.5) µm. CONIDIOGENOUS CELLS integrated, terminal, determinate, monoblastic and terminal cells of conidia, forming short, acropetal chains. The growth of conidiophores ceases with the formation of the conidium at its apex. The successive conidia then develop on the terminal cell of previously formed conidium. CONIDIA acrogenous, singly short catenate, mid brown to brown, smooth, cylindrical to fusiform, 3–7 pseudoseptate, 10–35.5(–21) × 5.5–11.5(–8.5) µm with thick black, conspicuous lamellae and with constrictions at septa or shows wavy margin.

COMMENT—*Lylea indica* shows affinity with *L. catenulata* in having pseudoseptate conidia with lamellae that develop in short, acropetal chains. However, *L. indica* produces macronematous conidiophores and conidia that always form unbranched chains resulting from the conidia successively developing from the terminal cell of an earlier conidium in the chain; conidia never arise from intercalary cells of a conidium as is found in *L. catenulata*. In addition, conidia in *L. indica* are considerably shorter (10–35.5 µm) than those of *L. catenulata* (40–67(–120) µm).

The new *Lylea* species differs from the other members of the genus [e.g., *L. tetracoila* (Corda) Hol.-Jech. (Holubová-Jechová 1978), *L. palmicola* Mercado et al. (Mercado et al. 1997)] in producing up to seven pseudoseptate conidia compared to 2–4 in (*L. tetracoila*) and 0–4 (*L. palmicola*). *Lylea indica* differs from *L. rhopalostylidis* McKenzie (McKenzie 2009) in producing significantly smaller conidia and conidiophores as well as having conidia with thick black conspicuous lamellae all along the mature conidial inner cell walls.

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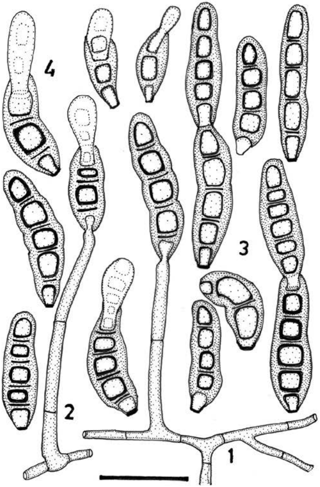

Figs.1–4. *Lylea indica*
1. Vegetative mycelium connected to a conidiophore with a terminal conidium.
2. Conidiophore bearing an apically germinated conidium.3. Conidial chain
4. Apically proliferating conidia. Scale bar = 20µm.

'National Facility for Culture Collection of Fungi' (No.SP/SO/PS-55/2005) at ARI. K.G. Karandikar thanks late Dr. P.G. Patwardhan for his incredible guidance and Principal K.M.C. College Khopoli for the support.

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The genus *Volvariella* in Spain: *V. dunensis* comb. & stat. nov. and observations on *V. earlei*

Alfredo Justo[1*] & María Luisa Castro[2]

*ajusto@clarku.edu or alfredo.justo@gmail.com
[1] Biology Department, Clark University. 950 Main St. Worcester, MA 01610 USA

[2] Facultade de Bioloxía, Universidade de Vigo. Campus As Lagoas-Marcosende Vigo, 36310 Spain

Abstract — *Volvariella nigrovolvacea* var. *dunensis* is raised to the species rank, and its delimitation from similar taxa is discussed. *Volvariella earlei* is recorded for the second time in Europe, and its taxonomy, nomenclature, and distribution are briefly discussed. A key to the Iberian species of *Volvariella* is provided.

Key words — *Agaricales*, *Agaricomycetes*, biodiversity, *Pluteaceae*

Introduction

In recent years the genus *Volvariella* Speg. (*Agaricales*, *Basidiomycota*) has been the subject of several regional (Justo & Castro 2004, Justo et al. 2005) or taxonomic (Vila et al. 1999) studies in the Iberian Peninsula (Spain, Portugal). After revising the collections deposited in several Iberian herbaria and identifying newly collected material, we have published an annotated checklist of the genus in our area (Justo & Castro 2010). According to our study 12 taxa of *Volvariella* occur in the Iberian Peninsula and Balearic Islands.

This paper presents additional taxonomic notes and observations resulting from our work on *Volvariella*. We raise *Volvariella nigrovolvacea* var. *dunensis* to species rank, based on morphological and ecological differences from related species, *V. nigrovolvacea* Kosina and *V. volvacea* (Bull.) Singer. *Volvariella earlei* is mentioned for the first time in our area and for the second time in Europe. Both species are fully described and their taxonomy and distribution are briefly discussed.

A key to all members of the genus *Volvariella* in the Iberian Peninsula and Balearic Islands is provided.

Material and methods

Standard methods for describing the basidiocarps were applied, using the terminology of Vellinga (1988) and Boekhout (1990). Color annotations for the macroscopic descriptions are from Munsell Color Company (2000). The notation [60, 2, 2] indicates that measurements were made on 60 basidiospores in 2 samples from 2 collections. At least 10 measurements per collection were performed for other microscopic features such as basidia (excluding sterigmata), cystidia, and pileipellis elements. Microscopical preparations were mounted in Congo Red, then the excess dye was removed and 5% KOH was added. The following abbreviations are used in the descriptions: avl for average length, avw for average width, Q for quotient of length and width and avQ for average quotient. Extreme measurements are indicated within parentheses. Herbarium acronyms follow Holmgren & Holmgren (1998) except "SCAT", which is used for the "Societat Catalana de Micologia" herbarium.

Taxonomy

1. *Volvariella dunensis* (Vila, Àngel & Llimona) Justo & M.L. Castro, **comb. & stat. nov.** FIG. 1

MYCOBANK MB 514014

BASIONYM: *Volvariella nigrovolvacea* var. *dunensis* Vila, Àngel & Llimona, Rev. Catalana Micol. 22: 131. 1999.

PILEUS 35–100 mm, subglobose or campanulate when young, later plano-convex, without umbo; surface radially fibrillose, especially towards margin, sometimes radially fissurate; gray or bluish gray [approx. Mu. GLEY 2 4/1 "bluish gray", 5/1 "dark bluish grey"], with some brown or grayish-brown tint in older specimens; margin entire, not striate. LAMELLAE crowded, free, (broadly) ventricose; up to 10 mm broad; white when young, later pink, with white flocculose edges. STIPE 25–50 × 9–14 mm, cylindrical or narrowly clavate, with slightly broadened base (up to 20 mm); white; pubescent in young specimens, then glabrous. VOLVA saccate, membranous, irregularly lobed fragile; white, sometimes leaving small patches on pileus. CONTEXT in pileus white, with dark grey tints under pileipellis especially in older specimens; in stipe white. SMELL fungoid. TASTE not recorded. SPORE PRINT not recorded.

BASIDIOSPORES [60, 2, 2] 7–8.5 × 4.5–6 µm, avl × avw = 7.7–7.9 × 5.1–5.2 µm, Q = 1.3–1.7(–1.8), avQ = 1.5–1.55, ellipsoid to oblong. BASIDIA 20–35 × 7–15 µm, 4-spored, broadly clavate. PLEUROCYSTIDIA (34–)50–95(–108) × (16–)20–45(–50) µm, clavate, (narrowly) utriform, obovoid; colorless; with thin, smooth walls; fairly abundant. CHEILOCYSTIDIA 20–80 × 15–60 µm, clavate or utriform, without apical appendages, colorless; with thin, smooth walls; abundant and relatively crowded. PILEIPELLIS a cutis made up of cylindrical elements (20–)

50–275 × 10–35(–50) µm, colorless or with brown intracellular pigment; with thin, smooth walls. STIPITIPELLIS a cutis; hyphae 5–20 µm wide, cylindrical, colorless or with brown pigment; with thin, smooth walls. CAULOCYSTIDIA 20–75 × 10–25 µm, clavate, utriform, lageniform, flexuous, sometimes with elongated or subcapitate apex, without internal septa, colorless or with brown pigment; with thin, smooth walls. CLAMP CONNECTIONS absent in all tissues.

ECOLOGY AND DISTRIBUTION — In open dunes with most of the basidiocarp growing deeply buried in the sand. Known from two localities on the Mediterranean coast of Spain (Barcelona: Viladecans, Prat de Llobregat). January–February.

COLLECTIONS EXAMINED—**SPAIN: Barcelona:** Viladecans (Baix Llobregat), in open dunes, 5.II.1998, J. Vila & F. Àngel, SCAT 3512 (Holotype); El Prat de Llobregat, El Pinar, in open dunes, 8.II.1997, F. Àngel, SCAT 3513.

COMMENTS—*Volvariella dunensis* was first described as a variety of *V. nigrovolvacea*. However examination of the Spanish collections revealed important morphological and ecological differences that separate this taxon from *V. nigrovolvacea* as well as from the morphologically similar *V. volvacea*.

Volvariella nigrovolvacea is an obscure and little-known species originally described from grassy fields in the Czech Republic (Kosina 1974). Its main characteristics are the relatively large basidiomes (pileus 100–150 mm), fibrillose pileus, glabrous stipe, and a well-developed, saccate, grey-brown volva. As already noted by Boekhout (1990), the only difference from *V. volvacea* seems to be the glabrous stipe.

The original microscopical description of *V. nigrovolvacea* could be more complete, as Kosina (1974) provided data only for the spores ("7–8.5 × 4.5–5.5 µm") and cheilocystidia ("ampulliform, fusiform, colorless, 47–70 × 13–18 µm, rare"). The type collection is lost (Dr. Jan Holec, pers. com.), preventing further microscopic study. It seems likely that *V. nigrovolvacea* is a synonym of *V. volvacea*, but this should be confirmed by new collections of *V. nigrovolvacea* from the type locality.

Contu & La Rocca (1999) described a collection identified as *V. nigrovolvacea* from Sardinia from dunes under *Juniperus*. These authors described a taxon with relatively small basidiocarps (pileus 15–50 mm), which contrast with the larger basidiocarps (pileus 100–150 mm) mentioned in the original description of *V. nigrovolvacea* (Kosina 1974).

In the Sardinian collections the pleurocystidia are described as fusiform or utriform and the cheilocystidia as fusiform, sometimes mucronate. Because of the incomplete microscopical description of *V. nigrovolvacea*, and the differences in macroscopical and ecological characters it is uncertain whether the taxon described by Contu & La Rocca (1999) is really the same as the one described by Kosina (1974).

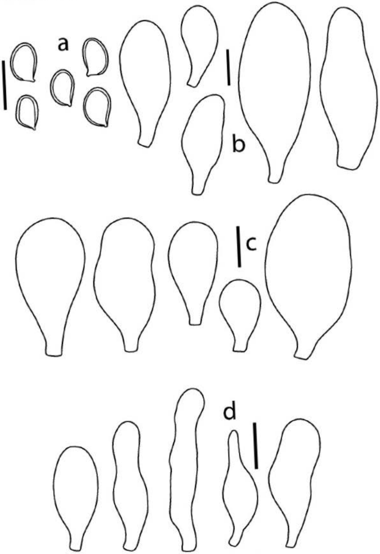

Fig 1. *Volvariella dunensis.*
a = spores; b = pleurocystidia; c = cheilocystidia; d = caulocystidia.
All from SCAT 3512 (Holotype). Scale bars a = 10 μm; b, c, d = 20 μm.

Although *V. dunensis* was first described as a variety of *V. nigrovolvacea*, these taxa differ in ecology and morphology of the volva and cheilocystidia. Moreover, the doubtful and uncertain status of *V. nigrovolvacea* contributed to our separating it from the well described and delimited *V. dunensis*.

Volvariella volvacea and *V. dunensis* resemble each other macroscopically, but *V. volvacea* has a well-developed grey-brown volva and fruits on organic-rich substrates (leaves, compost, sawdust) usually during summer and spring, at least in Europe (Boekhout 1990, Justo & Castro 2010). On the other hand, *V. dunensis* has a whitish, rather fragile volva and fruits on open dunes and is not directly associated with accumulations of organic matter during winter.

Cystidial shapes also differ in the two species. *Volvariella volvacea* has fusiform, lageniform, clavate or utriform pleurocystidia and cheilocystidia, usually with elongated apices, mucronate or with an apical flexuous appendage (data from the Spanish collections; Justo & Castro 2010). In *V. dunensis*, pleurocystidia and cheilocystidia are predominantly clavate, obovoid, or (narrowly) utriform, without elongated apices or appendages. The caulocystidia in *V. volvacea* are cylindrical to clavate, usually with 1–2 internal septa and measure 40–190 × 5–15 µm (data from the Spanish collections; Justo & Castro 2010), while in *V. dunensis* caulocystidia are predominantly clavate or utriform, have no internal septa, and measure 20–75 × 10–25 µm.

Vila et al. (1999), who compare *V. dunensis* with species of similar habitat, note that *V. arenaria* (Pat.) Singer, described from the Arabian Desert, has smaller basidiocarps (pileus ≤ 30 mm) and larger basidiospores (12–15 × 8–10 µm) while *V. psammophila* Singer, described from Argentina, has smaller basidiocarps (pileus ≤ 45 mm), smaller basidiospores (6.2–7.3 × 4.5–5.5 µm), and much narrower pleuro- and cheilocystidia (≤ 17 µm).

2. *Volvariella earlei* (Murrill) Shaffer, Mycologia 49: 550. 1957 FIG. 2

≡ *Volvariopsis earlei* Murrill, Mycologia 3: 282. 1911.

≡ *Volvaria earlei* (Murrill) Murrill, Mycologia 4: 332. 1912.

PILEUS 25–45 mm; hemispherical or conical when young, later plano-convex, slightly depressed at center in old specimens; surface glabrous or innately fibrillose, viscid at least in young specimens; white or ochraceous at center [Mu. 10YR 8/2–8/4]; margin translucently striate. LAMELLAE crowded, free, (broadly) ventricose, up to 6 mm broad; white when young, later pink, with white flocculose even edges. STIPE 30–50 × 2–6 mm, cylindrical, with slightly broadened base (up to 10 mm); white with some ochraceous tints [Mu. 10YR 8/2–8/3]; glabrous or pruinose. VOLVA saccate, membranous, 2–4 lobed, glabrous, white, up to 20 mm high. CONTEXT white or with some yellowish tints. SMELL not recorded. TASTE not recorded. SPORE PRINT not recorded.

BASIDIOSPORES [90, 6, 3] 11–16 × (7.5–)8–11 µm, avl × avw = 13.4–14.6 ×

9.1–9.7 Mm, Q = (1.25–)1.3–1.6(–1.7), avQ = 1.45–1.55 ellipsoid, more rarely broadly ellipsoid or oblong. BASIDIA 20–40 × 8–16 µm, 4-spored or 2-spored, rarely 1-spored, broadly clavate. PLEUROCYSTIDIA absent. CHEILOCYSTIDIA 30–70 × 10–35 µm, clavate, fusiform, lageniform or conical, usually each cheilocystidium with a flexuous apical appendage up to 40 µm long; with thin, smooth walls; abundant, crowded. PILEIPELLIS an ixocutis made up of cylindrical hyphae, 5–15 µm wide, colorless; with thin, smooth walls; embedded in a gelatinous, colorless, matrix. STIPITIPELLIS a cutis; hyphae 5–15 µm wide, cylindrical, colorless; with thin, smooth walls. CAULOCYSTIDIA (not always present) 65–140 × 10–25 µm, cylindrical, hyaline or with brown pigment, sometimes with 1(–2) internal septa; with thin, smooth walls; scattered. CLAMP CONNECTIONS absent in all tissues.

ECOLOGY AND DISTRIBUTION—In gardens, on soil. In Spain known from one locality (Madrid: Móstoles). June–July.

COLLECTIONS EXAMINED—**SPAIN: Madrid:** Móstoles, Coimbra Park, in garden, 7.VI.1986, F.D. Calonge, MA-Fungi 16324; idem, 7.VII.1987, MA-Fungi 19490; idem, 20.VII.1989, MA-Fungi 22816.

COMMENTS—*Volvariella earlei* is closely related to *V. gloiocephala* (DC.) Boekhout & Enderle, as both species have basidiospores over 12 µm long and a pileipellis as an ixocutis. However the two differ in several macro- and microscopical characters. *Volvariella gloiocephala* has medium-sized to relatively large basidiomes (pileus 50–150 mm), and has larger basidiospores (generally 13.0–16.5 × 8.0–9.3 µm, avQ = (1.5–)1.6–1.85), common and more or less clavate to fusiform pleurocystidia, and cheilocystidia that are sometimes apically papillate but not commonly rostrate (data from the Spanish collections; Justo & Castro 2010). *Volvariella earlei* produces smaller basidiomes (pileus 25–45 mm) with broader basidiospores, pleurocystidia that are absent (in the Spanish collections) or very rare (in North American collections, Shaffer 1957), and cheilocystidia that are usually rostrate.

Volvariella earlei, which was originally described from Cuba (Murrill 1911), has been reported thus far from the U.S.A (Coker 1947), Mexico (Vázquez et al. 1989), Africa (Heinemann 1975), and Sardinia (Contu 2006). The Spanish and the Italian collections were collected during late spring and summer (June–August) in artificially irrigated gardens, which suggests that *V. earlei* is a tropical species alien to Europe, but more research is needed to establish this with certainty.

The collections of *V. earlei* at MA herbarium were deposited under the name *Volvariella media* (Schumach.) Singer, but as Kosonen (1993) and Contu (2006) noted, the application of *Agaricus medius* Schumach., the basionym, is difficult to establish. In the original description, Schumacher (1803) described a small, whitish species that grows in coniferous forests (*Abies, Pinus*) during

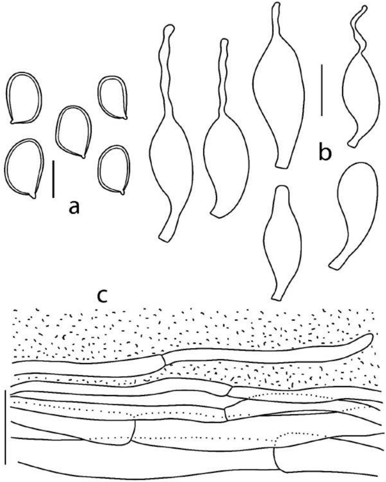

Fig 2. *Volvariella earlei*.
a = spores; b = cheilocystidia; c = pileipellis.
All from MA-Fungi 16324. Scale bars a = 10 μm; b, c = 20 μm.

the autumn (November) but provided no data on microscopic characters. Later authors have interpreted *Agaricus medius* in different ways: Bresadola (1929) described *Volvaria media* (Schumach.) Gillet, a nomenclatural synonym, as a small species with a gray, subtomentose volva and basidiospores of 7–9 ×

4–5 µm. Lange (1935) described a fungus that may correspond to *V. earlei* as described here based on its small basidiocarps, similar basidiospore size, and habitat on grassy fields, although some authors have argued that the species described by him is in fact just a small variant of *V. gloiocephala* (Contu 2006). Pilát (1959), who compared Bresadola's and Lange's different interpretations, proposed the name *Volvariella krizii* Pilát for the fungus described by Bresadola. Finally, Orton (1986) accounted for some British records that may represent *V. media* in the sense of Lange. In the Iberian bibliography there are three records under the names *Volvaria media* or *Volvariella media* (Torrend 1912, Rezende-Pinto 1943, Llimona et al. 1995). However none of them is provided with descriptions and/or cited herbarium collections. As we concur with Kosonen (1993) and Contu (2006) in considering *Agaricus medius* a doubtful name, we report the examined material as *V. earlei*.

Key to the species of *Volvariella* present in the Iberian Peninsula and Balearic Islands

1. Pileus viscid. Basidiospores > 12 µm long 2
1. Pileus not or only slightly viscid. Basidiospores < 12 µm long 3

2. Pileus 50–150 mm diam. Basidiospores with avQ = 1.6–1.85. Pleurocystidia common. Cheilocystidia rarely rostrate .... ***V. gloiocephala***
2. Pileus 25–45 mm diam. Basidiospores with avQ = 1.45–1.55. Pleurocystidia absent or scarce. Cheilocystidia commonly rostrate .... ***V. earlei***

3. Growing on wood 4
3. Not on wood 6

4. Pileus 30–100 mm diam., without distinct squamules. Pileipellis elements septate, up to 145(–200) µm long .... ***V. caesiotincta***
4. Pileus 50–200 mm diam., covered with distinct fibrillose squamules. Pileipellis elements rarely septate, up to 1000–1600(–2000) µm long 5

5. Pileus white, sometimes slightly yellowish in old specimens .... ***V. bombycina* var. *bombycina***
5. Pileus yellow from the beginning .... ***V. bombycina* var. *flaviceps***

6. Growing on basidiocarps of *Clitocybe nebularis* .... ***V. surrecta***
6. Habitat different 7

7. Basidiospores with avw = 3.5–4 µm. avQ = 1.7–1.8 .... ***V. murinella***
7. Basidiospores with avw = 4.4–5.3 µm. avQ = 1.3–1.55 8

8. Pileus covered with radial grey or grey-brown fibrils (at least in the center) 9
8. Pileus without radial grey or grey-brown fibrils 11

9. Pleurocystidia and cheilocystidia clavate, obovoid or (narrowly) utriform, without elongated apices. Caulocystidia clavate, utriform, lageniform, flexuous, without internal septa. Volva white, fragile. In open dunes .... ***V. dunensis***

9. Pleurocystidia and cheilocystidia fusiform, lageniform, clavate or utriform, commonly with elongated apices and/or apical appendages. Caulocystidia cylindrical, with internal septa. Volva grey-brown, not fragile. In grasslands in or outside forests or in places with abundant organic matter 10

10. Pileus 30–50 mm diam. Volva glabrous, not covering more than the lower 1/3 of the stipe . . . . ***V. taylorii***

10. Pileus 50–100 mm. Volva pubescent, usually covering more than the lower 1/3 of the stipe . . . . ***V. volvacea***

11. Pileus up to 60 mm diam. Stipe pubescent even in old specimens ***V. hypopithys***

11. Pileus up to 30 mm diam. Stipe glabrous in old specimens . . . . ***V. pusilla***

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An annotated checklist of *Volvariella* in the Iberian Peninsula and Balearic Islands

Alfredo Justo[1*] & María Luisa Castro[2]

*ajusto@clarku.edu or alfredo.justo@gmail.com
[1] Biology Department, Clark University
950 Main St. Worcester, MA 01610 USA

[2] Facultade de Bioloxía, Universidade de Vig
Campus As Lagoas-Marcosende , Vigo, 36310 Spain

Abstract — This checklist collates data on the 12 taxa of *Volvariella* reported from the Iberian Peninsula (Spain, Portugal) and Balearic Islands (Spain). The complete checklist, posted at http://www.mycotaxon.com/ resources/weblists.html, provides data on the collections, distribution, ecology, and phenology of each taxon.

Key words — *Agaricales*, *Agaricomycetes*, biodiversity, *Pluteaceae*

Introduction

Volvariella Speg. is a genus traditionally classified in the family *Pluteaceae* Kotl. & Pouzar (*Agaricales, Basidiomycota*), but recent molecular research has challenged its monophyly and taxonomic position within the *Agaricales* (Moncalvo et al. 2002, Matheny et al. 2006). Its main characteristics are the pluteoid basidiomes (i.e., free lamellae; context of pileus and stipe discontinuous), universal veil present in mature specimens as a saccate volva at the stipe base, brownish-pink spores in mass, and — primarily —inverse lamellar trama. *Volvariella* comprises about 50 species (Kirk & al. 2008) and is widely distributed around the world (Singer 1986).

Monographic studies of the genus have been mostly carried out in Europe (Kühner & Romagnesi 1956; Orton 1974, 1986; Boekhout 1990), North America (Shaffer 1957), and Africa (Heinemann 1975, Pegler 1977).

In the Iberian Peninsula (Spain, Portugal) and Balearic Islands (Spain) the records of *Volvariella* are scattered, as they are often included in general checklists. Prior to our study, the only taxonomic paper on this genus in this region was an article by Vila et al. (1999), which described the new taxon, *Volvariella nigrovolvacea* var. *dunensis*. Justo & Castro (2004 and Justo et al.

(2005) published studies on *Volvariella* within the Iberian Peninsula as a part of the Flora Mycologica Iberica project. Here, we present the first comprehensive account of *Volvariella* in the Iberian Peninsula and Balearic Islands.

Collections examined

We have studied the collections gathered by members of the Mycology Lab at Vigo University from 1991 to 2008. Collections of *Volvariella* deposited in several Iberian herbaria, both official and personal, have been examined and revised.

The information obtained from the bibliographic references of *Volvariella* in the Iberian literature has been incorporated into the distribution maps for each species.

Catalogue

In the online checklist (http://www.mycotaxon.com/resources/weblists.html) the following information is given for each taxon: a list of all collections examined; a map of its distribution in our area and some brief comments on its ecology and phenology.

The catalogue covers the following 12 taxa of *Volvariella* recorded in the Iberian Peninsula and Balearic Islands:

1. *Volvariella bombycina* (Schaeff.) Singer var. *bombycina*
2. *Volvariella bombycina* var. *flaviceps* (Murrill) Shaffer
3. *Volvariella caesiotincta* P.D. Orton
4. *Volvariella dunensis* (Vila et al.) Justo & M.L. Castro
5. *Volvariella earlei* (Murrill) Shaffer
6. *Volvariella gloiocephala* (DC.) Boekhout & Enderle
7. *Volvariella hypopithys* (Fr.) Shaffer
8. *Volvariella murinella* (Quél.) M.M. Moser ex Dennis et al.
9. *Volvariella pusilla* (Pers.) Singer
10. *Volvariella surrecta* (Knapp.) Singer
11. *Volvariella taylorii* (Berk. & Broome) Singer
12. *Volvariella volvacea* (Bull.) Singer

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The first record of *Parmotrema pseudocrinitum* (*Parmeliaceae*, lichenized *Ascomycota*) in South America

S. A. Michlig & L. I. Ferraro

andreamichlig@hotmail.com & lferraro@agr.unne.edu.ar
Instituto de Botánica del Nordeste
Sargento Cabral 2131, CC 209 Corrientes Capital, CP 3400, Argentina

Abstract — *Parmotrema pseudocrinitum* is reported for the first time in South America, from northern Argentina. A description of this species and comparisons with related species are presented. A key to species of *Parmotrema* with ciliate isidia and maps of their distribution are included.

Key words — lichens, protected areas, *Parmotrema crinitum*, *Parmotrema mellissii*, *Parmotrema melanochaetum*

Introduction

Parmeliaceae is one of the largest families of lichen-forming fungi and has been the subject of much recent research, particularly studies to establish phylogenetic relationships among the parmelioid taxa based on both morphological and molecular data (Crespo et al. 1999, 2001; Divakar et al. 2005, Louwhoff & Crisp 2000, Molina et al. 2004).

Parmotrema A. Massal. is one of the larger genera in the *Parmeliaceae* with approximately 350 species and a center of distribution in the world's tropical regions. As circumscribed by Blanco et al. (2005) based on recent molecular studies, the genus is characterized by an upper cortex of palisade plectenchyma or paraplectenchyma with vaults, a pored epicortex, the lack of pseudocyphellae, the presence or absence of cilia, laminal perforate or imperforate apothecia, ellipsoid ascospores, and filiform, cylindrical, bacilliform or sublageniform conidia.

As a result of research aimed at studying the species diversity of lichenized and non-lichenized fungi in protected areas in northern Argentina, *P. pseudocrinitum* was found for the first time in South America.

Materials and methods

The specimens studied were collected recently by the authors in two National Parks in northern Argentina and are preserved in CTES (Instituto de Botánica del Nordeste Herbarium).

The morphological analysis is based on observations of macroscopic and microscopic characters with stereoscopic and optical microscopes (Leica MZ6 and Olympus BX 50 respectively). Apothecia and pycnidia were cut by hand with a razor blade and then mounted in 5% KOH to study the ascospores and conidia. Measurements were made with objectives at 400 and 1000× magnification.

Chemical substances were identified using spot tests with 10% KOH (K), sodium hypochlorite (C), and K followed by C (KC), UV fluorescence, and Thin Layer Chromatography (TLC). TLC was carried out using solvents A and C according to the methodology proposed by Culberson (1972), Culberson & Kristinsson (1970), Culberson & Ammann (1979), and White & James (1985).

The distribution maps (FIGS. E–G) are based on records found in the literature (Calvelo & Liberatore 2002, Chen et al. 2005, Elix 1994, Elix & Gremmen 2002, Eliasaro & Donha 2003, Jungbluth 2006, Hale 1965, 1976; Hale & Kurokawa 1965, Krog 1974, Krog & Swinscow 1981, Kurokawa & Lai 2001, Louwhoff & Elix 1998, 2002; Marcelli & Ribeiro 2002, Nagaoka & Marcelli 1989, Nash & Elix 2002, Osorio 1992, 1994; Osorio & Fleig 1988, 1990; Sipman et al. 2008).

Taxonomy

Key to *Parmotrema* species with ciliate isidia

1a. Medulla K– 2

1b. Medulla K+ persistently yellow (stictic acid present) or yellow turning red (salazinic acid present) 6

2a. Isidia frequently becoming sorediate; medulla UV+ bright blue-green, KC+ orange (alectoronic acid present) .... *P. mellissii*

2b. Isidia rarely or not becoming sorediate; medulla UV–, KC– or KC+ 3

3a. Medulla P+ red (protocetraric acid present) .... *P. subcorallinum*

3b. Medulla P– (protocetraric acid absent) 4

4a. Medulla C+ salmon pink, KC+ reddish (olivetoric acid present) .... *P. horridum*

4b. Medulla C+ rose, KC+ rose (gyrophoric acid present) 5

5a. Upper surface strongly to rather distinctly maculate; rhizines simple .... *P. melanochaetum*

5b. Upper surface emaculate to rarely slightly maculate; rhizines simple to irregularly branched .... *P. pseudocrinitum*

6a. Medulla K+ yellow turning red (salazinic acid present) 7

6b. Medulla K+ persistently yellow (stictic acid present) 8

7a. Medulla UV+ yellow (liquexanthone present) .... *P. ultralucens*

7b. Medulla UV– (liquexanthone absent) .... *P. neosubcrinitum*

8a. Medulla uniformly white, yellow-orange pigment absent .... *P. crinitum*

8b. Medulla mostly white, yellow-orange pigment (euplectin) present near lower surface .... *P. ochrocrinitum*

Parmotrema pseudocrinitum (Abbayes) Hale, Phytologia 28(4): 338 (1974)
≡ *Parmelia pseudocrinita* Abbayes, Bull. Inst. Fr. Afr. Noire, Sér. A, 20: 19 (1958)

THALLUS foliose, mineral grey to grey green, corticolous, loosely to moderately attached to substrate, 4–15 cm in diameter; lobes rounded, (3–)5–10 mm wide, contiguous to partially imbricate, margin crenate, densely ciliate; cilia simple, occasionally furcate, (0.2–)0.4–1.3(–2) mm long, mostly present in the incisions of the margin, ascending. UPPER SURFACE smooth, rugose in some areas in the center of the thallus, rarely fissurate, emaculate to rarely slightly maculate, densely ciliate. ISIDIA laminal to occasionally marginal or submarginal, simple to coralloid, frequently with simple cilia, 0.2–1 mm long, or brown-tipped. SORALIA absent. PUSTULAE absent. MEDULLA white; K+ purple pigment absent. LOWER SURFACE black, smooth to rugose, shiny, moderate to densely rhizinate, with a narrow, brown erhizinate marginal zone, smooth to rugose; rhizines black, long, generally simple, sometimes furcate. APOTHECIA absent or present, sparse, (0.6–)1.5–6 mm wide, thalline exciple moderately to densely isidiate, the isidia frequently ciliate, simple or branched; disc imperforate, pale to dark brown, epruinose, ±rugose; mature ascospores not seen. PYCNIDIA rarely present, sparse, submarginal; conidia filiform, (6.6–)7–9.3(–13.28) µm.

CHEMISTRY — Cortex K+ yellow, UV– (atranorin); medulla K–, C+ rose, KC+ rose, UV– (gyrophoric acid).

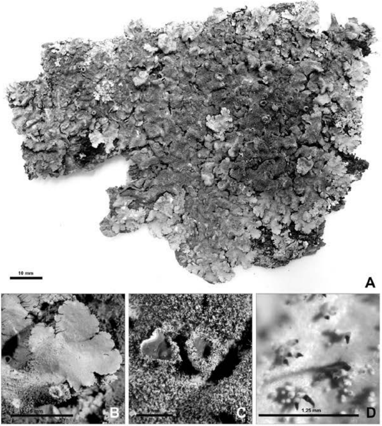
SPECIMENS_EXAMINED — ARGENTINA. Corrientes Province, Depto. Mburucuyá, Mburucuyá National Park, Estancia Santa Teresa, on *Enterolobium contortisiliquum*, 28/II/07, *Michlig, Niveiro & Meza Torres* 311 (CTES); Estancia Santa Teresa, in front of the historical center, on *Tabebuia heptaphylla*, 20/VII/2006, Ferraro et al. 8088 (CTES), Estancia Santa Teresa, near the historical center, 28° 01' S, 58° 01' W. Ferraro et al. 8094 (CTES), idem., 8101 (CTES). Misiones Province, Depto. Iguazú, Iguazú National Park, Camping site Ñandú, 28/IV/2004, Ferraro & Popoff 7426 (CTES).

DISTRIBUTION — *Parmotrema pseudocrinitum*, previously known from Africa (Hale 1965, Krog & Swinscow 1981), was recently reported for the first time from the Neotropics by Boom et al. (2007), who recorded it for Guatemala (FIG. E). This is the first record of the species for South America.

Discussion

Parmotrema pseudocrinitum is characterized by the ciliate lobes, the simple or branched, often ciliate isidia (FIGS. A,B,D), the white medulla and the presence of atranorin and gyrophoric acid as principal chemical substances. Boom et al. (2007) also mention the presence of minor quantities of lecanoric acid in the medulla.

Hale (1965) noted that the medulla in this species could have K+ purple pigmented areas near the lower surface, but in the material we examined, the medulla is completely white and no K+ purple pigment is present.



FIGS. A–D. *P. pseudocrinitum.* A: Complete thallus (scale bar = 10 mm). B: Lobes margins (scale bar = 5 mm). C: Apothecia with imperforate disc (scale bar = 5 mm). D: Ciliate isidia (scale bar = 0.6 mm).

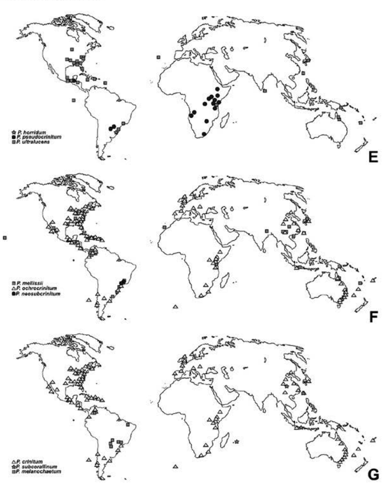
Apothecia with imperforate disc were present in many of the specimens studied (FIG. C) but as the ascospores were immature, their characteristics were not reported here. According to Krog & Swinscow (1981), the disc may become perforate and the ascospores measure 15–18 × 6–8(–10) µm. Pycnidia were only found in one specimen (Ferraro 8094). The observed conidia were slightly shorter than reported by Krog & Swinscow (1981) [(6.6–)7–9.3(–13.3) versus 10–12 µm long]. All Argentinean specimens were found on bark, but Krog & Swinscow (1981) mentioned that this species may also occur on rock.

Parmotrema pseudocrinitum is morphologically similar to the cosmopolitan species *P. crinitum* (Ach.) M. Choisy and *P. mellissii* (C.W. Dodge) Hale (Figs. F–G), characterized by the presence of ciliate lobes and isidia, but they are easily differentiated by their respective medullary chemistries. *Parmotrema crinitum* is clearly distinguished by stictic acid, which shows a persistent K+ yellow reaction. The ascospore size and conidial size and shape also differ. According to Elix (1994), the conidia of *P. crinitum* are sublageniform and 3–4 μm long, while those in *P. pseudocrinitum* are filiform and (6.6–)7–9.3(–13.28) μm long. The ascospores of *P. crinitum*, which are larger than those in *P. pseudocrinitum*, are 25–35 × 12–18 μm (Elix 1994, Krog & Swinscow 1981).

Parmotrema mellissii can be distinguished from *P. pseudocrinitum* by the presence of coralloid isidia that eventually become sorediate and the presence of alectoronic acid in the medulla (KC+ light orange and UV+ bright blue-green). Krog & Swinscow (1981) and Elix (1994) observed that the medulla in *P. mellissii* could have areas with an ochraceus K+ purple pigment (skyrin), the same reaction that was cited by Hale (1965) for *P. pseudocrinitum*. In *P. mellissii* apothecia are rarely found, the disc is imperforate, and the ascospores measure 10–14 × 16–22 μm (Hale 1965, Elix 1994); furthermore, pycnidia are not commonly found (Elix 1994, Krog & Swinscow 1981, Nash & Elix 2002). Eliasaro & Donha (2003) describe the conidia as filiform and 7–10 μm long, thus similar to those found in *P. pseudocrinitum*.

Parmotrema ochrocrinitum Elix & J. Johnst., *P. subcorallinum* (Hale) Hale, *P. horridum* Fleig, *P. ultralucens* (Krog) Hale, and *P. neosubcrinitum* C.H. Ribeiro & Marcelli are also characterized by the presence of ciliate isidia. *Parmotrema ochrocrinitum* and *P. subcorallinum* both resemble *P. crinitum*. The first is endemic to Australia (Fig. F) and can be distinguished by the presence of a yellow-orange pigment (euplectin) in the lower medulla (Elix & Johnston 1988). *Parmotrema subcorallinum*, a scattered species known mainly in southeast Asia (Fig. G), differs in producing protocetraric acid rather than stictic acid (Kurokawa & Lai 2001, Chen et al. 2005). *Parmotrema ultralucens* is a cosmopolitan species (Fig. E) distinguished by the presence of atranorin in the cortex and lichexanthone and salazinic acid in the medulla (Krog 1974). *Parmotrema neosubcrinitum*, known only from Brazil (Fig. F), resembles *P. ultralucens* but differs in the medullar chemistry (Marcelli & Ribeiro 2002). *Parmotrema horridum*, a Brazilian endemic (Fig. E), resembles *P. mellissii* but differs in containing olivetoric acid in the medulla (Fleig 1999).

Parmotrema melanochaetum (Kurok.) O. Blanco et al. is a South American species (Fig. G) characterized by the presence of ciliate isidia and gyrophoric acid in the medulla, similar to *P. pseudocrinitum*. According to Hale & Kurokawa (1965) and Hale (1976) the upper cortex is strongly to rather distinctly white maculate and the rhizines are simple, which differs on the material found in



FIGS. E–G. Maps showing the world distribution of *P. pseudocrinitum* and related species.
E: *P. horridum*, *P. pseudocrinitum*, and *P. ultralucens*.
F: *P. mellissii*, *P. ochrocrinitum*, and *P. neosubcrinitum*.
G: *P. crinitum*, *P. subcorallinum*, and *P. melanochaetum*.

Argentina. In the specimens studied, Only one specimen studied has a slightly maculate upper cortex and the rhizines are simple to irregularly branched. Due to these differences, we identify our material as *P. pseudocrinitum*. Nonetheless, a thorough revision of the types of these species is needed.

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MYCOTAXON

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On the infraspecific variability and taxonomic position of *Entoloma zuccherellii*

Jan Holec[1]* & Machiel Evert Noordeloos[2]

*jan_holec@nm.cz

[1]*National Museum, Mycological Department*
Václavské nám. 68, Prague 1, CZ 115 79, Czech Republic

[2]*Netherlands Centre for Biodiversity Naturalis, section NHN*
P. O. Box 9514, 2300 RA Leiden, The Netherlands

Abstract — A recent find of the enigmatic and extremely rare fungus *Entoloma zuccherellii* in the Czech Republic has given more insight in the infraspecific variation of that species. A detailed description of this find and comparison with Italian and Spanish finds are provided. The taxonomic and phylogenetic position of *E. zuccherellii* is discussed.

Key words — *Entolomataceae*, *Rhodocybe*, Czech Republic, spores

Introduction

In 2007 and 2008, the first author carried out a mycological research of Central Bohemia, a region around Prague, Czech Republic (Holec 2009). In 2007, special attention was focused on Kokořínsko Protected Landscape Area, a sandstone region 40 km NNE of Prague. In the Kokořínský důl Nature Reserve, an interesting lignicolous fungus resembling a small *Entoloma* species with a bluish-brown stipe was found. The first author was unable to identify it using the newest *Entoloma* monograph (Noordeloos 2004). A revision done by the second author showed that it was conspecific with *Rhodocybe zuccherellii* (Noordeloos & Hausknecht 2000), recently transferred to the genus *Entoloma* (Co-David et al. 2009). Records of this species are rare, and it was known previously only from the type locality in Italy and a second collection from Spain (Vila & Caballero 2009). Therefore the Czech find is published here in detail.

Material and methods

The first author microscopically examined material mounted in a 5% KOH solution using an Olympus BH-2 microscope, except for pileus and stipe cuticle pigments, which were observed in pure water. Spore measurements were determined from 20 randomly selected mature, fully developed spores. Microcharacters were drawn at a magnification of 1250 × using a drawing tube. Descriptive terminology follows Bas et al. (1988). Colour terms are English translations of the original field description written in Czech. For colour codes see Kornerup & Wanscher (1981). The collection studied is kept in the herbarium PRM (National Museum, Mycological Department, Prague, Czech Republic). Abbreviations: L = number of lamellae reaching up to the stipe, l = number of lamellulae between each pair of two lamellae, Q = quotient of length and width of the spores, Qav = mean value of Q in the collection studied.

Taxonomy

Entoloma zuccherellii (Noordel. & Hauskn.) Co-David & Noordel.,
Persoonia 23: 175, 2009. PLATES 1–3
≡ *Rhodocybe zuccherellii* Noordel. & Hauskn., Bollettino del Gruppo Micologico G. Bresadola, n.s. 43(3): 29, 2000.

MACROCHARACTERS (based on 3 basidiocarps found; 1 young, 2 mature) — PILEUS 4–10 mm, hemispherical with inflexed margin and flattened upper part, mat, slightly hygrophanous, margin indistinctly translucently striate, whole surface scarcely and finely white fibrillose-pruinose, dark brown when young and moist (5F4-6), then dark brown at centre and brown (5E5-6) to ochre-brown (5D6-7) towards margin, margin remaining dark brown when moist; LAMELLAE sparse, L = 13–20, l = 1–3, segmentiform, adnate when young, then emarginate, greyish brown-beige (4C3-4) when young, then pale yellowish beige (3A-B3), with concolorous, eroded edge; STIPE 7–15 × 1.5–2.5 mm, cylindrical or slightly broadened towards base, ground colour dark grey-brown (6F2-3) to grey-brown (6E3-4) with a slight steel blue tinge, whitish pruinose when young, then whitish fibrillose to finely fibrillose-scaly at apex, base whitish tomentose; TASTE and SMELL not recorded.

MICROCHARACTERS — BASIDIOSPORES (5.6)6.0–7.6(8.0) × (5.2)5.6–6.4(6.8) µm, average size 6.9 × 6.0 µm, Q = 1.06–1.29, Qav = 1.16, variable in size and shape, general shape subglobose to almost globose, rarely broadly ellipsoid, many-angled when fully mature, angles indistinct, usually with one big oil droplet, wall slightly thickened, large number of immature or poorly developed spores present (without angles, of deviating shape, without content, such spores were not measured); BASIDIA 27–32 × 7.0–9.5 µm, larger on lamellae edge, up to 37 × 10 µm, 4-spored, narrowly clavate to clavate, with slight median constriction, content granular; BASIDIOLES 16–27 × 7–8 µm, narrowly clavate to clavate, hyaline; LAMELLAE EDGE fertile, rarely with protruding clavate cells which are slightly larger than basidia, about 40 × 9–15 µm, with granular

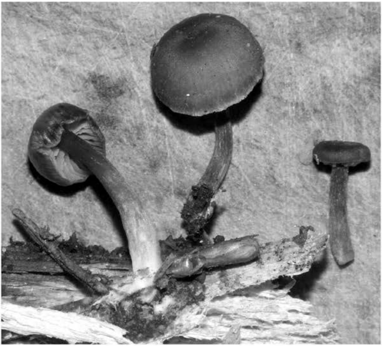

PLATE 1. *Entoloma zuccherellii*, Czech Republic, Kokořínský důl Nat. Reserve (PRM 909361). Photo J. Holec. Colour photo: http://www.nm.cz/english/departments/mycology-gallery.php

content; LAMELLAR TRAMA regular, cells long and cylindrical or shorter and slightly inflated, 4–22 µm broad, hyaline, wall with yellow membrane pigment; PILEIPELLIS a cutis of densely arranged parallel hyphae 4–15(19) µm broad, made up of long and cylindrical or shorter and fusiform to barrel-shaped elements (sometimes with a median constriction), terminal elements 12–20 µm broad, barrel-shaped, clavate, rarely with a mucronate projection, the cuticle is pale brown in mass, elements are hyaline („empty") with pale yellow membrane pigment as well as a rather pale, granulose intracellular pigment, pileocystidia absent; STIPITIPELLIS a cutis of densely arranged parallel hyphae 4–16 µm broad, made up of cylindrical to narrowly fusiform elements, with yellow membrane pigment and fine yellow-brown incrustations when observed in pure water, the cuticle is scarcely covered with narrow (5–7 µm) outgrowths or ascending terminal parts of narrower hyphae of the cutis, caulocystidia absent; CLAMP CONNECTIONS absent in all tissues.

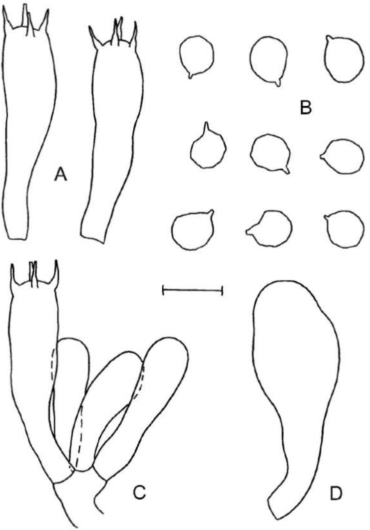

Plate 2. *Entoloma zuccherellii*, microcharacters (PRM 909361).
A: basidia, B: basidiospores, C: basidium and basidiolae,
D: protruding clavate cell on lamella edge.
Bar = 10 µm. Drawing by J. Holec.

MATERIAL STUDIED — CZECH REPUBLIC. CENTRAL BOHEMIA, Kokořínsko Protected Landscape Area, ca. 1 km NEE of the village of Kokořín near the town of Mšeno, KOKOŘÍNSKÝ DŮL NATURE RESERVE: trail along Pšovka stream, alt. 250 m, man-influenced mixed forest on E slope among sandstone rocks (*Fagus sylvatica, Picea abies, Quercus* sp., *Pinus sylvestris*), on decaying coniferous wood (*Picea*?), 19.X.2007 leg. T. Zíbar, det. M.E. Noordeloos (PRM 909361).

Discussion

The Czech collection is in good agreement with the type of *Entoloma zuccherellii* (Noordeloos & Hausknecht 2000) from Italy (Ravenna, Pineta di Classe), both in general appearance and in diagnostic characters such as the lignicolous habit, bluish tinges in the stipe, and (in particular) the small, weakly angled spores. The Czech material deviates slightly in the following characters: lamellae without violet tinge, emarginate at maturity; stipe with less distinct blue or violet tinge; spores slightly larger and slightly more prolonged (in holotype they measure 6.0–6.5 × 5.5–6.0 µm, Q = 1.0–1.2; Qav = 1.1); lamellar edges with scattered protruding clavate cells that do not, however, represent true cheilocystidia; and pileus cuticle of wider hyphae. However, the differences are subtle and seem to demonstrate infraspecific variability.

The collection described from Spain (Vila & Caballero 2009) possesses the most distinct blue-violet tinge among the three collections discussed. The blue-violet tinge is very distinct on the stipe and readily visible even on the pileus surface. However, intraspecific variability with regard to the expression of blue and/or violaceous tinges is a well-known phenomenon within *Entoloma*. Similar species (e.g., *Entoloma vinaceum* (Scop.) Arnolds & Noordel. and the closely related North American species *E. trachyosporum* Largent) have varieties based on the presence or absence of blue-violaceous tinges (Arnolds & Noordeloos 1980, Largent 1994, Noordeloos 2004). The photograph published by Vila & Caballero (2009: fig. 8) shows young and fresh basidiocarps where the blue-violet pigments are very pronounced. In other characters the Spanish collections are very similar to the Czech one (including the presence of cells resembling cheilocystidia).

Concerning the ecology, two records are from the coniferous wood (Italy: *Pinus*, Czech Republic: *Picea*?) and one is from the wood of *Alnus glutinosa* (Spain).

Based on all three collections, *E. zuccherellii* can be characterised as follows: small fungus (pileus up to 17 mm), pileus violet-grey (when fresh and young) or grey- to dark brown with a white pruinose-fibrillose surface, lamellae with bluish or violet tinges when young, stipe tinged blue-violet (stable characters seen in all published collections) with a white fibrillose surface, spores measuring 5.6–7.0(8.0) × 5.2–6.4(6.8) µm (Q = 1.0–1.3, Qav = 1.13) and globose to subglobose and indistinctly angular, distinct cheilocystidia

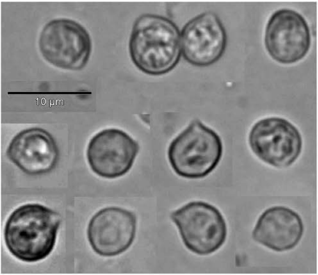

PLATE 3. *Entoloma zuccherellii*, variability of basidiospore shape (PRM 909361). Bar = 10 µm. Photo by M.E. Noordeloos.

absent, lacking clamp connections, and growing on wood of coniferous and broadleaved trees.

Entoloma pluteisimilis Noordel. & C.E. Hermos., which is microscopically very similar, differs mainly by the lack of blue or violaceous tinges in the basidiocarps. Both *E. zuccherellii* and *E. pluteisimilis* have small, very thin-walled, many-angled spores that resemble those of *Rhodocybe* when observed in the light microscope, which was the main reason that *E. zuccherellii* was published as a new species in *Rhodocybe* (Noordeloos & Hausknecht 2000). SEM studies by Dorien Langeveld (MSc student in Leiden), however, showed that within *Entoloma* a whole gradient can be found from the well-known relatively thick-walled and distinctly angular spores to the thin-walled spores with complete and incomplete facets as well as bumps, similar to those found in true *Rhodocybe* species (Co-David et al. 2009). *Entoloma zuccherellii* and *E. pluteisimilis* both have spores at the bottom end of this range with irregular rugulose surfaces and a few indistinct ribs.

The three-gene molecular phylogeny by Co-David et al. (2009) placed both species in a monophyletic clade within *Entoloma* and distant from *Rhodocybe*, supporting their transfer of *R. zuccherellii* to *Entoloma*. The description of *Entoloma lignicola* Largent, which shares similar small, thin-walled spores and a lignicolous habit (Largent 1989), suggests that it also belongs in the same clade.

Acknowledgements

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Contribution to the study of gasteroid and secotioid fungi of Chihuahua, Mexico

Gabriel Moreno[1*], Marcos Lizárraga[2], Martín Esqueda[3] & Martha L. Coronado[4]

*gabriel.moreno@uah.es

[1]*Dpto. de Biología Vegetal, Facultad de Biología, Universidad de Alcalá Alcalá de Henares, Madrid 28871, Spain*

[2]*Dpto. de Ciencias Básicas, Instituto de Ciencias Biomédicas Universidad Autónoma de Ciudad Juárez Anillo Envolvente Pronaf y Estocolmo s/n, Cd. Juárez, Chihuahua 32300, México*

[3]*Centro de Investigación en Alimentación y Desarrollo, A.C. Apartado Postal 1735, Hermosillo, Sonora 83000, México*

[4]*Centro de Estudios Superiores del Estado de Sonora Apartado postal 11, Admón. 11, Hermosillo, Sonora 83000, México*

Abstract — Including the twenty-seven new records reported herein, fifty-seven taxa of gasteroid fungi are now known from Chihuahua. *Geastrum schmidelii* var. *parvisporum* represents a new record for the Mexican mycobiota. A nom. nov. is proposed for *Agaricus texensis*, which is an illegitimate later homonym. The species presented are annotated with observations on macro- and microscopic characters, and SEM photomicrographs illustrating spore and capillitial characters are included for selected taxa.

Key words — *Agaricomycetes*, *Gasteromycetes* sensu lato, chorology, taxonomy

Introduction

Chihuahua, the largest state in Mexico, is located in the north and bordered by the Mexican states of Sonora to the west, Durango to the south, and Coahuila to the east and by the U.S. states of Texas and New Mexico to the north. The predominant vegetation types found in the state are coniferous forest, oak forest, grassland, xerophytic scrub, and tropical deciduous forest (Rzedowsky 1978). Prior to this study, thirty-one gasteroid taxa had previously been reported from Chihuahua. Initial records for the state are contained in the publications that follow.

Guzmán & Herrera (1973): *Arachnion album* Schwein., *Battarreoides diguetii*, *Bovista pusilla* (Batsch) Pers., *Cyathus montagnei* Tul. & C. Tul., *Lycoperdon* *marginatum* (as *L. candidum*), *Melanogaster umbrinigleba* Trappe & Guzmán, *Phallus impudicus* L., *Pisolithus arhizus* (as *P. tinctorius*), and *Scleroderma cepa*.

Pérez-Silva & Aguirre-Acosta (1986): *Agaricus aridicola* Geml et al. (as *Gyrophragmium dunalii*), *Calvatia cyathiformis* (Bosc) Morgan, *C. gigantea* (Batsch) Lloyd, *Crucibulum laeve* (as *C. vulgare*), *Cyathus olla* (Batsch) Pers., *Lycoperdon echinatum* Pers., *L. perlatum*, *L. umbrinum* Pers., *Melanogaster nauseosus* Coker & Couch, *Scleroderma verrucosum*, *Simblum texense* (G.F. Atk. & Long) Long, and *Tulostoma wrightii* Berk.

Laferriére & Gilbertson (1992): *Astraeus hygrometricus*, *Cyathus stercoreus*, *Disciseda hyalothrix* (as *D. pedicellata*), *Geastrum saccatum*, *G. triplex*, *Lycoperdon oblongisporum* Berk. & M.A. Curtis, *L. pyriforme*, and *Mycenastrum corium*.

Moreno-Fuentes et al. (1994): *Lycoperdon peckii* Morgan.

Quiñónez-Martínez et al. (1999): *Scleroderma areolatum*.

Materials and methods

Material for study was primarily collected by students of the Universidad Autónoma de Ciudad Juárez; however, one of us (ML) contributed several collections. The specimens are deposited in the Herbarium of the "Departamento de Ciencias Básicas, Universidad Autónoma de Ciudad Juárez" (cited here as UACJ; Mexico) and the Herbarium of the "Departamento de Biología Vegetal, Universidad de Alcalá, Madrid" (AH; Spain)

Microscopic characters (e.g., spore dimension, which includes ornamentation) were observed under the light microscope (Nikon Eclipse 80i) on material mounted in Hoyer's medium. Ultrastructural studies (e.g., spore ornamentation details) under the scanning electron microscope (SEM) were conducted on the specimens housed in Spain (AH). Samples were prepared according to the critical-point-drying method outlined in Moreno et al. (1995) and examined on a Zeiss DSM-950. Detailed descriptions, for the most part, are given only for species that represent new records for the state of Chihuahua.

Taxonomy

Agaricus deserticola G. Moreno, Esqueda & Lizárraga **nom. nov.**

MycoBank MB 516712

≡ *Secotium texense* Berk. & M.A. Curtis, Grevillea 2: 34 (1873)

≡ *Gyrophragmium texense* (Berk. & M.A. Curtis) Massee, Grevillea 19: 96 (1891)

≡ *Longia texensis* (Berk. & M.A. Curtis) Zeller, Mycologia 35: 414 (1943)

≡ *Longula texensis* (Berk. & M.A. Curtis) Zeller, Mycologia 37: 636 (1945)

≡ *Agaricus texensis* (Berk. & M.A. Curtis) Geml, Geiser & Royse, Mycol. Progr. 3: 172 (2004), nom. illegit., non *A. texensis* Berk. & M.A. Curtis (1853)

Specimens examined — **MEXICO. Chihuahua: Municipality of Juárez**, Nuevo Relleno Sanitario, leg. R. Rivas, 2.VI.1996, *UACJ 1128* in *AH 38925*. Samalayuca, growing on sandy soil, leg. A. Gatica, 1.IV.2000, *UACJ 1129*. Parque El Chamizal, growing on soil, leg. H.A. Peña, 13.III.2001, *UACJ 1134* in *AH 38926*. Samalayuca, Rancho Zorro Plateado, growing on sandy soil, leg. F. Garcia & F. Piñera, 20.IV.2003, *UACJ 1127*. **Municipality of Ahumada**, Villa Ahumada, Rancho Santa Mónica, growing on sandy soil among *Poaceae* grasses, leg. J. Piñera, A. Fernández, M. Méndez, R. Castellanos & F. García, 1.III.2003, *UACJ 1132*. **Municipality of Chihuahua**, Rancho El Capricho, associated with *Ephedra* sp., leg. F. García A. Rodríguez, E. Orozco & A. Fernández, 30.IV.2003, *UACJ 1133*. **Municipality of Juárez**, Ciudad Juárez, urban zone next to Instituto Tecnológico de Cd. Juárez, associated with *Washingtonia filifera* (Linden ex André) H. Wendl., leg. M. Lizárraga & S. Escobar, 15.V.2006, *UACJ 1130*.

Observations — This species is characterized by a broadly globose 7–12 cm tall basidiome with a 2–4 × 6.5–9 cm pileus, peridial remains that typically form a membranous double annulus, a striate 6.5–8 × 2–4 cm stalk that extends as a percurrent columella through the pileus, and which lacks a volva. The basidiospores are 6–8 × 5–6 µm, subglobose to ovoid, smooth, very dark, and lack a germ pore.

Macro- and micro-morphological studies have been made previously on Mexican material from Baja California (Ochoa & Moreno 2006) and Sonora (Moreno et al. 2007). Molecular phylogenetic analyses support this secotioid fungus in *Agaricus*, a genus previously restricted to agaricoid forms (Geml et al. 2004). This is the first report of this taxon from Chihuahua.

Astraeus hygrometricus (Pers.) Morgan, J. Cincinnati Soc. Nat. Hist. 12: 20 (1889)

Specimens examined — **MEXICO. Chihuahua: Municipality of Ocampo**, Basaseachi, in pine-oak wood, leg. M. Lizárraga, 12.VIII.2001, *UACJ 1146* in *AH 37847*.

Observations — A capillitium that is hyaline, septate and with clamp connections and spores that are globose, 8–12(–13) µm in diam., and with pronounced verrucae characterize *A. hygrometricus*. Molecular studies (Phosri et al. 2007) support several species within *Astraeus*.

These include *A. odoratus* Phosri, M.P. Martín & Watling (Phosri et al. 2004) and *A. asiaticus* Phosri et al. (Phosri et al. 2007), which have been described from Asia, as well as *A. pteridis* (Shear) Zeller (= *Geastrum hygrometricum* var. *giganteum* Lloyd) that has previously been reported from Mexico (Phosri et al. 2007). Although the true identity of *A. hygrometricus* is not fully resolved (see Phosri et al. 2007), macro- and microscopic characters of the Chihuahuan material agree with those previously described under *A. hygrometricus* from Baja California (Ochoa & Moreno 2006). Several previous reports of "*A. hygrometricus*" have been made from Chihuahua (Laferriére & Gilbertson 1992; Quiñónez-Martínez et al. 1999, 2005; Quiñónez-Martínez & Garza-Ocañas 2003).

Battarrea phalloides (Dicks.) Pers., Syn. Meth. Fung. (Göttingen) 1: 129 (1801)
= *Battarrea stevenii* (Libosch.) Fr., Syst. Mycol. 3: 7 (1829)

Specimens examined — **MEXICO. Chihuahua: Municipality of Ascensión,** Ejido Pancho Villa, among litter under *Prosopis* sp., leg. A. Gatica, 14.V.2000, *UACJ 1160*. **Municipality of Casas Grandes,** Casas Grandes, leg. M. Andrew, 19.VIII.2001, *UACJ 1147*. Ibidem, 18.V.2002, *UACJ 1148*.

Observations — This species is characterized by a 20–42 cm tall basidiome with a spore sac that is 1–2 × 4–8 cm, subglobose-depressed and dehisces when mature by a circumscissile opening, a brown-ferruginous gleba, a 18–40 × 1–2 cm, woody, fibrous stipe, and a free, fragile, sac-shaped volva that measures up to 6 × 4 cm. Spores are 5–6 × 4–6 µm, globose to subglobose, verruculose, ochraceous and elaters are 3.5–7 µm in diam., very variable in length, spiralled, pale yellow, aseptate, and unbranched.

This species is highly variable in size and grows mainly in xerophytic areas. Macro- and microscopic characters agree with the description given by Moreno et al. (1995), which was based on collections from Baja California. This is the first report for this species from Chihuahua.

Battarreoides diguetii (Pat. & Har.) R. Heim & T. Herrera, An. Inst. Biol. Univ. Mex. 32: 30 (1962, "1961")

Specimens examined — **MEXICO. Chihuahua: Municipality of Ahumada,** Villa Ahumada, Rancho Santa Mónica, on sandy soil next to *Larrea tridentata* Coville and *Opuntia* sp., leg. F. García, A. Fernández, M. Méndez, E. Orozco & A. Fernández, 1.III.2003, *UACJ 1149*. Sierra Peñascos, leg. M. Vargas & M. Astorga, 15.IV.2006, *UACJ 1151*. **Municipality of Juárez,** Samalayuca, next to *Larrea tridentata*, leg. A. Gatica & J. Córdova, 24.V.2003, *UACJ 1150*.

Observations — This species is characterized by its 14–20 cm tall basidiome and spore sac that is 3–6 × 2.5–4 cm, subglobose-depressed, and dehisces at maturity through several pores all over the spore sac surface. Gleba brown-ferruginous. Stipe 13–19 × 1–1.3 cm, woody, fibrous. Volva up to 1.2 × 1 cm, sac-shaped, free, fragile. Spores 4–5 µm, globose to subglobose, verruculose, ochraceous. Elaters 2–7 µm in diam., length very variable, spiralled, pale yellow, aseptate and not branched.

A macro- and microscopical study of this monospecific genus including SEM photographs was made by Moreno et al. (1995). *Battarreoides diguetii* was previously reported for Chihuahua by Guzmán & Herrera (1973) and Pérez-Silva & Aguirre-Acosta (1986).

Bovista aestivalis (Bonord.) Demoulin, Beih. Sydowia 8: 143 (1979)
≡ *Lycoperdon aestivale* Bonord., Handb. Allgem. mykol.: 251 (1851)
= *Lycoperdon polymorphum* Vittad., Monograph Lyc.: 39 (1842), nom. illegit., non *L. polymorphum* Scop. (1772)

Specimens examined — **MEXICO. Chihuahua: Municipality of Guachohi**, Cusarare, in pine-oak wood, leg. C. Mass & V. Manriquez, 12.VIII.2001, *AH 37830*. **Municipality of Bocoyna**, San Juanito, next to *Pinus* sp., leg. M.C. Natividad, B. Marín & M. Ángeles, 11.VIII.2001, *AH 37831*. **Municipality of Madera**, Presa Las Peñitas, in pine wood, leg. J. Vargas & J.M. Muñoz, 22.VIII.2003, *AH 37828*. **Municipality of Chihuahua**, Cumbres de Májalca, growing amid leafy debris under *Cupressus* sp. and *Quercus* sp., leg. M. Lizárraga, 15.XI.2003, *AH 37829, AH 37832*.

Observations — Macroscopically, this species is characterized by a granulose to spinulose exoperidium that sloughs off easily and a conspicuous mycelial cord that persists at the base. Microscopically, *B. aestivalis* exhibits a capillitium of the intermediate-type, having yellowish, straight (rarely undulate), fragile, thick-walled capillitial threads (4–6 µm in diam.) with numerous large (up to 1 µm in diam.) pits. The spores of *B. aestivalis* are smooth to verruculose (under LM) and globose (4–5 µm in diam.).

A study of this species including SEM micrographs was made by Ochoa & Moreno (2006) based on collections from Baja California. Molecular studies (Larsson & Jeppson 2008, Bates et al. 2009, Larsson et al. 2009) confirmed the identity of this species and its taxonomic position within the genus *Bovista* Pers. This is the first report of *B. aestivalis* from Chihuahua.

Bovista fusca Lév., Ann. Sci. Nat., Bot., Sér. 3, 5: 303 (1846) Figs. 1–3

= *Bovista ruizii* T. Herrera, Ann. Inst. Biol. Univ. Mexico 30: 35 (1960, "1959")

Specimens examined — **MEXICO. Chihuahua: Municipality of Guachochi**, Cusarare, leg. F. Piñera & R. Castellanos, 10.IV.2003, in pine-oak wood, *UACJ 1121* in *AH 37837*.

Observations — A single mature, globose (2.5 cm in diam.) basidiome was collected that exhibited an irregular, apical ostiole. Its exoperidium was absent, and the endoperidium was membranous, smooth, dark reddish-brown. Microscopically, the specimen exhibited reddish-brown capillitium of the *Bovista*-type with thick-walled (8–17 µm in diam.), highly branched capillitial threads with long tapering tips. The spores were ovoid to subglobose (4.5–5.5 × 3.5–4.5 µm), smooth to minutely ornamented (under LM), with hyaline, more-or-less truncate, pedicels (8–16.5 µm long). Under SEM the spores exhibited abundant, truncate verrucae that were variable in size, irregularly distributed, and occasionally joined apically to form short ridges.

The macro- and microscopic characters of our specimen agree with those given in the protologue of *Bovista ruizii* (Herrera 1960), a species described from Mexico that was later synonymized with *B. fusca* (Kreisel 1967). *Bovista fusca* is similar to *B. nigrescens* Pers., described from Europe and Asia; however that species has globose to subglobose spores (4.2–6 µm in diam.) and shorter (4–9 µm in length) pedicels (Kreisel 1967). Reports of *B. nigrescens* from Mexico

(Calonge et al. 2004) were later corrected to *B. fusca* (Calonge et al. 2005). This is the first report of *Bovista fusca* from Chihuahua.

Calvatia fragilis (Vittad.) Morgan, J. Cincinnati Soc. Nat. Hist. 12: 168 (1890)

FIGS. 4–6

SPECIMENS EXAMINED — **MEXICO. CHIHUAHUA: Municipality of Janos**, 4.3 KM TO SOUTHWEST OF RANCHO LA GARRAPATA WAY, SIERRA DE EN MEDIO, leg. M. Lizárraga, 1.X.2005, *UACJ 1154* in *AH 37840*.

OBSERVATIONS — The single collection made consisted of weathered specimens with small subgleba as well as lilac toned endoperidia and glebal remnants. Microscopically, the specimens exhibited ochraceous-yellowish, septate, fragile capillitial threads (2–5 µm in diam.) with numerous small pores. The spores were ochraceous, globose (5–7 µm in diam.), and spinulose, with ornamentation consisting of irregular to coralloid-shaped spines. Under SEM, occasional short, thin ridges that join the spines at their bases can be observed.

The closely related *Calvatia cyathiformis* can be distinguished from *C. fragilis* by its well-developed cellular subgleba with violaceous tones. Detailed descriptions have been made of *C. fragilis* collections from nearby areas, such as Baja California (Ochoa & Moreno 2006) and Arizona, USA (Bates et al. 2009). Previous reports of *Calvatia cyathiformis* from Chihuahua exist (Pérez-Silva & Aguirre-Acosta 1986, Laferriére & Gilbertson 1992). Some authors synonymize these species; however, both are valid species. *Calvatia fragilis* is reported here for the first time for Chihuahua.

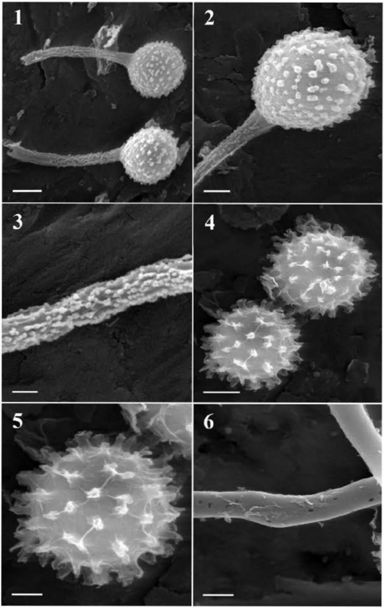
Crucibulum laeve (Huds.) Kambly, Gast. Iowa: 167 (1936)

SPECIMENS EXAMINED — **MEXICO. CHIHUAHUA: Municipality of Bocoyna**, SAN JUANITO, on cow dung, leg. M. Vargas & M, Andrew, 11.VIII.2001, *UACJ 1125*. **Municipality of Chihuahua**, CUMBRES DE MAJALCA, on decayed wood of *Quercus* sp., leg. M. Lizárraga & G. Márquez, 15.XI.2003, *UACJ 1124*.

OBSERVATIONS — This species is clearly characterized by its sessile, cyathiform, 3–7 × 5–8 mm basidiome that, when young, is covered by an orange yellowish tomentum that is lost at maturity. Peridioles are numerous, lenticular, 3–6 × 1–2 mm, and whitish with a funiculus while basidiospores are 7–9 × 4–6 µm, ellipsoid, hyaline, and smooth.

This cosmopolitan species was previously cited from Chihuahua by Pérez-Silva & Aguirre-Acosta (1986), Laferriére & Gilbertson (1992), and Quiñónez-Martínez et al. (1999).

FIGS. 1–3: *Bovista fusca* AH 37837. 1. Spores. 2. Spore ornamentation detail. 3. Spore pedicel ornamentation detail. FIGS. 4–6: *Calvatia fragilis* AH 37840. 4. Spores. 5. Spore ornamentation detail. 6. Pitted capillitium. Scale bar 1, 4, 6 = 2 µm; 2, 5 = 1 µm; 3 = 0.5 µm.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Cyathus stercoreus (Schwein.) De Toni, Syll. Fung. (Abellini) 7: 40 (1888)

SPECIMENS EXAMINED — **MEXICO. CHIHUAHUA: Municipality of Bocoyna**, SAN JUANITO, on cow dung, leg. M. Lizárraga, 11.VI.2001, *UACJ 1123* in *AH 37842*.

OBSERVATIONS — Basidiomes abundant on dung, morphology variable, in general conical and with a basal zone or with a conspicuous pedicel; exoperidium hairy and shaggy when young but becoming smooth, yellowish brown to brown with age. Endoperidium smooth, dark gray. Peridiole black, 1.5–3 mm in diam., double-walled and without a tunica, with a whitish funiculus. Spores of 22–28(–30) × 18–25(–28) µm, globose to subglobose or broadly ellipsoid, subhyaline, thick-walled up to 3 µm.

Cyathus pictus H.J. Brodie, which has large spores similar to those of *C. stercoreus*, grows on decayed *Eucalyptus* wood. *Cyathus pictus* is known only from Mexico, while *C. stercoreus* has a worldwide distribution (Brodie 1975). Laferriére & Gilbertson (1992) and Quiñónez-Martínez et al. (1999) previously reported *C. stercoreus* from Chihuahua.

Disciseda candida (Schwein.) Lloyd, Mycol. Writ. 1: 100 (1902)

SPECIMENS EXAMINED — **MEXICO. CHIHUAHUA: Municipality of Juárez**, KM 30 CIUDAD JUÁREZ TO CASAS GRANDES ROAD, next to *Prosopis glandulosa* Torr. and *Larrea tridentata*, leg. J. Carrasco, 20.X.2006, *UACJ 1155* in *AH 37815*

OBSERVATIONS — One basidiome was studied: subglobose, endoperidium light gray, fibrillose ostiole, spores globose to subglobose, 4–5 µm in diam., asperate to verruculose. Capillitium 3–4 µm in diam., hyaline, yellowish, with septa and pores.

Ochoa & Moreno (2006) published a morphological study (including SEM photos of the ornamented spores) of this species based on collections from Baja California. This is the first report of *D. candida* for Chihuahua.

Disciseda hyalothrix (Cooke & Massee) Hollós, Növ. Közl. 1: 107 (1902)
= *Disciseda pedicellata* (Morgan) Hollós, Term. Füz. 25: 103 (1902)

SPECIMENS EXAMINED — **MEXICO. CHIHUAHUA: Municipality of Juárez**, KM 10 TO SAN JERÓNIMO, on sandy and calcareous soil, leg. R. Martínez-Contreras, 23.III.2002, *UACJ 1082* in *AH 37816*.

OBSERVATIONS — In Mexico, *D. hyalothrix* has previously been reported from arid zones in Baja California (Ochoa & Moreno 2006) and Sonora (Moreno et al. 2007). It is characterized by large, strongly ornamented spores [(6–) 7–8 µm in diam.] with episporial spines that are apically fused and form flat tipped processes that are easily observed under phase contrast microscopy or (more clearly) under SEM.

The spores consistently exhibit pedicels that vary in length as the fungus matures; however, climatic conditions may also play a role in the variation observed. The Chihuahuan spores typically have pedicels that are approximately 2 µm long, although longer (≤ 4 µm) pedicels were also observed. Comparison of the type specimens of *Disciseda hyalothrix* and *D. pedicellata* by Moreno et al. (2003) concluded that these species are conspecific.

Laferriére & Gilbertson (1992) were the first to report *D. hyalothrix* from Chihuahua.

Disciseda verrucosa G. Cunn., Trans. & Proc. New Zealand Inst. 57: 205 (1926)
= *Disciseda arida* Velen., Novit. Mycol.: 169 (1939).

Specimens examined — MEXICO. **Chihuahua: Municipality of Juárez,** Dunas de Samalayuca, on sandy soil, leg. A, Gatica, 31.III.2000, *UACJ 1081* in *AH 37822*. **Municipality of Janos,** Km 100 Janos to Agua Prieta road, next to *Acacia* sp., leg. M. Lizárraga, 17.VIII.2008, *UACJ 1170* in *AH 37821*.

Observations — This species is clearly characterized by its 9–10 µm broad spores that are conspicuously ornamented with obtuse finger-like processes, typically curved at their apices (Pérez-Silva et al. 2000, Moreno et al. 2007).

This is the first report of *D. verrucosa* from Chihuahua. Bates et al. (2009) report this species from Arizona, but most North American records of are from Mexico (Sonora).

Geastrum fornicatum (Huds.) Hook., Curtis Fl. Londin. 4: 575 (1821)

Specimens examined — MEXICO. **Chihuahua: Municipality of Juárez,** Ciudad Juárez to Chihuahua road, under *Acacia* sp., leg. L.A. Rivera, 24.IV.2007, *UACJ 1099* in *AH 37857*.

Observations — The single basidiome collected possessed four rays supporting the endoperidial body and lacked the exoperidial mycelial layer. The endoperidial body is globose with a narrowly conical, truncate, fibrillose peristome that is lighter than the endoperidium but not distinctly delimited. The spores are globose (4.5–5 µm in diam.) and ornamented with conspicuous verrucae.

Geastrum quadrifidum Pers. is another species with a fornicate gastrocarp; however, this species has a distinctly delimited peristome and larger spores (5.5–6.5 µm in diam.). *Geastrum leptospermum* G.F. Atk. & Coker is another closely related fornicate species that has smaller spores [(3–)3.5(–4) µm in diam.] that are less coarse than those of *G. fornicatum* (see Sunhede 1989). The also closely related *G. jurei* Lazo, described from a single basidiome collected in Chile, is differentiated by its non-delimited peristome that is noticeably lighter than the endoperidium (Lazo 1972). More new collections are needed to determine its taxonomic delimitation.

We report *G. fornicatum* from Chihuahua for the first time here.

Geastrum saccatum Fr., Syst. Mycol. 3: 16 (1829)

Specimens examined — **MEXICO. Chihuahua: Municipality of Ocampo**, Basaseachic, on litter in pine-oak wood, leg. C. Salazar & D. Mejia, 8.X.2004, *UACJ 1103* in *AH 37851*. **Municipality of Madera**, Presa Peñitas, on litter in pine-oak wood, leg. A. Santiesteban, M. León, J. Carrasco & L. Grimaldo, 15.IX.2007, *UACJ 1161* in *AH 37849* and *UACJ 1107* in *AH 37850*.

Observations — This species is characterized by basidiomes with sessile, globose endoperidial bodies with fibrillose, distinctly delimited, occasionally recessed peristomes, non-hygroscopic rays, and 4–6 µm broad spores with pronounced verrucae.

Laferriére & Gilbertson (1992) previously reported *Geastrum saccatum* from Chihuahua.

Geastrum schmidelii* var. *parvisporum G. Moreno, Altés & Dios, Micologia 2000 (Trento), Ass. Micol. Bresadola: 159 (2000) Figs. 7–9

Specimens examined — **MEXICO. Chihuahua: Municipality of Cusihuriachi**, San Bernabé, amid leafy debris of *Quercus* sp. and *Cupressus* sp., leg. E. Orozco, 12.IV.2003, *AH 37848*.

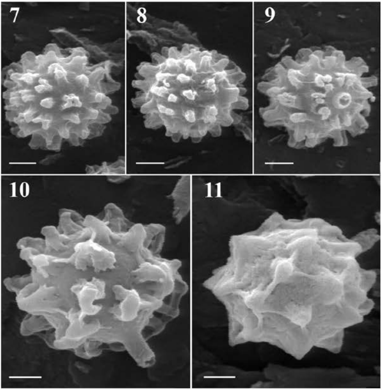
Observations — This species is characterized by non-hygroscopic rays, globose endoperidial bodies with short stalks that are covered with a fine pruinose layer, and recessed, plicate peristomes that are distinctly delimited by a rim. The 4.5–5(–5.5) µm broad spores possess dense, truncate verrucae.

The small spore size and other features observed in the Chihuahuan material agree with the description by Dios et al. (2000) of the same variety from Argentina (Dios et al. 2000). This taxon includes American material previously reported as *G. schmidelii* (Lloyd 1902, Coker & Couch 1928, Ponce de León 1946, Smith 1951) with spore dimensions that rarely exceed 5 µm in diam. However the spore dimensions cited for Arizonian material of *G. schmidelii* are (4.8–)5.6–6.4(–7.0) µm in diam., see Bates (2004). In contrast, European collections (*G. schmidelii* var. *schmidelii*) typically have larger spores [4.5–6.6 (–7) µm]. Under SEM, the spores exhibit long, slender, truncate verrucae, which are occasionally joined at their apices to form irregular-shaped ridges.

Geastrum schmidelii var. *parvisporum* is reported here for the first time from Mexico.

Geastrum triplex Jungh., Tijdschr. Nat. Gesch. Physiol. 7: 287 (1840)

Specimens examined — **MEXICO. Chihuahua: Municipality of Guachochi**, Cusarare, on litter of *Pinus* sp., leg. M. Lizárraga, 6.V.2000, *UACJ 1100* in *AH 37854*. **Municipality of Ocampo**, Basaseachic, on litter of *Pinus* sp., leg. M. Lizárraga, 12.VIII.2001, *UACJ 1098* in *AH 37853*. Ibidem, 8.X.2004, on leaf debris of *Quercus* sp., leg. E. Soto, N. Silva & M. Lizárraga, *UACJ 1101* in *AH 37856*. **Municipality of Bocoyna**, San Juanito, on litter in pine-oak wood, leg. C. Hernández-Ogaz, 15.IX.2006, *UACJ 1174* in *AH 37855*.



Figs. 7–9: *Geastrum schmidelii* var. *parvisporum* AH 37848. Spores. Figs. 10–11: *Lycoperdon atropurpureum* AH 37811. Spores. Scale bar 7–11 = 1 µm.

Observations — *Geastrum triplex* is characterized by its large size, non-hygroscopic rays, prominent pseudoparenchymatous collar, sessile endoperidial body that lacks an apophysis, and a distinctly delimited fibrillose peristome. Its 4–5 µm broad basidiospores possess dense, truncate verrucae.

This species is commonly found in Mexico (Calonge et al. 2004), and it was first reported for Chihuahua by Laferriére & Gilbertson (1992).

Geastrum xerophilum Long, Mycologia 34: 13 (1942)

= *Geaster pluriosteum* Long & Stouffer, Mycologia 40: 553 (1948)

Specimens examined — MEXICO. Chihuahua: **Municipality of Juárez**, Km 30 Ciudad Juárez to Casas Grandes road, in xerophytic area with *Larrea tridentata*, leg. J. Carrasco, 20.X.2006, *UACJ 1106* in *AH 37852*.

Observations — Basidiomes of *G. xerophilum* have subsessile, densely to minutely furfuraceous endoperidial bodies (1–2 cm in diam.) with short stipes, endoperidia that split into 6–7 rays (typically recurved at their tips and closely surrounding the endoperidial body at its base), a brownish gray gleba, and non-delimited, small, truncate, applanate to conical plicate peristomes that are concolorous with endoperidium. Microscopically, *G. xerophilum* exhibits glabrous, aseptate, unbranched capillitium (3–4 µm in diam.) that lack pores and globose, verrucose spores (4–5 µm in diam.) with dense, truncate verrucae.

This is the first report of *Geastrum xerophilum* from Chihuahua. It was previously reported in Mexico from the states of Morelos and Sonora (Pérez-Silva et al. 1999).

Lycoperdon atropurpureum Vittad., Monograph Lyc.: 42 (1842) Figs. 10–11

Specimens examined — **MEXICO. Chihuahua: Municipality of Bocoyna**, San Juanito, in pine wood, leg. H.A. Peña, 10.VIII.2001, *UACJ 1152* in *AH 37807*. Lago de Arareco, in pine-oak wood, leg. M. Andrew & M. Vargas, 11.VIII.2001, *UACJ 1153* in *AH 37808*. **Municipality of Guachochi**, Cusarare, in pine-oak wood, leg. C. Mass & V. Manriquez, 12.VIII.2001, *UACJ 1173* in *AH 37811*. **Municipality of Ocampo**, Basaseachic, in pine-oak wood, leg. E. Pedroza, 10.VIII.2002, *UACJ 1109* in *AH 37810*. **Municipality of Chihuahua**, Cumbres de Majalca, in cypress-oak wood, leg. M. Lizárraga, 15.XI.2003, *UACJ 1117* in *AH 37809*.

Observations — *Lycoperdon atropurpureum* is characterized by a gleba with purplish to violaceus tinges, an alveolate, well-developed subgleba, and exoperidia with well-formed, brown, slender, simple, fragile spines. Microscopically, the species exhibits a *Lycoperdon*-type capillitium of reddish brown, thick-walled capillitial threads with abundant, small pores and 4.5–6 µm broad, globose, coarsely verrucose basidiospores. Under the SEM, stout, conical spines can be observed on the spores.

Although Kreisel (1973), (Ortega et al. 1985), and Calonge (1998) regarded *L. decipiens* and *L. atropurpureum* as synonyms, Jeppson (1987) and Jeppson & Demoulin (1989) disagreed. Recent molecular studies have confirmed that the two species are distinct (Larsson & Jeppson 2008).

Although previous records of this taxon from Mexico exist (Calonge et al. 2004), it is reported here for the first time from Chihuahua.

Lycoperdon eximium Morgan, J. Cincinnati Soc. Nat. Hist. 14: 15 (1891)

Figs. 12–13

Specimens examined — **MEXICO. Chihuahua: Municipality of Ocampo**, Basaseachic, in pine wood, leg. M. Hernández, 22.VIII.2002, *UACJ 1108* in *AH 37859*.

Observations — Basidiomes pyriform, 3.5 cm high × 2.5 cm diam. Exoperidium comprising small, isolated verrucae and small, dark brown spines, occasionally joined apically with other spines. Endoperidium membranous, light brown. Gleba brown with lilaceous tones. Subgleba well-developed, 1.3 cm in length and 2 cm broad, cellular; cells up to 1 mm in diam. Capillitium of the *Lycoperdon*-type; capillitial threads 2–5 µm in diam., reddish brown, pitted. Spores 5–6 × 4–5 µm, ellipsoid, or rarely subglobose, smooth to verruculose, with a short pedicels. Spore ornamentation formed of abundant, dense verrucae, occasionally joined at their tips to form short ridges.

Our collection agrees well with the description of Coker & Couch (1928). This species is characterized by its cellular, well-developed subgleba, *Lycoperdon*-type capillitium, pored capillitial threads, and ellipsoid spores. *Lycoperdon eximium* is similar to *L. oblongisporum*, which Kreisel (1967) transferred to *Bovista* as *B. longispora* Kreisel, the epithet "*oblongispora*" having been used previously by Bottomley (1948) and thus not available. Although both *B. oblongispora* (Lloyd) Bottomley and *B. longispora* have ellipsoid spores, both species have very little to absent subgleba (Dennis 1953).

Previous records of *Lycoperdon eximium* from Valle de México exist (Herrera 1963); however, it is reported here for the first time from Chihuahua.

Lycoperdon lividum Pers., J. Bot. (Desvaux) 2: 18 (1809)

Specimens examined — **MEXICO. Chihuahua: Municipality of Bocoyna**, San Juanito, under *Pinus* sp., leg. M.C. Natividad, B. Marín & M.A. Samaniego, 11.VIII.2001, *UACJ 1115* in *AH 37858*.

Observations — Recognized by its pale brown, slightly granulose exoperidium; gleba greenish, subgleba alveolate, capillitium with abundant pores and 4.5–5.5 µm broad, rugose basidiospores.

Recently reported from the Mexican states of Baja California, Jalisco, Oaxaca, Tlaxcala, and Veracruz (Calonge et al. 2004), *L. lividum* is reported here for the first time from Chihuahua.

Lycoperdon marginatum Vittad. ex Moris & De Not., Fl. Caprar.: 226 (1839)

Specimens examined — **MEXICO. Chihuahua: Municipality of Bocoyna**, San Juanito, under *Pinus* sp., leg. M.C. Natividad, B. Marín & M.A. Samaniego, 11.VIII.2001, *AH 37819*. Ibidem, leg. A. Franco & J. Muñoz, 8.IX.2002, *UACJ 1113* in *AH 37820*.

Observations — *Lycoperdon marginatum* is principally recognized by its exoperidium with pyramidal verrucae (frequently composed 3–5 apically convergent spines) and that sloughs off the exoperidium in small plates as the fungus matures. This species is microscopically distinguished by verruculose spores that measure (3.2–)4.0–4.8(–5.6) µm in diam.

In their SEM examinations, Ochoa & Moreno 2006 observed no significant spore ornamentation differences in the Mexico and Spain collections. Laferriére & Gilbertson (1992) previously reported *L. marginatum* from Chihuahua.

Lycoperdon perlatum Pers., Observ. Mycol. (Lipsiae) 1: 4 (1796)

Specimens examined — **MEXICO. Chihuahua: Municipality of Ocampo**, Basaseachic, on litter in pine-oak wood, leg. J. Aguilar, 26.VIII.2002, *UACJ 1157* in *AH 37817*.

Observations — This species is easily recognized by its exoperidium of fragile, conical spines surrounded by a persistent, circular row of warts resembling a pearl necklace, a *Lycoperdon*-type capillitium with pores, and globose, 3.5–4.5 µm broad, verrucose spores.

Lycoperdon perlatum has been frequently cited in the Mexican mycobiota (Calonge et al. 2004). Reported from Chihuahua by Pérez-Silva & Aguirre-Acosta (1986), Quiñónez-Martínez et al. (1999, 2005), and Quiñónez-Martínez & Garza-Ocañas (2003).

Lycoperdon pyriforme Schaeff., Fung. Bavar. Palat. 4: 128 (1774)

= *Morganella pyriformis* (Schaeff.) Kreisel & D. Krüger, Mycotaxon 86: 175 (2003)

Specimens examined — **MEXICO. Chihuahua: Municipality of Ocampo**, Basaseachic, on decaying *Pinus* sp. wood, leg. M. Lizárraga & J. Vargas, 6.V.2000, *UACJ 1111* in *AH 37823*.

Observations — This species is recognized by its typically pyriform basidiomes with abundant, whitish, basal mycelial cords and its characteristic lignicolous habitat. The exoperidium is verruculose-granulose and spores are 3–4 µm in diam. and smooth to verruculose.

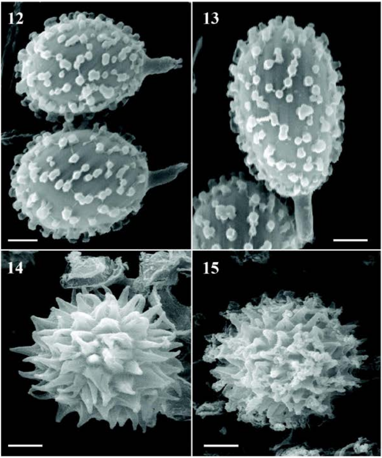
Krüger & Kreisel (2003) placed this species in *Morganella* Zeller (as *M. pyriformis*) based on molecular data. The molecular phylogenetic study of Larsson & Jeppson (2008), which included a broader sample of species in *Lycoperdaceae*, retains this species in *Lycoperdon*. Ochoa & Moreno (2006) studied spores of material from Baja California under SEM.

Lycoperdon pyriforme was first reported from Chihuahua by Laferriére & Gilbertson (1992).

Montagnea arenaria (DC.) Zeller, Mycologia 35: 418 (1943)

Specimens examined — **MEXICO. Chihuahua: Municipality of Juárez**, Km 10 Ciudad Juárez to Janos road, next to *Larrea tridentata*, leg. M. Lizárraga, 26.VIII.2000, *UACJ 1140*. Km 12 San Jerónimo to Cd. Juárez road, in sandy soil, leg. A. Franco & S. Escobar, 17.IX.2002, *UACJ 1141*. Samalayuca, Rancho El Zorro Plateado, leg. F. García & F. Piñera, 24.V.2003, *UACJ 1142* in *AH 37839*. Sierra de Juárez, in sandy soil, leg. A. Aguirre, 9.XII.2006, *UACJ 1138*. Sierra de Samalayuca, in sandy soil, leg. C. Salazar, 16.III.2007, *UACJ 1137*.

Observations — *Montagnea arenaria* is characterized by its pileus having an apical disc, radial gills, a hymenophore, and spores with a prominent germ pore.



Figs. 12–13: *Lycoperdon eximium* AH 37859. 12. Spores. 13. Spore ornamentation detail. Fig. 14: *Scleroderma areolatum* AH 37813. Spore. Fig. 15: *S. verrucosum* AH 37814. Spore. Scale bar 12–13 = 1 µm; 14–15 = 2 µm.

Hopple & Vilgalys (1999) studied the taxonomic position of *Montagnea* Fr.; their sequence analyses placed *M. arenaria* in the same clade as *Podaxis pistillaris* and members of *Coprinus* section *Comati* and the genus *Leucocoprinus*, thereby confirming the hypothesis of Singer (1986).

Spore sizes [(6–)7–8(–9) × (4–)5(–6) µm] in the collections studied here differ from those reported by Dios et al. (2001) based on Argentine collections (13–16 × 10–12 µm). This variation in spore size is frequently found among basidiomes in the same collection. Chen (1999) concluded in a study of the genus that "there is extraordinary variation in the size and shape of the fruiting bodies and spores of *Montagnea*" and indicated a wide spore size variation of 7–22 × 4.5–14 µm.

Although it is frequently observed in xerophytic areas of Chihuahua, this is the first published report of *Montagnea arenaria* for Chihuahua.

Mycenastrum corium (Guers.) Desv., Ann. Sci. Nat., Bot., Sér. 2, 17: 147 (1842)

Specimens examined — **MEXICO. Chihuahua: Municipality of Casas Grandes**, Casas Grandes, in grassland, leg. M. Andrew & M. Vargas, 19.VIII.2001. *UACJ 1144*. **Municipality of Juárez**, Ciudad Juarez, in Escuela de Veterinaria Inst. Ciencias Biomédicas, a garden, leg. S. Escobar & M. Lizárraga, 13.VI.2006, *UACJ 1145*.

Observations — Recognized by its thick peridium which stelliform splitting at apical portion, spores 8–12 µm in diam., reticulate and capillitium cyanophilous with numerous spinose projections. This taxon was first reported for Chihuahua by Laferriére & Gilbertson (1992).

Pisolithus arhizus (Scop.) Rauschert, Z. Pilzk. 25: 51 (1959)
= *Pisolithus tinctorius* (Pers.) Coker & Couch, Gast. East. U.S. Canada: 170 (1928)

Specimens examined — **MEXICO. Chihuahua: Municipality of Janos**, Presa Casa de Adobe, in riparian vegetation next to *Quercus* sp., leg. J. Martínez, S. Herrera & I. Márquez, 22.III.2001, *UACJ 1158*. **Municipality of Chihuahua**, Km 80 Namiquipa to Chihuahua way, next to *Quercus* sp., leg. S. Herrera, 28.VIII.2003, *UACJ 1159*. **Municipality of Madera**, Presa Peñitas, leg. M. Lizárraga, 23.VIII.2003, next to *Quercus* sp., *UACJ 1160*.

Observations — This taxon is recognized by its 9–13 µm broad, globose, spinulose basidiospores.

Pisolithus arhizus has been frequently reported for Mexico and is mainly associated with *Pinus* and *Quercus* (Calonge et al. 2004). It forms a complex comprising several taxa that are easily differentiated at the molecular level, but not morphologically.

Guzmán & Herrera (1973) previously reported *P. arhizus* from Chihuahua.

Podaxis pistillaris (L.) Fr., Syst. Mycol. 3: 63 (1829)

Specimens examined — **MEXICO. Chihuahua: Municipality of Juárez**, Ciudad Juárez, urban zone, next to *Prosopis* sp., leg. J. Martínez, 15.VI.2001, *UACJ 1137*. Campus del Instituto de Ciencias Biomédicas, Univ. Autónoma Ciudad Juárez, in sandy soil, leg. I. Márquez y J. Martínez, 25.VIII.2001, *UACJ 1522*. Ibidem, associated with *Larrea tridentata*, leg. I. Baca & W. Coronado, 13.VIII.2002, *UACJ 1136*. Km 12 San Jerónimo to Juárez road, associated with *Larrea tridentata*, leg. A. Franco, J. Soto &

S. Escobar, 17.IX.2002, *UACJ 1138*. Samalayuca, Rancho Zorro Plateado, in sandy soil, leg. J. Córdoba, 25.V.2003, *UACJ 1139*.

Observations — Recognized by its basidiome dehiscence by an irregular rupture at pileus base, spores 9.5–17 × 8.5–13.5 µm, broadly ellipsoid to oval, with a thick double-walled, prominent germ pore.

The large variability in basidiome and spore size exhibited by *Podaxis pistillaris* has produced taxonomic confusion.

A solitary to gregarious species typical of xeric areas, *P. pistillaris* is commonly found in the Municipality of Juárez, including urban zones. This is the first report from Chihuahua.

Schizostoma laceratum (Ehrenb. ex Fr.) Lév., Ann. Sci. Nat., Bot., Sér. 3, 5: 163 (1846), as "*lacerum*"

Specimens examined — **MEXICO. Chihuahua: Municipality of Juárez**, Samalayuca, in sandy soil, leg. M. Lizárraga, 4.III.2001, *UACJ 1135* in *AH 37846*. **Municipality of Cuahutemoc**, Rancho El Castillo, located between Coyame and Cuauhtémoc, in xeric area with *Larrea tridentata* and *Prosopis* sp. leg. J. Vargas, *UACJ 1143*.

Observations — Two collections of isolated specimens. Basidiome stipitate, up to 6.3 cm total tall. Spore sac subglobose of 1.5–2 × 2–2.5 cm, with a petalloid dehiscence produced by irregular fissuring downwards from the apex. Stipe white, 3–4 × 0.3–0.6 cm, which goes inside spore sac such as a columella. Exoperidium not observed. Capillitium 4–10 µm in diam., reddish brown to ochraceous red, with isolated filaments, thick-walled, with short and scarce branches which have obtuse endings; capillitium remains in the endoperidium and columella wall when maturing. Spores of 5–5.5 µm in diam., globose to subglobose, smooth.

Moreno et al. (1995) presented a macro- and microscopical study of this rare species, including SEM micrographs, based on collections from Baja California. This is the first report for *Schizostoma laceratum* from Chihuahua.

Scleroderma areolatum Ehrenb., Sylv. Mycol. Berol. (Berlin): 27 (1818)

Fig. 14

Specimens examined — **MEXICO. Chihuahua: Municipality of Juárez**, Campus of Instituto de Ciencias Biomédicas, Centro de Idiomas, Univ. Autónoma Ciudad Juárez, in a garden with *Salix* sp., leg. M. Lizárraga, 26.IX. 2007, *UACJ 1084* in *AH 37813*.

Observations — Basidiome small, 1–5 cm in diam., surface bruising instantly purplish to reddish with 5% KOH, peridium with small brownish scales, without a stem or occasionally with a poorly defined pseudostipe. Spores 12–16 µm in diam., globose, densely spiny but not reticulate; with spines up to 2 µm long. Under SEM spore ornamentation seen to be formed by large, conical spines that rarely join at apex.

Sims et al. (1995) constructed a key to the genus based mainly on spore ornamentation (spinulose, subreticulate, or reticulate), after which Guzmán & Ovrebo (2000) proposed a new genus section and cited a new species in the American Continent. *Scleroderma areolatum* has been confused with *S. verrucosum* (Guzmán 1970), which is treated below.

First reported in Chihuahuan mycobiota by Quiñónez-Martínez et al. (1999) and Quiñónez-Martínez & Garza-Ocañas (2003).

Scleroderma cepa Pers., Syn. Meth. Fung. (Göttingen) 1: 155 (1801)

Specimens examined — **MEXICO. Chihuahua: Municipality of Chihuahua**, Cumbres de Májala, in oak-cypress wood, leg. M. Lizárraga & H. Pelayo, 15.XI.2003, *UACJ 1083* in *AH 37812*.

Observations — *Scleroderma cepa* is characterized by spinulose 9–12 µm broad spores and a smooth, white peridium that becomes pinkish-brown to dark brown when handled or becomes mature. The surface is often cracked or areolate but not with raised warts as in *S. citrinum* which can be further distinguished by reticulate rather than spinulose spores (Kuo, 2004).

Guzmán & Herrera (1973) and Pérez-Silva & Aguirre-Acosta (1986) previously reported *S. cepa* for Chihuahua.

Scleroderma verrucosum (Bull.) Pers., Syn. Meth. Fung. (Göttingen) 1: 154 (1801) Fig. 15

Specimens examined — **MEXICO. Chihuahua: Municipality of Guadalupe**, Sierra La Amargosa, associated with *Quercus* sp., *Prosopis* sp. and *Larrea tridentata*, leg. C. Arteaga, 28.X.2007, *UACJ 1085* in *AH 37814*.

Observations — Characterized by its fragile peridium (≤ 1 mm thick in the dry basidiome) with small scales at maturity, generally well-developed pseudostipe, globose 9–12 µm broad in spores, and episporium formed by thick pyramidal spines.

Pérez-Silva & Aguirre-Acosta (1986) and Laferriére & Gilbertson (1992) reported *S. verrucosum* for Chihuahua.

Tulostoma albicans V.S. White, Bull. Torrey Bot. Club 28: 428 (1901)

Specimens examined — **MEXICO. Chihuahua: Municipality of Casas Grandes**, Km 36 Casas Grandes to Cd. Juárez road, leg. D. Mejía, 7.X.2005, next to *Larrea tridentata*, *UACJ 1076* in *AH 37841*.

Observations — *Tulostoma albicans* is recognized by its thin but clearly membranous exoperidium, circular mouth, and spores that are 4.5–5.5 µm in diam., globose, smooth to verruculose. Under SEM the spore ornamentation appears as small and irregular verrucae, some of which are anastomosed (Esqueda et al. 2004).

This is the first report of this species from Chihuahua.

Tulostoma cretaceum Long, Mycologia 36: 321 (1944) FIG. 16

SPECIMENS EXAMINED — **MEXICO. CHIHUAHUA: Municipality of Juárez**, SAMALAYUCA, RANCHO EL ZORRO PLATEADO, leg. T. Rubalcaba & G. García, 20.IV.2003, in sandy soil, *UACJ 1092* in *AH 37834*. ARROYO DE LAS VÍBORAS, SIERRA DE JUÁREZ, leg. A. Aguirre, 9.XII.2006, *UACJ 1066* in *AH 37835*.

OBSERVATIONS — Characterized by its whitish basidiome, hyphal exoperidium that is mixed with sand, fibrillose stoma that becomes indefinite when mature, cylindric stalk that arises from a conspicuous basal mycelial cord, filamentous branched septate capillitium, and smooth globose to subglobose spores 5–6 μm in diam.

When the fruiting body is enlarged, it can be confused with *Tulostoma obesum*, but that species generally has a straight stalk with a non-radicating (usually volviform) base, and capillitium broken into branches, seen under LM as dichotomous endings.

Known only from xeric areas in Baja California (Moreno et al. 1995) and Sonora (Esqueda et al. 2004). This is the first report of *T. cretaceum* for Chihuahua.

Tulostoma fimbriatum Fr., Syst. Mycol. 3: 43 (1829) FIG. 17

SPECIMENS EXAMINED — **MEXICO. CHIHUAHUA: Municipality of Ahumada**, EL SUECO, EJIDO BELLAVISTA, next to *Larrea tridentata*, leg. J. Martínez, 21.VII.2001, *UACJ 1088* in *AH 37844*.

OBSERVATIONS — This taxon is recognized by its fimbriate stoma, hyphal exoperidium, and spores 5–6 μm in diam., globose, with verrucose and subreticulate ornamentation.

Within the genus *Tulostoma*, this is one of the most widely distributed species worldwide. This is the first report for *T. fimbriatum* from Chihuahua.

Tulostoma involucratum Long, Mycologia 36: 330 (1944) FIG. 18

SPECIMENS EXAMINED — **MEXICO. CHIHUAHUA: Municipality of Juárez**, VALLE DE JUÁREZ, ARROYO CERCANO, next to *Larrea tridentata*, leg. J. Vargas, 6.VI.2000, *UACJ 1063* in *AH 37843*.

OBSERVATIONS — This species is characterized by its membranous exoperidium, tubular stoma, and echinulate spores [5–6(–7) μm diam] under LM and large compound verrucae under SEM. Specimens showed a conspicuous ellipsoid, short tubular stoma.

Esqueda et al. (2004) reported *T. involucratum* for the first time in Mexico; this is the first report for Chihuahua.

Tulostoma macrosporum G. Cunn., Proc. Linn. Soc. N.S.W. 50: 252 (1925) FIG. 19

SPECIMENS EXAMINED — **MEXICO. CHIHUAHUA: Municipality of Juárez**, CERRO EL MESUDO, KM 17.5 CIUDAD JUÁREZ TO JANOS ROAD, in xerophytic scrub, leg. C. Salazar & M. Lizárraga, 23.V.2007, *UACJ 1073* in *AH 37827* and *UACJ 1156*. Ibidem, in sandy soil, leg. M. Vargas, R. Carrasco & D. Sáenz, 20.IV.2008, *UACJ 1079* in *AH 37826*.

OBSERVATIONS — This species is recognized by its short tubular stoma, thinly membranous exoperidium, and mainly because of its spore size [8–12(–14) µm in diam.]. Spore ornamentation is formed by thick spines which are occasionally joined forming a short wave under SEM.

Altés & Moreno (1999), who conducted type studies A study with type materials of *T. macrosporum*, *T. meridionale* J.E. Wright, and *T. utahense* J.E. Wright, recognized *T. macrosporum* and *T. utahense* as autonomous taxa, and synonymised *T. meridionale* with *T. utahense*.

Tulostoma macrosporum is little known in the Mexican mycobiota (Esqueda et al. 2004; Calonge et al. 2004, 2007). This is the first report for Chihuahua.

Tulostoma melanocyclum Bres., Ann. Mycol. 2: 415. 1904.

SPECIMENS EXAMINED — **MEXICO. CHIHUAHUA: Municipality of Madera**, ZONA ARQUEOLÓGICA DE 40 CASAS, in litter of *Quercus* sp., leg. A. Jiménez-Leyva, 23.VIII.2003, *UACJ 1075* in *AH 37825*.

OBSERVATIONS — *Tulostoma melanocyclum* is mainly recognized by its macroscopical similarity to *T. brumale* Pers. and spores [5–6.5 µm in diam.] that appear echinulate under LM and with large spines fused at the apex under SEM (Esqueda et al. 2004).

This is the first report of *T. melanocyclum* for Chihuahua.

Tulostoma obesum Cooke & Ellis, Grevillea 6: 82 (1878)

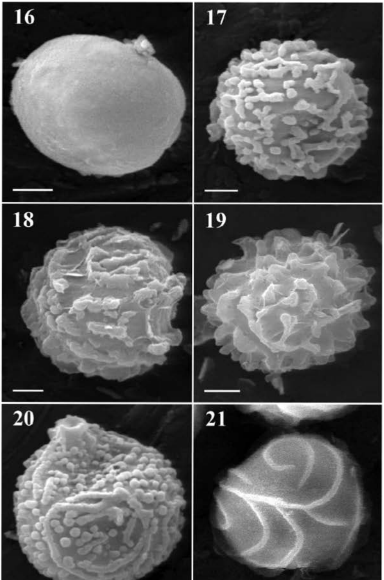
= *Tulostoma volvulatum* sensu auct., non *T. volvulatum* I.G. Borshch. (1865)

SPECIMENS EXAMINED — **MEXICO. CHIHUAHUA: Municipality of Juárez**, CERRO EL MESUDO, KM 17.5 CIUDAD JUÁREZ TO JANOS ROAD, in xerophytic scrub, leg. C. Salazar & M. Lizárraga, 23.V.2007, *UACJ 1067* in *AH 37845*.

OBSERVATIONS — Basidiome whitish, stoma rapidly becoming indefinite when maturing, stalk generally with a volviform base; capillitium thick-walled, septate, fragile, spores smooth, globose and frequently deformed shape, 5–6 µm in diam.

Altés et al. (1999) have summarized the taxonomic difficulties surrounding *T. obesum*. The species was known only in the Mexican mycobiota for Sonora (Esqueda et al. 2004), and this is the first report for Chihuahua.

FIG. 16: *Tulostoma cretaceum* AH 37835. Spore. FIG. 17: *T. fimbriatum* AH 37844. Spore. FIG. 18: *T. involucratum* AH 37843. Spore. FIG. 19: *T. macrosporum* AH 37826. Spore. FIG. 20: *T. pulchellum* var. *subfuscum* AH 37835. Spore. FIG. 21: *T. striatum* AH 37838. Spore. Scale bar 16–18, 20–21 = 1 µm; 19 = 2 µm.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Tulostoma pulchellum* var. *subfuscum (V.S. White) J.E. Wright, G. Moreno & Altés, Mycotaxon 43: 483 (1992) FIG. 20

= *Tulostoma subfuscum* V.S. White, Bull. Torrey Bot. Club 28: 433 (1901)

SPECIMENS EXAMINED — **MEXICO. CHIHUAHUA: Municipality of Juárez** SAN JERÓNIMO, KM 10 ASCENSIÓN TO CIUDAD JUÁREZ ROAD, next to *Prosopis glandulosa*, leg. R. Martínez, 23.IV.2002, *UACJ 1071* in *AH 37835*.

OBSERVATIONS — Recognized by its clearly membranous exoperidium, fibrillose, fimbriate and scutellate stoma, and basidiospores that are 4.5–6 µm in diam. and seen under SEM with dense verrucae and waves of variable length and shape.

This taxon is macro- and microscopically similar to *Tulostoma pulchellum* Sacc., which is distinguished by a spore ornamentation that is also verrucose but lacks waves. For this reason, Moreno et al. (1992) proposed it as a variety of *T. pulchellum* as originally suggested by Wright (1987). Calonge et al. (2004) recently reported the variety for Mexico based on a single incomplete basidiome from Baja California. The Chihuahuan collection has four complete basidiomes and one spore sac.

Tulostoma striatum G. Cunn., Proc. Linn. Soc. N.S.W. 50: 255 (1925) FIG. 21

SPECIMENS EXAMINED — **MEXICO. CHIHUAHUA: Municipality of Juárez**, VALLE DE JUÁREZ, EJIDO EL MILLÓN, in sandy soil, leg. T. Rubalcaba, J. Martínez, M. Ramírez & C. Muñoz, 19.IX.2001, *UACJ 1089* in *AH 37838*.

OBSERVATIONS — This species is distinguished by the usually obese spore sac, a rather short stipe, a clearly membranous exoperidium, fibrillose-fimbriate stoma, and spores [5–6.5 µm in diam.] with striate ornamentation (Esqueda et al. 2004). Although *T. striatum* is represented by only one spore sac in the UACJ herbarium, the typical basidiospore size (4–6 µm in diam.) and ornamentation is sufficient to confirm its identity.

This is the first record for *Tulostoma striatum* from Chihuahua.

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A new species of *Engleromyces* from China, a second species in the genus

M.A. Whalley[1], A.M.A. Khalil[1], T.-Z. Wei[2], Y.-J. Yao[2*] & A.J.S. Whalley[1*]

[1*] a.j.whalley@ljmu.ac.uk

[1]School of Pharmacy and Biomolecular Sciences, Liverpool John Moores University Byrom Street, Liverpool L3 3AF, UK

[2*] yaoyj@im.ac.cn

[2]Key Laboratory of Systematic Mycology and Lichenology, Institute of Microbiology Chinese Academy of Sciences, Beijing 100101, China

Abstract — *Engleromyces sinensis* is described as new and its distinguishing characteristics are contrasted with those of *E. goetzei* from Africa. Its distribution and bamboo host in China are discussed and its connection to folk medicine noted.

Key words — *Ascomycota*, taxonomy, *Xylariaceae*

Introduction

Engleromyces Henn. was erected for a single species, *E. goetzei*, occurring in East Africa (Hennings 1900). *Engleromyces* has been considered to have affinities to *Sarcoxylon* Cooke and *Thuemenella* Penz. & Sacc. being intermediate between the xylariaceous and hypocreaceous fungi (Saccardo 1902). Von Arx & Müller (1954) placed the genera in synonymy although later they accepted separate status (Müller & Von Arx 1973). Dennis (1961) and Rogers (1981) maintained the separation and agreed that the genus belongs to the *Xylariaceae*. In his review of *Sarcoxylon* and *Entonaema* Möller, Rogers (1981) noted that the key features of *Engleromyces* are

> " ... its polystichous perithecia, whitish flesh, yellowish exterior crust having areas with punctate perithecial ostioles interspersed with sterile areas of tissue. The stroma is apparently rather soft when fresh. Old herbarium material is hard and horny, but becomes soft and somewhat gelatinous when soaked in water."

*Corresponding authors.

Rogers (1981) also stated that he was unable to confirm a massive amyloid apical ring as detailed by Dennis (1961) because of the poor condition of asci in the material he examined, and he suggested that the asci deliquesce at maturity. The ascospores were described as inequilateral and are often crescentric to C-shaped. Furthermore he noted that the ascospores appear to possess a germ pore of variable position and that the presence of truncate apices at one or both ends of the spores is suggestive of cellular appendages that had dehisced.

During a study of the family *Xylariaceae* in the Mycological Herbarium of the Chinese Academy of Sciences, Beijing (HMAS), two collections (five specimens total) from Yunnan Province, China that had been identified as *E. goetzei* were examined. Although providing a clear account of the overall features of this fungus, neither the original description of *E. goetzei* from Africa (Henning 1900) nor subsequent ones by Lloyd (1917), Dennis (1961), and Rogers (1981) provide details on such microscopical characters as the apical apparatus, the asci, and aspects of ascospore morphology. Examination and comparison of the Chinese material with collections from East Africa provided further information on asci and ascospores but also indicated a number of significant differences between the African and Chinese material. We therefore provide additional information on *Engleromyces* from Africa and describe the collections from China as a second species in the genus.

Taxonomy

Engleromyces sinensis M.A. Whalley, A. Khalil, T.Z. Wei, Y.J. Yao & Whalley. **sp. nov.** FIGS 1–6.

MYCOBANK MB 515459.

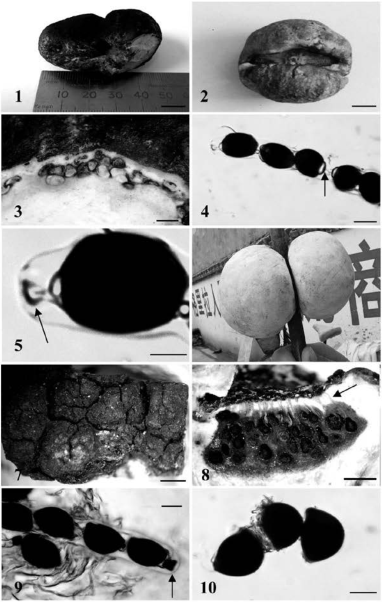
Stromata globosa vel subglobosa, 4.3–4.9 cm crassa × 4–5.5 cm longa et 1.6–4 cm alta, involuta culmi bambusae, pagino bubalina. Ostiola dispersa, plana vel pavum elevate. Annulo apicali in liquore iodata Melzeri cyanescente. Ascosporae atrae, late inequilaterales 15–19 × 11.5–12.5(–14) µm.

TYPE—Yunnan, China, Yulong County, Yulong mountain, 4 Nov 1958, S.-J. Han & L.-Y. Chen 5058, det. as *Engleromyces goetzei* [as "*goetsii*"] by S.-C. Teng, HMAS 32034 **(Holotype)**

Stromata seated on and partially enveloping bamboo culms forming two lobes, globose to subglobose, 4.3–4.9 × 4–5.5 cm and 1.6–4 cm in height. Surface

FIGS 1–6. *Engleromyces sinensis*. FIG. 1. Holotype, partially blackened stroma resulting from fire damage. FIG. 2. Immature specimen showing colour of stroma and position of bamboo culm. FIG. 3. Polystichous perithecial layer. FIG. 4. Ascus, showing ascospores with appendages (arrowed) and apical apparatus. FIG. 5. Funnel-shaped apical apparatus resembling a golf-tee (arrowed). FIG. 6. Fresh specimen in a Yunnan market, China. FIGS. 7–10. *Engleromyces goetzei*. FIG. 7. Surface of stroma. FIG. 8. Perithecia in discrete clusters, showing long ostiolar necks (arrowed). FIG. 9. Ascus, showing cuboid apical apparatus (arrowed). FIG. 10. Citriform ascospores.

Bar marker: FIGS 1 and 2, 1 cm; FIGS 3, 7 and 8, 2 mm; FIG. 4, 9 and 10, 10 µm; FIG. 5, 5 µm.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buff coloured with a pinkish hue when young, slightly dimpled when young becoming smoother and greyish brown with age. Internal flesh buff coloured, texture firm when fresh becoming woody. Ostioles scattered, slightly papillate becoming punctate with age. Perithecia polystichous, below a crust of ca. 1 mm, unevenly aggregated, spherical to flask shaped, asci 8-spored with apical apparatus blued in Melzer's Reagent, funnel or T-shaped, resembling a golf-tee, c. 4 × 4 µm. Ascospores uniseriate, black, smooth by SEM, broadly inequilateral with one or both ends truncate, with drop-like appendages visible on spores within the ascus, with no germ slit or pore observed, 15–19 × 11.5–12.5 (–14) µm.

ADDITIONAL COLLECTION EXAMINED: **CHINA.** YUNNAN: Yulong County, Yulong Mountain. 3000 m. on *Arundinaria*, 4 May 1974, M. Zang 46, det. as *Engleromyces goetzei* [as "*goetzii*"] by M. Zang, HMAS 40511.

Significant characteristic features differentiate the African and Chinese collections of *Engleromyces* and justify their separate taxonomic status. These differences include the overall size of the stromata, ascospore shape and dimensions, and the unique funnel or T-shaped apical apparatus present in the Chinese collections. There are a number of reports on this fungus, as *E. goetzei*, from China that compliment the description and provide additional data on distribution and ecology, e.g. from Muotuo County, Xiang (Tibet) at 2000–3500 m altitude in a coniferous forest with bamboo and also on bamboo culm in Yunnan, Sichuan (Mao et al. 1993, Mao 1998, 2000). Characters cited included stromata 6–10(–20) cm in diameter, spore-containing asci subcylindric and 135–150 × 16–19 µm, ascospores 15–21 × 11–15 µm, and filiform paraphyses. Mao et al. (1993) and Mao (1998, 2000) also reported antibacterial properties and its medicinal use to reduce inflammation. Ying & Zang (1994) cited 120–150 × 14–19 µm asci and 15–21 × 11–15 µm ascospores for collections from Lijiang, Yunnan (HMAS 32034, 40511) and Xizang. Yuan & Sun (1995) provided similar descriptions for collections from Sichuan and Yunnan and pointed out that the fungus contains cytochalasin D, a toxin that inhibits cell division and which can be used to treat skin cancer.

Engleromyces goetzei Henn., Bot. Jahrb. Syst. 28: 327 (1900). FIGS 7–10.

≡ *Stromne goetzei* (Henn.) Clem., Gen. fung. (Minneapolis): 44: 173 (1909).

Stromata seated upon and partially enveloping bamboo culms, subglobose up to 30 cm diameter, with an irregularly undulating, roughened surface, dark brown to black, with areas of orange pigmentation especially when young. Flesh solid, white, becoming light brown towards the surface. Perithecia oval to ellipsoid, 0.8–1 mm, compacted at different levels in a layer 3–4 mm deep, with long perithecial necks. Brown punctate ostioles scattered at the surface. Asci 8-spored, 103–121 × 12–15 µm with a large cuboid apical apparatus, c. 4 × 4 µm blued in Melzer's Reagent. Ascospores uniseriate, black, strongly inequilateral so as to appear citriform, (17.5–) 20–24 × 15–17.5 µm, with no germ slit or pore observed, paraphyses not seen.

COLLECTIONS EXAMINED: AFRICA, KENYA: Kivale, S. Aberdare Mts., 7800 ft., June 1961, I.A.S. Gibson, K(M) 162110. RWANDA (Congo Belge): Kivu, Foret d'Arundinaria alpina, Shamulamda, Massif du Biega, Nov 1951, G. Fontana K(M) 162108. KENYA: Turi, 1958, Baker, K(M) 162109.

Dennis (1961) description of collections of *Engleromyces* from the DR Congo and Rwanda is broadly in line with the one given above, although his ascospore measurements (22–27 × 15–20 µm) are slightly larger than in the material we examined. Rogers (1981), who examined material from Nyassa and Uganda in FH, noted that he was unable to confirm the massive apical ring blued by iodine because of the condition of the asci and indicated that the asci appear to deliquesce at maturity. He did, however, note what appeared to be a germ pore on the ascospores and also referred to the possible presence of cellular appendages. We have examined collections from Kenya and can confirm the presence of a large, cuboid, amyloid apical apparatus 4 × 4 µm, in some cases slightly tapering towards the base. Rogers (1981) also indicated that 'old herbarium material is hard and horny, but becomes soft and somewhat gelatinous when soaked in water'. We, however, did not observe this in *Engleromyces* collections from Kenya; on immersion in water the flesh absorbs water assuming the consistency of a firm bathroom sponge. It was not gelatinous. We consider Kokwaro's (1983) description of the flesh as like a heavy cake resembling the local millet bread 'ugali' as very apt. Thus *Engleromyces* clearly differs from *Entonaema* whose dried stromata readily take up water when submerged and become inflated and gelatinous again.

Discussion

Lloyd (1917) referred to *Engleromyces goetzei* as the largest pyrenomycete. Certainly collections from Africa justify this statement. Kokwaro (1983) stated that 'it is a semi-solid structure which can grow to the size of a football and weigh up to 4 kg. Its Kikuyu name 'Kicha-kia-Murangi' means 'that which sits on bamboo' and it is found only on the upper stems of the mountain bamboo *Arundinaria alpina* K. Schum. It partially envelopes the bamboo stem, often forming two lobes, hence its English name. 'baby's bottom' (Kokwaro, 1983). In a letter to Dr D.A. Reid at Kew on 3 June 1961, Mr I.A.S. Gibson, Forest Pathologist (Kenya), wrote 'I still cannot see where it gets its nutrient from to form such an enormous fruit body. One of the larger ones we have weighed at 4.5 kilos fresh and it was by no means all water!'. The collections from Yunnan that we examined are considerably smaller attaining a size of only 5.5 cm., which is in agreement with Teng (1996) (5–6 cm in the dried state), although Ying &

Zang (1994) recorded up to 20 cm diameter. Two of our authors, YJY and TZW, have seen specimens of *E. sinensis* larger than the holotype commonly for sale on market stalls in Yunnan.

Although possessing many of the features of *E. goetzei, E. sinensis* differs in a number of important characters. The ascospore dimensions are considerably smaller than those of the African collections and do not have the citriform to C-shape of the African material. The apical apparatus is also quite different, being T-shaped or resembling a golf-tee, totally unlike the cuboid apical apparatus found in the African collections. We were unable to observe a germ pore on the ascospores by scanning electron microscopy as spores were shrouded in the remains of the ascus, but we were able to observe appendages on at least one end of the ascospores by light microscopy. However, the ascospores were not in good condition, a problem also encountered by Rogers (1981) and Teng (1996). We found no evidence that the asci of the Kenyan or Chinese material deliquesced at maturity.

The host for both species of *Engleromyces* was recorded as *Arundinaria* in both Africa and China. The African species of bamboo has since been reclassified as *Yushania alpina* (K. Schum.) W.C. Lin and the bamboo from Yulong mountain in Yunnan is now referred to either *Fargesia melanostachys* (Hand.-Mazz.) T.P. Yi or *Fargesia yulongshanensis* T.P. Yi (Professor Nianhe Xia, pers. com.).

Engleromyces goetzei from Kenya has been the subject of chemical analysis and was found to contain a new cytochalasin, engleromycin (Pedersen et al. 1980). Interestingly, *E. goetzei* has been used in traditional African medicine for the treatment of a number of aliments including fever associated with malaria (Kokwaro, 1983). Cytochalasins are produced by many xylariaceous fungi, especially species of *Xylaria* Hill ex Schrank, *Rosellinia* De Not. and *Nemania* Gray (Whalley 1996, Whalley & Edwards 1995). The medicinal uses of *E. sinensis* in China have been recorded mostly under the name *E. goetzei* [as "*goetzii*"]. The fungus has long been used for treating illnesses and has anti-inflammatory and anti-microbial properties (Ying et al. 1987). A study of secondary metabolites from *Engleromyces* from Yunnan revealed a novel compound, neoengleromycin (Liu et al. 2002). These authors also refer to the folk-use of this fungus against infectious diseases and cancer in Tibet, Yunnan, and Sichuan Provinces. The cytochalasins are known to inhibit cell division (Betina 1989) and the link to treatment of cancer is therefore very interesting.

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Two new *Taifanglania* species identified through DELTA-assisted phenetic analysis

Yanfeng Han, Jiandong Liang, Zongqi Liang *, Xiao Zou & Xuan Dong

swallow112886@yahoo.com.cn jdliang214@yahoo.com.cn zqliang472@yahoo.com.cn coprinus@126.com juliette9805036@yahoo.com.cn
Institute of Fungus Resources, College of Life Sciences, Guizhou University Guiyang, China 550025

Abstract — Two new species isolated from soil samples from Mianyang City, Sichuan Province and Nantong City, Jiangsu Province, China, were revealed through classical morphology and DELTA-assisted analyses. Both species are described and illustrated and diagnostic characters revealed through DELTA are discussed. *Taifanglania berberidis* is characterized by brown colony, black reverse, phialides 7.2–13.5 × 1.8–4.2 µm, with an ellipsoidal swollen basal portion and fusiform conidia, 4.8–9.0 × 1.8–3.0 µm; *T. jiangsuensis* is distinguished by yellow colony, rough or smooth-walled hyphae, phialides 6–15 × 1.8–3.0 µm, with a cylindrical swollen basal portion and ellipsoidal or fusiform conidia, 3.6–6 × 2.4–3.0 µm, forming chains and often capitate at the top.

Key words — thermotolerant fungi, morphological character, numerical classification

Introduction

The genus *Taifanglania* was established by Liang et al. (2009), who selected *T. hechuanensis* as the type species and accepted nine species in the genus worldwide. *Taifanglania* species are thermophilic fungi that play an important role in cellulose degradation of compost, garbage, and straw (Liang et al. 2007; Kluczek-Turpeinen et al. 2003, 2007; Kluczek-Turpeinen 2007). In addition, they can produce novel active substances (Hill & Pitt 1999) and useful thermophilic enzymes such as laccases (Liang et al. 2007, 2009; Yang et al. 2006).

The recent use of molecular data in systematic analyses has enabled the identification of many new fungi (Luangsa-ard et al. 2004, 2005; Rehner & Buckley 2005; Sung et al. 2007). However, as noted by Hawksworth (2004), only about 11.5% of the known species were represented among the fungal sequences present in Genbank in 2004 and of those, regrettably approximately one-fifth was incorrectly identified. In addition, Paterson (2007, 2008) has

*Corresponding author

reported that mycotoxins present in some cultures may adversely affect DNA sequence analysis. For these reasons, many researchers use polyphasic taxonomy based on molecular, morphological, numerical approaches and physiological data (Houbraken et al. 2007; Samson et al. 2007; Varga et al. 2007a,b). In this regard, the DELTA expert morphology-based system offers many advantages to the classical taxonomic research of animal, plant and microbes that permit digital standardization of morphological characters to make them suitable for taxonomic identification (Carney 2003; Chang et al. 2000; Chen & Chen 2008; Li et al. 1993; Li 1996) and international communication (Chen & Kuoh 2000a,b; Han et al. 2009). In this paper we report and illustrate two new *Taifanglania* species, *T. berberidis* and *T. jiangsuensis*, that were identified using classical morphology in the DELTA system.

Materials and methods

Materials—The eleven *Taifanglania* species used in the study are listed in Table 1.

Sample collection and strain isolation — Strain GZUIFR-SGQH346 and GZUIFR-HC48.1 were isolated from soil samples of Mianyang City, Sichuan Province and Nantong City, Jiangsu Province, China, respectively. Two grams of soil were added to a flask containing 20 ml sterilized water and glass beads. Each soil suspension was shaken for about 10 min. and then diluted to concentrations of 10^{-1}–10^{-2}. One ml suspension (10^{-2}) was mixed with Martin medium in a sterilized Petri dish of 9 cm diam. Cultures were incubated at 40°C for 14 days.

Strain identification — The strains were transferred to Czapek agar. After incubation at 40°C for 7 days, the strains were identified based on colony characters and conidiogenous structures according to Liang et al. (2009).

Table 1. List of *Taifanglania* spp. for constructing DELTA database

No.	Names	References
1	*T. ampullaris* (Matsush.) Z.Q. Liang et al.	Matsushima 1971, Liang 2009
2	*T. ampulliphora* (Matsush.) Z.Q. Liang et al.	Matsushima 1975, Liang et al. 2009
3	*T. biformis* (Z.Q. Liang et al.) Z.Q. Liang et al.	Liang et al. 2007, 2009
4	*T. cinerea* (Z.Q. Liang et al.) Z.Q. Liang et al.	Liang et al. 2006, 2009
5	*T. curticatenata* (Z.Q. Liang & Y.F. Han) Z.Q. Liang et al.	Han et al. 2007, Liang et al. 2009
6	*T. furcata* (Z.Q. Liang et al.) Z.Q. Liang et al.	Liang et al. 2006, 2009
7	*T. hechuanensis* Z.Q. Liang et al.	Liang et al. 2002, 2009
8	*T. inflata* (Burnside) Z.Q. Liang et al.	Samson 1974, Liang et al. 2009
9	*T. major* (Z.Q. Liang et al.) Z.Q. Liang et al.	Chu et al. 2004, Liang et al. 2009
10	*T. berberidis*	(this work)
11	*T. jiangsuensis*	(this work)

TABLE 2. Characters and character states in *Taifanglania*

#1. Note/	#10. Phialides length/μm/
#2. Colony/	#11. Phialides width/μm/
#3. Colony color/ 1. Pale yellow/ 2. Pale-brown/ 3. Gray/ 4. White/ 5. Yellow/	#12. Phialides <shape>/ 1. cylindric/ 2. ovoid/ 3. ellipsoid/ 4. subglobose/ 5. fusiform/
#4. Reverse color/ 1. Yellow/ 2. Dark/ 3. Offwhite/	#13. Conidia surface/ 1. tiny rough/ 2. smooth/
#5. Colony texture/ 1. Compact velvety/ 2. Velvety, powdery or floccose to funiculose/ 3. Short floccose/ 4. Loose velvety/	#14. Conidia <shape>/ 1. ellipsoid/ 2. subglobose/ 3. cylindric/ 4. ovate/ 5. obovoid/ 6. fusiform/ 7. Lemon-shaped/
#6. Vegetative hyhpae <width μm>/	#15. Conidia width/μm/
#7. Hyhpae surface/ 1. tiny rough/ 2. smooth/	#16. Conidia length/μm/
#8. Conidiophore/ 1. present (simple) 2. lacking/	#17. Conidial chain/ 1. long/ 2. short/
#9. Phialides/	#18. Inhabit/ soil/

THE PHENETIC TREE GENERATED BY DELTA SYSTEM —Diagnostic characters and character states from the selected *Taifanglania* strains were entered into DELTA system as described by Han et al. (2009) to form the database (TABLE 2). According to the program CONFOR with the "todis" directives of Editor, the phenetic tree was generated by DELTA system using the PCLASS program.

New species

Taifanglania berberidis Y.F. Han & Z.Q. Liang, **sp. nov.** FIG. 1

MYCOBANK MB 516503

In agaro Czapekii, coloniae 75–80 mm diam., 14 diebus ad 40°C, planae, brunnea. Conidiophora absentia. Phialides singulares, 7.2–13.5 × 1.8–4.2 μm, e basi inflata ellipsoida in collum distinctum apice inspissato angustatae. Conidia fusiformia, 4.8–9.0 × 1.8–3.0 μm, catenata, interdum et capitata ad extremam.

Holotypus *GZUIFR-SGQH346 isolatus, e soli, Mianyang City, Provincia Sichuan, China. VIII, 2006, Y.F.HAN, in Guizhou Univ, conservatur.*

ETYMOLOGY: *berberidis* (Latin), referring to the associated plant genus.

Colony on Czapek agar reaching 75–80 mm diam. within 14 days at 40°C, flat, felty, with brown center and gray margin, irregularly radially grooved, faintly wavy at the margin. Reverse black. Vegetative hyphae hyaline, smooth-walled, 1.2–3.0 µm in diam. Phialides single, borne directly on the vegetative hyphae, 7.2–13.5 × 1.8–4.2 µm, with an ellipsoidal swollen basal portion, tapering into a distinct neck. Conidia hyaline, smooth-walled, fusiform, 4.8–9.0 × 1.8–3.0 µm, forming chains and sometimes capitate at the top.

Distribution: Sichuan Province, China.

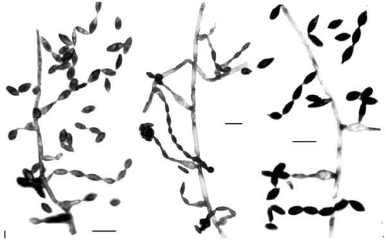

Fig. 1. Conidiogenous structures of *Taifanglania berberidis*. Bars = 10 µm

Comments: Other *Taifanglania* species characterized by fusiform conidia are *T. inflata*, *T. jiangsuensis*, *T. hechuanensis*, and *T. biformis*. The following characters separate those species from *T. berberidis*: *T. inflata* is mesophilic, *T. jiangsuensis* colonies are yellow, the reverse of *T. hechuanensis* colonies is gray, and *T. biformis* has an echinate conidiophore. *Taifanglania berberidis* can be distinguished by its thermophilic character, brown colony with the black reverse, single phialides, and often capitate top of conidial chain.

Taifanglania jiangsuensis Y.F. Han & Z.Q. Liang, **sp. nov.** Fig. 2

MycoBank MB 516504

In agaro Czapekii, coloniae 45–50 mm diam., 14 diebus ad 40°C, villiformis, flava. Conidiophora absentia. Phialides singulares, 6–15 × 1.8–3.0 µm, e basi inflata cylindrica in collum distinctum apice inspissato angustatae. Conidia ellipsoidea vel fusiformia, 3.6–6 × 2.4–3.0 µm, catenata, saepea et capitata ad extremam.

***Holotypus** GZUIFR-HC48.1 isolatus, e soli, Nantong City, Provincia Jiangsu, China. IV, 2005, Y.F.HAN, in Guizhou Univ, conservatur.*

ETYMOLOGY: *jiangsuensis* (Latin), referring to Jiangsu Province, where the type locality is situated.

COLONY on Czapek agar reaching 45–50 mm diam. within 14 days at 40°C, villiform, light yellow. Reverse yellow. VEGETATIVE HYPHAE hyaline, rough or smooth-walled, 0.6–1.2 µm diam. PHIALIDES single, sometimes proliferating, borne directly on the vegetative hyphae, 6–15 × 1.8–3.0 µm, with a cylindrical swollen basal portion, tapering into a distinct neck. CONIDIA hyaline, smooth-walled, ellipsoidal or fusiform, 3.6–6 × 2.4–3.0 µm, forming chains, often capitate at the top.

DISTRIBUTION: Jiangsu Province, China.

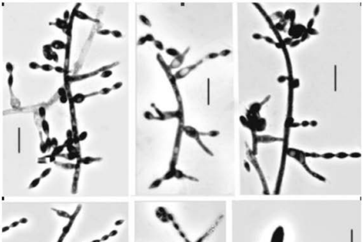

FIG. 2. Conidiogenous structures of *Taifanglania jiangsuensis*. Bars = 10 µm

COMMENTS: Other *Taifanglania* species that produce light colonies on Czapek agar are *T. inflata* and *T. ampullaris*. *T. jiangsuensis*. The fact that *T. inflata* is mesophilic and *T. ampullaris* produces smaller conidia (2.2–3.4 × 2–2.6 µm) differentiate those species from *T. jiangsuensis*. Additionally *T. jiangsuensis* may possess either smooth or rough hyphae.

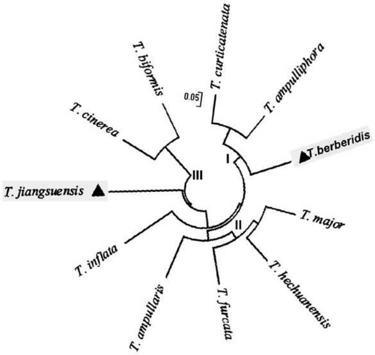

FIG. 3. Phenetic tree generated for *Taifanglania* spp. by DELTA.

Numerical taxonomy

Numerical character classification was not granted special priority, so that all characters selected were weighted equally in this study. The phenetic tree based on the morphological characteristics is presented in FIGURE 3, which separates *T. jiangsuensis* and *T. inflata* from each other and from all other *Taifanglania* species. The remaining species fall into three distinct groups (I–III).

Group I species (i.e., *T. curticatenata*, *T. ampulliphora*, *T. berberidis*) all produce brown colonies on Czapek agar. Both *T. curticatenata* and *T.*

ampulliphora are characterized by rough conidia (Han et al. 2007, Matushima 1975), separating them from *T. berberidis,* which produces smooth, fusiform conidia, which supports *T. berberidis* as an independent species.

Group II species (i.e., *T. major, T. hechuanensis, T. furcata, T. ampullaris*) share light colony color and phialides with ellipsoidal basal portions.

Group III includes *T. cinerea* and *T. biformis,* whose common characters are the villiform colony and conidia that are fusiform, ellipsoidal to cylindrical, and longer than 13 µm. Within the group, the unique biform conidiogenous structures separate *T. biformis* from *T. cinerea* (Liang et al. 2006, 2007).

The new species *T. jiangsuensis,* which stands on an independent branch, can be characterized by its yellow villiform colony, yellow reverse, and tiny rough hyphae.

The phenetic tree generated from morphological characters observed in the eleven *Taifanglania* species using the INTKEY program of DELTA system showed that colony color, colony texture, shape of conidia, reverse color, and conidial length are diagnostic for the identification of *Taifanglania* species.

In conclusion, *T. berberidis* and *T. jiangsuensis* are two new distinctive taxa with the support derived from morphology with the phenetic analysis of DELTA system.

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Additions to the knowledge of aphyllophoroid fungi (*Basidiomycota*) of Atlantic Rain Forest in São Paulo State, Brazil

Adriana de Mello Gugliotta[1*]

Margarida Pereira Fonsêca[2]

Vera Lúcia Ramos Bononi[1]

* *agugliottaibot@yahoo.com.br*

[1]*Instituto de Botânica, Seção de Micologia e Liquenologia*
Caixa Postal 3005, CEP 01061-970, São Paulo, SP, Brazil

[2]*Universidade Guarulhos, Ciências Biológicas*
Praça Tereza Cristina, 88 CEP 07023-070, Guarulhos, SP, Brazil

Abstract — The list of aphyllophoroid fungi of the Atlantic Rain Forest in the state of São Paulo is updated. Specimens were collected in four different areas of the Atlantic Rain Forest from 1988 to 2007. Exsiccates deposited in the Herbarium SP were also studied. A list of 85 species of *Basidiomycota* distributed into 11 families and four orders (*Agaricales*, *Hymenochaetales*, *Polyporales*, *Russulales*) is presented. All species are mentioned for the first time for the collection sites. Two species are reported for the first time for Brazil and 17 species are recorded for the first time for São Paulo State. The complete list of specimens is available at http://www.mycotaxon.com/resources/weblists.html.

Key words — diversity, macrofungi, neotropics, taxonomy

Introduction

The Atlantic Rain Forest, which has 20,000 species of plants of which 6000 are endemic, is the second largest block of tropical forests of Brazil. This biome, which formerly occupied 1,315,460 km² of Brazilian territory, extending through the region from Osório, Rio Grande do Sul State (29º53'S and 50º16'W) to Cabo de São Roque, Rio Grande do Norte State (05º31'S and 35º16'W), holds today less than 8% of its original extent and has become one the world's top five biological hotspots (Mittermeier et al. 1999, SOS Mata Atlântica/INPE 2009).

The state of São Paulo still holds a significant portion of this important biome (15% of the total remaining forest), largely in protected areas (Secretaria do Estado de Meio Ambiente 1996, 2000, SOS Mata Atlântica/INPE 2009). It includes several types of tropical ecosystems, such as the coasts of the Atlantic Ocean, the forests of lowlands and slopes of the Serra do Mar, inland forests and woods of *Araucaria* (Secretaria de Estado do Meio Ambiente 1996).

The aim of this study is to contribute to the knowledge of the diversity of aphyllophoroid fungi of the Atlantic Forest and the state of São Paulo, complementing the inventories in the Parque Estadual da Ilha do Cardoso (Bononi 1979a,b,c, 1984, Gugliotta & Capelari 1995, Gugliotta & Bononi 1999) and Parque Estadual das Fontes do Ipiranga (Bononi et al. 1981, Jesus 1993, Soares & Gugliotta 1998, Louza & Gugliotta 2007, Leal & Gugliotta 2008), and expanding the checklist for aphyllophoroid fungi cited from the Brazilian Atlantic Forest by Baltazar & Gibertoni (2009).

Materials and methods

Specimens were collected in four different areas of the Atlantic Rain Forest in the State of São Paulo, from 1988 to 2007:

1. Parque Estadual da Ilha do Cardoso (25°03'S–48°05'W, 22,500 ha), municipality of Cananéia;
2. Reserva Biológica de Paranapiacaba (23°46'S–46°18'W, 336 ha), municipality of Santo André;
3. Parque Estadual das Fontes do Ipiranga (23°39'S–46°37'W, 549.31 ha), municipality of São Paulo;
4. Reserva Florestal da Cidade Universitária "Armando de Salles Oliveira" da Universidade de São Paulo (23°33'S–46°43'W, 10 ha), municipality of São Paulo.

The studied material was deposited in SP herbarium (Holmgren & Holmgren 1998). Exsiccates from these localities deposited in the Herbarium SP were also studied. Micromorphological observations were made from material mounted in 5% KOH and Melzer's reagent; measurements were made in 5% KOH. Nomenclature, taxonomy and author citation followed databases: CBS (http://www.cbs.knaw.nl/databases/) and Index Fungorum (http://www.indexfungorum.org/Names/Names.asp).

Results and discussion

A list of 85 species of *Basidiomycota* distributed into 11 families and four orders (*Agaricales*, *Hymenochaetales*, *Polyporales*, *Russulales*) is presented. *Polyporaceae* is the most represented family with 30 species. All species are mentioned for the first time for the collection sites.

Schizopora trichiliae (Van der Byl) Ryvarden and *Porogramme albocincta* (Cooke & Massee) J. Lowe are recorded for the first time for Brazil.

Seventeen of the identified species are recorded for the first time for São Paulo State: *Amauroderma omphalodes* (Berk.) Torrend, *Coltricia cinnamomea* (Jacq.) Murrill, *Daedalea aethalodes* (Mont.) Rajchenb., *Dichochaete setosa* (Sw.) Parmasto, *Echinoporia aculeifera* (Berk. & M.A. Curtis) Ryvarden, *Henningsia brasiliensis* (Speg.) Speg., *Hymenochaete floridea* Berk. & Broome, *Hymenochaete minuscula* G. Cunn., *Hymenochaete pinnatifida* Burt, *Hymenochaete rubiginosa* (Dicks.) Lév., *Megasporoporia setulosa* (Henn.) Rajchenb., *Nigroporus macroporus* Ryvarden & Iturr., *Perenniporia ohiensis* (Berk.) Ryvarden, *Perenniporia piperis* (Rick) Rajchenb., *Phellinus ferrugineovelutinus* (Henn.) Ryvarden, *Tinctoporellus epimiltinus* (Berk. & Broome) Ryvarden and *Tyromyces fumidiceps* G.F. Atk.

Gugliotta & Capelari (1995) and Gugliotta & Bononi (1999) reported the occurrence of *Trametes versicolor* (L.) Lloyd in Parque Estadual da Ilha do Cardoso, Municipality of Cananéia, but the specimen (SP 193613) was examined later and re-identified as *Coriolopsis caperata* (Berk.) Murrill; the occurrence of *T. versicolor* in this area was not confirmed.

Acknowledgments

We extend our thanks to Clarice Loguercio Leite and Leif Ryvarden who kindly reviewed the manuscript. We are grateful to FAPESP (04/04310-2) for financial support.

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MYCOTAXON

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Fungi from palms in Argentina. 1

Mariana Capdet* & Andrea Irene Romero

*marianacapdet@gmail.com

PHHIDEB-CONICET, Depto. Biodiversidad y Biología Experimental
Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires
Av. Int. Güiraldes 2620, Buenos Aires C1428EHA, Argentina.

Abstract — Thirteen ascomycetes are reported from Argentina from fallen woody parts of three palms in two national parks. *Berkleasmium corticola*, *B. sinense*, *Brachysporiella gayana*, *Dictyosporium cocophylum*, *D. zeylanicum*, *Endocalyx melanoxanthus* var. *melanoxanthus*, *Ernakulamia cochinensis*, *Musicillium theobromae*, *Sporidesmium macrurum*, and *Stachylidium bicolor* are new records for Argentina. *Melanochaeta hemipsila* is reported for the first time as a teleomorph in this country.

Key words — fungal taxonomy, neotropical mycobiota, pyrenomycetes

Introduction

There are nearly 2800 species of palms in the world (Blomberry & Rodd 1982), most of which are used for food, edible oils, timber, and ornamental plants (Hyde & Cannon 1999). In Argentina, there are eleven native palms, ten of which are distributed in the northeast of the country (Cabral & Castro 2007). Many Argentine palm species are found in the Atlantic Forest, a region with great biodiversity but covering only 7–8% of the national surface (Galindo-Leal & Gusmão Câmara 2003). Several areas have been proposed as natural reserves for protection of *Euterpe edulis* Mart. ("palmito"), a palm species that is currently a candidate for vulnerable status (Ministry of Ecology of the Province of Misiones).

Little is known about fungi on palms in Argentina. Spegazzini (1881) was the first to describe some of them, such as *Ceratostoma australe* [≡ *Cannonia australis*], a very common ascomycete on woody spathes of *Butia yatay* (Mart.) Becc., from a cultivated palm tree in Buenos Aires province. Carmona et al. (1990) described a foliar spot caused by *Pestalotiopsis palmarum* (Cooke) Steyaert on *Syagrus romanzoffiana* (Cham.) Glassman (native to Argentina). There is also published work on a foliar spot caused by *Phytophthora palmivora* (E.J. Butler) E.J. Butler, a pathogenic chromistan fungal analogue, on leaves of *Chamaedorea elegans* Mart., a palm introduced from Mexico to Argentina (Cúndom et al. 2006).

Hyde and co-workers, who have studied fungi associated with palms from various countries, have reported and described many members of *Ascomycota* from palms (Hyde & Fröhlich 1997; Hyde et al. 1998, 2000; Fröhlich & Hyde 2000; Taylor & Hyde 2003).

In order to understand better the diversity of ascomycetes on woody parts of palms in Argentina, we studied ascomycetes on three Argentine palms — *Butia yatay*, *Euterpe edulis*, and *Syagrus romanzoffiana*. *Butia yatay* is an endangered species (Chebez 1994) and *E. edulis* is a candidate for vulnerable status (Ministry of Ecology of the Province of Misiones).

The present paper reports thirteen species from that study.

Materials and methods

The sampling area comprised two national parks: Iguazú in Misiones Province and El Palmar in Entre Ríos Province (Fig. 1).

The Iguazú national park covers an area of 67,620 hectares (25°41' S, 54°18' W) (APN 2008). This park is included in the "Paranaense province" (Cabrera & Willink 1980) of the Argentine phytogeographical regions. The climate is subtropical without a dry season. Annual rainfall averages vary between 1600 mm and 2000 mm and the annual average temperature is 20°C. The vegetation is subtropical forest, which represents the greatest animal and plant biodiversity in the country (Dirección de Bosques de Argentina 2003). The two palms studied in this area were *Syagrus romanzoffiana* and *Euterpe edulis*.

The El Palmar national park, which covers an area of 8500 hectares (31°55'S, 58°14' W), was established in 1965 with the aim of preserving *Butia yatay*, an endangered species (Chebez 1994). It is included in the Argentine phytogeographical region called "Espinal province" (Cabrera & Willink 1980). The climate is warm and humid in the north, and temperate and dry in the west and south. Rainfall ranges from 400 mm to 1500 mm, occurring mainly in spring and summer (Dirección de Bosques de Argentina 2003). The vegetation includes a savanna with palms, shrubs and gallery forest along the Uruguay river and grasslands. The palm studied here was *Butia yatay*, the only palm present in the park.

Four samplings (one per season) were carried out at each location during 2008, with a total of 825 samples gathered. Fallen rotten, woody parts, i.e. sheaths, petioles, spathes, foliar and floral rachides, were collected. The material was air-dried. Microscopic characters were observed from sporulation in vivo using light microscopy. Sizes of all the structures were based on 20 measurements. Drawings were made with a camera lucida. Photographs were taken with a Sony Digital camera. The specimens are deposited in the BAFC fungal reference collection (Holmgren et al. 1990).

The adopted classification system follows Kirk et al. (2008). For species already recorded from Argentina, brief information and references are given; new records

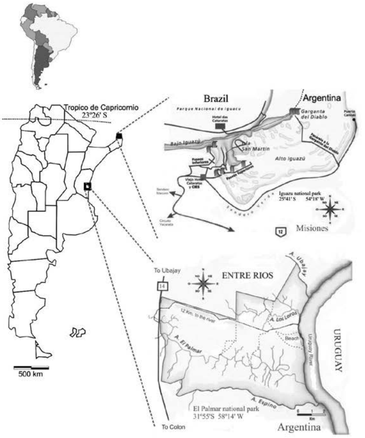


FIGURE 1 Sampling sites.

for Argentina are fully described and illustrated with information about anamorph-teleomorph relations. The type of substratum (petiole, spathe, floral rachis, etc) is given for each species.

Results

Thirteen taxa were identified, of which ten are new records for Argentina.

Cannonia australis (Speg.) Joanne E. Taylor & K.D. Hyde, Mycol. Res. 103: 1398 (1999). PL. 1 FIG. 1–3

DESCRIPTION & ILLUSTRATIONS: Taylor & Hyde (1999).

ANAMORPH — Unknown.

SUBSTRATUM — Spathe of *Syagrus romanzoffiana*. Peduncle and spathe of *Butia yatay*.

MATERIAL EXAMINED — **ARGENTINA. Entre Ríos, Dpto Colón:** EL PALMAR NATIONAL PARK. Col. Capdet, M. & Romero, A.I. 23.IV.2008 (BAFC 51673). **Misiones, Dpto Iguazú:** IGUAZÚ NATIONAL PARK. Col. Capdet, M. & Romero, A.I. 22.IV.2008 (BAFC 51674).

GEOGRAPHIC DISTRIBUTION — Argentina; Australia (Taylor & Hyde 1999).

REMARKS — The collected material coincides with Taylor & Hyde's description. This species was first described in Argentina by Spegazzini (1881) as *Ceratostoma australe* on *Butia yatay*. Subsequently, Taylor & Hyde (1999) reassigned the species to the new genus *Cannonia* and described material from Argentina (on *B. yatay* from Buenos Aires) and Australia (on *Trachycarpus fortunei* H. Wendl.). This species is frequently found, mainly in the spathe and the floral rachis of *B. yatay*, at any time of year. It also occurs on spathes of *Syagrus romanzoffiana*, but in more limited areas than on *B. yatay* spathes.

Cosmospora vilior (Starbäck) Rossman & Samuels, Stud. Mycol. 42: 126 (1999). PL. 1 FIG. 4–5

SYNONYMS: see Rossman et al. (1999).

DESCRIPTION & ILLUSTRATIONS: Samuels et al. (1990); Rossman et al. (1999).

ANAMORPH — *Acremonium berkeleyanum* (P. Karst.) W. Gams (Rossman et al. 1999).

SUBSTRATUM — Floral rachis of *Butia yatay* and on *Cannonia australis*.

MATERIAL EXAMINED — **ARGENTINA. Entre Ríos, Dpto Colón:** EL PALMAR NATIONAL PARK. Col.: Capdet, M. & Romero, A.I. 23.IV.2008 (BAFC 51675).

GEOGRAPHIC DISTRIBUTION — Argentina (Catania & Romero 2007), Brazil, Indonesia, New Zealand (Samuels et al. 1990), China (Nong & Zhuang 2005), Taiwan (Guu et al. 2007).

REMARKS — *Cosmospora vilior* is among the most common species in tropical and subtropical areas. It has been found on stromata of various members of the *Xylariaceae* in Taiwan (Guu et al. 2007). Recently, Catania & Romero (2007) reported this species on fallen twigs of *Podocarpus parlatorei* Pilg. (from the Yungas region, northwest Argentina) and on stromata of the *Diatrypaceae* family. In the current collection, the fungus grows on necks of *Cannonia australis* and on the floral rachis. The fungus has not been previously recorded in Entre Ríos province.

Melanochaeta hemipsila (Berk. & Broome) E. Müll., Harr & Sulmont, Revue Mycol., Paris 33: 377 (1969, "1968"). PL. 1 FIG. 6–14

SYNONYMS: see Müller et al. (1969).

TELEOMORPH — ASCOMATA perithecioid, scattered, superficial, globose or pyriform, black, covered with hairs, 0.2–0.4 mm long, 0.3–0.4 mm wide. ASCI cylindrical or narrow clavate, unitunicate, eight-spored, pedicellate, with a small refractive non-amyloid apical ring. ASCOSPORES biseriate, fusiform with rounded ends, curved or straight, 5-septate, central cells greenish brown, end cells hyaline, 47–62 × 9–13 µm.

ANAMORPH — ***Sporoschisma saccardoi*** E.W. Mason & S. Hughes, Mycol. Pap. 31: 20 (1949).

COLONIES velutinous, superficial, black, with mixed tufts of capitate hyphae and conidiophores. CONIDIOPHORES smooth, straight, hairy, tubular, up to 4-septate, up to 260 µm long, 10–18 µm wide, dark brown in the base, pale brown near the apex. CONIDIA formed enteroblastically inside the tubular collarette of the conidiogenous cells, cylindrical with ends flat, 5-septate, central cell brown, end cells much paler, 48–68 × 12–16 µm.

SUBSTRATUM — Spathe of *Euterpe edulis.*

MATERIAL EXAMINED — ARGENTINA. **Misiones, Dpto Iguazú:** IGUAZÚ NATIONAL PARK. Col. Capdet, M. & Romero, A.I. 09.VII.2008 (BAFC 51676).

GEOGRAPHIC DISTRIBUTION — TELEOMORPH: Australia, France, Sri Lanka, Thailand (Sivichai et al. 2000). ANAMORPH: Italy, Togo, USA (Hughes 1952); Canada, Indonesia, Italy (Nag Raj & Kendrick 1975); Taiwan (Matsushima 1980); Argentina (Arambarri & Cabello 1990); Australia, Brunei Darussalam, China, Malaysia, South Africa (Goh et al. 1997); Ecuador (Sivichai et al. 2000); Cuba, Perú (Heredia Abarca et al. 2004); France, Puerto Rico (Cybertruffle's Robigalia 2009).

REMARKS — The description of *M. hemipsila* coincides with those of Sivichai et al. (2000) and Hyde et al. (2000), but the ascospores are much larger in the Argentine material (47–62 × 9–13 vs 30–40 × 7.5–10 µm). Asci were not measured in the present material because they were not fully formed. The description of *S. saccardoi* given above agrees with the descriptions of Hughes (1949), Nag Raj & Kendrick (1975), Arambarri & Cabello (1990), Sivichai et al. (2000) and Hyde et al. (2000) except for the size of the conidia (27.5–47.5 × 11.5–15 µm vs 48–68 × 12–16 µm), but measurements of conidia in the Argentine material are very close to those given by Heredia Abarca et al. (2004) (52–68 × 12–15 µm).

Sporoschisma nigroseptatum D. Rao & P.Rag. Rao and *S. saccardoi* are very similar species, differing mainly in conidial size. It would be interesting to revise these two species because, if they do not exhibit significant differences, it may be appropriate to synonymize them. Arambarri & Cabello (1990) recorded

S. saccardoi from Buenos Aires province, but the species has not been previously recorded from Misiones.

Considering all the differences in the anamorph and teleomorph, a new species of *Melanochaeta* could be proposed. However, this is not established here since the material was inadequate to serve as a type.

Brachysporiella gayana Bat., Bol. Secr. Agric., Pernambuco 19(1–2): 109 (1952). PL. 2 FIG. 15–20

TELEOMORPH — *Ascotaiwania*, fide Kirk et al. (2008)

ANAMORPH — COLONIES hairy, dark brown or black. MYCELIUM immersed in the substratum, septate, smooth, brown. CONIDIOPHORES macronematous, mononematous, erect, dark brown, up to 225 µm long, 3–15 µm wide. CONIDIA obovoid to obclavate, truncate at the base, smooth, 24–41 µm long, 14–21 µm thick in the broadest part, 3–6 µm wide at the base, 3-septate, brown or olive green, basal cells progressively paler.

SUBSTRATUM — Spathe of *Euterpe edulis.*

MATERIAL EXAMINED — **ARGENTINA. Misiones, Dpto Iguazú:** IGUAZÚ NATIONAL PARK. Col. Capdet, M. & Romero, A.I. 09.VII.2008 (BAFC 51677).

GEOGRAPHIC DISTRIBUTION — Brazil, Ghana, Sierra Leone (Ellis 1959); USA (Ellis 1971); Japan (Matsushima 1975); Taiwan (Matsushima 1980); Cuba (Mercado Sierra 1981, Holubová-Jechová & Mercado Sierra 1984); Australia (Taylor & Hyde 2003); Costa Rica, Malawi, Malaysia, Puerto Rico, Venezuela (Cybertruffle's Robigalia 2009).

REMARKS — This material was identified using the key provided by Ellis (1971). The above description matches those of Holubová-Jechová & Mercado Sierra (1984) and Ellis (1971) except for small differences in conidial sizes.

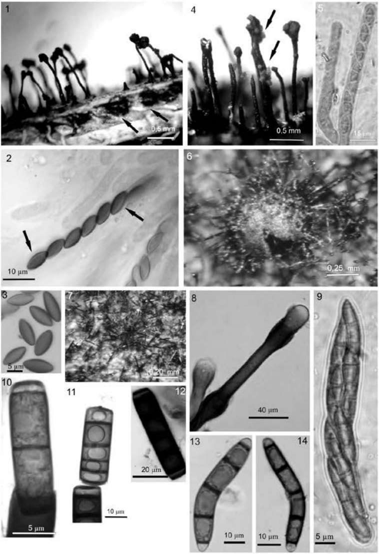
Berkleasmium corticola (P. Karst.) R.T. Moore, Mycologia 51(5): 735 (1961, "1959"). PL. 2 FIG. 21–24

TELEOMORPH — Unknown.

ANAMORPH — COLONIES composed of sporodochia, punctiform, black, shining, scattered and discrete. MYCELIUM immersed in the substratum, composed of pale brown, branched hyphae. CONIDIOPHORES simple, semimacronematous, easily broken in two or three parts. CONIDIA solitary, oval to ellipsoidal,

PLATE 1 FIGS. 1–3. *Cannonia australis*. 1: Appearance of ascomata on host surface. 2: Asci and ascospores (arrow = full length germ slit). 3: Ascospores. FIGS. 4–5. *Cosmospora vilior*. 4: *Cosmospora vilior* on ascomatal necks of *Cannonia australis*. 5: Asci. FIGS. 6–14. *Melanochaeta hemipsila*. 6: Hairy ascoma. 7: Conidiophores of *Sporoschisma saccardoi*. 8: Capitate setae. 9: Immature asci. 10: Conidiophore with conidia. 11: Chain of conidia. 12: Conidia. 13–14: Ascospores.

Scale bars: FIG. 1, 4 = 0,5 mm; FIG. 2, 11, 13–14 = 10 µm; FIG. 3, 9–10 = 5 µm ; FIG. 5 = 15 µm; FIG. 6 = 0.25 mm; FIG. 7 = 0.20 mm; FIG. 8 = 40 µm; FIG. 12 = 20 µm.


1
0,5 mm
4
0,5 mm
5
15 µm
2
10 µm
6
0,25 mm
3
5 µm
7
0,20 mm
8
40 µm
9
5 µm
10
5 µm
11
10 µm
12
20 µm
13
10 µm
14
10 µm

irregularly muriform, brown or olive green becoming distinctly paler towards the base, smooth, slightly narrower at the septa, 18–24 × 22–35 µm, with one hyaline conidiogenous cell sometimes present at the base, 10–13 µm diam.

SUBSTRATUM — Spathe of *Syagrus romanzoffiana* and petiole of *Butia yatay*.

MATERIAL EXAMINED — **ARGENTINA. Misiones, Dpto Iguazú:** IGUAZÚ NATIONAL PARK. Col. Capdet, M. & Romero, A.I. 07.V.2008 (BAFC 51678); **Entre Ríos, Dpto Colón:** EL PALMAR NATIONAL PARK. Col. Capdet, M. & Romero, A.I. 03.II.2009 (BAFC 51679).

GEOGRAPHIC DISTRIBUTION — Finland (Moore 1959).

REMARKS — The measurements for this species are close to those given by Moore (1959): 18–24 × 22–35 µm vs 18.5–26 × 26.5–34 µm. *Berkleasmium corticola* was first described by Karsten on birch from Finland, in a cold climate very different from subtropical Misiones.

Berkleasmium sinense Joanne E. Taylor, K.D. Hyde & E.B.G. Jones, Fungal Diversity Res. Ser. 12: 302 (2003). PL. 2 FIG. 25–28

TELEOMORPH — Unknown.

ANAMORPH — SPORODOCHIA punctiform, black, shining, scattered and discrete, 0.3 mm diam. MYCELIUM immersed in the substratum, composed of pale brown, branched hyhae. CONIDIOPHORES simple, semimacronematous. CONIDIOGENOUS CELLS hyaline, terminal, cylindrical, integrated, 2.5–3 µm diam. CONIDIA solitary, oval to ellipsoidal, irregularly muriform, brown or olive green becoming distinctly paler towards the base, smooth, slighty narrower at the septa, 42–52.5 × 18–28.5 µm, with 1–3 hyaline subtending cells at the base 9–12 µm diam.

SUBSTRATUM — Rachis of *Euterpe edulis*.

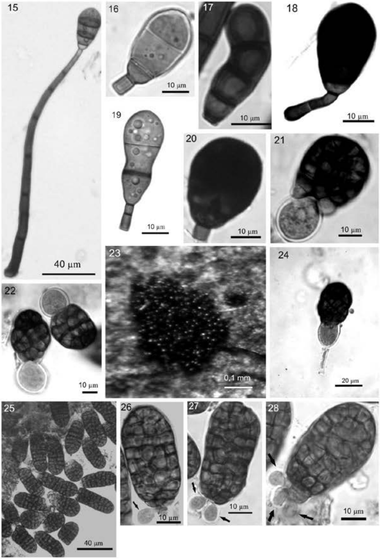
MATERIAL EXAMINED — **ARGENTINA. Misiones, Dpto Iguazú:** IGUAZÚ NATIONAL PARK. Col. Capdet, M. & Romero, A.I. 16.X.2008 (BAFC 51680).

GEOGRAPHIC DISTRIBUTION — China (Taylor & Hyde 2003).

REMARKS — The genus *Berkleasmium* Zobel, comprises approximately 34 species. Several have hyaline subtending cells. Measurements in the original description of *B. sinense* (Taylor & Hyde 2003) are similar to those in our material, but the subtending cells are smaller in our material. The Chinese specimen was recorded on *Trachycarpus fortunei* in a tropical climate.

PLATE 2 FIGS. 15–20. *Brachysporiella gayana*. 15: Conidiophore with conidia. 16–20: Conidia. FIGS. 21–24. *Berkleasmium corticola*. 23: General aspect. 21–24: Conidia with rest of conidiogenous cells. FIGS. 25–28. *Berkleasmium sinense*. Conidia (arrow = subtending cells).

Scale bars: FIG. 15, 25 = 40 µm; FIG. 16–22, 26–28 = 10 µm; FIG. 23 = 0.1 mm; FIG. 24 = 20.


15
16
17
18
19
20
21
22
23
24
25
26
27
28
40 µm
10 µm
0,1 mm
20 µm

Dictyosporium cocophylum Bat., Bol. Secr. Agric., Pernambuco 18: 5 (1951). PL. 3 FIG. 29–31

TELEOMORPH — Unknown.

ANAMORPH — COLONIES composed of sporodochia, black, opaque. CONIDIA 42–54 × 20–24 µm, cheiroid, not complanate, consisting mostly of 7 arms of cells forming, brown or olive-brown, cylinders, arms 7 µm wide, number of cells usually average 46 per conidia, appendages absent.

SUBSTRATUM — Floral rachis of *Butia yatay*.

MATERIAL EXAMINED — **ARGENTINA. Entre Ríos, Dpto Colón:** EL PALMAR NATIONAL PARK. Col. Capdet, M. & Romero, A.I. 15.IV.2009 (BAFC 51681).

GEOGRAPHIC DISTRIBUTION — Brazil (Goh et al. 1999).

REMARKS — Compared with the description by Goh et al. (1999), conidia in the Argentine material are smaller: 42–54 × 20–24 µm vs 53–76 × 19–22 µm. This may be because the conidia were not yet fully formed. This species was described from leaves of *Cocos nucifera* L. in association with lesions (Goh et al. 1999).

In Argentina, Spegazzini (1908) described *Dictyosporium yerbae* Speg. and Arambarri et al. (1987, 2001) reported two other species: *D. elegans* Corda and *D. triramosum* Aramb. et al.

Dictyosporium zeylanicum Petch, Ann. R. bot. Gdns Peradeniya 6(3): 252 (1917). PL. 3 FIG. 32–34

TELEOMORPH — Unknown.

ANAMORPH — COLONIES sporodochia, black, opaque. MYCELIUM branched, brown. CONODIOPHORES micronematous. CONIDIOGENOUS CELLS difficult to observe. CONIDIA cheiroid, complanate, consisting mostly of 5 arms of cells, the central arm dark brown, the next 2 arms lighter brown and the outer arms even lighter, often narrower at the septa, 28–34 × 20–23 µm, arms 5 µm wide, number of cells usually average 28, cells which are narrower at septa appearing more or less square, appendages absent.

SUBSTRATUM — Peduncle of *Euterpe edulis*.

MATERIAL EXAMINED — **ARGENTINA. Misiones, Dpto Iguazú:** IGUAZÚ NATIONAL PARK. Col. Capdet, M. & Romero, A.I. 17.X.2008 (BAFC 51682).

GEOGRAPHIC DISTRIBUTION — Brazil (Grandi & Silva 2006); Sri Lanka (Goh et al. 1999).

REMARKS — The present specimen agrees with the description by Goh et al. (1999), the only difference being the conidial size, which is slightly smaller in the Argentine material: 26–40 × 13–25 µm vs 28–34 × 20–23 µm.

Sporidesmium macrurum (Sacc.) M.B. Ellis, Mycol. Pap. 70: 53 (1958).

Pl. 3 Fig. 35–36

TELEOMORPH — Unknown.

ANAMORPH — COLONIES effuse, black, hairy. MYCELIUM partly superficial on the substratum branched, septate, hyaline to brown. CONIDIOPHORES macronematous, mononematous, up to 150 μm long, 4–5 μm wide, simple, septate, brown, swollen at the apex. CONIDIA straight or curved, rostrate, obclavate, 3- to 4-septate, smooth, becoming gradually paler towards the apex, basal cell dark brown and adjacent cell olive brown, 35–50 × 8–10 μm, 1–2 μm near the apex, 3–4 μm wide at the base.

SUBSTRATUM — Sheath of *Syagrus romanzoffiana*.

MATERIAL EXAMINED — ARGENTINA. **Misiones, Dpto Iguazú:** IGUAZÚ NATIONAL PARK. Col. Capdet, M. & Romero, A.I. 07.V.2008 (BAFC 51683).

GEOGRAPHIC DISTRIBUTION — Ghana, Indonesia, Malaysia (Ellis 1958); Papua-New Guinea (Matsushima 1971); Cuba (Holubová-Jechová & Mercado Sierra 1984); Puerto Rico (Cybertruffle's Robigalia 2009).

REMARKS — *Sporidesmium macrurum* is very common on palms. The conidia of the present collection have smooth walls and are smaller (35–50 × 8–10 μm vs 40–55 × 9–11) than those described by Ellis (1958).

Endocalyx melanoxanthus (Berk. & Broome) Petch., Ann. Bot. Lond. 22: 390. (1908) var. ***melanoxanthus*** PL. 3 FIG. 37–38

TELEOMORPH — Unknown.

ANAMORPH — CONIDIOMATA scattered, cupulate or cylindrical, brightly yellow or greenish yellow, 0.35 × 0.6 mm, peridial hyphae enclosing the inner black conidial mass. CONIDIOGENOUS CELLS holoblastic, cylindrical, integrated or terminal. CONIDIA solitary, 12–17 × 10–12 μm, reniforme, round or oval, dark brown, rugose, with a hyaline germ slit.

SUBSTRATUM — Sheath, petiole, rachis and peduncle of *Syagrus romanzoffiana*. Petiole of *Euterpe edulis* and *Butia yatay*.

MATERIAL EXAMINED — ARGENTINA. **Misiones, Dpto Iguazú:** IGUAZÚ NATIONAL PARK. Col. Capdet, M. & Romero, A.I. 17.VI.2009 (BAFC 51684); 20.VIII.2008 (BAFC 51685); 24.IV.2008 (BAFC 51686); **Entre Ríos, Dpto Colón:** EL PALMAR NATIONAL PARK. Col Capdet, M. & Romero, A.I. 20.VIII.2008 (BAFC 51685).

GEOGRAPHIC DISTRIBUTION — Ghana (Hughes 1952); Sri Lanka, Jamaica, Malaysia, Papua-New Guinea, Pakistan, Philippines, Sierra Leone, USA (Ellis 1971); Taiwan (Matsushima 1980); Japan (Okada & Tubaki 1984); Cuba (Holubová-Jechová & Mercado Sierra 1984); Peru (Matsushima 1993); Mexico (Heredia et al. 2000); Puerto Rico (Cybertruffle's Robigalia 2009).

Remarks — The examined material fits the description of Holubová-Jechová and Mercado Sierra (1984). *Endocalyx melanoxanthus* is very common in different palms, but its pathogenicity is uncertain. This anamorph was collected in all seasons and with high frequency.

Ernakulamia cochinensis (Subram.) Subram., Kavaka 22/23: 67 (1996, "1994/1995") Pl. 3 Fig. 39

Teleomorph — Unknown.

Anamorph — Colonies effuse, dark brown or black. Mycelium superficial. Conidia solitary, muriform, variable in shape, obconical or piriform, dark brown or black, often verrucose, 43–97 × 31–65 µm, with up to 12-septate appendages, pale brown, up to 90 µm long, 3–4 µm wide.

Substratum — Spathe of *Syagrus romanzoffiana*.

Material examined — ARGENTINA. Misiones, Dpto Iguazú: Iguazú National Park. Col. Capdet, M. & Romero, A.I. 07.V.2008 (BAFC 51687).

Geographic distribution — India (Ellis 1976); Japan, Mexico (Heredia Abarca et al. 1997); Cuba (Holubová-Jechová & Mercado Sierra 1986; Mercado Sierra et al. 1997, 2005); Malaysia (Cybertruffle's Robigalia 2009).

Remarks — Subramanian (1996) proposed the genus *Ernakulamia* for *Petrakia cochinensis* Subram., because he considered it as distinct from the type species *Petrakia echinata* (Peglion) Syd. & P. Syd. and *Piricauda* Bubák to which Ellis (1976) had transferred the taxon as *Piricauda cochinensis* (Subram.) M.B. Ellis. Most authors (Heredia Abarca et al. 1997, Taylor & Hyde 2003, Mercado Sierra et al. 1997, 2005) follow Ellis (1976) and retain the species in *Piricauda* without taking into account Subramanian (1996).

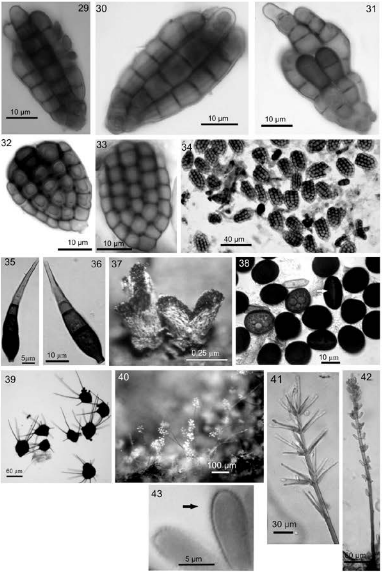
The above description of this species agrees with descriptions by Ellis (1976), Heredia Abarca et al. (1997), and Mercado Sierra et al. (1997, 2005); the conidial size range in the Argentine collection includes the size range given by Heredia Abarca et al. (1997): 43–97 × 31–65 µm vs 60–73 × 55–65 µm.

Musicillium theobromae (Turconi) Zare & W. Gams, Nova Hedwigia 85(3–4): 482 (2007). Pl. 3 Fig. 40–41

Teleomorph — Unknown.

Plate 3 Figs. 29–31. *Dictyosporium cocophylum*. Conidia. Figs. 32–34. *Dictyosporium zeylanicum*. Conidia. Figs. 35–36. *Sporidesmium macrurum*. Conidia. Figs. 37–38. *Endocalyx melanoxanthus* var. *melanoxanthus*. 37: General aspect of ascomata. 38: Conidia (arrow= full length germ slit). Fig. 39. *Ernakulamia cochinensis*. Conidia. Figs. 40–41. *Musicillium theobromae*. 40: Aspect general. 41: Conidiogenous cells. Figs. 42–43. *Stachylidium bicolor*. 42: Conidiophore. 43: Conidiophore with echinulate conidiogenous cells.

Scale bars: Fig. 29–33, 36, 38 = 10 µm; Fig. 34 = 40 µm ; Fig. 36, 43 = 5 µm; Fig. 37 = 0.25 mm; Fig. 39 = 60 µm; Fig. 40 = 100 µm; Fig. 41 = 30 µm; Fig. 42 = 80 µm.


29
10 µm
30
10 µm
31
10 µm
32
10 µm
33
10 µm
34
40 µm
35
5µm
36
10 µm
37
0,25 µm
38
10 µm
39
60 µm
40
100 µm
41
30 µm
42
30 µm
43
5 µm

Anamorph — Colonies scattered, pilose, black or brown. Mycelium composed of immersed, smooth, branched hyphae, septate, hyaline or brown, 2.5–3.5 µm wide. Conidiophores straight, enclosed, dark brown at the base to light brown at the apex, up to 360 µm long, 4.5–7.5 µm wide. Conidiogenous cells in whorls of 3–6, hyaline, scarcely tapering towards the tip, 15–65 µm long, 2–5 µm wide at the base. Conidia cylindrical or spherical, hyaline 3–7 × 2–3 µm.

Substratum — Floral rachis of *Euterpe edulis*.

Material examined — ARGENTINA. Misiones, Dpto Iguazú: Iguazú National Park. Col. Capdet, M. & Romero, A.I. 16.X.2008 (BAFC 51688).

Geographic distribution — Spain, Colombia, Portugal, Jamaica, Zimbabwe (Hughes 1951); Taiwan (Matsushima 1980); Georgia (Holubová-Jechová 1980), Cuba (Mercado Sierra et al. 1997); Brazil, Egypt, India, Iran, Nigeria (Zare et al. 2007); Australia, Nicaragua, Oman, Puerto Rico, Trinidad & Tobago, Venezuela (Cybertruffle's Robigalia 2009).

Remarks — *Musicillium theobromae* is perhaps best known as *Verticillium theobromae* (Hawksworth & Holliday 1970a), but Zare et al. (2007) recently established a new genus, *Musicillium*, based mainly on molecular characters. This species is a causal agent of "cigar-end rot" of banana. Morphologically similar to *V. albo-atrum* Reinke & Berthold, which also produces have dark conidiophores, *Musicillium theobromae* differs in its smaller conidia (3–7 × 2–3 µm vs 3.5–10.5 (–12.5) × 2–4 µm) and torulose mycelium (Hawksworth & Holliday 1970b).

Stachylidium bicolor Link, Mag. Gesell. Naturf. Freunde, Berlin 3: 15 (1809).

Pl. 3 Fig. 42–43

Teleomorph — Unknown.

Anamorph — Colonies scattered, olivaceous brown. Mycelium immersed in the substratum. Conidiophores solitary or clustered, up to 600 µm long, 3–5 µm wide, unbranched, septate, brown and light brown towards the apex, echinulate from the middle towards the apex, with whorls of 2–6 conidiogenous cells from the mid point upwards. Conidiogenous cells oval to oval-cylindrical, pale brown, echinulate, 9–14 × 4–5 µm. Conidia cylindrical to ellipsoidal, smooth, pale brown, oval, 4–6 × 2–2.5 µm.

Substratum — Floral rachis of *Euterpe edulis*.

Material examined — ARGENTINA. Misiones, Dpto Iguazú: Iguazú National Park. Col. Capdet, M. & Romero, A.I. 16.X.2008 (BAFC 51724).

Geographic distribution — Ghana (Hughes 1952); Japan (Matsushima 1975); Uganda (Matsushima 1980); Georgia (Holubová-Jechová 1980); Mexico (Heredia Abarca et al. 1997); Cuba, Malaysia, New Zealand, Papua-New Guinea, Sierra Leone, Solomon Islands, Taiwan, Venezuela, Zimbabwe (Cybertruffle's Robigalia 2009).

REMARKS — The description matches that by Matsushima (1975, 1980) except for conidial sizes which are, however, within the range he provided.

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MYCOTAXON

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Lichens of Ordu Province, Turkey

Kadir Kinalioğlu

kkinalioglu@hotmail.com
Giresun University, Faculty of Science and Arts, Department of Biology
Giresun, Turkey

Abstract – 314 taxa belonging to 99 genera are reported from Ordu province in the Central Black Sea region of Turkey. 263 taxa are reported for the first time from the province, and three species, *Arthopyrenia persoonii*, *Sphinctrina leucopodia*, and *Verrucaria submersella*, are new records for Turkey. The full checklist is available on http://www.mycotaxon.com/resources/weblists.html

Key words – Aydoğan hill, biota, biodiversity

Introduction

In the last two decades lichenological studies in Turkey have increased remarkably (e.g., Candan & Özdemir Türk 2008, Halıcı & Aksoy 2009, John & Nimis 1998, Kınalıoğlu 2009, Özdemir Türk 2003, Öztürk et al. 2005, Yazici & Aptroot 2008). However, the lichen composition of some provinces is still insufficiently known. One of these provinces is Ordu, situated in the central part of the Black Sea region of Turkey (Fig. 1). There have been four studies referring to lichens in Ordu province (Steiner 1909, Kınalıoğlu et al. 1998, John et al. 2000, Aslan et al. 2006). In these studies, a total of only 94 lichen taxa are cited from the province, suggesting that its lichen biota is very poorly known. The present study adds further information to our knowledge of the lichen biota of Turkey and in particular of Ordu.

Data here are compiled from Ordu, based on collections from 63 sites visited between 20 March 2004 and 2 November 2008. Turkey has three main floristic regions: the Euro-Siberian floristic region, the Mediterranean floristic region, and the Irano-Turanian floristic region. Ordu is located within the boundaries of the Euxianian section of the Euro-Siberian floristic region. It is situated at 40°18'–41°08' N, 36°52'–38°12' E at altitudes ranging from sea level to 3038 m. The province has an area of 6001 km², generally of rough topography. The most important peaks of Ordu are Kırgızlar peak (3038 m), Aşıt peak (2569 m), Eriço peak (2298 m), Deveci Mountain (1907 m), and Aydoğan peak

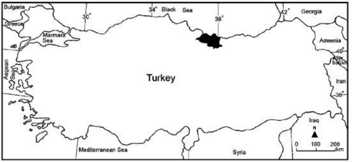

Fig. 1. Map of Turkey showing Ordu province.

(1971 m). There are also some facies plateaux at high altitudes, mainly Çambaşı, Perşembe, Keyfalan, Topçam, Argan, and Aydoğan. Upper Cretaceous volcanic facies (agglomerata, dacite, diorite, granodiorit) are mostly present. There are various big streams in the province such as Melet stream, Bülbül stream, and Civil stream. Small plains, which cover relatively minor areas, exist near the coastal area and stream mouths. The wide altitudinal variation, rough topography, influence of the adjacent sea, and big streams of the Ordu provide a wide range of climatic zones. However, oceanic climate prevails in Ordu. The mean rainfall per year is 1029.2 mm, the highest precipitations occur in October and December and the lowest in May and July. On average, there are 178 rainy days and 6 snowy days on a yearly basis. The mean annual maximum temperature is 27.5°C in August, while the mean minimum temperature is 3.9°C in February. The mean annual relative humidity is 76%. Vegetation cover varies with climate and altitude. Up to 1500 m, deciduous trees (*Alnus* spp., *Carpinus* spp., *Castanea sativa*, *Fagus orientalis*, *Quercus* spp.) and shrubs (e.g., *Corylus* spp., *Rhododendron* spp.) prevail. *Corylus* species are important crop plants as well. At 1500–1900 m the forest consists of *Picea orientalis* and *Pinus sylvestris* (Atalay 1994), which provide suitable habitats for a rich lichen flora. Above 1900 m alpine meadows are dominant.

Materials and methods

The collections were identified following standard techniques using various lichen guides (Brodo et al. 2001, Goward 1999, Purvis et al. 1992, Wasser 2005, Wirth 1995). Air-dried samples were examined using a stereo microscope and a light microscope. All samples are stored in the herbarium of the Faculty of Science and Arts, Giresun University, Giresun, Turkey. Lichen species new to Turkey are indicated by # in the Checklist, those new to Ordu province by *.

Results and discussion

Three of the lichen species in the Checklist are newly recorded for Turkey: *Arthopyrenia persoonii* A. Massal., *Sphinctrina leucopoda* Nyl., and *Verrucaria submersella* Servit are newly recorded for Turkey. *Arthopyrenia persoonii* might have been overlooked in Turkey in the past because of its inconspicuous appearance; the species, which colonizes the bark of deciduous trees such as *Fraxinus* sp. and *Juglans* sp. in Europe (Wirth 1994 & Berger et al.), was collected from the smooth bark of *Juglans regia*.

Sphinctrina leucopoda is pathogenic or commensalistic on *Pertusaria pertusa* (more rarely on other *Pertusaria* and *Diploschistes* species), in Europe and America particularly on old deciduous trees (Purvis et al. 1992); in Ordu it was lichenicolous on *Pertusaria pertusa* on *Corylus* sp. at 1080 m. *Verrucaria submersella,* which grows on wet noncalcareous rocks in the mountains of middle Europe (Ozenda & Clauzade 1970, Clauzade & Roux 1985), seems restricted to the stream banks at altitudes >1800 m. *Ionaspis lacustris* and *Usnea intermedia* are recorded for the second time from Turkey. *Ionaspis lacustris* is known throughout Europe and North America (Purvis et al. 1992) and in Europe is mainly found in the mediterranean mountain regions. In Turkey, it has been previously recorded from Akşehir (Steiner 1916). *Usnea intermedia* is known from Europe often on coniferous trees in submontane environments (Randlane et al. 2009); in Turkey, it was previously recorded from Bursa (Verseghy 1982).

The richness of geographical features of the Ordu (wide altitudinal range, rough topography and maritime influence) offers a wide range of niches so that a rich lichen biodiversity can be expected. Furthermore, due to the ecological features of the province, lichen species distributed elsewhere in Europe, America, and Asia co-occur with local lichens, leading to a rich lichen diversity. The number of known lichen taxa in Ordu, including records from the present study, is now 357. However, additional studies are necessary to extend the knowledge of the Ordu lichen biota, with the inner parts of the province particularly poorly explored.

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Lichenological notes 1: *Acarosporaceae*

Kerry Knudsen[1] & Jana Kocourková[2]

kk999@msn.com & kocourkovaj@fzp.czu.cz

[1]*Herbarium, Department of Botany and Plant Sciences, University of California Riverside CA, 92521-0124, USA*

[2]*Department of Ecology, Faculty of Environmental Sciences Czech University of Life Sciences Prague Kamýcká 129, Praha 6 - Suchdol, CZ-165 21, Czech Republic*

Abstract — A neotype is designated for *Acarospora interjecta*. *Acarospora pyrenopsoides* is not recognized as occurring in Canada. *Sarcogyne crustacea* is a new name for *Biatorella terrena*, a rare terricolous species from southern California, which is revised.

Key words — biological soil crusts, lichenicolous lichens

1. ***Acarospora interjecta*** H. Magn., Meddel. Göteborgs Bot. Trädgard 5: 69 (1930).

Type: **U.S.A. New Mexico:** Las Vegas, 1927, *Bro. G. Arséne 19749* (FH, neotype **designated here**).

Acarospora interjecta is a lichenicolous lichen parasitic on the yellow effigurate *Acarospora novomexicana* H. Magn. It was described from a single specimen in the herbarium of Bouly de Lesdain collected by Brother G. Arséne in New Mexico (Magnusson 1930). The holotype is believed to have been lost in the bombing of Dunkirk during WW2 when B. de Lesdain's herbarium was destroyed. No isotypes were cited in the original publication. At Farlow Herbarium (FH), the first author examined specimens of *A. novomexicana* collected in Las Vegas, New Mexico, by Brother G. Arséne, searching for other possible specimens of *A. interjecta*. Only one specimen of *A. interjecta* was found, but with several apothecia, growing on a paratype of *Acarospora novomexicana* on sandstone. It perfectly matches the protologue (Magnusson 1930) which, based on a scanty type, describes a brown species with rather thick paraphyses (2–3 μm), broadly globose to ellipsoid ascospores (3–4 × 2–2.5 μm) and asci (70–80 × 20 μm) with about 100 ascospores per ascus. The hymenium ranged from 100–170 μm in height. We further observed that the ascospores begin globose but in maturity become broadly ellipsoid [a development seen in some species like *A. strigata* (Nyl.) Jatta] and have a distinct perispore. We designate this specimen as a neotype.

Three other parasitic species of *Acarosporaceae* known from North America have ascospores with distinct perispores: two lichenicolous lichens [*Acarospora stapfiana* (Müll. Arg.) Hue on *Caloplaca* species and *A. succedens* H. Magn. on *Dimelaena oreina* (Ach.) Norman (Knudsen 2008a)] and one lichenicolous fungus [*Sarcogyne sphaerospora* J. Steiner on *Candelariella* species (Lendemer et al. 2009)]. Magnusson compared *A. interjecta* to *A. anatolica* H. Magn., a parasitic species known only from the holotype collected in Turkey on *D. oreina* (Magnusson 1930). *Acarospora anatolica* differs mainly from *A. interjecta* in having thinner paraphyses (1–1.5 µm) and in developing a thick elongated mycelial base (gomphate). The type of *A. anatolica* (BP) is scant and we hope to eventually evaluate new collections from Turkey.

2. *Acarospora pyrenopsoides* H. Magn., Meddel. Göteborgs Bot. Trädgard 2: 74 (1926).

TYPE: **GREENLAND.** NENNESE, *J. Vahl* (UPS, HOLOTYPE).

Acarospora pyrenopsoides was described from a collection by J. Vahl from Nennese on the east coast of Greenland (Magnusson 1926). It is a brown *Acarospora*, lacking secondary metabolites, forming a contiguous thallus several centimeters wide. For a description see Magnusson (1929: 156–157, not on page 356 as listed in the monograph index!). Magnusson considered it a distant relative of *A. nitrophila* H. Magn. and reported other specimens from Austria, Denmark, and Finland (Magnusson 1929). *Acarospora pyrenopsoides* was reported from Ellesmere Island in the Nunavut Territory of Canada (Thomson & Scotter 1985). The species is included on the checklist of the lichen-forming, lichenicolous, and allied fungi of the continental United States and Canada based on that report (Esslinger 2009). The collection was made by George W. Scotter and determined by John W. Thomson, who put a question mark by his determination. The first author recently compared the Scotter collection with the holotype from Greenland and they are not conspecific, differing distinctly in thallus types. Scotter's specimen has dispersed verruca while *A. pyrenopsoides* has a contiguous areolate thallus that is much darker in color too. Unfortunately, the small Scotter collection was not any species with which we are familiar and should be re-examined in the future after the *Acarosporaceae* for Fennoscandia are revised by Martin Westberg for the Nordic Lichen Flora series.

SPECIMEN EXAMINED. – **CANADA. NORTHWEST TERRITORIES:** ELLESMERE ISLAND, 79° 59′ N 85° 50′ 46″ W, 11.iv.2009, *Scotter* (WIS).

3. *Sarcogyne crustacea* K. Knudsen & Kocourk., **nom. nov.**

MycoBank MB 516741

= *Biatorella terrena* Hasse, The Bryologist 14 (1): 3 (1911), non *Sarcogyne terrena* H. Magn. 1935.

Type: **U.S.A. california: Los Angeles Co.,** San Gabriel Mountains, north fork of San Gabriel Canyon, Squirrel Inn, 1300 m, on earth between stones and base of rocks, vii.1901 *H.E. Hasse* (FH, **holotype**).

Biatorella terrena was described in The Bryologist (Hasse 1911) but not included in the flora of southern California (Hasse 1913) or the recent treatment of *Sarcogyne* for the Sonoran desert region (Knudsen & Standley 2008). It was only known from the holotype collected by Hasse. Neither Magnusson (1935) nor Knudsen & Standley (2008) saw the type until the first author of this paper discovered the holotype of *B. terrena* during a visit to the Farlow Herbarium (FH) in 2009. Hasse, who had not re-labeled the holotype before his death in 1915, wrote only the working name "*Biatorella fuscata*. Type" on the packet. We were in the process of describing a conspecific *Sarcogyne* but were hesitating because we had not been able to collect more substantial specimens for a type and for photography. We were happy that Hasse had already described the species.

Only one other species of terricolous *Sarcogyne* has been described, *Biatorella terrena* H. Magn. from Brazil (Magnusson 1927). Magnusson's name was illegitimate (a later homonym of *B. terrena* Hasse), which he rectified when he revised his species as *Sarcogyne terrena* H. Magn. (Magnusson 1935). Hasse's species now fits in the modern concept of *Sarcogyne* Flot. (Knudsen & Standley 2008). Because Magnusson had already used the specific epithet *terrena* in the genus *Sarcogyne*, we here propose a new name for Hasse's species, *S. crustacea*. *Sarcogyne terrena* needs a modern revision, but differs from *S. crustacea* especially in the lack of a corticated thallus, much smaller apothecia (0.2–0.3 mm in diam.) without a distinctly crenulate margin, the lack of an algal layer beneath the apothecium, and no observed pycnidia (Magnusson 1935).

The thallus of *Sarcogyne crustacea* is continuous, to 10 cm across, forming "pseudo-areoles" caused by splitting and drying of the soil separating the thallus into sections. The thallus is corticate, light beige to gray, with abundant black dots of pycnidia or nascent or abundant erumpent or sessile apothecia. The thallus is often partially or completely covered by soil particles or eroded. The cortex is up to 50 µm thick: the upper layer 5–7 µm thick, formed of the conglutinated and expanded apices of hyphae in a dark brown pigment zone, with a thin syncortex (sensu Knudsen 2008a) sealing the upper surface; the lower layer is 30–45 µm thick, hyaline, the hyphae irregularly oriented, 2–3(–4) µm in diam., septate, to subparaplectenchymatous, cells to 4 µm length. The algal layer is 10–50 µm thick, continuous, and uninterrupted, extending below the apothecia, but varying in height, algal cells mostly 7–10 µm in diam. The medulla is grayish-white, to 100 μm tall, thoroughly mixed with soil particles, gelatinized, with branching anticlinal hyphae, hyaline, 3–4 μm in diam., thin-walled, cells 3–7 μm long or septa indistinct. The apothecia are abundant, round, 0.4–1.5 mm in diam. and sessile. The margin is black, smooth in young apothecia to knobby and crenulate in older apothecia, becoming flexuous. The disc is smooth to rugulose, epruinose, and black or red, often redder when wetted. The exciple is up to 100 μm thick of radiating hyphae mostly 2 μm in diam., septate, cells 3–5 μm long, hyaline, outer layer formed of melanized hyphal apices, dark brown to black. The hymenium is 85–130 μm high, conglutinated. The epihymenium is dark brown, 10 μm thick, paraphyses mostly 2 μm in diam., branching, and apices not expanded or barely expanded, septate, cells 5–10 μm long, with some oil drops. The asci are 60–80 × 20 μm, with about 100 ascospores per ascus. The ascospores are simple, hyaline, mostly 4–5 × 1.5–2.0 μm. The subhymenium is 20–30 μm thick, I+ blue turning red. The hypothecium is indistinct. The conidiomata are pycnidial, abundant, globose, ca. 100 μm in diam., wall thin, exposed ostiole area black. Conidiogenous cells 5–10 × 1.0–2.0 μm, conidia hyaline, 4–5(–5.5) × 0.5–1.0 μm. The species lacks secondary metabolites detectable by spot tests.

Sarcogyne crustacea is currently only known from two sites in southern California in western North America. It occurs on thin granite-derived coarse-grained and rocky soils over granite bedrock in the Santa Ana and San Jacinto Mountains in Riverside County from 940–1100 meters in chaparral areas. In the modern collections, *S. crustacea* is a component of biological soil crusts in terraces formed by *Selaginella bigelovii* Underw., a species endemic to southern California. Associated lichen species growing on soil or decaying granite include such rare Sonoran endemics such as *Acarospora thelococcoides* (Nyl.) Zahlbr., *Aspicilia glaucopsina* (Nyl. ex Hasse) Hue, and *Ramonia gyalectiformis* (Zahlbr.) Vězda as well as some more wide-spread species including *Acarospora obpallens* (Nyl. ex Hasse) Zahlbr., *Candelariella citrina* B. de Lesd., *Placidium lacinulatum* (Ach.) Breuss, *Psora californica* Timdal, *P. luridella* (Tuck.) Fink, and *Toninia aromatica* (Turner) A. Massal. The holotype of *S. crustacea* is a historical record from the San Gabriel Mountains at 1300 m in Los Angeles County; it was collected between stones and at the base of rocks on soil and is mixed with an unknown lichen and a moss.

Sarcogyne crustacea is extremely rare. Terricolous habitats in coastal southern California have been severely reduced by development, the remaining habitat often degraded by grazing, recreational use, invasive weeds, and fire (Knudsen & Magney 2006, Knudsen 2008b, Knudsen & Kocourková 2009). Consequently, biological soil crusts comprised predominately of lichens are now relatively rare although Hasse reported terricolous lichens as common at beginning of 20th century (Hasse 1913). Because of the reduction of biological soil crusts, some species reported as common such as *Acarospora schleicheri* (Ach.) A. Massal. at beginning of 20th century (Hasse 1913) are now rare (Knudsen & Kocourková 2009). Some terricolous species possibly are already extinct like *Buellia bolacina* Tuck., a unique species known only from the holotype (Bungartz et al. 2008). Terricolous species, often rare, continue to be discovered and described from southern California, including recently several *Psora* (Timdal 2002) and *Cladonia* species (Ahti & Hammer 2002, Knudsen & Lendemer 2009), *Caloplaca obamae* K. Knudsen (Knudsen 2009), and a new *Rinodina* soon to be described by John Sheard.

Both the type of *Sarcogyne crustacea* and our best specimen from the Santa Ana Mountains are relatively poor. If better specimens are collected in the future, an epitype is needed as well as material for sequencing for phylogenetic analysis. We hope eventually to obtain good photographs of the species to present in one of our future floristic papers on the southern California lichen biota.

SPECIMEN EXAMINED. – **U.S.A. CALIFORNIA: Riverside Co.,** SANTA ANA MOUNTAINS, ELSINORE PEAK, south-facing slope on spike moss terraces above paved road, 33° 35' 48" N 117° 20' 21" W, 1101 m, 23.vi.2009, *K. Knudsen 11473 & R. Hernandez* (UCR); SAN JACINTO MOUNTAINS, spike-moss terraces on slope above San Jacinto River and Hwy 74, 33° 42' 39" N 116° 46' 36" W, 940 m, thallus eroded and covered with soil, 11.xi.2003, *K. Knudsen 689* (ASU, UCR).

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Dictyostelids from Ukraine 2: two new records of *Dictyostelium*

Pu Liu[1] & Yu Li[2]*

[1]*puliu1982@yahoo.com* & [2]*yuli966@126.com*
Engineering Research Center of Chinese Ministry of Education for Edible and Medicinal Fungi, Jilin Agricultural University
Changchun 130118, P. R. China

Abstract — Two species of *Dictyostelium* are reported for the first time in Ukraine. *D. magnum* and *D. brefeldianum* were isolated from forest soil and leaf litter collected from Yalta, Crimea, Ukraine. The descriptions and photographs of their important life cycle stages are provided based on Ukraine materials. The specimens have been deposited in the Herbarium of Mycological Institute of Jilin Agricultural University (HMJAU), Changchun, China.

Key words —cellular slime mold, taxonomy

Introduction

Dictyostelid cellular slime molds, or dictyostelids, are a relatively small but quite remarkable group of organisms (Raper 1984). In the life cycle, they share the protozoan characteristics of myxamoebae and pseudoplasmodia and fungal characteristics of fructifications and spores. Since Oskar Brefeld (1869) reported the first species of cellular slime mold and named *D. mucoroides* Bref., approximately 60 *Dictyostelium* species have been described (Kirk et al. 2008). *Dictyostelium* is the oldest and largest dictyostelid genus. The present paper is the second report of dictyostelids in Ukraine since *D. implicatum* H. Hagiw. and *D. tenue* Cavender, Raper & Norberg were first isolated from this country (Liu & Li 2010).

Materials and methods

The soil and leaf litter samples were collected during October 2008 in Baydar Valley, Eski-Kermen and Angara Valley, Yalta, Crimea, Ukraine. The samples were refrigerated at 4°C and isolated according to He & Li (2008). Five agar plates were established and incubated at 23°C with 12 h light and 12 h darkness.

*Corresponding author

The locations of each early aggregating clone and sorocarps were marked. The life cycle stages of cell aggregation, pseudoplasmodium, and sorocarp were observed under a Nikon dissecting microscope (SMZ1500) with 0.75–11.25× range (10× oculars). Spores, stalks, and sorocarps were measured using a Nikon light microscope (SMZ1000) with 10× oculars and 10, 40, and 100× (oil) objectives. Photographs were taken with a CANON S70 camera.

Results

1. ***Dictyostelium magnum*** H. Hagiw., Bull. Natn. Sci. Mus., Tokyo, Ser. B, 9(4): 155 (1983). FIG. 1 A–E

Sorocarps solitary, usually unbranched, phototropic, sometimes prostrate. Sorophores colorless, sinuous, 0.7–11.0(–60) mm long, usually tapering from bases to tips, bases expanded and stout, tips blunt. Sori white, globose, 30–500 µm diam. Spores hyaline, elliptical, usually 6.5–8.8 × 3.5–5.0 µm, without polar granules. Cell aggregations radiate. Pseudoplasmodia not migrating without sorophore formation, usually producing single sorogens. Myxamoebae irregular or triangular in the direction of movement.

SPECIMENS EXAMINED: MR041. Isolated from forest soil collected by the authors in Angara Valley (10 Oct. 2008, S0299-2), Yalta, Crimea, Ukraine in 2009. Deposited at the Herbarium of Mycological Institute of Jilin Agricultural University (HMJAU), Changchun, China.

COMMENTS—*Dictyostelium magnum* is a gigantic species. It is most likely to be confused with three other very large species — *D. firmibasis* H. Hagiw. (Hagiwara 1971), *D. giganteum* B.N. Singh (Raper 1984), and *D. septentrionale* Cavender (Raper 1984). The spores of *D. magnum* are, however, stouter and shorter than those of *D. firmibasis* (6.2–9.2 × 2.7–4.0 µm). Hagiwara et al. (1992) suggested *D. magnum,* isolated from soil samples collected in Taiwan, is probably synonymous with *D. giganteum,* and later mating tests by Hagiwara (1992) support this synonymy. Our research shows that these two species differ in spore and sorocarp sizes. The spores of *D. magnum* (6.5–8.8 × 3.5–5.0 µm) are bigger than those of *D. giganteum* (5.5–7.2 × 2.1–3.9µm). The sorocarps of *D. magnum* are somewhat smaller [0.7–11.0(–60) mm] than those of *D. giganteum* (0.5–70 mm). Such differences support their separation as two distinct species. In the laboratory, *D. septentrionale* itself needs lower temperature conditions (12–19 °C) and fails to fruit at higher temperatures (Raper 1984), whereas *D. magnum* could be cultured at 20–23 °C.

2. ***Dictyostelium brefeldianum*** H. Hagiw., Bull. Natn. Sci. Mus., Tokyo, Ser. B, 10(1): 39 (1984). FIG. 1 F–K

Sorocarps solitary, usually unbranched, phototropic, prostrate. Sorophores colorless, sinuous, 0.6–4.5(10.5) mm long, tapering from bases to tips, usually

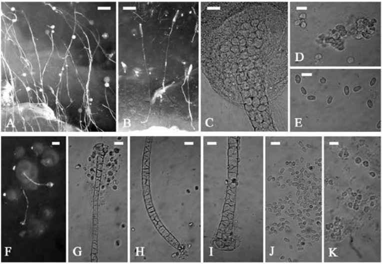

FIGURE 1. A–E, *Dictyostelium magnum*; F–K, *D. brefeldianum*. A, F, Sorocarps (bar = 0.5 mm); B, Pseudoplasmodia (bar = 0.3 mm); C, H, I, Sorophore bases (bar = 15 µm); D, K, Myxamoebae (bar = 15 µm); E, J, Spores (bar = 15 µm); G, Sorophore tips (bar = 15 µm).

consisting of one tier of cells except for the bases and tips, bases conical or round, tips capitate. Sori white, globose, 25–230(280) µm diam. Spores hyaline, oblong, mostly 5.3–7.3 × 3.0–4.0 µm, without polar granules, sometimes with irregular granules. Cell aggregations radiate. Pseudoplasmodia not migrating without sorophore formation, usually producing single sorogens. Myxamoebae irregular or triangular in the direction of movement.

SPECIMENS EXAMINED: MR043. Isolated from the mixture of forest soil and leaf litter collected in Baydar Valley (8 Oct. 2008, S0276-5) and forest soil collected in Angara Valley (10 Oct. 2008, S0308-3), Yalta, Crimea, Ukraine in 2009. Deposited at the Herbarium of Mycological Institute of Jilin Agricultural University (HMJAU), Changchun, China.

COMMENTS—*Dictyostelium brefeldianum* is a medium-sized species that is often prostrate and strongly phototropic. Its macroscopic characteristics are similar to the closely related species, *D. implicatum* H. Hagiw. (Hagiwara 1984a) and *D. arabicum* H. Hagiw. (Hagiwara 1991). However, it differs from those similar species in its capitate sorophore tips and oblong spores lacking polar granules. Other species with capitate tips include *D. crassicaule* H. Hagiw. (Hagiwara 1984b) and *D. septentrionale* (Raper 1984), which have stout and thick sorophores, *D. purpureum* Olive (Raper 1984) and *D. mexicanum* Cavender et al. (Raper 1984), which produce colored sorocarps, *D. longosporum* H. Hagiw.

(Hagiwara 1983a) with longer spores, and *D. capitatum* H. Hagiw. (Hagiwara 1983b) with smaller spores. Furthermore, *D. brefeldianum* is cosmopolitan and has already been reported in America, Canada, Germany, England, France, Denmark, Switzerland, Japan, New Guinea, Nepal, and Uganda (Hagiwara 1984). However, this is the first time *D. brefeldianum* has been isolated from samples from Ukraine.

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Five new records for the lichen biota of Turkey

Kadir Kınalıoğlu

kkinalioglu@hotmail.com
Giresun University, Faculty of Science and Arts, Department of Biology
28049, Giresun, Turkey

Abstract—Five lichen species (*Bacidia sipmanii*, *Buellia caldesiana*, *Byssoloma leucoblepharum*, *Collema occultatum* and *Porina lectissima*) are reported for the first time from Turkey. For each a short description is presented.

Key Words —biodiversity, Giresun, Konakönü

Introduction

Large parts of Turkey are still very insufficiently explored with regard to their lichen biota. In the last four years, however, many new lichen species have been reported for Turkey (e.g. Aslan et al. 2005, Breuss & John 2004, Candan & Özdemir Türk 2008, Çobanoğlu et al. 2008, Halıcı et al. 2007, Kınalıoğlu 2009a,b, Tufan et al. 2005, Yazıcı 2007 et al.).

For Trabzon province in the eastern Black Sea region 518 species have been reported (John 1995 [and references therein], 1999, 2000, 2002; John & Breuss 2004; John & Nimis 1998; John et al. 2000; Kınalıoğlu 2007b, 2008; Kınalıoğlu & Engin 2004; Yazıcı 1996, 1999, 2006; Yazıcı & Aslan 2002, 2005) and for Giresun province only 431 species (Aslan et al. 2002; Aslan & Yazıcı 2006; Duman & Yurdakulol 2007; Halıcı & Şenkardeşler 2009; John & Breuss 2004; Kınalıoğlu 2005, 2006, 2008, 2009; Kınalıoğlu & Engin 2004; Küçük 1990; Özgen et al. 2003; Steiner 1909; Süleyman et al. 2002; Yazıcı 2006; Yazıcı & Aptroot 2008). The present paper is a further contribution to the lichen biota of these provinces.

Materials and methods

Samples were collected in Trabzon and Giresun provinces between 2006 and 2008. They were identified with various lichen guides (e.g. Brodo et al. 2001, Purvis et al. 1992, Wirth 1995). The specimens are stored in the herbarium of the Faculty of Science and Arts, Giresun University, Giresun, Turkey; with someduplicates in herb. H. Sipman. The accession numbers of the collections are given in parentheses after the locality details.

Taxonomy

Bacidia sipmanii M. Brand et al.

A detailed description is provided by Brand et al. (2009).

The Turkish specimen was collected from siliceous rock. Thallus crustose, thin, small, areolate, grey-brown. Apothecia 0.1–0.9 mm diam., often few; disc slightly convex, light brown to dark brown or blackish brown, with a darker margin. Hymenium colourless, 43–60 µm tall; paraphyses simple, apices slightly swollen to 2 µm. Ascospores colourless, 25–45 × 1.5–2.5 µm, 4–8 celled. Conidia 20–28 × 0.8–0.9 µm, strongly curved. Thallus C–, K–, KC–, PD–.

Known from England, Ireland, France, Italy, and the Canary Islands on siliceous maritime rocks in the xeric supralittoral zone in crevices and underhangs, on vertical shaded volcanic outcrops and rarely on soil (Brand et al. 2009).

Specimen examined: Trabzon, Araklı, Konakönü place, sea shore, 40°57'17"N, 40°02'56"E, 3 m, 12 Aug. 2006, on siliceous rock, det. H. Sipman, (Kınalıoğlu 1568).

Buellia caldesiana Bagl.

A detailed description is provided by Scheidegger (1993).

The Turkish specimen was collected from siliceous rock. Thallus light yellowish or dirty white, crustose, rimose to areolate. Apothecia 0.3–0.8 mm diam, immarginate to thinly marginate; disc black, plane, weakly whitish pruinose. Hymenium 60–75 µm tall; epithecium olive. Hypothecium dark brownish. Asci *Lecanora*-type. Ascospores brown, 1-septate, oblong, 12–13 × 6.5–7 µm. Conidia not observed. Thallus C + orange.

Known from Europe on more or less calcareous rocks (Scheidegger 1993).

Specimen examined: Giresun, Center, SE slope of Gedikkaya hill, 40°54'35"N, 38°24'48"E, 190 m, 10 June 2006, on siliceous rock, det. H. Sipman, (Kınalıoğlu 1544).

Byssoloma leucoblepharum (Nyl.) Vain.

A detailed description is provided by Purvis et al. (1992).

The Turkish specimen was collected from *Erica arborea*. Thallus crustose, brownish-greyish, mostly thin. Apothecia 0.3–1.1 mm diam, flat; disc dark orange-brown, with a white-grey woolly margin spreading onto the thallus surface. Hypothecium brownish. Ascospores 10–17 × 2.5–4 diam., 4-celled, colourless. Thallus C–, K–, KC–, PD–.

Widely distributed in tropical and subtropical regions, extending to the temperate zone, on bark and leaves (Purvis et al. 1992).

Specimen examined: Trabzon, Araklı, Konakönü place, 40°57'44"N, 40°02'32"E, 8 m, 12 Aug. 2006, on *Erica arborea*, det. H. Sipman, (Kınalıoğlu 1690).

Collema occultatum Bagl.

A detailed description is provided by Purvis et al. (1992) and Zedda et al. (2009: 157).

The Turkish specimen was collected from *Fraxinus* sp. Thallus small, dark brownish, mostly scattered lobes, subcrustose to minutely globose or with foliose lobes. Apothecia dispersed or aggregated; disc 0.2–0.4 mm diam., flat to convex, brown, pink when young and black when mature. Ascospores 13–21.5 × 9–15 µm, cuboid-oblong, submuriform.

Known from Europe (especially Mediterranean region), North Africa and North America, on bark. (Purvis et al. 1992, Zedda et al. 2009).

Specimen examined: Trabzon, Araklı, Konakönü place, 40°57'44"N, 40°02'32"E, 8 m, 12 Aug. 2006, on *Fraxinus* sp., det. H. Sipman, (Kınalıoğlu 1694).

Porina lectissima (Fr.) Zahlbr.

A detailed description is provided by Purvis et al. (1992).

The Turkish specimen was collected from siliceous rock. Thallus brownish green, irregularly cracked, thin. Perithecia reddish dark brown or partly pinkish, projecting above the thallus surface, 0.2–0.4 mm diam. Ascospores 3-septate when mature, fusiform, colourless, 20–32 × 4–8 µm. Asci 8-spored, thin walled.

Known from Europe and North America on damp siliceous rock (Purvis et al. 1992).

Specimen examined: Trabzon, Araklı, Konakönü place, sea shore, 40°57'17"N, 40°02'56"E, 3 m, 12 Aug. 2006, on siliceous rock, det. H. Sipman, (Kınalıoğlu 1569).

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Two new species of the *Parmotrema subrugatum* group from the coast of São Paulo State, southeastern Brazil

Michel N. Benatti[1] & Marcelo P. Marcelli[2]

[1] *michel_benatti@yahoo.com.br* [2] *mpmarcelli@msn.com*

Instituto de Botânica, Seção de Micologia e Liquenologia
Caixa Postal 3005, São Paulo / SP, CEP 01061-970, Brazil

John A. Elix

John.Elix@anu.edu.au

Department of Chemistry, Building 33, Australian National University
Canberra, A.C.T. 0200, Australia

Abstract — During a survey of the *Parmeliaceae* in natural ecosystems and urbanized coastal areas of southeastern Brazil, two new *Parmotrema* species containing alectoronic acid were discovered: *P. hyperlaciniatulum* and *P. restingense*. These species are described and compared to *P. subrugatum*.

Key words — *Parmotrema lacinulatulum, Parmotrema maraense, Parmotrema wainioi*

Introduction

The genus *Parmotrema* A. Massal. is characterized by lobes with broad rotund apices and naked lower margins, the absence of pseudocyphellae, the frequent occurrence of marginal cilia, simple rhizines, and thick-walled, ellipsoid ascospores (Brodo et al. 2001, Nash & Elix 2002). More than 300 species are known worldwide (Nash & Elix 2002), and about one third of them occur in Brazil.

Two new species containing alectoronic acid are described in the present paper. These species were discovered by the authors during research on the broad-lobed species of *Parmeliaceae* at the coast in São Paulo State, Brazil (Benatti 2005), primarily situated between the municipalities of Ubatuba (23°02'S, 45°04'W) and Itanhaém (24°11'S, 46°47'W). This region includes urbanized areas and rocky shores, as well as mangrove and restinga forests as the predominant vegetation types.

The most common species of *Parmotrema* producing alectoronic acid in Brazil can be separated into two characteristic subgroups: (1) the *P. wainioi* group, with ascospores ca. 15–25 µm, filiform conidia over 6 µm long and abundant long cilia and (2), the *P. subrugatum* group, with larger ascospores 25–40 µm long, unciform conidia up to 6 µm long and shorter, less abundant cilia.

Both of the new species lack vegetative propagules, are corticolous in coastal mangrove or restinga forests, and belong to the *P. subrugatum* subgroup. Although we have included substantive information about the new species, more detailed morphological and chemical comparisons with other somewhat similar species can be found in Benatti (2005).

Material and methods

Specimens were distinguished by morphological characters using standard stereoscopic and light microscopes. Anatomical sections, including those of apothecia and pycnidia, were made with a razor blade by hand. The chemical constituents were checked by spot tests with potassium hydroxide (K), sodium hypochlorite (C) and *para*-phenylenediamine (P), and also examined under UV light (360 nm). Chemical constituents were identified by thin-layer chromatography (TLC) using solvent C (Bungartz 2001), high performance liquid chromatography (HPLC) (Elix et al. 2003) and comparison with authentic samples.

Since we had encountered problems dealing with the many morphological terms present in the literature, we specify here that lacinules represent adventitious, ribbon-like secondary outgrowths from the primary lobe margins. Lobules are similar, but short and rounded.

The diagnosis for each taxon refers exclusively to holotype characters and the English descriptions and comments to all the material studied.

The species

Parmotrema hyperlaciniatulum Benatti, Marcelli & Elix, **sp. nov.** FIG. 1

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Species cum thallo simili Parmotrematis laciniulatuli sed magis robusto et crasso, lobis angustis laciniatis demum laciniulatis, cortex superior continuus et emaculatus, ciliis parvis, conidiis minoribus et unciformibus differt. Atranorinam, chloroatranorinam, acidum alectoronicum, acidum α-collatolicum, acidum β-alectoronicum, acidum β-collatolicum, acidum dehydrocollatolicum, acidum dehydroalectoronicum, methyl pseudoalectoronatum, et methyl pseudo-α-collatolatum continens.

HOLOTYPE: Brazil, São Paulo State, Municipality of Itanhaém, Padre Manoel da Nóbrega Highway (SP-55) Km 108, at the crossing point with the Itanhaém River, mangroves by the side of the highway at the right margin of the river, 24°10'48.7"S, 46°48'07.1"W, 1 m alt., on trunk of *Rhizophora mangle* L., leg. M.P. Marcelli & L.R. Fontes 1670, 01-X-1979 (SP).

Thallus up to 14 cm wide, subcoriaceous to coriaceous, corticolous, grayish green but becoming dark gray in the herbarium, primarily lobed to sublobed, ultimately developing dense secondary laciniae; lobes irregularly branched, 1.5–4.0(–5.0) mm wide, primary lobes contiguous to ± imbricate, adnate to loosely adnate, secondary lacinules ascending, unattached, eventually twisted and subcanaliculate; apices ± plane to subconcave, subrotund; margin smooth to irregularly dissected, plane to ± ascending, weakly undulate in part, entire to incised, ciliate. Upper surface continuous to weakly and irregularly cracked, smooth to subrugose, sometimes with verrucae becoming papillose; maculae weak to distinct, linear, laminal, more obvious at the distal parts, sometimes developing fissures; lacinules linear and long, regularly spreading from margins, abundant at the thallus center, simple then dichotomously or irregularly branched, subcanaliculate to canaliculate, 0.2–15.0(–30.0) × 0.2–0.9(–1.1) mm, truncate, crowded, often covering parts of the upper surface, sometimes with papillose verrucae, underside cream or black. Soralia, pustules and isidia absent. Cilia black, simple or rarely furcate, 0.1–1.7(–2.4) × ca. 0.05 mm, frequent along the margins of the lobes and lacinules. Medulla white, with orange pigmented spots often present in the lower portion. Lower surface black, shiny, smooth to rugose, unevenly papillate; marginal zone shiny to opaque, usually pale brown but soon turning cream colored at the start of lacinules growth, smooth to rugose, unevenly papillate 0.5–4.5(–6.0) mm wide, naked; rhizines black, simple, sometimes agglutinated, 0.20–0.70 (–1.3) × 0.05–0.15 mm, sparse or frequent, grouped. Apothecia submarginal to subterminal, common, often originating on the lacinules, concave, 0.3–9.2 mm wide, substipitate, margins smooth to crenate or dentate-lacinulate, usually eciliate or rarely with scarce cilia, amphithecia and stipe smooth but becoming rugose with age; disc brown, epruinose, imperforate; ascospores ellipsoid, (22.5–)24.5–38.0(–40.0) × 14.0–21.5 µm, episporc (2.5–)3.0–3.5 µm wide. Pycnidia submarginal, common, abundant on the lacinules, with brown or black ostioles; conidia short unciform, 4.0–5.0 × ca. 1.0 µm.

Color reactions: upper cortex K+ yellow, UV–; medulla K–, C–, KC+ rose, P–, UV+ bluish green, and a K+ dark reddish pigment in the lower portions.

TLC/HPLC: cortical atranorin (minor) and chloroatranorin (minor); medullary alectoronic acid (major), α-collatolic acid (major), β-alectoronic acid (minor), β-collatolic acid (minor), dehydrocollatolic acid (minor), dehydroalectoronic acid (trace), methyl pseudoalectoronate (trace) and methyl pseudo-α-collatolate (trace).

Paratypes: Brazil, São Paulo State, Municipality of Itanhaém, Padre Manoel da Nóbrega Highway (SP-55) Km 108, at the crossing point with the Itanhaém River, mangrove by the highway's side at the river's right margin, 24°10'48.7"S, 46°48'07.1"W, 1 m alt., on trunk of *Rhizophora mangle*, leg. M.P. Marcelli & L.R. Fontes 1669, 10-I-1979 (SP); idem, on tree trunk, leg. M.P. Marcelli & A. Mathey 1672, 05-VIII-1981 (SP); idem, on trunk of *Laguncularia racemosa* C.F. Gaertn., leg. M.P. Marcelli & L.R. Fontes 2386, 01-IV-1988 (B); idem, on tree trunk, leg. M.P. Marcelli, B. Marbach & C.H. Ribeiro 29380, 21-VIII-1995 (G).

COMMENTS: This species is characterized by the absence of vegetative propagules, the narrow lobes which become laciniate and subcanaliculate and develop dense lacinules at the apices and margins, the substipitate apothecia with dentate-lacinulate, eciliate or sparsely ciliate margins, and pale brown lower margins which turn cream at the beginning of lacinule formation. An orange K+ dark red pigment is often present at the lower portions of the medulla, but this was not detected with HPLC.

The verrucae (or papillae) on the upper surface of the lobes and the lacinules resemble stout isidia, but lack a constricted base present in true isidia. They often support pycnidia.

Parmotrema hyperlaciniatulum differs from *P. subrugatum* and other species of this complex by the short, weakly inflated apothecia stipes (longer and markedly inflated in *P. subrugatum*) although the stipes do appear larger when developing on subcanaliculate lobe apices. Although most of the apothecia are eciliate, we noted that some apothecia in each specimen examined had a few poorly developed cilia.

Parmotrema lacinulatulum Krog from East Africa is superficially similar and we initially thought that the present material might represent this species. However *P. lacinulatulum* has a thinner and more fragile thallus, much broader lobes (5.0–8.0 mm), longer cilia (3.0–4.0 mm), a more continuous, emaculate upper cortex, longer sublageniform conidia (7.0–7.5 μm) and lacks a K+ orange pigment in the medulla (Krog 1991).

The lacinules of *P. hyperlaciniatulum* often cover large portions of the upper surface and extend to several centimeters long. With the aging of the thallus, the older, primary lobes die and disintegrate, but the subcanaliculate lacinules continue to grow and resemble somewhat small specimens of *Everniastrum*.

The mature thalli of *P. hyperlaciniatulum* must be collected and handled with care; otherwise, they may crumble since the older parts that keep the terminal parts together are often no longer present. This species is named after its habit, where the lobes gradually change their form, becoming laciniate and ultimately densely lacinulate.

Parmotrema restingense Marcelli, Benatti & Elix, **sp. nov.** FIG. 2

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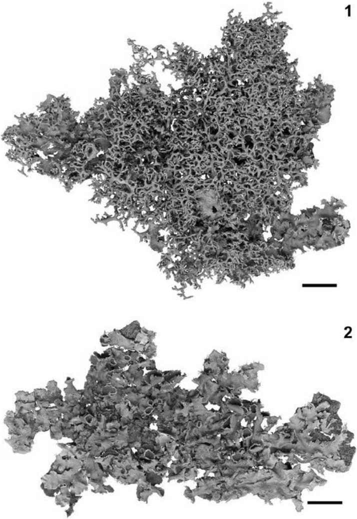
Species cum thallo simili Parmotrematis subrugati sed lobis angustatis, margine irregulariter sublacinulatis, margine inferior non continuus albida et apothecia laevigata vel ex parte lacinulata denticulata, eciliata differt. Atranorinam, chloroatranorinam, acidum alectoronicum, acidum α-collatolicum, acidum β-alectoronicum, acidum β-collatolicum, methyl pseudoalectoronatum, et methyl pseudo-α-collatolatum continens.



FIGURES 1–2. 1. The holotype of *P. hyperlaciniatulum*.
2. The holotype of *P. restingense*.
Bar = 1 cm.

Holotype: *Brazil, São Paulo State, Municipality of Cananéia, near the continental raft port to Cananéia, mangrove at the roadside, 24°59'10.2"S, 47°57'06.1"W, 1 m alt., on tree trunk, leg. M.P. Marcelli & J. Vieira Filho 1593, 23-XII-1979 (SP).*

Thallus up to 16.0 cm wide, submembranaceous to subcoriaceous, ramulicolous or corticolous, pale greenish gray becoming darker in the herbarium, lobate to sublobate. Lobes (1.5–)2.5–6.0(–9.0) mm wide, irregularly branched, contiguous to crowded, adnate, ascending when bearing apothecia, loosely attached; apices ± plane to subconvex and involute, subrotund to irregular; margin smooth near the apices, turning subcrenate or irregular, ± flat to ascending or subundulate, involute or revolute, entire to irregularly incised, partially dentate-sublacinulate, ciliate. Upper surface continuous but becoming irregularly cracked with age, smooth to subrugose; maculae weak to distinct, punctiform or sometimes aggregate and linear, laminal but more frequently appearing on the amphithecia and apothecial stipes. Adventitious lacinules generally sparse, very short, irregularly distributed along the lobe margins but occasionally intermixed with some small irregular lobules, simple or irregular, flat, 0.3–1.4(–2.5) × 0.2–0.7 mm, truncate or acute, underside concolorous with the lower margin or cream on lobes with apothecia. Cilia black, simple to furcate or rarely irregular, 0.2–2.8 × ca. 0.05 mm, frequent to abundant along the margins but scarce or absent at the apices of young lobes. Medulla white, rarely with spots of an orange pigment in the older parts. Soredia, pustulae and isidia absent. Lower surface black, shiny, smooth to rugose, weakly papillate or veined; marginal zone shiny, brown, smooth to subrugose, 1.5–5.5(–9.0) mm wide, naked, turning cream, white, or variegated under lobes with apothecia; rhizines black, simple, sometimes furcate or irregular, 0.10–1.60(–2.30) × 0.05(–0.15) mm, few to frequent but more abundant in some parts, occasionally becoming agglutinated, grouped. Apothecia submarginal or subterminal, originating in part from subcanaliculate lobes apices, common, ± concave to urceolate, becoming fissured and distorted with age, up to 9.5 mm wide, stipes inflated, margins smooth when young, then subcrenate and short dentate-lacinulate, eciliate, amphithecia and stipe smooth when young, becoming rugose, veined or vertically folded with age, sometimes with papillose wrinkles; discs brown, epruinose, imperforate; ascospores ellipsoid, (19.0–)25.0–36.0(–40.0) × (12.0–)14.0–18.0(–24.0) µm, epispore 2.5–4.0(–5.0) µm thick; pycnidia submarginal, frequent to abundant, with black ostioles; conidia unciform, (3.0–)4.0–5.0(–6.0) × ca. 1.0 µm.

Color reactions: upper cortex K+ yellow, UV–; medulla K–, C–, KC+ rose, P–, UV+ bluish green, with a K+ dark reddish pigment frequent only in old or necrotic areas of some thalli.

TLC/HPLC: cortical atranorin (minor) and chloroatranorin (minor); medullary alectoronic acid (major), α-collatolic acid (major), β-alectoronic acid (trace), β-collatolic acid (trace), methyl pseudoalectoronate (trace) and methyl pseudo-α-collatolate (trace).

PARATYPES: Brazil, São Paulo State, Municipality of Cananéia, Cardoso Island, restinga wood of Marujá Village, post-dune restinga vegetation at the southern part of the island, wood of bushes and small trees, 25°14'S, 48°01'W, 5 m alt., on small tree thin branch, leg. M.P. Marcelli 1747, 1751, 1752, 1753, 1754, 1755, 1756, 1761, 1762, 1763, 1764, 1766, 1767, 1768, 1769, 1770, 1771, 1772, 1775 (SP), 1759 (B) 20-X-1981. Municipality of Iguape, Barra do Ribeira, between Suamirim "River" and the ocean, low restinga forest near the mangrove, 24°38'S, 47°22'W, 2 m alt., on small tree trunk, leg. M.P. Marcelli & O. Yano 6375, 15-VII-1989 (G); idem, on thin small tree branch, leg. M.P. Marcelli & O. Yano 6872, 6873, 18-VII-1989 (SP); idem, sand dunes vegetation, 24°38'S, 47°22'W, 5 m alt., thin branch of small tree, leg. M.P. Marcelli & O. Yano 6808, 10-VII-1989 (SP); idem, urban zone, 24°39'S, 47°22'W, 5 m alt., tree trunk at the sidewalk, leg. M.P. Marcelli & O. Yano 7112, 7117, 7134, 22-VII-1989 (SP). Municipality of Ilha Comprida, Gambôa Nóbrega, 25°01'S, 47°54'W, 1 m alt., small tree trunk, leg. M.P. Marcelli 1594, 16-II-1982 (SP); idem, central area of the island, low restinga forest behind the propriety of the Kitaura family, 24°51'S, 44°42'W, 2 m alt., thin branch of small tree, leg. M.N. Benatti, A.A. Spielmann, L.S. Canêz, M.J. Kitaura & M.P. Marcelli 1730, 1748, 1749 (SP), 1747 (ASU), 02-IV-2004. Municipality of Peruíbe, margin of Guaraú River, mangrove at the edge of the river, 24°23'S, 47°02'W, 5 m alt., on trunk of *Rhizophora mangle*, leg. M.P. Marcelli & O. Yano 3907, 3909, 3927, 23-VII-1988 (SP).

COMMENTS: *Parmotrema restingense* is characterized by the absence of vegetative propagules, the densely ciliate margins that are sparsely and irregularly sublacinulate, the apothecia with smooth or shortly denticulate, always eciliate margins, and a lower cortex which is brown at the margins becoming white or cream only under the apothecia.

This is the most common species of the alectoronic acid containing group along the coast of São Paulo State. Previously it may well have been mistaken for *P. subrugatum*, which has a shiny white margin and only becomes pale brown in a very narrow transition zone towards the black center. In *P. restingense* the marginal zone is always brown, becoming white to ivory colored only under lobes bearing apothecia.

The frequent, ramified, subcanaliculate lacinules of *P. subrugatum* are very different from the uneven, short and simple, dentate lacinules seen in *P. restingense*. While the lacinules in *P. restingense* rarely exceed 1.5 mm in length (usually resulting from the irregular incised margins), those in *P. subrugatum* are regular in shape and branching pattern and may exceed 1 cm in length.

Similarly, the apothecia of *P. restingense* invariably have a smooth, eciliate margin that only becomes dentate with age, while those of *P. subrugatum* sometimes have apical cilia and frequent small lacinules (see below). The epithet refers to the predilection of the species for restinga forest habitats at the southeastern Brazilian littoral.

Parmotrema subrugatum (Kremp.) Hale, Phytologia 28: 339. 1974. FIG. 3

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≡ *Parmelia subrugata* Kremp., Verh. Zool. Bot. Gesell. Wien 18: 320. 1868.

HOLOTYPE: Brazil, Rio de Janeiro State, Serra dos Órgãos (Organ Mountains), leg. Helmreichen s.n. (M!).

THALLUS up to 11.0 cm wide, subcoriaceous, corticolous, becoming dark greenish gray in the herbarium, lobate to sublobate. LOBES 2.5–7.0 mm wide, irregularly branched, crowded, not adnate, subascending and distorted, loosely attached; APICES plane to subconvex and revolute when lacinulate, subrotund to subirregular; MARGIN smooth near the apices, soon turning subirregular, ± flat to ascending and becoming subundulate, involute or revolute, normally giving the lobes a canaliculate aspect, entire to irregularly incised, commonly lacinulate, ciliate. UPPER SURFACE continuous but becoming irregularly cracked with age, subrugose to rugose; MACULAE usually distinct, punctiform and aggregated, appearing irregularly on the lamina or frequently forming on the amphithecia and stipes of the apothecia where they sometimes become linear. ADVENTITIOUS LACINULES very common, short to medium, regularly distributed along the apices and margins of the lobes, occasionally intermixed with some small irregular lobules, often agglomerated, simple at first but soon becoming irregularly dichotomously branched, flat to partially subcanaliculate, 1.2–8.3 × 0.3–1.2 mm, normally truncate, often ciliate, underside generally cream and concolorous with the lower margin. CILIA black, simple to sometimes furcate or irregularly ramified, 0.3–2.5 × ca. 0.05 mm, usually common along the margins but scarce or absent at the apices of young lobes. MEDULLA white, spots of orange pigments absent even in the older parts. SOREDIA, PUSTULAE and ISIDIA absent, but with some grouped papilloid, dactyliform, massive and ± ciliate structures resembling thick isidia without a constricted base, 0.4–1.5 × 0.2–0.5 mm, ramified, appearing on some parts of the cortex or sometimes on the stipes of the apothecia, sometimes difficult to distinguish from the young apothecia, partially developing into laminal lacinules similar to those on the margins. LOWER SURFACE black, shiny, smooth to subrugose, weakly papillate; MARGINAL ZONE naked, shiny to opaque, smooth to subrugose, 1.0–6.5 mm wide, normally cream or white in an almost continuous line in the distal portions; brown only in young, smaller lobes bearing no lacinules or apothecia; CENTER black; RHIZINES black, simple, rarely furcate or irregular, 0.20–1.40(–2.20) × 0.05(–0.15) mm, frequent to abundant at some parts, often becoming agglutinated. APOTHECIA submarginal or subterminal partially originating from the subcanaliculate lobes apices, common, ± concave to urceolate, normally fissuring and becoming distorted with age, up to 17.5 mm diam., stipes inflated, margins smooth when young, then denticulate and sometimes lacinulate, eciliate except at the apices of the lacinules, amphithecia

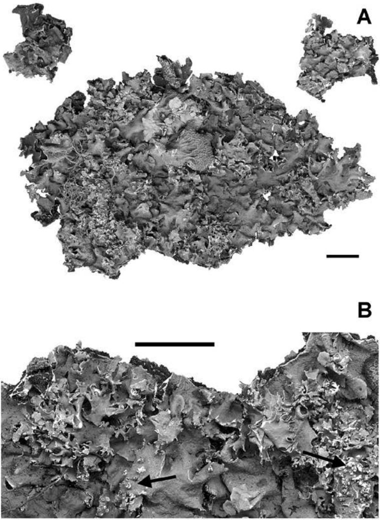

Figure 3. The holotype of *P. subrugatum*. A. The entire specimen.
B. Details of the marginal lacinules and the papilloid structures (arrows) that give rise to them.
Bars = 1 cm.

and stipe smooth when young, becoming strongly rugose and veined with age, sometimes with a few papilloid-isidioid structures as seen on the upper surface; disc dark brown, epruinose, imperforate or partially perforate when mature; ASCOSPORES ellipsoid to ovoid, (17.5–)26.5–35.0 × (12.0–)15.0–22.0 µm, epispore 2.5–4.0 µm thick; PYCNIDIA mainly submarginal and on the lacinules, frequent to abundant, with black ostioles; CONIDIA unciform, (4.0–5.0–6.0 × ca. 0.75 µm.

COLOR REACTIONS: upper cortex K+ yellow, UV–; medulla K–, C–, KC+ rose, P–, UV+ bluish green.

TLC: cortical atranorin; medullary alectoronic acid and α-collatolic acid, with or without rhodophyscin (fide Culberson 1969).

COMMENTS: *Parmotrema subrugatum* is characterized by the absence of vegetative propagules, the ciliate margins regularly developing dichotomously branched lacinules, the presence of laminal digitiform structures, the denticulate to lacinulate apothecia which are only ciliate at the apices of the lacinules, and by the black lower cortex with an usual white or cream marginal zone that is almost continuous along the distal parts of the thallus.

The name *P. subrugatum* has apparently been misapplied to several different species, some of which appear as synonyms in Hale's classic monograph on *Parmelia* subgen. *Amphigymnia* (Hale 1965).This species is apparently one of the most frequently confused species of those containing alectoronic acid, and its name has been misapplied for specimens which have a white (at least in part) lower marginal zone, eciliate apothecia, large ellipsoid ascospores (25–40 µm long) and short conidia (4–6 µm long).

Hale (1965) described *P. subrugatum* as having broad lobes (7–15 mm wide) with an ivory to brown or mottled lower margin. However, when comparing *P. maraense* Hale to *P. subrugatum* (Hale 1990), he refined his species concept, mentioning that *P. subrugatum* has a continuous white margin that turns dirty white with age.

The holotype of *P. subrugatum* (M!, FIGURE 3A) has an almost uniformly white marginal zone which distinguishes it from the other species of this group, where the marginal zone is initially brown and becomes pale only on aging. In this specimen, the margin is almost entirely shiny cream (probably white when freshly collected), with a few young lobes having a brown color.

This species normally forms abundant small, dichotomously branched lacinules along the margins throughout the thallus. In addition, they sometimes develop from the upper cortex, growing from scattered, isidioid-papillate structures (FIGURE 3B). These structures are quite different from anything we have seen in other species of the alectoronic chemical complex, and although they resemble large, thick isidia without a constricted base, their function is not apparent. In some parts, they resemble poorly developed apothecial primordia, and can readily be confused with them. However, on further development, their shape diverges from that of primordial apothecia and eventually they may form dichotomously branched lacinules like those along the margins.

Poorly developed thalli of *P. subrugatum* and *P. restingense* may appear very similar. One should look for true lacinules along the margins and the overall color of the lower marginal zone for confirmation. The presence of the papillate structures on the upper surface is also important for distinguishing *P. subrugatum*.

Parmotrema subrugatum is a species described from southeast Brazil, from a place mostly covered by the Atlantic rainforest, perhaps little above 1000 m high (Serra dos Órgãos) where commonly the trees become shorter and the cloud forest begins to appear. The additional specimen studied came from a place with similar climate and vegetation but of higher latitude.

ADDITIONAL SPECIMEN EXAMINED: Brazil, Rio Grande do Sul State, Municipality of Sobradinho, open place near the road, 29°24'20.2"S, 53°01'25.9"W, 375 m alt., corticolous, leg. A.A. Spielmann 360, 17-VII-2003 (SP).

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Three lichenized fungi new to Turkey

SEYHAN ORAN & ŞULE ÖZTÜRK

*seyhana@uludag.edu.tr & ozturks@uludag.edu.tr
Department of Biology, Faculty of Arts & Sciences, Uludag University
Bursa, Turkey

Abstract — In this study, three lichenized fungi (*Gyalecta ulmi*, *Ochrolechia subviridis* and *Opegrapha viridis*) are reported for the first time from the Turkish provinces of Çanakkale, İstanbul and Kırklareli. Comments on their habitat and substrata and a short description are provided for each taxon.

Key words — *Ascomycota*, epiphytic lichens, *Quercus* sp., *Fagus* sp.

Introduction

The total number of papers referring to lichens from Turkey was 361 at the end of 2004 (John 2004). Thereafter many studies have been carried out about the lichens of Turkey (Tufan et al. 2005, Güvenç et al. 2006, John & Türk 2006, Halıcı et al. 2007, Kınalıoğlu 2007, Candan & Türk 2008, Çobanoğlu et al. 2008, Halıcı & Aksoy 2009). In spite of the increase in the number of studies, knowledge of the lichen flora in Turkey is still insufficient. This paper aims at contributing to the knowledge of the lichen flora of Turkey.

Materials and methods

The specimens are stored in BULU (Herbarium of Uludag University, Science and Art Faculty, Bursa, Turkey) and their accession numbers are given in parenthesis at the end of the locality information. The specimens were examined with an Olympus SZ40 model stereomicroscope, and a Kruss light microscope. Specimens were examined in water, 10% KOH, and Lugol's iodine solution. Spore measurements were generally carried out in water.

Species recorded

Gyalecta ulmi (Sw.) Zahlbr. 1905

Detailed descriptions are provided by Clauzade & Roux (1985: 374), Purvis et al. (1992: 262) and Wirth (1995: 412).

Thallus thin or thick, smooth or cracked, whitish. Apothecia 0.5–2mm diam, numerous; true exciple pale, white-pruinose, smooth or often crenate; disc concave orange-brown to chestnut-brown and pruinose. Ascospores 15–25 × 5–9 µm, 3-septate, broad ellipsoid.

Specimen examined—ÇANAKKALE: Bayramiç; Kaz Dağı, Yeşilköy, Kırgındere place, oak woodland, 39°51'56"N, 26°50'46"E, alt. 643 m, on bark of *Quercus frainetto*, 18 Aug. 2005, leg. S. Oran, det. S. Oran (BULU 13843).

Gyalecta ulmi generally grows on calcareous substrata, such as soil and mosses in limestone areas, and is found on mature trees (e.g. *Ulmus*) in humid and sheltered sites (Purvis et al. 1992). Zedda (2002) reported this species from the trunks of old *Quercus pubescens* from Sardinia (Italy) and we recorded it from the trunks of *Q. frainetto*.

This is a rather rare lichen, found from Scandinavia to the Mediterranean-montane zone and known only from Europe and North Africa. Its populations are declining in many parts of Europe and it is a good indicator of long forest ecological continuity (Purvis et al. 1992, Wirth 1995, Zedda 2002).

Ochrolechia subviridis (Høeg) Erichsen 1930

Detailed descriptions are provided by Clauzade & Roux (1985: 530), Purvis et al. (1992: 400), Wirth (1995: 617), and Fos (1998: 210).

Thallus thick, smooth or warted, often densely covered with soft, branched or firm coralloid, cylindrical isidia, to 0.5 mm diam, becoming confluent towards centre and forming a continuous, uniformly concolorous crust, often breaking down into granular soralia. Apothecia rare. Isidia KC (+) red, C (+) red.

Specimens examined—ÇANAKKALE: Çan; road of Bayramiç–Çan, in the vicinity of Hacıkasım village, oak woodland, 39°56'46"N, 26°48'53"E, alt. 297 m, on bark of *Quercus frainetto*, 06 Jul. 2005, leg. S. Oran, det. S. Oran (BULU 13595).

İSTANBUL: Sarıyer; Belgrad Forests, Topkoru place, oak forest, 41°11'05"N, 28°59'07"E, alt. 138 m, on bark of *Quercus petraea*, 12 Jun. 2006, leg. S. Oran, det. S. Oran (BULU 14619).

KIRKLARELİ: Demirköy; Demirköy–Sivriler road, 7. km, 41°48'19"N, 27°49'01"E, alt. 195 m, on bark of *Quercus petraea*, 24 Jul. 2006, leg. S. Oran, det. S. Oran (BULU 11658).

This widespread species is found on bark of woodland and wayside broad-leaved trees (like *Quercus*) in submontane localities, humid and non-eutrophicated areas (Purvis et al. 1992, Wirth 1995).

Ochrolechia subviridis is frequent and occurs in oceanic and suboceanic Europe, British Isles, North America, Japan, and Korea (Purvis et al. 1992). In Europe it is known from southern Scandinavia to the Mediterranean region (Zedda 2002, Wirth 1995) and Syria (John et al. 2004).

Opegrapha viridis Pers. 1803

Detailed descriptions are provided by Clauzade & Roux (1985: 540), Purvis et al. (1992: 414) and Wirth (1995: 628).

Thallus very thin or inconspicuous, usually in small (2–4 cm) patches, dull olive or brown. Apothecia 0.4–1 × 0.12–0.4 mm, sessile, initially semi-immersed, short, rounded, scattered, seldom shortly furcate, often eliptical or button-like. Exciple K (+) olive-green; hymenium I (+) red. Ascospores 23–60 × 6–9 µm, 8 to 15–septate, with a perispore.

SPECIMENS EXAMINED—KIRKLARELİ: Demirköy; road of Sarpdere–Balaban, oak and beech forest, 41°52'19"N, 27°36'17"E, alt. 351 m, on bark of *Fagus orientalis*, 15 Jun. 2006, leg. S. Oran, det. S. Oran (BULU 15001). Kofçaz; road of Kula–Kocayazı, 9 km before Kocayazı, oak and beech forest, 41°59'42"N, 27°16'30"E, alt. 492 m, on bark of *Fagus orientalis*, 16 Jun. 2006, leg. S. Oran, det. S. Oran (BULU 15115). Demirköy; Demirköy–Sivriler road, 7. km, 41°48'19"N, 27°49'01"E, alt. 195 m, on bark of *Quercus cerris*, 24 Jul. 2006, leg. S. Oran, det. S. Oran (BULU 15326).

Opegrapha viridis grows on smooth, young (rarely old) shaded bark, particularly on broad-leaved trees (e.g., *Acer, Corylus, Ilex, Quercus, Salix*) in old woodland (Purvis et al. 1992).

This species occurs throughout the Euro-Siberian region and is widespread in Europe from southern Scandinavia to the Mediterranean region; it is also known from Asia (Wirth 1995, Zedda 2002). It is very local and recorded from England, Scotland, Ireland, Sweden, France, Germany, North America, and Tasmania (Purvis et al. 1992).

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Lepiotaceous fungi in California, U.S.A. *Leucoagaricus* sect. *Piloselli*

Else C. Vellinga

ecvellinga@comcast.net

Department of Plant and Microbial Biology, University of California at Berkeley Berkeley, CA 94720-3102, U.S.A.

Abstract — Eighteen red-bruising taxa in the *Leucoagaricus/Leucocoprinus* clade (*Agaricaceae*) are listed for California. Thirteen taxa are described in detail, with 7 proposed as new and 2 single specimen collections remaining unnamed. The species, all of which turn green with ammonia and produce spores without a germ pore, fall into 2 morphological groups (not phylogenetically supported): the pileus of one group comprises a trichodermal covering and the pileus surface of the second bears strands of repent, coloured hyphae. New taxa in the latter group are *La. flammeotinctoides* (more robust than *Lepiota flammeotincta* and with clavate cheilocystidia), *La. pyrrhophaeus* with irregular cheilocystidia and copper colours in the dried basidiocarps, and *La. pyrrhulus* with amygdaliform spores. Taxa in the 'trichodermal' group — *L. fuliginescens*, *La. cupresseus*, and *La. erythrophaeus* as well as new species *La. adelphicus*, *La. pardalotus*, *La. hesperius*, and *La. dyscritus* — are differentiated based on pileus covering, cheilocystidia, and reactions of the lamellae when damaged. The type collections of *L. fuliginescens* and *L. flammeotincta* were studied. DNA sequence data for all species are given and a key to 19 taxa, including *La. georginae* (from Washington), is provided.

Key words — biodiversity, *Leucoagaricus badhamii*, *La. pilatianus*, nrITS, type studies

Introduction

Classification

Leucoagaricus section *Piloselli* Singer harbours those species within the *Leucoagaricus/Leucocoprinus* clade of the *Agaricaceae* that stain red when bruised and discolour green with ammonia. The concept of this section has been changing over time, and which species belong to it has been subject to debate. Singer (1973) described the section, based on Kühner's work (1936), for species with lamellae that turn pink, have a white or lilac pileus, and a surface that reacts green with ammonia; *Lepiota georginae* (W.G. Sm.) Sacc. was chosen as the type. Locquin (1945) erected *Leucocoprinus* sect. *Anomali* Locq. (as "*Anomalae*") for species that change colour, with *Lc. meleagris* (Sowerby) Locq. and *Lc. brunnescens* (Peck) Locq. as representatives. Heinemann (1973 – the same year as Singer (1973) described section *Piloselli*) placed the reddening species in *Leucoagaricus* sect. *Anomali* Locq. One complication is that Locquin (1945) and Kühner (1936) did not give Latin descriptons to their infrageneric units, and so the combination of *Leucoagaricus* sect. *Anomali* has never been published validly. Furthermore, Locquin (1945) applied the name *Anomalae* also to a section in *Lepiota* characterized by the absence of clamp connections, and this section has been used in different ways by various authors (e.g. to accommodate species without clamp-connections within *Lepiota*, (Pegler 1986) though they belong to the *Leucoagaricus/Leucocoprinus* clade). A third section where species with a colour change have been placed is *Leucoagaricus* sect. *Annulosi* (Fr.) Singer (Singer 1973), typified by *La. leucothites* (Vittad.) Wasser, a white species that does not change colour and whose spores have a germ pore. Bon (1993) put *La. americanus* (Peck) Vellinga (as *La. bresadolae* (Schulzer) Bon) in *Leucoagaricus* subsect. *Rubescentes* (Wasser) Bon at the same time as he placed *La. meleagris* (Sowerby) Singer, a close relative of *La. americanus*, in sect. *Piloselli*.

Species that turn red, but not green, with ammonia and KOH, such as *La. croceovelutinus* (Bon & Boiffard) Bon & Boiffard, were also accommodated in sect. *Piloselli* (e.g. Bon 1993, Candusso & Lanzoni 1990).

Various authors placed some of those species in *Leucocoprinus* Pat. and other taxa in *Lepiota* (Pers. : Fr.) Gray. For example, Pegler (1986), who held a narrow concept of *Leucoagaricus* Singer and placed many of its species in *Lepiota*, listed *Lc. zeylanicus* (Berk.) Boedijn and *L. holospilota* (Berk. & Broome) Sacc. Other authors, e.g. Reid (1990), accommodated all reddening species in *Leucocoprinus*. Reid (1990) avoided a formal more detailed classification by referring species that stain with ammonia fumes to the "*Leucocoprinus badhamii* complex".

Another complication in understanding the species and their relationships is that the concepts of *La. badhamii* (Berk. & Broome) Singer and *La. americanus* (as *La. bresadolae* in Europe) were mixed up in the literature until Demoulin (1966) put things straight (see also Reid 1990).

Leucoagaricus sect. *Piloselli* has been subdivided into two subsections based on the respective absence [subsect. *Pilatianei* Migl. & L. Perrone (Migliozzi & Perrone 1992)] or presence [subsect. *Pilosellini* (Singer) Bon, *Pilatianei*)] of an apical excrescence on the cheilocystidia.

All the above attempts at classifications have been based on European collections. All European taxa, except *L. roseolivida* Murrill (syn. *La. marriagei* D.A. Reid), have a trichodermal pileus covering, whereas species with a cutis or entangled cutis, such as *L. flammeotincta* Kauffm., described from North America had not been taken into consideration.

Phylogenetic analyses of nrLSU and nrITS regions (Vellinga 2004a, 2004b) have shown that the three groups — those that redden with ammonia, those that turn green with ammonia with spores without a germ pore, and those that turn green and have spores with a germ pore — do not form a monophyletic group. Rather the first and third groups are monophyletic (Vellinga & Sundberg 2008; Vellinga 2004a), while the second one (green with ammonia, no germ pore) is polyphyletic. The nrITS data do not seem to support a simple division of *Leucoagaricus* sect. *Piloselli* into two subsections either, although there are clades comprising species with an apical excrescence on the cystidia (e.g. the clade to which *La. georginae* (W.G. Sm.) Candusso belongs), but the species with clavate or otherwise non-appendiculate cystidia do not form a monophyletic group. Pileus covering characteristics are, unfortunately, also not a good predictor for phylogenetic relationships.

The "*La. americanus* + *La. meleagris*" group takes an isolated position in the *Leucoagaricus/Leucocoprinus* clade (Vellinga 2004a).

The red bruising reaction in *Leucoagaricus meleagris* is caused by lepiotaquinone, an amino-1,4-benzoquinone derivative (Aulinger et al. 2000); N.B. the authors identified their specimens as *L. americana*, but the material turned out to be *La. meleagris* (pers. obs.). It is not known whether this same chemical causes the reddening reaction in all species.

Species recognition

It has proven impossible to classify every single collection found so far; species recognition based on morphology alone is often challenging.

Specimens in the field look often quite different from those brought home for description and study, as the basidiocarps of many species turn very dark from handling. Furthermore, old, weather-beaten specimens of different species can look very much alike, again because of the colour changes. Microscopical characters often cast the decisive vote in the identification process.

Although the tentative new species thus far represented by only one collection are not formally described, they are described as well as included in the identification key.

No new combinations are made in *Leucoagaricus* for species still accommodated in *Lepiota*, as the taxonomy of this clade is not yet stable (Vellinga 2004a).

Scope of the article

The present paper focuses on the California species of section *Piloselli*. Here, for this study, we take the same pragmatic approach as Reid (1990) by covering those species that turn red when scratched and that turn green with ammonia vapours.

Several conspicuous species, some quite common, have been described from California (*L. fuliginescens*, *La. cupresseus*, *La. marginatus*), but the group is not well covered in popular field guides (e.g. Arora 1986) or on web sites (e.g. Wood & Stevens 1996–2009). Species described from California by Murrill (1912) and Burlingham (1945) are now recognized, and their names used again.

The well-known species *L. flammeotincta* turned out to represent a complex of five different species with different nrITS sequences, but with only subtle microscopical differences and an almost identical macroscopical appearance.

The two reddening species with a germ pore in the spores, *La. americanus* and *La. meleagris*, are not treated here, although both fruit occasionally in California; descriptions based on European collections can be found in Vellinga (2001).

Vellinga (2007a) recently presented the lilac and dark pink species *L. roseolivida* and *L. decorata* Zeller with full descriptions and comparisons with the type collections, which are not repeated here.

A description of *Lepiota castanescens* Murrill, a species that stains red with ammonia, has also recently been published (Vellinga & Sundberg 2008). *Leucoagaricus erythrophaeus* was recently described for the interpretation of *L. roseifolia*, but its description is given here as well, as it can easily be confused with some of the other species.

The key below covers all known Californian species in the *Leucoagaricus*/*Leucocoprinus* clade that change red on bruising, although some species concepts are not yet completely settled.

Leucoagaricus sect. *Piloselli* in North America

Only a few reddening species have been described for the central, eastern, and southeastern parts of the U.S.A. *Leucoagaricus brunnescens* (Peck) Bon, described from Missouri (Peck 1904), is a small species that initially resembles *L. cristata* (Bolton : Fr.) P. Kumm. but changes colour on drying. Bon (1993) reported it for Europe, but whether it really is the same species is not clear.

Lepiota mutata Peck, a white species described from Kansas (Peck 1896) with a scurfy pileus surface that changes brown on drying might belong to section *Piloselli*.

Murrill described several species in the group of species with a germ pore: the widespread *La. americanus*, *L. muticolor* Murrill [from Alabama (Murrill 1914), for type study see Smith (1966)], and *L. sanguiflua* Murrill and *L. tinctoria* Murrill, both from Florida, and featured in an article on this group by Smith & Weber (1987). The last authors introduced an additional species in this group, *L. besseyi* H.V. Sm. & N.S. Weber, characterized by pleurocystidia. Of these species, only *La. americanus* has been encountered in California.

Diversity, ecology, and distribution

Further investigations and inventories of the state and its diverse habitats will undoubtedly add to the diversity, as we know it now. New species were being discovered up to the very end of the research for this article, even in material collected from well-studied areas. Recognition of these new species is critical. As is the case with the small brown species in the *L. oculata* group (Vellinga 2007b), many different species co-inhabit the same habitat and locality.

Collecting trips focused on the coastal area from Monterey north to Humboldt County and on the San Francisco Bay area, with occasional surveys of the lower parts of the Sierra Nevada (Yuba and Nevada counties). Some ecological trends are now apparent. Species of the *L. flammeotincta* group, which have never been found under Monterey cypress (*Callitropsis macrocarpa* (Hartw.) D.P. Little (syn. *Cupressus macrocarpa* Hartw.; *Hesperocyparis macrocarpa* (Hartw.) Bartel), do grow under redwood (*Sequoia sempervirens* (D. Don) Endl.) and in forests of various conifer species with tanbark oak (*Notholithocarpus densiflorus* (Hook. & Arn.) Manos et al.) along the coast and inland. *Leucoagaricus cupresseus* is known from two kinds of habitats: Monterey cypress plantings in coastal settings and kitchen gardens. It does not occur in an old east-facing cypress plantation but can fruit abundantly on west facing slopes under cypresses used as wind breaks close to the coast. Only two species (*La. erythrophaeus* and *L. flammeotincta*) were encountered at lower elevations of the central Sierra Nevada, but this habitat is not well investigated for lepiotaceous fungi. Two species seem so far to be restricted to old Monterey cypress plantations (*La. dyscritus* and *La. hesperius,* both described in this paper); in general, this habitat is very rich in lepiotaceous species (Guinberteau et al. 1998, Vellinga 2004b). Distribution data for other west coast states are scarce, but it appears that California has a unique '*Lepiota*' flora, richer in species than the more northern regions. *Leucoagaricus georginae*, however, has been recorded from Washington, but has not been encountered in California, yet. Only *Lepiota fuliginescens*, *L. flammeotincta*, and *L. castanescens* are widespread in the Pacific Coast states. However, for most species distribution and ecological data are still very incomplete.

Material and methods

Standard methods for describing basidiocarps were applied, using the terminology of Vellinga & Noordeloos (2001). Colour annotations in the macroscopical descriptions are from Munsell™ soil color charts (1975). Microscopical observations were made on dried material. The notation [60,4,3] indicates that measurements were made on 60 spores in four samples in three collections. At least 15 spores were measured per collection. The lamellar characters and spore shape and size were observed in Congo Red in 10% ammonia followed by ammonia only, and the pileus covering was observed in 10% ammonia. The following abbreviations are used: L for number of lamellae, l for number of lamellulae in between two lamellae, avl for average length, avw for average width, Q for quotient of length and width, and avQ for average quotient. The abbreviation *L.* is used for *Lepiota*, *La.* for *Leucoagaricus* and *Lc.* for *Leucocoprinus*.

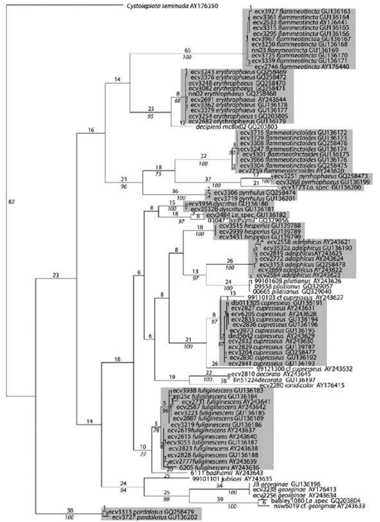

FIG. 1. Phylogram based on parsimony analyses of the nrITS region of species in *Leucoagaricus* sect. *Piloselli*. One of 10,000 MPT's is depicted, based on 305 parsimony informative characters. *Cystolepiota seminuda* was chosen as outgroup. The numbers above branches refer to the number of changes, the ones below the branches are bootstrap values (> 65%). The taxa treated in this paper are highlighted.

All collections are in UC unless otherwise stated. Herbarium abbreviations are according to Holmgren & Holmgren (1998). Latin descriptions of new species have been deposited in MycoBank. For many species, multiple illustrations are given to show the variability among collections belonging to the same species.

DNA was extracted from dried material using a Qiagen DNeasy® Blood and Tissue kit (Qiagen, Valencia, CA, USA). The nrITS region was amplified with the ITS-1F/ITS-4 primer set with an MJ PTC-100™ thermocycler (Applied Biosystems, Foster City, CA, USA) under conditions previously described (Gardes & Bruns 1993). PCR products were cleaned using 0.5 µl of ExoSAP IT (USB Corp, Cleveland, OH, USA) per reaction and cycled at 37°C for 45 min, followed by 80°C for 15 min. Sequencing was performed using Big Dye chemistry and an ABI PRISM 3100 Genetic Analyzer (both from Applied Biosystems, Foster City, CA, USA). Sequences were edited and contigs assembled using Sequencher 4.2.2 (Gene Codes Corporation, Ann Arbor, MI, USA). Newly produced sequences were deposited in GenBank, and their accession numbers listed with the collections.

The nrITS sequences were aligned with the program MAFFT version 6 (Katoh et al. 2002). For the phylogenetic analyses the Maximum Parsimony option in PAUP* v4 (Swofford 2002) was used. The sequence data base was also analyzed by maximum likelihood method (ML) using RAxML version 7.2.3 (Stamatakis et al. 2008); 100 rapid ML bootstraps were performed, and bootstrap values are included in the MP tree of Fig. 1. *Cystolepiota seminuda* (Lasch) Bon was chosen as outgroup. The analyses were only performed to determine whether the sequences matched sequences of previously sequenced species and collections, and were not used to infer a phylogeny of section *Piloselli*.

Taxonomy

1. *Lepiota fuliginescens* Murrill, Mycologia 4: 236. 1912. Figures 2–5

Type study — Smith (1966: 105–106).

Microscopical characters (from Vellinga type study; Figure 2) — Basidiospores [15,1,1] in side-view 6.0–7.6 × 3.9–4.9 µm, avl × avw = 6.7 × 4.4 µm, Q = 1.36–1.64, avQ = 1.52, ellipsoid, some subamygdaliform, in frontal view ellipsoid-ovoid, rather thick-walled, without germ pore, uni-guttulate, congophilous, immediately red-brown in Melzer's reagent (dextrinoid), metachromatic in Cresyl Blue. Basidia not observed. Lamella edge sterile. Cheilocystidia abundant, 27–70 × 8–16 µm, clavate, fusiform-lageniform to clavate with abrupt apical, cylindrical to moniliform appendage (12–28 × 4–6 µm), with brown contents in ammonia. Pleurocystidia absent. Pileus covering a cutis of cylindrical elements, 3–7 µm wide, with green-brown pigment in ammonia, giving rise to tufts of upright elements, 55–220 × 9–19 µm, narrowly fusiform and tapering towards apex or cylindrical with rounded apex, exuding green-brown pigment in ammonia, and with dark granules (as seen in ammonia). Clamp connections not observed.

Description of modern material (Figs 3–5)—Pileus 35–90 mm, convex when young, expanding to plano-convex without, or more rarely with, umbo, pale brown or pale grey (e.g. 10 R 4/3–2.5 YR 4/2; 5 YR–7.5 YR 5/3–4) when young, velvety all over, later with closed covering at centre or umbo (e.g. 7.5 YR 5/3) only and around centre splitting up into grayish patches (7.5 YR 6/3–6/4) forming a concentrical pattern close to centre and radial pattern in outer ¼ of radius, on whitish background, paler around centre than at umbo, and discolouring red at first, to dark purple brown to dark brown with age; margin exceeding lamellae. LAMELLAE, L = 70–90, l = 0 or 1(–3), very crowded, free and remote from stipe, subventricose to distinctly ventricose, up to 5–7

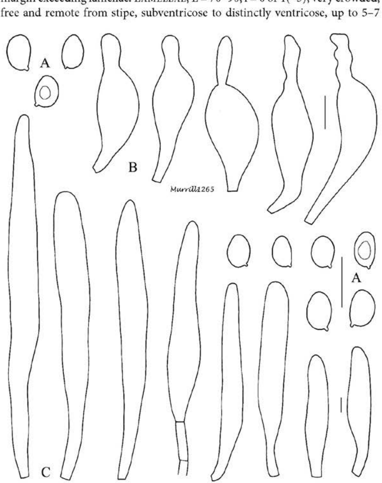

FIG. 2. *Lepiota fuliginescens* — A. spores; B. cheilocystidia; C. elements of pileus covering.(all from holotype collection). Scale bars 10 µm.

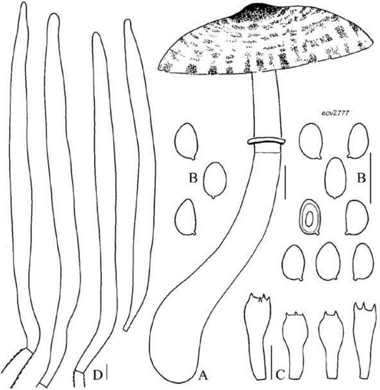

FIG. 3. *Lepiota fuliginescens* — A. Basidiocarp; B. spores, basidia, elements of pileus covering (all from ecv2777). Scale bar 10 mm (A); microscopic features 10 μm.

mm wide, white when young, to whitish with pinkish sheen, discolouring immediately under pressure to orange-red, changing to almost black, with age often vinaceous-purplish pink coloured, with cystidiose edge starting white, but rapidly changing to dark especially near pileus margin and contrasting with rest of lamellae. STIPE 60–125 × 5–16 mm, cylindrical but with up to 20 mm wide base, whitish all over when young, but rapidly changing when damaged to red, changing to dark brown with age, short fibrillose all over, but especially so above annulus, hollow, and white-tomentose at base. ANNULUS an ascending or descending cuff and a short, 2 mm wide, flaring part, sturdy, at first white and with rim concolourous with pileus centre, soon changing to dark brown, especially at edge. CONTEXT in pileus white at first, changing when cut via

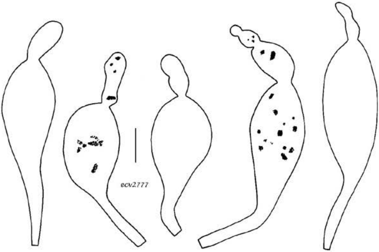

Fig. 4. *Lepiota fuliginescens* – Cheilocystidia (from collection ecv2777).
Scale bar 10 µm.

yellow to orange-red, or directly orange, in places; discoloration soon fading; in stipe white and shiny, or whitish and non-changing. Smell like the rubber component of the smell of *Lepiota cristata*, indistinct, slightly rancid.

Chemical tests — KOH 3% on lamella surface first red, changing to green.

Dried specimens dark with dark lamellae.

Basidiospores [296,19,19] in side view 5.8–8.8 × 3.5–5.2 µm, avl × avw = 6.1–7.3 × 3.8–4.5 µm, Q = 1.3–2.1, avQ = 1.6–1.85, ellipsoid to oblong, often amygdaliform, in frontal view ovoid or ellipsoid to oblong, uniguttulate, congophilous, dextrinoid, metachromatic in Cresyl blue, without germ pore. Basidia 15–30 × 6.0–9.0(–12) µm, 4-spored, rarely intermixed with some 2-spored ones. Lamella edge sterile. Cheilocystidia 19–60 × 6.0–25 µm, in most cases with apical, moniliform to cylindrical excrescence, 2.0–33 × 2.0–9.0 µm, with clavate to lageniform body, with dark granules and green-brown diffuse pigment in ammonia; in fresh material with green contents in ammonia. Pleurocystida absent. Pileus covering trichodermal, made up of upright long and relatively slender to more squat and relatively short elements, 58–330 × 10–27 µm, rarely with predominantly short elements not exceeding 100 µm; elements with rounded apex, slightly thick-walled, with brown intracellular (often in blobs) and dark brown (at base of elements) to pale brown (at apex) parietal pigment; in fresh material with some elements with blue-green contents in ammonia; repent hyphae on pileus surface cylindrical, with incrusting pigment especially in the cells just below the upright elements, and also with brown granular pigment (all pigment observations in ammonia). CLAMP CONNECTIONS absent.

HABITAT AND DISTRIBUTION – Solitary to gregarious in small groups, terrestrial on litter-rich soil, in various forest types, e.g. *Callitropsis macrocarpa* stands, under *Sequoia sempervirens* and other conifers in mixed woods, throughout coastal northern California, also in the Pacific Northwest, not uncommon. November to March in California, fruiting earlier in more northern regions.

COLLECTIONS EXAMINED – U.S.A., **Washington**, Skagit Co., Whidbey Island, Deception Pass State Park, 28-X-1995, S.A. Trudell 95-301-01. **California**, Alameda Co., Berkeley, UC-Berkeley campus, on the bank of Strawberry Creek, 6 December 2001, E.C. Vellinga 2777 (nrITS AY243639); ibidem, 7 January 2002, E.C. Vellinga 2823 (nrITS AY243638). Marin Co., Mount Tamalpais, Alpine-Kent Pump Road, 21 November 2001, E.C. Vellinga 2731 (nrITS AY243641); Point Reyes NP, southern part, 25 November 2003, R. Pastorino 11-25-c (nrITS GU136184); Point Reyes NP, along Olema Trail, 31 October 2009, S.P. Schechter (coll. E.C. Vellinga 4092); Mendocino Co., Jackson State Demonstration Forest, 22 November 2003, E.C. Vellinga 3128. Hendy Woods SP, 25 November 2002, E.C. Vellinga 2887 (nrITS GU136189). Navarro River Redwood SP, 25 November 2002, E.C. Vellinga 2903 and 2904. San Mateo Co., San Francisco Watershed, 8 December 2000, E.C. Vellinga 2587 (nrITS AY243642); ibidem, 23 December 2002, E.C. Vellinga 2974; ibidem, 25 February 2003, E.C. Vellinga 3053 (nrITS GU136187); ibidem, 5 December 2003, E.C. Vellinga 3159; ibidem, 25 November 2008, E.C. Vellinga 3938 (nrITS GU136183). San Mateo County Memorial Park, 4 November 2004, E.C. Vellinga 3219 (nrITS GU136186) and 3223 (nrITS GU136185). Moss Beach, 27 February 2001, F. Stevens (coll. E.C. Vellinga 2615) (nrITS AY243640); ibidem, 10 March 2001, E.C. Vellinga 2619 (nrITS AY243637); ibidem, 11 January 2002, E.C. Vellinga 2828 (nrITS GU136188); 28 January 2003, E.C. Vellinga 3029 and 3030.

COMMENTS — *Lepiota fuliginescens* is very closely related to the European species *La. badhamii* (FIG. 1). Morphologically the two are very similar, with only the spores of *L. fuliginescens* slightly smaller than those of *La. badhamii*. The differences in sequence data and in distribution warrant the recognition of two species. The sequence (GQ329056) from a collection in the Museo di Storia Naturale in Venice (MCVE), labled *La. badhamii,* represents a different, unknown, species.

Lepiota fuliginescens is quite variable, both in macroscopic characters and in shape and size of the elements of the pileus covering. The two groups within *L. fuliginescens* that can be distinguished based on nrITS sequences (FIG. 1) are not characterized by any corresponding morphological characters, though one of the two groups based on nrITS sequences seems to be characterized by short elements in the pileus covering, wheras the sizes of the pileus covering elements in the second group are very variable.

Lepiota fuliginescens and *La. badhamii* differ from the other species in section *Piloselli* by the combination of relatively big basidiocarps, a trichodermal pileus

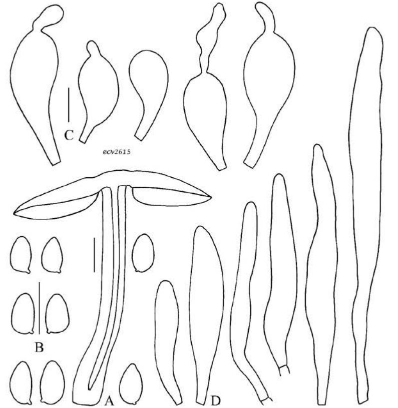

FIG. 5. *Lepiota fuliginescens* — A. Basidiocarp; B. spores;
C. cheilocystidia; D. elements of pileus covering (all from ecv2615).
Scale bar 10 mm (A); microscopic features 10 µm.

covering, clavate cheilocystidia with an apical excrescence, and amygdaliform to ellipsoid spores. The young specimens are very pale, but darken rapidly. *Leucoagaricus georginae*, reported from Washington, is much smaller with cystidioid elements on the pileus, but shares the cystidial characters with *L. fuliginescens*.

The type collection of *L. roseifolia* Murrill turned out to have clavate cheilocystidia with an apical excrescence (Vellinga et al. 2010), just like those of *L. fuliginescens*, but the lamellae of the dried specimen were not as dark coloured as those of *L. fuliginescens*. Modern day interpretations of *L. roseifolia* depict it as a different species, with clavate, non-appendiculate, cheilocystidia;

that species has recently been described as *La. erythrophaeus* (Vellinga et al. 2010). Sundberg (1967) recorded the cheilocystidia of *L. roseifolia* as clavate and elongate clavate, sometimes rostrate. He might have included *L. fuliginescens* in this description of *L. roseifolia*, a species otherwise lacking in his overview of lepiotaceous fungi in California.

Lepiota fuliginescens is known from a range of habitats, and is not, like *La. cupresseus*, restricted to habitats dominated by *Callitropsis macrocarpa*.

2. *Leucoagaricus cupresseus* (Burl.) Boisselet & Guinb., Bull. Féd. Ass. mycol. médit., n.s. 19: 34. 2001. FIGURES 6 & 7

≡ *Lepiota cupressea* Burl., Mycologia 37: 53. 1945.

TYPE STUDY — Sundberg (1976: 381–383).

SELECTED DESCRIPTIONS — Boisselet & Guinberteau (2001: 35–36); Burlingham (1945: 53–54).

PILEUS 30–120 mm, convex, irregularly convex, truncate convex when young, expanding to plano-convex with central depression with or without low broad umbo, often a bit irregular, at centre with pink-brown (5–7.5 YR 6/3–4 when young, later 7.5 YR 5/4) tufty-tomentose covering, around centre breaking open and more scaly-tufty, and with age in outer ¼ of radius radially arranged and streaked, darker to dark brown with age and with rain, on white background, when scratched turning red (both covering and background); margin exceeding lamellae for more than 2 mm in young specimens. LAMELLAE, L = 100–150, l = 0–3, crowded to very crowded, free and up to 6 mm from stipe, not ventricose, up to 10 mm wide, white at first, cream-white with age, with white cystidiose edge which turns dark brown with age, and immediately orange when damaged. STIPE 50–140 × 7–25 mm, cylindrical, in most specimens with big bulbous base, 25–50 mm wide, white at first, longitudinally innately fibrillose, often white-tomentose at base, shiny, orange when scratched or handled, turning ugly dark brown, hollow, protruding into pileus in some specimens. ANNULUS with ascending or descending white cuff, often relatively long, with small flaring white dull-tomentose part with thickened rim, changing orange when touched and turning dark brown with age. CONTEXT in pileus thick, white and dull, not changing colour when cut, except where knife stuck on pileus covering and there orange-red, in stipe white and orange in places, in younger specimens especially strongly orange-red in bulb, brownish in bulb in older specimens. SMELL indistinct, fungoid to slightly astringent. SPORE PRINT white.

CHEMICAL TESTS — KOH 3% on lamellae green to greenish.

DRIED SPECIMENS with dark lamellae.

BASIDIOSPORES [210,14,14] in side view 6.1–9.3 × 3.9–5.4 µm, avl × avw = 6.7–7.5 × 4.1–4.7 µm, Q = 1.4–2.0, avQ = 1.53–1.69, ellipsoid to oblong, amygdaliform, some with faint papilla, in frontal view ellipsoid to obovoid, uni-guttulate, congophilous, dextrinoid, metachromatic in Cresyl blue. BASIDIA 16–28 × 6.0–8.5 µm, 4-spored. LAMELLA EDGE sterile. CHEILOCYSTIDIA 23–89 × 6.0–16 µm, variable in shape, clavate, fusiform-clavate, lageniform-utriform, cylindrical, some lageniform with rather abrupt excrescence, or with subcapitate apex, with dark granules and contents in ammonia. PLEUROCYSTIDIA absent. PILEUS COVERING trichodermal with upright elements arising from a cutis of repent brown incrusted hyphae; upright terminal elements (50–)80–350 × 8.0–20 µm, in some collections in the smaller ranges, in others long and slender, cylindrical to narrowly fusiform, with parietal brown pigment, especially in lower half of the cells. CLAMP CONNECTIONS absent.

HABITAT AND DISTRIBUTION — Growing solitarily or in small groups under *Callitropsis macrocarpa* and always close to the coast, in west facing groves and under trees planted as wind breaks etc., known from Pacific Grove and Point Lobos in Monterey Co., northward to San Francisco and the Berkeley Marina on the San Francisco Bay; occasionally in kitchen gardens and on compost heaps. December-March.

COLLECTIONS EXAMINED — U.S.A., **California,** Alameda Co., Berkeley, Berkeley Marina, 17 December 2002, leg. T.D. Bruns & P. Boynton (coll. E.C. Vellinga 2950); ibidem, 22 December 2002, E.C. Vellinga 2958; ibidem, 30 January 2003, E.C. Vellinga 3041 & 3042; ibidem, 28 February 2004, E.C. Vellinga 3204 (nrITS GQ258477); ibidem, 9 January 2005, E.C. Vellinga 3339; ibidem, 15 December 2006, E. C. Vellinga 3538 & 3539; Berkeley, Keeler Ave, 5 January 2009, E.C. Vellinga 3973 (nrITS GU136195). Monterey Co., Moss Landing, Castroville Moss Landing cemetery, 13 January 2002, E.C. Vellinga 2831 (nrITS AY243628), 2832 (nrITS AY243630) & 2833 (nrITS GU136194); Pacific Grove, Esplanade Park, 13 January 2002, E.C. Vellinga 2836 (nrITS GU136196) & 2841 (nrITS GU136193); unknown locality (at Fungus Fair of the Fungus Federation of Santa Cruz), 12 January 2002, E.C. Vellinga 2829 (nrITS GU139787) and 2830 (nrITS GU136192). San Francisco Co., San Francisco, Sunset Blv, D.E. Desjardin 5642 (USFS); San Francisco, Land's end, 12 January 2006, D. Bojantchev (nrITS GU136191). San Mateo Co., Moss Beach, Fitzgerald Marine Reserve, 11 January 2002, E.C. Vellinga 2827 (nrITS AY243631); ibidem, 28 January 2003, E.C. Vellinga 3038.

COMMENTS — *Leucoagaricus cupresseus* has mainly been found in *Callitropsis macrocarpa* litter in coastal groves and under rows of trees planted as wind breaks. It has also been found in France, again under *C. macrocarpa,* on the Atlantic coast and in the Mediterranean area (Boisselet & Guinberteau 2001), but the one French specimen analyzed differed in nrITS sequence (Genbank accession number AY243627)from the Californian collections (Vellinga 2004b) (FIG. 1).

Leucoagaricus cupresseus is highly variable; a whole range of sizes was found in the basidiocarps growing in one row of planted cypresses (compare coll. ecv2832, and 2833; FIG. 7). The spores can vary from having a rounded apex

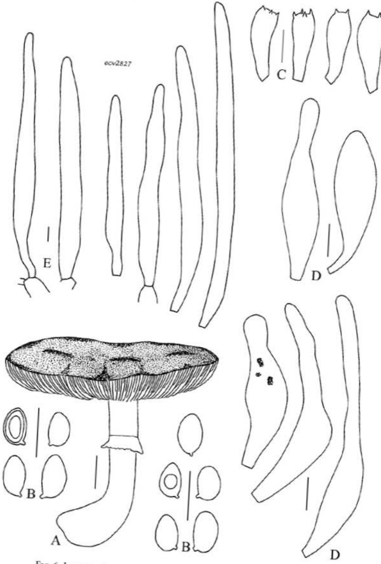

FIG. 6. *Leucoagaricus cupresseus* — A. Basidiocarp; B. spores; C. basidia; D. cheilocystidia; E. elements of pileus covering (all from ecv2827). Scale bar 10 mm (A); microscopic features 10 µm.

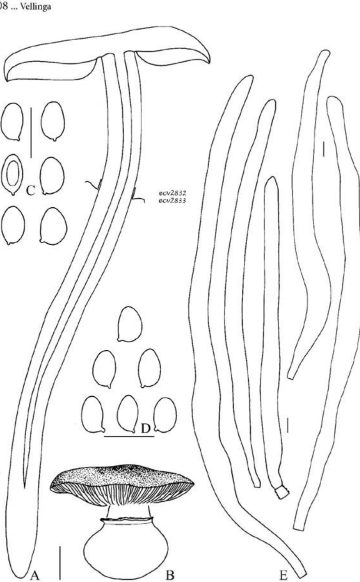

FIG. 7. *Leucoagaricus cupresseus* — Basidiocarps (A from collection ecv2833, B from ecv2832); spores (C from ecv2833, D from ecv2833); E, elements of pileus covering (from ecv2832) Scale bar 10 mm (A); microscopic features 10 µm.

to being amygdaliform and acuminate. Shape and size of the cheilocystidia are also very variable.

In the collections studied the cheilocystidia are predominantly utriform to lageniform, and clavate cystidia occur but are in the minority. Other authors (Sundberg 1976, Boisselet 2002) reported clavate cheilocystidia as the most common type.

Leucoagaricus marginatus (Burl.) Boisselet is very close to *La. cupresseus* and might actually represent a different variant. Burlingham (1945), who described both species in the same paper, did not compare the two directly; she only compared *L. marginata* with *L. rubrotinctoides* Murrill and *L. decorata*. *Leucoagaricus marginatus* differs from *La. cupresseus* in the pale reddish lilac pileus center (Burlingham 1945), and both are similar in stature and microscopical characters. Sundberg (1976), who studied the type collections of the two species, did not comment on their differences or taxonomic placement. Boisselet (2002) listed differences between two French species identified by him as *La. cupresseus* and *La. marginatus* respectively. The differences are gradual and some might be weather or age dependent, such as the differences in the ammonia reaction. The spores in the type collection of *La. cupresseus* are more amygdaliform than in *La. marginatus* and the elements of the pileus covering in *La. cupresseus* are more attenuated towards apex than in *La. marginatus* (Sundberg 1976).

Leucoagaricus pseudopilatianus Migl. et al. and its varieties *roseodiffractus* Migl. & Resta and *rugosoreticulatus* Migl. & Resta from southern Europe come very close and might well be identical to the French collections of *La. cupresseus* (Migliozzi et al. 2001, Migliozzi & Resta 2001). *Leucoagaricus pseudopilatianus* is a rather robust pale pink brownish species, with rounded (not attenuated), upright elements in the pileus covering, clavate cheilocystidia and amygdaliform spores with an indistinct apical papilla; the basidiocarps turn black on drying. This species was described at the same time that Boisselet & Guinberteau (2001) and Boisselet (2002) reported the French occurrences of *La. cupresseus* and *La. marginatus*.

The type collection of *Leucoagaricus cupresseus* was collected in the cypress groves of Point Lobos, south of Monterey, on the Pacific coast (Burlingham 1945). This is one of the two places in the world where *Callitropsis macrocarpa* occurs in native, not planted, groves (the other being just north of Point Lobos along the '17 Mile drive', also along the coast). *Callitropsis macrocarpa* has been planted in many parts of the world, but the occurrence of a species identical to or very closely related to *La. cupresseus* has only been confirmed for France (Boisselet & Guinberteau 2001, Boisselet 2002). Data on the mycoflora of cypress-dominated landscapes are lacking for other regions.

3. *Leucoagaricus adelphicus* Vellinga, **sp. nov.** FIGURES 8 & 9

MYCOBANK MB 515363

Leucoagarico pilatiano *similis, sed sine odore ligni cedri, etiam in nucleari spatii interne transcipti ("nrITS") ordine differt.*

HOLOTYPUS — "U.S.A., California, San Mateo County, San Francisco watershed, 8 Dec 2002, E.C. Vellinga 2584 (UC)." (nrITS AY243623).

ETYMOLOGY: *adelphicus* is the Latinized form of the Greek word αδελφικος, brotherly or sisterly, because of the closeness to *La. pilatianus*.

PILEUS 32–55 mm, plano-convex with or without broad low umbo to plano-concave with age, pale brown to brown, pinkish brown or orange-brown, (5 YR 5/3–4, 5 YR 4/3, 7.5 YR 7–6/4–6) to slightly darker at umbo than at rest of pileus, rather evenly coloured over pileus or with radiating streaks of colour on pale cream background, or much paler at margin (up to 5 YR 8/2–3), velvety tufty all over, and those tufts more crowded at centre than at margin; pileus surface when scratched slighty orange discolouring; margin conspicuously lighter than rest of pileus and fringed, exceeding lamellae. LAMELLAE moderately crowded to very crowded, 1(–3) lamellulae in between 2 lamellae, free and remote from

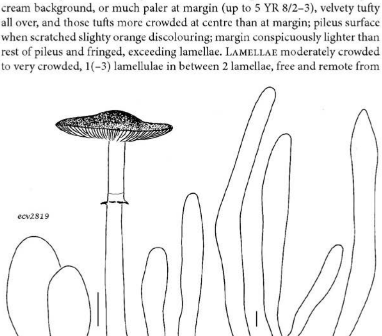

FIG. 8. *Leucoagaricus adelphicus* — A. Basidiocarp; B. cheilocystidia; C. pileus covering elements (all from ecv2819). Scale bar 10 mm (A); microscopic features 10 µm.

stipe, subventricose to ventricose up to 4 mm wide, white but slightly yellowish-pinkish, not changing colour on damaging, with white eroded cystidiose edge. STIPE 50–80 × 5–9 mm, cylindrical but in most specimens slightly widened at base, in upper part whitish with pinkish sheen, in lower half orange-brown from touching, white tomentose at base, hollow. ANNULUS an ascending or descending cuff with a small flaring part, white with dark rim. CONTEXT in pileus white and dull, rather thick, at centre orange-red from cutting, in stipe cortex white to pale brown and shiny. SMELL none, fungoid to astringent.

LAMELLAE of dried specimens not discoloured, pale.

BASIDIOSPORES [75,5,5] in side view 5.9–7.6 × 3.4–4.4 µm, avl × avw = 6.2–6.6 × 3.9–4.0 µm, Q = 1.43–1.89, avQ = 1.58–1.66, ellipsoid to oblong with round apex and flattened abaxial side, in frontal view ellipsoid to oblong and symmetrical, thick-walled, smooth, without germ pore, with guttule, congophilous, dextrinoid, metachromatic in Chresyl blue. BASIDIA 17–28 × 6.5–13 µm, most 4-spored, a few 2-spored. LAMELLA EDGE sterile. CHEILOCYSTIDIA 20–52 × 6.5–16 µm, clavate, broadly clavate, narrowly clavate, some narrowly utriform to cylindrical, with brown pigment and inclusions in ammonia. PLEUROCYSTIDA absent. PILEUS COVERING resembling a felted mat, trichodermal with upright elements, either solitary or in tufts, 77–317 × 9–20 µm, rarely not exceeding 200 µm in length, widest at 1/4 or 1/3 of length, and tapering towards apex, rarely blunt and relatively wide, with middle brown parietal pigment, but pale at tips. CLAMP CONNECTIONS absent.

HABITAT AND DISTRIBUTION — Solitary or in small groups, terrestrial and saprotrophic, in plantations of *Callitropsis macrocarpa*, in woods of *Quercus agrifolia* Nee, in *Eucalyptus* plantings, or in mixed conifer-broadleaf forests of central coastal California, November to January.

ADDITIONAL COLLECTIONS EXAMINED — U.S.A., **California**, Alameda Co., Oakland, 15 November 2001, D. Viess & D. Rust (coll. E.C. Vellinga 2669) (nrITS AY243622); Contra Costa Co., Tilden Regional Park, 26 November 2000, E.C. Vellinga 2558 (nrITS AY243621); ibidem, 4 Dececmber 2001, E.C. Vellinga 2772 (nrITS AY243624); ibidem, 6 January 2002, E.C. Vellinga 2819 (nrITS AY243625). San Mateo Co., San Francisco Watershed, 5 December 2003, E.C. Vellinga 3153 (nrITS GQ258478); ibidem, 1 December 2006, E.C. Vellinga 3532A (nrITS GU136190).

COMMENTS — *Leucoagaricus adelphicus* is morphologically and molecularly close to the European species *La. pilatianus* (Demoulin) Bon & Boiffard with which the following characters are shared: a warm brown, plushy-velvety-tomentose pileus surface, pale lamellae in dried specimens, basidiocarps not changing much colour on aging or when scratched; cheilocystidia clavate, and pileus covering made up of erect long, tapering elements. *Leucoagaricus adelphicus* lacks the typical cedar wood smell of *La. pilatianus,* and differs considerably in nrITS sequences from *La. pilatianus*.

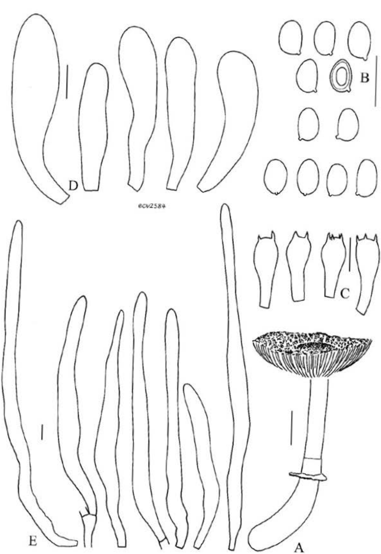

FIG. 9. *Leucoagaricus adelphicus* — A. Basidiocarp; B. spores; C. basidia; D. cheilocystidia; E. elements of pileus covering (all from holotype, collection ecv2584). Scale bar 10 mm (A); microscopic features 10 µm.

The name *Lepiota pulverapella* Zeller was at first considered for the taxon here described as *La. adelphicus*, but that species differs in the robust fruitbodies (also with warm brown colours), its habitat (in a field; Zeller 1933), and in the pileus covering structure and cheilocystidial shape (Sundberg 1995). Habitat, basidiocarp size, and structure of the pileus covering make this an enigmatic species. The context staining yellow when bruised (Zeller 1933) almost suggests a relationship with *La. americanus*, but that species has bigger spores with a germ pore. Zeller (1933) described the lamellae as 'drying a flesh color with darker rosy and vinaceous tinges,' characters absent from *La. adelphicus*. Unfortunately, Sundberg (1995) in his type study did not place the species in a phylogenetic or taxonomic framework or compare it to other described species.

Somewhat similar species are *La. hesperius* and *La. dyscritus*. The former differs in the lamellae that discolour on drying, while the latter shares the pale lamellae but differs in the structure of the pileus covering, which is made up of upright chains of relatively short elements. All three species can fruit at the same time in the Monterey cypress grove of the San Francisco watershed south of San Francisco.

Leucoagaricus adelphicus differs from *L. fuliginescens* in the absence of an apical excrescence on the cheilocystidia and the pale colours of the lamellae in dried basidiocarps.

The similar *Leucoagaricus aurantiovergens* A. Gennari & Migl. has longer spores (avQ = 2) and relatively wide elements of the pileus covering (Gennari & Migliozzi 1999). It stains immediately orange on the stipe when bruised. The cheilocystidia are clavate.

A third species from southern Europe, *Leucoagaricus pseudopilatianus*, resembles *La. cupresseus* much more than *La. adelphicus*. Migliozzi & Resta (2001), who published a key to the European species with clavate cheilocystidia, unfortunately did not include *La. cupresseus* and *La. marginatus* in their treatment and discussions.

4. *Leucoagaricus hesperius* Vellinga, **sp. nov.** FIGURE 10

MycoBank MB 515366

Prope Leucoagaricum adelphicum *et* La. pilatianum, *lamellis rubescentibus differt.*

Holotypus — "U.S.A., California, San Mateo County, San Francisco Watershed, 1 December 2006, E.C. Vellinga 3515 (UC)", (nrITS GU139788).

Etymology: *hesperius* is the Latinized form of the Greek word 'εσπεριος meaning 'evening-' and 'western'.

Pileus 30–53 mm, convex to plano-convex with slightly depressed centre, and sometimes with low umbo in centre, plano-concave or wavy with age, evenly pinkish-reddish brown (5–7.5 YR 6–5/4–6), or at centre more dark orange-brown (5 YR 4/6–5/6) and orange-brown around centre, plushy tufty-velutinous all

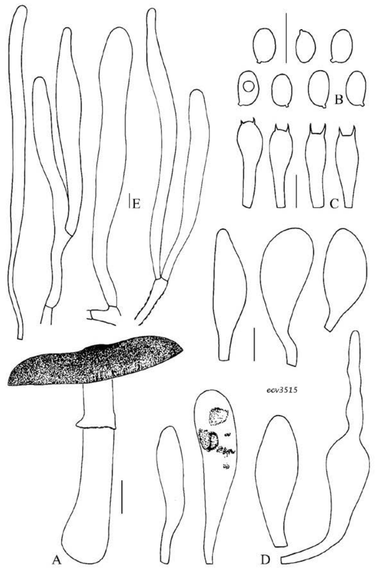

Fig. 10. *Leucoagaricus hesperius* — A. Basidiocarp; B. spores; C. basidia; D. cheilocystidia; E. elements of pileus covering (all from holotype, collection ecv3515). Scale bar 10 mm (A); microscopic features 10 µm.

over, though closed at centre, and on background of radially arranged covering, on a white background; margin cream and exceeding lamellae. LAMELLAE crowded to rather crowded, free and 1 mm remote from stipe, ventricose to segmentiform, 3–4.5 mm wide, whitish creamy, with age more orange coloured cream, with white cystidiose edge, turning red to almost black with pressure. STIPE 35–77 × 6–10 mm, slightly narrower at apex, widened at base to 14 mm, whitish at utmost apex, pale pinkish-brownish to brownish from handling and with age lower down, innately lengthwise fibrillose, and with fibrils blackening on stipe, hollow. ANNULUS a descending cuff with ragged upper tear and small flaring part, white with dark brown rim. CONTEXT dull, white and thick in pileus, white shiny in stipe. SMELL rather indistinct, vaguely like the rubber smell of *L. cristata*.

CHEMICAL TESTS – Ammonia 10% on pileus, annulus, and lamella edge green; no reaction on surface of lamellae.

DRIED SPECIMENS with medium to dark pink lamellae.

BASIDIOSPORES [70,3,3] in side-view 5.9–8.0 × 3.5–4.7 µm, avl × avw = 6.2–7.1 × 3.8–4.2 µm, Q = 1.3–1.85, avQ = 1.48–1.69, ellipsoid to oblong, with rounded apex, with adaxial side almost straight, and abaxial side convex, in frontal view ellipsoid to oblong, uniguttulate, with smooth thick wall, without a germ pore, congophilous, dextrinoid, metachromatic in Cresyl blue. BASIDIA 21–28 × 6.5–9.0 µm, 4-spored. LAMELLA EDGE sterile. CHEILOCYSTIDIA 31–73 × 8.5–16 µm, clavate, narrowly clavate, a few fusiform, some with long neck or excrescence (sizes included in measurements), with brown, evenly distributed intracellular pigment in ammonia and sometimes with dark irregular granular contents. PLEUROCYSTIDIA absent. PILEUS COVERING trichodermal with upright brown-walled elements, some articulated, but most upright elements single-celled; terminal elements 95–325 × 7.5–25 µm, with narrowed rounded apex; pigment brown to pale brown, parietal but also exuding in ammonia, and encrusting in connecting hyphae. CLAMP CONNECTIONS absent.

HABITAT AND DISTRIBUTION — In small groups, terrestrial in cypress duff in east facing *Callitropsis macrocarpa* plantation, only known from one locality south of San Francisco. December.

ADDITIONAL COLLECTIONS EXAMINED — U.S.A., **California**, San Mateo County, San Francisco Watershed, 13 December 2002, E.C. Vellinga 2939 (nrITS GU139789); ibidem, 2 December 2005, E.C. Vellinga 3429, 3430, 3431 (nrITS GU139790).

COMMENTS — *Leucoagaricus hesperius* resembles *La. pilatianus* and *La. adelphicus* but reacts more strongly when damaged, especially on the lamellae.

Leucoagaricus hesperius shares the reactions of the lamellae on drying with *L. pulverapella*, which is differentiated by a pileus covering made up of short elements (Sundberg 1995).

5. ***Leucoagaricus dyscritus*** Vellinga, **sp. nov.** FIGURES 11 & 12

MYCOBANK MB 515365

Leucoagarico adelphico *similis lamellis dilutis non-tinctis, pilei tegumento partibus brevibus aggregatis differt.*

HOLOTYPUS — "U.S.A., California, San Mateo County, San Francisco Watershed, 5 December 2008, E.C. Vellinga 3956 (UC)", (nrITS GU136180).

ETYMOLOGY: *dyscritus* is the Latinized form for the Greek δυσκριτος, which means 'difficult to distinguish'; it sounds confusingly similar to the word discrete.

PILEUS 20–35 mm, convex with small umbo, velvety to tufty-velvety at centre, dark reddish brown (5 YR 3/4, 4–3/3), around centre with very small radially arranged pinkish brown to reddish brown, (5 YR 4–5/4-6) pyramidal tufts on white to whitish background, very pale at margin and slightly exceeding lamellae, with pressure at margin blackish discoloured. LAMELLAE crowded to very crowded, free and remote (up to 1 mm) from stipe, subventricose to segmentiform up to 3 mm wide, whitish with white cystidiose edge. STIPE 50–90 × 4–6(–8) mm, slender and cylindrical or laterally compressed, slightly wider at utmost base, white or whitish shiny, discolouring reddish orange

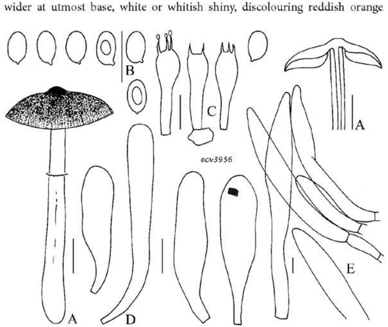

FIG. 11. *Leucoagaricus dyscritus* — A. Basidiocarp; B. spores; C. basidia; D. cheilocystidia; E. elements of pileus covering (all from holotype, collection ecv3956). Scale bar 10 mm (A); microscopic features 10 µm.

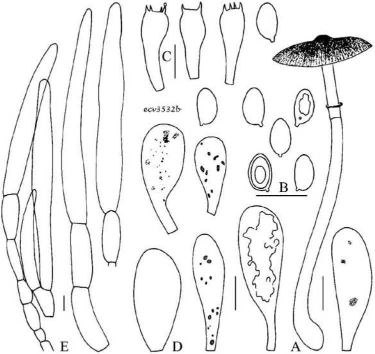

FIG. 12. *Leucoagaricus dyscritus* — A. Basidiocarp; B. spores; C. basidia; D. cheilocystidia; E. elements of pileus covering (all from ecv3532B). Scale bar 10 mm (A); microscopic features 10 µm.

where handled, with dark hairs in lower part, protruding into pileus, hollow. ANNULUS an ascending cuff and a small flaring part, or just only a funnel-shaped flaring part, white with contrasting very dark to black rim. CONTEXT dull and white, quite thick, in pileus, white shiny in stipe. SMELL cacao-like fungoid and slightly astringent.

DRIED SPECIMENS with light lamellae, without any trace of pink.

BASIDIOSPORES [80,5,5] in side view 5.1–8.0 × 3.4–4.7 µm, avl × avw = 5.8–7.2 × 3.7–4.1 µm, Q = 1.45–2.05, avQ = 1.56–1.82, ellipsoid to oblong, with rounded apex, in some specimens amygdaliform, in frontal view ellipsoid to oblong, thick-walled, smooth, without germ pore, uniguttulate, congophilous, dextrinoid, metachromatic in Cresyl blue. BASIDIA 20–25 × 6.5–10.0 µm, 4-spored. LAMELLA EDGE sterile. CHEILOCYSTIDIA 18-55 × 5.5-15 µm, clavate, narrowly clavate to almost cylindrical, fusiform, irregularly lageniform with rather short neck (up to 14 × 6.0 µm), with dark (not brown, but grey-greenish) granules in ammonia. PLEUROCYSTIDIA absent. PILEUS COVERING trichodermal with tufts or bundles of upright hyphae, made up of up to 5 elements in a row, with the terminal elements by far the biggest, and most differentiated; terminal elements 40–170 × 10–22 µm, tapering towards apex, with brown intracellular and parietal pigment; pigment exuding in ammonia; pigment parietal and sometimes incrusting in the penultimate elements. CLAMP CONNECTIONS absent.

HABITAT AND DISTRIBUTION – Solitary or in small groups, terrestrial, in duff of *Callitropsis macrocarpa* planting on east-facing slope, November and December. So far, known from the San Francisco Watershed, south of San Francisco.

ADDITIONAL COLLECTIONS EXAMINED — U.S.A., **California**, San Mateo Co., San Francisco Watershed, 10 December 1999, E.C. Vellinga 2389; 5 December 2003, E.C. Vellinga 3152 and 3155; ibidem, 6 December 2005, E.C. Vellinga 3428; ibidem, 1 December 2006, E.C. Vellinga 3532B (nrITS GU136181).

COMMENTS — *Leucoagaricus dyscritus* is characterized by non-staining lamellae and a pileus covering comprising squamules and tufts made up of short elements. In his type study, Sundberg (1995) noted that *L. pulverapella* has a similar pileus covering but differs in the much more robust basidiocarp (7-12 cm across), the pink discolouring lamellae, and its original habitat (Zeller 1933).

Similar species with an equally tomentose-velvety pileus covering that co-inhabit the same Monterey cypress grove south of San Francisco are *La. adelphicus*, with long elements in the pileus covering and non-staining lamellae, and *La. hesperius*, with discolouring lamellae and again a trichoderm made up of long elements. *Leucoagaricus* sp. (collection ecv2484) is much paler in general and has a more squamose pileus covering.

6. *Leucoagaricus erythrophaeus* Vellinga in Vellinga et al., Mycologia 102: 450. 2010 (in press; doi:10.3852/09-164).

MISAPPLIED NAME — *Lepiota roseifolia* sensu Arora (1986: 305); sensu Sundberg (1967: 115–119).

SELECTED DESCRIPTION — Vellinga et al., Mycologia 102: 450–451. 2010.

PILEUS 18–60 mm, when young hemispherical with inflexed margin, expanding via convex or widely conical to finally wavy plano-convex to slightly plano-concave, at centre with closed covering, velvety-plushy grey, dark purplish-reddish, to dark brown-black, around centre breaking open into concentrically arranged small fibrillose grayish brownish to dark brown-black squamules, often in bands, on white background, when touched immediately red-orange, changing to dark brown; margin irregular in young specimens, later evening out, exceeding lamellae. LAMELLAE free, and remote from stipe often attached to a kind of collarium, moderately crowded to crowded, ventricose, yellowish white, with white cystidiose edge, orange when touched, at least on edge, and edge darkening after being touched. Stipe 55–70 × 4–5 mm, cylindrical in upper 2/3 and widening toward up to 15 mm wide base, pale at apex and in untouched specimens pale over complete length, when touched first orange-red, changing to blackish and dark, cystidiose or hairy-cobwebby over whole length, protruding into pileus, hollow. Annulus an ascending or descending small, white cuff, with a flaring part with fringed edge, turning dark on edge with age and touching. Context white to whitish in pileus, orange where cut but soon vanishing, pale cream-coloured to yellowish in stipe, and orange where cut. Smell indistinct, astringent or lepiotoid. Taste not known.

Dried specimens with pink lamellae.

Basidiospores [228,13,10] in side view 5.9–8.8 × 3.5–4.9 µm, avl × avw = 6.2–7.4 × 3.8–4.2 µm, Q = 1.4–2.05, avQ = 1.61–1.78, ellipsoid to amygdaliform-ellipsoid, some oblong and subamygdaliform, in frontal view ellipsoid, relatively thick-walled, often uniguttulate, without germ pore, congophilous, dextrinoid, metachromatic in Cresyl Blue. Basidia 15–29 × 6.5–9.0 µm, narrowly clavate, with 4 sterigmata. Lamella edge sterile, with a continuous broad band or tufts of cheilocystidia with brown contents. Cheilocystidia 30–75 × 8.0–14.0 µm, narrowly clavate, narrowly utriform, to irregularly cylindrical and narrowed into an often long pedicel, some bifid, with brownish contents and some dark granules in ammonia; in fresh material with green-grey contents in ammonia. Pleurocystidia absent. Pileus covering a trichoderm, towards margin more cutis-like with differentiated terminal elements; terminal elements 96–350 × 9.0–20 µm, most often tapering towards apex, sometimes with blunt and rounded apex, in some specimens with many shorter elements, in others, only with those long elements; elements brown-walled at least in lower part, sometimes also with granulose or diffuse brown contents; repent connecting hyphae with dark granulose contents, sometimes also with parietal and incrusting pigments. Clamp connections absent from all tissues.

Habitat and distribution — In small groups, terrestrial, in different forests, e.g. in northern California mixed *Picea sitchensis* (Bong.) Carrière and *Tsuga heterophylla* Sarg. forests, or *Alnus rubra* Bong. and *Sequoia sempervirens* and in central coastal California *Pseudotsuga menziesii* (Mirb.) Franco with *Sequoia sempervirens* and various other tree species, throughout coastal California from Mendocino Co. northwards. Also reported from lower elevations of the western slope of the central Sierra Nevada, but actual distribution poorly known. End of October through beginning of December.

Collections examined – U.S.A., **California**, Humboldt Co., Arcata, Community Forest, 9 November 2004, E.C. Vellinga 3243 (nrITS GQ258469; Holotype, UC); Patrick's Point SP, 23 October 2003, E.C. Vellinga 3081, 3082 (nrITS GQ258471) and

3083; ibidem, 9 November 2004, E.C. Vellinga 3248 (nrITS GQ258470) and 3254 (nrITS GQ203805); Orrick, along Davison Road, 27 October 2007, N. Nguyen NN02 (nrITS GQ258468); ibidem, 7 November 2009, E.C. Vellinga 4108; Marin Co., near Alpine Lake, 15 November 2005, E.C. Vellinga 3376 (nrITS GQ258472) and 3379 (nrITS GU136177); Point Reyes NP, 31 October 2009, S.P. Schechter (coll. E.C. Vellinga 4094); Mendocino Co., Jackson State Demonstration Forest, 17 November 2001, E.C. Vellinga 2691 (nrITS AY243644); Van Damme SP, 18 November 2001, E.C. Vellinga 2682 (nrITS GU136179); San Mateo Co., San Mateo County Memorial Park, 4 November 2004, E.C. Vellinga 3217; Yuba Co., Tahoe NF, Hornswoggle Campground near Bullards Bar, 9 November 2005, E.C. Vellinga 3358; south of Challenge, along Oregon Hill Road, 10 November 2005, E.C. Vellinga 3362 (nrITS GU136178).

COMMENTS — *Leucoagaricus erythrophaeus* is better known as *Lepiota roseifolia*, but the type study (Vellinga et al. 2010) revealed that *L. roseifolia* is characterized by cheilocystidia with an apical excrescence and relatively broad and short elements on the pileus covering; the dried collection also lacked dark lamellae — all characters that do not fit the modern interpretation of that name.

Leucoagaricus erythrophaeus differs from *L. flammeotincta* and allies in the staining lamellae, the pseudocollarium to which the lamellae are attached, and in particular in the structure of the pileus covering that is composed of long often erect (trichodermal) elements. In *L. flammeotincta* s.l., the pileus covering is a cutis composed of strands of repent coloured hyphae. *Leucoagaricus pardalotus* shares the trichodermal pileus covering, is smaller, and has a distinct dark and white pattern on the pileus.

Lepiota roseifolia was reported from the Great Smoky Mountains National Park (Smith & Hesler 1938), but microscopical data were lacking, and it might well represent a different species in section *Piloselli*.

Leucoagaricus decipiens Contu, Vizzini & Vellinga is the Europan counterpart of *La. erythrophaeus* (Vellinga et al. 2010).

7. *Leucoagaricus pardalotus* Vellinga, **sp. nov.** FIGURE 13

MYCOBANK MB 515364

Lepiotae flammeotinctae *similis, pilei trichodermalis tegumento, cheilocystidiis cylindricoclavatis, colore minus intense rubescenti differt.*

HOLOTYPUS — "U.S.A., California, Mendocino Co., Van Damme SP, Fern Creek Canyon, 21 November 2004, E.C. Vellinga 3313," (nrITS GQ258479).

ETYMOLOGY: *pardalotus* is the latinized form of 'παρδαλωτος', spotted as a leopard, because of the black plushy patches and squamules on the pileus.

PILEUS 30–60 mm, convex with faint umbo, plano-convex to plano-concave with umbo, with plushy-velvety deep dark red-brown (5 YR 2.5/2, 7.5 YR 3/2) calotte, around umbo with small, dark brown v-shaped fibrillose squamules, radially arranged, often in streaks, on whitish background; outer 3 mm marginal zone sulcate and white; surface changing to faintly orange when scratched.

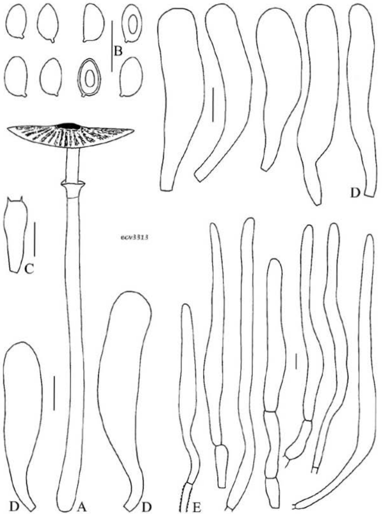

FIG. 13. *Leucoagaricus pardalotus* — A. Basidiocarp; B. spores; C. basidium; D. cheilocystidia; E. pileus covering elements (all from holotype, collection ecv3313). Scale bar 10 mm (A); microscopic features 10 µm.

LAMELLAE moderately crowded to rather distant, free and remote from stipe, attached to a rudimentary collarium, ventricose or subventricose, cream-greyish, when cut yellow to yellow-orange, with white, distinctly cystidiose-eroded edge, where touched dark brown. STIPE 80–110 × 3–7 mm, gradually widening towards 6-9 mm wide base, pale at apex, shiny but also with cystidia, below annulus brownish, orange to orange-red when touched and turning and staying dark brown, but pale fibrils mitigating the effect, hollow. ANNULUS made up of an ascending pale cuff and a flaring part, dark brown on under side, white on upper side. CONTEXT white to pale creamy in pileus, slightly orange where cut, especially below calotte, pale brown glass-like in stipe. SMELL like the rubber component of the smell of *L. cristata*.

DRIED SPECIMENS with coloured (pinkish) lamellae, and a dark stipe.

BASIDIOSPORES [34,2,2] in side view 6.6–8.8 × 3.9–4.7 µm, avl × avw = 7.4–7.5 × 4.3 µm, Q = 1.44–1.92(–2.14), avQ = 1.71–1.74, ellipsoid to oblong, most with straight adaxial side, some amygdaliform, in frontal view ellipsoid to oblong, uni-guttulate, without germ pore, thick-walled, congophilous, dextrinoid, metachromatic in Cresyl Blue. BASIDIA 18–23 × 7.0–8.5 µm, 4-spored. LAMELLA EDGE with tufts of cheilocystidia. CHEILOCYSTIDIA 26–65 × 8.0–12 µm, narrowly clavate, subutriform, cylindrical and attenuated towards pedicel, often a bit irregular, with brown granular contents in ammonia, but many without contents. PLEUROCYSTIDA absent. PILEUS COVERING with tufty squamules made up of erect elements, 110–325 × 7.5–12.5 µm, with rounded tips, not attenuated towards apex, with dark brown granular contents and with thickened brown walls; basal connecting hyphae with dark incrusting pigment; hyphae of pileitrama with some dark granules in ammonia. CLAMP CONNECTIONS absent.

HABITAT AND DISTRIBUTION — In small groups, terrestrial and saprotrophic, in damp places in mixed conifer forests on the north Californian coast, November. So far only found in Mendocino County.

ADDITIONAL COLLECTION EXAMINED — U.S.A., **California**, Mendocino Co., Jug Handle SR, 19 November 2007, E.C. Vellinga 3727 (nrITS GU136202).

COMMENTS — *Leucoagaricus pardalotus* may be taken for *L. flammeotincta* in the field, but the dense velvety plush calotte and scales and absence of the intense red discolouration on touching, distinguish it. It is one of the most beautiful species in the group. Microscopically the narrowly clavate cheilocystidia and the pileus covering made up of dense patches of upright dark brown elements set it apart from the other species.

The new species looks a bit similar to *Lepiota felina* (Pers.) P. Karst., but the absence of clamp connections, the reddening reactions, the shape of the ring, spores and cystidia all diagnose *La. pardalotus*.

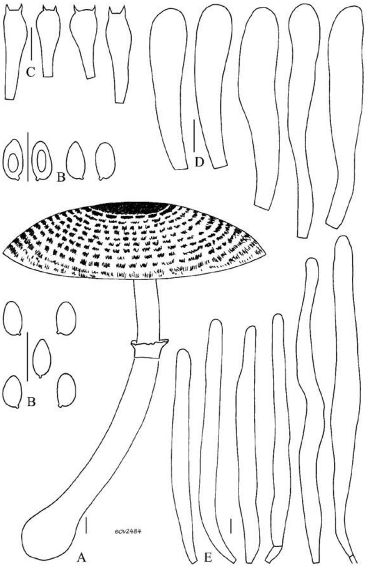

FIG. 14. *Leucoagaricus* sp. (collection ecv2484) — A. Basidiocarp; B. spores; C. basidia; D. cheilocystidia; E. elements of pileus covering. Scale bar 10 mm (A); microscopic features 10 µm.

8. *Leucoagaricus* sp. (collection ecv2484) FIGURE 14

PILEUS 70 mm, plano-convex, dark red-brown (5 YR 3/3) at centre and there closed and plush-like, around centre gradually outwards breaking up into red-brown (5 YR 4/3–5/3) short-fibrillose patches on white background; margin exceeding lamellae. LAMELLAE, L = around 80, l = 1, crowded, free and close to stipe, not ventricose, white, with white-fimbriate edge discolouring dark when touched. STIPE 90 × 8 mm, cylindrical but widened at bulbous, 15 mm wide base, whitish when untouched and staying so above annulus, in lower part with dark brown short fibrils on yellow-brownish background. ANNULUS an ascending cuff with short flaring part with dark purple-brown rim. CONTEXT white, unchanging, thick in pileus, whitish in stipe. SMELL unpleasant, fungoid.

CHEMICAL TESTS — Ammonia 10% or KOH 3% on lamella edge green, remaining basidocarp non-reactive.

DRIED SPECIMEN not discoloured, pale.

BASIDIOSPORES [15,1,1] in side-view 6.0–7.9 × 3.5–4.0 µm, avl × avw = 6.8 × 3.9 µm, Q = 1.61–2.0, avQ = 1.77, oblong to subcylindrical-amygdaliform, with rounded or more pointed apex, in frontal view ovoid with pointed or rounded apex, uniguttulate, congophilous, dextrinoid, metachromatic in Cresyl blue. BASIDIA 21–27 × 6.5–8.5 µm, 4- spored, some, close to lamella edge, thick-walled. LAMELLA EDGE sterile. CHEILOCYSTIDIA 49–75 × 8–11 µm, narrowly clavate, rarely subutriform, without apical excrescence, green in ammonia. PLEUROCYSTIDIA absent. PILEUS COVERING trichodermal, with erect dark brown, cylindrical elements, 125–240 × 11–20 µm, with rounded apex, with parietal pigment; lower, connecting hyphae with incrusting brown pigment. CLAMP CONNECTIONS absent.

HABITAT AND DISTRIBUTION — Solitary, terrestrial in duff, under *Quercus agrifolia*, in central coastal California, November. Found once in the San Francisco Bay area.

COLLECTION EXAMINED — U.S.A., **California**, Contra Costa Co., Tilden Regional Park, 16 November 2000, E.C. Vellinga 2484 (nrITS GU136182).

COMMENTS — This large conspicuous taxon was only found once. It differs from the other species in the pale colours and absence of strong reddening reactions.

9. *Lepiota flammeotincta* Kauffman, Papers Mich. Acad. Sci., Arts Letters 4: 331. 1924 (as '*Lepiota flammeatincta*'). FIGURES 15–18

SELECTED DESCRIPTION — Kauffman (1924: 331–332).

TYPE STUDY — Smith (1966: 103–105).

MICROSCOPICAL CHARACTERS (FROM VELLINGA TYPE STUDY; FIGURE 15) — BASIDIOSPORES [21,1,1] in side-view 7.4–9.3 × 4.4–5.0 µm, avl × avw = 7.9 × 4.7 µm, Q = 1.58–1.91, avQ = 1.7, oblong, some subamygdaliform, in frontal view oblong and not amygdaliform, thick-walled, with central guttule, without germ pore, congophilous, swelling in ammonia and Congo Red, dextrinoid, metachromatic in Cresyl Blue. BASIDIA 21–30 × 8.0–10 µm, 4-spored. LAMELLA EDGE sterile. CHEILOCYSTIDIA 30–45 × 5.0–9.0 µm, cylindrical, very narrowly clavate, a few wavy, not coloured. PLEUROCYSTIDIA absent. PILEUS COVERING made up of adnate hyphae, with parietal brown-grey pigment in ammonia, with extracellular red granules, and some elements filled with very dark pigments in clumps; hyphae unified in squamose fibrils; terminal elements cylindrical with rounded apex, 36–119 × 6.5–9.5 µm. CLAMP CONNECTIONS not observed.

DESCRIPTION OF MODERN MATERIAL (FIGS 16–18) — PILEUS (7–)14–45 mm, convex, plano-convex to applanate with small and low umbo, at centre pale grey brown at first, turning to dark brown (7.5 YR 3/2), almost black felted-tomentose, around centre with radially arranged fibrillose v-shaped squamules, starting out very pale, but changing to dark brown with age, on white to pale background which immediately and vividly discolours orange-red on touching, after some time completely dark brown. LAMELLAE, L = 35–50, l = (0–)1–3, moderately distant to moderately crowded, free and close to stipe, rounded off near stipe, (sub)ventricose, up to 6 mm wide, white to cream with pinkish

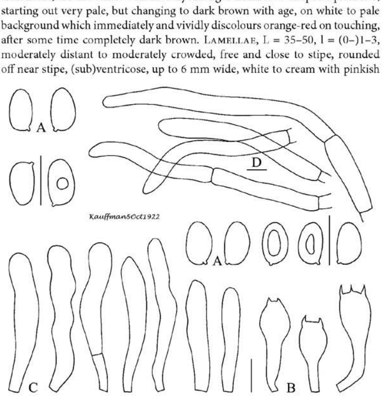

FIG. 15. *Lepiota flammeotincta* — A. spores; B. basidia; C. cheilocystidia; D. pileus covering elements (all from holotype collection). Scale bars 10 µm.

sheen, not changing colours when cut or touched; lamella edge white cystidiose, with some very fine colourless drops when young, dark where touched. STIPE 40–80 × 2.5–4 mm, cylindrical, gradually widening towards 4–7 mm wide base, white at first, but instantly intensely red staining when touched, changing to dark brown fibrillose where touched, lengthwise short-fibrillose hollow, with some white rhizomorphs. ANNULUS often absent in mature specimens, flimsy, not with a distinct cuff and flaring part, dark on outside, and with a dark rim, white on the inside. CONTEXT whitish in pileus, dull rather thick, immediately orange-red when cut; in stipe white at first, shiny, with age pale brownish to glassy yellowish. SMELL rubber-like to astringent lepiotoid and unpleasant, sometimes with fruity component.

CHEMICAL TESTS — KOH 3% on lamellae reddish, on pileus red, on stipe hard to see reaction.

DRIED SPECIMENS with dark pileus and stipe, but lamellae pale and strongly contrasting with the rest of the basidiocarps.

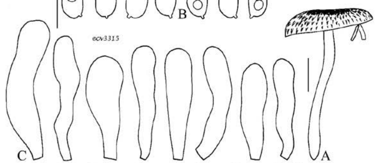

FIG. 16. *Lepiota flammeotincta* — A. basidiocarp; B. spores; C. cheilocystidia (from collection ecv3315). Scale bar 10 mm (A); microscopic features 10 µm.

BASIDIOSPORES [146,8,8] in side view 5.9–9.0 × 3.4–5.6 µm, avl × avw = 6.5–7.5 × 3.9–4.5 µm, Q = 1.5–2.1, avQ = 1.65–1.85, (the longer values for collections with a relatively high number of 2-spored basidia), oblong to almost cylindrical, with straight abaxial side, and convex adaxial side, some subamygdaliform, in frontal view oblong to almost cylindrical, thick-walled, smooth, without germ pore, and often uniguttulate, congophilous, dextrinoid, metachromatic in Cresyl blue, with walls swelling in ammonia. BASIDIA 16.5–32 × 6.5–9.0 µm, 4-spored, but in some collections with a relatively high number with 2 sterigmata. LAMELLA EDGE sterile. CHEILOCYSTIDIA 25–70 × 4.5–12.0(–13.0) µm, cylindrical, cylindrical-wavy (at least a few), more rarely narrowly clavate to narrowly utriform, with some dark brown granules or very pale brown in

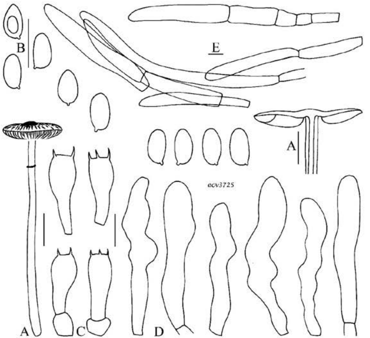

FIG. 17. *Lepiota flammeotincta* — A. Basidiocarp; B. spores; C. basidia; D. cheilocystidia; E. elements of pileus covering (all from collection ecv3725). Scale bar 10 mm (A); microscopic features 10 µm.

ammonia. PLEUROCYSTIDIA absent. PILEUS COVERING cutis-like with bundles of repent to ascending hyphae, made up of brown-walled, sometimes incrusted cells, also with dark granules and blobs and intracellular brown pigment (in ammonia); extracellular pigment blobs present; terminal elements, 55–180 × 5–16 µm, cylindrical to slightly inflated, not or differentiated with rounded or acuminate tips. CLAMP CONNECTIONS not observed.

HABITAT AND DISTRIBUTION – Solitary or gregarious in small groups, terrestrial and saprotrophic in litter, in different types of coniferous forests, e.g. in coastal pine forests, in coastal mixed forests and in the Sierra foothills, widespread and common, October through December. Also known from Oregon and Washington.

COLLECTIONS EXAMINED – U.S.A., **California,** Humboldt Co., Patrick's Point State Park, 9 November 2004, E.C. Vellinga 3250 (nrITS GU136168); near Orrick, along Davison Road, 10 November 2004, E.C. Vellinga 3266; ibidem, 27 October 2007, N.H. Nguyen 003 (nrITS GU136169); ibidem, 7 November 2009, E.C. Vellinga 4101; Marin Co., Tomales Bay State Park, 28 November 2001, E.C. Vellinga 2746 (nrITS AY176440)

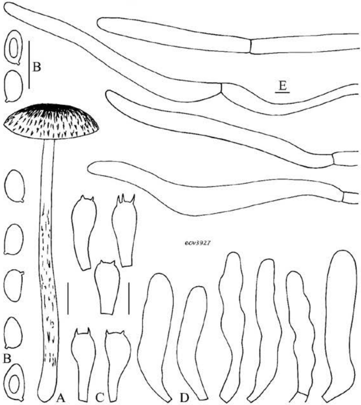

FIG. 18. *Lepiota flammeotincta* — A. Basidiocarp; B. spores; C. basidia; D. cheilocystidia; E. elements of pileus covering (all from ecv3927). Scale bar 10 mm (A); microscopic features 10 µm.

and 2757; ibidem, near Hearts Desire Beach, 22 November 2008, E.C. Vellinga 3927 (nrITS GU136163); Point Reyes NP, 6 October 2001, E.C. Vellinga 2644; Point Reyes NP along Sky Trail, 31 October 2009, S.P. Schechter (coll. E.C. Vellinga 4093); Mendocino Co., Jackson State Demonstration Forest, 18 November 2000, E.C. Vellinga 2533 (nrITS AY176441); ibidem, 17 November 2001, E.C. Vellinga 2704 and 2717; ibidem, 23 November 2002, E.C. Vellinga 2911, 2912 and 2913; ibidem, 20 November 2004, E.C. Vellinga 3295 (nrITS GU136166); Jughandle State Reserve, 19 November 2007, E.C. Vellinga 3725 (nrITS GU136170); Van Damme SP, 19 November 2000, E.C. Vellinga 2529. Nevada Co., San Juan Ridge, near North Columbia Schoolhouse on Tyler Foote Rd, 13 December 2003, E.C. Vellinga 3174; San Mateo Co., San Mateo County Memorial Park, 5 December 2008, F. Stevens et al. (coll. E.C. Vellinga 3967) (nrITS GU136167). Sonoma Co., Salt Point State Park, 22 November 2004, E.C. Vellinga 3315 (nrITS GU136165). Yuba Co., Challenge, along Oregon Rd, 10 November 2005, E.C. Vellinga

3359 (nrITS GU136171) and 3361 (nrITS GU136164). **Oregon,** Clackamas County, Mt Hood near Welches, 5 October 1922, C.H. Kauffman (Holotype, MICH).

Comments — What was thought to represent just one species, *L. flammeotincta,* turned out to be a complex, with two common taxa, *L. flammeotincta*, and *La. flammeotinctoides* (described below), two rarely observed species, and one putative taxon based on a single collection.

The distinction between the two common and most intensely reddening species is microscopical, based on the shape of the cheilocystidia: cylindrical and often wavy-constricted to narrowly clavate in *L. flammeotincta*, and only narrowly clavate, with an occasional cylindrical one, in *La. flammeotinctoides*. The lamellae of the more robust *La. flammeotinctoides* stain reddish, and nrITS sequences distinguish the two species very convincingly.

The other satellite taxa have irregularly shaped, non-cylindrical cheilocystidia, and differ in subtle pileus covering characters or spore shape. *Lepiota flammeotincta* and *La. flammeotinctoides* 'bleed' heavily, the others less so. It is amazing, and frustrating, that species that differ so clearly in sequence data are hard to distinguish morphologically.

The strong reddening reaction of *L. flammeotincta* might be the reason that KOH on the surfaces did not have the chance to turn the tissues green.

Kauffman's (1924) macroscopical description of *L. flammeotincta* is very accurate and complete, an excellent example of good and thorough observation without drowning in unnecessary details.

Smith (1966), who also studied the type collection, noted narrowly clavate cheilocystidia and slightly smaller spores than observed here. Only cylindrical and very narrowly clavate cheilocystidia, some wavy, were observed for this study.

Johnson (1999) included a collection from Costa Rica for which she used the name *L. flammeotincta,* but the nrITS, nrLSU, and mtSSU sequences (GenBank accession numbers U85331, U85296 and U85363 resp.) represent a different, unidentified species.

Unlike *La. erythrophaeus*, *L. fuliginescens*, and *La. adelphicus*, *L. flammeotincta* does not have a sister species in Europe. In fact, all European species of section *Piloselli*, except *L. roseolivida,* have a trichodermal pileus covering.

10. *Leucoagaricus flammeotinctoides* Vellinga, sp. nov. Figures 19 & 20

MycoBank MB 515367

Lepiotae flammeotinctae *similis, lamellis post tactum discolorentibus, cheilocystidiis (tenuiter) clavatis, nucleari spatii interne transcipti ("nrITS") ordine differt.*

Holotypus — "U.S.A., California, Mendocino County, Jughandle SR, 19 November 2007, E.C. Vellinga 3729 (UC)," (nrITS GU136173).

Etymology: The epithet *flammeotinctoides* refers to the resemblance to *L. flammeotincta*; the word combines the Latin '*flammeotincta*' with the suffix '*-oides*' derived from the Greek, resulting in a more euphonious word than the completely Latin and grammatically correct 'flammeotinctaster' with the same meaning.

PILEUS 31–60 mm, plano-convex, to applanate with central depression and (low, broad) umbo to wavy, at first dark grey at umbo, soon dark brown to dark red-brown (5 YR 3/3), plushy velvety-tomentose on umbo, around umbo with concentrical rings of dark brown material as on pileus centre, and further towards margin with small fibrillose radially arranged dark brown scales to small cobwebby fibrils on white background, gradually lighter towards margin to pale brown (7.5 YR 8/2), on pale background and margin; fibrils red when touched, but background not changing colour; marginal zone sulcate in some specimens. LAMELLAE, L = 50–60, l = 0 1, crowded or moderately crowded, free and 1 mm remote from stipe, some furcate, segmentiform to ventricose, 4–6 mm wide, white-cream to yellowish white coloured, orange near margin, orange-red when touched, with white cystidiose-dentate edge, changing via orange to dark with pressure and age, but this reaction can be slow and weak. STIPE 70–135 × 4–7 mm, slightly narrower at apex, 8–13 mm wide at base, protruding slightly into pileus, white, lengthwise innately fibrillose and hirsute all over, changing instantly to bright orange-red when bruised, turning dark brown with time, hollow. ANNULUS an ascending white cuff and a small flaring part with dark rim, with dark fibrils as on pileus, and turning completely dark. CONTEXT white to whitish and dull in pileus, but where cut (especially under umbo) red or orange but soon fading, shiny to glassy white to pale brownish with age in stipe, orange when cut (fresh specimens). SMELL none, indistinct or astringent lepiotoid to rubber-fungoid.

DRIED SPECIMENS dark with dark lamellae.

BASIDIOSPORES [140,8,8] in side view 5.9–8.8 × 3.1–4.6 µm, avl × avw = 6.4–7.8 × 3.5–4.1 µm, Q = 1.5–2.2, avQ = 1.74–1.88, ellipsoid to subcylindrical, with rounded apex, a few subamygdaliform, in frontal view similar as in side-view, thick-walled and smooth, uniguttulate, congophilous, dextrinoid, metachromatic in Cresyl blue. BASIDIA 18–29 × 6.5–9.5 µm, 4-spored. LAMELLA EDGE completely sterile, or with tufts and groups of cystidia. CHEILOCYSTIDIA 22–53(–75) × 5.0–15.0 µm, clavate, narrowly clavate, narrowly utriform or sublageniform, occasionally cylindrical, a few with really long pedicel, with dark brown contents and big inclusions or granules in ammonia. PLEUROCYSTIDIA absent. PILEUS COVERING cutis-like made up of strands of mostly repent, more rarely ascending brown-walled hyphae; terminal elements 63–200(–260) × 9.0–15.5 µm, cylindrical to slightly inflated, with rounded apex, or attenuated towards apex; penultimate elements often much shorter; pigment brown parietal and intracellular, exuding out of material in ammonia, with dark brown granules, and can be incrusting in all elements except terminal ones. CLAMP CONNECTIONS absent.

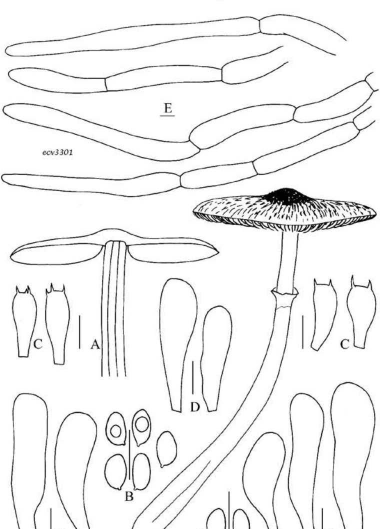

Fig. 19. *Leucoagaricus flammeotinctoides* — A. Basidiocarp; B. spores; C. basidia; D. cheilocystidia; E. elements of pileus covering (all from ecv3301) . Scale bar 10 mm (A); microscopic features 10 µm.

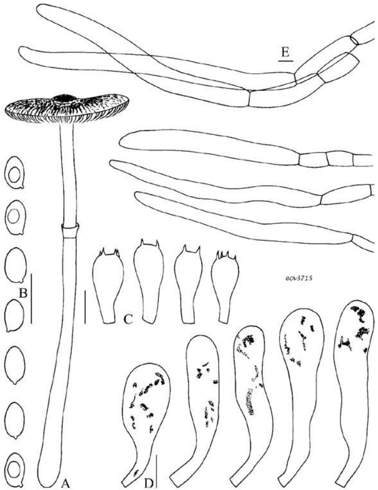

FIG. 20. *Leucoagaricus flammeotinctoides* — A. Basidiocarp; B. spores; C. basidia; D. cheilocystidia; E. elements of pileus covering (all from 3715) . Scale bar 10 mm (A); microscopic features 10 µm.

HABITAT AND DISTRIBUTION – Solitary to gregarious in small groups, terrestrial and saprotrophic, in coastal mixed coniferous forests, with or without *Sequoia sempervirens*, in northern California, November and early December.

Additional collections examined — U.S.A., **California**, Humboldt Co., Patrick's Point SP, 9 November 2004, E.C. Vellinga 3247 (nrITS GU136174); Marin Co., Samuel P. Taylor State Park, 28 November 2001, E.C. Vellinga 2759 (nrITS AY243620); Mendocino County, Jackson State Demonstration Forest, 20 November 2004, E.C. Vellinga 3301 (nrITS GU136175), 3304 (nrITS GQ258475) and 3308 (nrITS GQ258476); Van Damme SP, along Fern Canyon Trail, 18 November 2007, E.C. Vellinga 3715 (nrITS GU136172); San Mateo Co., San Mateo County Memorial Park, 5 December 2008, F.A. Stevens et al. (collection ecv3966) (nrITS GU136176).

Comments — *Leucoagaricus flammeotinctoides* resembles *L. flammeotincta* in the rapid staining reaction of pileus and stipe, but it differs in the bigger and more robust basidiocarps, the staining lamellae, and the narrowly clavate cheilocystidia. The lamellae are more remote from the stipe than in *L. flammeotincta*. Wavy cylindrical cheilocystidia, so characteristic for *L. flammeotincta*, have never been observed in this species.

It seems to be less common than *L. flammeotincta* s. str., not yet found outside the coastal forests, but its real distribution and occurrence are unknown.

The new species could be confused with *La. erythrophaeus* because of the staining lamellae, but that species has a pseudocollarium to which the lamellae are attached and a trichodermal pileus covering structure.

11. *Leucoagaricus pyrrhophaeus* **Vellinga, sp. nov.** Figure 21

MycoBank MB 515369

A Lepiota flammeotincta *cheilocystidiis clavatis ad lageniformibus vel irregularibus differt.*

Holotypus — "U.S.A., California, Humboldt County, near Orick, along Davidson's Road, 10 November 2004, E.C. Vellinga 3268 (UC)," (nrITS GU136199).

Etymology: derived from the Greek words πυρρος, 'red, flame-coloured, yellowish-red', and φαιος, 'dark'; chosen because of the reaction of the tissues when exposed to air.

Pileus 25-30 mm plano-convex with low umbo, dark red-brown (2.5 YR 2.5/3) at umbo, around umbo with concentrical and towards margin more radially oriented tufts of fibrils, v-shaped, concolorous with umbo, on white background which easily discolours orange; margin irregularly fringed, exceeding lamellae. Lamellae, L = around 50, l = 0, 1 or 3, moderately crowded, free and remote from stipe, ventricose, whitish with cystidiose edge glistening with some colourless drops; edge discolouring when touched to orange changing to dark brown-black. Stipe 50–70 × 2.5–3 mm, gradually widening downwards to 6 mm wide base, pale pinkish at apex, below annulus with dark fibrils where touched, turning orange, then dark, when scratched, cystidiose-fibrillose above annulus, hollow. Annulus not very elaborate, not a distinct cuff but funnel-shaped, with a broadened rim, pale on the inside, with dark upper rim, and some dark fibrils on outside.

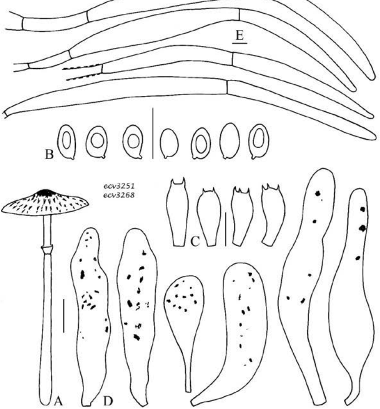

FIG. 21. *Leucoagaricus pyrrhophaeus* — A. Basidiocarp (holotype, collection ecv3268); B. spores; C. basidia; D. cheilocystidia; E. pileus covering elements (all microscopic features from collection ecv3251). Scale bar 10 mm (A); microscopic features 10 µm.

DRIED SPECIMENS copper coloured, with coloured lamellae.

BASIDIOSPORES [35,2,2] in side view 5.5–7.2 × 3.4–4.2 µm, avl × avw = 6.4–6.6 × 3.8 µm, Q = 1.4–2.0, avQ = 1.68–1.75, oblong, with flattened abaxial side, with rounded, non-amygdaliform apex, smooth and thick-walled, with guttule, without germ pore, congophilous, dextrinoid, metachromatic in Cresyl blue. BASIDIA 13–18 × 6.0–8.0 µm, 4-spored. LAMELLA EDGE sterile. CHEILOCYSTIDIA 30–68 × 9.0–13 µm, irregularly lageniform to utriform, some clavate, some narrowly lageniform, with brown contents and dark granules in ammonia. PLEUROCYSTIDIA absent. PILEUS COVERING with repent to upright brown-walled hyphae with brown contents and some dark granules in ammonia, some with incrusting pigments; most typically 3 coloured elements in a row, with the terminal element the biggest, and slightly differentiated, narrowing into acute apex, in most cases elements not widened at the septa; with lowest elements the narrowest or narrowing at base; terminal elements 115–285 × 12–20 µm; penultimate elements up to 25 µm wide. CLAMP CONNECTIONS absent.

HABITAT AND DISTRIBUTION – Solitary or in small groups, terrestrial in coastal coniferous forests of northern California, under *Picea sitchensis*, or in a mixed conifer forest with *Sequoia sempervirens*, *Picea sitchensis* and *Tsuga heterophylla*. So far only found in Humboldt County. November.

ADDITIONAL COLLECTION EXAMINED – U.S.A.: California, Humboldt Co., Patrick's Point State Park, 9 November 2004, E.C. Vellinga 3251 (nrITS GQ258473).

COMMENTS — *Leucoagaricus pyrrhophaeus* belongs to the group of species that look very much like *L. flammeotincta*. In particular, it resembles *Leucoagaricus* sp. (collection ecv3723), but differs in the hyphae of the pileus covering with non-inflated elements, resulting in smooth hyphae; *La. pyrrhulus* also comes close but has amygdaliform spores. All three have cheilocystidia that show a certain resemblance to Dr. Seuss creatures. *Leucoagaricus pyrrhophaeus* stains less easily red when touched than *L. flammeotincta* and *La. flammeotinctoides*; furthermore, the cheilocystidial shape also easily separates it from both these species. Thus far, nrITS sequences differentiate these taxa more easily than morphological characters.

12. *Leucoagaricus pyrrhulus* Vellinga, sp. nov. FIGURE 22

MYCOBANK MB 515368

A Lepiota flammeotincta in pileo fibrillis tenuibus, sporis amygdaliformibus, cheilocystidiis clavatis ad lageniformibus differt.

HOLOTYPUS — "U.S.A., California, Mendocino County, Jackson Demonstration State Forest, 20 November 2004, E.C. Vellinga 3306 (UC)", (nrITS GQ258474);

ETYMOLOGY: *pyrrhulus* is derived from the Greek word πυρρος, 'red, flame-coloured, yellowish-red'. Some linguistic freedom has been applied to coin the diminutive, referring to the small fibrils on the pileus surface in comparison to the other species in the complex.

PILEUS 15–30 mm, plano-convex to applanate without distinct umbo, dark brown at centre, white around centre with very small dark brown cobwebby fibrils and a dark margin from pressure (after bringing home), with some dark radial streaks from touching, with glistening surface, immediately orange when scratched. LAMELLAE, L = around 30, l = 0 or 1, moderately crowded, free but not remote from stipe, ventricose, cream with distinctly white cystidiose edge.

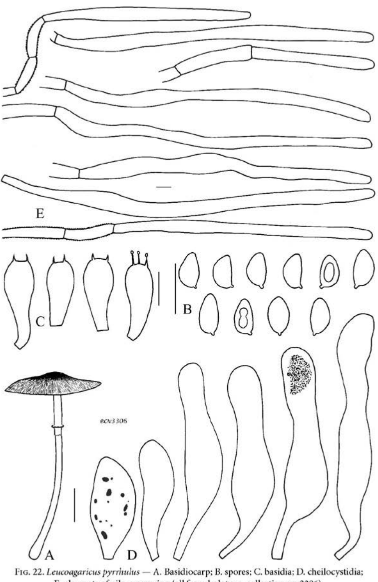

FIG. 22. *Leucoagaricus pyrrhulus* — A. Basidiocarp; B. spores; C. basidia; D. cheilocystidia; E. elements of pileus covering (all from holotype, collection ecv3306). Scale bar 10 mm (A); microscopic features 10 µm.

STIPE 30–50 × 1.5–2.5 mm, cylindrical or slightly widened at base, whitish all over, but dark where touched, hairy cystidiose all over, hollow. ANNULUS small, with a small ascending cuff, and a small dark flaring part. SMELL indistinct.

DRIED SPECIMENS with pink to dark lamellae.

BASIDIOSPORES [20,2,2] in side-view 6.1–7.8 × 3.2–4.4 µm, avl × avw = 6.8–6.9 × 3.7–4.0 µm, Q = 1.6–2.1, avQ = 1.7–1.83, amygdaliform-oblong or oblong with rounded apex, in frontal view oblong-obovoid, smooth, thick-walled, with one or more guttules, congophilous, dextrinoid, metachromatic in Cresyl blue. BASIDIA 21–26 × 7.0–8.5 µm, 4-spored. LAMELLA EDGE sterile. CHEILOCYSTIDIA 43–67 × 7.0–14 µm, lageniform with long neck, some with subcapitate apex or with moniliform neck, a few clavate, with green-brown contents and dark granules or concretions in ammonia. PLEUROCYSTIDIA absent. PILEUS COVERING a cutis made up of dark reddish brown hyphae in bundles on top of a yellow-brown lower layer with thin hyphae, some of which have finely incrusting pigment. Hyphae of upper layer with long cylindrical to slightly differentiated terminal elements, 80–250 × 9–13 µm, with rounded, non attenuated tips, with parietal pigment. CLAMP CONNECTIONS absent.

HABITAT AND DISTRIBUTION — Solitary, terrestrial in mixed coniferous forests with *Sequoia sempervirens*, in coastal northern California, found twice near Mendocino, November.

ADDITIONAL COLLECTION EXAMINED — U.S.A., **California**, Mendocino Co., Van Damme SP, Fern Canyon, 18 November 2007, E.C. Vellinga 3719 (nrITS GU136201).

COMMENTS — *Leucoagaricus pyrrhulus* is close in general appearance to the other species in the *L. flammeotincta* group, but it has finer fibrils on pileus, does not strongly discolour when touched, and is the only species with amygdaliform spores. It also differs in the shape and size of the cystidia from both *L. flammeotincta* and *La. flammeotinctoides* but the shape of the cheilocystidia is similar to those found in *La. pyrrhophaeus*.

Differences with the undescribed taxon, *Leucoagaricus* sp. (collection ecv3723), are subtle, but again, the amygdaliform spores distinguish *La. pyrrhulus*, and nrITS sequence data clearly separate them. More material is needed to assess the morphological diversity of and the distinctions among these taxa.

13. *Leucoagaricus* sp. (collection ecv3723) FIGURE 23

PILEUS 31 mm, wide-conical with umbo, deep dark brown and tomentose at umbo, around umbo with short, small dark radial fibrils on whitish background, not arranged into v-shaped squamules or cobwebby, but individually arranged; background whitish to dirty pale orange where touched. LAMELLAE, L = around 45, l = 0 or 1, free, but not remote from stipe, moderately spaced, not distant, nor crowded, subventricose, whitish with pinkish sheen, with white cystidiose edge, changing to yellow when pestered. STIPE 75 × 3 mm, gradually widening downwards to 6 mm, cream coloured when fresh, when picked immediately orange-red, changing to dirty and dark brown, hairy-tomentose, but in lower half with dark fibrils, hollow. ANNULUS an ascending cuff and a small flaring part which is dark brown and distinctly hairy-tomentose at underside. CONTEXT very thin in pileus, white, red at centre from cutting through the umbo, in stipe concolorous with surface. SMELL like the sweet and rubber components of the smell of *L. cristata*.

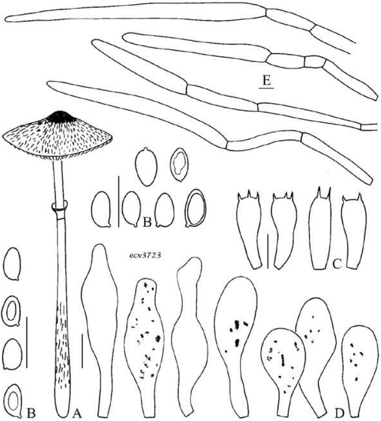

FIG. 23. *Leucoagaricus* sp. (collection ecv3723) — A. Basidiocarp; B. spores; C. basidia; D. cheilocystidia; E. elements of pileus covering. Scale bar 10 mm (A); microscopic features 10 µm.

DRIED SPECIMENS with red-copper tinges and pinkish lamellae.

BASIDIOSPORES [20,1,1] in side view 5.7–7.1 × 3.4–4.0 µm, avl × avw = 6.1 × 3.7 µm, Q = 1.55–1.85, avQ = 1.66, ellipsoid to oblong with slightly straighter adaxial then abaxial side, with rounded apex, a few subamygdaliform, in frontal view ellipsoid to oblong, with guttule, thick-walled, smooth, without germ pore, congophilous, dextrinoid, metachromatic in cresyl blue. BASIDIA 19–21 × 6.0–7.5 µm, 4-spored. LAMELLA EDGE sterile. CHEILOCYSTIDIA 20–48 × 9.0–13 µm, variable, clavate, more or less lageniform to utriform and relatively long, with brown contents and dark granules in ammonia. PLEUROCYSTIDIA absent. PILEUS COVERING around centre with repent red-brown-walled hyphae made up of 3–5 coloured elements; terminal elements slightly differentiated and inflated, longer than the penultimate cells, 100–250 × 15–18 µm. CLAMP CONNECTIONS absent.

HABITAT AND DISTRIBUTION – Solitary, terrestrial, in mixed forest, with *Picea sitchensis, Pinus muricata* D. Don, and *Sequoia sempervirens*, only found once, in Mendocino County, November.

COLLECTION EXAMINED – U.S.A., **California**, Mendocino Co., Jughandle State Natural Reserve, 19 November 2007, E.C. Vellinga 3723 (nrITS GU136200).

COMMENTS — More material is needed to assess whether this is a species in its own right. This collection is closely related to *La. pyrrhophaeus,* with which it shares the copper colours of the dried specimens. The shape of the pileus covering elements differs slightly in *La. pyrrhophaeus* as the cells in that species do not show inflations at the septa. The differences with the other taxa in the *L. flammeotincta* group are subtle, and pertain to the shape of the spores and cheilocystidia, and colour changes of the basidiocarps.

Key to the California species in the *Leucoagaricus /Leucocoprinus* clade that turn red on bruising

1. Pileus covering lilac or raspberry pink to lilac, fibrillose or plushy tomentose all over
   2. Pileus lilac to pink, fibrillose; basidiocarp slender; pileus covering with repent hyphae; spores amygdaliform . . . . *L. roseolivida*
      [not uncommon in California, description in Vellinga (2007a)]
   2. Pileus raspberry pink; basidiocarp sturdy, with pileus width equal to stipe length; pileus covering with upright elements; spores with rounded apex . . . . *L. decorata*
      [rare, only known from a few collections in California and Oregon, fruiting relatively late in the season; description in Vellinga (2007a)]
1. Pileus covering starting out very pale, changing to dark brown to black, or predominantly with dark brown to black, brown, grey or brick red colours; background can turn deep raspberry pink with age

3. Basidiocarps staining brick red with age and with ammonia, but not turning green with ammonia; spores with distinct apical papilla. . . . . . . ***L. castanescens***
[not uncommon in California, common further north, e.g. in Washington; description in Vellinga & Sundberg (2008)]
3. Basidiocarps staining green with ammonia (in strongly reddening species this reaction might be obscured); spores without apical papilla
  4. Spores with a germ pore
    5. Pileus (70–)100–230 mm with brown squamules; spores with distinct germ pore; elements of pileus covering tapering towards narrow apex; basidiocarps solitary or in small clusters . . . . ***La. americanus***
    [occasionally fruiting in the western states of North America, on wood chips or probably on hidden roots etc., widespread in North American and Europe; type description in Vellinga (2000); description of European material in Reid (1990), and Vellinga (2001)]
    5. Pileus 13–50(–80) mm with small, dot-like dark brown squamules (starting out pale grey-brown); spores with indistinct germ pore; elements of pileus covering with blunt apex; basidiocarps in big clusters . . . . ***La. meleagris***
    [occasionally fruiting in the western states of North America, on wood chips etc., widespread and known from eastern North America, Hawaii, Europe and Asia; description of European material in Reid (1990), and Vellinga (2001)]
  4. Spores without a germ pore
    6. Pileus covering made up of repent hyphae, with or without differentiated terminal elements . . . . ***L. flammeotincta*** group (5 taxa)
      7. Cheilocystidia (at least some) cylindrical and wavy (best seen when lamella edge is severely squashed), most cylindrical to narrowly clavate; lamellae not staining red when damaged . . . . 9. ***L. flammeotincta*** s. str.
      7. Cheilocystidia not wavy at all; lamellae often staining red when damaged
        8. Cheilocystidia clavate, narrowly clavate. . . . . 10. ***La. flammeotinctoides***
        8. Cheilocystidia variable, from clavate to irregularly utriform, or lageniform
          9. Spores amygdaliform; pileus with fine fibrils. . . . . 12. ***La. pyrrhulus***
          9. Spores with rounded, non-amygdaliform apex; pileus with v-shaped squamules
            10. Pileus covering elements not constricted at septa . . . . 11. ***La. pyrrhophaeus***
            10. Pileus covering elements slightly inflated and constricted at septa . . . . . . 13. ***Leucoagaricus*** sp. (collection ecv3723)
    6. Pileus covering trichodermal made up of upright elongated, rarely cystidioid, elements

12. Cheilocystidia clavate with terminal, often moniliform, excrescence; basidiocarps starting out rather pale and often developing pink-purple tinges
  13. Basidiocarps medium to large (pileus > 35 mm; stipe 60–125 × 5–16 mm, up to 20 mm at base); pileus covering made up of elongated elements only . . . . 1. ***L. fuliginescens***
  13. Basidiocarps small to medium (pileus < 35 mm; stipe 13–40 × 1.5–3 mm); pileus covering made up of cystidioid and clavate elements . . . . ***La. georginae***
  [known from the state of Washington and from Europe; included in the analysis of nrITS sequences of FIG. 1; description of European collections in Vellinga (2001)]
12. Cheilocystidia lacking long terminal excrescence, clavate, narrowly clavate or broadly clavate, fusiform to lageniform, cylindrical, or narrowly utriform
  14. Lamellae staining when damaged
    15. Lamellae attached to a collarium-like structure; cheilocystidia clavate, up to 90 µm long . . . . . . 6. ***La. erythrophaeus***
    15. Lamellae not attached to a collarium-like structure; cheilocystidia if clavate, shorter
      16. Basidiocarps sturdy, fleshy (pileus 30–120 mm); pileus with pink-brown tomentose covering, changing to evenly dark brown with age . . . . 2. ***La. cupresseus***
      16. Basidiocarps medium to small (pileus 30–60 mm); pileus warm red-brown or with dark centre and patches on light background
        17. Pileus warm red-brown all over; cheilocystidia varied, narrowly clavate, clavate, fusiform-utriform to clavate with terminal excrescence .4. ***La. hesperius***
        17. Pileus white with very dark centre and a radiating pattern of dark patches on an off-white background; cheilocystidia cylindrical . . . . 7. ***La. pardalotus***
  14. Lamellae not staining red when damaged (although lamella edge might discolour)
    18. Pileus dark red-brown, fibrillose around centre; cheilocystidia long (50–75 µm long), narrowly clavate . . . . 8. ***Leucoagaricus*** **sp.** (collection ecv2484)
    18. Pileus red-brown, warm red-brown, plush-like velvety-tomentose; cheilocystidia clavate, narrowly clavate (up to 55 µm long)
      19. Pileus covering with long elements; cheilocystidia clavate . . . . .3. ***La. adelphicus***
      19. Pileus covering with bundles of short elements; cheilocystidia narrowly clavate. . . . . 5. ***La. dyscritus***

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Four lichens of the genus *Lecidea* from China

Lu-Lu Zhang[1], Hai-Ying Wang[1], Li-Yan Sun[2] & Zun-Tian Zhao[1*]

*lichenzll@yahoo.com.cn & * ztzhao@sohu.com*
[1]*College of Life Sciences, Shandong Normal University*
Jinan, 250014, P. R. China

[2]*College of Pharmacology, Taishan Medical University*
Taian, 271016, P. R. China

Abstract — Two species (*Lecidea berengeriana, L. confluens*) and one variety (*L. lapicida* var. *pantherina*) new to China and an unknown species of *Lecidea* are reported. Photos of the thalli are presented.

Key words — *Lecideaceae*, Asia, taxonomy

Introduction

The genus *Lecidea (Lecideaceae)* was established by Acharius (1803). Its originally extremely wide circumscription became reduced step by step. Zahlbruckner used *Lecidea* in an extraordinary wide circumscription, accepting more than 1350 taxa in the rank of species. Subsequently, many obviously unnatural units have been excluded (e.g. *Adelolecia, Amygdalaria, Biatora, Carbonea, Claurouxia, Clauzadea, Melanolecia, Micarea, Miriquidica, Nesolechia, Porpidia, Psilolechia, Psora, Pyrrhospora, Rimularia, Schaereria, Tephromela, Trapelia, Trapeliopsis, Tylothallia*). *Lecidea* s. str. became a medium-sized (about 100 species), almost exclusively saxicolous genus (Hertel 1995), based on the structure of the ascomata, especially the nature of the hamathecial tissues, ascus apical structures, and exciple (Purvis et al. 1992, Hertel 1995). Hertel (1967, 1977, 1995) based his narrow concept of *Lecidea* s. str. on the type species, *Lecidea fuscoatra* (L.) Ach. However, there are still many taxa included in *Lecidea* that obviously do not belong in *Lecidea* s. str. (Hertel 2004).

Worldwide, *Lecidea* s. lat. includes about 400 known taxa. In China, 31 *Lecidea* s. lat. species have been reported (Wei 1991; Abass & Wu 1998; Aptroot 2002, 2003; Guo 2005). During our study of lichen flora of western China, one unknown species, two species, and a variety of *Lecidea* s. lat. new to China were found.

Materials and methods

The specimens examined are preserved in SDNU (Lichen Section of Botanical Herbarium, Shandong Normal University) or HMAS-L (Lichen Section, Herbarium of Mycology, Institute of Microbiology, Academia Sinica).

Thalli were examined and measured under dissecting microscope (COIC XTL7045B2). Characteristics of the apothecia were investigated by microscope (OLYMPUS CX21). Photos of the thalli were taken under OLYMPUS SZX12 with DP70. The chemical constituents were identified using thin layer chromatography (TLC) (Culberson 1972).

The new records

1. ***Lecidea berengeriana*** (A. Massal.) Nyl., Not. Sällsk. Fauna Fl. Fenn. Förh. 8: 144 (1866) FIG. 1A

≡ *Biatora berengeriana* A. Massal., Ric. Auton. Lich. Crost.: 128 (1852)

Thallus grayish to greenish-gray, verrucose, surface dull, esorediate; medulla I–. Apothecia sessile with a constricted base, 0.5–1.2 mm wide, flat and marginate when young but soon convex and immarginate, dark brown or blackish; exciple and hypothecium dark reddish brown, but outer edge of exciple colourless, giving the appearance of a thalline exciple; epithecium yellowish brown; hymenium 55–75 µm high, hyaline to pale yellowish, I+ blue, then turn red; hypothecium above dark reddish brown, below usually paler. Paraphyses 1.5–3 µm wide, becoming clavate to capitate and brown-walled at apices and to 6 µm wide, mostly simple. Asci *Porpidia*-type, 8-spored. Ascospores: hyaline, simple, fusiform-ellipsoid, 7.5–12.5 × 3–5 µm.

SPOT TESTS: thallus K–, C–, KC–, P–

SECONDARY METABOLITES: none

SPECIMENS EXAMINED: CHINA. **Gansu,** Tulugou, National forest park, on moss, alt. 2800 m, 19 Aug. 2007, J.G. Liu, 20072126 (SDNU); **Qinghai,** Qilian country, Mt. Niuxinshan, on moss, alt. 3200 m, 11 Aug. 2007, Z.S. Sun, LQ350(SDNU).

COMMENTS — *L. berengeriana* does not belong to the genus *Lecidea* s. str., but because its generic position is still unclear, it is retained in *Lecidea*. It is close to *L. hypnorum* and *L. sanguineoatra* but distinguished by its tartareous thallus and much broader, brown-walled apices of the paraphyses.

L. berengeriana has been reported from circumpolar in boreal regions of the Northern Hemisphere (Hertel & Printzen 2004). New to China.

2. ***Lecidea confluens*** (Weber) Ach., Meth. Lich.: 14 (1803) FIG. 1B

Thallus well developed, whitish gray, irregularly rimose-areolate. Medulla I+ blue. Apothecia black, 0.5–1.1 mm wide, immersed to ± sessile, arising between

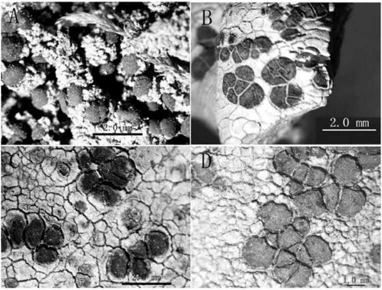

FIG. 1 Thalli of *Lecidea* species examined in the present study. A. *Lecidea berengeriana*, J.G Liu 20072126 (SDNU). B. *Lecidea confluens*, Z.T. Zhao 20071834 (SDNU). C. *Lecidea lapicida* var. *pantherina*, X.Y. Wang 025318 (HMAS-L). D. *Lecidea* sp. 1, J.G Liu 20071571-1 (SDNU).

the areoles; disc plane to slightly concave, epruinose, margin prominent; exciple blackish at out edge, colourless within; epithecium blackish green, hymenium colourless, 50–60 µm high; hypothecium dark brown. Asci *Lecidea*-type, 8-spored. Ascospores: hyaline, simple, ellipsoid, 8–10 × 3.5–5 µm.

SPOT TESTS: K–, C–, KC–, P–

SECONDARY METABOLITES: confluentic acid

SPECIMEN EXAMINED: CHINA. **Qinghai,** Xiangride country, Mt. Tuotushan, on rock, alt. 3080 m, 15 Aug. 2007, Z.T. Zhao, 20071834 (SDNU).

COMMENTS — *L. confluens* is morphologically close to *L. lapicida* and *L. tessellata*, but *L. confluens* has wider areoles, brown to dark brown hypothecium and smaller ascospores than *L. lapicida*, besides *L. lapicida* producing stictic or norstictic acid. *L. tessellata* has an almost colourless hypothecium and a bit smaller, blunter and more thick-walled ascospores. *L. confluens* has been reported from Eurasia, North America, and India (Upreti et al. 2006). New to China.

3. ***Lecidea lapicida*** **var.** ***pantherina*** (Hoffm.) Ach., Kongl. Vetensk. Akad. Nya Handl. 29: 232 (1808) Fig. 1c

= *Lecidea lactea* Flörke ex Schaer., Lich. Helv. Spicil. 3: 127 (1828)

Thallus bluish-gray with yellow shade, medium, irregulately cracked-areolate, areolate plane; medulla I+ intensively violet-blue. Hypothallus ± distinct, black. Apothecia black, subimmersed to immersed to the thallus, not constricted at the base, or rarely somewhat constricted, 0.6–1.5 mm wide; margin rather thick and entire; disc plane. Exciple concolorous to the epithecium externally, colorless or pale brown internally; epithecium blackish-green; hymenium 40–60 µm high, I+ blue; subhymenium colorless; hypothecium with various heights, yellowish brown to blackish-brown. Paraphyses simple. Asci *Lecidea*-type, 8-spored. Ascospores: hyaline, simple, ellipsoid, 10–14 × 5–7 µm.

Spot tests: Thallus K+ yellow, then red, KC+ yellow, C–, P+ yellow, medulla K–, C–, KC–, P–

Secondary metabolites: norstictic acid

Specimen examined: CHINA. **Sichuan**, Xiaojin country, Mt. Balangshan, on rock, alt. 4300 m, 18 Aug. 1982, X.Y. Wang, 025318 (HMAS-L).

Comments —It is morphologically similar to *L. lapicida* but differs in the predominance of norstictic acid.

L. lapicida var. *pantherina* has been reported from Asia (Hertel 1977, Inoue 1982) Europe, and North America. Its southern hemisphere distribution is mapped by Hertel (1997). New to China.

4. ***Lecidea*** **sp. 1** Fig. 1d

Thallus crustose, whitish gray to gray, developed well, esorediate, irregularly areolate. Areoles contiguous, flat to slightly convex, 0.2–0.9 mm in diam; cortex, 20–35 µm; medulla white, I+ deeply blue. Hypothallus distinct, black-blue.

Apothecia black, sitting in between the areoles, usually not overtopping the areoles, 0.5–1.2 mm wide, singular or in sometimes large and dense groups (then outline of apothecia angular). Margin thin; disc flat to slightly convex, dull, weakly pruinose. Epihymenium green-black, 12.5–20 µm; hymenium hyaline, 50–62.5 µm high; subhymenium hyaline to light yellow 30–70 µm thick; hypothecium pale brown. Paraphyses simple not branched. Asci *Lecidea*-type, clavate, 40–50 × 15–18 µm, 8-spored. Ascospores hyaline, simple, wall thick, ellipsoid to broadly ellipsoid, 6.2–10 × 3.5–5 µm.

Spot tests: cortex and medulla K–, C–, KC–, P–

Secondary metabolites (chemotype C): confluentic acid, unknown (Rf class 5, blue-white in UV fluorescence after charring)

Substrate: on wood.

HABITAT: in arid climate. 38.2°N, 100.22°E

SPECIMEN EXAMINED: CHINA. **Qinghai**, Qilian country, Mt. Niuxinshan, on dead wood, alt. 3200 m, 11 Aug. 2007, J.G. Liu, 20071571-1 (SDNU)

COMMENTS —This species is characterized by its moderately thallus with a I+ deeply blue medulla, its distinct hypothallus, its pale brown hypothecium, and its small, thick-walled ascospores. This species is very close to *L. tessellata* but it has distinct blue-black hypothallus, an unknown secondary metabolite besides confluentic acid, and its cortex is a palisade plectenchyma. Besides, this species grows on wood while *L. tessellata* grows on rock.

Acknowledgements

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MYCOTAXON

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A new anamorphic rust fungus with a new record of *Uredinales* from Azad Kashmir, Pakistan

N.S. Afshan[1*], S.H. Iqbal[2], A.N. Khalid[2] & A.R. Niazi[2]

*pakrust@gmail.com
[1] Centre for Undergraduate Studies, University of the Punjab
Quaid-e-Azam Campus, Lahore, 54590, Pakistan

drankhalid@gmail.com mushroomniazi@gmail.com
[2] Department of Botany, University of the Punjab
Quaid-e-Azam Campus, Lahore, 54590, Pakistan

Abstract — *Milesia kashmiriana* on *Athyrium dentigerum* is described as a new species, with *Puccinia coronata* var. *himalensis* as a new record for Pakistan.

Key words — *Hyalopsora*, Muchal, Neelum Valley, Sharda

Introduction

Azad Kashmir is a floristically rich area from which only about 23 species of rust fungi have been reported (Ahmad et al. 1997). In order to explore this floristically rich area, extensive surveys were carried out. During such surveys of the rust flora of Azad Kashmir, Pakistan, one member of Pteridophytes, *Athyrium dentigerum*, was found infected with a new anamorphic rust fungus *Milesia kashmiriana* belonging to *Pucciniastraceae*. Another rust, *Puccinia coronata* var. *himalensis*, is the first member of the *Uredinales* ever reported on *Piptatherum vicarium*.

Materials and methods

Freehand sections of infected tissue and spores were mounted in lactophenol and gently heated to boiling. The preparations were observed under a NIKON YS 100 microscope and photographed with a JSM5910 scanning electron microscope. Drawings of spores and paraphyses were made using a Camera Lucida (Ernst Leitz Wetzlar, Germany). Spore dimensions were taken using an ocular micrometer. At least 25 spores were measured for each spore stage. The rusted specimens have been deposited in the herbarium of the Botany Department, at the University of the Punjab, Lahore (LAH).

* Corresponding author

Enumeration of taxa

Milesia kashmiriana Afshan, S.H. Iqbal, Khalid & Niazi, **sp. nov.** (Figs. A–D)

MycoBank MB 516713

Telia ignota. Uredinia amphigena, subepidermalia, flavido vel aurantio- flavidae. Urediniosporae, ovoideae, ellipsoideae vel pyriformae, dilute flavido vel aurantio-flavidae, 11–17 × 21–37 μm;, poris germinationis 1–4, aequatorialibus; membrana 0.9–2 μm crassa, pariete levi vel echinulato; pedicellis hyalinis, 2–3 × 8–24 μm.

Holotype: On *Athyrium dentigerum* (Clarke) Mehra & Bir, Pakistan, Azad Jammu & Kashmir, Neelum valley, Muchal, at 3000 m a.s.l., 03 November, 2006. NSA # 786. (LAH Herbarium No. NSA 1020).

Etymology: Named after the locality, Azad Jammu & Kashmir.

Telia not observed. Uredinia amphigenous, golden to yellow or yellowish orange, erumpent, powdery, covered by the epidermis or soon naked, scattered or irregularly grouped, rounded, 0.06–0.09 × 0.3–0.4 mm. Urediniospores ovoid to ellipsoid or nearly cylindrical to pyriform, light yellow to yellowish orange, sometimes with yellowish orange granules, 11–17 × 21–37 μm; germ pores 1–4, equatorial, capitate; wall 0.9–2 μm thick, smooth or finely echinulate; pedicel hyaline, minute, thin, 2–3 × 8–24 μm. Paraphyses absent.

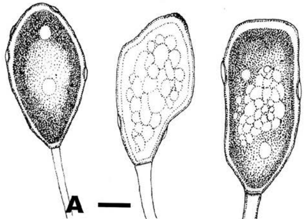
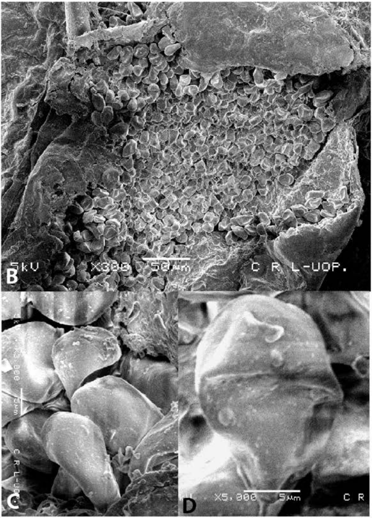


Fig. A: Lucida drawing of urediniospores of *Milesia kashmiriana* sp. nov. (type). Scale bar = 12 μm.

Comments: The uredinia of genera *Hyalopsora, Milesina* and *Uredinopsis* (*Pucciniastraceae*) are classified in the anamorph genus *Milesia*. *Milesia*



FIGS. B–D: *Milesia kashmiriana* sp. nov. (type)
(B). Cross section of uredinium containing urediniospores
(C). SEM photograph of urediniospores (D). A finely echinulated urediniospore.

kashmiriana most probably belongs to the genus *Hyalopsora* because of the morphological characters of urediniospores and uredinia.

Urediniospores of *Milesia kashmiriana* and *Hyalopsora polypodii* (Pers.) Magnus 1901 resemble each other in urediniospore shape and wall ornamentation, but *H. polypodii* has shorter urediniospores (17–27 µm) with 3–5 scattered germ pores.

Urediniospores of *M. kashmiriana* are different from those of *H. hakodatensis* Hirats. f. 1932 in size and shape; *H. hakodatensis* has shorter urediniospores (20–27.5 µm).

Uredinopsis intermedia Kamei 1932 differs in its larger (12–30 × 18–32 µm), wedge-shaped or rhomboidal urediniospores.

Urediniospores of *M. kashmiriana* also differ from the larger (15–23 × 23–42 µm) spores of *H. diplazii* Hirats. f. 1940. Moreover, the absence of paraphyses and the presence of smooth to finely echinulate urediniospores distinguish *M. kashmiriana* from *H. diplazii,* which has a few paraphyses and distinctly verrucose urediniospores.

Milesia kashmiriana is similar to *Uredinopsis daisenensis* Hirats. f. 1936 in a few respects, but the presence of shorter urediniospores (21–37 µm vs. 21–43 µm) with smooth to finely echinulate wall ornamentation and the absence of beaks differentiates it from *U. daisenensis.*

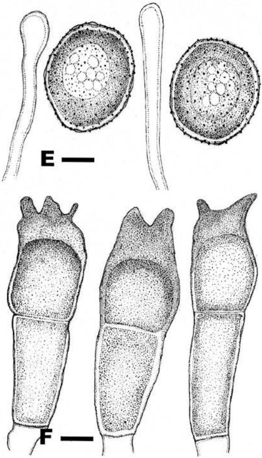
Uredinopsis komagatakensis Hirats. f. 1943 has shorter (17–32 µm) urediniospores with smooth or few longitudinal lines of minute papillae on the spore walls that contrast with the smooth to finely echinulate urediniospores in *M. kashmiriana* has.

On the basis of the above-mentioned comparisons, the present species seems new to science but will be kept in the anamorph genus *Milesia* until the telial stage is discovered.

Puccinia coronata* var. *himalensis Barclay, Trans. Linn. Soc. London, Bot., Ser. 2, 3: 227 (1891) (Figs. E–F)

Spermogonia and aecia unknown. Uredinia amphigenous, brown, 0.07–0.09 × 0.1–0.3 mm. Urediniospores globose-subglobose or ovoid, 13–19 × 14–21 µm; germ pores (2–) 4–8, scattered, obscure; wall 1.5–2 µm thick, pale yellow to nearly colorless, echinulate; pedicel minute, deciduous. Paraphyses clavate, apex 12–13 µm wide while 7–9 µm thick below, up to 50 µm long. Telia amphigenous, long covered by the epidermis, or only tardily exposed, without paraphyses, blackish brown, sori 0.06–0.08 × 0.09–0.2 mm. Teliospores golden to brown, paler basally, 14–19 × 27–47 (–54) µm, wall up to 2 µm thick at sides while about 2–5 µm thick apically excluding digitations, apex coronate with digitations, 4–12 µm long; pedicel short, yellowish brown to brown, 8–9 × 9–15 µm.

Material examined: On *Piptatherum vicarium* (Grigorj.) Roshev. (= *Oryzopsis microcarpa* Pilg.), with II, III stages, Pakistan, Azad Jammu & Kashmir, Neelum valley, Muchal, at 3000 m a.s.l., 03 November, 2006. NSA # 907. (LAH Herbarium No. NSA 1047).



Figs. E–F: Lucida drawings of *Puccinia coronata* var. *himalensis* (E). Echinulated urediniospores (F) Coronate teliospores. Scale bar = 10 µm.

Comments: *Puccinia coronata* var. *avenae* W.P. Fraser & Ledingham 1933, *P. coronata* Corda 1837 var. *coronata,* and *P. coronata* var. *gibberosa* (Lagerh.) Jørst. 1949 have previously been reported from Pakistan (Afshan et al. 2008, Ahmad et al. 1997, Iqbal et al. 2008).

Puccinia coronata var. *himalensis* has been reported on different members of *Poaceae* from Europe to India, Japan and North and South America (Cummins

1971). The variety is a new record for Pakistan, and *Piptatherum vicarium* represents a new host for the *Uredinales*.

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MYCOTAXON

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Cadophora malorum and *Cryptosporiopsis ericae* isolated from medicinal plants of the *Orchidaceae* in China

Juan Chen, Hai-Ling Dong,
Zhi-Xia Meng & Shun-Xing Guo*

kibchenjuan@126.com
Institute of Medicinal Plant Development, Chinese Academy of Medical Sciences,
& Peking Union Medical College
Beijing 100194, P. R. China

Abstract —Two species in the anamorphic genera *Cadophora* and *Cryptosporiopsis* are newly recorded as endophytes from medicinal plants of the *Orchidaceae* in China. *Cadophora malorum* was isolated from a stem of *Bletilla striata* in Hubei Province, and *Cryptosporiopsis ericae* from a root of *Spiranthes sinensis* in Tibet. These are the first records of these fungi from plants of the *Orchidaceae*.

Key words — endophytic fungi, taxonomy

Introduction

Orchids are unique among plants in their modes of nutrition (myco-heterotrophy) involving direct and often obligate relationships with fungi (Leake 1994). Thus, fungi are critical for an orchid's growth and development. Orchid mycorrhizas have been historically regarded as the third distinct structural lineage of mycorrhizas in addition to ecto-related and arbuscular mycorrhizas (Imhof 2009). Recently, non-mycorrhizal endophytic fungi associated with orchids have been shown to serve as potential growth promoters and source of bioactivity substances (Guo & Wang 2001), implying further application in the fields of cultivation and natural medicine.

During a survey of endophytic fungi associated with traditional medicinal plants of *Bletilla striata* (Thunb.) Rchb.f. and *Spiranthes sinensis* (Pers.) Ames (*Orchidaceae*) in China, *Cadophora malorum* and *Cryptosporiopsis ericae* were isolated from plant tissues. These are the first records of these anamorphic species from orchids.

Corresponding author. E-mail: sxguo2006@yahoo.com.cn

Materials and methods

Eighty-eight strains of endophytic fungi were isolated from healthy orchid plants of *Bletilla striata,* collected from Lichuan County, Hubei Province, and fifty-five strains from *Spiranthes sinensis*, collected from Linzhi County, Tibet. The isolation of endophytic fungi was performed by the modified method described by Bayman et al. (1997). In brief, roots and stems were surface-sterilized in a sequence of 75% ethanol for 1 min, 2.5% NaClO for 5 min, 75% ethanol for 1 min, and then rinsed in sterile distilled water. The endophytic fungi were first identified morphologically from published descriptions and the identifications confirmed through sequence analyses. After the extraction of genomic DNA from pure fungal cultures, the ITS regions were amplified and sequenced. Sequences were compared with fungal ITS sequences in GenBank using BLAST searches. These isolates are preserved as living cultures in the China General Microbiological Culture Collection Center, Institute of Microbiology, Chinese Academy of Sciences (CGMCC).

Taxonomy

Cadophora malorum (Kidd & Beaumont) W. Gams, Studies in Mycology 45: 188, 2000. FIG. 1 A–B

COLONIES on PDA after 2 weeks in the dark at room temperature 2.0 cm diam, brown, usually with white margin. Mycelium superficial and immersed. Aerial mycelium bristly, composed of pale brown, smooth thick hyphae. Colony margin irregularly wavy. CONIDIOSPORES simple, straight or slight flexuous, hyaline and smooth, monophialidic phialides, integrated and terminal or discrete, ampulliform, lageniform with hyaline collarettes. CONIDIA simple, straight, oblong, rounded at the ends, colorless, smooth, 2–3 × 0.3–0.5 µm (FIG. 1A–B).

SPECIMENS EXAMINED: CHINA: HUBEI PROVINCE, Lichuan County, in *Bletilla striata* (*Orchidaceae*) stem, 10 Sept. 2004, Zhi-Xia Meng BJ-10-1(CGMCC10118)

REMARKS: *Cadophora* has been treated as a synonym of *Phialophora* (Conant 1937). Gams (2000) suggested using the generic name *Cadophora* for *Phialophora*-like species with affinities to the *Dermateaceae* in the *Helotiales*. Harrington & McNew (2003) molecular analyses supported Gams' view that members of the genus *Cadophora* were anamorphs of the *Helotiales* and distinguished from the morphologically similar anamorphic genus *Phialophora* in the *Chaetothyriales*. *Cadophora* species differ from true *Phialophora* species by pale to hyaline collarettes on top of their phialides (Gams 2000). In fact, morphological identification of the two genera was difficult because pigmentation in these species is often quite variable (Harrington & McNew 2003), making it necessary to combine morphological and molecular observations to identify

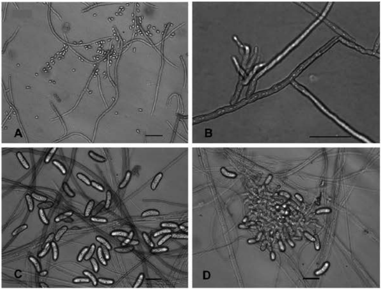

Fig. 1 *Cadophora malorum* (A–B) (CGMCC10118) and *Cryptosporiopsis ericae* (C–D) (CGMCC10119) showing conidia and phialides. Scale bar = 20μm

them. Morphology and ITS sequence (FJ450054) of our sample are identical to *C. malorum* (100% similarity with GenBank sequence DQ404350 from *Cadophora malorum*).

The known *Cadophora* species appear to be plant pathogens, root associates, or wood colonizers (Harrington & McNew 2003). *Cadophora malorum* is a common species in the genus that has been identified as a plant pathogen (Frisullo 2002). In our study, *C. malorum* was isolated from a stem of healthy *Bletilla striata*. The exact relationship between *C. malorum* and the orchid host plant needs further study.

Cryptosporiopsis ericae Sigler, Studies in Mycology 53: 57, 2005. Fig. 1 C–D

Colonies on PDA at room temperature after 21 d up to 8.0 cm diam, flat, felty, white to gray at the beginning and becoming grayish orange with age. Pale yellowish brown droplets occurred in the centre. Colony reverse gray orange when pigments produced. Conidiospores phialides, formed in hemispherical sporodochial conidiomata. Hyphae of young conidiomata moniliform and hyaline, older conidiomata composed of yellowish or black brown hyphae. Conidial masses white initially, becoming to pale to golden yellow in age.

MACROCONIDIA cylindrical, slightly curved, rounded at the apex, nonseptate, smooth, hyaline, becoming to golden yellow and guttulate in age, 18–23 × 5.5–7.8 µm (FIG. 1 C–D). MICROCONIDIA nonseptate, hyaline, oblong, 10–12 × 4–5.5 µm (not shown).

SPECIMENS EXAMINED: CHINA: TIBET, in root *Spiranthes sinensis* (*Orchidaceae*), Aug. 2007, Zhi-Xia Meng SC-b-2 (CGMCC10119).

REMARKS: *Cryptosporiopsis ericae* was isolated and described from ericaceous plant roots from western North America (Sigler et al. 2005). Characteristics of conidiomata and conidia of our specimen coincided with the original description. Moreover, the ITS sequence of Chinese material (GU945547) was 99% identical to the *C. ericae* sequence (AY853167) in the GenBank database.

Many *Cryptosporiopsis* species are known from roots of woody plants, especially from ericaceous plants (Kowalski & Bartnik 1995, Verkley et al. 2003). The Chinese record is the first report of the species from herbaceous orchid plant root.

Although some species of *Cryptosporiopsis* (e.g. *C. radicicola*, a frequent colonizer of oak roots) may be host specific, the precise ecological roles in host roots remain unknown (Kowalski & Bartink 1995). *Cryptosporiopsis ericae* has been isolated from ericaceous roots, but Berch et al. (2002) found no formation of mycorrhizal structures (hyphal coils) in re-synthesis experiments done with salal (*Gaultheria shallon*) and *C. ericae*. Similarly, Wang et al. (2007) indicated that *C. ericae* was endophytic but non-mycorrhizal and non-pathogenic for their inoculated host, *Populus tremuloides* Michx.

In addition, cryptocandin (a unique lipopeptide antimycotic) has been described from *Cryptosporiopsis* sp. that might be useful clinically for the treatment of a variety of mycoses (Fischer et al. 1984, Strobel et al. 1999). The role of *C. ericae* in the medicinal host plant needs to be studied to establish whether it is associated with pharmacodynamic effects.

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Geographic origins and phylogenetic affinities of the putative Hawaiian endemic *Rhodocollybia laulaha*

M.R. Keirle[1,2,3], P.G. Avis[2,4], D.E. Desjardin[5], D.E. Hemmes[6], & G.M. Mueller[2,7]

keirlem@scf.edu

[1] *Natural Science Department, State College of Florida Bradenton, FL 34207 USA*

[2] *Department of Botany, The Field Museum, Chicago, IL 60605 USA*

[3] *Committee on Evolutionary Biology, University of Chicago Chicago, IL 60637 USA*

[4] *Department of Biology, Indiana University Northwest Gary, IN 46408 USA*

[5] *Department of Biology, San Francisco State University San Francisco, CA 94132 USA*

[6] *Department of Biology, University of Hawaii, Hilo, HI 96720 USA*

[7] *Chicago Botanic Garden, Glencoe, IL 60022 USA*

Abstract — The Hawaiian mushroom *Rhodocollybia laulaha* was selected as a model to investigate patterns of gene flow between geographically isolated fungal populations from ecologically and bioclimatically varied sites. Its morphology (distinctive when compared to other members of the genus) and affinity for endemic Hawaiian forest suggested that it was endemic to Hawaii. However, speculation as to its closest non-Hawaiian relative and its overall placement within the genus was based on mostly anecdotal evidence. The present morphological and genetic research identifies a well-supported clade comprising *R. laulaha* individuals from across the Hawaiian Islands, reveals *R. lignitilis* (described in 2004 from the Neotropics) to be conspecific with *R. laulaha*, and identifies *R. unakensis* from Texas as a putative sister taxon. Different possible historical scenarios are discussed regarding the migration and establishment of *R laulaha* ancestors between the Americas and Hawaii. *Rhodocollybia lignitilis* is synonymized with *R. laulaha*, and *Marasmius clavipes* is transferred to *Rhodocollybia*.

Key words — ITS, LSU, species range

Introduction

Rhodocollybia laulaha Desjardin et al. was described from the Hawaiian Islands in 1999. At that time, it was recognized as morphologically distinct from other known *Rhodocollybia* species in having pale-orange to grayish-orange, labyrinthine, constricted lamellae (Desjardin et al. 1999). Its specific epithet 'laulaha' is the Hawaiian word for 'common and widespread'. Indeed *R. laulaha*'s range extends from the northwesternmost coast of Kauai to the southeasternmost corner of the Big Island and is present on all major islands in between. It fruits prolifically from July through December with peak mushroom production in August and September. In an analysis of the phenology and abundance of several putative Hawaiian endemic mushrooms, *R. laulaha* proved the most prolific mushroom producer of the taxa studied (Hemmes & Desjardin 2002). While its range extends the entire length of the modern Hawaiian Islands, it is significantly restricted by habitat. The forest habitat to which *Rhodocollybia laulaha* is limited (montane wet forest, montane mesic forest, lowland mesic forest, and lowland alien forest) is highly fragmented on the Hawaiian Islands creating a spatially subdivided system with forest 'islands' distributed across oceanic islands.

Rhodocollybia is a small genus with 35 species and subspecies described for the genus in online fungal databases (Farr et al. 2005) and an additional six neotropical species recently described from Costa Rica and Panama (Mata et al. 2004). Phylogenetic analyses utilizing nuclear large subunit (nLSU) and internal transcribed spacer (ITS) gene regions suggest that the genus *Rhodocollybia* is monophyletic and is most closely related to members of the genus *Lentinula* (Wilson & Desjardin 2005). Members of the genus *Rhodocollybia* are broadly distributed throughout temperate regions of North America and Europe and montane regions of Central America. A single *Rhodocollybia* species was described from Indonesia (*Rhodocollybia spissa* (A.W. Wilson et al.) A.W. Wilson & Desjardin; Wilson & Desjardin 2005), a single species from Thailand (*Marasmius clavipes* ⊠ *Rhodocollybia clavipes*), and a single *Rhodocollybia* of uncertain specific identity has been reported from South Africa (van der Westhuizen & Eicker 1994, as *Collybia distorta* (Fr.) Quél.). A taxon similar in appearance to *Rhodocollybia butyracea* (Bull.) Lennox is common in Australia (G.M. Mueller, pers. com.). A phylogenetic reconstruction using nLSU data placed *Rhodocollybia laulaha* in the monophyletic clade containing other *Rhodocollybia* species from the New World (Wilson & Desjardin 2005).

Support for the populations of *R. laulaha* belonging to a single species endemic to the Hawaiian Islands was based solely on its morphological distinctiveness and its reliable association with endemic Hawaiian rain forest vegetation (Desjardin et al. 1999). Understanding of the role of long distance spore dispersal in the maintenance of fungal species cohesion is in its infancy. Some evidence suggests that fungal spores are seldom dispersed for distances greater than 100 meters indicating that despite rare long distance dispersal events, significant gene flow via spore dispersal even between islands within

Hawaii is quite unlikely (Bergemann & Miller 2002, Burnett 2003). Other evidence suggests that a single fungal species can sustain appreciable gene flow across virtually global distributions (James et al. 2001, Petersen & Hughes 2007), but the dispersal mechanisms in such cases remain unclear.

The possibility exists that a putatively endemic Hawaiian taxon like *R. laulaha* does not actually represent a single lineage but rather the descendents of multiple independent introductions. Global phylogeography studies of the upside-down jellyfish genus *Cassiopea* using mitochondrial haplotype data suggest that two species of *Cassiopea* within the Hawaiian Islands represent independent introductions during the last 100 years – one from the Indo-Pacific, the other from the Red Sea/Atlantic. Genetic data indicate that the two species of *Cassiopea* currently occupying the island of Oahu are separated by 14–40 million years of reproductive isolation despite nearly identical morphology (Holland et al. 2004).

The goal of the present study was to determine whether or not *R. laulaha* represents several lineages with independent introductions to the Hawaiian Islands or a single lineage and single migration event to Hawaii. Additionally, we sought to identify a potential geographic source for the ancestor(s) of *R. laulaha* and to estimate the number of introductions if more than one. This type of search for a 'sister taxon' is difficult, especially for organisms such as fungi with largely unknown distributions. A recent estimation of worldwide macrofungal diversity calculated only 16–41% of macrofungi to be known to science and that endemism levels for macrofungi may be as high as 40–72% (Mueller et al. 2007). Considering that there is an extreme paucity of data regarding native species of macrofungi from most global regions outside of Europe and North America, it is safe to say that our knowledge of fungal diversity and distribution is minimal.

Investigations of other taxonomic groups have led to hypotheses on the progenitors of Hawaiian radiations: members of the plant bug genus *Sarona* in Hawaii represent radiation of a single introduction from the Americas (Asquith 1995); the spectacular honeycreeper radiation appears to be the sister group to a New World cardueline finch (*Carpodacus mexicanus*) whose common ancestor traveled to Hawaii roughly 3.5 million years ago (Tarr & Fleischer 1995); and the well-known Hawaiian silversword alliance members are descendants of a single California tarweed migrant that moved to Hawaii probably about 5 million years ago (Baldwin & Robichaux 1995). Nevertheless, the sister clade of many Hawaiian radiations remains unclear including that of the large Hawaiian *Drosophilidae* radiation, whose common ancestor may have arrived in Hawaii before formation of the oldest modern high island of Kauai (Desalle 1995). Members of the spider genus *Tetragnatha* in Hawaii are thought to represent at least two independent origins in Hawaii (Gillespie et al. 1994). [Note: Some

TABLE 1. *Rhodocollybia* species and outgroup taxon included in the analysis of ITS sequence data.

SPECIES	HERBARIUM*	COLLECTION ID	GEOGRAPHIC ORIGIN	GENBANK ACCESSION
G. dryophilus (outgroup)	TENN	57012	Macon, Co., NC	DQ241781
R. amica	TENN	56662	Costa Rica	AF505754
R. butyracea	TENN	55660	Turkey	AY313289
R. butyracea	TENN	56303	Mexico	AY313290
R. butyracea	TENN	59317	Austria	AY313291
R. butyracea		PL 33	Czech Republic	EF062462
R. butyracea	TENN	55660	Turkey	AY256689
R. butyracea	TENN	53580	Sweden	AY313293
R. butyracea		cult. 8250	USA	AY313292
R. butyracea		OKM 2756	USA	DQ444317
R. clavipes	SFSU	DED 8151	Thailand	GU369941
R. dotae	NY	REH 7007	Costa Rica	AF505758
R. laulaha	SFSU	DEH 61492	Maui, HI	GU369942
R. laulaha	F	MRK 56	Big Island, HI	GU369943
R. laulaha	SFSU	DED 6393	Kauai, HI	GU369944
R. laulaha	F	MRK 57	Big Island, HI	GU369945
R. laulaha	F	MRK 58	Maui, HI	GU369946
R. laulaha	SFSU	DEH 502	Big Island, HI	GU369947
R. laulaha	SFSU	DEH 482	Big Island, HI	GU369948
R. laulaha	SFSU	DEH 847	Big Island, HI	GU369949
R. laulaha	SFSU	DEH 600	Kauai, HI	GU369950
R. laulaha	F	MRK 50	Big Island, HI	GU369951
R. laulaha	F	MRK 52	Big Island, HI	GU369952
R. laulaha	SFSU	DEH 952	Kauai, HI	GU369953
R. laulaha	SFSU	DEH 004	Kauai, HI	GU369954
R. laulaha	F	MRK 53	Big Island, HI	GU369955
R. laulaha	F	MRK 51	Big Island, HI	GU369956
R. laulaha	F	MRK 54	Big Island, HI	GU369957
R. laulaha	F	MRK 55	Big Island, HI	GU369958
R. lignitilis	NY	REH 7907	Panama	AF505753
R. lignitilis	TENN	56628	Costa Rica	GU369959
R. maculata	TENN	59459	USA	AY256688
R. maculata	TENN	59459	USA	AY313296
R. maculata	CFH	AFTOL ID 540	USA	DQ404383
R. maculata	TENN	56568	USA	AY313297
R. pandipes	TENN	59546	Dominican Republic	AY313288
R. pandipes	TENN	53838	Costa Rica	AY313294
R. prolixa	NY	EFM 1403	Costa Rica	AF505748
R. tablensis		EN 2066	Costa Rica	AF505755
R. turpis	TENN	58017	Costa Rica	AF505749
R. unakensis	TENN	58545	Beaumont, TX	AY313298

* TENN = University of Tennessee; SFSU = Harry D. Thiers Herbarium, San Francisco State University; NY = New York Botanical Garden; F = Field Museum of Natural History, Chicago, IL; CFH = Clark Fungal Herbarium, Worchester, MA.

portion of the Hawaiian island chain has been above water for 29 million years, so with potential island hopping, there is a possibility of the oldest age being around 29 my, not 5 my.]

Material and methods

Eleven Big Island, two Maui, and four Kauai *R. laulaha* specimens, a single Thai specimen (*Marasmius clavipes* ≡ *Rhodocollybia clavipes*), and a single Costa Rican collection of *R. lignitilis* J.L. Mata & Halling were sequenced for the ITS locus using the fungal specific ITS primers ITS1F and ITS4. The following thermocycler PCR settings were used: 94°C (1 minute), 50°C (45 seconds), 50 to 72°C ramp (1 minute), 72°C (1 minute), repeat 30 times, 72°C, (7 minutes) – (Vilgalys and Hester, 1990). PCR products were run on an agarose gel and excised bands were cleaned using gelase. Cycle sequencing was conducted using Big Dye v. 3.1. A 3730 ABI capillary sequencer was used for sequencing. Sequences were aligned with twenty-one GenBank sequences representing ten *Rhodocollybia* species and a *Gymnopus dryophilus* (Bull.) Murrill outgroup sequence (Table 1). Alignment was carried out using *Clustal X 1.83* (Thompson et al., 1994) software with further manual alignment using *MacClade v. 3.7* (Maddison & Maddison 1997). Phylogenetic reconstructions were performed using *PAUP 4.0b10* (Swofford 2000). A heuristic parsimony search and bootstrapping were conducted using a random stepwise addition with 1000 replicates. Of 1011 total characters, 561 ambiguously aligned characters were excluded from the analysis resulting in a total of 105 parsimony informative characters.

Additionally, a separate data set comprising six *R. laulaha* specimens (one Big Island, three Maui, and two Kauai), two *R. lignitilis* specimens from Panama and Costa Rica, a *R. unakensis* (Murrill) Halling specimen from Texas, and five GenBank sequences

Table 2. *Rhodocollybia* species included in the analysis of LSU sequence data.

Species	Herbarium*	Collection ID	Geographic Origin	GenBank Accession
R. badiialba	SFSU	DLL 9199	USA	AY639439
R. butyracea var. *asema*		GLM 46024	Germany	AY207163
R. butyracea var. *asema*	NY	REH 6705	USA	AY639440
R. laulaha	SFSU	DED 5873	Big Island, HI	AY639441
R. laulaha	F	MRK 120	Maui, HI	GU369960
R. laulaha	F	MRK 121	Maui, HI	GU369961
R. laulaha	F	MRK 123	Maui, HI	GU369962
R. laulaha	F	MRK 160	Kauai, HI	GU369963
R. laulaha	F	MRK 163	Kauai, HI	GU369964
R. lignitilis	NY	REH 7907	Panama	GU369965
R. lignitilis	TENN	56628	Costa Rica	GU369966
R. maculata	DU	RV94	USA	AF042597
R. maculata	CFH	AFTOL ID 540	USA	AY639880
R. unakensis	TENN	58545	Beaumont, TX	GU369967

* TENN = University of Tennessee; SFSU = Harry D. Thiers Herbarium, San Francisco State University; NY = New York Botanical Garden; F = Field Museum of Natural History, Chicago, IL; CFH = Clark Fungal Herbarium, Worchester, MA; DU = Duke University Fungal Herbarium.

representing three additional *Rhodocollybia* species was created for the 28S LSU locus using the 28S fungal specific primers LROR and LR6 (Table 2). PCR, sequencing, alignment, and analysis procedures were the same as for the ITS. The LSU internal primer LR3 was used in addition to the LROR and LR6 primers for sequencing. Of 835 total characters, 34 characters were parsimony informative. No positions in the alignment were ambiguous. Both data sets were also subjected to analysis using Bayesian methods (Ronquist & Huelsenbeck 2003) to obtain support statistics. Ten thousand trees resulted from 1,000,000 generations. Burn in was reached at 8500 trees.

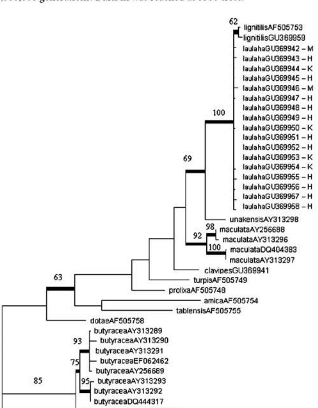

Figure 1. One of 52 equally most parsimonious trees of length 386 based on nuclear ribosomal ITS sequence data. Bootstrap support values greater than 60 appear above branches. Branches with Bayesian posterior probability values greater than 95% indicated as thickened branches. Island is indicated for seventeen *R. laulaha* collections (H=Big Island; M=Maui, K=Kauai).

Results

Both the ITS and LSU phylogenies (Figs. 1–2) indicate that *R. lignitilis* from Panama and Costa Rica is nested within *R. laulaha* of Hawaii with bootstrap support values of 100 and 99 respectively and greater than 95% Bayesian posterior probability support in each analysis. Their closest relative included in this analysis is *R. unakensis* from Texas; however, the *R. laulaha* clade is significantly diverged from other *Rhodocollybia* species. The *R. laulaha* clade is within the Maculata subclade (as distinguished from the Butyracea subclade in Mata et al. 2004). Variability within the ITS region is not sufficient to discern patterns within the *R. laulaha* clade across the Hawaiian Islands or even between Hawaiian individuals and the two collections from the neotropics. *Marasmius clavipes* of Thailand nests clearly within the genus *Rhodocollybia* and is formally transferred herein to *Rhodocollybia*.

Rhodocollybia clavipes (Corner) Desjardin & Keirle, **comb. nov.**

MycoBank MB516790

Basionym: *Marasmius clavipes* Corner, Beih. Nova Hedwigia 111: 42. 1996.

Type: Borneo, Mt. Kinabalu, Mesilau, 1700 m elev., RSNB 8180A (E!).

Additional material examined: Thailand, Chiang Mai Province, Doi Inthanon National Park, Hwy 1009 at junction with road to Mae Chem, 28 June 2007, *D.E. Desjardin 8151* (BBH, SFSU).

Discussion

It is perhaps not surprising that *R. lignitilis* appears to be conspecific with *R. laulaha* based on these molecular analyses. Despite the significant oceanic interruption in the species range, there are striking morphological similarities between the two taxa. Detailed examination of the protologues for *R. lignitilis* and *R. laulaha* indicates that the macromorphological and micromorphological features of the two are consistent and overlapping (cf. Desjardin et al., 1999 and Mata et al., 2004). As there are no fixed substitutions in the ITS of *R. lignitilis* that would permit reliable genetic differentiation between the two, it seems safe to declare them conspecific with the name *R. laulaha* having priority. Unfortunately, the neotropical population of *R. laulaha* is currently known from only two specimens: TENN 56628 from Costa Rica and R.E.H. no. 7907 from Panama. It is intriguing that a mushroom so common and so prolific in Hawaii has been collected on only two occasions in the neotropics, despite the fact that the specific collecting localities in Costa Rica and Panama from which it is known have been intensively sampled by mushroom biologists. Nonetheless, few mycologists focused on collecting *Rhodocollybia* in these areas and many of the *Rhodocollybia* described from Costa Rica and Panama are known from only a few specimens.

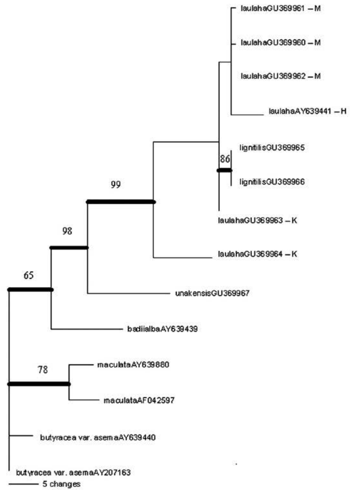

FIGURE 2. Single most parsimonious tree of length 71 based on nuclear ribosomal LSU sequence data. Bootstrap support values greater than 60 appear above branches. Branches with Bayesian posterior probability values greater than 95% indicated as thickened branches. Island is indicated for six *R. laulaha* collections (H=Big Island; M=Maui, K=Kauai).

Knowledge of this expanded range of *R. laulaha* into the neotropics allows for speculation about the biogeographic history of Hawaiian *Rhodocollybia*. The closest potential relative of *R. laulaha* (its sister taxon as recovered in the current analyses, which admittedly represents limited sampling) is *R. unakensis*. The specimen of *R. unakensis* used in this analysis was found near Beaumont, Texas (latitude 30.11°N), well within the North American subtropics. One cannot help but notice the connection between Hawaiian *Rhodocollybia* and *Rhodocollybia* in the Americas. The type collection from Unaka Springs, Tennessee, and the specimen we used in the analyses from Beaumont, Texas, are within the American subtropics. This would seem to be in line with many other Hawaiian taxa that also trace their ancestry to the New World (e.g. Baldwin & Robichaux 1995).

There are at least two straightforward scenarios that would explain the species distributions observed here. If *R. laulaha* originated in Hawaii, perhaps evolving from a New World ancestor that migrated west, the Costa Rican and Panamanian populations would represent relatively recent reverse migrations back to the Americas. If such a scenario were true, it might explain the relative lack of abundance of *R. laulaha* in the neotropics. Perhaps the oak forests of Central America provide a less than ideal habitat for this specialized Hawaiian endemic. Conversely, if *R. laulaha* originated in the New World and has only recently established in Hawaii, its rapid spread and colonization of Hawaiian endemic rain forests might reflect a case of 'ecological release' whereby constraints found in its native land are removed and it is able to expand its range and numbers with ease. Unfortunately, testing these conflicting hypotheses is not possible unless a considerable number of *R. laulaha* individuals can be collected from the neotropics. The latter scenario might appear more likely than the former in that it entails a single long distance migration event. However, without any way to assess the difficulty with which a mushroom species accomplishes such migration, it is impossible to argue that one migration event is any more likely than two events. Perhaps if appropriate genetic markers could be developed, a comparison of neutral and non-neutral markers or of synonymous and non-synonymous substitutions in a protein-coding marker might provide evidence in the Hawaiian *R. laulaha* populations of active positive selection or relaxed selection consistent with ecological release.

Clearly this investigation requires additional neotropical specimens. Ideally, with sufficient individuals representing the neotropics, multiple genetic markers might be able to determine current patterns of gene flow between Hawaii and the Americas (if realized) and the geography of origin – is *R. laulaha* Hawaiian or New World?

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Jahnula morakotii sp. nov. and *J. appendiculata* from a peat swamp in Thailand

Somsak Sivichai & Nattawut Boonyuen

sivichai@gmail.com & nattawut@biotec.or.th
BIOTEC-Mycology Laboratory, National Center for Genetic Engineering and Biotechnology, National Science and Technology Development Agency 113 Paholyothin Rd., Khlong 1, Klong Luang, Pathum Thani 12120, Thailand

Abstract — During a long-term study of wood colonization by freshwater fungi in the Sirindhorn peat swamp forest in the south of Thailand, two interesting *Jahnula* species were encountered. *Jahnula appendiculata* occurred commonly on eight species of timber, while *J. morakotii* occurred only once. *Jahnula morakotii* differs from all other *Jahnula* species in having the smallest ascospores with bipolar cellular appendages and lacking a sheath. The morphology of *J. morakotii* is illustrated and compared with other species in the genus.

Keywords — *Ascomycota*, colonization of wood, systematics

Introduction

During a long-term colonization study by freshwater fungi, of wood submerged in the Sirindhorn peat swamp forest, Narathiwat, in the south of Thailand, two *Jahnula* species were found.. After several years of wood exposure, *Jahnula appendiculata* and *J. morakotii* were encountered. *Jahnula appendiculata* was found several times on test blocks of seven timber species after two to three years of submergence, while *J. morakotii*, was found only once on one timber species after the wood had been exposed for two years.

All thirteen *Jahnula* species that have been described occur in freshwater habitats and mostly from tropical regions (Hyde 1992, Hyde & Wong 1999, Pang et al. 2002, Pinruan et al. 2002, Raja & Shearer 2006, Raja et al. 2009). Thus far, *J. appendiculata* and *J. morakotii* are known only from the Sirindhorn peat swamp forest in Thailand (Pinruan et al. 2002 and this study) and may be restricted to this unique habitat (water pH 5.8–6.2, with a river system running through this acidic peat bog). *Jahnula appendiculata* was first described on a natural submerged palm trunk (Pinruan et al. 2002), while *J. morakotii* was collected on a single test block of *Azadirachta indica* var. *siamensis*. The characteristic features of the new species include: globose to subglobose, always stalked, superficial ascomata, pseudoparaphysate hamathecium, bitunicate, fissitunicate asci, and brown, uniseptate ascospores with bipolar cellular appendages. These traits are congruent with taxa in the *Jahnulales*, especially the genus *Jahnula*. However, this fungus could not be assigned to any species currently included in *Jahnula* and is therefore described as new.

Materials and methods

Nine timber species (*Azadirachta indica* var. *siamensis* Valeton, *Erythrophleum teysmannii* Craib, *Melaleuca cajuputi* Powell, *Shorea obtusa* Wall., *S. roxburghii* G. Don, *S. siamensis* Miq., *Wrightia tomentosa* Roem. & Schult., *Xylia xylocarpa* (Roxb.) W. Theob., *Zollingeria dongnaiensis* Pierre) were submerged in the Sirindhorn peat swamp forest in Narathiwat Province, Thailand on 12 March 2001 in order to follow their colonization by freshwater fungi over a 10-year period. Twelve sets of test blocks (15 × 2.5 × 2.5 cm^3, 5 blocks per set for each timber species), free of preservative, were threaded on a nylon rope and autoclaved 3 times before submergence in the Sirindhorn peat swamp forest in Narathiwat.

Nine sets of test blocks (one of each timber species) were recovered at 1 and 6 months, and 1, 2 and 3 years and returned to the laboratory in a clean polystyrene foam box. Test blocks were washed with stream water to remove silt and mud from the surface. Each set of test blocks was separated and single blocks were placed in pre-sterilized plastic boxes with moist tissue papers layered on the bottom. Test blocks were incubated at 20°C in a cabinet with cool white fluorescent light. Test blocks were examined for sporulating fungi after one week, and 1, 2 and 3 months following removal from the river. Assessment procedures were as described by Sivichai et al. (2002).

Material was examined using a stereomicroscope and fungi isolated and identified. Preparations were mounted in lactophenol-cotton blue, and sealed with polyvinyl alcohol. Single-ascospore isolations were made and grown on Corn Meal Agar (CMA, Difco?). Ascospores were spread over the agar surface with a flame-sterilized inoculation loop dipped in 0.05% (w/v) Triton X-100. Plates were incubated at 20°C in a cabinet with cool, white fluorescent light and examined with a microscope each day for signs of germination. Six to eight germinated ascospores were transferred to new plates and incubated in the same cabinet. Dried specimens are deposited in the BIOTEC Bangkok Herbarium (BBH #27681).

Taxonomic description

Jahnula morakotii Sivichai & Boonyuen, **sp. nov.** FIGS. 1–11

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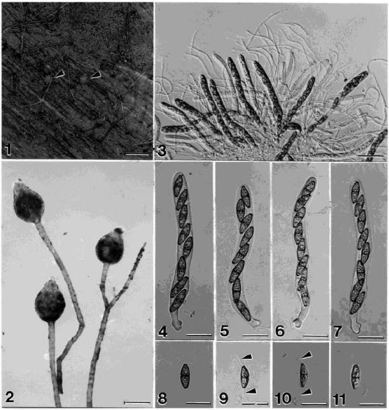
Ascomata 100–180 µm diametro, globosa ad subglobosa, gregaria, superficialia cum caule vel sessilia. Pseudoparaphyses septatae, hyalinae 1.5–2 µm lata, ca. 150 µm longis. Asci 107.5–120 × 9–11.5 µm, octospori, cylindrici, pedicellati, bitunicati, fissitunicati, camera oculari et annulo tenui instructi. Ascosporae 17.5–20 × 5–6.5 µm, fusiformae?, brunneae, guttulatae uniseriatae vel biseriatae, uniseptatae, constrictae, rectae vel aliquantum curvatae, duobus appendicibus cellularibus terminalibus longis hyalinis praeditae.



FIGS. 1–11. *Jahnula morakotii*. (Holotype SS2447). 1. Superficial ascomata on test block (arrowed). 2. Ascomata with long and septate stalks. 3. Squash mount of asci and pseudoparaphyses. 4–7. Cylindrical asci with pedicels. 8–11. Ascospores with bipolar appendages (arrowed).
Measure bars for FIG. 1 = 200 µm. FIG. 2 = 100 µm. FIG. 3 = 30 µm. FIGS. 4–11 = 20 µm.

HOLOTYPE: Thailand. Narathiwat: Sirindhorn peat swamp forest on submerged wood test block (*Azadirachta indica*), 10 March 2003 by Somsak Sivichai & Nattawut Boonyuen, BIOTEC SS2447.

ETYMOLOGY: "*morakotii*" in honor of Professor Morakot Tanticharoen, the past director of BIOTEC: National Center for Genetic Engineering and Biotechnology, who supports our Mycology Laboratory in Thailand.

Ascomata 100–180 µm diam, globose to subglobose, superficial with septate stalk, 18–30 µm wide, or sessile (FIGS. 1–2). Peridial wall of large, thin-walled cells. Pseudoparaphyses septate, hyaline, 1.5–2 µm wide, up to 150 µm in length

(FIG. 3). Asci 107.5–120 × 9–11.5 µm (mean = 116 × 11 µm, n = 50), 8-spored, cylindrical, pedicellate, bitunicate, fissitunicate, with a shallow ocular chamber and faint ring (FIGS. 3–7). Ascospores 17.5–20 × 5–6.5 µm (mean=19 × 6 µm, n = 50), fusiform, brown, multi-guttulate, uniseriate or biseriate, slightly constricted at the septa, straight to curved with cellular bipolar hyaline apical appendages.

HABITAT: Saprobic on submerged wood test block (*Azadirachta indica*) in peat swamp forest.

GEOGRAPHICAL DISTRIBUTION: Thailand.

COMMENTS: *Jahnula morakotii* was collected only once on an *Azadirachta indica* test block, and it can be considered a rare fungus. *Jahnula morakotii* differs from all *Jahnula* species in having the smallest ascospores among all described species (17.5–20 × 5–6.5 µm). Species most similar in ascospore size to *J. morakotii* are *J. bipileata* Raja & Shearer (25–30 × 9–10 µm) and *J. australiensis* K.D. Hyde (19–30 × 6–8 µm), however, they lack the bipolar appendages of *J. morakotii* (Raja & Shearer 2006). *Jahnula appendiculata* is the only other species with bipolar appendages but the ascospores of this species are longer and wider (45–52.5 × 22.5–27.5 µm) than those of *J. morakotii* (17.5–20 × 5–6.5 µm). In addition, ascospores of *J. appendiculata* have a thick sheath that is absent in *J. morakotii* (Pinruan et al. 2002).

Jahnula appendiculata Pinruan, K.D. Hyde & E.B.G. Jones, Sydowia 54(2): 243. 2002. FIGS. 12–19

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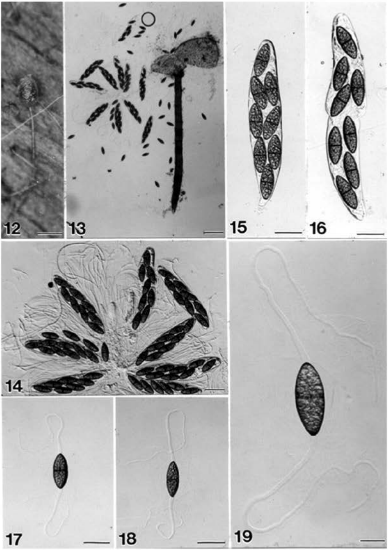
Ascomata 280–350 µm in diam, pale brown, globose to subglobose, semi-immersed, becoming erumpent, but with the base remaining immersed, or superficial with stalk attached to the base (FIG. 12), stalk up to 2 mm long and 65 µm wide, brown (FIG. 13). Pseudoparaphyses septate, hyaline, 2–3 µm wide and up to 500 µm long, filamentous, septate, unbranching (FIG. 14).

Asci 320–450 × 38–45 µm (mean = 400 × 42 µm, n = 50) (FIGS. 14–16), 8-spored, cylindrical to cylindric-clavate, pedicellate, bitunicate, fissitunicate (FIG. 16), with a shallow ocular chamber and faint ring (FIGS. 15–16). Ascospores 45–52.5 × 22.5–27.5 µm (mean = 49 × 25 µm, n = 100), ellipsoid-fusiform, apices pointed, brown, guttulate, uniseptate, uniseriate or biseriate, slightly constricted at the septa, wall minutely verrucose, ascospore surrounded by a thick mucilaginous sheath, ends with a small subapical hood-like rim, and a long, appendage arising from both apices, up to 150 µm long and 5 µm diam. (FIGS. 17–19).

HABITAT: Freshwater. Saprobic on submerged wood (*Azadirachta indica* var. *siamensis*, *Erythrophleum teysmannii*, *Melaleuca cajuputi*, *Shorea obtusa*,



FIGS. 12–19. *Jahnula appendiculata*. 12. Superficial ascoma with stalk on test block. 13. Squash mount of an ascoma with a long septate stalk. 14. Squash mount of asci and pseudoparaphyses. 15–16. Cylindric-clavate asci. 17–19. Ascospores with bipolar appendages and a thick mucilaginous sheath.

Measure bars for FIG. 12 = 500 µm. FIG. 13 = 100 µm. FIG. 14 = 50 µm. FIGS. 15–18 = 40 µm. FIG. 19 = 20 µm.

S. roxburghii, Wrightia tomentosa, Xylia xylocarpa, Zollingeria dongnaiensis) in a peat swamp forest.

Geographical distribution: Thailand.

Specimens examined: **Thailand. Narathiwat:** Sirindhorn peat swamp forest on submerged test blocks (*M. cajuputi*), BIOTEC SS2414; BIOTEC SS2415; (*W. tomentosa*), BIOTEC SS2429; (*X. xylocarpa*), BIOTEC SS2438; (*A. indica*), BIOTEC SS2448; (*S. obtusa*), BIOTEC SS2466; 22 February 2003, Somsak Sivichai & Nattawut Boonyuen; (*E. teysmannii*), BIOTEC SS2900; (*X. xylocarpa*), BIOTEC SS2903; (*M. cajuputi*), BIOTEC SS2906; (*A. indica*), BIOTEC SS2911; BIOTEC SS2915; (*Z. dongnaiensis*), BIOTEC SS2922; (*S. roxbordhii*), BIOTEC SS2924; (*S. obtusa*), BIOTEC SS2934; 30 January 2004, Somsak Sivichai & Nattawut Boonyuen.

Comments: Morphological features of *J. appendiculata* from our study agree with the type collection reported by Pinruan et al. (2002). Ascospore size in this study agrees with the range that was reported for the type specimen, as did measurements for the ascomata and asci. All major characters also agreed with the holotype specimen. Pinruan et al. (2002) noted that the frequency of occurrence of *J. appendiculata* was 1.7% and regarded this species as a common fungus. In this study, seven of the nine timber species were colonized by *J. appendiculata* but the fungus did not occur on *E. teysmannii* and *S. siamensis*. *Jahnula appendiculata* is known only from one site and therefore may be well adapted to the acidic waters of the peat swamp forest. Moreover, it has not been collected on natural submerged wood and test blocks at other test sites (e.g. Khao Yai National Park, Doi Inthano National Park, Kaeng Krachan National Park, and Khao Sok National Park, Thailand, in the past eight years.

Acknowledgements

We would like to thank Prof. Carol Shearer and Dr. Ka-Lai Pang for their comments and suggestions for the improvement of the manuscript, and Dr. Shaun R. Pennycook for assistance with formatting the article. This work was supported by the TRF/BIOTEC special Programme for Biodiversity Research and Training grant BRT R_647001. We would like to thank Profs. Morakot Tanticharoen and Gareth Jones, Drs. Kanyawim Kirtikara and Nigel Hywel-Jones at BIOTEC for their constant interest and support in our study.

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MYCOTAXON

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Puccinia anaphalidis-virgatae, a new species, and a new variety of rust fungi from Fairy Meadows, Northern Pakistan

N. S. Afshan [1]*, A. N. Khalid[2], S. H. Iqbal[2], A. R. Niazi[2] & A. Sultan[2]

*pakrust@gmail.com
[1]Centre for Undergraduate studies, University of the Punjab
Quaid-e-Azam Campus, Lahore, 54590, Pakistan
[2]Department of Botany, University of the Punjab
Quaid-e-Azam Campus, Lahore, 54590, Pakistan

Abstract — *Puccinia anaphalidis-virgatae* on *Anaphalis virgata* is described as a new species from Pakistan. Previous records of rusts on genus *Anaphalis* have been species of *Miyagia*, *Phakopsora*, and *Uromyces*; this is the first *Puccinia* species recorded on this host genus. A new variety *P. helictotrichi* var. *pakistanica* is described based on its resemblance to *P. helictotrichi*; however, it differs in size and number of germ pores of urediniospores and apical thickness of teliospores.

Key words — *Miyagia*, Nanga Parbat, *Phakopsora anaphalidis-adnatae*, *Pucciniales*, rust mycobiota

Introduction

This paper is a continuation of our publications describing the rust fungi of Pakistan. The taxa presented and described in this paper were collected from Fairy Meadows, Northern Pakistan. Out of all rust fungi previously recorded from Pakistan, 68 species of rust fungi have been reported from northern areas of Pakistan with only 12 taxa from Fairy Meadows, including one species each of *Aecidium*, *Chrysomyxa*, *Cronartium*, *Hyalopsora*, *Melampsora*, and *Pucciniastrum* and six species of *Puccinia* (Afshan et al. 2009, Iqbal et al. 2009).

Numerous new records and new species can still be expected as a result of ongoing fieldwork in these areas of Pakistan because of the high diversity of vascular plants i.e. 3000 species (Iqbal et al. 2009). During recent rust surveys in northern areas of Pakistan, one specimen was determined to be new to science, i.e., *Puccinia anaphalidis-virgatae* on *Anaphalis virgata*. *Puccinia helictotrichi*

* Corresponding author

var. *pakistanica* on *Helictotrichon virescens* is also being proposed as new to science. The present paper contributes to the knowledge of the rust mycobiota of Fairy Meadows, Northern Pakistan.

Materials and methods

Specimens were collected from Fairy Meadows, Pakistan. Freehand sections of infected tissues and spores were mounted in lactophenol and gently heated to boiling. The preparations were observed under a NIKON YS 100 microscope and photographed with JSM5910 Scanning Electron Microscope. For SEM, dried plant material was hand-sectioned with a razor blade and mounted on SEM stubs. The samples were coated with gold in a sputter-coater and examined with a JSM5910 Scanning Electron Microscope. Spores and paraphyses were drawn using a Camera Lucida (Ernst Leitz Wetzlar, Germany). Spores were measured with an ocular micrometer. At least 25 spores were measured for each spore state. The specimens were deposited in the Herbarium of the Botany Department, University of the Punjab, Lahore (LAH).

Enumeration of taxa

Puccinia anaphalidis-virgatae Khalid, Afshan & S.H. Iqbal, **sp. nov.** FIGS. A–H
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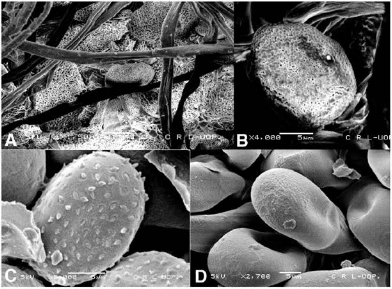
Aeciosporae ovoideae, obovoideae vel ellipsoideae, hyalinae vel dilute flavidae, densiter verrucosae vel coronatae, 19–22 × 21–29 µm. Cellulis peridii irregularibus, 47–65 × 20–29 µm, hyalinis vel dilute flavidis. Uredinia in pagina abaxiali foliorum, 0.7–2.0 × 4–7 mm, aureo-brunnea. Urediniosporae globosae vel subglobosae, 17–24 × 20–28 µm; pariete 1.5–2 µm crasso, echinulato, pallide flavido vel dilute brunneo; poris germationis 5–6, dispersis; paraphysibus clavatis, hyalinis vel dilute flavidis, 5–7 × 55–72 µm; pedicellis 4–8 × 10–25 µm. Telia atra, 0.9–2 × 2–7 mm. Teliosporae 2-cellulares, raro unicellulares, aureo-brunneae vel castaneo-brunneae, oblongae, fusiformes, ellipsoideae vel late ellipsoideae, 20–24(–26) × 50–64(–70) µm; apicaliter castaneo-brunneae, basaliter pallidae, apice obtuso, conico vel oblique conico, 5–10 µm crasso, pariete 1.5–2 µm crasso, levi, pedicellis persistentibus, hyalinis vel dilute brunneis, 8–13 × 32–50 µm.

HOLOTYPE: On *Anaphalis virgata* Thomson ex C.B. Clarke (*Asteraceae*), I + II + III, Pakistan, Northern Areas, Fairy Meadows, 3036 m a.s.l., 12 Aug 2007. NSA # G01 (LAH - NSA 1004).

ETYMOLOGY: Named after the host plant *Anaphalis virgata*.

SPERMOGONIA not found. AECIA on stems, orange, 0.1–0.2 × 0.2–0.3 mm, cupulate. AECIOSPORES ovoid to obovoid or ellipsoid, hyaline to pale yellow, finely verrucose to coronate, 19–22 × 21–29 µm. Peridial cells irregular to fusiform in shape, moderately rugose, 47–65 × 20–29 µm, hyaline to pale yellow. UREDINIA on leaves and stems, abaxial, 0.7–2 × 4–7 mm, golden brown. UREDINIOSPORES globose to subglobose, 17–24 × 20–28 µm; wall 1.5–2 µm

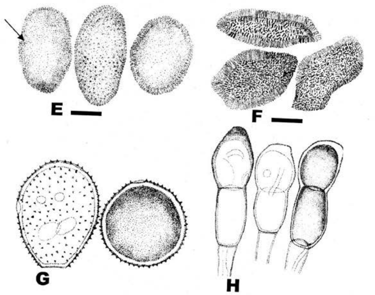


Figs. A–D: *Puccinia anaphalidis-virgatae* (type) (A) SEM photograph of peridial cells and aeciospores. (B) An aeciospore showing verrucose wall ornamentation. (C) Echinulate urediniospores. (D) SEM photograph of smooth walled teliospores.

thick, pale yellow to pale brown, sparsely echinulate; germ pores 5–6, scattered; paraphyses clavate, hyaline to pale yellow, 5–7 × 55–72 µm; pedicel fragile, 4–8 × 10–25 µm. Telia on stems, black, 0.9–2 × 2–7 mm. Teliospores mostly two-celled, few one-celled, golden brown to chestnut brown, oblong to fusiform or ellipsoid to broadly ellipsoid, 20–24(–26) × 50–64(–70) µm; apex chestnut brown, paler basally, apex mostly rounded but sometimes conical or obliquely conical, 5–10 µm thick; wall 1.5–2 µm thick, smooth; pedicel persistent, hyaline to pale brown, 8–13 × 32–50 µm.

Comments: Previously, *Phakopsora anaphalidis-adnatae* Khalid & S.H. Iqbal was reported on *Anaphalis adnata* DC. from Pakistan (Khalid & Iqbal 1996b).

Other rust fungi reported on *Anaphalis* spp. include *Miyagia anaphalidis* Miyabe on *A. acutifolia, A. aureopunctata, A. brevifolia, A. hancockii, A. margaritacea* subsp. *angustior, A. margaritacea* subsp. *japonica, A. margaritacea* subsp. *yedoensis, A. morrisonicola, A. sinica, A. subdecurrens, A. yedoensis,* and *A. zeylanica* from Japan, China, Sri Lanka, and Taiwan; *Miyagia macrospora* Hirats. f. on *A. aureopunctata, A. contorta, A. morrisonicola, A. nepalensis,* and *A. xylorhiza* from China, Nepal, and Taiwan; *Phakopsora artemisiae* Hirats. on



Figs. E–H: *Puccinia anaphalidis-virgatae* (E). Aeciospores showing germ pores (F). Peridial cells of the aecidia (G). Urediniospores showing germ pores (H). Teliospores Scale bar for E & G = 10 µm, F = 5 µm, H = 15 µm.

A. margaritacea, and *A. sinica* from China and Nepal; *Phakopsora compositarum* T. Miyake on *A. sinica* from China; *Phakopsora elephantopi* Hirats. on *A. sinica* from China; *Uromyces amoenus* Syd. & P. Syd. on *A. alpicola*, *A. busua, A. contorta,* and *A. margaritacea* from China, Japan and Nepal; and *Uromyces langtangensis* Durrieu on *A. nepalensis* from Nepal (Sawada 1943, Ito 1950, Hiratsuka 1969, Hiratsuka 1973, Tai 1979, Azbukina 1984, Durrieu 1987, Guo 1989, Ono et al. 1990, Hiratsuka & Chen 1991, Hiratsuka et al. 1992, Zhuang 1993, Zhuang & Wei 1994, Gjaerum 1995, Khalid & Iqbal 1996a,b, Cao et al. 2000, Zhuang 2005).

Puccinia anaphalidis-virgatae is characterized by the absence of peridia in uredinia and telia and up to 6 scattered germ pores in urediniospores. Another characteristic feature is the presence of thickened, rounded, or conical apices of the teliospores with persistent pedicels.

Species in the genus *Miyagia* have peridiate uredinia and telia while the absence of peridial uredinia and telia is characteristic of the genus *Puccinia* (Cummins & Hiratsuka 2003). The uredinia and telia of *Miyagia anaphalidis* are peridiate with a peridium of laterally adherent, palisade-like paraphyses.

Moreover, aecia of *Miyagia* are erumpent and uredinioid with aeciospores borne singly on pedicels. The aecia of *P. anaphalidis-virgatae* are of the aecidium type with a peridium. *Miyagia anaphalidis* is somewhat comparable to the *P. anaphalidis-virgatae* in the size and wall ornamentation of the urediniospores and teliospores. *Puccinia anaphalidis-virgatae* with urediniospores having 5–6 scattered germ pores differs from *M. anaphalidis* with 2 equatorial germ pores.

Puccinia anaphalidis-virgatae differs from *P. horti-kirstenboschi* Berndt & E. Uhlmann reported on *Helichrysum* sp. by the size and shape of teliospores. *P. anaphalidis-virgatae* has larger (20–26 × 50–64 (–70) µm vs. 17–23 × 40–55 µm) teliospores with thicker (5–10 µm vs. 0.5–1.5 µm) apices than in *P. horti-kirstenboschi*.

P. anaphalidis-virgatae is similar to *P. subindumentana* Berndt reported on *Helichrysum chrysophorum* by the shape and apical thickness of teliospores. However, aeciospores are smaller (19–22 × 21–29 µm vs. 25–30 × 27–33 µm) and teliospores are wider (20–26 µm vs. 16–22.5 µm) with a persistent pedicel. *P. anaphalidis-virgatae* has smaller aeciospores (19–22 × 21–29 µm vs. 23–31 × 29–41 µm) and urediniospores (17–24 × 20–28 µm vs. 24.5–29.5 × 28–34.5 µm) than in *P. cornurediata* Berndt reported on *Helichrysum petiolatum* D. Don. Moreover, *P. anaphalidis-virgatae* lacks peridia in uredinia while *P. cornurediata* possesses slightly tapering, orange-yellow peridium in uredinia.

Puccinia helictotrichi var. _pakistanica_ Afshan & Khalid, **var. nov.** FIGS. I–J

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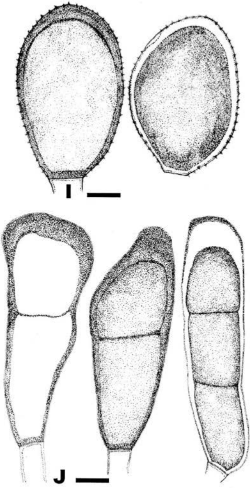
Spermogonia et aecia ignota. Uredinia amphigena, subepidermalia. Urediniosporae globosae vel subglobosae, ovoidae vel ellipsoideae, 19–25 × 23–29(–32) µm; pariete 1–1.5 µm crasso, pallide brunneo vel brunnea, echinulato; poris germinationis 2–4, aequatorialibus vel supra-aequatorialibus. Telia amphigena, subepidermalia, atra. Teliosporae 1–3-cellulares, oblongae vel clavatae, 14–21 × (36–)44–56 µm, pariete levi, 1.5–2 µm crassa, ad apicem 4–7 µm crasso, cinnamomea vel atro-brunneo, basaliter pallidae; apice truncato vel obtuso; pedicellis hyalino vel dilute brunneis, 5–8 × 11–14 µm.

HOLOTYPE: On *Helictotrichon virescens* (Nees ex Steud.) Henrard (*Poaceae*), II + III stages, Pakistan, Northern Areas, Fairy Meadows, 3036 m a.s.l., 12 Aug 2007. NSA # 69. (LAH - NSA 1075).

ETYMOLOGY: Named after the country, Pakistan.

SPERMOGONIA and AECIA unknown. UREDINIA amphigenous, subepidermal, yellowish brown to golden brown, 0.09–0.1 × 0.1–2.0 mm. UREDINIOSPORES globose to subglobose or ovoid to ellipsoid, 19–25 × 23–29(–32) µm; wall 1–1.5 µm thick, pale brown to cinnamon brown, echinulate; germ pores 2–4, equatorial to supraequatorial, pedicel hyaline, 4–6 µm wide and up to 16 µm long. TELIA amphigenous, covered by epidermis, dark brown to blackish brown, loculate with paraphyses, 0.09–0.5 × 0.2–0.8 mm. TELIOSPORES 1–3-



FIGS. I–J: *Puccinia helictotrichi* var. *pakistanica*
(I) Echinulate urediniospores. (J) Teliospores. Scale bar = 10 µm.

celled, oblong to clavate, septa usually horizontal, but sometimes oblique in three-celled spores, 14–21 × (36–)44–56 µm (mean 17 × 44 µm); wall 1.5–2 µm thick, cinnamon brown to golden brown but paler basally, smooth; apex mostly truncate, sometimes rounded, 4–7 µm thick; germ pores obscure; pedicel hyaline to pale brown, 5–8 × 11–14 µm.

COMMENTS: *Puccinia helictotrichi* var. *pakistanica* is characterized by the presence of 1–3-celled teliospores with sometimes oblique septa in three-celled spores. The presence of 2–4 equatorial germ pores in urediniospores and the absence of uredinial paraphyses also make it different from other *Puccinia* species reported on hosts in the same tribe.

Puccinia helictotrichi var. *pakistanica* closely resembles *P. helictotrichi* Jørst. by the shape and wall ornamentation of urediniospores and size of teliospores. These varieties can be separated by the size of urediniospores. *P. helictotrichi* var. *pakistanica* has smaller urediniospores (19–25 × 23–29 (–32) µm vs. 18–26 × 24–48 µm) than *P. helictotrichi*. Another characteristic difference is the presence of 1–3-celled teliospores with thicker apices (4–7 µm vs. 2–4 µm) and 2–4 equatorial germ pores of urediniospores in the *P. helictotrichi* var. *pakistanica* than in *P. helictotrichi* that possesses 1–2 celled teliospores with 6–12 scattered, obscure germ pores.

Puccinia helictotrichi var. *pakistanica* is similar to *P. brachypodii* var. *poae-nemoralis* (G.H. Otth) Cummins & H.C. Greene in the shape, wall ornamentation, and size of urediniospores. These species differ in the size of teliospores, which are smaller in *P. helictotrichi* var. *pakistanica* (14–21 × (36–) 44–56 µm vs. 12–27 × 30–80 µm). The presence of 1–3-celled teliospores, sometimes with a vertical septum in three-celled teliospores and absence of uredinial paraphyses in *P. helictotrichi* var. *pakistanica* make it different from *P. brachypodii* var. *poae-nemoralis*.

On the basis of close resemblance with *P. helictotrichi*, this species is described as a new variety of *P. helictotrichi* i.e. *P. helictotrichi* var. *pakistanica*.

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MYCOTAXON

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Book reviews and notices

Compiled by

Else C. Vellinga[1]

bookreviews@mycotaxon.com
861 Keeler Avenue, Berkeley CA 94708-1323, U.S.A.

Introduction

This installment of Book reviews and notices focuses on two different topics, ascomycetes in different parts of the world, and mushroom guide books from North America. A checklist of the non-lichenized species occurring in Sweden (free to download from the author's web site) and several books on taxonomically or ecologically defined lichen groups are treated in the first part, followed by the review of field oriented guides. The present selection of guides covers the southeast, the northwest, the northern plains in between, the oak associated mycoflora of the eastern U.S.A., and the genus *Lactarius*. The books are as different in layout, user friendliness, and approach as their subjects. Guides are the ideal medium to familiarize amateur mycologists with the huge changes that have recently taken place in the classification of fungi. But the main purposes are to provide accurate names and especially to introduce non-mycologists to the diversity and beauty of this fascinating group of organisms.

A list of recently published books to be included in future reviews is given at the end.

Ascomycetes

The non-lichenized Ascomycetes of Sweden. By O.E. Eriksson. 2009. Department of Ecology and Environmental Science, Umeå University, SE-901 87, Umeå, Sweden. <ove.eriksson@emg.umu.se>. Pp. 461, maps 1. ISBN 978-91-7264-989-2. Price not indicated; free for download at <http://www8.umu.se/myconet/asco/asco_pdfs/indexPDF.html>

[1] Books for consideration for coverage in this column should be mailed to the Book Review Editor at the address above. All unsigned entries are by the Book Review Editor.

While the non-lichenized pyrenomycetes and the lichenized fungi known from Sweden have been summarized in relatively recent checklists (Eriksson 1992, Santesson et al. 2004), no overall listing of the phylum has been appeared since that of Fries (1849), something Nannfeldt (1936) commented was a "deplorable state" over 70 years ago. This new checklist remedies this situation, covering all non-lichenized ascomycetes except lichenicolous genera (unless they also include non-lichenicolous species; others being covered in Santesson et al. 2004) and yeasts. It enumerates 2692 species placed in 772 genera and dispersed through 159 families. The genera are, thankfully, all treated alphabetically, but a synopsis by subphylum, class, order, and family is provided at the start. By each generic name, the family placement is indicated, and there is also a letter to indicate the type of spore-bearing structure (e.g. "D" for discomycetes). For each species, information is included in the categories of synonyms, citations in the works of Fries, references to literature, exsiccate citations, host or habitat, distribution (by provinces, or for new records with specimen details), anamorph, and notes. No new scientific names are introduced in the work.

The notes section often includes important and new information or corrections relating to bibliography, nomenclature, or taxonomy — for instance the retention of *Trichothyrina* as distinct from *Lichenopeltella,* as *T. alpestris* has setae with a furrow not seen in *Lichenopeltella* species. Detailed notes are provided on 112 "Excluded species" (pp. 297-306), some of which will require more work to resolve conclusively. The bibliography is most impressive at 53 pages and will be an immediate source of elusive references for workers on these fungi. The work ends with a massive 99-page epithet-index to both accepted names and synonyms. One thing that is missing here, however, and which was an especially useful feature of Eriksson's earlier pyrenomycete checklist, is a listing of species by their host organisms; that would add enormous value to any future edition, but at least Eriksson (1992) can be consulted for such information on the pyrenocarpous representatives. I would also have included the dates of publication of at least all the accepted names, as in the British checklist (Cannon et al. 1985), but appreciate that would have involved much additional work and that this can now be obtained at no cost from the *Index Fungorum* website if required.

The work has, characteristically, been meticulously prepared and involved much scouring of not only publications but also herbaria. But that does not mean that there are no slips, as is always inevitable in such a fact-packed work. I will not make any enumeration here, but as it concerns a subheading I do point out that it should be "Subphylum" not "Subclass" before *Pezizomycotina* on p. 7. Additionally, author citations of species names are given for infraspecific taxa other than those including the type, which is contrary to the practice in the CODE (e.g. the "Lib." should have been omitted in "*Acrospermum graminum*

Lib. var. *decipiens* (Pass.) O.E. Erikss." on p. 21). Corrections and updates are already being reported on the web pages devoted to the project (<http://www8.umu.se/myconet/asco/indexASCO.html>).

Today, fungi with no known sexual structures can be placed by molecular phylogenetic methods within the ascomycete system based on the sexual stages. This means that in the future such phylum-based checklists should logically include the hordes of fungi known only in the mitosporic state. This would involve a major expansion of ascomycete checklists in the future, and here Eriksson has, as a matter of policy, included only taxa represented by the teleomorph in Sweden — with the exception of members of *Erysiphales* "where we can expect that the teleomorph will be found" (p. 4). The names of anamorphs for species found forming teleomorphs in the country are, however, provided as noted above.

Although this list may seem enormous in comparison with the checklists for non-lichenized ascomycetes in many other countries, it constitutes a huge stride towards the elusive goal of a full national inventory. It is now **the** key reference work for anyone concerned with non-lichenized ascomycetes in Sweden, and all ascomycologists and conservationists should be indebted to Ove for the herculean effort he has put in bringing this task to publication.

Cannon PF, Hawksworth DL, Sherwood-Pike MA. 1985. The British *Ascomycotina*: an annotated checklist. Slough: Commonwealth Agricultural Bureaux.

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DAVID L. HAWKSWORTH
Departamento de Biología Vegetal II, Facultad de Farmacia
Universidad Complutense de Madrid, Plaza Ramòn y Cajal, 28040 Madrid, Spain

Lichens. By H. Thüs & M. Schultz. 2009. Spektrum Akademischer Verlag, Tiergartenstraβe 17, 69121 Heidelberg, Germany. <scsc-books@springer.com>. Pp. 209, plates 6, figs 171. Süβwasserflora von Mitteleuropa. Vol. 21. *Fungi.* Part 1. ISBN 978-3-8274-1594-3. Price: € 64.95, CHF 94.50.

This series, eventually comprising 24 volumes, some with several separately bound parts, aims to cover the freshwater "flora" of Central Europe. It is a classic reference work for algologists, with 19 of the volumes dealing with different algal and cyanobacterial groups. It is pleasing to see lichens included in this prestigious work, and especially as they appear as the first part in the volume on "*Fungi*". The book aims to be a tool for the identification of all freshwater lichens occurring in Central Europe, and the introduction notes the categories of aquatic (able to survive under water for more than a year), amphibian (occurring in splash zones), riparian (living close to, but never in, water), and terrestrial (with a low tolerance of submersion). Ecological factors affecting occurrences are outlined, including pH, nutrients, and sediments, but somewhat surprisingly nothing on zonation patterns or the use of lichens in assessments of river capacities. Following a clearly presented glossary, there is a "General key" which, in addition to the genera treated, includes 23 lichens that are not — notably in the genera *Catillaria, Lecanora,* and *Physcia*. The main body of the work, however, comprises "keys to species and species profiles". Thirty-six genera are treated alphabetically, pyrenocarpous ones predominating, with *Thelidium* and *Verrucaria* as the most speciose genera with 18 and 24 species respectively. The latest generic concepts are employed, with, for example, the acceptance of *Hydropunctaria* and *Sporodictyon*.

Each generic account cites the pertinent literature followed by sometimes extensive discussion on status or circumscription, followed by a key to the treated species. As in the "General key", species not accorded separate entries are sometimes included in these keys. For each species there is information on synonyms, a description, notes on ecology and distribution, and most importantly notes on separations from other similar species. In a few instances "s.l." is used to embrace groups of closely allied and difficult to separate species (e.g. *Verrucaria margacea* s.l.). Author citations of scientific names are given with the year of publications throughout, whether accepted names or synonyms — an increasing practice that merits general adoption. There are schematic diagrams of sections of vertical sections of perithecia in some genera and fine half-tone macro-photographs showing the habit of the species as they would be seen in the field with a hand lens. The half-tones are supplemented by six colour plates at the end of the book — more use of colour should be considered for any future edition. The collection details of all figured specimens are included, together with an indication of the herbarium in which they are preserved — something too often missing in illustrated guides.

The book is authoritative, comprehensive, pocket-sized, strongly bound, and entirely in English. Also, while focussed on central Europe, it must be pointed out that many of the taxa have wide distributions in Mediterranean, western, and northern Europe in particular, as well as other continents. This work consequently has the potential to generate a renewed interest in the so-often neglected freshwater lichens not only by lichenologists, but further by ecologists freshwater biologists, and geographers internationally.

David L. Hawksworth
Departamento de Biología Vegetal II, Facultad de Farmacia
Universidad Complutense de Madrid, Plaza Ramòn y Cajal, 28040 Madrid, Spain

Taxonomical Revision of the *Caloplaca saxicola* group (*Teloschistaceae*, lichen-forming fungi). By E. Gaya. 2009. J. Cramer in der Gebrüder Borntraeger Verlagsbuchhandlung, Johannesstraße 3A, 70176 Stuttgart, Germany. <mail@schweizerbart.de>. Pp. 191, plates 36 (5 col.), figs 2. Bibliotheca Lichenologica No. 101. ISBN 978-3-443-58080-3. Price: € 73.00.

This has been a taxonomically confusing group, with great uncertainty over the application of names, and so this worldwide revision was much needed. The group comprises saxicolous species that are lobate-effigurate and have ellipsoid ascospores with a median septum at least 3 µm thick. The "group" is restricted to a smaller core to exclude *Caloplaca cirrochroa, C. marina, C. microthallina, C. scopularis, C. verruculifera*, etc. The characters employed in the differentiation of the taxa are described in detail, with in-depth accounts of thallus features and tissue types, as well as of exciple types, paraphyses, ascospores, and conidia. In the *C. saxicola* group itself, eleven species and five subspecies are recognized, and a further ten species considered as closely related are also treated in detail (incl. *C. aurantia, C. flavescens, C. thallincola,* and sorediate species). For each species information is provided on synonyms, types, in some cases a transcription of the original diagnosis, illustrations, distribution, ecology, specimens examined, and there are particularly full descriptions and discussions (under "Remarks"). The microscopic features of each accepted species are shown in one or more full-pages of line drawings, and macroscopic appearances of the thalli are illustrated in a series of coloured plates. The colour is especially valuable here, as the nuances of oranges and yellows can aid species recognition in these lichens. Something I did miss was any photomicrographs of sections to show the different tissue structures of the cortices and the exciple types to help relate the necessarily somewhat schematic line drawings to what is actually seen in the microscope. The revision is based entirely on morphological and anatomical features, to some extent supported by principal component analyses, and no molecular data in support of the revised taxonomy are presented. This carefully executed work will need to be taken into account in re-assessing which taxa are actually present and which names have been wrongly used, in national and regional checklists. For example, *C. arnoldii* of UK authors is *C. arnoldii* subsp. *obliterata,* and *C. saxicola* includes *C. murorum*; the name *C. saxicola* is to be proposed for conservation. This may not be the last word on the group, especially as more material from Asia and the Southern Hemisphere becomes available and the concepts merit challenging by molecular phylogenetic approaches, but it represents a major step forward.

David L. Hawksworth
Departamento de Biología Vegetal II, Facultad de Farmacia
Universidad Complutense de Madrid, Plaza Ramòn y Cajal, E-28040 Madrid, Spain

Revision of the corticolous *Opegrapha* species from the Palaeotropics. By D. Ertz. 2009. J. Cramer in der Gebrüder Borntraeger Verlagsbuchhandlung, Johannesstraße 3A, 70176 Stuttgart, Germany. <mail@schweizerbart.de>. Pp. 176, figs 124. Bibliotheca Lichenologica No. 102. ISBN 978-3-443-58081-0. Price: € 73.00.

A major obstacle to getting to grips with crustose lichens in tropical countries has been the lack of authoritative revisions. Reassessments are needed of the thousands of names introduced in the nineteenth century, often published with the briefest of diagnoses and no illustrations. Good progress to that end has been made with graphids, thelotremes, and some pyrenocarpous groups, and here *Opegrapha* species on trees or wood are tackled. But this work does not only deal with palaeotropical material from the past (from tropical Africa, Asia, and Australia), it is also based on collections made by the author in Benin, Gabon, La Réunion, Rwanda, and Zambia. In all, 52 species are accepted, of which seven are tentatively (and responsibly) named using "aff.", eight are described as new to science, and two proved to be lichenicolous; 31 names are newly recognized as synonyms; six species were found to belong in other genera (notably *Arthonia*, *Enterographa*, *Lecanographa*, and *Patellaria*); and nine names are categorized as doubtful or otherwise excluded. A staggering 17 generic names are listed as synonyms of *Opegrapha*. There is a user-friendly key based on the artificial but pragmatic categories of spore septation, but no attempt to discuss phylogenetic relationships within these species or the genus as a whole. For each accepted species, there is the expected information on synonyms and types, detailed descriptions; notes on chemistry, ecology, and distribution; highly pertinent "observations"; and lists of additional specimens examined. The accompanying illustrations comprise photomicrographs showing the habit and details of the lirellae, line drawings of asci and ascospores; and maps of the known world distributions. Photomicrographs of vertical sections of the lirellae, showing details of the excipular structures, would have added value. Damien is to be congratulated on yet another meticulously executed contribution to his elucidations of opegraphoid lichens, and in this case one which also forms a base-line for further exploration and identification of existing collections from the Palaeotropics. A companion work to tie these results into the taxa described from the Neotropics would now be most welcome.

David L. Hawksworth
Departamento de Biología Vegetal II, Facultad de Farmacia
Universidad Complutense de Madrid, Plaza Ramòn y Cajal, 28040 Madrid, Spain

Porosty pięrea kosodrzewiny w Polskiej części Tatr Wysokich. By M. Węgrzyn. 2009. Instytut Botanik im. W. Szafera, Polska Akademia Nauk, ul. Lubicz 46, 31-512 Kraków, Poland. <l.frey@botany.pl>. Pp. 117, figs 10, maps 224. ISBN 978-83-89648-64-8. Price: € 25.00.

This is an account of the lichens of the dwarf pine (*Pinus mugo*) belt of the Polish part of the High Tatra Mountains, which occurs at an altitude of around 1550-1800 m. Forty eight sites were examined, which yielded a total of 225 lichens and five lichenicolous fungi — roughly 25% of all the lichen species known from the Polish Tatra Mountains as a whole. For each species, information on the ecology and sites in which they were found is presented. Most species are characterized as alpine, with a few subalpine and many "multizonal" species. However, in the locality data presented, many of the species occurred in only 1-3 sites and 64% were categorized as "very rare". Indeed, 89 species were ones classified as "vulnerable or endangered", and 13 as "critically endangered" in Poland as a whole; the latter include *Bryoria implexa, Catolechia wahlenbergii, Evernia divaricata, Hypogymnia vittata,* and *Solorina crocea.* Some of the results were somewhat surprising to me, for example a single occurrence of *Xanthoria parietina*, and also only one of *Alectoria sarmentosa* as opposed to ten of *A. ochroleuca* (the reverse of the situation on the high Scottish mountains). Distribution maps are provided for all but one of the lichen species. The area had not been given much attention by lichenologists since Motyka dismissed it as very poor in lichens in the mid-1920s, but it clearly is a site of conservation importance with so many species that are rare or endangered in Poland today. Although in Polish, there is a welcome one-page summary in English, and the legends to the tables and figures are also given in both languages. This is clearly a carefully executed study, and one that will provide a baseline against which to monitor any of the future changes that might be expected to occur as a result of climate change.

David L. Hawksworth
Departamento de Biología Vegetal II, Facultad de Farmacia
Universidad Complutense de Madrid, Plaza Ramòn y Cajal, E-28040 Madrid, Spain

Guides

Macrofungi associated with oaks of eastern North America. By D.E. Binion, S.L. Stephenson, W.C. Roody, H.H. Burdsall, Jr, L.N. Vasilyeva & O.K. Miller, Jr. 2008. West Virginia University Press, PO Box 6295, Morgantown, WV 26506, U.S.A. <press@wvu.edu>. Pp. xv + 467, plates. ISBN 978-1-933202-36-5. Price $44.95.

Not the shape of the mushrooms, but their ecology is the main organizer of this guidebook in which macrofungi associated with oaks in the eastern parts of North America (without Mexico) are treated. After a short introduction to the oak habitat and fungi in general, mushrooms are shown in three sections (mycorrhizal fungi, parasites, and decomposers). Over 200 species are treated, each one on two pages with a photo on the left and the text on the right. A short list of references and tips for further reading, a glossary, and a short chapter on mushroom poisons follow at the end of the book. There are no keys to the species that are treated. The photos are in general of very good quality (a few are out of focus), the names are usually up to date, and attention has been paid to details, such as the names of the authors of the species. Data on habitat and distribution are a little too scant, and in some cases wrong; e.g. *Tremella* is put in with the decomposers, though it parasitizes other fungi.

It is refreshing to see so many polypores and crust fungi in a 'mushroom' guide! The rare species *Globifomes graveolens* and *Porodisculus pendulus* are well illustrated, together with their more common relatives. The mycorrhizal life style of some of some of the crust-forming species might come as a surprise to the users. Determining which lifestyle your fungus has may be difficult, but by flipping through the pages you get a lot of extra knowledge from this heavy book.

In short, a well-executed, interesting, and well-illustrated book.

Mushrooms and other fungi of the midcontinental United States. (Bur Oak Guide). 2[nd] Ed. By D.M. Huffman, L.H. Tiffany, G. Knaphus & R.A. Healy. 2008. University of Iowa Press, 119 W. Park Road, 100 Kuhl House, Iowa City, IA 52242-1000, U.S.A. <uipress@uiowa.edu>. Pp. 384, plates 300, figs 21. ISBN 978-1-58729-627-7. Price $39.95.

This is the second edition of a guide to the mushrooms of Iowa, with more species (especially ascomycete truffles) covered and some photographs replaced. This book has the usual set up of an introduction to mushrooms, a subdivision into larger groups (e.g., *Agaricales*, *Boletales*, *Aphyllophorales*, gasteromycetes, jelly fungi, and ascomycetes) with species treated alphabetically and — within the *Agaricales* — further subdivided according to family. A glossary, and lists of general and technical references complete the book. The layout is clear, with photos on the left page and (short) descriptions on the right, usually with two species on a page. Keys to the around 300 species that are treated in the book are also given.

Some photos are very good, but some of the older ones are too dark with colours too inaccurate for identification purposes. Additionally, some names do not seem plausible. As is common in most guides, the source for the photos and descriptions is not given.

Names have been updated in some cases (e.g. *Microstoma floccosum* replaces *Sarcoscypha floccosa* of the first edition), but *Hygrophorus* has been retained for species that are now universally accommodated in *Hygrocybe*, the family *Lepiotaceae* no longer exists, nor is there any longer an order '*Aphyllophorales*' or the equally artificial '*Gasteromycetes*'.

Nevertheless, this remains a nice first introduction to the fungi of this midcontinental state, where forests and mushroom guides are not very common.

Mushrooms of the Pacific Northwest. Timber Press Field Guide. By S. Trudell & J. Ammirati. 2009. Timber Press, 133 SW 2nd Avenue #450, Portland, OR 97204, U.S.A. <info@timberpress.com>. Pp 352, plates 530, figs 22. ISBN 9780881929355. Price $27.95.

This book is like a whiff of fresh air in mushroom field guide land. It clearly states the geographical area that it covers, the introduction tells about the life styles of mushrooms, the hazards and pleasures of mushroom hunting, the pit falls of identification keys, and of course poisonings and much more. The bulk of the book is taken up by photos and descriptions of mushrooms. Spore print colour codes the top of the page; the descriptions are informative and well written (not in telegraph style), and for many photos a collection number is given, so the names can be verified. The emphasis is not on the charismatic megafunga, although certainly big mushrooms are treated, but the less conspicuous fruitbodies feature prominently. Names are generally up-to-date, and author names are consistently spelled in the same way. Names also seem correct and to fit the pictures. The only negative comment I can make is that the photos are a little on the small side; making them bigger would have increased the price of the book significantly. The book is slightly too big and too beautiful to be taken out into the field, but it would definitely like to live in your car, for the after-the-hunt identification spell. The price is also extremely reasonable, and this book deserves to be used all through the western states.

Mushrooms of the southeastern United States. By A.E. Bessette, W.C. Roody, A.R. Bessette & D.L. Dunaway. 2007. Syracuse University Press, 621 Skytop Road, Suite 110, Syracuse, NY 13244-5290, U.S.A. <supress@syr.edu>. Pp. 400, plates 527. ISBN 978-0-8156-3112-5. Price $95.00.

The southeastern parts of the U.S.A. are well known for their plant and fungal diversity, but field guides to the latter are rare and cover only parts of this hugely diverse area. The present book by Bessette et al. fills this gap and aims at illustrating and describing over 450 species from various fungal groups forming macroscopic basidiocarps. Field characteristics are emphasized in the keys and descriptions. The format is similar to that of the earlier book by Bessette et al. (1997) that covers the northeastern parts of the U.S.A.: all plates with 6 figures per page cluster together, followed by all descriptions. All are organized alphabetically by group, and the groups are morphologically recognized (in other words, not phylogenetically). The introduction to mycology and a glossary will be helpful for the mycological novice. There are two sections of references, one with technical literature, the other with so-called non-technical publications. Four appendices, with scant information on microscopic examination of mushrooms, chemical reagents used in mushroom identification, classification, and mycophagy (including recipes and photos of tempting dishes) complete the book.

The guide gives a good first introduction to the mushroom flora of the area, with the emphasis on the larger and showier species. It is very nice to see a good selection of subtropical polypores depicted. However, there are many shortcomings in the details.

It is not at all clear where the descriptions come from. The authors claim that they are based on the original descriptions. This is in many cases not true (e.g. the original description of *Leucocoprinus cepistipes* does not fit the present interpretation of the species and is extremely unspecific). The second problem is that there is no specified information on the photos — in the ideal situation descriptions should be based on the material depicted, which has been vouchered and is available for further study in a publicly accessible herbarium. Field guides are in particular an excellent venue to make the amateur mycologists aware and familiar with the large changes happening in our understanding of the fungal phylogenies and consequently in classifications. Unfortunately, the argument that all is in flux has been applied, resulting in no changes at all. Two examples: the genus *Paxillus* still harbours both *P. involutus* and *P. atrotomentosus*, although the latter, a non-mycorrhizal species, has long been accepted in *Tapinella*; likewise, *Omphalotus illudens* is called *O. olearius*, which is a strictly European species. The nomenclature and author citations are appalling, as if there are no easily accessible on-line data files available.

In conclusion, this book gets a mixed report — beautiful well-photographed mushrooms make up for the mistakes in the details and the outdated nomenclature.

Bessette AE, Bessette AR, Fischer DW, 1997. Mushrooms of northeastern North America. Syracuse University Press.

Milk mushrooms of North America. A field identification guide to the genus *Lactarius*. By A.E. Bessette, D.B. Harris & A.R. Bessette. 2009. Syracuse University Press, 621 Skytop Road, Suite 110, Syracuse, NY 13244-5290, U.S.A. <supress@syr.edu>. Pp. 256, plates 263. ISBN 978-0-8156-3229-0. Price $110.00.

Though not really a field guide, this treatment of the genus *Lactarius* for North America (excluding Mexico) has that feel, as it does not cover microscopic characters, and the keys and descriptions of *Lactarius* species are written in language that should be clear for a beginning amateur. Besides the genus *Lactarius*, a few species from related genera *Zelleromyces*, *Bondarzewia*, *Arcangeliella*, and two fungal parasites of *Lactarius* species are illustrated and provided with descriptions. An introduction to the characters of the genus, the edibility, ecology, and field characters lay the basis for the bulk of the book. Dichotomous keys treat the species divided by region (western species vs eastern species). The plates are grouped together with 3 figures per page, and are organized alphabetically by species, often with multiple photos per species to show the colour variation (unfortunately it is not often clear whether the colour variation is in the mushroom or due to the photo). The descriptions are also alphabetical. Approximately two-thirds of the species are represented by a colour photo. Source information is not given for the photos or the descriptions, nor is there an indication whether the photos are connected to the descriptions. The authors are most familiar with the northeastern species, and the ecology and distribution of the western species are scantily covered. More attention could have been paid to the details, such as the references and the author names for each species. Recent literature and developments in *Lactarius* classification have not been incorporated in this book, unfortunately. Future research will probably result in the rejection of many of the European names that are applied to American species. The book serves perfectly as a colour guide to the much more technical and out-of-print work by Hesler & Smith (1979), but it falls short of being a critical assessment of the genus in North America. Last but not least, the price will be a severe impediment for wide usage of this book.

Hesler LR, Smith AH, 1979. North American species of *Lactarius*. The University of Michigan Press, Ann Arbor.

Book Announcements

***Agaricus* L. *Allopsalliota* Nauta & Bas. Fungi Europaei 1.** 2nd Ed. By L. A. Parra Sánchez. 2008. Edizioni Candusso, Via Ottone Primo 90, 17021 Alassio SV, Italy. <maxcandusso@libero.it>. Pp. 824, Plates 396 + 42, figs 114. ISBN 88-901057-7-1. Price € 75.00.

Compléments à la Flore des champignons supérieurs du Maroc de G. Malençon et R. Bertault. By J.-C. Maire, P.-A. Moreau, G. Robich (editors). 2009. Confédération européenne de mycologie méditerranéenne, Nice. Pp. 775, plates 58, figs 50. No ISBN number. Price ca. € 116.00.

Common interior Alaska cryptogams. Fungi, lichenicolous fungi, lichenized fungi, slime molds, mosses, and liverworts. By G.A. Laursen & R.D. Seppelt. 2009. University of Alaska Press, PO Box 756240, Fairbanks, AK 99775, U.S.A. <fypress@uaf.edu> Pp. 256, plates 338, figs 113. ISBN 9781602230583. Price $26.95.

***Conocybe* Fayod. *Pholiotina* Fayod. Fungi Europaei 11.** By A. Hausknecht. 2009. Edizioni Candusso, Via Ottone Primo 90, 17021 Alassio SV, Italy. <maxcandusso@libero.it>. Pp. 968, plates 46 + 403, figs 150, maps 154. ISBN 88-901057-8-X. Price € 79.00.

Edible wild mushrooms of Illinois and surrounding states: A field-to-kitchen guide. By J. McFarland & G.M. Mueller. 2009. University of Illinois Press, University of Illinois Press, 1325 South Oak Street, MC-566, Champaign, IL 61820-6903, U.S.A. <uipress@uillinois.edu>. Pp. 232, plates 292. ISBN 978-0-252-07643-5. Price $24.95.

Fungi from different environments. By J.K. Misra & S.K. Deshmukh (editors). 2009. Science Publishers, 234 May Street, P.O. Box 699, Enfield, NH 03748, U.S.A. <info@scipub.net>. Pp. 405. ISBN 978-1-57808-578-1. Price $119.95.

Fungus flora of tropical Africa. Volume 2. Monograph of *Lactarius* in tropical Africa. By A. Verbeken & R. Walleyn. 2010. National Botanic Garden of Belgium, Nieuwelaan 38, 1860 Meise, Belgium, <sales@br.fgov.be>. Pp. 151, plates 54. ISBN 978-90-726-1981-5. Price € 50.00.

Il genere *Crepidotus* in Europa. By G. Consiglio & L. Setti. 2009. Associazione Micologica Bresadola, Via A. Volta, 46, 38100 Trento, Italy. <amb@ambbresadola.it> Pp. 344, numerous plates, figs. No ISBN number. Price € 50.00 or € 60.00.

The kingdom *Fungi*. The biology of mushrooms, molds and lichens. By S.L. Stephenson. 2010. Timber Press, 133 SW 2nd Avenue #450, Portland, OR 97204, U.S.A. <info@timberpress.com>. Pp. 328, plates 124. ISBN 978-0-88192-891-4. Price $34.95, £ 20.00.

Notable macrofungi from Brazil's Paraná pine forests. Macrofungo notáveis das florestas de Pinheiro-do-Paraná. By A.A.R. de Meijer. 2009 (2008). Embrapa Informação Tecnológica, Parque Estação Biológica, Caixa Postal 040315, Brasília, DF, Brazil 70770-901. <vendas@sct.embrapa.br>. Pp. 418, plates 102. figs 47. ISBN 978-85-89281-17-1. Price R$120.00.

Pictorial atlas of soil and seed fungi: Morphologies of cultured fungi and key to species. 3rd Ed. By T. Watanabe. 2010. Routledge, Taylor & Francis Group, 270 Madison Avenue, New York, NY 10016, U.S.A. ISBN 978-1-4398041-9-3. Price $143.96.

Quelques espèces nouvelles ou mal délimitées d'*Amanita* de la sous-section *Vaginatinae*. 1° complément à *Amaniteae*, Fungi Europaei 9. By P. Neville † & S. Poumarat. 2009. Fungi non delineati LI-LII. Edizioni Candusso, Via Ottone Primo 90, 17021 Alassio SV, Italy. <maxcandusso@libero.it>. Price € 26.00.

Schimmelpilze und deren Bestimmung. 3. neu bearbeite Aufl. By L.E. Petrini & O. Petrini. 2010. J. Cramer in der Gebrüder Borntraeger Verlagsbuchhandlung, Johannesstraße 3A, 70176 Stuttgart, Germany. <mail@schweizerbart.de>. Pp. x + 170, figs 33. ISBN 978-3-443-50035-1. Price € 39.80.

Taxonomic studies on *Agaricales* of Hokkaido, Northern Japan, with special reference to *Melanoleuca, Oudemasiella, Xerula, Volvariella* and *Pluteus*. By S. Takehashi, T. Hoshino & T. Kasuya. 2010. Non profit organization The forum of Fungi in northern Japan, Kanayama 1-3 10-3, Teine-ku, Sapporo, Hokkaido, 006-0041, Japan. <BXG05024@nifty.com>. Available from SANO Books, Sakae-machi 6-19, Aioi-city, Hyogo 678-0008, Japan, <c_sano@d2.dion.ne.jp>. Pp. 145 + xiii, numerous plates, numerous figs. ISBN 978-4-9905010-0-6. Price ¥ 5.600.

NOMENCLATURAL NOVELTIES AND TYPIFICATIONS PROPOSED IN MYCOTAXON 112

Author Index—volume one hundred twelve

Errata

Volume 101

p. 50, line 5	for: *T. recifese*	read: *T. recifense*
p. 85, line 38	for: *Lecanora crytella*	read: *Lecanora cyrtella*

Volume 103

p. 198, last line	for: *Skeletocutis roseolus*	read: *Skeletocutis roseola*
p. 235, ABSTR. line 8	for: *grummosopilosus*	read: *grumosopilosus*

Volume 105

p. 31(TAB. col.2, line6)	for: *P. amoenerosea*	read: *P. amoene-roseus*

Volume 107

p. 18, line 3	for: *Psudocercospora bonducellae*	read: *Pseudocercospora bonducellae*
p. 32, line 25	for: *entomoloïdes*	read: *entolomoides*

Volume 108

p.53, line 24	*for:* from subgen.	*read:* from *Boletus* subgen.
p. 235, ABSTR, line 7	for: *D. muraliicola*	read: *D. muralicola*
p. 239, line 32	for: *D. muraliicola*	read: *D. muralicola*

Volume 109

p. 76, line 8	for: *amoeneroseus*	read: *amoene-roseus*
p. 79, line 8	for: *P. amoeneroseus*	read: *P. amoene-roseus*
p. 80, FIG. line 5	for: *amoeneroseus*	read: *amoene-roseus*
p. 252, line 14	for: *Dac. ellipsosporum*	read: *Dac. ellipsospora*
line 25	for: *Dac. haptotylum*	read: *Dac. haptoptyla*
p. 297, FIG. line 3	for: *D. triticirepentis*	read: *D. tritici-repentis*
FIG. line 8	for: *C. intermedius*	read: *C. intermedia*
p. 399, ABSTR. line 2	for: *H. obpyriform*	read: *H. obpyriforme*
p. 410, line 16	for: *pseudomicrosporum*	read: *pseudomicrosorum*
p. 514	for: *Moellerodiscus coprosomae*... p. 439	*read:* ... p. 437
	for: *Oxyporus piceicola*... p. 314	*read:* .... p. 308

Volume 111

p.113, ABSTRACT, lines 4–6

for: *Aspicilia moenium, Lecanora albellula, Pertusaria pupillaris, Porina aenea,* and *Rinodina fatiscens* are new to Turkey.

read: *Aspicilia moenium* is new to Turkey.

p.491, line 17	*for:* It s	*read:* It is
p.491, line 34	*delete the words:* rather than gyrophoric acid	
p.492, line 21	*for:* under site of lobe margins	*read:* underside of lobe margins
p.493, line 2	*for:* It occurs on bark ...	*read:* It occurs on bark ...
p.493, line 32	*for:* ... from *X. verrucigera* in the chemistry, since it contains ... *read:* ... from *X. verrucigera* in their chemistry, since it contains ...	
p.502, line 1	*for:* (turkey)	*read:* (Turkey)

REVIEWERS—VOLUME ONE HUNDRED TWELVE

The Editors express their appreciation to the following individuals who have, prior to acceptance for publication, reviewed one or more of the papers prepared for this volume.

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MYCOTAXON BECOMES AN ONLINE JOURNAL IN 2011

FROM THE *EDITOR-IN-CHIEF*

MYCOTAXON ONLINE! — After three months of consideration, we have decided to convert our journal from a print medium into an **exclusively online publication,** beginning with the January–March 2011 volume, MYCOTAXON 115. To facilitate the most seamless transition possible, we shall make all papers from MYCOTAXON 2010 volumes available for free download over the next few months. Our table of contents, abstracts, book reviews, nomenclatural novelties are already online, and we now host almost 70 previously summarized annotated distributional species lists on our online resources page.

The decision to make this revolutionary change was not easily reached. Many on the editorial staff and advisory board initially resisted the changeover, formally proposed by MYCOTAXON founding editor Dick Korf in mid-February. However, a judicial cost-benefit analysis shows that the move is both timely and wise. Even the most inveterate bibliophiles among us confess (some rather shame-facedly) that we have come to depend on easily searched PDF files for our own individual research. For instance, I now find a reference much more quickly on a laptop than when I walk the few steps over to my now over-loaded library shelves to ferret out the pertinent passage on the correct page in the proper volume.

Although a print version will no longer be available after our final 2010 volume, there are many benefits to both subscribers and authors. One important plus is that as many color plates as authors wish to include will now be available at no cost to us (or them!). We will reduce subscription rates, as we will eliminate virtually all of the printing and mailing costs, which will soon be needed only to cover mailing printed volumes to selected libraries as required by the International Code of Botanical Nomenclature. We are simultaneously "going green" and advancing the future of publishing. More information and regular updates about the journal's radical change are available at

WWW.MYCOTAXON.COM/GOGREEN.HTML

THE DOI: AN INVALUABLE AUTHOR RESOURCE AND RESEARCH TOOL — Effective immediately, we ask all authors to determine for each reference in their LITERATURE CITED (bibliography) section whether it has a DOI number as an online document. [This new requirement, which will be also be included on the expert review comments forms sent to the Editor-in-Chief, must be completed before authors submit a paper for accessioning and nomenclature review.]

Authors can easily check all their references for DOI numbers by signing up for a free account at CrossRef <http://www.crossref.org/SimpleTextQuery/>. After registration, authors may freely enter a whole set of references from their paper, formatted exactly as Mycotaxon requires, in the box provided. (You will be restricted to checking 1000 references per month.) The results will give you a DOI reference to every paper that has one. You can click on the DOI to see the first page or at least the abstract of the cited article and you can check to see whether you have spelled everything correctly. You must then add the DOI to the end of each citation. Here's an example of 4 cited references:

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Ewald, OM. 2009. Using Latin in diagnoses: a guide for the perplexed. North Aeerican Fungi 4: 1-9.

Hodge KT, Gams W, Samson RA, Korf RP, Seifert KA. 2005. Lectotypification and status of *Isaria* Pers. : Fr. Taxon 54: 485-489.

Korf RP. 2007. On the genus *Solenopezia* (*Fungi: Lachnaceae*) and ICBN Art. 58—a sleeping dog bites back. Bol. Soc. Argent. Bot. 43: 29-32.

Strongman DB, Wang J, Xu, S. 2010. New trichomycetes from western China. Mycologia 101: 174-184.

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Hodge KT, Gams W, Samson RA, Korf RP, Seifert KA. 2005. Lectotypification and status of Isaria Pers. : Fr. Taxon 54: 485-489.

doi:10.2307/25065379

Korf RP. 2007. On the genus Solenopezia (Fungi: Lachnaceae) and ICBN Art. 58—a sleeping dog bites back. Bol. Soc. Argent. Bot. 43: 29-32.

Strongman DB, Wang J, Xu, S. 2010. New trichomycetes from western China. Mycologia 101: 174-184.

doi:10.3852/09-029

PMid:20120240

Your revised citations:

Ewald, OM. 2009. Using Latin in diagnoses: a guide for the perplexed. North American Fungi 4: 1-9. doi:10.2509/naf2009.004.002

Hodge KT, Gams W, Samson RA, Korf RP, Seifert KA. 2005. Lectotypification and status of *Isaria* Pers. : Fr. Taxon 54: 485-489. doi:10.2307/25065379

Korf RP. 2007. On the genus *Solenopezia* (*Fungi: Lachnaceae*) and ICBN Art. 58—a sleeping dog bites back. Bol. Soc. Argent. Bot. 43: 29-32.

Strongman DB, Wang J, Xu, S. 2010. New trichomycetes from western China. Mycologia 101: 174-184. doi:10.3852/09-029

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More information on this new process is available at

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NOMENCLATURE — Mycotaxon has long listed the new taxa, new taxonomic combinations, and new names in the end pages of each volume. However, readers have had to read the papers to learn that an already named taxon has been typified. We now include this previously overlooked information in our newly expanded NOMENCLATURAL NOVELTIES AND TYPIFICATIONS page. We also now supply the basionym for each 'nom. nov.' within our lists — particularly helpful as it provides a link between a previously 'known' name and a new 'unknown' one.

In 2009 we initiated a formal NOMENCLATURE SECTION that printed IN TOTO new conservation/rejection proposals currently being evaluated by the IAPT permanent Nomenclature Committee for *Fungi* (CF) as well as formal Committee reports, proposals to amend the CODE that directly affect fungal nomenclature, and spirited opinion pieces on nomenclature. All formal proposals, however, are first (or contemporaneously) published in TAXON, which posts them for free download on its website, <www.ingentaconnect.com/content/iapt/tax>. We have decided to offer MYCOTAXON readers only brief proposal summaries and the URL where the complete proposal can be downloaded. Our Nomenclature section will therefore resume in Mycotaxon 113 in an abbreviated form: although we will only summarize the formal proposals, we still welcome original papers from those wishing to comment on any proposal still under consideration by the CF.

MYCOTAXON 112—Our 2010 April–June volume contributes 91 new fungal names and typifications in 46 papers by 143 authors and co-authors representing 24 countries and assisted by 88 expert reviewers. As always, authors include many excellent drawings and photographs, and we wish to draw attention to the subtle blues and browns in the lovely full-color plate of several new entolomas described from the Primorsky Territory in Russia on page 233. Enjoy!

Warm regards,

Lorelei Norvell,
MYCOTAXON *Editor-in-Chief*
6 June 2010

Four easy steps to successful Mycotaxon publication in 2010

Mycotaxon's complete instructions, which were last updated in January, 2010, are posted on the Instructions to Authors page on the Mycotaxon website listed below. Prospective authors should download instructions PDF, expert reviewer comment and submission forms, and helpful templates by clicking the 'file download page' link on the instructions page before preparing a paper intending for the journal. Below is a summary of our simple '4-step' publication process.

Step 1—Peer review: Authors send a formatted text document with illustration files and Mycotaxon Reviewer Comments Form to two experts for peer review. Authors should (i) make certain that both peer reviewers have Emailed the comment forms to the *Editor-in-Chief* <editor@mycotaxon.com> and (ii) revise their manuscript according to reviewer suggestions **before** submitting a master text file to the *Nomenclature Editor* for nomenclatural review. NEW: doi reference numbers should be added to the cited references prior to sending a manuscript out for review. (See pp. 515–515, this volume.)

Step 2—Nomenclatural review: Authors next Email their revised master text file (containing footnotes, tables and captions but ***NO*** illustrations) to the *Nomenclature Editor* <PennycookS@LandcareResearch.co.nz> for accession and pre-submission review. The Email message *MUST* include the word 'Mycotaxon' on the subject line and *MUST* include names **and** Email addresses of all peer reviewers. The Nomenclature Editor will return annotated files with a list of needed corrections to the authors and *Editor-in-Chief.*

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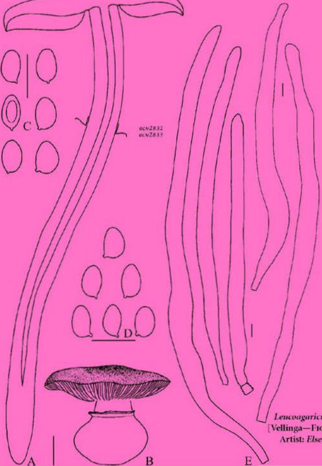
VOLUME 112 APRIL–JUNE 20



Leucoagaricus cupr
[Vellinga—FIGURE 7
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MYCOTAXON is evolving!

In January 2011, we will convert to an online format and will no longer offer a printed version of the journal. MYCOTAXON has, from its inception, worked at being a fast and affordable means of sharing taxonomic and nomenclatural discoveries. Rising postage costs and our efforts to "go green" have made it clear to us that moving to an online format offers subscribers and authors numerous advantages. You will receive additional information about what these changes will mean to you in the next volume of MYCOTAXON. You can also keep up to date on this changeover at:

www.mycotaxon.com/gogreen.html

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Among the many advantages an online MYCOTAXON offers authors is the opportunity to publish an unlimited number of pages and color illustrations, both at NO COST! All articles submitted to MYCOTAXON now require authors to provide Digital Object Identifiers (DOIs) in their cited references. More information on this new process is available at:

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